Appendix J – Geotechnical Report (Peto MacCallum)

September 2023

GEOTECHNICAL INVESTIGATION
MAPLE GROVE ROAD IMPROVEMENTS AND CORRIDOR STUDY
FOUNTAIN STREET TO HESPELER ROAD
CAMBRIDGE, ONTARIO

for

THE REGIONAL OF MUNICIPALITY WATERLOO
c/o IBI GROUP

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PML Ref.: 18KF047
Report: 1
March 10, 2022

Peto MacCallum Ltd.
CONSULTING ENGINEERS

March 10, 2022

PML Ref.: 18KF047
Report: 1

The Regional Municipality of Waterloo
c/o Mr. Michael McGann, P.Eng.
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Dear Mr. McGann

Geotechnical Investigation
Maple Grove Road Improvements and Corridor Study
Fountain Street to Hespeler Road
Cambridge, Ontario

Please find attached our geotechnical investigation report for the above noted project. Authorization to conduct the investigation was provided in IBI consulting services agreement C2018-07, dated August 24, 2018.

We trust that the enclosed report has been completed within our terms of reference as set out in the proposal request, and is sufficient for your immediate needs. Should you have any questions please contact our office.

Sincerely

Peto MacCallum Ltd.

William Loghrin, P.Eng.
Project Engineer, Geotechnical Services

WL:tm

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1. INTRODUCTION

Peto MacCallum Ltd. (PML) is pleased to report the results of the geotechnical investigation recently completed for the proposed Maple Grove Road Improvements and Corridor Study in Cambridge, Ontario. Authorization to proceed with this assignment was provided in IBI consulting services agreement C2018-07, dated August 24, 2018.

The salient elements to the project will include:

- Rehabilitation and road widening for the 4.3 km long section of Maple Grove Road from Fountain Street to Hespeler Road, and 1.5 km of Hespeler Road near the Maple Grove Road intersection. The proposed roadworks will encompass three areas including: rehabilitation of the current four lane section from Fountain Street North to Vondrau Drive, widening of the current two-lane section from Vondrau Drive to Old Maple Grove Road, and widening and rehabilitation of the current two-lane section from Old Maple Grove to Hespeler Road (including a section of Fisher Mills Road).
- A new bypass, or realignment of about 1.2 km of Maple Grove Road is also being considered. The realignment might shift the Hespeler Road and Beaverdale Road intersections southward. The bypass option may include a grade separation structure near the current Old Maple Grove Road and Maple Grove Road intersection, a crossing of Beaverdale Road about 200 m south of Old Maple Grover Road, and connection to Hespeler Road via a grade separation structure approximately 500 m south of the existing Hespeler Road and Maple Grove Road intersection.
- Ellis Creek Bridge widening or construction of new pedestrian trail bridges on both sides of the current Ellis Creek bridge;
- An interchange including grade separation structure is being considered as a possible alternative to the current Hespeler Road and Maple Grove Road intersection;
- Intersection improvements are being considered, and may include roundabouts or traffic signals at Vondrau Drive, Boxwood Drive, Speedsville Road, future Compass Trail, Beaverdale Road, and Hespeler Road.
- New watermain, sanitary sewer, storm sewer and low impact development facilities will also be constructed along the project route.
- Rehabilitation and/or reconstruction of the Maple Grove Road and Hespeler Road roadway pavements.

The proposed improvements are further amalgamated into two potential scenarios. Scenario 1 includes four-laning of the current Maple Grove Road alignment, along with the potential intersection improvements. Scenario 2 involves four-laning of the existing Maple Grove Road, intersection improvements, and construction of the new bypass extending from the Maple Grove Road and Old Maple Grove Road intersection to a new intersection/interchange at Hespeler Road.

1.1 Previous Investigations

PML is very familiar with the subsurface conditions along Maple Grove Road, having completed numerous investigations for the road's construction in the 1980's, specifically:

- Geotechnical Investigation, Proposed Maple Grove Road Link, Highway 8 to Fountain Street, PML Ref: 86F78/A/B/C, with reports dated April, May, August, November and December 1986
- Geotechnical Investigation, Proposed Waterway Crossing, Maple Grove Road Extension at Ellis Creek, PML Ref: 87F496/A, with reports dated May 1989
- Geotechnical Investigation, Proposed Widening of Beaverdale Road, Beaverdale Road at Maple Grove Road, PML Ref: 87F497B, dated April 1989
- Geotechnical Investigation, Proposed Maple Grove Road Realignment, Briardeen Road to Fisher Mills Road, PML Ref: 87F497, dated December 1987

Investigations have also been conducted at the site by LVM, specifically:

- Geotechnical Investigation, Widening of Maple Grove Road, Fountain Street to Speedsville Road, 160-P030373-0100-GE-0001-00, dated June 2011.

The applicable log of borehole sheets from the previous LVM investigation has been included in Appendix A.

1.2 Purpose of the Current Investigation

The purpose of this current geotechnical investigation was to determine the detailed subsurface soil and ground water conditions at the site. Based on the findings, we have prepared this geotechnical engineering report with preliminary recommendations pertaining to the proposed road widening, grade separation structures and bridges, underground sewer and watermain installations, and pavement reconstruction. Specific items addressed in this geotechnical report include:

- A description of the site and the field investigation procedure;
- A summary of the subsurface soil and ground water conditions encountered, including the presence of any topsoil, organic, fill or other anomalous features below grade;
- Log of borehole sheets, a borehole location plan drawing, and geotechnical laboratory test results;
- Foundation design options for the grade separation structure and Ellis Creek trail bridges, including shallow and deep foundation recommendations, bearing resistances, settlement projections and site class for seismic design;
- Retaining wall design parameters including lateral earth pressures;
- Excavation recommendations, including safe side slopes and dewatering requirements,
- Pipe bedding, cover and backfill requirements, including material and compaction requirements, suitability of excavated soils for reuse as backfill;
- Soil infiltration rates for design of low impact development (LID) measures;
- Pavement design recommendations for rehabilitation/recycling and or new construction including full AASHTO ESAL pavement design and GBE analysis;
- Asbestos in asphalt samples; and,
- Chemical test results and recommendations on potential excess soil.

The comments and recommendations provided in this report are based on the site conditions at the time of the investigation, and are applicable only to the proposed project as described in the report. Any changes in the project, including invert depths and layout will require review by PML to assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

2. INVESTIGATION METHODOLOGY

2.1 Geotechnical Investigation

The fieldwork for the geotechnical investigation was conducted between December 3, 2018 and February 22, 2019. The investigation program comprises 109 boreholes (Boreholes 1 to 10 and 101 to199) advanced to between 3.7 and 17.4 m depth and 99 hand augers (TP1001 to 1099) advanced to between 10 and 890 mm depth at the locations shown on the appended Borehole Location Plan, Drawing 1. Details of the subsurface conditions encountered are presented on the appended Log of Borehole sheets, the pavement structures are summarized in Table 1, and the hand auger findings are presented in Table 2.

The number of boreholes and their locations were programmed by PML and approved by the client. The borehole locations were established in the field and surveyed by PML using a Sokkia GCX3 GNSS Receiver.

The boreholes were advanced using a Diedrich D50, CME-55, CME-75 and GeoProbe truck and track mounted drillrigs fitted with continuous flight solid and hollow stem augers, diamond tipped rock coring, and automatic hammer, supplied and operated by specialist drilling contractors. The work was carried out under full-time supervision of PML engineering staff members who directed the drilling and sampling operations, documented the soil stratigraphy, monitored ground water conditions and processed the recovered samples.

The ground water conditions in the boreholes were closely monitored during the course of the fieldwork. Upon completion of drilling, monitoring wells were installed in twenty-five of the boreholes, located along the shoulders of Maple Grove Road and Hespeler Road. The wells were constructed using clean 50 mm diameter screened and solid PVC Schedule 40 pipe, filter sand packing, bentonite seal and protective locks and caps. Copies of the well records from the driller will be kept on file for future reference in accordance with O. Reg. 903, as amended. The field work program included a series of water level readings to establish the stabilized ground water levels, and reference is given to Table 3 for particulars. It should be noted that the ground water levels can vary subject to weather events and seasonal weather conditions.

Representative samples of the overburden were secured from selected boreholes at regular intervals of depth. Standard Penetration Tests (SPT) were carried out in conjunction with the sampling operations using a conventional split spoon sampler. Ground water observations were carried out in the open boreholes during and after completion of drilling.

All of the recovered samples were returned to PML's laboratory for detailed visual examination, classification and routine moisture content determinations. The laboratory testing also included 47 particle size distribution analyses on samples of the pavement granulars and major subgrade soil types encountered. Reference is given to the appended Figures 1 to 10 for the results of the particle size analyses on samples.

Six samples were also submitted for Miller Box Resistivity and corrosivity analysis, the results of which are presented in Figures 11 to 16.

A total of 30 auger samples of the roadway asphalt were collected from the Maple Grove Road, Hespeler Road and intersecting Cambridge roads, and submitted to Lex Scientific Inc. to check for asbestos content.

2.2 Chemical Testing

A limited chemical testing program was included in the geotechnical program to assess the geoenvironmental quality of the site soil in order to provide comments regarding on-site or off-site re-use and disposal options of excess soil.

As part of the geoenvironmental procedural protocol, recovered soil samples were examined for visual and olfactory evidence of potential contamination.

Representative samples collected during the geotechnical investigation were submitted for chemical analysis to SGS Canada Inc. (SGS), a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited laboratory in Lakefield, Ontario. The chemical testing program is outlined in the appended Table 4. The results of the chemical analyses are provided on the SGS 'Certificates of Analysis' presented in Appendix A.

Details concerning the geoenvironmental chemical testing program, including procedures and results of chemical testing are provided in Section 5, below.

3. SUMMARIZED FINDINGS

As defined in The Physiography of Southern Ontario, Third Edition, by L.J. Chapman and D.F. Putnam, the project site is situated in the physiographic region known as the Waterloo Hills. The near surface soils in the Waterloo Hills is generally composed of sandy hills, some of them being ridges of sandy till while others are kames or kame moraines, with outwash sands occupying the intervening hollows.

As noted above, it is understood that the current alignment of Maple Grove Road was constructed in the 1980's. Reference is given to PML's previous projects 87F496 and 87F497, for the previous geotechnical investigation and recommendations for what is the current Maple Grove Road. It is also understood that Speedsville Road, Beaverdale Road, and Hespeler Road are generally much older roadways than the current Maple Grove Road.

Reference is made to the appended Log of Borehole sheets for details of the recent investigation field work including soil descriptions, inferred soil stratigraphy, SPT N values, ground water observations and laboratory moisture content determinations. Reference is also given to the appended Figures 1 to 10 for the results of particle size analyses conducted on samples of the roadway granular base, subbase and subgrade materials.

Due to the soil sampling procedures and the limited size of samples, the depth / elevation demarcations on the borehole logs must be viewed as "transitional" zones, and cannot be construed as exact geologic boundaries between layers.

The site conditions and soil stratigraphy encountered along the Maple Grove Road, Hespeler Road, and intersecting Cambridge Roads are discussed in the sections below.

3.1 Maple Grove Road

Boreholes 1 to 5, and 101 to 144 were advanced on Maple Grove Road from Fountain Street North to east of Hespeler Road (including a section of Fisher Mills Road). The general subsurface stratigraphy encountered along the lanes, shoulders and ditches of Maple Grove Road comprised surficial pavement structure or topsoil overlying fill, sand / gravelly sand / sand and gravel, silty sand / sandy silt, silt / clayey silt, and sandy silt till / silt till / clayey silt till.

3.1.1 Pavement Structures

The 4 km long section of Maple Grove Road under investigation generally comprises a four-lane urban street from Fountain Street North to Vondrau Drive, and a two-lane rural road with granular shoulders from Vondrau Drive to the Maple Grove Road / Hespeler Road intersection. However, Maple Grove Road also has wider rural and urban sections with additional through lanes and turning lanes, locally near the Vondrau Drive, Speedsville Road, Beaverdale Road, and Hespeler Road intersections. The paved surface of Maple Grove Road is generally in fair to poor condition with intermittent to frequent severe transverse cracking, localized moderate to severe map cracking and severe edge alligator cracking. The Fisher Mills Road section east of the Hespeler Road and Maple Grove Road intersection is in very poor condition with extensive and severe transverse cracking and alligator cracking.

Reference is given to Table 1 for further details of the pavement structures encountered below the lanes and shoulders. For the purposes of this assignment, the Maple Grove Road Pavement structures are further divided into the following three sections: Fountain Street North to Vondrau Drive, Vondrau Drive to Old Maple Grove Road, and Old Maple Grove Road to Hespeler Road.

Boreholes 101 and 102 were advanced in the current four-lane portion of Maple Grove Road extending from Fountain Street to the Vondrau Drive intersection. In this area, the pavement structure was 650 and 730 mm thick. The pavement components comprised 185 mm of asphalt, over 135 to 225 mm of granular base, over 330 mm of granular subbase. The pavement subgrade in this area comprised sandy silt fill, underlain by sand and clayey silt till deposits.

Boreholes 103 to 125 were advanced in the lanes and shoulders of the current two-lane portion of Maple Grove Road extending from east of the Vondrau Drive intersection to the Old Maple Grove Road intersection. In this area, the pavement structure was between 460 and 1,400 mm thick. The pavement structure encountered below the existing lanes comprised 100 to 185 mm of asphalt (median 140 mm), 0 to 320 mm of granular base (median 200 mm), and 290 to 1205 mm of granular subbase (median 625 mm). The pavement structure encountered below the existing gravel and paved shoulders comprised 130 to 150 mm of asphalt locally, and a combined 540 to 1400 mm of granular base / subbase (median 700 mm). The pavement subgrade in this area comprised localized fill overlying native soils comprised of sandy silt, clayey silt, silty sand, silt and sand.

Boreholes 1 to 5, and 126 to 144 were advanced in the current two-lane section of Maple Grove Road extending from Old Maple Grove Road to east of the Hespeler Road intersection. In this area the pavement structures were between 570 and 1100 mm thick. The pavement structures encountered below the existing lanes comprised 100 to 160 mm of asphalt (median 140 mm), 150 to 320 mm of granular base (median 200 mm), and 350 to 800 mm of granular subbase (median 520 mm). The pavement structure encountered on the gravel and paved shoulders comprised 120 mm of asphalt locally, and a combined 450 to 1100 mm of granular base/subbase (median 660 mm). The pavement subgrade in this area comprised localized fill overlying native deposits comprised of sand, silty sand, sandy silt, sand and gravel, and gravelly sand.

Reference is given to the appended Figure 1 for the results of particle size analyses conducted on samples of the granular base and subbase below Maple Grove Road. In general, the samples of granular base and subbase materials tested were marginally too silty to meet the Region of Waterloo and Ontario Provincial Standard Specifications (OPSS) for Granular A or B. It is noted that the fines content of the granular samples may have increased in part due to the process of auger sampling.

3.1.2 Topsoil and Topsoil Fill

Surficial topsoil was encountered in Borehole 2, and hand augers TP1001 to TP1044. Reference is given to the appended Log of Borehole sheets and Table 2 for the topsoil thicknesses encountered.

3.1.3 Fill

Fill was encountered along Maple Grove Road, below the pavement structure in Boreholes 3 to 5, 101 to 117, 119 to 123, 128, 130 to 137, and 144. The fill comprised sand and gravel, gravelly sand, sand, silty sand, sandy silt, silt, and clayey silt, with occasional or trace organics in localized areas. The fill was loose to very dense with SPT N values ranging from 4 to greater than 50 blows per 0.3 m penetration of the split spoon sampler. The fill extended to between 0.9 and 7.9 m depths. The fill was damp to saturated, with moisture contents between 2 and 23%.

Reference is given to the appended Figure 4 for the results of particle size analysis on samples of the fill.

3.1.4 Sand / Gravelly Sand / Sand and Gravel

Near surface sand / gravelly sand / sand and gravel deposits were encountered in Boreholes 1, 2, 4, 5, 102, 107, 110 to 112, 114 to 117, 120, 122, 125 to 127, 131, 138, 140 to 143, and extended to between 2.3 and 9.2 m depth. The sand / gravelly sand / sand and gravel was generally encountered below the pavement structure, fill and occasionally were interlayered with silty sand / sandy silt and silt / clayey silt deposits. These deposits contained occasional to numerous cobbles, occasional boulders and occasional silty layers. The sand / gravelly sand / sand and gravel was very loose to very dense with SPT N values ranging from 2 to greater than 50 blows per 0.3 m penetration of the split spoon sampler. The sand / gravelly sand / sand and gravel was moist to saturated with depth, based on moisture contents ranging from 2 to 32%.

A deeper gravelly sand deposit was also encountered below silt / clayey silt deposits in Boreholes 3 and 4, and extended to 12.5 and 18.6 m depths, respectively. The gravelly sand deposit contained occasional cobbles, occasional boulders, and occasional clayey silt seams. The gravelly sand in Boreholes 3 and 4 was very dense with SPT N values greater than 50 blows per 0.3 m penetration. The gravelly sand was saturated with moisture contents between 5 and 25%.

Reference is given to the appended Figures 5 and 6 for the results of particle size analyses on samples of the gravelly sand and sand.

3.1.5 Silty Sand / Sandy Silt

Silty sand / sandy silt deposits were encountered in Boreholes 103, 104, 110, 119, 123, 124, 132, 134, 139, 140, 142, 144, and extended to between 2.3 and 5.0 m depth. Silty sand / sandy silt was generally encountered below the fill and occasionally interlayered with the sand / gravelly sand / sand and gravel. The silty sand / sandy silt was loose to very dense with SPT N values ranging from 5 to greater than 50 blows per 0.3 m penetration. The silty sand / sandy silt deposits were moist to saturated with moisture contents ranging from 4 to 23%.

Reference is given to the appended Figure 7 for the results of particle size analysis on samples of the silty sand.

3.1.6 Silt / Clayey Silt

Silt / clayey silt deposits were encountered in Boreholes 3 and 4, below the fill and sand deposits, and extended to 8.6 and 10.1 m depth, respectively. The silt / clayey silt was compact to dense / very stiff with SPT N values ranging from 19 to 41 blows per 0.3 m penetration. The silt / clayey silt was wet / about plastic limit (APL) with moisture contents between 12 and 15%.

3.1.7 Sandy Silt Till / Silt Till / Clayey Silt Till.

Sandy silt till / silt till / clayey silt till deposits were encountered in Boreholes 1, 2, 5, 101 to 103, 105 to 109, 111 to 115, 118, 120 to 122, 124, 128 to 133 to 135, 140, and 141, and extended to between 3.7 and 16.5 m depth. Cobbles, boulders and localized sand and gravel layers were encountered within the till deposits. The till deposits encountered along Maple Grove Road were compact to very dense/ stiff to hard with SPT N values ranging from 13 to greater than 50 blows per 0.3 m penetration of the split spoon sampler. The till deposits were moist to saturated/drier than plastic limit (DTPL) to APL with moisture contents between 5 and 19%.

Reference is given to the appended Figures 8 and 10 for the results of particle size analyses on samples of the sandy silt till and clayey silt tills.

3.1.8 Ground Water

Wet and saturated soil conditions were observed below 1.4 to 10.7 m depths (Elevation 294 to 311). Water level readings in the wells installed, taken on March 28, 2019, were between 0.3 and 7.4 m depths (about Elevations 290 and 309). The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site.

However, it should be noted that the presence of the relatively impermeable silty or clayey soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

3.2 Hespeler Road

Boreholes 6, 7, 8, 145 to 164 were advanced on Hespeler Road, to between 4.6 and 12.8 m depth. The general subsurface stratigraphy encountered comprised a pavement structure, fill, sand / silty sand / sand and gravel, silt, clayey silt till / sandy silt till / silty sand till, underlain by bedrock.

3.2.1 Pavement Structure

In general the pavements observed on Hespeler Road are in fair to good condition with intermittent transverse and longitudinal cracking. Hespeler Road, from the Maple Grove Road intersection extending to the south, comprises a divided four-lane section, with paved median and concrete barrier, and fully paved shoulders. Hespeler Road, from the Maple Grove Road intersection extending to the north, comprises a divided four lane section, curb median, and partly paved shoulders.

The pavement structure encountered below the lanes and shoulders of Hespeler Road was 650 to 1300 mm thick. The pavement components below the travelled lanes comprised 120 to 185 mm of asphalt (median 155), 140 to 375 mm of granular base (median 195 mm), and 290 to 960 mm of granular subbase (median 570 mm). The pavement components encountered below the shoulders comprised 0 to 160 mm of asphalt locally, 0 to 410 mm of granular base (median 225 mm), and 300 to 710 mm of granular subbase (median 395 mm).

Reference is given to Table 1 for further details of the pavements encountered below the lanes and shoulders.

Reference is given to the appended Figure 2 for the results of particle size analyses on samples of the granular base and subbase.

3.2.2 Fill

Fill was encountered in Boreholes 6, 7, 8, 162 to 164, to between 2.3 to 5.0 m depth. The fill comprised sand, silty sand, silt and sandy silt. The fill was compact to very dense with SPT N values from 14 to greater than 50 blows per 0.3 m penetration. The fill was damp to wet with moisture content between 6 and 21%.

Reference is given to the appended Figure 4 for the results of particle size analysis on a sample of the fill.

3.2.3 Sand / Silty Sand / Sand and Gravel

Sand / silty sand / sand and gravel deposits were encountered below the pavement structure and fill in Boreholes 6, 145 to 154, 157, 160 and 161, and extended to between 0.9 and 7.6 m depth. The sand / silty sand / sand and gravel deposits were loose to dense with SPT N values ranging from 7 to greater than 50 blows per 0.3 m penetration. The sand / silty sand / sand and gravel deposits were damp to saturated with depth, based on moisture contents between 2 and 21%.

Reference is given to the appended Figures 5 and 6 for the results of particle size analyses on samples of the gravelly sand and sand.

3.2.4 Silt / Clayey Silt

Silt / clayey silt deposits were encountered below the fill, and below and between layers of sand / silty sand / sand and gravel, and extended to between 2.1 and 5.0 m depth. The silt / clayey silt was compact to dense / very stiff to hard base on SPT N values of 18 to greater than 50 blows per 0.3 m penetration. The silt/clayey silt was moist to saturated / APL with moisture contents between 14 and 22%.

Reference is given to the appended Figure 9 for the results of particle size analyses on samples of the silt.

3.2.5 Clayey Silt Till / Sandy Silt Till / Silty Sand Till

Clayey silt till / sandy silt till / silty sand till was encountered in Boreholes 6 to 8, 148 to 150, and 152 to 162, and extended to between 4.5 to 11.2 m depth. Cobbles, boulders and localized sand and gravel layers were encountered within the till deposits. The clayey silt till / sandy silt till / silty sand till was compact to dense / very stiff to hard with SPT N values ranging from 14 to greater than 50 blows per 0.3 m penetration.

Reference is given to the appended Figures 8 and 10 for the results of particle size analyses on samples of the sandy silt till and clayey silt till.

3.2.6 Bedrock

Bedrock was encountered in Boreholes 6 and 8 at 11.2 and 5.0 m depth, respectively. The bedrock encountered in Borehole 8 was cored to 12.8 m depth. The bedrock in Borehole 8 was penetrated using hollow stem augers and split spoon sampler to 5.3 m depth. The bedrock comprised weathered hard buff dolostone.

3.2.7 Ground Water

Wet and saturated soil conditions were observed below 1.2 to 4.4 m depths (Elevation 288 to 306). Water level readings in the wells installed in selected boreholes, taken on March 28, 2019, were between 0.3 and 4.7 m depths (Elevations 289 to 313). The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site.

However, it should be noted that the presence of the relatively impermeable silt / clayey silt and till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

3.3 Vondrau Drive

Boreholes 165 to 169 were advanced on Vondrau Drive, to between 4.7 and 5.0 m depth. The general subsurface stratigraphy encountered on Vondrau Drive comprised a pavement structure supported on fill, and sandy silt till / clayey silt till.

Vondrau Drive is an asphalt road with gravel shoulders. The pavements observed along Vondrau Drive are generally in fair to good condition with intermittent transverse and longitudinal cracking. The pavement structure encountered on the lanes and shoulders of Vondrau Drive was 600 to 1340 mm thick. Below the travelled lanes the pavement comprised 130 to 150 mm of asphalt, 160 to 230 mm of granular base, and 300 to 650 mm of granular subbase. Reference is given to Table 1 for further details of the pavements encountered below the lanes and shoulders.

Fill was encountered below the pavement structure in Boreholes 166 to 169, and extended to between 1.4 to 2.3 m depth. The fill was compact to dense with SPT N values ranging from 12 to 46 blows per 0.3 m penetration. The fill comprised silt, clayey silt, silty sand, and sand and gravel. The fill was moist to wet with moisture contents between 2 and 12%.

Sandy silt till / clayey silt till was encountered below the pavement structure and fill, and extended the 4.7 to 5.0 m termination depths. The till deposits were very stiff to hard / compact to very dense with SPT N values ranging from 16 to greater than 50 blows per 0.3 m penetration. The till deposits were moist to wet / DTPL with moisture contents between 5 to 15%.

Free water seepage was not observed within the investigation depths. The presence of the relatively impermeable till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

3.4 Boxwood Drive

Boreholes 170 to 174 were advanced on Boxwood Drive, to a typical 5.0 m depth. The general subsurface stratigraphy encountered on Boxwood Drive comprised a pavement structure supported on fill and sandy silt till / clayey silt till / silt till.

Boxwood Drive is an asphalt road with gravel shoulders. The pavements observed on Boxwood Drive are in fair to good condition with intermittent severe transverse cracking. The pavement structure encountered in Boreholes 170 to 174 on Boxwood Drive was 640 to 730 mm thick. The pavement components below the travelled lanes comprised 135 to 150 mm of asphalt, 0 to 155 mm of granular base, and 340 to 595 mm of granular subbase. The granular base / subbase was moist. Reference is given to Table 1 for further details of the pavements encountered below the lanes and shoulders.

Fill was encountered below the pavement structure in Boreholes 170 to 174, and extended to between 1.4 to 2.3 m depth. The fill comprised sandy silt, silt, and silty sand. The fill was loose to compact and comprised 6 to 28 blows per 0.3 m penetration. The fill was moist with moisture contents ranging from 8 to 21%.

Sandy silt till / clayey silt till / silt till was encountered below the fill in Boreholes 170 to 174, and extended to the 5.0 m termination depths. The till deposits were compact to very dense / very stiff to hard with SPT N values ranging from 12 to greater than 50 blows per 0.3 m penetration. The till deposits were moist to saturated / DTPL to APL with moisture contents ranging between 5 and 19%.

Wet and saturated soil conditions were observed below 3.4 and 4.7 m depths (Elevation 305 to 309). The wet soil conditions and seepage into the boreholes reflect the ground water levels at the site.

The presence of the relatively impermeable till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

3.5 Speedsville Road

Boreholes 175 to 185 were advanced on Speedsville Road, to between 4.7 and 5.0 m depth. The general subsurface stratigraphy comprised a pavement structure supported on fill, localized buried topsoil, silt / silty sand / sandy silt, sand / sand and gravel, underlain by sandy silt till / clayey silt till deposits.

The pavements observed on Speedsville Road were in poor to fair condition with extensive edge cracking and localized alligator cracking. The surficial pavement structure encountered in Boreholes 175 to 185 was 310 to 1100 mm thick. The pavement components comprised 45 to 150 mm of asphalt, 0 to 375 mm of granular base, and 265 to 860 mm of granular subbase. The pavement granular base and subbase were generally moist. Reference is given to Table 1 for further details of the pavements encountered below the lanes and shoulders.

Fill was encountered below the pavement structure in Boreholes 175 to 185, and extended to between 0.7 and 1.9 m depths. The fill comprised sand, sandy silt, silty sand, sand and gravel and clayey silt, and frequently contained trace organics. The fill was loose to compact with SPT N values ranging from 7 to 23 blows per 0.3 m penetration. The fill was moist to wet with moisture contents between 5 and 23%.

Buried topsoil was encountered Borehole 184 below the fill and extended to about 1 m depth.

Silt / silty sand / sandy silt was encountered below the fill in Boreholes 180, 181, 183 and 185, and extended to between 1.4 and 3.0 m depth. The silt / silty sand / sandy silt was loose to compact with SPT N values between 7 to 18 blows per 0.3 m penetration. The silt / silty sand / sandy silt was moist to saturated with moisture contents between 10 to 18%.

Sand / sand and gravel was encountered below the fill, silt / silty sand/sandy silt in Boreholes 175 to 179, 181, and 183 to 185, and extended to between 1.7 and 5.0 m depth. The sand/sand and gravel was very loose to dense with SPT N values between 3 to 34 blows per 0.3 m penetration. The sand / sand and gravel was moist to saturated with moisture contents between 2 and 22%.

Sandy silt till / clayey silt till / silty sand till deposits were encountered below the silt / silty sand / sandy silt and sand / sand and gravel in Boreholes 178 to 185, and extended to the 4.7 to 5.0 m termination depths. The till deposits were compact to very dense / very stiff to hard with SPT N values ranging from 17 to greater than 50 blows per 0.3 m penetration.

Wet and saturated soil conditions were observed below 1.2 to 4.5 m depths (Elevation 303 to 308). The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site.

However, it is noted that the presence of the relatively impermeable till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

3.6 Briardean Road

Boreholes 186 to 189 were advanced on Briardean Road, to between 4.8 and 5.0 m depths. The general subsurface stratigraphy encountered comprised pavement structure, fill, sand and sandy silt till.

The pavements observed on Briardean Road are in poor condition with severe edge cracking, and alligator cracking. The surficial pavement structure encountered in Boreholes 186 to 189 was between 115 and 290 mm thick. The pavement components comprised 45 to 105 mm of asphalt, 70 to 205 mm of granular base / subbase. Reference is given to Table 1 for further details of the pavements encountered below the lanes and shoulders.

Fill encountered below the pavement structure in Boreholes 187 to 189 extended to between 0.6 and 2.1 m depth. The fill typically comprised clayey silt and sandy silt, with trace organics locally. The fill was loose to compact / firm to stiff with SPT N values ranging from 7 to 11 blows per 0.3 m penetration. The fill was moist to wet.

Sand was encountered below the pavement structure and fill deposits in Boreholes 186 and 187, and extended to 4.0 m depth. The sand was compact with SPT N values ranging from 10 to 17 blows per 0.3 m penetration. The sand was damp to moist with moisture contents of 4%.

Sandy silt till deposits were encountered below the fill and sand deposits in Boreholes 186 to 189, and extended to the 4.8 to 5.0 m borehole termination depths. The till deposits were compact to very dense with SPT N values ranging from 18 to greater than 50 blows per 0.3 m penetration. The till was moist to saturated.

Wet and saturated soil conditions were observed below 4.2 m depth (Elevation 309), in Borehole 188. The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site.

However, it is noted that the presence of the relatively impermeable till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

3.7 Beaverdale Road

Boreholes 9, 10, 190 to 199 were advanced on Beaverdale Road, to between 5.0 and 17.4 m depth. The general subsurface stratigraphy comprised pavement structure, fill, sandy silt / silty sand, sand / gravelly sand / sand and gravel, silt / clayey silt, silt till / clayey silt till / sandy silt till, underlain by bedrock.

The pavements observed on Beaverdale Road are in fair condition with intermittent transverse and longitudinal cracking. The pavement structure encountered on Beaverdale Road, in Boreholes 10, and 190 to 199, was between 450 and 1200 mm thick. The pavement components comprised 110 to 255 mm of asphalt, 145 to 500 mm of granular base, and 0 to 870 mm of granular subbase. The granular base / subbase was typically moist with moisture contents between 2 and 8%. Reference is given to Table 1 for further details of the pavements encountered below the lanes and shoulders.

Fill was encountered surficially in Boreholes 9 and below the pavement structure in Boreholes 10, 192, 194, 195, 197 and 198, and extended to between 1.5 to 2.3 m depth. The fill was very loose to compact with SPT N values ranging from 2 to greater than 50 blows per 0.3 m penetration. The fill was damp to saturated with moisture contents between 4 and 13%.

Sandy silt / silty sand deposits were encountered below the pavement structure and fill in Boreholes 190, 191, 193, 194, 195, 197, and 199, and extended to between 1.4 to 5.0 m depth. The sandy silt/silty sand was very loose to compact with SPT N values ranging from 3 to 18 blows per 0.3 m penetration. The sandy silt/silty silt was damp to saturated with moisture contents ranging from 3 to 19%.

Sand/gravelly sand/sand and gravel deposits were encountered below the sandy silt/silty sand in Boreholes 9, 190 to 195, and extended to between 3.8 and 5.2 m depth. The sand / gravelly sand / sand and gravel were compact to very dense with SPT N values ranging from 12 to greater than 50 blows per 0.3 m penetration. The sand / gravelly sand / sand and gravel were damp to saturated with moisture contents between 2 to 20%.

Silt / clayey silt were encountered below the fill and sand deposits in Boreholes 10 and 198, and extended to between 5.0 and 9.0 m depth. The silt / clayey silt was compact / soft to very stiff with SPT N values between 4 and 29 blows per 0.3 m penetration. The silt / clayey silt was wet to saturated / APL to WTPL with moisture contents between 15 and 25%.

Silt till / clayey silt till / sandy silt till was encountered in Boreholes 9, 10, 191 to 193, and 196 to 197, below the pavement structure, fill, sandy silt / silty sand, sand / gravelly sand / sand and gravel, silt / clayey silt, and extended to between 5.0 and 17.1 m depth. The till deposits were compact to dense / very stiff to hard with SPT N value ranging from 17 to greater than 50 blows per 0.3 m penetration. The till soils were moist to saturated with moisture contents ranging from 7 to 20%.

A layer of very dense saturated sand was encountered locally in Borehole 10 and extended to the 15.5 m termination depth.

Wet and saturated soil conditions were observed below 1.2 to 5.2 m depths (Elevation 300 to 306). Water level readings in the well installed in Borehole 8, taken on March 28, 2019, was at 5.1 m depth (about Elevation 303). The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site.

However, it is noted that the presence of the relatively impermeable silt / clayey silt and till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

4. DISCUSSION AND RECOMMENDATIONS

4.1 Foundations

It is understood that bridge structures are being considered for the bypass option or as upgrades to existing intersections, as noted in the following table:

Location	Proposed Structure Details	Boreholes
Old Maple Grove Road and Maple Grove Road	Construction of a grade separation structure at the Old Maple Grove Road and Maple Grove Road intersection to allow the Maple Grove Road to overpass the future bypass road.	1 and 2
Ellis Creek Bridges	Widening of the existing bridge on Maple Grove Road or construction of pedestrian bridges on each side of Maple Grove Road.	3 and 4
Hespeler Road at Maple Grove Road	Construction of a grade separation structure and interchange ramps in place of the current signalized intersection.	5 and 6
Hespeler Road south of Maple Grove Road	Construction of a grade separation structure and associated ramps to allow Hespeler Road to underpass the propose bypass road.	7 and 8
Beaverdale Road south of Maple Grove Road	Construction of a grade separation for an underpass of Beaverdale Road south of the existing Maple Grove Road Intersection.	9 and 10

Details of the recommended bridge foundation options are detailed in the sections below.

4.2 Shallow Foundations

Based on the results of the investigation, the proposed bridges may be supported on conventional strip or spread footing foundations. Foundations should extend a minimum of 0.3 m into the competent hard / very dense native gravelly sand and till deposits, however deeper founding levels may be required for frost and scour protection. Footings constructed in the native hard / very dense gravelly sand and till deposits may be designed using a net bearing resistance at serviceability limit states (SLS) of 400 kPa, and a net soil bearing resistance at ultimate limit state (ULS) of 600 kPa. The recommended minimum founding depths and maximum founding elevations are shown in the following tables:

GRADE SEPARATION, OLD MAPLE GROVE ROAD
FOUNDING LEVELS FOR 600 kPa AT ULS AND 400 kPa AT SLS

BOREHOLE NO.	1	2
MINIMUM DEPTH (m)	9.5	8.1
MAXIMUM ELEVATION	298.0	298.4

ELLIS CREEK CROSSING
FOUNDING LEVELS FOR 600 kPa AT ULS AND 400 kPa AT SLS

BOREHOLE NO.	3	4
MINIMUM DEPTH (m)	8.9	10.4
MAXIMUM ELEVATION	292.0	292.5

GRADE SEPARATION, HESPELER ROAD AT MAPLE GROVE ROAD
FOUNDING LEVELS FOR 600 KPA AT ULS AND 400 KPA AT SLS

BOREHOLE NO.	5	6
MINIMUM DEPTH (m)	8.9	7.9
MAXIMUM ELEVATION	295.2	293.4

GRADE SEPARATION, HESPELER ROAD SOUTH OF MAPLE GROVE ROAD
FOUNDING LEVELS FOR 600 KPA AT ULS AND 400 KPA AT SLS

BOREHOLE NO.	7	8
MINIMUM DEPTH (m)	3.4	3.3
MAXIMUM ELEVATION	292.6	291.9

GRADE SEPARATION, BYPASS AT BEAVERDALE ROAD
FOUNDING LEVELS FOR 600 KPA AT ULS AND 400 KPA AT SLS

BOREHOLE NO.	9	10
MINIMUM DEPTH (m)	5.5	9.3
MAXIMUM ELEVATION	303.0	292.3

Reduced bearing resistances may be available at shallower depths. Upon request we would be pleased to provide further details in this regard.

All footings subject to frost action should be provided with the 1.2 m of earth cover. The depth of potential scour should also be considered.

It is essential that all foundation excavations be inspected by geotechnical personnel from PML to check the competency of the founding surfaces and ensure that the geotechnical requirements presented in this report are properly implemented. All backfill, frost protection and cover for concrete abutments should be placed in accordance with Ontario Provincial Standard Drawing (OPSD) 3101.150.

The saturated native soils at this site are prone to disturbance by the weather elements and construction traffic. Accordingly, a 50 mm skim slab of lean concrete should be provided over the base of the approved founding subgrade, prior to erection of formwork or placement of reinforcing steel.

Provided the footings are designed and constructed for the SLS resistance outlined above, total settlements should not exceed 25 mm with differential settlements of 75% of this value.

4.3 Pile Foundations

Steel H-piles could be used to support the foundation loads at the abutments. The piles should be driven to an appropriate set in very dense / hard till, very dense gravelly sand, or on bedrock, and the envisaged termination depths are shown in the following tables.

GRADE SEPARATION, OLD MAPLE GROVE ROAD
PILE FOUNDING LEVELS

BOREHOLE NO.	1	2
MINIMUM DEPTH (m)	12.2	10.8
MAXIMUM ELEVATION	295.3	295.7

ELLIS CREEK CROSSING
PILE FOUNDING LEVELS

BOREHOLE NO.	3	4
MINIMUM DEPTH (m)	11.6	13.1
MAXIMUM ELEVATION	289.3	289.8

GRADE SEPARATION, HESPELER ROAD AT MAPLE GROVE ROAD
PILE FOUNDING LEVELS

BOREHOLE NO.	5	6
MINIMUM DEPTH (m)	12.5	10.6
MAXIMUM ELEVATION	291.6	290.7

GRADE SEPARATION, HESPELER ROAD SOUTH OF MAPLE GROVE ROAD
PILE FOUNDING LEVELS

BOREHOLE NO.	7	8
MINIMUM DEPTH (m)	6.9	5.0
MAXIMUM ELEVATION	289.1	289.6

GRADE SEPARATION, BYPASS AT BEAVERDALE ROAD
PILE FOUNDING LEVELS

BOREHOLE NO.	9	10
MINIMUM DEPTH (m)	10.6	12.0
MAXIMUM ELEVATION	297.9	289.6

For preliminary design, the following factored geotechnical axial resistance at ULS for the following sections of steel piles is considered to be appropriate.

PILE SECTION	FACTORED GEOTECHNICAL AXIAL RESISTANCE PER PILE AT ULS (kN)	ALLOWABLE AXIAL RESISTANCE PER PILE AT SLS (kN)
HP 310x110	1400	900
HP 360x152	1900	1250

The geotechnical reaction at SLS allows for 25 mm compression of the founding medium.

It is anticipated that the working platforms to drive the piles will be cut into the existing embankment. Any additional fill that may be required at these locations should comprise OPSS Granular A material to allow installation of the piles without damage. Alternative granular material such as Granular B could be employed provided the maximum particle size does not exceed 75 mm.

The piles should be installed and monitored in accordance with the requirements of OPSS 903. This should involve confirmation of the founding elevation, alignment, plumbness, uniformity of set and quality of splices and should be done on a full-time basis by experienced geotechnical personnel.

Pile caps should be provided with at least 1.2 m of earth cover or equivalent thermal insulation as protection against frost action. A 25 mm thick layer of polystyrene insulation is thermally equivalent to 600 mm of soil cover.

For an integral abutment design, the H-piles should be also driven to refusal in till or on bedrock anticipated at the depths and axial resistance that are indicated on the previous pages.

To accommodate movement of the integral abutment system, two concentric CSPs that extend at least 3 m below the bottom of the abutment should be placed around the pile to create an annular space. The inner CSP should be filled with sand meeting the gradation requirements of Granular B Type 1. Alternatively, a single CSP or auger hole filled with loose uniform sand meeting the requirements shown below maybe used.

SIEVE DESIGNATION		PERCENTAGE PASSING BY MASS
2 mm	#10	100
600 µm	#30	80 – 100
425 µm	#40	40 – 80
250 µm	#60	5 – 25
150 µm	#100	0 – 6

Resistance to lateral loads may be provided in part by mobilization of passive resistance along the pile below the annular space. The lateral resistances recommended for the two pile sections are:

	HP 310 x 110	**HP 360 x 152**
Factored Lateral Resistance at ULS	100 kN	130 kN
Lateral Resistance at SLS	30 kN	40 kN

If additional lateral resistance is required, batter piles should be employed.

The coefficient of horizontal subgrade reaction, k_s (MN/m^3), for Granular A or B backfill and native sand / silty sand / silt / clayey silt may be computed using the following equation to evaluate the point of counterflexure:

$$k_s = n_h z/b$$

where k_s = coefficient of horizontal subgrade reaction

n_h = coefficient related to soil density

= 10 MN/m^3 for Granular A and B backfill

= 4 MN/m^3 for native sand / silt / clayey silt

z = depth, (m)

b = pile width, (m)

Group action for lateral loading should be considered, as the lateral capacity of a pile group may be less than the sum of the lateral capacities of individual piles. For design a reduction of the coefficient of subgrade reaction may be required when the spacing between piles in the direction of loading is less than eight pile diameters. Group action can be evaluated by reducing the coefficient of horizontal subgrade reaction by a reduction factor, R, as follows:

PILE SPACING d = PILE DIAMATER OR WIDTH	**HORIZONTAL SUBGRADE REACTION REDUCTION FACTOR, R**
8d	1.00
6d	0.70
4d	0.40
3d	0.25

Pile spacing normal to the direction of loading has no influence provided it is greater than 2.5 times the pile diameter.

4.4 Excavation and Ground water Control

Provided adequate ground water control has been achieved, the excavation side slopes may be assumed to be within a Type 3 soil, for which side slopes can be no steeper than one horizontal to one vertical (1H:1V). It may be necessary to flatten the side slopes to 3H:1V if excessively loose / soft conditions or concentrated seepage zones are encountered. Workers should not enter an unprotected excavation if there is evidence of ongoing ground water seepage in the banks. All construction work should be carried out in accordance with the Occupational Health and Safety Act (OHSA).

It is anticipated that excavations for the proposed bridges and grade separation structures and buried utility installations will extend to the depths described in the following table.

LOCATION	EXCAVATION DEPTH[1]	GROUND WATER DEPTH[2]
Maple Grove Road Servicing	3 m	0.3 to 7.4 m
Hespeler Road Servicing	3 m	0.3 to 4.4 m
Cambridge Roads Servicing	3 m	1.2 to 4.7 m
Old Maple Grove	10 m	1.1 m
Ellis Creek	11 m	7.4 m
Hespeler Road at Maple Grove Road	9 m	0.3 m
Hespeler Road Grade Separation	4 m	4.7 m
Beaver Dale Road Overpass	10 m	5.1 m

Notes:

1. Based on typical utility installation depths and minimum excavation depth for footing foundation construction in unsupported excavations at the bridge sites.
2. Based on observed seepage and ground water levels in boreholes.

The excavations will be advanced through the existing pavement structure and fill into the underlying native subgrade. Excavations for some of the proposed foundations are anticipated to extend several metres below the ground water level, and into saturated sand / gravelly sand / sand and gravel deposits. At these locations, rigorous dewatering will be required to maintain a safe and sufficiently dry excavation and the use of keg wells, well points, or deep well dewatering is envisaged. In this regard, it may be preferable to employ pile foundations and to reconfigure the grade separation configuration to avoid temporary construction dewatering and permanent dewatering measures.

Regardless of the dewatering method chosen, the hydraulic head and ground water inflow must be properly controlled to ensure stable and safe excavation and to facilitate construction. The design of the dewatering system should be left to the contractor's discretion, and the system should meet a performance specification to maintain and control ground water at least 0.3 m below the excavation base level, in order to provide a stable excavation base throughout construction.

It should be noted that, under the Ontario Water Resources Act, the Water Taking and Transfer Regulation 387/04, a Permit to Take Water (PTTW) from the Ministry of Environment, Conservation and Parks (MECP) is required if the dewatering discharge is greater than 50,000 L/day. In accordance with the above noted regulatory requirements and in compliance with the MECP's PTTW Manual (April 2005), and application should be filed to the MECP for the subject property construction dewatering PTTW, if the dewatering discharge is greater than 400,000 L/day, or about 4.6 L/S. If the dewatering discharge is between 50,000 L/day (or about 0.6 L/S) and 400,000 L/day (or about 4.6 L/S) dewatering activities need to be registered on the Environmental Activity and Sector Registry (EASR). PML would be pleased to assist with this process, if required.

As noted in the table above, major dewatering measures would be required for open cut foundation construction at some of the bridge sites. Moreover, installation of new sewers or watermain to typical 3 m invert depths would also require rigorous dewatering in localized areas underlain by wet to saturated sand / gravelly sand / sand and gravel deposits. Therefore, an EASR or PTTW may be required depending on the construction techniques employed. Further reference is given to our hydrogeological investigation report (to be provided under separate cover) for more detailed estimates of the construction dewatering anticipated.

It is recommended that test pits be carried out during the tendering stage of the project in order that prospective contractors may familiarize themselves with soil and ground water conditions. Also, the dewatering requirements should be established by the contractor in the context of a performance specification.

In general, where adequate space is available it will be possible to use open cut excavations in conjunction with sump pumping to control ground water flow. If space is not available for enlarged open cut excavations then consideration should be given to using an engineered system to support the excavation walls. The soil parameters presented in the following table may be used for the design. The parameters are based on the Rankin method of analysis which ignores wall friction.

SOIL TYPE	FILL	NATIVE DEPOSITS	
		COHESIONLESS	COHESIVE
Coefficient of Active Earth Pressure K_a	0.39	0.33	0.36
Coefficient of Passive Earth Pressure K_p	2.56	3.00	2.77
Angle of Internal Friction Ø	26	30	--
Cohesive Strength c_u	--	--	100
Unit Weight γ (kN/m^3)	19	21	20

It will also be important to ensure that the excavation(s) do not undermine existing in-ground structures, roads and or other services in their proximity. The need for underpinning or braced excavation can be established according to criteria illustrated on the appended Figure 17. It should be noted that a trench liner box may not be relied on for bracing purposes. For the soil stratigraphy encountered, the bracing system may be designed as a multi-braced system using a rectangular stress distribution in accordance with methods outlined in the latest Canadian Foundation Engineering Manual (CFEM) and summarized on the appended Figure 18, or as a singly-braced system using a triangular stress distribution and summarized on the appended Figure 19. The system design should also consider load effects from ground water, the adjacent embankments, structures and construction equipment.

The ground surface adjacent to a braced excavation is expected to experience some inward movement and vertical settlement. The magnitude of movements adjacent to a braced cut can be limited by proper selection of the lateral earth pressure coefficient provided good quality workmanship and construction practice is employed.

4.5 Abutment Backfilling

Backfill adjacent to the bridges should be placed in accordance with OPSS 401, and 501, and OPSD 3101.150. The backfill should be placed in 300 mm maximum lifts and compacted to at least 95% standard Proctor maximum dry density (SPMDD), as verified by insitu density testing.

The backfill should comprise free draining granular material such as OPS Granular B Type I. Subject to field inspection and testing, the insitu pavement granulars to be excavated may be suitable for re-use as backfill, otherwise imported granular fill will be required. The use of wet backfill material should be specifically avoided within the top 1 m of backfill below the pavement subgrade level, to help maintain stable subgrade conditions for pavement construction.

Backfill should be brought up simultaneously on each side of the structure and operation of heavy equipment within 1 m of the abutment should be restricted to minimize the potential for movement and/or damage of the structure due to the lateral earth pressure induced by compaction.

The structure must be designed to support the stress imposed by roadway traffic and the overlying fill as well as to resist the unbalanced lateral earth pressure and compaction pressure imposed by the backfill.

The lateral earth and water pressure, P (kPa), may be computed using the equivalent fluid pressure method presented in Section 6.12 of the Canadian Highway Bridge Design Code (CHBDC), CAN/CSA-S6-14, December 2014, or employing the following equation.

$$P = K(\gamma h + q) + C_p$$

where
- P = total lateral pressure at depth h (m) below ground surface (kPa)
- K = lateral earth pressure coefficient of compacted backfill
- h = depth below grade (m) at which lateral pressure is calculated
- γ = unit weight of compacted sand and gravel backfill
- q = vertical stress at depth h due to surcharge loads (kPa)
- C_p = compaction pressure (refer to clause 6.12.3 of CHBDC)

For walls restrained at the top, the total lateral compaction pressure may be computed as 12 kPa added at the backfill surface, reducing linearly to 0 kPa at a depth of 1.7 m, plus a further lateral surcharge of 0.15 times the at-rest lateral pressure added over the full backfilled height of the wall.

Appropriate factors of safety must be used in the design.

The following design parameters may be assumed for granular backfill materials compacted to 95% SPMDD:

PARAMETER	OPS GRANULAR A	OPS GRANULAR B TYPE I	NATIVE SOIL
Angle of Internal Friction (degrees)	35	32	26
Unit Weight (kN/m^3)	23	21	20
Coefficient of Active Earth Pressure (K_a)	0.27	0.31	0.39
Coefficient of Earth Pressure At Rest (K_o)	0.43	0.47	0.56
Coefficient of Passive Earth Pressure (K_p)	3.70	3.23	2.56
Coefficient of friction between soil and concrete	0.45	0.40	0.35

4.6 Embankment Construction

In areas where the road grades are to be raised or the road platform will be widened into the adjacent ditches, engineered embankment fill will be required to establish the new pavement subgrade layers under the traveled lanes and shoulders.

It is anticipated that extensive lane and intersection configuration realignment will require road platform widenings, along Maple Grove Road from east of Vondrau Drive to the Hespeler Road intersection and for the grade separations structures along the proposed bypass.

Prior to construction of the widening embankments, if any, all sidewalks and curbs (if applicable) should be removed, and any insitu topsoil or otherwise soft and deleterious materials should be subexcavated to the level of stable, mineral soil subgrade.

The exposed subgrade should be proofrolled and inspected to identify any local wet / unstable areas, and to evaluate if any frost tapers are necessary. Depending on the depth below the final subgrade surface, any wet / unstable areas encountered may have to be further subexcavated and backfilled with similar, drier material. On unconfined sloped subgrade surfaces steeper than 3H:1V, suitable benching should be provided to mitigate long-term movement of the new fill zone. Reference is made to OPSD 208.010 for particulars.

The majority of the insitu mineral and fill soils should be suitable for re-use in fill sections, and for any embankment widening. Any organic soils / topsoil, or excessively wet material encountered within the subexcavated depths should be segregated and disposed, or used to dress the ground surface or embankment slopes.

When imported material is required, it will be necessary to minimize the variation in subgrade materials beneath the pavement structure with respect to strength and frost susceptibility. Any bulk fill that is imported should be similar to the insitu deposits. Engineered fill material should be compacted to at least 95% SPMDD. Further generic recommendations for engineered fill construction are presented in Appendix D of this report.

Regardless of the source, fill used to establish the pavement subgrade should comprise approved materials subject to field inspection by a geotechnical engineer during construction. Embankment fill should be placed in lifts with a maximum thickness of 300 mm, and be compacted to at least 95% SPMDD.

Settlement of the existing road platform is not expected to occur in areas where the road grades remain at their current levels, or where the subgrade comprises compact to very dense / stiff to hard native deposits. Settlements should be anticipated in areas where the road grades are to be raised, and in areas where the road platform is to be widened over very loose subgrade soils. The amount of settlement will be dependent on the level of the grade change. If required, PML can provide further recommendations in this regard.

Final embankment slopes should be graded and dressed with a suitable cover to prevent erosion. Effort should be made to use 3H:1V earth slopes where possible. As a minimum, the new slopes should be seeded and mulched (as per OPSS 804) as soon after grading as possible to prevent erosion.

4.7 Buried Pipes and Backfill

Provided adequate ground water control is achieved, no bearing problems are anticipated for sewer or watermain pipes founded in the native mineral soils encountered along the proposed alignment, or engineered fill. Conventional bedding and cover materials such as OPSS Granular A per OPSS 1010 will be suitable. Localized areas of very soft or very loose fill and otherwise deleterious soils should be anticipated under existing roadways and in proximity to existing utilities, and in these areas it will be necessary to subexcavate the deleterious soils and place additional bedding material below the pipe.

Material containing stones larger than 50 mm size should not be used in the bedding or cover layers. The bedding should be constructed in accordance with applicable municipal and Ontario Provincial Standard Drawings (OPSD). The bedding and cover material should be placed in 150 mm lifts and compacted to a minimum 95% SPMDD.

The backfill materials beneath roads, walkways and other settlement sensitive areas should be placed in 300 mm maximum lifts and compacted to a minimum of 95% SPMDD. The use of wet material should be specifically avoided within the top 1.2 m below pavement subgrade level. For landscaped and parkland areas where pavement support or post construction settlement are not a concern, the trench / excavation backfill should be compacted to at least 90% SPMDD.

The majority of the onsite mineral soils are expected to be reusable for backfill provided they are not exposed to the elements for prolonged time periods, allowed to become wet or frozen, or mixed with other deleterious materials.

Topsoil and organic materials may be reused for landscaping purposes only, or disposed of off-site.

The in-situ clayey silt and till soils will tend to retain a voided structure when placed as backfill. Sufficient compaction must be applied to breakdown all lumps / clods within the fill matrix to achieve a non-voided condition. Significant post construction settlement could otherwise result.

All trenching operations should be carried out in such a manner as to minimize the length of trench left open, while still efficiently accommodating pipe laying and compaction procedures.

4.8 Stormwater Infiltration and LID

It is understood that onsite storm water infiltration parameters are required as part of LID. The following table provides hydraulic conductivity and infiltration design parameters for the major onsite soils encountered above the ground water level. An appropriate factor of safety should also be used for design.

SOIL	HYDRAULIC CONDUCTIVITY (cm/s)	INFILTRATION RATE (mm/hr)
Clayey Silt / Silt / Sandy Silt	Less than $1x10^{-6}$	Less than 0.04
Silty Sand	$1x10^{-6}$ to $1x10^{-4}$	Less than 1 to 5
Sand / Gravelly Sand / Sand and Gravel	$1x10^{-4}$ to$1x10^{-3}$	5 to 50

Cognizant of the low permeability and infiltration rates of the clayey silt, silt, sandy silt ad silty sand infiltration is expected to be negligible for much of the site. Infiltration may be possible in localized areas where sand/gravelly sand/sand and gravel deposits were encountered above the ground water level.

4.9 Corrosion Potential

Composite soil samples from Boreholes 109, 124, 132, 144, 146 and 163, were submitted for analysis to check the potential for corrosion of ductile iron, and to evaluate the potential for sulphate attack on buried concrete.

The corrosivity of the soil on ductile iron pipe was evaluated in accordance with the AWWA system that uses resistivity, sulphides, pH, redox potential and drainage characteristics as the main indicators of soil/bedrock aggressiveness. The resistivity of the soil was tested using the Miller Box method. The AWWA procedure uses a point system to evaluate the corrosivity of the soil at the site. Points were assigned to each indicator in accordance with its anticipated contribution to the total corrosion potential of the soil as determined by laboratory testing. Figures 11 to 16, and the SGS Certificate of Analysis in Appendix D present the testing results.

CORROSIVITY ANALYSIS

Sample	BH108 SS4 to 6	BH124 SS5	BH132 SS4	BH143 SS5 to 6	BH145 SS5	BH163 SS5
Depth	2.3 to 5.0 m	3.1 to 3.5 m	3.1 to 3.5 m	3.1 to 5.0 m	4.5 to 5.0 m	3.1 to 3.5 m
pH	8.50	8.96	8.83	9.17	9.42	8.55
Points	0	3	3	3	3	3
Sulfides	Trace	Negative	Negative	Negative	Negative	Negative
Points	2	0	0	0	0	0
Moisture Condition	Poor Drainage	Poor Drainage	Poor Drainage	Poor Drainage	Poor Drainage	Fair Drainage
Points	2	2	2	2	2	1
Resistivity (ohm-cm)	1000	7000	6000	2200	1500	1700
Points	10	0	0	2	8	8
Redox Potential (mV)	222	242	238	276	272	226
Points	0	0	0	0	0	0
Total Points[1]	14	5	5	7	13	12

Note (1): Ten points or more indicate that soil is corrosive to ductile iron pipe, and. protection is needed.

The results of the AWWA analysis indicated that some of the buried pipe will be installed in an environment that is corrosive to ductile iron.

The sulphate content tests conducted on samples from Boreholes 108, 124, 132, 143, 145, and 163, to evaluate the potential for sulphate attack on buried concrete structures are provided on the SGS Certificates of Analysis in Appendix D. The results indicated the potential for sulphate attack on buried concrete is negligible. For further comments regarding cement requirements, refer to the current CSA A23.1.

4.10 Pavement Design

4.10.1 Maple Grove Road

Pavement design analyses for reconstruction of Maple Grove Road and Hespeler Road were carried out in accordance with the 1993 AASHTO *Guide for the Design of Pavement Structures* and AASHTOWare DARWin 3.01, as modified by the *Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions*, March 19, 2008 (MTO Publication MI-183). The MTO Routine Method, as outlined in the *Pavement Design and Rehabilitation Manual*, 1990, was also considered in the analysis.

An initial design service life of 20 years was selected as the minimum requirement to minimize traffic disruptions required by rehabilitation in the future.

Along Maple Grove Road the pavement subgrade soils included mixed deposits of cohesive and cohesionless fill and native soils. The majority of the subgrade soils were silty, and occasionally the fill soils contained organics in localized areas. The subgrade soils generally ranged from loose to dense. The condition and performance of the existing pavements was also taken into consideration in the analysis. As noted in Section 3.1, the pavements along Maple Grove Road were generally in a poor to fair condition. Based on the above, the following 'Roadbed Soil Resilient Modulus' values were used for pavement design computations along Maple Grove Road: from Fountain Street to Vondrau Drive 30,000 kPa, from Vondrau Drive to Old Maple Grove Road 30,000 kPa, and from Old Maple Grove Road to Hespeler Road 40,000 kPa.

PML's design approach was to assess the strength of the existing pavements, as compared to the design, and to assess the rehabilitation options versus full-depth pavement reconstruction. Reference is made to Table 1 attached, where the structural capacity of the existing pavements was calculated using granular base equivalency (GBE) values which were assessed for the pavement components based on the existing pavement conditions and the borehole findings. The GBE calculations utilized reduced equivalency factors for old pavement of 1.25 for asphalt, 0.75 for granular base, and 0.5 for granular subbase.

For full depth reconstruction (where applicable), consideration was given to traditional Granular A base over Granular B subbase pavement designs, as well as those utilizing only a Granular A base.

Traffic data was provided to PML by the Region of Waterloo and included average annual daily traffic (AADT) figures and percentage trucks along Maple Grove Road for two design scenarios. Scenario 1 included traffic for a four lane design along the current alignment. Scenario 2 included a four lane design along the current alignment and construction of the proposed bypass. It is also noted that a series of analyses was also conducted for the proposed roundabout sites, due to the unique heavier traffic loading at the roundabout. The traffic data was provided for 2018. A 2025 construction year AADT (2025) was extrapolated using a compound growth rate ranging from 0 to 2.7% as appropriate for the scenario and subsection of Maple Grove Road being analyzed.

Based on the traffic data provided, the proposed lane configurations, and the subsurface findings, the Maple Grove Road alignment has been divided into three major sections, with the following factors utilized:

MAPLE GROVE ROAD TRAFFIC DATA

ROADWAY SECTION	FUTURE # OF LANES	CURRENT PAVEMENT CONDITION	2018 AADT (VPD)	HEAVY TRUCK (%)	TRUCK FACTOR
Maple Grove Road from Fountain Street to Vondrau Drive	4	Poor to fair	19,950	8	1.9
Maple Grove Road from Vondrau Drive to Old Maple Grove Road	4	Poor to fair	18,650	6	1.9
Maple Grove Road from Old Maple Grove Road to Hespeler Road	4	Poor to fair	18,740	6	1.9

Reference is given to Appendix B for the detailed traffic data provided by the Region of Waterloo

As noted previously, two scenarios are under consideration: Scenario 1 involves four-laning of the current Maple Grove Road alignment; and Scenario 2 involves four-laning of the current Maple Grove Road alignment along with construction of a bypass from Old Maple Grove Road to Hespeler Road.

The pavement design analyses established an AASHTO Structural Number (SN) required, given the traffic and subgrade conditions, which subsequently was converted to an MTO granular base equivalency (GBE) value. Reference is made to Appendix B, where raw printouts for trial runs of DARWin 3.01 are included and for the detailed traffic data provided by the Region of Waterloo.

4.10.1.1 New Construction

Based on the general usage, frost susceptibility, and strength of the expected subgrade soils, the following pavement component thicknesses should be used for widening areas (beyond the existing gravel shoulders), for areas where utility replacement is required, or in areas where other pavement rehabilitation methods (provided below) are not considered feasible.

RECOMMENDED NEW CONSTRUCTION PAVEMENT STRUCTURE (TRADITIONAL GRANULAR A OVER GRANULAR B CONSTRUCTION)

LOCATION	ASPHALT (mm)	GRANULAR A BASE (mm)	GRANULAR B SUBBASE (mm)	TOTAL THICKNESS (mm)	SN	GBE
Maple Grove Road – Scenario 1, Four-laning without bypass						
Fountain Street to Vondrau Drive	170	150	600	920	146	890
Vondrau Drive to Old Maple Grove Road	160	150	600	910	142	870
Old Maple Grove Road to Hespeler Road	160	150	450	760	129	772
Roundabout at Vondrau Drive	190	150	650	990	159	965
Roundabouts at Boxwood Drive, Speedsville Road, and Compass Trail	180	150	625	955	153	929
Roundabout at Beaverdale Road	180	150	450	780	137	810
Roundabout at Hespeler Road	210	150	550	910	159	939
Maple Grove Road –Scenario 2, Four-laning with bypass						
Fountain Street to Vondrau Drive	170	150	600	920	146	890
Vondrau Drive to Old Maple Grove Road	160	150	600	910	142	870
Old Maple Grove Road to Hespeler Road	150	150	400	760	120	718
Roundabout at Vondrau Drive,	190	150	650	990	159	965

RECOMMENDED NEW CONSTRUCTION PAVEMENT STRUCTURE
(TRADITIONAL GRANULAR A OVER GRANULAR B CONSTRUCTION)

LOCATION	ASPHALT (mm)	GRANULAR A BASE (mm)	GRANULAR B SUBBASE (mm)	TOTAL THICKNESS (mm)	SN	GBE
Roundabouts at Boxwood Drive, Speedsville Road, and Compass Trail	180	150	625	955	153	929
Roundabout at Beaverdale Road	170	150	450	770	133	790
Roundabout at Hespeler Road	200	150	570	920	156	932

The below table presents an alternative pavement design based on a Granular A only construction:

RECOMMENDED NEW CONSTRUCTION PAVEMENT STRUCTURE
(GRANULAR A ONLY CONSTRUCTION)

LOCATION	ASPHALT (mm)	GRANULAR A BASE (mm)	GRANULAR B SUBBASE (mm)	TOTAL THICKNESS (mm)	SN	GBE
Maple Grove Road – Scenario 1, Four-laning without bypass						
Fountain Street to Vondrau Drive	170	550	--	720	148	890
Vondrau Drive to Old Maple Grove Road	160	550	--	710	144	870
Old Maple Grove Road to Hespeler Road	160	450	--	610	130	770
Roundabout at Vondrau Drive	190	590	--	780	162	970
Roundabouts at Boxwood Drive, Speedsville Road, and Compass Trail	180	575	--	755	156	935
Roundabout at Beaverdale Road	180	450	--	630	139	810
Roundabout at Hespeler Road	210	520	--	730	161	940

RECOMMENDED NEW CONSTRUCTION PAVEMENT STRUCTURE (GRANULAR A ONLY CONSTRUCTION)

LOCATION	ASPHALT (mm)	GRANULAR A BASE (mm)	GRANULAR B SUBBASE (mm)	TOTAL THICKNESS (mm)	SN	GBE
Maple Grove Road – Scenario 2, Four-laning with bypass						
Fountain Street to Vondrau Drive	170	550	--	720	148	890
Vondrau Drive to Old Maple Grove Road	160	550	--	710	144	870
Old Maple Grove Road to Hespeler Road	150	420	--	570	126	720
Roundabout at Vondrau Drive	190	590	--	780	162	970
Roundabouts at Boxwood Drive, Speedsville Road, and Compass Trail	180	575	--	755	156	935
Roundabout at Beaverdale Road	170	450	--	620	134	790
Roundabout at Hespeler Road	200	530	--	730	158	930

The current pavement structures encountered along Maple Grove Road were also analyzed to evaluate the potential rehabilitation or reconstruction requirements. As noted above, the recommended minimum design GBE is between 718 and 890 mm for the new lanes, and between 790 and 935 m for the proposed roundabout sites. For comparison purposes, along the existing lanes of Maple Grove Road the current effective GBE varies as follows:

- The GBE for the four lane section of Maple Grove Road between Fountain Street to east of Vondrau Drive is 498 to 565 mm (average 531), and the required design GBE is 890 mm;
- The GBE for the two-lane section of Maple Grove Road from east of Vondrau Drive to Old Maple Grove Road is 415 to 784 (median 628 mm), and the required design GBE is 870 mm; and,
- The GBE for the two-lane section of Maple Grove Road from Old Maple Grove Road to Hespeler Road is 463 to 675 mm (median 598 mm) and the required design GBEs are 772 and 718 for Scenario 1 and Scenario 2, respectively.

The existing pavement structures of Maple Grove Road do not meet the new pavement design requirements. The median GBE deficiency of the existing pavements would be between 174 and 359 in Scenario 1 without the bypass, and would be between 120 and 361 in Scenario 2 with the bypass construction. Therefore, the existing pavement structures in the current two to four lane sections of Maple Grove Road are not adequate to carry the future design traffic volumes and the pavements will have to be strengthened.

4.10.1.2 Pavement Rehabilitation Options

It is understood that the section of Maple Grove Road under consideration will be widened throughout to provide a four lane cross section. If significant grade raises can be accommodated, for the sections of Maple Grove Road east of Vondrau Drive, then a partial depth pavement rehabilitation of the existing two lanes and shoulders could be considered in conjunction with roadway and pavement widening. However, considering the significant structural deficiencies noted above, the rehabilitation options are limited to a pulverize and overlay alternative, as follows.

Pulverize the existing asphalt and underlying granular base to a typical depth of 300 mm. After pulverizing and fine grading, place a new asphalt overlay as per the following table, which also shows the corresponding grade raise that would be required.

PULVERIZE 300 mm AND PAVE REHABILITATION STRATEGY

LOCATION	RECOMMENDED ASPHALT THICKNESS (mm)	CORRESPONDING GRADE RAISE (mm)
Maple Grove Road – Scenario 1 without bypass		
Fountain Street to Vondrau Drive	n/a*	n/a*
Vondrau Drive to Old Maple Grove Road	160	160
Old Maple Grove Road to Hespeler Road	160	160
Roundabout at Vandrau Drive	n/a*	n/a*
Roundabout at Boxwood Drive, Speedsville Road and Compass Trail	n/a*	n/a*
Roundabout at Beaverdale Road	n/a*	n/a*
Roundabout at Hespeler Road*	n/a*	n/a*

Maple Grove Road – Scenario 2 with bypass		
Fountain Street to Vondrau Drive	n/a*	n/a*
Vondrau Drive to Old Maple Grove Road	160	160
Old Maple Grove Road to Hespeler Road	150	150
Roundabout at Vandrau Drive	n/a*	n/a*
Roundabout at Boxwood Drive, Speedsville Road and Compass Trail	n/a*	n/a*
Roundabout at Beaverdale Road	n/a*	n/a*
Roundabout at Hespeler Road	n/a*	n/a*

*Full depth reconstruction will be required due to grade restrictions, alignment changes, and traffic loading.

In localized areas where the existing asphalt is more than 150 mm thick, PML recommends that the asphalt be milled as required prior to pulverizing such that a 50-50% mixture of asphalt to granular can be achieved. The pulverizing depth should be set to a typical 300 mm, and the pre-milling must be adjusted where necessary to ensure that the pulverized product contains a maximum 50% asphalt coated particles. After pulverizing, the pulverized material should be graded as necessary, compacted, and then paved. It is noted that the pulverize option will eliminate the potential for future reflection cracking.

In general, the boreholes have confirmed the total pavement thickness on the gravel shoulder matches the main lane pavement thickness. As such, if pulverizing is employed for the existing lanes, then the existing shoulder pavement structures can generally be strengthened though a partial depth removal at the existing surface granular (as necessary), and placement of 150 mm new Granular A base followed by paving the specified asphalt thicknesses.

Widening of the road platform beyond the extent of the existing shoulders would require excavation to strip topsoil and deleterious materials, and construction of new pavement structures as noted above. In widening areas, the subgrade level will also require adjustment as necessary, in order to maintain proper drainage to the existing pavement structures. In this regard, for areas where the current pavement structure thickness exceeds the new design, additional Granular B subbase should be provided below the new pavements as necessary to match the existing lanes and shoulders. The granular base and subbase layers should daylight to ditches if a rural configuration is maintained, or flow to subdrains at the pavement edge if an urban configuration is constructed.

4.10.1.3 Pavement Types and Depths

The following asphalt thicknesses and materials should be utilized for the reconstruction and rehabilitation options presented above.

MAPLE GROVE ROAD (EXCLUDING ROUNDABOUT)
FOUNTAIN STREET TO EAST OF VONDRAU DRIVE

THICKNESS (mm)	MATERIAL	LIFT
50	Superpave 12.5FC 2	Surface Course
60	Superpave 19.0	Upper Binder Course
60	Superpave 19.0	Lower Binder Course

MAPLE GROVE ROAD (EXCLUDING ROUNDABOUTS)
EAST OF VONDRAU DRIVE TO OLD MAPLE GROVE ROAD

THICKNESS (mm)	MATERIAL	LIFT
40	Superpave 12.5FC 2	Surface Course
60	Superpave 19.0	Upper Binder Course
60	Superpave 19.0	Lower Binder Course

**MAPLE GROVE ROAD (EXCLUDING ROUNDABOUTS)
FROM OLD MAPLE GROVE ROAD TO HESPELER ROAD**

THICKNESS (mm)	MATERIAL	LIFT
40	Superpave 12.5FC 2	Surface Course
60	Superpave 19.0	Upper Binder Course
60[1]	Superpave 19.0	Lower Binder Course

Notes:
1. May be reduced to 50 mm for widening Scenario 2 with construction of the bypass

VONDRAU DRIVE ROUNDABOUT

THICKNESS (mm)	MATERIAL	LIFT
50	Superpave 12.5FC 2	Surface Course
70	Superpave 19.0	Upper Binder Course
70	Superpave 19.0	Lower Binder Course

**BOXWOOD DRIVE SPEEDSVILLE ROAD AND COMPASS TRAIL
ROUNDABOUTS**

THICKNESS (mm)	MATERIAL	LIFT
40	Superpave 12.5FC 2	Surface Course
70	Superpave 19.0	Upper Binder Course
70	Superpave 19.0	Lower Binder Course

BEAVERDALE ROAD ROUNDABOUT

THICKNESS (mm)	MATERIAL	LIFT
50	Superpave 12.5FC 2	Surface Course
60	Superpave 19.0	Upper Binder Course
60	Superpave 19.0	Lower Binder Course

HESPELER ROAD ROUNDABOUT

THICKNESS (mm)	MATERIAL	LIFT
40	Superpave 12.5FC 2	Surface Course
50	Superpave 19.0	Upper Binder Course
50	Superpave 19.0	Middle Binder Course
60[1]	Superpave 19.0	Lower Binder Course

Notes:
1. May be reduced to 50 mm for widening Scenario 2 with construction of the bypass

4.10.2 Hespeler Road

Along Hespeler Road the pavement subgrade soils included mixed deposits of cohesionless fill and native soils. The majority of the subgrade soils were silty. The subgrade soils generally ranged from loose to dense. The condition and performance of the existing pavements was also taken into consideration in the analysis. As noted in Section 3.2, the pavements along Hespeler Road were generally in a fair to good condition. Based on the above, the 'Roadbed Soil Resilient Modulus' value used for pavement design computations along Hespeler Road was 40,000 kPa.

Based on the traffic data provided, the proposed lane configurations, and the subsurface findings, the Hespeler Road alignment has been divided into two major sections, with the following factors utilized:

HESPELER ROAD TRAFFIC DATA

ROADWAY SECTION	FUTURE # OF LANES	CURRENT PAVEMENT CONDITION	2018 AADT (VPD)	HEAVY TRUCK (%)	TRUCK FACTOR
Hespeler Road from Maple Grove Road north to Guelph Avenue	4	Fair to good	19,390	11.0	1.9
Hespeler Road from Maple Grove Road south to Queen Street West	4	Fair to good	30,750	12.1	1.9

Reference is given to Appendix B, where raw printouts for train runs of DARWin 3.0 are included and for the detailed traffic data provided by the Region of Waterloo

As noted previously, two scenarios are under consideration: Scenario 1 involves four-laning of the current Maple Grove Road alignment; and Scenario 2 involves four-laning of the current Maple Grove Road alignment along with construction of a bypass from Old Maple Grove Road to Hespeler Road. The approximate route of the bypass is shown on the Borehole Location Plan.

4.10.2.1 New Construction

Based on the general usage, frost susceptibility, and strength of the expected subgrade soils, the following pavement component thicknesses should be used for widening areas (beyond the existing paved shoulders), for areas where utility replacement is required, or in areas where other pavement rehabilitation methods are not considered feasible.

RECOMMENDED NEW CONSTRUCTION PAVEMENT STRUCTURE (TRADITIONAL GRANULAR A OVER GRANULAR B CONSTRUCTION)

LOCATION	ASPHALT (mm)	GRANULAR A BASE (mm)	GRANULAR B SUBBASE (mm)	TOTAL THICKNESS (mm)	SN	GBE
Hespeler Road – Scenario 1, Four-laning Maple Grove Road without bypass						
From Maple Grove Road to the north	180	150	450	780	137	810
From Maple Grove Road to the south	190	150	500	840	146	865
Hespeler Road –Scenario 2, Four-laning Maple Grove Road with bypass						
From Maple Grove Road to the north	180	150	450	780	137	810
From Maple Grove Road to the south	180	150	500	830	142	845

The below table presents an alternative pavement design based on a Granular A only construction:

RECOMMENDED NEW CONSTRUCTION PAVEMENT STRUCTURE (GRANULAR A ONLY CONSTRUCTION)

LOCATION	ASPHALT (mm)	GRANULAR A BASE (mm)	GRANULAR B SUBBASE (mm)	TOTAL THICKNESS (mm)	SN	GBE
Hespeler Road – Scenario 1, Four-laning Maple Grove Road without bypass						
From Maple Grove Road to the north	180	450	--	630	139	810
From Maple Grove Road to the south	190	485	--	675	148	865
Hespeler Road –Scenario 2, Four-laning Maple Grove Road with bypass						
From Maple Grove Road to the north	180	450	--	630	139	810
From Maple Grove Road to the south	180	485	--	665	144	845

The current pavement structures encountered along Hespeler Road were also analyzed to evaluate the potential rehabilitation or reconstruction requirements. As noted above, the recommended minimum design GBE is between 810 and 865 mm for the new lanes, For comparison purposes the current effective GBE for the existing lanes of Hespeler Road is 498 to 803 mm (median 645), and the GBE for the existing shoulders of Hespeler Road is 405 to 615 (median 473 mm). The pavement design requirements for the Hespeler Road and Maple Grove Road roundabout are described in the Maple Grove Road section above.

The existing pavement structures of Hespeler Road do not meet the new pavement design requirements. The median GBE deficiency of the existing pavements would be between 165 and 392 in Scenario 1 without the bypass, and would be between 165 and 372 in Scenario 2 with the bypass construction. Therefore, the existing pavement structures in the current lanes and shoulders sections of Hespeler Road are not adequate to carry the future design traffic volumes and the pavements will have to be strengthened or reconstructed.

4.10.2.2 Pavement Rehabilitation Options

It is understood that Hespeler Road will generally maintain the current four lane divided roadway configuration, with median sewer and concrete barrier wall/cubing. If grades cannot be raised, then full depth reconstruction of the roadway will be required to achieve the strength needed to satisfy the 20 year pavement design parameters.

If significant grade raises can be accommodated as part of the road improvements, then a partial depth pavement rehabilitation of the existing four lanes and shoulders could be considered. However, considering the significant structural deficiencies noted above, the rehabilitation options are limited to a pulverize and overlay alternative, as follows.

Pulverize the existing asphalt and underlying granular base to a typical depth of 300 mm. After pulverizing and fine grading, place a new asphalt overlay as per the following table, which also shows the corresponding grade raise that would be required.

PULVERIZE 300 mm AND PAVE REHABILITATION STRATEGY

LOCATION	RECOMMENDED ASPHALT THICKNESS (mm)	CORRESPONDING GRADE RAISE (mm)
Hespeler Road – Scenario 1, Four-laning Maple Grove Road without bypass		
From Maple Grove Road to the north	180	180
From Maple Grove Road to the south	190	190
Hespeler Road –Scenario 2, Four-laning Maple Grove Road with bypass		
From Maple Grove Road to the north	180	180
From Maple Grove Road to the south	180	180

In localized areas where the existing asphalt is more than 150 mm thick, PML recommends that the asphalt be milled, as required, prior to pulverizing such that a 50-50% mixture of asphalt to granular can be achieved. The pulverizing depth should be set to a typical 300 mm, and the pre-milling must be adjusted where necessary to ensure that the pulverized product contains a maximum 50% asphalt coated particles. After pulverizing, the pulverized material should be graded as necessary, compacted, and then paved. It is noted that the pulverize option will eliminate the potential for future reflection cracking.

In general, the boreholes have confirmed the total pavement thickness on the paved and gravel shoulder matches the main lane pavement thickness. As such, if pulverizing is employed, the paved shoulder can be treated the same as the main lanes, however, gravel shoulders should have a partial subexcavation of the granulars and placement of 150 mm new Granular A base followed by paving the specified asphalt thicknesses.

Widening of the road platform beyond the extent of the existing shoulders would require excavation to strip topsoil and deleterious materials, and construction of new pavement structures as noted above. In widening areas, the subgrade level will also require adjustment as necessary, in order to maintain proper drainage to the existing pavement structures and minimize potential for differential frost heave. In this regard, for areas where the current pavement structure thickness exceeds the new design, additional Granular B subbase should be provided below the new pavements as necessary to match the existing lanes and shoulders. The granular base and subbase layers should daylight to ditches if a rural configuration is maintained, or flow to subdrains at the pavement edge if an urban configuration is constructed.

4.10.2.3 Pavement Types and Depths

The following asphalt thicknesses and materials should be utilized for the reconstruction of Hespeler Road.

HESPELER ROAD (EXCLUDING ROUNDABOUT)
FROM MAPLE GROVE ROAD NORTH TO GUELPH AVENUE

THICKNESS (mm)	MATERIAL	LIFT
50	Superpave 12.5FC 2	Surface Course
60	Superpave 19.0	Upper Binder Course
60	Superpave 19.0	Lower Binder Course

HESPELER ROAD (EXCLUDING ROUNDABOUT)
FROM MAPLE GROVE ROAD SOUTH TO QUEEN STREET WEST

THICKNESS (mm)	MATERIAL	LIFT
40	Superpave 12.5FC 2	Surface Course
60	Superpave 19.0	Upper Binder Course
60	Superpave 19.0	Lower Binder Course

4.10.3 Cambridge Roadways

Roadway traffic details including AADT, commercial vehicle usage and growth rates were not provided for the Hespeler Road and the City of Cambridge roadways. Consequently, we have provided the following pavement component thicknesses to reinstate the roads intersecting Maple Grove Road. The pavement structures were selected to match the typical pavement components encountered in the boreholes. The reinstatement pavement designs would have a similar performance to the current pavement structures

REINSTATEMENT OF EXISTING PAVEMENT STRUCTURE
(TRADITIONAL GRANULAR A OVER GRANULAR B CONSTRUCTION)

LOCATION	ASPHALT (mm)	GRANULAR A BASE (mm) [1]	GRANULAR B SUBBASE (mm) [1]	TOTAL THICKNESS (mm) [1]	SN	GBE
Hespeler Road	160	200	600	960	149	920
Vondrau Drive	140	150	450	740	120	730
Boxwood Drive	140	150	300	590	107	630
Speedsville Road	80	150	300	530	82	510
Briardean Road	80	150	--	230	55	310
Beaverdale Road	160	250	500	910	147	900

Selection of the asphalt mix designs would require detailed traffic information.

4.10.4 General Pavement Construction Recommendations

It is expected that pavement construction will be carried out during the drier time of the year and that the subgrade is stable, as determined by proofrolling and inspection by PML personnel. Preparation of the subgrade should involve removal of any existing topsoil, organic fills or other obvious deleterious materials, followed by proofrolling of the subgrade with a heavy roller to ensure adequate support. If the subgrade is wet and unstable, subexcavation and placement of additional granular subbase or select subgrade material (SSM) material will be required. Where necessary, any backfill beneath the pavement should be placed in maximum 300 mm lifts and be compacted to 95% standard Proctor maximum dry density (SPMDD).

The pavement materials should conform to current OPSS and municipal specifications. The Granular A base and Granular B subbase courses should be placed in thin lifts and compacted to a minimum of 100% SPMDD. Asphalt should comprise Superpave 12.5FC 2 over Superpave 19.0 and should use an asphalt cement with a PGAC of 70-28 for surface courses and a PGAC of 64-28 for binder courses. Traffic Category D would be applicable for the majority of this project, with the exception of the Hespeler Road Roundabout and the section of Hespeler Road extending from the Maple Grove Road intersection south to Queen Street West where Traffic Category E would be applicable. Asphalt should be placed to a minimum of 92% of the material's maximum relative density (MRD). Reference is made to OPS Specification 310.

In general, the existing granular base and subbase materials are expected to be marginally too silty to meet the OPSS Granular A or B specification, or the RMOW specifications for Granular B. Consequently, any excavated existing granular base and subbase are would only be suitable for reuse as SSM below the new pavement structure. Imported new Granular A and Granular B (if used) will be required within the new pavements.

During construction, testing should be conducted to confirm the gradation and compatibility characteristics of the granular base materials and the mix design properties of the asphalt.

Proofrolling procedures and the placement and compaction of all the granular materials and asphalt for the pavement construction should be inspected on a continuous basis by PML personnel.

In areas where reconstruction is chosen, and an urban cross section is to be constructed, longitudinal subdrains should be provided to prevent water accumulation on the pavement subgrade surface. The pavement structure subgrade should be graded so that water is directed to longitudinal drains at the pavement edge. The subdrains should be discharged in to the catch basins. The subdrains may consist of 100 mm diameter perforated filter wrapped plastic pipes, bedded in concrete sand (as per OPSS1002 Table 1 Gradation Requirements for Fine Aggregate), and set within the subbase layer at the level of the subgrade surface. It is noted that water was not typically observed within the in-situ pavement granulars; as such, if partial depth rehabilitation is chosen, the existing pavement drainage appears to be performing adequately.

4.11 Asbestos Testing

A total of 30 samples of the roadway asphalt were collected and submitted to Lex Scientific Inc. to check for asbestos. Auger samples from Boreholes 103, 105, 109, 111, 114, 117, 121, 126, 128, 132, 135, 137, 141, 145, 148, 153, 157, 160, 163, 166, 169, 171, 174, 175, 178, 183, 188, 191, and 198 were analyzed, and the results of which are presented on the Lex Scientific Certificate of Analysis presented in Appendix D. Asbestos was not detected in any of the tested samples.

4.12 Geotechnical Review and Construction Inspection and Testing

It is recommended that the design drawings be submitted to PML for general geotechnical review for compatibility with site conditions and recommendations of this report.

Earthworks operations should be carried out under the supervision of PML to approve subgrade preparation, backfill materials, placement and compaction procedures, and verify the specified degree of compaction is achieved uniformly throughout fill materials.

The comments and recommendations provided in the report are based on the information revealed in the boreholes. Conditions away from and between boreholes may vary, particularly where service trenches exist. Geotechnical review during construction should be on going to confirm the subsurface conditions are substantially similar to those encountered in the boreholes, which may otherwise require modification to the original recommendations.

5. GEOENVIRONMENTAL CONSIDERATIONS

As noted, a chemical testing program was completed on selected soil samples recovered during the geotechnical investigation. PML understands that excess soil may be generated during construction, the volume of which is unknown at this time. A limited chemical testing program was completed to check the geoenvironmental quality of the site soils at selected sampling locations in order to provide commentary regarding on-site or off-site re-use and / or disposal options of excess soil.

A Phase One Environmental Site Assessment (ESA) was not within the scope of work for this assignment. Accordingly, soil and ground water impairment that has not been identified by the limited chemical testing program may exist elsewhere at the site. The limited chemical testing program does not constitute an Environmental Site Assessment as defined under the Environmental Protection Act and O. Reg. 153/04, as amended.

5.1 Chemical Testing Protocol

Representative samples collected during the geotechnical investigation were returned to our laboratory for detailed visual examination. Soil samples were submitted for chemical analysis to SGS Canada Inc. (SGS), which is a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited laboratory. The chemical analyses conducted by SGS were in accordance with the O. Reg. 153/04, as amended, Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act dated March 9, 2004, amended as of July 1, 2011.

As part of the geoenvironmental procedural protocol, all recovered soil samples were examined for visual and olfactory evidence of potential contamination.

The rationale for sample selection was based on materials exhibiting visual and/or olfactory evidence of contamination, material most likely to be contaminated (i.e. fill materials), site coverage and materials most likely to be excavated during construction.

A total of 20 soil samples were submitted for chemical analysis. Samples were submitted for parameters including metals and other regulated parameters (ORPs), including electrical conductivity (EC), sodium adsorption ratio (SAR), petroleum hydrocarbon (PHC) fractions F1 to F4, and volatile organic compounds (VOCs) including benzene, toluene, ethylbenzene and xylene (BTEX). Reference is made to Table 4, attached for a detailed listing of samples submitted for analysis.

5.2 Site Condition Standards

The Ministry of the Environment, Conservation and Parks (MECP) has developed a set of Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (April 15, 2011) and O.Reg. 153/04, as amended. The standards consist of nine tables (Table 1 through Table 9) that provide criteria for maximum concentrations of various contaminants. In general, the applicable Table and corresponding Site Condition Standards (SCSs) depend on the site location, land use, soil texture, bedrock depth, soil pH and the applicable potable or non-potable ground water condition at the investigation site.

The current and proposed use of the site is as a transportation corridor, which is classified as a community property use. Based on review of the above factors, PML selected the Generic Criteria of the O.Reg. 153/04, Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act dated April 15, 2011. In particular, the Table 2 (T2) Full Depth Generic Site Condition Standards in a Potable Ground Water Condition for Industrial / Commercial / Community (ICC) property use would likely apply to the majority of the site.

In order to determine the Site Sensitivity, Sections 41 and 43.1 of O. Reg. 153/04, as amended were evaluated by PML as per the following table:

SITE CONDITION STANDARD AND SITE SENSITIVITY ANALYSIS

CRITERIA	RESULT
Current Property Use O. Reg. 153/04, as amended Part I Section 1	Community
Potable vs. Non-Potable Ground Water O. Reg. 153/04, as amended Part IX Section 35	Potable
Proximity to Areas of Natural Significance O. Reg. 153/04, as amended Part IX Section 41 (1) (a)	Less than 30 m in localized areas
Soil pH O. Reg. 15/04, as amended Section 41 (1) b	Surface Soil: 5 to 9 Subsurface Soil: 5 to 11
Soil Texture O. Reg. 153/04, as amended Part IX Section 42	Coarse
Proximity to a Water Body O. Reg. 153/04, as amended Part IX Section 43.1	Less than 30 m, locally at Ellis Creek
Shallow Soil O. Reg. 153/04, as amended Part IX Section 43.1	No
Site Condition Standards	Table 1 (T1) Site Condition Standards (SCSs) for residential/ parkland/institutional/industrial/ commercial/community (RPI/ICC) in localized areas, and Table 2 (T2) SCS for industrial/commercial/ community (ICC) for the remainder of the site.

For the option of re-using the excess soils with minimal environmental restrictions, the O. Reg. 153/04, as amended, Full Depth Background Table 1 (T1) SCSs for RPI/ICC property uses were utilized.

For the option of re-using the excess soils with minimal environmental restrictions, the O.Reg. 153/04, as amended, Full Depth Background Table 1 (T1) SCSs for RPI/ICC property uses were utilized. In addition, the Full Depth Generic SCSs (T2) in a Potable Ground Water Condition for ICC property uses were also examined.

It is noted that a comparison to the Table 3 SCSs for non-potable ground water condition, Tables 4 and 5 SCSs for stratified site condition, Tables 6 and 7 SCSs for shallow bedrock condition and Table 8 or Table 9 SCSs for use within 30 m of a water body were not conducted as part of this assignment. If the potential receiving site for excess soil falls within one of these categories, additional evaluation by PML will be required to confirm conformance.

5.3 Analytical Findings and Conclusions

Laboratory Certificates of Analysis compared to the Table 1 and 2 SCSs are included in Appendix D. The measured values and corresponding SCSs (labelled as L1/L2) are shown on the certificates of analysis. In the event of an exceedance of the SCSs, the level is shown in highlighted text, where applicable.

The following table outlines a summary of the suitability for re-use of excess soil material based on the chemical testing program:

SAMPLE	TABLE 1 (RPI/ICC)	TABLE 2 (ICC) (SITE)
BH2 SS3	Yes	Yes
BH3 SS5	No[1]	Yes
BH6 SS10	Yes	Yes
BH108 SS2	No[1]	Yes
BH108 SS5	Yes	Yes
BH115 SS3B	No[1]	No[1]
BH115 SS4	Yes	Yes
BH129 SS2B	No[1]	No[1]
BH129 SS4	No[1]	Yes
BH144 SS5	No[1]	Yes
BH164 SS2B	No[1]	Yes
BH164 SS6	Yes	Yes
BH179 SS2	No[1]	No[1]
BH179 SS4	No[1]	Yes
BH184 SS3	Yes	Yes
BH184 SS6	Yes	Yes
BH187 SS2	No[2]	Yes
BH187 SS6	No[3]	Yes
BH192 SS3	No[1,2]	No[2]
BH192 SS5A	Yes	Yes

Notes: (1) Due to EC and / or SAR
(2) Due to PHCs
(3) Due to benzene

5.3.1 On-site Re-use

Based on the results of chemical testing, the measured concentrations of the tested parameters in the submitted samples met the Table 2 ICC SCSs, with the exception of EC and/or SAR only at three locations (BH115, BH129 and BH179) and PHCs in one sample (BH192 SS3).

The elevated EC and SAR values are likely related to the historical use of de-icing salt on the roadway surface. It is noted that EC and SAR are physical, non-health related parameters typically affecting vegetation and elevated levels of these parameters are relevant to soils that must support plant growth. Elevated levels are usually an indication of salts within the soil (typically de-icing salts used in parking lots and roadways).

Under O. Reg. 153/04, as amended, where a SCS is exceeded solely because a substance has been used on an highway for purposes of keeping traffic safe under conditions of snow and ice, the applicable site condition standard is deemed not to be exceeded. In this regard, the tested soil samples exhibiting EC and SAR exceedances only (i.e., samples in the above table with a superscript note 1) would not be considered "contaminated", if re-used on site as part of the road reconstruction or another highway site where paved surfaces are to be constructed and continued de-icing salt application can be expected to occur for traffic safety. Reference is made to O. Reg. 153/04 (as amended), s. 48 (3) and O. Reg. 339 s. 2 for a full outline of the regulations regarding soils impacted by de-icing salt.

5.3.2 Off-site Re-use

Based on the results of chemical testing, the measured concentrations of the tested parameters in the submitted samples met the Table 1 SCSs, with the exception of EC and/or SAR only at ten locations, PHCs in two samples and benzene in one sample.

In this regard, off-site re-use will be subject to certain handling requirements. The following table outlines a summary of the suitability for re-use of excess soil material based on the limited chemical testing program.

TABLE 1 (RPI/ICC)	TABLE 2 (ICC)	LICENSED LANDFILL
No (due to elevated EC/SAR, PHCs and benzene)	Selectively*	TCLP testing would be required

* Soil with elevated EC and SAR only, can be re-used at other "highway" sites as discussed above.

Considering the exceedances described above, the excess soil would be subject to the following restrictions for off-site disposal:

- The extent of the contaminated soil identified above is delineated;
- The receiving site for EC and/or SAR impacted soil must be a highway site;
- All analytical results and environmental assessment reports must be fully disclosed to the receiving site owners / authorities and they have agreed to receive the material;
- The work must be completed in accordance with local by-laws governing soil movement and/or placement at other sites;
- The applicable SCSs for the receiving site have been determined, as confirmed by the environmental consultant and the SCSs are consistent with the chemical quality of the soil originating at the source Site;
- Transportation and placement of the excess soil is monitored by the environmental consultant to check the material is appropriately placed at the pre-approved site;
- The receiving site must be arranged and/or approved well in advance of excavation in order to avoid delays during construction. As well, it is noted the chemical testing requirements for various receiving sites is site-specific and additional testing may be required, beyond that provided in this report; and,
- The excavation work should be conducted in accordance with a Soil Management Plan prepared by a qualified professional to ensure that all surplus excavated material is tested and managed appropriately, and that imported fill material is of suitable quality and meets the SCSs applicable to the site. Re-use of excess excavated soil on site is also subject to acceptance for re-use by the geotechnical consultant at the time of construction based on geotechnical considerations.

It is recommended that transportation of fill material from the Source Site to the Receiving Site(s) be carried out in accordance with the MECP document Management of Excess Soil – A Guideline for Best Management Practices dated January, 2014.

It is recommended that additional sampling and chemical testing be conducted during construction to verify the chemical quality of the excess soil to assess the appropriate management/disposal options for the soil leaving the site. It is also recommended that a toxicity characteristic leaching procedure (TCLP) test be completed on any material being considered for landfill disposal under O.Reg. 347, as amended. TCLP testing classifies a material for landfill disposal purposes.

It should be noted there is no legal imperative to remove or treat the soil that exceeds the applicable Site Condition Standard, provided it is demonstrated that there is no offsite impact or adverse effect. However, if contaminated soil is left on site, the landowner assumes liability associated with the contamination. The liability concerns could include potential scrutiny from the MECP, neighbouring property owners and the public; potential for decreased value of the land and issues during potential divesting of the property due to environmental liability concerns on the part of future owners or their financiers / insurers.

It should be noted that the soil conditions may differ from those encountered during this assignment. PML should be contacted if impacted soil conditions become apparent to further assess and appropriately handle the materials, if any, and to evaluate whether modifications to the conclusions documented in this report are necessary.

6. CLOSURE

We trust that this report is sufficient for your immediate needs. Should you have any questions please don't hesitate to contact our office.

Sincerely

Peto MacCallum Ltd.

William Loghrin, P.Eng.
Project Engineer, Geotechnical Services

Gerry Mitchell, MEng, P.Eng.
Senior Consultant

WL/GM:tm

TABLE 1

DETAILS OF EXISTING PAVEMENT THICKNESSES

LOCATION	BOREHOLE	ASPHALT (mm)	BASE (mm)	SUBBASE (mm)	TOTAL PAVEMENT (mm)	GBE (mm)
Maple Grove Road, Existing Travelled Lanes	101	185	225	330	740	565
	102	185	135	330	650	498
	103	140	180	290	610	455
	105	150	170	625	945	628
	106	180	300	610	1090	755
	107	185	215	300	700	543
	109	140	320	0	460	415
	111	140	220	740	1100	710
	113	110	200	630	940	603
	114	120	180	800	1100	685
	117	110	170	670	950	600
	118	100	0	820	920	535
	121	145	0	1205	1350	784
	124	120	270	600	990	653
	125	130	270	540	940	635
	126	145	175	570	890	598
	128	130	210	710	1050	675

TABLE 1

DETAILS OF EXISTING PAVEMENT THICKNESSES

LOCATION	BOREHOLE	ASPHALT (mm)	BASE (mm)	SUBBASE (mm)	TOTAL PAVEMENT (mm)	GBE (mm)
Maple Grove Road, Existing Travelled Lanes Cont'd	129	120	270	530	920	618
	132	150	200	350	700	513
	133	150	210	360	720	525
	134	150	150	450	750	525
	135	155	225	520	900	623
	136	125	175	350	650	463
	137	100	190	610	900	573
	139	160	220	520	900	625
	140	140	320	440	900	635
	141	100	200	800	1100	675
	142	105	165	540	810	525
	Median	140	200	540	900	601
Maple Grove Road, Existing Shoulders	1	0	0	770	770	385
	3	0	100	830	930	490
	4	130	670	0	800	665
	5	150	0	730	880	553
	104	0	0	650	650	325

TABLE 1

DETAILS OF EXISTING PAVEMENT THICKNESSES

LOCATION	BOREHOLE	ASPHALT (mm)	BASE (mm)	SUBBASE (mm)	TOTAL PAVEMENT (mm)	GBE (mm)
Maple Grove Road, Existing Shoulders Cont'd	108	0	0	540	540	270
	110	0	0	640	640	320
	112	0	0	900	900	450
	115	0	0	1150	1150	575
	116	0	0	1400	1400	700
	119	0	0	600	600	300
	120	0	0	540	540	270
	122	0	0	870	870	435
	123	0	0	600	600	300
	127	0	0	1100	1100	550
	130	0	0	670	670	335
	131	120	0	450	570	375
	138	0	310	380	690	423
	143	0	100	550	650	350
	144	0	150	450	600	338
	Median	0	0	660	680	380

TABLE 1

DETAILS OF EXISTING PAVEMENT THICKNESSES

LOCATION	BOREHOLE	ASPHALT (mm)	BASE (mm)	SUBBASE (mm)	TOTAL PAVEMENT (mm)	GBE (mm)
Hespeler Road, Existing Lanes	145	155	230	640	1025	686
	148	155	285	420	860	618
	150	165	375	330	870	653
	151	185	195	570	950	663
	152	145	205	620	970	645
	153	155	185	410	750	538
	154	150	220	290	660	498
	157	140	190	420	750	528
	158	120	140	840	1100	675
	159	160	170	870	1200	763
	160	135	205	960	1300	803
	162	155	185	570	910	618
	163	160	180	580	920	625
	Median	155	195	570	920	645

TABLE 1

DETAILS OF EXISTING PAVEMENT THICKNESSES

LOCATION	BOREHOLE	ASPHALT (mm)	BASE (mm)	SUBBASE (mm)	TOTAL PAVEMENT (mm)	GBE (mm)
Hespeler Road, Existing Shoulders	6	110	230	340	680	480
	7	120	0	710	830	505
	8	120	0	680	800	490
	146	0	410	330	740	473
	147	0	300	420	720	435
	149	0	280	390	670	405
	155	80	220	400	700	465
	156	120	200	330	650	465
	161	90	280	300	670	473
	164	160	180	560	900	615
	Median	100	225	395	710	473
Vondrau Drive	165	140	160	320	620	455
	166	130	230	490	850	580
	167	0	0	650	650	325
	168	145	155	300	600	448
	169	150	160	400	710	508
	Median	140	160	400	650	455

TABLE 1

DETAILS OF EXISTING PAVEMENT THICKNESSES

LOCATION	BOREHOLE	ASPHALT (mm)	BASE (mm)	SUBBASE (mm)	TOTAL PAVEMENT (mm)	GBE (mm)
Boxwood Drive	170	0	0	660	660	330
	171	135	0	595	730	466
	172	145	155	340	640	468
	173	150	80	420	650	458
	174	140	140	400	680	480
	Median	140	40	508	655	462
Speedsville Road	175	60	180	860	1100	640
	176	45	375	480	900	578
	177	150	0	370	520	373
	178	75	0	615	690	401
	179	60	0	420	480	285
	180	65	0	410	475	286
	181	50	0	570	620	348
	182	45	0	495	540	304
	183	50	250	450	750	475
	184	95	215	390	700	475
	185	45	0	265	310	189
	Median	60	0	450	620	373

TABLE 1

DETAILS OF EXISTING PAVEMENT THICKNESSES

LOCATION	BOREHOLE	ASPHALT (mm)	BASE (mm)	SUBBASE (mm)	TOTAL PAVEMENT (mm)	GBE (mm)
Briardean Road	186	60	0	180	240	165
	187	45	0	70	115	91
	188	105	0	175	280	219
	189	85	0	205	290	209
	Median	73	0	178	260	187
Beaverdale Road	190	170	160	870	1200	768
	191	160	270	220	650	513
	192	155	145	310	610	458
	193	190	270	740	1200	810
	194	165	280	500	945	666
	195	255	435	510	1200	900
	196	120	220	400	740	515
	197	130	350	490	970	670
	198	110	160	460	730	488
	199	125	145	180	450	355
	Median	158	245	475	843	591

Note: Determined with reduced equivalency factors for old pavement of 1.25 for asphalt, 0.75 for granular base, and 0.5 for granular subbase.

TABLE 2

HAND AUGER SUMMARY

TEST PIT	ELEVATION	TOPSOIL FILL THICKNESS (mm)	UNDERLYING FILL TYPE	HAND AUGER DEPTH (mm)
1001	309.42	135	Brown Sand and Gravel	200
1002	309.58	190	Brown Sand and Gravel	200
1003	310.82	145	Brown Sand and Gravel	200
1004	311.53	165	Brown Sand and Gravel	200
1005	312.13	60	Brown Sand and Gravel	200
1006	312.30	180	Brown Silt Sand	260
1007	313.26	150	NFP Frozen	150
1008	311.83	260	Light Brown Sandy Silt	520
1009	309.39	240	Light Brown Sandy Silt	280
1010	306.19	250	Light Brown Sandy Silt	430
1011	305.60	300	Brown Sand and Gravel	350
1012	305.24	290	Brown Sand and Gravel	300
1013	304.00	60	NFP Frozen	60
1014	303.77	280	Light Brown Sandy Silt	410
1015	303.76	240	Brown Sand and Gravel	250
1016	304.55	260	Light Brown Sandy Silt	340
1017	306.38	120	NFP Frozen	120
1018	308.26	220	Light Brown Sandy Silt	290
1019	309.96	90	NFP Frozen	90
1020	310.91	210	Light Brown Sandy Silt	340
1021	311.14	230	Light Brown Sandy Silt	360
1022	309.85	180	Brown Sand and Gravel	190
1023	308.02	320	Light Brown Sandy Silt	630

NFP = No Further Progress

TABLE 2

HAND AUGER SUMMARY

TEST PIT	ELEVATION	TOPSOIL FILL THICKNESS (mm)	UNDERLYING FILL TYPE	HAND AUGER DEPTH (mm)
1024	306.99	200	Brown Sand and Gravel	200
1025	306.99	240	Light Brown Silty Sand to Sandy Silt	760
1026	307.24	290	Light Brown Silty Sand	780
1027	307.56	300	Light Brown Silty Sand	400
1028	309.42	170	Brown Sand and Gravel	200
1029	309.98	270	Light Brown Silty Sand	390
1030	311.85	160	Brown Gravelly Sand	200
1031	311.42	380	Light Brown Sand	600
1032	310.00	310	Light Brown Silty Sand	510
1033	306.86	75	Brown Gravelly Sand	200
1034	305.65	90	Brown Gravelly Sand	200
1035	303.85	280	Brown Sandy Silt	310
1036	301.55	210	Light Brown Silty Sand	370
1037	301.09	150	Brown Gravelly Sand	200
1038	299.85	140	Light Brown Sandy Silt	380
1039	302.71	140	Brown Sand and Gravel	200
1040	303.60	170	Light Brown Silty Sand	250
1041	303.86	10	NFP Frozen	10
1042	301.84	0	Brown Sand	450
1043	304.21	350	Brown Sand	660
1044	306.41	150	Light Brown Sand	180
1045	315.45	190	Light Brown Silty Sand	360
1046	312.99	130	Brown Sand Silt	310

NFP = No Further Progress

TABLE 2

HAND AUGER SUMMARY

TEST PIT	ELEVATION	TOPSOIL FILL THICKNESS (mm)	UNDERLYING FILL TYPE	HAND AUGER DEPTH (mm)
1047	312.06	25	Brown Sand and Gravel	200
1048	309.70	0	Brown Gravelly Sand	200
1049	306.92	190	Light Brown Silt Sand	230
1050	304.82	320	Brown Sand and Gravel	350
1051	303.43	100	Brown Gravelly Sand	200
1052	302.11	60	Brown Sand and Gravel	200
1053	300.45	0	Brown Sand and Gravel	200
1054	299.64	150	Brown Silt Sand	180
1055	298.35	60	Light Brown Silt Sand	280
1056	298.24	10	Brown Sand and Gravel	200
1057	296.43	190	Light Brown Silty Sand	360
1058	295.41	180	Brown Silt Sand	410
1059	294.89	100	Brown Silt Sand	400
1060	293.64	170	Brown Silt Sand	410
1061	292.16	0	Brown Sand and Gravel	200
1062	292.03	35	Brown Sand and Gravel	200
1063	290.89	45	Brown Sand and Gravel	200
1064	289.52	60	Brown Sand and Gravel	200
1065	308.13	0	Brown Sand and Gravel	200
1066	309.44	0	Brown Sand and Gravel	200
1067	309.66	45	Brown Sand and Gravel	200
1068	309.97	95	Brown Sand and Gravel	200
1069	309.99	35	Brown Sand and Gravel	200

NFP = No Further Progress

TABLE 2

HAND AUGER SUMMARY

TEST PIT	ELEVATION	TOPSOIL FILL THICKNESS (mm)	UNDERLYING FILL TYPE	HAND AUGER DEPTH (mm)
1070	309.05	390	Brown Silty Sand	410
1071	312.41	240	Brown Silty Sand	250
1072	312.67	260	Brown Silty Sand	300
1073	311.54	90	NFP Frozen	90
1074	310.52	120	Brown Silty Sand	220
1075	310.22	260	Brown Sandy Silt	340
1076	309.63	60	NFP Frozen	60
1077	309.33	150	Brown Sand and Gravel	160
1078	306.92	280	Brown Sandy Silt	750
1079	305.78	300	Light Brown Silty Sand	380
1080	305.18	280	Light Brown Sandy Silt	360
1081	304.86	290	Light Brown Sandy Silt	780
1082	306.65	330	Brown Sand and Gravel	350
1083	306.66	190	Light Brown Sandy Silt	890
1084	307.21	280	Light Brown Sandy Silt	450
1085	309.38	300	Brown Silty Sand	620
1086	310.94	105	Brown Sand and Gravel	200
1087	312.23	45	Brown Sand and Gravel	200
1088	312.74	185	Brown Sand and Gravel	200
1089	312.49	80	Brown Sand and Gravel	200
1090	311.98	230	Light Brown Silt Sand	330
1091	313.12	210	Brown Silty Sand	330
1092	312.60	10	NFP Frozen	10

NFP = No Further Progress

TABLE 2

HAND AUGER SUMMARY

TEST PIT	ELEVATION	TOPSOIL FILL THICKNESS (mm)	UNDERLYING FILL TYPE	HAND AUGER DEPTH (mm)
1093	309.87	90	NFP Frozen	90
1094	308.35	210	NFP Frozen	210
1095	309.53	10	NFP Frozen	10
1096	310.38	90	NFP Frozen	90
1097	309.18	200	Light Brown Silty Sand	280
1098	308.79	150	Brown Silty Sand	180
1099	309.56	180	Light Brown Silty Sand	500

NFP = No Further Progress

TABLE 3

SUMMARY OF GROUND WATER DATA

Location	Elevation of Ground Surface (m)	Screened Interval (m)	Screen Elevation Top to Bottom	Lithology Screened	Depth to Ground Water (m) March 28, 2019	Ground Water Elevation (m)
2	306.48	6.1 to 9.1	300.4 to 297.3	Gravelly Sand, Sandy Silt Till	1.10	305.4
4	302.86	12.2 to 15.2	290.7 to 287.6	Gravelly Sand	7.37	295.5
6	301.25	8.1 to 11.2	293.2 to 290.1	Silty Sand Till	0.28	301.0
8	295.15	3.8 to 5.3	291.3 to 289.8	Clayey Silt Till	4.72	290.4
9	308.45	4.6 to 7.6	303.9 to 300.8	Sand, Sandy Silt Till	5.08	303.4
104	311.39	3.1 to 4.6	308.3 to 306.8	Silty Sand	2.19	309.2
108	312.63	3.1 to 4.6	309.6 to 308.1	Sandy Silt Till	--	N/A
110	307.01	3.1 to 4.6	304.0 to 302.4	Sand	1.99	305.0
112	305.77	3.1 to 4.6	302.7 to 301.2	Silty Sand Till	1.24	304.5
115	304.57	3.1 to 4.6	301.52 to 300.0	Sand	1.69	302.9
116	305.35	3.1 to 4.6	302.3 to 300.8	Sand	2.09	303.3
122	310.42	3.0 to 4.5	307.4 to 305.9	Sand and Gravel, Sandy Silt Till	1.37	309.1
123	308.02	3.0 to 4.5	305.0 to 303.5	Sandy Silt	1.67	306.4
127	309.27	3.0 to 4.5	306.3 to 304.8	Sand	3.90	305.4
130	312.1	3.0 to 4.5	309.1 to 307.6	Clayey Silt Till, Silt Till	2.57	309.5
131	311.68	3.0 to 4.5	308.7 to 307.2	Sand	4.04	307.6
138	301.03	3.0 to 4.5	298.0 to 296.5	Gravelly Sand	1.94	299.1

TABLE 3

SUMMARY OF GROUND WATER DATA

Location	Elevation of Ground Surface (m)	Screened Interval (m)	Screen Elevation Top to Bottom	Lithology Screened	Depth to Ground Water (m) March 28, 2019	Ground Water Elevation (m)
143	304.34	3.0 to 4.5	301.3 to 299.8	Gravelly Sand	1.82	302.5
144	307.12	3.0 to 4.5	304.1 to 302.6	Sandy Silt	3.25	303.9
145	316.54	3.0 to 4.5	313.5 to 312.0	Silt	3.13	313.4
147	312.55	3.0 to 4.5	309.6 to 308.1	Silt	1.81	310.7
149	307.72	3.0 to 4.5	304.7 to 303.2	Silty Gravelly Sand, Sandy Silt Till	2.74	305.0
155	299.27	3.0 to 4.5	296.3 to 294.8	Sandy Silt Till	3.5	295.8
161	293.35	3.0 to 4.5	290.4 to 288.9	Clayey Silt	4.38	289.0
164	290.24	3.0 to 4.5	287.2 to 285.7	Fill	Dry	--

*Site was visited on February 28, 2019, however all four wells were inaccessible due to snow and ice cover.

TABLE 4

SUMMARY OF SAMPLES SUBMITTED FOR CHEMICAL ANALYSIS

Borehole	Sample No.	Approx. Depth (m)	Soil or Ground Water Description	Type of Chemical Analysis					Rationale
				Metals	ORPs*	EC and SAR	PHCs	VOCs including BTEX	
2	SS3	1.5 to 2.0	Soil	X	X	X	X	X	Top of phreatic zone
3	SS5	3.1 to 3.5	Soil	X	X	X	X	X	Fill
6	SS10	10.6 to 10.7	Soil	X	X	X	X	X	Deep phreatic zone, over bedrock
108	SS2	0.8 to 1.2	Soil	X	X	X	X	X	Fill
108	SS5	3.1 to 3.5	Soil	X	X	X	X	X	Check native soil
115	SS3B	1.5 to 2.0	Soil	X	X	X	X	X	Fill, top of phreatic zone
115	SS4	2.3 to 2.7	Soil	X	X	X	X	X	Native soil under fill
129	SS2B	0.9 to 1.2	Soil	X	X	X	X	X	Native soil under pavement granular
129	SS4	2.3 to 2.7	Soil	X	X	X	X	X	Check native soil
144	SS5	3.1 to 3.5	Soil	X	X	X	X	X	Top of phreatic zone
164	SS2B	0.9 to 1.2	Soil	X	X	X	X	X	Fill under pavement granular
164	SS6	4.5 to 5.0	Soil	X	X	X	X	X	Deep fill
179	SS2	0.8 to 1.2	Soil	X	X	X	X	X	Fill
179	SS4	2.3 to 2.7	Soil	X	X	X	X	X	Check native soil
184	SS3	1.5 to 2.0	Soil	X	X	X	X	X	Top of phreatic zone
184	SS6	4.5 to 5.0	Soil	X	X	X	X	X	Deep phreatic zone

TABLE 4

SUMMARY OF SAMPLES SUBMITTED FOR CHEMICAL ANALYSIS

Borehole	Sample No.	Approx. Depth (m)	Soil or Ground Water Description	Type of Chemical Analysis					Rationale
				Metals	ORPs*	EC and SAR	PHCs	VOCs including BTEX	
187	SS2	0.8 to 1.2	Soil	X	X	X	X	X	Native soil under fill
187	SS6	4.5 to 5.0	Soil	X	X	X	X	X	Check native soil
192	SS3	1.5 to 2.0	Soil	X	X	X	X	X	Fill
192	SS5A	3.1 to 3.2	Soil	X	X	X	X	X	Check native soil

Notes:
EC – Electrical Conductivity
SAR – Sodium Adsorption Ratio
ORPs – Other Regulated Parameters
PHCs – Petroleum Hydrocarbons
VOCs – Volatile Organic Compounds
BTEX – Benzene, Toluene, Ethylbenzene, Xylene
PAHs – Polycyclic Aromatic Hydrocarbons
* ORPs include arsenic, antimony, selenium, mercury, pH, chromium IV and boron hot water soluble.

Peto MacCallum Ltd.
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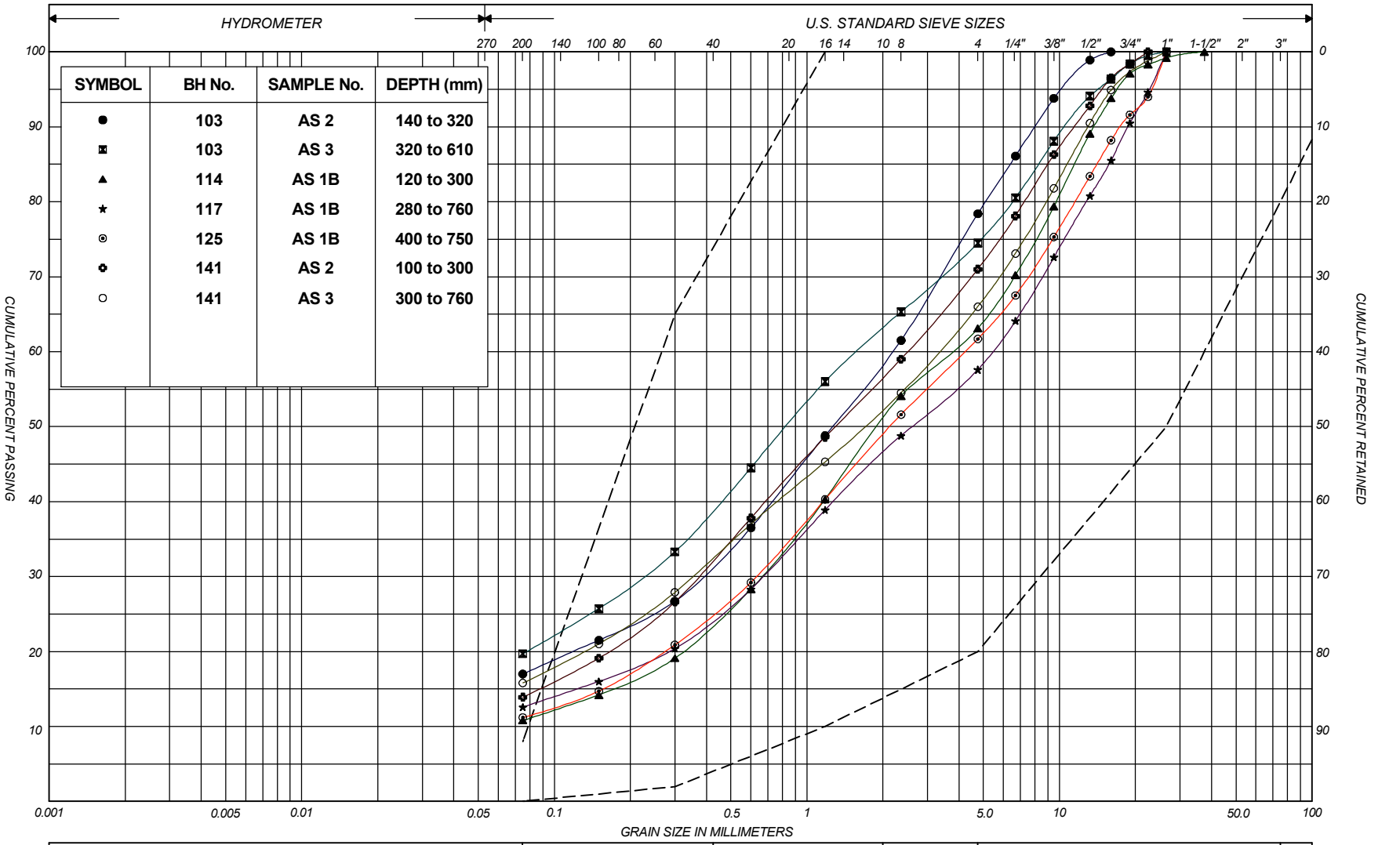
PROJECT NO. 18KF047
FIGURE NO. 1

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (mm)
●	103	AS 2	140 to 320
⊠	103	AS 3	320 to 610
▲	114	AS 1B	120 to 300
★	117	AS 1B	280 to 760
⊙	125	AS 1B	400 to 750
✿	141	AS 2	100 to 300
○	141	AS 3	300 to 760

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND						

REMARKS: MAPLE GROVE ROAD

GRANULAR BASE AND SUBBASE SAMPLES COMPARED TO OPSS GRANULAR B TYPE 1 SPECIFICATONS

Peto MacCallum Ltd.
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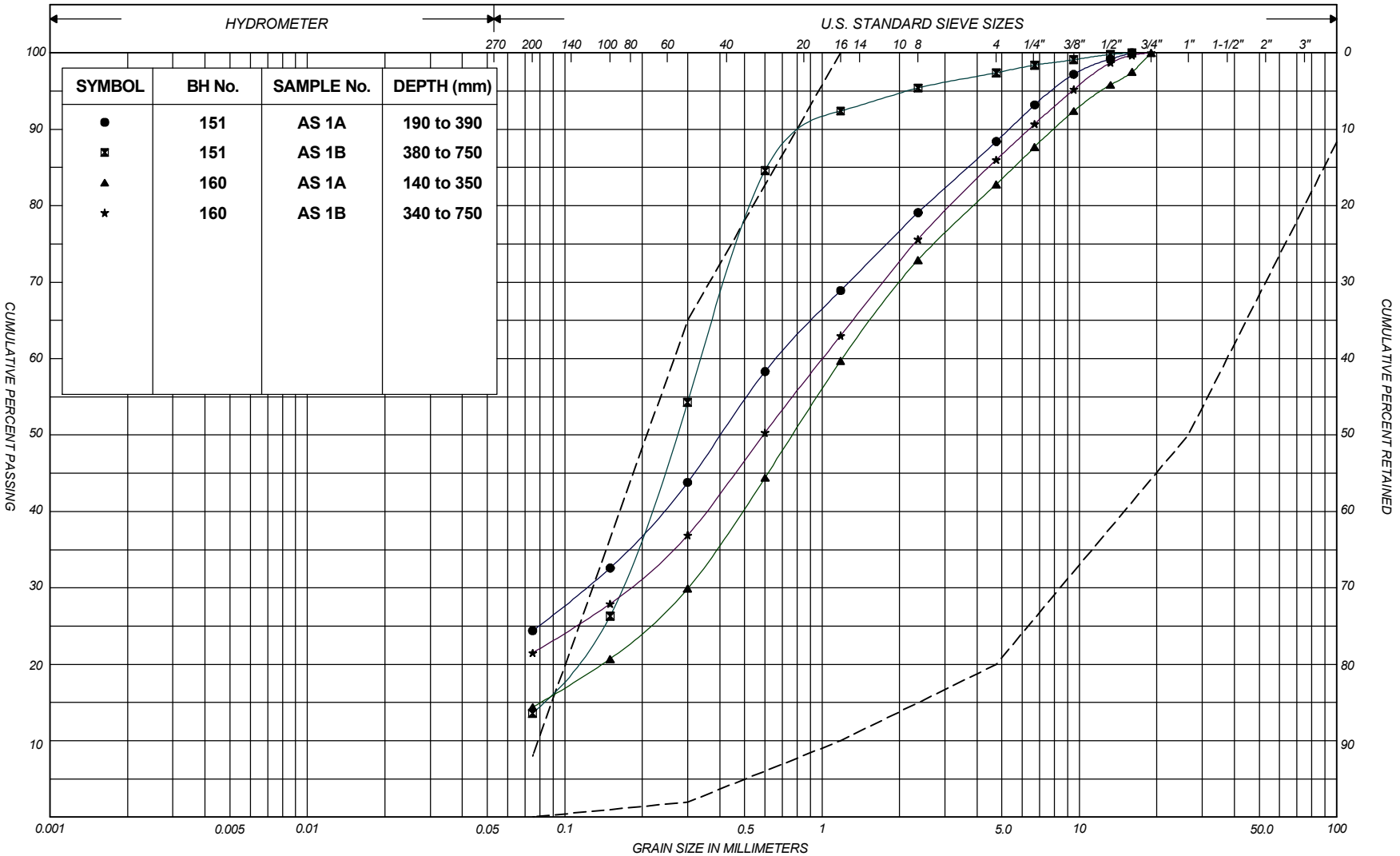
PROJECT NO. 18KF047
FIGURE NO. 2

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (mm)
●	151	AS 1A	190 to 390
⊠	151	AS 1B	380 to 750
▲	160	AS 1A	140 to 350
★	160	AS 1B	340 to 750

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COB BLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

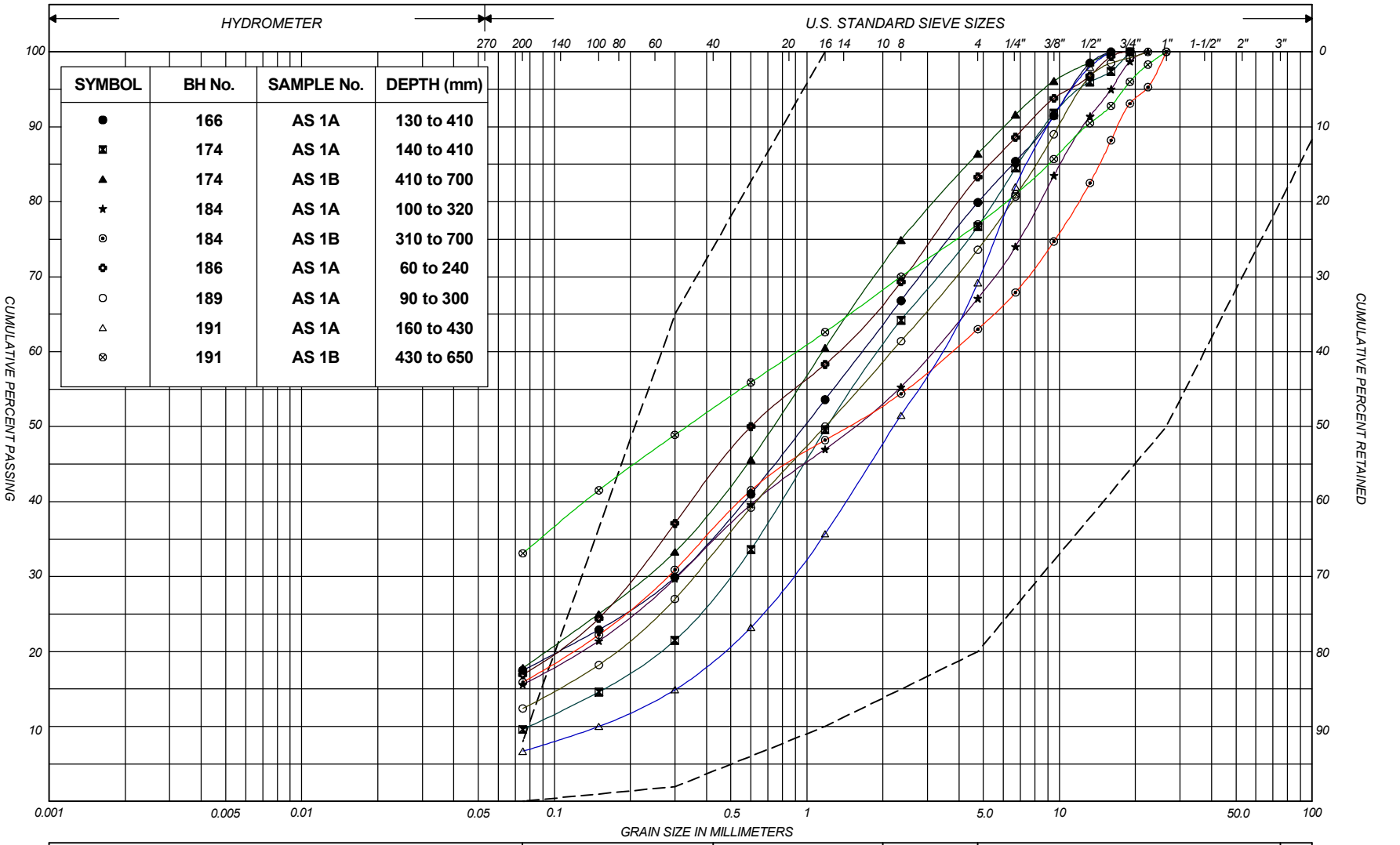
REMARKS: HESPELER ROAD

GRANULAR BASE AND SUBBASE COMPARED TO OPSS GRANULAR B TYPE 1 SPECIFICATONS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 3

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (mm)
●	166	AS 1A	130 to 410
⊠	174	AS 1A	140 to 410
▲	174	AS 1B	410 to 700
★	184	AS 1A	100 to 320
⊙	184	AS 1B	310 to 700
✿	186	AS 1A	60 to 240
○	189	AS 1A	90 to 300
△	191	AS 1A	160 to 430
⊗	191	AS 1B	430 to 650

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COB BLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

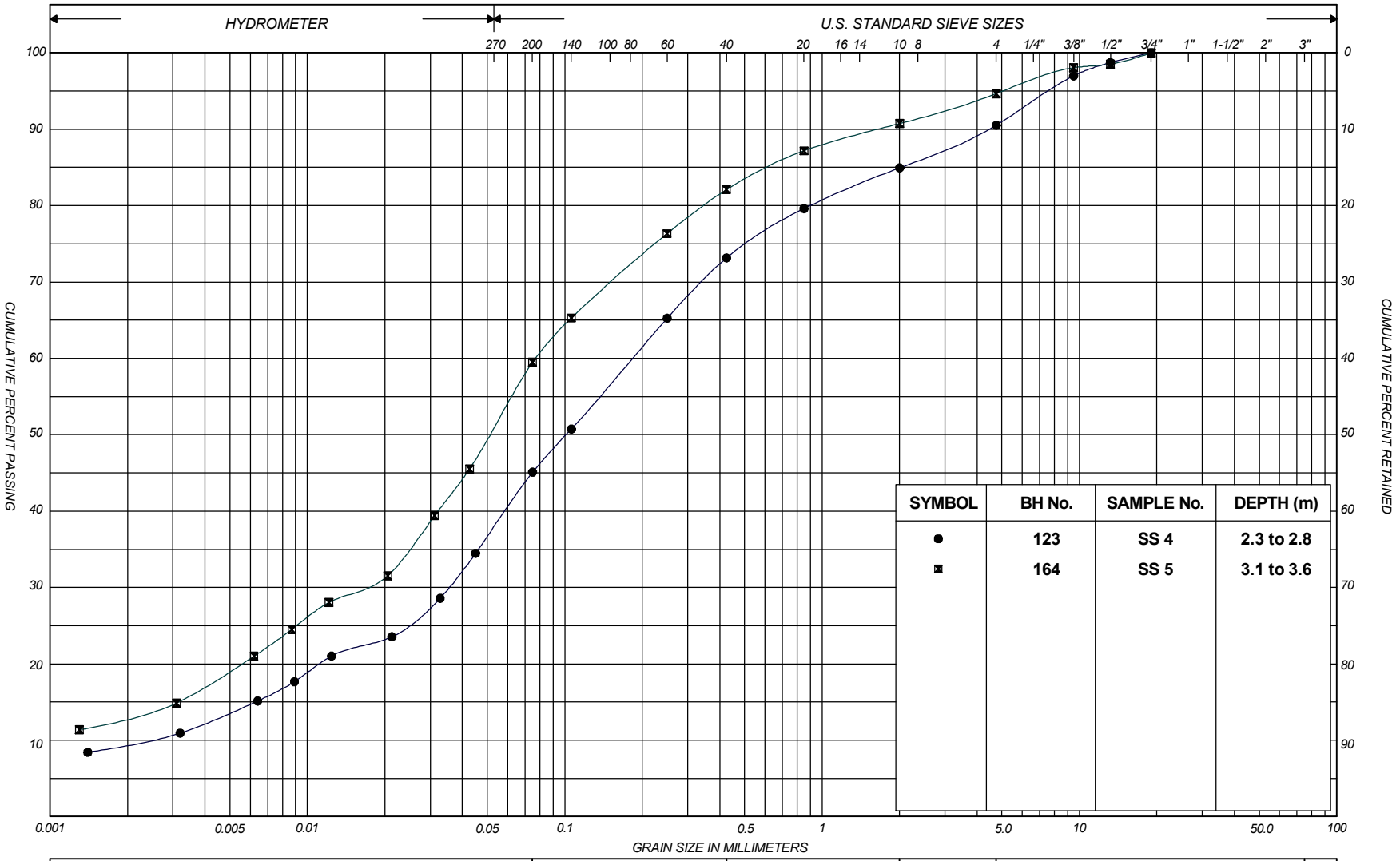
REMARKS: VONDRAU DRIVE, BOXWOOD DRIVE, SPEEDSVILLE ROAD, BRIARDEAN ROAD AND BEAVERDALE ROAD

GRANULAR BASE AND SUBBASE COMPARED TO OPSS GRANULAR B TYPE 1 SPECIFICATONS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 4

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	123	SS 4	2.3 to 2.8
⊠	164	SS 5	3.1 to 3.6

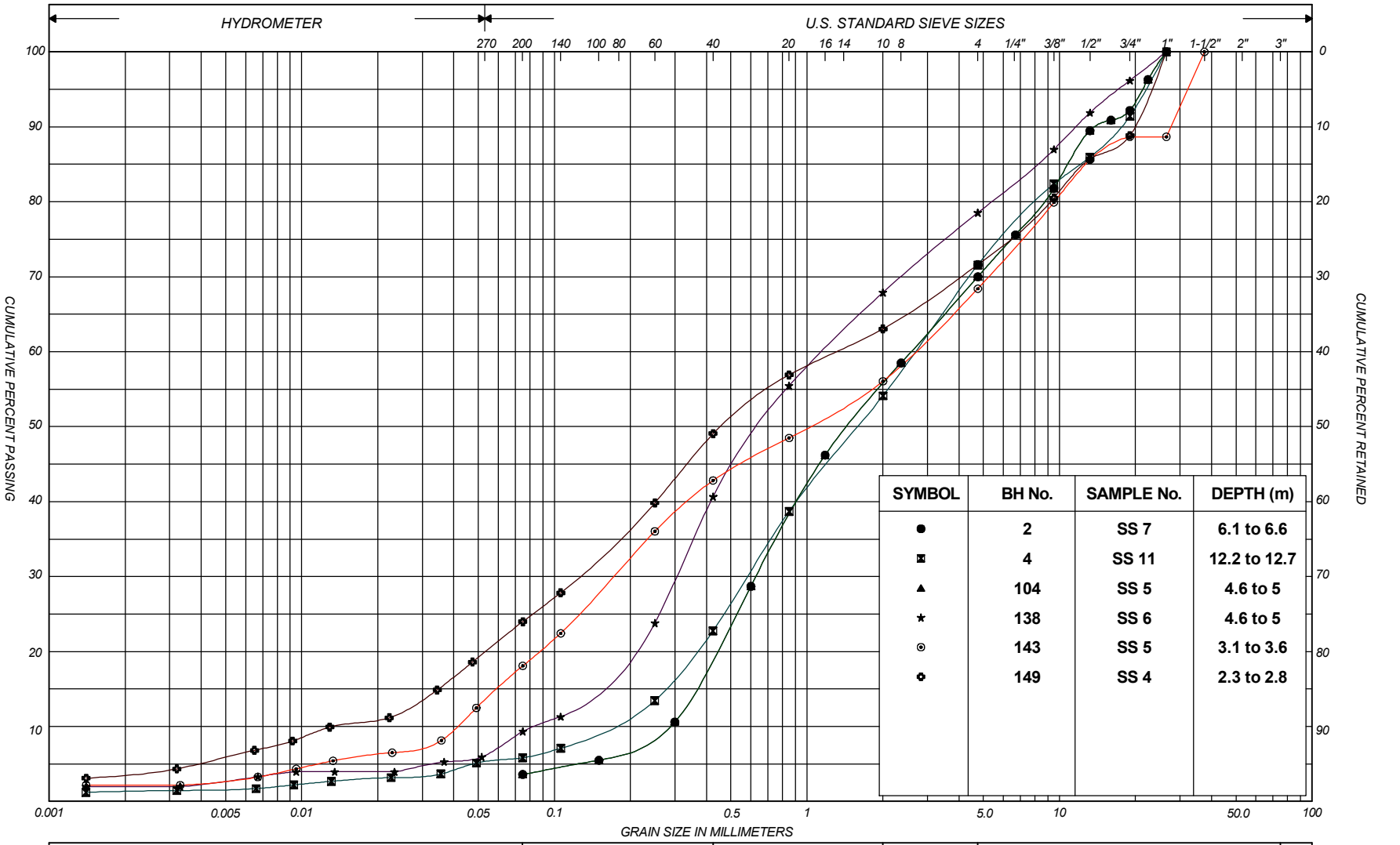
SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

REMARKS: FILL (SANDY SILT)

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

PROJECT NO. 18KF047
FIGURE NO. 5



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	2	SS 7	6.1 to 6.6
⊠	4	SS 11	12.2 to 12.7
▲	104	SS 5	4.6 to 5
★	138	SS 6	4.6 to 5
⊙	143	SS 5	3.1 to 3.6
✪	149	SS 4	2.3 to 2.8

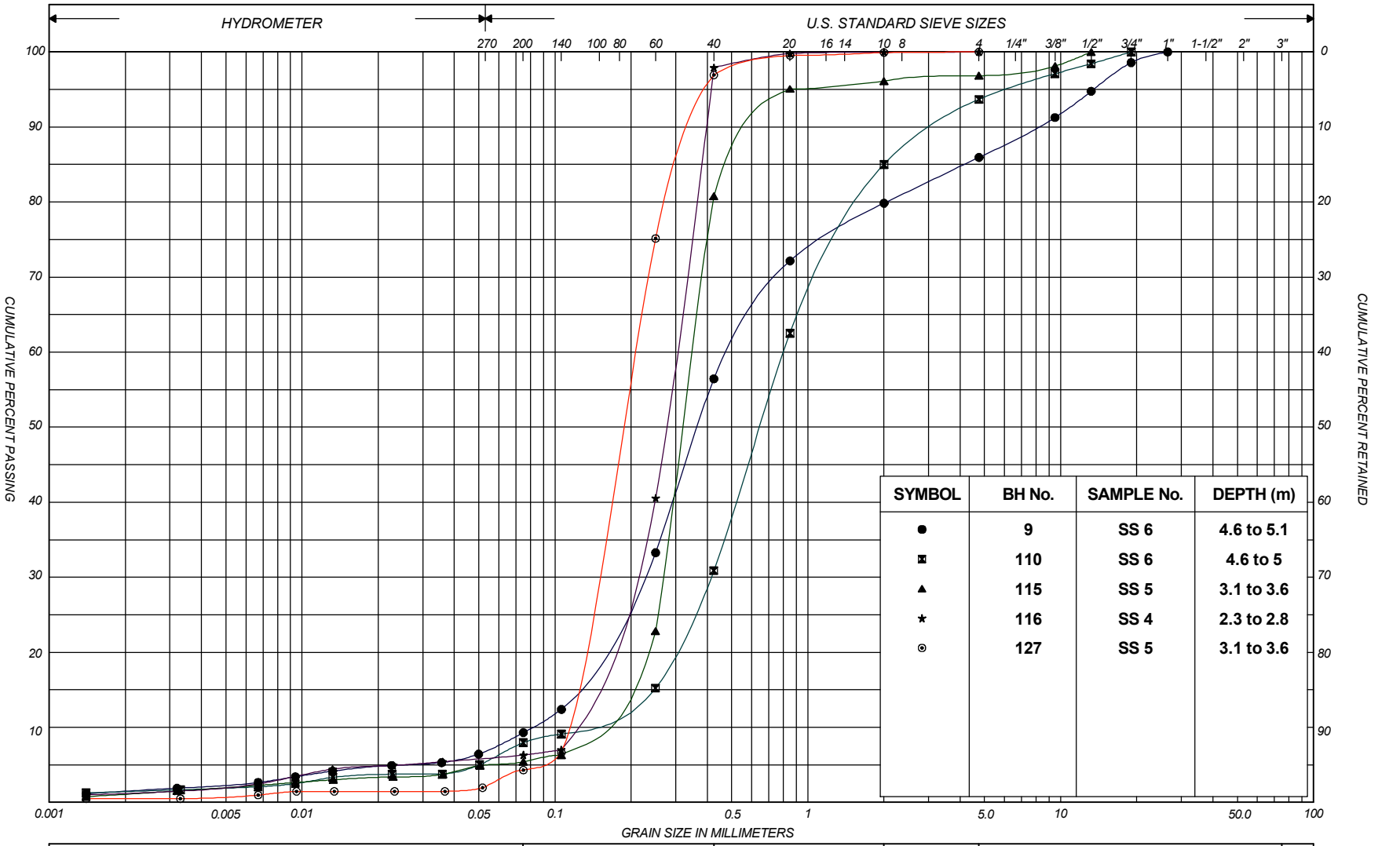
SILT & CLAY			FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES	UNIFIED
CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES	M.I.T.
CLAY	SILT	V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND	GRAVEL			U.S. BUREAU

REMARKS: GRAVELLY SAND AND SILTY GRAVELLY SAND

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 6

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	9	SS 6	4.6 to 5.1
■	110	SS 6	4.6 to 5
▲	115	SS 5	3.1 to 3.6
★	116	SS 4	2.3 to 2.8
⊙	127	SS 5	3.1 to 3.6

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

REMARKS: SAND

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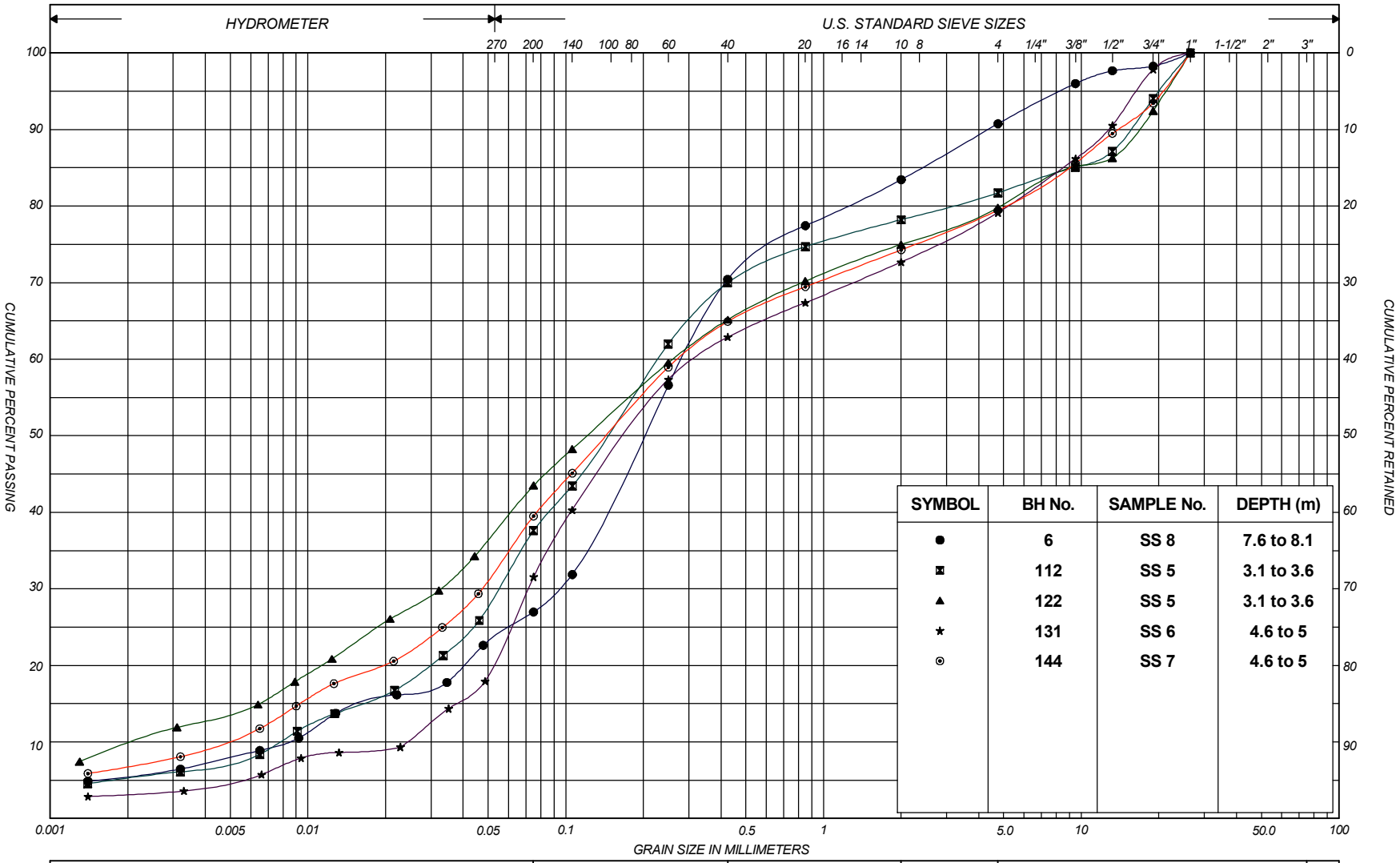
PROJECT NO. 18KF047
FIGURE NO. 7

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	6	SS 8	7.6 to 8.1
⊠	112	SS 5	3.1 to 3.6
▲	122	SS 5	3.1 to 3.6
★	131	SS 6	4.6 to 5
⊙	144	SS 7	4.6 to 5

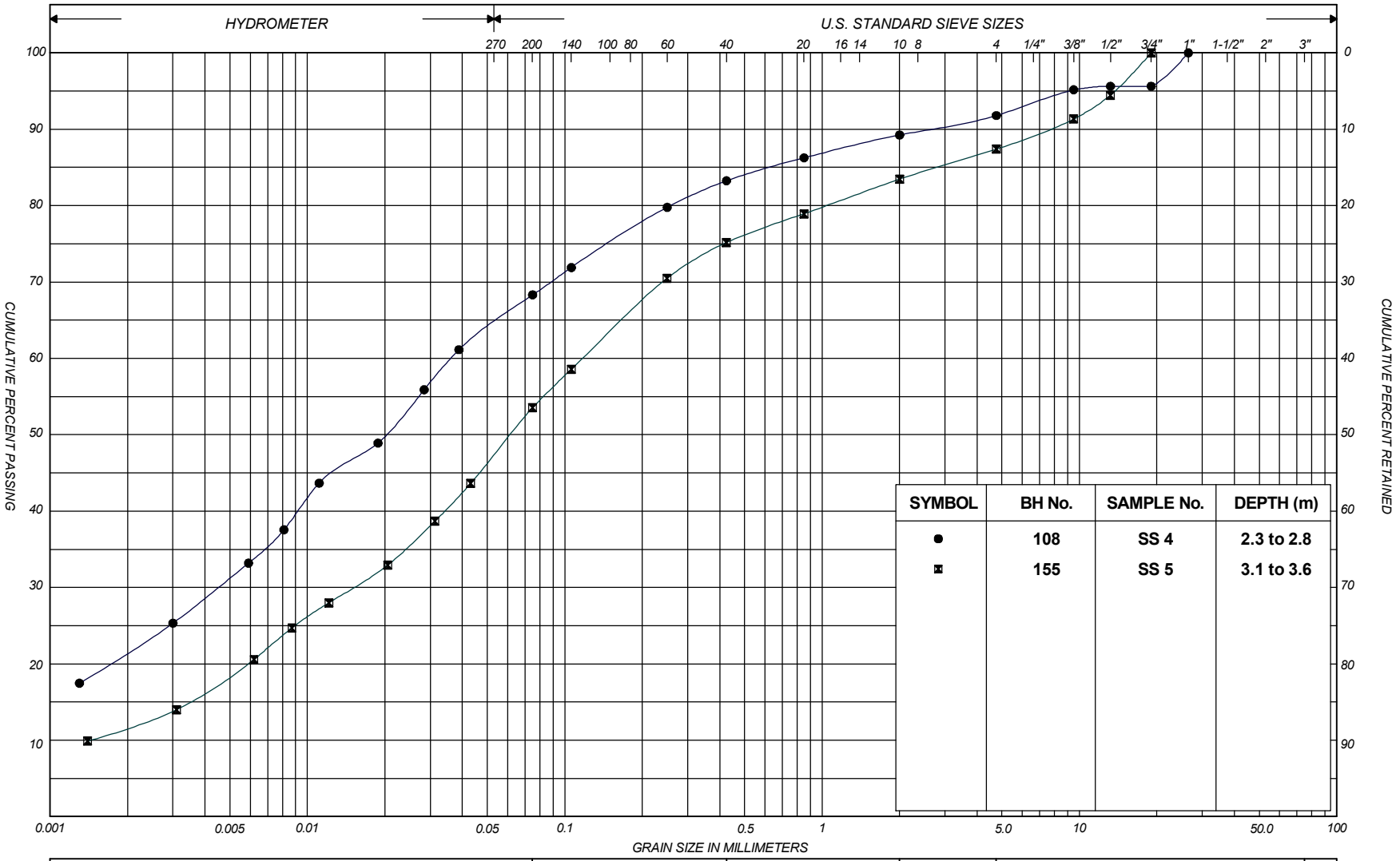
SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL			COBBLES	UNIFIED
			SAND							
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL			COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL				U.S. BUREAU
			SAND							

REMARKS: SILTY SAND

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 8

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	108	SS 4	2.3 to 2.8
⊠	155	SS 5	3.1 to 2.6

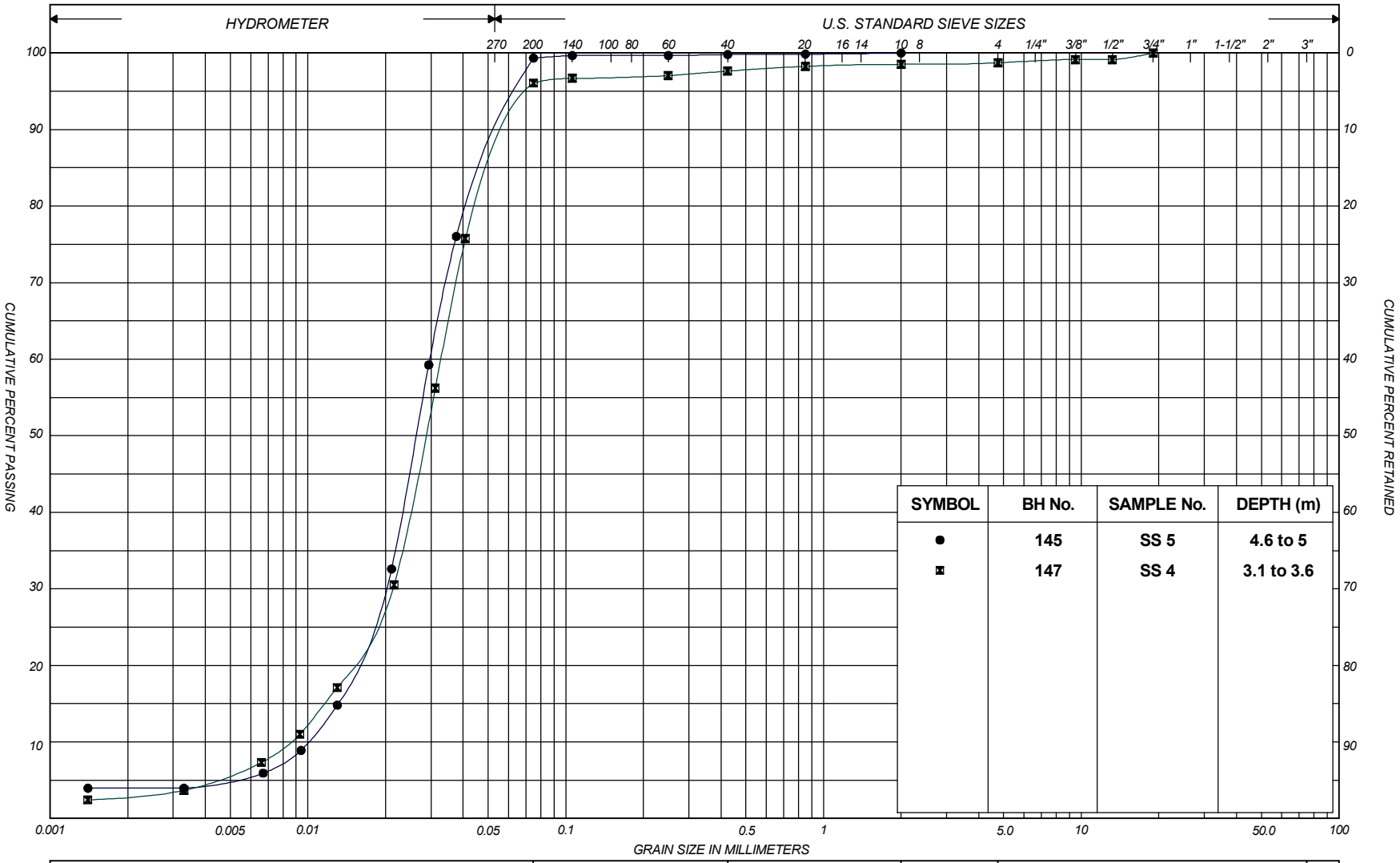
SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

REMARKS: SANDY SILT TILL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 9

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	145	SS 5	4.6 to 5
⊠	147	SS 4	3.1 to 3.6

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND						

REMARKS: SILT

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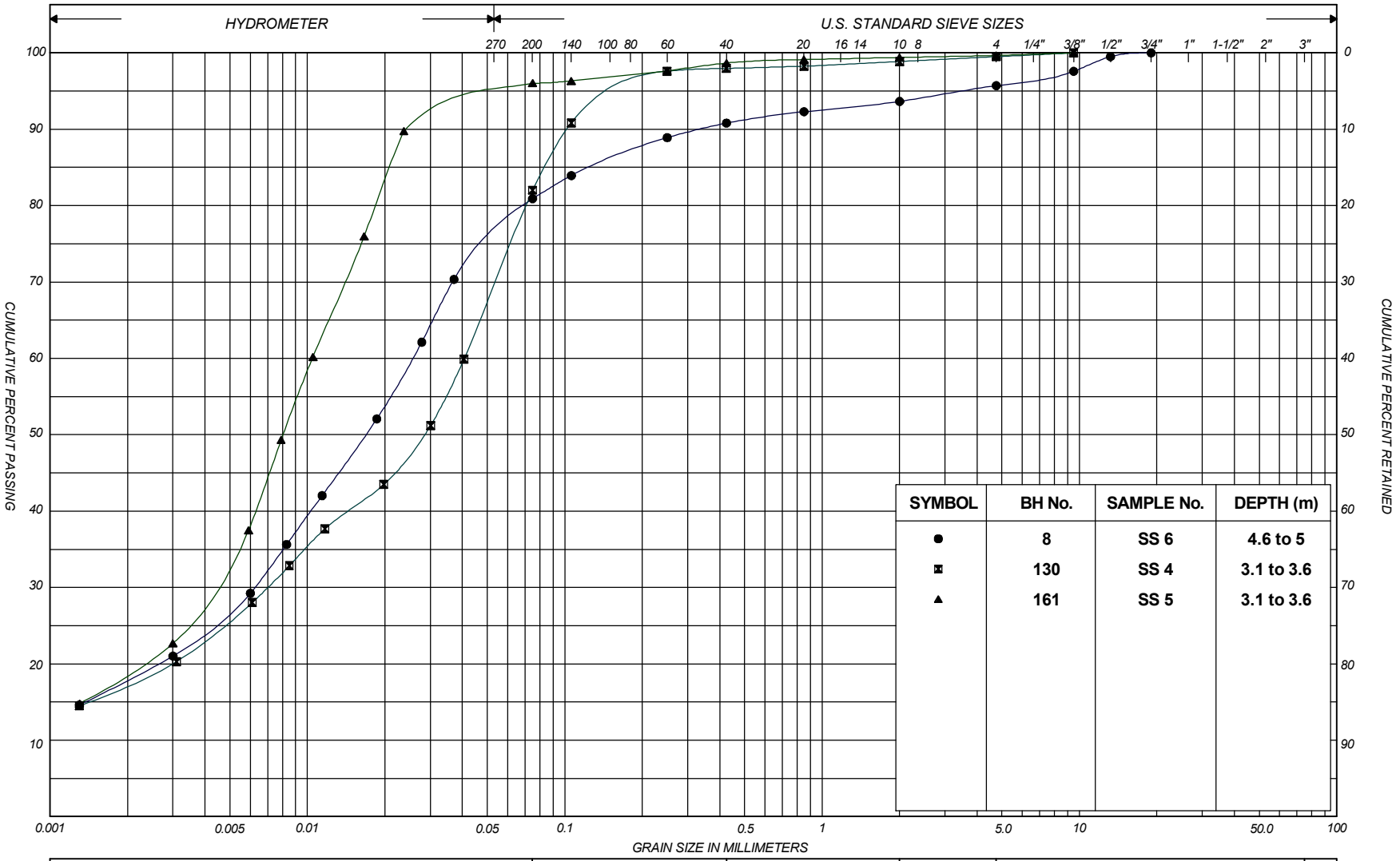
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 10

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	8	SS 6	4.6 to 5
⊠	130	SS 4	3.1 to 3.6
▲	161	SS 5	3.1 to 3.6

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND						

REMARKS: CLAYEY SILT TILL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

RESISTIVITY OF SOIL

CLIENT : IBI Group

PROJECT : Maple Grove Road Improvements and Corridor Study

LOCATION : Fountain Street to Hespeler Road, Cambridge

PML Ref : 18KF047

REPORT No. : 1

FIGURE No : 11

TESTED BY : F.Patel C.Tech

DATE TESTED : 20 Mar 2019

LAB NO.	LOCATION	RESISTIVITY(Ohm-cm)		MOISTURE CONTENT						
		NATIVE CONDITION	SATURATED CONDITION	TARE No.	WET SOIL + TARE (g)	DRY SOIL + TARE (g)	TARE (g)	WATER (g)	DRY SOIL (g)	MOISTURE %
1970165-A	BH-109 SN-4/5 (7-11)									
			1000	S2	180.11	166.39	35.0	13.72	131.39	10.4

REMARKS : Sample received in saturated condition

REVIEWED BY: jn

REVIEWED DATE: March 21, 2019

Peto MacCallum Ltd.
CONSULTING ENGINEERS

RESISTIVITY OF SOIL

CLIENT : IBI Group

PROJECT : Maple Grove Road Improvements and Corridor Study

LOCATION : Fountain Street to Hespeler Road, Cambridge

PML Ref : 18KF047

REPORT No. : 1

FIGURE No : 12

TESTED BY : F.Patel C.Tech

DATE TESTED : 20 Mar 2019

LAB NO.	LOCATION	RESISTIVITY(Ohm-cm)		MOISTURE CONTENT						
		NATIVE CONDITION	SATURATED CONDITION	TARE No.	WET SOIL + TARE (g)	DRY SOIL + TARE (g)	TARE (g)	WATER (g)	DRY SOIL (g)	MOISTURE %
1970165-B	BH-124 SN-6 (15-16.5)									
			7000	3	148.59	137.24	37.36	11.35	99.88	11.4

REMARKS : Sample received in saturated condition

REVIEWED BY: JN

REVIEWED DATE: March 21, 2019

Peto MacCallum Ltd.
CONSULTING ENGINEERS

RESISTIVITY OF SOIL

CLIENT : IBI Group

PROJECT : Maple Grove Road Improvements and Corridor Study

LOCATION : Fountain Street to Hespeler Road, Cambridge

PML Ref : 18KF047

REPORT No. : 1

FIGURE No : 13

TESTED BY : F.Patel C.Tech

DATE TESTED : 20 Mar 2019

LAB NO.	LOCATION	RESISTIVITY(Ohm-cm)		MOISTURE CONTENT						
		NATIVE CONDITION	SATURATED CONDITION	TARE No.	WET SOIL + TARE (g)	DRY SOIL + TARE (g)	TARE (g)	WATER (g)	DRY SOIL (g)	MOISTURE %
1970165-C	BH-132 SN-5 (10-11.5)									
			6000	G8	159.74	144.97	36.60	14.77	108.37	13.6

REMARKS : Sample received in saturated condition

REVIEWED BY: jn

REVIEWED DATE: March 21, 2019

Peto MacCallum Ltd.
CONSULTING ENGINEERS

RESISTIVITY OF SOIL

CLIENT : IBI Group

PROJECT : Maple Grove Road Improvements and Corridor Study

LOCATION : Fountain Street to Hespeler Road, Cambridge

PML Ref : 18KF047

REPORT No. : 1

FIGURE No : 14

TESTED BY : F.Patel C.Tech

DATE TESTED : 20 Mar 2019

LAB NO.	LOCATION	RESISTIVITY(Ohm-cm)		MOISTURE CONTENT						
		NATIVE CONDITION	SATURATED CONDITION	TARE No.	WET SOIL + TARE (g)	DRY SOIL + TARE (g)	TARE (g)	WATER (g)	DRY SOIL (g)	MOISTURE %
1970165-D	BH-144 SN-6 (15-16.5)									
			2200	G1	166.78	156.65	36.27	10.13	120.38	8.4

REMARKS : Sample received in saturated condition

REVIEWED BY: JN

REVIEWED DATE: March 21, 2019

Peto MacCallum Ltd.
CONSULTING ENGINEERS

RESISTIVITY OF SOIL

CLIENT : IBI Group

PROJECT : Maple Grove Road Improvements and Corridor Study

LOCATION : Fountain Street to Hespeler Road, Cambridge

PML Ref : 18KF047

REPORT No. : 1

FIGURE No : 15

TESTED BY : F.Patel C.Tech.

DATE TESTED : 18 Mar 2019

LAB NO.	LOCATION	RESISTIVITY(Ohm-cm)		MOISTURE CONTENT						
		NATIVE CONDITION	SATURATED CONDITION	TARE No.	WET SOIL + TARE (g)	DRY SOIL + TARE (g)	TARE (g)	WATER (g)	DRY SOIL (g)	MOISTURE %
1970165-E	BH-146 SN-4/5 (7-11)									
			1500	8	184.85	159.71	34.45	25.14	125.26	20.1

REMARKS : Sample received in saturated condition

REVIEWED BY: _____

REVIEWED DATE: March 21, 2019

Peto MacCallum Ltd.
CONSULTING ENGINEERS

RESISTIVITY OF SOIL

CLIENT : IBI Group

PROJECT : Maple Grove Road Improvements and Corridor Study

LOCATION : Fountain Street to Hespeler Road, Cambridge

PML Ref : 18KF047

REPORT No. : 1

FIGURE No : 16

TESTED BY : F.Patel C.Tech

DATE TESTED : 18 Mar 2019

LAB NO.	LOCATION	RESISTIVITY(Ohm-cm)		MOISTURE CONTENT						
		NATIVE CONDITION	SATURATED CONDITION	TARE No.	WET SOIL + TARE (g)	DRY SOIL + TARE (g)	TARE (g)	WATER (g)	DRY SOIL (g)	MOISTURE %
1970165-F	BH-163 SN-3/4 (5-9)									
			1700	13	159.02	148.70	34.73	10.32	113.97	9.1

REMARKS : Sample received in saturated condition

REVIEWED BY: jn

REVIEWED DATE: March 21, 2019

NOTES

1. The need to underpin existing footings/utilities is dependent upon soil type, proximity of the existing facility to the face of the excavation, loads imposed on the foundation and permissible movements.

   ZONE A:
   Foundations of relatively heavy and/or settlement sensitive structures/ utilities located in Zone A generally require underpinning.

   ZONE B:
   Foundations of structures located within Zone B generally do not require underpinning. Consideration should be given to underpinning of settlement sensitive utilities or heavy foundation units located in this zone.

   ZONE C:

   Utilities and foundations located within Zone C do not normally require underpinning.

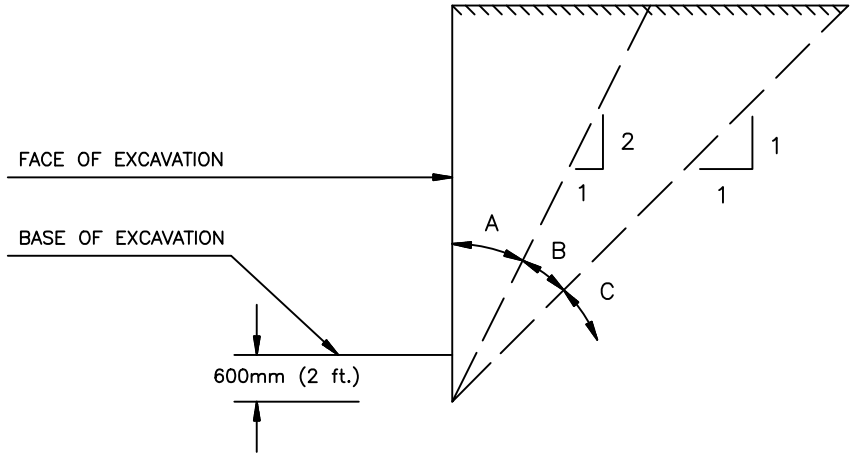
   Underpinning of foundations located in Zones A and B should extend at least into Zone C.

2. As an alternative to underpinning, it may be possible to control movement of existing utilities and foundations by supporting the face of the excavation with bracing/tiebacks or a rigid (caisson) wall. Horizontal and vertical earth pressures imposed on the excavation wall by non–underpinned foundations must be considered in the design of the support system.

3. A condition survey should be conducted prior to construction and appropriate monitoring (surface and insitu) carried out during construction to monitor any movement which may occur.

4. All work should be carried out in accordance with the Occupational Health and Safety Act and local regulations. Good quality workmanship and construction practices are to be employed.

5. This sheet is to be read in conjunction with text of report for this project. Additional comments and recommendations concerning these general guidelines will be provided if required.



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STANDARD DRAWING

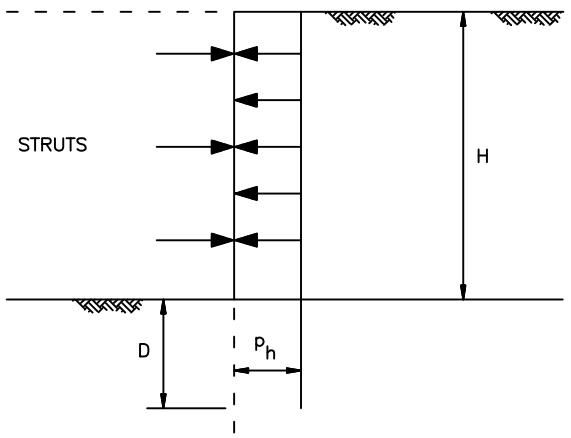
GENERAL RECOMMENDATIONS REGARDING UNDERPINNING OF FOUNDATIONS/UTILITIES LOCATED CLOSE TO EXCAVATION

DATE	JOB NUMBER	FIGURE NO.
MARCH 2022	18KF047	17

NOTES

1. The actual magnitude and distribution of the horizontal earth pressures which will act on the bracing system are dependent upon the permissible lateral/vertical movements adjacent to the excavation, the soil type, groundwater conditions, drainage provisions, temporary/permanent surcharge loads, the type of bracing system adopted, weather conditions, quality of workmanship and length of time the excavation will be supported. Hence, the recommended pressure diagram and design parameters should be reviewed when construction details, schedule and type of support system are established.
2. Stability of base of excavation must be confirmed when bracing system design, excavation geometry and surcharge loads are established. If groundwater table is well above base of excavation and/or artesian conditions exist, local lowering of the groundwater level will be necessary to prevent bottom heave/piping of the base of the excavation.
3. Earth pressure diagram is applicable to maximum depth of cut of 12m (40 ft.).
4. Structural components of bracing system should be confirmed adequate for each level of excavation.
5. If sheeting will not permit drainage, bracing system must be designed to resist water pressure.
6. Surcharge loads such as street/construction traffic, supported utilities, adjacent foundations, temporary stockpiles and other loads carried by bracing system are not included in earth pressure diagram.
7. Temporary surcharge loading should not be closer to the face of the excavation than half the depth of excavation unless accounted for in bracing design.
8. If settlement sensitive structures are located near the excavation, special measures should be undertaken to control settlements. A condition survey should be conducted prior to construction and apppropriate monitoring (surface and insitu) carried out during construction.
9. Earth pressure diagram is applicable for relatively short construction periods. If excavation is to be open for long periods, monitoring of deformation is essential, earth pressure diagram must be reviewed, and remedial works may be required.
10. Earth pressure diagram does not account for extended periods of exposure of the excavation to freezing temperatures.
11. Bracing system should be regularly examined for signs of distress.
12. All work should be carried out in accordance with the Occupational Health and Safety Act and local regulations. Good quality workmanship and construction practices are to be employed.
13. This sheet should be read in conjunction with text of report for this project. Additional comments and recommendations concerning these general guidelines will be provided if required.

EARTH PRESSURE DIAGRAM



p_h = design lateral earth pressure
= 0.65 $K\gamma H$

K = lateral earth pressure coefficient

γ = unit weight of soil

H = depth of excavation

D = depth of embedment of soldier piles (if used).

RECOMMENDED DESIGN PARAMETERS

γ = 21.0 kN/m^3

K = 0.36 (movement of retained soil acceptable)
0.56 (movement of adjacent structures/facilities unacceptable)

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LATERAL EARTH PRESSURE DISTRIBUTION

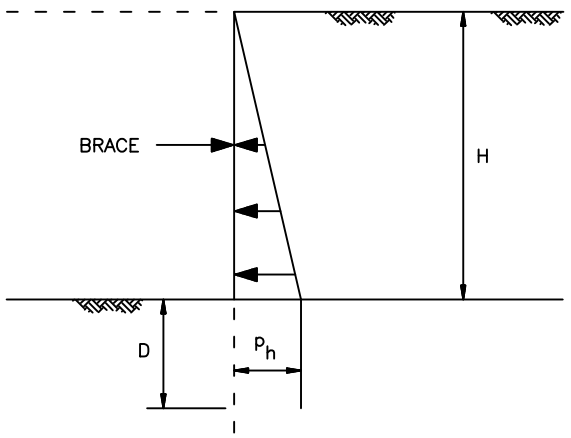
MULTI–BRACED CUTS IN COHESIONLESS SOILS

DATE	JOB NUMBER	FIGURE NO.
MARCH 2022	18KF047	18

NOTES

1. The actual magnitude and distribution of the horizontal earth pressures which will act on the bracing system are dependent upon the permissible lateral/vertical movements adjacent to the excavation, the soil type, groundwater conditions, drainage provisions, temporary/permanent surcharge loads, the type of bracing system adopted, weather conditions, quality of workmanship and length of time the excavation will be supported. Hence, the recommended pressure diagram and design parameters should be reviewed when construction details, schedule and type of support system are established.
2. Stability of base of excavation must be confirmed when bracing system design, excavation geometry and surcharge loads are established. If groundwater table is well above base of excavation and/or artesian conditions exist, local lowering of the groundwater level will be necessary to prevent bottom heave/piping of the base of the excavation.
3. Earth pressure diagram is applicable to maximum depth of cut of 12m (40 ft.).
4. Structural components of bracing system should be confirmed adequate for each level of excavation.
5. If sheeting will not permit drainage, bracing system must be designed to resist water pressure.
6. Surcharge loads such as street/construction traffic, supported utilities, adjacent foundations, temporary stockpiles and other loads carried by bracing system are not included in earth pressure diagram.
7. Temporary surcharge loading should not be closer to the face of the excavation than half the depth of excavation unless accounted for in bracing design.
8. If settlement sensitive structures are located near the excavation, special measures should be undertaken to control settlements. A condition survey should be conducted prior to construction and apppropriate monitoring (surface and insitu) carried out during construction.
9. Earth pressure diagram is applicable for relatively short construction periods. If excavation is to be open for long periods, monitoring of deformation is essential, the earth pressure diagram must be reviewed, and remedial works may be required.
10. Earth pressure diagram does not account for extended periods of exposure of the excavation to freezing temperatures.
11. Bracing system should be regularly examined for signs of distress.
12. All work should be carried out in accordance with the Occupational Health and Safety Act and local regulations. Good quality workmanship and construction practices are to be employed.
13. This sheet should be read in conjunction with text of report for this project. Additional comments and recommendations concerning these general guidelines will be provided if required.

EARTH PRESSURE DIAGRAM



p_h = design lateral earth pressure
= $K\gamma H$

K = lateral earth pressure coefficient

γ = unit weight of soil

H = depth of excavation

D = depth of embedment of soldier piles (if used).

RECOMMENDED DESIGN PARAMETERS

γ = 21.0 kN/m^3

K = 0.36 (movement of retained soil acceptable)
0.56 (movement of adjacent structures/facilities unacceptable)

Peto MacCallum Ltd
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LATERAL EARTH PRESSURE DISTRIBUTION

SINGLY–BRACED CUTS IN COHESIONLESS SOILS

DATE	JOB NUMBER	FIGURE NO.
MARCH 2022	18KF047	19

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. - Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	TW	Thinwall Open
WS	Washed Sample	TP	Thinwall Piston
SB	Scraper Bucket Sample	OS	Oesterberg Sample
AS	Auger Sample	FS	Foil Sample
CS	Chunk Sample	RC	Rock Core
ST	Slotted Tube Sample	USS	Undisturbed Shear Strength
PH	Sample Advanced Hydraulically	RSS	Remoulded Shear Strength
PM	Sample Advanced Manually		

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

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LOG OF BOREHOLE NO. 1

17T 553178E 4808977N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Shoulder, at Old Maple Grove Road — ***BORING DATE*** December 7, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	307.53	SURFACE ELEVATION 307.53					
0.0		PAVEMENT STRUCTURE: 770 mm granular base/subbase		1	SS	47	
0.77	306.76	GRAVELLY SAND: Compact to dense brown gravelly sand, trace silt, damp		2	SS	33	
1.0				3	SS	17	
2.0							
2.3	305.2	SAND: Loose to compact brown sand, some silt, trace gravel, wet		4	SS	24	▼ El. 305.2
3.0				5	SS	8	
4.0							
5.0				6	SS	9	
6.0							
6.1	301.4	becoming saturated		7	SS	8	
7.0							
8.0				8	SS	10	
9.0							
9.2	298.3	SANDY SILT TILL: Very dense grey sandy silt, trace gravel, occasional cobbles, wet		9	SS	94/275mm	Washed to clear casing from SS9 to termination
10.0							
10.7	296.8	occasional silty sand layers		10	SS	50/100mm	
11.0							
12.0				11	SS	50/100mm	
13.0							
13.1	294.4	BOREHOLE TERMINATED AT 13.1 m, NO FURTHER PROGRESS DUE TO HYDRAULIC CONDITIONS					Upon completion of augering Cave at 3.0 m No free water
14.0							
15.0							

ELEVATION SCALE: 307, 306, 305, 304, 303, 302, 301, 300, 299, 298, 297, 296, 295

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 2

17T 553244E 4808993N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Old Maple Grove Road, Offroad, South-East Corner, at Maple Grove — ***BORING DATE*** December 11, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 306.48			
0.0	306.37	TOPSOIL: Dark brown sandy silty, trace gravel, rootlets, moist	1	SS	7
		GRAVELLY SAND: Compact brown gravelly sand, trace silt, moist	2	SS	12
1.2	305.3	becoming saturated	3	SS	9
			4	SS	5
			5	SS	10
			6	SS	16
			7	SS	13
7.8	298.7	SANDY SILT TILL: Very dense grey sandy silt, trace gravel, trace clay, occasional cobbles, saturated	8	SS	44
			9	SS	50/125mm
			10	SS	50/125mm
			11	SS	50/100mm
		CONTINUED			

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%)

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stickup with Protective Casing

El. 305.4

El. 305.2

Bentonite Seal

Filter Sand

30 66 4

Screen

Added drilling mud from SS6 to completion

NOTES *Low N value due to hydraulic disturbance.

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 2

17T 553244E 4808993N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Old Maple Grove Road, Offroad, South-East Corner, at Maple Grove — ***BORING DATE*** December 11, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE									
			12	SS	91/250mm	291				
16.5										
290.0	SAND AND GRAVEL: Grey sand and gravel, some silt, occasional cobbles, saturated		13	SS	9*	290				
17.7						289				
288.8	BOREHOLE TERMINATED AT 17.7 m, NO FURTHER PROGRESS DUE TO HYDRAULIC CONDITIONS									Water Level Readings: Date Depth Elev. 2019-03-28 1.1 305.4 2018-12-13 1.3 305.2

NOTES *Low N value due to hydraulic disturbance.

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 3

17T 553983E 4809375N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Shoulder, East of Beaverdale Road — ***BORING DATE*** December 3, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continious Flight Hollow Stem Augers and HQ Diamond Coring — ***TECHNICIAN*** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES	ELEVATION SCALE
	300.92	SURFACE ELEVATION 300.92					
0.0	300.92	PAVEMENT STRUCTURE: 100 mm granular base, damp, over 830 mm granular subbase, damp		1	SS	28	
0.93	299.99	FILL: Brown medium sand, trace silt, trace gravel, damp		2	SS	39	300
1.5	299.4	becoming brown sand, some silt, damp		3	SS	27	299
2.3	298.6	becoming brown sandy silt, moist		4	SS	43	298
				5	SS	23	297
				6	SS	34	296
6.1	294.8	SILT: Compact to dense brown silt, some sand, trace clay, wet		7	SS	29	295
				8	SS	41	293
8.6	292.3	GRAVELLY SAND: Very dense brown gravelly sand, some silt, occasional cobble, occasional boulder, saturated		9	SS	95/140mm	292
10.7	290.2	becoming grey		10	SS	50/50mm	291
12.5	288.4	BOREHOLE TERMINATED AT 12.7 m, NO FURTHER PROGRESS DUE TO HYDRAULIC CONDITIONS AND REFUSAL ON BOULDERS		11	SS	50/100mm	290
							289

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 296.6

Sampler wet from SS7 to completion

Upon completion of augering Wet cave at 4.3 m

NOTES

▼ GROUND WATER STRIKE

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LOG OF BOREHOLE/MONITORING WELL NO. 4

17T 553904E 4809328N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Shoulder, East of Beaverdale Road — ***BORING DATE*** December 5, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 302.86				
0.0	302.86	PAVEMENT STRUCTURE: 130 mm asphalt, over 670 mm granular base/subbase, damp		1	SS	23
0.80	302.06	FILL: Brown gravelly sand, trace silt, occasional cobbles, damp		2	SS	10
1.5	301.4	becoming brown silty sand, trace gravel, damp		3	SS	29
				4	SS	18
				5	SS	40
				6	SS	22
				7	SS	18
7.9	295.0	SAND: Dense dark grey course sand, trace silt, trace gravel, wet		8	SS	32
8.6	294.3	CLAYEY SILT: Very stiff brown clayey silt, some sand, trace gravel, APL		9	SS	19
10.1	292.8	GRAVELLY SAND: Very dense grey gravelly sand, trace silt, occasional cobbles, occasional boulders, saturated		10	SS	50/150mm
				11	SS	50/150mm
				12	SS	50/125mm
		CONTINUED				

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 295.5
El. 292.2
Filter Sand
28 66 6
Screen

NOTES

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

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LOG OF BOREHOLE/MONITORING WELL NO. 4

17T 553904E 4809328N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Shoulder, East of Beaverdale Road — ***BORING DATE*** December 5, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE									
15.2										
287.7	occasional clayey silt seams		13	SS	25/150mm	287				
			14	SS	50/50mm	286				
						285				
18.6			15	SS	50/25mm					
284.3	BOREHOLE TERMINATED AT 18.6 m AUGER REFUSAL ON BOULDER/ POSSIBLE BEDROCK									

Water Level Readings:

Date	Depth	Elev.
2018-12-05	10.7	292.2
2019-03-28	7.4	295.5

NOTES

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

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LOG OF BOREHOLE NO. 5

17T 554344E 4809364N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Shoulder, at Hespeler Road — **BORING DATE** December 3, 2018 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
	304.09	SURFACE ELEVATION 304.09				
0.0	304.09	PAVEMENT STRUCTURE: 150 mm asphalt, over 730 mm granular subbase		1	SS	18
0.88	303.21	FILL: Brown silty sand, some gravel, damp		2	SS	29
1.5	302.6	becoming wet		3	SS	18
2.1	302.0	SAND: Loose to compact brown sand, trace silt, wet		4	SS	18
				5	SS	6
4.6	299.5	occasional silt seams		6	SS	18
6.1	298.0	becoming dense grey		7	SS	38
7.6	296.5	becoming very dense brown sand, trace silt, trace gravel, wet		8	SS	56
8.6	295.5	CLAYEY SILT TILL: Hard grey clayey silt, some sand, trace gravel, APL		9	SS	50/100mm
9.9	294.2	GRAVELLY SAND: Very dense brown gravelly sand, some silt, some clay, saturated		10	SS	50/50mm
12.5	291.6	BOREHOLE TERMINATED AT 12.5 m, NO FURTHER PROGRESS DUE TO AUGER REFUSAL ON POSSIBLE BEDROCK		11	SS	50/25mm

ELEVATION SCALE: 304, 303, 302, 301, 300, 299, 298, 297, 296, 295, 294, 293, 292

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ EI. 298.0

Upon completion of augering
Cave at 2.7 m
No free water

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 6

17T 554409E 4809249N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Shoulder, at Maple Grove Road — ***BORING DATE*** December 13, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continious Flight Hollow Stem Augers and HQ Diamond Coring — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 301.25			
0.0		PAVEMENT STRUCTURE: 110 mm asphalt, over 230 mm granular base, damp, over 340 mm granular subbase, moist	1	AS	
0.68	300.57	FILL: Brown sand, some gravel, trace silt, wet	2	SS	28
1.7	299.6	becoming clayey, occasional cobbles	3	SS	26
2.3	299.0	SAND AND GRAVEL: Compact to dense grey sand and gravel, some silt, numerous cobbles, saturated	4	SS	62
			5	SS	16
			6	SS	22
			7	SS	64
7.6	293.7	SILTY SAND TILL: Very Dense grey silty sand, trace gravel, occasional cobbles, saturated	8	SS	50/100mm
			9	SS	50/100mm
			10	SS	30/100mm
11.2	290.1	WEATHERED BEDROCK: Hard buff dolostone	11	RC	
12.8	288.5	BOREHOLE TERMINATED AT 12.8 m			

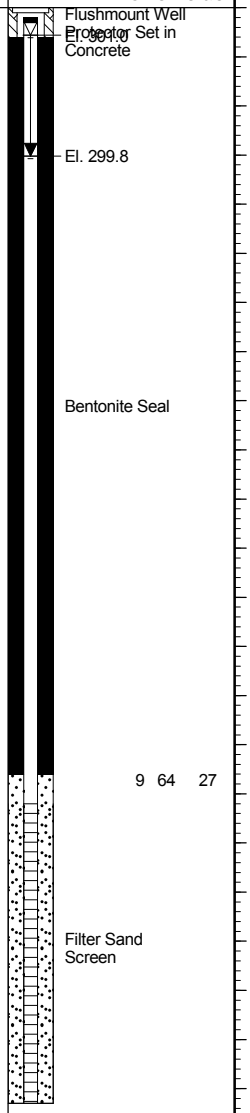
SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%)

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL



DEPTH (m)	RUN (m)	REC (%)	RQD (%)	WWR (%)
11.2				
	1.60	100	42	100
12.8				

Water Level Readings:

Date	Depth	Elev.
2018-12-13	1.5	299.8
2019-03-28	0.3	301.0

NOTES

RQD (Rock Quality Designation) is the total length of those pieces of sound core which are 10 cm or greater in length in a core run expressed as a percentage of the total length of that core run. RQD is measured on minimum NQ size (nominal 50 mm diameter) cores. WWR (wash water return) is the observed fraction of drilling water which has returned to the surface during coring.

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 7

17T 554250E 4808851N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Southbound Shoulder, South of Maple Grove Road — **BORING DATE** December 7, 2018 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 296.00					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 710 mm granular base/subbase		1	SS	30	
0.83	295.08	FILL: Brown sand, trace gravel, damp becoming moist		2	SS	22	295
1.5	294.5	becoming brown silty sand, wet		3	SS	48	
2.0				4	SS	51	294
3.1	292.9	CLAYEY SILT TILL: Hard grey clayey silt, some sand, trace to some gravel, occasional cobbles, DTPL		5	SS	71	293
4.0							292
5.0				6	SS	59	291
6.0							290
6.9	289.1	BOREHOLE TERMINATED AT 6.9 m AUGER REFUSAL ON POSSIBLE BEDROCK		7	SS	50/150mm	
7.0				8	SS	50/25mm	
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 294.5

Upon completion of augering
Cave at 4.0 m
No free water

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 8

17T 554255E 4808783N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Northbound Shoulder, South of Maple Grove Road — **BORING DATE** December 10, 2018 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 295.15				
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 800 mm granular base/subbase, moist		1	SS	38
0.80	294.35	FILL: Brown sand, some gravel, trace silt, damp		2	SS	49
1.5	293.7	becoming silty		3	SS	50/75mm
2.3	292.9	becoming brown gravel, some silt, some sand, damp		4	SS	50/150mm
3.0	292.2	CLAYEY SILT TILL: Hard brown clayey silt, some gravel, some sand, DTPL		5	SS	50/150mm
5.0				6	SS	50/150mm
5.3	289.9	WEATHERED BEDROCK: Buff dolostone		7	SS	50/25mm
		BOREHOLE TERMINATED AT 5.3 m, DUE TO AUGER REFUSAL				

ELEVATION SCALE: 295, 294, 293, 292, 291, 290

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
Filter Sand
Screen El. 290.5
4 15 81

Water Level Readings:

Date	Depth	Elev.
2018-12-10	Dry	---
2019-03-28	4.7	290.5

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 9

17T 553782E 4808873N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Beaverdale Road, Southbound Shoulder, South of Maple Grove Road — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH (m)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 308.45			
0.0	308.45				
0.20		TOPSOIL: Dark brown silty sand topsoil, damp	1	SS	26
0.36	308.09	FILL: Silty sand, damp	1A	SS	
		becoming light brown sand and gravel, damp	2	SS	55
1.0					
1.5	307.0	SAND: Compact brown sand, some gravel, some silt, occasional cobbles, moist	3	SS	14
2.0					
2.3	306.2	becoming moist to wet	4	SS	38
3.0			5	SS	43
4.0					
			6	SS	37
5.0					
5.2	303.3	SANDY SILT TILL: Very dense brown sandy silt, some gravel, occasional cobble, saturated			
6.0			7	SS	54
7.0					
7.6	300.9	becoming very dense brown silty sand, some gravel	8	SS	50/50mm
8.0					
9.0			9	SS	50/80mm
9.9	298.6	CLAYEY SILT TILL: Hard brown clayey silt, some sand, DTPL			
10.0			10	SS	63
11.0					
12.0			11	SS	50/130mm
13.0					
13.1	295.4	occasional sandy silt layers	12	SS	50/130mm
14.0					
15.0		CONTINUED			

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu; ▲POCKET PENETROMETER O Q; 50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 308 307 306 305 304 303 302 301 300 299 298 297 296 295 294

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

WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete

Bentonite Seal

Filter Sand

14 77 9

El. 303.4
El. 303.3

Screen

NOTES

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 9

17T 553782E 4808873N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Beaverdale Road, Southbound Shoulder, South of Maple Grove Road — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
15.0	CONTINUED FROM PREVIOUS PAGE					
			13	SS	50/130mm	293
						292
17.1			14	SS	50/130mm	
291.4 / 17.4	WEATHERED BEDROCK: Grey dolostone		15	SS	50/50mm	
291.1	BOREHOLE TERMINATED AT 17.4 m DUE TO AUGER REFUSAL					

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu; ▲ POCKET PENETROMETER O Q; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●

50 100 150 200

20 40 60 80

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

WATER CONTENT (%)

10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Water Level Readings:

Date	Depth	Elev.
2019-01-31	5.2	303.3
2019-03-28	5.1	303.4

NOTES

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 10

17T 553821E 4808765N

PROJECT Maple Grove Road Improvements and Corridor Study ***PML REF.*** 18KF047

LOCATION Beaverdale Road, Northbound Shoulder, South of Maple Grove Road ***BORING DATE*** December 13, 2018 ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers ***TECHNICIAN*** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 301.62				
0.0		PAVEMENT STRUCTURE: 230 mm asphalt, over 500 mm granular base		1	SS	8
0.73	300.86	FILL: Brown sand, some gravel, trace silt, moist		2	SS	2
1.5		becoming brown grey sand, trace silt, wet				
1.7	299.9	becoming wet to saturated		3	SS	13
		CLAYEY SILT: Very stiff brown clayey silt, trace sand, APL		4	SS	29
				5	SS	25
				6	SS	17
9.0	292.6	CLAYEY SILT TILL: Hard brown clayey silt, some sand, some gravel, DTPL		7	SS	50/100mm
10.8	290.8	occasional sandy silt layers				
				8	SS	50/125mm
13.8	287.8	SAND: Very dense brown sand, some silt, trace gravel, wet				
		CONTINUED				

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 301, 300, 299, 298, 297, 296, 295, 294, 293, 292, 291, 290, 289, 288, 287

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 300.4

NOTES

GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 10

17T 553821E 4808765N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Beaverdale Road, Northbound Shoulder, South of Maple Grove Road — ***BORING DATE*** December 13, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE									
15.5	BOREHOLE TERMINATED AT 15.5 m		9	SS	50/125mm		>>			Upon completion of augering Cave at 5.8 m Free water at 1.2 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 101

17T 550386E 4808149N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Lane 2 — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.25					309
0.0	PAVEMENT STRUCTURE: 185 mm asphalt, over 225 mm granular base, damp, over 330 mm granular subbase, moist		1A / 1B	AS		
0.74 / 308.51	FILL: Brown sandy silt, trace gravel, moist		2	SS	14	308
1.2	becoming dark brown clayey silt, trace organics, trace sand, moist					
1.5 / 307.8	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, some sand, trace gravel, DTPL		3	SS	22	307
			4	SS	38	
			5	SS	22	306
4.5 / 304.8	becoming grey, occasional silt seams		6	SS	26	305
5.0 / 304.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering;
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 102

17T 550453E 4808185N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Lane 2 — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 309.52					
0.0		PAVEMENT STRUCTURE: 185 mm asphalt, over 135 mm granular base, damp, over 330 mm granular subbase, moist		1A, 1B	AS		309
0.65	308.87	FILL: Brown sandy silt, trace gravel, trace clay, moist, occasional clayey silt layers, occasional cobbles		2	SS	15	
1.0				3	SS	21	308
2.0							
2.3	307.2	becoming dark brown, occasional organic inclusions, wood pieces		4	SS	16	307
3.0							
3.0	306.5	SAND: Dense brown sand, some gravel, some silt, saturated, occasional cobbles		5	SS	36	306
4.0							
4.5	305.0	CLAYEY SILT TILL: Very stiff brown clayey silt, some sand, DTPL		6	SS	26	305
5.0							
5.0	304.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 103

17T 550766E 4808260N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Left Turn Lane — **BORING DATE** February 1, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 310.95					
0.0		PAVEMENT STRUCTURE: 140 mm asphalt, over 180 mm granular base,		1	AS		
				2	AS		
0.61	310.34	damp, over 290 mm granular subbase, damp		3	AS		
1.0		FILL: Brown sandy silt, some gravel, trace clay, moist		4	SS	57	310
1.3	309.7	SILTY SAND: Dense brown silty sand, some gravel, moist to wet		5	SS	32	
2.0				6	SS	39	309
3.0	308.0	becoming very dense, saturated		7	SS	54	308
4.0							307
4.5	306.5	CLAYEY SILT TILL: Hard grey clayey		8	SS	48	
5.0	306.0	silt, some sand, trace gravel, APL BOREHOLE TERMINATED AT 5.0 m					306

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
22 61 17
26 55 20

▼ El. 308.0
Sampler wet at 3.0 m

Upon completion of augering;
Free water at 3.5 m
Cave at 3.8 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 104

17T 550892E 4808283N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Maple Grove Road, Eastbound Midshoulder
BORING DATE February 1, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 311.39				
0.0		PAVEMENT STRUCTURE: 650 mm granular base/subbase, moist				
0.65	310.74	FILL: Brown clayey silt, trace gravel, trace sand, moist		1	SS	50/125mm
1.2	310.2	becoming dark brown, trace organics, some sand		2	SS	13
1.8	309.6	SILTY SAND: Loose brown silty sand, trace gravel, wet		3	SS	5
3.0	308.4	becoming grey, compact		4	SS	18
4.5	306.9	GRAVELLY SAND: Dense grey gravelly sand, trace silt, saturated		5	SS	37
5.0	306.4	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 311, 310, 309, 308, 307

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 309.2
Filter Sand Screen

30 66 4

Upon completion of augering
Wet cave at 4.5 m

Water Level Readings:

Date	Depth	Elev.
2019-02-01	3.0	308.4
2019-03-28	2.2	309.2

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 105

17T 551018E 4808316N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — **BORING DATE** February 20, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 311.98					
0.0		PAVEMENT STRUCTURE: 150 mm asphalt, over 170 mm granular base, moist, over 625 mm granular subbase, moist		1	AS		
0.95	311.03	FILL: Grey silty sand, some gravel, moist		2	SS	50	311
1.0							
2.0				3	SS	49	310
				4	SS	10	
3.0							
3.0	309.0	SANDY SILT TILL: Compact brown sandy silt, trace gravel, trace clay, moist		5	SS	15	309
4.0							308
4.5							
	307.5	becoming very dense, wet		6	SS	76/325mm	
5.0							307
5.0	307.0	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 106

17T 551224E 4808372N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** February 20, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 312.87					
0.0	PAVEMENT STRUCTURE: 180 mm asphalt, over 300 mm granular base, moist, over 610 mm granular subbase, moist		1A	AS		
1.1			2	SS	47	312
311.8	FILL: Hard brown silty sand, some gravel, trace clay, moist					
2.3			3	SS	42	311
310.6	CLAYEY SILT TILL: Hard brown clayey silt, some sand, some gravel, DTPL		4	SS	33	
						310
			5	SS	48	
						309
4.5						
308.4	becoming grey		6	SS	43	308
5.0						
307.9	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 107

17T 551365E 4808395N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Right Turn Lane — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 313.37					
0.0		PAVEMENT STRUCTURE: 185 mm asphalt over 215 m granular base over, 300 mm granular subbase		1A 1B	AS		313
0.70	312.67	FILL: Brown sand, gravel, moist		2	SS	23	
1.0							
1.4	312.0	brown clayey silt, some gravel, occasional cobbles, wet		3	SS	7	312
2.0							
2.1	311.3	SAND: Loose brown sand, some gravel, trace silt, saturated		4	SS	6	311
2.9							
3.0	310.5	SANDY SILT TILL: Compact to very dense, brown sandy silt, some clay, trace gravel, wet		5	SS	24	310
4.0							
4.7				6	SS	50/75mm	309
5.0	308.7	BOREHOLE TERMINATED AT 4.7 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 311.0

Upon Completion of Augering
Free water at 2.4 m
Cave to 3.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 108

17T 551524E 4808449N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 14, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	312.63	SURFACE ELEVATION 312.63				
0.0		PAVEMENT STRUCTURE: 540 mm granular base/subbase, moist		1	SS	50/75mm
0.54	312.09	FILL: Brown silty sand, some gravel, numerous cobbles, moist		2	SS	19
1.0						
1.5	311.1	trace clay, wet		3	SS	15
2.0	310.6	SANDY SILT TILL: Dense to very dense brown sandy silt, trace gravel, trace clay, damp		4	SS	36
3.0				5	SS	65
4.0						
5.0	307.6	BOREHOLE TERMINATED AT 5.0 m		6	SS	64

ELEVATION SCALE: 312, 311, 310, 309, 308

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

8 23 68

Water Level Readings:

Date	Depth	Elev.
2018-01-14	DRY	----

NOTES Monitoring well buried after installation.

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 109

17T 551679E 4808477N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Maple Grove Road, Eastbound Midlane
BORING DATE February 20, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 309.87				
0.0 / 309.87	PAVEMENT STRUCTURE: 140 mm asphalt, over 320 mm granular base, moist		1A		
0.46 / 309.41			1B	AS	
	FILL: Brown sandy silt, some gravel, occasional clayey silt layers, moist		2	SS	23
1.4 / 308.5	becoming brown clayey silt, some sand, trace gravel, moist		3	SS	7
2.3 / 307.6	SANDY SILT TILL: Compact brown sandy silt, trace gravel, occasional cobbles, moist		4	SS	17
3.0 / 306.9	becoming very dense		5	SS	54
5.0 / 304.9	BOREHOLE TERMINATED AT 5.0 m		6	SS	50/75mm

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 110

17T 551813E 4808506N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — **BORING DATE** January 14, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 307.01				
0.0	307.01	PAVEMENT STRUCTURE: 640 mm granular base/subbase, moist		1	SS	50/100 mm
0.64						
0.90		FILL: Dark brown sandy silt, trace clay, rootlets, moist, contains organics		2	SS	23
1.0	306.11	SANDY SILT: Compact brown sandy silt, trace gravel, moist				
				3	SS	18
2.0						
2.3	304.7	SAND: Compact brown sand, trace silt, trace gravel, saturated		4	SS	15
3.0						
				5	SS	13
4.0						
5.0				6	SS	30
	302.0	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 306, 305, 304, 303

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 305.0
Filter Sand Screen

6 86 8

Water Level Readings:

Date	Depth	Elev.
2019-01-14	4.0	303.0
2019-03-28	2.0	305.0

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 111

17T 551930E 4808555N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** February 20, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 306.14					306
0.0		PAVEMENT STRUCTURE: 140 mm asphalt, over 220 mm granular base, moist, over 740 mm granular subbase, moist		1A	AS		
1.1	305.0	FILL: Brown silty sand, some gravel, moist		2	SS	35	305
1.5	304.6	SAND: Compact brown sand, trace silt, trace gravel, wet		3	SS	28	
2.3	303.8	becoming grey, silty		4	SS	18	304
3.0	303.1	SANDY SILT TILL: Dense to very dense grey sandy silt, some gravel, moist		5	SS	47	303
5.0	301.1	BOREHOLE TERMINATED AT 5.0 m		6	SS	50/125mm	302

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 112

17T 552014E 4808590N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 14, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 305.77			
0.0	PAVEMENT STRUCTURE: 900 mm granular base/subbase, moist	1	SS	50/100mm
0.90 304.87	FILL: Brown sand and gravel, trace silt, occasional cobbles, damp	2	SS	27
1.5 304.3	SAND: Compact brown sand, some silt, trace gravel, saturated	3	SS	28
2.3 303.5	SILTY SAND TILL: Compact to dense brown silty sand, some gravel, saturated	4	SS	13
		5	SS	19
4.5 301.3	becoming grey	6	SS	32
5.0 300.8	BOREHOLE TERMINATED AT 5.0 m			

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%)

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete

El. 304.6

Bentonite Seal

18 44 38

Filter Sand Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-14	3.1	302.7
2019-03-28	1.2	304.6

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 113

17T 552300E 4808686N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — ***BORING DATE*** January 15, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 304.98				
0.0	304.98	PAVEMENT STRUCTURE: 110 mm asphalt, over 200 mm granular base, damp, over 630 mm granular subbase, moist		1	SS	50/125mm
0.94	304.04	FILL: Grey silt, some sand, trace gravel, moist		2	SS	37
1.5	303.5	SILTY SAND TILL: Compact to very dense brown silty sand, some gravel, trace clay, moist		3	SS	61
2.3	302.7	becoming grey, saturated		4	SS	7*
				5	SS	25
5.0	300.0	BOREHOLE TERMINATED AT 5.0 m		6	SS	80

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 302.7
Sampler wet at 2.3 m

Upon completion of augering
No cave
Free water at 3.0 m

NOTES * Low N value due to hydraulic disturbance.

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 114

17T 552382E 4808724N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 15, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 304.71					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 180 mm granular base, damp, over 800 mm granular subbase, moist		1A 1B 1C	AS		
1.1	303.6	FILL: Dark brown silty sand, some organics, wood pieces, moist		2	SS	53	304
1.5	303.2	becoming dark grey silty sand, wet		3	SS	18	303
2.3	302.4	SAND: Compact grey sand, some silt, trace gravel, saturated		3	SS	23	302
4.5				5	SS	11	301
5.0	300.2	SILT TILL: Dense grey silt, some sand, trace gravel, trace clay, wet		6	SS	42	300
	299.7	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
37 52 11

▼ El. 303.2

Upon completion of augering
Cave at 2.3 m
Free water at 1.5 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 115

17T 552454E 4808741N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — **BORING DATE** January 16, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 304.57				
0.0		PAVEMENT STRUCTURE: 1150 mm of granular base/subbase, moist		1	SS	50/125mm
1.2	303.4	FILL: Brown silty sand, trace gravel, moist		2	SS	26
1.7	302.9	becoming dark brown, contains organics, rootlets, wet		3	SS	11
2.3	302.3	SAND: Compact brown sand, trace silt, trace gravel, saturated		4	SS	11
3.0	301.6	occasional cobbles		5	SS	12
4.5	300.1	SANDY SILT TILL: Dense grey sandy silt, trace gravel, trace clay, saturated		6	SS	31
5.0	299.6	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 304, 303, 302, 301, 300

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete

Bentonite Seal El. 302.9

3 91 5

Filter Sand Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-16	2.2	302.4
2019-03-28	1.7	302.9

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 116

17T 552511E 4808775N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 16, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 305.35					
0.0	PAVEMENT STRUCTURE: 1400 mm granular base/subbase, moist		1	SS	50/100mm	305
1.0			2	SS	40	
1.4						304
1.7	FILL: Grey silty sand, moist		3	SS	9	
1.9	becoming dark brown, occasional					
2.0	303.5 rootlets, trace clay, contains organics					303
	SAND: Very loose to loose grey sand, trace silt, saturated		4	SS	2	
3.0			5	SS	5	302
4.0						
4.5						301
300.9	becoming compact, trace to some gravel		6	SS	16	
5.0	300.4 BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 303.3
0 94 6
Filter Sand Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-16	2.3	303.1
2019-03-28	2.1	303.3

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 117

17T 552594E 4808789N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — **BORING DATE** January 16, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 306.90					
0.0		PAVEMENT STRUCTURE: 110 mm asphalt, over 170 mm granular base, damp, over 670 mm granular subbase, moist		1A 1B	AS		
0.95	305.95	FILL: Brown sandy silt, trace gravel, moist		2	SS	68	306
1.5							
1.7	305.2	becoming dark brown sandy silt, trace clay, rootlets, contains organics		3	SS	15	305
		SAND: Very loose brown sand, some silt, wet		4	SS	2	
3.0							304
	303.9	becoming compact, trace gravel, occasional cobbles, saturated		5	SS	18	303
5.0				6	SS	20	302
	301.9	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

42 45 13

▼ El. 304.6
Sampler wet from 2.3 m to completion

Upon completion of augering
Wet cave at 3.0 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 118

17T 552668E 4808816N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 18, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.27					
0.0	PAVEMENT STRUCTURE: 100 mm asphalt, over 820 mm granular base/subbase		1A			309
			1B	AS	47	
0.92			2A			
1.0 308.35	SANDY SILT TILL: Dense, to very dense, brown sandy silt, some gravel, moist; occasional cobbles		2B	SS		
			3	SS	51	308
2.0						
			4	SS	40	307
3.0						
			5	SS	52	306
4.0 305.3	becoming saturated					
						305
5.0 304.3	BOREHOLE TERMINATED AT 5.0 m		6	SS	59	
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 119

17T 552738E 4808824N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 310.76					
0.0	PAVEMENT STRUCTURE: 600 mm granular base/subbase, moist		1	AS		
0.60 / 310.16	FILL: Brown silty sand, some gravel, occasional cobbles, moist		2	SS	17	310
1.5 / 309.3	SANDY SILT: Compact brown sandy silt, some gravel, trace clay, moist		3	SS	21	309
2.3 / 308.5	becoming dense to very dense, occasional cobbles		4	SS	41	308
			5	SS	45	307
5.0 / 305.8	BOREHOLE TERMINATED AT 5.0 m		6	SS	72	306

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 120

17T 552810E 4808854N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 29, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 311.73					
0.0		PAVEMENT STRUCTURE: 540 mm granular base/subbase, moist		1	AS		
0.54	311.19	FILL: Brown sandy silt, some gravel, occasional cobbles, moist		2	SS	50/50mm	311
1.0							
				3	SS	11	310
2.0							
2.3	309.4	SAND: Dense brown sand, some gravel, some silt, saturated		4	SS	56	
3.0							309
				5	SS	46	
4.0							308
4.5	307.2	CLAYEY SILT TILL: Hard grey clayey silt, some sand, trace gravel, DTPL		6	SS	57	307
5.0	306.7	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 309.4

Upon completion of augering
Cave at 2.6 m
Free water at 2.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 121

17T 552893E 4808870N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 18, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 311.56					
0.0		PAVEMENT STRUCTURE: 145 mm asphalt, over 1205 mm granular base/subbase		1	AS		311
1.0				2	SS	22	
1.4	310.2	FILL: Compact brown to grey silty sand, trace gravel, moist, occasional topsoil inclusions		3	SS	19	310
2.0							
2.1	309.5	SANDY SILT TILL: Compact brown sandy silt, some gravel, trace clay, moist, occasional cobbles		4	SS	20	309
3.0				5	SS	29	
4.0	307.6	CLAYEY SILT TILL: Hard, grey clayey silt, some sand, trace gravel, DTPL					308
5.0				6	SS	33	307
5.0	306.6	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT — NATURAL MOISTURE CONTENT — LIQUID LIMIT
w_P — w — w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 122

17T 552949E 4808875N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — ***BORING DATE*** January 16, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
	310.42	SURFACE ELEVATION 310.42				
0.0		PAVEMENT STRUCTURE: 870 mm granular base/subbase, moist		1	SS	
0.87	309.55	FILL: Brown clayey silt, some gravel, some sand, moist		2	SS	12
1.5	308.9	becoming brown sand and gravel, trace silt, occasional cobbles, saturated		3	SS	5
2.3	308.1	SAND AND GRAVEL: Compact brown sand and gravel, trace silt, occasional cobbles, saturated		4	SS	33
3.0	307.4	SANDY SILT TILL: Compact brown sandy silt, some gravel, trace clay, occasional cobbles, saturated		5	SS	16
4.5	305.9	becoming very dense, grey		6	SS	85/275mm
5.0	305.4	BOREHOLE TERMINATED AT 5.0 m				

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 310, 309, 308, 307, 306

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

WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

20 36 43

Water Level Readings:

Date	Depth	Elev.
2019-01-16	2.2	308.2
2019-03-28	1.4	309.0

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 123

17T 553028E 4808907N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 31, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 308.02				
0.0		PAVEMENT STRUCTURE: 600 mm granular base/subbase		1	AS	
0.60	307.42	FILL: Compact, brown sand, some silt, trace gravel, moist		2	SS	27
1.4	306.6	loose, wet		3	SS	4
2.1	305.9	grey sandy silt, some clay, trace gravel, wet, occasional rootlets, contains organics		4	SS	6
2.9	305.1	SANDY SILT: Loose to compact grey sandy silt, trace gravel, trace clay, saturated		5	SS	9
5.0	303.0	BOREHOLE TERMINATED AT 5.0 m		6	SS	11

ELEVATION SCALE: 307, 306, 305, 304

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Water Level Readings:

Date	Depth	Elev.
2019-01-31	2.9	305.1
2019-03-28	1.7	306.3

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 124

17T 553107E 4808925N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — **BORING DATE** January 17, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 307.29					
	PAVEMENT STRUCTURE: 120 mm asphalt over, 270 mm granular base over, moist, 600 mm granular subbase, moist		1A, 1B	AS		307
0.99 / 306.30	SILTY SAND: Compact to dense brown silty sand, trace gravel, moist		2A, 2B	SS	45	
1.4 / 305.9	becoming saturated		3	SS	17	306
			4	SS	21	305
			5	SS	13	304
4.7 / 302.6	SANDY SILT TILL: Dense brown sandy silt, some gravel, trace clay, saturated; occasional cobbles		6A, 6B	SS	31	303
5.0 / 302.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 305.9

Upon Completion of Augering
Wet cave at 1.8 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 125

17T 553160E 4808959N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 17, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 307.34					
0.0	PAVEMENT STRUCTURE: 130 mm asphalt, over 270 mm granular base over 540 mm granular subbase, moist		1A	AS		23 62 15
			1B			38 51 11
0.94			2A	SS	46	
306.40	SAND: Dense brown sand, some silt,		2B			
1.4	moist, with occasional topsoil inclusions					
305.9	becoming compact, trace gravel, wet to saturated		3	SS	16	▼ El. 305.8
2.0			4	SS	10	
2.9						
304.4	becoming loose, silty to some silt		5	SS	7	
5.0			6	SS	9	
302.3	BOREHOLE TERMINATED AT 5.0 m					Upon Completion of Augering Free water at 1.5 m Cave to 2.1 m

ELEVATION SCALE: 307, 306, 305, 304, 303

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 126

17T 553234E 4809014N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Lane 2 — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 308.49					
0.0		PAVEMENT STRUCTURE: 145 mm asphalt over 175 mm granular base over, moist, 570 mm granular subbase, moist		1A, 1B	AS		308
0.89	307.60	SAND: Compact brown sand, some silt, moist		2	SS	50/75mm	
1.0				3	SS	21	307
2.0				4	SS	13	306
2.9	305.6	becoming saturated		5	SS	13	305
4.0							304
5.0				6	SS	14	
5.0	303.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 305.6

Upon Completion of Augering
Wet cave to 3.4 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 127

17T 553308E 4809052N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — ***BORING DATE*** January 30, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 309.27				
0.0	PAVEMENT STRUCTURE: 1100 mm of granular base/subbase, moist		1	AS	
1.1			2A	SS	42
308.2	SAND: Compact brown sand, trace silt, moist		2B		
			3	SS	12
			4	SS	11
			5	SS	12
4.0					
305.3	becoming saturated		6	SS	12
5.0					
304.3	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
Filter Sand
0 96 4
Screen El. 305.4

Water Level Readings:

Date	Depth	Elev.
2019-01-30	4.2	305.1
2019-03-28	3.9	305.4

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 128

17T 553371E 4809105N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 17, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 310.39					
0.0		PAVEMENT STRUCTURE: 130 mm asphalt, over 210 mm granular base, moist, over 710 mm granular subbase, moist		1A 1B	AS		310
1.1	309.3	FILL: Dense brown silty sand, some gravel, moist; occasional cobbles		2	SS	45	
1.7	308.7	SANDY SILT TILL: Compact to dense brown sandy silt, some gravel, occasional cobbles, moist		3A 3B	SS	45	309
				4	SS	16	308
				5	SS	31	307
				6	SS	31	306
5.0	305.4	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 129

17T 553435E 4809144N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — ***BORING DATE*** January 17, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 311.22					
	PAVEMENT STRUCTURE: 120 mm asphalt, over 270 mm granular base, moist, over 530 mm granular subbase, moist		1A, 1B	AS		311
0.92 / 310.30	SILTY SAND TILL: Compact to very dense brown sandy silt, some gravel to gravelly, moist, numerous cobbles		2A, 2B	SS	65	310
			3	SS	24	
			4	SS	47	309
			5	SS	47	308
						307
5.0 / 306.2	BOREHOLE TERMINATED AT 5.0 m		6	SS	37	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 130

17T 553496E 4809188N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Maple Grove Road, Westbound Midshoulder
BORING DATE February 1, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 312.10				
0.0		PAVEMENT STRUCTURE: 670 mm granular base/subbase, moist				
0.67	311.43	FILL: Brown sandy silt, some gravel, occasional cobbles, damp		1	SS	48
1.5	310.6	CLAYEY SILT TILL: Very stiff brown clayey silt, trace gravel, trace sand, DTPL		2	SS	21
2.0				3	SS	25
3.0	309.1	SILT TILL: Dense to very dense brown silt, some sand, trace gravel, wet		4	SS	42
5.0	307.1	BOREHOLE TERMINATED AT 5.0 m		5	SS	50/100mm

ELEVATION SCALE: 312, 311, 310, 309, 308

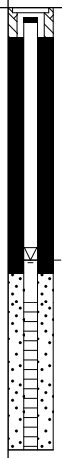
SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL



1 17 82

Upon completion of augering
Wet cave at 4.5 m

Water Level Readings:

Date	Depth	Elev.
2019-02-01	4.0	308.1
2019-03-28	2.6	309.5

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 131

17T 553567E 4809203N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Partly Paved Shoulder — **BORING DATE** February 19, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (m)	ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
0.0		SURFACE ELEVATION 311.68					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 450 mm granular		1A	AS		
0.57	311.11	base/subbase, moist		1B			311
0.57	311.11	FILL: Brown sand, some silt, trace gravel, damp		2	SS	50	
1.0							
1.0				3	SS	20	310
2.0							
2.3	309.4	SAND: Dense brown sand, some silt, trace gravel, occasional to numerous cobbles, moist		4	SS	49	309
3.0				5	SS	50/75mm	
4.0							308
4.5	307.2						
5.0	306.7	SILTY SAND TILL: Very dense brown silty sand, some gravel, occasional cobbles, saturated		6	SS	80/275mm	307
5.0		BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
50 mm Plastic Riser
Bentonite Seal
Filter Sand
Slotted Screen
El. 307.7

21 48 32

Water Level Readings:

Date	Depth	Elev.
2019-02-19	DRY	----
2019-03-28	4.0	307.7

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 132

17T 553638E 4809236N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Right Turn Lane — ***BORING DATE*** February 22, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 310.39					
0.0	PAVEMENT STRUCTURE: 150 mm asphalt, over 200 mm granular base, moist, over 350 mm granular subbase, moist					310
0.70 / 309.69	FILL: Brown sand, some silt, trace gravel, damp		1	SS	63	
1.0						309
			2	SS	25	
2.0						
2.3 / 308.1	SILTY SAND: Compact brown silty sand, trace gravel, occasional cobbles, moist to wet		3	SS	9	308
3.0						
			4	SS	16	307
4.0						
4.5 / 305.9	becoming saturated		5	SS	15	306
5.0 / 305.4	BOREHOLE TERMINATED AT 5.0 m					
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Wet cave at 4.8 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 133

17T 553765E 4809285N

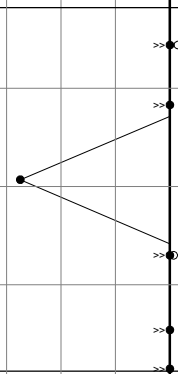
PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Left Turn Lane — **BORING DATE** February 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 306.82					
0.0	PAVEMENT STRUCTURE: 150 mm asphalt, over 210 mm granular base, moist, over 360 mm granular subbase, moist		1	SS	50/25mm	
0.72 / 306.10	FILL: Brown sand and gravel, some silt, occasional cobbles, moist		2	SS	50/125mm	306
1.0			3	SS	45	305
2.0						
2.3 / 304.5	SANDY SILT TILL: Very dense brown sandy silt, some gravel, occasional cobbles, moist		4	SS	50/100mm	304
3.0			5	SS	50/100mm	
3.7 / 303.1	BOREHOLE TERMINATED AT 3.7 m NO FURTHER PROGRESS DUE TO AUGER AND SPLITSPOON REFUSAL IN PROBABLE BOULDER		6	SS	50/50mm	
4.0						
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80



PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering
No cave
No free water

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 134

17T 553808E 4809307N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Lane 2 — **BORING DATE** January 28, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	305.45	SURFACE ELEVATION 305.45					
0.0	305.45	PAVEMENT STRUCTURE: 150 mm asphalt, over 150 mm granular base, moist, over 450 mm granular subbase, moist		1A 1B	AS		305
0.75	304.70	FILL: Brown gravelly sand, some silt, numerous cobbles, damp		2	SS	85/275mm	
1.5	304.0	SAND AND GRAVEL: Very dense brown sand and gravel, trace silt, numerous cobbles, occasional boulders, moist		3	SS	50/75mm	304
2.0				4	SS	50/25mm	303
2.7	302.8	SILTY SAND: Dense to very dense brown silty sand, trace gravel, saturated		5	SS	34	302
4.0	301.5	SANDY SILT TILL: Compact to very dense brown sandy silt, trace gravel, occasional cobbles, moist		6	SS	93/275mm	301
5.0	300.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
Wet cave at 4.0 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 135

17T 553871E 4809318N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Lane 1 — **BORING DATE** January 28, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 303.81					
0.0		PAVEMENT STRUCTURE: 155 mm asphalt, over 225 mm granular base, moist, over 520 mm granular subbase, moist		1A 1B	AS		
0.90	302.91	FILL: Brown sand and gravel, trace silt, moist		2	SS	20	303
1.5	302.3	becoming brown silty sand, some gravel, moist		3	SS	19	302
2.0				4	SS	79/225mm	
3.0	300.8	becoming brown silt, some sand, trace gravel, trace clay, moist		5	SS	20	301
4.1	299.7	SANDY SILT TILL: Compact brown sandy silt, some gravel, occasional cobbles, moist		6	SS	29	300
5.0	298.8	BOREHOLE TERMINATED AT 5.0 m					299

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 136

17T 553957E 4809350N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Lane 2 — ***BORING DATE*** January 28, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 301.46					
0.0 / 301.46	PAVEMENT STRUCTURE: 125 mm asphalt, over 175 mm granular base, moist, over 350 mm granular subbase, moist		1A, 1B	AS		301
0.65 / 300.81	FILL: Brown sand, some gravel, trace silt, occasional cobbles, moist		2	SS	60	
1.5 / 300.0	becoming grey sandy silt, trace clay, trace gravel, moist		3	SS	21	300
2.3 / 299.2	SANDY SILT: Compact brown sandy silt, some gravel, occasional cobbles, moist		4	SS	57	299
			5	SS	26	298
						297
5.0 / 296.5	BOREHOLE TERMINATED AT 5.0 m		6	SS	25	

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 137

17T 553975E 4809370N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Lane 2 — ***BORING DATE*** January 28, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 301.11				
0.0	PAVEMENT STRUCTURE: 100 mm asphalt, over 190 mm granular base, moist, over 610 mm granular subbase, moist		1A / 1B	AS	
0.90 / 300.21	FILL: Brown sand and gravel, trace silt, occasional cobbles, damp		2	SS	59
1.5 / 299.6	becoming silt, some sand, trace gravel		3	SS	35
2.3 / 298.8	becoming sand, some silt, trace gravel, trace clay		4	SS	49
3.0 / 298.1	becoming brown silt, some sand, trace gravel, trace clay, wet		5	SS	21
4.5 / 296.6	SANDY SILT: Compact dark brown sandy silt, trace gravel, organics, wet		6	SS	17
5.0 / 296.1	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 301, 300, 299, 298, 297

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 138

17T 554142E 4809382N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — **BORING DATE** January 28, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES
	SURFACE ELEVATION 301.03				
0.0	PAVEMENT STRUCTURE: 310 mm granular base, moist, over 380 mm granular subbase, moist		1A / 1B	AS	
0.69 / 300.34	SAND: Compact brown sand, some silt, trace gravel, occasional cobbles, moist		2	SS	30
			3	SS	15
2.3 / 298.7	GRAVELLY SAND: Compact to dense brown gravelly sand, some silt, occasional cobbles, saturated		4	SS	24
			5	SS	25
			6	SS	38
5.0 / 296.0	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 300, 299, 298, 297

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

21 69 9

Water Level Readings:

Date	Depth	Elev.
2019-01-28	2.4	298.6
2019-03-28	1.9	299.1

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 139

17T 554218E 4809382N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** February 20, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES
	SURFACE ELEVATION 303.18				
0.0	PAVEMENT STRUCTURE: 160 mm asphalt, over 220 mm granular base, moist, over 520 mm granular subbase, moist		1	AS	
0.90 / 302.28	SAND: Very dense brown sand, some silt, trace gravel, moist		2	SS	79
			3	SS	50/100mm
2.3 / 300.9	SANDY SILT: Dense brown sandy silt, trace gravel, moist		4	SS	55
3.0 / 300.2	SAND: Compact to dense brown sand, some silt, saturated		5	SS	31
5.0 / 298.2	BOREHOLE TERMINATED AT 5.0 m		6	SS	17

ELEVATION SCALE: 303, 302, 301, 300, 299

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 50 100 150 200; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 300.2

Upon completion of augering
Wet cave at 3.0 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 140

17T 554288E 4809359N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Right Turn Lane to Ramp — ***BORING DATE*** February 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 304.20					
0.0 / 304.20	PAVEMENT STRUCTURE: 140 mm asphalt, over 320 mm granular base, moist, over 440 mm granular subbase, moist		1	AS		304
0.90 / 303.30	SILTY SAND: Dense brown silty sand, trace to some gravel, moist		2	SS	44	303
2.3 / 301.9	SAND: Dense brown sand, trace silt, trace gravel, moist		3	SS	36	302
3.0 / 301.2	becoming saturated		4	SS	34	301
4.0 / 300.2	SANDY SILT TILL: Very dense brown sandy silt, some gravel, wet		5	SS	29	300
5.0 / 299.2	BOREHOLE TERMINATED AT 5.0 m		6	SS	84/275mm	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 300.2

Upon completion of augering
No cave
Free water at 4.0 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 141

17T 554370E 4809352N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Left Turn Lane — ***BORING DATE*** February 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH (metres) / ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 303.94			
0.0	PAVEMENT STRUCTURE: 100 mm asphalt, over 200 mm granular base, moist, over 800 mm granular subbase, moist	1	AS	
		2	AS	
		3	AS	
1.1		4	SS	43
302.8	SAND: Compact brown sand, trace silt, trace gravel, occasional silty zones, moist			
		5	SS	36
2.0				
		6	SS	30
3.0				
300.9	becoming wet	7	SS	15
4.0				
4.5				
299.4	SILTY SAND TILL: Dense brown silty sand, trace gravel, trace clay, wet	8	SS	40
5.0				
298.9	BOREHOLE TERMINATED AT 5.0 m			

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●

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

WATER CONTENT (%)

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

29 57 14

34 50 16

El. 299.9

Upon completion of augering
Wet cave at 4.0 m

NOTES

GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 142

17T 554511E 4809329N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Maple Grove Road, Westbound Midlane
BORING DATE February 21, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 302.31					
0.0		PAVEMENT STRUCTURE: 105 mm asphalt, over 165 mm granular base, moist, over 540 mm granular subbase, moist		1	AS		302
0.81	301.50	SANDY SILT: Compact to dense brown sandy silt, some gravel, occasional cobbles, moist		2	SS	22	
1.0				3	SS	46	301
2.0	2.3						
	300.0	GRAVELLY SAND: Dense brown gravelly sand, some silt, occasional cobbles, wet		4	SS	50	300
3.0				5	SS	29	299
4.0	4.5						298
	4.7	becoming grey, occasional boulders		6	SS	50/75mm	
	297.6	BOREHOLE TERMINATED AT 4.65 m					
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 300.0
Sampler wet at 2.3 m

Upon completion of augering
Cave at 3.0 m
Free water at 1.6 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 143

17T 554565E 4809319N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** February 21, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 304.34				
0.0	304.34	PAVEMENT STRUCTURE: 100 mm granular base, moist, over 550 mm granular subbase, moist		1	SS	29
0.65	303.69	SAND: Compact brown sand, some gravel, some silt, moist		2	SS	13
1.0				3	SS	22
2.0				4	SS	56
2.7	301.6	GRAVELLY SAND: Dense brown gravelly sand, some silt, saturated		5	SS	57
3.0						
4.0				6	SS	50/125mm
5.0	299.3	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 304, 303, 302, 301, 300

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
50 mm Plastic Riser
Bentonite Seal
El. 302.5
Filter Sand
32 50 18
Slotted Screen

Water Level Readings:

Date	Depth	Elev.
2019-02-21	4.7	299.6
2019-03-28	1.8	302.5

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 144

17T 554628E 4809302N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — **BORING DATE** February 21, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 307.12				
0.0	307.12	PAVEMENT STRUCTURE: 150 mm granular base, moist, over 450 mm granular subbase, moist		1	SS	50/100mm
0.60	306.52	FILL: Brown sand, trace silt, trace gravel, moist		2	SS	9
1.0				3	SS	6
2.0						
2.3	304.8	SANDY SILT: Compact brown sandy silt, some gravel, wet		4	SS	9
3.0				5	SS	14
4.0				6	SS	28
5.0				7	SS	31
5.0	302.1	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 307, 306, 305, 304, 303

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
50 mm Plastic Riser
Bentonite Seal
Filter Sand
El. 303.8
Slotted Screen

21 40 40

Water Level Readings:

Date	Depth	Elev.
2019-02-21	4.8	302.3
2019-03-28	3.3	303.8

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 145

17T 554647E 4809833N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Centre Median — **BORING DATE** January 30, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
0.0	316.54	SURFACE ELEVATION 316.54				
		PAVEMENT STRUCTURE: 155 mm asphalt over 230 mm granular base over, moist, 640 mm granular subbase, moist		1A, 1B	AS	
1.1				2	SS	35
1.4	315.1	SANDY SILT: Dense brown sandy silt, trace gravel, moist				
		SAND AND GRAVEL: Dense brown sand and gravel, trace silt, damp		3	SS	49
2.1	314.4	SILT: Compact brown silt, some sand, trace gravel, moist to wet		4	SS	18
				4	SS	29
4.0	312.5	becoming saturated				
5.0	311.5			5	SS	21
		BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 316, 315, 314, 313, 312

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
Filter Sand
El. 313.4
Screen

0 1 99

Water Level Readings:

Date	Depth	Elev.
2019-01-30	4.1	312.4
2019-03-28	3.1	313.4

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 146

17T 554612E 4809751N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Northbound Midshoulder — **BORING DATE** January 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 313.83					
0.0	PAVEMENT STRUCTURE: 410 mm granular base, moist, over 330 mm granular subbase, moist		1A	AS		
0.74			1B			
313.09	SAND: Compact brown sand, some silt, trace gravel, moist		2	SS	18	313
1.4						
312.4	SILT: Dense brown silt, some sand, trace clay, moist to wet		3	SS	35	312
2.1						
311.7	becoming compact		4	SS	29	
2.9						311
310.9	becoming saturated		5	SS	28	
						310
5.0			6	SS	21	309
308.8	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
Free water at 4.4 m
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 147

17T 554561E 4809699N

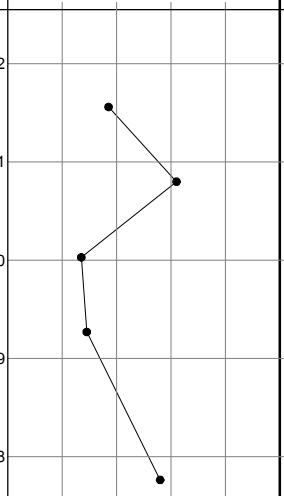
PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Southbound Midshoulder — **BORING DATE** January 24, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

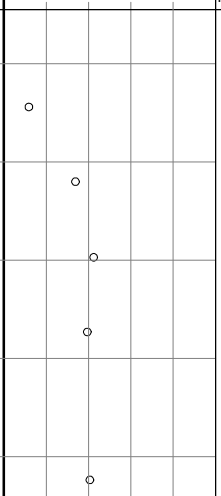
DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 312.55				
0.0	PAVEMENT STRUCTURE: 300 mm granular base, moist, over 420 mm granular subbase, moist				
0.72 / 311.83	SAND: Dense brown sand, some silt, trace gravel, moist		1	SS	37
1.2 / 311.4	SILT: Compact to very dense brown silt, some sand, trace clay, moist to wet		2	SS	62
2.3 / 310.3	becoming saturated		3	SS	27
			4	SS	29
5.0 / 307.6	BOREHOLE TERMINATED AT 5.0 m		5	SS	56

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●



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

WATER CONTENT (%)



UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete

50 mm Plastic Riser

Bentonite Seal

El. 310.8

Filter Sand

1 3 96

Slotted Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-24	3.4	309.2
2019-03-28	1.8	310.8

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 148

17T 554527E 4809623N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 2 — ***BORING DATE*** January 24, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	310.30	SURFACE ELEVATION 310.30					
0.0		PAVEMENT STRUCTURE: 155 mm asphalt, over 285 mm granular base, moist, over 420 mm granular subbase, moist		1	AS		310
0.86	309.44	SAND: Dense to very dense brown sand, some gravel, trace silt, occasional cobbles, moist		2	SS	50/50mm	
1.0							309
				3	SS	37	
2.0	308.3	SANDY SILT TILL: Compact brown sandy silt, trace gravel, trace clay, moist					
				4	SS	42	308
3.0							
				5	SS	24	307
4.0							
4.5	305.8	SAND AND GRAVEL: Dense brown sand and gravel, trace silt, occasional cobbles, saturated		6	SS	37	306
5.0	305.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 306.0

Upon completion of augering
No cave
Free water at 4.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 149

17T 554512E 4809545N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Northbound Midshoulder — **BORING DATE** January 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	307.72	SURFACE ELEVATION 307.72				
0.0	307.72	PAVEMENT STRUCTURE: 280 mm granular base, moist over, 390 mm granular subbase, moist		1A, 1B	AS	
0.67	307.05	SAND: Dense to compact brown sand, some silt, damp		2	SS	41
1.0				3	SS	18
2.1	305.6	SILTY GRAVELLY SAND: Compact brown silty gravelly sand, moist, occasional cobbles		4	SS	21
3.0				5A, 5B	SS	25
3.3	304.4	SANDY SILT TILL: Compact to very dense brown sandy silt, some gravel, trace clay, moist; numerous cobbles		6	SS	96/200 mm
4.9	302.8	BOREHOLE TERMINATED AT 4.9 m				

ELEVATION SCALE: 307, 306, 305, 304, 303

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
28 48 24

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 305.0
Filter Sand
Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-21	DRY	---
2019-03-28	2.7	305.0

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 150

17T 554477E 4809470N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 2 — ***BORING DATE*** January 24, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 305.62					
0.87 / 304.75	PAVEMENT STRUCTURE: 165 mm asphalt, over 375 mm granular base, moist, over 330 mm granular subbase, moist		1A, 1B	AS		305
	SILTY SAND: Compact brown silty sand, trace gravel, moist		2	SS	29	
			3	SS	32	304
2.3 / 303.3	becoming compact, wet		4	SS	11	303
			5	SS	15	
4.0 / 301.6	SANDY SILT TILL: Compact grey sandy silt, trace gravel, trace clay, saturated					302
			6	SS	17	301
5.0 / 300.6	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Wet cave at 3.7 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 151

17T 554442E 4809408N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Left Turn Lane — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 304.18									
0.0		PAVEMENT STRUCTURE: 185 mm asphalt over 195 mm granular base, moist over, 570 mm granular subbase, moist		1A, 1B	AS		304				12 64 24
0.95	303.23	SAND: Compact brown sand, some silt, trace gravel, moist		2A, 2B	SS	35					3 84 14
1.0							303				
2.0				3	SS	19					
2.1	302.1	becoming saturated					302				El. 301.8
				4	SS	12					
2.9	301.3	becoming loose									
3.0				5	SS	8	301				
4.0							300				
5.0				6	SS	7					
5.0	299.2	BOREHOLE TERMINATED AT 5.0 m									Upon Completion of Augering Free water at 2.4 m Cave to 2.4 m
6.0											
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											
14.0											
15.0											

SHEAR STRENGTH (kPa): ┼ FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●

20 40 60 80

PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT

w_P w w_L

WATER CONTENT (%): 10 20 30 40

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 152

17T 554413E 4809298N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 2 — **BORING DATE** January 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 302.00					
	PAVEMENT STRUCTURE: 145 mm asphalt over, 205 mm granular base, moist over, 620 mm granular subbase, moist		1A, 1B	AS		
0.97 / 301.03	SAND: Compact, brown sand, some silt, moist		2A, 2B	SS	45	301
1.4 / 300.6	becoming saturated		3	SS	13	
			4	SS	7	300
			5	SS	7	299
4.0 / 298.0	CLAYEY SILT TILL: Very stiff brown clayey silt, some sand, trace gravel, APL		6	SS	26	298
5.0 / 297.0	BOREHOLE TERMINATED AT 5.0 m					297

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 300.8

Upon Completion of Augering
Wet cave at 1.2 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 153

17T 554385E 4809237N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Left Turn Lane — ***BORING DATE*** January 30, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	301.31	SURFACE ELEVATION 301.31					
0.0	301.31	PAVEMENT STRUCTURE: 155 mm asphalt, over 185 mm granular base, moist, over 410 mm granular subbase, moist		1A, 1B	AS		301
0.75	300.56	SAND: Dense to very dense brown sand, some gravel, trace silt, moist; occasional to numerous cobbles		2	SS	41	
1.0				3	SS	50/100mm	300
2.0	299.3	SANDY SILT TILL: Very dense grey sandy silt, some gravel, moist		4	SS	66	299
3.0				5	SS	71	298
4.0	297.3	becoming saturated					297
5.0	296.3	BOREHOLE TERMINATED AT 5.0 m		6	SS	29	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 298.0

Upon Completion of Augering
Free water at 3.3 m
No cave

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 154

17T 554355E 4809158N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 1 — ***BORING DATE*** January 24, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 300.32			
0.0 / 300.32	PAVEMENT STRUCTURE: 150 mm asphalt, over 220 mm granular base, moist, over 290 mm granular subbase, moist	1A, 1B	AS	
0.66 / 0.90 / 299.42	SAND: Very dense brown sand, some silt, wet to saturated	2	SS	57
	SANDY SILT TILL: Dense brown sandy silt, some gravel, trace clay, moist	3	SS	43
2.3 / 298.0	occasional layers of gravelly sand, numerous cobbles	4	SS	38
3.1 / 297.2	becoming very dense, saturated	5	SS	62/250mm
4.0 / 296.3	becoming grey, numerous cobbles, saturated	6	SS	50/125mm
5.0 / 295.3	BOREHOLE TERMINATED AT 5.0 m			

ELEVATION SCALE: 300, 299, 298, 297, 296

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 298.5

Upon completion of augering
Cave at 3.4 m
Free water at 1.8 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 155

17T 554324E 4809095N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Southbound Midshoulder — **BORING DATE** January 21, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 299.27				
0.0	PAVEMENT STRUCTURE: 80 mm asphalt over, 220 mm granular base, moist, over 400 mm granular subbase, moist		1A, 1B	AS	
0.70 / 298.57	SILTY SAND TILL: Dense to very dense brown silty sand, some gravel, damp, occasional cobbles		2	SS	42
			3	SS	96/275 mm
			4	SS	92/275 mm
2.9 / 296.4	SANDY SILT TILL: Very dense brown sandy silt, some gravel, damp, occasional cobbles		5	SS	50/125mm
4.6 / 294.7	BOREHOLE TERMINATED AT 4.6 m		6	SS	50/125 mm

ELEVATION SCALE: 299, 298, 297, 296, 295

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST ×, ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Water Level Readings:

Date	Depth	Elev.
2019-01-21	DRY	---
2019-03-28	3.5	295.8

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 156

17T 554338E 4809049N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midshoulder — ***BORING DATE*** January 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 298.75					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt over, 200 mm granular base, moist over, 330 mm granular subbase, moist		1A 1B	AS		
0.65	298.10	FILL: Compact brown to grey silt, some sand and gravel, some clay, moist to wet		2	SS	13	298
1.4	297.4	SANDY SILT TILL: Dense to compact sandy silt, some gravel, trace clay, moist, occasional cobbles		3	SS	52	297
2.9				4	SS	14	296
3.0	295.9	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, some sand, trace to some gravel, APL, numerous cobbles		5	SS	16	295
4.9				6	SS	76/250 mm	294
5.0	293.9	BOREHOLE TERMINATED AT 4.9					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 157

17T 554282E 4808939N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 2 — ***BORING DATE*** January 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 297.30					
0.0	PAVEMENT STRUCTURE: 140 mm asphalt over, 190 mm granular base, moist, over 420 mm granular subbase, moist		1A / 1B	AS		297
0.75 / 296.55	SAND: Very dense brown sand, some silt, trace gravel, damp; layered		2	SS	61	
1.4 / 295.9	CLAYEY SILT: Very stiff brown clayey silt, some sand, trace gravel, APL		3	SS	14	296
2.1 / 295.2	SANDY SILT: Compact brown sandy silt, trace clay, moist		4	SS	26	295
3.8 / 293.5	SANDY SILT TILL: Dense brown sandy silt, some gravel, trace clay, moist; numerous cobbles		5	SS	41	294
4.6 / 292.7	BOREHOLE TERMINATED AT 4.6 m		6	SS	50/125mm	293

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 158

17T 554277E 4808864N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 2 — ***BORING DATE*** January 22, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	296.31	SURFACE ELEVATION 296.31					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt over, 140 mm granular base, moist, over 840 mm granular subbase, moist		1A			296
				1B	AS		
1.0				2	SS	39	
1.1	295.2	SANDY SILT TILL: Dense grey sandy silt, trace to some clay, wet to saturated					295
1.7	294.6	becoming moist		3A	SS	53	
2.0				3B			
2.1	294.2	with layers of sand and gravel, sand seams, and occasional clayey silt seams		4	SS	68	294
3.0				5A	SS	57	
				5B			293
4.0							292
4.7	291.6	BOREHOLE TERMINATED AT 4.7 m		6	SS	50/75mm	
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT — NATURAL MOISTURE CONTENT — LIQUID LIMIT
w_P — w — w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
Cave to 4.2 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 159

17T 554252E 4808828N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 1 — ***BORING DATE*** January 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 295.80					
0.0	PAVEMENT STRUCTURE: 160 mm asphalt over, 170 mm granular base, moist, over 870 mm granular subbase, moist		1A	AS		
			1B			
1.0			2	SS	41	295
1.2 / 294.6	SANDY SILT TILL: Very dense brown sandy silt, some gravel, moist; numerous cobbles					
			3	SS	50/75 mm	
2.0						294
			4	SS	50/150mm	
2.9 / 292.9	occasional clayey lenses					293
3.0			5	SS	89	
4.0						292
4.8 / 291.0	BOREHOLE TERMINATED AT 4.8 m		6	SS	50/125mm	
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 160

17T 554228E 4808724N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 1 — ***BORING DATE*** January 22, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 294.43								
0.0	PAVEMENT STRUCTURE: 135 mm asphalt over, 205 mm granular base, moist, over 960 mm granular subbase, moist		1A	AS		294			17 68 14
			1B						14 65 22
1.0			2	SS	67				
1.3									
293.1	SAND: Very dense brown sand, some silt and gravel, damp; numerous cobbles		3	SS	50/50mm	293			
2.0									
292.4	SANDY SILT TILL: Very dense sandy silt, some gravel, damp; numerous cobbles		4	SS	50/125mm	292			
3.0			5	SS	50/125 mm				El. 291.1
3.8						291			
290.6	becoming saturated								
4.0									
4.6			6	SS	50/125 mm	290			
289.8	BOREHOLE TERMINATED AT 4.6 m								Upon Completion of Augering Free water at 3.3 m Cave to 3.9 m
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									
14.0									
15.0									

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30 40

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 161

17T 554189E 4808653N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Southbound Midshoulder — **BORING DATE** January 24, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 293.35					
0.0		PAVEMENT STRUCTURE: 90 mm asphalt, over 280 mm granular base, moist, over 300 mm granular subbase, moist		1A, 1B	AS		293
0.67	292.68	SAND: Dense brown sand, some silt, trace gravel, damp		2	SS	46	
1.0							292
1.4	292.0	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, trace sand, moist		3	SS	28	
2.0				4	SS	40	291
3.0				5	SS	82	290
4.0							
4.5	288.9	SAND: Very dense brown sand, some silt, trace gravel, trace clay, saturated		6	SS	60	289
5.0	288.4	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
50 mm Plastic Riser
Bentonite Seal
Filter Sand
0 4 96
Slotted Screen
El. 289.0

Water Level Readings:

Date	Depth	Elev.
2019-01-24	DRY	----
2019-03-28	4.4	289.0

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 162

17T 554186E 4808575N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 2 — ***BORING DATE*** January 22, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES
	SURFACE ELEVATION 292.36				
	PAVEMENT STRUCTURE: 155 mm asphalt over, 185 mm granular base, moist, over, 570 mm granular subbase, moist		1A, 1B	AS	
0.91 / 291.45	FILL: Brown silt, some sand, trace clay, trace gravel, occasional cobbles, moist		2A, 2B	SS	36
			3	SS	86/200mm
			4	SS	37
			5	SS	27
4.0 / 288.4	SILTY SAND TILL: Very dense brown silty sand, some gravel, saturated; occasional cobbles		6	SS	86/275mm
4.9 / 287.5	BOREHOLE TERMINATED AT 4.9 m				

ELEVATION SCALE: 292, 291, 290, 289, 288

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 288.0

Upon Completion of Augering
Free water at 4.4 m
No cave

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 163

17T 554154E 4808516N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 1 — ***BORING DATE*** January 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 291.54					
	PAVEMENT STRUCTURE: 160 mm asphalt over, 180 mm granular base, moist, over, 580 mm granular subbase, moist		1A, 1B	AS		291
0.92 / 290.62	FILL: Brown sandy silt, some gravel, trace clay, moist, numerous cobbles		2A, 2B	SS	34	
			3	SS	18	290
			4	SS	14	289
			5	SS	24	
						288
			6	SS	37	287
5.0 / 286.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 164

17T 554142E 4808425N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Hespeler Road, Northbound Midshoulder
BORING DATE January 22, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	290.24	SURFACE ELEVATION 290.24				
0.0		PAVEMENT STRUCTURE: 160 mm asphalt over, 180 mm granular base, moist, over, 560 mm granular subbase, moist		1A 1B	AS	
0.90	289.34	FILL: Brown silt, some sand, trace clay, trace gravel, moist		2A 2B	SS	23
1.0				3	SS	43
2.1	288.1	becoming brown sandy silt, trace gravel, trace clay, moist		4	SS	13
3.0				5	SS	19
4.0				6	SS	30
5.0	285.2	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 290, 289, 288, 287, 286

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
Filter Sand
5 35 59
Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-22	DRY	----
2019-03-28	DRY	----

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 165

17T 550721E 4808136N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Southbound Midlane, Lane 2 — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 308.24					308
0.0		PAVEMENT STRUCTURE: 140 mm asphalt, over 160 mm granular base, moist, over 320 mm granular subbase, moist					
0.62	307.62	SANDY SILT TILL: Compact to very dense brown sandy silt, some gravel, trace clay, moist		1	SS	24	307
1.0							
2.0				2	SS	77	306
3.0				3	SS	50/125mm	
3.0	305.2	becoming grey		4	SS	79	305
4.0							304
5.0				5	SS	50/125mm	
5.0	303.2	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 166

17T 550716E 4808200N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Northbound Midlane, Left Turn Lane — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 309.65					
0.0		PAVEMENT STRUCTURE: 130 mm asphalt, over 230 mm granular base, moist, over 490 mm granular subbase, moist		1A 1B	AS		
0.85	308.80	FILL: Brown silt, some sand, trace clay, trace gravel, occasional cobbles, wet		2	SS	29	309
1.5	308.2	SANDY SILT TILL: Very dense brown sandy silt, some gravel, trace clay, numerous cobbles, moist		3	SS	76	308
				4	SS	50/125mm	307
				5	SS	50/125mm	306
5.0	304.7	BOREHOLE TERMINATED AT 5.0 m		6	SS	50/150mm	305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT — NATURAL MOISTURE CONTENT — LIQUID LIMIT
w_P — w — w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
20 62 18

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 167

17T 550680E 4808294N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Southbound Midshoulder — ***BORING DATE*** February 1, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 309.81				
0.0		PAVEMENT STRUCTURE: 650 mm granular base/subbase, moist				
0.65	309.16	FILL: Brown clayey silt, some sand, trace gravel, moist		1	SS	21
1.0						
				2	SS	46
2.0						
2.3	307.5	SANDY SILT TILL: Very dense brown sandy silt, some gravel, moist		3	SS	84
3.0						
				4	SS	50/100mm
4.0						
5.0				5	SS	50/125mm
5.0	304.8	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 168

17T 550672E 4808368N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Northbound Midlane — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 310.24				
0.0	PAVEMENT STRUCTURE: 145 mm asphalt over 155 mm granular base, moist, over, 300 mm granular subbase, moist		1A / 1B	AS	
0.60 / 309.64	FILL: Brown silty sand, some gravel, moist; occasional cobbles		2	SS	26
1.4 / 308.8	becoming clayey silt, some sand, trace gravel, occasional organic inclusions, wet		3	SS	12
2.1 / 308.1	SANDY SILT TILL: Dense to very dense brown sandy silt, some gravel, moist to wet, occasional cobbles		4	SS	36
			5	SS	63
4.9			6	SS	92/250 mm
305.3	BOREHOLE TERMINATED AT 4.9 m				

ELEVATION SCALE: 310, 309, 308, 307, 306

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 50 100 150 200; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 169

17T 550649E 4808437N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Southbound Midlane — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	310.51	SURFACE ELEVATION 310.51				
0.0	310.51	PAVEMENT STRUCTURE: 150 mm asphalt over 160 mm granular base, moist, over, 400 mm granular subbase, moist		1A 1B	AS	
0.71	309.80	FILL: Brown sand and gravel, some silt, moist		2	SS	29
1.4	309.1	CLAYEY SILT TILL: Very stiff brown clayey silt, some sand, trace gravel, DTPL		3	SS	16
2.1	308.4	SANDY SILT TILL: Very dense brown sandy silt, some gravel, moist to wet, occasional saturated layers, occasional cobbles		4	SS	21
				5	SS	52
4.7	305.8	BOREHOLE TERMINATED AT 4.7m		6	SS	50/50mm

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 310, 309, 308, 307, 306

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 308.1

Upon Completion of Augering
Free water at 2.4 m
Cave to 3.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 170

17T 551476E 4808203N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Boxwood Drive, Southbound Midshoulder — **BORING DATE** January 25, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 309.28				
0.0		PAVEMENT STRUCTURE: 660 mm granular base/subbase, moist		1A	AS	
				1B		
0.66	308.62	FILL: Dark grey sandy silt, trace gravel, trace clay, organic inclusions, moist		2	SS	28
1.0						
1.5	307.8	SANDY SILT TILL: Dense to very dense brown sandy silt, some gravel, trace clay, occasional cobbles, moist		3	SS	12
2.0				4	SS	20
3.0						
3.0	306.3	becoming saturated		5	SS	44
4.0						
5.0				6	SS	74
5.0	304.3	BOREHOLE TERMINATED AT 5.0 m				
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 305.0

Upon completion of augering
No cave
Free water at 4.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 171

17T 551459E 4808317N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Boxwood Drive, Northbound Midlane — **BORING DATE** January 25, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 312.27				
0.0	PAVEMENT STRUCTURE: 135 mm asphalt, over 595 mm granular base/subbase, moist		1	AS	
0.73 / 311.54	FILL: Brown sandy silt, some gravel, trace clay, occasional cobbles, moist		2	SS	18
1.5 / 310.8	CLAYEY SILT TILL: Very stiff brown clayey silt, some sand, some gravel, APL		3	SS	19
			4	SS	44
3.0 / 309.3	SANDY SILT: Dense brown sandy silt, some gravel, trace clay, occasional cobbles, moist to wet		5	SS	40
4.5 / 307.8	SILT TILL: Very dense brown silt, some sand, trace gravel, saturated		6	SS	61
5.0 / 307.3	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 312, 311, 310, 309, 308

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 307.6

Upon completion of augering
No cave
Free water at 4.7 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 172

17T 551412E 4808458N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Boxwood Drive, Southbound Midlane — ***BORING DATE*** January 25, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 312.78					
0.0		PAVEMENT STRUCTURE: 145 mm asphalt, over 155 mm granular base, moist, over 340 mm granular base, moist		1	AS		
0.64	312.14	FILL: Brown silty sand, moist		2	SS	7	312
1.0				3	SS	7	
2.0							311
2.2	310.6	SANDY SILT TILL: Compact brown sandy silt, some gravel, occasional cobbles, saturated		4	SS	50/125mm	
3.0							310
3.0	309.8	CLAYEY SILT TILL: Very stiff to hard grey clayey silt, some sand, trace gravel, DTPL		5	SS	46	
4.0							309
5.0				6	SS	49	308
5.0	307.8	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 309.4

Upon completion of augering
No cave
Free water at 3.4 m due to seepage from above.

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 173

17T 551399E 4808545N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Boxwood Drive, Northbound Midlane — ***BORING DATE*** January 25, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 311.79					
0.0		PAVEMENT STRUCTURE: 150 mm asphalt, over 80 mm granular base, moist, over 420 mm granular subbase, moist		1A 1B	AS		
0.65	311.14	FILL: Brown sandy silt, some gravel, occasional cobbles, moist		2	SS	20	311
1.4	310.4	SANDY SILT TILL: Compact brown sandy silt, trace gravel, trace clay, moist		3	SS	14	310
2.3	309.5	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, some sand, trace gravel, occasional cobbles, DTPL		4	SS	25	309
3.0	308.8	becoming hard, grey		5	SS	51	308
5.0	306.8	BOREHOLE TERMINATED AT 5.0 m		6	SS	38	307

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 174

17T 551375E 4808622N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Boxwood Drive, Southbound Midlane — ***BORING DATE*** January 25, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 310.72					
0.0 / 310.72	PAVEMENT STRUCTURE: 140 mm asphalt, over 140 mm granular base, moist, over 400 mm granular subbase, moist		1A, 1B	AS		310
0.68 / 310.04	FILL: Brown silt, some sand, trace gravel, trace clay, moist		2	SS	6	
			3	SS	8	309
2.3 / 308.4	SILT TILL: Compact to dense brown silt, some sand, trace gravel, trace clay, moist		4	SS	14	308
3.2 / 307.5	SANDY SILT TILL: Very dense grey sandy silt, some gravel, trace clay, occasional cobbles, moist		5	SS	32	307
5.0 / 305.7	BOREHOLE TERMINATED AT 5.0 m		6	SS	98/250mm	306

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

23 67 10

14 69 18

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 175

17T 552295E 4808216N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Southbound Midlane — ***BORING DATE*** February 20, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
0.0	310.45	SURFACE ELEVATION 310.45				
		PAVEMENT STRUCTURE: 60 mm asphalt, over 180 mm granular base, moist, over 860 mm granular subbase, moist		1	AS	
1.1	309.4	FILL: Brown sand, trace silt, trace gravel, moist		2	SS	50/100mm
1.6	308.9	SAND: Compact brown sand, some gravel, trace silt, moist		3	SS	12
				4	SS	17
				5	SS	16
4.5	306.0	becoming saturated		6	SS	12
5.0	305.5	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 310, 309, 308, 307, 306

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 306.2

Upon completion of augering
Wet cave at 4.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 176

17T 552274E 4808325N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Northbound Midshoulder — ***BORING DATE*** February 19, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.86					
0.0	PAVEMENT STRUCTURE: 45 mm asphalt, over 375 mm granular base, moist, over 480 mm granular subbase, moist		1A 1B	AS		
0.90 308.96	FILL: Brown sand, some gravel, trace silt, occasional cobbles, moist		2	SS	11	309
1.3 308.6	SAND: Compact brown sand, trace gravel, trace silt, moist		3	SS	20	308
			4	SS	16	
			5	SS	13	307
3.6 306.3	becoming wet					306
4.5 305.4	becoming saturated		6	SS	14	305
5.0 304.9	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 305.4

Upon completion of augering
Wet cave at 4.5 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 177

17T 552256E 4808372N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Speedsville Road, Southbound Midshoulder — **BORING DATE** February 19, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
0.0	309.27	SURFACE ELEVATION 309.27					309
		PAVEMENT STRUCTURE: 150 mm asphalt, over 370 mm granular base/subbase, moist		1	AS		
0.52	308.75	FILL: Brown sand, some gravel, some silt, moist		2	SS	16	308
1.00	308.27	SAND: Very loose to compact brown sand, some silt, trace gravel, moist		3	SS	5	
				4	SS	9	307
				5	SS	3	306
4.5	304.8	becoming dense, saturated		6	SS	34	305
5.0	304.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Cave at 4.0 m
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 178

17T 552241E 4808458N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Speedsville Road, Northbound Midlane
BORING DATE February 19, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 307.42					
0.69	PAVEMENT STRUCTURE: 75 mm asphalt, over 615 mm granular base/subbase, moist		1	AS		
0.90	FILL: Brown sand, some gravel, some silt, damp		2	SS	13	
1.2 306.2	becoming dark brown to black sandy silt, trace gravel, organics, wet					
	SAND: Compact brown sand, some silt, trace gravel, saturated		3	SS	15	
			4	SS	22	
3.0 304.4	SANDY SILT TILL: Very dense grey sandy silt, some gravel, trace clay, occasional cobbles, moist		5	SS	89	
5.0 302.4	BOREHOLE TERMINATED AT 5.0 m		6	SS	80	

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Sampler wet at 1.5 m
▼ El. 305.3

Upon completion of augering
Cave at 2.4 m
Free water at 2.1 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 179

17T 552216E 4808535N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Southbound Midlane — ***BORING DATE*** January 15, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 306.38				
0.0		PAVEMENT STRUCTURE: 60 mm asphalt, over 420 mm granular base/subbase, moist		1	SS	47
0.48	305.90	FILL: Brown sand, some silt, trace gravel, wet		2	SS	7
1.5						
1.7	304.7	SAND: Loose brown sand, some silt, trace gravel, wet to saturated		3	SS	13
		CLAYEY SILT: Very stiff to hard grey clayey silt, some sand, trace gravel, APL to DTPL		4	SS	26
				5	SS	31
5.0	301.4	BOREHOLE TERMINATED AT 5.0 m		6	SS	74/275mm

ELEVATION SCALE: 306, 305, 304, 303, 302

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 304.9

Upon completion of augering
Cave at 1.8 m
Free water at 1.5 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 180

17T 552212E 4808581N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Speedsville Road, Northbound Midshoulder — **BORING DATE** February 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 305.83					
0.48 / 305.35	PAVEMENT STRUCTURE: 65 mm asphalt, over 410 mm granular base/subbase, moist					
1.5	FILL: Brown silty sand, trace gravel, moist to wet		1	SS	21	
304.3	SANDY SILT: Loose to compact brown sandy silt, some gravel, wet		2	SS	13	
3.0			3	SS	7	
302.8	SANDY SILT TILL: Dense to very dense brown sandy silt		4	SS	32	
5.0			5	SS	50/100mm	
300.8	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 303.7

Upon completion of augering
Wet cave at 2.1 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 181

17T 552163E 4808772N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Northbound Midlane — ***BORING DATE*** January 15, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 305.99					
0.0		PAVEMENT STRUCTURE: 50 mm asphalt, over 570 mm granular base/subbase, moist		1	SS	50/150mm	
0.62	305.37	FILL: Grey silty sand, trace gravel, trace organics, rootlets, wet		2	SS	18	305
1.0							
1.5	304.5	SANDY SILT: Compact brown and grey mottled sandy silt, trace gravel, trace clay, wet, occasional clayey silt lenses		3	SS	13	304
2.0							
2.3		becoming saturated		4	SS	15	
	303.6	SAND: Compact brown sand, some silt, trace gravel, occasional cobbles, saturated					303
3.0				5	SS	20	
4.0							302
4.6	301.4	SILTY SAND TILL: Dense grey silty sand, some gravel, numerous cobbles, saturated		6	SS	49	
5.0	301.0	BOREHOLE TERMINATED AT 5.0 m					301
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 303.7
Sampler wet from 2.3 m to completion

Upon completion of augering
Cave at 4.3 m
Free water at 4.0 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 182

17T 552142E 4808842N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Southbound Midlane — ***BORING DATE*** January 18, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 306.92					
0.0		PAVEMENT STRUCTURE: 45 mm asphalt over, 495 mm granular base/subbase, moist		1A	AS		
0.54				1B			
0.75	306.17	FILL: Grey sand, some silt, trace gravel, moist		2	SS	24	306
1.0		SILTY SAND: Compact brown silty sand, trace gravel, moist					
1.4	305.5	SILT: Compact brown silt, some sand, trace clay and gravel, wet		3	SS	18	305
2.0							
2.1	304.8	SANDY SILT TILL: Compact to dense brown sandy silt, some gravel, wet; occasional cobbles, occasional gravel layers		4	SS	29	
3.0				5	SS	49	304
4.0	302.9	CLAYEY SILT TILL: Very stiff grey clayey silt, some sand, APL					303
5.0				6	SS	23	302
5.0	301.9	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 183

17T 552127E 4808922N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Northbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 307.66					
0.0		PAVEMENT STRUCTURE: 50 mm asphalt over 250 mm granular base, moist, over, 450 mm granular subbase, moist		1A, 1B	AS		307
0.75	306.91	FILL: Compact brown sand and gravel, trace silt, moist, occasional cobbles		2	SS	23	
1.0							
1.4	306.3	compact dark grey sand, some silt, saturated, occasional rootlets, occasional organic inclusions		3A, 3B	SS	13	306
1.9	305.8	SAND: Compact brown sand, some silt, trace gravel, saturated		4	SS	20	
2.0							305
3.0				5	SS	13	
4.0							304
4.0	303.7	SANDY SILT TILL: Compact grey sandy silt, some clay, trace gravel, saturated		6	SS	17	303
5.0							
5.0	302.7	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 305.9

Upon Completion of Augering
Free water at 1.8 m
Cave to 2.1 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 184

17T 552110E 4808973N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Speedsville Road, Southbound Midlane — **BORING DATE** January 18, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 308.16					308
0.0	PAVEMENT STRUCTURE: 95 mm asphalt over, 215 mm granular base, moist, over 390 mm granular subbase, moist		1A, 1B	AS		
0.70						
0.95	FILL: Compact brown sand, some gravel, trace silt, moist, occasional organic inclusions		2A, 2B	SS	21	
307.21						307
1.4						
306.8	TOPSOIL: Compact dark brown silty sand, moist; occasional rootlets		3	SS	5	
	SAND: Loose to compact brown sand, some silt, saturated		4	SS	10	306
			5	SS	11	305
4.0						
304.2	SANDY SILT TILL: Compact grey sandy silt, trace gravel, saturated		6	SS	29	304
5.0						
303.2	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
33 51 16
37 47 16

▼ El. 306.7

Upon Completion of Augering
Free water at 1.5 m
Cave at 2.7 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 185

17T 552093E 4809065N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Northbound Partly Paved Shoulder — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES
	SURFACE ELEVATION 309.59				
0.31 / 309.28	PAVEMENT STRUCTURE: 45 mm asphalt over 265 mm granular base/subbase, moist		1A / 1B	AS	
0.70 / 308.89	FILL: Dark grey clayey silt fill, some sand, trace gravel, wet, occasional organics		2	SS	12
1.4 / 308.2	SILTY SAND: Compact brown silty sand, saturated				
	SAND AND GRAVEL: Dense brown sand and gravel, trace silt, saturated		3	SS	33
2.1 / 307.5	SANDY SILT TILL: Dense brown sandy silt, some grave, trace clay, moist to wet, occasional cobbles		4	SS	44
2.9 / 306.7	becoming grey		5	SS	38
4.0 / 305.6	becoming very dense				
4.7 / 304.9	BOREHOLE TERMINATED AT 4.7 m		6	SS	50/75 mm

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 308.4

Upon Completion of Augering
Free water at 1.2 m
Cave to 1.2 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 186

17T 552887E 4808649N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Briardean Road, Southbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 310.46					
0.24 310.22	PAVEMENT STRUCTURE: 60 mm asphalt, over 180 mm granular base/subbase, moist		1A 1B	AS		310
	SAND: Compact brown sand, some silt, moist to damp		2	SS	17	
			3	SS	10	309
			4	SS	11	308
			5	SS	16	
4.0 306.5	SANDY SILT TILL: Dense brown sandy silt, some gravel, trace clay, saturated					307
			6	SS	36	306
5.0 305.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

17 66 17

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 187

17T 552882E 4808695N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Briardean Road, Northbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 312.13					312
0.28 / 311.85	PAVEMENT STRUCTURE: 45 mm asphalt, over 70 mm granular base/subbase, moist		1A, 1B	AS		
0.65 / 311.48	FILL: Dark brown sandy silt, trace organics, moist		2	SS	12	311
	brown sand, some gravel, trace silt, moist					
	SAND: Compact, brown sand, some silt, moist		3	SS	14	
			4	SS	14	310
			5	SS	15	309
4.0 / 308.1	SANDY SILT TILL: Compact brown sandy silt, some gravel, moist, occasional cobbles		6	SS	27	308
5.0 / 307.1	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 188

17T 552866E 4808764N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Briardean Road, Southbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 312.92					
0.28	PAVEMENT STRUCTURE: 105 mm asphalt, moist, over 175 mm granular base/subbase, moist		1A, 1B, 1C	AS		
0.55 / 312.37	FILL: Dark grey clayey silt, some sand, wet, occasional organics becoming brown sandy silt, trace to some gravel, some clay, moist, occasional cobbles		2	SS	10	312
			3	SS	11	311
2.1 / 310.8	SANDY SILT TILL: Dense to very dense brown sandy silt, some sand, trace gravel, saturated		4	SS	18	310
			5	SS	36	309
			6	SS	73	308
5.0 / 307.9	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 308.7

Upon Completion of Augering
Free water at 4.2 m
No cave

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 189

17T 552859E 4808807N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Briardean Road, Northbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 312.61					
0.29 / 312.32	PAVEMENT STRUCTURE: 85 mm asphalt, over 205 mm granular base/subbase, moist		1A / 1B	AS		312
0.65 / 311.96	FILL: Brown clayey silt, some sand, trace gravel, wet		2	SS	7	
	becoming brown sandy silt, some clay, trace gravel, wet, occasional cobbles		3	SS	9	311
2.1 / 310.5	SANDY SILT TILL: Dense to very dense sandy silt, some gravel, moist, numerous cobbles		4	SS	39	310
			5	SS	77/175mm	309
4.8 / 307.8	BOREHOLE TERMINATED AT 4.8 m		6	SS	82/275mm	308

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

26 61 12

Upon Completion of Augering
Free water at 4.2 m
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 190

17T 553783E 4808922N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Breaverdale Road, Northbound Midlane — **BORING DATE** January 17, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 311.74						SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER O Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80; PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30 40		
0.0	PAVEMENT STRUCTURE: 170 mm asphalt, over 160 mm granular base, moist, over 870 mm granular subbase, moist		1A	AS					
			1B						
1.0			2	SS	24	311			
1.2									
310.5	SILTY SAND: Compact brown silty sand, some gravel, moist; occasional cobbles								
2.0			3	SS	11	310			
			4	SS	11				
2.9						309			
308.8	SAND AND GRAVEL: Compact to dense brown sand and gravel, trace silt, moist; numerous cobbles								
3.0			5	SS	23				
4.0						308			
			6	SS	35	307			
5.0									
5.0									
306.7	BOREHOLE TERMINATED AT 5.0 m								Upon Completion of Augering No free water No cave
6.0									
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									
14.0									
15.0									

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 191

17T 553761E 4808997N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Southbound Midlane — ***BORING DATE*** January 17, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 313.43					
0.0		PAVEMENT STRUCTURE: 160 mm asphalt, over 270 mm granular base, moist, over 220 mm granular subbase, moist		1A 1B	AS		313
0.65	312.78	SANDY SILT: Compact brown sandy silt, some gravel, trace clay, moist, occasional cobbles		2	SS	15	
1.4	312.0	SAND AND GRAVEL: Dense brown sand and gravel, trace silt, moist to damp; numerous cobbles		3	SS	36	312
2.1	311.3	becoming very dense		4	SS	79	311
3.0				5	SS	50/275mm	
4.0							310
4.7				6A 6B	SS	76	309
5.0	308.4	SILT TILL: Very dense brown silt, some sand, moist BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
31 62 7
23 44 33

Upon Completion of Augering
No free water
Cave to 3.6 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 192

17T 553749E 4809064N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Northbound Midlane — ***BORING DATE*** January 18, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 312.60					
0.0		PAVEMENT STRUCTURE: 155 mm asphalt, over 145 mm granular base, moist, over 310 mm granular subbase, moist		1A 1B	AS		312
0.61	311.99	FILL: Brown sand, trace silt, trace gravel, moist; occasional coal fragments		2	SS	8	
1.0				3	SS	13	311
2.1	310.5	SAND: Compact brown sand, some silt, some gravel, damp, occasional cobbles		4	SS	20	
2.0							310
2.9	309.7	SANDY SILT: Dense brown sandy silt, some gravel, trace clay, moist, occasional cobbles		5A 5B	SS	36	
3.0							309
3.2	309.4	SAND: Dense brown sand, some silt, trace gravel, damp					
4.0	308.6	SANDY SILT TILL: Very dense brown sandy silt, trace gravel, moist		6	SS	62	308
5.0							
5.0	307.6	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 193

17T 553723E 4809147N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Breaverdale Road, Southbound Midlane — **BORING DATE** January 18, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 309.84									
0.0		PAVEMENT STRUCTURE: 190 mm asphalt over, 270 mm granular base, moist, over, 740 mm granular subbase, moist		1A	AS						
				1B							
				2	SS	50/50mm	309				
1.0											
1.2	308.6	SILTY SAND: Loose brown silty sand, trace gravel, damp		3	SS	6	308				
2.0											
				4	SS	7					
2.9	306.9	SAND AND GRAVEL: Compact brown sand and gravel, some silt, saturated, occasional cobbles					307				
3.0				5	SS	19					
4.0	305.8	SANDY SILT TILL: Dense brown sandy silt, trace gravel, saturated					306				
				6	SS	33	305				
5.0	304.8	BOREHOLE TERMINATED AT 5.0 m									Upon Completion of Augering Free water at 3.3 m No cave
6.0											
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											
14.0											
15.0											

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; 50 100 150 200; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%): 10 20 30 40

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 194

17T 553711E 4809208N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Northbound Midlane, Left Turn Lane — ***BORING DATE*** February 1, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 308.39					
0.0	PAVEMENT STRUCTURE: 165 mm asphalt, over 280 mm granular base, moist, over 500 mm granular subbase, moist		1	SS	50/75mm	308
0.95 / 307.44	FILL: Brown sand, some silt, trace gravel, moist		2	SS	74	
1.5 / 306.9	SILTY SAND: Loose dark brown silty sand, some gravel, damp		3	SS	8	307
2.3 / 306.1	SAND: Compact brown sand, some silt, trace gravel, wet		4	SS	25	306
			5	SS	29	
3.8 / 304.6	becoming saturated		6	SS	14	305
5.0			7	SS	19	304
303.4	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 304.7

Upon completion of augering
Wet cave at 3.7 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 195

17T 553688E 4809303N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Breaverdale Road, Southbound Midlane, Left Turn Lane — **BORING DATE** February 1, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.71					
0.0	PAVEMENT STRUCTURE: 255 mm asphalt, over 435 mm granular base, moist, over 510 mm granular subbase, moist		1	SS	50/100mm	
			2	SS	8	309
1.2						
1.5	FILL: Brown sand, some silt, trace gravel, moist					
308.2	SILTY SAND: Compact dark brown silty sand, moist		3	SS	18	308
2.3						
307.4	GRAVELLY SAND: Compact brown gravelly sand, some silt, moist		4	SS	12	307
			5	SS	17	
3.8						306
305.9	SILTY SAND TILL: Compact brown silty sand, wet		6	SS	23	
			7	SS	24	305
5.0						
304.7	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 306.0

Upon completion of augering
Cave at 3.7 m
No free water

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 196

17T 553680E 4809349N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Northbound Midlane — ***BORING DATE*** January 16, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	310.23	SURFACE ELEVATION 310.23					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 220 mm granular base, moist, over 400 mm granular subbase, moist		1A 1B	AS		310
0.74	309.49	SANDY SILT TILL: Compact brown sandy silt, some gravel, trace clay, wet		2	SS	17	309
1.5	308.7	becoming dense, saturated		3	SS	37	308
				4	SS	39	
				5	SS	44	307
							306
5.0	305.2	BOREHOLE TERMINATED AT 5.0 m		6	SS	47	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 197

17T 553654E 4809437N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Southbound Midlane — ***BORING DATE*** January 16, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.27					
0.0	PAVEMENT STRUCTURE: 130 mm asphalt, over 350 mm granular base, moist, over 490 mm granular subbase, moist		1A 1B	SS		309
0.97 308.2	FILL: Brown sand, some gravel, some silt, occasional cobbles, moist		2A 2B	SS	21	
	becoming dark grey sandy silt, trace gravel, organics, wet		3	SS	7	308
2.3 307.0	SANDY SILT: Loose brown sandy silt, some gravel, trace clay, wet		4	SS	11	307
3.0 306.3	becoming saturated		5	SS	3*	306
4.5 304.8	SILT TILL: Dense grey silt, some sand, trace gravel, trace clay, saturated		6	SS	40	305
5.0 304.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Sampler wet from 2.3 m to completion

▼ El. 305.3

Upon completion of augering
No cave
Free water at 4.0 m

NOTES * Low N value due to hydraulic disturbance

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 198

17T 553643E 4809511N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Breaverdale Road, Northbound Midlane — **BORING DATE** January 16, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.40					
0.0 / 309.40	PAVEMENT STRUCTURE: 110 mm asphalt, over 160 mm granular base, moist, over 460 mm granular subbase, moist		1A, 1B	AS		309
0.73 / 308.67	FILL: Grey silty sand, trace gravel, moist		2	SS	16	
1.5 / 307.9	SILT: Loose brown silt, some sand, trace gravel, wet		3	SS	8	308
2.3 / 307.1	becoming compact, saturated		4	SS	13	307
			5	SS	10	306
4.6 / 304.8	CLAYEY SILT: Stiff to firm grey clayey silt, some sand, APL to WTPL		6	SS	4	305
5.0 / 304.4	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 199

17T 553624E 4809568N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Southbound Midlane — ***BORING DATE*** January 16, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	309.86	SURFACE ELEVATION 309.86					
0.0	309.86	PAVEMENT STRUCTURE: 125 mm asphalt, over 145 mm granular base, moist, over 180 mm granular subbase, moist		1	SS	50/100mm	
0.45	309.41	SANDY SILT: Compact brown sandy silt, trace gravel, damp		2	SS	10	309
1.0							
1.5	308.4	becoming loose, saturated		3	SS	6	308
2.0				4	SS	8	
3.0	306.9	occasional clayey silt lenses		5	SS	8	307
4.0							306
5.0	304.9	BOREHOLE TERMINATED AT 5.0 m		6	SS	9	305
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

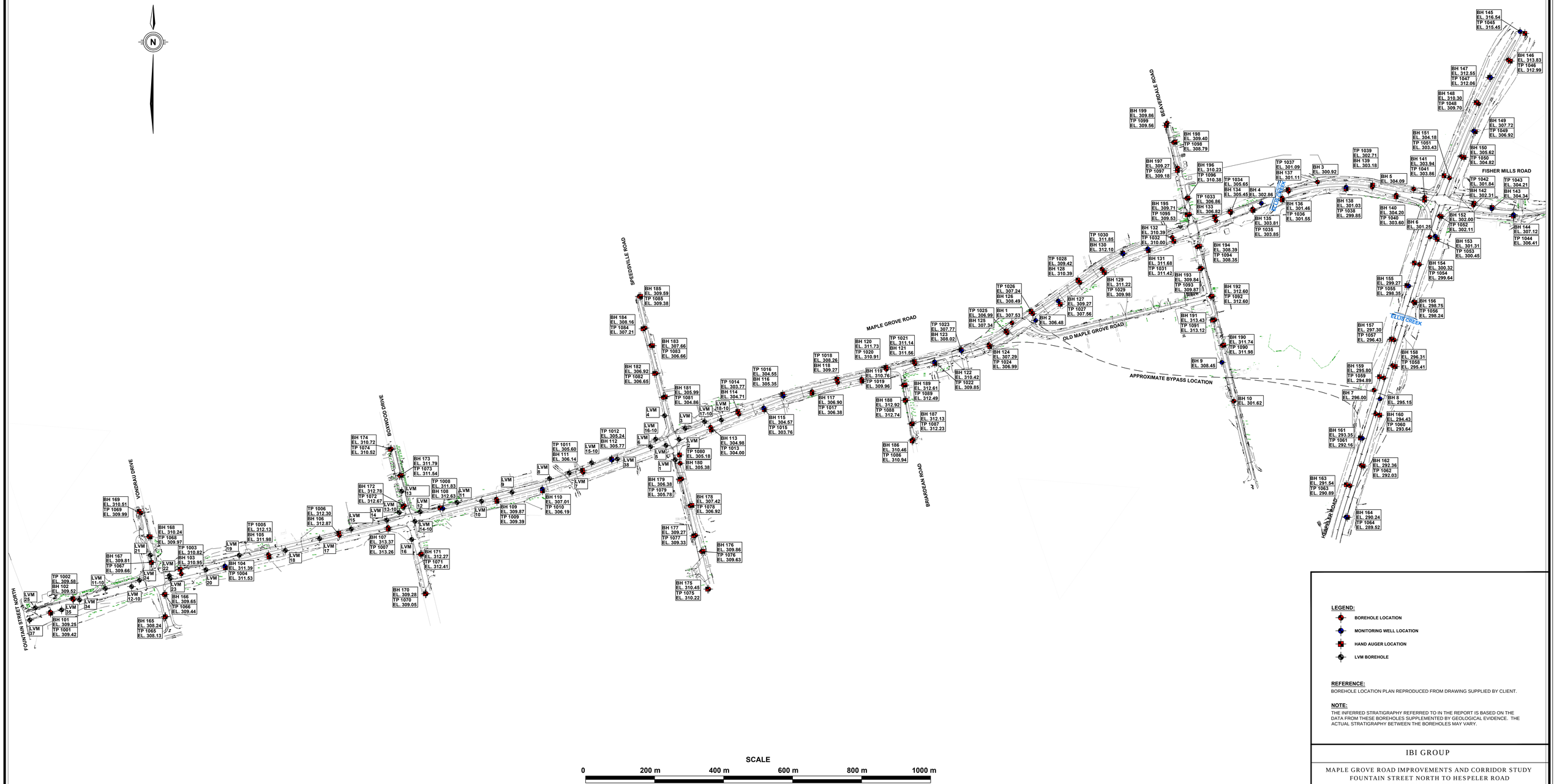
UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Cave at 3.7 m
No free water

NOTES



LEGEND:

- BOREHOLE LOCATION
- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- LVM BOREHOLE

REFERENCE:
BOREHOLE LOCATION PLAN REPRODUCED FROM DRAWING SUPPLIED BY CLIENT.

NOTE:
THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

IBI GROUP

MAPLE GROVE ROAD IMPROVEMENTS AND CORRIDOR STUDY
FOUNTAIN STREET NORTH TO HESPELER ROAD
CAMBRIDGE, ONTARIO

BOREHOLE LOCATION PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN:	DATE	SCALE	JOB NO.	DRAWING NO.
WL	MARCH 2022	AS SHOWN	18KF047	1
CHECKED: WL				
APPROVED: GM				

APPENDIX A

ENGLOBE BOREHOLES

LIST OF ABBREVIATIONS

The abbreviations commonly employed on the borehole logs, on the figures, and in the text of the report, are as follows:

Sample Types		Soil Tests and Properties	
AS	auger sample	SPT	Standard Penetration Test
CS	chunk sample	UC	unconfined compression
RC	rock core	FV	field vane test
SS	split spoon	ø	angle of internal friction
TW	thin-walled, open	γ	unit weight
WS	wash sample	w_p	plastic limit
		w	water content
		w_l	liquid limit
		I_L	liquidity index
		I_p	plasticity index
		PP	pocket penetrometer

Penetration Resistances	
Dynamic Penetration Resistance	The number of blows by a 63.5 kg (140 lb.) hammer dropped 0.76 m (30 in.) required to drive a 50 mm (2 in.) diameter 60 ° cone a distance 0.30 m (12 in.). The cone is attached to 'A' size drill rods and casing is not used.
Standard Penetration Resistance, N (ASTM D1586)	The number of blows by a 63.5 kg (140 lb.) hammer dropped 0.76 m (30 in.) required to drive a standard split spoon sampler 0.30 m (12 in.)
WH	sampler advanced by static weight of hammer
PH	sampler advanced by hydraulic pressure
PM	sampler advanced by manual pressure

Soil Description		
Cohesionless Soils	**SPT N-Value**	**D_r (%)**
Relative Density (D_r)	(blows per 0.30 m)	
Very Loose	0 to 4	0 to 20
Loose	4 to 10	20 to 40
Compact	10 to 30	40 to 60
Dense	30 to 50	60 to 80
Very Dense	over 50	80 to 100
Cohesive Soils	Undrained Shear Strength (C_u)	
Consistency	**kPa**	**psf**
Very Soft	less than 12	less than 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000
DTPL	Drier than plastic limit	
APL	About plastic limit	
WTPL	Wetter than plastic limit	

LVM

Borehole Number: 1

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 30, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone / Standard Penetration	Shear Strength (PP) kPa / Shear Strength (FV) kPa	Water Content (%)	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value	X 20 40 60 80 X; ● 20 40 60 80 ●	▲ 50 100 150 200 ▲; ■ 50 100 150 200 ■	WP WL; 10 20 30	
0.00	Ground Elevation		0.00							
	PAVEMENT STRUCTURE: Asphaltic concrete: 80 mm; Granular 'A': 100 mm; Granular 'B': 200 mm			1	AS					asphaltic concrete
	FILL: loose dark brown silt (topsoil), trace sand and gravel, very moist to wet									native backfill
1.00			-1.00							
	SAND: compact brown silty sand, trace gravel, wet			2	SS	9			●	
				3	SS	14				
2.00			-2.00							
	Borehole terminated at 2.13 m									
3.00			-3.00							
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 2

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *November 3, 2009*

Depth (m)	Description	Elevation (m)	Number	Type	N-Value
0.00	Ground Elevation	0.00			
	FILL: dark brown silt (topsoil), moist				
	SILT: compact brown fine sandy silt, wet		1	SS	23
	saturated				
1.00	loose, saturated	-1.00	2	SS	5
			3	SS	14
	SILT TILL: compact brown sandy silt, some gravel, moist; occasional sand seams, saturated				
2.00		-2.00	4	SS	29
3.00	hard grey clayey silt, some sand and fine gravel, DTPL	-3.00	5	SS	38
4.00		-4.00			
			6	SS	43\150mm
5.00	Borehole terminated at 4.88 m	-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80

Shear Strength (PP) kPa: ▲ 50 100 150 200

Shear Strength (FV) kPa: ■ 50 100 150 200

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

bentonite seal

At drilling completion water level at 0.91 m

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *RM*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 3

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 30, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material : 750 mm					
1.00	***FILL:*** compact brown silty sand and gravel, moist		-1.00	1	SS	18
	trace tar					
	dark brown silt, some topsoil, organics and sand, trace gravel, very moist			2	SS	18
2.00	***SAND:*** compact brown silty sand, some gravel, very moist to wet		-2.00	3	SS	14
	grey, saturated					
3.00	***SILT TILL:*** compact grey sandy silt, trace gravel, very moist		-3.00	4	SS	15
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill; native cave; At drilling completion dry cave at 3.05 m

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 4

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 30, 2009*

Depth (m)	Description	Symbol	Elevation (m)	SAMPLE Number	SAMPLE Type	SAMPLE N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCUTRE: Asphaltic concrete: 50 mm; Granular 'A': 100 mm; Granular 'B': 300 mm					
	FILL: dark brown silt, some topsoil and sand, trace gravel, moist					
1.00	***SAND:*** compact grey silty sand, some gravel, very moist		-1.00	1	SS	21
	Borehole terminated at 1.52 m					
2.00			-2.00			
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration (●): 20 40 60 80

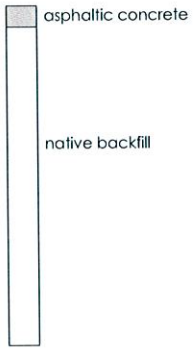
Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

WP — WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 5

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *November 3, 2009*

Depth (m)	Description	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation	0.00			
	FILL: dark brown silt (topsoil), moist				
	SAND AND GRAVEL: loose to compact brown silty sand and gravel, moist		1	SS	10
1.00	***SILT TILL:*** hard brown silt, some clay, sand and gravel, DTPL	-1.00	2	SS	15
	grey, DTPL		3	SS	12
2.00		-2.00	4	SS	21
3.00		-3.00	5	SS	30
	some grey silt layers, saturated				
4.00		-4.00	6	SS	23
	some fine to coarse sand layers, saturated		7	SS	30
5.00	Borehole terminated at 5.03 m	-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: bentonite seal

At drilling completion water level at 4.57 m

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *RM*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 6

Ground Elevation: *N/A*

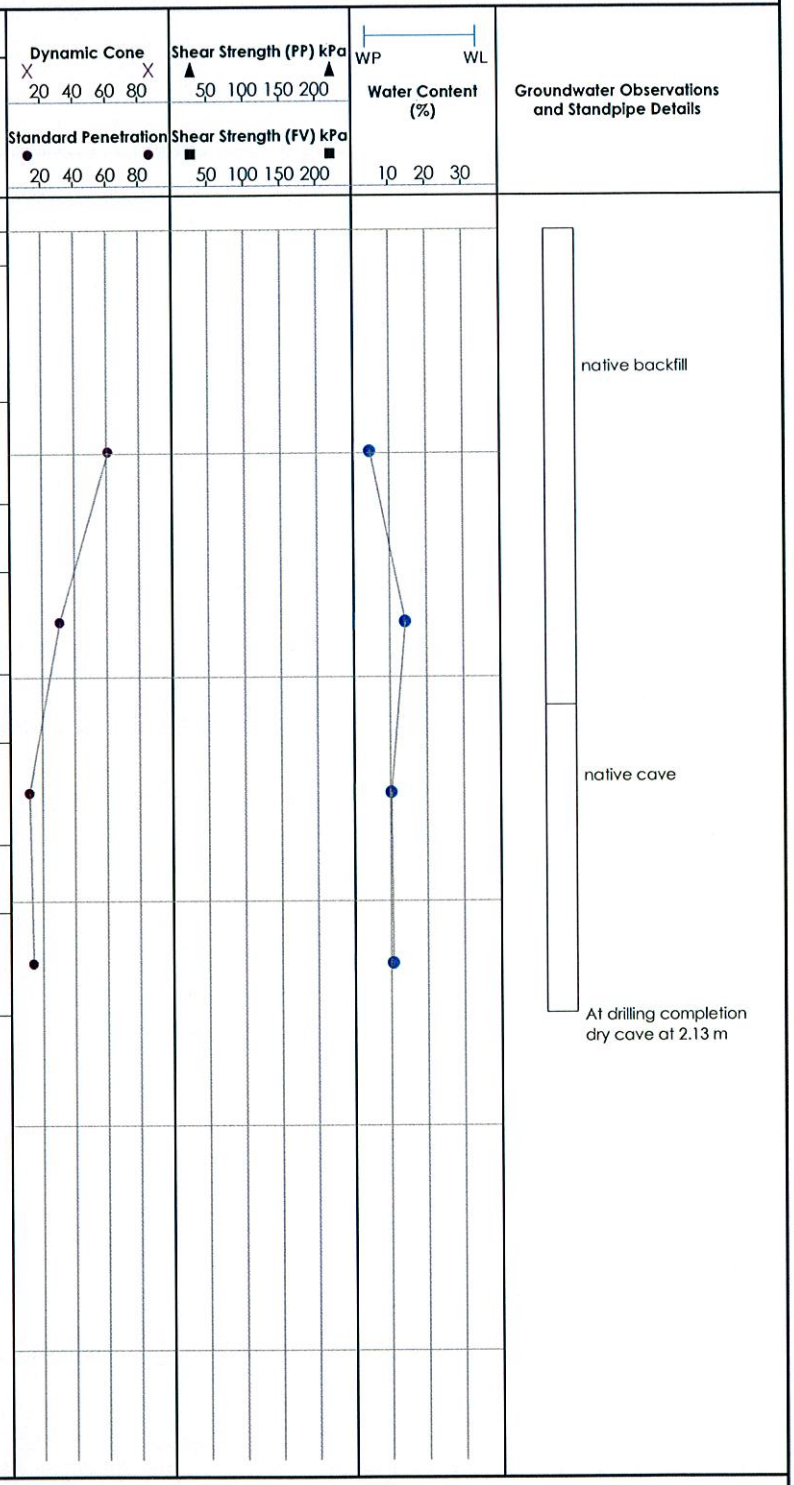
Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 400 mm				AS	
1.00	***FILL:*** very dense dark brownish grey silt, some sand, trace gravel and brick, moist		-1.00	1	SS	61
	dense grey, brown and black silty sand and gravel, some tar, very moist			2	SS	31
2.00			-2.00			
	SILT TILL: compact grey sandy silt, trace gravel, very moist to wet			3	SS	12
3.00			-3.00			
				4	SS	14
	Borehole terminated at 2.13 m					
4.00			-4.00			
5.00			-5.00			



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 7

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							asphaltic concrete
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm Granular 'A': 150 mm Granular 'B': 500 mm									native backfill
1.00	Borehole terminated at 0.80 m upon auger refusal on culvert		-1.00							
2.00			-2.00							
3.00			-3.00							
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 8

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm				AS	
1.00	***FILL:*** compact brown silty sand, some gravel, very moist		-1.00	1	SS	14
2.00	***SAND:*** compact brown silty sand, some gravel, very moist		-2.00	2	SS	17
	trace gravel, wet to saturated			3	SS	17
3.00	silty sand, saturated		-3.00	4	SS	16
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

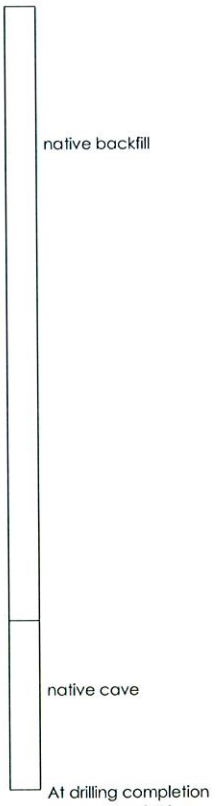
Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 9

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	SAMPLE Number	Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			1	AS	asphalt
1.00	***FILL:*** dense grey brown sandy silt, trace gravel, moist		-1.00	2	SS	44
	SILT TILL: compact brown silt, some sand, trace gravel, moist; rusty			3	SS	28
2.00	dense		-2.00	4	SS	41
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 10

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 28, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							
	PAVEMENT STRUCTURE: Granular material: 850 mm			1	AS					native backfill
1.00	***FILL:*** compact dark brownish grey silt, some sand, trace gravel and clay		-1.00	2	SS	19				
	SILT TILL: compact brown silt, some sand, trace gravel and clay, moist			3	SS	22				
2.00			-2.00							
3.00	dense, moist to very moist		-3.00	4	SS	38				native cave
	Borehole terminated at 3.51 m									
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 11

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm					
1.00	***SILT TILL:*** compact brown silt, some sand, trace gravel, moist		-1.00	1	SS	26
	sandy silt			2	SS	18
3.00	dense, trace clay		-3.00	3	SS	33
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 12

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Aspahltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 400 mm					
1.00	***SILT TILL:*** very dense brown silt, some sand, trace gravel, moist		-1.00	1	SS	63
	compact sandy silt, trace gravel			2	SS	18
2.00	dense, trace sand		-2.00	3	SS	44
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

asphaltic concrete

native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 13

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 30 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone / Standard Penetration	Shear Strength (PP) kPa / Shear Strength (FV) kPa	Water Content (%)	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value	X 20 40 60 80 X; ● 20 40 60 80 ●	▲ 50 100 150 200 ▲; ■ 50 100 150 200 ■	WP WL; 10 20 30	
0.00	Ground Elevation		0.00							
	PAVEMENT STRUCTURE: Aspahltic concrete: 100 mm; Granular 'A': 200 mm; Granular 'B': 300 mm									asphaltic concrete
	FILL: compact brown sandy silt, trace gravel, very moist									native backfill
1.00			-1.00	1	SS	12	●		●	
	Borehole terminated at 1.52 m									
2.00			-2.00							
3.00			-3.00							
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 14

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			1	AS	
1.00	***SILT TILL:*** compact brown sandy silt, some gravel, moist		-1.00	2	SS	24
	trace gravel, moist			3	SS	25
2.00			-2.00			
	some sand, moist			4	SS	21
3.00			-3.00	5	SS	26
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

WP — WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

asphaltic concrete

native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 15

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm			1	AS	
1.00	***FILL:*** compact brown sand and gravel, some silt, damp to moist		-1.00	2	SS	28
2.00	***SAND:*** dense brown silty sand, some gravel, moist		-2.00	3	SS	34
	very dense			4	SS	69
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 16

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 30, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							asphaltic concrete
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm Granular 'B': 500 mm									native backfill
	SILT TILL: compact brown silt, some sand, trace gravel and clay, moist									
1.00			-1.00	1	SS	16	●		●	
	Borehole terminated at 1.52 m									
2.00			-2.00							
3.00			-3.00							
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 17

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			1	AS	
1.00	***SAND:*** dense brown sand, some silt and gravel, moist		-1.00	2	SS	35
	SILT TILL: compact brown sandy silt, some gravel, moist			3	SS	15
2.00	very dense, trace gravel		-2.00	4	SS	72
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X — 20 40 60 80 — X

Standard Penetration: ● — 20 40 60 80 — ●

Shear Strength (PP) kPa: ▲ — 50 100 150 200 — ▲

Shear Strength (FV) kPa: ■ — 50 100 150 200 — ■

WP — Water Content (%) — WL

10 20 30

Groundwater Observations and Standpipe Details

asphaltic concrete

native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 18

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm					
1.00	***FILL*** compact brown silty sand and gravel, moist		-1.00	1	SS	15
	loose brown to dark brown, some gravel, moist to very moist			2	SS	7
2.00	compact, brown		-2.00	3	SS	11
3.00	***SAND:*** compact brown silty sand, some gravel, very moist		-3.00	4	SS	13
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

native cave

At dilling completion dry cave at 3.05 m

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 19

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm					
1.00	***FILL:*** compact brown to dark brown sandy silt, some gravel, moist to very moist		-1.00	1	SS	20
	dense, grey and brown, moist			2	SS	32
2.00	cobbles		-2.00			
	compact, dark grey brown, moist to very moist			3	SS	17
3.00			-3.00			
	SAND: compact grey silty sand, trace gravel, very moist			4	SS	18
	Borehole terminated at 3.66 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 20

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Granular 'A': 200 mm Granular 'B': 700 mm					
1.00	***FILL:*** dense dark brown silt, some sand, trace gravel and organics, moist to very moist		-1.00	1	SS	30
	grey and brown sandy silt, trace gravel and tar			2	SS	30
2.00	***SAND:*** compact grey silty sand, some gravel, very moist		-2.00	3	SS	14
3.00	trace gravel, wet		-3.00	4	SS	23
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

native cave

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 21

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 30, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 100 mm; Granular 'A': 100 mm; Granular 'B': 600 mm					
1.00	***SAND AND GRAVEL:*** dense brown silty sand and gravel, moist		-1.00	1	SS	33
	Borehole terminated at 1.52 m					
2.00			-2.00			
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 22

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm				AS	
					AS	
1.00	***FILL:*** compact brown silty sand, some gravel, moist to very moist		-1.00	1	SS	14
				2	SS	16
2.00	***SAND:*** dense brown silty sand, some gravel, very moist		-2.00	3	SS	33
3.00	***SILT TILL:*** dense grey brown silt, some sand and gravel, trace clay, very moist		-3.00	4	SS	49
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

Water Content (%) WP WL 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 23

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), some sand, moist					
	compact brown silty sand, some gravel, moist					
1.00			-1.00	1	SS	23
	silty sand and gravel, occasional cobbles, very moist			2	SS	24
2.00			-2.00			
	SAND: compact brown silty sand, some fine gravel, moist to very moist			3	SS	22
3.00			-3.00			
	very dense, some fine to coarse gravel			4	SS	77
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X — 20 40 60 80 — X

Standard Penetration: ● — 20 40 60 80 — ●

Shear Strength (PP) kPa: ▲ — 50 100 150 200 — ▲

Shear Strength (FV) kPa: ■ — 50 100 150 200 — ■

WP — Water Content (%) — WL

10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 24

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	SAMPLE Number	SAMPLE Type	SAMPLE N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 450 mm					
1.00	***FILL:*** dense brown silty sand, some gravel, moist		-1.00	1	SS	45
	SAND: very dense brown silty sand, some gravel, occasional cobbles, moist					
2.00			-2.00	2	SS	75
	Borehole terminated at 2.13 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

WP — WL — Water Content (%) 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 25

Ground Elevation: *N/A*

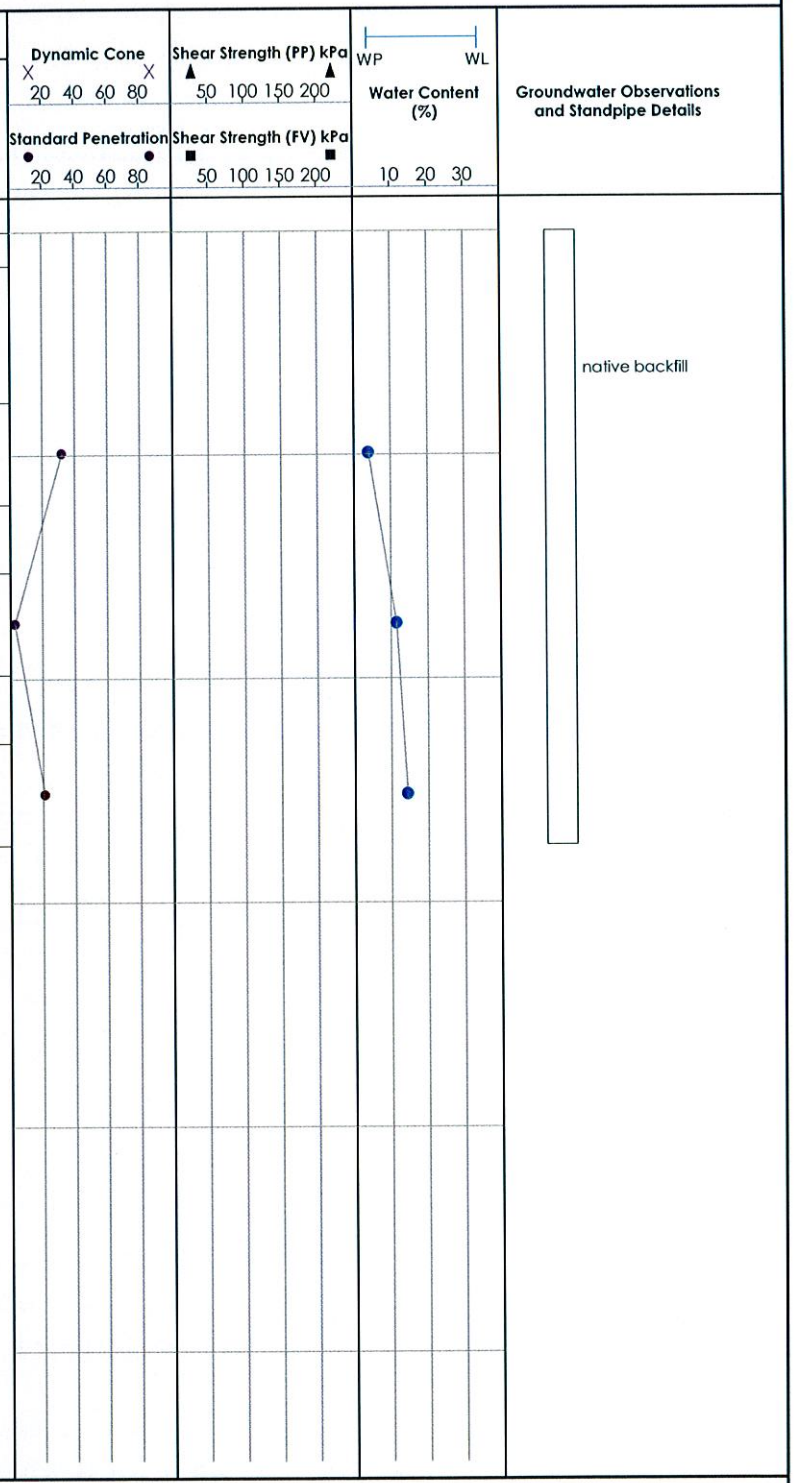
Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm				AS	
					AS	
1.00	***FILL:*** dense brown sand and gravel, some silt, damp to moist		-1.00	1	SS	32
	very loose silty sand, some gravel, very moist			2	SS	3
2.00	***SILT TILL:*** compact brown silt, some clay, trace sand and gravel, very moist		-2.00	3	SS	21
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 26

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *November 2, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 150 mm; Granular 'A': 100 mm; Grnaular 'B': 600 mm			1	AS	
1.00	***SILT TILL:*** compact brown silt, trace sand, clay and gravel, very moist to wet		-1.00	2	SS	15
	dense, some mineral fragments			3	SS	42
2.00			-2.00	4	SS	46
3.00			-3.00	5	SS	44
4.00			-4.00			
	grey, some clay			6	SS	32
5.00	Borehole terminated at 5.03 m		-5.00			

Dynamic Cone / Standard Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: *Auger sample taken at 0.00-0.10 m.*
Bulk sample taken from 2.29-3.05 m.

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 27

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

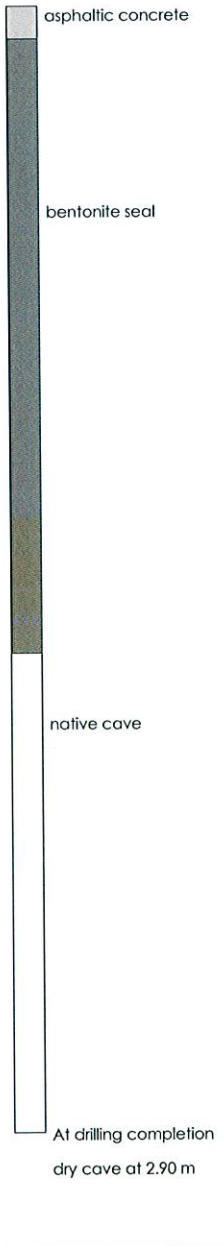
Drill Date: *November 2, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 200 mm; Grnaular 'B': 300 mm					
	FILL: dense brown silty sand and gravel, occasional cobbles, moist			1	SS	35
1.00			-1.00			
	compact			2	SS	17
2.00			-2.00			
	dark brown silt, some sand, trace wood and gravel, very moist			3	SS	12
	SAND: compact brown silty sand, trace gravel, saturated					
3.00			-3.00			
				4	SS	16
4.00			-4.00			
	some gravel			5	SS	17
5.00			-5.00			
	Borehole terminated at 5.03 m					

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

WP WL — Water Content (%) 10 20 30



Groundwater Observations and Standpipe Details

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: *Auger sample taken at 0.00-0.10 m.*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 28

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *November 2, 2009*

Depth (m)	Description	Symbol	Elevation (m)	SAMPLE Number	SAMPLE Type	SAMPLE N-Value
	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Granular material: 750 mm					
	FILL: compact brown sand, some gravel, very moist		-1.00	2	SS	16
1.00						
	SILT TILL: compact brown silt, some sand, trace gravel and clay, moist			3	SS	22
2.00			-2.00			
	very dense, trace sand			4	SS	50\150mm
3.00			-3.00			
	occasional cobbles			5	SS	50\150mm
	numerous cobbles					
4.00			-4.00			
	grey brown			6	SS	50\150mm
5.00	Borehole terminated at 4.88 m		-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 29

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *November 2, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 200 mm; Granular 'B': 300 mm			1	AS	
1.00	***FILL:*** compact brown silty sand, some gravel, moist		-1.00	2	SS	16
	SILT TILL: compact brown silt, some sand, trace gravel, moist			3	SS	16
2.00			-2.00			
				4	SS	15
3.00			-3.00			
	SAND: very dense brown silty sand, trace gravel, damp			5	SS	50
	some gravel, occasional cobbles, moist to very moist					
4.00			-4.00			
				6	SS	56
5.00	***SILT TILL:*** very dense brown sandy silt, trace gravel, moist		-5.00			
	Borehole terminated at 5.03 m					

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

Water Content (%) WP WL 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: *Auger sample taken from 0.00-0.10 m*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 30

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 100 mm; Granular 'B': 600 mm					
1.00	***SAND:*** compact to very dense grey brown silty sand, some gravel, numerous cobbles and boulders, moist		-1.00	1	AS	*
	compact, brown			2	SS	11
2.00	dense, occasional cobbles		-2.00	3	SS	39
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X): 20 40 60 80

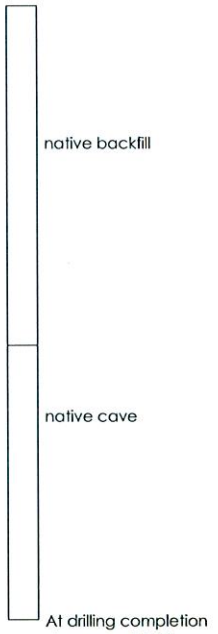
Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

Water Content (%): WP – WL; 10 20 30

Groundwater Observations and Standpipe Details



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: **Sampler bouncing on cobbles and boulders*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 31

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 100 mm; Granular 'B': 500 mm					
1.00	***FILL:*** compact brown sand, some silt, trace gravel, very moist		-1.00	1	SS	16
	dark brownish grey silt, some sand, trace gravel, moist to very moist			2	SS	24
2.00			-2.00			
	SAND AND GRAVEL: compact brown silty sand and gravel, occasional cobbles, very moist			3	SS	25
3.00			-3.00			
	SILT TILL: compact brown silt, some sand, trace gravel and clay, very moist			4	SS	17
4.00			-4.00			
	dense, trace sand			5	SS	42
5.00	Borehole terminated at 5.03 m		-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP 10 20 30 WL

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 32

Ground Elevation: *N/A*

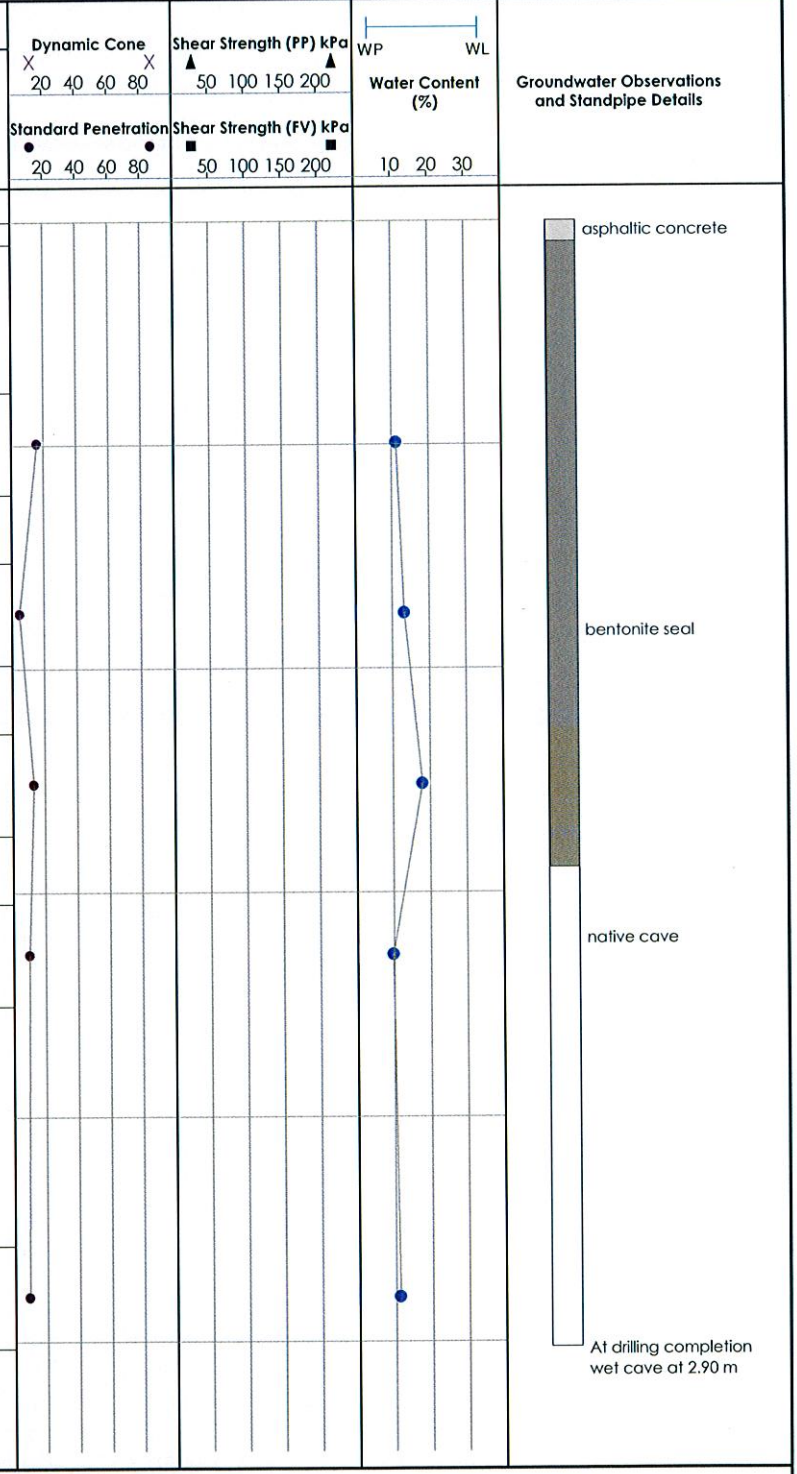
Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation	0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			AS	
1.00	***FILL:*** compact dark brown and grey silt, some sand, trace gravel, very moist	-1.00	1	SS	16
	loose dark brown silt, some sand, organics and gravel, very moist		2	SS	5
2.00	***SAND:*** compact grey silty fine sand, trace gravel, wet	-2.00	3	SS	13
	grey brown silty sand, saturated				
3.00		-3.00	4	SS	10
	brown, trace gravel				
4.00		-4.00			
	loose, grey		5	SS	9
5.00	Borehole terminated at 5.03 m	-5.00			



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 33

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm					
1.00	***FILL:*** dense brown silty sand, some gravel, occasional cobbles, moist		-1.00	1	SS	46
	numerous cobbles and boulders			2	SS	43
2.00			-2.00	3		50\50mm
3.00	***SAND AND GRAVEL:*** dense grey and brown sand and gravel, some silt, numerous cobbles and boulders, damp to moist		-3.00	4	SS	44
	SILT TILL: dense brown sandy silt, some gravel, moist					
4.00	compact brown silt, trace sand, gravel and clay, very moist		-4.00	5	SS	28
5.00	Borehole terminated at 5.03 m		-5.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration ● 20 40 60 80

Shear Strength (PP) kPa ▲ 50 100 150 200 — Shear Strength (FV) kPa ■ 50 100 150 200

WP WL — Water Content (%) 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: *Bulk sample taken from 3.05-3.96 m*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 34

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation	0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm			BS / AS	
	FILL: very dense brown sand and gravel, some silt, numerous cobbles and boulders, moist		1		*
1.00		-1.00			
	grey brown silty sand, some gravel		2	SS	60
2.00		-2.00			
	compact, brown to dark brown		3	SS	20
3.00		-3.00			
	trace topsoil and organics, moist to very moist		4	SS	13
	Borehole terminated at 3.51 m				
4.00		-4.00			
5.00		-5.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

Water Content (%) WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: **Sampler bouncing on cobbles and boulders*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 35

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							
	FILL: dark brown silt (topsoil), some sand, trace gravel, moist									
	compact brown silt, some sand, trace gravel, clay and wood fragments, moist									
1.00			-1.00	1	SS	19				
										native backfill
				2	SS	49				
2.00	dense brown silt, some sand and gravel, trace clay, occasional cobbles, moist		-2.00							
	loose brown to dark brown, trace gravel and wood fragments, very moist			3	SS	7				
	SAND: compact grey silty sand, some gravel, moist									
3.00			-3.00	4	SS	23				
	Borehole terminated at 3.66 m									
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 36

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), some sand, moist					
	compact grey to brown silt, some clay and sand, trace gravel, damp to moist			1	SS	20
1.00			-1.00			
	brown			2	SS	10
2.00			-2.00			
	SILT TILL: compact brown silt, some clay and sand, trace gravel, moist to very moist			3	SS	20
3.00			-3.00			
	dense, trace sand			4	SS	33
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X) / Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲) / Shear Strength (FV) kPa (■): 50 100 150 200

Water Content (%): WP – WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 37

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *November 3, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), very moist					
	compact brown silty sand, some gravel, moist to very moist			1	SS	18
1.00			-1.00	2	SS	7
	SAND TILL: compact brown silty sand, some gravel, moist to very moist			3	SS	13
2.00	***SAND:*** compact brown fine to coarse sand, some silt, saturated		-2.00	4	SS	23
	SILT TILL: very dense brown silt, some sand and gravel, trace clay, moist			5	SS	27\150mm
3.00			-3.00			
	Borehole terminated at 3.35 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *RM*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 38

Ground Elevation: *N/A*

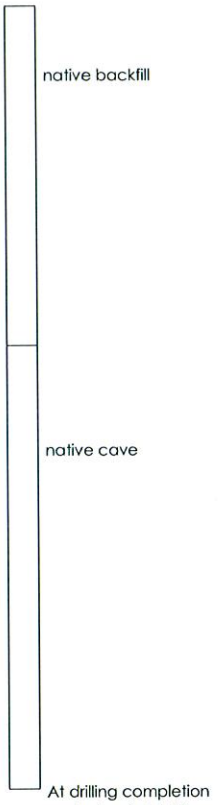
Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							
	PAVEMENT STRUCTURE: Granular material: 750 mm									
1.00	***FILL:*** loose brown to dark brown silt, some sand and gravel		-1.00	1	SS	8				
	brown sand and gravel			2	SS	4				
2.00			-2.00							
	SAND: compact brown silty sand, trace gravel, wet			3	SS	17				
3.00			-3.00							
	some gravel			4	SS	16				
	Borehole terminated at 3.51 m									
4.00			-4.00							
5.00			-5.00							



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 01-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 110 mm; Granular 'A': 100 mm; Granular 'B': 300 mm			1	AS	
	FILL: compact brown silty sand, trace gravel, moist					
1.00			-1.00	2	SS	23
	SILT TILL: dense brown silt, some sand, trace gravel and clay, moist					
				3	SS	43
2.00			-2.00			
	very dense, occasional cobbles			4	SS	52
3.00			-3.00			
	dense			5	SS	39
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.10-0.20 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 02-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, moist			1	AS	
1.00	***SILT TILL:*** compact brown silt, some sand, trace clay and gravel, moist		-1.00	2	SS	28
	very dense			3	SS	58
2.00			-2.00			
	compact			4	SS	25
3.00			-3.00			
	dense, occasional cobbles			5	SS	46
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X — 20 40 60 80 — X

Standard Penetration: ● — 20 40 60 80 — ●

Shear Strength (PP) kPa: ▲ — 50 100 150 200 — ▲

Shear Strength (FV) kPa: ■ — 50 100 150 200 — ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.30-0.61 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 03-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown silty sand and gravel, moist					
	compact silt, some sand, trace gravel, very moist			2	SS	17
1.00			-1.00			
	SILT TILL: compact brown silt, some clay, trace sand and gravel, moist			3	SS	22
2.00			-2.00			
	grey brown, wet			4	SS	27
	moist					
3.00			-3.00	5	SS	90
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 04-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 120 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			1	AS	
1.00	***SILT TILL:*** compact brown sandy silt, trace clay and gravel, very moist		-1.00	2	SS	22
	some clay and sand			3	SS	20
2.00			-2.00			
	dense			4	SS	40
3.00			-3.00			
	trace clay, moist			5	SS	48
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

Water Content (%): WP – WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.12-0.25 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 05-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), trace sand, moist					
	compact brown silty sand, trace gravel and topsoil					
1.00			-1.00	2	SS	11
	SILT: compact brown silt, some sand and clay, trace gravel, moist					
2.00			-2.00	3	SS	20
	SAND: compact brown silty sand, wet					
3.00			-3.00	4	SS	25
				5	SS	31
	SILT TILL: dense brown silt, some sand and clay,trace gravel, very moist					
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 06-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), trace sand, moist					
	brown silt, some sand, trace gravel, occasional cobbles					
	SAND: loose brown silty sand, moist		-1.00	2	SS	6
1.00						
	SILT TILL: dense grey brown silt, some clay, trace sand and gravel, moist			3	SS	31
2.00			-2.00			
	hard grey clayey silt, DTPL			4	SS	30
3.00			-3.00			
				5	SS	30
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

Borehole Number: 07-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topoil), some sand, trace gravel, moist					
	rusty brown sand, some silt and gravel					
1.00			-1.00	2	SS	8
	trace gravel					
				3	SS	8
2.00			-2.00			
	SILT TILL: compact brown silt, some clay, trace sand and gravel, moist			4	SS	16
	fine sand seam, moist					
3.00			-3.00			
	dense, grey			5	SS	32
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 08-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 120 mm; Granular 'A': 100 mm; Granular 'B': 300 mm			1	AS	
	FILL: compact brown and dark brown silty sand, some gravel, moist to very moist			2	SS	17
1.00			-1.00			
				3	SS	14
2.00			-2.00			
	loose silt, some sand, trace clay and gravel, very moist			4	SS	6
	SILT TILL: compact brown silt, some clay, trace sand and gravel, moist					
3.00			-3.00	5	SS	10
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.12-0.20m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 09-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-30*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 120 mm; Granular 'A': 150 mm			1	AS	
	FILL: dense brown sand and gravel, some silt, occasional cobbles, very moist			2	SS	38
1.00			-1.00			
	very dense silt and sand, some gravel, moist			3	SS	58
2.00			-2.00			
	dense sandy silt			4	SS	32
	SILT TILL: compact brown silt, some sand, trace gravel, moist					
3.00			-3.00	5	SS	18
4.00			-4.00	6	SS	23
	Borehole terminated at 4.27 m					

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.12-0.25 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 11-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 150 mm; Granular 'A': 100 mm					
	FILL: compact brown silty sand and gravel, occasional cobbles, moist			1	AS	
1.00			-1.00	2	SS	27
	SILT TILL: dense brown silt, some sand, trace gravel and clay, moist			3	SS	30
2.00			-2.00	4	SS	30
	occasional cobbles					
3.00	some clay		-3.00	5	SS	34
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

Water Content (%) WP WL 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.25-0.61 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 12-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 120 mm; Granular 'A': 100 mm; Granular 'B': 400 mm			1	AS	
	SILT TILL: very dense brown silt, some sand, trace gravel, occasional cobbles, moist			2	SS	84
1.00			-1.00			
	dense			3	SS	48
2.00			-2.00			
	very dense, trace clay			4	SS	96
3.00			-3.00			
				5	SS	50\150mm
	Borehole terminated at 3.20 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.12-0.25 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

Borehole Number: 13-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), some sand, moist			1	AS	
	brown silty sand, some gravel					
	SILT TILL: compact brown silt, some sand, trace clay and gravel, moist			2	SS	16
1.00			-1.00			
	very moist			3	SS	28
2.00			-2.00			
	dense, occasional cobbles, moist			4	SS	30
3.00			-3.00			
				5	SS	33
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.15-0.30 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

Borehole Number: 14-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, trace topsoil, moist					
1.00	***SILT TILL:*** compact brown silt, some sand, trace clay and gravel, moist		-1.00	1	SS	21
	very moist			2	SS	32
2.00	occasional cobbles, moist		-2.00	3	SS	36
3.00	very dense, some gravel		-3.00	4	SS	77
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200

Shear Strength (FV) kPa: 50 100 150 200

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 15-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, occasional cobbles, moist			1	AS	
	sand, some silt, trace gravel, very moist			2	SS	22
1.00			-1.00			
	SAND: compact brown sand, some silt, trace gravel, saturated			3	SS	15
2.00			-2.00			
	SILT TILL: compact brown silt, some sand, trace gravel and clay, very moist			4	SS	12
3.00			-3.00			
	grey, some clay			5	SS	37
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X — 20 40 60 80 — X

Standard Penetration: ● — 20 40 60 80 — ●

Shear Strength (PP) kPa: ▲ — 50 100 150 200 — ▲

Shear Strength (FV) kPa: ■ — 50 100 150 200 — ■

Water Content (%): WP — 10 20 30 — WL

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.15-0.46 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 16-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, occasional cobbles, moist			1	AS	
	dense			2	SS	42
1.00			-1.00			
	SAND: dense grey and brown silty sand, some gravel, very moist to wet			3	SS	31
2.00			-2.00			
	wet to saturated			4	SS	22
3.00			-3.00			
	SILT TILL: compact grey silt, some fine sand, trace gravel, very moist			5	SS	14
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.30-0.61 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 17-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-30*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, occasional cobbles, moist					
	dense grey brown silty sand, trace gravel and bricks, very moist			1	SS	44
1.00			-1.00			
	SAND: dense grey sand, some silt and organics, trace topsoil, wet			2	SS	36
	SILT TILL: dense grey silt, some sand, trace gravel and clay, moist					
2.00			-2.00			
	compact, trace brown organics, saturated			3	SS	10
3.00			-3.00			
	silt some clay, trace sand and gravel, moist			4	SS	16
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X — X; 20 40 60 80

Standard Penetration: ● — ●; 20 40 60 80

Shear Strength (PP) kPa: ▲ — ▲; 50 100 150 200

Shear Strength (FV) kPa: ■ — ■; 50 100 150 200

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 18-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, moist					
	compact			1	SS	22
1.00			-1.00			
				2	SS	10
2.00	Borehole terminated at 2.13 m upon contact with water main		-2.00			
3.00			-3.00			
4.00			-4.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

Water Content (%): WP – WL; 10 20 30

Groundwater Observations and Standpipe Details

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

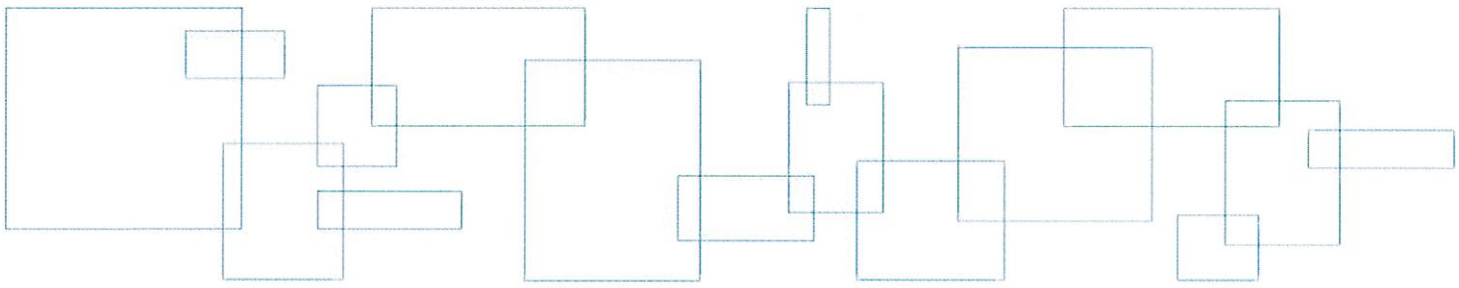
Field Tech.: *DSouter*

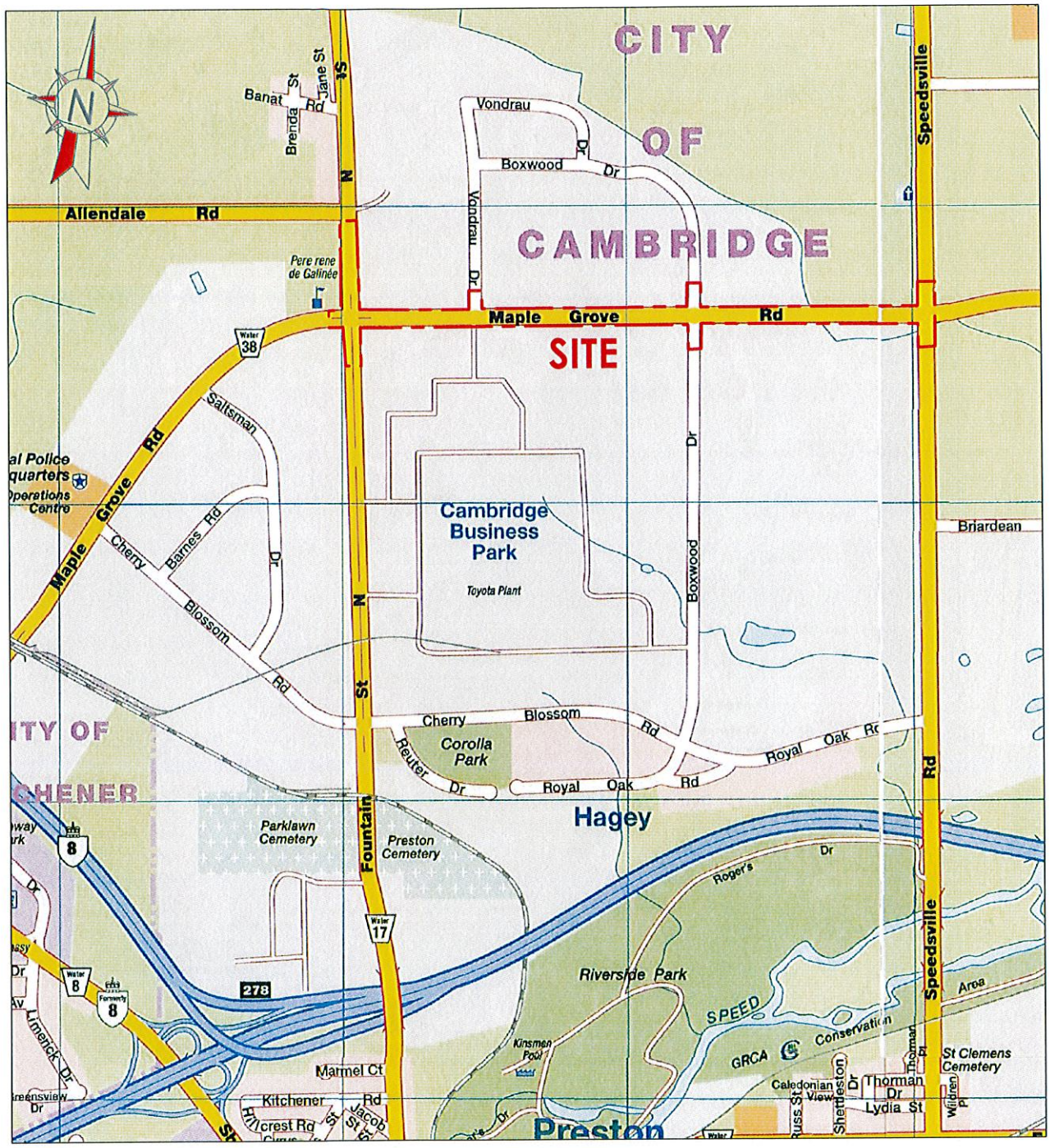
Sheet: *1 of 1*

Drafted by: *SMeteer*

Appendix 4 Drawings

Drawing 1: Location Plan
Drawings 2 to 4: Site Plans





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SCALE 1:15000

NOTES :
1-REFERENCES : MAPART PUBLISHING, Page 48-49,
Kitchcner-Waterloo Map Book (2009)

Project

Widening of Maple Grove Road

Fountain Street to Speedsville Road, Cambridge, Ontario

Title

LOCATION PLAN

LVM inc.
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared	SMeteer	Discipline	GEOTECHNICAL
Drawn	SMeteer	Scale	1:15000
Checked	VMarshall	Date	2010-10-19

Project manager: VMarshall
Sequence no.: 01 of 04

M. dept.	Project	Work pckg.	Sub-w.p.	Disc.	Drawing no.	Rev.
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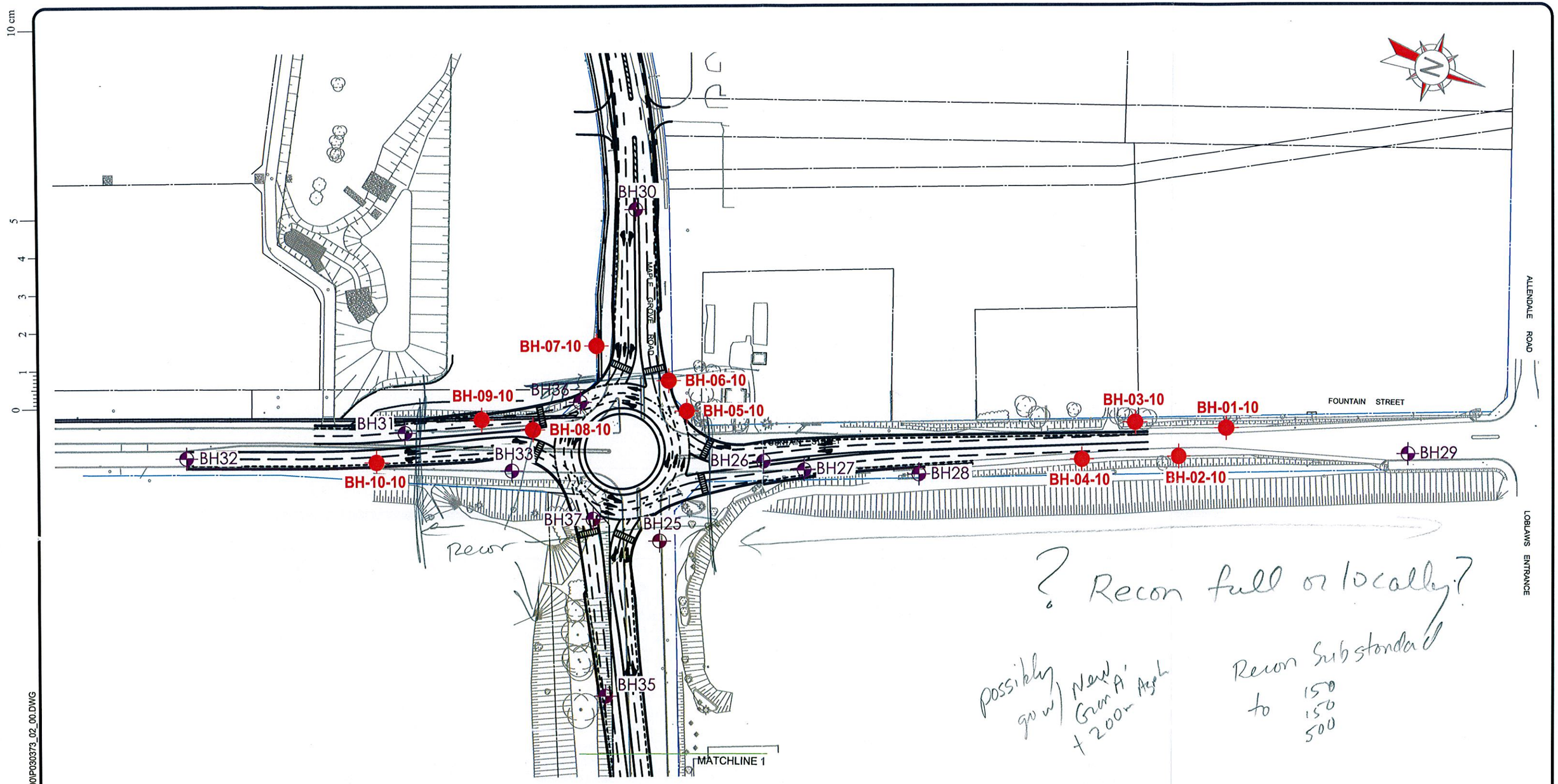

LEGEND :

- BOREHOLE LOCATION
  Current Investigation
- BOREHOLE LOCATION
  Previous Investigation, NEA 8506G1

NOTES :
1-REFERENCES : MTE CONSULTANTS INC.,
Drawing No. 33619-100-FD3, September 2009

Project

Widening of Maple Grove Road

Fountain Street to Speedsville Road, Cambridge, Ontario

Title

SITE PLAN

LVM inc.
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared SMeteer	Discipline GEOTECHNICAL	Project manager VMarshall			
Drawn SMeteer	Scale 1:2000	Sequence no. 02 of 04	Rev. 00		
Checked VMarshall	Date 2010-10-19				

M. dept.	Project	Work pckg.	Sub-w.p.	Disc.	Drawing no.	Rev.
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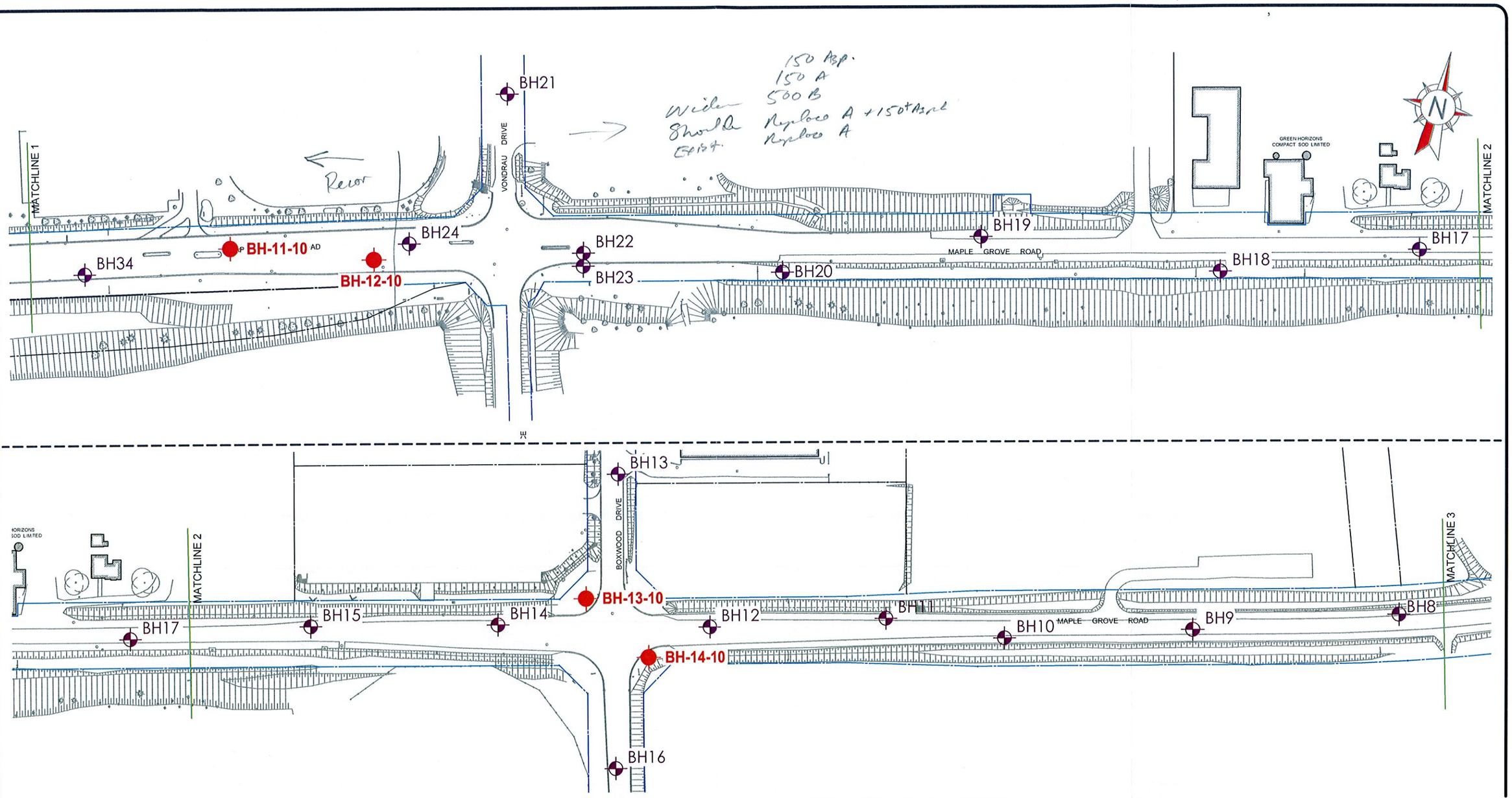

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LEGEND :

- BOREHOLE LOCATION Current Investigation
- BOREHOLE LOCATION Previous Investigation, NEA 8506G1

NOTES :
1-REFERENCES : MTE CONSULTANTS INC., Drawing No. 33619-100-FD3, September 2009

Project

Widening of Maple Grove Road

Fountain Street to Speedsville Road, Cambridge, Ontario

Title

SITE PLAN

LVM inc.
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared SMeteer	Discipline GEOTECHNICAL	Project manager VMarshall				
Drawn SMeteer	Scale 1:2000	Sequence no. 03 of 04	Rev. 00			
Checked VMarshall	Date 2010-10-19					
M. dept. 160	Project P030373	Work pckg. 100	Sub-w.p.	Disc. GE	Drawing no. 3	Rev. 00

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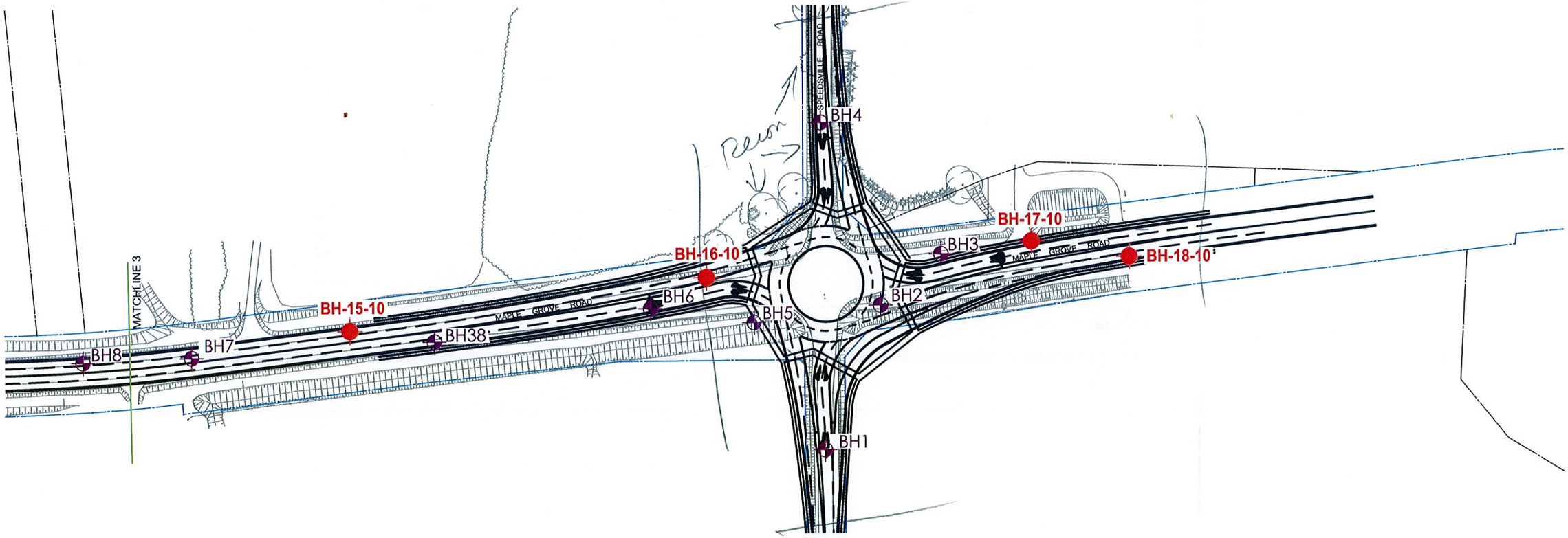

LEGEND :

BOREHOLE LOCATION
Current Investigation

BOREHOLE LOCATION
Previous Investigation, NEA 8506G1

NOTES :
1-REFERENCES : MTE CONSULTANTS INC.,
Drawing No. 33619-100-FD3, September 2009

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Project

Widening of Maple Grove Road

Fountain Street to Speedsville Road, Cambridge, Ontario

Title

SITE PLAN

LVM inc.
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared SMeteer	Discipline GEOTECHNICAL		Project manager VMarshall			
Drawn SMeteer	Scale 1:2000		Sequence no. 04 of 04	Rev. 00		
Checked VMarshall	Date 2010-10-19					
M. dept. 160	Project P030373	Work pckg. 100	Sub-w.p.	Disc. GE	Drawing no. 4	Rev. 00

APPENDIX B

REGIONAL MUNICIPALITY OF WATERLOO
TRAFFIC DATA
AND
DARWIN PRINTOUTS

REGIONAL MUNICIPALITY OF WATERLOO - TRAFFIC DATA

Location Maple Grove Road (Fountain St N to Hespeler Rd)

Maple Grove Road		AADT					Vehicle Classification			Speed		
		2018	2036		2041							
From	To	Base Year	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Passenger Cars	Trucks & Buses	Tractor Trailers	Posted	Average	85th %ile
Fountain St N	Vondrau Drive	19,950	32,530	32,530	36,250	35,850	92.0%	1.0%	7.0%	70	53	66
Vondrau Drive	Boxwood Drive	18,180	30,680	30,520	34,390	33,840	95.0%	1.0%	4.0%	70	64	76
Boxwood Drive	Speedsville Road	18,650	30,490	30,260	34,200	33,580	94.0%	1.0%	5.0%	70	71	81
Speedsville Road	Brairdean Rd	18,850	26,640	26,290	30,190	29,540	94.0%	1.0%	5.0%	70	71	80
Brairdean Rd	Compass Trial	19,800	26,380	26,020	29,930	29,510	94.0%	1.0%	5.0%	70	71	80
Compass Trial	Old Maple Grove Road	20,030	26,430	26,070	29,980	29,560	95.0%	1.0%	4.0%	70	60	75
Old Maple Grove Road	Beaverdale Road	18,740	24,710	15,960	27,710	18,260	94.0%	1.0%	5.0%	70	67	76
Beaverdale Road	Hespeler Road	19,700	25,220	16,340	28,090	18,610	95.0%	1.0%	4.0%	70	62	72

Hespeler Road		AADT					Vehicle Classification			Speed		
		2018	2036		2041							
							Passenger Cars	Trucks & Buses	Tractor Trailer	Posted	Average	85 %ile
Guelph Avenue	Maple Grove Road	19,390	27,650	28,380	30,600	30,730	89.0%	2.7%	8.3%	80	-	-
Maple Grove Road	Beaverdale Rd/Queen St W	30,750	39,930	31,600	43,330	33,500	87.8%	3.1%	9.0%	80	-	-

Notes

The above data **should not be used for any other purpose** other than to carry out analysis needed for the Maple Grove Road widening Environmental Assessment Study only.

Scenario	Definition
Scenario 1	Without the Maple Grove Road Bypass Concept
Scenario 2	With the Maple Grove Road Bypass Concept

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Peto MacCallum Ltd.
16 Franklin Street South
Kitchener, Ontario
Canada

Flexible Structural Design Module

Maple Grove Road - Fountain Street to Vondrau Drive
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	13,712,381
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	146 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	23,930
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	8 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.6 %
Growth	Compound
Total Calculated Cumulative ESALs	13,712,381

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	170	-	71
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	600	-	54
Total	-	-	-	920	-	146

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	169	71
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	600	54
Total	-	-	-	-	-	-	-	919	146

1997 AASHTO Pavement Design

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Kitchener, Ontario
Canada

Flexible Structural Design Module

Maple Grove Road - Fountain Street to Vondrau Drive
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	13,666,539
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	146 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	23,850
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	8 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.6 %
Growth	Compound
Total Calculated Cumulative ESALs	13,666,539

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	170	-	71
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	600	-	54
Total	-	-	-	920	-	146

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	169	71
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	601	54
Total	-	-	-	-	-	-	-	920	146

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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16 Franklin Street South
Kitchener, Ontario
Canada

Flexible Structural Design Module

Maple Grove Road - Vondrau Drive to Old Maple Grove Road
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	9,737,473
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	139 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	22,430
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.7 %
Growth	Compound
Total Calculated Cumulative ESALs	9,737,473

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	160	-	67
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	600	-	54
Total	-	-	-	910	-	142

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	160	67
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	564	51
Total	-	-	-	-	-	-	-	874	139

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Peto MacCallum Ltd.
16 Franklin Street South
Kitchener, Ontario
Canada

Flexible Structural Design Module

Maple Grove Road - Vondrau Drive to Old Maple Grove Road
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	9,588,066
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	139 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	22,310
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.6 %
Growth	Compound
Total Calculated Cumulative ESALs	9,588,066

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	160	-	67
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	600	-	54
Total	-	-	-	910	-	142

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	160	67
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	566	51
Total	-	-	-	-	-	-	-	876	139

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Flexible Structural Design Module

Maple Grove Road - Old Maple Grove Road to Hespeler Road
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	8,292,244
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	125 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	21,110
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	1.7 %
Growth	Compound
Total Calculated Cumulative ESALs	8,292,244

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	160	-	67
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	450	-	41
Total	-	-	-	760	-	129

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	156	66
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	427	38
Total	-	-	-	-	-	-	-	733	125

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Flexible Structural Design Module

Maple Grove Road - Old Maple Grove Road to Hespeler Road
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	6,242,444
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	120 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	18,740
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	0 %
Growth	Compound
Total Calculated Cumulative ESALs	6,242,444

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	150	-	63
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	400	-	36
Total	-	-	-	700	-	120

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	149	63
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	404	36
Total	-	-	-	-	-	-	-	703	120

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Flexible Structural Design Module

Maple Grove Road Roundabouts - Fountain Street to Vondrau Drive
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	27,424,762
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	159 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	23,930
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	8 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.6 %
Growth	Compound
Total Calculated Cumulative ESALs	27,424,762

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	190	-	80
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	650	-	59
Total	-	-	-	990	-	159

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	188	79
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	654	59
Total	-	-	-	-	-	-	-	992	159

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Flexible Structural Design Module

Maple Grove Road Roundabouts - Vondrau Drive to Old Maple Grove Road
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	19,474,945
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	153 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	22,430
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.7 %
Growth	Compound
Total Calculated Cumulative ESALs	19,474,945

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	180	-	76
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	625	-	56
Total	-	-	-	955	-	153

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	179	75
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	633	57
Total	-	-	-	-	-	-	-	962	153

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Flexible Structural Design Module

Maple Grove Road Roundabouts - Old Maple Grove Road to Hespeler Road
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,584,489
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	137 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	21,110
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	1.7 %
Growth	Compound
Total Calculated Cumulative ESALs	16,584,489

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	180	-	76
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	450	-	41
Total	-	-	-	780	-	137

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	174	73
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	476	43
Total	-	-	-	-	-	-	-	800	137

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Flexible Structural Design Module

Maple Grove Road Roundabouts - Fountain Street to Vondrau Drive
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	27,333,079
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	159 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	23,850
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	8 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.6 %
Growth	Compound
Total Calculated Cumulative ESALs	27,333,079

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	190	-	80
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	650	-	59
Total	-	-	-	990	-	159

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	188	79
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	654	59
Total	-	-	-	-	-	-	-	993	159

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Flexible Structural Design Module

Maple Grove Road Roundabouts - Vondrau Drive to Old Maple Grove Road
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	19,176,131
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	152 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	22,310
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.6 %
Growth	Compound
Total Calculated Cumulative ESALs	19,176,131

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	180	-	76
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	625	-	56
Total	-	-	-	955	-	153

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	178	75
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	624	56
Total	-	-	-	-	-	-	-	952	152

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Flexible Structural Design Module

Maple Grove Road Roundabouts - Old Maple Grove Road to Hespeler Road
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	12,484,888
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	132 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	18,740
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	0 %
Growth	Compound
Total Calculated Cumulative ESALs	12,484,888

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	170	-	71
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	450	-	41
Total	-	-	-	770	-	133

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	166	70
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	456	41
Total	-	-	-	-	-	-	-	773	132

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Flexible Structural Design Module

Hespeler Road - Guelph Avenue to Maple Grove Road
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,529,928
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	137 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	22,280
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	11 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2 %
Growth	Compound
Total Calculated Cumulative ESALs	16,529,928

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	180	-	76
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	450	-	41
Total	-	-	-	780	-	137

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	174	73
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	477	43
Total	-	-	-	-	-	-	-	801	137

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Flexible Structural Design Module

Hespeler Road - Guelph Avenue to Maple Grove Road
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,552,185
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	137 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	22,310
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	11 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2 %
Growth	Compound
Total Calculated Cumulative ESALs	16,552,185

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	180	-	76
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	450	-	41
Total	-	-	-	780	-	137

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	174	73
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	477	43
Total	-	-	-	-	-	-	-	801	137

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Flexible Structural Design Module

Hespeler Road - Maple Grove Road to Beaverdale Road/Queen Street West
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	26,516,086
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	146 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	34,140
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	12.1 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	1.5 %
Growth	Compound
Total Calculated Cumulative ESALs	26,516,086

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	190	-	80
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	500	-	45
Total	-	-	-	840	-	146

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	187	79
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	514	46
Total	-	-	-	-	-	-	-	852	146

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Flexible Structural Design Module

Hespeler Road - Maple Grove Road to Beaverdale Road/Queen Street West
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	22,033,277
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	142 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	31,570
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	12.1 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	0.4 %
Growth	Compound
Total Calculated Cumulative ESALs	22,033,277

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	180	-	76
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	500	-	45
Total	-	-	-	830	-	142

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	182	76
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	495	45
Total	-	-	-	-	-	-	-	827	142

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Peto MacCallum Ltd.
16 Franklin Street South
Kitchener, Ontario
Canada

Flexible Structural Design Module

Hespeler Road Roundabout - Maple Grove Road to Beaverdale Road/Queen Street West
Scenario 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	53,032,171
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	159 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	34,140
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	12.1 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	1.5 %
Growth	Compound
Total Calculated Cumulative ESALs	53,032,171

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	210	-	88
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	550	-	50
Total	-	-	-	910	-	159

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	209	88
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	559	50
Total	-	-	-	-	-	-	-	918	159

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Peto MacCallum Ltd.
16 Franklin Street South
Kitchener, Ontario
Canada

Flexible Structural Design Module

Hespeler Road Roundabout - Maple Grove Road to Beaverdale Road/Queen Street West
Scenario 2

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	44,066,554
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	85 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	40,000 kPa
Stage Construction	1
Calculated Design Structural Number	156 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	31,570
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	80 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	12.1 %
Average Initial Truck Factor (ESALs/truck)	1.9
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	0.4 %
Growth	Compound
Total Calculated Cumulative ESALs	44,066,554

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt	0.42	1	200	-	84
2	Granular A	0.14	1	150	-	21
3	Granular B	0.09	1	570	-	51
Total	-	-	-	920	-	156

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)
1	Asphalt	0.42	1	-	-	2,760,000	-	203	85
2	Granular A	0.14	1	150	-	250,000	-	150	21
3	Granular B	0.09	1	-	-	150,000	-	553	50
Total	-	-	-	-	-	-	-	906	156

APPENDIX C

ENGINEERED FILL

ENGINEERED FILL

The information presented in this appendix is intended for general guidance only. Site specific conditions and prevailing weather may require modification of compaction standards, backfill type or procedures. Each site must be discussed, and procedures agreed with Peto MacCallum Ltd. prior to the start of the earthworks and must be subject to ongoing review during construction. This appendix is not intended to apply to embankments. Steeply sloping ravine residential lots require special consideration.

For fill to be classified as engineered fill suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

1. Purpose

The site specific purpose of the engineered fill must be recognized. In advance of construction, all parties should discuss the project and its requirements and agree on an appropriate set of standards and procedures.

2. Minimum Extent

The engineered fill envelope must extend beyond the footprint of the structure to be supported. The minimum extent of the envelope should be defined from a geotechnical perspective by:

- at founding level, extend a minimum 1.0 m beyond the outer edge of the foundations, greater if adequate layout has not yet been completed as noted below; and
- extend downward and outward at a slope no greater than 45° to meet the subgrade

All fill within the envelope established above must meet the requirements of engineered fill in order to support the structure safely. Other considerations such as survey control, or construction methods may require an envelope that is larger, as noted in the following sections.

Once the minimum envelope has been established, structures must not be moved or extended without consultation with Peto MacCallum Ltd. Similarly, Peto MacCallum Ltd. should be consulted prior to any excavation within the minimum envelope.

3. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor in consultation with engineering staff from Peto MacCallum Ltd. Careful consideration of the maximum building envelope is required.

During construction it is necessary to have a qualified surveyor provide total station control on the three dimensional extent of filling.

4. Subsurface Preparation

Prior to placement of fill, the subgrade must be prepared to the satisfaction of Peto MacCallum Ltd. All deleterious material must be removed and in some cases, excavation of native mineral soils may be required.

Particular attention must be paid to wet subgrades and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching may be necessary and natural drainage paths must not be blocked.

5. Suitable Fill Materials

All material to be used as fill must be approved by Peto MacCallum Ltd. Such approval will be influenced by many factors and must be site and project specific. External fill sources must be sampled, tested and approved prior to material being hauled to site.

6. Test Section

In advance of the start of construction of the engineered fill pad, the Contractor should conduct a test section. The compaction criterion will be assessed in consultation with Peto MacCallum Ltd. for the various fill material types using different lift thicknesses and number of passes for the compaction equipment proposed by the Contractor.

Additional test sections may be required throughout the course of the project to reflect changes in fill sources, natural moisture content of the material and weather conditions.

The Contractor should be particularly aware of changes in the moisture content of fill material. Site review by Peto MacCallum Ltd. is required to ensure the desired lift thickness is maintained and that each lift is systematically compacted, tested and approved before a subsequent lift is commenced.

7. Inspection and Testing

Uniform, thorough compaction is crucial to the performance of the engineered fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be carried out under the full time inspection by Peto MacCallum Ltd.

All founding surfaces for all buildings and residential dwellings or any part thereof (including but not limited to footings and floor slabs) on structural fill or native soils must be inspected and approved by PML engineering personnel prior to placement of the base/subbase granular material and/or concrete. The purpose of the inspection is to ensure the subgrade soils are capable of supporting the building/house foundation and floor slab loads and to confirm the building/house envelope does not extend beyond the limits of any structural fill pads.

8. Protection of Fill

Fill is generally more susceptible to the effects of weather than natural soil. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where adequate protection has not been provided, it may be necessary to provide deeper footings or to strip and recompact some of the fill.

9. Construction Delay Time Considerations

The integrity of the fill pad can deteriorate due to the harsh effects of our Canadian weather. Hence, particular care must be taken if the fill pad is constructed over a long time period.

It is necessary therefore, that all fill sources are tested to ensure the material compactability prior to the soil arriving at site. When there has been a lengthy delay between construction periods of the fill pad, it is necessary to conduct subgrade proof rolling, test pits or boreholes to verify the adequacy of the exposed subgrade to accept new fill material.

When the fill pad will be constructed over a lengthy period of time, a field survey should be completed at the end of each construction season to verify the areal extent and the level at which the compacted fill has been brought up to, tested and approved.

In the following spring, subexcavation may be necessary if the fill pad has been softened attributable to ponded surface water or freeze/thaw cycles.

A new survey is required at the beginning of the next construction season to verify that random dumping and/or spreading of fill has not been carried out at the site.

10. Approved Fill Pad Surveillance

It should be appreciated that once the fill pad has been brought to final grade and documented by field survey, there must be ongoing surveillance to ensure that the integrity of the fill pad is not threatened.

Grading operations adjacent to fill pads can often take place several months or years after completion of the fill pad.

It is imperative that all site management and supervision staff, the staff of Contractors and earthwork operators be fully aware of the boundaries of all approved engineered fill pads.

Excavation into an approved engineered fill pad should never be contemplated without the full knowledge, approval and documentation by the geotechnical consultant.

If the fill pad is knowingly built several years in advance of ultimate construction, the areal limits of the fill pad should be substantially overbuilt laterally to allow for changes in possible structure location and elevation and other earthwork operations and competing interests on the site. The overbuilt distance required is project and/or site specified.

Iron bars should be placed at the corner/intermediate points of the fill pad as a permanent record of the approved limits of the work for record keeping purposes.

11. Unusual Working Conditions

Construction of fill pads may at times take place at night and/or during periods of freezing weather conditions because of the requirements of the project schedule. It should be appreciated therefore, that both situations present more difficult working conditions. The Owner, Contractor, Design Consultant and Geotechnical Engineer must be willing to work together to revise site construction procedures, enhance field testing and surveillance, and incorporate design modifications as necessary to suit site conditions.

When working at night there must be sufficient artificial light to properly illuminate the fill pad and borrow areas.

Placement of material to form an engineered fill pad during winter and freezing temperatures has its own special conditions that must be addressed. It is imperative that each day prior to placement of new fill, the exposed subgrade must be inspected and any overnight snow or frozen material removed. Particular attention should be given to the borrow source inspection to ensure only nonfrozen fill is brought to the site.

The Contractor must continually assess the work program and have the necessary spreading and compacting equipment to ensure that densification of the fill material takes place in a minimum amount of time. Changes may be required to the spreading methods, lift thickness, and compaction techniques to ensure the desired compaction is achieved uniformly throughout each fill lift.

The Contractor should adequately protect the subgrade at the end of each shift to minimize frost penetration overnight. Since water cannot be added to the fill material to facilitate compaction, it is imperative that densification of the fill be achieved by additional compaction effort and an appropriate reduced lift thickness. Once the fill pad has been completed, it must be properly protected from freezing temperatures and ponding of water during the spring thaw period.

If the pad is unusually thick or if the fill thickness varies dramatically across the width or length of the fill pad, Peto MacCallum Ltd. should be consulted for additional recommendations. In this case, alternative special provisions may be recommended, such as providing a surcharge preload for a limited time or increase the degree of compaction of the fill.

APPENDIX D

LEX AND SGS CERTIFICATES OF ANALYSIS

Asbestos

SOLUTIONS
FOR A WORKING WORLD

CERTIFICATE OF ANALYSIS

Company:	Peto MacCallum Ltd (Kitchener)	**Report Date:**	20-Mar-19
Contact:	Mr.Dylan Brice	**Analysis Date:**	20-Mar-19
Client Address:	16 Franklin St S, Kitchener, ON	**Received Date:**	11-Mar-19
Client Reference:	18KF047	**LEX Project Number:**	08190541
Sampling Date:		**Number of Analyses:**	30

Analysis Requested **Bulk Asbestos by PLM**

Analysis was performed in accordance with the method EPA/600/R-93/116, Method for the Determination of Asbestos in Bulk Building Materials adopted in Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations - made under the Occupational Health and Safety Act Ontario Regulation 278/05. LEX Scientific Inc. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP 101949) by the National Institute of Standards and Technology for analysis of bulk materials for asbestos.

German Leal, B.Sc.
Laboratory Manager

			Fibrous Asbestos Content %		Other Materials Content %
Client Sample:	BH 102-AGS.1	**Asbestos Detected?**		**No**	
LEX Sample:	01	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

This test report relates only to the items tested and must not be used to claim product endorsement by NVLAP or any agency of the United States government. This test report must not be reproduced, except in full, without the written consent of the laboratory.

291 Woodlawn Road West, Unit B-12 Guelph, Ontario N1H 7L6
1.800.824.7082
e-mail: admin@lexscientific.com Website: www.lexscientific.com

		Fibrous Asbestos Content %		Other Materials Content %	
Client Sample:	BH 103-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	02	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 105-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	03	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 109-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	04	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 111-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	05	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 114-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	06	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 117-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	07	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

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		Fibrous Asbestos Content %	Other Materials Content %
Client Sample:	BH 121-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	08	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 126-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	09	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 128-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	10	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 132-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	11	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 135-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	12	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 137-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	13	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

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		Fibrous Asbestos Content %		Other Materials Content %	
Client Sample:	BH 141-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	14	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 145-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	15	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 148-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	16	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 153-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	17	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 157-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	18	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 160-AGS.1	**Asbestos Detected?**	**No**		
LEX Sample:	19	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

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		Fibrous Asbestos Content %		Other Materials Content %	
Client Sample:	BH 163-AGS.1	**Asbestos Detected?**		**No**	
LEX Sample:	20	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 166-AGS.1	**Asbestos Detected?**		**No**	
LEX Sample:	21	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 169-AGS.1	**Asbestos Detected?**		**No**	
LEX Sample:	22	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 171-AGS.1	**Asbestos Detected?**		**No**	
LEX Sample:	23	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 174-AGS.1	**Asbestos Detected?**		**No**	
LEX Sample:	24	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	BH 175-AGS.1	**Asbestos Detected?**		**No**	
LEX Sample:	25	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Asphalt	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

This test report relates only to the items tested and must not be used to claim product endorsement by NVLAP or any agency of the United States government. This test report must not be reproduced, except in full, without the written consent of the laboratory.

		Fibrous Asbestos Content %	Other Materials Content %
Client Sample:	BH 178-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	26	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 183-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	27	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 188-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	28	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 191-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	29	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	
Client Sample:	BH 198-AGS.1	**Asbestos Detected?**	**No**
LEX Sample:	30	**Chrysotile:** None Detected	**Cellulose:** None Detected
Layers Analyzed:	Asphalt	**Amosite:** None Detected	**MMVF:** None Detected
Colour:	Black	**Crocidolite:** None Detected	**Other Fibres:** None Detected
Description:	Pulverized Asphalt	**Other Amphiboles:** None Detected	**Non Fibrous:** 100
		Comments: N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

This test report relates only to the items tested and must not be used to claim product endorsement by NVLAP or any agency of the United States government. This test report must not be reproduced, except in full, without the written consent of the laboratory.

Corrosivity

FINAL REPORT

CA14588-FEB19 R1

18KF047

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS

Client	Peto MacCallum Ltd
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada
Contact	Dylan Brice
Telephone	519-893-7500
Facsimile	519-893-0654
Email	dbrice@petomaccallum.com; khanes@petomaccallum.com
Project	18KF047
Order Number	
Samples	Soil (6)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2000
Facsimile	705-652-6365
Email	
SGS Reference	CA14588-FEB19
Received	02/25/2019
Approved	03/01/2019
Report Number	CA14588-FEB19 R1
Date Reported	03/01/2019

COMMENTS

Temperature of Sample upon Receipt: 5 degrees C
Cooling Agent Present: no
Custody Seal Present: no

Chain of Custody Number: 01358

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

SIGNATORIES

Brad Moore Hon. B.Sc

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Client: Peto MacCallum Ltd
Project: 18KF047
Project Manager: Dylan Brice
Samplers: D Brice

PACKAGE: **- Corrosivity Index** (SOIL)

			Sample Number	5	6	7	8	9	10
			Sample Name	BH108 SS6	BH124 SS5	BH132 SS4	BH143 SS5	BH145 SS5	BH163 SS5
			Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
			Sample Date	14/01/2019	17/01/2019	22/02/2019	21/02/2019	21/02/2019	21/01/2019
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Corrosivity Index									
Corrosivity Index	none	1		6	4	14	6	14	4
Soil Redox Potential	mV	-		222	242	238	276	272	226
Sulphide	%	0.02		0.06	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
pH	pH Units	0.05		8.50	8.96	8.83	9.17	9.42	8.55
Resistivity (calculated)	ohms.cm	-9999		2500	6600	1000	2500	970	5800

PACKAGE: **- General Chemistry** (SOIL)

			Sample Number	5	6	7	8	9	10
			Sample Name	BH108 SS6	BH124 SS5	BH132 SS4	BH143 SS5	BH145 SS5	BH163 SS5
			Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
			Sample Date	14/01/2019	17/01/2019	22/02/2019	21/02/2019	21/02/2019	21/01/2019
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
General Chemistry									
Conductivity	uS/cm	2		403	151	964	401	1030	172

PACKAGE: **- Metals and Inorganics** (SOIL)

			Sample Number	5	6	7	8	9	10
			Sample Name	BH108 SS6	BH124 SS5	BH132 SS4	BH143 SS5	BH145 SS5	BH163 SS5
			Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
			Sample Date	14/01/2019	17/01/2019	22/02/2019	21/02/2019	21/02/2019	21/01/2019
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Metals and Inorganics									
Moisture Content	%	0.1		9.8	18.4	15.9	10.3	15.9	8.2
Sulphate	µg/g	0.4		120	11	12	6.4	22	12

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D Brice

PACKAGE: **- Other (ORP)** (SOIL)

Sample Number			5	6	7	8	9	10		
Sample Name			BH108 SS6	BH124 SS5	BH132 SS4	BH143 SS5	BH145 SS5	BH163 SS5		
Sample Matrix			Soil	Soil	Soil	Soil	Soil	Soil		
Sample Date			14/01/2019	17/01/2019	22/02/2019	21/02/2019	21/02/2019	21/01/2019		
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	
Other (ORP)										
Chloride	µg/g	0.4		70	11	430	95	320	21	

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0346-FEB19	µg/g	0.4	<0.4	4	20	95	80	120	102	75	125
Sulphate	DIO0346-FEB19	µg/g	0.4	<0.4	1	20	94	80	120	94	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0041-FEB19	%	0.02	<0.02	ND	20	119	80	120			

QC SUMMARY

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS

Request for Laboratory Services and CHAIN OF CUSTODY

No: 01358

Page ____ of ____

SGS Environment, Health and Safety
- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

Laboratory Information Section - Lab use only

Received By: SCOTT Fox
Received Date: 02/22/19 (mm\dd\yy)
Received Time: 14:12 am / (pm) (circle)

Received By (signature): S
Custody Seal Present: Y / (N) (circle)
Custody Seal Intact: Y / (N)

Cooling Agent Present: Y / (N) Type: ____
Temperature Upon Receipt (°C): 5°C, 5°C, 5°C

LAB LIMS #: CA14579-Feb 19
COTT CA14588-Feb 19.

REPORT INFORMATION

Company: PETO MacCallum LTD
Contact: DYLAN BRICE
Address: 16 FRANKLIN ST S
KIT, ONT, N2C 1R4
Phone: 519-893-7500
Fax: 519-893-0654
Email: dbrice@petomaccallum.com

INVOICE INFORMATION

(X) (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 18KF047
Site Location/ID: 1 CAMBRIDGE

TURNAROUND TIME (TAT) REQUIRED

(X) Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 3pm or on weekends : TAT begins the next business day

RUSH TAT (Additional Charges May Apply) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

DRINKING WATER SAMPLES (POTABLE WATER FOR HUMAN CONSUMPTION) MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153 (2011):
☐ Table 1 ☐ Res/Park Soil Texture:
☐ Table 2 ☐ Ind/Com ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ Medium
☐ Table ____ ☐ Fine

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	M+I	PHC F1-F4 w/ BTEX			Corrosivity PKG							COMMENTS: Field Filtered (F) Preserved (P)
1	BH 144 SS 5	Feb 21/19		4	S	X	X	X									
2	BH 108 SS 6	Jan 14/19		1						X							
3	BH 124 SS 5	Jan 17/19		1						X							
4	BH 132 SS 4	Feb 22/19		1						X							
5	BH 143 SS 5	Feb 21/19		1						X							
6	BH 145 SS 5	Jan 30/19		1						X							
7	BH 163 SS 5	Jan 21/19		1						X							
8																	
9																	
10																	

Observations/Comments/Special Instructions

Sampled By (NAME): D. BRICE **Signature:** [signature] Date: 02/22/19 (mm/dd/yy)

Relinquished by (NAME): D. BRICE **Signature:** [signature] Date: 02/22/19 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 25 July, 2016

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SGS

SAMPLE INTEGRITY REPORT

Project Number: 18 KF 047

ONTARIO REGULATION 153/04

SGS Sample ID CA 14579 feb 19

Date / Time Sampled Jan 14, 17, ~~30~~ feb 21, 22

Client Sample ID See C of C

ALL

Sample Submission General Sample Integrity Violations	
Temperature >10 C upon receipt if not sampled same day	☐
No evidence of cooling trend initiated if sampled same day	☐
Chain of Custody not submitted	☐
Chain of Custody incomplete	☑ no reg selected
Chain of Custody not signed / dated	☐
Chain of Custody not a current version	☐
Bottles / Samples listed on CoC but not received	☑ did not rec' BH114 SS5
Bottles / Samples received but not listed on the CoC	☑ rec'd BH14 SS3 - on hold.
Sample container received empty	☐

Sample Specific Sample Integrity Violations							
Sample received past hold time	☐	☐	☐	☐	☐	☐	☐
Incorrect preservation (including no preservation where required)	☐	☐	☐	☐	☐	☐	☐
Headspace present in VOC vial (aqueous)	☐	☐	☐	☐	☐	☐	☐
Sample(s) received frozen	☐	☐	☐	☐	☐	☐	☐
Bottle(s) broken or damaged in transport	☐	☐	☐	☐	☐	☐	☐
Discrepancy between sample label and chain of custody	☑	☐	☐	☐	☐	☐	☐
Analysis requirements absent / unclear	☐	☐	☐	☐	☐	☐	☐
Missing or incorrect sample label(s)	☐	☐	☐	☐	☐	☐	☐
Inappropriate sample container used	☑	☐	☐	☐	☐	☐	☐
Insufficient number of bottles received	☐	☐	☐	☐	☐	☐	☐
Limited sample volume	☐	☐	☐	☐	☐	☐	☐
Insufficient sample volume	☐	☐	☐	☐	☐	☐	☐
Sample contains multiple phases	☐	☐	☐	☐	☐	☐	☐

Sediment Log							
Groundwater samples contain visible sediment / particulate	☐	☐	☐	☐	☐	☐	☐
Groundwater contains greater than 1cm of sediment / particulate matter in bottle	☐	☐	☐	☐	☐	☐	☐

Additional Comments/Remarks:

No issues upon receipt ☐ Initials: _____

all of 14588 rec'd in plastic bags - transferred to soil jars.

for 14588 - 10's only had bore hole #, not in format of "BHx SSx"

Moore, Brad (Lakefield)

From: Dylan Brice <dbrice@petomaccallum.com>
Sent: Monday, February 25, 2019 5:47 PM
To: Moore, Brad (Lakefield)
Subject: Re: 18KF047 Table?

Hi Brad,

Yes, could we please get 3 sets of results.

T1 All

T2 RPI

T2 ICC

Thanks,

Dylan Brice

Get Outlook for Android

From: Moore, Brad (Lakefield) <brad.moore@sgs.com>
Sent: Monday, February 25, 2019 4:52:27 PM
To: Dylan Brice
Subject: 18KF047 Table?

Hi Dylan,

The attached CofC was picked up with your samples today and I noticed that there is no table indicated for the Reg 153 parameters. Is there a table you would like the results compared to?

Regards,

Brad Moore, Hon.B.Sc.,
Environment, Health & Safety
Project Specialist

SGS Canada Inc.
Phone: +1 705-652-2143
Mobile: +1 705-559-9095

E-mail: brad.moore@sgs.com

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O.Reg. 153/04, As Amended, Table 1 Standards (Soil)

(Residential / Parkland / Institutional / Industrial / Commercial / Community Property Use)

and

O.Reg. 153/04, As Amended, Table 2 Standards (Soil)

(Industrial / Commercial / Community Property Use)

FINAL REPORT

CA14505-DEC18 R1

18KF047

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Peto MacCallum Ltd	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Dylan Brice	Telephone	705-652-2000
Telephone	519-893-7500	Facsimile	705-652-6365
Facsimile	519-893-0654	Email	
Email	dbrice@petomaccallum.com; khanes@petomaccallum.com	SGS Reference	CA14505-DEC18
Project	18KF047	Received	12/20/2018
Order Number		Approved	12/27/2018
Samples	Soil (3)	Report Number	CA14505-DEC18 R1
		Date Reported	05/09/2019

COMMENTS

CCME Method Compliance: Analyses were conducted using analytical procedures that comply with the Reference Method for the CWS for Petroleum Hydrocarbons in Soil and have been validated for use at the SGS laboratory, Lakefield, ON site.

Quality Compliance: Instrument performance / calibration quality criteria were met and extraction and analysis limits for holding times were met.

nC6 and nC10 response factors within 30% of response factor for toluene: YES

nC10, nC16 and nC34 response factors within 10% of the average response for the three compounds: YES

C50 response factors within 70% of nC10 + nC16 + nC34 average: YES

Linearity is within 15%: YES

F4G - gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
The results for F4 and F4G are both reported and the greater of the two values is to be used in application to the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

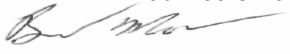
Temperature of Sample upon Receipt: 3 degrees C
Cooling Agent Present: yes
Custody Seal Present: no

Chain of Custody Number: 00342

sample 12 received past 14d hold time for PHC+BTEX.

SIGNATORIES

Brad Moore Hon. B.Sc



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Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - BTEX** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	11	12	13
				Sample Name	BH2 SS 3	BH3 SS 5	BH6 SS 10
				Sample Matrix	Soil	Soil	Soil
				Sample Date	11/12/2018	04/12/2018	13/12/2018
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
BTEX							
Benzene	µg/g	0.02	0.02	0.32	< 0.02	< 0.02	< 0.02
Ethylbenzene	µg/g	0.05	0.05	1.1	< 0.05	< 0.05	< 0.05
Toluene	µg/g	0.05	0.2	6.4	< 0.05	< 0.05	< 0.05
Xylene (total)	µg/g	0.05	0.05	26	< 0.05	< 0.05	< 0.05
m/p-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05
o-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05

PACKAGE: **REG153 - Hydrides** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	11	12	13
				Sample Name	BH2 SS 3	BH3 SS 5	BH6 SS 10
				Sample Matrix	Soil	Soil	Soil
				Sample Date	11/12/2018	04/12/2018	13/12/2018
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Hydrides							
Antimony	µg/g	0.8	1.3	40	< 0.8	< 0.8	< 0.8
Arsenic	µg/g	0.5	18	18	0.9	1.5	1.0
Selenium	µg/g	0.7	1.5	5.5	< 0.7	< 0.7	< 0.7

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - Metals and Inorganics** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	11	12	13
					Sample Name	BH2 SS 3	BH3 SS 5	BH6 SS 10
					Sample Matrix	Soil	Soil	Soil
					Sample Date	11/12/2018	04/12/2018	13/12/2018
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Metals and Inorganics							
Moisture Content	%	-			18.6	13.9	9.5
Barium	µg/g	0.1	220	670	4.4	11	14
Beryllium	µg/g	0.02	2.5	8	0.07	0.11	0.10
Boron	µg/g	1	36	120	3	4	4
Cadmium	µg/g	0.02	1.2	1.9	0.18	0.25	0.23
Chromium	µg/g	0.5	70	160	3.6	5.6	8.2
Cobalt	µg/g	0.01	21	80	1.2	2.3	2.0
Copper	µg/g	0.1	92	230	3.4	8.2	7.0
Lead	µg/g	0.1	120	120	9.1	7.8	6.1
Molybdenum	µg/g	0.1	2	40	< 0.1	0.2	0.2
Nickel	µg/g	0.5	82	270	2.6	4.9	4.2
Silver	µg/g	0.05	0.5	40	< 0.05	< 0.05	< 0.05
Thallium	µg/g	0.02	1	3.3	< 0.02	0.03	0.03
Uranium	µg/g	0.002	2.5	33	0.27	0.32	0.47
Vanadium	µg/g	3	86	86	8	9	10
Zinc	µg/g	0.7	290	340	57	74	67
Water Soluble Boron	µg/g	0.5		2	< 0.5	< 0.5	< 0.5

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - Other (ORP)** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	11	12	13
					Sample Name	BH2 SS 3	BH3 SS 5	BH6 SS 10
					Sample Matrix	Soil	Soil	Soil
					Sample Date	11/12/2018	04/12/2018	13/12/2018
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Other (ORP)							
Mercury	µg/g	0.05	0.27	3.9	< 0.05	< 0.05	< 0.05
Sodium Adsorption Ratio	---	0.2	2.4	12	0.7	10.0	0.4
SAR Calcium	mg/L	0.09			25.7	23.9	12.1
SAR Magnesium	mg/L	0.02			4.6	4.1	8.3
SAR Sodium	mg/L	0.15			15.4	216	7.4
Conductivity	mS/cm	0.002	0.57	1.4	0.12	1.3	0.19
pH	pH Units	0.05			7.89	7.86	8.15
Chromium VI	µg/g	0.2	0.66	8	< 0.2	< 0.2	< 0.2
Free Cyanide	µg/g	0.05			< 0.05	< 0.05	< 0.05

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - PHCs** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	11	12	13
				Sample Name	BH2 SS 3	BH3 SS 5	BH6 SS 10
				Sample Matrix	Soil	Soil	Soil
				Sample Date	11/12/2018	04/12/2018	13/12/2018
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
PHCs							
F1 (C6-C10)	µg/g	10	25	55	< 10	< 10	< 10
F1-BTEX (C6-C10)	µg/g	10			< 10	< 10	< 10
F2 (C10-C16)	µg/g	10	10	230	< 10	< 10	< 10
F3 (C16-C34)	µg/g	50	240	1700	< 50	< 50	< 50
F4 (C34-C50)	µg/g	50	120	3300	< 50	< 50	< 50
Chromatogram returned to baseline at nC50	Yes / No	-			YES	YES	YES

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED L1	REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED L2
BH3 SS 5					
Conductivity	EPA 6010/SM 2510	µg/g	1.3	0.57	
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	10.0	2.4	

QC SUMMARY

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0408-DEC18	mS/cm	0.002	<0.002	0	10	99	90	110	NA		

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA5055-DEC18	µg/g	0.05	<0.05	ND	20	104	80	120	83	75	125

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-IENVIIC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0322-DEC18	µg/g	0.2	<0.2	ND	20	98	80	120	97	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EMS0120-DEC18	µg/g	0.05	<0.05	ND	20	109	80	120	103	70	130

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-IENVISPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
SAR Calcium	ESG0063-DEC18	mg/L	0.09	<0.09	3	20	97	80	120	NV	70	130
SAR Magnesium	ESG0063-DEC18	mg/L	0.02	<0.02	7	20	97	80	120	NV	70	130
SAR Sodium	ESG0063-DEC18	mg/L	0.15	<0.15	2	20	96	80	120	126	70	130

QC SUMMARY

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0120-DEC18	ug/g	0.05	<0.05	ND	20	94	70	130	107	70	130
Arsenic	EMS0120-DEC18	µg/g	0.5	<0.5	17	20	101	70	130	95	70	130
Barium	EMS0120-DEC18	ug/g	0.1	<0.1	19	20	104	70	130	92	70	130
Beryllium	EMS0120-DEC18	µg/g	0.02	<0.02	16	20	96	70	130	96	70	130
Boron	EMS0120-DEC18	µg/g	1	<1	16	20	110	70	130	108	70	130
Cadmium	EMS0120-DEC18	µg/g	0.02	<0.02	ND	20	96	70	130	109	70	130
Cobalt	EMS0120-DEC18	µg/g	0.01	<0.01	20	20	98	70	130	111	70	130
Chromium	EMS0120-DEC18	µg/g	0.5	<0.5	19	20	101	70	130	113	70	130
Copper	EMS0120-DEC18	µg/g	0.1	<0.1	ND	20	98	70	130	107	70	130
Molybdenum	EMS0120-DEC18	µg/g	0.1	<0.1	8	20	98	70	130	96	70	130
Nickel	EMS0120-DEC18	ug/g	0.5	<0.5	20	20	97	70	130	111	70	130
Lead	EMS0120-DEC18	ug/g	0.1	<0.1	ND	20	97	70	130	106	70	130
Antimony	EMS0120-DEC18	µg/g	0.8	<0.8	ND	20	101	70	130	102	70	130
Selenium	EMS0120-DEC18	µg/g	0.7	<0.7	ND	20	101	70	130	99	70	130
Thallium	EMS0120-DEC18	µg/g	0.02	<0.02	18	20	97	70	130	104	70	130
Uranium	EMS0120-DEC18	µg/g	0.002	<0.002	15	20	94	70	130	97	70	130
Vanadium	EMS0120-DEC18	µg/g	3	<3	18	20	102	70	130	113	70	130
Zinc	EMS0120-DEC18	µg/g	0.7	<0.7	ND	20	98	70	130	108	70	130

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENVIGC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F1 (C6-C10)	GCM0298-DEC18	µg/g	10	<10	ND	30	98	80	120	101	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENVIGC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F2 (C10-C16)	GCM0307-DEC18	µg/g	10	<10	ND	30	119	80	120	113	60	140
F3 (C16-C34)	GCM0307-DEC18	µg/g	50	<50	ND	30	119	80	120	113	60	140
F4 (C34-C50)	GCM0307-DEC18	µg/g	50	<50	ND	30	119	80	120	113	60	140

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	ARD0063-DEC18	pH Units	0.05		0	20	100	80	120			

Volatile Organics

Method: EPA 5035A/5030B/8260C I Internal ref.: ME-CA-[ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Benzene	GCM0297-DEC18	µg/g	0.02	< 0.02	ND	50	86	60	130	87	50	140
Ethylbenzene	GCM0297-DEC18	µg/g	0.05	< 0.05	ND	50	86	60	130	87	50	140
m/p-xylene	GCM0297-DEC18	µg/g	0.05	< 0.05	ND	50	86	60	130	87	50	140
o-xylene	GCM0297-DEC18	µg/g	0.05	< 0.05	ND	50	87	60	130	88	50	140
Toluene	GCM0297-DEC18	µg/g	0.05	< 0.05	ND	50	87	60	130	87	50	140

QC SUMMARY

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-IENVI SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Water Soluble Boron	ESG0057-DEC18	µg/g	0.5	<0.5	ND	20	104	80	120	113	70	130

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS

Request for Laboratory Services and CHAIN OF CUSTODY

No: 00342

SGS Environment, Health and Safety
- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

Page ___ of ___

Laboratory Information Section - Lab use only

Received By: Email
Received Date: 12\20\18 (mm\dd\yy)
Received Time: 03:30 am / pm (circle)
Received By (signature): [signature]
Custody Seal Present: Y / N (circle)
Custody Seal Intact: Y / N
Cooling Agent Present: (Y) / N Type: ___
Temperature Upon Receipt (°C) 2,7,8 3x3
LAB LIMS #: CA14505-DEC 18

REPORT INFORMATION

Company: PETO MacCallum LTD
Contact: D. BRICE
Address: 16 FRANKLIN ST S
KIT, ONT, N2C 1R4
Phone: 519-893-7500
Fax: 519-893-0654
Email: dbrice@petomaccallum.com

INVOICE INFORMATION

☒ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #: ___ P.O. #: ___
Project #: 18KF047 Site Location/ID: CAMBRIDGE

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 3pm or on weekends : TAT begins the next business day

RUSH TAT (Additional Charges May Apply) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: ___ Rush Confirmation ID: ___

DRINKING WATER SAMPLES (POTABLE WATER FOR HUMAN CONSUMPTION) MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153 (2011):
☒ Table 1 ☒ Res/Park Soil Texture: ☐ Coarse
☒ Table 2 ☒ Ind/Com ☐ Medium
☐ Table 3 ☐ Agri/Other ☐ Fine
☐ Table ___

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☒ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	HAT	PHC F1-F4 +BTEX									COMMENTS: Field Filtered (F) Preserved (P)
1	BH2 SS3	Dec 11/18	10:00	4	S	X	X									
2	BH3 SS5	Dec 4/18	13:00	4	S	X	X									
3	BH6 SS10	Dec 13/18	15:00	4	S	X	X									
4																
5																
6																
7																
8																
9																
10																

Observations/Comments/Special Instructions: 2 C.O.A req'd: T1 / T2 ICC/RPI

Sampled By (NAME): D. BRICE Signature: [signature] Date: 12/20/18 (mm/dd/yy) Pink Copy - Client

Relinquished by (NAME): D. BRICE Signature: [signature] Date: 12/20/18 (mm/dd/yy) Yellow & White Copy - SGS

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SGS

SAMPLE INTEGRITY REPORT

Project Number: 18KF047

ONTARIO REGULATION 153/04

SGS Sample ID CA14505 Dec 18

Date / Time Sampled Dec 4, 11, 13/2018

Client Sample ID See COFC

	ALL
Sample Submission General Sample Integrity Violations	
Temperature >10 C upon receipt if not sampled same day	☐
No evidence of cooling trend initiated if sampled same day	☐
Chain of Custody not submitted	☐
Chain of Custody incomplete	☐
Chain of Custody not signed / dated	☐
Chain of Custody not a current version	☐
Bottles / Samples listed on CoC but not received	☐
Bottles / Samples received but not listed on the CoC	☐
Sample container received empty	☐

Sample Specific Sample Integrity Violations							
Sample received past hold time	☐	☐	☐	☐	☐	☐	☐
Incorrect preservation (including no preservation where required)	☐	☐	☐	☐	☐	☐	☐
Headspace present in VOC vial (aqueous)	☐	☐	☐	☐	☐	☐	☐
Sample(s) received frozen	☐	☐	☐	☐	☐	☐	☐
Bottle(s) broken or damaged in transport	☐	☐	☐	☐	☐	☐	☐
Discrepancy between sample label and chain of custody	☐	☐	☐	☐	☐	☐	☐
Analysis requirements absent / unclear	☐	☐	☐	☐	☐	☐	☐
Missing or incorrect sample label(s)	☐	☐	☐	☐	☐	☐	☐
Inappropriate sample container used	☐	☐	☐	☐	☐	☐	☐
Insufficient number of bottles received	☐	☐	☐	☐	☐	☐	☐
Limited sample volume	☐	☐	☐	☐	☐	☐	☐
Insufficient sample volume	☐	☐	☐	☐	☐	☐	☐
Sample contains multiple phases	☐	☐	☐	☐	☐	☐	☐
Sediment Log							
Groundwater samples contain visible sediment / particulate	☐	☐	☐	☐	☐	☐	☐
Groundwater contains greater than 1cm of sediment / particulate matter in bottle	☐	☐	☐	☐	☐	☐	☐

Additional Comments/Remarks:

No issues upon receipt ☑ Initials: KH

FINAL REPORT

CA14579-FEB19 R1

18KF047

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Peto MacCallum Ltd	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Dylan Brice	Telephone	705-652-2000
Telephone	519-893-7500	Facsimile	705-652-6365
Facsimile	519-893-0654	Email	
Email	dbrice@petomaccallum.com; khanes@petomaccallum.com	SGS Reference	CA14579-FEB19
Project	18KF047	Received	02/28/2019
Order Number		Approved	03/05/2019
Samples	Soil (1)	Report Number	CA14579-FEB19 R1
		Date Reported	05/09/2019

COMMENTS

CCME Method Compliance: Analyses were conducted using analytical procedures that comply with the Reference Method for the CWS for Petroleum Hydrocarbons in Soil and have been validated for use at the SGS laboratory, Lakefield, ON site.

Quality Compliance: Instrument performance / calibration quality criteria were met and extraction and analysis limits for holding times were met.

nC6 and nC10 response factors within 30% of response factor for toluene: YES

nC10, nC16 and nC34 response factors within 10% of the average response for the three compounds: YES

C50 response factors within 70% of nC10 + nC16 + nC34 average: YES

Linearity is within 15%: YES

F4G - gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
The results for F4 and F4G are both reported and the greater of the two values is to be used in application to the CWS PHC.

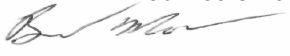
Hydrocarbon results are expressed on a dry weight basis.

Temperature of Sample upon Receipt: 5 degrees C
Cooling Agent Present:No
Custody Seal Present:No

Chain of Custody Number:01358

SIGNATORIES

Brad Moore Hon. B.Sc



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Client: Peto MacCallum Ltd
Project: 18KF047
Project Manager: Dylan Brice
Samplers: D.Bruce

PACKAGE: **REG153 - BTEX** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Sample Number	11
Sample Name	BH 144 SS5
Sample Matrix	Soil
Sample Date	21/02/2019

Parameter	Units	RL	L1	L2	Result
BTEX					
Benzene	µg/g	0.02	0.02	0.32	< 0.02
Ethylbenzene	µg/g	0.05	0.05	1.1	< 0.05
Toluene	µg/g	0.05	0.2	6.4	< 0.05
Xylene (total)	µg/g	0.05	0.05	26	< 0.05
m/p-xylene	µg/g	0.05			< 0.05
o-xylene	µg/g	0.05			< 0.05

PACKAGE: **REG153 - Hydrides** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Sample Number	11
Sample Name	BH 144 SS5
Sample Matrix	Soil
Sample Date	21/02/2019

Parameter	Units	RL	L1	L2	Result
Hydrides					
Antimony	µg/g	0.8	1.3	40	< 0.8
Arsenic	µg/g	0.5	18	18	2.1
Selenium	µg/g	0.7	1.5	5.5	< 0.7

Client: Peto MacCallum Ltd
Project: 18KF047
Project Manager: Dylan Brice
Samplers: D.Bruce

PACKAGE: **REG153 - Metals and Inorganics** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Sample Number	11
Sample Name	BH 144 SS5
Sample Matrix	Soil
Sample Date	21/02/2019

Parameter	Units	RL	L1	L2	Result
Metals and Inorganics					
Moisture Content	%	-			8.6
Barium	µg/g	0.1	220	670	17
Beryllium	µg/g	0.02	2.5	8	0.14
Boron	µg/g	1	36	120	4
Cadmium	µg/g	0.02	1.2	1.9	0.15
Chromium	µg/g	0.5	70	160	6.2
Cobalt	µg/g	0.01	21	80	2.6
Copper	µg/g	0.1	92	230	8.1
Lead	µg/g	0.1	120	120	7.1
Molybdenum	µg/g	0.1	2	40	0.2
Nickel	µg/g	0.5	82	270	5.7
Silver	µg/g	0.05	0.5	40	< 0.05
Thallium	µg/g	0.02	1	3.3	0.05
Uranium	µg/g	0.002	2.5	33	0.36
Vanadium	µg/g	3	86	86	10
Zinc	µg/g	0.7	290	340	74
Water Soluble Boron	µg/g	0.5		2	< 0.5

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Bruce

PACKAGE: **REG153 - Other (ORP)** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Sample Number	11
Sample Name	BH 144 SS5
Sample Matrix	Soil
Sample Date	21/02/2019

Parameter	Units	RL	L1	L2	Result
Other (ORP)					
Mercury	µg/g	0.05	0.27	3.9	< 0.05
Sodium Adsorption Ratio	---	0.2	2.4	12	3.2
SAR Calcium	mg/L	0.09			34.2
SAR Magnesium	mg/L	0.02			19.2
SAR Sodium	mg/L	0.15			94.2
Conductivity	mS/cm	0.002	0.57	1.4	0.52
pH	pH Units	0.05			8.15
Chromium VI	µg/g	0.2	0.66	8	< 0.2
Free Cyanide	µg/g	0.05			< 0.05

Client: Peto MacCallum Ltd
Project: 18KF047
Project Manager: Dylan Brice
Samplers: D.Bruce

PACKAGE: **REG153 - PHCs** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Sample Number	11
Sample Name	BH 144 SS5
Sample Matrix	Soil
Sample Date	21/02/2019

Parameter	Units	RL	L1	L2	Result
PHCs					
F1 (C6-C10)	µg/g	10	25	55	< 10
F1-BTEX (C6-C10)	µg/g	10			< 10
F2 (C10-C16)	µg/g	10	10	230	< 10
F3 (C16-C34)	µg/g	50	240	1700	< 50
F4 (C34-C50)	µg/g	50	120	3300	< 50
Chromatogram returned to baseline at nC50	Yes / No	-			YES

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED L1	REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED L2
BH 144 SS5					
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	3.2	2.4	

QC SUMMARY

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0015-MAR19	mS/cm	0.002	<0.002	0	10	99	90	110	NA		

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA5075-FEB19	µg/g	0.05	<0.05	ND	20	95	80	120	79	75	125

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-IENVIIC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0003-MAR19	µg/g	0.2	<0.2	ND	20	99	80	120	107	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EMS0006-MAR19	µg/g	0.05	<0.05	ND	20	106	80	120	101	70	130

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-IENVISPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
SAR Calcium	ESG0003-MAR19	mg/L	0.09	<0.09	NV	20	102	80	120	95	70	130
SAR Magnesium	ESG0003-MAR19	mg/L	0.02	<0.02	2	20	99	80	120	98	70	130
SAR Sodium	ESG0003-MAR19	mg/L	0.15	<0.15	10	20	96	80	120	92	70	130

QC SUMMARY

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENVISPE-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0006-MAR19	ug/g	0.05	<0.05	ND	20	100	70	130	110	70	130
Arsenic	EMS0006-MAR19	µg/g	0.5	<0.5	1	20	104	70	130	108	70	130
Barium	EMS0006-MAR19	ug/g	0.1	<0.1	4	20	108	70	130	104	70	130
Beryllium	EMS0006-MAR19	µg/g	0.02	<0.02	2	20	100	70	130	98	70	130
Boron	EMS0006-MAR19	µg/g	1	<1	2	20	108	70	130	103	70	130
Cadmium	EMS0006-MAR19	µg/g	0.02	<0.02	7	20	99	70	130	109	70	130
Cobalt	EMS0006-MAR19	µg/g	0.01	<0.01	1	20	101	70	130	113	70	130
Chromium	EMS0006-MAR19	µg/g	0.5	<0.5	2	20	100	70	130	112	70	130
Copper	EMS0006-MAR19	µg/g	0.1	<0.1	1	20	101	70	130	110	70	130
Molybdenum	EMS0006-MAR19	µg/g	0.1	<0.1	NV	20	96	70	130	88	70	130
Nickel	EMS0006-MAR19	ug/g	0.5	<0.5	4	20	100	70	130	113	70	130
Lead	EMS0006-MAR19	ug/g	0.1	<0.1	1	20	102	70	130	101	70	130
Antimony	EMS0006-MAR19	µg/g	0.8	<0.8	ND	20	96	70	130	96	70	130
Selenium	EMS0006-MAR19	µg/g	0.7	<0.7	ND	20	102	70	130	106	70	130
Thallium	EMS0006-MAR19	µg/g	0.02	<0.02	NV	20	104	70	130	107	70	130
Uranium	EMS0006-MAR19	µg/g	0.002	<0.002	4	20	99	70	130	97	70	130
Vanadium	EMS0006-MAR19	µg/g	3	<3	1	20	103	70	130	111	70	130
Zinc	EMS0006-MAR19	µg/g	0.7	<0.7	0	20	102	70	130	108	70	130

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENVIGC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F1 (C6-C10)	GCM0008-MAR19	µg/g	10	<10	ND	30	99	80	120	81	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENVIGC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F2 (C10-C16)	GCM0003-MAR19	µg/g	10	<10	ND	30	113	80	120	98	60	140
F3 (C16-C34)	GCM0003-MAR19	µg/g	50	<50	6	30	113	80	120	98	60	140
F4 (C34-C50)	GCM0003-MAR19	µg/g	50	<50	9	30	113	80	120	98	60	140

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	ARD0001-MAR19	pH Units	0.05		0	20	100	80	120			

Volatile Organics

Method: EPA 5035A/5030B/8260C I Internal ref.: ME-CA-[ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Benzene	GCM0007-MAR19	µg/g	0.02	< 0.02	ND	50	89	60	130	NV	50	140
Ethylbenzene	GCM0007-MAR19	µg/g	0.05	< 0.05	ND	50	89	60	130	NV	50	140
m/p-xylene	GCM0007-MAR19	µg/g	0.05	< 0.05	ND	50	89	60	130	NV	50	140
o-xylene	GCM0007-MAR19	µg/g	0.05	< 0.05	ND	50	89	60	130	NV	50	140
Toluene	GCM0007-MAR19	µg/g	0.05	< 0.05	ND	50	88	60	130	NV	50	140

QC SUMMARY

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-IENVI SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Water Soluble Boron	ESG0002-MAR19	µg/g	0.5	<0.5	ND	20	100	80	120	89	70	130

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS

SGS Environment, Health and Safety

Request for Laboratory Services and CHAIN OF CUSTODY

No: 01358

Page ___ of ___

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

Laboratory Information Section - Lab use only

Received By: Scott Fox
Received Date: 02/22/19 (mm\dd\yy)
Received Time: 14:12 am / (pm) (circle)

Received By (signature): S
Custody Seal Present: Y / (N) (circle)
Custody Seal Intact: Y / (N)

Cooling Agent Present: Y / (N) Type:
Temperature Upon Receipt (°C) 5°C, 5°C, 5°C

LAB LIMS #: CA14579-Feb 19
COTT CA14588-Feb 19.

REPORT INFORMATION

Company: PETO MacCALLUM LTD
Contact: DYLAN BRICE
Address: 16 FRANKLIN ST S
KIT, ONT, N2C 1R4
Phone: 519-893-7500
Fax: 519-893-0654
Email: dbrice@petomaccallum.com

INVOICE INFORMATION

[X] (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 18KF047
Site Location/ID: 1 CAMBRIDGE

TURNAROUND TIME (TAT) REQUIRED

[X] Regular TAT (5-7days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 3pm or on weekends : TAT begins the next business day

RUSH TAT (Additional Charges May Apply) [ ] 1 Day [ ] 2 Days [ ] 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153 (2011):
[ ] Table 1 [ ] Res/Park Soil Texture:
[ ] Table 2 [ ] Ind/Com [ ] Coarse
[ ] Table 3 [ ] Agri/Other [ ] Medium
[ ] Table ____ [ ] Fine

Other Regulations:
[ ] Reg 347/558 (3 Day min TAT)
[ ] PWQO [ ] MMER
[ ] CCME [ ] Other:
[ ] MISA

Sewer By-Law:
[ ] Sanitary
[ ] Storm
Municipality:

DRINKING WATER SAMPLES (POTABLE WATER FOR HUMAN CONSUMPTION) MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

RECORD OF SITE CONDITION (RSC) [ ] YES [ ] NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	M+I	PHC F1-F4 w/BTEX			Corrosivity PKG							COMMENTS: Field Filtered (F) Preserved (P)
1	BH 144 SS 5	Feb 21/19		4	S	X	X	X									
2	BH 108 SS 6	Jan 14/19		1						X							
3	BH 129 SS 5	Jan 17/19		1						X							
4	BH 132 SS 4	Feb 22/19		1						X							
5	BH 143 SS 5	Feb 21/19		1						X							
6	BH 145 SS 5	Jan 30/19		1						X							
7	BH 163 SS 5	Jan 21/19		1						X							
8																	
9																	
10																	

Observations/Comments/Special Instructions

Sampled By (NAME): D. BRICE
Signature:

Relinquished by (NAME): D. BRICE
Signature:

Date: 02 / 22 / 19 (mm/dd/yy)
Date: 02 / 22 / 19 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 25 July, 2016

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(Printed copies are available upon request.) Attention

Request for Laboratory Services and CHAIN OF CUSTODY

No: 002160

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Scott Tom
Received Date (mm/dd/yyyy): 02/28/19 (mm\dd\yy)
Received Time: 17:36 hrs.
Received By (signature):
Custody Seal Present: ☒ NO
Custody Seal Intact: ☒ NO
Cooling Agent Present: ☒ NO
Temperature Upon Receipt (°C) 6°C, 6°C, 6°C 6°C x3
LAB LIMS #: CA14579-Feb19

REPORT INFORMATION

Company: Peto MacCallum LTD
Contact: Dylan Brice
Address: 16 Franklin St S
Kit, ONT, N2C 1R4
Phone: 519-893-7500
Fax: 519-893-0654
Email: dbrice@petomaccallum.com

INVOICE INFORMATION

☒ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 18KF047
Site Location/ID: Cambridge

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:
Rush Confirmation ID:

REGULATIONS

Regulation 153/04:
☒ Table 1 ☒ Res/Park
☒ Table 2 ☒ Ind/Com
☐ Table 3 ☐ Agri/Other
☐ Table ____
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PHC F1-F4 ☒ BTEX ☒ VOC ☐ BTEX/F1 ☐ F2-F4 ☐	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	COMMENTS:
1	BH 144 SS 5	Feb21/19	-	4	S		X	X							
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															

Observations/Comments/Special Instructions

Sampled By (NAME): D. Brice
Signature:
Date: 02/28/19 (mm/dd/yy)

Relinquished by (NAME): D. Brice
Signature:
Date: 02/28/19 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

SGS

SAMPLE INTEGRITY REPORT

Project Number: 18KF047

ONTARIO REGULATION 153/04

SGS Sample ID CA 14579 feb19

Date / Time Sampled Jan 14,17,~~18~~30feb 21,22

Client Sample ID See C of C

ALL

Sample Submission General Sample Integrity Violations	
Temperature >10 C upon receipt if not sampled same day	☐
No evidence of cooling trend initiated if sampled same day	☐
Chain of Custody not submitted	☐
Chain of Custody incomplete	☑ no reg selected
Chain of Custody not signed / dated	☐
Chain of Custody not a current version	☐
Bottles / Samples listed on CoC but not received	☑ did not rec' BH114555
Bottles / Samples received but not listed on the CoC	☑ rec'd BH14 SS3 - on hold.
Sample container received empty	☐

Sample Specific Sample Integrity Violations							
Sample received past hold time	☐	☐	☐	☐	☐	☐	☐
Incorrect preservation (including no preservation where required)	☐	☐	☐	☐	☐	☐	☐
Headspace present in VOC vial (aqueous)	☐	☐	☐	☐	☐	☐	☐
Sample(s) received frozen	☐	☐	☐	☐	☐	☐	☐
Bottle(s) broken or damaged in transport	☐	☐	☐	☐	☐	☐	☐
Discrepancy between sample label and chain of custody	☑	☐	☐	☐	☐	☐	☐
Analysis requirements absent / unclear	☐	☐	☐	☐	☐	☐	☐
Missing or incorrect sample label(s)	☐	☐	☐	☐	☐	☐	☐
Inappropriate sample container used	☑	☐	☐	☐	☐	☐	☐
Insufficient number of bottles received	☐	☐	☐	☐	☐	☐	☐
Limited sample volume	☐	☐	☐	☐	☐	☐	☐
Insufficient sample volume	☐	☐	☐	☐	☐	☐	☐
Sample contains multiple phases	☐	☐	☐	☐	☐	☐	☐

Sediment Log							
Groundwater samples contain visible sediment / particulate	☐	☐	☐	☐	☐	☐	☐
Groundwater contains greater than 1cm of sediment / particulate matter in bottle	☐	☐	☐	☐	☐	☐	☐

Additional Comments/Remarks:

No issues upon receipt ☐ Initials: _____

all of 14588 rec'd in plastic bags - transferred to soil jars.

for 14588 - 10's only had bore hole #, not in format of "BHx SSx"

Moore, Brad (Lakefield)

From: Dylan Brice <dbrice@petomaccallum.com>
Sent: Monday, February 25, 2019 5:47 PM
To: Moore, Brad (Lakefield)
Subject: Re: 18KF047 Table?

Hi Brad,

Yes, could we please get 3 sets of results.

T1 All

T2 RPI

T2 ICC

Thanks,

Dylan Brice

Get Outlook for Android

From: Moore, Brad (Lakefield) <brad.moore@sgs.com>
Sent: Monday, February 25, 2019 4:52:27 PM
To: Dylan Brice
Subject: 18KF047 Table?

Hi Dylan,

The attached CofC was picked up with your samples today and I noticed that there is no table indicated for the Reg 153 parameters. Is there a table you would like the results compared to?

Regards,

Brad Moore, Hon.B.Sc.,
Environment, Health & Safety
Project Specialist

SGS Canada Inc.
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SGS

SAMPLE INTEGRITY REPORT

Project Number: 18KF047

ONTARIO REGULATION 153/04

SGS Sample ID ON 14579-Feb19

Date / Time Sampled 02/12/2019

Client Sample ID BH 144555

	ALL
Sample Submission General Sample Integrity Violations	
Temperature >10 C upon receipt if not sampled same day	☐
No evidence of cooling trend initiated if sampled same day	☐
Chain of Custody not submitted	☐
Chain of Custody incomplete	☐
Chain of Custody not signed / dated	☐
Chain of Custody not a current version	☐
Bottles / Samples listed on CoC but not received	☐
Bottles / Samples received but not listed on the CoC	☐
Sample container received empty	☐

Sample Specific Sample Integrity Violations							
Sample received past hold time	☐	☐	☐	☐	☐	☐	☐
Incorrect preservation (including no preservation where required)	☐	☐	☐	☐	☐	☐	☐
Headspace present in VOC vial (aqueous)	☐	☐	☐	☐	☐	☐	☐
Sample(s) received frozen	☐	☐	☐	☐	☐	☐	☐
Bottle(s) broken or damaged in transport	☐	☐	☐	☐	☐	☐	☐
Discrepancy between sample label and chain of custody	☐	☐	☐	☐	☐	☐	☐
Analysis requirements absent / unclear	☐	☐	☐	☐	☐	☐	☐
Missing or incorrect sample label(s)	☐	☐	☐	☐	☐	☐	☐
Inappropriate sample container used	☐	☐	☐	☐	☐	☐	☐
Insufficient number of bottles received	☐	☐	☐	☐	☐	☐	☐
Limited sample volume	☐	☐	☐	☐	☐	☐	☐
Insufficient sample volume	☐	☐	☐	☐	☐	☐	☐
Sample contains multiple phases	☐	☐	☐	☐	☐	☐	☐
Sediment Log							
Groundwater samples contain visible sediment / particulate	☐	☐	☐	☐	☐	☐	☐
Groundwater contains greater than 1cm of sediment / particulate matter in bottle	☐	☐	☐	☐	☐	☐	☐

Additional Comments/Remarks:

No issues upon receipt ☑ Initials: KM

FINAL REPORT

CA14401-JAN19 R1

18KF047

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS

Client	Peto MacCallum Ltd
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada
Contact	Dylan Brice
Telephone	519-893-7500
Facsimile	519-893-0654
Email	dbrice@petomaccallum.com; khanes@petomaccallum.com
Project	18KF047
Order Number	
Samples	Soil (4)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2000
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Email	
SGS Reference	CA14401-JAN19
Received	01/18/2019
Approved	01/24/2019
Report Number	CA14401-JAN19 R1
Date Reported	05/09/2019

COMMENTS

CCME Method Compliance: Analyses were conducted using analytical procedures that comply with the Reference Method for the CWS for Petroleum Hydrocarbons in Soil and have been validated for use at the SGS laboratory, Lakefield, ON site.

Quality Compliance: Instrument performance / calibration quality criteria were met and extraction and analysis limits for holding times were met.

nC6 and nC10 response factors within 30% of response factor for toluene: YES

nC10, nC16 and nC34 response factors within 10% of the average response for the three compounds: YES

C50 response factors within 70% of nC10 + nC16 + nC34 average: YES

Linearity is within 15%: YES

F4G - gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
The results for F4 and F4G are both reported and the greater of the two values is to be used in application to the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

Temperature of Sample upon Receipt: 2 degrees C
Cooling Agent Present:Yes
Custody Seal Present:No

Chain of Custody Number:003582

SIGNATORIES

Brad Moore Hon. B.Sc

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Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D. Brice

PACKAGE: **REG153 - BTEX** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	8	9	10	11
				Sample Name	BH108 SS2	BH108 SS5	BH115 SS3B	BH115 SS4
				Sample Matrix	Soil	Soil	Soil	Soil
				Sample Date	14/01/2019	14/01/2019	16/01/2019	16/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
BTEX								
Benzene	µg/g	0.02	0.02	0.32	< 0.02	< 0.02	< 0.02	< 0.02
Ethylbenzene	µg/g	0.05	0.05	1.1	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	µg/g	0.05	0.2	6.4	< 0.05	< 0.05	< 0.05	< 0.05
Xylene (total)	µg/g	0.05	0.05	26	< 0.05	< 0.05	< 0.05	< 0.05
m/p-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05	< 0.05
o-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05	< 0.05

PACKAGE: **REG153 - Hydrides** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	8	9	10	11
				Sample Name	BH108 SS2	BH108 SS5	BH115 SS3B	BH115 SS4
				Sample Matrix	Soil	Soil	Soil	Soil
				Sample Date	14/01/2019	14/01/2019	16/01/2019	16/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Hydrides								
Antimony	µg/g	0.8	1.3	40	< 0.8	< 0.8	< 0.8	< 0.8
Arsenic	µg/g	0.5	18	18	2.1	2.7	1.0	0.6
Selenium	µg/g	0.7	1.5	5.5	< 0.7	< 0.7	0.7	< 0.7

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D. Brice

PACKAGE: **REG153 - Metals and Inorganics** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	8	9	10	11
					Sample Name	BH108 SS2	BH108 SS5	BH115 SS3B	BH115 SS4
					Sample Matrix	Soil	Soil	Soil	Soil
					Sample Date	14/01/2019	14/01/2019	16/01/2019	16/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Metals and Inorganics								
Moisture Content	%	-			8.8	9.3	21.5	17.9
Barium	µg/g	0.1	220	670	32	55	21	5.5
Beryllium	µg/g	0.02	2.5	8	0.23	0.39	0.12	0.09
Boron	µg/g	1	36	120	5	7	3	2
Cadmium	µg/g	0.02	1.2	1.9	0.12	0.12	0.19	0.04
Chromium	µg/g	0.5	70	160	9.3	14	5.2	3.4
Cobalt	µg/g	0.01	21	80	3.9	6.4	2.0	1.2
Copper	µg/g	0.1	92	230	11	14	8.5	4.4
Lead	µg/g	0.1	120	120	8.1	12	5.6	3.5
Molybdenum	µg/g	0.1	2	40	0.3	0.2	0.2	< 0.1
Nickel	µg/g	0.5	82	270	7.8	14	3.3	2.1
Silver	µg/g	0.05	0.5	40	< 0.05	< 0.05	< 0.05	< 0.05
Thallium	µg/g	0.02	1	3.3	0.03	0.07	< 0.02	< 0.02
Uranium	µg/g	0.002	2.5	33	0.39	0.45	1.2	0.20
Vanadium	µg/g	3	86	86	15	21	12	6
Zinc	µg/g	0.7	290	340	53	58	33	22
Water Soluble Boron	µg/g	0.5		2	< 0.5	< 0.5	< 0.5	< 0.5

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D. Brice

PACKAGE: **REG153 - Other (ORP)** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	8	9	10	11
				Sample Name	BH108 SS2	BH108 SS5	BH115 SS3B	BH115 SS4
				Sample Matrix	Soil	Soil	Soil	Soil
				Sample Date	14/01/2019	14/01/2019	16/01/2019	16/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Other (ORP)								
Mercury	µg/g	0.05	0.27	3.9	< 0.05	< 0.05	< 0.05	< 0.05
Sodium Adsorption Ratio	---	0.2	2.4	12	2.7	1.9	2.2	0.2
SAR Calcium	mg/L	0.09			35.6	16.8	39.0	54.0
SAR Magnesium	mg/L	0.02			40.0	5.6	4.1	4.8
SAR Sodium	mg/L	0.15			98.4	35.3	54.0	6.5
Conductivity	mS/cm	0.002	0.57	1.4	0.54	0.35	3.3	0.13
pH	pH Units	0.05			8.22	8.05	7.82	7.88
Chromium VI	µg/g	0.2	0.66	8	< 0.2	< 0.2	< 0.2	< 0.2
Free Cyanide	µg/g	0.05			< 0.05	< 0.05	< 0.05	< 0.05

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D. Brice

PACKAGE: **REG153 - PHCs** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	8	9	10	11
				Sample Name	BH108 SS2	BH108 SS5	BH115 SS3B	BH115 SS4
				Sample Matrix	Soil	Soil	Soil	Soil
				Sample Date	14/01/2019	14/01/2019	16/01/2019	16/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
PHCs								
F1 (C6-C10)	µg/g	10	25	55	< 10	< 10	< 10	< 10
F1-BTEX (C6-C10)	µg/g	10			< 10	< 10	< 10	< 10
F2 (C10-C16)	µg/g	10	10	230	< 10	< 10	< 10	< 10
F3 (C16-C34)	µg/g	50	240	1700	< 50	< 50	< 50	< 50
F4 (C34-C50)	µg/g	50	120	3300	< 50	< 50	< 50	< 50
Chromatogram returned to baseline at nC50	Yes / No	-			YES	YES	YES	YES

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED L1	REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED L2
BH108 SS2					
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	2.7	2.4	
BH115 SS3B					
Conductivity	EPA 6010/SM 2510	µg/g	3.3	0.57	1.4

QC SUMMARY

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0310-JAN19	mS/cm	0.002	<0.002	0	10	99	90	110	NA		

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA5038-JAN19	µg/g	0.05	<0.05	ND	20	104	80	120	95	75	125

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-IENVIIC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0280-JAN19	µg/g	0.2	<0.2	ND	20	94	80	120	123	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EMS0103-JAN19	µg/g	0.05	<0.05	NV	20	112	80	120	97	70	130

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-IENVISPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
SAR Calcium	ESG0049-JAN19	mg/L	0.09	<0.09	9	20	98	80	120	90	70	130
SAR Magnesium	ESG0049-JAN19	mg/L	0.02	<0.02	12	20	98	80	120	95	70	130
SAR Sodium	ESG0049-JAN19	mg/L	0.15	<0.15	1	20	94	80	120	90	70	130

QC SUMMARY

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENVISPE-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0103-JAN19	ug/g	0.05	<0.05	NV	20	100	70	130	103	70	130
Arsenic	EMS0103-JAN19	µg/g	0.5	<0.5	1	20	102	70	130	103	70	130
Barium	EMS0103-JAN19	ug/g	0.1	<0.1	2	20	108	70	130	98	70	130
Beryllium	EMS0103-JAN19	µg/g	0.02	<0.02	6	20	102	70	130	100	70	130
Boron	EMS0103-JAN19	µg/g	1	<1	14	20	103	70	130	99	70	130
Cadmium	EMS0103-JAN19	µg/g	0.02	<0.02	12	20	100	70	130	110	70	130
Cobalt	EMS0103-JAN19	µg/g	0.01	<0.01	1	20	102	70	130	114	70	130
Chromium	EMS0103-JAN19	µg/g	0.5	<0.5	0	20	104	70	130	116	70	130
Copper	EMS0103-JAN19	µg/g	0.1	<0.1	2	20	101	70	130	106	70	130
Molybdenum	EMS0103-JAN19	µg/g	0.1	<0.1	NV	20	98	70	130	90	70	130
Nickel	EMS0103-JAN19	ug/g	0.5	<0.5	1	20	99	70	130	112	70	130
Lead	EMS0103-JAN19	µg/g	0.1	<0.1	1	20	101	70	130	102	70	130
Antimony	EMS0103-JAN19	µg/g	0.8	<0.8	ND	20	97	70	130	106	70	130
Selenium	EMS0103-JAN19	µg/g	0.7	<0.7	ND	20	101	70	130	106	70	130
Thallium	EMS0103-JAN19	µg/g	0.02	<0.02	15	20	101	70	130	107	70	130
Uranium	EMS0103-JAN19	µg/g	0.002	<0.002	7	20	96	70	130	94	70	130
Vanadium	EMS0103-JAN19	µg/g	3	<3	0	20	102	70	130	113	70	130
Zinc	EMS0103-JAN19	µg/g	0.7	<0.7	2	20	99	70	130	105	70	130

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F1 (C6-C10)	GCM0267-JAN19	µg/g	10	<10	ND	30	113	80	120	103	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F2 (C10-C16)	GCM0255-JAN19	µg/g	10	<10	ND	30	105	80	120	104	60	140
F3 (C16-C34)	GCM0255-JAN19	µg/g	50	<50	ND	30	105	80	120	104	60	140
F4 (C34-C50)	GCM0255-JAN19	µg/g	50	<50	ND	30	105	80	120	104	60	140

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	ARD0074-JAN19	pH Units	0.05		0	20	100	80	120			

Volatile Organics

Method: EPA 5035A/5030B/8260C I Internal ref.: ME-CA-[ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Benzene	GCM0267-JAN19	µg/g	0.02	<0.02	ND	50	89	60	130	89	50	140
Ethylbenzene	GCM0267-JAN19	µg/g	0.05	<0.05	ND	50	86	60	130	87	50	140
m/p-xylene	GCM0267-JAN19	µg/g	0.05	<0.05	ND	50	90	60	130	93	50	140
o-xylene	GCM0267-JAN19	µg/g	0.05	<0.05	ND	50	88	60	130	91	50	140
Toluene	GCM0267-JAN19	µg/g	0.05	<0.05	ND	50	98	60	130	94	50	140

QC SUMMARY

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-IENVI SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Water Soluble Boron	ESG0045-JAN19	µg/g	0.5	<0.5	ND	20	93	80	120	90	70	130

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

No: 003582

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

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CA14401-Jan19

Laboratory Information Section - Lab use only

Received By: Email
Received Date (mm/dd/yyyy): 01/18/19 (mm\dd\yy)
Received Time: 01:55
Received By (signature):
Custody Seal Present: ☐
Custody Seal Intact: ☐
Cooling Agent Present: ☐
Temperature Upon Receipt (°C): 7, 6,7 2x3
LAB LIMS #:

REPORT INFORMATION

Company: PETO MacCallum LTD
Contact: Dylan Brice
Address: 16 Franklin St S
Kit, ont, N2C 1R4
Phone: 519-893-7500
Email: dbrice@petomaccallum.com
Email:

INVOICE INFORMATION

☒ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 18KF047
Site Location/ID: Cambridge

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date:
Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☒ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	PHC F1-F4 ☒ VOC ☐ BTEX ☒ BTEX/F1 ☐ F2-F4 ☐	VOC ☐ BTEX ☐ THM ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	COMMENTS:
1	BH 108 SS2	01/14/19	1100	4	S		X			X						
2	BH 108 SS5	01/14/19	1100	4	S		X			X						
3	BH 115 SS3B	01/16/19	1300	4	S		X			X						
4	BH 115 SS4	01/16/19	1300	4	S		X			X						
5																
6																
7																
8																
9																
10																
11																
12																

Observations/Comments/Special Instructions

Sampled By (NAME): D. BRICE Signature: Date: 01/18/19 (mm/dd/yy)
Relinquished by (NAME): D. BRICE Signature: Date: 01/18/19 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

SGS

SAMPLE INTEGRITY REPORT

Project Number: 18KF047

ONTARIO REGULATION 153/04

SGS Sample ID: CA14401-Jan19

Date / Time Sampled: Jan 16, 2019

Client Sample ID: See Cofe.

	ALL
Sample Submission General Sample Integrity Violations	
Temperature >10 C upon receipt if not sampled same day	☐
No evidence of cooling trend initiated if sampled same day	☐
Chain of Custody not submitted	☐
Chain of Custody incomplete	☐
Chain of Custody not signed / dated	☐
Chain of Custody not a current version	☐
Bottles / Samples listed on CoC but not received	☐
Bottles / Samples received but not listed on the CoC	☐
Sample container received empty	☐

Sample Specific Sample Integrity Violations							
Sample received past hold time	☐	☐	☐	☐	☐	☐	☐
Incorrect preservation (including no preservation where required)	☐	☐	☐	☐	☐	☐	☐
Headspace present in VOC vial (aqueous)	☐	☐	☐	☐	☐	☐	☐
Sample(s) received frozen	☐	☐	☐	☐	☐	☐	☐
Bottle(s) broken or damaged in transport	☐	☐	☐	☐	☐	☐	☐
Discrepancy between sample label and chain of custody	☐	☐	☐	☐	☐	☐	☐
Analysis requirements absent / unclear	☐	☐	☐	☐	☐	☐	☐
Missing or incorrect sample label(s)	☐	☐	☐	☐	☐	☐	☐
Inappropriate sample container used	☐	☐	☐	☐	☐	☐	☐
Insufficient number of bottles received	☐	☐	☐	☐	☐	☐	☐
Limited sample volume	☐	☐	☐	☐	☐	☐	☐
Insufficient sample volume	☐	☐	☐	☐	☐	☐	☐
Sample contains multiple phases	☐	☐	☐	☐	☐	☐	☐

Sediment Log							
Groundwater samples contain visible sediment / particulate	☐	☐	☐	☐	☐	☐	☐
Groundwater contains greater than 1cm of sediment / particulate matter in bottle	☐	☐	☐	☐	☐	☐	☐

Additional Comments/Remarks:

No issues upon receipt

☒ Initials: _____

FINAL REPORT

CA14594-JAN19 R1

18KF047

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS

Client	Peto MacCallum Ltd
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada
Contact	Dylan Brice
Telephone	519-893-7500
Facsimile	519-893-0654
Email	dbrice@petomaccallum.com; khanes@petomaccallum.com
Project	18KF047
Order Number	
Samples	Soil (10)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2000
Facsimile	705-652-6365
Email	
SGS Reference	CA14594-JAN19
Received	01/29/2019
Approved	02/01/2019
Report Number	CA14594-JAN19 R1
Date Reported	05/09/2019

COMMENTS

CCME Method Compliance: Analyses were conducted using analytical procedures that comply with the Reference Method for the CWS for Petroleum Hydrocarbons in Soil and have been validated for use at the SGS laboratory, Lakefield, ON site.

Quality Compliance: Instrument performance / calibration quality criteria were met and extraction and analysis limits for holding times were met.

nC6 and nC10 response factors within 30% of response factor for toluene: YES

nC10, nC16 and nC34 response factors within 10% of the average response for the three compounds: YES

C50 response factors within 70% of nC10 + nC16 + nC34 average: YES

Linearity is within 15%: YES

F4G - gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
The results for F4 and F4G are both reported and the greater of the two values is to be used in application to the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

Temperature of Sample upon Receipt: 1 degrees C
Cooling Agent Present:Yes
Custody Seal Present:No

Chain of Custody Number:002157

SIGNATORIES

Brad Moore Hon. B.Sc

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Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - BTEX** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	8	9	10	11	12	13	14	15
					Sample Name	BH 129 SS2B	BH 129 SS4	BH 164 SS2B	BH 164 SS6	BH 179 SS2	BH 179 SS4	BH 184 SS3	BH 184 SS6
					Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
					Sample Date	19/01/2019	19/01/2019	22/01/2019	22/01/2019	22/01/2019	15/01/2019	18/01/2019	18/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
BTEX													
Benzene	µg/g	0.02	0.02	0.32	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Ethylbenzene	µg/g	0.05	0.05	1.1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	µg/g	0.05	0.2	6.4	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Xylene (total)	µg/g	0.05	0.05	26	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m/p-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
o-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

PACKAGE: **REG153 - BTEX** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	16	17
					Sample Name	BH 192 SS3	BH 192 SS5A
					Sample Matrix	Soil	Soil
					Sample Date	18/01/2019	18/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	
BTEX							
Benzene	µg/g	0.02	0.02	0.32	< 0.02	< 0.02	
Ethylbenzene	µg/g	0.05	0.05	1.1	< 0.05	< 0.05	
Toluene	µg/g	0.05	0.2	6.4	< 0.05	< 0.05	
Xylene (total)	µg/g	0.05	0.05	26	< 0.05	< 0.05	
m/p-xylene	µg/g	0.05			< 0.05	< 0.05	
o-xylene	µg/g	0.05			< 0.05	< 0.05	

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - Hydrides** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Parameter	Units	RL	L1	L2	Sample Number	8	9	10	11	12	13	14	15
					Sample Name	BH 129 SS2B	BH 129 SS4	BH 164 SS2B	BH 164 SS6	BH 179 SS2	BH 179 SS4	BH 184 SS3	BH 184 SS6
					Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
					Sample Date	19/01/2019	19/01/2019	22/01/2019	22/01/2019	22/01/2019	15/01/2019	18/01/2019	18/01/2019
Hydrides													
Antimony	µg/g	0.8	1.3	40		< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Arsenic	µg/g	0.5	18	18		1.5	2.1	1.5	2.1	2.0	1.4	2.9	1.1
Selenium	µg/g	0.7	1.5	5.5		< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7

PACKAGE: **REG153 - Hydrides** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Parameter	Units	RL	L1	L2	Sample Number	16	17
					Sample Name	BH 192 SS3	BH 192 SS5A
					Sample Matrix	Soil	Soil
					Sample Date	18/01/2019	18/01/2019
Hydrides							
Antimony	µg/g	0.8	1.3	40		< 0.8	< 0.8
Arsenic	µg/g	0.5	18	18		2.4	1.6
Selenium	µg/g	0.7	1.5	5.5		< 0.7	< 0.7

PACKAGE: **REG153 - Metals and Inorganics** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Parameter	Units	RL	L1	L2	Sample Number	8	9	10	11	12	13	14	15
					Sample Name	BH 129 SS2B	BH 129 SS4	BH 164 SS2B	BH 164 SS6	BH 179 SS2	BH 179 SS4	BH 184 SS3	BH 184 SS6
					Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
					Sample Date	19/01/2019	19/01/2019	22/01/2019	22/01/2019	22/01/2019	15/01/2019	18/01/2019	18/01/2019
Metals and Inorganics													
Moisture Content	%	-				6.8	6.5	7.0	7.8	15.4	10.4	17.2	12.3
Barium	µg/g	0.1	220	670		9.2	13	7.9	33	17	26	14	13
Beryllium	µg/g	0.02	2.5	8		0.11	0.12	0.10	0.28	0.30	0.21	0.30	0.11

Client: Peto MacCallum Ltd
Project: 18KF047
Project Manager: Dylan Brice
Samplers: D.Brice

PACKAGE: **REG153 - Metals and Inorganics** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	8	9	10	11	12	13	14	15
					Sample Name	BH 129 SS2B	BH 129 SS4	BH 164 SS2B	BH 164 SS6	BH 179 SS2	BH 179 SS4	BH 184 SS3	BH 184 SS6
					Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
					Sample Date	19/01/2019	19/01/2019	22/01/2019	22/01/2019	22/01/2019	15/01/2019	18/01/2019	18/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Metals and Inorganics (continued)													
Boron	µg/g	1	36	120	3	4	4	6	2	5	3	4
Cadmium	µg/g	0.02	1.2	1.9	0.07	0.12	0.09	0.13	0.08	0.08	0.11	0.17
Chromium	µg/g	0.5	70	160	4.6	5.1	4.1	10	6.4	7.9	8.6	4.7
Cobalt	µg/g	0.01	21	80	1.6	2.0	1.5	3.8	2.5	3.0	3.4	1.7
Copper	µg/g	0.1	92	230	8.3	7.4	5.2	9.9	6.5	8.2	5.4	4.5
Lead	µg/g	0.1	120	120	4.6	7.3	5.3	9.0	5.7	6.0	11	4.8
Molybdenum	µg/g	0.1	2	40	< 0.1	0.6	0.1	0.2	0.1	0.1	0.1	0.1
Nickel	µg/g	0.5	82	270	3.4	4.3	3.5	7.8	6.3	6.6	5.7	3.4
Silver	µg/g	0.05	0.5	40	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Thallium	µg/g	0.02	1	3.3	0.02	0.04	< 0.02	0.06	0.03	0.05	0.03	0.02
Uranium	µg/g	0.002	2.5	33	0.25	0.40	0.29	0.39	0.22	0.41	0.30	0.35
Vanadium	µg/g	3	86	86	8	8	7	14	11	13	19	10
Zinc	µg/g	0.7	290	340	29	56	39	60	39	44	55	50
Water Soluble Boron	µg/g	0.5		2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - Metals and Inorganics** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	16	17
					Sample Name	BH 192 SS3	BH 192 SS5A
					Sample Matrix	Soil	Soil
					Sample Date	18/01/2019	18/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**
Metals and Inorganics						
Moisture Content	%	-			5.4	9.3
Barium	µg/g	0.1	220	670	15	11
Beryllium	µg/g	0.02	2.5	8	0.15	0.17
Boron	µg/g	1	36	120	4	5
Cadmium	µg/g	0.02	1.2	1.9	0.27	0.12
Chromium	µg/g	0.5	70	160	6.4	6.2
Cobalt	µg/g	0.01	21	80	2.3	2.6
Copper	µg/g	0.1	92	230	13	6.1
Lead	µg/g	0.1	120	120	29	6.6
Molybdenum	µg/g	0.1	2	40	0.4	0.2
Nickel	µg/g	0.5	82	270	6.0	5.1
Silver	µg/g	0.05	0.5	40	< 0.05	< 0.05
Thallium	µg/g	0.02	1	3.3	0.04	0.03
Uranium	µg/g	0.002	2.5	33	0.33	0.36
Vanadium	µg/g	3	86	86	12	13
Zinc	µg/g	0.7	290	340	100	47
Water Soluble Boron	µg/g	0.5		2	< 0.5	< 0.5

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - Other (ORP)** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	8	9	10	11	12	13	14	15
					Sample Name	BH 129 SS2B	BH 129 SS4	BH 164 SS2B	BH 164 SS6	BH 179 SS2	BH 179 SS4	BH 184 SS3	BH 184 SS6
					Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
					Sample Date	19/01/2019	19/01/2019	22/01/2019	22/01/2019	22/01/2019	15/01/2019	18/01/2019	18/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Other (ORP)													
Mercury	µg/g	0.05	0.27	3.9	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sodium Adsorption Ratio	---	0.2	2.4	12	13.2	10.3	3.3	0.2	17.3	4.2	1.5	0.3
SAR Calcium	mg/L	0.09			11.7	5.1	11.9	19.6	12.5	10.0	26.2	15.0
SAR Magnesium	mg/L	0.02			3.2	2.3	9.2	5.2	1.2	2.2	18.8	4.6
SAR Sodium	mg/L	0.15			197	112	61.7	4.8	239	55.6	41.0	4.6
Conductivity	mS/cm	0.002	0.57	1.4	1.0	0.62	0.44	0.18	1.3	0.36	0.28	0.14
pH	pH Units	0.05			8.32	8.24	8.16	8.06	8.02	8.03	7.88	8.11
Chromium VI	µg/g	0.2	0.66	8	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Free Cyanide	µg/g	0.05			< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: D.Brice

PACKAGE: **REG153 - Other (ORP)** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	16	17
					Sample Name	BH 192 SS3	BH 192 SS5A
					Sample Matrix	Soil	Soil
					Sample Date	18/01/2019	18/01/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**
Other (ORP)						
Mercury	µg/g	0.05	0.27	3.9	< 0.05	< 0.05
Sodium Adsorption Ratio	---	0.2	2.4	12	3.5	0.8
SAR Calcium	mg/L	0.09			9.8	14.3
SAR Magnesium	mg/L	0.02			5.9	3.1
SAR Sodium	mg/L	0.15			56.1	12.5
Conductivity	mS/cm	0.002	0.57	1.4	0.37	0.17
pH	pH Units	0.05			8.30	8.19
Chromium VI	µg/g	0.2	0.66	8	0.2	< 0.2
Free Cyanide	µg/g	0.05			< 0.05	< 0.05

Client: Peto MacCallum Ltd
Project: 18KF047
Project Manager: Dylan Brice
Samplers: D.Brice

PACKAGE: **REG153 - PHCs** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Parameter	Units	RL	L1	L2	Sample Number 8	9	10	11	12	13	14	15
					Sample Name: BH 129 SS2B	BH 129 SS4	BH 164 SS2B	BH 164 SS6	BH 179 SS2	BH 179 SS4	BH 184 SS3	BH 184 SS6
					Sample Matrix: Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
					Sample Date: 19/01/2019	19/01/2019	22/01/2019	22/01/2019	22/01/2019	15/01/2019	18/01/2019	18/01/2019
PHCs												
F1 (C6-C10)	µg/g	10	25	55	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
F1-BTEX (C6-C10)	µg/g	10			< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
F2 (C10-C16)	µg/g	10	10	230	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
F3 (C16-C34)	µg/g	50	240	1700	< 50	< 50	62	< 50	< 50	< 50	< 50	< 50
F4 (C34-C50)	µg/g	50	120	3300	98	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Chromatogram returned to baseline at nC50	Yes / No	-			YES	YES	YES	YES	YES	YES	YES	YES

PACKAGE: **REG153 - PHCs** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

Parameter	Units	RL	L1	L2	Sample Number 16	17
					Sample Name: BH 192 SS3	BH 192 SS5A
					Sample Matrix: Soil	Soil
					Sample Date: 18/01/2019	18/01/2019
PHCs						
F1 (C6-C10)	µg/g	10	25	55	< 10	< 10
F1-BTEX (C6-C10)	µg/g	10			< 10	< 10
F2 (C10-C16)	µg/g	10	10	230	< 10	< 10
F3 (C16-C34)	µg/g	50	240	1700	371	< 50
F4 (C34-C50)	µg/g	50	120	3300	1570	< 50
CCME F4G-sg (GHH)	µg/g	200	120	3300	5680	
Chromatogram returned to baseline at nC50	Yes / No	-			NO	YES

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED L1	REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED L2
BH 129 SS2B					
Conductivity	EPA 6010/SM 2510	µg/g	1.0	0.57	
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	13.2	2.4	12
BH 129 SS4					
Conductivity	EPA 6010/SM 2510	µg/g	0.62	0.57	
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	10.3	2.4	
BH 164 SS2B					
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	3.3	2.4	
BH 179 SS2					
Conductivity	EPA 6010/SM 2510	µg/g	1.3	0.57	
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	17.3	2.4	12
BH 179 SS4					
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	4.2	2.4	
BH 192 SS3					
F3 (C16 to C34)	CCME Tier 1	µg/g	371	240	
F4 (C34 to C50)	CCME Tier 1	µg/g	1570	120	
Gravimetric Heavy Hydrocarbons	CCME Tier 1	µg/g	5680	120	3300
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	µg/g	3.5	2.4	

QC SUMMARY

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0008-FEB19	mS/cm	0.002	<0.002	0	10	99	90	110	NA		

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA5072-JAN19	µg/g	0.05	<0.05	ND	20	106	80	120	88	75	125

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-IENVIIC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0431-JAN19	µg/g	0.2	<0.2	ND	20	91	80	120	86	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EMS0164-JAN19	µg/g	0.05	<0.05	ND	20	106	80	120	99	70	130

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-IENVISPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
SAR Calcium	ESG0002-FEB19	mg/L	0.09	<0.09	2	20	91	80	120	93	70	130
SAR Magnesium	ESG0002-FEB19	mg/L	0.02	<0.02	8	20	100	80	120	108	70	130
SAR Sodium	ESG0002-FEB19	mg/L	0.15	<0.15	6	20	100	80	120	105	70	130

QC SUMMARY

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENVISPE-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0164-JAN19	ug/g	0.05	<0.05	NV	20	102	70	130	105	70	130
Arsenic	EMS0164-JAN19	µg/g	0.5	<0.5	7	20	110	70	130	101	70	130
Barium	EMS0164-JAN19	ug/g	0.1	<0.1	3	20	105	70	130	95	70	130
Beryllium	EMS0164-JAN19	µg/g	0.02	<0.02	4	20	107	70	130	101	70	130
Boron	EMS0164-JAN19	µg/g	1	<1	7	20	105	70	130	91	70	130
Cadmium	EMS0164-JAN19	µg/g	0.02	<0.02	NV	20	108	70	130	111	70	130
Cobalt	EMS0164-JAN19	µg/g	0.01	<0.01	4	20	107	70	130	110	70	130
Chromium	EMS0164-JAN19	µg/g	0.5	<0.5	5	20	106	70	130	111	70	130
Copper	EMS0164-JAN19	µg/g	0.1	<0.1	5	20	106	70	130	104	70	130
Molybdenum	EMS0164-JAN19	µg/g	0.1	<0.1	NV	20	102	70	130	93	70	130
Nickel	EMS0164-JAN19	ug/g	0.5	<0.5	0	20	106	70	130	109	70	130
Lead	EMS0164-JAN19	µg/g	0.1	<0.1	9	20	109	70	130	105	70	130
Antimony	EMS0164-JAN19	µg/g	0.8	<0.8	ND	20	103	70	130	118	70	130
Selenium	EMS0164-JAN19	µg/g	0.7	<0.7	ND	20	108	70	130	100	70	130
Thallium	EMS0164-JAN19	µg/g	0.02	<0.02	17	20	102	70	130	101	70	130
Uranium	EMS0164-JAN19	µg/g	0.002	<0.002	0	20	106	70	130	101	70	130
Vanadium	EMS0164-JAN19	µg/g	3	<3	2	20	106	70	130	108	70	130
Zinc	EMS0164-JAN19	µg/g	0.7	<0.7	2	20	105	70	130	103	70	130

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F1 (C6-C10)	GCM0395-JAN19	µg/g	10	<10	ND	30	103	80	120	98	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F2 (C10-C16)	GCM0377-JAN19	µg/g	10	<10	ND	30	102	80	120	115	60	140
F3 (C16-C34)	GCM0377-JAN19	µg/g	50	<50	ND	30	102	80	120	115	60	140
F4 (C34-C50)	GCM0377-JAN19	µg/g	50	<50	ND	30	102	80	120	115	60	140

QC SUMMARY

Petroleum Hydrocarbons (F4G)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
CCME F4G-sg (GHH)	GCM0406-JAN19	ug/g	200	<200	NA	30	102	80	120	NA	60	140

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	ARD0111-JAN19	pH Units	0.05		0	20	100	80	120			

QC SUMMARY

Volatile Organics

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-IENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Benzene	GCM0395-JAN19	µg/g	0.02	<0.02	ND	50	91	60	130	84	50	140
Ethylbenzene	GCM0395-JAN19	µg/g	0.05	<0.05	ND	50	84	60	130	88	50	140
m/p-xylene	GCM0395-JAN19	µg/g	0.05	<0.05	ND	50	90	60	130	92	50	140
o-xylene	GCM0395-JAN19	µg/g	0.05	<0.05	ND	50	88	60	130	91	50	140
Toluene	GCM0395-JAN19	µg/g	0.05	<0.05	ND	50	92	60	130	92	50	140

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-IENVI SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Water Soluble Boron	ESG0079-JAN19	µg/g	0.5	<0.5	ND	20	98	80	120	100	70	130

QC SUMMARY

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS Request for Laboratory Services and CHAIN OF CUSTODY

No: 002157

Page ____ of ____

Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Laboratory Information Section - Lab use only

Received By: SCOTT Ro
Received Date (mm/dd/yyyy): 01/29/19 (mm\dd\yy)
Received Time: 12:05
Received By (signature): S
Custody Seal Present: ☐ N/A
Custody Seal Intact: ☐ -
Cooling Agent Present: ☑ 1
Temperature Upon Receipt (°C) 1°, 1°, 2° 1X3
CA 14594 - JAN19
LAB LIMS #: _____

REPORT INFORMATION

Company: PETO MacCALLUM LTD
Contact: DYLAN BRICE
Address: 16 FRANKLIN ST S
KIT, ONT, N2C 1R4
Phone: 519-893-7500
Fax: 519-893-0654
Email: dbrice@petomaccallum.com

INVOICE INFORMATION

☒ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #: P.O. #:
Project #: 18KF047
Site Location/ID: CAMBRIDGE

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☒ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ Res/Park ☐ Ind/Com ☐ Agri/Other
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PHC F1-F4 ☐ VOC ☐ BTEX ☐ BTEX/F1 ☐ F2-F4 ☐	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	COMMENTS:
1	BH 129 SS2B	JAN 19/19		4	S		X	X							
2	BH 129 SS4	"					X	X							
3	BH 164 SS2B	JAN 22/19					X	X							
4	BH 164 SS6	"					X	X							
5	BH 179 SS2	JAN 15/19					X	X							
6	BH 179 SS4	"					X	X							
7	BH 184 SS3	JAN 18/19					X	X							
8	BH 184 SS6	"					X	X							
9	BH 192 SS3	"					X	X							
10	BH 192 SS5A	"					X	X							
11															
12															

Observations/Comments/Special Instructions

Sampled By (NAME): D. BRICE Signature: Date: 01/28/19 (mm/dd/yy)
Relinquished by (NAME): D. BRICE Signature: Date: 01/28/19 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

SGS

SAMPLE INTEGRITY REPORT

Project Number: 18KF047

ONTARIO REGULATION 153/04

SGS Sample ID CA14594-Jan19

Date / Time Sampled Jan 15,18,19,22/2019

Client Sample ID See CofC

	ALL
Sample Submission General Sample Integrity Violations	
Temperature >10 C upon receipt if not sampled same day	☐
No evidence of cooling trend initiated if sampled same day	☐
Chain of Custody not submitted	☐
Chain of Custody incomplete	☐
Chain of Custody not signed / dated	☐
Chain of Custody not a current version	☐
Bottles / Samples listed on CoC but not received	☐
Bottles / Samples received but not listed on the CoC	☐
Sample container received empty	☐

Sample Specific Sample Integrity Violations							
Sample received past hold time	☐	☐	☐	☐	☐	☐	☐
Incorrect preservation (including no preservation where required)	☐	☐	☐	☐	☐	☐	☐
Headspace present in VOC vial (aqueous)	☐	☐	☐	☐	☐	☐	☐
Sample(s) received frozen	☐	☐	☐	☐	☐	☐	☐
Bottle(s) broken or damaged in transport	☐	☐	☐	☐	☐	☐	☐
Discrepancy between sample label and chain of custody	☐	☐	☐	☐	☐	☐	☐
Analysis requirements absent / unclear	☐	☐	☐	☐	☐	☐	☐
Missing or incorrect sample label(s)	☐	☐	☐	☐	☐	☐	☐
Inappropriate sample container used	☐	☐	☐	☐	☐	☐	☐
Insufficient number of bottles received	☐	☐	☐	☐	☐	☐	☐
Limited sample volume	☐	☐	☐	☐	☐	☐	☐
Insufficient sample volume	☐	☐	☐	☐	☐	☐	☐
Sample contains multiple phases	☐	☐	☐	☐	☐	☐	☐
Sediment Log							
Groundwater samples contain visible sediment / particulate	☐	☐	☐	☐	☐	☐	☐
Groundwater contains greater than 1cm of sediment / particulate matter in bottle	☐	☐	☐	☐	☐	☐	☐

Additional Comments/Remarks:

No issues upon receipt ☑ Initials: KH

FINAL REPORT

CA14250-FEB19 R2

18KF047

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS

Client	Peto MacCallum Ltd
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada
Contact	Dylan Brice
Telephone	519-893-7500
Facsimile	519-893-0654
Email	dbrice@petomaccallum.com; khanes@petomaccallum.com
Project	18KF047
Order Number	
Samples	Soil (2)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2000
Facsimile	705-652-6365
Email	
SGS Reference	CA14250-FEB19
Received	02/11/2019
Approved	02/14/2019
Report Number	CA14250-FEB19 R2
Date Reported	05/09/2019

COMMENTS

CCME Method Compliance: Analyses were conducted using analytical procedures that comply with the Reference Method for the CWS for Petroleum Hydrocarbons in Soil and have been validated for use at the SGS laboratory, Lakefield, ON site.

Quality Compliance: Instrument performance / calibration quality criteria were met and extraction and analysis limits for holding times were met.

nC6 and nC10 response factors within 30% of response factor for toluene: YES

nC10, nC16 and nC34 response factors within 10% of the average response for the three compounds: YES

C50 response factors within 70% of nC10 + nC16 + nC34 average: YES

Linearity is within 15%: YES

F4G - gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
The results for F4 and F4G are both reported and the greater of the two values is to be used in application to the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

Temperature of Sample upon Receipt: 3 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:006361

QC Batch - GCM0146-FEB19 - PHC F3 (C16-C34) and F4 (C34-C50) Duplicate RPD are outside control limits. The average of the two duplicates is less than five times the RL therefore a greater uncertainty is expected.

SIGNATORIES

Brad Moore Hon. B.Sc

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Client: Peto MacCallum Ltd
Project: 18KF047
Project Manager: Dylan Brice
Samplers: Kurtis Pettitt

PACKAGE: **REG153 - BTEX** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	8	9
				Sample Name	BH187 SS2	BH187 SS6
				Sample Matrix	Soil	Soil
				Sample Date	07/02/2019	07/02/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**
BTEX						
Benzene	µg/g	0.02	0.02	0.32	< 0.02	0.03
Ethylbenzene	µg/g	0.05	0.05	1.1	< 0.05	< 0.05
Toluene	µg/g	0.05	0.2	6.4	< 0.05	0.06
Xylene (total)	µg/g	0.05	0.05	26	< 0.05	< 0.05
m/p-xylene	µg/g	0.05			< 0.05	< 0.05
o-xylene	µg/g	0.05			< 0.05	< 0.05

PACKAGE: **REG153 - Hydrides** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	8	9
				Sample Name	BH187 SS2	BH187 SS6
				Sample Matrix	Soil	Soil
				Sample Date	07/02/2019	07/02/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**
Hydrides						
Antimony	µg/g	0.8	1.3	40	< 0.8	< 0.8
Arsenic	µg/g	0.5	18	18	0.9	1.8
Selenium	µg/g	0.7	1.5	5.5	< 0.7	< 0.7

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: Kurtis Pettitt

PACKAGE: **REG153 - Metals and Inorganics** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	8	9
					Sample Name	BH187 SS2	BH187 SS6
					Sample Matrix	Soil	Soil
					Sample Date	07/02/2019	07/02/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**
Metals and Inorganics						
Moisture Content	%	-			3.2	6.6
Barium	µg/g	0.1	220	670	6.0	11
Beryllium	µg/g	0.02	2.5	8	0.08	0.10
Boron	µg/g	1	36	120	2	4
Cadmium	µg/g	0.02	1.2	1.9	0.04	0.12
Chromium	µg/g	0.5	70	160	2.6	5.0
Cobalt	µg/g	0.01	21	80	1.2	2.0
Copper	µg/g	0.1	92	230	4.7	11
Lead	µg/g	0.1	120	120	2.5	5.6
Molybdenum	µg/g	0.1	2	40	< 0.1	0.2
Nickel	µg/g	0.5	82	270	2.8	4.1
Silver	µg/g	0.05	0.5	40	< 0.05	< 0.05
Thallium	µg/g	0.02	1	3.3	< 0.02	0.04
Uranium	µg/g	0.002	2.5	33	0.13	0.34
Vanadium	µg/g	3	86	86	4	9
Zinc	µg/g	0.7	290	340	17	51
Water Soluble Boron	µg/g	0.5		2	< 0.5	< 0.5

Client: Peto MacCallum Ltd
Project: 18KF047
Project Manager: Dylan Brice
Samplers: Kurtis Pettitt

PACKAGE: **REG153 - Other (ORP)** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	8	9
					Sample Name	BH187 SS2	BH187 SS6
					Sample Matrix	Soil	Soil
					Sample Date	07/02/2019	07/02/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**
Other (ORP)						
Mercury	µg/g	0.05	0.27	3.9	< 0.05	< 0.05
Sodium Adsorption Ratio	---	0.2	2.4	12	1.3	0.3
SAR Calcium	mg/L	0.09			29.0	16.0
SAR Magnesium	mg/L	0.02			9.0	6.9
SAR Sodium	mg/L	0.15			30.8	6.3
Conductivity	mS/cm	0.002	0.57	1.4	0.18	0.18
pH	pH Units	0.05			8.21	8.23
Chromium VI	µg/g	0.2	0.66	8	< 0.2	< 0.2
Free Cyanide	µg/g	0.05			< 0.05	< 0.05

Client: Peto MacCallum Ltd

Project: 18KF047

Project Manager: Dylan Brice

Samplers: Kurtis Pettitt

PACKAGE: **REG153 - PHCs** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

					Sample Number	8	9
					Sample Name	BH187 SS2	BH187 SS6
					Sample Matrix	Soil	Soil
					Sample Date	07/02/2019	07/02/2019
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**
PHCs						
F1 (C6-C10)	µg/g	10	25	55	< 10	< 10
F1-BTEX (C6-C10)	µg/g	10			< 10	< 10
F2 (C10-C16)	µg/g	10	10	230	< 10	< 10
F3 (C16-C34)	µg/g	50	240	1700	54	< 50
F4 (C34-C50)	µg/g	50	120	3300	137	< 50
Chromatogram returned to baseline at nC50	Yes / No	-			YES	YES

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	REG153 / SOIL / COARSE - TABLE 1 - Residential/Parkland/Industrial - UNDEFINED L1	REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED L2
BH187 SS2					
F4 (C34 to C50)	CCME Tier 1	µg/g	137	120	
BH187 SS6					
Benzene	EPA 5035A/5030B/8260C	µg/g	0.03	0.02	

QC SUMMARY

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0209-FEB19	mS/cm	0.002	<0.002	0	10	99	90	110	NA		

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA5022-FEB19	µg/g	0.05	<0.05	ND	20	100	80	120	NV	75	125

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-IENVIIC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0137-FEB19	µg/g	0.2	<0.2	ND	20	111	80	120	85	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EMS0062-FEB19	µg/g	0.05	<0.05	ND	20	102	80	120	92	70	130

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-IENVISPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
SAR Calcium	ESG0035-FEB19	mg/L	0.09	<0.09	1	20	97	80	120	95	70	130
SAR Magnesium	ESG0035-FEB19	mg/L	0.02	<0.02	3	20	96	80	120	99	70	130
SAR Sodium	ESG0035-FEB19	mg/L	0.15	<0.15	1	20	95	80	120	102	70	130

QC SUMMARY

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENVISPE-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0062-FEB19	ug/g	0.05	<0.05	ND	20	100	70	130	106	70	130
Arsenic	EMS0062-FEB19	µg/g	0.5	<0.5	7	20	105	70	130	101	70	130
Barium	EMS0062-FEB19	ug/g	0.1	<0.1	4	20	100	70	130	85	70	130
Beryllium	EMS0062-FEB19	µg/g	0.02	<0.02	4	20	103	70	130	98	70	130
Boron	EMS0062-FEB19	µg/g	1	<1	14	20	102	70	130	96	70	130
Cadmium	EMS0062-FEB19	µg/g	0.02	<0.02	9	20	103	70	130	107	70	130
Cobalt	EMS0062-FEB19	µg/g	0.01	<0.01	5	20	104	70	130	109	70	130
Chromium	EMS0062-FEB19	µg/g	0.5	<0.5	8	20	106	70	130	113	70	130
Copper	EMS0062-FEB19	µg/g	0.1	<0.1	5	20	105	70	130	104	70	130
Molybdenum	EMS0062-FEB19	µg/g	0.1	<0.1	1	20	99	70	130	88	70	130
Nickel	EMS0062-FEB19	ug/g	0.5	<0.5	5	20	106	70	130	111	70	130
Lead	EMS0062-FEB19	µg/g	0.1	<0.1	0	20	105	70	130	102	70	130
Antimony	EMS0062-FEB19	µg/g	0.8	<0.8	ND	20	100	70	130	104	70	130
Selenium	EMS0062-FEB19	µg/g	0.7	<0.7	ND	20	102	70	130	98	70	130
Thallium	EMS0062-FEB19	µg/g	0.02	<0.02	3	20	107	70	130	100	70	130
Uranium	EMS0062-FEB19	µg/g	0.002	<0.002	4	20	102	70	130	96	70	130
Vanadium	EMS0062-FEB19	µg/g	3	<3	10	20	106	70	130	109	70	130
Zinc	EMS0062-FEB19	µg/g	0.7	<0.7	5	20	105	70	130	106	70	130

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENVIGC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F1 (C6-C10)	GCM0141-FEB19	µg/g	10	<10	ND	30	104	80	120	108	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 I Internal ref.: ME-CA-[ENVIGC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F2 (C10-C16)	GCM0146-FEB19	µg/g	10	<10	ND	30	106	80	120	78	60	140
F3 (C16-C34)	GCM0146-FEB19	µg/g	50	<50	164	30	106	80	120	78	60	140
F4 (C34-C50)	GCM0146-FEB19	µg/g	50	<50	168	30	106	80	120	78	60	140

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	ARD0033-FEB19	pH Units	0.05		0	20	100	80	120			

Volatile Organics

Method: EPA 5035A/5030B/8260C I Internal ref.: ME-CA-[ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Benzene	GCM0140-FEB19	µg/g	0.02	< 0.02	ND	50	86	60	130	92	50	140
Ethylbenzene	GCM0140-FEB19	µg/g	0.05	< 0.05	ND	50	88	60	130	93	50	140
m/p-xylene	GCM0140-FEB19	µg/g	0.05	< 0.05	ND	50	87	60	130	92	50	140
o-xylene	GCM0140-FEB19	µg/g	0.05	< 0.05	ND	50	89	60	130	92	50	140
Toluene	GCM0140-FEB19	µg/g	0.05	< 0.05	ND	50	86	60	130	91	50	140

QC SUMMARY

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-IENVI SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Water Soluble Boron	ESG0032-FEB19	µg/g	0.5	<0.5	ND	20	102	80	120	109	70	130

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 006361 Page ____ of ____

CA14250 – Feb 19.

Laboratory Information Section - Lab use only

Received By: Ismail
Received By (signature):
Received Date (mm/dd/yyyy): 02/11/19 (mm\dd\yy)
Received Time: 01:50
Custody Seal Present: ☑
Custody Seal Intact: ☑
Cooling Agent Present: ☑
Temperature Upon Receipt (°C): 6.5.6 3x3
LAB LIMS #:

REPORT INFORMATION

Company: Peto Macca GTD
Contact: Dylan Brice
Address: 16 FRANKLIN STS KIT, ONT N2C1R4
Phone: 519-893-7500
Email: 519-893-0654
Email: dbrice@petomaccallum.com

INVOICE INFORMATION

☒ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 18E2047
Site Location/ID: CAMBRIDGE

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date:
Rush Confirmation ID:

REGULATIONS

Regulation 153/04: ☒ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	PHC F1-F4 ☒ VOC ☐ BTEX ☐ BTEX/F1 ☐ F2-F4 ☐	VOC ☐ BTEX ☒ THM ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	COMMENTS:
1	BH187 SS2	Feb 7/19	9:45am	4	Soil	☒	☒				☒					
2	BH187 SS6	Feb 7/19	10:15am	4	Soil	☒	☒				☒					
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																

Observations/Comments/Special Instructions

Sampled By (NAME): Kurtis Reith Signature: Date: 02/11/19 (mm/dd/yy) Pink Copy - Client
Relinquished by (NAME): Kurtis Reith Signature: Date: 02/11/19 (mm/dd/yy) Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

SGS

SAMPLE INTEGRITY REPORT

Project Number: 18RF047

SGS Sample ID CA14250-Feb19

Date / Time Sampled Feb 7, 2019

Client Sample ID BH/MW SS2/16

ONTARIO REGULATION 153/04

ALL

Sample Submission General Sample Integrity Violations	
Temperature >10 C upon receipt if not sampled same day	☐
No evidence of cooling trend initiated if sampled same day	☐
Chain of Custody not submitted	☐
Chain of Custody incomplete	☐
Chain of Custody not signed / dated	☐
Chain of Custody not a current version	☐
Bottles / Samples listed on CoC but not received	☐
Bottles / Samples received but not listed on the CoC	☐
Sample container received empty	☐

PHC F1-F4 not checked off, samples going for it as per BM

Sample Specific Sample Integrity Violations							
Sample received past hold time	☐	☐	☐	☐	☐	☐	☐
Incorrect preservation (including no preservation where required)	☐	☐	☐	☐	☐	☐	☐
Headspace present in VOC vial (aqueous)	☐	☐	☐	☐	☐	☐	☐
Sample(s) received frozen	☐	☐	☐	☐	☐	☐	☐
Bottle(s) broken or damaged in transport	☐	☐	☐	☐	☐	☐	☐
Discrepancy between sample label and chain of custody	☐	☐	☐	☐	☐	☐	☐
Analysis requirements absent / unclear	☑	☐	☐	☐	☐	☐	☐
Missing or incorrect sample label(s)	☐	☐	☐	☐	☐	☐	☐
Inappropriate sample container used	☐	☐	☐	☐	☐	☐	☐
Insufficient number of bottles received	☐	☐	☐	☐	☐	☐	☐
Limited sample volume	☐	☐	☐	☐	☐	☐	☐
Insufficient sample volume	☐	☐	☐	☐	☐	☐	☐
Sample contains multiple phases	☐	☐	☐	☐	☐	☐	☐
Sediment Log							
Groundwater samples contain visible sediment / particulate	☐	☐	☐	☐	☐	☐	☐
Groundwater contains greater than 1cm of sediment / particulate matter in bottle	☐	☐	☐	☐	☐	☐	☐

Additional Comments/Remarks:

No issues upon receipt ☐ Initials: _____

APPENDIX E

STATEMENT OF LIMITATIONS

STATEMENT OF LIMITATIONS

This report is prepared for and made available for the sole use of the client named. Peto MacCallum Ltd. (PML) hereby disclaims any liability or responsibility to any person or entity, other than those for whom this report is specifically issued, for any loss, damage, expenses, or penalties that may arise or result from the use of any information or recommendations contained in this report. The contents of this report may not be used or relied upon by any other person without the express written consent and authorization of PML.

This report shall not be relied upon for any purpose other than as agreed with the client named without the written consent of PML. It shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. A portion of this report may not be used as a separate entity: that is to say the report is to be read in its entirety at all times.

The report is based solely on the scope of services which are specifically referred to in this report. No physical or intrusive testing has been performed, except as specifically referenced in this report. This report is not a certification of compliance with past or present regulations, codes, guidelines and policies.

The scope of services carried out by PML is based on details of the proposed development and land use to address certain issues, purposes and objectives with respect to the specific site as identified by the client. Services not expressly set forth in writing are expressly excluded from the services provided by PML. In other words, PML has not performed any observations, investigations, study analysis, engineering evaluation or testing that is not specifically listed in the scope of services in this report. PML assumes no responsibility or duty to the client for any such services and shall not be liable for failing to discover any condition, whose discovery would require the performance of services not specifically referred to in this report.

The findings an comments made by PML in this report are based on the conditions observed at the time of PML's site reconnaissance. No assurances can be made and no assurances are given with respect to any potential changes in site conditions following the time of completion of PML's field work. Furthermore, regulations, codes and guidelines may change at any time subsequent to the date of this report and these changes may effect the validity of the findings and recommendations given in this report.

STATEMENT OF LIMITATIONS

The results and conclusions with respect to site conditions are therefore in no way intended to be taken as a guarantee or representation, expressed or implied, that the site is free from any contaminants from past or current land use activities or that the conditions in all areas of the site and beneath or within structures are the same as those areas specifically sampled.

Any investigation, examination, measurements or sampling explorations at a particular location may not be representative of conditions between sampled locations. Soil, ground water, surface water, or building material conditions between and beyond the sampled locations may differ from those encountered at the sampling locations and conditions may become apparent during construction which could not be detected or anticipated at the time of the intrusive sampling investigation.

Budget estimates contained in this report are to be viewed as an engineering estimate of probable costs and provided solely for the purposes of assisting the client in its budgeting process. It is understood and agreed that PML will not in any way be held liable as a result of any budget figures provided by it.

The Client expressly waives its right to withhold PML's fees, either in whole or in part, or to make any claim or commence any action or bring any other proceedings, whether in contract, tort, or otherwise against PML in anyway connected with advice or information given by PML relating to the cost estimate or Environmental Remediation/Cleanup and Restoration or Soil and Ground Water Management Plan Cost Estimate.

Appendix K – Hydrogeological Site Assessment (Peto MacCallum)

September 2023

HYDROGEOLOGICAL SITE ASSESSMENT
PROPOSED MAPLE GROVE ROAD AND CORRIDOR STUDY
FOUNTAIN STREET TO HESPELER ROAD
CAMBRIDGE, ONTARIO

for

REGION OF WATERLOO
C/O IBI GROUP

PETO MacCALLUM LTD.
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PML Ref.: 18KF047
Report: 2
March 15, 2022

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Appendix I – Statement of Limitations

Peto MacCallum Ltd.
CONSULTING ENGINEERS

March 15, 2022

PML Ref.: 18KF047
Report: 2

Region of Waterloo
c/o Mr. John Bayley, P. Eng.
IBI Group
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Dear Mr. Bayley

Hydrogeological Site Assessment
Proposed Maple Grove Road Improvements and Corridor Study
Fountain Street to Hespeler Road
Cambridge, Ontario

1. INTRODUCTION

Peto MacCallum Ltd. (PML) was retained by the Region of Waterloo in the care of IBI Group to carry out a Hydrogeological Site Assessment (HSA) for the proposed Maple Grove Road Improvements and Corridor Study, from Fountain Street to Hespeler Road, in Cambridge, Ontario, hereinafter referred to as the site (see Figure 1). Authorization to proceed with this assignment was provided in IBI Group consulting services agreement C2018-07, dated august 2018.

A geotechnical investigation (PML Ref.: 18KF047, Report 1, dated March 10, 2022) was conducted by PML concurrently with the hydrogeological investigation.

1.1 Project Understanding

It is understood that the proposed construction work will involve:

- Rehabilitation and road widening for the 4.3 km long section of Maple Grove Road from Fountain Street to Hespeler Road, and 1.5 km of Hespeler Road near the Maple Grove Road intersection. The proposed roadworks will encompass three areas including: rehabilitation of the current four lane section from Fountain Street North to Vondrau Drive, widening of the current two lane section from Vondrau Drive to Old Maple Grove Road, and widening and rehabilitation of the current two lane section from Old Maple Grove to Hespeler Road (including a section of Fisher Mills Road).

- A new bypass, or realignment of about 1.2 km of Maple Grove Road is also being considered. The realignment might shift the Hespeler Road and Beaverdale Road intersections southward. The bypass option may include a grade separation structure near the current Old Maple Grove Road and Maple Grove Road intersection, a crossing of Beaverdale Road about 200 m south of Old Maple Grover Road, and connection to Hespeler Road via a grade separation structure approximately 500 m south of the existing Hespeler Road and Maple Grove Road intersection.

- Ellis Creek Bridge widening or construction of new pedestrian trail bridges on both sides of the current Ellis Creek bridge;

- An interchange including grade separation structure is being considered as a possible alternative to the current Hespeler Road and Maple Grove Road intersection;

- Intersection improvements are being considered, and may include roundabouts or traffic signals at Vondrau Drive, Boxwood Drive, Speedsville Road, future Compass Trail, Beaverdale Road, and Hespeler Road.

- New watermain, sanitary sewer, storm sewer and low impact development facilities will also be constructed along the project route.

- Rehabilitation and/or reconstruction of the Maple Grove Road and Hespeler Road roadway pavements.

Detailed design of the buried services and structures were not available at the time of this assessment. However, it is assumed that buried services will be typically installed with inverts up to 3 m depth below existing surface grades. The potential depth and footprint of excavations for structures was estimated based on the geotechnical recommendations.

1.2 Previous Investigations

PML is very familiar with the subsurface conditions along Maple Grove Road, having completed numerous investigations for the road's construction in the 1980's, specifically:

- Geotechnical Investigation, Proposed Maple Grove Road Link, Highway 8 to Fountain Street, PML Ref: 86F78/A/B/C, with reports dated April, May, August, November and December 1986.

- Geotechnical Investigation, Proposed Waterway Crossing, Maple Grove Road Extension at Ellis Creek, PML Ref: 87F496/A, with reports dated May 1989.
- Geotechnical Investigation, Proposed Widening of Beaverdale Road, Beaverdale Road at Maple Grove Road, PML Ref: 87F497B, dated April 1989.
- Geotechnical Investigation, Proposed Maple Grove Road Realignment, Briardeen Road to Fisher Mills Road, PML Ref: 87F497, dated December 1987.

Investigations have also been conducted at the site by LVM, specifically:

- Geotechnical Investigation, Widening of Maple Grove Road, Fountain Street to Speedsville Road, 160-P030373-0100-GE-0001-00, dated June 2011.

1.3 Construction Dewatering Water Taking Permitting

Construction dewatering, like other water takings in Ontario, is governed by the Ontario Water Resources Act (OWRA) and the Water Taking and Transfer Regulation 387/04, a regulation under the OWRA. In accordance with these regulatory requirements, an application for a Permit-To-Take-Water (PTTW) should be filed with the Ministry of Environment, Conservation and Parks (MECP) if the construction dewatering discharge rate is expected to be greater than 400,000 L/day or about 4.6 L/s. If the dewatering discharge is expected to be greater than 50,000 L/d and less than 400,000 L/d the water taking will not require the MECP PTTW approval process and can instead be registered with the Environmental Activity and Sector Registry (EASR).

1.4 Purpose and Scope of Work

The objective of the subject HSA was to provide a hydrogeological study with comments and recommendations for design and construction of the proposed road reconstruction, buried services, and potential structure construction in accordance with the Region of Waterloo and regulating agencies requirements.

The report has been prepared in accordance with the Ontario Water Resources Act (OWRA), Ontario Regulation 387/04 (Water Taking and Transfer).

Based on the project requirements, as well as the standard practice guidelines, this HSA methodology is as follows:

- Attend the site to visually examine the terrain and land use on the site and in the vicinity and identify all watercourses within 250 m of the site.
- Review relevant reference materials, published data, Ministry of Environment, Conservation and Parks (MECP) well records and previous hydrogeological and/or engineering reports prepared for other projects in the area of the subject property to determine the hydrostratigraphy and hydrogeological conditions at the site and the regional setting.
- Coordinate with the geotechnical investigation the drilling and installation of about 23 monitoring wells along the planned alignment, including Hespeler Road, with two at the Hespeler Road interchange, two at the Ellis Creek crossing, and one at the intersection of Beaverdale Road and Old Maple Grove Road.
- Utilize the 25 monitoring wells (installed as part of the geotechnical investigation) to record ground water levels and determine the depth to the ground water table and vertical and horizontal ground water gradients.
- Coordinate with the geotechnical investigation the sampling and grain size testing of 33 shallow and deep soil samples for characterization of the soil and estimation of conductivity and/or infiltration properties.
- Conduct slug/bail down tests on ten (10) monitoring wells to assess the hydraulic characteristics of the stratigraphic unit.
- Utilize the borehole information, soil sample testing results and monitoring well findings completed in the geotechnical investigation along with findings from the MECP private well records to confirm the site specific hydrostratigraphy and hydrogeologic conditions.
- To assess the potential impact of discharging ground water during construction dewatering, conduct sampling and chemical testing of three (3) ground water samples for parameters listed in the Region of Waterloo Sanitary and Storm Sewer-use bylaw 2016-128 and selected Provincial Water Quality Objectives (PWQO) parameters. Also, one surface water sample obtained from Ellis Creek will be analyzed for selected PWQO parameters, if necessary. PWQO parameters will be chosen based on assessment of potential contaminant sources in the vicinity.
- Based on the findings and design drawings, develop a conceptual model of the site and assess the potential construction dewatering requirements (estimated dewatering rates and dewatering zones of influence).
- Conduct a water well survey of operating private wells within the estimated dewatering zone of influence.

The comments and recommendations provided in this report are based on the site conditions at the time of the investigation, and are applicable only to the proposed project as described in the report. Any changes in the project, including invert depths and layout will require review by PML to assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

2. BACKGROUND REVIEW

2.1 General, Site Physiographic, Geologic and Hydrogeologic Settings

The land use surrounding the section of Maple Grove Road under investigation is predominantly industrial between Fountain Street North and Boxwood Drive and predominantly agricultural from Boxwood Drive to Hespeler Road. A residential subdivision is being built south of Maple Grove Road between Briardeen Road and Beaverdale Road, and existing residential areas are located on Old Maple Grove Road, on Beaverdale Road north of Maple Grove Road, and east of Hespeler Road.

An aerial photograph of the Site and vicinity is included in Figure 1.

According to Chapman and Putnam (Physiography of Southern Ontario, Ministry of Natural Resources, 1984), the site alignment is located in the physiographic region known as the Guelph Drumlin Field, an area including about 300 broad, oval drumlins with gradual slopes. The physiographic landforms in the area include drumlinized till plains from Fountain Street North nearly to Speedsville Road, and Spillways containing higher amounts of sand and gravel over the remainder of the alignment. Selected maps from OGSEarth showing the physiographic region and landform are included in Appendix A, Figures 1 and 2. OGSEarth is a collection of Ontario Geological Survey geoscientific maps and data hosted by the Ontario Ministry of Northern Development and Mines which can be viewed using programs such as Google Earth.

The OGSEarth map of Surficial Geology of Southern Ontario (OGS Survey, 2003), see Appendix A, Figure 3, indicates that surficial geology along Maple Grove Road from Fountain Street North to Speedsville Road is sandy silt to silty sand till, and the remainder is glaciofluvial deposits (sandy

deposits from rivers and deltas), with the exception of the local vicinity of Ellis Creek, where modern alluvial deposits are to be found.

The bedrock underlying Maple Grove Road from Fountain Street North to Speedsville Road is the Salina formation, typically dolostone and shale, and the remainder of the alignment is the Guelph formation, typically dolostone (Paleozoic Geology of Southern Ontario, OGS, OGSEarth, 2007), see Appendix A, Figure 4.

According to the map “Bedrock Topography – Cambridge Area”, O.G.S. Map P.1985, 1979, the bedrock beneath the Site varies from about 260 mASL at Fountain Street North (about 50 m below existing ground surface), to about 290 mASL at Hespeler Road (about 10 m below the existing ground surface).

Surface elevations at the boreholes range from about 290.2 to 316.5 mASL. The topographic contours can be seen the Topographic Contour Maps, Parts 1 and 2 in Appendix B.

According to the Grand River Conservation Authority (GRCA), the project is located within the Lower Speed River and Ellis Creek subcatchment areas of the Grand River Watershed. A large part of Maple Grove Road, from east of Boxwood Road to Old Maple Grove Road, and from Beaverdale Road to Hespeler Road, is located within or adjacent to the GRCA regulation limits (see GRCA Regulated Watercourses Map in Appendix B) due to the crossings of (west to east): Middle Creek, East Creek and Ellis Creek (also known as Chilligo Creek or Fisher Mills Creek). The creeks flow southerly to Speed River. GRCA-designated wetlands border these creek along much of their lengths.

A potential contaminating activity (PCA) noted in our site reconnaissance included the Toyota Motor Manufacturing operation between Fountain Street and Boxwood Drive. In addition, properties adjacent to Maple Grove Road may have septic systems in the vicinity of potential construction dewatering.

The regional ground water flow is interpreted to be generally in a southerly and/or southeasterly direction towards Speed River.

2.2 MECP Water Well Records Review

The water wells recorded by the MECP within approximately 500 m of the project limits are summarized in a table and are mapped on Figure 1 and 2, in Appendix C. These well records include all recorded wells regardless of their current status. The records date from 1948 to 2017.

Wells with record dates prior to 2005 are primarily domestic water supply wells, and are typically more than 30 m deep and after 2005 are primarily monitoring wells and test holes. Static ground water levels recorded vary considerably but typically ranged from 5 to 25 m below ground surface.

With regards to well head protection areas (WHPA), the site intersects with the WHPA-C and WHPA-D radius zones of a wellhead protection area of a municipal well located at 1084 Fountain Street North (about 380 m south of the Maple Grove Road). The length of Maple Grove included is from Fountain Street to Boxwood Drive. The WHPA of the well is depicted on the GRCA figure attached in Appendix B.

The possible impact of the water control methods on private and municipal well is described in Section 6.

3. FIELD WORK AND LABORATORY ANALYSES

3.1 Borehole Drilling and Monitoring Well Installation

The fieldwork for the geotechnical investigation was conducted between December 3, 2018 and February 22, 2019. The investigation program comprised 109 boreholes (Boreholes 1 to 10 and 101 to 199) advanced to between 3.7 and 17.4 m depth and 99 hand augers (TP1001 to 1099) advanced to between 10 and 890 mm depth at the locations shown on the appended Borehole Location Plan Drawing 1. Details of the subsurface conditions encountered are presented on the appended Log of Borehole sheets, and pavement and hand auger findings are presented in the geotechnical report.

The location of the boreholes are shown on Drawing 1, attached.

The number of boreholes and their locations were programmed by PML and approved by the client. The borehole locations were established in the field and surveyed by PML using a Sokkia GCX3 GNSS Receiver.

The boreholes were advanced using a Diedrich D50, CME-55, CME-75 and GeoProbe truck and track mounted drillrigs fitted with continuous flight solid and hollow stem augers, diamond tipped rock coring, and automatic hammer, supplied and operated by specialist drilling contractors. The work was carried out under full-time supervision of PML engineering staff members who directed the drilling and sampling operations, documented the soil stratigraphy, monitored ground water conditions and processed the recovered samples.

The ground water conditions in the boreholes were closely monitored during the course of the fieldwork. The ground water conditions were assessed during drilling by visual examination of the soil, the split spoon sampler and drill rods as the samples were being retrieved and, where encountered, by measuring the ground water level in the open boreholes.

Upon completion of drilling, monitoring wells were installed in twenty-five of the boreholes, located along the shoulders of Maple Grove Road and Hespeler Road. The wells were constructed using clean 50 mm diameter screened and solid PVC Schedule 40 pipe, filter sand packing, bentonite seal and protective locks and caps. Copies of the well records from the driller will be kept on file for future reference in accordance with O. Reg. 903, as amended. The field work program included ground water level readings to establish the ground water levels (see Section 4). It should be noted that the ground water levels can vary subject to weather events and seasonal weather conditions.

Representative soil samples were taken at regular depth intervals using a conventional split spoon sampler in conjunction with Standard Penetration Tests (ASTM D1586-11) using a conventional split spoon sampler.

All of the recovered samples were returned to PML's laboratory for detailed visual examination, classification and routine moisture content determinations. The laboratory testing also included 47 particle size distribution analyses on samples of the pavement granulars and major subgrade soil

types encountered. Reference is given to the appended Figures 1 to 10 in Appendix D for the results of the particle size analyses on samples.

A limited chemical testing program was included in the geotechnical program to assess the geoenvironmental quality of the site soil in order to provide comments regarding on site or offsite re-use and disposal options of excess soil. For details, see the geotechnical report.

Reference is given to the attached Borehole Log Sheets and Appendix D, Figures 1 to 10 for the results of the drilling and particle size analyses on soil samples recovered. The applicable log of borehole sheets from the previous LVM investigation has been included in Appendix A.

3.2 Borehole Permeability Testing

In order to estimate the hydraulic conductivity of the soil surrounding the well screens, borehole permeability testing was conducted in the monitoring wells of boreholes BH/MW2, BH/MW6, BH/MW110, BH/MW112, BH/MW115, BH/MW122, BH/MW123, BH/MW138, BH/MW143 and BH/MW147.

In the test, a volume of water (the 'slug') was rapidly removed from the monitoring well and periodic water level measurements were recorded manually and with an electronic transducer (a Solinst Levelogger), as the water level recovered inside the well.

Using the Hvorslev method (Hvorslev, 1951), the data was plotted on a semi-logarithmic scale to estimate the basic time lag T_0, which, combined with the geometric configuration of the well screens, resulted to an estimation of hydraulic conductivity (K-value) for the soils in the vicinity of the well screen. The plots of normalized head versus elapsed time and the estimation of the basic time lags (T_0 values) are included in Appendix F. T_0 was estimated by fitting an exponential trend line to the data, typically between the normalized head interval of 0.15 and 0.25, as recommended by Butler (1997) to overcome the ambiguity of double straight-line effects or concave results, and calculating T_0 from the inverse of the slope of the fit line. A plot exhibiting concave-upward curvature reflects compressibility of the formation indicating that a storage effect may exist.

The K-values were estimated using the following equation:

$$K = \frac{r^2}{2LT_0} \ln\left(\frac{L}{R}\right)$$

where: K = hydraulic conductivity (cm/s)

L = the length of the screen (cm)

R = the radius of the borehole (cm)

r = the radius of the well casing (cm)

T_0 = the basic time lag in seconds (-1/slope of line fitted to data, see Appendix F).

Slug tests conducted in monitoring wells with partially submerged well screens are influenced by sand pack drainage and re-saturation. Under this condition, the above procedure was modified using the method outlined by Binkhorst and Robbins (1998) in which an 'effective' well casing radius, r_e, based on the specific yield of the sand pack, replaces the well casing radius, r. The specific yield of the sand pack was taken to be 0.25.

3.3 Water Sampling

In order to determine the management options for the potential discharge of construction ground water control takings, ground water samples were collected from monitoring wells BH/MW2, BH/MW110 and BH/MW143, on April 30, 2019, following well development on March 27 to 29, 2019, which consisted of removing an equivalent of about 3 to 10 times the respective well volume. Additionally, a sample of the water in Ellis Creek was collected and analyzed. The ground water samples were collected using a Waterra Ecobailer. The samples obtained were immediately placed in bottles supplied by SGS Canada Inc. (SGS) and stored at low temperatures. The collected water samples were taken to SGS for chemical analyses immediately after collection.

3.4 Laboratory Analyses

3.4.1 Ground Water Sample Chemical Analyses

The ground water samples collected were delivered to SGS Canada Inc for chemical analyses. SGS is accredited by The Standards Council of Canada (SCC) and The Canadian Association for Laboratory Accreditation (CALA).

To assess the baseline ground water quality with respect to future disposal options during potential construction dewatering, and in accordance with the RFP, the ground water samples were analyzed for the following parameters:

- Region of Waterloo Sanitary and Storm Sewer Bylaw,
- a suite of metals,
- nitrate, hardness, ammonia and chlorine.

To assess the baseline water quality of the water in Ellis Creek, a creek water sample was analyzed for the following parameters:

- a suite of metals,
- pH, nitrate, hardness, ammonia, chlorine, BOD, cyanide, TSS, sulphate, and chloride.

The Chain-of-Custody Record and the laboratory reports are included in Appendix G, and the results are discussed in Section 4.10.

3.4.2 Soil Particle Size Distribution Analyses

Soil samples were submitted to the PML laboratory for particle size distribution analyses and the particle size distribution curves of these soil samples are shown on Figures 1 through 10 in Appendix D. The percentages of gravel, sand, silt and clay from the laboratory tests are reported on the attached borehole logs.

The hydraulic conductivity of selected soil samples was estimated using the grain size distribution and an established empirical formula as described below.

The hydraulic conductivity of sands and sandy soils were estimated using the grain size distribution and the following equation (Vukovic and Soro, 1992):

$$K = C\ f(n) d_e^2\ \frac{g}{\nu}$$

where:

- Hydraulic conductivity K has units of m/s
- Constant C = 8.3 x 10^{-3}, 2.4 x 10^{-3}, or 0.7 x 10^{-3} for coarse, medium, or fine grained sand, respectively.
- Porosity function $f(n) = \frac{n^3}{(1-n)^2}$ where $n = 0.255\left(1 + 0.83^{C_u}\right)$ and $C_u = \frac{d_{60}}{d_{10}}$.
- Grain diameter d_x = grain diameter, in mm, for which x% of the sample is finer based on the grain size distribution curve.
- Effective grain size diameter $d_e = f\left(\frac{d_{30}}{d_5}\right)$ (see below)

  The soil uniformity, d_{30}/d_5, and an empirical relationship (Figure 3 of Vukovic and Soro, 1992) are applied to the soil's grain size distribution curve to estimate the effective grain size diameter d_e.
- Gravitational constant g = 9.81 m/s^2.
- Ground water kinematic viscosity ν = 1.3 x 10^{-6} m^2/s (at assumed 10°C).

The results are discussed in Section 4.9.

3.5 Water Well Survey

A door-to-door private well survey was conducted in July and August 2019. Details are available in Section 6.1.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets, tables, figures and drawings for details of the field work including soil classification, inferred stratigraphy, standard penetration test N values, ground water observations, moisture content, monitoring well details and laboratory test results.

Our findings and interpretation of the site subsurface conditions are presented below.

Due to the soil sampling procedures and limited sample size, the depth/elevation demarcation on the borehole logs must be viewed as “transitional” zones between layers, and cannot be construed as exact geologic boundaries between layers.

Also, it should be noted that the ground surface elevations at the borehole locations are referenced for describing the soil stratigraphy only. The provided elevations should not be used or relied upon for any other purposes.

4.1 Maple Grove Road

Boreholes 1 to 5, and 101 to 144 were advanced on Maple Grove Road from Fountain Street North to east of Hespeler Road (including a section of Fisher Mills Road). The general subsurface stratigraphy encountered along the lanes, shoulders and ditches of Maple Grove Road comprised

- Surficial pavement structure or topsoil
- Fill (various),
- Sand/gravelly sand/sand and gravel, silty sand/sandy silt,
- Silt/clayey silt, and
- Sandy silt till/silt till/clayey silt till.

4.1.1 Pavement Structures

For details see the geotechnical report.

4.1.2 Topsoil and Topsoil Fill

Surficial topsoil was encountered in Borehole 2 and hand augers TP1001 to TP1044. Reference is given to the appended Log of Borehole sheets and the geotechnical report for the topsoil thicknesses encountered.

4.1.3 Fill

Fill was encountered along Maple Grove Road below the pavement structure in Boreholes 3 to 5, 101 to 117, 119 to 123, 128, 130 to 137, and 144. The fill comprised sand and gravel, gravelly sand, sand, silty sand, sandy silt, silt, and clayey silt, with occasional or trace organics in localized areas. The fill was loose to very dense with SPT N values ranging from 4 to greater than 50 blows per 0.3 m penetration of the split spoon sampler. The fill extended to between 0.9 and 7.9 m depths. The fill was damp to saturated, with moisture contents between 2 and 23%.

Reference is given to Figure 4 in Appendix D for the results of particle size analysis on samples of the fill.

4.1.4 Sand/Gravelly Sand/Sand and Gravel

Near surface sand/gravelly sand/sand and gravel deposits were encountered in Boreholes 1, 2, 4, 5, 102, 107, 110 to 112, 114 to 117, 120, 122, 125 to 127, 131, 138, 140 to 143, and extended to between 2.3 and 9.2 m depth. The sand/gravelly sand/sand and gravel was generally encountered below the pavement structure, fill, and occasionally were interlayered with silty sand/sandy silt and silt/clayey silt deposits. These deposits contained occasional to numerous cobbles, occasional boulders and occasional silty layers. The sand/gravelly sand/sand and gravel was very loose to very dense with SPT N values ranging from 2 to greater than 50 blows per 0.3 m penetration of the split spoon sampler. The sand/gravelly sand/sand and gravel was moist to saturated with depth, based on moisture contents ranging from 2 to 32%.

A deeper gravelly sand deposit was also encountered below silt/clayey silt deposits in Boreholes 3 and 4, and extended to 12.5 and 18.6 m depths, respectively. The gravelly sand deposit contained occasional cobbles, occasional boulders, and occasional clayey silt seams. The gravelly sand in Boreholes 3 and 4 was very dense with SPT N values greater than 50 blows per 0.3 m penetration. The gravelly sand was saturated with moisture contents between 5 and 25%.

Reference is given to Figures 5 and 6 in Appendix D for the results of particle size analyses on samples of the gravelly sand and sand.

4.1.5 Silty Sand/Sandy Silt

Silty sand/sandy silt deposits were encountered in Boreholes 103, 104, 110, 119, 123, 124, 132, 134, 139, 140, 142, 144, and extended to between 2.3 and 5.0 m depth. Silty sand/sandy silt was generally encountered below the fill and occasionally interlayered with the sand/gravelly sand/sand and gravel. The silty sand/sandy silt was loose to very dense with SPT N values ranging from 5 to greater than 50 blows per 0.3 m penetration. The silty sand/sandy silt deposits were moist to saturated with moisture contents ranging from 4 to 23%.

Reference is given to Figure 7 in Appendix D for the results of particle size analysis on samples of the silty sand.

4.1.6 Silt/Clayey Silt

Silt/clayey silt deposits were encountered in Boreholes 3 and 4, below the fill and sand deposits, and extended to 8.6 and 10.1 m depth, respectively. The silt/clayey silt was compact to dense/very stiff with SPT N values ranging from 19 to 41 blows per 0.3 m penetration. The silt/clayey silt was wet/about plastic limit (APL) with moisture contents between 12 and 15%.

4.1.7 Sandy Silt Till/Silt Till/Clayey Silt Till.

Sandy silt till/silt till/clayey silt till deposits were encountered in Boreholes 1, 2, 5, 101 to 103, 105 to 109, 111 to 115, 118, 120 to 122, 124, 128 to 133 to 135, 140, and 141, and extended to between 3.7 and 16.5 m depth. Cobbles, boulders and localized sand and gravel layers were encountered

within the till deposits. The till deposits encountered along Maple Grove Road were compact to very dense/ stiff to hard with SPT N values ranging from 13 to greater than 50 blows per 0.3 m penetration of the split spoon sampler. The till deposits were moist to saturated/drier than plastic limit (DTPL) to APL with moisture contents between 5 and 19%.

Reference is given to the appended Figures 8 and 10 in Appendix D for the results of particle size analyses on samples of the sandy silt till and clayey silt tills.

4.1.8 Ground Water

Wet and saturated soil conditions were observed below 1.4 to 10.7 m depths (elevation 294 to 311). Hydrostatic ground water level readings in the wells installed, taken on March 28, 2019, were between 1.1 and 7.4 m depths (average 2.6 m), elevations about 295 to 309 (average 305). A full listing is available in Table 1. No artesian ground water conditions were identified.

The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site. However, it should be noted that the presence of the relatively impermeable silty or clayey soils could result in the development of perched ground water conditions following short term and seasonal precipitation events. The ground water level is subject to seasonal fluctuations and variations in precipitation and climate.

The majority of the investigated length of Maple Grove Road is underlain by layers of wet or saturated sandy soils that may be categorized as aquifers.

4.2 Hespeler Road

Boreholes 6, 7, 8, 145 to 164 were advanced on Hespeler Road, to between 4.6 and 12.8 m depth. The general subsurface stratigraphy encountered comprised:

- Pavement structure;
- Fill
- Sand / silty sand / sand and gravel

- Silt
- Clayey silt till / sandy silt till/ silty sand till
- Bedrock

4.2.1 Pavement Structure

For details see the geotechnical report.

4.2.2 Fill

Fill was encountered in Boreholes 6, 7, 8, 162 to 164, to between 2.3 to 5.0 m depth. The fill comprised sand, silty sand, silt and sandy silt. The fill was compact to very dense with SPT N values from 14 to greater than 50 blows per 0.3 m penetration. The fill was damp to wet with moisture content between 6 and 21%.

Reference is given to Figure 4 in Appendix D for the results of particle size analysis on a sample of the fill.

4.2.3 Sand/Silty Sand/Sand and Gravel

Sand/silty sand/sand and gravel deposits were encountered below the pavement structure and fill in Boreholes 6, 145 to 154, 157, 160 and 161, and extended to between 0.9 and 7.6 m depth. The sand/silty sand/sand and gravel deposits were loose to dense with SPT N values ranging from 7 to greater than 50 blows per 0.3 m penetration. The sand/silty sand/sand and gravel deposits were damp to saturated with depth, based on moisture contents between 2 and 21%.

Reference is given to Figures 5 and 6 in Appendix D for the results of particle size analyses on samples of the gravelly sand and sand.

4.2.4 Silt/Clayey Silt

Silt/clayey silt deposits were encountered below the fill, and below and between layers of sand/silty sand/sand and gravel, and extended to between 2.1 and 5.0 m depth. The silt/clayey silt was compact to dense/very stiff to hard base on SPT N values of 18 to greater than 50 blows per 0.3 m penetration. The silt/clayey silt was moist to saturated/APL with moisture contents between 14 and 22%.

Reference is given to Figure 9 in Appendix D for the results of particle size analyses on samples of the silt.

4.2.5 Clayey Silt Till/Sandy Silt Till/Silty Sand Till

Clayey silt till/sandy silt till/silty sand till was encountered in Boreholes 6 to 8, 148 to 150, and 152 to 162, and extended to between 4.5 to 11.2 m depth. Cobbles, boulders and localized sand and gravel layers were encountered within the till deposits. The clayey silt till/sandy silt till/silty sand till was compact to dense / very stiff to hard with SPT N values ranging from 14 to greater than 50 blows per 0.3 m penetration.

Reference is given to Figures 8 and 10 in Appendix D for the results of particle size analyses on samples of the sandy silt till and clayey silt till.

4.2.6 Bedrock

Bedrock was encountered in Boreholes 6 and 8 at 11.2 and 5.0 m depth, respectively. The bedrock encountered in Borehole 8 was cored to 12.8 m depth. The bedrock in Borehole 8 was penetrated using hollow stem augers and split spoon sampler to 5.3 m depth. The bedrock comprised weathered hard buff dolostone.

4.2.7 Ground Water

Wet and saturated soil conditions were observed below 1.2 to 4.4 m depths (elevation 288 to 306). Hydrostatic ground water level readings in the wells installed in selected boreholes, taken on March

28, 2019, were between 0.3 and 4.7 m depths (average 2.9), elevations 289 to 313 (average 301). A full listing is available in Table 1. No artesian ground water conditions were identified.

The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site. However, it should be noted that the presence of the relatively impermeable silt/clayey silt and till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events. The ground water level is subject to seasonal fluctuations and variations in precipitation and climate.

The majority of the investigated length of Hespeler Road was underlain by layers of wet or saturated sandy soils that may be categorized as aquifers.

4.3 Vondrau Drive

Boreholes 165 to 169 were advanced on Vondrau Drive, to between 4.7 and 5.0 m depth. The general subsurface stratigraphy encountered on Vondrau Drive comprised a pavement structure supported on fill, and sandy silt till/clayey silt till.

Fill was encountered below the pavement structure in Boreholes 166 to 169, and extended to between 1.4 to 2.3 m depth. The fill was compact to dense with SPT N values ranging from 12 to 46 blows per 0.3 m penetration. The fill comprised silt, clayey silt, silty sand, and sand and gravel. The fill was moist to wet with moisture contents between 2 and 12%.

Sandy silt till/clayey silt till was encountered below the pavement structure and fill, and extended the 4.7 to 5.0 m termination depths. The till deposits were very stiff to hard/compact to very dense with SPT N values ranging from 16 to greater than 50 blows per 0.3 m penetration. The till deposits were moist to wet/DTPL with moisture contents between 5 to 15%.

Free water seepage was not observed within the investigation depths. The presence of the relatively impermeable till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

4.4 Boxwood Drive

Boreholes 170 to 174 were advanced on Boxwood Drive, to a typical 5.0 m depth. The general subsurface stratigraphy encountered on Boxwood Drive comprised a pavement structure supported on fill and sandy silt till/clayey silt till/silt till.

Fill was encountered below the pavement structure in Boreholes 170 to 174, and extended to between 1.4 to 2.3 m depth. The fill comprised sandy silt, silt, and silty sand. The fill was loose to compact and comprised 6 to 28 blows per 0.3 m penetration. The fill was moist with moisture contents ranging from 8 to 21%.

Sandy silt till/clayey silt till/silt till was encountered below the fill in Boreholes 170 to 174, and extended to the 5.0 m termination depths. The till deposits were compact to very dense/very stiff to hard with SPT N values ranging from 12 to greater than 50 blows per 0.3 m penetration. The till deposits were moist to saturated/DTPL to APL with moisture contents ranging between 5 and 19%.

Wet and saturated soil conditions were observed below 3.4 and 4.7 m depths (elevation 305 to 309). The wet soil conditions and seepage into the boreholes reflect the ground water levels at the site. The presence of the relatively impermeable till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

4.5 Speedsville Road

Boreholes 175 to 185 were advanced on Speedsville Road, to between 4.7 and 5.0 m depth. The general subsurface stratigraphy comprised a pavement structure supported on fill, localized buried topsoil, silt/silty sand/sandy silt, sand/sand and gravel, underlain by sandy silt till/clayey silt till deposits.

Fill was encountered below the pavement structure in Boreholes 175 to 185, and extended to between 0.7 and 1.9 m depths. The fill comprised sand, sandy silt, silty sand, sand and gravel and clayey silt, and frequently contained trace organics. The fill was loose to compact with SPT N values

ranging from 7 to 23 blows per 0.3 m penetration. The fill was moist to wet with moisture contents between 5 and 23%.

Silt/silty sand/sandy silt was encountered below the fill in Boreholes 180, 181, 183 and 185, and extended to between 1.4 and 3.0 m depth. The silt/silty sand/sandy silt was loose to compact with SPT N values between 7 to 18 blows per 0.3 m penetration. The silt/silty sand/sandy silt was moist to saturated with moisture contents between 10 to 18%.

Sand/sand and gravel was encountered below the fill, silt/silty sand/sandy silt in Boreholes 175 to 179, 181, and 183 to 185, and extended to between 1.7 and 5.0 m depth. The sand/sand and gravel was very loose to dense with SPT N values between 3 to 34 blows per 0.3 m penetration. The sand/sand and gravel was moist to saturated with moisture contents between 2 and 22%.

Sandy silt till/clayey silt till/silty sand till deposits were encountered below the silt/silty sand/sandy silt and sand/sand and gravel in Boreholes 178 to 185, and extended to the 4.7 to 5.0 m termination depths. The till deposits were compact to very dense/very stiff to hard with SPT N values ranging from 17 to greater than 50 blows per 0.3 m penetration.

Wet and saturated soil conditions were observed below 1.2 to 4.5 m depths (elevation 303 to 308). The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site. However, it is noted that the presence of the relatively impermeable till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

4.6 Briardean Road

Boreholes 186 to 189 were advanced on Briardean Road, to between 4.8 and 5.0 m depths. The general subsurface stratigraphy encountered comprised pavement structure, fill, sand and sandy silt till.

Fill encountered below the pavement structure in Boreholes 187 to 189 extended to between 0.6 and 2.1 m depth. The fill typically comprised clayey silt and sandy silt, with trace organics locally.

The fill was loose to compact/firm to stiff with SPT N values ranging from 7 to 11 blows per 0.3 m penetration. The fill was moist to wet.

Sand was encountered below the pavement structure and fill deposits in Boreholes 186 and 187, and extended to 4.0 m depth. The sand was compact with SPT N values ranging from 10 to 17 blows per 0.3 m penetration. The sand was damp to moist with moisture contents of 4%.

Sandy silt till deposits were encountered below the fill and sand deposits in Boreholes 186 to 189, and extended to the 4.8 to 5.0 m borehole termination depths. The till deposits were compact to very dense with SPT N values ranging from 18 to greater than 50 blows per 0.3 m penetration. The till was moist to saturated.

Wet and saturated soil conditions were observed below 4.2 m depth (elevation 309), in Borehole 188. The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site. However, it is noted that the presence of the relatively impermeable till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

4.7 Beaverdale Road

Boreholes 9, 10, 190 to 199 were advanced on Beaverdale Road, to between 5.0 and 17.4 m depth. The general subsurface stratigraphy comprised pavement structure, fill, sandy silt/silty sand, sand/gravelly sand/sand and gravel, silt/clayey silt, silt till/clayey silt till/sandy silt till, underlain by bedrock.

Fill was encountered surficially in Boreholes 9 and below the pavement structure in Boreholes 10, 192, 194, 195, 197 and 198, and extended to between 1.5 to 2.3 m depth. The fill was very loose to compact with SPT N values ranging from 2 to greater than 50 blows per 0.3 m penetration. The fill was damp to saturated with moisture contents between 4 and 13%.

Sandy silt/silty sand deposits were encountered below the pavement structure and fill in Boreholes 190, 191, 193, 194, 195, 197, and 199, and extended to between 1.4 to 5.0 m depth. The sandy

silt/silty sand was very loose to compact with SPT N values ranging from 3 to 18 blows per 0.3 m penetration. The sandy silt/silty silt was damp to saturated with moisture contents ranging from 3 to 19%.

Sand/gravelly sand/sand and gravel deposits were encountered below the sandy silt/silty sand in Boreholes 9, 190 to 195, and extended to between 3.8 and 5.2 m depth. The sand/gravelly sand/sand and gravel were compact to very dense with SPT N values ranging from 12 to greater than 50 blows per 0.3 m penetration. The sand/gravelly sand/sand and gravel were damp to saturated with moisture contents between 2 to 20%.

Silt/clayey silt were encountered below the fill and sand deposits in Boreholes 10 and 198, and extended to between 5.0 and 9.0 m depth. The silt/clayey silt was compact/soft to very stiff with SPT N values between 4 and 29 blows per 0.3 m penetration. The silt/clayey silt was wet to saturated/APL to WTPL with moisture contents between 15 and 25%.

Silt till/clayey silt till/sandy silt till was encountered in Boreholes 9, 10, 191 to 193, and 196 to 197, below the pavement structure, fill, sandy silt/silty sand, sand/gravelly sand/sand and gravel, silt/clayey silt, and extended to between 5.0 and 17.1 m depth. The till deposits were compact to dense/very stiff to hard with SPT N value ranging from 17 to greater than 50 blows per 0.3 m penetration. The till soils were moist to saturated with moisture contents ranging from 7 to 20%.

A layer of very dense saturated sand was encountered locally in Borehole 10 and extended to the 15.5 m termination depth.

Wet and saturated soil conditions were observed below 1.2 to 5.2 m depths (elevation 300 to 306). Water level readings in the well installed in Borehole 9, taken on March 28, 2019, was at 5.1 m depth (about elevation 303). The wet soil conditions and seepage into the boreholes and the water levels in the monitoring wells generally reflect the ground water levels at the site. However, it is noted that the presence of the relatively impermeable silt/clayey silt and till soils could result in the development of perched ground water conditions following short term and seasonal precipitation events.

4.8 Additional Ground Water Comments

According to the measured ground water levels on March 19, 2019, the depth to the measured ground water level was particularly small at Boreholes 2 (1.1 m) and 123 (1.7 m), which are close to the East Creek crossing (near Old Maple Grove Road), and at Borehole 6 (0.3 m), which is located just south of the Maple Grove Road / Hespeler Road intersection. The depth to the measured ground water level was particularly large at Borehole 4 (7.4 m), which is close to the Ellis Creek crossing (the road surface is about 6 to 7 m above the surface of the creek), and at Borehole 9 (5.1 m), which is located on Beaverdale Road at the proposed bypass location.

The lowest measured ground water elevations were located close to the Speedsville Road intersection (the Middle Creek crossing), the Ellis Creek crossing of Maple Grove Road, and Ellis Creek crossing of Hespeler Road; all regions of low surface elevation.

Considering that the monitoring wells were screened in the near-surface aquifer, and given the above, it is understood that the ground water levels generally correspond to surface topography, and the ground water in the vicinity of the project site will generally flow towards the closest creek. From Fountain Street to Boxwood Drive, flow is expected to be southery towards West Creek; from Boxwood Drive to Briardeen Road, flow is expected to be towards Middle Creek; from Briardeen Road to Beaverdale Road, flow is expected towards East Creek; and from Beaverdale to Hespeler Road and along Hespeler Road, ground water flow is expect towards Ellis Creek.

4.9 Estimated Hydraulic Conductivities

The hydraulic conductivity K-values of the soils encountered surrounding the monitoring well screens and the near-surface soils were estimated using in-situ permeability test data and grain size distribution test results as described in Sections 3.2 and 3.4.2 and are listed on Table 2.

Based on the K-values listed on Table 2, the range of hydraulic conductivity of the soil types are listed in Table A, below. The hydraulic conductivities assumed for calculation purposes are described in Section 5.

TABLE A

SUMMARIZED HYDRAULIC CONDUCTIVITY RESULTS

SOIL TYPE(S)	HYDRAULIC CONDUCTIVITY RANGE (cm/s)
Gravelly Sand	4×10^{-6} to 1×10^{-1}
Sand / Silty Sand	9×10^{-6} to 2×10^{-2}
Sandy Silt / Silt	2×10^{-6} to 4×10^{-5}

4.10 Ground Water Sample Chemical Test Results

The analyses carried out by SGS on non-filtered ground water samples from monitoring wells BH/MW2, BH/MW110 and BH/MW143, in accordance with the chain-of-custody record and the protocols described above (Section 3.3 and 3.4.1), are included in the laboratory report in Appendix G.

To provide an estimate of the how the dewatering discharge water may compare to expected regulatory compliance criteria for discharge to a storm sewer, and subsequent conveyance to a watercourse, or direct discharge to a watercourse or ditch, the water quality was compared to the local storm sewer bylaw criteria, Provincial Water Quality Objectives (PWQO), and where no PWQO limit exists, the guidelines of the Canadian Council of Ministers of the Environment (CCME). Where applicable, the CCME limit is the short-term freshwater water quality guideline for the protection of aquatic life.

The ground water samples complied with the parameters corresponding to discharge to a sanitary sewer with the exception of the chloride concentration in the water sample from BH/MW110.

The ground water samples complied with the parameters corresponding to discharge to a storm sewer (also requiring compliance with watercourse discharge criteria) with the exception of a number of metals, chlorine, fluoride, chloride, 4AA-phenolics, and suspended solids (see Table 3).

The compliance of cyanide, chlorine (BH/MW143 only), nitrite (BH/MW113 only) and 4AAP-Phenolics (BH/MW2 only) were inconclusive due to the laboratory's detection limit.

The creek water sample complied with PWQO and CCME for the parameters listed in Section 3.4.1, with the exception of chlorine. The compliance of cyanide was inconclusive due to the laboratory's detection limit.

The results are summarized in Table 3, attached.

Since the results are for total (non-dissolved) forms, it is expected that the concentrations of the majority of the non-compliant parameters will be reduced by treatment with a sedimentation tank and/or filtration bags prior to discharge. Further discussion is presented in Section 6.5.

5. GROUND WATER CONTROL REQUIREMENTS

5.1 Potential Construction Methods

Since it is very early in the design process, the methods of construction and installation, specific locations, and invert depths and footprint dimensions are unknown and for further assessment are assumed as discussed in this subsection. The assumptions are not to be construed as directives.

5.1.1 Buried Services

It is assumed herein for the purposes of estimation that open cut installation methods will be utilized along the length of Maple Grove Road and Hespeler Road for installation of buried sewer and watermain services. With the exception of the structure locations (see below), no other features are assumed to potentially require water taking due to excavation or drainage.

The estimated excavation depths and dimensions for servicing assumes typical maximum depths of 3.0 m and width of 1.5 m. The ground water control measures must be in place to maintain dry working conditions and stable bottom and sides of the excavation. Ground water levels are to be lowered at least 0.5 m below the excavation depth.

5.1.2 Potential Bridge Structures

It is understood that bridge structures are being considered for the bypass option or as upgrades to existing intersections, as noted in the following table:

TABLE B
POTENTIAL BRIDGE STRUCTURES

LOCATION	PROPOSED STRUCTURE DETAILS	EXCAVATION DEPTH[1]
Old Maple Grove Road and Maple Grove Road	Construction of a grade separation structure at the Old Maple Grove Road and Maple Grove Road intersection to allow the Maple Grove Road to overpass the future bypass road.	10 m
Ellis Creek Bridges	Widening of the existing bridge on Maple Grove Road or construction of pedestrian bridges on each side of Maple Grove Road.	11 m
Hespeler Road at Maple Grove Road	Construction of a grade separation structure and interchange ramps in place of the current signalized intersection.	9 m
Hespeler Road south of Maple Grove Road	Construction of a grade separation structure and associated ramps to allow Hespeler Road to underpass the propose bypass road.	4 m
Beaverdale Road south of Maple Grove Road	Construction of a grade separation for an underpass of Beaverdale Road south of the existing Maple Grove Road Intersection.	10 m

Note:

1. Based on minimum excavation depth for footing foundation construction in unsupported excavations at the bridge sites.

Details regarding the preliminary potential foundation options, depths, and recommendations are explained in the geotechnical report. Included are shallow foundations (footings) and pile foundations.

Excavations for some of the proposed foundations are anticipated to extend several metres below the ground water level, and into saturated sand/gravelly sand/sand and gravel deposits. At these locations, rigorous dewatering will be required to maintain a safe and sufficiently dry excavation and the use of keg wells, well points, or deep well dewatering is envisaged. In this regard, it may be

preferable to employ pile foundations and to reconfigure the grade separation configuration to avoid temporary construction dewatering and permanent dewatering measures.

The estimated excavation depths and dimensions for structures assumes maximum depths as listed in Table B, above, and a footprint of 25 m by 25 m. Depths are assumed to include bedding and overexcavation.

The design of the dewatering system should be left to the contractor's discretion, and the system should meet a performance specification to maintain and control ground water at least 0.5 m below the excavation base level, in order to provide a stable excavation base and sides throughout construction.

In general, where adequate space is available it will be possible to use open cut excavations in conjunction with sump pumping to control ground water flow. If space is not available for enlarged open cut excavations then consideration should be given to using an engineered system to support the excavation walls.

An assessment of the anticipated dewatering discharge rates and further recommendations are described in the following sections.

5.2 Hydrogeological Conceptual Site Models

The anticipated construction dewatering rates needed to achieve the required drawdown levels for maintaining dry working conditions and stable excavation bottom and slopes depend on the proposed excavation depths, dimensions and the site and surrounding hydrogeological conditions such as existing ground water levels and soil permeability.

The project has been divided into thirteen zones for construction dewatering analysis, as shown on Drawing 1 and listed below:

i) Zone 1 – Maple Grove Road at Vondrau Drive (Servicing)

ii) Zone 2 – Maple Grove Road at Boxwood Drive (Servicing)

iii) Zone 3 – Maple Grove Road at Speedsville Road (Servicing)

iv) Zone 4 – Maple Grove Road at Briardeen Road (Servicing)

v) Zone 5A & B – Maple Grove Road at Old Maple Grove Road (Servicing & Structure)

vi) Zone 6 – Maple Grove Road at Beaverdale Road (South) (Servicing)

vii) Zone 7 – Maple Grove Road at Beaverdale Road (North) (Servicing)

viii) Zone 8A & B – Beaverdale Road Overpass (Servicing & Structure)

ix) Zone 9A & B – Maple Grove Road at Ellis Creek Crossing (Servicing & Structure)

x) Zone 10 – Hespeler Road, North of Maple Grove Road (Servicing)

xi) Zone 11A &B – Hespeler Road at Maple Grove Road (Servicing & Structure)

xii) Zone 12 – Hespeler Road at Ellis Creek Crossing (Servicing)

xiii) Zone 13A & B – Hespeler Road Proposed Bypass (Servicing & Structure)

The construction dewatering requirements of the proposed development features are described in the following sections.

For each zone a simplified hydrogeological conceptual site model (HCSM) was developed based on the field and laboratory data compiled to date, and the estimated excavation depths and dimensions. For the assessment, the HCSM for each zone were developed as described in brief below.

The HCSM uses the findings from the nearest boreholes and monitoring wells to each zone. The model stratigraphy was based on the borehole findings and ground water levels were based on the measured depths and observed depths of saturated soils.

The soil through which seepage occurs, and corresponding model hydraulic conductivities were conservatively estimated from the measured slug test values and estimates based on grain size distribution using the geomean for the soil type, a factor of safety of three, and minor roundoff. To be conservative, no shoring is assumed.

Where the proposed dewatering is within an estimated influence distance of a creek, the creek acts as a ground water source, and is taken into consideration for the estimation of the dewatering discharge rate.

The relevant assumptions for the HCSM are summarized in Table 4, attached.

5.3 Construction Dewatering Discharge Rates

The construction dewatering discharge rates are estimated for the proposed installation of servicing and construction of structures based on the above-noted HCSM and the anticipated construction activities. The approximate calculations for determining the construction dewatering discharge rates are summarized on Table 4.

The construction dewatering rates are estimated based on the following considerations:

i) It is assumed that ground water is drawn down 0.5 m below the excavation depth (by wellpoints or sumps).

ii) A trench box may be used during sewer installation if needed, but has no influence on the calculations.

iii) The zones delineated herein are for the hydrogeological assessment; the dewatering contractor may use smaller dewatering zones, thus limiting the dewatering discharge rates.

iv) Servicing - The discharge rate for zones longer than 100 m are calculated based on a length of 100 m. Since the discharge rate is directly proportionate to the length, the value on Table 4 may be used to estimate the rate for the actual dewatered length.

v) Structures – The discharge rate is stated for a single structure with an estimated footprint and location.

The dewatering discharge rates and the estimated zone of influence for each zone are summarized on Table C, below. The “dewatering zone of influence” (or DZOI) is the maximum radius of the cone-shaped profile of the temporary lowered ground water level if no barriers are used during construction dewatering.

TABLE C

SUMMARIZED CONSTRUCTION DEWATERING REQUIREMENTS

ZONE NO.	ESTIMATED REQUIRED DISCHARGE RATE (L/day)		ESTIMATED DZOI (m)	ZONE NO.	ESTIMATED REQUIRED DISCHARGE RATE (L/day)		ESTIMATED DZOI (m)
	RATE	FOR EVERY			RATE	FOR EVERY	
1	80,000	100 m	20	**8B**	225,000	structure	75
2	-	-	-	**9A**	-	-	-
3	128,000	100 m	30	**9B**	334,000	structure	55
4	100,000	100 m	25	**10**	7,000	100 m	5
5A	80,000 [28,000] *	100 m [20 m]	20	**11A**	96,000	100 m	25
5B	281,000	structure	110	**11B**	270,000	structure	105
6	-	-	-	**12**	96,000	100 m	25
7	9,000	100 m	5	**13A**	-	-	-
8A	-	-	-	**13B**	-	-	-

Notes:
1) – indicates only minor sump pumping anticipated.
2) * Top rate is for dewatering > 20 m from creek and bracketed value is for < 20 m from creek.

Based on these preliminary estimates, according to the regulations (see Section 1.2), since some of the construction dewatering discharge rates are expected to be greater than 50,000 L/day, but less than 400,000 L/day, the water taking must be registered on the Environmental Activity and Sector Registry (EASR).

With regards to the above assessment, please note the following:

- The discharge rate and DZOI are conservatively estimated to minimize the risk of not being prepared for unanticipated soil or ground water conditions that may require higher pump rates or cause greater dewatering impacts.

- The discharge rates are estimated under steady state conditions. Pumping rates prior to steady state, controlled by the dewatering contractor, are often increased to achieve the desired drawdown in the shortest period of time but must remain below the 400,000 L/d limit for EASR applicability.

- Estimated rates are typically per 100 m length, or per structure. If multiple lengths or structures are to be dewatered simultaneously, the rate will increase accordingly.

- The estimated dewatering rates do not include surface water which is to be prevented from entering the excavation area.

- As a reasonable worst case, structures are assumed to be founded in an open excavations without shoring. Excavation depths, footprints and locations are assumed; **it is recommended that the assessment be re-evaluated based on detailed design when available**.

- While an EASR is recommended here, higher rates may be determined based on the detailed design, especially for structures.

5.4 Water Taking Permit

As noted above, the preliminary estimates indicate that registration as an EASR is likely to be sufficient for the water taking. For this purpose, a Water Taking Plan and Discharge Plan will be required according to O. Reg. 63/16. The Water Taking Plan includes the estimated discharge rates, dewatering zones of influence, impact assessment, and a monitoring program, if needed. The Discharge Plan includes the estimated dewatering discharge rate and proposed discharge locations, methods of transfer, and erosion control measures. Registering with the EASR also requires notification of the municipality, online registration and payment of a required fee.

6. CONSTRUCTION DEWATERING IMPACT ASSESSMENT

The following potential impacts were postulated as a consequence of ground water level lowering during excavation for the proposed development features:

i) A drop of ground water level in existing (functional) water wells, if any,

ii) A reduction of ground water flow to existing waterbodies, if any,

iii) Induced movement of a contaminant plume, if existing,

iv) Ground subsidence in the adjacent structures, and

v) Potential impact of dewatering discharge water quality.

Please note that these impacts are preliminary and have been based on assumed inverts and potential work.

6.1 Drop of Ground Water Level in Existing Water Wells

As noted in Table C, above, the estimated dewatering zones of influence (DZOI) for buried service installation are relatively small, with all less than 30 m, and for some zones the zones of influence are negligible (less than 5 m at Zones 2, 6, 7, 8A, 9A and 10). For this reason, no impact on private wells is to be expected from work in these Zones. As a precaution, a door-to-door well survey of properties adjacent to the alignment where the potential zone of influence may intercept and thus impact on private water wells. A letter and questionnaire were left at each property in which no one responded in person, so that the questionnaire could be completed by phone. The properties and responses are included in the well survey summary listed in Table H-1 in Appendix H. The locations of the properties surveyed are shown on the maps in Figures H-1, H-2, and H-3 in Appendix H.

As stated in Section 2.2, Maple Grove Road, from Fountain Street to Boxwood Drive, intersects with the WHPA-C and WHPA-D radius zones of a wellhead protection area of a municipal well located at 1084 Fountain Street North (about 380 m south of the Maple Grove Road). The WHPA of the wells are depicted on the GRCA figure attached in Appendix B. However, it is expected that the construction dewatering will not have an impact on the municipal well ground water levels since the

municipal well lies far outside the DZOI, and the dewatering will be within a near-surface aquifer not expected to be connected to the deeper aquifer from which municipal water is typically collected.

6.2 Reduction of Ground Water Flow to Waterbodies

The parts of the alignment where a watercourse may be intercepted by the dewatering zone of influence include where Middle Creek flows adjacent to Maple Grove Road on the east and west sides of Speedsville Road, in the vicinity of the East Creek crossing, and at the Ellis Creek crossing. The relatively short radius of the zones of influence suggests minimal impact on ground water flow to waterbodies is to be expected. The impact is expected to be minimal since the dewatering is temporary and localized, and discharge water is expected to be directed to the watercourses (after appropriate treatment, if any).

6.3 Induced Movement of Contaminant Plumes

No contaminant plumes are known to exist within the zones of influence. However, the Toyota manufacturing plant is a PCA and it is possible that private septic beds may be in the vicinity of dewatering influence. During dewatering it is recommended that monitoring of ground water quality be conducted to detect the movement of contaminant plumes, if any (in addition to the quality of the discharge water).

6.4 Ground Subsidence in Adjacent Structures (Settlement)

Ground settlement (soil compression) may result from the increase in effective stresses caused by the lowering of the ground water level and subsequent decrease in pore water pressure during construction dewatering. This settlement can cause damage to buildings and structures close to the dewatering. Ground settlement is most likely to occur where the estimated drawdown is significant, structures are located close to the dewatering (within the DZOI), and soils within the drawdown depths are compressible.

Based on inspection of aerial photographs, no buildings are expected to be located within the relatively short DZOIs for the servicing installation.

For the potential construction of bridge structures, buildings appear to be located within the DZOI of Beaverdale Road at the Proposed Bypass (Zone 8B), Maple Grove Road at Ellis Creek (Zone 9B), and Hespeler Road at Maple Grove Road (Zone 11B). Settlement may be a concern at these locations if constructed as assumed herein, but should be re-assessed at a later stage of design.

Nevertheless, any existing buildings predicted to experience more than about one meter of ground water drawdown should be included in a pre-condition survey and monitored for settlement during dewatering.

6.5 Potential Impact of Dewatering Discharge Quality

It is expected that the water pumped during dewatering is to be directed to a ditch or storm sewer (where available).

Based on the chemical test results (Section 4.10 above) of the non-filtered ground water samples (as required by the Region of Waterloo Sewer-Use Bylaw and PWQO sampling protocol) taken from monitoring wells BH/MW2, BH/MW110 and BH/MW143, the sample's quality complied with all the criteria for discharge to a Region storm sewer and/or watercourse with the exception of a number of metals, chlorine, fluoride, chloride, 4AA-phenolics, and suspended solids, as summarized in Table 3.

It is expected that treatment of the discharge water by filtration or sedimentation will significantly reduce the concentrations of metals and suspended solids. Additional treatment methods may be required to reduce the concentrations of the parameters to compliance levels. As a last resort the local regulatory agencies (MECP, GRCA, Region of Waterloo) may allow temporary exceedances of specific parameters if an appeal is made.

Additional confirmatory sampling and analyses of the construction dewatering discharge during a trial dewatering and during the dewatering period should be performed to confirm compliance.

7. OTHER DEVELOPMENT CONSIDERATIONS

7.1 Ground Water Recharge

The potential for ground water recharge, according to the GRCA, is show in the attached Average Annual Recharge figure in Appendix B. It can be seen that average annual recharge along Maple Grove Road is primarily in the range of 100 to 200 mm/year from Fountain Street North to Speedsville Road, and primarily in the range of 300 to 400 mm/year from Speedsville Road to Hespeler Road and along Hespeler Road within the limits of the project. Lower recharge rates are expected at the crossings of Ellis Creek. The borehole findings generally indicate spatial heterogeneity with respect to sand, silty sand and sandy silt; however, the paucity of clayey soils would indicate that the project alignment would generally be disposed to ground water recharge.

7.2 Infiltration of Storm Water

Hydraulic conductivities were estimated using in-situ methods and by analysis of the soil distribution in samples. The results are listed on Table 2, and the range of hydraulic conductivity of the soil types are summarized on Table D, below, along with the estimated infiltration rate.

TABLE D

SUMMARIZED HYDRAULIC CONDUCTIVITY RESULTS

SOIL TYPE(S)	HYDRAULIC CONDUCTIVITY RANGE (cm/s)	APPROXIMATE INFILTRATION RATE RANGE (mm/hr)
Gravelly Sand	4×10^{-6} to 1×10^{-1}	20 to 295
Sand / Silty Sand	9×10^{-6} to 2×10^{-2}	24 to 190
Sandy Silt / Silt	2×10^{-6} to 4×10^{-5}	16 to 36

The range of values determined in this manner was relatively wide for each soil type, and thus, considering also the prevailing heterogeneity of the stratigraphy of high permeability soils such as sand and gravels, the potential for the use of Low Impact Development (LID) measures, such as infiltration facilities to maintain the local recharge rate after development, is diverse. Permeability and infiltration

rates are expected to be too low for infiltration facilities in some areas, while in others, the rates will be sufficient.

Ground water depths are sufficiently deep to allow for buried infiltration facilities in many locations. Where storm water infiltration facilities are being considered, local site evaluation and infiltration (percolation) testing at design depths should be conducted and an appropriate factor of safety should also be used for design.

8. CONCLUDING REMARKS AND RECOMMENDATIONS

Based on the proposed works and our findings of the Site setting, subsurface conditions, results of field work and laboratory analyses as well as the pertinent applicable regulatory requirements, the hydrogeological site assessment salient points are outlined as follows:

- In general, the soil profile along Maple Grove Road within the project limits comprises a surficial pavement layer or topsoil, over fill, over sand/gravelly sand/sand and gravel, or silty sand/sandy silt, over sandy silt till/silt till/clayey silt till deposits. Along Hespeler Road, the profile comprises a surficial pavement structure, over fill, over sand/silty sand/sand and gravel, with deposits of silt/clayeys silt/clayey silt till/sandy silt till or silty sand till below or interlayered.

- The hydrostatic ground water level depths range from about 1.1 to 7.4 m bgs (elevations 295 to 309) along Maple Grove Road and about 0.3 to 4.7 bgs (elevations 289 to 313) along Hespeler Road.

- The ground water drawdown during construction dewatering for the servicing (sewers) is anticipated to range from no drawdown to about 2.0 m bgs and for the potential construction of structures about no drawdown to about 8.3 bgs. As a reasonable worst case, structures are assumed to use open excavations without shoring.

- The estimated dewatering zones of influence (DZOI) for the required drawdown for servicing range from 0 to 27 m and for the potential structures range from 0 to 111 m.

- The estimated dewatering rates for servicing range from minor sump pumping to about 85,000 L/day per 100 m dewatered length. For the potential construction of structures, the range is from minor sump pumping to about 220,000 L/day.

- Since the currently estimated discharge rates are expected to be greater than 50,000 L/day, but less than 400,000 L/day, registration of the water taking as an EASR is required. This document will serve as the primary document supporting this determination.

- As described in Section 6, the impact of the construction dewatering (the drawdown of the local ground water table) is expected to be minimal, primarily due to the short DZOI of the dewatering over the majority of the project limits. No contaminant plumes are anticipated to migrate toward the site due to the dewatering, however, some watercourses will intercepted by the DZOI, and if the structures are constructed as assumed herein, some private water well users may be negatively impacted and some settlement may be experienced at buildings within the DZOI.

- The ground water samples complied with the parameters corresponding to discharge to a sanitary sewer with the exception of the chloride concentration in one water sample. The ground water samples complied with the parameters corresponding to discharge to a storm sewer (also requiring compliance with watercourse discharge criteria) with the exception of a number of metals, chlorine, fluoride, chloride, 4AA-phenolics, and suspended solids. It is expected that the ground water discharge can be treated by sedimentation and/or filtration to comply with PWQO and sanitary and storm sewer standards.

We recommend the following:

- Long-term ground water level monitoring should be conducted to identify the seasonal high and low ground water levels and time periods.

- The servicing and bridge structure construction methods, inverts, dimensions and locations have been assumed. The estimated ground water discharge rates, DZOI, and associated impacts may have to be revised once the design and construction methods are more complete. Additional hydrogeological investigation may be prudent to fill in information gaps.

- When the design is deemed to be final and dewatering discharge method considerations have been made, if an EASR is still appropriate, a Water-Taking Plan and Discharge Plan (includes discharge rates, DZOI, impact assessment, monitoring program, proposed discharge locations, methods of transfer, and erosion control measures) required for the EASR registration (MECP water taking permit) for construction

dewatering must be prepared by a qualified person based on this report. PML would be pleased to provide this service.

- Since ground water levels vary over time, it is best to schedule excavation for periods of low ground water levels. Dewatering methods (sumps, wellpoints) should be no deeper than required to achieve the desired drawdown. Surface water intrusion should be minimized.

- No shoring has been assumed in this analysis. The use of sheetpile walls or founding methods that do not require dewatering such as piles or steel-lined caissons, will reduce the required dewatering.

- Any shoring drawings, dewatering plans, and excavation plans should be reviewed by PML for proper implementation of the geotechnical and hydrogeological findings and recommendations presented in this report as well as the geotechnical report submitted under a separate cover.

- All compliance monitoring (discharge water quality, ground water levels and potential settlement) should be performed as set out in the Water Taking Plan, noted above.

A statement of limitations is included in Appendix I that should be read in conjunction with this report.

We trust you will find this report complete within our terms of reference. When we may be of further service for in-construction inspection and review services or should you have any questions, please do not hesitate to contact this office.

Sincerely,

Peto MacCallum Ltd.

Andrew Cooke, PhD, P.Eng.
Senior Engineer
Geoenvironmental and
Hydrogeological Services

Mahaboob Alam, MSc., PhD, P.Geo.
Director
Discipline Lead, Geoenvironmental and
Hydrogeological Services

AC/ST:ac

TABLE 1

GROUND WATER LEVEL READINGS IN MONITORING WELLS

MONITORING WELL (MW) No.(1)	GROUND SURFACE ELEVATION(2)	MID-SCREEN ELEVATION(2) (DEPH, m)	HYDROSTATIC GROUND WATER LEVEL ELEVATION (DEPTH, m) (3)		
			MARCH 19, 2019	APRIL 16-17, 2019	MAY 10, 2019
MW2	306.48	298.9 (7.6)	305.4 (1.10)	305.5 (1.03)	-
MW4	302.86	289.2 (13.7)	295.5 (7.37)	-	-
MW6	301.25	291.7 (9.6)	301.0 (0.28)	300.6 (0.62)	-
MW8	295.15	290.7 (4.5)	290.4 (4.72)	-	-
MW9	308.45	302.4 (6.1)	303.4 (5.08)	-	-
MW104	311.39	307.6 (3.8)	309.2 (2.19)	-	-
MW108	312.63	308.9 (3.7)	Damaged	-	-
MW110	307.01	303.2 (3.8)	302.5 (4.51)	305.4 (1.58)	305.5 (1.53)
MW112	305.77	302.0 (3.8)	301.4 (4.40)	304.6 (1.13)	-
MW115	304.57	300.8 (3.8)	300.2 (4.35)	303.0 (1.54)	-

Notes:

(1) See Drawing 1 for approximate locations and Log of Borehole sheets for details of monitoring well installation.

(2) Ground surface elevations at the monitoring well locations were surveyed by PML and are geodetic.

(3) Water levels measured using a Solinst flat tape water level reader.

TABLE 1

GROUND WATER LEVEL READINGS IN MONITORING WELLS

MONITORING WELL (MW) No.(1)	GROUND SURFACE ELEVATION(2)	MID-SCREEN ELEVATION(2) (DEPH, m)	HYDROSTATIC GROUND WATER LEVEL ELEVATION (DEPTH, m) (3)		
			MARCH 19, 2019	APRIL 16-17, 2019	MAY 10, 2019
MW116	305.35	301.6 (3.8)	300.8 (4.53)	-	-
MW122	310.42	306.7 (3.7)	305.9 (4.55)	308.8 (1.61)	-
MW123	308.02	304.3 (3.7)	306.4 (1.67)	306.4 (1.59)	306.4 (1.60)
MW127	309.27	305.6 (3.7)	305.4 (3.9)	-	-
MW130	312.10	308.4 (3.7)	309.5 (2.57)	-	-
MW131	311.68	308.0 (3.7)	307.6 (4.04)	-	-
MW138	301.03	297.3 (3.7)	299.1 (1.94)	298.9 (2.18)	299.5 (1.57)
MW143	304.34	300.6 (3.7)	302.5 (1.82)	301.3 (3.07)	-
MW144	307.12	303.4 (3.7)	303.9 (3.25)	-	-
MW145	316.54	312.7 (3.8)	313.4 (3.13)	-	-

Notes:

(1) See Drawing 1 for approximate locations and Log of Borehole sheets for details of monitoring well installation.

(2) Ground surface elevations at the monitoring well locations were surveyed by PML and are geodetic.

(3) Water levels measured using a Solinst flat tape water level reader.

TABLE 1

GROUND WATER LEVEL READINGS IN MONITORING WELLS

MONITORING WELL (MW) No.[1]	GROUND SURFACE ELEVATION[2]	MID-SCREEN ELEVATION[2] (DEPH, m)	HYDROSTATIC GROUND WATER LEVEL ELEVATION (DEPTH, m) [3]		
			MARCH 19, 2019	APRIL 16-17, 2019	MAY 10, 2019
MW147	312.50	308.8 (3.7)	310.7 (1.81)	310.7 (1.76)	-
MW149	307.72	304.0 (3.7)	305.0 (2.74)	-	-
MW155	299.27	295.6 (3.7)	295.8 (3.5)	-	-
MW161	293.35	289.7 (3.7)	289.0 (4.38)	-	-
MW164	290.24	286.5 (3.7)	DRY	-	-

Notes:

(1) See Drawing 1 for approximate locations and Log of Borehole sheets for details of monitoring well installation.

(2) Ground surface elevations at the monitoring well locations were surveyed by PML and are geodetic.

(3) Water levels measured using a Solinst flat tape water level reader.

TABLE 2

ESTIMATED HYDRAULIC CONDUCTIVITY (K) VALUES FROM SOIL SAMPLE GRAIN SIZE DISTRIBUTION AND BOREHOLE PERMEABILITY TEST RESULTS

BOREHOLE (BH) or MONITOR-ING WELL (MW) NO.	MONITORING WELL (MW) MID-SCREEN ELEVATION (DEPTH, m)	SOIL TYPE (1) (SAMPLE NO., DEPTH) AND / OR MONITORING WELL (MW) SCREEN SOIL TYPE	% CLAY (2)	ESTIMATED K-VALUES FROM GRAIN SIZE DISTRIBUTION TEST RESULTS (cm/sec) (3)	ESTIMATED K-VALUES FROM BOREHOLE PERMEABILITY TESTS (cm/sec) (4)
BH/MW2	298.9 (7.6)	Gravelly Sand (SS7, 6.1 to 6.6 m)	<3%	1×10^{-1} (V)	7×10^{-3}
		Sandy Silt Till	-	-	
BH/MW6	291.7 (9.6)	Silty Sand Till (SS8, 7.6 to 8.1 m)	7%	2×10^{-5} (V)	7×10^{-4}
BH/MW9	No MW	Sand (SS6, 4.6 to 5.1 m)	2%	2×10^{-3} (V)	-
BH/MW110	303.2 (3.8)	Sand (SS6, 4.6 to 5.0 m)	3%	2×10^{-2} (V)	1×10^{-5}
BH/MW112	302.0 (3.8)	Silty Sand (SS5, 3.1 to 3.5 m)	6%	1×10^{-5} (V)	9×10^{-6}
BH/MW115	300.8 (3.8)	Sand (SS5, 3.1 to 3.6 m)	2%	9×10^{-3} (V)	5×10^{-3}

Notes:

(1) See Log of Borehole Sheets for soil sample description.
(2) % Clay is percentage of the total soil sample finer than 0.002 mm by weight.
(3) K-value determination using grain size distribution method by Vukovic and Soro (1992) (V).
(4) K-value estimated using Hvorslev's Method.

TABLE 2

ESTIMATED HYDRAULIC CONDUCTIVITY (K) VALUES FROM SOIL SAMPLE GRAIN SIZE DISTRIBUTION AND BOREHOLE PERMEABILITY TEST RESULTS

BOREHOLE (BH) or MONITOR-ING WELL (MW) NO.	MONITORING WELL (MW) MID-SCREEN ELEVATION (DEPTH, m)	SOIL TYPE (1) (SAMPLE NO., DEPTH) AND / OR MONITORING WELL (MW) SCREEN SOIL TYPE	% CLAY (2)	ESTIMATED K-VALUES FROM GRAIN SIZE DISTRIBUTION TEST RESULTS (cm/sec) (3)	ESTIMATED K-VALUES FROM BOREHOLE PERMEABILITY TESTS (cm/sec) (4)
BH/MW122	306.7 (3.7)	Sand and Gravel	-	-	6×10^{-6}
		Sandy Silt (SS5, 3.1 to 3.6 m)	12%	2×10^{-6} (V)	
BH/MW123	-	Sandy Silt (Fill) (SS4, 2.3 to 2.8 m)	9%	2×10^{-6} (V)	-
	304.3 (3.7)	Sandy Silt	-	-	3×10^{-6}
BH/MW131	No MW	Silty Sand (SS6, 4.6 to 5.0m)	3%	6×10^{-5} (V)	-
BH/MW138	297.3 (3.7)	Gravelly Sand (SS6, 4.6 to 5.0 m)	2%	4×10^{-3} (V)	4×10^{-6}
BH/MW143	300.6 (3.7)	Gravelly Sand (SS5, 3.1 to 3.5 m)	2%	1×10^{-3} (V)	3×10^{-4}
BH/MW147	308.8 (3.7)	Silt (SS5, 3.0 to 3.5 m)	3%	3×10^{-5} (V)	4×10^{-5}

Notes:

(1) See Log of Borehole Sheets for soil sample description.
(2) % Clay is percentage of the total soil sample finer than 0.002 mm by weight.
(3) K-value determination using grain size distribution method by Vukovic and Soro (1992) (V).
(4) K-value estimated using Hvorslev's Method.

TABLE 3

ELEVATED GROUND WATER SAMPLE CONCENTRATIONS FOR SANITARY SEWER, STORM SEWER AND WATERCOURSE DISCHARGE

PARAMETER[1]	WATER SAMPLE CONCENTRATION (mg/L)[1]				CONCENTRATION LIMIT (mg/L)	
	BH2	BH110	BH143	Ellis Creek	SEWER BYLAW	PWQO / CCME[2]
Chlorine	0.09	0.30	< 0.02*	0.27		0.002
Cyanide	< 0.01*	< 0.01*	< 0.01*	<0.01*		0.005
Fluoride	0.13		0.13			0.12
Nitrite (as N)		< 0.3*				0.06
Aluminum	0.656	4.03	0.451			0.075
Aluminum (dis)	0.075	0.198	0.154			0.015
Cobalt		0.00347				0.0009
Copper		0.0124				0.005
Iron	0.988	5.72	0.584			0.30
Lead	0.00393	0.0147	0.00120			0.001
Phosphorous	0.055	0.263				0.030
Uranium	0.00903					0.005
Vanadium		0.00811				0.006
Zinc		0.072				0.02
Chloride		2200	700		1500 (SAN)	640
4AAP-Phenolics	< 0.002	0.006	0.008			0.001
Suspended Solids	139	110	176		15 (STM)	15

Notes:

(1) All parameters are “total” (include both solid and dissolved forms).

(2) PWQO are revised interim values where applicable. CCME uses limit for protection of aquatic life, short term value is used where applicable.

* Compliance inconclusive, lab detection limit is greater than CCME limit.

TABLE 4

SUMMARIZED CALCULATIONS OF ESTIMATED DEWATERING DISCHARGE RATE AND ZONE OF INFLUENCE

ZONE No.	ZONE NAME	LOWEST PROPOSED EXCAVATION DEPTH (m) (1)	CLOSEST MONITORING WELLS OR BOREHOLES (2)	GROUND WATER STRIKE DEPTH (m) (3)	HYDROSTATIC GROUND WATER LEVEL DEPTH (m) (4)	LOWERED GROUND WATER LEVEL DEPTH (m) (IF REQUIRED) (5)	AVERAGE DRAW-DOWN REQUIRED S_0 (m) (6)	SOIL TYPE (7)	ESTIMATED ZONE OF INFLUENCE R_0 (m) (8)	ESTIMATED DEWATERING DISCHARGE RATE (Q = KiA)[9]				
										DIM-ENSIONS (m)	K (m/s)	I (%)	A (m^2)	Q (L/day)
1	Maple Grove Road at Vondrau Drive (Servicing)	3.0	BH101-103, BH/MW104, BH105, BH165-169	2.9	2.2	3.5	1.3	Silty Sand	17	100 x 1.5	2×10^{-5}	0.075	414	53,300 (per 100 m)
2	Maple Grove Road at Boxwood Drive (Servicing)	3.0	BH106, BH107, BH/MW108, BH109, BH170-174	3.7	3.7	3.5	**NONE**	Only minor sump pumping anticipated.						
3	Maple Grove Road at Speedsville Drive (Servicing)	3.0	BH/MW110, BH111, BH/MW112, BH113, BH114, BH/MW115, BH175-185	2.0	1.5	3.5	2.0	Sand	27	100 x 1.5 100 x 1.5	2×10^{-5} 2×10^{-5}	0.075 0.103	556 556	35,800 (GW) 49,500 (Creek) 85,300 (Total) (per 100 m)
4	Maple Grove Road at Briardeen Road (Servicing)	3.0	BH/MW116, BH117-121, BH/MW122, BH/MW123, BH186-189	2.5	1.7	3.5	1.8	Sand	24	100 x 1.5	2×10^{-5}	0.075	515	66,400 (per 100 m)
5A	Maple Grove Road at Old Maple Grove Road (Servicing)	3.0	BH1, BH/MW2, BH124-126, BH/MW127, BH128, BH129	2.2	2.2	3.5	1.3	Sand	17	100 x 1.5	2×10^{-5}	0.075	414	53,300 (per 100 m) (>20 m away from creek)
										17 x 1.5	2×10^{-5}	0.109	100	18,700 (< 20 m of creek)
5B	Maple Grove Road at Old Maple Grove Road (Structure)	10.0	BH1, BH/MW2, BH124-126, BH/MW127, BH128, BH129	2.2	2.2	10.5	8.3	Sand	111	25 x 25	2×10^{-5}	0.075	1,455	187,400 (per structure)

Notes:

(1) Based on typical servicing depths and minimum excavation depth for footing foundation construction in unsupported excavations at the bridge sites.
(2) See Drawing 1 for approximate borehole locations.
(3) Model value based on reported or interpreted depth to ground water strike.
(4) Model value based on the average measured hydrostatic ground water level for zone.
(5) Ground water level lowered during construction dewatering is assumed to be 0.5 m below the general excavation level.
(6) Difference between the hydrostatic ground water level measured in the monitoring wells and the lowered ground water level elevation.
(7) See Log of Borehole Sheets for soil description.
(8) $R_0 = 3000 S_o K^{1/2}$, R_o in m, S_o in m and K in m/s. Rounded to nearest 1 m.
(9) For Zones greater than 100 m in length, estimate is for a dewatered length of 100 m. K is model K of soil. Q = KiA, where K=hydraulic conductivity, i=hydraulic gradient = S_o / R_o and A = seepage area in excavation floor and sides below the ground water strike level.

TABLE 4

SUMMARIZED CALCULATIONS OF ESTIMATED DEWATERING DISCHARGE RATE AND ZONE OF INFLUENCE

ZONE No.	ZONE NAME	LOWEST PROPOSED EXCAVATION DEPTH (m) (1)	CLOSEST MONITORING WELLS OR BOREHOLES (2)	GROUND WATER STRIKE DEPTH (m) (3)	HYDROSTATIC GROUND WATER LEVEL DEPTH (m) (4)	LOWERED GROUND WATER LEVEL DEPTH (m) (IF REQUIRED) (5)	AVERAGE DRAW-DOWN REQUIRED S_0 (m) (6)	SOIL TYPE (7)	ESTIMATED ZONE OF INFLUENCE R_0 (m) (8)	ESTIMATED DEWATERING DISCHARGE RATE (Q = KiA)[9]				
										DIM-ENSIONS (m)	K (m/s)	I (%)	A (m^2)	Q (L/day)
6	Maple Grove Road at Beaverdale Road (South) (Servicing)	3.0	BH/MW130, BH/MW131, BH132-134, BH191-195	3.0	3.0	3.5	**NONE**	Only minor sump pumping anticipated.						
7	Maple Grove Road at Beaverdale Road (North) (Servicing)	3.0	BH196-199	1.9	1.9	3.5	1.6	Sandy silt	2	100 x 1.5	2×10^{-7}	0.75	475	6,100 (per 100 m)
8A	Beaverdale Road at Proposed Bypass (Servicing)	3.0	BH/MW9, BH10, BH190	5.2	5.1	3.5	**NONE**	Only minor sump pumping anticipated.						
8B	Beaverdale Road at Proposed Bypass (Structure)	10.0	BH/MW9, BH10, BH190	5.2	5.1	10.5	5.4	Silty Sand	72	25 x 25	2×10^{-5}	0.075	1,165	150,000 (per structure)
9A	Maple Grove Road at Ellis Creek (Servicing)	3.0	BH3, BH/MW4, BH135-137	7.4	7.4	3.5	**NONE**	Only minor sump pumping anticipated.						
9B	Maple Grove Road at Ellis Creek (Structure)	11.0	BH3, BH/MW4, BH135-137	7.4	7.4	11.5	4.1	Silty Sand	55	25 x 25	2×10^{-5}	0.126	1,025	222,600 (per structure)
10	Hespeler Road North of Maple Grove Road (Servicing)	3.0	BH/MW145, BH146, BH/MW147, BH148	2.6	2.4	3.5	1.1	Sandy silt	1	100 x 1.5	2×10^{-7}	0.75	373	4,800 (per 100 m)

Notes:

(1) Based on typical servicing depths and minimum excavation depth for footing foundation construction in unsupported excavations at the bridge sites.
(2) See Drawing 1 for approximate borehole locations.
(3) Model value based on reported or interpreted depth to ground water strike.
(4) Model value based on the average measured hydrostatic ground water level for zone.
(5) Ground water level lowered during construction dewatering is assumed to be 0.5 m below the general excavation level.
(6) Difference between the hydrostatic ground water level measured in the monitoring wells and the lowered ground water level elevation.
(7) See Log of Borehole Sheets for soil description.
(8) $R_0 = 3000 S_o K^{1/2}$, R_o in m, S_o in m and K in m/s. Rounded to nearest 1 m.
(9) For Zones greater than 100 m in length, estimate is for a dewatered length of 100 m. K is model K of soil. Q = KiA, where K=hydraulic conductivity, i=hydraulic gradient = S_o / R_o and A = seepage area in excavation floor and sides below the ground water strike level.

TABLE 4

SUMMARIZED CALCULATIONS OF ESTIMATED DEWATERING DISCHARGE RATE AND ZONE OF INFLUENCE

ZONE No.	ZONE NAME	LOWEST PROPOSED EXCAVATION DEPTH (m) (1)	CLOSEST MONITORING WELLS OR BOREHOLES (2)	GROUND WATER STRIKE DEPTH (m) (3)	HYDROSTATIC GROUND WATER LEVEL DEPTH (m) (4)	LOWERED GROUND WATER LEVEL DEPTH (m) (IF REQUIRED) (5)	AVERAGE DRAW-DOWN REQUIRED S_0 (m) (6)	SOIL TYPE (7)	ESTIMATED ZONE OF INFLUENCE R_0 (m) (8)	ESTIMATED DEWATERING DISCHARGE RATE ($Q = KiA$)[9]				
										DIM-ENSIONS (m)	K (m/s)	I (%)	A (m^2)	Q (L/day)
11A	Hespeler Road at Maple Grove Road (Servicing)	3.0	BH5, BH/MW6, BH/MW138, BH139-142, BH/MW143, BH/MW144, BH150-153	3.0	1.8	3.5	1.7	Sand	23	100 x 1.5	2×10^{-5}	0.075	495	63,800 (per 100 m)
11B	Hespeler Road at Maple Grove Road (Structure)	9.0	BH5, BH/MW6, BH/MW138, BH139-142, BH/MW143, BH/MW144, BH150-153	3.0	1.8	9.5	7.7	Silty Sand	103	25 x 25	2×10^{-5}	0.075	1,395	180,000 (per structure)
12	Hespeler Road at Ellis Creek (Servicing)	3.0	BH154, BH/MW155, BH156, BH157	1.8	1.8	3.5	1.7	Silty Sand	23	100 x 1.5	2×10^{-5}	0.075	495	63,800 (per 100 m)
13A	Hespeler Road at Proposed Bypass (Servicing)	3.0	BH7, BH/MW8, BH158-160, BH/MW161, BH162, BH163, BH/MW164	4.0	4.0	3.5	**NONE**	Only minor sump pumping anticipated.						
13B	Hespeler Road at Proposed Bypass (Structure)	4.0	BH/MW161, BH162, BH163, BH/MW164	4.0	4.0	4.5	**NONE**	Only minor sump pumping anticipated.						

Notes:

(1) Based on typical servicing depths and minimum excavation depth for footing foundation construction in unsupported excavations at the bridge sites.
(2) See Drawing 1 for approximate borehole locations.
(3) Model value based on reported or interpreted depth to ground water strike.
(4) Model value based on the average measured hydrostatic ground water level for zone.
(5) Ground water level lowered during construction dewatering is assumed to be 0.5 m below the general excavation level.
(6) Difference between the hydrostatic ground water level measured in the monitoring wells and the lowered ground water level elevation.
(7) See Log of Borehole Sheets for soil description.
(8) $R_0 = 3000 S_o K^{1/2}$, R_o in m, S_o in m and K in m/s. Rounded to nearest 1 m.
(9) For Zones greater than 100 m in length, estimate is for a dewatered length of 100 m. K is model K of soil. Q = KiA, where K=hydraulic conductivity, i=hydraulic gradient = S_o / R_o and A = seepage area in excavation floor and sides below the ground water strike level.

Reference:
- Image from GoogleEarth, June 2019.

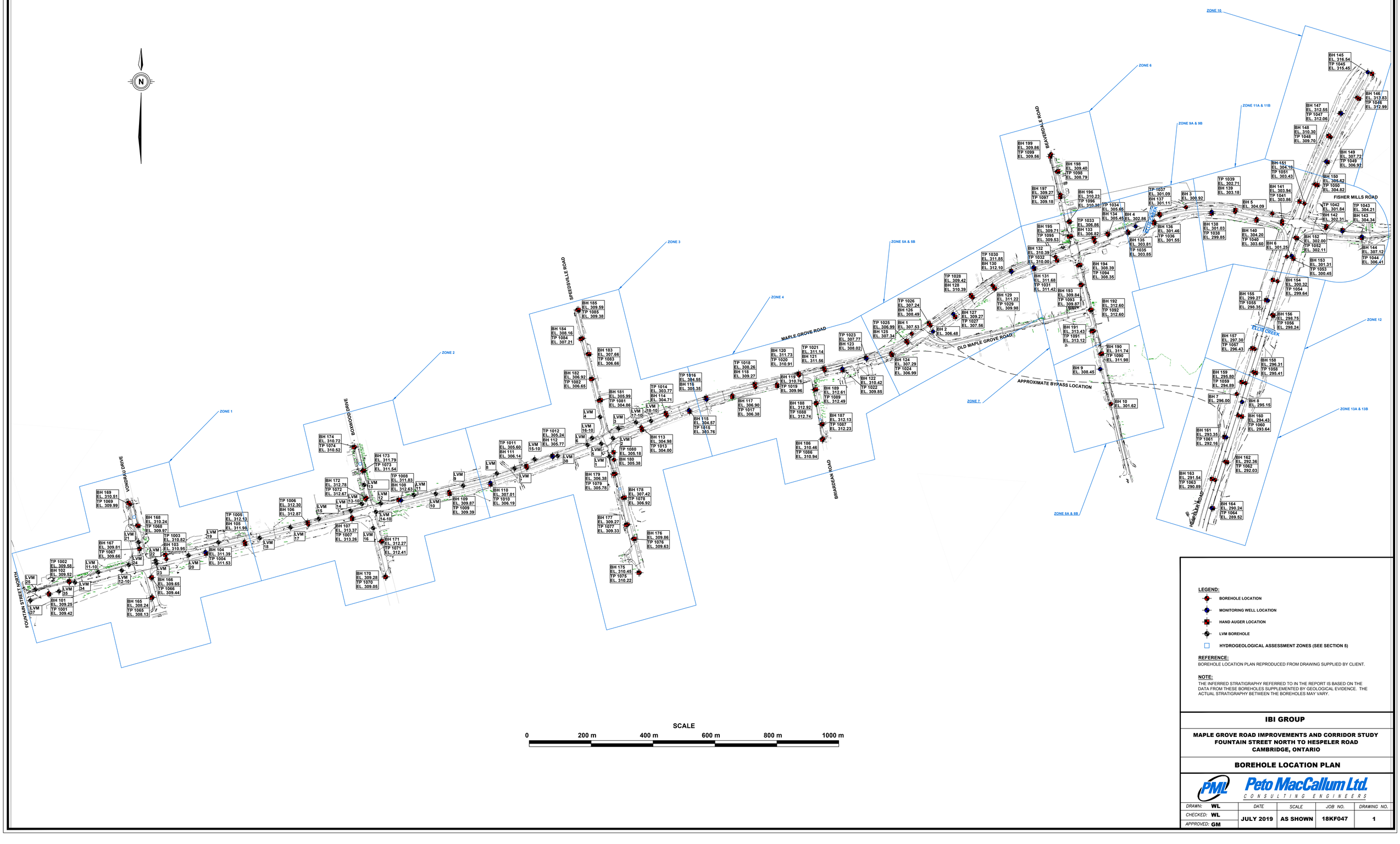
THE REGIONAL MUNICIPALITY OF WATERLOO

HYDROGEOLOGICAL SITE ASSESSMENT FOR PROPOSED MAPLE GROVE ROAD IMPROVEMENTS, CAMBRIDGE, ONTARIO

2019 AERIAL PHOTOGRAPH

Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	DATE	SCALE	JOB NO.	FIGURE NO.
A.C.				
CHECKED: A.C.	JUL. 2019	AS SHOWN	18KX004	1
APPROVED: S.T.				



LEGEND:

- BOREHOLE LOCATION
- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- LVM BOREHOLE
- HYDROGEOLOGICAL ASSESSMENT ZONES (SEE SECTION 5)

REFERENCE:
BOREHOLE LOCATION PLAN REPRODUCED FROM DRAWING SUPPLIED BY CLIENT.

NOTE:
THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

IBI GROUP

MAPLE GROVE ROAD IMPROVEMENTS AND CORRIDOR STUDY
FOUNTAIN STREET NORTH TO HESPELER ROAD
CAMBRIDGE, ONTARIO

BOREHOLE LOCATION PLAN

Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN: WL	DATE	SCALE	JOB NO.	DRAWING NO.
CHECKED: WL	JULY 2019	AS SHOWN	18KF047	1
APPROVED: GM				

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. - Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	TW	Thinwall Open
WS	Washed Sample	TP	Thinwall Piston
SB	Scraper Bucket Sample	OS	Oesterberg Sample
AS	Auger Sample	FS	Foil Sample
CS	Chunk Sample	RC	Rock Core
ST	Slotted Tube Sample	USS	Undisturbed Shear Strength
PH	Sample Advanced Hydraulically	RSS	Remoulded Shear Strength
PM	Sample Advanced Manually		

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

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LOG OF BOREHOLE NO. 1

17T 553178E 4808977N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Shoulder, at Old Maple Grove Road — ***BORING DATE*** December 7, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	307.53	SURFACE ELEVATION 307.53					
0.0		PAVEMENT STRUCTURE: 770 mm granular base/subbase		1	SS	47	
0.77	306.76	GRAVELLY SAND: Compact to dense brown gravelly sand, trace silt, damp		2	SS	33	
1.0				3	SS	17	
2.0							
2.3	305.2	SAND: Loose to compact brown sand, some silt, trace gravel, wet		4	SS	24	▼ El. 305.2
3.0				5	SS	8	
4.0							
5.0				6	SS	9	
6.0							
6.1	301.4	becoming saturated		7	SS	8	
7.0							
8.0				8	SS	10	
9.0							
9.2	298.3	SANDY SILT TILL: Very dense grey sandy silt, trace gravel, occasional cobbles, wet		9	SS	94/275mm	Washed to clear casing from SS9 to termination
10.0							
10.7	296.8	occasional silty sand layers		10	SS	50/100mm	
11.0							
12.0				11	SS	50/100mm	
13.0							
13.1	294.4	BOREHOLE TERMINATED AT 13.1 m, NO FURTHER PROGRESS DUE TO HYDRAULIC CONDITIONS					Upon completion of augering Cave at 3.0 m No free water
14.0							
15.0							

ELEVATION SCALE: 307, 306, 305, 304, 303, 302, 301, 300, 299, 298, 297, 296, 295

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 2

17T 553244E 4808993N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Old Maple Grove Road, Offroad, South-East Corner, at Maple Grove — ***BORING DATE*** December 11, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 306.48			
0.0	306.37	TOPSOIL: Dark brown sandy silty, trace gravel, rootlets, moist	1	SS	7
		GRAVELLY SAND: Compact brown gravelly sand, trace silt, moist	2	SS	12
1.2	305.3	becoming saturated	3	SS	9
			4	SS	5
			5	SS	10
			6	SS	16
			7	SS	13
7.8	298.7	SANDY SILT TILL: Very dense grey sandy silt, trace gravel, trace clay, occasional cobbles, saturated	8	SS	44
			9	SS	50/125mm
			10	SS	50/125mm
			11	SS	50/100mm
		CONTINUED			

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%)

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stickup with Protective Casing

El. 305.4

El. 305.2

Bentonite Seal

Filter Sand

30 66 4

Screen

Added drilling mud from SS6 to completion

NOTES *Low N value due to hydraulic disturbance.

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 2

17T 553244E 4808993N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Old Maple Grove Road, Offroad, South-East Corner, at Maple Grove — ***BORING DATE*** December 11, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE									
			12	SS	91/250mm	291				
16.5										
290.0	SAND AND GRAVEL: Grey sand and gravel, some silt, occasional cobbles, saturated		13	SS	9*	290				
17.7						289				
288.8	BOREHOLE TERMINATED AT 17.7 m, NO FURTHER PROGRESS DUE TO HYDRAULIC CONDITIONS									Water Level Readings: Date Depth Elev. 2019-03-28 1.1 305.4 2018-12-13 1.3 305.2

NOTES *Low N value due to hydraulic disturbance.

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 3

17T 553983E 4809375N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Shoulder, East of Beaverdale Road — ***BORING DATE*** December 3, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continious Flight Hollow Stem Augers and HQ Diamond Coring — ***TECHNICIAN*** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES	ELEVATION SCALE
	300.92	SURFACE ELEVATION 300.92					
0.0	300.92	PAVEMENT STRUCTURE: 100 mm granular base, damp, over 830 mm granular subbase, damp		1	SS	28	
0.93	299.99	FILL: Brown medium sand, trace silt, trace gravel, damp		2	SS	39	300
1.5	299.4	becoming brown sand, some silt, damp		3	SS	27	299
2.3	298.6	becoming brown sandy silt, moist		4	SS	43	298
				5	SS	23	297
				6	SS	34	296
6.1	294.8	SILT: Compact to dense brown silt, some sand, trace clay, wet		7	SS	29	295
				8	SS	41	293
8.6	292.3	GRAVELLY SAND: Very dense brown gravelly sand, some silt, occasional cobble, occasional boulder, saturated		9	SS	95/140mm	292
10.7	290.2	becoming grey		10	SS	50/50mm	291
12.5	288.4	BOREHOLE TERMINATED AT 12.7 m, NO FURTHER PROGRESS DUE TO HYDRAULIC CONDITIONS AND REFUSAL ON BOULDERS		11	SS	50/100mm	290
							289

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 296.6

Sampler wet from SS7 to completion

Upon completion of augering Wet cave at 4.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 4

17T 553904E 4809328N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Shoulder, East of Beaverdale Road — ***BORING DATE*** December 5, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 302.86				
0.0	302.86	PAVEMENT STRUCTURE: 130 mm asphalt, over 670 mm granular base/subbase, damp		1	SS	23
0.80	302.06	FILL: Brown gravelly sand, trace silt, occasional cobbles, damp		2	SS	10
1.5	301.4	becoming brown silty sand, trace gravel, damp		3	SS	29
				4	SS	18
				5	SS	40
				6	SS	22
				7	SS	18
7.9	295.0	SAND: Dense dark grey course sand, trace silt, trace gravel, wet		8	SS	32
8.6	294.3	CLAYEY SILT: Very stiff brown clayey silt, some sand, trace gravel, APL		9	SS	19
10.1	292.8	GRAVELLY SAND: Very dense grey gravelly sand, trace silt, occasional cobbles, occasional boulders, saturated		10	SS	50/150mm
				11	SS	50/150mm
				12	SS	50/125mm
		CONTINUED				

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 295.5
El. 292.2
Filter Sand
28 66 6
Screen

NOTES

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 4

17T 553904E 4809328N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Shoulder, East of Beaverdale Road — ***BORING DATE*** December 5, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE									
15.2										
287.7	occasional clayey silt seams		13	SS	25/150mm	287				
			14	SS	50/50mm	286				
						285				
18.6			15	SS	50/25mm					
284.3	BOREHOLE TERMINATED AT 18.6 m AUGER REFUSAL ON BOULDER/ POSSIBLE BEDROCK									

Water Level Readings:

Date	Depth	Elev.
2018-12-05	10.7	292.2
2019-03-28	7.4	295.5

NOTES

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 5

17T 554344E 4809364N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Shoulder, at Hespeler Road — **BORING DATE** December 3, 2018 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
	304.09	SURFACE ELEVATION 304.09				
0.0	304.09	PAVEMENT STRUCTURE: 150 mm asphalt, over 730 mm granular subbase		1	SS	18
0.88	303.21	FILL: Brown silty sand, some gravel, damp		2	SS	29
1.5	302.6	becoming wet		3	SS	18
2.1	302.0	SAND: Loose to compact brown sand, trace silt, wet		4	SS	18
				5	SS	6
4.6	299.5	occasional silt seams		6	SS	18
6.1	298.0	becoming dense grey		7	SS	38
7.6	296.5	becoming very dense brown sand, trace silt, trace gravel, wet		8	SS	56
8.6	295.5	CLAYEY SILT TILL: Hard grey clayey silt, some sand, trace gravel, APL		9	SS	50/100mm
9.9	294.2	GRAVELLY SAND: Very dense brown gravelly sand, some silt, some clay, saturated		10	SS	50/50mm
12.5	291.6	BOREHOLE TERMINATED AT 12.5 m, NO FURTHER PROGRESS DUE TO AUGER REFUSAL ON POSSIBLE BEDROCK		11	SS	50/25mm

ELEVATION SCALE: 304, 303, 302, 301, 300, 299, 298, 297, 296, 295, 294, 293, 292

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ EI. 298.0

Upon completion of augering
Cave at 2.7 m
No free water

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 6

17T 554409E 4809249N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Shoulder, at Maple Grove Road — ***BORING DATE*** December 13, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continious Flight Hollow Stem Augers and HQ Diamond Coring — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 301.25			
0.0		PAVEMENT STRUCTURE: 110 mm asphalt, over 230 mm granular base, damp, over 340 mm granular subbase, moist	1	AS	
0.68	300.57	FILL: Brown sand, some gravel, trace silt, wet	2	SS	28
1.7	299.6	becoming clayey, occasional cobbles	3	SS	26
2.3	299.0	SAND AND GRAVEL: Compact to dense grey sand and gravel, some silt, numerous cobbles, saturated	4	SS	62
			5	SS	16
			6	SS	22
			7	SS	64
7.6	293.7	SILTY SAND TILL: Very Dense grey silty sand, trace gravel, occasional cobbles, saturated	8	SS	50/100mm
			9	SS	50/100mm
			10	SS	30/100mm
11.2	290.1	WEATHERED BEDROCK: Hard buff dolostone	11	RC	
12.8	288.5	BOREHOLE TERMINATED AT 12.8 m			

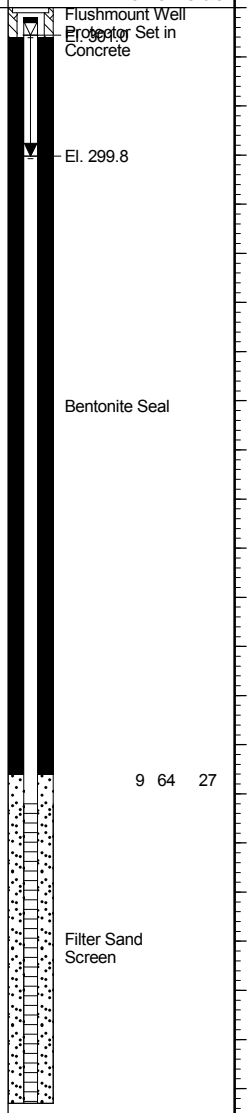
SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%)

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL



DEPTH (m)	RUN (m)	REC (%)	RQD (%)	WWR (%)
11.2				
	1.60	100	42	100
12.8				

Water Level Readings:

Date	Depth	Elev.
2018-12-13	1.5	299.8
2019-03-28	0.3	301.0

NOTES

RQD (Rock Quality Designation) is the total length of those pieces of sound core which are 10 cm or greater in length in a core run expressed as a percentage of the total length of that core run. RQD is measured on minimum NQ size (nominal 50 mm diameter) cores. WWR (wash water return) is the observed fraction of drilling water which has returned to the surface during coring.

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 7

17T 554250E 4808851N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Southbound Shoulder, South of Maple Grove Road — **BORING DATE** December 7, 2018 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 296.00					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 710 mm granular base/subbase		1	SS	30	
0.83	295.08	FILL: Brown sand, trace gravel, damp becoming moist		2	SS	22	295
1.5	294.5	becoming brown silty sand, wet		3	SS	48	
2.0				4	SS	51	294
3.1	292.9	CLAYEY SILT TILL: Hard grey clayey silt, some sand, trace to some gravel, occasional cobbles, DTPL		5	SS	71	293
4.0							292
5.0				6	SS	59	291
6.0							290
6.9	289.1	BOREHOLE TERMINATED AT 6.9 m AUGER REFUSAL ON POSSIBLE BEDROCK		7	SS	50/150mm	
7.0				8	SS	50/25mm	
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 294.5

Upon completion of augering
Cave at 4.0 m
No free water

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 8

17T 554255E 4808783N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Northbound Shoulder, South of Maple Grove Road — **BORING DATE** December 10, 2018 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 295.15				
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 800 mm granular base/subbase, moist		1	SS	38
0.80	294.35	FILL: Brown sand, some gravel, trace silt, damp		2	SS	49
1.5	293.7	becoming silty		3	SS	50/75mm
2.3	292.9	becoming brown gravel, some silt, some sand, damp		4	SS	50/150mm
3.0	292.2	CLAYEY SILT TILL: Hard brown clayey silt, some gravel, some sand, DTPL		5	SS	50/150mm
5.0				6	SS	50/150mm
5.3	289.9	WEATHERED BEDROCK: Buff dolostone		7	SS	50/25mm
		BOREHOLE TERMINATED AT 5.3 m, DUE TO AUGER REFUSAL				

ELEVATION SCALE: 295, 294, 293, 292, 291, 290

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
Filter Sand
Screen El. 290.5
4 15 81

Water Level Readings:

Date	Depth	Elev.
2018-12-10	Dry	---
2019-03-28	4.7	290.5

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 9

17T 553782E 4808873N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Beaverdale Road, Southbound Shoulder, South of Maple Grove Road — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH (m)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 308.45			
0.0	308.45				
0.20		TOPSOIL: Dark brown silty sand topsoil, damp	1	SS	26
0.36	308.09	FILL: Silty sand, damp	1A	SS	
		becoming light brown sand and gravel, damp	2	SS	55
1.0					
1.5	307.0	SAND: Compact brown sand, some gravel, some silt, occasional cobbles, moist	3	SS	14
2.0					
2.3	306.2	becoming moist to wet	4	SS	38
3.0			5	SS	43
4.0					
			6	SS	37
5.0					
5.2	303.3	SANDY SILT TILL: Very dense brown sandy silt, some gravel, occasional cobble, saturated			
6.0			7	SS	54
7.0					
7.6	300.9	becoming very dense brown silty sand, some gravel	8	SS	50/50mm
8.0					
9.0			9	SS	50/80mm
9.9	298.6	CLAYEY SILT TILL: Hard brown clayey silt, some sand, DTPL			
10.0			10	SS	63
11.0					
12.0			11	SS	50/130mm
13.0					
13.1	295.4	occasional sandy silt layers	12	SS	50/130mm
14.0					
15.0		CONTINUED			

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu; ▲POCKET PENETROMETER O Q; 50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 308 307 306 305 304 303 302 301 300 299 298 297 296 295 294

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

WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete

Bentonite Seal

Filter Sand

14 77 9

El. 303.4
El. 303.3

Screen

NOTES

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 9

17T 553782E 4808873N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Beaverdale Road, Southbound Shoulder, South of Maple Grove Road — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
15.0	CONTINUED FROM PREVIOUS PAGE					
			13	SS	50/130mm	293
						292
17.1			14	SS	50/130mm	
291.4 / 17.4	WEATHERED BEDROCK: Grey dolostone		15	SS	50/50mm	
291.1	BOREHOLE TERMINATED AT 17.4 m DUE TO AUGER REFUSAL					

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu; ▲ POCKET PENETROMETER O Q; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●

50 100 150 200

20 40 60 80

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

WATER CONTENT (%)

10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Water Level Readings:

Date	Depth	Elev.
2019-01-31	5.2	303.3
2019-03-28	5.1	303.4

NOTES

▼ GROUND WATER STRIKE

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 10

17T 553821E 4808765N

PROJECT Maple Grove Road Improvements and Corridor Study ***PML REF.*** 18KF047

LOCATION Beaverdale Road, Northbound Shoulder, South of Maple Grove Road ***BORING DATE*** December 13, 2018 ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers ***TECHNICIAN*** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 301.62				
0.0		PAVEMENT STRUCTURE: 230 mm asphalt, over 500 mm granular base		1	SS	8
0.73	300.86	FILL: Brown sand, some gravel, trace silt, moist		2	SS	2
1.5		becoming brown grey sand, trace silt, wet				
1.7	299.9	becoming wet to saturated		3	SS	13
		CLAYEY SILT: Very stiff brown clayey silt, trace sand, APL		4	SS	29
				5	SS	25
				6	SS	17
9.0	292.6	CLAYEY SILT TILL: Hard brown clayey silt, some sand, some gravel, DTPL		7	SS	50/100mm
10.8	290.8	occasional sandy silt layers				
				8	SS	50/125mm
13.8	287.8	SAND: Very dense brown sand, some silt, trace gravel, wet				
		CONTINUED				

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 301, 300, 299, 298, 297, 296, 295, 294, 293, 292, 291, 290, 289, 288, 287

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 300.4

NOTES

GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 10

17T 553821E 4808765N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Beaverdale Road, Northbound Shoulder, South of Maple Grove Road — ***BORING DATE*** December 13, 2018 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE									
15.5	BOREHOLE TERMINATED AT 15.5 m		9	SS	50/125mm		>>			Upon completion of augering Cave at 5.8 m Free water at 1.2 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 101

17T 550386E 4808149N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Lane 2 — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.25					309
0.0	PAVEMENT STRUCTURE: 185 mm asphalt, over 225 mm granular base, damp, over 330 mm granular subbase, moist		1A / 1B	AS		
0.74 / 308.51	FILL: Brown sandy silt, trace gravel, moist		2	SS	14	308
1.2	becoming dark brown clayey silt, trace organics, trace sand, moist					
1.5 / 307.8	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, some sand, trace gravel, DTPL		3	SS	22	307
			4	SS	38	
			5	SS	22	306
4.5 / 304.8	becoming grey, occasional silt seams		6	SS	26	305
5.0 / 304.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering;
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 102

17T 550453E 4808185N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Lane 2 — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 309.52					
0.0		PAVEMENT STRUCTURE: 185 mm asphalt, over 135 mm granular base, damp, over 330 mm granular subbase, moist		1A, 1B	AS		309
0.65	308.87	FILL: Brown sandy silt, trace gravel, trace clay, moist, occasional clayey silt layers, occasional cobbles		2	SS	15	
1.0				3	SS	21	308
2.0							
2.3	307.2	becoming dark brown, occasional organic inclusions, wood pieces		4	SS	16	307
3.0							
3.0	306.5	SAND: Dense brown sand, some gravel, some silt, saturated, occasional cobbles		5	SS	36	306
4.0							
4.5	305.0	CLAYEY SILT TILL: Very stiff brown clayey silt, some sand, DTPL		6	SS	26	305
5.0							
5.0	304.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 103

17T 550766E 4808260N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Left Turn Lane — **BORING DATE** February 1, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 310.95					
0.0		PAVEMENT STRUCTURE: 140 mm asphalt, over 180 mm granular base,		1	AS		
				2	AS		
0.61	310.34	damp, over 290 mm granular subbase, damp		3	AS		
1.0		FILL: Brown sandy silt, some gravel, trace clay, moist		4	SS	57	310
1.3	309.7	SILTY SAND: Dense brown silty sand, some gravel, moist to wet		5	SS	32	
2.0				6	SS	39	309
3.0	308.0	becoming very dense, saturated		7	SS	54	308
4.0							307
4.5	306.5	CLAYEY SILT TILL: Hard grey clayey		8	SS	48	
5.0	306.0	silt, some sand, trace gravel, APL BOREHOLE TERMINATED AT 5.0 m					306

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
22 61 17
26 55 20

▼ El. 308.0
Sampler wet at 3.0 m

Upon completion of augering;
Free water at 3.5 m
Cave at 3.8 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 104

17T 550892E 4808283N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Maple Grove Road, Eastbound Midshoulder
BORING DATE February 1, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 311.39				
0.0		PAVEMENT STRUCTURE: 650 mm granular base/subbase, moist				
0.65	310.74	FILL: Brown clayey silt, trace gravel, trace sand, moist		1	SS	50/125mm
1.2	310.2	becoming dark brown, trace organics, some sand		2	SS	13
1.8	309.6	SILTY SAND: Loose brown silty sand, trace gravel, wet		3	SS	5
3.0	308.4	becoming grey, compact		4	SS	18
4.5	306.9	GRAVELLY SAND: Dense grey gravelly sand, trace silt, saturated		5	SS	37
5.0	306.4	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 311, 310, 309, 308, 307

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 309.2
Filter Sand Screen

30 66 4

Upon completion of augering
Wet cave at 4.5 m

Water Level Readings:

Date	Depth	Elev.
2019-02-01	3.0	308.4
2019-03-28	2.2	309.2

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 105

17T 551018E 4808316N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — **BORING DATE** February 20, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 311.98					
0.0		PAVEMENT STRUCTURE: 150 mm asphalt, over 170 mm granular base, moist, over 625 mm granular subbase, moist		1	AS		
0.95	311.03	FILL: Grey silty sand, some gravel, moist		2	SS	50	311
1.0							
2.0				3	SS	49	310
				4	SS	10	
3.0							
3.0	309.0	SANDY SILT TILL: Compact brown sandy silt, trace gravel, trace clay, moist		5	SS	15	309
4.0							308
4.5							
	307.5	becoming very dense, wet		6	SS	76/325mm	
5.0							307
5.0	307.0	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 106

17T 551224E 4808372N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** February 20, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 312.87					
0.0	PAVEMENT STRUCTURE: 180 mm asphalt, over 300 mm granular base, moist, over 610 mm granular subbase, moist		1A	AS		
1.1			2	SS	47	312
311.8	FILL: Hard brown silty sand, some gravel, trace clay, moist					
2.3			3	SS	42	311
310.6	CLAYEY SILT TILL: Hard brown clayey silt, some sand, some gravel, DTPL		4	SS	33	
						310
			5	SS	48	
						309
4.5						
308.4	becoming grey		6	SS	43	308
5.0						
307.9	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 107

17T 551365E 4808395N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Right Turn Lane — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 313.37					
0.0		PAVEMENT STRUCTURE: 185 mm asphalt over 215 m granular base over, 300 mm granular subbase		1A 1B	AS		313
0.70	312.67	FILL: Brown sand, gravel, moist		2	SS	23	
1.0							
1.4	312.0	brown clayey silt, some gravel, occasional cobbles, wet		3	SS	7	312
2.0							
2.1	311.3	SAND: Loose brown sand, some gravel, trace silt, saturated		4	SS	6	311
2.9							
3.0	310.5	SANDY SILT TILL: Compact to very dense, brown sandy silt, some clay, trace gravel, wet		5	SS	24	310
4.0							
4.7				6	SS	50/75mm	309
5.0	308.7	BOREHOLE TERMINATED AT 4.7 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 311.0

Upon Completion of Augering
Free water at 2.4 m
Cave to 3.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 108

17T 551524E 4808449N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 14, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	312.63	SURFACE ELEVATION 312.63				
0.0		PAVEMENT STRUCTURE: 540 mm granular base/subbase, moist		1	SS	50/75mm
0.54	312.09	FILL: Brown silty sand, some gravel, numerous cobbles, moist		2	SS	19
1.0						
1.5	311.1	trace clay, wet		3	SS	15
2.0	310.6	SANDY SILT TILL: Dense to very dense brown sandy silt, trace gravel, trace clay, damp		4	SS	36
3.0				5	SS	65
4.0						
5.0	307.6	BOREHOLE TERMINATED AT 5.0 m		6	SS	64

ELEVATION SCALE: 312, 311, 310, 309, 308

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

8 23 68

Water Level Readings:

Date	Depth	Elev.
2018-01-14	DRY	----

NOTES Monitoring well buried after installation.

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 109

17T 551679E 4808477N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Maple Grove Road, Eastbound Midlane
BORING DATE February 20, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 309.87				
0.0 / 309.87	PAVEMENT STRUCTURE: 140 mm asphalt, over 320 mm granular base, moist		1A		
0.46 / 309.41			1B	AS	
	FILL: Brown sandy silt, some gravel, occasional clayey silt layers, moist		2	SS	23
1.4 / 308.5	becoming brown clayey silt, some sand, trace gravel, moist		3	SS	7
2.3 / 307.6	SANDY SILT TILL: Compact brown sandy silt, trace gravel, occasional cobbles, moist		4	SS	17
3.0 / 306.9	becoming very dense		5	SS	54
5.0 / 304.9	BOREHOLE TERMINATED AT 5.0 m		6	SS	50/75mm

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 110

17T 551813E 4808506N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — **BORING DATE** January 14, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 307.01				
0.0	307.01	PAVEMENT STRUCTURE: 640 mm granular base/subbase, moist		1	SS	50/100 mm
0.64						
0.90		FILL: Dark brown sandy silt, trace clay, rootlets, moist, contains organics		2	SS	23
1.0	306.11	SANDY SILT: Compact brown sandy silt, trace gravel, moist				
				3	SS	18
2.0						
2.3	304.7	SAND: Compact brown sand, trace silt, trace gravel, saturated		4	SS	15
3.0						
				5	SS	13
4.0						
5.0				6	SS	30
	302.0	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 306, 305, 304, 303

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 305.0
Filter Sand Screen

6 86 8

Water Level Readings:

Date	Depth	Elev.
2019-01-14	4.0	303.0
2019-03-28	2.0	305.0

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 111

17T 551930E 4808555N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** February 20, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 306.14					306
0.0		PAVEMENT STRUCTURE: 140 mm asphalt, over 220 mm granular base, moist, over 740 mm granular subbase, moist		1A	AS		
1.1	305.0	FILL: Brown silty sand, some gravel, moist		2	SS	35	305
1.5	304.6	SAND: Compact brown sand, trace silt, trace gravel, wet		3	SS	28	
2.3	303.8	becoming grey, silty		4	SS	18	304
3.0	303.1	SANDY SILT TILL: Dense to very dense grey sandy silt, some gravel, moist		5	SS	47	303
5.0	301.1	BOREHOLE TERMINATED AT 5.0 m		6	SS	50/125mm	302

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 112

17T 552014E 4808590N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 14, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 305.77			
0.0	PAVEMENT STRUCTURE: 900 mm granular base/subbase, moist	1	SS	50/100mm
0.90 304.87	FILL: Brown sand and gravel, trace silt, occasional cobbles, damp	2	SS	27
1.5 304.3	SAND: Compact brown sand, some silt, trace gravel, saturated	3	SS	28
2.3 303.5	SILTY SAND TILL: Compact to dense brown silty sand, some gravel, saturated	4	SS	13
		5	SS	19
4.5 301.3	becoming grey	6	SS	32
5.0 300.8	BOREHOLE TERMINATED AT 5.0 m			

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%)

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete

El. 304.6

Bentonite Seal

18 44 38

Filter Sand Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-14	3.1	302.7
2019-03-28	1.2	304.6

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 113

17T 552300E 4808686N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — ***BORING DATE*** January 15, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 304.98				
0.0	304.98	PAVEMENT STRUCTURE: 110 mm asphalt, over 200 mm granular base, damp, over 630 mm granular subbase, moist		1	SS	50/125mm
0.94	304.04	FILL: Grey silt, some sand, trace gravel, moist		2	SS	37
1.5	303.5	SILTY SAND TILL: Compact to very dense brown silty sand, some gravel, trace clay, moist		3	SS	61
2.3	302.7	becoming grey, saturated		4	SS	7*
				5	SS	25
5.0	300.0	BOREHOLE TERMINATED AT 5.0 m		6	SS	80

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 302.7
Sampler wet at 2.3 m

Upon completion of augering
No cave
Free water at 3.0 m

NOTES * Low N value due to hydraulic disturbance.

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 114

17T 552382E 4808724N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 15, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 304.71					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 180 mm granular base, damp, over 800 mm granular subbase, moist		1A 1B 1C	AS		
1.1	303.6	FILL: Dark brown silty sand, some organics, wood pieces, moist		2	SS	53	304
1.5	303.2	becoming dark grey silty sand, wet		3	SS	18	303
2.3	302.4	SAND: Compact grey sand, some silt, trace gravel, saturated		3	SS	23	302
4.5				5	SS	11	301
5.0	300.2	SILT TILL: Dense grey silt, some sand, trace gravel, trace clay, wet		6	SS	42	300
	299.7	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
37 52 11

▼ El. 303.2

Upon completion of augering
Cave at 2.3 m
Free water at 1.5 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 115

17T 552454E 4808741N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — **BORING DATE** January 16, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 304.57				
0.0		PAVEMENT STRUCTURE: 1150 mm of granular base/subbase, moist		1	SS	50/125mm
1.2	303.4	FILL: Brown silty sand, trace gravel, moist		2	SS	26
1.7	302.9	becoming dark brown, contains organics, rootlets, wet		3	SS	11
2.3	302.3	SAND: Compact brown sand, trace silt, trace gravel, saturated		4	SS	11
3.0	301.6	occasional cobbles		5	SS	12
4.5	300.1	SANDY SILT TILL: Dense grey sandy silt, trace gravel, trace clay, saturated		6	SS	31
5.0	299.6	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 304, 303, 302, 301, 300

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete

Bentonite Seal El. 302.9

3 91 5

Filter Sand Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-16	2.2	302.4
2019-03-28	1.7	302.9

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 116

17T 552511E 4808775N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 16, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 305.35					
0.0	PAVEMENT STRUCTURE: 1400 mm granular base/subbase, moist		1	SS	50/100mm	305
1.0			2	SS	40	
1.4						304
1.7	FILL: Grey silty sand, moist		3	SS	9	
1.9	becoming dark brown, occasional					
2.0	303.5 rootlets, trace clay, contains organics					303
	SAND: Very loose to loose grey sand, trace silt, saturated		4	SS	2	
3.0			5	SS	5	302
4.0						
4.5						301
300.9	becoming compact, trace to some gravel		6	SS	16	
5.0	300.4 BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 303.3
0 94 6
Filter Sand Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-16	2.3	303.1
2019-03-28	2.1	303.3

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 117

17T 552594E 4808789N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — **BORING DATE** January 16, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 306.90					
0.0		PAVEMENT STRUCTURE: 110 mm asphalt, over 170 mm granular base, damp, over 670 mm granular subbase, moist		1A 1B	AS		
0.95	305.95	FILL: Brown sandy silt, trace gravel, moist		2	SS	68	306
1.5							
1.7	305.2	becoming dark brown sandy silt, trace clay, rootlets, contains organics		3	SS	15	305
		SAND: Very loose brown sand, some silt, wet		4	SS	2	
3.0							304
	303.9	becoming compact, trace gravel, occasional cobbles, saturated		5	SS	18	303
5.0				6	SS	20	302
	301.9	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

42 45 13

▼ El. 304.6
Sampler wet from 2.3 m to completion

Upon completion of augering
Wet cave at 3.0 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 118

17T 552668E 4808816N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 18, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.27					
0.0	PAVEMENT STRUCTURE: 100 mm asphalt, over 820 mm granular base/subbase		1A			309
			1B	AS	47	
0.92			2A			
1.0 308.35	SANDY SILT TILL: Dense, to very dense, brown sandy silt, some gravel, moist; occasional cobbles		2B	SS		
			3	SS	51	308
2.0						
			4	SS	40	307
3.0						
			5	SS	52	306
4.0 305.3	becoming saturated					
						305
5.0 304.3	BOREHOLE TERMINATED AT 5.0 m		6	SS	59	
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 119

17T 552738E 4808824N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 310.76					
0.0	PAVEMENT STRUCTURE: 600 mm granular base/subbase, moist		1	AS		
0.60 / 310.16	FILL: Brown silty sand, some gravel, occasional cobbles, moist		2	SS	17	310
1.5 / 309.3	SANDY SILT: Compact brown sandy silt, some gravel, trace clay, moist		3	SS	21	309
2.3 / 308.5	becoming dense to very dense, occasional cobbles		4	SS	41	308
			5	SS	45	307
5.0 / 305.8	BOREHOLE TERMINATED AT 5.0 m		6	SS	72	306

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 120

17T 552810E 4808854N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 29, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 311.73					
0.0		PAVEMENT STRUCTURE: 540 mm granular base/subbase, moist		1	AS		
0.54	311.19	FILL: Brown sandy silt, some gravel, occasional cobbles, moist		2	SS	50/50mm	311
1.0							
				3	SS	11	310
2.0							
2.3	309.4	SAND: Dense brown sand, some gravel, some silt, saturated		4	SS	56	
3.0							309
				5	SS	46	
4.0							308
4.5	307.2	CLAYEY SILT TILL: Hard grey clayey silt, some sand, trace gravel, DTPL		6	SS	57	307
5.0	306.7	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 309.4

Upon completion of augering
Cave at 2.6 m
Free water at 2.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 121

17T 552893E 4808870N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 18, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 311.56					
0.0		PAVEMENT STRUCTURE: 145 mm asphalt, over 1205 mm granular base/subbase		1	AS		311
1.0				2	SS	22	
1.4	310.2	FILL: Compact brown to grey silty sand, trace gravel, moist, occasional topsoil inclusions		3	SS	19	310
2.0							
2.1	309.5	SANDY SILT TILL: Compact brown sandy silt, some gravel, trace clay, moist, occasional cobbles		4	SS	20	309
3.0				5	SS	29	
4.0	307.6	CLAYEY SILT TILL: Hard, grey clayey silt, some sand, trace gravel, DTPL					308
5.0				6	SS	33	307
5.0	306.6	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT — NATURAL MOISTURE CONTENT — LIQUID LIMIT
w_P — w — w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 122

17T 552949E 4808875N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — ***BORING DATE*** January 16, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
	310.42	SURFACE ELEVATION 310.42				
0.0		PAVEMENT STRUCTURE: 870 mm granular base/subbase, moist		1	SS	
0.87	309.55	FILL: Brown clayey silt, some gravel, some sand, moist		2	SS	12
1.5	308.9	becoming brown sand and gravel, trace silt, occasional cobbles, saturated		3	SS	5
2.3	308.1	SAND AND GRAVEL: Compact brown sand and gravel, trace silt, occasional cobbles, saturated		4	SS	33
3.0	307.4	SANDY SILT TILL: Compact brown sandy silt, some gravel, trace clay, occasional cobbles, saturated		5	SS	16
4.5	305.9	becoming very dense, grey		6	SS	85/275mm
5.0	305.4	BOREHOLE TERMINATED AT 5.0 m				

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 310, 309, 308, 307, 306

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

WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

20 36 43

Water Level Readings:

Date	Depth	Elev.
2019-01-16	2.2	308.2
2019-03-28	1.4	309.0

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 123

17T 553028E 4808907N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** January 31, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 308.02				
0.0		PAVEMENT STRUCTURE: 600 mm granular base/subbase		1	AS	
0.60	307.42	FILL: Compact, brown sand, some silt, trace gravel, moist		2	SS	27
1.4	306.6	loose, wet		3	SS	4
2.1	305.9	grey sandy silt, some clay, trace gravel, wet, occasional rootlets, contains organics		4	SS	6
2.9	305.1	SANDY SILT: Loose to compact grey sandy silt, trace gravel, trace clay, saturated		5	SS	9
5.0	303.0	BOREHOLE TERMINATED AT 5.0 m		6	SS	11

ELEVATION SCALE: 307, 306, 305, 304

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Water Level Readings:

Date	Depth	Elev.
2019-01-31	2.9	305.1
2019-03-28	1.7	306.3

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 124

17T 553107E 4808925N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — **BORING DATE** January 17, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 307.29					
	PAVEMENT STRUCTURE: 120 mm asphalt over, 270 mm granular base over, moist, 600 mm granular subbase, moist		1A, 1B	AS		307
0.99 / 306.30	SILTY SAND: Compact to dense brown silty sand, trace gravel, moist		2A, 2B	SS	45	
1.4 / 305.9	becoming saturated		3	SS	17	306
			4	SS	21	305
			5	SS	13	304
4.7 / 302.6	SANDY SILT TILL: Dense brown sandy silt, some gravel, trace clay, saturated; occasional cobbles		6A, 6B	SS	31	303
5.0 / 302.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 305.9

Upon Completion of Augering
Wet cave at 1.8 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 125

17T 553160E 4808959N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 17, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 307.34					
0.0	PAVEMENT STRUCTURE: 130 mm asphalt, over 270 mm granular base over 540 mm granular subbase, moist		1A	AS		23 62 15
			1B			38 51 11
0.94			2A	SS	46	
306.40	SAND: Dense brown sand, some silt,		2B			
1.4	moist, with occasional topsoil inclusions					
305.9	becoming compact, trace gravel, wet to saturated		3	SS	16	▼ El. 305.8
2.0			4	SS	10	
2.9						
304.4	becoming loose, silty to some silt		5	SS	7	
5.0			6	SS	9	
302.3	BOREHOLE TERMINATED AT 5.0 m					Upon Completion of Augering Free water at 1.5 m Cave to 2.1 m

ELEVATION SCALE: 307, 306, 305, 304, 303

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 126

17T 553234E 4809014N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Lane 2 — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 308.49					
0.0		PAVEMENT STRUCTURE: 145 mm asphalt over 175 mm granular base over, moist, 570 mm granular subbase, moist		1A, 1B	AS		308
0.89	307.60	SAND: Compact brown sand, some silt, moist		2	SS	50/75mm	
1.0				3	SS	21	307
2.0				4	SS	13	306
2.9	305.6	becoming saturated		5	SS	13	305
4.0							304
5.0				6	SS	14	
5.0	303.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 305.6

Upon Completion of Augering
Wet cave to 3.4 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 127

17T 553308E 4809052N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — ***BORING DATE*** January 30, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 309.27				
0.0	PAVEMENT STRUCTURE: 1100 mm of granular base/subbase, moist		1	AS	
1.1			2A	SS	42
308.2	SAND: Compact brown sand, trace silt, moist		2B		
			3	SS	12
			4	SS	11
			5	SS	12
4.0					
305.3	becoming saturated		6	SS	12
5.0					
304.3	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
Filter Sand
0 96 4
Screen El. 305.4

Water Level Readings:

Date	Depth	Elev.
2019-01-30	4.2	305.1
2019-03-28	3.9	305.4

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 128

17T 553371E 4809105N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** January 17, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 310.39					
0.0		PAVEMENT STRUCTURE: 130 mm asphalt, over 210 mm granular base, moist, over 710 mm granular subbase, moist		1A 1B	AS		310
1.1	309.3	FILL: Dense brown silty sand, some gravel, moist; occasional cobbles		2	SS	45	
1.7	308.7	SANDY SILT TILL: Compact to dense brown sandy silt, some gravel, occasional cobbles, moist		3A 3B	SS	45	309
				4	SS	16	308
				5	SS	31	307
				6	SS	31	306
5.0	305.4	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 129

17T 553435E 4809144N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane — ***BORING DATE*** January 17, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 311.22					
	PAVEMENT STRUCTURE: 120 mm asphalt, over 270 mm granular base, moist, over 530 mm granular subbase, moist		1A, 1B	AS		311
0.92 / 310.30	SILTY SAND TILL: Compact to very dense brown sandy silt, some gravel to gravelly, moist, numerous cobbles		2A, 2B	SS	65	310
			3	SS	24	
			4	SS	47	309
			5	SS	47	308
						307
5.0 / 306.2	BOREHOLE TERMINATED AT 5.0 m		6	SS	37	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 130

17T 553496E 4809188N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Maple Grove Road, Westbound Midshoulder
BORING DATE February 1, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 312.10				
0.0		PAVEMENT STRUCTURE: 670 mm granular base/subbase, moist				
0.67	311.43	FILL: Brown sandy silt, some gravel, occasional cobbles, damp		1	SS	48
1.5	310.6	CLAYEY SILT TILL: Very stiff brown clayey silt, trace gravel, trace sand, DTPL		2	SS	21
2.0				3	SS	25
3.0	309.1	SILT TILL: Dense to very dense brown silt, some sand, trace gravel, wet		4	SS	42
5.0	307.1	BOREHOLE TERMINATED AT 5.0 m		5	SS	50/100mm

ELEVATION SCALE: 312, 311, 310, 309, 308

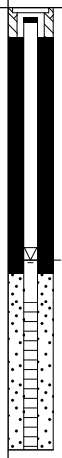
SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL



1 17 82

Upon completion of augering
Wet cave at 4.5 m

Water Level Readings:

Date	Depth	Elev.
2019-02-01	4.0	308.1
2019-03-28	2.6	309.5

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 131

17T 553567E 4809203N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Partly Paved Shoulder — **BORING DATE** February 19, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (m)	ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
0.0		SURFACE ELEVATION 311.68					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 450 mm granular		1A	AS		
0.57	311.11	base/subbase, moist		1B			311
0.57	311.11	FILL: Brown sand, some silt, trace gravel, damp		2	SS	50	
1.0							
1.0				3	SS	20	310
2.0							
2.3	309.4	SAND: Dense brown sand, some silt, trace gravel, occasional to numerous cobbles, moist		4	SS	49	309
3.0				5	SS	50/75mm	
4.0							308
4.5	307.2						
5.0	306.7	SILTY SAND TILL: Very dense brown silty sand, some gravel, occasional cobbles, saturated		6	SS	80/275mm	307
5.0		BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
50 mm Plastic Riser
Bentonite Seal
Filter Sand
Slotted Screen
El. 307.7

21 48 32

Water Level Readings:

Date	Depth	Elev.
2019-02-19	DRY	----
2019-03-28	4.0	307.7

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 132

17T 553638E 4809236N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Right Turn Lane — ***BORING DATE*** February 22, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 310.39					
0.0	PAVEMENT STRUCTURE: 150 mm asphalt, over 200 mm granular base, moist, over 350 mm granular subbase, moist					310
0.70 / 309.69	FILL: Brown sand, some silt, trace gravel, damp		1	SS	63	
1.0						309
			2	SS	25	
2.0						
2.3 / 308.1	SILTY SAND: Compact brown silty sand, trace gravel, occasional cobbles, moist to wet		3	SS	9	308
3.0						
			4	SS	16	307
4.0						
4.5 / 305.9	becoming saturated		5	SS	15	306
5.0 / 305.4	BOREHOLE TERMINATED AT 5.0 m					
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Wet cave at 4.8 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 133

17T 553765E 4809285N

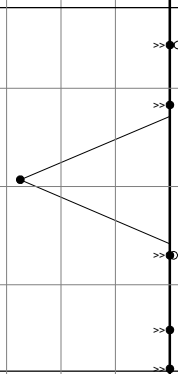
PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Left Turn Lane — **BORING DATE** February 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 306.82					
0.0	PAVEMENT STRUCTURE: 150 mm asphalt, over 210 mm granular base, moist, over 360 mm granular subbase, moist		1	SS	50/25mm	
0.72 / 306.10	FILL: Brown sand and gravel, some silt, occasional cobbles, moist		2	SS	50/125mm	306
1.0			3	SS	45	305
2.0						
2.3 / 304.5	SANDY SILT TILL: Very dense brown sandy silt, some gravel, occasional cobbles, moist		4	SS	50/100mm	304
3.0			5	SS	50/100mm	
3.7 / 303.1	BOREHOLE TERMINATED AT 3.7 m NO FURTHER PROGRESS DUE TO AUGER AND SPLITSPOON REFUSAL IN PROBABLE BOULDER		6	SS	50/50mm	
4.0						
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80



PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering
No cave
No free water

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 134

17T 553808E 4809307N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Lane 2 — **BORING DATE** January 28, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	305.45	SURFACE ELEVATION 305.45					
0.0	305.45	PAVEMENT STRUCTURE: 150 mm asphalt, over 150 mm granular base, moist, over 450 mm granular subbase, moist		1A 1B	AS		305
0.75	304.70	FILL: Brown gravelly sand, some silt, numerous cobbles, damp		2	SS	85/275mm	
1.5	304.0	SAND AND GRAVEL: Very dense brown sand and gravel, trace silt, numerous cobbles, occasional boulders, moist		3	SS	50/75mm	304
2.0				4	SS	50/25mm	303
2.7	302.8	SILTY SAND: Dense to very dense brown silty sand, trace gravel, saturated		5	SS	34	302
4.0	301.5	SANDY SILT TILL: Compact to very dense brown sandy silt, trace gravel, occasional cobbles, moist		6	SS	93/275mm	301
5.0	300.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
Wet cave at 4.0 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 135

17T 553871E 4809318N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Lane 1 — **BORING DATE** January 28, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 303.81					
0.0		PAVEMENT STRUCTURE: 155 mm asphalt, over 225 mm granular base, moist, over 520 mm granular subbase, moist		1A 1B	AS		
0.90	302.91	FILL: Brown sand and gravel, trace silt, moist		2	SS	20	303
1.5	302.3	becoming brown silty sand, some gravel, moist		3	SS	19	302
2.0				4	SS	79/225mm	
3.0	300.8	becoming brown silt, some sand, trace gravel, trace clay, moist		5	SS	20	301
4.1	299.7	SANDY SILT TILL: Compact brown sandy silt, some gravel, occasional cobbles, moist		6	SS	29	300
5.0	298.8	BOREHOLE TERMINATED AT 5.0 m					299

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 136

17T 553957E 4809350N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Lane 2 — ***BORING DATE*** January 28, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 301.46					
0.0 / 301.46	PAVEMENT STRUCTURE: 125 mm asphalt, over 175 mm granular base, moist, over 350 mm granular subbase, moist		1A, 1B	AS		301
0.65 / 300.81	FILL: Brown sand, some gravel, trace silt, occasional cobbles, moist		2	SS	60	
1.5 / 300.0	becoming grey sandy silt, trace clay, trace gravel, moist		3	SS	21	300
2.3 / 299.2	SANDY SILT: Compact brown sandy silt, some gravel, occasional cobbles, moist		4	SS	57	299
			5	SS	26	298
						297
5.0 / 296.5	BOREHOLE TERMINATED AT 5.0 m		6	SS	25	

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 137

17T 553975E 4809370N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane, Lane 2 — ***BORING DATE*** January 28, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 301.11				
0.0	PAVEMENT STRUCTURE: 100 mm asphalt, over 190 mm granular base, moist, over 610 mm granular subbase, moist		1A / 1B	AS	
0.90 / 300.21	FILL: Brown sand and gravel, trace silt, occasional cobbles, damp		2	SS	59
1.5 / 299.6	becoming silt, some sand, trace gravel		3	SS	35
2.3 / 298.8	becoming sand, some silt, trace gravel, trace clay		4	SS	49
3.0 / 298.1	becoming brown silt, some sand, trace gravel, trace clay, wet		5	SS	21
4.5 / 296.6	SANDY SILT: Compact dark brown sandy silt, trace gravel, organics, wet		6	SS	17
5.0 / 296.1	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 301, 300, 299, 298, 297

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 138

17T 554142E 4809382N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — **BORING DATE** January 28, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES
	SURFACE ELEVATION 301.03				
0.0	PAVEMENT STRUCTURE: 310 mm granular base, moist, over 380 mm granular subbase, moist		1A / 1B	AS	
0.69 / 300.34	SAND: Compact brown sand, some silt, trace gravel, occasional cobbles, moist		2	SS	30
			3	SS	15
2.3 / 298.7	GRAVELLY SAND: Compact to dense brown gravelly sand, some silt, occasional cobbles, saturated		4	SS	24
			5	SS	25
			6	SS	38
5.0 / 296.0	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 300, 299, 298, 297

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

21 69 9

Water Level Readings:

Date	Depth	Elev.
2019-01-28	2.4	298.6
2019-03-28	1.9	299.1

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 139

17T 554218E 4809382N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Westbound Midlane — ***BORING DATE*** February 20, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES
	SURFACE ELEVATION 303.18				
0.0	PAVEMENT STRUCTURE: 160 mm asphalt, over 220 mm granular base, moist, over 520 mm granular subbase, moist		1	AS	
0.90 / 302.28	SAND: Very dense brown sand, some silt, trace gravel, moist		2	SS	79
			3	SS	50/100mm
2.3 / 300.9	SANDY SILT: Dense brown sandy silt, trace gravel, moist		4	SS	55
3.0 / 300.2	SAND: Compact to dense brown sand, some silt, saturated		5	SS	31
5.0 / 298.2	BOREHOLE TERMINATED AT 5.0 m		6	SS	17

ELEVATION SCALE: 303, 302, 301, 300, 299

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 50 100 150 200; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 300.2

Upon completion of augering
Wet cave at 3.0 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 140

17T 554288E 4809359N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Right Turn Lane to Ramp — ***BORING DATE*** February 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 304.20					
0.0 / 304.20	PAVEMENT STRUCTURE: 140 mm asphalt, over 320 mm granular base, moist, over 440 mm granular subbase, moist		1	AS		304
0.90 / 303.30	SILTY SAND: Dense brown silty sand, trace to some gravel, moist		2	SS	44	303
2.3 / 301.9	SAND: Dense brown sand, trace silt, trace gravel, moist		3	SS	36	302
3.0 / 301.2	becoming saturated		4	SS	34	301
4.0 / 300.2	SANDY SILT TILL: Very dense brown sandy silt, some gravel, wet		5	SS	29	300
5.0 / 299.2	BOREHOLE TERMINATED AT 5.0 m		6	SS	84/275mm	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 300.2

Upon completion of augering
No cave
Free water at 4.0 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 141

17T 554370E 4809352N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Maple Grove Road, Eastbound Midlane, Left Turn Lane — ***BORING DATE*** February 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH (metres) / ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 303.94			
0.0	PAVEMENT STRUCTURE: 100 mm asphalt, over 200 mm granular base, moist, over 800 mm granular subbase, moist	1	AS	
		2	AS	
		3	AS	
1.1		4	SS	43
302.8	SAND: Compact brown sand, trace silt, trace gravel, occasional silty zones, moist			
		5	SS	36
2.0				
		6	SS	30
3.0				
300.9	becoming wet	7	SS	15
4.0				
4.5				
299.4	SILTY SAND TILL: Dense brown silty sand, trace gravel, trace clay, wet	8	SS	40
5.0				
298.9	BOREHOLE TERMINATED AT 5.0 m			

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●

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

WATER CONTENT (%)

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

29 57 14

34 50 16

El. 299.9

Upon completion of augering
Wet cave at 4.0 m

NOTES

GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 142

17T 554511E 4809329N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Maple Grove Road, Westbound Midlane
BORING DATE February 21, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 302.31					
0.0		PAVEMENT STRUCTURE: 105 mm asphalt, over 165 mm granular base, moist, over 540 mm granular subbase, moist		1	AS		302
0.81	301.50	SANDY SILT: Compact to dense brown sandy silt, some gravel, occasional cobbles, moist		2	SS	22	
1.0				3	SS	46	301
2.0	2.3						
	300.0	GRAVELLY SAND: Dense brown gravelly sand, some silt, occasional cobbles, wet		4	SS	50	300
3.0				5	SS	29	299
4.0	4.5						298
	4.7	becoming grey, occasional boulders		6	SS	50/75mm	
	297.6	BOREHOLE TERMINATED AT 4.65 m					
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 300.0
Sampler wet at 2.3 m

Upon completion of augering
Cave at 3.0 m
Free water at 1.6 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 143

17T 554565E 4809319N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Westbound Midshoulder — **BORING DATE** February 21, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 304.34				
0.0	304.34	PAVEMENT STRUCTURE: 100 mm granular base, moist, over 550 mm granular subbase, moist		1	SS	29
0.65	303.69	SAND: Compact brown sand, some gravel, some silt, moist		2	SS	13
1.0				3	SS	22
2.0				4	SS	56
2.7	301.6	GRAVELLY SAND: Dense brown gravelly sand, some silt, saturated		5	SS	57
3.0						
4.0				6	SS	50/125mm
5.0	299.3	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 304, 303, 302, 301, 300

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
50 mm Plastic Riser
Bentonite Seal
El. 302.5
Filter Sand
32 50 18
Slotted Screen

Water Level Readings:

Date	Depth	Elev.
2019-02-21	4.7	299.6
2019-03-28	1.8	302.5

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 144

17T 554628E 4809302N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Maple Grove Road, Eastbound Midshoulder — **BORING DATE** February 21, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 307.12				
0.0	307.12	PAVEMENT STRUCTURE: 150 mm granular base, moist, over 450 mm granular subbase, moist		1	SS	50/100mm
0.60	306.52	FILL: Brown sand, trace silt, trace gravel, moist		2	SS	9
1.0				3	SS	6
2.0						
2.3	304.8	SANDY SILT: Compact brown sandy silt, some gravel, wet		4	SS	9
3.0				5	SS	14
4.0				6	SS	28
5.0				7	SS	31
5.0	302.1	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 307, 306, 305, 304, 303

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
50 mm Plastic Riser
Bentonite Seal
Filter Sand
El. 303.8
Slotted Screen

21 40 40

Water Level Readings:

Date	Depth	Elev.
2019-02-21	4.8	302.3
2019-03-28	3.3	303.8

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 145

17T 554647E 4809833N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Centre Median — **BORING DATE** January 30, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
0.0	316.54	SURFACE ELEVATION 316.54				
		PAVEMENT STRUCTURE: 155 mm asphalt over 230 mm granular base over, moist, 640 mm granular subbase, moist		1A, 1B	AS	
1.1				2	SS	35
1.4	315.1	SANDY SILT: Dense brown sandy silt, trace gravel, moist				
		SAND AND GRAVEL: Dense brown sand and gravel, trace silt, damp		3	SS	49
2.1	314.4	SILT: Compact brown silt, some sand, trace gravel, moist to wet		4	SS	18
				4	SS	29
4.0	312.5	becoming saturated				
5.0	311.5			5	SS	21
		BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 316, 315, 314, 313, 312

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
Filter Sand
El. 313.4
Screen

0 1 99

Water Level Readings:

Date	Depth	Elev.
2019-01-30	4.1	312.4
2019-03-28	3.1	313.4

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 146

17T 554612E 4809751N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Northbound Midshoulder — **BORING DATE** January 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 313.83					
0.0	PAVEMENT STRUCTURE: 410 mm granular base, moist, over 330 mm granular subbase, moist		1A	AS		
0.74			1B			
313.09	SAND: Compact brown sand, some silt, trace gravel, moist		2	SS	18	313
1.4						
312.4	SILT: Dense brown silt, some sand, trace clay, moist to wet		3	SS	35	312
2.1						
311.7	becoming compact		4	SS	29	
2.9						311
310.9	becoming saturated		5	SS	28	
						310
5.0			6	SS	21	309
308.8	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
Free water at 4.4 m
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 147

17T 554561E 4809699N

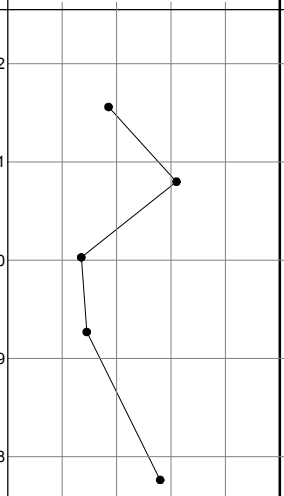
PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Southbound Midshoulder — **BORING DATE** January 24, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

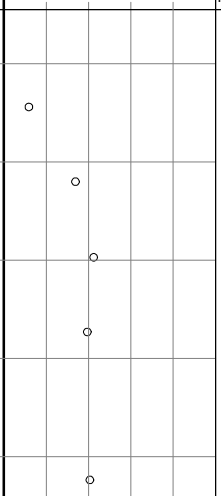
DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 312.55				
0.0	PAVEMENT STRUCTURE: 300 mm granular base, moist, over 420 mm granular subbase, moist				
0.72 / 311.83	SAND: Dense brown sand, some silt, trace gravel, moist		1	SS	37
1.2 / 311.4	SILT: Compact to very dense brown silt, some sand, trace clay, moist to wet		2	SS	62
2.3 / 310.3	becoming saturated		3	SS	27
			4	SS	29
5.0 / 307.6	BOREHOLE TERMINATED AT 5.0 m		5	SS	56

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●



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

WATER CONTENT (%)



UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount Well Protector Set in Concrete

50 mm Plastic Riser

Bentonite Seal

El. 310.8

Filter Sand

1 3 96

Slotted Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-24	3.4	309.2
2019-03-28	1.8	310.8

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 148

17T 554527E 4809623N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 2 — ***BORING DATE*** January 24, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	310.30	SURFACE ELEVATION 310.30					
0.0		PAVEMENT STRUCTURE: 155 mm asphalt, over 285 mm granular base, moist, over 420 mm granular subbase, moist		1	AS		310
0.86	309.44	SAND: Dense to very dense brown sand, some gravel, trace silt, occasional cobbles, moist		2	SS	50/50mm	
1.0							309
				3	SS	37	
2.0	308.3	SANDY SILT TILL: Compact brown sandy silt, trace gravel, trace clay, moist					
				4	SS	42	308
3.0							
				5	SS	24	307
4.0							
4.5	305.8	SAND AND GRAVEL: Dense brown sand and gravel, trace silt, occasional cobbles, saturated		6	SS	37	306
5.0	305.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 306.0

Upon completion of augering
No cave
Free water at 4.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 149

17T 554512E 4809545N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Northbound Midshoulder — **BORING DATE** January 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	307.72	SURFACE ELEVATION 307.72				
0.0	307.72	PAVEMENT STRUCTURE: 280 mm granular base, moist over, 390 mm granular subbase, moist		1A, 1B	AS	
0.67	307.05	SAND: Dense to compact brown sand, some silt, damp		2	SS	41
1.0				3	SS	18
2.1	305.6	SILTY GRAVELLY SAND: Compact brown silty gravelly sand, moist, occasional cobbles		4	SS	21
3.0				5A, 5B	SS	25
3.3	304.4	SANDY SILT TILL: Compact to very dense brown sandy silt, some gravel, trace clay, moist; numerous cobbles		6	SS	96/200 mm
4.9	302.8	BOREHOLE TERMINATED AT 4.9 m				

ELEVATION SCALE: 307, 306, 305, 304, 303

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
28 48 24

Flushmount Well Protector Set in Concrete
Bentonite Seal
El. 305.0
Filter Sand
Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-21	DRY	---
2019-03-28	2.7	305.0

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 150

17T 554477E 4809470N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 2 — ***BORING DATE*** January 24, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 305.62					
0.87 / 304.75	PAVEMENT STRUCTURE: 165 mm asphalt, over 375 mm granular base, moist, over 330 mm granular subbase, moist		1A, 1B	AS		305
	SILTY SAND: Compact brown silty sand, trace gravel, moist		2	SS	29	
			3	SS	32	304
2.3 / 303.3	becoming compact, wet		4	SS	11	303
			5	SS	15	
4.0 / 301.6	SANDY SILT TILL: Compact grey sandy silt, trace gravel, trace clay, saturated					302
			6	SS	17	301
5.0 / 300.6	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Wet cave at 3.7 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 151

17T 554442E 4809408N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Left Turn Lane — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 304.18									
0.0		PAVEMENT STRUCTURE: 185 mm asphalt over 195 mm granular base, moist over, 570 mm granular subbase, moist		1A, 1B	AS		304				12 64 24
0.95	303.23	SAND: Compact brown sand, some silt, trace gravel, moist		2A, 2B	SS	35					3 84 14
1.0							303				
2.0				3	SS	19					
2.1	302.1	becoming saturated					302				El. 301.8
				4	SS	12					
2.9	301.3	becoming loose									
3.0				5	SS	8	301				
4.0							300				
5.0				6	SS	7					
5.0	299.2	BOREHOLE TERMINATED AT 5.0 m									Upon Completion of Augering Free water at 2.4 m Cave to 2.4 m
6.0											
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											
14.0											
15.0											

SHEAR STRENGTH (kPa): ┼ FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●

20 40 60 80

PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT

w_P w w_L

WATER CONTENT (%): 10 20 30 40

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 152

17T 554413E 4809298N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 2 — **BORING DATE** January 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 302.00					
	PAVEMENT STRUCTURE: 145 mm asphalt over, 205 mm granular base, moist over, 620 mm granular subbase, moist		1A, 1B	AS		
0.97 / 301.03	SAND: Compact, brown sand, some silt, moist		2A, 2B	SS	45	301
1.4 / 300.6	becoming saturated		3	SS	13	
			4	SS	7	300
			5	SS	7	299
4.0 / 298.0	CLAYEY SILT TILL: Very stiff brown clayey silt, some sand, trace gravel, APL		6	SS	26	298
5.0 / 297.0	BOREHOLE TERMINATED AT 5.0 m					297

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 300.8

Upon Completion of Augering
Wet cave at 1.2 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 153

17T 554385E 4809237N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Left Turn Lane — ***BORING DATE*** January 30, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	301.31	SURFACE ELEVATION 301.31					
0.0	301.31	PAVEMENT STRUCTURE: 155 mm asphalt, over 185 mm granular base, moist, over 410 mm granular subbase, moist		1A, 1B	AS		301
0.75	300.56	SAND: Dense to very dense brown sand, some gravel, trace silt, moist; occasional to numerous cobbles		2	SS	41	
1.0				3	SS	50/100mm	300
2.0	299.3	SANDY SILT TILL: Very dense grey sandy silt, some gravel, moist		4	SS	66	299
3.0				5	SS	71	298
4.0	297.3	becoming saturated					297
5.0	296.3	BOREHOLE TERMINATED AT 5.0 m		6	SS	29	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 298.0

Upon Completion of Augering
Free water at 3.3 m
No cave

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 154

17T 554355E 4809158N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 1 — ***BORING DATE*** January 24, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 300.32			
0.0 / 300.32	PAVEMENT STRUCTURE: 150 mm asphalt, over 220 mm granular base, moist, over 290 mm granular subbase, moist	1A, 1B	AS	
0.66 / 0.90 / 299.42	SAND: Very dense brown sand, some silt, wet to saturated	2	SS	57
	SANDY SILT TILL: Dense brown sandy silt, some gravel, trace clay, moist	3	SS	43
2.3 / 298.0	occasional layers of gravelly sand, numerous cobbles	4	SS	38
3.1 / 297.2	becoming very dense, saturated	5	SS	62/250mm
4.0 / 296.3	becoming grey, numerous cobbles, saturated	6	SS	50/125mm
5.0 / 295.3	BOREHOLE TERMINATED AT 5.0 m			

ELEVATION SCALE: 300, 299, 298, 297, 296

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 298.5

Upon completion of augering
Cave at 3.4 m
Free water at 1.8 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 155

17T 554324E 4809095N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Southbound Midshoulder — **BORING DATE** January 21, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 299.27				
0.0	PAVEMENT STRUCTURE: 80 mm asphalt over, 220 mm granular base, moist, over 400 mm granular subbase, moist		1A, 1B	AS	
0.70 / 298.57	SILTY SAND TILL: Dense to very dense brown silty sand, some gravel, damp, occasional cobbles		2	SS	42
			3	SS	96/275 mm
			4	SS	92/275 mm
2.9 / 296.4	SANDY SILT TILL: Very dense brown sandy silt, some gravel, damp, occasional cobbles		5	SS	50/125mm
4.6 / 294.7	BOREHOLE TERMINATED AT 4.6 m		6	SS	50/125 mm

ELEVATION SCALE: 299, 298, 297, 296, 295

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST ×, ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Water Level Readings:

Date	Depth	Elev.
2019-01-21	DRY	---
2019-03-28	3.5	295.8

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 156

17T 554338E 4809049N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midshoulder — ***BORING DATE*** January 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 298.75					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt over, 200 mm granular base, moist over, 330 mm granular subbase, moist		1A 1B	AS		
0.65	298.10	FILL: Compact brown to grey silt, some sand and gravel, some clay, moist to wet		2	SS	13	298
1.4	297.4	SANDY SILT TILL: Dense to compact sandy silt, some gravel, trace clay, moist, occasional cobbles		3	SS	52	297
2.9				4	SS	14	296
3.0	295.9	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, some sand, trace to some gravel, APL, numerous cobbles		5	SS	16	295
4.9				6	SS	76/250 mm	294
5.0	293.9	BOREHOLE TERMINATED AT 4.9					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 157

17T 554282E 4808939N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 2 — ***BORING DATE*** January 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 297.30					
0.0	PAVEMENT STRUCTURE: 140 mm asphalt over, 190 mm granular base, moist, over 420 mm granular subbase, moist		1A / 1B	AS		297
0.75 / 296.55	SAND: Very dense brown sand, some silt, trace gravel, damp; layered		2	SS	61	
1.4 / 295.9	CLAYEY SILT: Very stiff brown clayey silt, some sand, trace gravel, APL		3	SS	14	296
2.1 / 295.2	SANDY SILT: Compact brown sandy silt, trace clay, moist		4	SS	26	295
3.8 / 293.5	SANDY SILT TILL: Dense brown sandy silt, some gravel, trace clay, moist; numerous cobbles		5	SS	41	294
4.6 / 292.7	BOREHOLE TERMINATED AT 4.6 m		6	SS	50/125mm	293

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 158

17T 554277E 4808864N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 2 — ***BORING DATE*** January 22, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	296.31	SURFACE ELEVATION 296.31					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt over, 140 mm granular base, moist, over 840 mm granular subbase, moist		1A			296
				1B	AS		
1.0				2	SS	39	
1.1	295.2	SANDY SILT TILL: Dense grey sandy silt, trace to some clay, wet to saturated					295
1.7	294.6	becoming moist		3A	SS	53	
2.0				3B			
2.1	294.2	with layers of sand and gravel, sand seams, and occasional clayey silt seams		4	SS	68	294
3.0				5A	SS	57	
				5B			293
4.0							292
4.7	291.6	BOREHOLE TERMINATED AT 4.7 m		6	SS	50/75mm	
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT — NATURAL MOISTURE CONTENT — LIQUID LIMIT
w_P — w — w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon Completion of Augering
No free water
Cave to 4.2 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 159

17T 554252E 4808828N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 1 — ***BORING DATE*** January 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 295.80					
0.0	PAVEMENT STRUCTURE: 160 mm asphalt over, 170 mm granular base, moist, over 870 mm granular subbase, moist		1A	AS		
			1B			
1.0			2	SS	41	295
1.2 / 294.6	SANDY SILT TILL: Very dense brown sandy silt, some gravel, moist; numerous cobbles					
			3	SS	50/75 mm	
2.0						294
			4	SS	50/150mm	
2.9 / 292.9	occasional clayey lenses					293
3.0			5	SS	89	
4.0						292
4.8 / 291.0	BOREHOLE TERMINATED AT 4.8 m		6	SS	50/125mm	
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 160

17T 554228E 4808724N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 1 — ***BORING DATE*** January 22, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 294.43								
0.0	PAVEMENT STRUCTURE: 135 mm asphalt over, 205 mm granular base, moist, over 960 mm granular subbase, moist		1A	AS		294			17 68 14
			1B						14 65 22
1.0			2	SS	67				
1.3									
293.1	SAND: Very dense brown sand, some silt and gravel, damp; numerous cobbles		3	SS	50/50mm	293			
2.0									
292.4	SANDY SILT TILL: Very dense sandy silt, some gravel, damp; numerous cobbles		4	SS	50/125mm	292			
3.0			5	SS	50/125 mm				El. 291.1
3.8						291			
290.6	becoming saturated								
4.0									
4.6			6	SS	50/125 mm	290			
289.8	BOREHOLE TERMINATED AT 4.6 m								Upon Completion of Augering Free water at 3.3 m Cave to 3.9 m
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									
14.0									
15.0									

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30 40

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 161

17T 554189E 4808653N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Hespeler Road, Southbound Midshoulder — **BORING DATE** January 24, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 293.35					
0.0		PAVEMENT STRUCTURE: 90 mm asphalt, over 280 mm granular base, moist, over 300 mm granular subbase, moist		1A, 1B	AS		293
0.67	292.68	SAND: Dense brown sand, some silt, trace gravel, damp		2	SS	46	
1.0							292
1.4	292.0	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, trace sand, moist		3	SS	28	
2.0				4	SS	40	291
3.0				5	SS	82	290
4.0							
4.5	288.9	SAND: Very dense brown sand, some silt, trace gravel, trace clay, saturated		6	SS	60	289
5.0	288.4	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
50 mm Plastic Riser
Bentonite Seal
Filter Sand
0 4 96
Slotted Screen
El. 289.0

Water Level Readings:

Date	Depth	Elev.
2019-01-24	DRY	----
2019-03-28	4.4	289.0

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 162

17T 554186E 4808575N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Northbound Midlane, Lane 2 — ***BORING DATE*** January 22, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES
	SURFACE ELEVATION 292.36				
	PAVEMENT STRUCTURE: 155 mm asphalt over, 185 mm granular base, moist, over, 570 mm granular subbase, moist		1A, 1B	AS	
0.91 / 291.45	FILL: Brown silt, some sand, trace clay, trace gravel, occasional cobbles, moist		2A, 2B	SS	36
			3	SS	86/200mm
			4	SS	37
			5	SS	27
4.0 / 288.4	SILTY SAND TILL: Very dense brown silty sand, some gravel, saturated; occasional cobbles		6	SS	86/275mm
4.9 / 287.5	BOREHOLE TERMINATED AT 4.9 m				

ELEVATION SCALE: 292, 291, 290, 289, 288

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 288.0

Upon Completion of Augering
Free water at 4.4 m
No cave

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 163

17T 554154E 4808516N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Hespeler Road, Southbound Midlane, Lane 1 — ***BORING DATE*** January 21, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 291.54					
	PAVEMENT STRUCTURE: 160 mm asphalt over, 180 mm granular base, moist, over, 580 mm granular subbase, moist		1A, 1B	AS		291
0.92 / 290.62	FILL: Brown sandy silt, some gravel, trace clay, moist, numerous cobbles		2A, 2B	SS	34	
			3	SS	18	290
			4	SS	14	289
			5	SS	24	
						288
			6	SS	37	287
5.0 / 286.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 164

17T 554142E 4808425N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Hespeler Road, Northbound Midshoulder
BORING DATE January 22, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	290.24	SURFACE ELEVATION 290.24				
0.0		PAVEMENT STRUCTURE: 160 mm asphalt over, 180 mm granular base, moist, over, 560 mm granular subbase, moist		1A 1B	AS	
0.90	289.34	FILL: Brown silt, some sand, trace clay, trace gravel, moist		2A 2B	SS	23
1.0				3	SS	43
2.1	288.1	becoming brown sandy silt, trace gravel, trace clay, moist		4	SS	13
3.0				5	SS	19
4.0				6	SS	30
5.0	285.2	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 290, 289, 288, 287, 286

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Flushmount Well Protector Set in Concrete
Bentonite Seal
Filter Sand
5 35 59
Screen

Water Level Readings:

Date	Depth	Elev.
2019-01-22	DRY	----
2019-03-28	DRY	----

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 165

17T 550721E 4808136N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Southbound Midlane, Lane 2 — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 308.24					308
0.0		PAVEMENT STRUCTURE: 140 mm asphalt, over 160 mm granular base, moist, over 320 mm granular subbase, moist					
0.62	307.62	SANDY SILT TILL: Compact to very dense brown sandy silt, some gravel, trace clay, moist		1	SS	24	307
1.0							
2.0				2	SS	77	306
3.0				3	SS	50/125mm	
3.0	305.2	becoming grey		4	SS	79	305
4.0							304
5.0				5	SS	50/125mm	
5.0	303.2	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 166

17T 550716E 4808200N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Northbound Midlane, Left Turn Lane — ***BORING DATE*** January 29, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 309.65					
0.0		PAVEMENT STRUCTURE: 130 mm asphalt, over 230 mm granular base, moist, over 490 mm granular subbase, moist		1A 1B	AS		
0.85	308.80	FILL: Brown silt, some sand, trace clay, trace gravel, occasional cobbles, wet		2	SS	29	309
1.5	308.2	SANDY SILT TILL: Very dense brown sandy silt, some gravel, trace clay, numerous cobbles, moist		3	SS	76	308
				4	SS	50/125mm	307
				5	SS	50/125mm	306
5.0	304.7	BOREHOLE TERMINATED AT 5.0 m		6	SS	50/150mm	305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT — NATURAL MOISTURE CONTENT — LIQUID LIMIT
w_P — w — w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
20 62 18

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 167

17T 550680E 4808294N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Southbound Midshoulder — ***BORING DATE*** February 1, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 309.81				
0.0		PAVEMENT STRUCTURE: 650 mm granular base/subbase, moist				
0.65	309.16	FILL: Brown clayey silt, some sand, trace gravel, moist		1	SS	21
1.0						
				2	SS	46
2.0						
2.3	307.5	SANDY SILT TILL: Very dense brown sandy silt, some gravel, moist		3	SS	84
3.0						
				4	SS	50/100mm
4.0						
5.0				5	SS	50/125mm
5.0	304.8	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 168

17T 550672E 4808368N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Northbound Midlane — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 310.24				
0.0	PAVEMENT STRUCTURE: 145 mm asphalt over 155 mm granular base, moist, over, 300 mm granular subbase, moist		1A / 1B	AS	
0.60 / 309.64	FILL: Brown silty sand, some gravel, moist; occasional cobbles		2	SS	26
1.4 / 308.8	becoming clayey silt, some sand, trace gravel, occasional organic inclusions, wet		3	SS	12
2.1 / 308.1	SANDY SILT TILL: Dense to very dense brown sandy silt, some gravel, moist to wet, occasional cobbles		4	SS	36
			5	SS	63
4.9			6	SS	92/250 mm
305.3	BOREHOLE TERMINATED AT 4.9 m				

ELEVATION SCALE: 310, 309, 308, 307, 306

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 50 100 150 200; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 169

17T 550649E 4808437N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Vondrau Drive Southbound Midlane — ***BORING DATE*** January 31, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	310.51	SURFACE ELEVATION 310.51				
0.0	310.51	PAVEMENT STRUCTURE: 150 mm asphalt over 160 mm granular base, moist, over, 400 mm granular subbase, moist		1A 1B	AS	
0.71	309.80	FILL: Brown sand and gravel, some silt, moist		2	SS	29
1.4	309.1	CLAYEY SILT TILL: Very stiff brown clayey silt, some sand, trace gravel, DTPL		3	SS	16
2.1	308.4	SANDY SILT TILL: Very dense brown sandy silt, some gravel, moist to wet, occasional saturated layers, occasional cobbles		4	SS	21
				5	SS	52
4.7	305.8	BOREHOLE TERMINATED AT 4.7m		6	SS	50/50mm

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 310, 309, 308, 307, 306

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 308.1

Upon Completion of Augering
Free water at 2.4 m
Cave to 3.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 170

17T 551476E 4808203N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Boxwood Drive, Southbound Midshoulder — **BORING DATE** January 25, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 309.28				
0.0		PAVEMENT STRUCTURE: 660 mm granular base/subbase, moist		1A	AS	
				1B		
0.66	308.62	FILL: Dark grey sandy silt, trace gravel, trace clay, organic inclusions, moist		2	SS	28
1.0						
1.5	307.8	SANDY SILT TILL: Dense to very dense brown sandy silt, some gravel, trace clay, occasional cobbles, moist		3	SS	12
2.0				4	SS	20
3.0						
3.0	306.3	becoming saturated		5	SS	44
4.0						
5.0				6	SS	74
5.0	304.3	BOREHOLE TERMINATED AT 5.0 m				
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 305.0

Upon completion of augering
No cave
Free water at 4.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 171

17T 551459E 4808317N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Boxwood Drive, Northbound Midlane — **BORING DATE** January 25, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 312.27				
0.0	PAVEMENT STRUCTURE: 135 mm asphalt, over 595 mm granular base/subbase, moist		1	AS	
0.73 / 311.54	FILL: Brown sandy silt, some gravel, trace clay, occasional cobbles, moist		2	SS	18
1.5 / 310.8	CLAYEY SILT TILL: Very stiff brown clayey silt, some sand, some gravel, APL		3	SS	19
			4	SS	44
3.0 / 309.3	SANDY SILT: Dense brown sandy silt, some gravel, trace clay, occasional cobbles, moist to wet		5	SS	40
4.5 / 307.8	SILT TILL: Very dense brown silt, some sand, trace gravel, saturated		6	SS	61
5.0 / 307.3	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 312, 311, 310, 309, 308

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 307.6

Upon completion of augering
No cave
Free water at 4.7 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 172

17T 551412E 4808458N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Boxwood Drive, Southbound Midlane — ***BORING DATE*** January 25, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 312.78					
0.0		PAVEMENT STRUCTURE: 145 mm asphalt, over 155 mm granular base, moist, over 340 mm granular base, moist		1	AS		
0.64	312.14	FILL: Brown silty sand, moist		2	SS	7	312
1.0				3	SS	7	
2.0							311
2.2	310.6	SANDY SILT TILL: Compact brown sandy silt, some gravel, occasional cobbles, saturated		4	SS	50/125mm	
3.0							310
3.0	309.8	CLAYEY SILT TILL: Very stiff to hard grey clayey silt, some sand, trace gravel, DTPL		5	SS	46	
4.0							309
5.0				6	SS	49	308
5.0	307.8	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 309.4

Upon completion of augering
No cave
Free water at 3.4 m due to seepage from above.

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 173

17T 551399E 4808545N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Boxwood Drive, Northbound Midlane — ***BORING DATE*** January 25, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 311.79					
0.0		PAVEMENT STRUCTURE: 150 mm asphalt, over 80 mm granular base, moist, over 420 mm granular subbase, moist		1A 1B	AS		
0.65	311.14	FILL: Brown sandy silt, some gravel, occasional cobbles, moist		2	SS	20	311
1.4	310.4	SANDY SILT TILL: Compact brown sandy silt, trace gravel, trace clay, moist		3	SS	14	310
2.3	309.5	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, some sand, trace gravel, occasional cobbles, DTPL		4	SS	25	309
3.0	308.8	becoming hard, grey		5	SS	51	308
5.0	306.8	BOREHOLE TERMINATED AT 5.0 m		6	SS	38	307

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 174

17T 551375E 4808622N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Boxwood Drive, Southbound Midlane — ***BORING DATE*** January 25, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 310.72					
0.0 / 310.72	PAVEMENT STRUCTURE: 140 mm asphalt, over 140 mm granular base, moist, over 400 mm granular subbase, moist		1A, 1B	AS		310
0.68 / 310.04	FILL: Brown silt, some sand, trace gravel, trace clay, moist		2	SS	6	
			3	SS	8	309
2.3 / 308.4	SILT TILL: Compact to dense brown silt, some sand, trace gravel, trace clay, moist		4	SS	14	308
3.2 / 307.5	SANDY SILT TILL: Very dense grey sandy silt, some gravel, trace clay, occasional cobbles, moist		5	SS	32	307
5.0 / 305.7	BOREHOLE TERMINATED AT 5.0 m		6	SS	98/250mm	306

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

23 67 10

14 69 18

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 175

17T 552295E 4808216N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Southbound Midlane — ***BORING DATE*** February 20, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Brice

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
0.0	310.45	SURFACE ELEVATION 310.45				
		PAVEMENT STRUCTURE: 60 mm asphalt, over 180 mm granular base, moist, over 860 mm granular subbase, moist		1	AS	
1.1	309.4	FILL: Brown sand, trace silt, trace gravel, moist		2	SS	50/100mm
1.6	308.9	SAND: Compact brown sand, some gravel, trace silt, moist		3	SS	12
				4	SS	17
				5	SS	16
4.5	306.0	becoming saturated		6	SS	12
5.0	305.5	BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 310, 309, 308, 307, 306

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 306.2

Upon completion of augering
Wet cave at 4.3 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 176

17T 552274E 4808325N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Northbound Midshoulder — ***BORING DATE*** February 19, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.86					
0.0	PAVEMENT STRUCTURE: 45 mm asphalt, over 375 mm granular base, moist, over 480 mm granular subbase, moist		1A 1B	AS		
0.90 308.96	FILL: Brown sand, some gravel, trace silt, occasional cobbles, moist		2	SS	11	309
1.3 308.6	SAND: Compact brown sand, trace gravel, trace silt, moist		3	SS	20	308
			4	SS	16	
			5	SS	13	307
3.6 306.3	becoming wet					306
4.5 305.4	becoming saturated		6	SS	14	305
5.0 304.9	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 305.4

Upon completion of augering
Wet cave at 4.5 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 177

17T 552256E 4808372N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Speedsville Road, Southbound Midshoulder — **BORING DATE** February 19, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
0.0	309.27	SURFACE ELEVATION 309.27					309
		PAVEMENT STRUCTURE: 150 mm asphalt, over 370 mm granular base/subbase, moist		1	AS		
0.52	308.75	FILL: Brown sand, some gravel, some silt, moist		2	SS	16	308
1.00	308.27	SAND: Very loose to compact brown sand, some silt, trace gravel, moist		3	SS	5	
				4	SS	9	307
				5	SS	3	306
4.5	304.8	becoming dense, saturated		6	SS	34	305
5.0	304.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Cave at 4.0 m
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 178

17T 552241E 4808458N

PROJECT Maple Grove Road Improvements and Corridor Study
PML REF. 18KF047
LOCATION Speedsville Road, Northbound Midlane
BORING DATE February 19, 2019
ENGINEER W. Loghrin
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 307.42					
0.69	PAVEMENT STRUCTURE: 75 mm asphalt, over 615 mm granular base/subbase, moist		1	AS		
0.90	FILL: Brown sand, some gravel, some silt, damp		2	SS	13	
1.2 306.2	becoming dark brown to black sandy silt, trace gravel, organics, wet					
	SAND: Compact brown sand, some silt, trace gravel, saturated		3	SS	15	
			4	SS	22	
3.0 304.4	SANDY SILT TILL: Very dense grey sandy silt, some gravel, trace clay, occasional cobbles, moist		5	SS	89	
5.0 302.4	BOREHOLE TERMINATED AT 5.0 m		6	SS	80	

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Sampler wet at 1.5 m
▼ El. 305.3

Upon completion of augering
Cave at 2.4 m
Free water at 2.1 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 179

17T 552216E 4808535N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Southbound Midlane — ***BORING DATE*** January 15, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 306.38				
0.0		PAVEMENT STRUCTURE: 60 mm asphalt, over 420 mm granular base/subbase, moist		1	SS	47
0.48	305.90	FILL: Brown sand, some silt, trace gravel, wet		2	SS	7
1.5						
1.7	304.7	SAND: Loose brown sand, some silt, trace gravel, wet to saturated		3	SS	13
		CLAYEY SILT: Very stiff to hard grey clayey silt, some sand, trace gravel, APL to DTPL		4	SS	26
				5	SS	31
5.0	301.4	BOREHOLE TERMINATED AT 5.0 m		6	SS	74/275mm

ELEVATION SCALE: 306, 305, 304, 303, 302

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 304.9

Upon completion of augering
Cave at 1.8 m
Free water at 1.5 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 180

17T 552212E 4808581N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Speedsville Road, Northbound Midshoulder — **BORING DATE** February 22, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 305.83					
0.48 / 305.35	PAVEMENT STRUCTURE: 65 mm asphalt, over 410 mm granular base/subbase, moist					
1.5	FILL: Brown silty sand, trace gravel, moist to wet		1	SS	21	
304.3	SANDY SILT: Loose to compact brown sandy silt, some gravel, wet		2	SS	13	
3.0			3	SS	7	
302.8	SANDY SILT TILL: Dense to very dense brown sandy silt		4	SS	32	
5.0			5	SS	50/100mm	
300.8	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

El. 303.7

Upon completion of augering
Wet cave at 2.1 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 181

17T 552163E 4808772N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Northbound Midlane — ***BORING DATE*** January 15, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 305.99					
0.0		PAVEMENT STRUCTURE: 50 mm asphalt, over 570 mm granular base/subbase, moist		1	SS	50/150mm	
0.62	305.37	FILL: Grey silty sand, trace gravel, trace organics, rootlets, wet		2	SS	18	305
1.0							
1.5	304.5	SANDY SILT: Compact brown and grey mottled sandy silt, trace gravel, trace clay, wet, occasional clayey silt lenses		3	SS	13	304
2.0							
2.3		becoming saturated		4	SS	15	
	303.6	SAND: Compact brown sand, some silt, trace gravel, occasional cobbles, saturated					303
3.0				5	SS	20	
4.0							302
4.6	301.4	SILTY SAND TILL: Dense grey silty sand, some gravel, numerous cobbles, saturated		6	SS	49	
5.0	301.0	BOREHOLE TERMINATED AT 5.0 m					301
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 303.7
Sampler wet from 2.3 m to completion

Upon completion of augering
Cave at 4.3 m
Free water at 4.0 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 182

17T 552142E 4808842N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Southbound Midlane — ***BORING DATE*** January 18, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 306.92					
0.0		PAVEMENT STRUCTURE: 45 mm asphalt over, 495 mm granular base/subbase, moist		1A	AS		
0.54				1B			
0.75	306.17	FILL: Grey sand, some silt, trace gravel, moist		2	SS	24	306
1.0		SILTY SAND: Compact brown silty sand, trace gravel, moist					
1.4	305.5	SILT: Compact brown silt, some sand, trace clay and gravel, wet		3	SS	18	305
2.0							
2.1	304.8	SANDY SILT TILL: Compact to dense brown sandy silt, some gravel, wet; occasional cobbles, occasional gravel layers		4	SS	29	
3.0				5	SS	49	304
4.0	302.9	CLAYEY SILT TILL: Very stiff grey clayey silt, some sand, APL					303
5.0				6	SS	23	302
5.0	301.9	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 183

17T 552127E 4808922N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Northbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 307.66					
0.0		PAVEMENT STRUCTURE: 50 mm asphalt over 250 mm granular base, moist, over, 450 mm granular subbase, moist		1A, 1B	AS		307
0.75	306.91	FILL: Compact brown sand and gravel, trace silt, moist, occasional cobbles		2	SS	23	
1.0							
1.4	306.3	compact dark grey sand, some silt, saturated, occasional rootlets, occasional organic inclusions		3A, 3B	SS	13	306
1.9	305.8	SAND: Compact brown sand, some silt, trace gravel, saturated		4	SS	20	
2.0							305
3.0				5	SS	13	
4.0							304
4.0	303.7	SANDY SILT TILL: Compact grey sandy silt, some clay, trace gravel, saturated		6	SS	17	303
5.0							
5.0	302.7	BOREHOLE TERMINATED AT 5.0 m					
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 305.9

Upon Completion of Augering
Free water at 1.8 m
Cave to 2.1 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 184

17T 552110E 4808973N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Speedsville Road, Southbound Midlane — **BORING DATE** January 18, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 308.16					308
0.0	PAVEMENT STRUCTURE: 95 mm asphalt over, 215 mm granular base, moist, over 390 mm granular subbase, moist		1A, 1B	AS		
0.70						
0.95	FILL: Compact brown sand, some gravel, trace silt, moist, occasional organic inclusions		2A, 2B	SS	21	
307.21						307
1.4						
306.8	TOPSOIL: Compact dark brown silty sand, moist; occasional rootlets		3	SS	5	
	SAND: Loose to compact brown sand, some silt, saturated		4	SS	10	306
			5	SS	11	305
4.0						
304.2	SANDY SILT TILL: Compact grey sandy silt, trace gravel, saturated		6	SS	29	304
5.0						
303.2	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
33 51 16
37 47 16

▼ El. 306.7

Upon Completion of Augering
Free water at 1.5 m
Cave at 2.7 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 185

17T 552093E 4809065N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Speedsville Road, Northbound Partly Paved Shoulder — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES
	SURFACE ELEVATION 309.59				
0.31 / 309.28	PAVEMENT STRUCTURE: 45 mm asphalt over 265 mm granular base/subbase, moist		1A / 1B	AS	
0.70 / 308.89	FILL: Dark grey clayey silt fill, some sand, trace gravel, wet, occasional organics		2	SS	12
1.4 / 308.2	SILTY SAND: Compact brown silty sand, saturated				
	SAND AND GRAVEL: Dense brown sand and gravel, trace silt, saturated		3	SS	33
2.1 / 307.5	SANDY SILT TILL: Dense brown sandy silt, some grave, trace clay, moist to wet, occasional cobbles		4	SS	44
2.9 / 306.7	becoming grey		5	SS	38
4.0 / 305.6	becoming very dense				
4.7 / 304.9	BOREHOLE TERMINATED AT 4.7 m		6	SS	50/75 mm

ELEVATION SCALE: 309, 308, 307, 306, 305

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 308.4

Upon Completion of Augering
Free water at 1.2 m
Cave to 1.2 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 186

17T 552887E 4808649N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Briardean Road, Southbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 310.46					
0.24 310.22	PAVEMENT STRUCTURE: 60 mm asphalt, over 180 mm granular base/subbase, moist		1A 1B	AS		310
	SAND: Compact brown sand, some silt, moist to damp		2	SS	17	
			3	SS	10	309
			4	SS	11	308
			5	SS	16	
4.0 306.5	SANDY SILT TILL: Dense brown sandy silt, some gravel, trace clay, saturated					307
			6	SS	36	306
5.0 305.5	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

17 66 17

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 187

17T 552882E 4808695N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Briardean Road, Northbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 312.13					312
0.28 / 311.85	PAVEMENT STRUCTURE: 45 mm asphalt, over 70 mm granular base/subbase, moist		1A, 1B	AS		
0.65 / 311.48	FILL: Dark brown sandy silt, trace organics, moist		2	SS	12	311
	brown sand, some gravel, trace silt, moist					
	SAND: Compact, brown sand, some silt, moist		3	SS	14	
			4	SS	14	310
			5	SS	15	309
4.0 / 308.1	SANDY SILT TILL: Compact brown sandy silt, some gravel, moist, occasional cobbles		6	SS	27	308
5.0 / 307.1	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 188

17T 552866E 4808764N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Briardean Road, Southbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 312.92					
0.28	PAVEMENT STRUCTURE: 105 mm asphalt, moist, over 175 mm granular base/subbase, moist		1A, 1B, 1C	AS		
0.55 / 312.37	FILL: Dark grey clayey silt, some sand, wet, occasional organics becoming brown sandy silt, trace to some gravel, some clay, moist, occasional cobbles		2	SS	10	312
			3	SS	11	311
2.1 / 310.8	SANDY SILT TILL: Dense to very dense brown sandy silt, some sand, trace gravel, saturated		4	SS	18	310
			5	SS	36	309
			6	SS	73	308
5.0 / 307.9	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 308.7

Upon Completion of Augering
Free water at 4.2 m
No cave

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 189

17T 552859E 4808807N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Briardean Road, Northbound Midlane — ***BORING DATE*** February 7, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Solid Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 312.61					
0.29 / 312.32	PAVEMENT STRUCTURE: 85 mm asphalt, over 205 mm granular base/subbase, moist		1A / 1B	AS		312
0.65 / 311.96	FILL: Brown clayey silt, some sand, trace gravel, wet		2	SS	7	
	becoming brown sandy silt, some clay, trace gravel, wet, occasional cobbles		3	SS	9	311
2.1 / 310.5	SANDY SILT TILL: Dense to very dense sandy silt, some gravel, moist, numerous cobbles		4	SS	39	310
			5	SS	77/175mm	309
4.8 / 307.8	BOREHOLE TERMINATED AT 4.8 m		6	SS	82/275mm	308

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

26 61 12

Upon Completion of Augering
Free water at 4.2 m
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 190

17T 553783E 4808922N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Breaverdale Road, Northbound Midlane — **BORING DATE** January 17, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 311.74						SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER O Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80; PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30 40		
0.0	PAVEMENT STRUCTURE: 170 mm asphalt, over 160 mm granular base, moist, over 870 mm granular subbase, moist		1A	AS					
			1B						
1.0			2	SS	24	311			
1.2									
310.5	SILTY SAND: Compact brown silty sand, some gravel, moist; occasional cobbles								
2.0			3	SS	11	310			
			4	SS	11				
2.9						309			
308.8	SAND AND GRAVEL: Compact to dense brown sand and gravel, trace silt, moist; numerous cobbles								
3.0			5	SS	23				
4.0						308			
			6	SS	35	307			
5.0									
5.0									
306.7	BOREHOLE TERMINATED AT 5.0 m								Upon Completion of Augering No free water No cave
6.0									
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									
14.0									
15.0									

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 191

17T 553761E 4808997N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Southbound Midlane — ***BORING DATE*** January 17, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 313.43					
0.0		PAVEMENT STRUCTURE: 160 mm asphalt, over 270 mm granular base, moist, over 220 mm granular subbase, moist		1A 1B	AS		313
0.65	312.78	SANDY SILT: Compact brown sandy silt, some gravel, trace clay, moist, occasional cobbles		2	SS	15	
1.4	312.0	SAND AND GRAVEL: Dense brown sand and gravel, trace silt, moist to damp; numerous cobbles		3	SS	36	312
2.1	311.3	becoming very dense		4	SS	79	311
3.0				5	SS	50/275mm	
4.0							310
4.7				6A 6B	SS	76	309
5.0	308.4	SILT TILL: Very dense brown silt, some sand, moist BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL
31 62 7
23 44 33

Upon Completion of Augering
No free water
Cave to 3.6 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 192

17T 553749E 4809064N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Northbound Midlane — ***BORING DATE*** January 18, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 312.60					
0.0		PAVEMENT STRUCTURE: 155 mm asphalt, over 145 mm granular base, moist, over 310 mm granular subbase, moist		1A 1B	AS		312
0.61	311.99	FILL: Brown sand, trace silt, trace gravel, moist; occasional coal fragments		2	SS	8	
1.0				3	SS	13	311
2.1	310.5	SAND: Compact brown sand, some silt, some gravel, damp, occasional cobbles		4	SS	20	
2.0							310
2.9	309.7	SANDY SILT: Dense brown sandy silt, some gravel, trace clay, moist, occasional cobbles		5A 5B	SS	36	
3.0							309
3.2	309.4	SAND: Dense brown sand, some silt, trace gravel, damp					
4.0	308.6	SANDY SILT TILL: Very dense brown sandy silt, trace gravel, moist		6	SS	62	308
5.0							
5.0	307.6	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

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

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon Completion of Augering
No free water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 193

17T 553723E 4809147N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Breaverdale Road, Southbound Midlane — **BORING DATE** January 18, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 309.84									
0.0		PAVEMENT STRUCTURE: 190 mm asphalt over, 270 mm granular base, moist, over, 740 mm granular subbase, moist		1A	AS						
				1B							
				2	SS	50/50mm	309				
1.0											
1.2	308.6	SILTY SAND: Loose brown silty sand, trace gravel, damp		3	SS	6	308				
2.0											
				4	SS	7					
2.9	306.9	SAND AND GRAVEL: Compact brown sand and gravel, some silt, saturated, occasional cobbles					307				
3.0				5	SS	19					
4.0	305.8	SANDY SILT TILL: Dense brown sandy silt, trace gravel, saturated					306				
				6	SS	33	305				
5.0	304.8	BOREHOLE TERMINATED AT 5.0 m									Upon Completion of Augering Free water at 3.3 m No cave
6.0											
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											
14.0											
15.0											

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; 50 100 150 200; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%): 10 20 30 40

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 194

17T 553711E 4809208N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Northbound Midlane, Left Turn Lane — ***BORING DATE*** February 1, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** D. Patterson

DEPTH / ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 308.39					
0.0	PAVEMENT STRUCTURE: 165 mm asphalt, over 280 mm granular base, moist, over 500 mm granular subbase, moist		1	SS	50/75mm	308
0.95 / 307.44	FILL: Brown sand, some silt, trace gravel, moist		2	SS	74	
1.5 / 306.9	SILTY SAND: Loose dark brown silty sand, some gravel, damp		3	SS	8	307
2.3 / 306.1	SAND: Compact brown sand, some silt, trace gravel, wet		4	SS	25	306
			5	SS	29	
3.8 / 304.6	becoming saturated		6	SS	14	305
5.0			7	SS	19	304
303.4	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 304.7

Upon completion of augering
Wet cave at 3.7 m

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 195

17T 553688E 4809303N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Breaverdale Road, Southbound Midlane, Left Turn Lane — **BORING DATE** February 1, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.71					
0.0	PAVEMENT STRUCTURE: 255 mm asphalt, over 435 mm granular base, moist, over 510 mm granular subbase, moist		1	SS	50/100mm	
			2	SS	8	309
1.2						
1.5	FILL: Brown sand, some silt, trace gravel, moist					
308.2	SILTY SAND: Compact dark brown silty sand, moist		3	SS	18	308
2.3						
307.4	GRAVELLY SAND: Compact brown gravelly sand, some silt, moist		4	SS	12	307
			5	SS	17	
3.8						306
305.9	SILTY SAND TILL: Compact brown silty sand, wet		6	SS	23	
			7	SS	24	305
5.0						
304.7	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

▼ El. 306.0

Upon completion of augering
Cave at 3.7 m
No free water

NOTES

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 196

17T 553680E 4809349N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Northbound Midlane — ***BORING DATE*** January 16, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	310.23	SURFACE ELEVATION 310.23					
0.0		PAVEMENT STRUCTURE: 120 mm asphalt, over 220 mm granular base, moist, over 400 mm granular subbase, moist		1A 1B	AS		310
0.74	309.49	SANDY SILT TILL: Compact brown sandy silt, some gravel, trace clay, wet		2	SS	17	309
1.5	308.7	becoming dense, saturated		3	SS	37	308
				4	SS	39	
				5	SS	44	307
							306
5.0	305.2	BOREHOLE TERMINATED AT 5.0 m		6	SS	47	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 197

17T 553654E 4809437N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Southbound Midlane — ***BORING DATE*** January 16, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.27					
0.0	PAVEMENT STRUCTURE: 130 mm asphalt, over 350 mm granular base, moist, over 490 mm granular subbase, moist		1A 1B	SS		309
0.97 308.2	FILL: Brown sand, some gravel, some silt, occasional cobbles, moist		2A 2B	SS	21	
	becoming dark grey sandy silt, trace gravel, organics, wet		3	SS	7	308
2.3 307.0	SANDY SILT: Loose brown sandy silt, some gravel, trace clay, wet		4	SS	11	307
3.0 306.3	becoming saturated		5	SS	3*	306
4.5 304.8	SILT TILL: Dense grey silt, some sand, trace gravel, trace clay, saturated		6	SS	40	305
5.0 304.3	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Sampler wet from 2.3 m to completion

▼ El. 305.3

Upon completion of augering
No cave
Free water at 4.0 m

NOTES * Low N value due to hydraulic disturbance

▼ GROUND WATER STRIKE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 198

17T 553643E 4809511N

PROJECT Maple Grove Road Improvements and Corridor Study — **PML REF.** 18KF047

LOCATION Breaverdale Road, Northbound Midlane — **BORING DATE** January 16, 2019 — **ENGINEER** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Pettitt

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 309.40					
0.0 / 309.40	PAVEMENT STRUCTURE: 110 mm asphalt, over 160 mm granular base, moist, over 460 mm granular subbase, moist		1A, 1B	AS		309
0.73 / 308.67	FILL: Grey silty sand, trace gravel, moist		2	SS	16	
1.5 / 307.9	SILT: Loose brown silt, some sand, trace gravel, wet		3	SS	8	308
2.3 / 307.1	becoming compact, saturated		4	SS	13	307
			5	SS	10	306
4.6 / 304.8	CLAYEY SILT: Stiff to firm grey clayey silt, some sand, APL to WTPL		6	SS	4	305
5.0 / 304.4	BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No cave
No free water

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 199

17T 553624E 4809568N

PROJECT Maple Grove Road Improvements and Corridor Study — ***PML REF.*** 18KF047

LOCATION Breaverdale Road, Southbound Midlane — ***BORING DATE*** January 16, 2019 — ***ENGINEER*** W. Loghrin

BORING METHOD Continuous Flight Hollow Stem Augers — ***TECHNICIAN*** K. Pettitt

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	309.86	SURFACE ELEVATION 309.86					
0.0	309.86	PAVEMENT STRUCTURE: 125 mm asphalt, over 145 mm granular base, moist, over 180 mm granular subbase, moist		1	SS	50/100mm	
0.45	309.41	SANDY SILT: Compact brown sandy silt, trace gravel, damp		2	SS	10	309
1.0							
1.5	308.4	becoming loose, saturated		3	SS	6	308
2.0				4	SS	8	
3.0	306.9	occasional clayey silt lenses		5	SS	8	307
4.0							306
5.0	304.9	BOREHOLE TERMINATED AT 5.0 m		6	SS	9	305
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Cave at 3.7 m
No free water

NOTES

APPENDIX A

Site Physiographic, Geologic and Hydrogeologic Settings

Reference:
- Image from OGSEarth, Physiography of Southern Ontario, Chapman, L.J., and Putnam, D.F. 2007.

THE REGIONAL MUNICIPALITY OF WATERLOO

HYDROGEOLOGICAL SITE ASSESSMENT FOR PROPOSED MAPLE GROVE ROAD IMPROVEMENTS, CAMBRIDGE, ONTARIO

ONTARIO GEOLOGICAL SURVEY PHYSIOGRAPHIC REGION MAP

Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	CHECKED:	APPROVED:	DATE	SCALE	JOB NO.	FIGURE NO.
A.C.	A.C.	S.T.	JUL. 2019	AS SHOWN	18KX004	1

Reference:
- Image from OGSEarth, Physiography of Southern Ontario, Chapman, L.J., and Putnam, D.F. 2007.

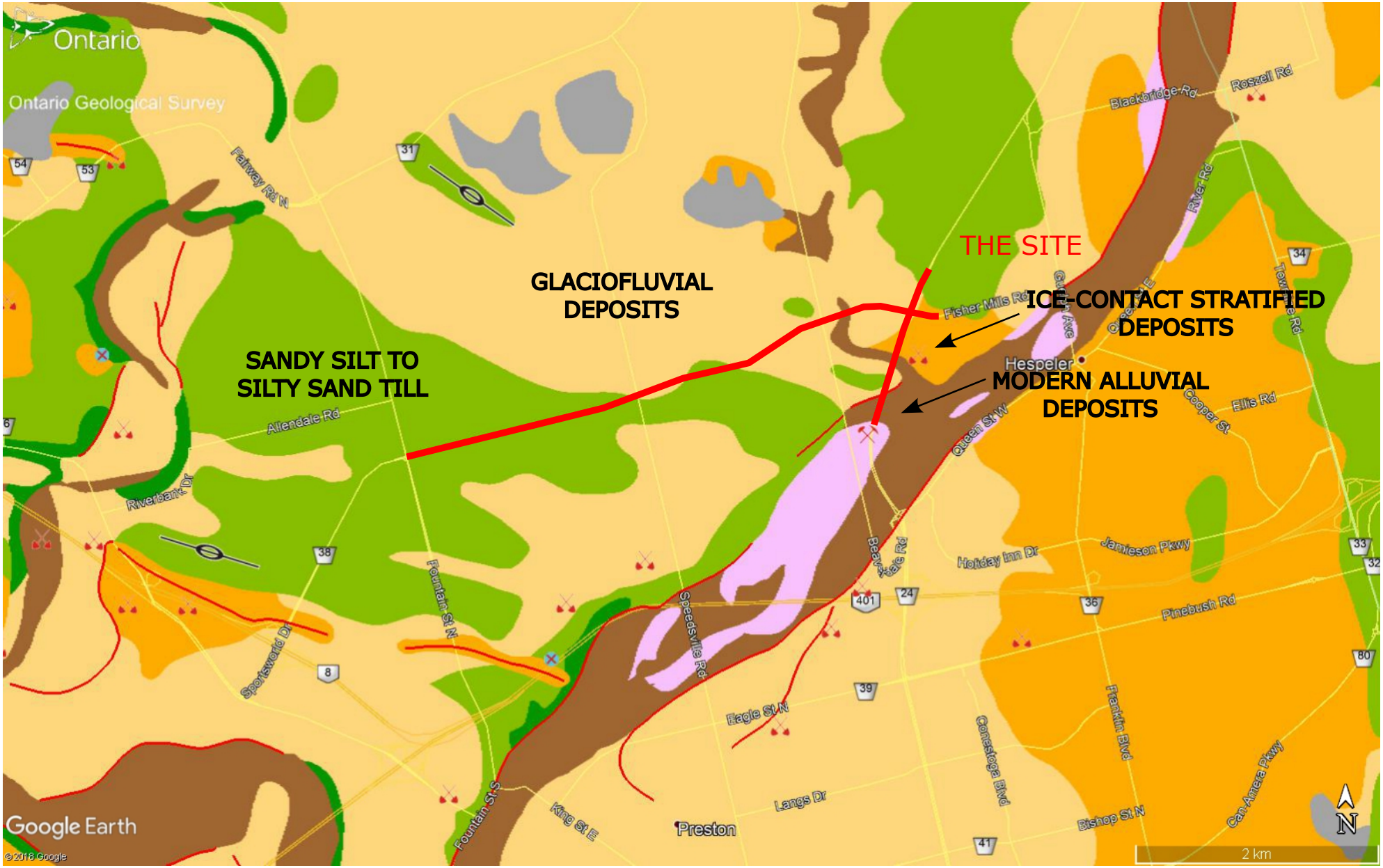
THE REGIONAL MUNICIPALITY OF WATERLOO

HYDROGEOLOGICAL SITE ASSESSMENT FOR PROPOSED MAPLE GROVE ROAD IMPROVEMENTS, CAMBRIDGE, ONTARIO

ONTARIO GEOLOGICAL SURVEY PHYSIOGRAPHIC LANDFORM MAP

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	DATE	SCALE	JOB NO.	FIGURE NO.
A.C.				
CHECKED: A.C.	JUL. 2019	AS SHOWN	18KX004	2
APPROVED: S.T.				



Reference:
- Image from OGSEarth, Surficial Geology of Southern Ontario, Chapman, OGS Survey, 2010.

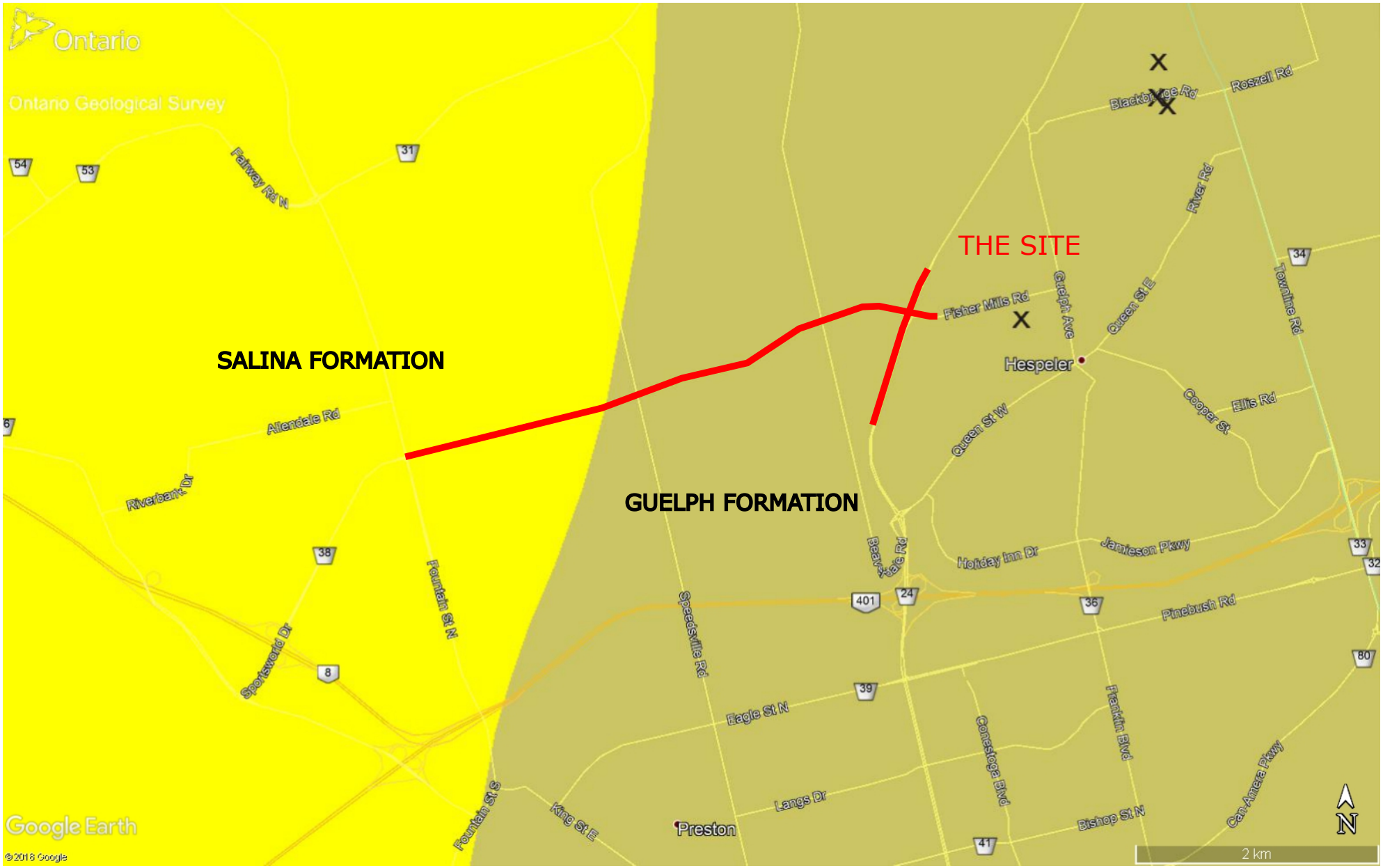
THE REGIONAL MUNICIPALITY OF WATERLOO

HYDROGEOLOGICAL SITE ASSESSMENT FOR PROPOSED MAPLE GROVE ROAD IMPROVEMENTS, CAMBRIDGE, ONTARIO

ONTARIO GEOLOGICAL SURVEY SURFICIAL GEOLOGY MAP

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	CHECKED:	APPROVED:	DATE	SCALE	JOB NO.	FIGURE NO.
A.C.	A.C.	S.T.	JUL. 2019	AS SHOWN	18KX004	3



Reference:
- Image from OGSEarth, Paleozoic Geology of Southern Ontario, Armstrong and Dodge, 2007.

THE REGIONAL MUNICIPALITY OF WATERLOO

HYDROGEOLOGICAL SITE ASSESSMENT FOR PROPOSED MAPLE GROVE ROAD IMPROVEMENTS, CAMBRIDGE, ONTARIO

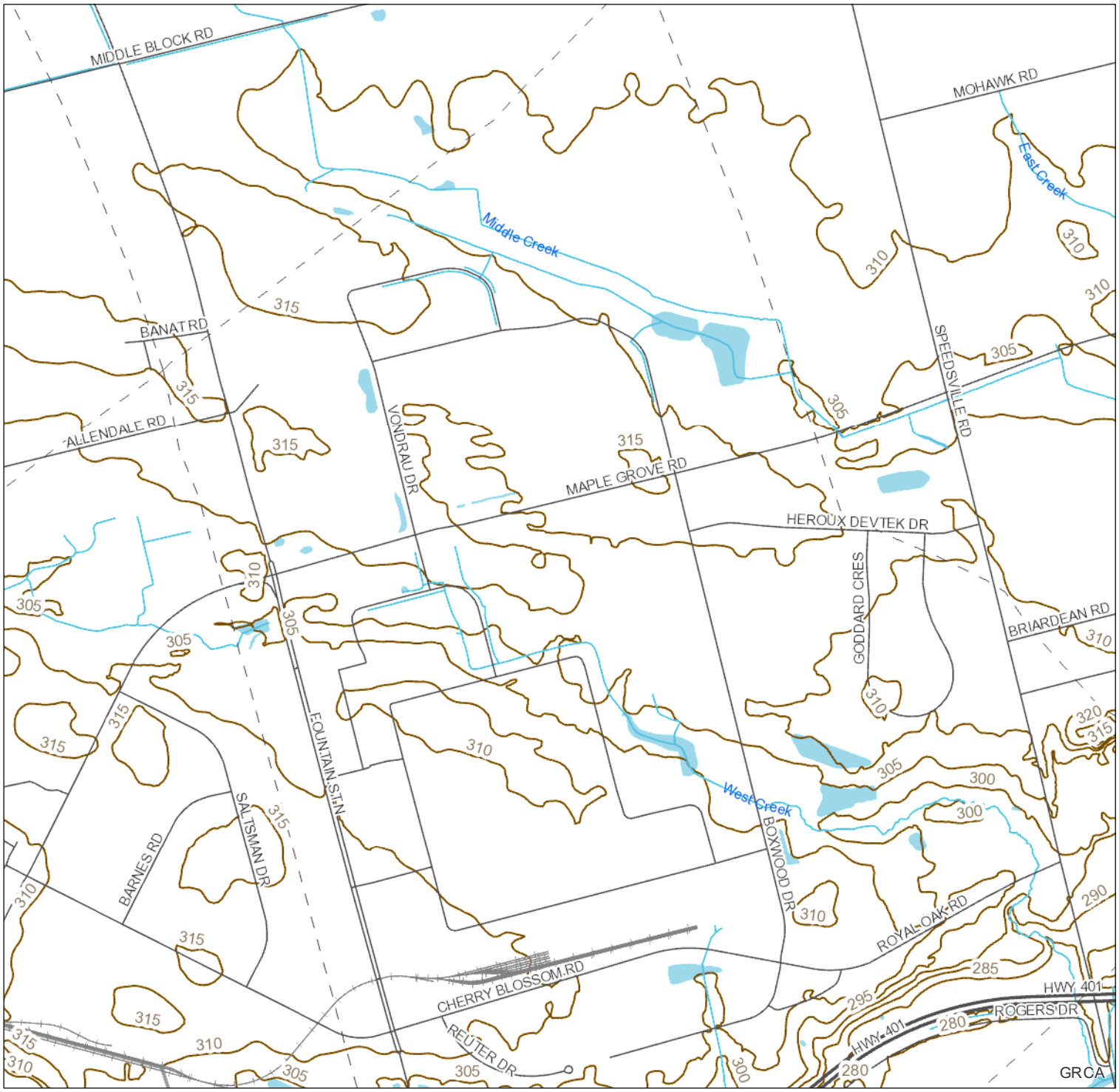
ONTARIO GEOLOGICAL SURVEY BEDROCK GEOLOGY MAP

Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	DATE	SCALE	JOB NO.	FIGURE NO.
A.C.	JUL. 2019	AS SHOWN	18KX004	4
CHECKED: A.C.				
APPROVED: S.T.				

APPENDIX B

Grand River Conservation Authority (GRCA) Maps



Grand River Conservation Authority

Date: Jul 04, 2019

Maple Grove Improvements

Topographical Contour Map (Part 1)

Legend

- Municipal Boundary (GRCA)
- Watercourse - Local (GRCA)
- Contour 5m (ON)
- Park - Local (GRCA)
- Waterbody - Local (GRCA)
- Great Lakes - Local (GRCA)

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The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to: https://maps.grandriver.ca/Sources-and-Citations.pdf

0 95 190 380 570 Metres

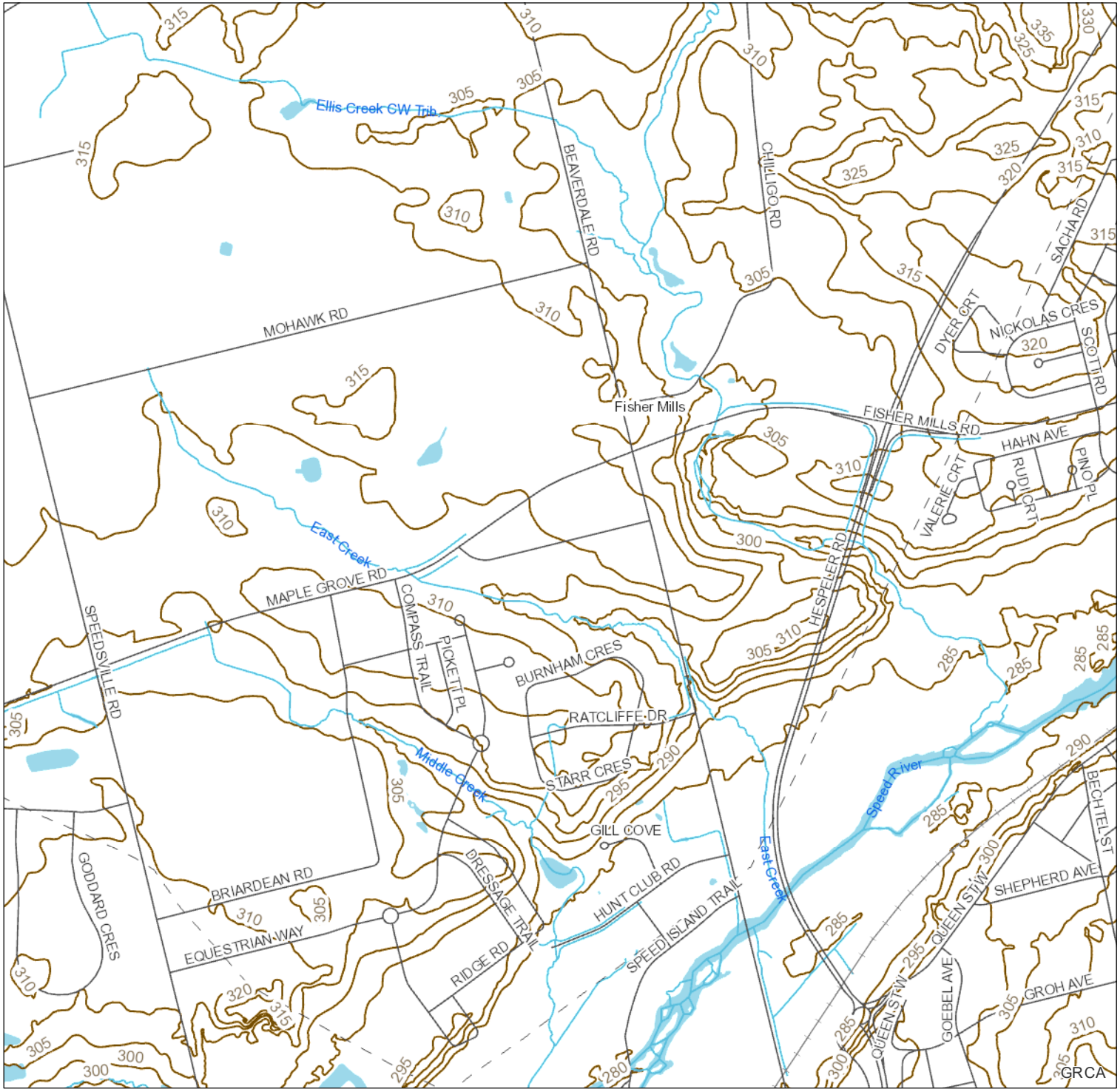
N

Map Centre (UTM NAD83 z17): 551,105.02 4,808,214.55

This map is not to be used for navigation

NAD 1983 UTM Zone 17N

Scale: 15,706



Grand River Conservation Authority

Date: Jul 04, 2019

Maple Grove Improvements

Topographical Contour Map (Part 2)

Legend

- Municipal Boundary (GRCA)
- Watercourse - Local (GRCA)
- Contour 5m (ON)
- Park - Local (GRCA)
- Waterbody - Local (GRCA)
- Great Lakes - Local (GRCA)

Copyright Grand River Conservation Authority, 2019.
Disclaimer: This map is for illustrative purposes only. Information contained herein is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.
The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to: https://maps.grandriver.ca/Sources-and-Citations.pdf

0 95 190 380 570 Metres

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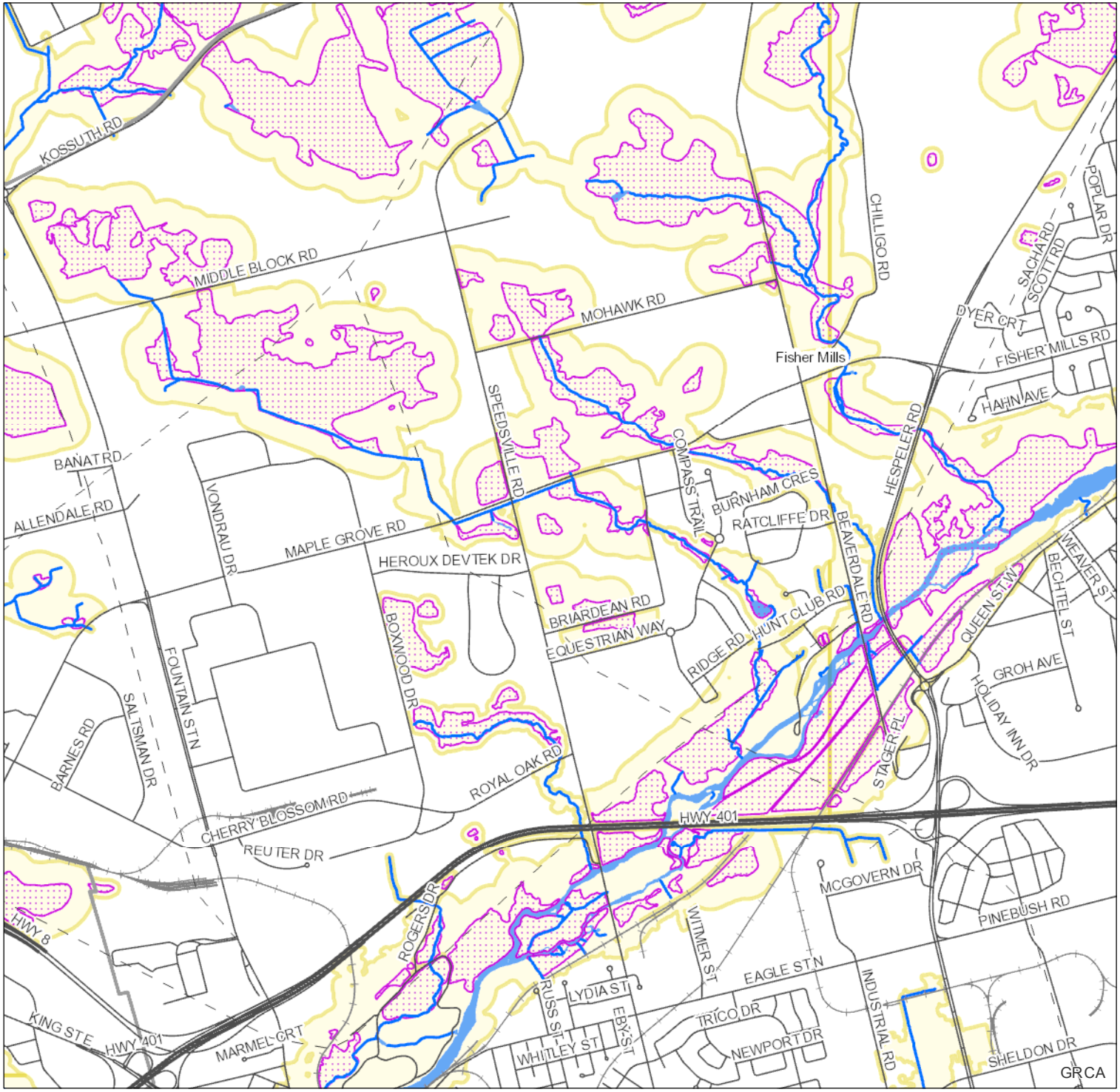
This map is not to be used for navigation

NAD 1983 UTM Zone 17N

Scale: 15,706



Map Centre (UTM NAD83 z17): 552,446.71 4,808,406.94

This map is not to be used for navigation

Grand River Conservation Authority

Date: Jun 06, 2019

Maple Grove Road

Regulated Watercourses and Wetlands

Legend

- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

This legend is static and may not fully reflect the layers shown on the map. The text of Ontario Regulation 150/06 supercedes the mapping as represented by these layers.

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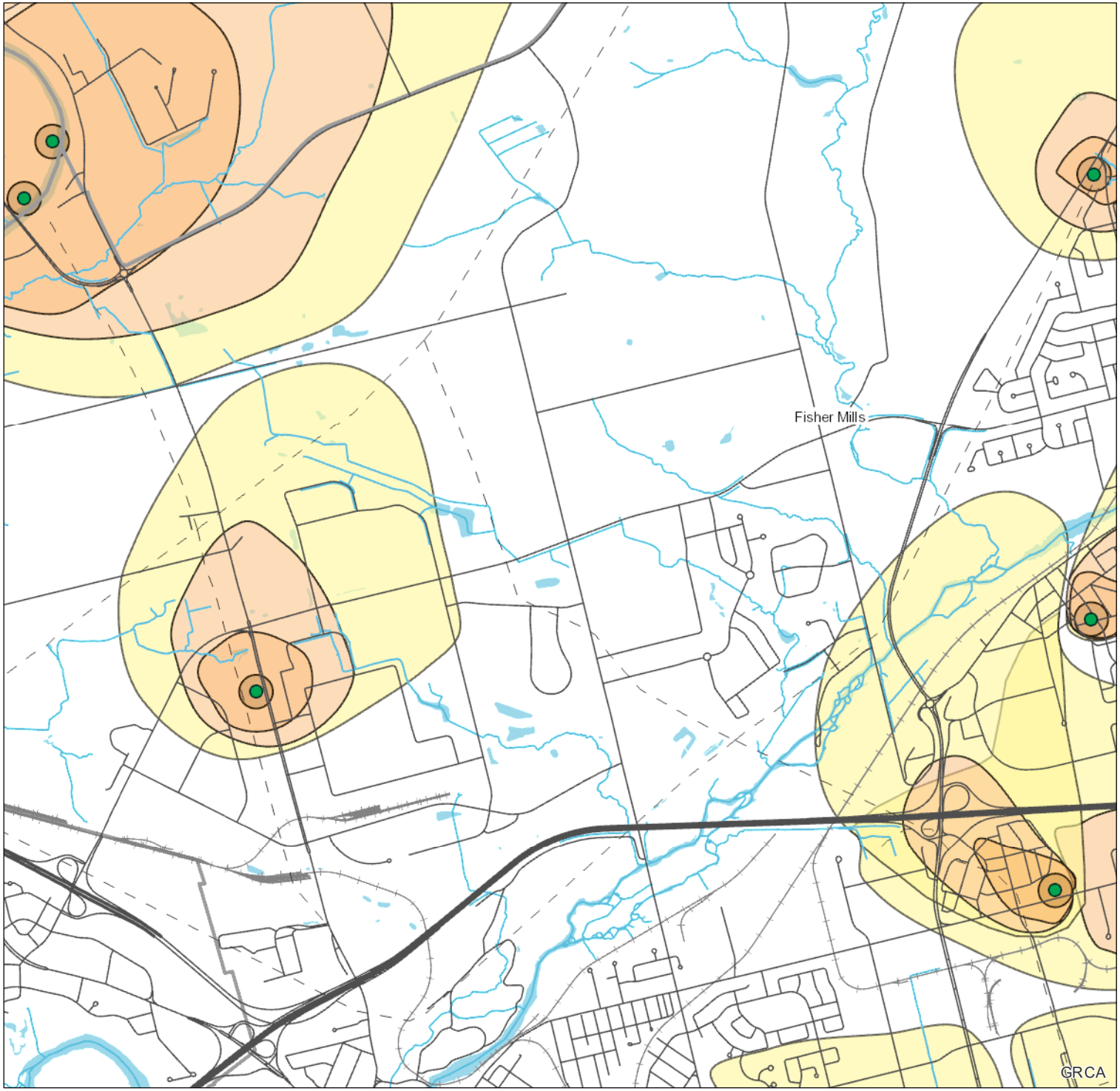
The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to: https://maps.grandriver.ca/Sources-and-Citations.pdf

0 175 350 700 1,050 Metres

N

NAD 1983 UTM Zone 17N

Scale: 29,087



Grand River Conservation Authority

Date: Jul 02, 2019

Maple Grove Reconstruction

Wellhead Protection Areas

Legend

- Municipal Well (GRCA)
- Municipal Boundary (GRCA)
- Watercourse - Local (GRCA)

WHPA-Wellhead Protection Area (GRCA)

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D
- Park - Local (GRCA)
- Waterbody - Local (GRCA)
- Great Lakes - Local (GRCA)

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The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to: https://maps.grandriver.ca/Sources-and-Citations.pdf

0 200 400 800 1,200 Metres

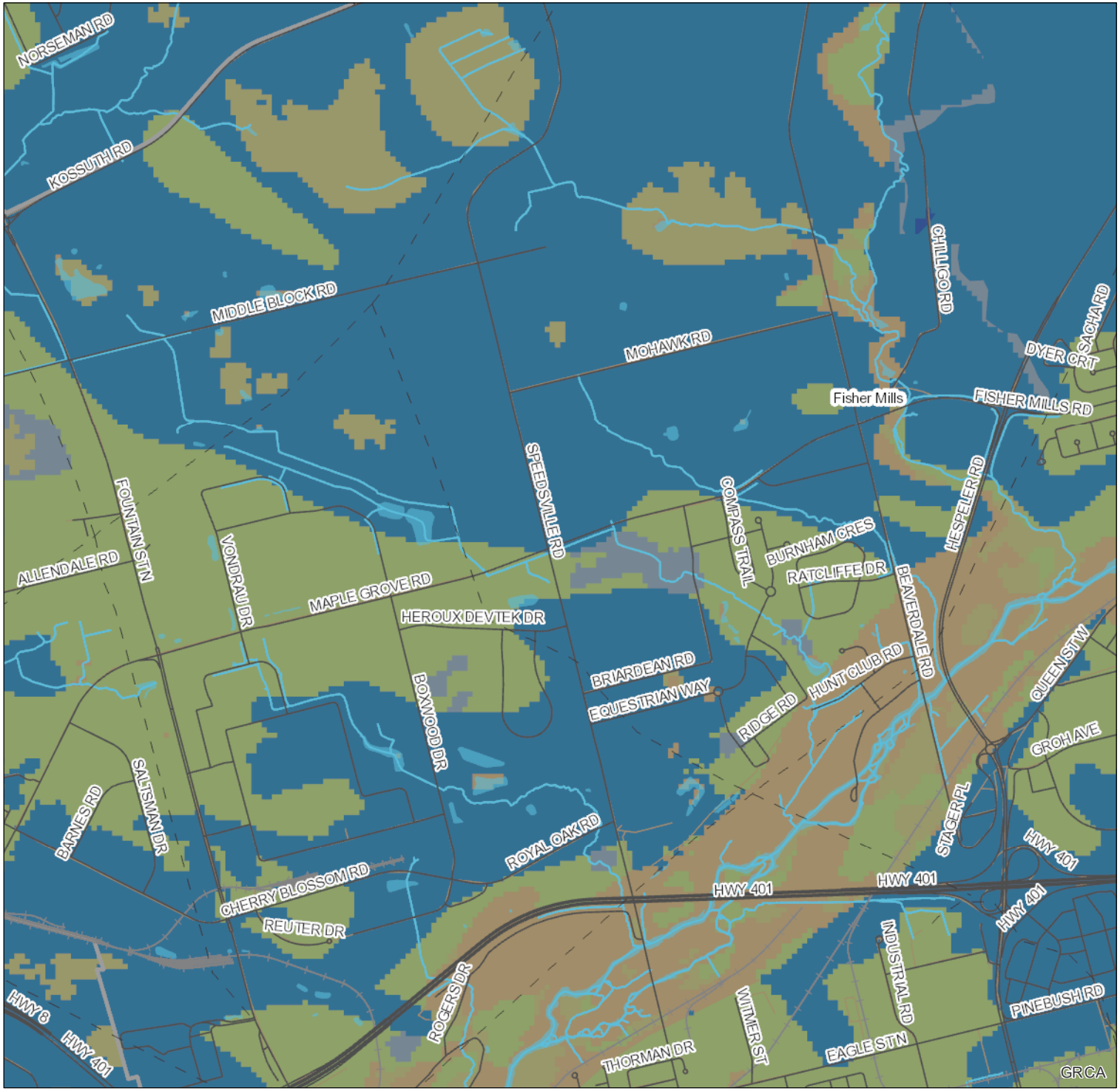
N

Map Centre (UTM NAD83 z17): 552,146.29 4,808,620.36

This map is not to be used for navigation

NAD 1983 UTM Zone 17N

Scale: 33,246



Map Centre (UTM NAD83 z17): 552,251.63 4,808,667.82

This map is not to be used for navigation

Grand River Conservation Authority

Date: Jul 15, 2019

Maple Grove Road Reconstruction

Average Annual Recharge

Legend

- Municipal Boundary (GRCA)
- Watercourse - Local (GRCA)
- Park - Local (GRCA)
- Waterbody - Local (GRCA)

Average Annual Recharge (GRCA)

- less than 50 mm/yr
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- > 400
- Great Lakes - Local (GRCA)

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Disclaimer: This map is for illustrative purposes only. Information contained herein is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.
The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to: https://maps.grandriver.ca/Sources-and-Citations.pdf

0 165 330 660 990 Metres

N

NAD 1983 UTM Zone 17N

Scale: 27,174

APPENDIX C

MECP Water Well Records and Map

NOTES:
- THIS FIGURE WAS REPRODUCED FROM THE MECP WATER WELL MAPPING WEBSITE.
- WHITE NUMBERS ARE ASSIGNED BY PML TO WELLS WITHIN OR CLOSE TO THE ESTIMATED DEWATERING ZONE OF INFLUENCE AND CORRESPOND TO ATTACHED WELL RECORD SUMMARY LIST.

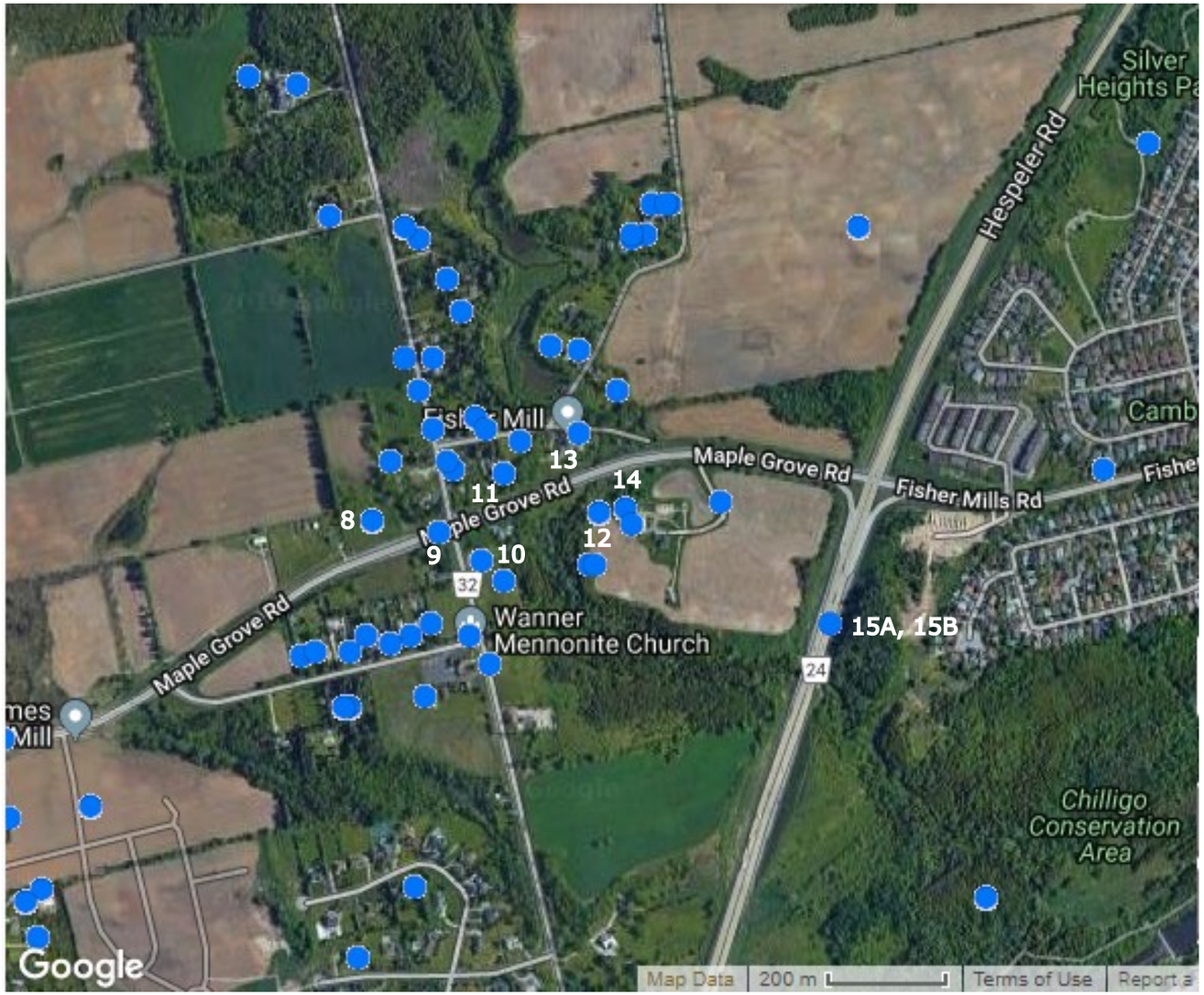
THE REGIONAL MUNICIPALITY OF WATERLOO

HYDROGEOLOGICAL SITE ASSESSMENT FOR PROPOSED MAPLE GROVE ROAD IMPROVEMENTS, CAMBRIDGE, ONTARIO

MECP-RECORDED WATER WELL LOCATION MAP (PART 1)

Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	CHECKED:	APPROVED:	DATE	SCALE	JOB NO.	FIGURE NO.
A.C.	A.C.	S.T.	JUL. 2019	AS SHOWN	18KX004	1



NOTES:
- THIS FIGURE WAS REPRODUCED FROM THE MECP WATER WELL MAPPING WEBSITE.
- WHITE NUMBERS ARE ASSIGNED BY PML TO WELLS WITHIN OR CLOSE TO THE ESTIMATED DEWATERING ZONE OF INFLUENCE AND CORRESPOND TO ATTACHED WELL RECORD SUMMARY LIST.

THE REGIONAL MUNICIPALITY OF WATERLOO					
HYDROGEOLOGICAL SITE ASSESSMENT FOR PROPOSED MAPLE GROVE ROAD IMPROVEMENTS, CAMBRIDGE, ONTARIO					
MECP-RECORDED WATER WELL LOCATION MAP (PART 2)	DRAWN: **A.C.**	DATE	SCALE	JOB NO.	FIGURE NO.
	CHECKED: **A.C.**	**JUL. 2019**	**AS SHOWN**	**18Kx004**	**2**
	APPROVED: **S.T.**				

Peto MacCallum Ltd. CONSULTING ENGINEERS

MECP WELL RECORD TABLE ABBREVIATIONS AND DESCRIPTIONS

Header Descriptions

ABBREVIATION	DESCRIPTION
UTM	UTM in Zone, Easting, Northing and Datum is NAD83
LOT	UTM estimated from Centroid of Lot
W	UTM not from Lot Centroid
DATE CNTR	Date Work Completed and Well Contractor Licence Number
CASING DIA	Casing diameter in inches
WATER	Unit of Depth in Feet. See below for Meaning of Code
PUMP TEST	Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour:Minutes
WELL USE	See below for Meaning of Code
SCREEN	Screen Depth and Length in feet
WELL	Well ID, AUDIT #, Well Tag, A for abandonment; P for Partial Data Entry Only
FORMATION	See below for Meaning of Code

Meaning of Core Material and Descriptive Terms

ABBV	DESCRIPTION	ABBV	DESCRIPTION	ABBV	DESCRIPTION	ABBV	DESCRIPTION
CLN	CLEAN	FILL	FILL	MARL	MARL	SILT	SILT
DRY	DRY	FLDS	FELDSPAR	MGRD	MEDIUM-GRAINED	SLTE	SLATE
QTZ	QUARTZ	FLNT	FLINT	MGVL	MEDIUM GRAVEL	SLTY	SILTY
BLDR	BOULDERS	FOSS	FOSILIFEROUS	MRBL	MARBLE	SNDS	SANDSTONE
BSLT	BASALT	FSND	FINE SAND	MSND	MEDIUM SAND	SNDY	SAN DY
CGRD	COARSE-GRAINED	GNIS	GNEISS	MUCK	MUCK	SOFT	SOFT
CGVL	COARSE GRAVEL	GRNT	GRANITE	OBDN	OVERBURDEN	SPST	SOAPSTONE
CHRT	CHERT	GRSN	GREENSTONE	PCKD	PACKED	STKY	STICKY
CLAY	CLAY	GRVL	GRAVEL	PEAT	PEAT	STNS	STONES
CLYY	CLAYEY	GRWK	GREYWACKE	PGVL	PEA GRAVEL	STNY	STONEY
CMTD	CEMENTED	GVLY	GRAVELLY	PORS	POROUS	THIK	THICK
CONG	CONGLOMERATE	GYPS	GYPSUM	PRDG	PREVIOUSLY DUG	THIN	THIN
CRYS	CRYSTALLINE	HARD	HARD	PRDR	PREV. DRILLED	TILL	TILL
CSND	COARSE SAND	HPAN	HARDPAN	QRTZ	QUARTZITE	UNKN	UNKNOWN TYPE
DKCL	DARK-COLOURED	IRFM	IRON FORMATION	QSND	QUICKSAND	VERY	VERY
DLMT	DOLOMITE	LIMY	LIMY	ROCK	ROCK	WBRG	WATER-BEARING
DNSE	DENSE	LMSN	LIMESTONE	SAND	SAND	WDFR	WOOD FRAGMENTS
DRTY	DIRTY	LOAM	TOPSOIL	SHLE	SHALE	WTHD	WEATHERED
FCRD	FRACTURED	LOOS	LOOSE	SHLY	SHALY		
FGRD	FINE-GRAINED	LTCL	LIGHT-COLOURED	SHRP	SHARP		
FGVL	FINE GRAVEL	LYRD	LAYERED	SHST	SCHIST		

Core Color

ABBV	DESCRIPTION
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLC K	BLACK
BLGY	BLUE-GREY

Well Use

ABBV	DESCRIPTION
DO	Domestic
ST	Livestock
IR	Irrigation
IN	Industrial
CO	Commercial
MN	Municipal
PS	Public
AC	Cooling And AC
NU	Not Used
OT	Other
TH	Test Hole
DE	Dewatering
MO	Monitoring
MT	Monitoring and Test Hole

Water Kind

ABBV	DESCRIPTION
FR	Fresh
SA	Salty
SU	Sulphur
MN	Minerial
UK	Not Stated
GS	Gas
IR	Iron
UT	Untested
OT	Other

MECP WELL RECORD SUMMARY

Maple Grove Road Improvements

Summarized well records of wells within UTM Easting +/- 500 m and UTM Northing +/- 500 m of project limits

PML Number	UTM ZONE	UTM EASTING	UTM NORTHING	LOT	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
	17	549992	4808771	W	2017/08 7554	6		//10/:			7293962 (Z249046) A124085	
	17	554274	4808092	W	2017/05 6875						7289059 (Z259176) A107440 A	
	17	554276	4808073	W	2017/05 6875						7289055 (Z259175) A081358 A	
	17	554267	4808074	W	2017/05 6875						7289056 (Z259177) A219050 A	
	17	554231	4808403	W	2017/05 6875						7289058 (Z259179) A109351 A	
	17	554232	4808045	W	2017/05 6875						7289057 (Z259178) A078479 A	
	17	554275	4808071	W	2017/05 6875						7289054 (Z259185) A219049 A	
	17	549807	4808536	W	2017/04 7556	2.41	UT 0400	225/268/7/1:0	DO		7289407 (Z254600) A213743	BRWN LOAM 0003 YLLW CLAY STNS SNDY 0190 GREY CLAY STNS BLDR 0381 GREY GRVL 0400
	17	554165	4807730	W	2016/11 7241	2			OT	0004 5	7276802 (Z209884) A	
	17	551150	4807859	W	2016/10 7320						7275827 (Z243931) A	
	17	551050	4807846	W	2016/10 7320						7275825 (Z243932) A035893 A	
	17	551082	4807808	W	2016/10 7320						7275826 (Z243930) A	
	17	554381	4808019	W	2016/07 7238	2				0010 10	7269317 (Z232812) A202874	FILL BLDR 0005 BLDR SAND WBRG 0015 ROCK 0020
	17	551069	4807818	W	2016/06 7472	2			MO	0020 10	7269366 (Z239785) A206236	
	17	551149	4807859	W	2016/06 7472	2			MO	0025 10	7269365 (Z239786) A206237	
	17	553002	4808634	W	2015/11 7385	6.25	80	28/34/15/1:0	CO		7253745 (Z221369) A194131	BRWN SAND STNS 0020 GREY CLAY STNS 0075 BRWN GRVL SAND 0080
	17	554599	4807768	W	2015/10 7190	2	34		MO	0020 10	7254448 (Z202411) A187143	BRWN CSND GRVL DNSE 0010 BRWN SILT SAND TILL 0025 GREY SILT SAND TILL 0035 GREY LMSN ROCK WTHD 0036
	17	552289	4808414	W	2015/07 6607						7249895 (C27568) A179846 P	
	17	552403	4807935	W	2015/05 6607						7249858 (C25946) A157138 P	
	17	552383	4808034	W	2015/05 6607						7249864 (C25935) A179944 P	
	17	553041	4807752	W	2015/05 6607						7249827 (C22168) A175312 P	
	17	552404	4807956	W	2015/05 6607	5.09	6		MO	0004 10	7249812 (Z169926) A157137	SILT SAND GRVL 0004 SAND SILT GRVL 0012 SILT CLAY GRVL 0014
4	17	551647	4808419	W	2014/10 7385						7231632 (Z189655) A159750	
	17	550280	4808233	W	2014/08 6607						7234611 (C24002) A146721 P	
	17	551589	4808307	W	2014/07 7148						7223747 (Z190618) A	
	17	554154	4807852	W	2014/06 7221	0.79			MO		7223165 (Z188887) A	
	17	554105	4807835	W	2014/06 7221	0.79			MO		7223162 (Z188889) A	
	17	554224	4807897	W	2014/06 7221	0.79			MO		7223169 (Z188893) A	
	17	554199	4807851	W	2014/06 7221	0.79			MO		7223166 (Z188886) A	
	17	554252	4807907	W	2014/06 7221	0.79			MO		7223168 (Z188892) A	
	17	554248	4807875	W	2014/06 7221	0.79			MO		7223167 (Z188885) A	
	17	554160	4808004	W	2014/06 7221	0.79			MO		7223174 (Z188881) A	
	17	554189	4807914	W	2014/06 7221	0.79			MO		7223160 (Z188891) A	
	17	554121	4807915	W	2014/06 7221	0.79			MO		7223161 (Z188890) A	
	17	554067	4807909	W	2014/06 7221	0.79			MO		7223163 (Z188880) A	
	17	554132	4807982	W	2014/06 7221	0.79			MO		7223171 (Z188895) A	
	17	554158	4808004	W	2014/06 7221	0.79			MO		7223172 (Z188884) A	
	17	554184	4807924	W	2014/06 7221	0.79			MO		7223170 (Z188894) A	
	17	554084	4807900	W	2014/06 7221	0.79			MO		7223164 (Z188888) A	
	17	550346	4807767	W	2014/04 7238						7220583 (Z178731) A	
	17	554942	4807682	W	2014/04 6032						7220324 (C24575) A138156 P	
3	17	551579	4808417	W	2014/03 7215						7221371 (C24752) A159750 P	
	17	550313	4807710	W	2014/02 7238						7220567 (Z178661) A007293 A	
	17	553938	4809194	W	2014/01 6607	2	2		MT	0005 5	7221777 (Z162586) A157171	BRWN SAND WBRG 0008 BRWN SILT CLAY 0010
	17	554196	4807756	W	2013/07 7472	2.04			MO	0008 2	7211001 (Z179065) A153521	BRWN SAND GRVL 0010
	17	554196	4807756	W	2013/07 7472	2.04			MO	0008 2	7210995 (Z179063) A153520	BRWN SAND GRVL 0010
	17	554151	4807669	W	2013/07 7472	2.04			MO	0008 2	7210996 (Z179064) A153519	BRWN SAND GRVL 0010
	17	551389	4808160	W	2013/06 7320	2			MO	0009 10	7204921 (Z170689) A147595	BLCK LOAM 0001 BRWN SAND GRVL 0007 BRWN SAND SILT STNS 0017 GREY SAND GRVL 0019
	17	551145	4808065	W	2013/06 7320				MO		7204920 (Z170688) A	
	17	553079	4808776	W	2013/05 6607						7204033 (C20857) A141585 P	
	17	551840	4807800	W	2013/04 7238						7200369 (Z167329) A	
	17	552089	4808414	W	2013/04 7238						7200373 (Z167322) A	
	17	552175	4808346	W	2013/04 7238						7200371 (Z167327) A	
	17	552018	4808445	W	2013/04 7238						7200372 (Z167323) A	
	17	551697	4808201	W	2013/04 7238						7200370 (Z167328) A	
	17	552124	4809202	W	2012/10 2644	6 6	FR 0120 FR 0125	31/100/25/1:30	DO		7194228 (Z157491) A129797	BRWN SAND 0012 GREY CLAY STNS 0041 GREY CLAY 0110 GREY LMSN 0125
	17	553523	4808945	W	2012/09 7385	6.11	FR 0065	31/37/10/1:0	DO		7189274 (Z158669) A136318	BRWN SAND 0015 BRWN CLAY GRVL 0040 GREY CLAY GRVL 0045 GREY CLAY 0060 BRWN GRVL SAND CGRD 0065
	17	554980	4807949	W	2012/08 7464	1.57			NU	0006 10	7190395 (Z157973) A131634	BRWN SAND SILT CLAY 0009 BRWN SAND GRVL 0014 BRWN SILT SAND STNS 0016
	17	554980	4807950	W	2012/08 7238	2	UT 0030		MO	0030 10	7186724 (Z155381) A135541	BLCK LOAM 0002 BRWN TILL STNS 0030 BRWN SILT 0040
	17	552533	4807942	W	2012/07 6607						7189056 (C19019) A126265 P	
15A	17	554347	4809098	W	2012/06 7472				MO		7185909 (Z151849) A120094 A	
	17	554161	4809303	W	2012/06 6607						7210113 (C16730) A126179 P	
	17	554512	4807702	W	2012/05 7238	2			TH	0032 10	7184564 (Z146736) A102186	BRWN FILL SAND SOFT 0005 BRWN STNS STNS LYRD 0035 BRWN CLAY GRVL HARD 0038 GREY SAND SOFT 0042
1	17	551145	4808389	W	2012/04 7385				NU		7180761 (Z145536) A	

MECP WELL RECORD SUMMARY

Maple Grove Road Improvements

Summarized well records of wells within UTM Easting +/- 500 m and UTM Northing +/- 500 m of project limits

PML Number	UTM ZONE	UTM EASTING	UTM NORTHING	LOT	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
	17	554923	4807667	W	2012/01 7282						7189020 (C17016) A120809 P	
	17	553982	4809494	W	2011/12 7416	6.61	FR 0047 FR 0078 FR 0118	14/28/38/1:	DO	0045 3	7173732 (Z117364) A098181	BRWN SAND GRVL LOOS 0006 BRWN CLAY STNS DNSE 0014 BRWN GRVL PCKD 0028 GREY CLAY DNSE 0035 GREY GRVL SAND DNSE 0043 BRWN LMSN FCRD 0048 GREY LMSN 0128
	17	553553	4809068	W	2011/10 7385	6.11	FR 0079	49/54/10/1:	DO		7171436 (Z139284) A114520	BRWN CLAY SAND GRVL 0022 GREY CLAY 0073 BRWN CLAY SAND GRVL 0076 BRWN CSND CGVL 0079
15B	17	554348	4809102	W	2011/09 7238	2.13			MO	0008 5	7169178 (Z135857) A120094	BRWN STNS SAND SILT 0012
	17	551022	4808527	W	2011/08 7464						7177199 (M10666) A117074 P	
	17	550720	4808399	W	2011/08 7302						7168392 (Z139291) A	
	17	550886	4808570	W	2011/08 7302						7168393 (Z139292) A	
	17	554288	4808002	W	2011/08 7238						7169677 (Z135826) A078478 A	
	17	554352	4807992	W	2011/08 7238						7169680 (Z135823) A	
	17	554321	4808028	W	2011/08 7238						7169678 (Z135827) A081359 A	
	17	554340	4807995	W	2011/08 7238						7169676 (Z135824) A	
	17	554320	4807972	W	2011/08 7238						7169679 (Z135825) A	
	17	554327	4808111	W	2011/03 7238	2	UT 0003		MO	0015 5	7160738 (Z129136) A109352	BRWN SAND GRVL 0008 GREY LMSN 0020
	17	554278	4808094	W	2011/03 7238	2	UT 0003		MO	0000 20	7160737 (Z129137) A107440	BRWN SAND GRVL 0005 GREY LMSN 0020
	17	554224	4808046	W	2011/03 7238	2	UT 0003		MO	0013 7	7160736 (Z129134) A109351	BRWN SAND GRVL 0008 GREY LMSN 0020
	17	554324	4808113	W	2011/03 7238	2	UT 0003		MO	0023 7	7160739 (Z129135) A107439	BRWN SAND GRVL 0010 GREY LMSN 0030
	17	550795	4808368	W	2010/12 7366						7157764 (M04778) A097876	
	17	549958	4808712	W	2010/11 7385	6.11	FR 0138	84/85/10/1:0	DO		7156257 (Z115526) A102256	BRWN CLAY STNS 0020 GREY CLAY GRVL 0025 GREY CLAY 0100 GREY CLAY GRVL 0130 GREY GRVL SAND CSND 0138
	17	554591	4807821	W	2010/11 6607						7167770 (M07401) A110414 P	
	17	550795	4808368	W	2010/10 7366	1.5			MO		7153406 (M04832) A097876	BRWN FILL GRVL DNSE 0003 BRWN SILT DNSE 0012 GREY CLAY SILT DNSE 0020
	17	554288	4807939	W	2010/09 7238						7152209 (Z121792) A	8
7	17	552932	4808890	W	2010/06 6607	2	15		MO		7149416 (M06645) A092263	BRWN SILT LOAM 0002 GREY SILT GRVL 0011 GREY GRVL SILT 0020
	17	555005	4807785	W	2010/05 7320	2.00 2.00			TH		7145952 (M05096) A097502	BLCK LOAM 0001 BRWN SAND STNS 0006 BRWN SAND SILT STNS 0012 BRWN SAND DNSE 0014 BRWN SAND 0019 BRWN SILT STNS DNSE 0029 BRWN SILT DNSE 0034
	17	554869	4807743	W	2010/05 6607	1.25	20		NU		7151816 (M06622) A094872	
	17	554928	4807647	W	2010/03 7238	1.97			MO		7143391 (M06024) A094242	BRWN SAND STNS SILT 0041 BRWN SILT STNS SAND 0050
	17	554367	4808001	W	2010/01 7238						7158267 (Z124127) A	
	17	550045	4809221	W	2009/09 6607		9				7131438 (M05650) A	
6	17	552839	4808876	W	2009/08 6607		UK 0007		NU		7128513 (M04555) A	
	17	552010	4809231	W	2009/07 7407	6			DO		7126675 (Z52949) A	
	17	554340	4808005	W	2009/07 6607	1.25	UK 0005		MO	0020 16	7130837 (Z101293) A088212	BRWN SILT SAND GRVL 0005 BRWN SAND GRVL SILT 0008 GREY DLMT ROCK 0036
	17	554322	4807979	W	2009/07 6607	1.25	UK 0005		MO	0017 15	7130839 (Z101292) A088214	BRWN SAND SILT GRVL 0006 GREY DLMT ROCK 0032
	17	554368	4808000	W	2009/07 6607	1.25	UK 0005		MO	0013 5	7130838 (Z101291) A088213	BRWN SILT SAND GRVL 0005 GREY DLMT ROCK 0018
	17	554316	4808094	W	2008/12 6607	2	3		MO	0005 2	7117002 (Z86849) A081356	BRWN SILT LOAM FILL 0000 BRWN SAND 0006 GREY STNS ROCK 0008
	17	554275	4808093	W	2008/12 6607	1.25	3		MO	0005 5	7117000 (Z86848) A081358	BRWN SILT LOAM 0000 BRWN SILT SAND GRVL 0004 BRWN SILT LOAM 0005 GREY STNS ROCK 0010
	17	554347	4808052	W	2008/12 6607	1.97	5		MO	0006 2	7116998 (Z86921) A081357	BRWN SILT LOAM 0000 BRWN SAND 0006 BRWN SAND GRVL 0008 GREY STNS ROCK 0009
	17	554311	4808024	W	2008/12 6607	2	5		MT	0005 5	7117350 (Z86847) A081359	BRWN SILT LOAM FILL 0000 BRWN SAND SILT GRVL 0005 BRWN SAND SILT 0008 GREY DLMT ROCK 0010
	17	554353	4808000	W	2008/12 6607	1.25	5		MO	0006 5	7117348 (Z86913) A081360	BRWN SILT LOAM FILL 0001 BRWN SILT SAND FILL 0004 BRWN SILT LOAM 0006 GREY DLMT ROCK 0011
	17	554283	4808006	W	2008/11 6607	1.25	5		MO	0012 5	7116984 (Z86858) A078478	BRWN SILT LOAM FILL 0000 BLCK SAND SILT FILL 0004 BLCK PEAT 0005 GREY SAND 0007 GREY ROCK 0017
	17	554249	4808029	W	2008/11 6607	1.25	5		MO	0006 5	7116980 (Z86850) A078480	BRWN SILT LOAM FILL 0000 BRWN SILT SAND GRVL 0002 GREY FILL 0005 BRWN SAND SILT 0005 GREY ROCK 0010
	17	554230	4808050	W	2008/11 6607	1.25	UT 0005		MO	0006 5	7116981 (Z86851) A078479	BRWN SILT LOAM FILL 0000 BRWN SILT SAND GRVL 0004 GREY STNS ROCK 0010
	17	549852	4809625	W	2008/06 7320	2	FR 0004		TH		7106211 (Z61920) A067671	BRWN GRVL 0001 BRWN SAND FILL 0004 BRWN SAND WBRG 0014 BRWN SILT CLAY 0015
	17	549827	4809627	W	2008/06 7320	2	FR 0004		TH		7106212 (Z61919) A067672	BRWN GRVL 0001 BRWN SAND FILL 0004 BRWN SAND WBRG 0014 BRWN SILT CLAY 0015
	17	554741	4807993	W	2008/06 7320						7112300 (M01847) A067664 A	
	17	554741	4807993	W	2008/04 7320	1.5	FR 0015		TH	0015 5	7105680 (M01824) A067664	BRWN GRVL SAND 0002 BRWN SAND 0015 BRWN SAND GRVL 0020
	17	554636	4807703	W	2007/11 7238	2			NU	0004 10	7052928 (Z72689) A059392	BRWN FILL SAND DRY 0003 BRWN SAND CLAY 0013
	17	552151	4808322	W	2007/11 7190	2				0015 5	7053870 (Z54308) A047941	GREY SAND GRVL 0020
5	17	552316	4808700	W	2007/11 6032	1.97			NU	0005 10	7054193 (Z66328) A005269	BRWN SAND GRVL 0010 GREY ROCK 0015
	17	552521	4808259	W	2006/12 1737	6			NU	0037 3	7042095 (Z54497) A044537	BRWN CSND 0015 BRWN CLAY SAND STNY 0021 GREY CLAY STNS HARD 0036 GREY CLAY HARD 0040
	17	552491	4808313	W	2006/11 1737	6			NU	0037 3	7042092 (Z54491) A044538	BRWN SAND GRVL 0014 BRWN CLAY STNS 0023 GREY SAND GRVL 0029 GREY CLAY HARD 0040
	17	553385	4807773	W	2006/11 1737	6			NU		7042094 (Z54493) A044540	BRWN LMSN HARD 0025
	17	549891	4808605	W	2006/06 1737	6	FR 0134	78/18/15/1:0	DO	0132 3	6510911 (Z46411) A037487	BRWN CLAY SNDY 0007 GREY GRVL 0017 GREY CLAY STNS 0125 GREY GRVL 0135
	17	554689	4807800	W	2006/03 6607	2	FR 0010			0010 10	6510550 (Z44191) A037785	BRWN SAND GRVL 0005 GREY SAND 0020
	17	554708	4807791	W	2006/03 6607	2	15			0010 10	6510579 (Z44238) A041036	BRWN SAND GRVL 0005 BRWN SAND SILT 0015 BRWN SAND SILT WBRG 0020
	17	550307	4807980	W	2006/02 6809	2 2				0102 20	6510554 (Z39555) A030191	SILT SNDY 0020 GREY CLAY SILT 0025 SAND 0050 BRWN SAND GRVL 0060 GREY SILT SNDY CLAY 0100 GREY GRVL 0125 BRWN FSND SLTY 0126 ROCK 0128
	17	554677	4807765	W	2006/02 6607	2	10			0010 10	6510510 (Z42269) A037836	BRWN GRVL 0003 BRWN SAND 0010 BRWN SAND STNS WBRG 0020
	17	554623	4807828	W	2006/01 7282	2.06			NU	0009 6	6510497 (Z40815) A036959	BLCK 0000 BRWN GRVL SAND LOAM 0020 BRWN SAND GRVL SOFT 0023
	17	550324	4807730	W	2006/01 6809	2				0010 10	6510555 (Z39558) A030192	BRWN CLAY GRVL 0008 BRWN CLAY SAND GRVL 0011 SAND GRVL 0018 SILT GRVL 0020
	17	554602	4807852	W	2006/01 6607	1.97	13			0010 10	6510502 (Z42247) A037829	BLCK GRVL 0003 BRWN SAND SILT 0010 BRWN SILT SAND 0015 BRWN SILT SAND WBRG 0020
	17	550055	4807761	W	2005/12 6607	1.97	10			0005 10	6510924 (Z42203) A036852 A	BRWN FILL 0005 BRWN SAND SILT 0010 SAND SILT WBRG 0015
	17	550137	4807766	W	2005/12 6607	1.97	10			0035 5	6510457 (Z42202) A036834	BRWN STNS SAND 0005 BRWN SAND SILT WBRG 0030 GREY TILL HARD 0040
	17	554700	4807871	W	2005/10 7238	1.97			NU	0010 10	6510327 (Z39684) A031813	SILT GRVL 0007 TILL SILT 0020

MECP WELL RECORD SUMMARY

Maple Grove Road Improvements

Summarized well records of wells within UTM Easting +/- 500 m and UTM Northing +/- 500 m of project limits

PML Number	UTM ZONE	UTM EASTING	UTM NORTHING	LOT	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
	17	553635	4808643	W	2005/07 2663	6.25	FR 0203	60/97/20/1:	DO		6510179 (Z28974) A017779	LOAM 0002 BRWN CLAY STNS 0070 BRWN LMSN 0203
	17	550940	4807705	W	2005/01 7238	1.97			NU	0025 10	6510462 (Z34428) A035840	BRWN SAND SILT GRVL 0015 GREY SILT CLAY GRVL 0034
	17	550423	4807846	W	2004/09 6607	1.97	FR 0010			0005 10	6509860 (Z17106) A015719	BRWN SAND 0010 SAND SILT 0013 SILT SAND 0015
	17	552825	4807920	W	2004/09 1737						6509979 (Z11664)	
	17	552852	4807914	W	2004/09 1737	6	FR 0155	110/113//1:	DO		6509978 (Z11663) A011590	BRWN SAND SILT 0015 GREY CLAY 0065 GREY STNS 0108 GREY LMSN 0155
	17	554009	4807979	W	2004/02 7238	0.98	FR 0013		NU	0036 10	6509604 (Z09023) A008954	BRWN CSND CGVL DNSE 0013 GREY LMSN 0023 WHIT LMSN 0046
	17	550403	4807681	W	2004/01 6607	1.97	FR 0007			0011 5	6509714 (Z07549) A007293	BRWN SAND SILT 0004 BRWN SILT SAND TILL 0007 BRWN SAND SILT 0008 BRWN SILT TILL SAND 0016
	17	554394	4809774	L	2003/07 4005	6	UK 0075 UK 0094	16/60/20/1:0	DO		6509428 (258655)	BRWN CLAY SNDY 0004 BRWN SAND GRVL STNS 0009 BRWN LMSN 0075 GREY LMSN 0100
	17	549898	4807731	L	2003/04 6974				DO		6509346 (258791) A	
	17	551113	4809621	L	2003/04 6974				ST		6509347 (258792) A	
	17	554643	4807663	W	2002/12 7190	1.92				0007 6	6510459 (Z31452) A029356	BRWN SAND FILL LOOS 0010 BRWN SAND DNSE 0014
	17	552800	4807700	W	2002/12 7177				NU		6509329 (247649) A	
	17	554030	4809822	W	2000/06 2663				DO		6508676 (220549) A	
	17	554064	4809816	W	2000/05 2663	6.25 6.25	FR 0100 FR 0122	22/85/20/1:	DO		6508677 (220548)	LOAM 0003 BRWN SAND 0042 BRWN CLAY STNS 0054 GREY LMSN 0115 GREY LMSN 0122
	17	554055	4809819	W	2000/05 2663	6.25 6.25			DO		6508678 (220547) A	
	17	553543	4808521	W	1999/08 1737	6 6	FR 0121 FR 0249	63/165/30/2:30	DO ST		6508484 (209329)	BRWN CLAY SILT SOFT 0018 BRWN CLAY SNDY 0028 BRWN MGVL 0041 GREY MSND SILT 0067 GREY CLAY SILT 0075 GREY CLAY STNS 0075 BRWN LMSN SOFT 0095 BRWN LMSN 0255
	17	552084	4809830	W	1999/03 4207	6.25	FR 0148	38/140/100/1:0	DO		6508481 (201131)	BRWN SAND 0005 GREY CLAY SAND SILT 0121 GREY SAND SILT 0135 GREY GRVL CLAY 0146 GREY CGVL 0147
2	17	551186	4808418	W	1999/03 1737	10 10	FR 0144 FR 0435	64/131/450/72:	IR		6508443 (200720)	BRWN SILT SNDY SOFT 0024 GREY TILL HARD 0078 GREY GRVL SAND SILT 0090 GREY GRVL TILL BLDR 0108 GREY TILL HARD 0121 GREY LMSN SHLE SOFT 0142 BRWN LMSN HARD 0354 GREY LMSN HARD 0407 BRWN LMSN HARD 0432 GREY LMSN HARD 0455
	17	552000	4809222	W	1998/10 2336	6	FR 0102	28/37/20/1:0	DO		6508287 (191795)	BRWN SAND GRVL 0018 GREY CLAY STNS 0098 GREY CSND CGVL 0102
13	17	553912	4809413	W	1997/09 3518	6.25	FR 0025	8/12/15/1:0	DO		6508167 (119032)	BRWN CLAY STNS HARD 0007 GREY CLAY STNS HARD 0020 BRWN GRVL CGRD LOOS 0025
	17	552330	4807992	W	1997/08 2336	6	FR 0095	60/61/12/1:0	DO		6508140 (184431)	BRWN CLAY STNS 0015 GREY CLAY STNS 0093 GREY GRVL CGRD 0095
	17	553917	4809555	W	1996/04 1737	6 6	FR 0093	12/35/15/2:0	DO		6507908 (146314)	BRWN SAND SOFT 0005 BRWN TILL SAND SOFT 0018 BRWN GRVL STNS LOOS 0041 GREY LMSN HARD 0095
	17	549894	4808625	W	1995/12 3518	6	FR 0135	83/90/15/1:0	DO		6507900 (105042)	BRWN CLAY STNS LOOS 0012 GREY CLAY STNS HARD 0115 GREY SILT STNS LYRD 0133 BRWN GRVL LOOS 0135
	17	550972	4809774	W	1995/12 2336	6	FR 0110	60/79/20/1:0	DO ST		6507901 (166988)	PRDG 0012 BRWN SAND 0018 GREY CLAY STNS 0100 BRWN SAND 0110 BRWN CGVL 0110
	17	549844	4808550	W	1995/09 3518	6	FR 0122	85/95/10/1:0	DO		6507786 (165516)	BRWN SAND STNS LOOS 0015 GREY STNS BLDR CLAY 0119 BRWN GRVL LOOS 0122
	17	549869	4808621	W	1995/07 3518	6	FR 0115	80/90/10/1:0	DO		6507785 (133696)	BRWN SAND STNS BLDR 0042 GREY CLAY STNS HARD 0110 BRWN GRVL LOOS 0115
8	17	553562	4809272	W	1994/07 2663	6 6	FR 0099 FR 0123	57/100/20/1:0	DO		6507640 (141428)	LOAM 0001 BRWN SAND 0005 BRWN CLAY SAND GRVL 0025 BRWN CLAY HPAN 0050 BRWN CLAY SNDY GRVL 0093 GREY LMSN FCRD 0097 GREY LMSN 0123
	17	553998	4809746	W	1994/05 2663	6 6	FR 0060 FR 0083 FR 0093 FR 0103	15/15/20/1:0	DO		6507605 (141403)	BRWN FSND 0022 GREY CLAY GRVL 0030 GREY CLAY HPAN 0040 GRVL SAND SOFT 0048 GREY LMSN 0055 UNKN 0103
	17	555002	4809722	W	1994/03 4207	6	FR 0119	80/119/30/1:0	DO		6507648 (124761)	BRWN SAND 0025 BRWN SAND GRVL 0039 GREY CLAY 0105 GREY CLAY GRVL 0117 GREY GRVL 0119
	17	553901	4808355	W	1993/09 3317	6 6	FR 0097	12/60/9/1:30	DO		6507590 (128307)	LOAM 0001 BRWN CLAY STNS 0002 BRWN LMSN 0050 GREY LMSN 0065 BRWN LMSN 0088 GREY LMSN 0109
	17	553077	4808390	L	1993/06 4207						6507546 (124218)	
	17	553077	4808390	L	1993/06 4207	6	FR 0067	14/65/15/1:0	DO		6507519 (124266)	BRWN CLAY GRVL 0050 BRWN CLAY 0063 BRWN GRVL 0067
	17	553077	4808390	L	1993/06 4207	6	FR 0092	27/90/15/23:0	DO		6507520 (093911)	BRWN CLAY GRVL 0061 BRWN CLAY 0078 BRWN GRVL SILT 0090 BRWN GRVL 0092
	17	553077	4808390	L	1993/06 4207	6	FR 0067	16/65/15/1:0	DO		6507518 (124267)	BRWN CLAY GRVL 0052 BRWN CLAY 0065 BRWN GRVL 0067
	17	553077	4808390	L	1993/05 1737	6 6	FR 0154	46/95/20/1:30	DO		6507457 (122470)	LOAM 0001 BRWN SAND CLAY SOFT 0009 GREY CLAY HARD 0014 BRWN SAND CGVL CLAY 0029 GREY CLAY HARD 0056 GREY HPAN GVLY HARD 0062 BRWN LMSN HARD 0083 GREY LMSN HARD 0203 BRWN LMSN MGRD HARD 0249 BLUE LMSN MGRD 0255
	17	553441	4809035	W	1992/10 4552	7 6	FR 0110 FR 0140	40/55/10/1:0	DO		6507335 (093435)	BRWN SAND BLDR LOOS 0026 GREY GRVL SAND LOOS 0040 GREY GRVL SAND LOOS 0080 BRWN LMSN HARD 0095 GREY LMSN HARD 0106 WHIT LMSN SOFT 0127 YLLW LMSN LMSN SOFT 0139 GREY LMSN 0142
	17	553077	4808390	L	1992/10 4207	6 6	FR 0105 FR 0155	70/187/7/1:0	DO		6507341 (093877)	BRWN GRVL SAND CLAY 0035 BRWN CLAY STNS 0077 GREY LMSN 0187
	17	553934	4809193	W	1991/05 3518	6	FR 0025	4/16/30/1:0		0021 4	6507245 (104956) A	BRWN STNS CLAY HARD 0004 GREY CLAY HARD 0012 BRWN STNS BLDR LOOS 0025 BRWN STNS CLAY HARD 0026
14	17	553999	4809293	W	1991/05 3518	6	FR 0025	8/16/30/1:0		0021 4	6507247 (104954) A	BRWN STNS CLAY HARD 0004 GREY CLAY HARD 0012 BRWN STNS SAND LOOS 0025 BRWN STNS CLAY HARD 0026
	17	554004	4809263	W	1991/05 3518	6 5	FR 0025	4/16/30/1:0		0021 4	6507248 (104953) A	BRWN STNS CLAY HARD 0004 GREY CLAY HARD 0012 BRWN STNS SAND LOOS 0025 BRWN STNS CLAY HARD 0028
12	17	553949	4809283	W	1991/05 3518	6	FR 0025	5/16/30/1:0		0021 4	6507246 (104955) A	BRWN STNS CLAY HARD 0004 GREY CLAY HARD 0012 BRWN STNS SAND LOOS 0025 BRWN STNS CLAY HARD 0026
	17	550127	4808699	W	1991/01 1737	6	FR 0114 FR 0121	91/96/12/2:0	DO	0118 3	6507081 (77842)	BRWN CLAY STNS SOFT 0018 GREY CLAY HARD 0032 GREY CLAY GRVL HARD 0114 GREY GRVL SAND SOFT 0121
	17	554002	4809759	W	1990/09 3518	6 6	FR 0094	10/50/15/2:0	DO		6507048 (81443)	BRWN SAND SOFT 0015 BRWN STNS CLAY HARD 0030 GREY CLAY STNS HARD 0055 BLUE ROCK HARD 0080 WHIT ROCK HARD 0094
	17	554025	4809762	W	1990/09 3518	6 6	FR 0095	10/65/9/2:0	DO AC		6507047 (81444)	BRWN SAND SOFT 0015 BRWN STNS SAND LOOS 0023 GREY CLAY STNS HARD 0047 BLUE ROCK HARD 0060 BRWN ROCK HARD 0080 WHIT ROCK HARD 0095
	17	550538	4809756	W	1990/08 4552	6 5	FR 0120	28/60/10/1:30	DO		6506913 (61231)	LOAM 0002 GRVL GRVL 0028 CLAY DNSE 0110 GRVL CMTD 0120
11	17	553788	4809353	W	1990/08 4207	6 6	FR 0072 FR 0074	42/75/15/1:0	DO		6507018 (61731)	GREY GRVL CLAY 0040 GREY CLAY 0060 GREY GRVL STNS 0070 WHIT LMSN 0075
10	17	553749	4809202	W	1990/06 4552	6	FR 0060	40/45/10/1:0	DO		6506891 (61214)	BRWN SAND STNS LOOS 0002 BRWN CLAY GRVL DNSE 0005 GREY CLAY STNS DNSE 0053 GREY GRVL CMTD 0059 GREY GRVL LOOS 0062
	17	553468	4809044	W	1990/05 4552	6	FR 0070	//15/1:30	DO		6506890 (61213)	BRWN SAND LOOS 0005 BRWN GRVL LOOS 0048 GREY CLAY STNS 0067 BRWN GRVL HARD 0070
	17	553663	4809544	W	1989/11 4552	6	FR 0095	40/70/10/:	DO		6506719 (61168)	BRWN SAND 0020 BRWN GRVL CLAY 0056 GREY LMSN 0106
	17	553625	4809070	W	1989/08 2663	6 6	FR 0084	63//15/1:0	DO		6506631 (69127)	SAND GRVL LOOS 0020 GREY CLAY SAND LOOS 0075 GRVL 0084
	17	553756	4809427	W	1988/11 3518	6 6	FR 0113	66/79/12/1:0	DO		6506520 (55120)	BRWN SAND CLAY SOFT 0010 GREY CLAY STNS HARD 0058 BRWN STNS SAND LOOS 0065 BRWN ROCK HARD 0113
	17	552974	4808609	W	1988/07 4207	6 6	FR 0127	30/129/15/1:0	DO		6506399 (37210)	BRWN SAND SILT 0005 GREY CLAY STNS 0065 GREY GRVL SILT 0079 GREY LMSN 0090 BRWN LMSN 0110 WHIT LMSN 0129

MECP WELL RECORD SUMMARY

Maple Grove Road Improvements

Summarized well records of wells within UTM Easting +/- 500 m and UTM Northing +/- 500 m of project limits

PML Number	UTM ZONE	UTM EASTING	UTM NORTHING	LOT	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
	17	553694	4809358	W	1988/06 4207	6 6	FR 0085	50/87/15/1:0	DO		6506359 (20175)	GREY CLAY GRVL 0065 GREY GRVL CLAY 0079 WHIT LMSN 0087
	17	553634	4809747	W	1988/06 4207	6 6	FR 0044	7/46/25/1:0	DO		6506358 (20181)	BRWN SILT CLAY 0020 GREY GRVL SILT 0038 GREY LMSN 0046
	17	552989	4808548	W	1988/03 3518	6	FR 0103	10/75//:	DO		6506462 (26856)	BRWN STNS SAND LOOS 0010 GREY STNS CLAY LOOS 0055 GREY CLAY STNS SOFT 0070 BRWN STNS BLDR HARD 0085 BLUE ROCK HARD 0103
	17	553864	4807945	W	1987/10 4207	6 6	FR 0035	4/37/5/1:0	DO		6506231 (15554)	BRWN CLAY LOAM 0002 GREY LMSN 0037
	17	553888	4808366	W	1987/10 4207	6 6	FR 0035 FR 0066	11/67/5/1:0	DO		6506232 (15553)	BRWN CLAY LOAM 0002 GREY LMSN 0067
	17	553658	4809088	W	1987/08 4207	6 6	FR 0105 FR 0122	60/126/6/1:0	DO		6506179 (08262)	BRWN CLAY STNS 0012 GREY CLAY GRVL 0065 BRWN GRVL CLAY 0089 GREY LMSN 0126
	17	554014	4808053	W	1987/07 4207	6 6	FR 0030 FR 0035	5/35/50/1:0	DO		6506181 (08253)	BRWN CLAY STNS 0004 GREY LMSN 0037
	17	553907	4808268	W	1987/05 4207	6 6	FR 0023 FR 0035	5/37/10/1:0	DO		6506138 (08165)	BRWN CLAY STNS 0010 GREY LMSN 0037
	17	553896	4808314	W	1987/05 4207	6 6	FR 0040	10/43/7/1:0	DO		6506137 (08179)	BRWN CLAY STNS 0004 GREY LMSN 0030 WHIT LMSN 0043
	17	550334	4807760	W	1986/11 2801	20 10	FR 0091	63/90/300/72:0	PS	0109 16	6505937 (05801)	LOAM 0001 SAND 0003 GRVL SAND 0008 GREY GRVL CLAY 0026 GREY CLAY BLDR HARD 0048 GREY CLAY BLDR STKY 0076 CLAY GRVL 0084 BLDR GRVL 0091 SAND GRVL PCKD 0108 SAND GRVL 0126 SHLE 0127
	17	553875	4808407	W	1986/09 4207	6 6	FR 0030 FR 0070	15/74/15/1:0	DO		6505946 (NA)	BRWN CLAY GRVL LOAM 0002 GREY GRVL CLAY 0005 GREY LMSN SOFT 0010 GREY LMSN 0074
	17	553596	4809060	W	1986/08 4207	6 6	FR 0095	55/97/5/1:0	DO		6505945 (NA)	BRWN SAND 0010 BRWN STNS GRVL 0035 BRWN CLAY 0070 BRWN GRVL CLAY 0076 BRWN GRVL 0085 GREY LMSN 0097
	17	552962	4808330	W	1986/07 4207	6	FR 0088	40/85/15/1:0	DO		6505944 (NA)	BRWN SAND 0010 BRWN GRVL SAND 0040 BRWN CLAY GRVL 0080 BRWN GRVL CLAY 0086 GRVL 0088
	17	553018	4808138	W	1985/07 2564	5 5	FR 0140 FR 0145	35/100/12/2:0	DO		6505690 ()	SAND CLAY 0080 LMSN 0147
	17	552957	4808432	W	1983/11 3518	5 5	FR 0110 FR 0120	75/100/8/1:30	DO		6505667 ()	BLCK LOAM 0001 GREY SAND 0040 GREY CLAY SAND LYRD 0089 GREY LMSN SHLE 0120
	17	553905	4808303	W	1982/05 4208	6	FR 0030	6/35/15/1:0	DO		6505399 ()	GREY STNS CLAY 0005 GREY LMSN 0035
	17	550005	4808636	W	1982/03 4208	6	FR 0128	80/100/40/2:0	ST		6505402 ()	GREY CLAY GRVL 0125 GREY GRVL 0128
	17	553513	4808950	W	1981/08 4208	6	FR 0090	65/95/5/1:0	DO		6505213 ()	BRWN SAND MUCK 0015 BRWN CLAY STNS 0045 GREY CLAY GRVL 0070 GREY LMSN 0095
	17	553814	4809403	W	1979/10 5477	5 5	FR 0076 FR 0097	25/25/10/1:0	DO		6504992 ()	BRWN SAND GRVL 0018 GREY CLAY HPAN LYRD 0070 GREY LMSN 0100
	17	551734	4809863	W	1977/08 5469	36	FR 0008	8//5/1:0	DO		6504653 ()	LOAM 0001 BRWN SAND 0015 GREY SAND 0018 GREY CLAY 0018
	17	550552	4809761	W	1977/08 5469	36	FR 0008	8/9/4/1:0	DO		6504652 ()	LOAM 0001 BRWN SAND 0008 BRWN SAND WTHD 0018
	17	552974	4808043	W	1976/09 4208	6	FR 0055	19/50/25/1:0	DO		6504561 ()	BRWN CLAY GRVL 0010 BRWN SAND 0022 GREY CLAY SAND GRVL 0050 GREY GRVL 0055
	17	552954	4807993	W	1976/09 4208	6	FR 0110	77/100/15/1:0	DO		6504560 ()	BRWN CLAY SAND GRVL 0025 GREY CLAY SNDY 0085 GREY LMSN 0112
	17	550354	4807723	W	1976/07 2801	12 7	FR 0095	62/84/200/24:0	NU	0108 10	6504494 ()	LOAM 0001 BRWN BLDR CLAY GRVL 0005 SAND GRVL 0010 GREY CLAY STNS 0019 SAND GRVL 0022 STNS SILT CLAY 0060 STNS SILT CLAY 0085 SAND GRVL 0086 BRWN STNS SILT CLAY 0095 BRWN GRVL SAND CLAY 0109 GREY GRVL CLAY 0113 GREY CLAY GRVL 0129 BLCK SHLE GRVL SOFT 0133 BLCK SHLE LMSN LYRD 0142 BRWN LMSN SHLE LYRD 0146 GREY LMSN HARD 0156 GREY LMSN SOFT LYRD 0163 BRWN LMSN SOFT 0168 BRWN LMSN 0171 BRWN LMSN 0184 GREY LMSN 0189 BRWN LMSN 0197 GREY LMSN 0200 BRWN LMSN 0204
9	17	553674	4809243	W	1976/06 5469	5	FR 0121	28/80/24/3:0	DO		6504475 ()	BRWN SAND 0028 BRWN CLAY STNS 0079 GREY LMSN 0121
	17	550324	4807713	W	1976/06 2801	2	FR 0090	60//20/:	NU	0096 11	6504495 ()	LOAM 0001 SAND GRVL BLDR 0010 GREY GRVL CLAY 0015 SAND GRVL CLAY 0026 CLAY SILT STNS 0074 BRWN CLAY SAND GRVL 0083 BRWN CLAY SILT GRVL 0090 GRVL SAND 0104 GRVL LOOS 0107 SAND GRVL SHLE 0114 GREY SAND GRVL CLAY 0120 SAND GRVL CLAY 0127
	17	550384	4807733	W	1976/06 2801	2	FR 0095	60/61/10/1:0	NU	0103 11	6504493 ()	LOAM 0001 CLAY GRVL BLDR 0005 SAND GRVL 0011 GREY CLAY STNY SOFT 0017 SAND GRVL 0020 CLAY SILT GRVL 0095 SAND GRVL PCKD 0104 SAND GRVL 0107 SAND GRVL CLAY 0114 CLAY SNDY SOFT 0129 BLCK SHLE GRVL SOFT 0133 BLCK SHLE SOFT LYRD 0143
	17	552384	4807883	W	1976/06 2801	12 11		106/147/30/1:0	NU		6504492 () A	BRWN LOAM 0001 BRWN CLAY STNS SAND 0083 SAND GRVL 0084 CLAY GRVL 0091 FSND GRVL CLAY 0107 GREY LMSN 0109 GREY LMSN 0112 BRWN LMSN 0125 BRWN LMSN LYRD 0149 WHIT LMSN 0169 GREY LMSN 0182 GREY LMSN 0190 BRWN LMSN 0197 BRWN LMSN LYRD 0205 BRWN LMSN 0236 BRWN LMSN LYRD 0255 BRWN LMSN 0290 BRWN LMSN 0297 BRWN LMSN SOFT 0320 GREY LMSN 0358
	17	551964	4809343	W	1974/04 3518	5	FR 0136	36/45/15/:	DO		6504148 ()	BLCK LOAM LOOS 0002 GREY SAND LOOS 0010 GREY GRVL SAND LOOS 0065 GREY CLAY GRVL LYRD 0107 GREY SAND CLAY LYRD 0120 GREY SAND GRVL PCKD 0136 GREY GRVL HARD 0138
	17	550129	4808683	W	1973/09 3518	5 5	FR 0115	60/76/8/4:0	DO		6504043 ()	PRDG 0010 GREY CLAY GRVL 0099 GREY CLAY HPAN 0115 BRWN GRVL 0119
	17	553650	4808972	W	1973/03 5469	5	FR 0135	46/100/6/14:0	DO		6503766 ()	PRDG 0005 BRWN CLAY GRVL BLDR 0017 BRWN CLAY GRVL 0068 GREY GRVL CMTD 0087 BRWN ROCK 0120 GREY ROCK 0143
	17	553664	4809423	W	1972/11 1657	5	FR 0108	36/80/5/2:0	DO		6503700 ()	BRWN CLAY 0008 BRWN CLAY BLDR 0022 BRWN CLAY 0031 GRVL 0032 CLAY GRVL 0043 WHIT BLDR 0044 GREY CLAY 0055 BRWN ROCK 0063 WHIT LMSN 0108
	17	553744	4807823	W	1971/06 3518	7 6	FR 0021	4/18/8/4:30	DO		6503415 ()	BLCK LOAM 0001 BRWN LMSN 0014 BLUE LMSN 0021 BRWN LMSN 0032
	17	552734	4808473	W	1970/05 2406	10	FR 0140 FR 0174	26/31/75/1:0	PS		6503217 ()	BRWN LOAM 0001 GREY CLAY GRVL 0064 BRWN MSND GRVL 0072 GREY ROCK 0170 BRWN ROCK 0197
	17	553864	4809573	W	1969/12 1657	5 5	FR 0119	20/110/10/1:0	DO		6503124 ()	BRWN CLAY MSND 0004 MSND GRVL 0024 CLAY 0032 GRVL MSND 0045 GREY ROCK 0123
	17	553714	4809623	W	1967/11 2521	4 4	FR 0114	19/45/10/2:0	DO		6501180 ()	MSND 0012 GRVL 0043 GREY LMSN 0114
	17	552024	4807643	W	1967/10 3533	5	FR 0076	50/55/10/5:0	DO		6501152 ()	GRVL 0025 CLAY STNS 0050 CLAY 0070 HPAN 0076 GRVL 0077
	17	553614	4809543	W	1967/10 2521	4 4	FR 0115	30/50/10/2:0	DO		6501179 ()	PRDG 0018 CLAY STNS 0030 GRVL 0050 GREY ROCK 0115
	17	553689	4809373	W	1967/09 2521	4 4	FR 0134	35/70/10/2:0	DO		6501173 ()	CLAY 0025 GRVL 0076 GREY ROCK 0134
	17	549864	4809298	W	1966/10 3413	30	FR 0024	7/24/3/24:0	DO		6501097 ()	CLAY 0024 GRVL 0025 CLAY 0027
	17	553689	4809678	W	1966/09 2521	4 4	FR 0112	19/45/10/2:0	DO		6501175 ()	MSND GRVL BLDR 0044 GREY LMSN 0112
	17	553614	4809773	W	1966/09 2521	4 4	FR 0109	17/50/10/2:0	DO		6501176 ()	GRVL MSND 0010 GRVL STNS 0030 CLAY 0043 GREY LMSN 0109
	17	553484	4809793	W	1966/08 2521	4 4	FR 0122	20/65/8/1:0	DO		6501248 ()	MSND 0020 GRVL 0054 BLUE LMSN 0122
	17	553639	4809488	W	1965/09 2521	4 4	FR 0113	30/40/10/1:0	DO		6501178 ()	PRDG 0023 CLAY 0054 GREY LMSN 0113
	17	552939	4808748	W	1965/03 4819	7	FR 0086	40/48/15/6:0	DO		6501166 ()	CLAY STNS 0021 HPAN 0049 CLAY 0086 GRVL 0088
	17	551934	4807663	W	1965/03 1905	5	FR 0069	40/50/10/4:0	DO		6501151 ()	PRDG 0018 CLAY GRVL 0065 CLAY MSND 0069 MSND GRVL 0071
	17	553589	4809373	W	1964/11 2521	4 4	FR 0139	40/60/10/2:0	ST DO		6501165 ()	CLAY MSND 0012 GRVL BLDR 0075 GREY LMSN 0139

MECP WELL RECORD SUMMARY

Maple Grove Road Improvements

Summarized well records of wells within UTM Easting +/- 500 m and UTM Northing +/- 500 m of project limits

PML Number	UTM ZONE	UTM EASTING	UTM NORTHING	LOT	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
	17	550089	4808598	W	1964/07 3413	30	FR 0010	10/10/3/24:0	DO		6501103 ()	GRVL 0010 CLAY 0018
	17	553564	4808173	W	1964/06 2406	5 5	FR 0145	74/100/15/2:0	DO		6501162 ()	MSND 0045 BRWN ROCK 0075 WHIT ROCK 0124 BRWN ROCK 0148
	17	550014	4809273	W	1964/04 3533	7	FR 0120	80/90/15/10:0	ST DO		6501096 ()	LOAM 0002 MSND 0015 CLAY 0051 HPAN CLAY 0072 HPAN 0085 CLAY GRVL 0110 GRVL 0121
	17	553864	4808248	W	1962/08 4719	5 5	FR 0020	6/7/12/2:0	DO		6501161 ()	PRDG 0005 GREY ROCK 0028
	17	553614	4809543	W	1962/08 2521	4 4	FR 0125	27/60/9/2:0	DO		6501177 ()	MSND GRVL 0020 CLAY 0051 GREY LMSN 0125
	17	549914	4809248	W	1962/05 2519	30	FR 0013	4/14/2/0:30	DO		6501095 ()	LOAM 0001 BRWN CLAY 0002 BRWN MSND 0003 GRVL 0004 BRWN CLAY 0009 BLUE CLAY 0013 GRVL 0014
	17	550214	4808073	W	1961/11 2519	30	FR 0019	19//1/:	ST		6501106 ()	LOAM 0001 BRWN CLAY ROCK 0015 BRWN MSND 0025
	17	552264	4807998	W	1961/08 4719	5 5	FR 0140	37/70/10/2:0	DO		6501150 ()	PRDG 0008 CLAY BLDR 0026 CLAY GRVL 0035 BRWN CLAY 0042 BRWN CLAY GRVL 0072 GRVL SILT MSND 0100 GREY ROCK 0148
	17	554814	4809373	W	1961/08 2406	5 5	FR 0074	14/38/10/2:0	DO		6501171 ()	BRWN CLAY 0004 FSND 0016 BRWN CLAY MSND 0027 BRWN LMSN 0058 BRWN STNS 0074 STNS 0080
	17	549914	4808548	W	1961/06 2519	30	FR 0010 UK 0014	10/17/10/1:0	DO		6501102 ()	LOAM 0001 BRWN CLAY 0004 BRWN FSND 0010 GRVL 0012 BRWN CLAY 0014 GRVL 0015 BLUE CLAY 0018
	17	552364	4807648	W	1960/12 4719	5 5	FR 0175	72/76/12/2:0	DO		6501149 ()	PRDG 0018 CLAY GRVL 0102 GREY ROCK 0160 BRWN ROCK 0182
	17	553524	4809048	W	1960/11 4719	5	FR 0076	51/72/7/6:0	DO	0078 4	6501163 ()	LOAM 0001 CLAY GRVL BLDR 0034 CLAY GRVL 0072 CLAY SILT MSND 0076 GRVL MSND 0082
	17	549914	4808773	W	1960/08 3524	5	FR 0124	78/87/15/12:0	DO		6501101 ()	LOAM 0001 CLAY HPAN 0022 HPAN BLDR 0058 HPAN CLAY 0120 MSND 0123 GRVL 0124
	17	550009	4808573	W	1960/04 4208	5	FR 0127	27/35/10/1:0	DO		6501100 ()	LOAM 0006 STNS CLAY 0025 GRVL CLAY HPAN 0115 GRVL MSND 0125 GRVL 0129
	17	553824	4807873	W	1959/09 2414	5 3 3	SU 0060	-2///:	DO		6501158 ()	LOAM 0001 FSND 0004 BRWN LMSN 0012 GREY LMSN 0035 BRWN LMSN 0050 GREY LMSN 0090
	17	550164	4808373	W	1958/09 4719	6	FR 0115	74/87/12/5:0	ST DO		6501105 ()	CLAY BLDR 0022 CLAY GRVL 0098 GRVL 0115 GREY GRVL MSND CLAY 0125
	17	554514	4807763	W	1958/04 2414	4	FR 0080	54/80/7/2:0	DO		6500149 ()	PRDG 0078 GREY LMSN 0098
	17	550064	4808748	W	1958/03 1705	4	FR 0115	83/90/4/6:0	DO		6501099 ()	HPAN STNS 0022 BLUE CLAY 0042 MSND GRVL 0064 HPAN GRVL 0082 HPAN STNS 0098 MSND GRVL 0102 BLUE CLAY 0110 CSND 0114 GRVL 0115
	17	553764	4809023	W	1956/06 2521	4 4 4	FR 0118	42/60/5/1:0	DO		6501170 ()	MSND 0012 CLAY 0068 FSND 0071 GREY LMSN 0118
	17	551889	4808723	W	1956/05 4719	5 5	FR 0170	37/41/9/4:30	ST DO		6501153 ()	MSND 0022 MSND CLAY 0044 HPAN 0096 SHLE 0116 GREY ROCK 0147 BRWN LMSN 0170
	17	549814	4808733	W	1955/08 3524	7	FR 0098	55/80/20/30:0	IR		6501098 ()	LOAM 0002 BLDR GRVL 0028 HPAN 0092 MSND CLAY 0096 GRVL 0101
	17	553739	4809448	W	1954/11 2521	4 4 4	FR 0107	35/60/10/1:0	DO		6501174 ()	HPAN BLDR 0062 GRVL 0079 GREY LMSN 0107
	17	553729	4809073	W	1954/05 3122	4 4	FR 0139	64/80/15/3:0	ST DO		6501169 ()	CLAY BLDR 0028 HPAN 0086 MSND 0091 ROCK 0139
	17	549939	4808598	W	1953/12 3122	4 4	UK 0235	106/125/15/4:0	ST DO		6501104 ()	CLAY BLDR 0050 CLAY STNS 0074 CLAY STNS MSND 0092 CLAY MSND STNS 0138 CSND 0139 ROCK 0235
	17	553789	4809168	W	1951/09 2521	4 4 4	FR 0125	35/45/10/0:30	ST DO		6501168 ()	GRVL MSND 0015 HPAN 0050 GRVL MSND 0080 LMSN 0125
	17	553889	4808023	W	1951/07 2414	5 5	FR 0052	10/28/3/2:0	DO		6501160 ()	LOAM 0002 WHIT ROCK 0052 BRWN ROCK 0074
	17	554514	4807723	W	1949/06 2414	6 6	FR 0064	31/39/10/1:0	DO		6500143 ()	CLAY STNS 0024 BRWN CLAY 0036 GRVL 0044 BRWN LMSN 0049 BLUE ROCK 0064
	17	552289	4809673	W	1948/09 2414	5 5	FR 0162	28/28/10/2:0	IR		6501167 ()	CSND 0020 GRVL 0026 MSND STNS 0030 FSND 0039 BLUE CLAY 0055 BRWN HPAN 0076 YLLW CLAY 0079 MSND 0087 GRVL 0097 BLUE ROCK 0101 WHIT ROCK 0132 BRWN ROCK 0162 BLCK ROCK 0163
	17	554885	4807799	L	1948/07 2414	5 5	FR 0075	32/40/10/3:0	DO		6501183 ()	FSND 0072 CSND 0075
	17	553839	4808348	W	1948/05 2414	5 5 5	FR 0140	60/66/15/2:0	PS		6501164 ()	GRVL 0024 HPAN 0038 BRWN CLAY 0050 HPAN 0062 GRVL 0063 HPAN 0086 GRVL 0088 MSND 0090 LMSN 0120 BLUE ROCK 0140

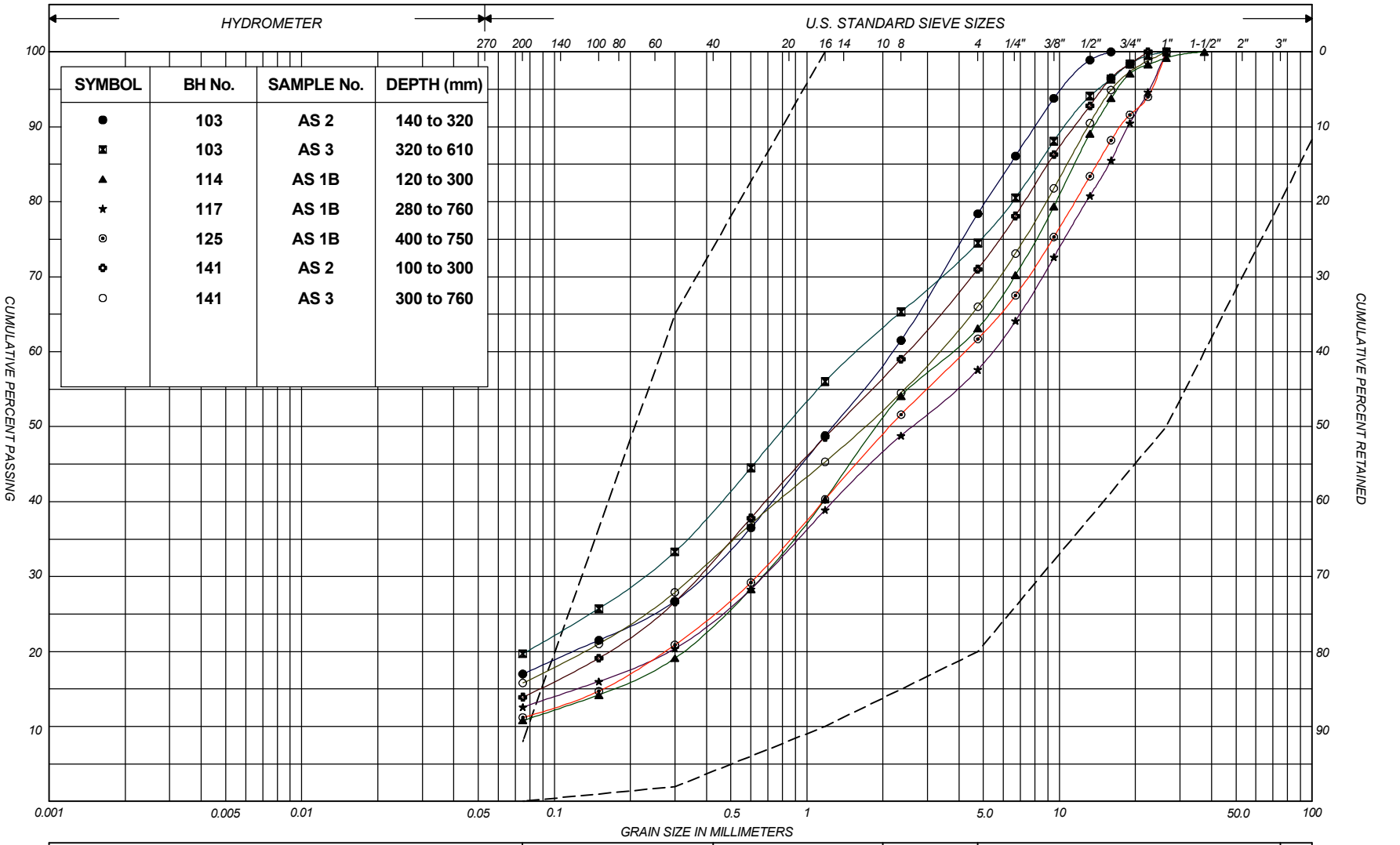
APPENDIX D

Particle Size Distribution Charts

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 1

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (mm)
●	103	AS 2	140 to 320
⊠	103	AS 3	320 to 610
▲	114	AS 1B	120 to 300
★	117	AS 1B	280 to 760
⊙	125	AS 1B	400 to 750
✿	141	AS 2	100 to 300
○	141	AS 3	300 to 760

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND						

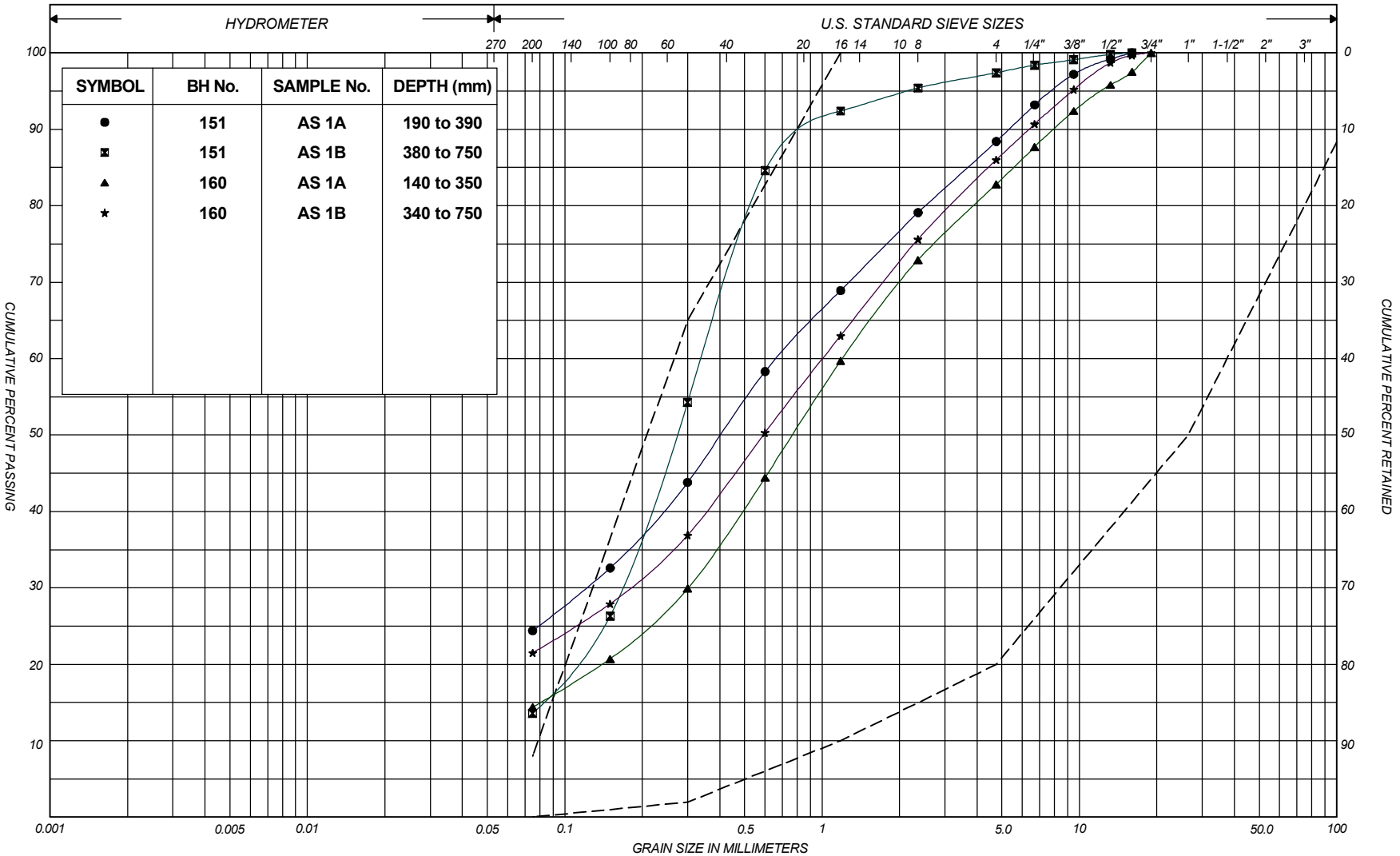
REMARKS: MAPLE GROVE ROAD

GRANULAR BASE AND SUBBASE SAMPLES COMPARED TO OPSS GRANULAR B TYPE 1 SPECIFICATONS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 2

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (mm)
●	151	AS 1A	190 to 390
⊠	151	AS 1B	380 to 750
▲	160	AS 1A	140 to 350
★	160	AS 1B	340 to 750

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COB BLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

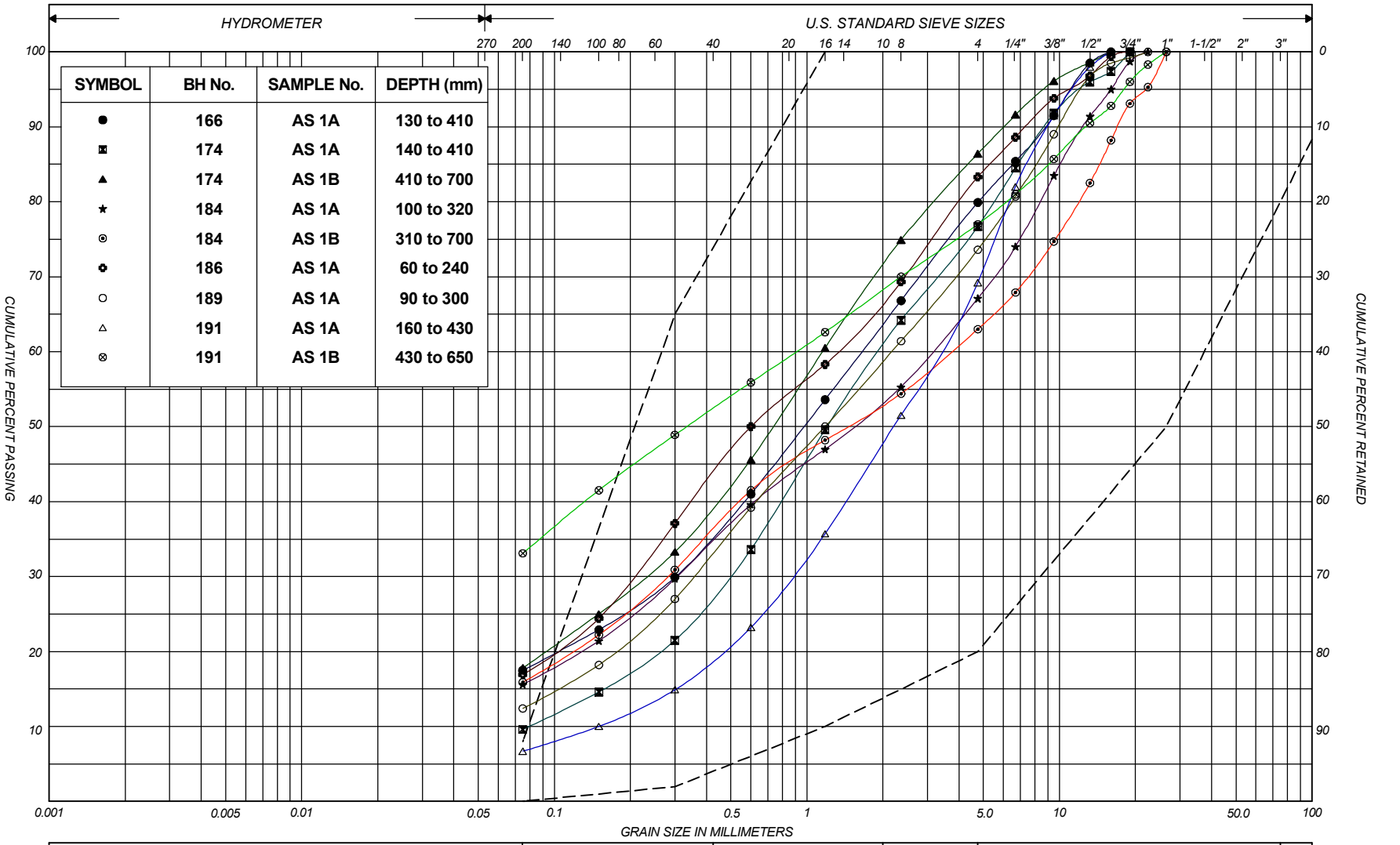
REMARKS: HESPELER ROAD

GRANULAR BASE AND SUBBASE COMPARED TO OPSS GRANULAR B TYPE 1 SPECIFICATONS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 3

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (mm)
●	166	AS 1A	130 to 410
⊠	174	AS 1A	140 to 410
▲	174	AS 1B	410 to 700
★	184	AS 1A	100 to 320
⊙	184	AS 1B	310 to 700
✿	186	AS 1A	60 to 240
○	189	AS 1A	90 to 300
△	191	AS 1A	160 to 430
⊗	191	AS 1B	430 to 650

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COB BLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

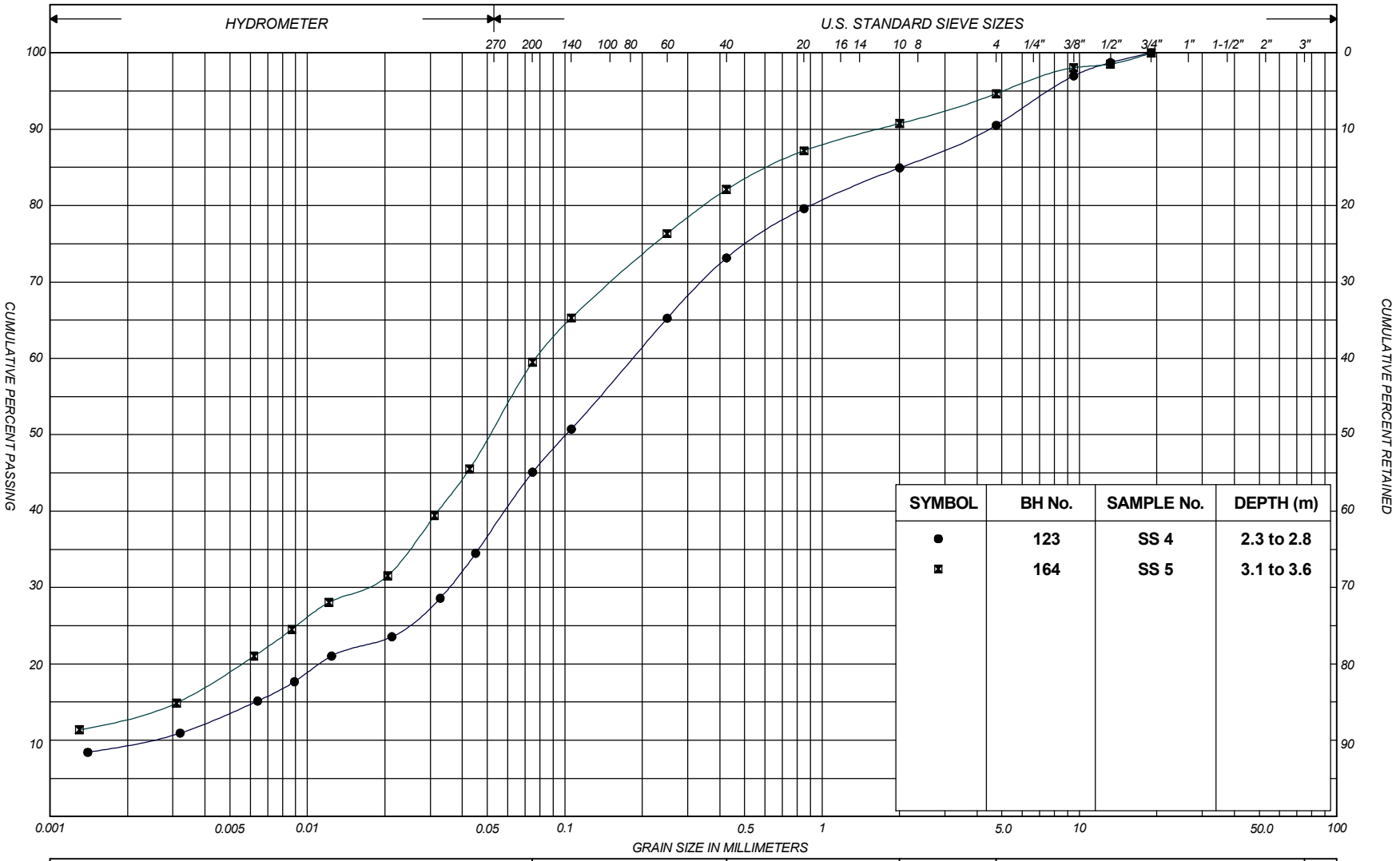
REMARKS: VONDRAU DRIVE, BOXWOOD DRIVE, SPEEDSVILLE ROAD, BRIARDEAN ROAD AND BEAVERDALE ROAD

GRANULAR BASE AND SUBBASE COMPARED TO OPSS GRANULAR B TYPE 1 SPECIFICATONS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 4

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	123	SS 4	2.3 to 2.8
⊠	164	SS 5	3.1 to 3.6

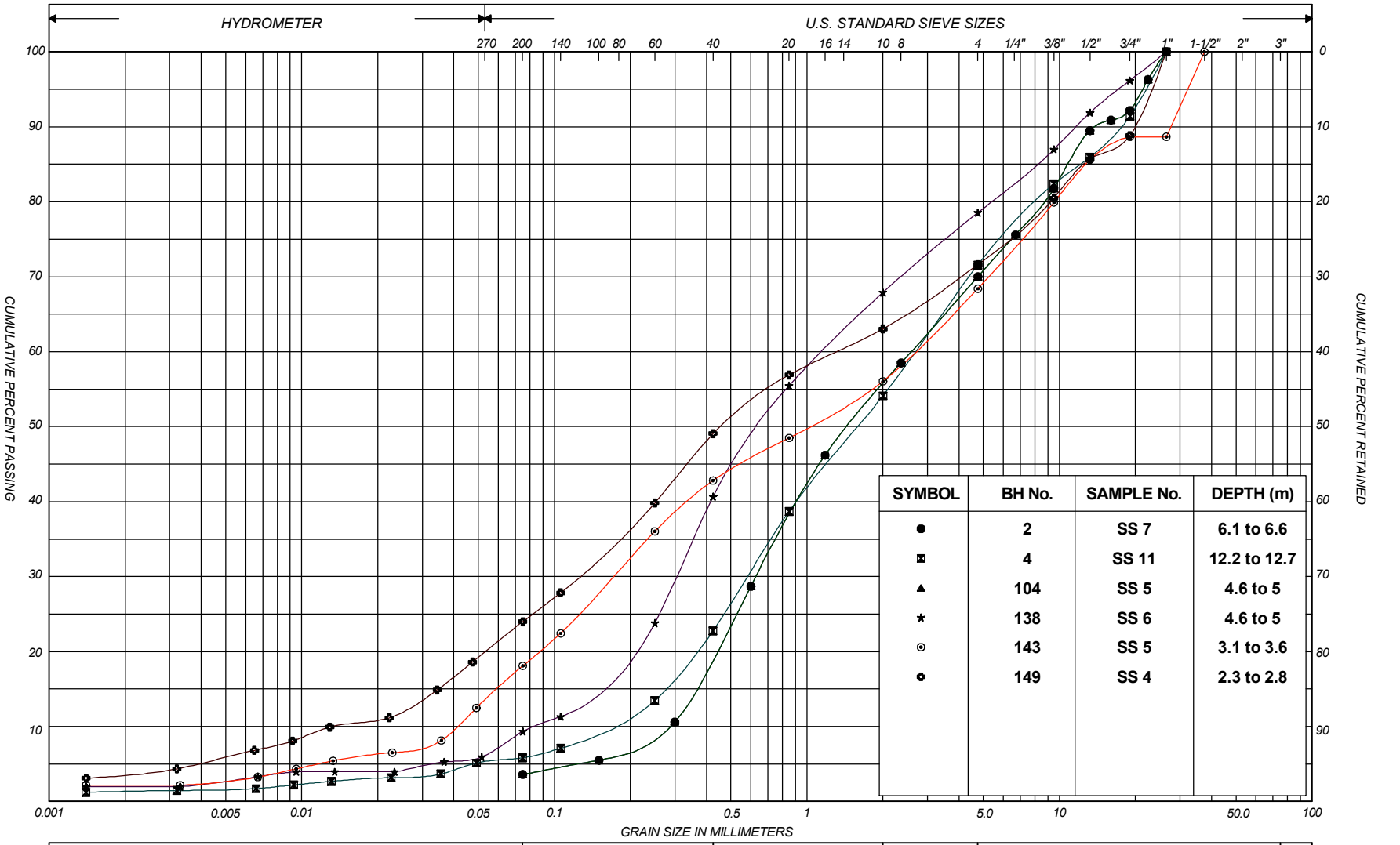
SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

REMARKS: FILL (SANDY SILT)

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

PROJECT NO. 18KF047
FIGURE NO. 5



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	2	SS 7	6.1 to 6.6
⊠	4	SS 11	12.2 to 12.7
▲	104	SS 5	4.6 to 5
★	138	SS 6	4.6 to 5
⊙	143	SS 5	3.1 to 3.6
✪	149	SS 4	2.3 to 2.8

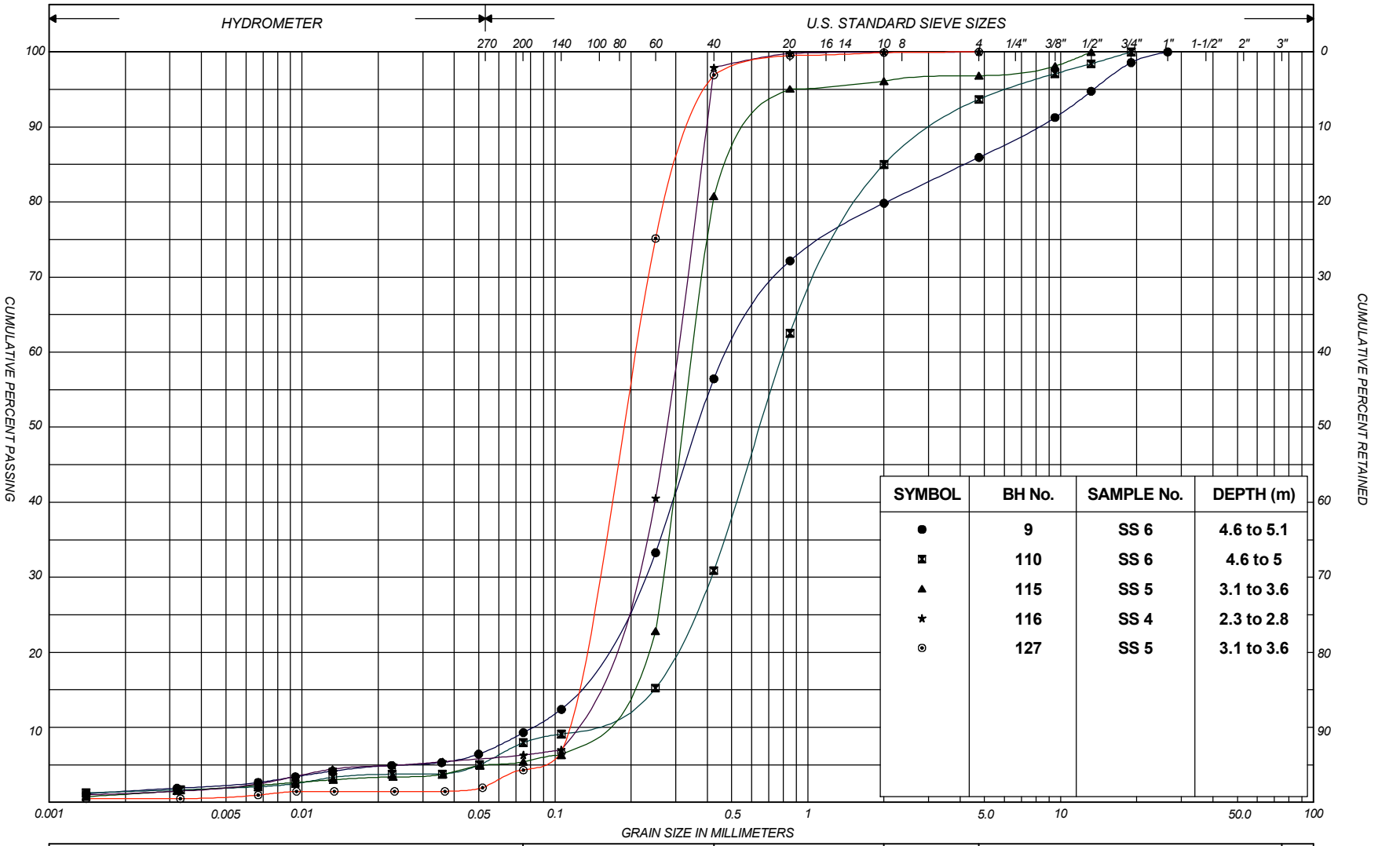
SILT & CLAY			FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES	UNIFIED
CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES	M.I.T.
CLAY	SILT	V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND	GRAVEL			U.S. BUREAU

REMARKS: GRAVELLY SAND AND SILTY GRAVELLY SAND

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 6

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	9	SS 6	4.6 to 5.1
■	110	SS 6	4.6 to 5
▲	115	SS 5	3.1 to 3.6
★	116	SS 4	2.3 to 2.8
⊙	127	SS 5	3.1 to 3.6

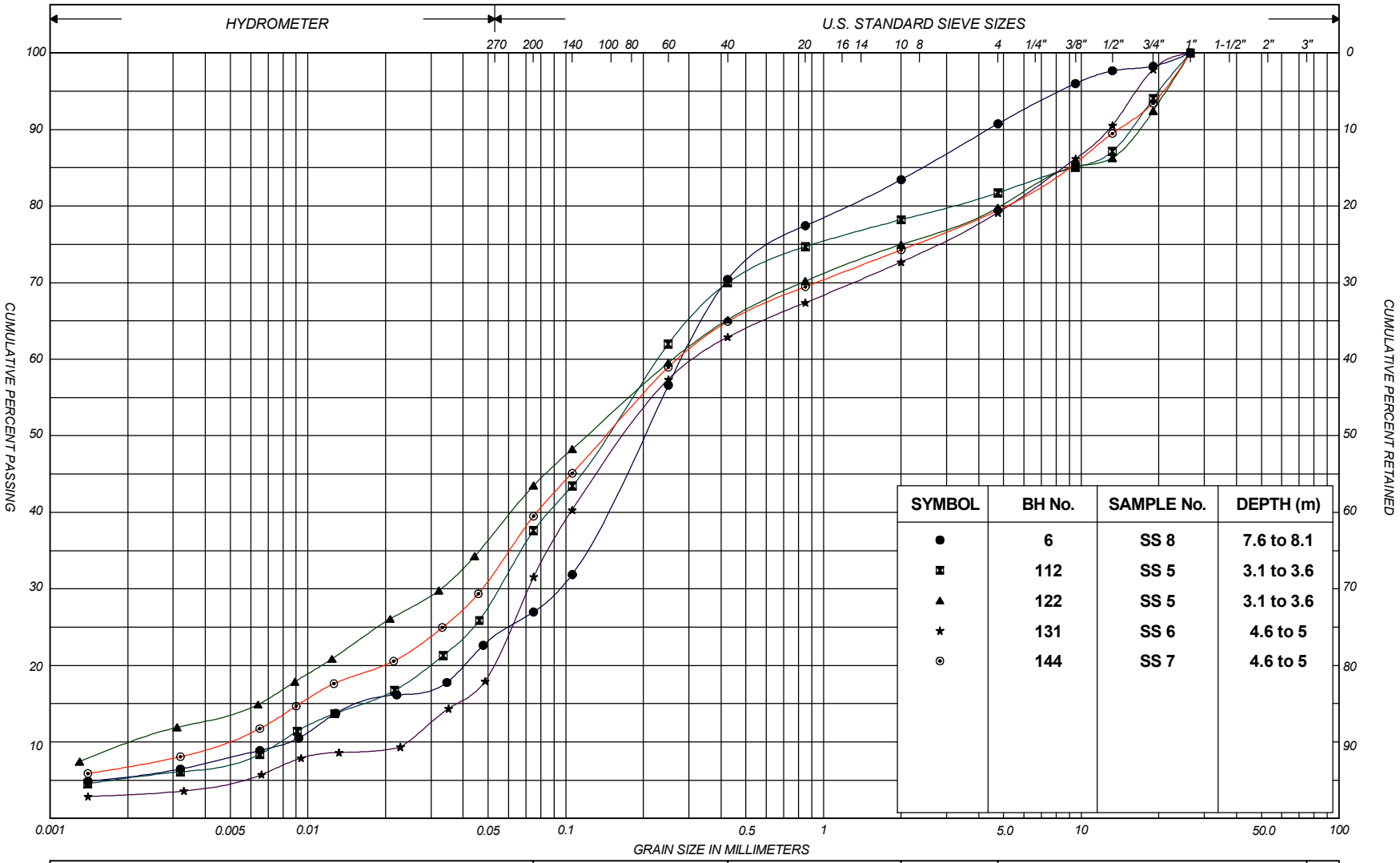
SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

REMARKS: SAND

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 7

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	6	SS 8	7.6 to 8.1
⊠	112	SS 5	3.1 to 3.6
▲	122	SS 5	3.1 to 3.6
★	131	SS 6	4.6 to 5
⊙	144	SS 7	4.6 to 5

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL			COBBLES	UNIFIED
			SAND							
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL			COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL				U.S. BUREAU
			SAND							

REMARKS: SILTY SAND

Peto MacCallum Ltd.
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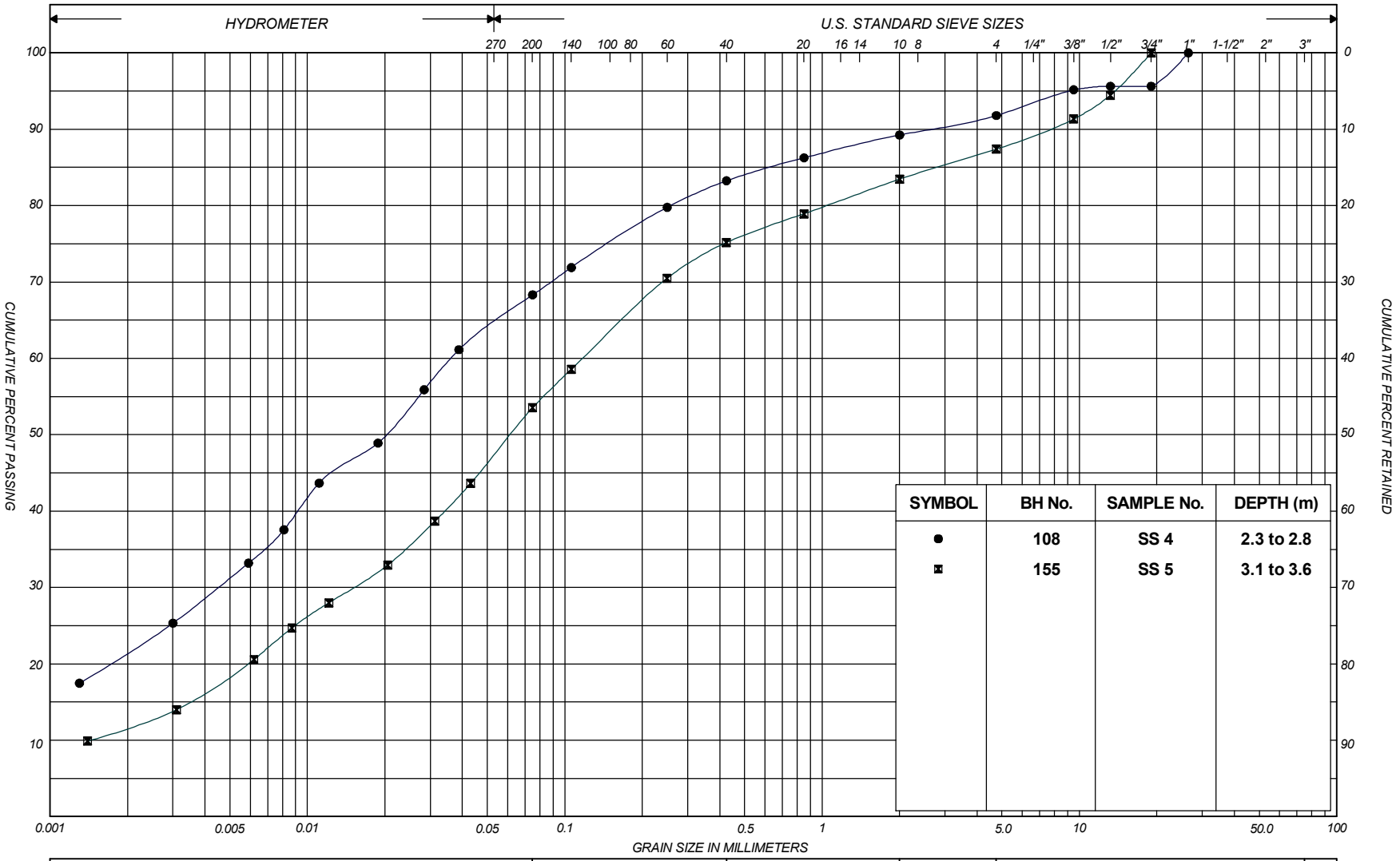
PROJECT NO. 18KF047
FIGURE NO. 8

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	108	SS 4	2.3 to 2.8
⊠	155	SS 5	3.1 to 2.6

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND							

REMARKS: SANDY SILT TILL

Peto MacCallum Ltd.
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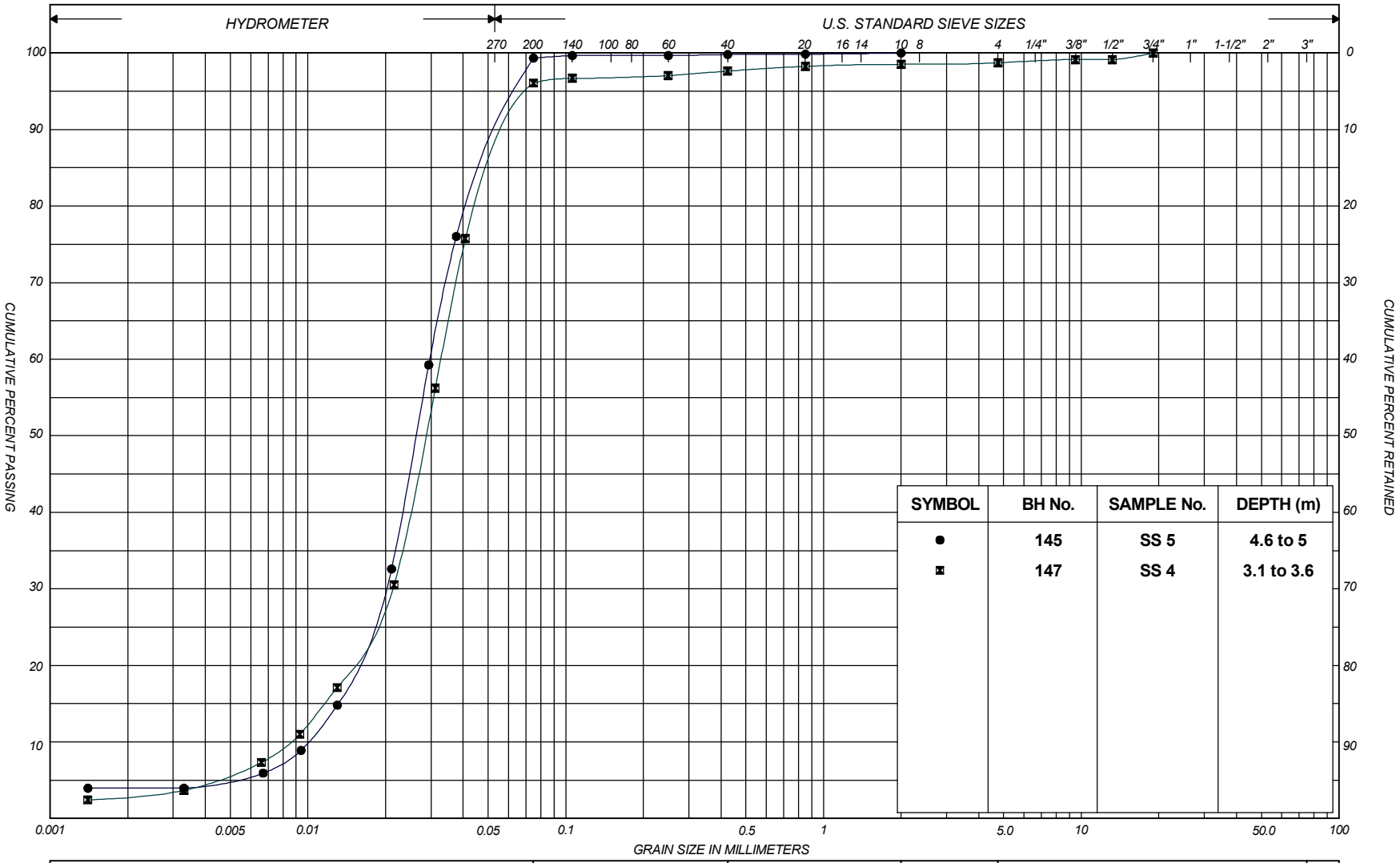
PROJECT NO. 18KF047
FIGURE NO. 9

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	145	SS 5	4.6 to 5
⊠	147	SS 4	3.1 to 3.6

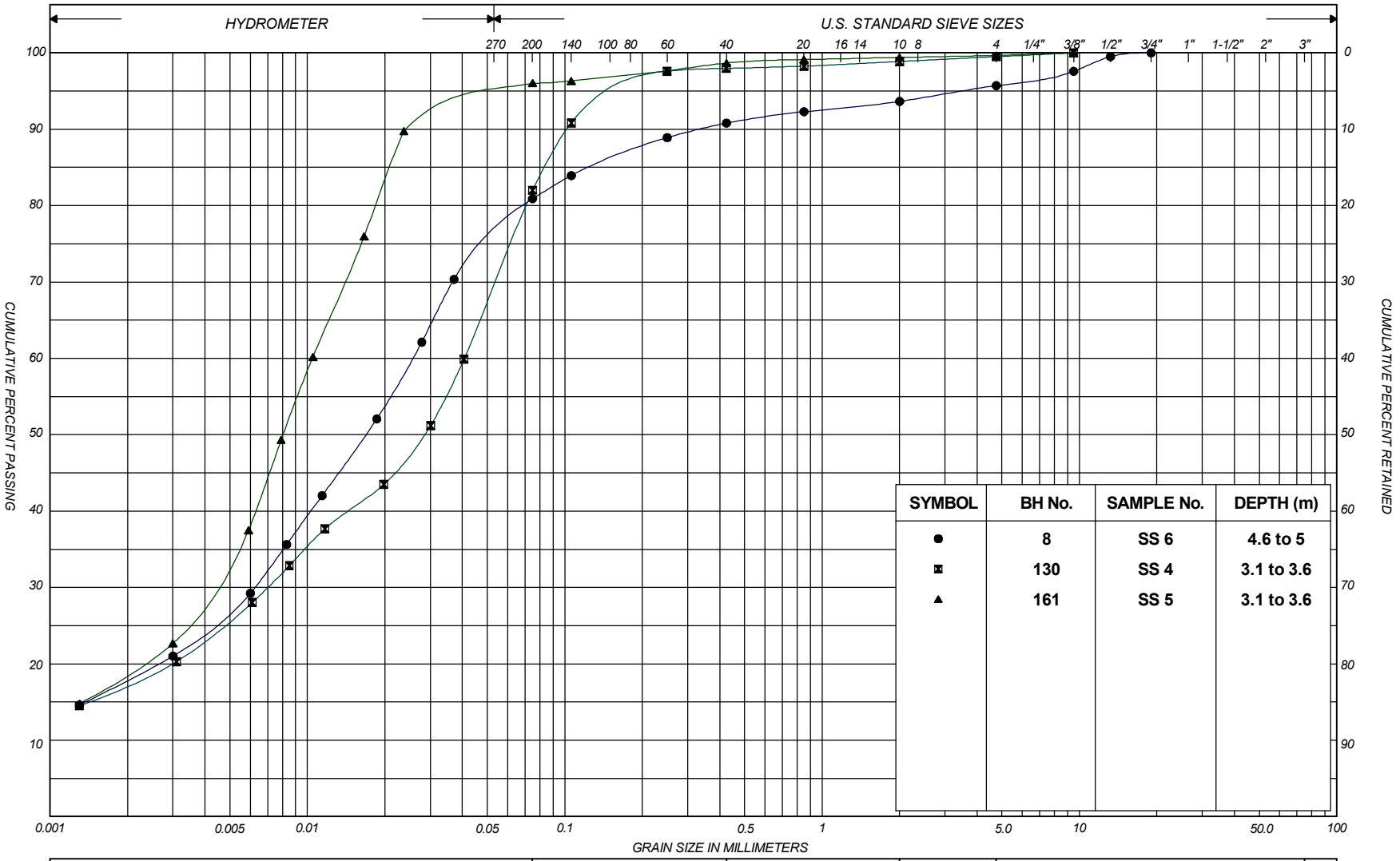
SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND						

REMARKS: SILT

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PROJECT NO. 18KF047
FIGURE NO. 10

PARTICLE SIZE DISTRIBUTION CHART



SYMBOL	BH No.	SAMPLE No.	DEPTH (m)
●	8	SS 6	4.6 to 5
⊠	130	SS 4	3.1 to 3.6
▲	161	SS 5	3.1 to 3.6

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
			SAND						

REMARKS: CLAYEY SILT TILL

APPENDIX E

LVM Borehole Logs

LIST OF ABBREVIATIONS

The abbreviations commonly employed on the borehole logs, on the figures, and in the text of the report, are as follows:

Sample Types		Soil Tests and Properties	
AS	auger sample	SPT	Standard Penetration Test
CS	chunk sample	UC	unconfined compression
RC	rock core	FV	field vane test
SS	split spoon	ø	angle of internal friction
TW	thin-walled, open	γ	unit weight
WS	wash sample	w_p	plastic limit
		w	water content
		w_l	liquid limit
		I_L	liquidity index
		I_p	plasticity index
		PP	pocket penetrometer

Penetration Resistances	
Dynamic Penetration Resistance	The number of blows by a 63.5 kg (140 lb.) hammer dropped 0.76 m (30 in.) required to drive a 50 mm (2 in.) diameter 60 ° cone a distance 0.30 m (12 in.). The cone is attached to 'A' size drill rods and casing is not used.
Standard Penetration Resistance, N (ASTM D1586)	The number of blows by a 63.5 kg (140 lb.) hammer dropped 0.76 m (30 in.) required to drive a standard split spoon sampler 0.30 m (12 in.)
WH	sampler advanced by static weight of hammer
PH	sampler advanced by hydraulic pressure
PM	sampler advanced by manual pressure

Soil Description		
Cohesionless Soils	**SPT N-Value**	**D_r (%)**
Relative Density (D_r)	(blows per 0.30 m)	
Very Loose	0 to 4	0 to 20
Loose	4 to 10	20 to 40
Compact	10 to 30	40 to 60
Dense	30 to 50	60 to 80
Very Dense	over 50	80 to 100
Cohesive Soils	Undrained Shear Strength (C_u)	
Consistency	**kPa**	**psf**
Very Soft	less than 12	less than 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000
DTPL	Drier than plastic limit	
APL	About plastic limit	
WTPL	Wetter than plastic limit	

LVM

Borehole Number: 1

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 30, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone / Standard Penetration	Shear Strength (PP) kPa / Shear Strength (FV) kPa	Water Content (%)	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value	X 20 40 60 80 X; ● 20 40 60 80 ●	▲ 50 100 150 200 ▲; ■ 50 100 150 200 ■	WP WL; 10 20 30	
0.00	Ground Elevation		0.00							
	PAVEMENT STRUCTURE: Asphaltic concrete: 80 mm; Granular 'A': 100 mm; Granular 'B': 200 mm			1	AS					asphaltic concrete
	FILL: loose dark brown silt (topsoil), trace sand and gravel, very moist to wet									native backfill
1.00			-1.00							
	SAND: compact brown silty sand, trace gravel, wet			2	SS	9			●	
				3	SS	14				
2.00			-2.00							
	Borehole terminated at 2.13 m									
3.00			-3.00							
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 2

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *November 3, 2009*

Depth (m)	Description	Elevation (m)	Number	Type	N-Value
0.00	Ground Elevation	0.00			
	FILL: dark brown silt (topsoil), moist				
	SILT: compact brown fine sandy silt, wet		1	SS	23
	saturated				
1.00	loose, saturated	-1.00	2	SS	5
			3	SS	14
	SILT TILL: compact brown sandy silt, some gravel, moist; occasional sand seams, saturated				
2.00		-2.00	4	SS	29
3.00	hard grey clayey silt, some sand and fine gravel, DTPL	-3.00	5	SS	38
4.00		-4.00			
			6	SS	43\150mm
5.00	Borehole terminated at 4.88 m	-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80

Shear Strength (PP) kPa: ▲ 50 100 150 200

Shear Strength (FV) kPa: ■ 50 100 150 200

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

bentonite seal

At drilling completion water level at 0.91 m

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *RM*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 3

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 30, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material : 750 mm					
1.00	***FILL:*** compact brown silty sand and gravel, moist		-1.00	1	SS	18
	trace tar					
	dark brown silt, some topsoil, organics and sand, trace gravel, very moist			2	SS	18
2.00	***SAND:*** compact brown silty sand, some gravel, very moist to wet		-2.00	3	SS	14
	grey, saturated					
3.00	***SILT TILL:*** compact grey sandy silt, trace gravel, very moist		-3.00	4	SS	15
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill; native cave; At drilling completion dry cave at 3.05 m

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 4

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 30, 2009*

Depth (m)	Description	Symbol	Elevation (m)	SAMPLE Number	SAMPLE Type	SAMPLE N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCUTRE: Asphaltic concrete: 50 mm; Granular 'A': 100 mm; Granular 'B': 300 mm					
	FILL: dark brown silt, some topsoil and sand, trace gravel, moist					
1.00	***SAND:*** compact grey silty sand, some gravel, very moist		-1.00	1	SS	21
	Borehole terminated at 1.52 m					
2.00			-2.00			
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration (●): 20 40 60 80

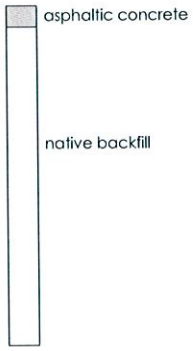
Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

WP — WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 5

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *November 3, 2009*

Depth (m)	Description	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation	0.00			
	FILL: dark brown silt (topsoil), moist				
	SAND AND GRAVEL: loose to compact brown silty sand and gravel, moist		1	SS	10
1.00	***SILT TILL:*** hard brown silt, some clay, sand and gravel, DTPL	-1.00	2	SS	15
	grey, DTPL		3	SS	12
2.00		-2.00	4	SS	21
3.00		-3.00	5	SS	30
	some grey silt layers, saturated				
4.00		-4.00	6	SS	23
	some fine to coarse sand layers, saturated		7	SS	30
5.00	Borehole terminated at 5.03 m	-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: bentonite seal

At drilling completion water level at 4.57 m

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *RM*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 6

Ground Elevation: *N/A*

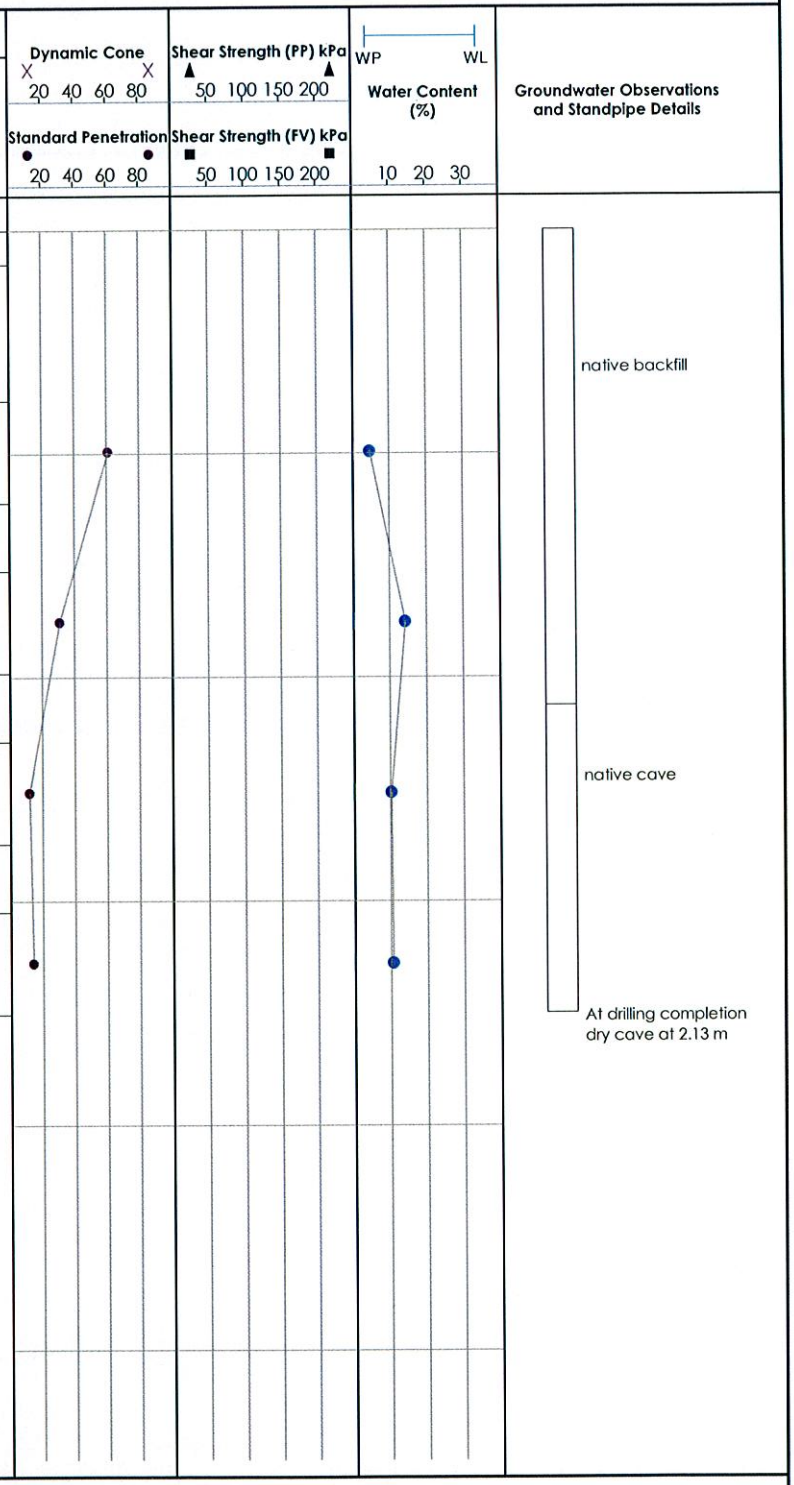
Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 400 mm				AS	
1.00	***FILL:*** very dense dark brownish grey silt, some sand, trace gravel and brick, moist		-1.00	1	SS	61
	dense grey, brown and black silty sand and gravel, some tar, very moist			2	SS	31
2.00			-2.00			
	SILT TILL: compact grey sandy silt, trace gravel, very moist to wet			3	SS	12
3.00			-3.00			
				4	SS	14
	Borehole terminated at 2.13 m					
4.00			-4.00			
5.00			-5.00			



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 7

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							asphaltic concrete
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm Granular 'A': 150 mm Granular 'B': 500 mm									native backfill
1.00	Borehole terminated at 0.80 m upon auger refusal on culvert		-1.00							
2.00			-2.00							
3.00			-3.00							
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 8

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm				AS	
1.00	***FILL:*** compact brown silty sand, some gravel, very moist		-1.00	1	SS	14
2.00	***SAND:*** compact brown silty sand, some gravel, very moist		-2.00	2	SS	17
	trace gravel, wet to saturated			3	SS	17
3.00	silty sand, saturated		-3.00	4	SS	16
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

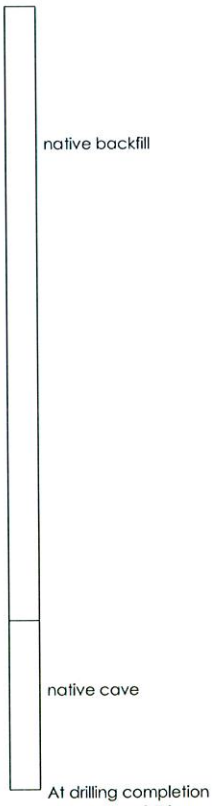
Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 9

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	SAMPLE Number	Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			1	AS	asphalt
1.00	***FILL:*** dense grey brown sandy silt, trace gravel, moist		-1.00	2	SS	44
	SILT TILL: compact brown silt, some sand, trace gravel, moist; rusty			3	SS	28
2.00	dense		-2.00	4	SS	41
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 10

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 28, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							
	PAVEMENT STRUCTURE: Granular material: 850 mm			1	AS					native backfill
1.00	***FILL:*** compact dark brownish grey silt, some sand, trace gravel and clay		-1.00	2	SS	19				
	SILT TILL: compact brown silt, some sand, trace gravel and clay, moist			3	SS	22				
2.00			-2.00							
3.00	dense, moist to very moist		-3.00	4	SS	38				native cave
	Borehole terminated at 3.51 m									
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 11

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm					
1.00	***SILT TILL:*** compact brown silt, some sand, trace gravel, moist		-1.00	1	SS	26
	sandy silt			2	SS	18
3.00	dense, trace clay		-3.00	3	SS	33
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 12

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Aspahltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 400 mm					
1.00	***SILT TILL:*** very dense brown silt, some sand, trace gravel, moist		-1.00	1	SS	63
	compact sandy silt, trace gravel			2	SS	18
2.00	dense, trace sand		-2.00	3	SS	44
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

asphaltic concrete

native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 13

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 30 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone / Standard Penetration	Shear Strength (PP) kPa / Shear Strength (FV) kPa	Water Content (%)	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value	X 20 40 60 80 X; ● 20 40 60 80 ●	▲ 50 100 150 200 ▲; ■ 50 100 150 200 ■	WP WL; 10 20 30	
0.00	Ground Elevation		0.00							
	PAVEMENT STRUCTURE: Aspahltic concrete: 100 mm; Granular 'A': 200 mm; Granular 'B': 300 mm									asphaltic concrete
	FILL: compact brown sandy silt, trace gravel, very moist									native backfill
1.00			-1.00	1	SS	12	●		●	
	Borehole terminated at 1.52 m									
2.00			-2.00							
3.00			-3.00							
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 14

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			1	AS	
1.00	***SILT TILL:*** compact brown sandy silt, some gravel, moist		-1.00	2	SS	24
	trace gravel, moist			3	SS	25
2.00			-2.00			
	some sand, moist			4	SS	21
3.00			-3.00	5	SS	26
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

WP — WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

asphaltic concrete

native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 15

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm			1	AS	
1.00	***FILL:*** compact brown sand and gravel, some silt, damp to moist		-1.00	2	SS	28
2.00	***SAND:*** dense brown silty sand, some gravel, moist		-2.00	3	SS	34
	very dense			4	SS	69
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 16

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 30, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							asphaltic concrete
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm Granular 'B': 500 mm									native backfill
	SILT TILL: compact brown silt, some sand, trace gravel and clay, moist									
1.00			-1.00	1	SS	16	●		●	
	Borehole terminated at 1.52 m									
2.00			-2.00							
3.00			-3.00							
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 17

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			1	AS	
1.00	***SAND:*** dense brown sand, some silt and gravel, moist		-1.00	2	SS	35
	SILT TILL: compact brown sandy silt, some gravel, moist			3	SS	15
2.00	very dense, trace gravel		-2.00	4	SS	72
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X — 20 40 60 80 — X

Standard Penetration: ● — 20 40 60 80 — ●

Shear Strength (PP) kPa: ▲ — 50 100 150 200 — ▲

Shear Strength (FV) kPa: ■ — 50 100 150 200 — ■

WP — Water Content (%) — WL

10 20 30

Groundwater Observations and Standpipe Details

asphaltic concrete

native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 18

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm					
1.00	***FILL*** compact brown silty sand and gravel, moist		-1.00	1	SS	15
	loose brown to dark brown, some gravel, moist to very moist			2	SS	7
2.00	compact, brown		-2.00	3	SS	11
3.00	***SAND:*** compact brown silty sand, some gravel, very moist		-3.00	4	SS	13
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

native cave

At dilling completion dry cave at 3.05 m

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 19

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Granular material: 750 mm					
1.00	***FILL:*** compact brown to dark brown sandy silt, some gravel, moist to very moist		-1.00	1	SS	20
	dense, grey and brown, moist			2	SS	32
2.00	cobbles		-2.00			
	compact, dark grey brown, moist to very moist			3	SS	17
3.00			-3.00			
	SAND: compact grey silty sand, trace gravel, very moist			4	SS	18
	Borehole terminated at 3.66 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 20

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Granular 'A': 200 mm Granular 'B': 700 mm					
1.00	***FILL:*** dense dark brown silt, some sand, trace gravel and organics, moist to very moist		-1.00	1	SS	30
	grey and brown sandy silt, trace gravel and tar			2	SS	30
2.00	***SAND:*** compact grey silty sand, some gravel, very moist		-2.00	3	SS	14
3.00	trace gravel, wet		-3.00	4	SS	23
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

native cave

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 21

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 30, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 100 mm; Granular 'A': 100 mm; Granular 'B': 600 mm					
1.00	***SAND AND GRAVEL:*** dense brown silty sand and gravel, moist		-1.00	1	SS	33
	Borehole terminated at 1.52 m					
2.00			-2.00			
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 22

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm				AS	
					AS	
1.00	***FILL:*** compact brown silty sand, some gravel, moist to very moist		-1.00	1	SS	14
				2	SS	16
2.00	***SAND:*** dense brown silty sand, some gravel, very moist		-2.00	3	SS	33
3.00	***SILT TILL:*** dense grey brown silt, some sand and gravel, trace clay, very moist		-3.00	4	SS	49
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

Water Content (%) WP WL 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 23

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), some sand, moist					
	compact brown silty sand, some gravel, moist					
1.00			-1.00	1	SS	23
	silty sand and gravel, occasional cobbles, very moist			2	SS	24
2.00			-2.00			
	SAND: compact brown silty sand, some fine gravel, moist to very moist			3	SS	22
3.00			-3.00			
	very dense, some fine to coarse gravel			4	SS	77
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X — 20 40 60 80 — X

Standard Penetration: ● — 20 40 60 80 — ●

Shear Strength (PP) kPa: ▲ — 50 100 150 200 — ▲

Shear Strength (FV) kPa: ■ — 50 100 150 200 — ■

WP — Water Content (%) — WL

10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 24

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	SAMPLE Number	SAMPLE Type	SAMPLE N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 450 mm					
1.00	***FILL:*** dense brown silty sand, some gravel, moist		-1.00	1	SS	45
	SAND: very dense brown silty sand, some gravel, occasional cobbles, moist					
2.00			-2.00	2	SS	75
	Borehole terminated at 2.13 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

WP — WL — Water Content (%) 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 25

Ground Elevation: *N/A*

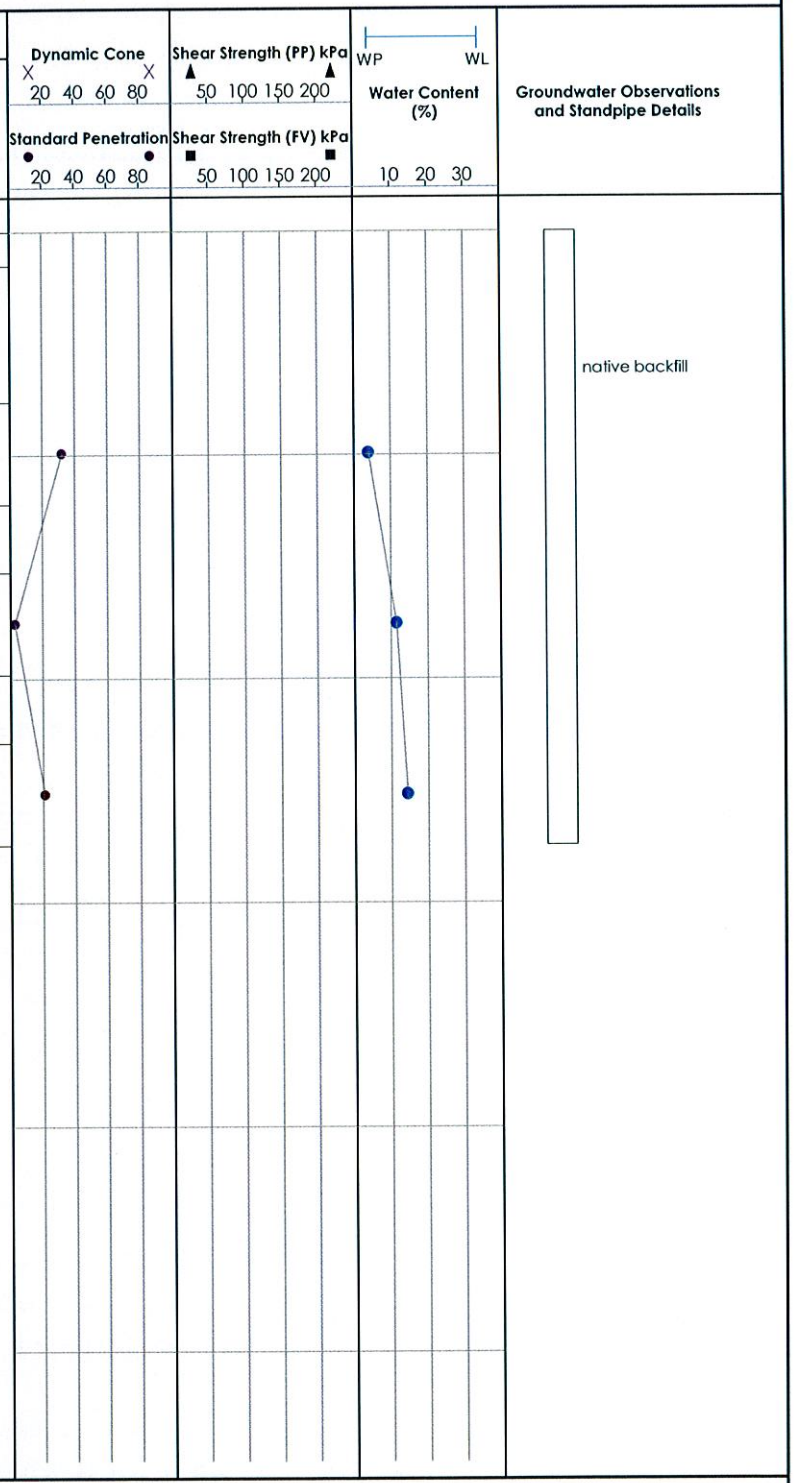
Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm				AS	
					AS	
1.00	***FILL:*** dense brown sand and gravel, some silt, damp to moist		-1.00	1	SS	32
	very loose silty sand, some gravel, very moist			2	SS	3
2.00	***SILT TILL:*** compact brown silt, some clay, trace sand and gravel, very moist		-2.00	3	SS	21
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 26

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *November 2, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 150 mm; Granular 'A': 100 mm; Grnaular 'B': 600 mm			1	AS	
1.00	***SILT TILL:*** compact brown silt, trace sand, clay and gravel, very moist to wet		-1.00	2	SS	15
	dense, some mineral fragments			3	SS	42
2.00			-2.00	4	SS	46
3.00			-3.00	5	SS	44
4.00			-4.00			
	grey, some clay			6	SS	32
5.00	Borehole terminated at 5.03 m		-5.00			

Dynamic Cone / Standard Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: *Auger sample taken at 0.00-0.10 m.*
Bulk sample taken from 2.29-3.05 m.

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 27

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

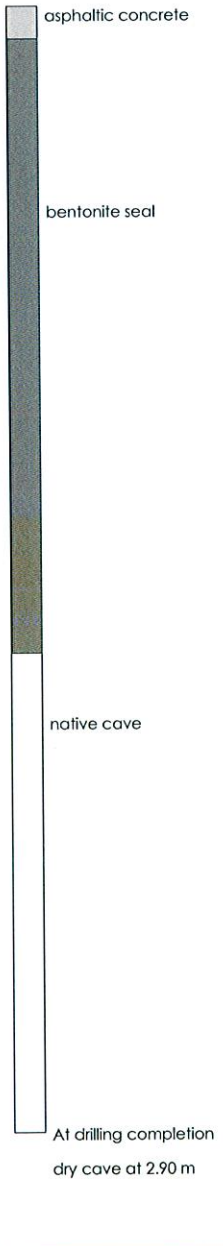
Drill Date: *November 2, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 200 mm; Grnaular 'B': 300 mm					
	FILL: dense brown silty sand and gravel, occasional cobbles, moist			1	SS	35
1.00			-1.00			
	compact			2	SS	17
2.00			-2.00			
	dark brown silt, some sand, trace wood and gravel, very moist			3	SS	12
	SAND: compact brown silty sand, trace gravel, saturated					
3.00			-3.00			
				4	SS	16
4.00			-4.00			
	some gravel			5	SS	17
5.00			-5.00			
	Borehole terminated at 5.03 m					

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

WP WL — Water Content (%) 10 20 30



Groundwater Observations and Standpipe Details

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: *Auger sample taken at 0.00-0.10 m.*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 28

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *November 2, 2009*

Depth (m)	Description	Symbol	Elevation (m)	SAMPLE Number	SAMPLE Type	SAMPLE N-Value
	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Granular material: 750 mm					
	FILL: compact brown sand, some gravel, very moist		-1.00	2	SS	16
1.00						
	SILT TILL: compact brown silt, some sand, trace gravel and clay, moist			3	SS	22
2.00			-2.00			
	very dense, trace sand			4	SS	50\150mm
3.00			-3.00			
	occasional cobbles			5	SS	50\150mm
	numerous cobbles					
4.00			-4.00			
	grey brown			6	SS	50\150mm
5.00	Borehole terminated at 4.88 m		-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 29

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *November 2, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 200 mm; Granular 'B': 300 mm			1	AS	
1.00	***FILL:*** compact brown silty sand, some gravel, moist		-1.00	2	SS	16
	SILT TILL: compact brown silt, some sand, trace gravel, moist			3	SS	16
2.00			-2.00			
				4	SS	15
3.00			-3.00			
	SAND: very dense brown silty sand, trace gravel, damp			5	SS	50
	some gravel, occasional cobbles, moist to very moist					
4.00			-4.00			
				6	SS	56
5.00	***SILT TILL:*** very dense brown sandy silt, trace gravel, moist		-5.00			
	Borehole terminated at 5.03 m					

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

Water Content (%) WP WL 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: *Auger sample taken from 0.00-0.10 m*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 30

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 100 mm; Granular 'B': 600 mm					
1.00	***SAND:*** compact to very dense grey brown silty sand, some gravel, numerous cobbles and boulders, moist		-1.00	1	AS	*
	compact, brown			2	SS	11
2.00	dense, occasional cobbles		-2.00	3	SS	39
	Borehole terminated at 2.74 m					
3.00			-3.00			
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X): 20 40 60 80

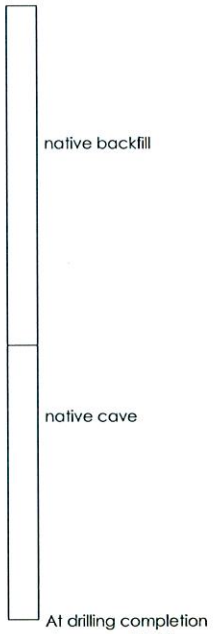
Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

Water Content (%): WP – WL; 10 20 30

Groundwater Observations and Standpipe Details



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: **Sampler bouncing on cobbles and boulders*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 31

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 100 mm; Granular 'B': 500 mm					
1.00	***FILL:*** compact brown sand, some silt, trace gravel, very moist		-1.00	1	SS	16
	dark brownish grey silt, some sand, trace gravel, moist to very moist			2	SS	24
2.00			-2.00			
	SAND AND GRAVEL: compact brown silty sand and gravel, occasional cobbles, very moist			3	SS	25
3.00			-3.00			
	SILT TILL: compact brown silt, some sand, trace gravel and clay, very moist			4	SS	17
4.00			-4.00			
	dense, trace sand			5	SS	42
5.00	Borehole terminated at 5.03 m		-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP 10 20 30 WL

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 32

Ground Elevation: *N/A*

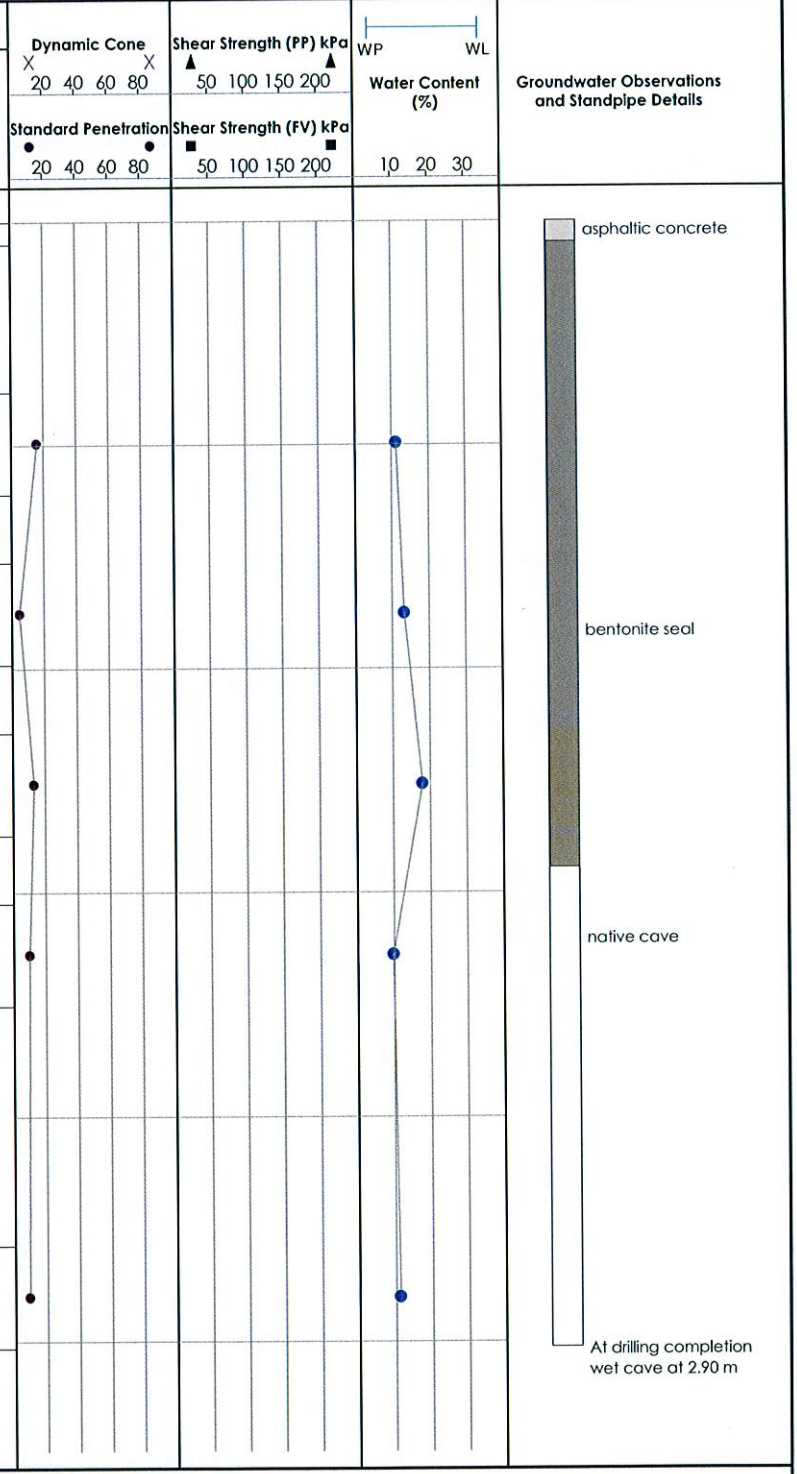
Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation	0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			AS	
1.00	***FILL:*** compact dark brown and grey silt, some sand, trace gravel, very moist	-1.00	1	SS	16
	loose dark brown silt, some sand, organics and gravel, very moist		2	SS	5
2.00	***SAND:*** compact grey silty fine sand, trace gravel, wet	-2.00	3	SS	13
	grey brown silty sand, saturated				
3.00		-3.00	4	SS	10
	brown, trace gravel				
4.00		-4.00			
	loose, grey		5	SS	9
5.00	Borehole terminated at 5.03 m	-5.00			



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 33

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 150 mm; Granular 'A': 150 mm; Granular 'B': 500 mm					
1.00	***FILL:*** dense brown silty sand, some gravel, occasional cobbles, moist		-1.00	1	SS	46
	numerous cobbles and boulders			2	SS	43
2.00			-2.00	3		50\50mm
3.00	***SAND AND GRAVEL:*** dense grey and brown sand and gravel, some silt, numerous cobbles and boulders, damp to moist		-3.00	4	SS	44
	SILT TILL: dense brown sandy silt, some gravel, moist					
4.00	compact brown silt, trace sand, gravel and clay, very moist		-4.00	5	SS	28
5.00	Borehole terminated at 5.03 m		-5.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration ● 20 40 60 80

Shear Strength (PP) kPa ▲ 50 100 150 200 — Shear Strength (FV) kPa ■ 50 100 150 200

WP WL — Water Content (%) 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: *Bulk sample taken from 3.05-3.96 m*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 34

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation	0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 150 mm; Granular 'A': 150 mm			BS / AS	
	FILL: very dense brown sand and gravel, some silt, numerous cobbles and boulders, moist		1		*
1.00		-1.00			
	grey brown silty sand, some gravel		2	SS	60
2.00		-2.00			
	compact, brown to dark brown		3	SS	20
3.00		-3.00			
	trace topsoil and organics, moist to very moist		4	SS	13
	Borehole terminated at 3.51 m				
4.00		-4.00			
5.00		-5.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

Water Content (%) WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes: **Sampler bouncing on cobbles and boulders*

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 35

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Job No.: *8506G1*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Drill Date: *October 29, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							
	FILL: dark brown silt (topsoil), some sand, trace gravel, moist									
	compact brown silt, some sand, trace gravel, clay and wood fragments, moist									
1.00			-1.00	1	SS	19				
										native backfill
				2	SS	49				
2.00	dense brown silt, some sand and gravel, trace clay, occasional cobbles, moist		-2.00							
	loose brown to dark brown, trace gravel and wood fragments, very moist			3	SS	7				
	SAND: compact grey silty sand, some gravel, moist									
3.00			-3.00	4	SS	23				
	Borehole terminated at 3.66 m									
4.00			-4.00							
5.00			-5.00							

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 36

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 29, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), some sand, moist					
	compact grey to brown silt, some clay and sand, trace gravel, damp to moist			1	SS	20
1.00			-1.00			
	brown			2	SS	10
2.00			-2.00			
	SILT TILL: compact brown silt, some clay and sand, trace gravel, moist to very moist			3	SS	20
3.00			-3.00			
	dense, trace sand			4	SS	33
	Borehole terminated at 3.51 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone (X) / Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲) / Shear Strength (FV) kPa (■): 50 100 150 200

Water Content (%): WP – WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 37

Ground Elevation: *N/A*

Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *November 3, 2009*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), very moist					
	compact brown silty sand, some gravel, moist to very moist			1	SS	18
1.00			-1.00	2	SS	7
	SAND TILL: compact brown silty sand, some gravel, moist to very moist			3	SS	13
2.00	***SAND:*** compact brown fine to coarse sand, some silt, saturated		-2.00	4	SS	23
	SILT TILL: very dense brown silt, some sand and gravel, trace clay, moist			5	SS	27\150mm
3.00			-3.00			
	Borehole terminated at 3.35 m					
4.00			-4.00			
5.00			-5.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *RM*

Sheet: *1 of 1*

Drafted by: *SM*

Borehole Number: 38

Ground Elevation: *N/A*

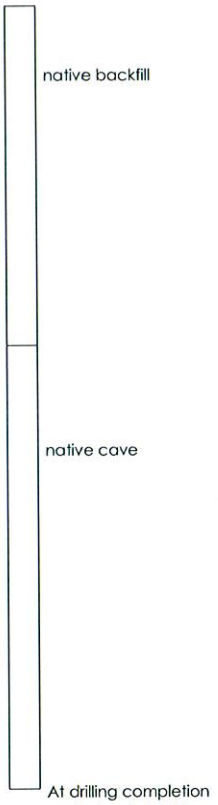
Project: *Geotechnical Investigation - Widening of Maple Grove Road*

Location: *Fountain Street to Speedville Road, Cambridge, Ontario*

Job No.: *8506G1*

Drill Date: *October 28, 2009*

SOIL PROFILE				SAMPLE			Dynamic Cone (X) 20 40 60 80 / Standard Penetration (●) 20 40 60 80	Shear Strength (PP) kPa (▲) 50 100 150 200 / Shear Strength (FV) kPa (■) 50 100 150 200	WP WL Water Content (%) 10 20 30	Groundwater Observations and Standpipe Details
Depth (m)	Description	Symbol	Elevation (m)	Number	Type	N-Value				
0.00	Ground Elevation		0.00							
	PAVEMENT STRUCTURE: Granular material: 750 mm									
1.00	***FILL:*** loose brown to dark brown silt, some sand and gravel		-1.00	1	SS	8				
	brown sand and gravel			2	SS	4				
2.00			-2.00							
	SAND: compact brown silty sand, trace gravel, wet			3	SS	17				
3.00			-3.00							
	some gravel			4	SS	16				
	Borehole terminated at 3.51 m									
4.00			-4.00							
5.00			-5.00							



Reviewed by: *CA*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DS*

Sheet: *1 of 1*

Drafted by: *SM*

LVM

Borehole Number: 01-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 110 mm; Granular 'A': 100 mm; Granular 'B': 300 mm			1	AS	
	FILL: compact brown silty sand, trace gravel, moist					
1.00			-1.00	2	SS	23
	SILT TILL: dense brown silt, some sand, trace gravel and clay, moist					
				3	SS	43
2.00			-2.00			
	very dense, occasional cobbles			4	SS	52
3.00			-3.00			
	dense			5	SS	39
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.10-0.20 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 02-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, moist			1	AS	
1.00	***SILT TILL:*** compact brown silt, some sand, trace clay and gravel, moist		-1.00	2	SS	28
	very dense			3	SS	58
2.00			-2.00			
	compact			4	SS	25
3.00			-3.00			
	dense, occasional cobbles			5	SS	46
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X — 20 40 60 80 — X

Standard Penetration: ● — 20 40 60 80 — ●

Shear Strength (PP) kPa: ▲ — 50 100 150 200 — ▲

Shear Strength (FV) kPa: ■ — 50 100 150 200 — ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.30-0.61 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 03-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown silty sand and gravel, moist					
	compact silt, some sand, trace gravel, very moist			2	SS	17
1.00			-1.00			
	SILT TILL: compact brown silt, some clay, trace sand and gravel, moist			3	SS	22
2.00			-2.00			
	grey brown, wet			4	SS	27
	moist					
3.00			-3.00	5	SS	90
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 04-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 120 mm; Granular 'A': 150 mm; Granular 'B': 500 mm			1	AS	
1.00	***SILT TILL:*** compact brown sandy silt, trace clay and gravel, very moist		-1.00	2	SS	22
	some clay and sand			3	SS	20
2.00			-2.00			
	dense			4	SS	40
3.00			-3.00			
	trace clay, moist			5	SS	48
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

Water Content (%): WP – WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.12-0.25 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 05-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), trace sand, moist					
	compact brown silty sand, trace gravel and topsoil					
1.00			-1.00	2	SS	11
	SILT: compact brown silt, some sand and clay, trace gravel, moist					
2.00			-2.00	3	SS	20
	SAND: compact brown silty sand, wet					
3.00			-3.00	4	SS	25
				5	SS	31
	SILT TILL: dense brown silt, some sand and clay,trace gravel, very moist					
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 06-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), trace sand, moist					
	brown silt, some sand, trace gravel, occasional cobbles					
	SAND: loose brown silty sand, moist		-1.00	2	SS	6
1.00						
	SILT TILL: dense grey brown silt, some clay, trace sand and gravel, moist			3	SS	31
2.00			-2.00			
	hard grey clayey silt, DTPL			4	SS	30
3.00			-3.00			
				5	SS	30
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

Borehole Number: 07-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topoil), some sand, trace gravel, moist					
	rusty brown sand, some silt and gravel					
1.00			-1.00	2	SS	8
	trace gravel					
				3	SS	8
2.00			-2.00			
	SILT TILL: compact brown silt, some clay, trace sand and gravel, moist			4	SS	16
	fine sand seam, moist					
3.00			-3.00			
	dense, grey			5	SS	32
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 08-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 120 mm; Granular 'A': 100 mm; Granular 'B': 300 mm			1	AS	
	FILL: compact brown and dark brown silty sand, some gravel, moist to very moist			2	SS	17
1.00			-1.00			
				3	SS	14
2.00			-2.00			
	loose silt, some sand, trace clay and gravel, very moist			4	SS	6
	SILT TILL: compact brown silt, some clay, trace sand and gravel, moist					
3.00			-3.00	5	SS	10
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.12-0.20m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 09-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-30*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 120 mm; Granular 'A': 150 mm			1	AS	
	FILL: dense brown sand and gravel, some silt, occasional cobbles, very moist			2	SS	38
1.00			-1.00			
	very dense silt and sand, some gravel, moist			3	SS	58
2.00			-2.00			
	dense sandy silt			4	SS	32
	SILT TILL: compact brown silt, some sand, trace gravel, moist					
3.00			-3.00	5	SS	18
4.00			-4.00	6	SS	23
	Borehole terminated at 4.27 m					

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; bentonite seal

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.12-0.25 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 11-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
0.00	***PAVEMENT STRUCTURE:*** Asphaltic concrete: 150 mm; Granular 'A': 100 mm					
	FILL: compact brown silty sand and gravel, occasional cobbles, moist			1	AS	
1.00			-1.00	2	SS	27
	SILT TILL: dense brown silt, some sand, trace gravel and clay, moist			3	SS	30
2.00			-2.00	4	SS	30
	occasional cobbles					
3.00	some clay		-3.00	5	SS	34
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone (X) 20 40 60 80 — Standard Penetration (●) 20 40 60 80

Shear Strength (PP) kPa (▲) 50 100 150 200 — Shear Strength (FV) kPa (■) 50 100 150 200

Water Content (%) WP WL 10 20 30

Groundwater Observations and Standpipe Details: asphaltic concrete; native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.25-0.61 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 12-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-24*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	PAVEMENT STRUCTURE: Asphaltic concrete: 120 mm; Granular 'A': 100 mm; Granular 'B': 400 mm			1	AS	
	SILT TILL: very dense brown silt, some sand, trace gravel, occasional cobbles, moist			2	SS	84
1.00			-1.00			
	dense			3	SS	48
2.00			-2.00			
	very dense, trace clay			4	SS	96
3.00			-3.00			
				5	SS	50\150mm
	Borehole terminated at 3.20 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.12-0.25 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

Borehole Number: 13-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: dark brown silt (topsoil), some sand, moist			1	AS	
	brown silty sand, some gravel					
	SILT TILL: compact brown silt, some sand, trace clay and gravel, moist			2	SS	16
1.00			-1.00			
	very moist			3	SS	28
2.00			-2.00			
	dense, occasional cobbles, moist			4	SS	30
3.00			-3.00			
				5	SS	33
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.15-0.30 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

Borehole Number: 14-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, trace topsoil, moist					
1.00	***SILT TILL:*** compact brown silt, some sand, trace clay and gravel, moist		-1.00	1	SS	21
	very moist			2	SS	32
2.00	occasional cobbles, moist		-2.00	3	SS	36
3.00	very dense, some gravel		-3.00	4	SS	77
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200

Shear Strength (FV) kPa: 50 100 150 200

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 15-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, occasional cobbles, moist			1	AS	
	sand, some silt, trace gravel, very moist			2	SS	22
1.00			-1.00			
	SAND: compact brown sand, some silt, trace gravel, saturated			3	SS	15
2.00			-2.00			
	SILT TILL: compact brown silt, some sand, trace gravel and clay, very moist			4	SS	12
3.00			-3.00			
	grey, some clay			5	SS	37
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X — 20 40 60 80 — X

Standard Penetration: ● — 20 40 60 80 — ●

Shear Strength (PP) kPa: ▲ — 50 100 150 200 — ▲

Shear Strength (FV) kPa: ■ — 50 100 150 200 — ■

Water Content (%): WP — 10 20 30 — WL

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.15-0.46 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 16-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, occasional cobbles, moist			1	AS	
	dense			2	SS	42
1.00			-1.00			
	SAND: dense grey and brown silty sand, some gravel, very moist to wet			3	SS	31
2.00			-2.00			
	wet to saturated			4	SS	22
3.00			-3.00			
	SILT TILL: compact grey silt, some fine sand, trace gravel, very moist			5	SS	14
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X 20 40 60 80 X

Standard Penetration: ● 20 40 60 80 ●

Shear Strength (PP) kPa: ▲ 50 100 150 200 ▲

Shear Strength (FV) kPa: ■ 50 100 150 200 ■

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes: *Auger Sample taken from 0.30-0.61 m*

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 17-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-30*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, occasional cobbles, moist					
	dense grey brown silty sand, trace gravel and bricks, very moist			1	SS	44
1.00			-1.00			
	SAND: dense grey sand, some silt and organics, trace topsoil, wet			2	SS	36
	SILT TILL: dense grey silt, some sand, trace gravel and clay, moist					
2.00			-2.00			
	compact, trace brown organics, saturated			3	SS	10
3.00			-3.00			
	silt some clay, trace sand and gravel, moist			4	SS	16
	Borehole terminated at 3.51 m					
4.00			-4.00			

Dynamic Cone: X — X; 20 40 60 80

Standard Penetration: ● — ●; 20 40 60 80

Shear Strength (PP) kPa: ▲ — ▲; 50 100 150 200

Shear Strength (FV) kPa: ■ — ■; 50 100 150 200

Water Content (%): WP — WL; 10 20 30

Groundwater Observations and Standpipe Details: native backfill

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

LVM

Borehole Number: 18-10

Ground Elevation: *N/A*

Project: *Widening of Maple Grove Road*

Job No.: *P030373-100*

Location: *Fountain Street to Speedsville Road, Cambridge, Ontario*

Drill Date: *2010-09-23*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		0.00			
	FILL: brown sand and gravel, some silt, moist					
	compact			1	SS	22
1.00			-1.00			
				2	SS	10
2.00	Borehole terminated at 2.13 m upon contact with water main		-2.00			
3.00			-3.00			
4.00			-4.00			

Dynamic Cone (X): 20 40 60 80

Standard Penetration (●): 20 40 60 80

Shear Strength (PP) kPa (▲): 50 100 150 200

Shear Strength (FV) kPa (■): 50 100 150 200

Water Content (%): WP – WL; 10 20 30

Groundwater Observations and Standpipe Details

Reviewed by: *VMarshall*

Drill Method: *Solid Stem Auger*

Notes:

Field Tech.: *DSouter*

Sheet: *1 of 1*

Drafted by: *SMeteer*

APPENDIX F

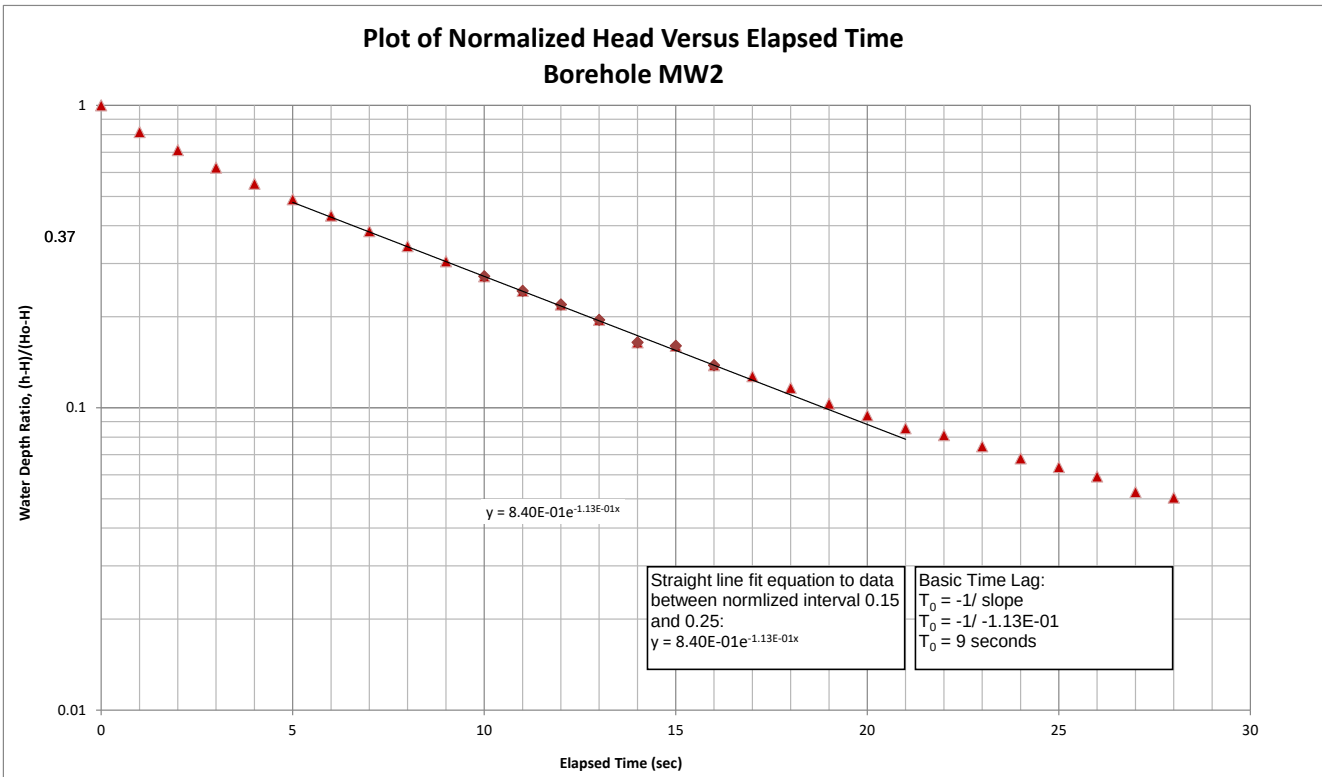
Borehole Permeability Testing Plots

Estimation of K by Slug Test, based on Hvorslev equation

Date:	Apr. 16, 2019		Static water depth, H:	1.03	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	1.49	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW2		Basic time lag, To:	9	sec
Well Screen Bottom:	8.5	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	306.48	masl			
Static Water Level:	1.03	mbgs			
Ground Elevation:	306.48	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**6.5E-03**	cm/s
WATER LEVEL BEFORE TEST = H =	1.03	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	1.486	304.99
1.0	1.402	305.08
2.0	1.354	305.13
3.0	1.314	305.17
4.0	1.281	305.20
5.0	1.253	305.23
6.0	1.227	305.25
7.0	1.205	305.28
8.0	1.186	305.29
9.0	1.169	305.31
10.0	1.154	305.33
11.0	1.141	305.34
12.0	1.130	305.35
13.0	1.119	305.36
14.0	1.105	305.38
15.0	1.103	305.38
16.0	1.093	305.39
17.0	1.088	305.39
18.0	1.083	305.40
19.0	1.077	305.40
20.0	1.073	305.41
21.0	1.069	305.41
22.0	1.067	305.41
23.0	1.064	305.42
24.0	1.061	305.42
25.0	1.059	305.42
26.0	1.057	305.42
27.0	1.054	305.43
28.0	1.053	305.43

Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.456	0.456	1.000
1	0.372	0.456	0.816
2	0.324	0.456	0.711
3	0.284	0.456	0.623
4	0.251	0.456	0.550
5	0.223	0.456	0.489
6	0.197	0.456	0.432
7	0.175	0.456	0.384
8	0.156	0.456	0.342
9	0.139	0.456	0.305
10	0.124	0.456	0.272
11	0.111	0.456	0.243
12	0.100	0.456	0.219
13	0.089	0.456	0.195
14	0.075	0.456	0.164
15	0.073	0.456	0.160
16	0.063	0.456	0.138
17	0.058	0.456	0.127
18	0.053	0.456	0.116
19	0.047	0.456	0.103
20	0.043	0.456	0.094
21	0.039	0.456	0.086
22	0.037	0.456	0.081
23	0.034	0.456	0.075
24	0.031	0.456	0.068
25	0.029	0.456	0.064
26	0.027	0.456	0.059
27	0.024	0.456	0.053
28	0.023	0.456	0.050


Plot of Normalized Head Versus Elapsed Time
Borehole MW2
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
5
10
15
20
25
30
Elapsed Time (sec)
y = 8.40E-01e-1.13E-01x
Straight line fit equation to data between normlized interval 0.15 and 0.25:
y = 8.40E-01e-1.13E-01x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -1.13E-01
T0 = 9 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	Apr. 17, 2019		Static water depth, H:	0.62	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	2.09	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW6		Basic time lag, To:	54	sec
Well Screen Bottom:	11.4	mbgs	Length of well screen, L:	300	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	301.25	masl			
Static Water Level:	0.62	mbgs			
Ground Elevation:	301.25	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**6.8E-04**	cm/s
WATER LEVEL BEFORE TEST = H =	0.62	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	2.085	299.16
1.0	2.024	299.23
2.0	1.989	299.26
3.0	1.957	299.29
4.0	1.926	299.32
5.0	1.896	299.35
6.0	1.868	299.38
7.0	1.840	299.41
8.0	1.813	299.44
9.0	1.788	299.46
10.0	1.733	299.52
11.0	1.734	299.52
12.0	1.714	299.54
13.0	1.689	299.56
14.0	1.667	299.58
15.0	1.646	299.60
16.0	1.625	299.62
17.0	1.604	299.65
18.0	1.583	299.67
19.0	1.563	299.69
20.0	1.543	299.71
21.0	1.524	299.73
22.0	1.505	299.75
23.0	1.486	299.76
24.0	1.468	299.78
25.0	1.451	299.80
26.0	1.433	299.82
27.0	1.417	299.83
28.0	1.400	299.85
29.0	1.385	299.87
30.0	1.366	299.88
31.0	1.353	299.90
32.0	1.337	299.91
33.0	1.324	299.93
34.0	1.310	299.94
35.0	1.296	299.95
36.0	1.283	299.97
37.0	1.270	299.98
38.0	1.256	299.99

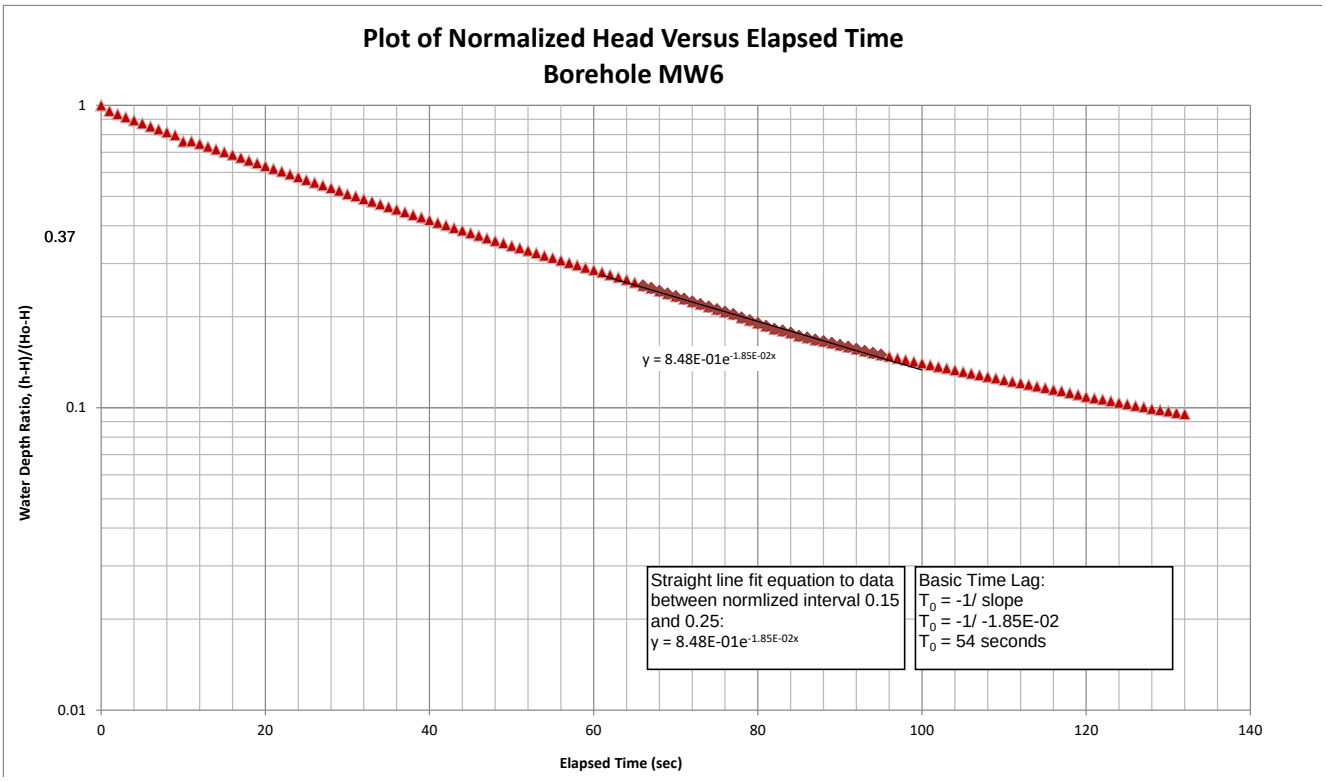
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	1.465	1.465	1.000
1	1.404	1.465	0.958
2	1.369	1.465	0.935
3	1.337	1.465	0.912
4	1.306	1.465	0.892
5	1.276	1.465	0.871
6	1.248	1.465	0.852
7	1.220	1.465	0.833
8	1.193	1.465	0.814
9	1.168	1.465	0.797
10	1.113	1.465	0.759
11	1.114	1.465	0.761
12	1.094	1.465	0.746
13	1.069	1.465	0.730
14	1.047	1.465	0.715
15	1.026	1.465	0.700
16	1.005	1.465	0.686
17	0.984	1.465	0.672
18	0.963	1.465	0.657
19	0.943	1.465	0.644
20	0.923	1.465	0.630
21	0.904	1.465	0.617
22	0.885	1.465	0.604
23	0.866	1.465	0.591
24	0.848	1.465	0.579
25	0.831	1.465	0.567
26	0.813	1.465	0.555
27	0.797	1.465	0.544
28	0.780	1.465	0.533
29	0.765	1.465	0.522
30	0.746	1.465	0.509
31	0.733	1.465	0.501
32	0.717	1.465	0.490
33	0.704	1.465	0.481
34	0.690	1.465	0.471
35	0.676	1.465	0.461
36	0.663	1.465	0.452
37	0.650	1.465	0.443
38	0.636	1.465	0.434

39.0	1.244	300.01
40.0	1.231	300.02
41.0	1.219	300.03
42.0	1.208	300.04
43.0	1.196	300.05
44.0	1.185	300.07
45.0	1.174	300.08
46.0	1.163	300.09
47.0	1.152	300.10
48.0	1.142	300.11
49.0	1.133	300.12
50.0	1.123	300.13
51.0	1.114	300.14
52.0	1.105	300.15
53.0	1.096	300.15
54.0	1.087	300.16
55.0	1.078	300.17
56.0	1.070	300.18
57.0	1.062	300.19
58.0	1.054	300.20
59.0	1.046	300.20
60.0	1.038	300.21
61.0	1.031	300.22
62.0	1.023	300.23
63.0	1.016	300.23
64.0	1.008	300.24
65.0	1.000	300.25
66.0	0.992	300.26
67.0	0.984	300.27
68.0	0.977	300.27
69.0	0.970	300.28
70.0	0.962	300.29
71.0	0.956	300.29
72.0	0.949	300.30
73.0	0.942	300.31
74.0	0.936	300.31
75.0	0.930	300.32
76.0	0.924	300.33
77.0	0.919	300.33
78.0	0.911	300.34
79.0	0.905	300.35
80.0	0.899	300.35
81.0	0.893	300.36
82.0	0.887	300.36
83.0	0.883	300.37
84.0	0.879	300.37
85.0	0.873	300.38
86.0	0.870	300.38
87.0	0.866	300.38
88.0	0.863	300.39
89.0	0.860	300.39
90.0	0.856	300.39
91.0	0.853	300.40
92.0	0.849	300.40
93.0	0.846	300.40
94.0	0.842	300.41
95.0	0.839	300.41
96.0	0.837	300.41

39	0.624	1.465	0.426
40	0.611	1.465	0.417
41	0.599	1.465	0.409
42	0.588	1.465	0.401
43	0.576	1.465	0.393
44	0.565	1.465	0.385
45	0.554	1.465	0.378
46	0.543	1.465	0.371
47	0.532	1.465	0.363
48	0.522	1.465	0.357
49	0.513	1.465	0.350
50	0.503	1.465	0.343
51	0.494	1.465	0.337
52	0.485	1.465	0.331
53	0.476	1.465	0.325
54	0.467	1.465	0.319
55	0.458	1.465	0.313
56	0.450	1.465	0.307
57	0.442	1.465	0.301
58	0.434	1.465	0.296
59	0.426	1.465	0.291
60	0.418	1.465	0.285
61	0.411	1.465	0.280
62	0.403	1.465	0.275
63	0.396	1.465	0.270
64	0.388	1.465	0.265
65	0.380	1.465	0.259
66	0.372	1.465	0.254
67	0.364	1.465	0.249
68	0.357	1.465	0.243
69	0.350	1.465	0.239
70	0.342	1.465	0.234
71	0.336	1.465	0.229
72	0.329	1.465	0.224
73	0.322	1.465	0.220
74	0.316	1.465	0.216
75	0.310	1.465	0.212
76	0.304	1.465	0.208
77	0.299	1.465	0.204
78	0.291	1.465	0.199
79	0.285	1.465	0.195
80	0.279	1.465	0.190
81	0.273	1.465	0.186
82	0.267	1.465	0.182
83	0.263	1.465	0.180
84	0.259	1.465	0.177
85	0.253	1.465	0.173
86	0.250	1.465	0.171
87	0.246	1.465	0.168
88	0.243	1.465	0.166
89	0.240	1.465	0.164
90	0.236	1.465	0.161
91	0.233	1.465	0.159
92	0.229	1.465	0.156
93	0.226	1.465	0.154
94	0.222	1.465	0.152
95	0.219	1.465	0.150
96	0.217	1.465	0.148

97.0	0.833	300.42
98.0	0.831	300.42
99.0	0.828	300.42
100.0	0.825	300.42
101.0	0.823	300.43
102.0	0.820	300.43
103.0	0.818	300.43
104.0	0.815	300.43
105.0	0.813	300.44
106.0	0.810	300.44
107.0	0.808	300.44
108.0	0.805	300.44
109.0	0.803	300.45
110.0	0.801	300.45
111.0	0.799	300.45
112.0	0.797	300.45
113.0	0.795	300.46
114.0	0.792	300.46
115.0	0.790	300.46
116.0	0.788	300.46
117.0	0.786	300.46
118.0	0.784	300.47
119.0	0.782	300.47
120.0	0.779	300.47
121.0	0.777	300.47
122.0	0.776	300.47
123.0	0.774	300.48
124.0	0.772	300.48
125.0	0.771	300.48
126.0	0.769	300.48
127.0	0.767	300.48
128.0	0.765	300.48
129.0	0.764	300.49
130.0	0.763	300.49
131.0	0.761	300.49
132.0	0.760	300.49
133.0	0.758	300.49
134.0	0.757	300.49
135.0	0.755	300.49
136.0	0.753	300.50
137.0	0.752	300.50
138.0	0.750	300.50
139.0	0.749	300.50
140.0	0.748	300.50
141.0	0.747	300.50
142.0	0.745	300.51
143.0	0.744	300.51
144.0	0.742	300.51
145.0	0.741	300.51
146.0	0.739	300.51
147.0	0.738	300.51
148.0	0.737	300.51
149.0	0.736	300.51
150.0	0.735	300.52
151.0	0.734	300.52
152.0	0.733	300.52
153.0	0.732	300.52
154.0	0.731	300.52

97	0.213	1.465	0.146
98	0.211	1.465	0.144
99	0.208	1.465	0.142
100	0.205	1.465	0.140
101	0.203	1.465	0.138
102	0.200	1.465	0.137
103	0.198	1.465	0.135
104	0.195	1.465	0.133
105	0.193	1.465	0.131
106	0.190	1.465	0.130
107	0.188	1.465	0.128
108	0.185	1.465	0.127
109	0.183	1.465	0.125
110	0.181	1.465	0.123
111	0.179	1.465	0.122
112	0.177	1.465	0.121
113	0.175	1.465	0.119
114	0.172	1.465	0.118
115	0.170	1.465	0.116
116	0.168	1.465	0.115
117	0.166	1.465	0.114
118	0.164	1.465	0.112
119	0.162	1.465	0.110
120	0.159	1.465	0.109
121	0.157	1.465	0.107
122	0.156	1.465	0.106
123	0.154	1.465	0.105
124	0.152	1.465	0.104
125	0.151	1.465	0.103
126	0.149	1.465	0.101
127	0.147	1.465	0.100
128	0.145	1.465	0.099
129	0.144	1.465	0.098
130	0.143	1.465	0.097
131	0.141	1.465	0.096
132	0.140	1.465	0.095
133	0.138	1.465	0.094
134	0.137	1.465	0.093
135	0.135	1.465	0.092
136	0.133	1.465	0.091
137	0.132	1.465	0.090
138	0.130	1.465	0.089
139	0.129	1.465	0.088
140	0.128	1.465	0.088
141	0.127	1.465	0.087
142	0.125	1.465	0.085
143	0.124	1.465	0.085
144	0.122	1.465	0.084
145	0.121	1.465	0.083
146	0.119	1.465	0.082
147	0.118	1.465	0.081
148	0.117	1.465	0.080
149	0.116	1.465	0.079
150	0.115	1.465	0.078
151	0.114	1.465	0.078
152	0.113	1.465	0.077
153	0.112	1.465	0.076
154	0.111	1.465	0.076


Plot of Normalized Head Versus Elapsed Time
Borehole MW6
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
20
40
60
80
100
120
140
Elapsed Time (sec)
y = 8.48E-01e-1.85E-02x
Straight line fit equation to data between normlized interval 0.15 and 0.25:
y = 8.48E-01e-1.85E-02x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -1.85E-02
T0 = 54 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	May 10, 2019		Static water depth, H:	1.525	mbgs
Conducted by:	J O		Water depth at time t = 0, Ho:	1.83	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW110		Basic time lag, To:	5,000	sec
Well Screen Bottom:	4.6	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	307.01	masl			
Static Water Level:	1.53	mbgs			
Ground Elevation:	307.01	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**1.2E-05**	cm/s
WATER LEVEL BEFORE TEST = H =	1.525	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	1.828	305.18
2.0	1.828	305.18
4.0	1.827	305.18
6.0	1.828	305.18
8.0	1.828	305.18
10.0	1.825	305.18
12.0	1.824	305.19
14.0	1.823	305.19
16.0	1.824	305.19
18.0	1.829	305.18
20.0	1.826	305.18
22.0	1.827	305.18
24.0	1.828	305.18
26.0	1.828	305.18
28.0	1.829	305.18
30.0	1.829	305.18
32.0	1.828	305.18
34.0	1.828	305.18
36.0	1.828	305.18
38.0	1.829	305.18
40.0	1.828	305.18
42.0	1.828	305.18
44.0	1.829	305.18
46.0	1.828	305.18
48.0	1.828	305.18
50.0	1.829	305.18
52.0	1.829	305.18
54.0	1.829	305.18
56.0	1.829	305.18
58.0	1.830	305.18
60.0	1.829	305.18
62.0	1.828	305.18
64.0	1.828	305.18
66.0	1.829	305.18
68.0	1.828	305.18
70.0	1.829	305.18
72.0	1.829	305.18
74.0	1.828	305.18
76.0	1.824	305.19

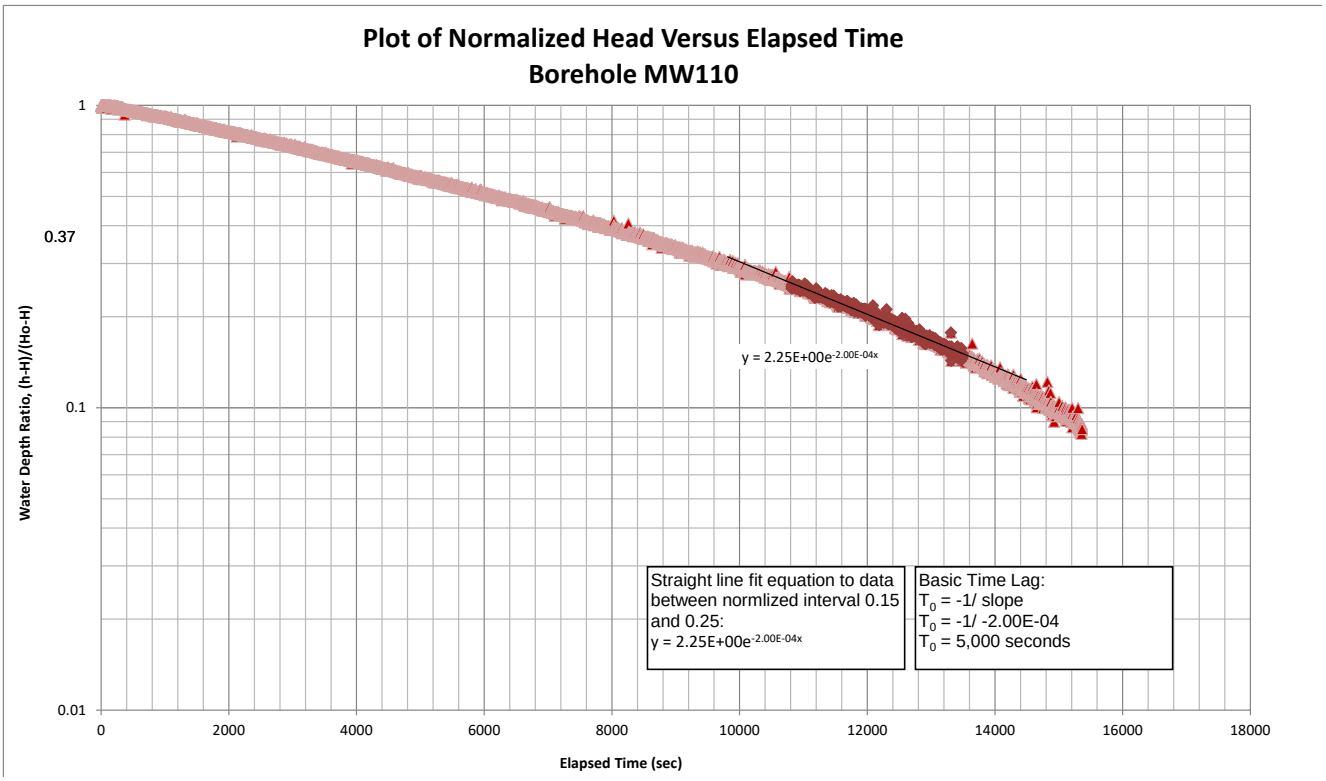
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.303	0.303	1.000
2	0.303	0.303	1.000
4	0.302	0.303	0.994
6	0.303	0.303	0.999
8	0.303	0.303	0.998
10	0.300	0.303	0.989
12	0.299	0.303	0.985
14	0.298	0.303	0.982
16	0.299	0.303	0.985
18	0.304	0.303	1.002
20	0.301	0.303	0.990
22	0.302	0.303	0.995
24	0.303	0.303	1.000
26	0.303	0.303	0.999
28	0.304	0.303	1.000
30	0.304	0.303	1.000
32	0.303	0.303	0.999
34	0.303	0.303	0.999
36	0.303	0.303	0.999
38	0.304	0.303	1.001
40	0.303	0.303	0.999
42	0.303	0.303	1.000
44	0.304	0.303	1.001
46	0.303	0.303	1.000
48	0.303	0.303	0.998
50	0.304	0.303	1.001
52	0.304	0.303	1.001
54	0.304	0.303	1.000
56	0.304	0.303	1.003
58	0.305	0.303	1.004
60	0.304	0.303	1.003
62	0.303	0.303	1.000
64	0.303	0.303	0.999
66	0.304	0.303	1.001
68	0.303	0.303	1.000
70	0.304	0.303	1.001
72	0.304	0.303	1.002
74	0.303	0.303	0.997
76	0.299	0.303	0.986

78.0	1.826	305.18
80.0	1.823	305.19
82.0	1.823	305.19
84.0	1.829	305.18
86.0	1.830	305.18
88.0	1.829	305.18
90.0	1.828	305.18
92.0	1.828	305.18
94.0	1.829	305.18
96.0	1.829	305.18
98.0	1.828	305.18
100.0	1.828	305.18
102.0	1.828	305.18
104.0	1.829	305.18
106.0	1.828	305.18
108.0	1.828	305.18
110.0	1.828	305.18
112.0	1.828	305.18
114.0	1.828	305.18
116.0	1.827	305.18
118.0	1.827	305.18
120.0	1.827	305.18
122.0	1.828	305.18
124.0	1.827	305.18
126.0	1.827	305.18
128.0	1.827	305.18
130.0	1.827	305.18
132.0	1.827	305.18
134.0	1.826	305.18
136.0	1.827	305.18
138.0	1.827	305.18
140.0	1.828	305.18
142.0	1.828	305.18
144.0	1.828	305.18
146.0	1.827	305.18
148.0	1.828	305.18
150.0	1.827	305.18
152.0	1.827	305.18
154.0	1.827	305.18
156.0	1.827	305.18
158.0	1.825	305.18
160.0	1.822	305.19
162.0	1.821	305.19
164.0	1.821	305.19
166.0	1.826	305.18
168.0	1.826	305.18
170.0	1.826	305.18
172.0	1.826	305.18
174.0	1.827	305.18
176.0	1.827	305.18
178.0	1.826	305.18
180.0	1.827	305.18
182.0	1.826	305.18
184.0	1.827	305.18
186.0	1.826	305.18
188.0	1.826	305.18
190.0	1.827	305.18
192.0	1.826	305.18

78	0.301	0.303	0.992
80	0.298	0.303	0.981
82	0.298	0.303	0.982
84	0.304	0.303	1.002
86	0.305	0.303	1.004
88	0.304	0.303	1.001
90	0.303	0.303	1.000
92	0.303	0.303	0.997
94	0.304	0.303	1.000
96	0.304	0.303	1.003
98	0.303	0.303	0.997
100	0.303	0.303	0.999
102	0.303	0.303	0.999
104	0.304	0.303	1.001
106	0.303	0.303	0.999
108	0.303	0.303	0.998
110	0.303	0.303	1.000
112	0.303	0.303	0.999
114	0.303	0.303	0.997
116	0.302	0.303	0.995
118	0.302	0.303	0.996
120	0.302	0.303	0.996
122	0.303	0.303	0.998
124	0.302	0.303	0.996
126	0.302	0.303	0.996
128	0.302	0.303	0.995
130	0.302	0.303	0.997
132	0.302	0.303	0.996
134	0.301	0.303	0.993
136	0.302	0.303	0.996
138	0.302	0.303	0.997
140	0.303	0.303	0.997
142	0.303	0.303	0.997
144	0.303	0.303	0.997
146	0.302	0.303	0.996
148	0.303	0.303	0.998
150	0.302	0.303	0.997
152	0.302	0.303	0.996
154	0.302	0.303	0.995
156	0.302	0.303	0.995
158	0.300	0.303	0.990
160	0.297	0.303	0.978
162	0.296	0.303	0.975
164	0.296	0.303	0.976
166	0.301	0.303	0.991
168	0.301	0.303	0.993
170	0.301	0.303	0.992
172	0.301	0.303	0.992
174	0.302	0.303	0.994
176	0.302	0.303	0.994
178	0.301	0.303	0.992
180	0.302	0.303	0.994
182	0.301	0.303	0.991
184	0.302	0.303	0.994
186	0.301	0.303	0.993
188	0.301	0.303	0.991
190	0.302	0.303	0.995
192	0.301	0.303	0.992

194.0	1.825	305.19
196.0	1.826	305.18
198.0	1.826	305.18
200.0	1.827	305.18
202.0	1.825	305.18
204.0	1.825	305.18
206.0	1.826	305.18
208.0	1.828	305.18
210.0	1.826	305.18
212.0	1.826	305.18
214.0	1.825	305.18
216.0	1.826	305.18
218.0	1.826	305.18
220.0	1.824	305.19
222.0	1.825	305.18
224.0	1.826	305.18
226.0	1.825	305.18
228.0	1.825	305.18
230.0	1.826	305.18
232.0	1.825	305.18
234.0	1.825	305.18
236.0	1.826	305.18
238.0	1.826	305.18
240.0	1.826	305.18
242.0	1.827	305.18
244.0	1.826	305.18
246.0	1.825	305.18
248.0	1.825	305.18
250.0	1.826	305.18
252.0	1.824	305.19
254.0	1.824	305.19
256.0	1.825	305.19
258.0	1.826	305.18
260.0	1.822	305.19
262.0	1.819	305.19
264.0	1.820	305.19
266.0	1.819	305.19
268.0	1.824	305.19
270.0	1.825	305.18
272.0	1.822	305.19
274.0	1.825	305.19
276.0	1.826	305.18
278.0	1.824	305.19
280.0	1.824	305.19
282.0	1.824	305.19
284.0	1.823	305.19
286.0	1.823	305.19
288.0	1.823	305.19
290.0	1.822	305.19
292.0	1.823	305.19
294.0	1.824	305.19
296.0	1.823	305.19
298.0	1.824	305.19
300.0	1.824	305.19
302.0	1.824	305.19
304.0	1.824	305.19
306.0	1.823	305.19
308.0	1.823	305.19

194	0.300	0.303	0.988
196	0.301	0.303	0.992
198	0.301	0.303	0.991
200	0.302	0.303	0.995
202	0.300	0.303	0.990
204	0.300	0.303	0.989
206	0.301	0.303	0.992
208	0.303	0.303	1.000
210	0.301	0.303	0.990
212	0.301	0.303	0.991
214	0.300	0.303	0.989
216	0.301	0.303	0.992
218	0.301	0.303	0.991
220	0.299	0.303	0.985
222	0.300	0.303	0.990
224	0.301	0.303	0.991
226	0.300	0.303	0.990
228	0.300	0.303	0.990
230	0.301	0.303	0.990
232	0.300	0.303	0.989
234	0.300	0.303	0.990
236	0.301	0.303	0.992
238	0.301	0.303	0.991
240	0.301	0.303	0.991
242	0.302	0.303	0.994
244	0.301	0.303	0.992
246	0.300	0.303	0.990
248	0.300	0.303	0.989
250	0.301	0.303	0.991
252	0.299	0.303	0.987
254	0.299	0.303	0.987
256	0.300	0.303	0.988
258	0.301	0.303	0.993
260	0.297	0.303	0.978
262	0.294	0.303	0.970
264	0.295	0.303	0.970
266	0.294	0.303	0.970
268	0.299	0.303	0.985
270	0.300	0.303	0.990
272	0.297	0.303	0.979
274	0.300	0.303	0.987
276	0.301	0.303	0.990
278	0.299	0.303	0.986
280	0.299	0.303	0.987
282	0.299	0.303	0.984
284	0.298	0.303	0.983
286	0.298	0.303	0.982
288	0.298	0.303	0.982
290	0.297	0.303	0.979
292	0.298	0.303	0.983
294	0.299	0.303	0.986
296	0.298	0.303	0.983
298	0.299	0.303	0.985
300	0.299	0.303	0.984
302	0.299	0.303	0.984
304	0.299	0.303	0.984
306	0.298	0.303	0.983
308	0.298	0.303	0.983


Plot of Normalized Head Versus Elapsed Time
Borehole MW110
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Elapsed Time (sec)
y = 2.25E+00e-2.00E-04x
Straight line fit equation to data between normlized interval 0.15 and 0.25:
y = 2.25E+00e-2.00E-04x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -2.00E-04
T0 = 5,000 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	Apr. 15, 2019		Static water depth, H:	1.13	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	2.14	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW112		Basic time lag, To:	6,369	sec
Well Screen Bottom:	4.3	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	305.77	masl			
Static Water Level:	1.13	mbgs			
Ground Elevation:	305.77	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**9.2E-06**	cm/s
WATER LEVEL BEFORE TEST = H =	1.13	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	2.138	303.63
1.0	2.135	303.64
2.0	2.133	303.64
3.0	2.134	303.64
4.0	2.129	303.64
5.0	2.129	303.64
6.0	2.128	303.64
7.0	2.127	303.64
8.0	2.127	303.64
9.0	2.126	303.64
10.0	2.127	303.64
11.0	2.125	303.65
12.0	2.124	303.65
13.0	2.124	303.65
14.0	2.123	303.65
15.0	2.123	303.65
16.0	2.123	303.65
17.0	2.123	303.65
18.0	2.121	303.65
19.0	2.119	303.65
20.0	2.121	303.65
21.0	2.120	303.65
22.0	2.120	303.65
23.0	2.121	303.65
24.0	2.119	303.65
25.0	2.119	303.65
26.0	2.119	303.65
27.0	2.119	303.65
28.0	2.118	303.65
29.0	2.122	303.65
30.0	2.121	303.65
31.0	2.119	303.65
32.0	2.125	303.65
33.0	2.125	303.64
34.0	2.110	303.66
35.0	2.112	303.66
36.0	2.112	303.66
37.0	2.111	303.66
38.0	2.110	303.66

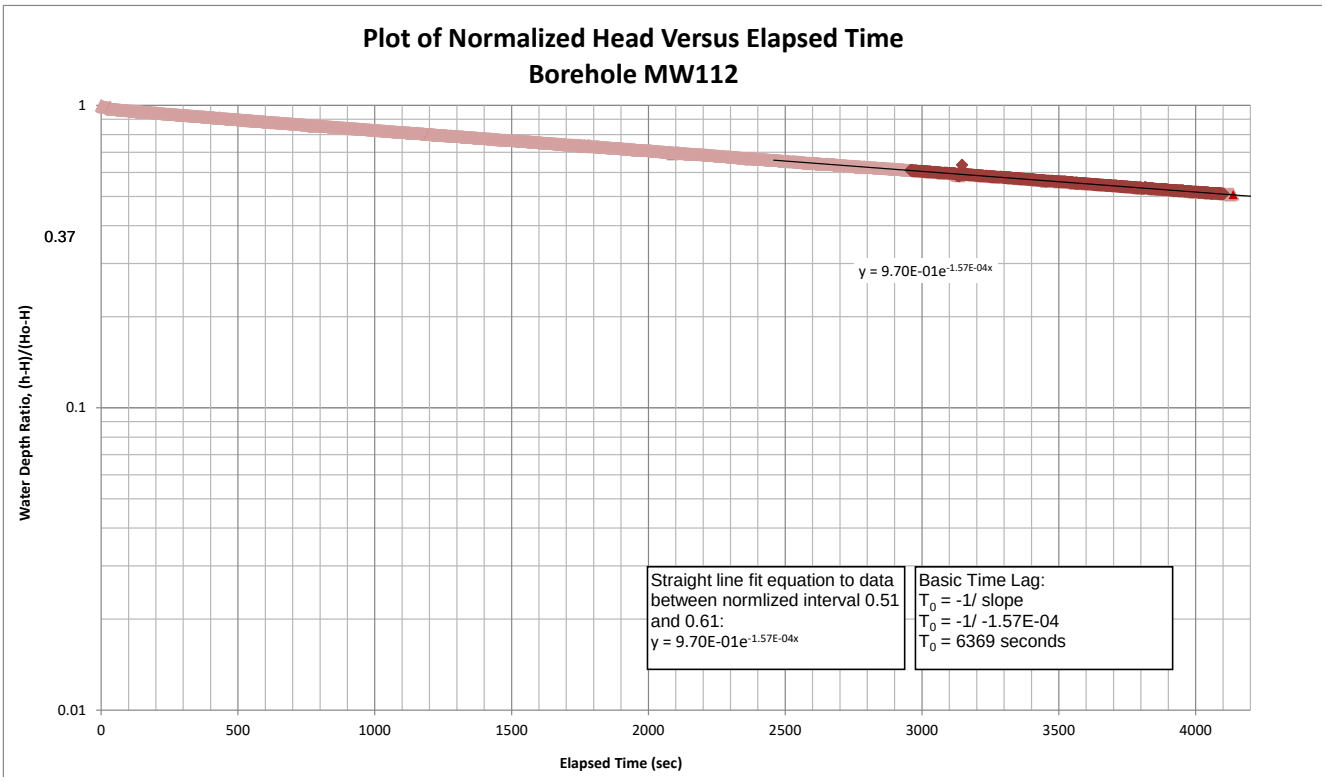
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	1.008	1.008	1.000
1	1.005	1.008	0.997
2	1.003	1.008	0.995
3	1.004	1.008	0.996
4	0.999	1.008	0.991
5	0.999	1.008	0.991
6	0.998	1.008	0.990
7	0.997	1.008	0.989
8	0.997	1.008	0.988
9	0.996	1.008	0.988
10	0.997	1.008	0.989
11	0.995	1.008	0.987
12	0.994	1.008	0.986
13	0.994	1.008	0.986
14	0.993	1.008	0.985
15	0.993	1.008	0.985
16	0.993	1.008	0.985
17	0.993	1.008	0.985
18	0.991	1.008	0.983
19	0.989	1.008	0.981
20	0.991	1.008	0.983
21	0.990	1.008	0.982
22	0.990	1.008	0.982
23	0.991	1.008	0.983
24	0.989	1.008	0.981
25	0.989	1.008	0.981
26	0.989	1.008	0.981
27	0.989	1.008	0.981
28	0.988	1.008	0.980
29	0.992	1.008	0.984
30	0.991	1.008	0.983
31	0.989	1.008	0.981
32	0.995	1.008	0.987
33	0.995	1.008	0.987
34	0.980	1.008	0.972
35	0.982	1.008	0.974
36	0.982	1.008	0.974
37	0.981	1.008	0.973
38	0.980	1.008	0.972

39.0	2.109	303.66
40.0	2.109	303.66
41.0	2.109	303.66
42.0	2.109	303.66
43.0	2.108	303.66
44.0	2.109	303.66
45.0	2.108	303.66
46.0	2.108	303.66
47.0	2.108	303.66
48.0	2.107	303.66
49.0	2.108	303.66
50.0	2.107	303.66
51.0	2.107	303.66
52.0	2.107	303.66
53.0	2.107	303.66
54.0	2.107	303.66
55.0	2.106	303.66
56.0	2.106	303.66
57.0	2.106	303.66
58.0	2.106	303.66
59.0	2.105	303.66
60.0	2.105	303.66
61.0	2.105	303.66
62.0	2.105	303.66
63.0	2.105	303.66
64.0	2.104	303.67
65.0	2.104	303.67
66.0	2.104	303.67
67.0	2.104	303.67
68.0	2.104	303.67
69.0	2.103	303.67
70.0	2.103	303.67
71.0	2.103	303.67
72.0	2.103	303.67
73.0	2.103	303.67
74.0	2.103	303.67
75.0	2.103	303.67
76.0	2.102	303.67
77.0	2.102	303.67
78.0	2.102	303.67
79.0	2.102	303.67
80.0	2.102	303.67
81.0	2.101	303.67
82.0	2.101	303.67
83.0	2.102	303.67
84.0	2.103	303.67
85.0	2.102	303.67
86.0	2.103	303.67
87.0	2.101	303.67
88.0	2.101	303.67
89.0	2.100	303.67
90.0	2.100	303.67
91.0	2.100	303.67
92.0	2.100	303.67
93.0	2.099	303.67
94.0	2.099	303.67
95.0	2.099	303.67
96.0	2.099	303.67

39	0.979	1.008	0.971
40	0.979	1.008	0.971
41	0.979	1.008	0.971
42	0.979	1.008	0.971
43	0.978	1.008	0.971
44	0.979	1.008	0.971
45	0.978	1.008	0.970
46	0.978	1.008	0.970
47	0.978	1.008	0.970
48	0.977	1.008	0.969
49	0.978	1.008	0.970
50	0.977	1.008	0.970
51	0.977	1.008	0.969
52	0.977	1.008	0.969
53	0.977	1.008	0.969
54	0.977	1.008	0.969
55	0.976	1.008	0.968
56	0.976	1.008	0.968
57	0.976	1.008	0.968
58	0.976	1.008	0.968
59	0.975	1.008	0.967
60	0.975	1.008	0.967
61	0.975	1.008	0.967
62	0.975	1.008	0.967
63	0.975	1.008	0.967
64	0.974	1.008	0.966
65	0.974	1.008	0.966
66	0.974	1.008	0.966
67	0.974	1.008	0.966
68	0.974	1.008	0.966
69	0.973	1.008	0.966
70	0.973	1.008	0.965
71	0.973	1.008	0.966
72	0.973	1.008	0.965
73	0.973	1.008	0.965
74	0.973	1.008	0.965
75	0.973	1.008	0.965
76	0.972	1.008	0.964
77	0.972	1.008	0.964
78	0.972	1.008	0.964
79	0.972	1.008	0.964
80	0.972	1.008	0.964
81	0.971	1.008	0.964
82	0.971	1.008	0.964
83	0.972	1.008	0.964
84	0.973	1.008	0.965
85	0.972	1.008	0.964
86	0.973	1.008	0.965
87	0.971	1.008	0.964
88	0.971	1.008	0.963
89	0.970	1.008	0.962
90	0.970	1.008	0.962
91	0.970	1.008	0.962
92	0.970	1.008	0.962
93	0.969	1.008	0.961
94	0.969	1.008	0.961
95	0.969	1.008	0.961
96	0.969	1.008	0.961

97.0	2.099	303.67
98.0	2.098	303.67
99.0	2.098	303.67
100.0	2.098	303.67
101.0	2.098	303.67
102.0	2.097	303.67
103.0	2.097	303.67
104.0	2.097	303.67
105.0	2.097	303.67
106.0	2.097	303.67
107.0	2.097	303.67
108.0	2.097	303.67
109.0	2.096	303.67
110.0	2.096	303.67
111.0	2.096	303.67
112.0	2.096	303.67
113.0	2.096	303.67
114.0	2.097	303.67
115.0	2.096	303.67
116.0	2.096	303.67
117.0	2.095	303.67
118.0	2.095	303.67
119.0	2.095	303.68
120.0	2.095	303.68
121.0	2.095	303.68
122.0	2.095	303.67
123.0	2.095	303.68
124.0	2.095	303.68
125.0	2.095	303.68
126.0	2.094	303.68
127.0	2.093	303.68
128.0	2.094	303.68
129.0	2.093	303.68
130.0	2.092	303.68
131.0	2.092	303.68
132.0	2.093	303.68
133.0	2.093	303.68
134.0	2.092	303.68
135.0	2.091	303.68
136.0	2.092	303.68
137.0	2.092	303.68
138.0	2.091	303.68
139.0	2.091	303.68
140.0	2.091	303.68
141.0	2.091	303.68
142.0	2.091	303.68
143.0	2.092	303.68
144.0	2.092	303.68
145.0	2.091	303.68
146.0	2.084	303.69
147.0	2.091	303.68
148.0	2.091	303.68
149.0	2.090	303.68
150.0	2.090	303.68
151.0	2.089	303.68
152.0	2.090	303.68
153.0	2.089	303.68
154.0	2.088	303.68

97	0.969	1.008	0.961
98	0.968	1.008	0.961
99	0.968	1.008	0.960
100	0.968	1.008	0.960
101	0.968	1.008	0.960
102	0.967	1.008	0.960
103	0.967	1.008	0.959
104	0.967	1.008	0.960
105	0.967	1.008	0.959
106	0.967	1.008	0.959
107	0.967	1.008	0.959
108	0.967	1.008	0.959
109	0.966	1.008	0.958
110	0.966	1.008	0.958
111	0.966	1.008	0.958
112	0.966	1.008	0.958
113	0.966	1.008	0.959
114	0.967	1.008	0.959
115	0.966	1.008	0.958
116	0.966	1.008	0.959
117	0.965	1.008	0.958
118	0.965	1.008	0.957
119	0.965	1.008	0.957
120	0.965	1.008	0.957
121	0.965	1.008	0.957
122	0.965	1.008	0.957
123	0.965	1.008	0.957
124	0.965	1.008	0.957
125	0.965	1.008	0.957
126	0.964	1.008	0.957
127	0.963	1.008	0.955
128	0.964	1.008	0.956
129	0.963	1.008	0.956
130	0.962	1.008	0.955
131	0.962	1.008	0.954
132	0.963	1.008	0.955
133	0.963	1.008	0.955
134	0.962	1.008	0.955
135	0.961	1.008	0.954
136	0.962	1.008	0.954
137	0.962	1.008	0.955
138	0.961	1.008	0.953
139	0.961	1.008	0.953
140	0.961	1.008	0.953
141	0.961	1.008	0.954
142	0.961	1.008	0.953
143	0.962	1.008	0.954
144	0.962	1.008	0.954
145	0.961	1.008	0.953
146	0.954	1.008	0.946
147	0.961	1.008	0.953
148	0.961	1.008	0.953
149	0.960	1.008	0.952
150	0.960	1.008	0.952
151	0.959	1.008	0.951
152	0.960	1.008	0.952
153	0.959	1.008	0.951
154	0.958	1.008	0.950

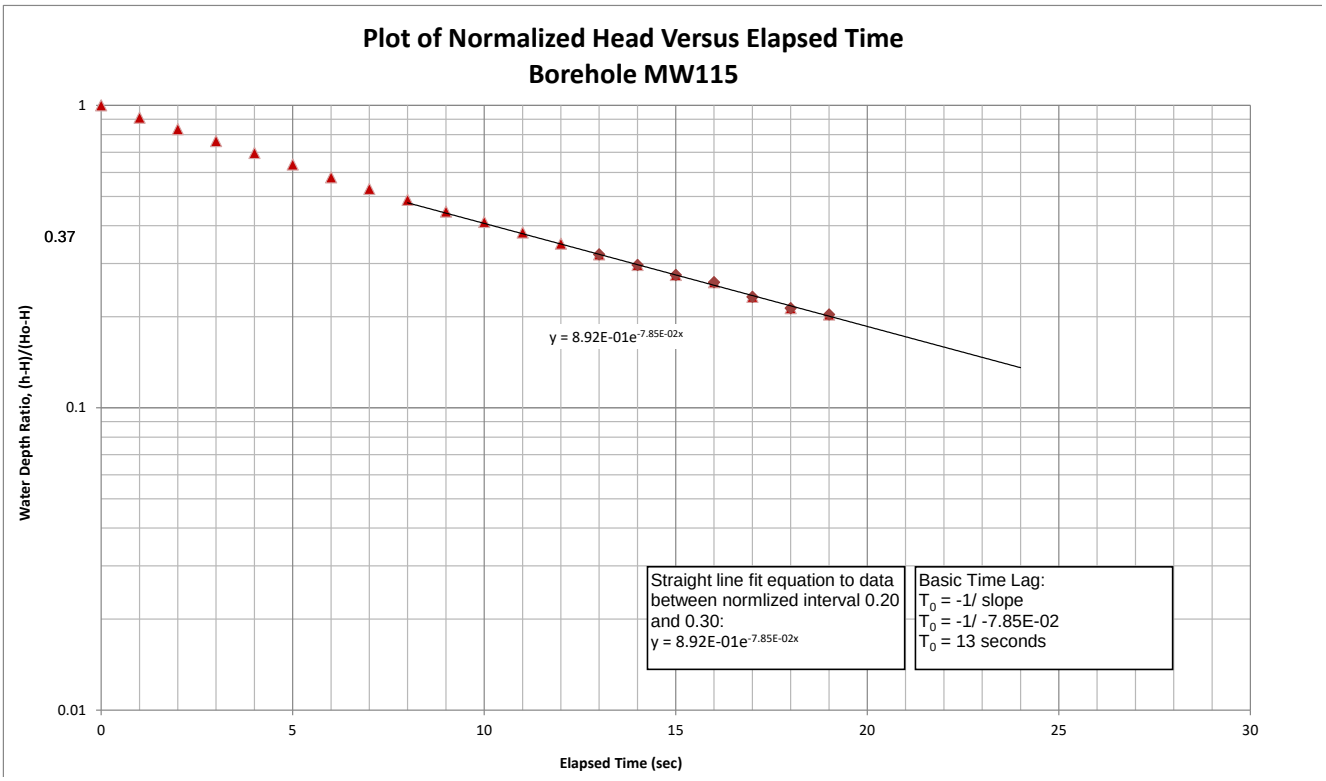

Plot of Normalized Head Versus Elapsed Time
Borehole MW112
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
500
1000
1500
2000
2500
3000
3500
4000
Elapsed Time (sec)
y = 9.70E-01e-1.57E-04x
Straight line fit equation to data between normlized interval 0.51 and 0.61:
y = 9.70E-01e-1.57E-04x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -1.57E-04
T0 = 6369 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	Apr. 15, 2019		Static water depth, H:	1.54	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	1.88	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW115		Basic time lag, To:	13	sec
Well Screen Bottom:	4.4	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	304.57	masl			
Static Water Level:	1.54	mbgs			
Ground Elevation:	304.57	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**4.5E-03**	cm/s
WATER LEVEL BEFORE TEST = H =	1.54	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	1.877	302.69
1.0	1.847	302.72
2.0	1.821	302.75
3.0	1.797	302.77
4.0	1.774	302.80
5.0	1.754	302.82
6.0	1.735	302.84
7.0	1.718	302.85
8.0	1.704	302.87
9.0	1.690	302.88
10.0	1.679	302.89
11.0	1.668	302.90
12.0	1.657	302.91
13.0	1.648	302.92
14.0	1.640	302.93
15.0	1.633	302.94
16.0	1.628	302.94
17.0	1.618	302.95
18.0	1.612	302.96
19.0	1.609	302.96

Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.337	0.337	1.000
1	0.307	0.337	0.911
2	0.281	0.337	0.834
3	0.257	0.337	0.762
4	0.234	0.337	0.696
5	0.214	0.337	0.637
6	0.195	0.337	0.578
7	0.178	0.337	0.529
8	0.164	0.337	0.487
9	0.150	0.337	0.446
10	0.139	0.337	0.412
11	0.128	0.337	0.380
12	0.117	0.337	0.349
13	0.108	0.337	0.321
14	0.100	0.337	0.296
15	0.093	0.337	0.275
16	0.088	0.337	0.260
17	0.078	0.337	0.232
18	0.072	0.337	0.213
19	0.069	0.337	0.203


Plot of Normalized Head Versus Elapsed Time
Borehole MW115
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
5
10
15
20
25
30
Elapsed Time (sec)
y = 8.92E-01e-7.85E-02x
Straight line fit equation to data between normlized interval 0.20 and 0.30:
y = 8.92E-01e-7.85E-02x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -7.85E-02
T0 = 13 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	Apr. 15, 2019		Static water depth, H:	1.61	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	3.14	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW122		Basic time lag, To:	54,644	sec
Well Screen Bottom:	4.6	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	310.42	masl	Estimated Sy of sand pack:	0.30	
Static Water Level:	1.61	mbgs	Estimated effective $2r_e$:	11.9	cm
Ground Elevation:	310.42	masl	$K^* = r_e 2\ln(L/R)/(2LTo)$ =	**5.8E-06**	cm/s
WATER LEVEL BEFORE TEST = H =	1.61	mbgs	* modified to account for sand pack.		

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	3.136	307.28
1.0	3.126	307.29
2.0	3.124	307.30
3.0	3.129	307.29
4.0	3.127	307.29
5.0	3.125	307.29
6.0	3.125	307.29
7.0	3.125	307.30
8.0	3.124	307.30
9.0	3.124	307.30
10.0	3.124	307.30
11.0	3.124	307.30
12.0	3.124	307.30
13.0	3.123	307.30
14.0	3.123	307.30
15.0	3.123	307.30
16.0	3.123	307.30
17.0	3.123	307.30
18.0	3.122	307.30
19.0	3.122	307.30
20.0	3.122	307.30
21.0	3.122	307.30
22.0	3.122	307.30
23.0	3.122	307.30
24.0	3.122	307.30
25.0	3.122	307.30
26.0	3.122	307.30
27.0	3.121	307.30
28.0	3.119	307.30
29.0	3.118	307.30
30.0	3.118	307.30
31.0	3.117	307.30
32.0	3.117	307.30
33.0	3.117	307.30
34.0	3.117	307.30
35.0	3.116	307.30
36.0	3.116	307.30
37.0	3.116	307.30
38.0	3.116	307.30

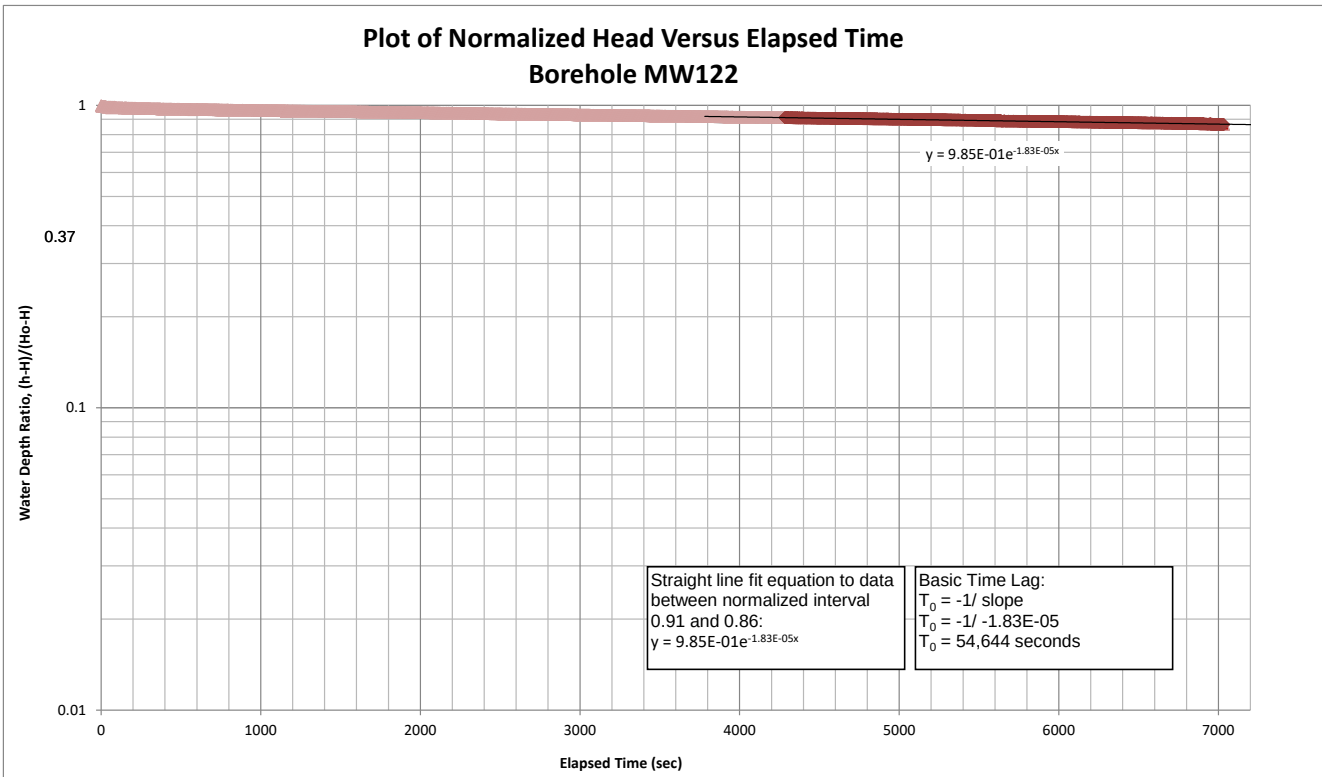
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	1.526	1.526	1.000
1	1.516	1.526	0.994
2	1.514	1.526	0.992
3	1.519	1.526	0.995
4	1.517	1.526	0.994
5	1.515	1.526	0.993
6	1.515	1.526	0.993
7	1.515	1.526	0.993
8	1.514	1.526	0.992
9	1.514	1.526	0.992
10	1.514	1.526	0.992
11	1.514	1.526	0.992
12	1.514	1.526	0.992
13	1.513	1.526	0.992
14	1.513	1.526	0.992
15	1.513	1.526	0.991
16	1.513	1.526	0.991
17	1.513	1.526	0.991
18	1.512	1.526	0.991
19	1.512	1.526	0.991
20	1.512	1.526	0.991
21	1.512	1.526	0.991
22	1.512	1.526	0.991
23	1.512	1.526	0.991
24	1.512	1.526	0.991
25	1.512	1.526	0.991
26	1.512	1.526	0.991
27	1.511	1.526	0.990
28	1.509	1.526	0.989
29	1.508	1.526	0.988
30	1.508	1.526	0.988
31	1.507	1.526	0.988
32	1.507	1.526	0.988
33	1.507	1.526	0.988
34	1.507	1.526	0.987
35	1.506	1.526	0.987
36	1.506	1.526	0.987
37	1.506	1.526	0.987
38	1.506	1.526	0.987

39.0	3.116	307.30
40.0	3.116	307.30
41.0	3.116	307.30
42.0	3.116	307.30
43.0	3.117	307.30
44.0	3.116	307.30
45.0	3.117	307.30
46.0	3.116	307.30
47.0	3.117	307.30
48.0	3.116	307.30
49.0	3.116	307.30
50.0	3.118	307.30
51.0	3.116	307.30
52.0	3.116	307.30
53.0	3.116	307.30
54.0	3.116	307.30
55.0	3.116	307.30
56.0	3.116	307.30
57.0	3.116	307.30
58.0	3.116	307.30
59.0	3.117	307.30
60.0	3.116	307.30
61.0	3.116	307.30
62.0	3.116	307.30
63.0	3.116	307.30
64.0	3.101	307.32
65.0	3.112	307.31
66.0	3.115	307.30
67.0	3.116	307.30
68.0	3.117	307.30
69.0	3.114	307.31
70.0	3.115	307.31
71.0	3.116	307.30
72.0	3.115	307.30
73.0	3.113	307.31
74.0	3.115	307.31
75.0	3.115	307.31
76.0	3.114	307.31
77.0	3.115	307.31
78.0	3.115	307.31
79.0	3.114	307.31
80.0	3.114	307.31
81.0	3.115	307.31
82.0	3.115	307.31
83.0	3.115	307.31
84.0	3.115	307.31
85.0	3.117	307.30
86.0	3.117	307.30
87.0	3.115	307.30
88.0	3.112	307.31
89.0	3.109	307.31
90.0	3.108	307.31
91.0	3.108	307.31
92.0	3.108	307.31
93.0	3.108	307.31
94.0	3.108	307.31
95.0	3.108	307.31
96.0	3.108	307.31

39	1.506	1.526	0.987
40	1.506	1.526	0.987
41	1.506	1.526	0.987
42	1.506	1.526	0.987
43	1.507	1.526	0.987
44	1.506	1.526	0.987
45	1.507	1.526	0.987
46	1.506	1.526	0.987
47	1.507	1.526	0.987
48	1.506	1.526	0.987
49	1.506	1.526	0.987
50	1.508	1.526	0.988
51	1.506	1.526	0.987
52	1.506	1.526	0.987
53	1.506	1.526	0.987
54	1.506	1.526	0.987
55	1.506	1.526	0.987
56	1.506	1.526	0.987
57	1.506	1.526	0.987
58	1.506	1.526	0.987
59	1.507	1.526	0.987
60	1.506	1.526	0.987
61	1.506	1.526	0.987
62	1.506	1.526	0.987
63	1.506	1.526	0.987
64	1.491	1.526	0.977
65	1.502	1.526	0.984
66	1.505	1.526	0.987
67	1.506	1.526	0.987
68	1.507	1.526	0.988
69	1.504	1.526	0.986
70	1.505	1.526	0.986
71	1.506	1.526	0.987
72	1.505	1.526	0.987
73	1.503	1.526	0.985
74	1.505	1.526	0.986
75	1.505	1.526	0.986
76	1.504	1.526	0.986
77	1.505	1.526	0.986
78	1.505	1.526	0.986
79	1.504	1.526	0.986
80	1.504	1.526	0.986
81	1.505	1.526	0.986
82	1.505	1.526	0.986
83	1.505	1.526	0.986
84	1.505	1.526	0.986
85	1.507	1.526	0.987
86	1.507	1.526	0.987
87	1.505	1.526	0.987
88	1.502	1.526	0.984
89	1.499	1.526	0.982
90	1.498	1.526	0.981
91	1.498	1.526	0.982
92	1.498	1.526	0.982
93	1.498	1.526	0.982
94	1.498	1.526	0.982
95	1.498	1.526	0.982
96	1.498	1.526	0.982

97.0	3.108	307.31
98.0	3.108	307.31
99.0	3.108	307.31
100.0	3.107	307.31
101.0	3.108	307.31
102.0	3.107	307.31
103.0	3.107	307.31
104.0	3.107	307.31
105.0	3.107	307.31
106.0	3.107	307.31
107.0	3.108	307.31
108.0	3.108	307.31
109.0	3.108	307.31
110.0	3.108	307.31
111.0	3.107	307.31
112.0	3.108	307.31
113.0	3.107	307.31
114.0	3.107	307.31
115.0	3.109	307.31
116.0	3.108	307.31
117.0	3.107	307.31
118.0	3.107	307.31
119.0	3.107	307.31
120.0	3.107	307.31
121.0	3.106	307.31
122.0	3.107	307.31
123.0	3.106	307.31
124.0	3.106	307.31
125.0	3.106	307.31
126.0	3.106	307.31
127.0	3.106	307.31
128.0	3.107	307.31
129.0	3.106	307.31
130.0	3.107	307.31
131.0	3.106	307.31
132.0	3.106	307.31
133.0	3.106	307.31
134.0	3.108	307.31
135.0	3.107	307.31
136.0	3.106	307.31
137.0	3.106	307.31
138.0	3.106	307.31
139.0	3.106	307.31
140.0	3.105	307.31
141.0	3.105	307.31
142.0	3.105	307.31
143.0	3.105	307.31
144.0	3.105	307.31
145.0	3.106	307.31
146.0	3.106	307.31
147.0	3.106	307.31
148.0	3.106	307.31
149.0	3.106	307.31
150.0	3.107	307.31
151.0	3.106	307.31
152.0	3.106	307.31
153.0	3.106	307.31
154.0	3.106	307.31

97	1.498	1.526	0.982
98	1.498	1.526	0.982
99	1.498	1.526	0.981
100	1.497	1.526	0.981
101	1.498	1.526	0.981
102	1.497	1.526	0.981
103	1.497	1.526	0.981
104	1.497	1.526	0.981
105	1.497	1.526	0.981
106	1.497	1.526	0.981
107	1.498	1.526	0.981
108	1.498	1.526	0.982
109	1.498	1.526	0.982
110	1.498	1.526	0.981
111	1.497	1.526	0.981
112	1.498	1.526	0.981
113	1.497	1.526	0.981
114	1.497	1.526	0.981
115	1.499	1.526	0.982
116	1.498	1.526	0.981
117	1.497	1.526	0.981
118	1.497	1.526	0.981
119	1.497	1.526	0.981
120	1.497	1.526	0.981
121	1.496	1.526	0.981
122	1.497	1.526	0.981
123	1.496	1.526	0.980
124	1.496	1.526	0.981
125	1.496	1.526	0.980
126	1.496	1.526	0.980
127	1.496	1.526	0.980
128	1.497	1.526	0.981
129	1.496	1.526	0.981
130	1.497	1.526	0.981
131	1.496	1.526	0.980
132	1.496	1.526	0.980
133	1.496	1.526	0.980
134	1.498	1.526	0.982
135	1.497	1.526	0.981
136	1.496	1.526	0.980
137	1.496	1.526	0.980
138	1.496	1.526	0.980
139	1.496	1.526	0.980
140	1.495	1.526	0.980
141	1.495	1.526	0.980
142	1.495	1.526	0.980
143	1.495	1.526	0.980
144	1.495	1.526	0.980
145	1.496	1.526	0.981
146	1.496	1.526	0.980
147	1.496	1.526	0.980
148	1.496	1.526	0.980
149	1.496	1.526	0.980
150	1.497	1.526	0.981
151	1.496	1.526	0.980
152	1.496	1.526	0.981
153	1.496	1.526	0.981
154	1.496	1.526	0.980


Plot of Normalized Head Versus Elapsed Time
Borehole MW122
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
1000
2000
3000
4000
5000
6000
7000
Elapsed Time (sec)
y = 9.85E-01e-1.83E-05x
Straight line fit equation to data between normalized interval 0.91 and 0.86:
y = 9.85E-01e-1.83E-05x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -1.83E-05
T0 = 54,644 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	May 10, 2019		Static water depth, H:	1.6	mbgs
Conducted by:	J O		Water depth at time t = 0, Ho:	2.10	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW123		Basic time lag, To:	19,493	sec
Well Screen Bottom:	4.7	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	308.02	masl			
Static Water Level:	1.60	mbgs			
Ground Elevation:	308.02	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**3.0E-06**	cm/s
WATER LEVEL BEFORE TEST = H =	1.6	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	2.099	305.92
2.0	2.100	305.92
4.0	2.098	305.92
6.0	2.096	305.92
8.0	2.097	305.92
10.0	2.093	305.93
12.0	2.091	305.93
14.0	2.091	305.93
16.0	2.095	305.93
18.0	2.095	305.92
20.0	2.095	305.92
22.0	2.094	305.93
24.0	2.094	305.93
26.0	2.094	305.93
28.0	2.094	305.93
30.0	2.093	305.93
32.0	2.093	305.93
34.0	2.093	305.93
36.0	2.092	305.93
38.0	2.093	305.93
40.0	2.092	305.93
42.0	2.092	305.93
44.0	2.090	305.93
46.0	2.088	305.93
48.0	2.087	305.93
50.0	2.090	305.93
52.0	2.090	305.93
54.0	2.090	305.93
56.0	2.090	305.93
58.0	2.089	305.93
60.0	2.089	305.93
62.0	2.088	305.93
64.0	2.088	305.93
66.0	2.089	305.93
68.0	2.085	305.94
70.0	2.082	305.94
72.0	2.088	305.93
74.0	2.087	305.93
76.0	2.087	305.93

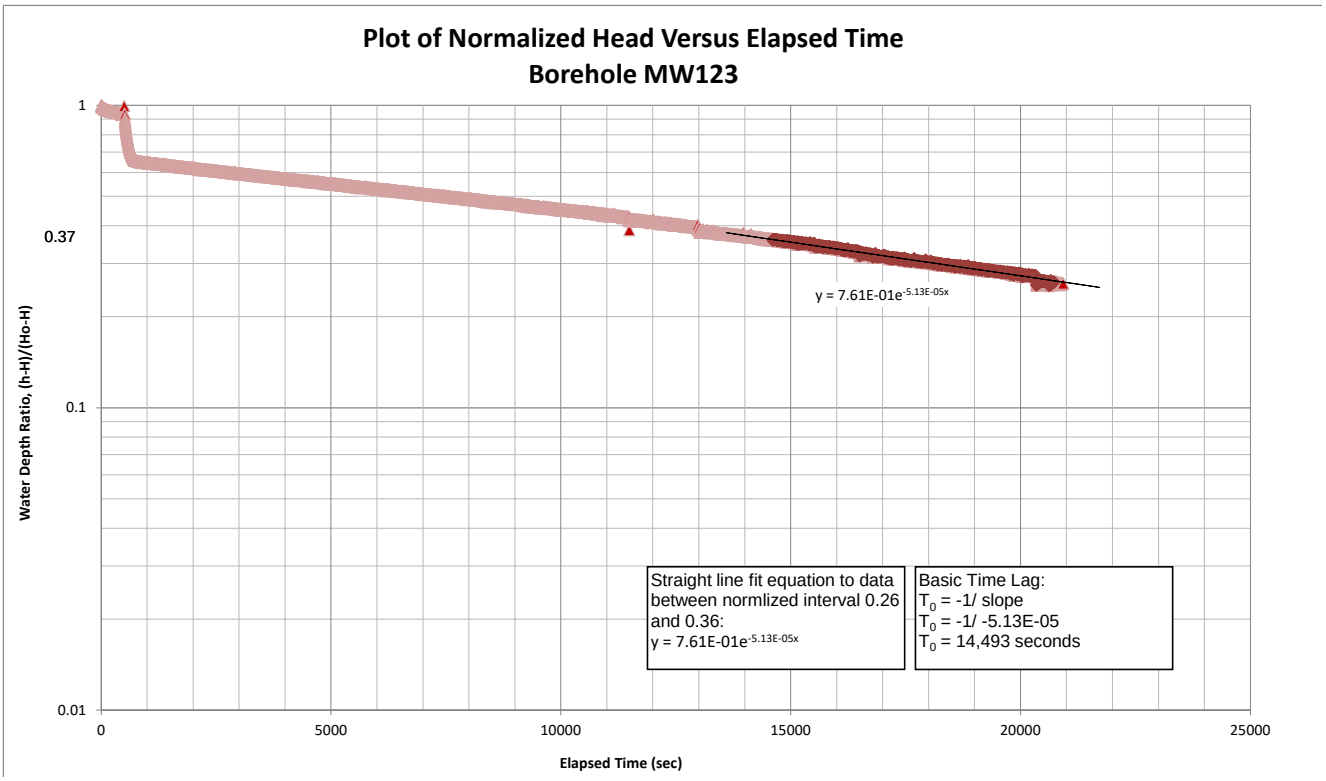
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.499	0.499	1.000
2	0.500	0.499	1.001
4	0.498	0.499	0.998
6	0.496	0.499	0.994
8	0.497	0.499	0.996
10	0.493	0.499	0.987
12	0.491	0.499	0.984
14	0.491	0.499	0.983
16	0.495	0.499	0.991
18	0.495	0.499	0.992
20	0.495	0.499	0.992
22	0.494	0.499	0.990
24	0.494	0.499	0.990
26	0.494	0.499	0.990
28	0.494	0.499	0.989
30	0.493	0.499	0.989
32	0.493	0.499	0.988
34	0.493	0.499	0.987
36	0.492	0.499	0.986
38	0.493	0.499	0.987
40	0.492	0.499	0.985
42	0.492	0.499	0.985
44	0.490	0.499	0.981
46	0.488	0.499	0.978
48	0.487	0.499	0.976
50	0.490	0.499	0.981
52	0.490	0.499	0.982
54	0.490	0.499	0.981
56	0.490	0.499	0.981
58	0.489	0.499	0.981
60	0.489	0.499	0.979
62	0.488	0.499	0.978
64	0.488	0.499	0.978
66	0.489	0.499	0.979
68	0.485	0.499	0.971
70	0.482	0.499	0.966
72	0.488	0.499	0.977
74	0.487	0.499	0.976
76	0.487	0.499	0.976

78.0	2.087	305.93
80.0	2.086	305.93
82.0	2.086	305.93
84.0	2.085	305.93
86.0	2.085	305.93
88.0	2.083	305.94
90.0	2.084	305.94
92.0	2.085	305.93
94.0	2.085	305.94
96.0	2.085	305.93
98.0	2.085	305.94
100.0	2.084	305.94
102.0	2.084	305.94
104.0	2.084	305.94
106.0	2.083	305.94
108.0	2.082	305.94
110.0	2.083	305.94
112.0	2.083	305.94
114.0	2.082	305.94
116.0	2.083	305.94
118.0	2.082	305.94
120.0	2.083	305.94
122.0	2.080	305.94
124.0	2.082	305.94
126.0	2.082	305.94
128.0	2.082	305.94
130.0	2.082	305.94
132.0	2.082	305.94
134.0	2.082	305.94
136.0	2.081	305.94
138.0	2.081	305.94
140.0	2.081	305.94
142.0	2.081	305.94
144.0	2.080	305.94
146.0	2.080	305.94
148.0	2.081	305.94
150.0	2.081	305.94
152.0	2.081	305.94
154.0	2.080	305.94
156.0	2.080	305.94
158.0	2.080	305.94
160.0	2.080	305.94
162.0	2.080	305.94
164.0	2.080	305.94
166.0	2.080	305.94
168.0	2.081	305.94
170.0	2.079	305.94
172.0	2.079	305.94
174.0	2.079	305.94
176.0	2.078	305.94
178.0	2.079	305.94
180.0	2.079	305.94
182.0	2.079	305.94
184.0	2.078	305.94
186.0	2.078	305.94
188.0	2.079	305.94
190.0	2.079	305.94
192.0	2.079	305.94

78	0.487	0.499	0.975
80	0.486	0.499	0.974
82	0.486	0.499	0.973
84	0.485	0.499	0.972
86	0.485	0.499	0.972
88	0.483	0.499	0.968
90	0.484	0.499	0.971
92	0.485	0.499	0.972
94	0.485	0.499	0.971
96	0.485	0.499	0.972
98	0.485	0.499	0.971
100	0.484	0.499	0.969
102	0.484	0.499	0.969
104	0.484	0.499	0.969
106	0.483	0.499	0.968
108	0.482	0.499	0.966
110	0.483	0.499	0.967
112	0.483	0.499	0.967
114	0.482	0.499	0.967
116	0.483	0.499	0.967
118	0.482	0.499	0.966
120	0.483	0.499	0.967
122	0.480	0.499	0.962
124	0.482	0.499	0.965
126	0.482	0.499	0.966
128	0.482	0.499	0.965
130	0.482	0.499	0.966
132	0.482	0.499	0.966
134	0.482	0.499	0.965
136	0.481	0.499	0.964
138	0.481	0.499	0.963
140	0.481	0.499	0.964
142	0.481	0.499	0.964
144	0.480	0.499	0.963
146	0.480	0.499	0.962
148	0.481	0.499	0.963
150	0.481	0.499	0.963
152	0.481	0.499	0.964
154	0.480	0.499	0.962
156	0.480	0.499	0.961
158	0.480	0.499	0.961
160	0.480	0.499	0.962
162	0.480	0.499	0.962
164	0.480	0.499	0.961
166	0.480	0.499	0.962
168	0.481	0.499	0.963
170	0.479	0.499	0.960
172	0.479	0.499	0.960
174	0.479	0.499	0.960
176	0.478	0.499	0.958
178	0.479	0.499	0.959
180	0.479	0.499	0.960
182	0.479	0.499	0.960
184	0.478	0.499	0.958
186	0.478	0.499	0.957
188	0.479	0.499	0.959
190	0.479	0.499	0.959
192	0.479	0.499	0.959

194.0	2.078	305.94
196.0	2.077	305.94
198.0	2.078	305.94
200.0	2.078	305.94
202.0	2.076	305.94
204.0	2.077	305.94
206.0	2.077	305.94
208.0	2.075	305.94
210.0	2.076	305.94
212.0	2.076	305.94
214.0	2.078	305.94
216.0	2.077	305.94
218.0	2.077	305.94
220.0	2.077	305.94
222.0	2.077	305.94
224.0	2.076	305.94
226.0	2.077	305.94
228.0	2.077	305.94
230.0	2.077	305.94
232.0	2.076	305.94
234.0	2.076	305.94
236.0	2.076	305.94
238.0	2.076	305.94
240.0	2.075	305.94
242.0	2.076	305.94
244.0	2.074	305.95
246.0	2.076	305.94
248.0	2.076	305.94
250.0	2.075	305.94
252.0	2.076	305.94
254.0	2.075	305.95
256.0	2.075	305.95
258.0	2.075	305.95
260.0	2.074	305.95
262.0	2.075	305.94
264.0	2.075	305.94
266.0	2.075	305.95
268.0	2.075	305.94
270.0	2.075	305.95
272.0	2.074	305.95
274.0	2.074	305.95
276.0	2.074	305.95
278.0	2.074	305.95
280.0	2.074	305.95
282.0	2.073	305.95
284.0	2.074	305.95
286.0	2.075	305.95
288.0	2.075	305.95
290.0	2.074	305.95
292.0	2.074	305.95
294.0	2.075	305.95
296.0	2.074	305.95
298.0	2.074	305.95
300.0	2.074	305.95
302.0	2.073	305.95
304.0	2.073	305.95
306.0	2.074	305.95
308.0	2.073	305.95

194	0.478	0.499	0.958
196	0.477	0.499	0.955
198	0.478	0.499	0.957
200	0.478	0.499	0.957
202	0.476	0.499	0.954
204	0.477	0.499	0.956
206	0.477	0.499	0.955
208	0.475	0.499	0.952
210	0.476	0.499	0.953
212	0.476	0.499	0.955
214	0.478	0.499	0.957
216	0.477	0.499	0.955
218	0.477	0.499	0.955
220	0.477	0.499	0.957
222	0.477	0.499	0.955
224	0.476	0.499	0.954
226	0.477	0.499	0.955
228	0.477	0.499	0.955
230	0.477	0.499	0.955
232	0.476	0.499	0.955
234	0.476	0.499	0.954
236	0.476	0.499	0.954
238	0.476	0.499	0.954
240	0.475	0.499	0.952
242	0.476	0.499	0.953
244	0.474	0.499	0.949
246	0.476	0.499	0.953
248	0.476	0.499	0.953
250	0.475	0.499	0.952
252	0.476	0.499	0.953
254	0.475	0.499	0.951
256	0.475	0.499	0.951
258	0.475	0.499	0.952
260	0.474	0.499	0.951
262	0.475	0.499	0.952
264	0.475	0.499	0.952
266	0.475	0.499	0.951
268	0.475	0.499	0.952
270	0.475	0.499	0.951
272	0.474	0.499	0.950
274	0.474	0.499	0.949
276	0.474	0.499	0.950
278	0.474	0.499	0.950
280	0.474	0.499	0.950
282	0.473	0.499	0.948
284	0.474	0.499	0.950
286	0.475	0.499	0.951
288	0.475	0.499	0.951
290	0.474	0.499	0.950
292	0.474	0.499	0.950
294	0.475	0.499	0.951
296	0.474	0.499	0.950
298	0.474	0.499	0.949
300	0.474	0.499	0.950
302	0.473	0.499	0.948
304	0.473	0.499	0.948
306	0.474	0.499	0.949
308	0.473	0.499	0.949


Plot of Normalized Head Versus Elapsed Time
Borehole MW123
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
5000
10000
15000
20000
25000
Elapsed Time (sec)
y = 7.61E-01e-5.13E-05x
Straight line fit equation to data between normlized interval 0.26 and 0.36:
y = 7.61E-01e-5.13E-05x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -5.13E-05
T0 = 14,493 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	May 10, 2019		Static water depth, H:	1.57	mbgs
Conducted by:	J O		Water depth at time t = 0, Ho:	2.19	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW138		Basic time lag, To:	13,477	sec
Well Screen Bottom:	4.5	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	301.03	masl			
Static Water Level:	1.57	mbgs			
Ground Elevation:	301.03	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**4.3E-06**	cm/s
WATER LEVEL BEFORE TEST = H =	1.57	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	2.188	298.84
2.0	2.188	298.84
4.0	2.187	298.84
6.0	2.187	298.84
8.0	2.186	298.84
10.0	2.185	298.85
12.0	2.181	298.85
14.0	2.181	298.85
16.0	2.186	298.84
18.0	2.186	298.84
20.0	2.186	298.84
22.0	2.187	298.84
24.0	2.187	298.84
26.0	2.187	298.84
28.0	2.186	298.84
30.0	2.185	298.84
32.0	2.186	298.84
34.0	2.186	298.84
36.0	2.185	298.84
38.0	2.186	298.84
40.0	2.186	298.84
42.0	2.186	298.84
44.0	2.185	298.84
46.0	2.183	298.85
48.0	2.184	298.85
50.0	2.181	298.85
52.0	2.180	298.85
54.0	2.186	298.84
56.0	2.187	298.84
58.0	2.186	298.84
60.0	2.185	298.85
62.0	2.185	298.85
64.0	2.185	298.84
66.0	2.186	298.84
68.0	2.184	298.85
70.0	2.183	298.85
72.0	2.184	298.85
74.0	2.185	298.85
76.0	2.184	298.85

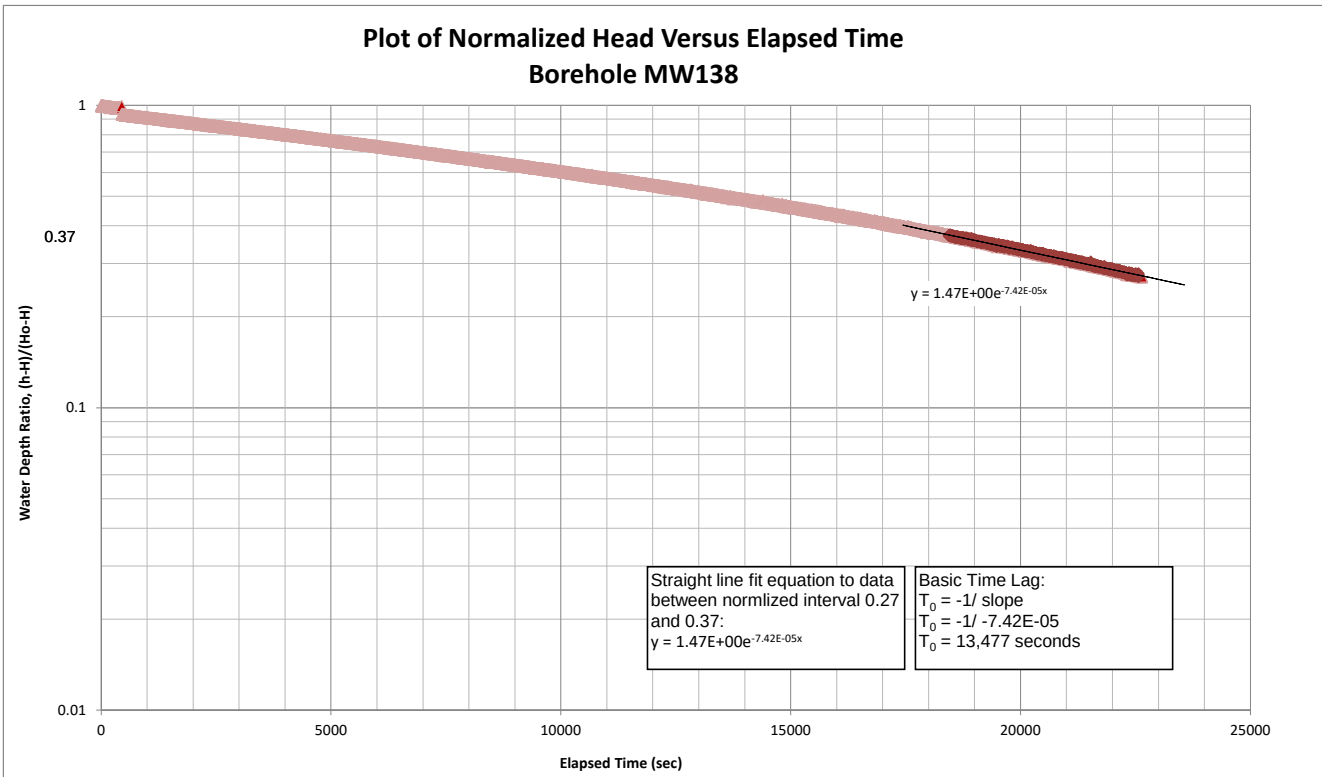
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.618	0.618	1.000
2	0.618	0.618	0.999
4	0.617	0.618	0.997
6	0.617	0.618	0.999
8	0.616	0.618	0.997
10	0.615	0.618	0.994
12	0.611	0.618	0.988
14	0.611	0.618	0.988
16	0.616	0.618	0.997
18	0.616	0.618	0.996
20	0.616	0.618	0.996
22	0.617	0.618	0.998
24	0.617	0.618	0.998
26	0.617	0.618	0.998
28	0.616	0.618	0.996
30	0.615	0.618	0.996
32	0.616	0.618	0.996
34	0.616	0.618	0.997
36	0.615	0.618	0.995
38	0.616	0.618	0.996
40	0.616	0.618	0.997
42	0.616	0.618	0.997
44	0.615	0.618	0.995
46	0.613	0.618	0.992
48	0.614	0.618	0.993
50	0.611	0.618	0.989
52	0.610	0.618	0.987
54	0.616	0.618	0.997
56	0.617	0.618	0.998
58	0.616	0.618	0.996
60	0.615	0.618	0.994
62	0.615	0.618	0.995
64	0.615	0.618	0.995
66	0.616	0.618	0.996
68	0.614	0.618	0.993
70	0.613	0.618	0.992
72	0.614	0.618	0.994
74	0.615	0.618	0.994
76	0.614	0.618	0.993

78.0	2.185	298.85
80.0	2.185	298.84
82.0	2.185	298.84
84.0	2.185	298.84
86.0	2.184	298.85
88.0	2.183	298.85
90.0	2.183	298.85
92.0	2.183	298.85
94.0	2.184	298.85
96.0	2.185	298.84
98.0	2.183	298.85
100.0	2.184	298.85
102.0	2.184	298.85
104.0	2.183	298.85
106.0	2.183	298.85
108.0	2.184	298.85
110.0	2.184	298.85
112.0	2.184	298.85
114.0	2.183	298.85
116.0	2.184	298.85
118.0	2.184	298.85
120.0	2.183	298.85
122.0	2.184	298.85
124.0	2.184	298.85
126.0	2.184	298.85
128.0	2.183	298.85
130.0	2.183	298.85
132.0	2.183	298.85
134.0	2.182	298.85
136.0	2.183	298.85
138.0	2.183	298.85
140.0	2.183	298.85
142.0	2.182	298.85
144.0	2.182	298.85
146.0	2.183	298.85
148.0	2.182	298.85
150.0	2.182	298.85
152.0	2.182	298.85
154.0	2.182	298.85
156.0	2.181	298.85
158.0	2.181	298.85
160.0	2.182	298.85
162.0	2.181	298.85
164.0	2.182	298.85
166.0	2.181	298.85
168.0	2.182	298.85
170.0	2.182	298.85
172.0	2.181	298.85
174.0	2.182	298.85
176.0	2.181	298.85
178.0	2.182	298.85
180.0	2.181	298.85
182.0	2.180	298.85
184.0	2.176	298.85
186.0	2.176	298.85
188.0	2.182	298.85
190.0	2.182	298.85
192.0	2.180	298.85

78	0.615	0.618	0.994
80	0.615	0.618	0.996
82	0.615	0.618	0.995
84	0.615	0.618	0.995
86	0.614	0.618	0.994
88	0.613	0.618	0.992
90	0.613	0.618	0.992
92	0.613	0.618	0.992
94	0.614	0.618	0.993
96	0.615	0.618	0.995
98	0.613	0.618	0.992
100	0.614	0.618	0.993
102	0.614	0.618	0.994
104	0.613	0.618	0.992
106	0.613	0.618	0.992
108	0.614	0.618	0.993
110	0.614	0.618	0.994
112	0.614	0.618	0.993
114	0.613	0.618	0.992
116	0.614	0.618	0.993
118	0.614	0.618	0.993
120	0.613	0.618	0.992
122	0.614	0.618	0.994
124	0.614	0.618	0.993
126	0.614	0.618	0.993
128	0.613	0.618	0.991
130	0.613	0.618	0.992
132	0.613	0.618	0.992
134	0.612	0.618	0.990
136	0.613	0.618	0.992
138	0.613	0.618	0.991
140	0.613	0.618	0.992
142	0.612	0.618	0.990
144	0.612	0.618	0.989
146	0.613	0.618	0.991
148	0.612	0.618	0.991
150	0.612	0.618	0.990
152	0.612	0.618	0.991
154	0.612	0.618	0.990
156	0.611	0.618	0.989
158	0.611	0.618	0.989
160	0.612	0.618	0.990
162	0.611	0.618	0.988
164	0.612	0.618	0.989
166	0.611	0.618	0.988
168	0.612	0.618	0.989
170	0.612	0.618	0.990
172	0.611	0.618	0.989
174	0.612	0.618	0.991
176	0.611	0.618	0.988
178	0.612	0.618	0.991
180	0.611	0.618	0.988
182	0.610	0.618	0.987
184	0.606	0.618	0.980
186	0.606	0.618	0.981
188	0.612	0.618	0.990
190	0.612	0.618	0.990
192	0.610	0.618	0.987

194.0	2.181	298.85
196.0	2.181	298.85
198.0	2.181	298.85
200.0	2.180	298.85
202.0	2.181	298.85
204.0	2.182	298.85
206.0	2.181	298.85
208.0	2.181	298.85
210.0	2.180	298.85
212.0	2.180	298.85
214.0	2.181	298.85
216.0	2.180	298.85
218.0	2.181	298.85
220.0	2.180	298.85
222.0	2.180	298.85
224.0	2.181	298.85
226.0	2.181	298.85
228.0	2.180	298.85
230.0	2.181	298.85
232.0	2.181	298.85
234.0	2.180	298.85
236.0	2.180	298.85
238.0	2.180	298.85
240.0	2.179	298.85
242.0	2.180	298.85
244.0	2.180	298.85
246.0	2.180	298.85
248.0	2.179	298.85
250.0	2.180	298.85
252.0	2.180	298.85
254.0	2.180	298.85
256.0	2.179	298.85
258.0	2.179	298.85
260.0	2.180	298.85
262.0	2.179	298.85
264.0	2.180	298.85
266.0	2.180	298.85
268.0	2.178	298.85
270.0	2.179	298.85
272.0	2.180	298.85
274.0	2.179	298.85
276.0	2.178	298.85
278.0	2.179	298.85
280.0	2.178	298.85
282.0	2.178	298.85
284.0	2.179	298.85
286.0	2.178	298.85
288.0	2.179	298.85
290.0	2.180	298.85
292.0	2.178	298.85
294.0	2.178	298.85
296.0	2.177	298.85
298.0	2.177	298.85
300.0	2.176	298.85
302.0	2.176	298.85
304.0	2.176	298.85
306.0	2.175	298.85
308.0	2.177	298.85

194	0.611	0.618	0.989
196	0.611	0.618	0.988
198	0.611	0.618	0.989
200	0.610	0.618	0.988
202	0.611	0.618	0.989
204	0.612	0.618	0.989
206	0.611	0.618	0.989
208	0.611	0.618	0.988
210	0.610	0.618	0.987
212	0.610	0.618	0.987
214	0.611	0.618	0.988
216	0.610	0.618	0.987
218	0.611	0.618	0.988
220	0.610	0.618	0.987
222	0.610	0.618	0.987
224	0.611	0.618	0.988
226	0.611	0.618	0.988
228	0.610	0.618	0.987
230	0.611	0.618	0.989
232	0.611	0.618	0.988
234	0.610	0.618	0.987
236	0.610	0.618	0.986
238	0.610	0.618	0.986
240	0.609	0.618	0.986
242	0.610	0.618	0.987
244	0.610	0.618	0.987
246	0.610	0.618	0.987
248	0.609	0.618	0.985
250	0.610	0.618	0.987
252	0.610	0.618	0.987
254	0.610	0.618	0.986
256	0.609	0.618	0.985
258	0.609	0.618	0.985
260	0.610	0.618	0.986
262	0.609	0.618	0.985
264	0.610	0.618	0.987
266	0.610	0.618	0.986
268	0.608	0.618	0.984
270	0.609	0.618	0.986
272	0.610	0.618	0.987
274	0.609	0.618	0.985
276	0.608	0.618	0.984
278	0.609	0.618	0.985
280	0.608	0.618	0.984
282	0.608	0.618	0.984
284	0.609	0.618	0.986
286	0.608	0.618	0.984
288	0.609	0.618	0.985
290	0.610	0.618	0.986
292	0.608	0.618	0.983
294	0.608	0.618	0.984
296	0.607	0.618	0.983
298	0.607	0.618	0.983
300	0.606	0.618	0.981
302	0.606	0.618	0.980
304	0.606	0.618	0.980
306	0.605	0.618	0.979
308	0.607	0.618	0.982


Plot of Normalized Head Versus Elapsed Time
Borehole MW138
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
5000
10000
15000
20000
25000
Elapsed Time (sec)
y = 1.47E+00e-7.42E-05x
Straight line fit equation to data between normlized interval 0.27 and 0.37:
y = 1.47E+00e-7.42E-05x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -7.42E-05
T0 = 13,477 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	Apr. 17, 2019		Static water depth, H:	3.07	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	3.81	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW143		Basic time lag, To:	1,275	sec
Well Screen Bottom:	4.6	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	304.34	masl	Estimated Sy of sand pack:	0.30	
Static Water Level:	3.07	mbgs	Estimated effective $2r_e$:	11.9	cm
Ground Elevation:	304.34	masl	$K^* = r_e 2\ln(L/R)/(2LTo)$ =	**2.5E-04**	cm/s
WATER LEVEL BEFORE TEST = H =	3.07	mbgs	* modified to account for sand pack.		

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	3.807	300.53
1.0	3.803	300.54
2.0	3.805	300.54
3.0	3.801	300.54
4.0	3.800	300.54
5.0	3.799	300.54
6.0	3.799	300.54
7.0	3.798	300.54
8.0	3.797	300.54
9.0	3.796	300.54
10.0	3.797	300.54
11.0	3.797	300.54
12.0	3.798	300.54
13.0	3.797	300.54
14.0	3.796	300.54
15.0	3.796	300.54
16.0	3.796	300.54
17.0	3.796	300.54
18.0	3.795	300.55
19.0	3.795	300.55
20.0	3.795	300.55
21.0	3.794	300.55
22.0	3.794	300.55
23.0	3.795	300.55
24.0	3.794	300.55
25.0	3.794	300.55
26.0	3.794	300.55
27.0	3.793	300.55
28.0	3.793	300.55
29.0	3.792	300.55
30.0	3.792	300.55
31.0	3.792	300.55
32.0	3.793	300.55
33.0	3.792	300.55
34.0	3.791	300.55
35.0	3.791	300.55
36.0	3.791	300.55
37.0	3.790	300.55
38.0	3.790	300.55

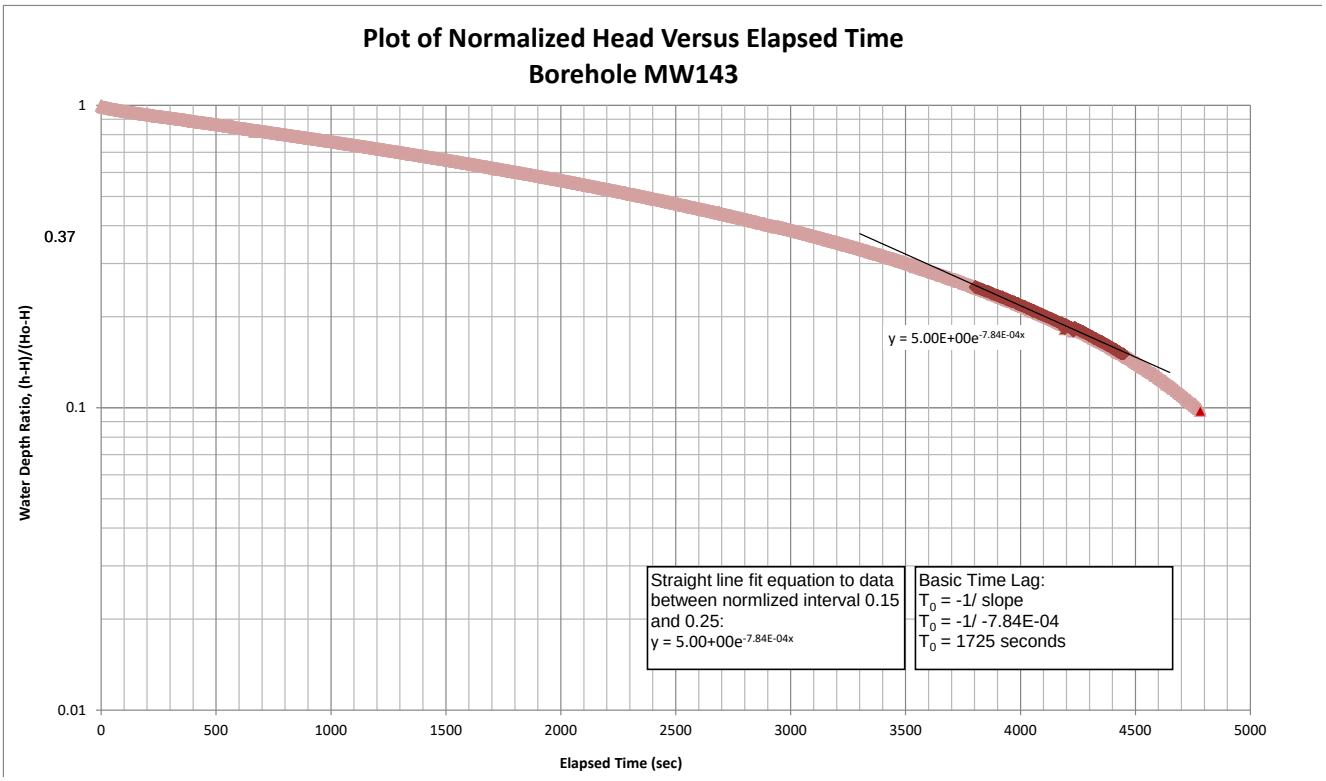
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.737	0.737	1.000
1	0.733	0.737	0.995
2	0.735	0.737	0.997
3	0.731	0.737	0.992
4	0.730	0.737	0.991
5	0.729	0.737	0.989
6	0.729	0.737	0.989
7	0.728	0.737	0.988
8	0.727	0.737	0.986
9	0.726	0.737	0.985
10	0.727	0.737	0.986
11	0.727	0.737	0.986
12	0.728	0.737	0.988
13	0.727	0.737	0.986
14	0.726	0.737	0.985
15	0.726	0.737	0.985
16	0.726	0.737	0.985
17	0.726	0.737	0.985
18	0.725	0.737	0.984
19	0.725	0.737	0.984
20	0.725	0.737	0.984
21	0.724	0.737	0.982
22	0.724	0.737	0.982
23	0.725	0.737	0.984
24	0.724	0.737	0.982
25	0.724	0.737	0.982
26	0.724	0.737	0.982
27	0.723	0.737	0.981
28	0.723	0.737	0.981
29	0.722	0.737	0.980
30	0.722	0.737	0.980
31	0.722	0.737	0.980
32	0.723	0.737	0.981
33	0.722	0.737	0.980
34	0.721	0.737	0.978
35	0.721	0.737	0.978
36	0.721	0.737	0.978
37	0.720	0.737	0.977
38	0.720	0.737	0.977

39.0	3.790	300.55
40.0	3.789	300.55
41.0	3.789	300.55
42.0	3.789	300.55
43.0	3.789	300.55
44.0	3.788	300.55
45.0	3.788	300.55
46.0	3.788	300.55
47.0	3.789	300.55
48.0	3.787	300.55
49.0	3.787	300.55
50.0	3.787	300.55
51.0	3.786	300.55
52.0	3.787	300.55
53.0	3.786	300.55
54.0	3.786	300.55
55.0	3.786	300.55
56.0	3.786	300.55
57.0	3.786	300.55
58.0	3.785	300.56
59.0	3.785	300.56
60.0	3.785	300.56
61.0	3.784	300.56
62.0	3.785	300.56
63.0	3.784	300.56
64.0	3.784	300.56
65.0	3.783	300.56
66.0	3.783	300.56
67.0	3.783	300.56
68.0	3.782	300.56
69.0	3.783	300.56
70.0	3.782	300.56
71.0	3.782	300.56
72.0	3.782	300.56
73.0	3.782	300.56
74.0	3.781	300.56
75.0	3.780	300.56
76.0	3.780	300.56
77.0	3.780	300.56
78.0	3.780	300.56
79.0	3.779	300.56
80.0	3.780	300.56
81.0	3.779	300.56
82.0	3.778	300.56
83.0	3.779	300.56
84.0	3.779	300.56
85.0	3.779	300.56
86.0	3.778	300.56
87.0	3.778	300.56
88.0	3.778	300.56
89.0	3.778	300.56
90.0	3.778	300.56
91.0	3.777	300.56
92.0	3.777	300.56
93.0	3.777	300.56
94.0	3.776	300.56
95.0	3.776	300.56
96.0	3.776	300.56

39	0.720	0.737	0.977
40	0.719	0.737	0.976
41	0.719	0.737	0.976
42	0.719	0.737	0.976
43	0.719	0.737	0.976
44	0.718	0.737	0.974
45	0.718	0.737	0.974
46	0.718	0.737	0.974
47	0.719	0.737	0.976
48	0.717	0.737	0.973
49	0.717	0.737	0.973
50	0.717	0.737	0.973
51	0.716	0.737	0.972
52	0.717	0.737	0.973
53	0.716	0.737	0.972
54	0.716	0.737	0.972
55	0.716	0.737	0.972
56	0.716	0.737	0.972
57	0.716	0.737	0.972
58	0.715	0.737	0.970
59	0.715	0.737	0.970
60	0.715	0.737	0.970
61	0.714	0.737	0.969
62	0.715	0.737	0.970
63	0.714	0.737	0.969
64	0.714	0.737	0.969
65	0.713	0.737	0.967
66	0.713	0.737	0.967
67	0.713	0.737	0.967
68	0.712	0.737	0.966
69	0.713	0.737	0.967
70	0.712	0.737	0.966
71	0.712	0.737	0.966
72	0.712	0.737	0.966
73	0.712	0.737	0.966
74	0.711	0.737	0.965
75	0.710	0.737	0.963
76	0.710	0.737	0.963
77	0.710	0.737	0.963
78	0.710	0.737	0.963
79	0.709	0.737	0.962
80	0.710	0.737	0.963
81	0.709	0.737	0.962
82	0.708	0.737	0.961
83	0.709	0.737	0.962
84	0.709	0.737	0.962
85	0.709	0.737	0.962
86	0.708	0.737	0.961
87	0.708	0.737	0.961
88	0.708	0.737	0.961
89	0.708	0.737	0.961
90	0.708	0.737	0.961
91	0.707	0.737	0.959
92	0.707	0.737	0.959
93	0.707	0.737	0.959
94	0.706	0.737	0.958
95	0.706	0.737	0.958
96	0.706	0.737	0.958

97.0	3.776	300.56
98.0	3.776	300.56
99.0	3.776	300.56
100.0	3.775	300.57
101.0	3.775	300.57
102.0	3.775	300.57
103.0	3.775	300.57
104.0	3.775	300.57
105.0	3.774	300.57
106.0	3.774	300.57
107.0	3.774	300.57
108.0	3.774	300.57
109.0	3.774	300.57
110.0	3.774	300.57
111.0	3.773	300.57
112.0	3.773	300.57
113.0	3.773	300.57
114.0	3.772	300.57
115.0	3.771	300.57
116.0	3.773	300.57
117.0	3.772	300.57
118.0	3.772	300.57
119.0	3.772	300.57
120.0	3.772	300.57
121.0	3.771	300.57
122.0	3.771	300.57
123.0	3.771	300.57
124.0	3.770	300.57
125.0	3.771	300.57
126.0	3.770	300.57
127.0	3.770	300.57
128.0	3.770	300.57
129.0	3.770	300.57
130.0	3.769	300.57
131.0	3.769	300.57
132.0	3.769	300.57
133.0	3.769	300.57
134.0	3.769	300.57
135.0	3.769	300.57
136.0	3.769	300.57
137.0	3.769	300.57
138.0	3.768	300.57
139.0	3.767	300.57
140.0	3.768	300.57
141.0	3.768	300.57
142.0	3.767	300.57
143.0	3.767	300.57
144.0	3.767	300.57
145.0	3.767	300.57
146.0	3.766	300.57
147.0	3.767	300.57
148.0	3.766	300.57
149.0	3.766	300.57
150.0	3.766	300.57
151.0	3.766	300.57
152.0	3.766	300.57
153.0	3.765	300.58
154.0	3.765	300.58

97	0.706	0.737	0.958
98	0.706	0.737	0.958
99	0.706	0.737	0.958
100	0.705	0.737	0.957
101	0.705	0.737	0.957
102	0.705	0.737	0.957
103	0.705	0.737	0.957
104	0.705	0.737	0.957
105	0.704	0.737	0.955
106	0.704	0.737	0.955
107	0.704	0.737	0.955
108	0.704	0.737	0.955
109	0.704	0.737	0.955
110	0.704	0.737	0.955
111	0.703	0.737	0.954
112	0.703	0.737	0.954
113	0.703	0.737	0.954
114	0.702	0.737	0.953
115	0.701	0.737	0.951
116	0.703	0.737	0.954
117	0.702	0.737	0.953
118	0.702	0.737	0.953
119	0.702	0.737	0.953
120	0.702	0.737	0.953
121	0.701	0.737	0.951
122	0.701	0.737	0.951
123	0.701	0.737	0.951
124	0.700	0.737	0.950
125	0.701	0.737	0.951
126	0.700	0.737	0.950
127	0.700	0.737	0.950
128	0.700	0.737	0.950
129	0.700	0.737	0.950
130	0.699	0.737	0.948
131	0.699	0.737	0.948
132	0.699	0.737	0.948
133	0.699	0.737	0.948
134	0.699	0.737	0.948
135	0.699	0.737	0.948
136	0.699	0.737	0.948
137	0.699	0.737	0.948
138	0.698	0.737	0.947
139	0.697	0.737	0.946
140	0.698	0.737	0.947
141	0.698	0.737	0.947
142	0.697	0.737	0.946
143	0.697	0.737	0.946
144	0.697	0.737	0.946
145	0.697	0.737	0.946
146	0.696	0.737	0.944
147	0.697	0.737	0.946
148	0.696	0.737	0.944
149	0.696	0.737	0.944
150	0.696	0.737	0.944
151	0.696	0.737	0.944
152	0.696	0.737	0.944
153	0.695	0.737	0.943
154	0.695	0.737	0.943


Plot of Normalized Head Versus Elapsed Time
Borehole MW143
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Elapsed Time (sec)
y = 5.00E+00e-7.84E-04x
Straight line fit equation to data between normlized interval 0.15 and 0.25:
y = 5.00+00e-7.84E-04x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -7.84E-04
T0 = 1725 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	Apr. 17, 2019		Static water depth, H:	1.76	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	2.47	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW147		Basic time lag, To:	1,692	sec
Well Screen Bottom:	3.6	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	312.55	masl			
Static Water Level:	1.76	mbgs			
Ground Elevation:	312.55	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**3.5E-05**	cm/s
WATER LEVEL BEFORE TEST = H =	1.76	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	2.466	310.08
1.0	2.465	310.09
2.0	2.464	310.09
3.0	2.463	310.09
4.0	2.463	310.09
5.0	2.462	310.09
6.0	2.461	310.09
7.0	2.460	310.09
8.0	2.460	310.09
9.0	2.473	310.08
10.0	2.465	310.09
11.0	2.464	310.09
12.0	2.459	310.09
13.0	2.461	310.09
14.0	2.462	310.09
15.0	2.461	310.09
16.0	2.460	310.09
17.0	2.461	310.09
18.0	2.459	310.09
19.0	2.459	310.09
20.0	2.458	310.09
21.0	2.458	310.09
22.0	2.457	310.09
23.0	2.456	310.09
24.0	2.455	310.10
25.0	2.454	310.10
26.0	2.454	310.10
27.0	2.453	310.10
28.0	2.452	310.10
29.0	2.452	310.10
30.0	2.451	310.10
31.0	2.451	310.10
32.0	2.450	310.10
33.0	2.449	310.10
34.0	2.449	310.10
35.0	2.448	310.10
36.0	2.447	310.10
37.0	2.446	310.10
38.0	2.446	310.10

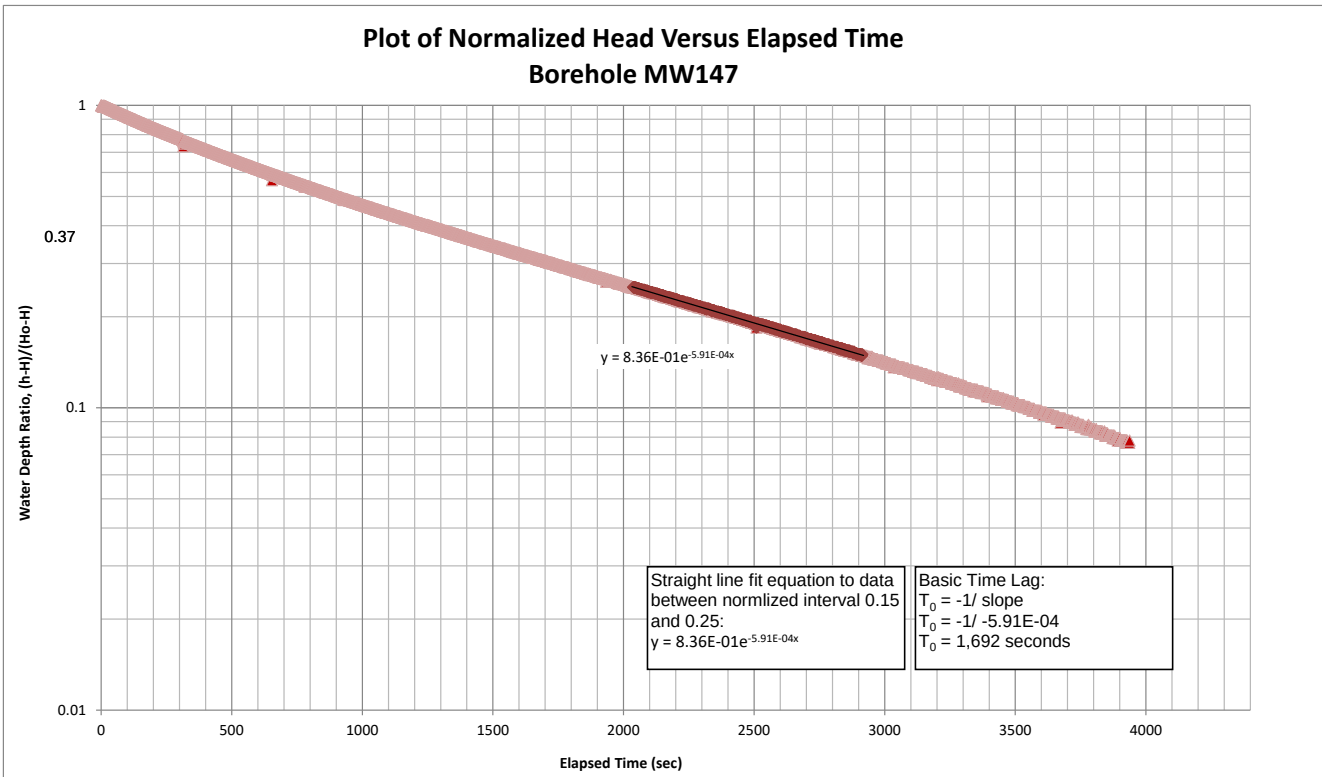
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.706	0.706	1.000
1	0.705	0.706	0.999
2	0.704	0.706	0.997
3	0.703	0.706	0.996
4	0.703	0.706	0.996
5	0.702	0.706	0.994
6	0.701	0.706	0.993
7	0.700	0.706	0.992
8	0.700	0.706	0.992
9	0.713	0.706	1.010
10	0.705	0.706	0.999
11	0.704	0.706	0.997
12	0.699	0.706	0.990
13	0.701	0.706	0.993
14	0.702	0.706	0.994
15	0.701	0.706	0.993
16	0.700	0.706	0.992
17	0.701	0.706	0.993
18	0.699	0.706	0.990
19	0.699	0.706	0.990
20	0.698	0.706	0.989
21	0.698	0.706	0.989
22	0.697	0.706	0.987
23	0.696	0.706	0.986
24	0.695	0.706	0.984
25	0.694	0.706	0.983
26	0.694	0.706	0.983
27	0.693	0.706	0.982
28	0.692	0.706	0.980
29	0.692	0.706	0.980
30	0.691	0.706	0.979
31	0.691	0.706	0.979
32	0.690	0.706	0.977
33	0.689	0.706	0.976
34	0.689	0.706	0.976
35	0.688	0.706	0.975
36	0.687	0.706	0.973
37	0.686	0.706	0.972
38	0.686	0.706	0.972

39.0	2.445	310.11
40.0	2.445	310.11
41.0	2.444	310.11
42.0	2.444	310.11
43.0	2.443	310.11
44.0	2.443	310.11
45.0	2.442	310.11
46.0	2.441	310.11
47.0	2.440	310.11
48.0	2.440	310.11
49.0	2.440	310.11
50.0	2.439	310.11
51.0	2.438	310.11
52.0	2.438	310.11
53.0	2.437	310.11
54.0	2.437	310.11
55.0	2.435	310.12
56.0	2.435	310.12
57.0	2.435	310.12
58.0	2.434	310.12
59.0	2.433	310.12
60.0	2.433	310.12
61.0	2.432	310.12
62.0	2.431	310.12
63.0	2.431	310.12
64.0	2.430	310.12
65.0	2.430	310.12
66.0	2.429	310.12
67.0	2.429	310.12
68.0	2.428	310.12
69.0	2.427	310.12
70.0	2.427	310.12
71.0	2.427	310.12
72.0	2.426	310.12
73.0	2.425	310.13
74.0	2.425	310.13
75.0	2.424	310.13
76.0	2.423	310.13
77.0	2.423	310.13
78.0	2.422	310.13
79.0	2.422	310.13
80.0	2.421	310.13
81.0	2.421	310.13
82.0	2.420	310.13
83.0	2.419	310.13
84.0	2.418	310.13
85.0	2.418	310.13
86.0	2.418	310.13
87.0	2.417	310.13
88.0	2.417	310.13
89.0	2.416	310.13
90.0	2.415	310.14
91.0	2.415	310.14
92.0	2.414	310.14
93.0	2.413	310.14
94.0	2.413	310.14
95.0	2.412	310.14
96.0	2.412	310.14

39	0.685	0.706	0.970
40	0.685	0.706	0.970
41	0.684	0.706	0.969
42	0.684	0.706	0.969
43	0.683	0.706	0.967
44	0.683	0.706	0.967
45	0.682	0.706	0.966
46	0.681	0.706	0.965
47	0.680	0.706	0.963
48	0.680	0.706	0.963
49	0.680	0.706	0.963
50	0.679	0.706	0.962
51	0.678	0.706	0.960
52	0.678	0.706	0.960
53	0.677	0.706	0.959
54	0.677	0.706	0.959
55	0.675	0.706	0.956
56	0.675	0.706	0.956
57	0.675	0.706	0.956
58	0.674	0.706	0.955
59	0.673	0.706	0.953
60	0.673	0.706	0.953
61	0.672	0.706	0.952
62	0.671	0.706	0.950
63	0.671	0.706	0.950
64	0.670	0.706	0.949
65	0.670	0.706	0.949
66	0.669	0.706	0.948
67	0.669	0.706	0.948
68	0.668	0.706	0.946
69	0.667	0.706	0.945
70	0.667	0.706	0.945
71	0.667	0.706	0.945
72	0.666	0.706	0.943
73	0.665	0.706	0.942
74	0.665	0.706	0.942
75	0.664	0.706	0.941
76	0.663	0.706	0.939
77	0.663	0.706	0.939
78	0.662	0.706	0.938
79	0.662	0.706	0.938
80	0.661	0.706	0.936
81	0.661	0.706	0.936
82	0.660	0.706	0.935
83	0.659	0.706	0.933
84	0.658	0.706	0.932
85	0.658	0.706	0.932
86	0.658	0.706	0.932
87	0.657	0.706	0.931
88	0.657	0.706	0.931
89	0.656	0.706	0.929
90	0.655	0.706	0.928
91	0.655	0.706	0.928
92	0.654	0.706	0.926
93	0.653	0.706	0.925
94	0.653	0.706	0.925
95	0.652	0.706	0.924
96	0.652	0.706	0.924

97.0	2.411	310.14
98.0	2.411	310.14
99.0	2.410	310.14
100.0	2.409	310.14
101.0	2.409	310.14
102.0	2.408	310.14
103.0	2.407	310.14
104.0	2.407	310.14
105.0	2.406	310.14
106.0	2.406	310.14
107.0	2.406	310.14
108.0	2.405	310.15
109.0	2.405	310.15
110.0	2.404	310.15
111.0	2.403	310.15
112.0	2.403	310.15
113.0	2.402	310.15
114.0	2.402	310.15
115.0	2.401	310.15
116.0	2.401	310.15
117.0	2.400	310.15
118.0	2.399	310.15
119.0	2.398	310.15
120.0	2.399	310.15
121.0	2.397	310.15
122.0	2.397	310.15
123.0	2.396	310.15
124.0	2.396	310.15
125.0	2.395	310.16
126.0	2.395	310.16
127.0	2.394	310.16
128.0	2.394	310.16
129.0	2.393	310.16
130.0	2.392	310.16
131.0	2.392	310.16
132.0	2.392	310.16
133.0	2.390	310.16
134.0	2.390	310.16
135.0	2.390	310.16
136.0	2.389	310.16
137.0	2.389	310.16
138.0	2.387	310.16
139.0	2.388	310.16
140.0	2.387	310.16
141.0	2.386	310.16
142.0	2.386	310.16
143.0	2.386	310.16
144.0	2.385	310.17
145.0	2.384	310.17
146.0	2.384	310.17
147.0	2.383	310.17
148.0	2.382	310.17
149.0	2.382	310.17
150.0	2.381	310.17
151.0	2.381	310.17
152.0	2.381	310.17
153.0	2.380	310.17
154.0	2.380	310.17

97	0.651	0.706	0.922
98	0.651	0.706	0.922
99	0.650	0.706	0.921
100	0.649	0.706	0.919
101	0.649	0.706	0.919
102	0.648	0.706	0.918
103	0.647	0.706	0.916
104	0.647	0.706	0.916
105	0.646	0.706	0.915
106	0.646	0.706	0.915
107	0.646	0.706	0.915
108	0.645	0.706	0.914
109	0.645	0.706	0.914
110	0.644	0.706	0.912
111	0.643	0.706	0.911
112	0.643	0.706	0.911
113	0.642	0.706	0.909
114	0.642	0.706	0.909
115	0.641	0.706	0.908
116	0.641	0.706	0.908
117	0.640	0.706	0.907
118	0.639	0.706	0.905
119	0.638	0.706	0.904
120	0.639	0.706	0.905
121	0.637	0.706	0.902
122	0.637	0.706	0.902
123	0.636	0.706	0.901
124	0.636	0.706	0.901
125	0.635	0.706	0.899
126	0.635	0.706	0.899
127	0.634	0.706	0.898
128	0.634	0.706	0.898
129	0.633	0.706	0.897
130	0.632	0.706	0.895
131	0.632	0.706	0.895
132	0.632	0.706	0.895
133	0.630	0.706	0.892
134	0.630	0.706	0.892
135	0.630	0.706	0.892
136	0.629	0.706	0.891
137	0.629	0.706	0.891
138	0.627	0.706	0.888
139	0.628	0.706	0.890
140	0.627	0.706	0.888
141	0.626	0.706	0.887
142	0.626	0.706	0.887
143	0.626	0.706	0.887
144	0.625	0.706	0.885
145	0.624	0.706	0.884
146	0.624	0.706	0.884
147	0.623	0.706	0.882
148	0.622	0.706	0.881
149	0.622	0.706	0.881
150	0.621	0.706	0.880
151	0.621	0.706	0.880
152	0.621	0.706	0.880
153	0.620	0.706	0.878
154	0.620	0.706	0.878


Plot of Normalized Head Versus Elapsed Time
Borehole MW147
Water Depth Ratio, (h-Hi)/(Ho-H)
1
0.37
0.1
0.01
0
500
1000
1500
2000
2500
3000
3500
4000
Elapsed Time (sec)
y = 8.36E-01e-5.91E-04x
Straight line fit equation to data between normlized interval 0.15 and 0.25:
y = 8.36E-01e-5.91E-04x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -5.91E-04
T0 = 1,692 seconds

APPENDIX G

Ground Water Sample Laboratory Reports

FINAL REPORT

CA15046-MAY19 R1

18KX004

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS

Client	Peto MacCallum Ltd
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada
Contact	Dylan Patterson
Telephone	519-893-7500
Facsimile	519-893-0654
Email	dpatterson@petomaccallum.com; khanes@petomaccallum.com
Project	18KX004
Order Number	
Samples	Ground Water (3)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA15046-MAY19
Received	05/01/2019
Approved	05/07/2019
Report Number	CA15046-MAY19 R1
Date Reported	07/18/2019

COMMENTS

RL - SGS Reporting Limit

Temperature of Sample upon Receipt: 7 degrees C
Cooling Agent Present:Yes
Custody Seal Present:No

Chain of Custody Number:002164

Raise RL for NO2 on #8 due to matrix interference

SIGNATORIES

Brad Moore Hon. B.Sc

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Legend..... 18

Annexes..... 19

PACKAGE: **SANSEW - General Chemistry** (WATER)

L1 = SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92

L2 = SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92

				Sample Number	7	8	9
				Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
				Sample Matrix	Ground Water	Ground Water	Ground Water
				Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
General Chemistry							
Biochemical Oxygen Demand (BOD5)	mg/L	2	300		< 4↑	< 4↑	< 4↑
Total Suspended Solids	mg/L	2	350	15	139	110	176
Total Kjeldahl Nitrogen	as N mg/L	0.5	100		< 0.5	< 0.5	< 0.5
Ammonia+Ammonium (N)	as N mg/L	0.1			< 0.1	0.2	0.1

PACKAGE: **SANSEW - Metals and Inorganics** (WATER)

L1 = SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92

L2 = SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92

				Sample Number	7	8	9
				Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
				Sample Matrix	Ground Water	Ground Water	Ground Water
				Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Metals and Inorganics							
Total Chlorine	mg/L	0.02			0.09	0.30	< 0.02
Cyanide (total)	mg/L	0.01	2		< 0.01	< 0.01	< 0.01
Fluoride	mg/L	0.06	10		0.13	0.08	0.13
Sulphate	mg/L	0.2	1500		45	63	36
Nitrite (as N)	as N mg/L	0.03			< 0.03	< 0.3↑	< 0.03
Nitrate (as N)	as N mg/L	0.06			< 0.06	0.20	0.77
Nitrate + Nitrite (as N)	as N mg/L	0.06			< 0.06	<0.3↑	0.77
Hardness	mg/L as CaCO3	0.05			342	998	259
Aluminum (total)	mg/L	0.001	50		0.656	4.03	0.451

PACKAGE: **SANSEW - Metals and Inorganics**
(WATER)

L1 = SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92

L2 = SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92

				Sample Number	7	8	9
				Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
				Sample Matrix	Ground Water	Ground Water	Ground Water
				Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Metals and Inorganics (continued)							
Aluminum (dissolved)	mg/L	0.001			0.075	0.198	0.154
Antimony (total)	mg/L	0.0009	5		< 0.0009	< 0.0009	< 0.0009
Arsenic (total)	mg/L	0.0002	1		0.0005	0.0021	0.0003
Bismuth (total)	mg/L	0.000007	5		0.000015	0.000074	0.000011
Cadmium (total)	mg/L	0.000003	0.5	0.05	0.000051	0.000357	0.000026
Chromium (total)	mg/L	0.00008	5	0.2	0.00145	0.00569	0.00212
Cobalt (total)	mg/L	0.000004	5		0.000788	0.00347	0.000473
Copper (total)	mg/L	0.0002	3	1	0.0020	0.0124	0.0021
Iron (total)	mg/L	0.007	50		0.988	5.72	0.584
Lead (total)	mg/L	0.00001	5	0.05	0.00393	0.0147	0.00120
Manganese (total)	mg/L	0.00001	5		0.253	0.674	0.0567
Molybdenum (total)	mg/L	0.00004	5		0.00033	0.00128	0.00898
Nickel (total)	mg/L	0.0001	3	0.5	0.0018	0.0077	0.0028
Phosphorus (total)	mg/L	0.003	10		0.055	0.263	0.019
Selenium (total)	mg/L	0.00004	5		< 0.00004	0.00014	0.00012
Silver (total)	mg/L	0.00005	5		< 0.00005	< 0.00005	< 0.00005
Tin (total)	mg/L	0.00006	5		0.00104	0.00074	0.00128
Titanium (total)	mg/L	0.00005	5		0.0215	0.111	0.0191
Vanadium (total)	mg/L	0.00001	5		0.00158	0.00811	0.00099

PACKAGE: **SANSEW - Metals and Inorganics** (WATER)

L1 = SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92

L2 = SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92

					Sample Number	7	8	9
					Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
					Sample Matrix	Ground Water	Ground Water	Ground Water
					Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Metals and Inorganics (continued)							
Zinc (total)	mg/L	0.002	3	0.5	0.020	0.072	0.013
Boron (total)	mg/L	0.002			0.013	0.029	0.024
Beryllium (total)	mg/L	0.000007			0.000034	0.000191	0.000019
Thallium (total)	mg/L	0.000005			0.000005	0.000097	0.000008
Uranium (total)	mg/L	0.000002			0.00903	0.00117	0.000302
Tungsten (total)	mg/L	0.00002			0.00003	0.00012	0.00030
Zirconium (total)	mg/L	0.002			< 0.002	< 0.002	< 0.002

PACKAGE: **SANSEW - Microbiology** (WATER)

L1 = SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92

L2 = SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92

					Sample Number	7	8	9
					Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
					Sample Matrix	Ground Water	Ground Water	Ground Water
					Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Microbiology							
Fecal Coliform	cfu/100mL	-		200	< 2↑	< 2↑	0

PACKAGE: **SANSEW - Oil and Grease** (WATER)

L1 = SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92

L2 = SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92

					Sample Number	7	8	9
					Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
					Sample Matrix	Ground Water	Ground Water	Ground Water
					Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Oil and Grease							
Oil & Grease (total)	mg/L	2			< 2	< 2	< 2
Oil & Grease (animal/vegetable)	mg/L	4	100		< 4	< 4	< 4
Oil & Grease (mineral/synthetic)	mg/L	4	15		< 4	< 4	< 4

PACKAGE: **SANSEW - Other (ORP)** (WATER)

L1 = SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92

L2 = SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92

					Sample Number	7	8	9
					Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
					Sample Matrix	Ground Water	Ground Water	Ground Water
					Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Other (ORP)							
pH	no unit	0.05	9.5	9	7.35	7.18	7.79
Chromium VI	µg/L	0.2			< 0.2	0.3	0.7
Chloride	mg/L	0.2	1500		11	2200	700
Mercury (total)	mg/L	0.00001	0.1	0.001	< 0.00001	0.00002	< 0.00001

Client: Peto MacCallum Ltd
Project: 18KX004
Project Manager: Dylan Patterson
Samplers: Dylan Patterson

PACKAGE: **SANSEW - Phenols** (WATER)

L1 = SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92

L2 = SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92

Sample Number					7	8	9
Sample Name					BH 2 GW1	BH110 GW1	BH143 GW1
Sample Matrix					Ground Water	Ground Water	Ground Water
Sample Date					30/04/2019		
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Phenols							
4AAP-Phenolics	mg/L	0.002	1		< 0.002	0.006	0.008

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	SANSEW / WATER / - - Waterloo Discharges to - Sanitary Sewers and Combined Sewers - BL_50_92 L1	SANSEW / WATER / - - Waterloo Discharges to - Storm Sewers - BL_50_92 L2
BH 2 GW1					
Total Suspended Solids	SM 2540D	mg/L	139		15
BH110 GW1					
Chloride	EPA300/MA300-Ions1.3	mg/L	2200	1500	
Total Suspended Solids	SM 2540D	mg/L	110		15
BH143 GW1					
Total Suspended Solids	SM 2540D	mg/L	176		15

QC SUMMARY

Ammonia by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENV]SFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0032-MAY19	as N mg/L	0.1	<0.1	2	10	103	90	110	101	75	125

Anions by IC

Method: EPA300/MA300-Ions1.3 I Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0042-MAY19	mg/L	0.2	<0.2	ND	20	93	80	120	92	75	125
Sulphate	DIO0042-MAY19	mg/L	0.2	<0.2	ND	20	98	80	120	92	75	125
Nitrate + Nitrite (as N)	DIO0043-MAY19	mg/L	0.06	<0.06	NA		NA			NA		
Nitrite (as N)	DIO0043-MAY19	mg/L	0.03	<0.03	5	20	101	80	120	103	75	125
Nitrate (as N)	DIO0043-MAY19	mg/L	0.06	<0.06	1	20	101	80	120	103	75	125
Nitrite (as N)	DIO0052-MAY19	mg/L	0.03	<0.03	ND	20	97	80	120	96	75	125
Chloride	DIO0055-MAY19	mg/L	0.2		5	20	93	80	120	95	75	125

QC SUMMARY

Biochemical Oxygen Demand

Method: SM 5210 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0005-MAY19	mg/L	2	< 2	14	30	109	70	130	92	70	130

Chlorine

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Chlorine	EWL0055-MAY19	mg/L	0.02	< 0.02	ND	20	93	90	110	NA		

Cyanide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0025-MAY19	mg/L	0.01	<0.01	ND	10	98	90	110	90	75	125

QC SUMMARY

Fluoride by Specific Ion Electrode

Method: SM 4500 I Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0066-MAY19	mg/L	0.06	<0.06	0	10	95	90	110	83	75	125

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A I Internal ref.: ME-CA-IENVIIC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0071-MAY19	ug/L	0.2	<0.2	12	20	99	80	120	88	75	125
Chromium VI	DIO0086-MAY19	ug/L	0.2	<0.2	6	20	98	80	120	102	75	125

Mercury by CVAAS

Method: EPA 7471A/SM 3112B I Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0002-MAY19	mg/L	0.00001	< 0.00001	ND	20	110	80	120	121	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0012-MAY19	mg/L	0.00005	<0.00005	ND	20	97	90	110	85	70	130
Aluminum (total)	EMS0012-MAY19	mg/L	0.001	<0.001	ND	20	95	90	110	NV	70	130
Aluminum (dissolved)	EMS0012-MAY19	mg/L	0.001	< 0.001	ND	20	95	90	110	NV	70	130
Arsenic (total)	EMS0012-MAY19	mg/L	0.0002	<0.0002	2	20	95	90	110	105	70	130
Beryllium (total)	EMS0012-MAY19	mg/L	0.000007	<0.000007	6	20	94	90	110	NV	70	130
Boron (total)	EMS0012-MAY19	mg/L	0.002	<0.002	4	20	95	90	110	NV	70	130
Bismuth (total)	EMS0012-MAY19	mg/L	0.000007	<0.000007	4	20	93	90	110	NV	70	130
Cadmium (total)	EMS0012-MAY19	mg/L	0.000003	<0.000003	ND	20	95	90	110	92	70	130
Cobalt (total)	EMS0012-MAY19	mg/L	0.000004	<0.000004	10	20	97	90	110	124	70	130
Chromium (total)	EMS0012-MAY19	mg/L	0.00008	<0.00008	8	20	94	90	110	NV	70	130
Copper (total)	EMS0012-MAY19	mg/L	0.0002	<0.0002	9	20	97	90	110	116	70	130
Iron (total)	EMS0012-MAY19	mg/L	0.007	<0.007	7	20	93	90	110	NV	70	130
Manganese (total)	EMS0012-MAY19	mg/L	0.00001	<0.00001	5	20	97	90	110	NV	70	130
Molybdenum (total)	EMS0012-MAY19	mg/L	0.00004	<0.00004	6	20	93	90	110	NV	70	130
Nickel (total)	EMS0012-MAY19	mg/L	0.0001	<0.0001	8	20	97	90	110	NV	70	130
Lead (total)	EMS0012-MAY19	mg/L	0.00001	<0.00001	4	20	93	90	110	87	70	130
Antimony (total)	EMS0012-MAY19	mg/L	0.0009	<0.0009	15	20	107	90	110	88	70	130
Selenium (total)	EMS0012-MAY19	mg/L	0.00004	<0.00004	ND	20	93	90	110	114	70	130
Tin (total)	EMS0012-MAY19	mg/L	0.00006	<0.00006	2	20	90	90	110	NV	70	130
Titanium (total)	EMS0012-MAY19	mg/L	0.00005	<0.00005	8	20	91	90	110	NV	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Thallium (total)	EMS0012-MAY19	mg/L	0.000005	<0.000005	ND	20	95	90	110	83	70	130
Uranium (total)	EMS0012-MAY19	mg/L	0.000002	<0.000002	7	20	94	90	110	90	70	130
Vanadium (total)	EMS0012-MAY19	mg/L	0.00001	<0.00001	7	20	96	90	110	NV	70	130
Tungsten (total)	EMS0012-MAY19	mg/L	0.00002	<0.00002	4	20	93	90	110	NV	70	130
Zinc (total)	EMS0012-MAY19	mg/L	0.002	<0.002	8	20	97	90	110	NV	70	130
Zirconium (total)	EMS0012-MAY19	mg/L	0.002	<0.002	ND	20	103	90	110	NV	70	130

Metals in aqueous samples - ICP-OES

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Hardness	EMS0012-MAY19	mg/L as CaCO3	0.05	<0.05	5	20	93	90	110	NV	70	130
Phosphorus (total)	EMS0012-MAY19	mg/L	0.003	<0.003	10	20	96	90	110	NV	70	130

QC SUMMARY

Microbiology

Method: SM 9222D | Internal ref.: ME-CA-[ENV]MIC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fecal Coliform	BAC9034-MAY19	cfu/100mL	-	ACCEPTED	ACCEPTED							

Oil & Grease

Method: MOE E3401 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (total)	GCM0047-MAY19	mg/L	2	<2			98	75	125			

QC SUMMARY

Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | Internal ref.: ME-CA-IENVIGC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High
Oil & Grease (animal/vegetable)	GCM0047-MAY19	mg/L	4	< 4			NA	70	130			
Oil & Grease (mineral/synthetic)	GCM0047-MAY19	mg/L	4	< 4			NA	70	130			

pH

Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High
pH	EWL0052-MAY19	no unit	0.05	NA	0		100			NA		

QC SUMMARY

Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-IENVISFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0030-MAY19	mg/L	0.002	<0.002	10	10	103	90	110	100	75	125
4AAP-Phenolics	SKA0037-MAY19	mg/L	0.002	<0.002	2	10	108	90	110	108	75	125

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-IENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0071-MAY19	mg/L	2	< 2	0	10	NV	90	110	NA		

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-IENVISFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen	SKA0028-MAY19	as N mg/L	0.5	<0.5	8	10	102	90	110	NV	75	125

QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.
Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.
LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.
Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.
RL: Reporting limit
RPD: Relative percent difference
AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.
Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.
Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

No: 002164

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Oleg Mozhin
Received Date (mm/dd/yyyy): 05/1/19 (mm\dd\yy)
Received Time: 14:30
Received By (signature):
Custody Seal Present: ☑ no
Custody Seal Intact: ☑ no
Cooling Agent Present: ☑ ice pack
Temperature Upon Receipt (°C) 9.0 9.0 9.7 °C x3
LAB LIMS #: CA 15046-May 19

REPORT INFORMATION

Company: Peto MacCallum
Contact: Dylan Patterson
Address: 16 Franklin St S

Phone: 519-893-7500
Fax:
Email: dpatterson@petomaccallum.com; bloghrin@petomaccallum.com

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:

Phone:
Email: scooke@petomaccallum.com

PROJECT INFORMATION

Quotation #: P.O. #:
Project #: 181-7004 Site Location/ID: Maple Grove Rd

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153/04:
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium
☐ Table 3 ☐ Agri/Other ☐ Fine
☐ Table ____

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☑ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☑ Sanitary
☑ Storm
Municipality: Waterloo Region

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics PWQO	PHC F1-F4 ☐ VOC ☐ BTEX ☐ BTEX/F1 ☐ F2-F4 ☐	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	Hardness	Nitrate	Ammonia	Chlorine			COMMENTS:
1	BH 2 GW1	4/30/19	3	18	GW		✓								✓	✓	✓	✓			
2	BH 110 GW1	4/30/19	2	17	GW		✓								✓	✓	✓	✓			
3	BH 110 GW10	5/1/19	10:30	1	GW		✓								✓	✓	✓	✓			
4	BH 143 GW1	4/30/19	4	15	GW		✓								✓	✓	✓	✓			
5	BH 143 GW10	5/1/19	11	3	GW		✓								✓	✓	✓	✓			
6																					
7																					
8	All BH 110 - Same Sample																				
9	All BH 143 - Same Sample.																				
10	As per Andrew Cooke.																				
11																					
12																					

Observations/Comments/Special Instructions: BH 110 GW10 - Sampled 1 of 2 general bottles on 5/1/19. BH 143 GW10 Sampled 1 of 2 General bottles & 0.1 L grease & SVOC ABNs on 5/1/19

Sampled By (NAME): Dylan Patterson	Signature:	Date: 04/30/19 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME):	Signature:	Date: 05/01/19 (mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

FINAL REPORT

CA15046-MAY19 R1

18KX004

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS

Client	Peto MacCallum Ltd
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada
Contact	Dylan Patterson
Telephone	519-893-7500
Facsimile	519-893-0654
Email	dpatterson@petomaccallum.com; khanes@petomaccallum.com
Project	18KX004
Order Number	
Samples	Ground Water (3)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA15046-MAY19
Received	05/01/2019
Approved	05/07/2019
Report Number	CA15046-MAY19 R1
Date Reported	07/18/2019

COMMENTS

RL - SGS Reporting Limit

Temperature of Sample upon Receipt: 7 degrees C
Cooling Agent Present:Yes
Custody Seal Present:No

Chain of Custody Number:002164

Raise RL for NO2 on #8 due to matrix interference

SIGNATORIES

Brad Moore Hon. B.Sc

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Client: Peto MacCallum Ltd
Project: 18KX004
Project Manager: Dylan Patterson
Samplers: Dylan Patterson

PACKAGE: **PWQO - General Chemistry** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number			7	8	9
Sample Name			BH 2 GW1	BH110 GW1	BH143 GW1
Sample Matrix			Ground Water	Ground Water	Ground Water
Sample Date			30/04/2019		
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**	**Result**
General Chemistry						
Biochemical Oxygen Demand (BOD5)	mg/L	2		< 4↑	< 4↑	< 4↑
Total Suspended Solids	mg/L	2		139	110	176
Total Kjeldahl Nitrogen	as N mg/L	0.5		< 0.5	< 0.5	< 0.5
Ammonia+Ammonium (N)	as N mg/L	0.1		< 0.1	0.2	0.1

PACKAGE: **PWQO - Metals and Inorganics** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number			7	8	9
Sample Name			BH 2 GW1	BH110 GW1	BH143 GW1
Sample Matrix			Ground Water	Ground Water	Ground Water
Sample Date			30/04/2019		
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**	**Result**
Metals and Inorganics						
Total Chlorine	mg/L	0.02	0.002	**0.09**	**0.30**	**< 0.02**
Cyanide (total)	mg/L	0.01	0.005	**< 0.01**	**< 0.01**	**< 0.01**
Fluoride	mg/L	0.06		0.13	0.08	0.13
Sulphate	mg/L	0.2		45	63	36
Nitrite (as N)	as N mg/L	0.03		< 0.03	< 0.3↑	< 0.03
Nitrate (as N)	as N mg/L	0.06		< 0.06	0.20	0.77
Nitrate + Nitrite (as N)	as N mg/L	0.06		< 0.06	<0.3↑	0.77
Hardness	mg/L as CaCO3	0.05		342	998	259
Aluminum (total)	mg/L	0.001	0.015	**0.656**	**4.03**	**0.451**
Aluminum (dissolved)	mg/L	0.001	0.015	**0.075**	**0.198**	**0.154**
Antimony (total)	mg/L	0.0009	0.02	< 0.0009	< 0.0009	< 0.0009
Arsenic (total)	mg/L	0.0002	0.005	0.0005	0.0021	0.0003

Client: Peto MacCallum Ltd
Project: 18KX004
Project Manager: Dylan Patterson
Samplers: Dylan Patterson

PACKAGE: **PWQO - Metals and Inorganics** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	7	8	9
Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
Sample Matrix	Ground Water	Ground Water	Ground Water
Sample Date	30/04/2019		

Parameter	Units	RL	L1	Result	Result	Result
Metals and Inorganics (continued)						
Bismuth (total)	mg/L	0.000007		0.000015	0.000074	0.000011
Cadmium (total)	mg/L	0.000003	0.0001	0.000051	**0.000357**	0.000026
Chromium (total)	mg/L	0.00008		0.00145	0.00569	0.00212
Cobalt (total)	mg/L	0.000004	0.0009	0.000788	**0.00347**	0.000473
Copper (total)	mg/L	0.0002	0.001	**0.0020**	**0.0124**	**0.0021**
Iron (total)	mg/L	0.007	0.3	**0.988**	**5.72**	**0.584**
Lead (total)	mg/L	0.00001	0.001	**0.00393**	**0.0147**	**0.00120**
Manganese (total)	mg/L	0.00001		0.253	0.674	0.0567
Molybdenum (total)	mg/L	0.00004	0.04	0.00033	0.00128	0.00898
Nickel (total)	mg/L	0.0001	0.025	0.0018	0.0077	0.0028
Phosphorus (total)	mg/L	0.003	0.01	**0.055**	**0.263**	**0.019**
Selenium (total)	mg/L	0.00004	0.1	< 0.00004	0.00014	0.00012
Silver (total)	mg/L	0.00005	0.0001	< 0.00005	< 0.00005	< 0.00005
Tin (total)	mg/L	0.00006		0.00104	0.00074	0.00128
Titanium (total)	mg/L	0.00005		0.0215	0.111	0.0191
Vanadium (total)	mg/L	0.00001	0.006	0.00158	**0.00811**	0.00099
Zinc (total)	mg/L	0.002	0.02	0.020	**0.072**	0.013
Boron (total)	mg/L	0.002	0.2	0.013	0.029	0.024
Beryllium (total)	mg/L	0.000007	0.011	0.000034	0.000191	0.000019

PACKAGE: **PWQO - Metals and Inorganics** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

				Sample Number	7	8	9
				Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
				Sample Matrix	Ground Water	Ground Water	Ground Water
				Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**		**Result**	**Result**	**Result**
Metals and Inorganics (continued)							
Thallium (total)	mg/L	0.000005	0.0003		0.000005	0.000097	0.000008
Uranium (total)	mg/L	0.000002	0.005		0.00903	0.00117	0.000302
Tungsten (total)	mg/L	0.00002	0.03		0.00003	0.00012	0.00030
Zirconium (total)	mg/L	0.002	0.004		< 0.002	< 0.002	< 0.002

PACKAGE: **PWQO - Microbiology** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

				Sample Number	7	8	9
				Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
				Sample Matrix	Ground Water	Ground Water	Ground Water
				Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**		**Result**	**Result**	**Result**
Microbiology							
Fecal Coliform	cfu/100mL	-			< 2↑	< 2↑	0

PACKAGE: **PWQO - Oil and Grease** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

				Sample Number	7	8	9
				Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
				Sample Matrix	Ground Water	Ground Water	Ground Water
				Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**		**Result**	**Result**	**Result**
Oil and Grease							
Oil & Grease (total)	mg/L	2			< 2	< 2	< 2
Oil & Grease (animal/vegetable)	mg/L	4			< 4	< 4	< 4
Oil & Grease (mineral/synthetic)	mg/L	4			< 4	< 4	< 4

PACKAGE: **PWQO - Other (ORP)** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

			Sample Number	7	8	9
			Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
			Sample Matrix	Ground Water	Ground Water	Ground Water
			Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**	**Result**
Other (ORP)						
pH	no unit	0.05	8.5	7.35	7.18	7.79
Chromium VI	µg/L	0.2	1	< 0.2	0.3	0.7
Chloride	mg/L	0.2		11	2200	700
Mercury (total)	mg/L	0.00001	0.0002	< 0.00001	0.00002	< 0.00001

PACKAGE: **PWQO - Phenols** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

			Sample Number	7	8	9
			Sample Name	BH 2 GW1	BH110 GW1	BH143 GW1
			Sample Matrix	Ground Water	Ground Water	Ground Water
			Sample Date	30/04/2019		
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**	**Result**
Phenols						
4AAP-Phenolics	mg/L	0.002	0.001	< 0.002	0.006	0.008

EXCEEDANCE SUMMARY

BH 2 GW1

Parameter	Method	Units	Result	PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E L1
Aluminum	SM 3030/EPA 200.8	µg/L	0.656	0.015
Aluminum (dissolved)	SM 3030/EPA 200.8	µg/L	0.075	0.015
Copper	SM 3030/EPA 200.8	µg/L	0.0020	0.001
Iron	SM 3030/EPA 200.8	µg/L	0.988	0.3
Lead	SM 3030/EPA 200.8	µg/L	0.00393	0.001
Phosphorous	SM 3030/EPA 200.8	µg/L	0.055	0.01
Uranium	SM 3030/EPA 200.8	µg/L	0.00903	0.005
Chlorine	SM 4500	µg/L	0.09	0.002
Cyanide	SM 4500	µg/L	< 0.01	0.005
4AAP-Phenolics	SM 5530B-D	mg/L	< 0.002	0.001

BH110 GW1

Aluminum	SM 3030/EPA 200.8	µg/L	4.03	0.015
Aluminum (dissolved)	SM 3030/EPA 200.8	µg/L	0.198	0.015
Cadmium	SM 3030/EPA 200.8	µg/L	0.000357	0.0001
Cobalt	SM 3030/EPA 200.8	µg/L	0.00347	0.0009
Copper	SM 3030/EPA 200.8	µg/L	0.0124	0.001
Iron	SM 3030/EPA 200.8	µg/L	5.72	0.3
Lead	SM 3030/EPA 200.8	µg/L	0.0147	0.001
Phosphorous	SM 3030/EPA 200.8	µg/L	0.263	0.01
Vanadium	SM 3030/EPA 200.8	µg/L	0.00811	0.006
Zinc	SM 3030/EPA 200.8	µg/L	0.072	0.02
Chlorine	SM 4500	µg/L	0.30	0.002
Cyanide	SM 4500	µg/L	< 0.01	0.005
4AAP-Phenolics	SM 5530B-D	mg/L	0.006	0.001

BH143 GW1

Aluminum	SM 3030/EPA 200.8	µg/L	0.451	0.015
Aluminum (dissolved)	SM 3030/EPA 200.8	µg/L	0.154	0.015
Copper	SM 3030/EPA 200.8	µg/L	0.0021	0.001
Iron	SM 3030/EPA 200.8	µg/L	0.584	0.3
Lead	SM 3030/EPA 200.8	µg/L	0.00120	0.001
Phosphorous	SM 3030/EPA 200.8	µg/L	0.019	0.01
Chlorine	SM 4500	µg/L	< 0.02	0.002
Cyanide	SM 4500	µg/L	< 0.01	0.005
4AAP-Phenolics	SM 5530B-D	mg/L	0.008	0.001

QC SUMMARY

Ammonia by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENV]SFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0032-MAY19	as N mg/L	0.1	<0.1	2	10	103	90	110	101	75	125

Anions by IC

Method: EPA300/MA300-Ions1.3 I Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0042-MAY19	mg/L	0.2	<0.2	ND	20	93	80	120	92	75	125
Sulphate	DIO0042-MAY19	mg/L	0.2	<0.2	ND	20	98	80	120	92	75	125
Nitrate + Nitrite (as N)	DIO0043-MAY19	mg/L	0.06	<0.06	NA		NA			NA		
Nitrite (as N)	DIO0043-MAY19	mg/L	0.03	<0.03	5	20	101	80	120	103	75	125
Nitrate (as N)	DIO0043-MAY19	mg/L	0.06	<0.06	1	20	101	80	120	103	75	125
Nitrite (as N)	DIO0052-MAY19	mg/L	0.03	<0.03	ND	20	97	80	120	96	75	125
Chloride	DIO0055-MAY19	mg/L	0.2		5	20	93	80	120	95	75	125

QC SUMMARY

Biochemical Oxygen Demand

Method: SM 5210 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0005-MAY19	mg/L	2	< 2	14	30	109	70	130	92	70	130

Chlorine

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Chlorine	EWL0055-MAY19	mg/L	0.02	< 0.02	ND	20	93	90	110	NA		

Cyanide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0025-MAY19	mg/L	0.01	<0.01	ND	10	98	90	110	90	75	125

QC SUMMARY

Fluoride by Specific Ion Electrode

Method: SM 4500 I Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0066-MAY19	mg/L	0.06	<0.06	0	10	95	90	110	83	75	125

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A I Internal ref.: ME-CA-IENVIIC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0071-MAY19	ug/L	0.2	<0.2	12	20	99	80	120	88	75	125
Chromium VI	DIO0086-MAY19	ug/L	0.2	<0.2	6	20	98	80	120	102	75	125

Mercury by CVAAS

Method: EPA 7471A/SM 3112B I Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0002-MAY19	mg/L	0.00001	< 0.00001	ND	20	110	80	120	121	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0012-MAY19	mg/L	0.00005	<0.00005	ND	20	97	90	110	85	70	130
Aluminum (total)	EMS0012-MAY19	mg/L	0.001	<0.001	ND	20	95	90	110	NV	70	130
Aluminum (dissolved)	EMS0012-MAY19	mg/L	0.001	< 0.001	ND	20	95	90	110	NV	70	130
Arsenic (total)	EMS0012-MAY19	mg/L	0.0002	<0.0002	2	20	95	90	110	105	70	130
Beryllium (total)	EMS0012-MAY19	mg/L	0.000007	<0.000007	6	20	94	90	110	NV	70	130
Boron (total)	EMS0012-MAY19	mg/L	0.002	<0.002	4	20	95	90	110	NV	70	130
Bismuth (total)	EMS0012-MAY19	mg/L	0.000007	<0.000007	4	20	93	90	110	NV	70	130
Cadmium (total)	EMS0012-MAY19	mg/L	0.000003	<0.000003	ND	20	95	90	110	92	70	130
Cobalt (total)	EMS0012-MAY19	mg/L	0.000004	<0.000004	10	20	97	90	110	124	70	130
Chromium (total)	EMS0012-MAY19	mg/L	0.00008	<0.00008	8	20	94	90	110	NV	70	130
Copper (total)	EMS0012-MAY19	mg/L	0.0002	<0.0002	9	20	97	90	110	116	70	130
Iron (total)	EMS0012-MAY19	mg/L	0.007	<0.007	7	20	93	90	110	NV	70	130
Manganese (total)	EMS0012-MAY19	mg/L	0.00001	<0.00001	5	20	97	90	110	NV	70	130
Molybdenum (total)	EMS0012-MAY19	mg/L	0.00004	<0.00004	6	20	93	90	110	NV	70	130
Nickel (total)	EMS0012-MAY19	mg/L	0.0001	<0.0001	8	20	97	90	110	NV	70	130
Lead (total)	EMS0012-MAY19	mg/L	0.00001	<0.00001	4	20	93	90	110	87	70	130
Antimony (total)	EMS0012-MAY19	mg/L	0.0009	<0.0009	15	20	107	90	110	88	70	130
Selenium (total)	EMS0012-MAY19	mg/L	0.00004	<0.00004	ND	20	93	90	110	114	70	130
Tin (total)	EMS0012-MAY19	mg/L	0.00006	<0.00006	2	20	90	90	110	NV	70	130
Titanium (total)	EMS0012-MAY19	mg/L	0.00005	<0.00005	8	20	91	90	110	NV	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Thallium (total)	EMS0012-MAY19	mg/L	0.000005	<0.000005	ND	20	95	90	110	83	70	130
Uranium (total)	EMS0012-MAY19	mg/L	0.000002	<0.000002	7	20	94	90	110	90	70	130
Vanadium (total)	EMS0012-MAY19	mg/L	0.00001	<0.00001	7	20	96	90	110	NV	70	130
Tungsten (total)	EMS0012-MAY19	mg/L	0.00002	<0.00002	4	20	93	90	110	NV	70	130
Zinc (total)	EMS0012-MAY19	mg/L	0.002	<0.002	8	20	97	90	110	NV	70	130
Zirconium (total)	EMS0012-MAY19	mg/L	0.002	<0.002	ND	20	103	90	110	NV	70	130

Metals in aqueous samples - ICP-OES

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Hardness	EMS0012-MAY19	mg/L as CaCO3	0.05	<0.05	5	20	93	90	110	NV	70	130
Phosphorus (total)	EMS0012-MAY19	mg/L	0.003	<0.003	10	20	96	90	110	NV	70	130

QC SUMMARY

Microbiology

Method: SM 9222D | Internal ref.: ME-CA-[ENV]MIC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fecal Coliform	BAC9034-MAY19	cfu/100mL	-	ACCEPTED	ACCEPTED							

Oil & Grease

Method: MOE E3401 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (total)	GCM0047-MAY19	mg/L	2	<2			98	75	125			

QC SUMMARY

Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | Internal ref.: ME-CA-IENVIGC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (animal/vegetable)	GCM0047-MAY19	mg/L	4	< 4			NA	70	130			
Oil & Grease (mineral/synthetic)	GCM0047-MAY19	mg/L	4	< 4			NA	70	130			

pH

Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0052-MAY19	no unit	0.05	NA	0		100			NA		

QC SUMMARY

Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-IENVISFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0030-MAY19	mg/L	0.002	<0.002	10	10	103	90	110	100	75	125
4AAP-Phenolics	SKA0037-MAY19	mg/L	0.002	<0.002	2	10	108	90	110	108	75	125

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-IENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0071-MAY19	mg/L	2	< 2	0	10	NV	90	110	NA		

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-IENVISFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen	SKA0028-MAY19	as N mg/L	0.5	<0.5	8	10	102	90	110	NV	75	125

QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.
Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.
LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.
Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.
RL: Reporting limit
RPD: Relative percent difference
AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.
Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.
Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

No: 002164

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Oleg Mozhin
Received Date (mm/dd/yyyy): 05/1/19 (mm\dd\yy)
Received Time: 14:30
Received By (signature):
Custody Seal Present: ☑ no
Custody Seal Intact: ☑ no
Cooling Agent Present: ☑ ice pack
Temperature Upon Receipt (°C) 9.0 9.0 9.7 °C x3
LAB LIMS #: CA 15046-May 19

REPORT INFORMATION

Company: Peto MacCallum
Contact: Dylan Patterson
Address: 16 Franklin St S

Phone: 519-893-7500
Fax:
Email: dpatterson@petomaccallum.com; bloghrin@petomaccallum.com

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:

Phone:
Email: scooke@petomaccallum.com

PROJECT INFORMATION

Quotation #: P.O. #:
Project #: 181-7004 Site Location/ID: Maple Grove Rd

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153/04:
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium
☐ Table 3 ☐ Agri/Other ☐ Fine
☐ Table ____

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☑ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☑ Sanitary
☑ Storm
Municipality: Waterloo Region

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics PWQO	PHC F1-F4 ☐ VOC ☐ BTEX ☐ BTEX/F1 ☐ F2-F4 ☐	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	Hardness	Nitrate	Ammonia	Chlorine			COMMENTS:
1	BH 2 GW1	4/30/19	3	18	GW		✓								✓	✓	✓	✓			
2	BH 110 GW1	4/30/19	2	17	GW		✓								✓	✓	✓	✓			
3	BH 110 GW10	5/1/19	10:30	1	GW		✓								✓	✓	✓	✓			
4	BH 143 GW1	4/30/19	4	15	GW		✓								✓	✓	✓	✓			
5	BH 143 GW10	5/1/19	11	3	GW		✓								✓	✓	✓	✓			
6																					
7																					
8	All BH 110 - Same Sample																				
9	All BH 143 - Same Sample.																				
10	As per Andrew Cooke.																				
11																					
12																					

Observations/Comments/Special Instructions: BH 110 GW10 - Sampled 1 of 2 general bottles on 5/1/19. BH 143 GW10 Sampled 1 of 2 General bottles & 0.1 L grease & SVOC ABNs on 5/1/19

Sampled By (NAME): Dylan Patterson	Signature:	Date: 04/30/19 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME):	Signature:	Date: 05/01/19 (mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

FINAL REPORT

CA14050-MAY19 R2

18KX004, Maple Drove Rd

Prepared for

Peto MacCallum Ltd

First Page

CLIENT DETAILS

Client	Peto MacCallum Ltd
Address	16 Franklin St S Kitchener, ON N2C 1R4. Canada
Contact	Dylan Patterson
Telephone	519-893-7500
Facsimile	519-893-0654
Email	dpatterson@petomaccallum.com; khanes@petomaccallum.cor
Project	18KX004, Maple Drove Rd
Order Number	
Samples	Surface Water (1)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
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SGS Reference	CA14050-MAY19
Received	05/01/2019
Approved	05/07/2019
Report Number	CA14050-MAY19 R2
Date Reported	07/18/2019

COMMENTS

PWQO - Provincial Water Quality Objectives

Limits based on MOE PIBS 3303E publication July 1994 reprinted February 1999

a PWQO limit based on pH >6.5-9.0 (at pH 4.5-5.5 PWQO = 15ug/L, pH >5.5-6.5 PWQO 10% above background levels in geological area.

b PWQO limit based on Hardness <75 mg/L (For Hardness >75 mg/L PWQO = 1100 ug/L)

c PWQO limit based on Hardness 0-100 mg/L(For Hardness >100 mg/L PWQO = 0.5 ug/L)

d PWQO limit based on Cr VI (PWQO limit for Cr III = 8.9 ug/L)

e PWQO limit based on Hardness 0-20 (For Hardness >20 mg/L PWQO = 5 ug/L)

f PWQO limit based on Hardness <30 (For Hardness 30-80 PWQO = 3 ug/L, & >80 PWQO=5)

SIGNATORIES

Brad Moore Hon. B.Sc

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Client: Peto MacCallum Ltd
Project: 18KX004, Maple Drove Rd
Project Manager: Dylan Patterson
Samplers: Dylan Patterson

PACKAGE: **PWQO - General Chemistry** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	6
Sample Name	Creek W1
Sample Matrix	Surface Water
Sample Date	30/04/2019

Parameter	Units	RL	L1	Result
General Chemistry				
Biochemical Oxygen Demand (BOD5)	mg/L	2		5
Total Suspended Solids	mg/L	2		5
Ammonia+Ammonium (N)	as N mg/L	0.1		< 0.1

PACKAGE: **PWQO - Metals and Inorganics** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	6
Sample Name	Creek W1
Sample Matrix	Surface Water
Sample Date	30/04/2019

Parameter	Units	RL	L1	Result
Metals and Inorganics				
Total Chlorine	mg/L	0.02	0.002	**0.27**
Cyanide (total)	mg/L	0.01	0.005	**< 0.01**
Sulphate	mg/L	0.2		18
Nitrite (as N)	as N mg/L	0.03		< 0.03
Nitrate (as N)	as N mg/L	0.06		4.97
Nitrate + Nitrite (as N)	as N mg/L	0.06		4.97
Hardness	mg/L as CaCO3	0.05		246
Silver	µg/L	0.05	0.1	< 0.05
Aluminum	µg/L	0.3	15	11.2
Arsenic	µg/L	0.2	5	0.3
Boron	µg/L	2	200	10
Beryllium	µg/L	0.007	11	< 0.007
Cadmium	µg/L	0.003	0.1	0.008

Client: Peto MacCallum Ltd
Project: 18KX004, Maple Drove Rd
Project Manager: Dylan Patterson
Samplers: Dylan Patterson

PACKAGE: **PWQO - Metals and Inorganics** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	6
Sample Name	Creek W1
Sample Matrix	Surface Water
Sample Date	30/04/2019

Metals and Inorganics (continued)

Parameter	Units	RL	L1	Result
Cobalt	µg/L	0.004	0.9	0.095
Chromium	µg/L	0.08		0.18
Copper	µg/L	0.2	1	1.2
Iron	ug/L	7	300	85
Molybdenum	µg/L	0.04	40	0.38
Nickel	µg/L	0.1	25	0.4
Phosphorus	mg/L	0.003		0.006
Lead	µg/L	0.01	1	0.09
Antimony	µg/L	0.09	20	< 0.09
Selenium	µg/L	0.04	100	0.14
Thallium	µg/L	0.005	0.3	< 0.005
Uranium	µg/L	0.002	5	0.863
Vanadium	µg/L	0.01	6	0.36
Tungsten	µg/L	0.02	30	< 0.02
Zinc	µg/L	2	20	2
Zirconium	µg/L	2	4	< 2

Client: Peto MacCallum Ltd
Project: 18KX004, Maple Drove Rd
Project Manager: Dylan Patterson
Samplers: Dylan Patterson

PACKAGE: **PWQO - Other (ORP)** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	6
Sample Name	Creek W1
Sample Matrix	Surface Water
Sample Date	30/04/2019

Parameter	Units	RL	L1	Result
Other (ORP)				
pH	no unit	0.05	8.5	7.93
Chromium VI	µg/L	0.2	1	< 0.2
Chloride	mg/L	0.2		58
Mercury (total)	mg/L	0.00001	0.0002	< 0.00001

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E L1
Creek W1				
Copper	SM 3030/EPA 200.8	µg/L	1.2	1
Chlorine	SM 4500	µg/L	0.27	0.002
Cyanide	SM 4500	µg/L	< 0.01	0.005

QC SUMMARY

Ammonia by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENV]SFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0023-MAY19	as N mg/L	0.1	<0.1	1	10	100	90	110	102	75	125

Anions by IC

Method: EPA300/MA300-Ions1.3 I Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0038-MAY19	mg/L	0.2	<0.2	ND	20	91	80	120	98	75	125
Sulphate	DIO0038-MAY19	mg/L	0.2	<0.2	5	20	96	80	120	86	75	125
Nitrate + Nitrite (as N)	DIO0040-MAY19	mg/L	0.06	<0.06	NA		NA			NA		
Nitrite (as N)	DIO0040-MAY19	mg/L	0.03	<0.03	ND	20	97	80	120	91	75	125
Nitrate (as N)	DIO0040-MAY19	mg/L	0.06	<0.06	0	20	99	80	120	103	75	125

QC SUMMARY

Biochemical Oxygen Demand

Method: SM 5210 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0005-MAY19	mg/L	2	< 2	14	30	109	70	130	92	70	130

Chlorine

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Chlorine	EWL0055-MAY19	mg/L	0.02	< 0.02	ND	20	93	90	110	NA		

Cyanide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0020-MAY19	mg/L	0.01	<0.01	ND	10	100	90	110	102	75	125

QC SUMMARY

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-[ENV]IC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0054-MAY19	ug/L	0.2	<0.2	2	20	95	80	120	103	75	125

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0002-MAY19	mg/L	0.00001	< 0.00001	ND	20	110	80	120	121	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0012-MAY19	ug/L	0.05	< 0.002	ND	20	97	90	110	85	70	130
Arsenic	EMS0012-MAY19	ug/L	0.2	< 0.2	2	20	95	90	110	105	70	130
Beryllium	EMS0012-MAY19	ug/L	0.007	< 0.007	6	20	94	90	110	NV	70	130
Boron	EMS0012-MAY19	ug/L	2	< 2	4	20	95	90	110	NV	70	130
Cadmium	EMS0012-MAY19	ug/L	0.003	< 0.003	ND	20	95	90	110	92	70	130
Cobalt	EMS0012-MAY19	ug/L	0.004	< 0.004	10	20	97	90	110	124	70	130
Chromium	EMS0012-MAY19	ug/L	0.08	< 0.08	8	20	94	90	110	NV	70	130
Copper	EMS0012-MAY19	ug/L	0.2	< 0.2	9	20	97	90	110	116	70	130
Iron	EMS0012-MAY19	ug/L	7	< 7	7	20	93	90	110	NV	70	130
Molybdenum	EMS0012-MAY19	ug/L	0.04	< 0.04	6	20	93	90	110	NV	70	130
Nickel	EMS0012-MAY19	ug/L	0.1	< 0.1	8	20	97	90	110	NV	70	130
Lead	EMS0012-MAY19	ug/L	0.01	< 0.01	4	20	93	90	110	87	70	130
Phosphorus	EMS0012-MAY19	mg/L	0.003	< 0.003	10	20	96	90	110	NV	70	130
Antimony	EMS0012-MAY19	ug/L	0.09	< 0.09	15	20	107	90	110	88	70	130
Selenium	EMS0012-MAY19	ug/L	0.04	< 0.04	ND	20	93	90	110	114	70	130
Thallium	EMS0012-MAY19	ug/L	0.005	< 0.005	ND	20	95	90	110	83	70	130
Uranium	EMS0012-MAY19	ug/L	0.002	< 0.002	7	20	94	90	110	90	70	130
Vanadium	EMS0012-MAY19	ug/L	0.01	< 0.01	7	20	96	90	110	NV	70	130
Tungsten	EMS0012-MAY19	ug/L	0.02	< 0.02	4	20	93	90	110	NV	70	130
Zinc	EMS0012-MAY19	ug/L	2	< 2	8	20	97	90	110	NV	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Zirconium	EMS0012-MAY19	ug/L	2	< 2	ND	20	103	90	110	NV	70	130

Metals in aqueous samples - ICP-OES

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Hardness	EMS0012-MAY19	mg/L as CaCO3	0.05	<0.05	5	20	93	90	110	NV	70	130

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0052-MAY19	no unit	0.05	NA	0		100			NA		

QC SUMMARY

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0071-MAY19	mg/L	2	< 2	0	10	NV	90	110	NA		

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

No: 002163

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Oleg Mozhin
Received Date (mm/dd/yyyy): 05/1/19 (mm\dd\yy)
Received Time: 14:30
Received By (signature): _____
Custody Seal Present: ☐ no
Custody Seal Intact: ☐ no
Cooling Agent Present: ☑ ice pads
Temperature Upon Receipt (°C): 7°, 7°, 7° 7x3
LAB LIMS #: CAL4050-MAY19

REPORT INFORMATION

Company: Peto MacCallum
Contact: Dylan Patterson
Address: 16 Franklin St S
Phone: 519-893-7500
Fax: dpatterson@petomaccallum.com
Email: bloghrin@petomaccallum.com

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email: acooke@petomaccallum.com

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 18KX004
Site Location/ID: Maple Grove Rd

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days) — TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ Res/Park ☐ Ind/Com ☐ Agri/Other Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☑ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & ~~Inorganics~~ PWQO	PHC F1-F4 ☐ VOC ☐ BTEX ☐ F1 ☐ F2-F4 ☐	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	pH	Hardness	nitrate	chloride	cyanide	BOD	COMMENTS: TSS / Sulphate / chloride / ammonia
1	Creek W1	4/30/19	1pm	10	W	N	✓								✓	/	/	/	/	/	✓ / ✓ / ✓ / ✓
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					

Observations/Comments/Special Instructions

Sampled By (NAME): Dylan Patterson	**Signature:** Dylan Patterson	Date: 04/30/19 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME):	**Signature:** Dylan Patterson	Date: 05/01/19 (mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2013

APPENDIX H

Well Survey Summary and Maps

Region of Waterloo

343.2 0 171.59 343.2 Meters

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

WGS_1984_Web_Mercator_Auxiliary_Sphere

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THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- Addresses
- Roads
  - Highway
  - Arterial/Collector
  - Local
  - Private
- Airport
- Assessment Parcels

FIGURE H-1

Well Survey Map, Part 1

Notes

Region of Waterloo

343.2 0 171.59 343.2 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere

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  - Highway
  - Arterial/Collector
  - Local
  - Private
- Airport
- Assessment Parcels

FIGURE H-2
Well Survey Map, Part 2

Notes

Region of Waterloo

343.2 0 171.59 343.2 Meters

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THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- Addresses
- Roads
  - Highway
  - Arterial/Collector
  - Local
  - Private
- Airport
- Assessment Parcels

FIGURE H-3
Well Survey Map, Part 3

Notes

TABLE H-1: MAPLE GROVE ROAD IMPROVEMENTS AND CORRIDOR STUDY
Well Survey Results

Address	No. on Map H-1	Responded to Survey?	Well Location	Date of install	Type	Depth	Flow rate	Water Shortages?	Treatment	Drink?	Septic System	Name of Owner or respondant
1370 Maple Grove Road	**1**	No										
3200 Maple Grove Road	**2**	Yes	Northwest of house			~60'		No	Softener, iron filter, UV	No		*Removed*
??? Maple Grove Road (East of 915 Briardeen Road)	**3**	Construction site										
1755 Speedsville Road	**4**	Yes	Northeast of house		Dug	Shallow, ~50'	Good		Filter, UV, Softener	Yes	Southeast of house	*Removed*
915 Briardeen Road	**5**	No										
875 Briardeen Road	**6**	No										
2070 Beaverdale Road	**7**	Yes	Back of house, 50 to 70' away	Replaced 15 years ago	Drilled	~ 130'	Good	No	No, but has high iron	Yes, but not used often		*Removed*
			In basement	>40 years		20'						
2050 Beaverdale Road	**8**	No										
2030 Beaverdale Road	**9**	Yes	By driveway	>20 years	Drilled			No	De-ionizing	No	Behind house	Removed
			Inside house	very old	Dug					Not used at all		
2010 Beaverdale Road	**10**	Yes	Front yard	~ 1965	Drilled	~ 130'		No	De-ionizing, softener	Yes	Behind house	*Removed*
1965 Beaverdale Road	**11**	No - appears to be vacant										
1945 Beaverdale Road	**12**	No										
1905 Beaverdale Road	**13**	Yes	In basement	1952	Dug	~10'		No	UV	No	yes	*Removed*
1900 Beaverdale Road	**14**	No										
1840 Beaverdale Road	**15**	No										
1825 Beaverdale Road	**16**	Did not want to respond										
1820 Beaverdale Road	**17**	Yes	South of house					No	Yes	Yes		*Removed*
1725 Beaverdale Road	**18**	No										
1640 Beaverdale Road	**19**	No										
1580 Beaverdale Road	**20**	Yes	Front of house		Drilled	Shallow	Good	No	Filter and softener	Yes	front of house	*Removed*
635 Fishermills	**21**	No										
566 Fishermills	**22**	Yes	East of house	1997	Drilled	~ 25', GWL 8'		No	UV, softener, iron filter	Yes		*Removed*

APPENDIX I

Statement of Limitations

STATEMENT OF LIMITATIONS

This report is prepared for and made available for the sole use of the client named. Peto MacCallum Ltd. (PML) hereby disclaims any liability or responsibility to any person or entity, other than those for whom this report is specifically issued, for any loss, damage, expenses, or penalties that may arise or result from the use of any information or recommendations contained in this report. The contents of this report may not be used or relied upon by any other person without the express written consent and authorization of PML.

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The report is based solely on the scope of services which are specifically referred to in this report. No physical or intrusive testing has been performed, except as specifically referenced in this report. This report is not a certification of compliance with past or present regulations, codes, guidelines and policies.

The scope of services carried out by PML is based on details of the proposed development and land use to address certain issues, purposes and objectives with respect to the specific site as identified by the client. Services not expressly set forth in writing are expressly excluded from the services provided by PML. In other words, PML has not performed any observations, investigations, study analysis, engineering evaluation or testing that is not specifically listed in the scope of services in this report. PML assumes no responsibility or duty to the client for any such services and shall not be liable for failing to discover any condition, whose discovery would require the performance of services not specifically referred to in this report.

STATEMENT OF LIMITATIONS
(continued)

The findings and comments made by PML in this report are based on the conditions observed at the time of PML's site reconnaissance. No assurances can be made and no assurances are given with respect to any potential changes in site conditions following the time of completion of PML's field work. Furthermore, regulations, codes and guidelines may change at any time subsequent to the date of this report and these changes may affect the validity of the findings and recommendations given in this report.

The results and conclusions with respect to site conditions are therefore in no way intended to be taken as a guarantee or representation, expressed or implied, that the site is free from any contaminants from past or current land use activities or that the conditions in all areas of the site and beneath or within structures are the same as those areas specifically sampled.

Any investigation, examination, measurements or sampling explorations at a particular location may not be representative of conditions between sampled locations. Soil, ground water, surface water, or building material conditions between and beyond the sampled locations may differ from those encountered at the sampling locations and conditions may become apparent during construction which could not be detected or anticipated at the time of the intrusive sampling investigation.

Budget estimates contained in this report are to be viewed as an engineering estimate of probable costs and provided solely for the purposes of assisting the client in its budgeting process. It is understood and agreed that PML will not in any way be held liable as a result of any budget figures provided by it.

The Client expressly waives its right to withhold PML's fees, either in whole or in part, or to make any claim or commence an action or bring any other proceedings, whether in contract, tort, or otherwise against PML in anyway connected with advice or information given by PML relating to the cost estimate or Environmental Remediation/Cleanup and Restoration or Soil and Ground Water Management Plan Cost Estimate.