THURBER ENGINEERING LTD.

PAVEMENT DESIGN REPORT

VILLAGE OF ALTON – PAVEMENT REHABILITATION

QUEEN STREET WEST
MISSISSAUGA ROAD TO JAMES STREET NORTH

&

MAIN STREET NORTH
MARY STREET TO HIGHPOINT SIDE ROAD

Report

to

TOWN OF CALEDON

C/O

R.V. ANDERSON ASSOCIATES LIMITED

Date: March 4, 2021
File: 25174

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DESIGN SUMMARY

Town of Caledon is considering rehabilitation of Queen Street West and Main Street North, in the Village of Alton, Caledon, Ontario. In preparation of the Class Environmental Assessment (EA) report, Thurber Engineering Ltd. was retained to evaluate the pavement condition on Main Street North and Queen Street West to provide pavement rehabilitation recommendations. The investigation limits for Queen Street West extended from Mississauga Road to James Street, while the limits on Main Street North included Mary Street to Highpoint Side Road. The pavement investigation included a visual pavement condition survey, load-deflection testing, pavement cores, boreholes, laboratory testing, and chemical analysis on selected samples.

Both roadways generally comprise a two-lane rural platform, with single lane in each direction; although a section of Queen Street has an urban platform with curb and gutters. Both roadways comprise a flexible pavement, with narrow gravel shoulders. The pavement condition survey considered Queen Street in *Poor* condition from Mississauga Road to Osprey Mills Drive and in Excellent condition from Osprey Mills Drive to James Street. The pavement condition on Main Street is considered in Poor-to-Fair condition.

The asphalt thickness in Queen Street ranges from 45 to 60 mm (average thickness of 55 mm), with a granular base/subbase that extends to depth below 650 mm. The existing asphalt thickness in Main Street varies from 30 to 70 mm (average thickness of 45 mm), with a granular base/subbase that extends to depth below 550 mm. Subgrade soils in the area predominantly observed to be silty sand some clay. The potential for frost susceptibility of the subgrade soil is considered low.

Based on the AASHTO pavement design analysis, and the completed pavement evaluation of the in-situ pavement structure, the existing pavement is generally considered structurally and functionally deficient to support anticipated traffic levels for the next 20 years; therefore, pavement rehabilitation will be required. The results of the design analysis indicate that the most viable and practical strategy for extending pavement service life on Main Street North and Queen Street West includes full depth reclamation with expanded asphalt stabilization, with an asphalt overlay.

Details of the pavement investigation, analysis, and recommendations are provided within the ensuing report.

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MAIN STREET NORTH AND QUEEN STREET WEST
PAVEMENT DESIGN REPORT

ABBREVIATIONS

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway Transportation Officials
EAS	Expanded Asphalt Stabilization
ESALs	Equivalent Single Axle Loads
FDR	Full Depth Reclamation
HMA	Hot Mix Asphalt
LEF	Load Equivalency Factor
NB	Northbound
OMC	Optimum Moisture Content
OPSS	Ontario Provincial Standard Specifications
OPSD	Ontario Provincial Standard Drawings
PDR	Pavement Design Report
RAP	Reclaimed Asphalt Pavement
ROP	Road Occupancy Permit
RVA	R.V Anderson Associates Ltd
SB	Southbound
SPMDD	Standard Proctor Maximum Dry Density
SN_{Des}	Design Structural Number
Thurber	Thurber Engineering Ltd.

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MAIN STREET NORTH AND QUEEN STREET WEST
PAVEMENT DESIGN REPORT

TABLE OF CONTENTS

APPENDICES

THURBER

MAIN STREET NORTH AND QUEEN STREET WEST
PAVEMENT DESIGN REPORT

1 INTRODUCTION

Town of Caledon is considering rehabilitation of Queen Street West and Main Street North, in the Village of Alton, Caledon, Ontario. In preparation of the Class Environmental Assessment (EA) Report, Thurber Engineering Ltd. (Thurber) was retained by R.V Anderson Associates Ltd (RVA) on behalf of Town of Caledon to evaluate the pavement condition on Main Street North and Queen Street West, and provide pavement rehabilitation recommendations.

It is understood that DBA Engineering Ltd. had previously prepared a pavement design report for the rehabilitation of Queen Street from James Street to 1.0 km easterly and Main Street from Mary Street to 1.0 km southerly. The scope of this report includes a supplemental investigation to the previous investigation and includes a pavement investigation of Queen Street West (Queen Street) from Mississauga Road to James Street and of Main Street North (Main Street) from Mary Street to Highpoint Side Road in the Village of Alton, Ontario. The evaluation of these roadways assessed the existing pavement and subsurface condition along the roadway sections, and based on the findings of the evaluation, structural and functional capacity of the pavement was determined to accommodate future requirements.

This report presents the results of the field investigation, data analysis, and pavement design recommendations. This pavement investigation was carried out in accordance with Town of Caledon Request for Proposal # 2018-81.

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

2 SITE AND PROJECT DESCRIPTION

Both roadways generally comprise a two-lane rural platform, with single lane in each direction; although a section of Queen Street has an urban platform with curb and gutters. Both streets comprise a flexible pavement, with narrow gravel shoulders. Existing pavement on both roadways comprise a flexible pavement, with narrow gravel shoulders in rural platform areas. Six (6) intersections exist along these roadways within the study area. These includes Mississauga Road, Osprey Mills Drive, John Street, James Street North, Mary Street and Highpoint Side Road. The posted speed limit within the project limits varied from 40 to 70 km/hr.

Project chainage for the investigation was established in the field and extended along Queen Street from Mississauga Road (Station 10+000) to James Street (Station 10+700), while along Main Street the investigation extended from Mary Street (Station 20+000) to the Highpoint Side Road (Station 21+550). For the purposes of this pavement investigation, it is assumed that Main Street is oriented in the North-South direction, while, Queen Street is oriented in the East-West direction. A key plan of the of the project limits are provided Appendix A.

3 PAVEMENT EVALUATION

3.1 Investigation Methodology

The pavement evaluation of Queen Street and Main Street assessed the current condition of the pavement and determined the remaining life based on collected information and structural design requirements. As part of this evaluation, Thurber completed pavement investigation that consisted of completing a detailed pavement surface distress survey, Falling Weight Deflectometer (FWD) testing, extracting pavement cores, and borehole drilling with laboratory testing and chemical analysis on selected pavement and soil samples.

An initial site visit was carried out in January 2020 to assess site conditions and develop a fieldwork plan for the investigation. Photographs were taken on subsequent site visits, with typical photographs provided in Appendix B. A detailed pavement surface condition survey was completed in March 2020 to assess the condition of the existing pavement surface and to identify the type and severity of specific pavement distress present. Pavement condition survey sheets are provided in Appendix C.

A total of 20 boreholes were advanced in both travel lanes on Main Street, with an additional 7 boreholes advanced on Queen Street. Prior to drilling pavement cores were extracted at each location. The pavement cores were returned to Thurber's Oakville office for visual assessment and logging. Pavement core logs with photographs of typical core samples are provided in Appendix D. Boreholes were advanced to depths of 1.5 to 2.1 m. Detailed results and findings are provided in the borehole logs in Appendix E.

Prior to the start of the drilling investigation, public utility clearances were obtained through Ontario One-Call. A Road Occupancy Permit (ROP) was obtained prior to commencement of drilling. Traffic control was provided by Alliance Traffic Control Inc., while the boreholes were advanced using truck-mounted hydraulic drill rig supplied and operated by Malone's Soil Samples Company Ltd. The field investigation was carried out under the full-time supervision of Thurber technical staff.

A member of Thurber's technical staff supervised the drilling, measured the existing pavement thickness, logged soil and groundwater conditions, and collected samples of the granular material and subgrade soils. The samples were labelled and transported to Thurber's laboratory. Selected samples of the granular material were subjected to gradation analysis, while particle size analyses (sieve and hydrometer) were conducted on selected subgrade samples. Detailed results of laboratory testing are provided in Appendix F, while results of the chemical analysis results are provided in Appendix G.

In addition to the destructive pavement investigation, FWD testing was also completed on 50 m intervals in each direction. The FWD testing was completed by Applied Research Associates Inc. (ARA), on April 6, 2020, with the analysis of collected data by Thurber. Results of the FWD analysis are provided in Appendix H.

3.2 Pavement Condition

The existing pavement condition in Queen Street West from Mississauga Road to Osprey Mills Drive (approximately 350 m east of Mississauga Road) is in **Poor-to-very Poor** condition, while, from Osprey Mills Drive to James Street is in **Excellent** condition since this section was recently paved. The existing pavement condition survey evaluated the overall pavement in Main Street North is in **Poor-to-Fair** condition. Predominant pavement distress in the Poor pavement areas were observed to include: extensive, severe, (alligatored) pavement edge, wheel-path, longitudinal and transverse cracking. Extensive, severe, wheel-path rutting was also observed along both roadways.

3.3 Existing Pavement and Subsurface Conditions

3.3.1 Existing Pavement Structures

Pavement cores and boreholes were advanced along both roadway sections to assess the subsurface pavement condition and layer thicknesses. A summary of the results from the pavement investigation are provided in the ensuing sections.

Queen Street West

The asphalt thickness on Queen Street from Mississauga Road to Osprey Mills Drive in both directions varied from 45 to 60 mm, with an average thickness of 55 mm, while the asphalt thickness in the new pavement section from Osprey Mills Drive to James Street ranged between 80 and 90 mm, which appears to be paved in a single lift.

The asphalt layers were supported by granular base/subbase layers that extended to depths typically beyond 650 mm, with an average granular thickness of 800 mm. The granular base and subbase layers were observed to be consistent in composition and consisted of sandy crushed gravel trace silt to sandy gravel some silt. Both granular base and subbase layers were observed to meet OPSS Granular A gradation requirements; although most samples had increased fines passing the 75 µm sieve size.

Main Street North

The asphalt thickness on Main Street in both directions varied from 30 to 70 mm, with an average thickness of 45 mm. From visual inspection of the pavement cores located on cracks, it was observed that the cracks extended the full depth of the asphalt.

The asphalt layers were supported by granular base/subbase layers that generally extended to depths beyond 550 mm, with an average granular thickness of 800 mm. The granular base and subbase layers were observed to be consistent in composition and consisted of sand and crushed gravel trace silt to sand with crushed gravel with RAP. Results of laboratory testing on the granular base/subbase samples found both materials to generally meet the OPSS Granular A gradation requirements; although most samples had increased fines passing the 75 µm sieve size.

3.3.2 Subgrade Soil

Existing pavements within the project limits are supported by subgrade soil that predominantly consisted of clayey silt and sand silty sand some clay. Standard Penetration Tests (SPT) at some selected borehole locations, showed N-values ranged from 6 to 16 blows per 300 mm, indicating a firm to very stiff soil consistency.

Laboratory testing on selected samples indicate that subgrade soils have low frost susceptibility, with a low potential for soil erodibility. Atterberg limit determination was completed on two soil samples. Test results determined, the subgrade soil as an inorganic silts and low plasticity clay (CL-ML), with a liquid limit of ranging from 17 to 21 percent and a plasticity index of 5 and 6.

Moisture conditions of the subgrade soil were typically observed to be moist, with typical natural moisture contents ranging from 10 to 16 percent. The base/subbase was observed to dry to moist and having a moisture content ranging from 3 to 8 percent.

3.4 Soil Analytical Results

3.4.1 Scope of Sampling and Analysis

Thurber completed a limited analytical program on selected samples of the existing granular base, subbase, and subgrade materials collected from auger cuttings at five boreholes along the Main Street and two boreholes along Queen Street project segments. The purpose of the chemical sampling and analysis was to document the chemical quality of a limited number of samples and present potential options for reuse of the granular base, subbase, and subgrade materials which may be excavated during the proposed rehabilitation works. The quantity of granular materials to be excavated (if any) during construction is unknown at this time.

The samples were submitted for chemical analysis under chain-of-custody protocol to ALS Environmental (ALS) at 5730 Coopers Avenue in Mississauga, Ontario. ALS is an independent laboratory that meets the requirements of Section 47 of Ontario Regulations (O. Reg.) 153/04, as amended.

Eight granular material samples from the Main Street segment were submitted for bulk analysis of metals and inorganics, and three of the eight samples were also submitted for analysis of petroleum hydrocarbons (PHCs) Fractions F1 to F4.

Additionally, four granular material samples from the Queen Street segment were submitted for bulk analysis of metals and inorganics, and three of the four samples were also submitted for analysis of petroleum hydrocarbons (PHCs) Fractions F1 to F4.

A sample of granular materials collected at borehole M09 (~Station 20+675) at Main Street North segment was analyzed for Toxicity Characteristic Leachate Procedure (“TCLP”) analysis in of metals and inorganic compounds and volatile organic compounds (VOCs), accordance O. Reg. 347 for comparison with general requirements for disposal at an Ontario Ministry of Environment Conservation and Parks (MECP) licenced waste facility.

Copies of the laboratory Certificates of Analysis are included in Appendix G.

3.4.2 Quality Assurance and Quality Control Measures

The quality assurance and quality control (QA/QC) program consisted of the use of laboratory supplied sampling containers to minimize the potential for cross-contamination, and handling of the samples under chain-of-custody protocol. The soil samples were placed directly into laboratory supplied sampling containers that were pre-labelled with analytical parameters,

sample identification, and sampling date, using dedicated nitrile gloves. The samples for PHC Fraction F1 analyses were collected using a dedicated syringe and placed directly into glass vials containing methanol.

ALS conducted an internal Quality Assurance program in accordance with O. Reg. 153/04 analytical protocols. This included testing of duplicates and reference material spikes on batch samples to check the precision, accuracy, and reliability of the analytical test results.

3.4.3 Regulatory Standards

The Ontario Ministry of the Environment, Conservation and Parks (MECP) sets out generic standards for a prescribed list of potential contaminants and the applicable site condition standards (SCSs) in nine tables (Table 1 through Table 9) provided under O. Reg. 153/04 in the MECP document *"Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", April 15, 2011* (MECP Standards). In General, the applicable SCSs depend on the property use, potable versus non-potable groundwater condition, proximity to areas of natural significance, soil pH and texture, proximity to a water body, and soil depth and the investigation site.

As an initial screening for the option of re-using the granular material samples were compared to MECP's Table 1 "Full Depth Background Site Condition Standards" (MECP Table 1 Standards) for property uses other than agricultural, and MECP's Table 2 "Full Depth Site Condition Standards in a Potable Water Condition" for Residential / Parkland / Institutional (RPI) Property Uses for coarse-grained soils (MECP Table 2 RPI Standards).

Assessment of the soils with respect to the new Excess Soils Regulation, O. Reg. 406/19, was beyond the scope of this assignment, and may not be applicable depending on the anticipated project design, reuse of the materials and schedule. Additional sampling, analyses and associated filing of reports with MECP by O. Reg. 153/04 Qualified Person may be required if it is determined that the O. Reg. 406/19 is applicable based on the actual project design and schedule.

For disposal of excess material at a licensed landfill, if required, the TCLP results were compared to the O. Reg. 347, as amended, Schedule 4 Criteria.

3.4.4 Analytical Results

Based on the results of analysis, the concentrations of the tested parameters exceeded various MECP Table 1 Standards and MECP Table 2 RPI Standards.

The concentrations and respective MECP Table 1 Standards, MECP Table 2 RPI Standards, and O. Reg. 347 Schedule 4 Criteria are provided on the Certificates of Analysis, attached.

Queen Street West

Generally, the concentrations of the four samples submitted for the Queen Street segment exceeded MECP Table 1 Standards and MECP Table 2 RPI Standards for EC and/or SAR. The samples collected along the Queen Street segment met MECP Table 1 Standards and MECP Table 2 RPI Standards for metal parameters, with the exception of the sample collected from borehole at Station 10+600 EBL (between 95 mm and 425 mm bgs) exceeded the MECP Table 1 Standard for silver. Various other metals and inorganic parameters were detected in the samples tested, however met the MECP Table 1 Standards.

PHCs Fractions F1 to F4 were not detected in the three samples submitted for analysis of PHCs F1 to F4.

Main Street North

Generally, the concentrations of the eight samples submitted for the Main Street segment exceeded MECP Table 1 Standards and MECP Table 2 RPI Standards for electrical conductivity (EC) and/or sodium adsorption ratio (SAR). It should be noted that EC and SAR are not considered to exceed the MECP Standards, if the source was road de-icing salt. The samples collected along the Main Street segment met MECP Table 1 Standards and MECP Table 2 RPI Standards for metal, with the exception of the sample collected from borehole at Station 20+150 NBL (between 60 mm and 400 mm bgs) which exceeded MECP Table 1 and Table 2 Standards for cobalt, and the sample collected from borehole at Station 20+750 NBL (between 45 mm and 250 mm bgs) which exceeded the MECP Table 1 Standard for silver.

Concentrations of PHCs Fractions F3 and F4 exceeded MECP Table 1 Standards and MECP Table 2 RPI Standards in samples collected from borehole at Station 20+150 NBL (between 60 mm and 400 mm bgs) and borehole at Station 20+225 SBL (between 70 mm and 375 mm bgs). Although reported as not detected, it is noted that the detection limit for PHC Fraction F2 for these samples was raised during analysis and exceeded both the MECP Table 1 Standards and MECP Table 2 RPI Standards. PHCs F1 to F4 were not detected in the sample collected from borehole at Station 21+275 SBL (between 35 mm and 300 mm bgs).

The concentrations of the leachate TCLP analysis completed on the sample collected from borehole at Station 20+675 SBL (between 450 mm and 1,500 mm bgs) were below the reportable

detection limits and/or met the respective Schedule 4, *Leachate Quality Criteria*, provided under O. Reg. 347. The concentration of leachable barium (0.71 mg/L) was detected within the sample, however the concentration is below the respective Schedule 4 Leachate Quality Criteria of 100 mg/L.

3.4.5 Asbestos Testing

Asbestos testing was completed on four asphalt samples (i.e. two samples from each road segment). It should be noted that a total of eight asphalt samples were submitted to the lab, however testing was only completed on the following samples:

- Queen Street – Station 10+075 WB Lane (0 – 80 mm)
- Queen Street – Station 10+300 EB Lane (0 – 65 mm)
- Main Street – Station 21+500 NB Lane (0 – 45 mm)
- Main Street – Station 20+522 SB Lane (0 – 45 mm)

Based on the results of the testing, asbestos fibres were not observed by the lab in the asphalt samples tested.

3.5 Falling Weight Deflectometer Testing

The structural adequacy of both roadways was evaluated by Falling Weight Deflectometer (FWD) pavement load/deflection testing. The FWD tests were completed on 50 m intervals for each lane and in both directions. At each test location, a series of four load applications was applied to the pavement surface. The first application was a "seating" load to ensure the FWD load plate was firmly resting on the pavement surface. The next three loads were approximately 35, 50, and 65 kN. Pavement surface deflections under the load were measured by sensors (velocity transducers) placed at fixed spacing from the load plate in accordance with SHRP testing protocols. The average asphalt and granular base/subbase thicknesses from the field investigation were used in the analysis of the FWD data.

The analysis of the FWD deflection data was completed in in accordance with the procedures outlined in the *AASHTO Guide for Design of Pavement Structures* (1993). The parameters calculated as part of this analysis include:

Normalized Deflection: The deflection (D_0) measured at the centre of the load plate is a good indicator of overall pavement strength. The deflection at this location is a function of the pavement layer stiffness and the support capacity of the subgrade soil. Because deflection is a function of load and because of slight variations in measured load at each test point, a linear extrapolation

of the measured deflection is made to adjust deflections at all test locations to a “standard” load level of 40 kN.

Materials Characterization: The pavement thickness data from the boreholes was used in conjunction with the FWD results to estimate the stiffness (strength) of the existing pavement. Pavement layer stiffness back-calculation uses closed form models to estimate layer elastic modulus values, given the layer thickness and FWD data.

The procedure as outlined in the *AASHTO 1993 Guide for Design of Pavement Structures*, Part III, Chapter 5, was used to determine the properties of the as-constructed flexible pavements. The resultant data includes the composite elastic pavement modulus (E_p) for the combination of all bound layers above the subgrade (e.g., the asphalt concrete and granular bases), and the subgrade elastic modulus (E_s). The subgrade resilient modulus (M_R) is determined by reducing the value of E_s by a conversion factor of 3.

Effective Structural Number: Based on the back-calculated pavement moduli, the effective structural number (SN_{Eff}) of the existing pavement was calculated using the 1993 AASHTO Guide for Design of Pavement Structures procedure.

Results of the pavement load/deflection testing and data analysis are summarized in Table 3-2, with detailed FWD test results provided in Appendix H.

Table 3-1. Summary of FWD Analysis Results

Facility	Direction	D_0 (μm)		M_R (MPa)		E_P (MPa)		SN_{Eff} (mm)	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Main Street North	NB	722	167	28	7	215	45	113	8
	SB	898	207	21	7	170	50	130	12
Queen Street West	EB	501	106	42	13	323	99	139	45
	WB	523	186	36	16	280	102	147	49

On average, the normalized deflections on Main Street North ranged from about 722 to 898 μm; however, the normalized deflections on Queen Street West was lower than Main Street North values and varied from 501 to 523 μm. The subgrade strength (M_R) was back-calculated and had an overall average M_R value of 25 MPa and 39 MPa for Main Street and Queen Street, respectively.

The average effective structural number (SN_{Eff}) for Main Street North was observed to be 122 mm, whereas, the average SN_{Eff} for Queen Street West was 143 mm. It is worth noting that the unusual high SN_{Eff} values are largely the result of the thicker granular base/subbase thickness.

4 TRAFFIC ANALYSIS

Traffic information was provided by R.V. Anderson that included traffic volume counts and truck percentage. The estimated Average Annual Daily Traffic (AADT) and Truck Percentage for each roadway is provided in Table 4-1. The traffic volumes were forecasted to the rehabilitation year of 2021, using a modest growth rate of 2.0 percent.

Table 4-1. Traffic Information

Location	Year 2018 AADT	Year 2019 AADT	Forecasted 2021 AADT	Truck Percentage
Main Street North	2,545	-	2,701	3.8 %
Queen Street West	-	488	508	6.4 %

Typical truck factors for major vehicle classes were assigned to each vehicle class, as proposed by the Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions. A truck factor of 1.5 was applied to represent all truck traffic on the roadways.

4.1 ESAL Calculations

The traffic data was used to determine the pavement damage caused by the anticipated traffic volumes. Using axle load equivalency factors (LEF), the pavement damage caused by different axle loads and axle groups are converted to a standard axle load known as an Equivalent Single Axle Loads (ESALs). The ESALs calculation was completed in accordance with the MTO Procedures for Estimating Traffic Loads for Pavement Designs.

A 50 percent direction distribution and a 100 percent lane distribution were applied to estimate truck traffic in the design lane. Based on the traffic analysis, the 20-year design ESALs for Main Street North and Queen Street West was estimated and provided in Table 4-2

Table 4-2: Estimated ESAL

Location	20-year ESAL
Main Street North	683,154
Queen Street West	216,399

5 PAVEMENT REHABILITATION ASSESSMENT

The assessment of an appropriate holding strategy for Main Street North and Queen Street West has taken into consideration the functional and structural needs required to extend the pavement service life of up to 20-years. The understanding of these requirements is critical for the development of future rehabilitation strategies.

5.1 Functional Requirements

A road's functional capacity is a measure of how well the pavement serves the user. This serviceability index is often referred to as 'Ride Comfort' and is reflective of the pavement condition at a particular time during the service life of the pavement. Pavement distresses that impact a pavement's functional ability to serve the travelling public include: transverse cracking; alligator/ fatigue cracking, pavement rutting; potholes; ravelling; as well as distortions.

Both Main Street North and Queen Street West within the project limits were in considered in *Fair- to-very Poor* condition with exception of Queen Street West from Osprey Mills to James Street which was in excellent condition. It was found that the distressed areas with several functional pavement distresses such as transverse and longitudinal cracking, patches, and potholes that affect the ride comfort. Any rehabilitation treatments considered for these roadways will need to improve the overall rideability of the existing pavement.

5.2 Structural Requirements

The structural capacity of a pavement is the physical condition of the roadway that adversely affects the load-carrying capability of the pavement structure. The structural assessment of roadways was completed by identifying pavement distresses that observed localized structural distress (such as alligator/fatigue cracking and pavement rutting), as well as FWD load/deflection testing.

FWD testing is an effective non-destructive tool that quantifies the structural capacity of the existing pavement structure. To determine the structural adequacy of the pavement, the SN_{Eff} (as determined by the FWD testing) is compared to the design structural number (SN_{Des}) calculated below.

5.2.1 Design Structural Number

The pavement design analysis was carried out using the methodology outlined in the 1993 AASHTO "*Guide for the Design of Pavement Structures*", as modified by the Ministry's "*Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions*", and the

MTO "*Pavement Design and Rehabilitation Manual*". This analysis was completed to determine the structural requirements for the pavements to support anticipated traffic volumes.

The AASHTO procedure for the design of flexible pavements determines a required Structural Number that characterizes the structural capacity of the pavement layers, for a given set of inputs. The following inputs were used in calculating the required structural number for Main Street and Queen Street in the AASHTO method. Although the average subgrade strength from the FWD testing was 40 MPa along Queen Street and 28 MPa for Main Street, localized tests measure soil support values as low as 13 MPa. For this reason, as subgrade support strength of 15 MPa was used for developing pavement rehabilitation designs. Other inputs used in the AASHTO Design analysis include:

- Design period = 20 years
- Initial serviceability = 4.2
- Terminal serviceability = 2.0
- Reliability level = 85 percent
- Overall standard of deviation = 0.44

Based on the selected input values, ESALs calculated in Section 4.2, a Design Structural Number (SN_{Des}) of 116 mm is required to support traffic anticipated on Main Street North, over a 20-year design period. For Queen Street West, the SN_{Des} required to support the traffic volumes anticipated over a 20-year period is 98 mm.

The back-calculated SN_{Eff} values from the FWD testing are compared with the required SN_{Des} in Figure 6.1 and 6.2, with detailed comparison provided in Appendix I.

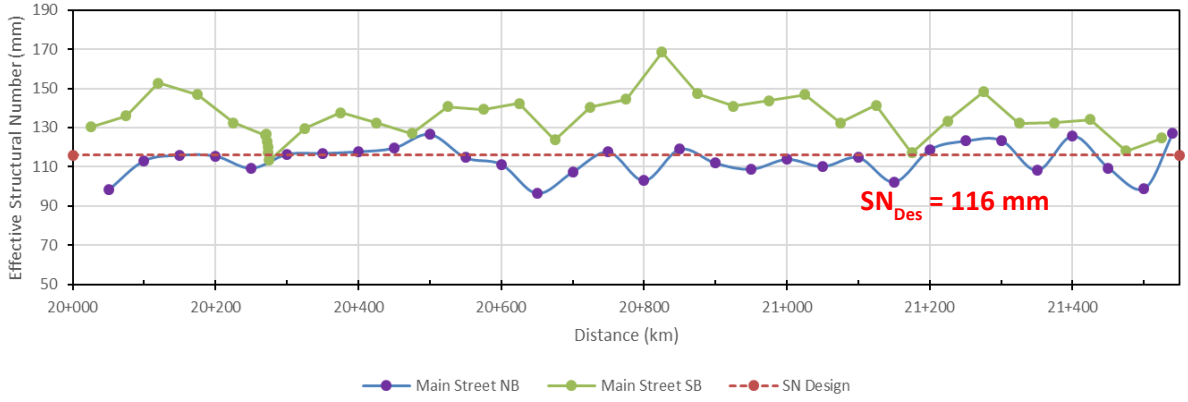

Figure 5-1. Structural Testing Comparison – Main Street

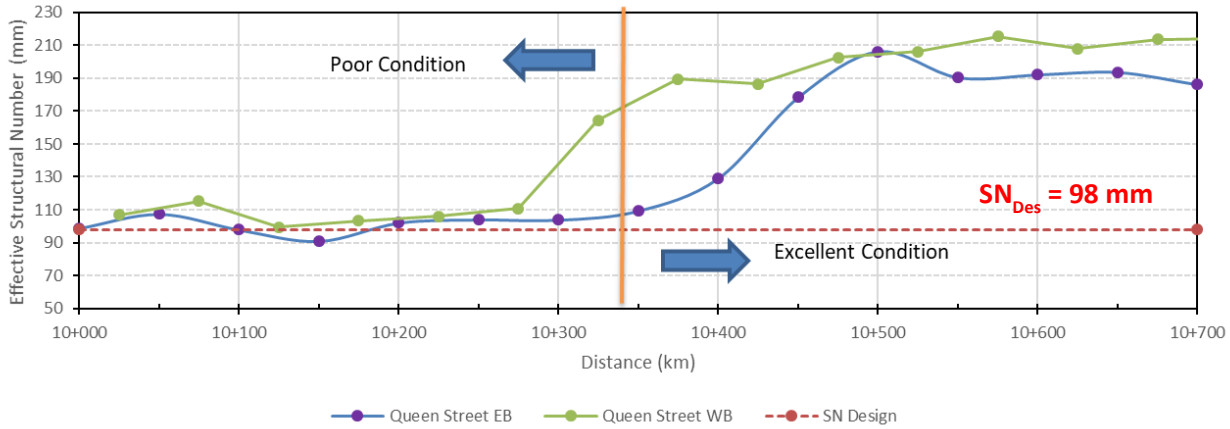

Figure 5-2. Structural Testing Comparison – Queen Street

The results of the FWD analysis indicated that the existing pavement structure at most test points are structurally adequate to support the anticipated future traffic; however, the increased structural capacity is largely the results of a thicker granular base/subbase.

In addition to the total pavement strength, an assessment of the existing asphalt is required that the driving surface can support the anticipated traffic volumes. Based on the current condition and thickness, the existing asphalt is considered inadequate for the anticipate design life.

5.3 Rehabilitation Alternatives

Based on the results of the pavement/geotechnical investigation and design analyses, three viable strategies were considered for the rehabilitation of these roadways. Each option is discussed below for the treatments ability to address the observed distress, the level of effort required, and the amount of improvement expected.

5.3.1 Asphalt Replacement

This rehabilitation option includes completely removal of the existing asphalt, followed by the placement of new asphalt. A complete replacement of the existing asphalt is usually considered when: the cost of resurfacing for the amount of existing distresses is too high; there is little remaining life in the original pavement; or the original pavement no longer serves the purpose for which it was intended (e.g., geometrics, structural capacity). As the existing granular base/subbase was found to be suitable, removal of the existing granular material would not be required; however, some grading will be required to adjust asphalt thickness fluctuations.

Under this strategy, the existing asphalt would be removed full asphalt depth, with the underlying granular graded to accommodate the placement of a new asphalt surface. An alternate to asphalt removal includes Full Depth Reclamation (FDR) where the existing asphalt is pulverized with the underlying granular base. Regardless of the removal process preferred, the exposed granular base should be graded as required and paved with 100 mm of new Hot Mix Asphalt (HMA).

It is noteworthy that removing the existing asphalt will reduce the potential of a grade raise, while incorporating the FDR processing will require a grade raise of roughly 110 mm; however, this removal option is considered more environmentally sustainable as less existing material would be removed from site.

5.3.2 Expanded Asphalt Stabilization and New HMA Overlay

Another viable rehabilitation option includes the FDR process of the existing asphalt with the underlying Granular base material and stabilizing the processed material with an expanded asphalt emulsion. The process is carried out in-place and reuses the existing bituminous covered aggregates to a stabilized thickness between 75 and 150 mm. Prior to stabilizing, the processed material can be graded and shaped as required. After a curing period, dependant on the emulsion used, the stabilized material is surfaced with an asphalt wearing course.

The pavement design analysis for this rehabilitation strategy of the existing pavement would include pulverizing the existing asphalt with part of underlying Granular, then using expanded asphalt emulsion to stabilize 100 mm of the pulverized material. After a short curing period, the stabilized base should be overlaid with 50 mm of new HMA.

This rehabilitation alternative is considered viable for the rehabilitation of Main Street and Queen Street. Incorporating the FDR with asphalt stabilization process into the pavement design/ rehabilitation strategy has several advantages including: the reuse of in-place materials; minimal grade raise; and easier construction staging around work area, as traffic can operate on the stabilized base shortly after processing. Furthermore, it is expected that this strategy will provide the most cost-effective solution for this project.

5.3.3 Full Pavement Reconstruction

Full pavement reconstruction is typically considered when the quality and thickness of the existing pavement materials are considered inadequate to support the future truck traffic. As the existing granular base/subbase thickness was found to be suitable on both roadways, and the quality of this material generally met OPSS Gradation requirements for Granular A, removal of the existing

granular material is not required. Therefore, rehabilitation treatments should be limited to the asphalt surface.

For this reason, full pavement reconstruction is not a practical nor cost effective solution and has not been considered further this analysis.

6 DESIGN AND CONSTRUCTION RECOMMENDATIONS

6.1 Queen Street and Main Street Rehabilitation

In consideration of the condition of the existing pavement surface, it is recommended that the rehabilitation of each roadway consists of Full Depth Reclamation with Expanded Asphalt Stabilization, followed by the placement of an asphalt overlay. Pulverizing the existing asphalt should be completed to a depth of 150 mm and stabilized with an expanded asphalt emulsion. The stabilized base should be overlaid with 50 mm of new HMA. The new pavement layers shall comprise of the following material type and layer thicknesses:

50 mm	HL 3 (HS)
100 mm	Expanded Asphalt Stabilization

Prior to stabilizing, the pulverized material should be graded to correct roadway profile, crossfall, and grades. It is important to note that this rehabilitation strategy is recommended for both roadways; however, along Queen Street, this strategy should only be applied to the rural pavement area considered in poor condition (Mississauga Road to Osprey Mills Drive).

6.2 Queen Street - Osprey Mills Road to James Street

Based on the pavement analyses, the section of Queen Street between Osprey Mills Road and James Street is in excellent condition and is generally considered structurally and functionally adequate to support anticipated traffic levels for the next 20 years. Therefore, no rehabilitation strategy is required at this time; however, future routine maintenance will be required for the pavement to meet a 20-year design life.

6.3 Pavement Materials

6.3.1 Asphalt Materials

All HMA materials should meet the requirements of OPSS.MUNI 1101 and OPSS.MUNI 1150 and paved to the requirements of OPSS.MUNI 310. The asphalt mixes should be compacted to at least 92 percent (of the MRD) for the HL 3 (HS) material. An asphalt cement binder grade of

PG 58-28 should be used. A tack coat shall be utilized between the stabilized base and the asphalt overlay, all vertical faces, and at all tie-in to existing locations, as per OPSS 308.

The FDR with EAS processing should meet the requirements of OPSS.MUNI 331, *Construction Specifications for Full Depth Reclamation with Expanded Asphalt Stabilization*. It is reiterated that the pulverized material should be graded prior to stabilization to improve the roadway profile and crossfall.

6.3.2 Granular Material

New granular base material should not be required, however, should minor grading be required where full-depth base repairs are required. New granular base material should consist of OPSS Granular A – 19 mm Crusher Run Limestone. All new granular material should meet the requirements of OPSS 1010, be compacted in accordance with the requirements of OPSS.MUNI 501.

6.4 Transition Treatments

Smooth transitions are required in all areas where new pavement meets an existing asphalt surface. All longitudinal and transverse joints shall meet the requirements of OPSS.MUNI 310. All longitudinal joints should be staggered between the asphalt lifts. The staggering of the longitudinal joints shall be accomplished by offsetting the paving edge in the upper asphalt course by a minimum of 150 mm.

At the paving limits, the transverse tie-in of the existing pavement surface should be cold planed to a depth of 50 mm, full width, to provide a straight clean vertical surface so that the new asphalt material can be placed flush with the top of the existing pavement surface.

6.5 Crossfall Correction

Some crossfall corrections should not be anticipated; however, in pulverizing the existing asphalt, the processed material can be graded to obtain the desired crossfall of 2 percent.

6.6 Drainage Improvements

Pavement drainage is critical for optimum pavement performance. As part of the rehabilitation strategy, drainage improvements should be considered. In rural pavement areas, drainage along existing ditches should be review and improved to maintain positive subsurface drainage from the pavement. Ditching along existing roadways should be in accordance with OPSD 200 series and should be directed toward an appropriate outlet.

In areas where an urban platform is considered, subdrain pipes should be installed beneath the curb and gutter at the edge of the pavement platform. Construction of the new urban platform should be in accordance with OPSD 216 series. Subdrains should be constructed using standard 150 mm diameter (minimum) filter cloth wrapped flexible perforated pipe, installed as per the wrapped trench detail in OPSD 216.021. The material used to wrap the subdrain trench should consist of OPSS 1860 Class I non-woven geotextile, with a Filtration Opening Size (FOS) of 75 to 150 µm.

6.7 Soil Management, Reuse, and Disposal

The scope of the analytical testing for this project was limited to granular and asphalt materials at select borehole locations. The potential for environmental issues elsewhere along the project alignments was not assessed and the inspection and testing of materials in the project area other than samples of granular and asphalt materials discussed in this report was not completed. It should be noted that the environmental testing completed for this project does not constitute a Phase One or Phase Two Environmental Site Assessment (ESA) under O. Reg. 153/04 or O. Reg.406/19.

Due to the inherent variability of subsurface conditions, inspection will be required during construction in order to confirm that the quality of excess excavated granular materials (if any) are consistent with the conditions documented during this investigation. Additional analytical testing of excavated granular materials should be expected during construction to meet the requirements of re-use on-site and/or receivers of excess materials off-site (as applicable).

Where excavation of existing pavement structure is required, asphalt should be removed separately from granular materials and recycled at an approved recycling facility or disposed of appropriately off-site. Asphalt should not be mixed with excess excavated granular or other materials; fill receivers may not accept excess excavated materials if it contains asphalt.

Any materials encountered during excavation that exhibit visual or olfactory evidence of environmental impact (i.e. staining or odours) will need to be segregated under the direction of an O. Reg. 153/04 Qualified Person (QP) into separate stockpiles to determine appropriate handling options. Impacted materials will need to be tested by the Contractor and reassessed at that time to determine if the stockpiled materials can be reused or will need to be handled as waste and disposed of at a licensed facility.

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6.8 Construction Inspection and Testing

The successful performance of the pavement and roadworks will depend largely on good workmanship and quality control during construction. It is therefore recommended that materials testing and inspection by qualified personnel be provided during construction. The inspection and testing should include observation and inspection of asphalt paving and sampling as well as onsite recommendation and coordination.

7 CLOSURE

Full time supervision of the field activities including obtaining utility clearances and direction of the drilling operations was provided by experienced Thurber personnel, while pavement coring, drilling and sampling equipment was supplied and operated by Malone's Soil Samples Company of Caledon, Ontario. The FWD testing for this investigation was completed by Applied Research Associates Inc., with the analysis of the data completed by Thurber Engineering Ltd.

Overall supervision of the field program, interpretation of the field data, and preparation of the report was conducted by Saman Esfandiarpour Ph.D., and Mr. Mark Popik M.E.ng, P.Eng., and was reviewed by Mr. Weiss Mehdawi M.Eng., P.Eng., the technical reviewer for this assignment.

The analysis presented in this report is based on design inputs provided by others, supplemented by a field investigation program and Thurber's experience with the project area and similar projects of this type. We note any changes in materials, or construction procedures, may have a significant impact on assumptions made for the purposes of developing the recommended pavement designs. It is strongly suggested that all materials and construction practices be completed in accordance with Halton Region and MTO standards and specifications.

Respectfully Submitted,

Thurber Engineering Ltd.

Weiss Mehdawi, M.Eng., P.Eng.
Review Principal

Mark Popik, M.Eng., P.Eng.
Principal Pavement Engineer

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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

2. COMPLETE REPORT

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

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

3. BASIS OF REPORT

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

4. USE OF THE REPORT

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

5. INTERPRETATION OF THE REPORT

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

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

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

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

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

7. INDEPENDENT JUDGEMENTS OF CLIENT

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

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Appendix A

Project Key Plan

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Main Street North and Queen Street West
Village of Alton - Caledon, ON

Key Plan

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Appendix B

Photographs of Typical Conditions

Queen Street West and Main Street North
Village of Alton, Caledon, Ontario

Photographs of Typical Conditions

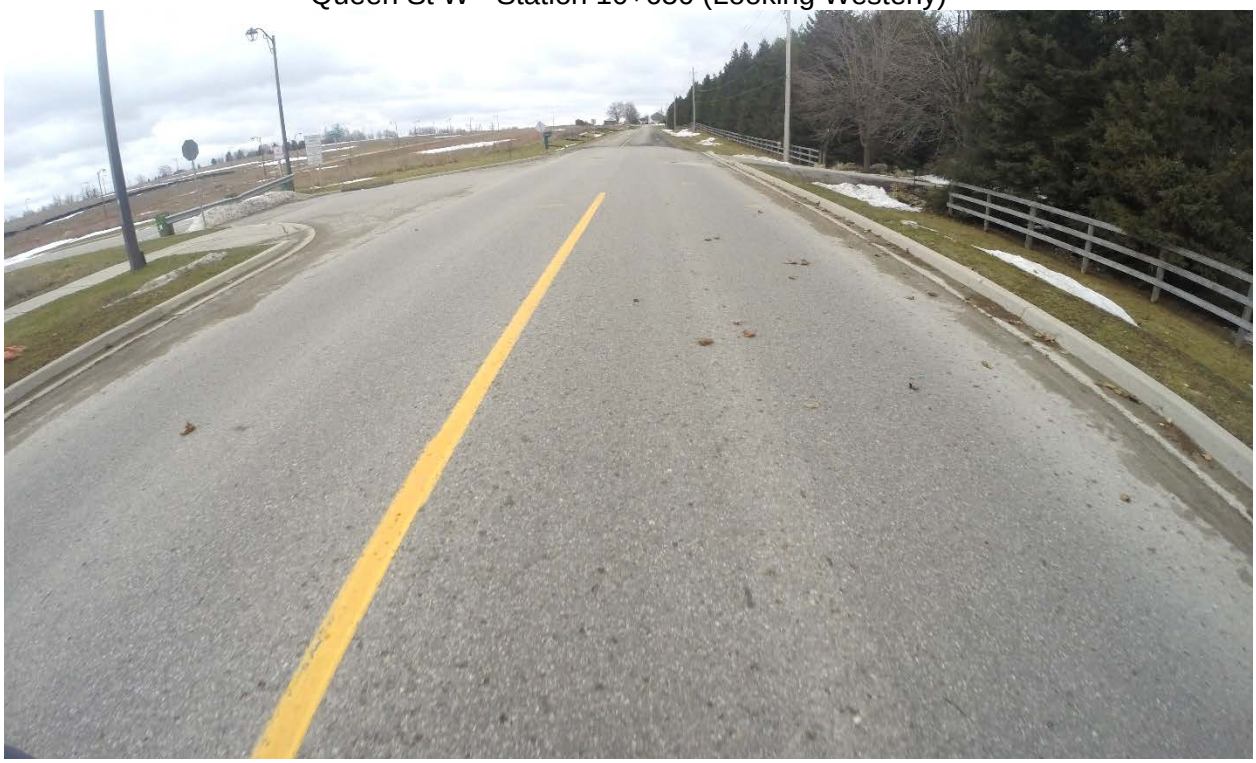
Typical Photograph # 1
Queen St W - Station 10+075 (Looking Westerly)

Typical Photograph # 2
Queen St W - Station 10+290 (Looking Westerly)

Photographs of Typical Conditions

Typical Photograph # 3
Queen St W - Station 10+400 (Looking Westerly)

Typical Photograph # 4
Queen St W - Station 10+650 (Looking Westerly)



Photographs of Typical Conditions

Typical Photograph # 5
Main St N - Station 20+175 (Looking Southerly)

Typical Photograph # 6
Main St N - Station 20+400 (Looking Southerly)

Photographs of Typical Conditions

Typical Photograph # 7
Main St N - Station 20+665 (Looking Southerly)

Typical Photograph # 8
Main St N - Station 20+825 (Looking Southerly)

Photographs of Typical Conditions

Typical Photograph # 9
Main St N - Station 21+150 (Looking Southerly)

Typical Photograph # 10
Main St N - Station 21+525 (Looking Southerly)

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Appendix C

Pavement Condition Survey Sheets

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FLEXIBLE PAVEMENT CONDITION EVALUATION FORM (MUNICIPALITIES)

Queen Street West (Section 1 of 2)

Road No. (Street): Queen Street West **Location From:** Mississauga Rd **To:** Osprey Mills Drive

Section Length: 0.35 **(Km)** **Survey Date:** Mar-20 **Traffic Direction:** B (B (Both Directions); N (North); S (South); E (East); W (West))

Contract No: **Work Project No:** 25174 **Class:** M (F: Freeway, C: Connecting Link, A: Major Arterial, M: Minor Arterial, R: Residential)

Pavement Condition Rating: 25 **Riding Condition Rating:** 2.5 **Evaluated by:** Randy Pomerleau

10 Excellent 8 Good 6 Fair 4 Poor 2 Very Poor 0 (X)

Pavement Distress Manifestation			Weighting	Severity of Distress: Slight	Moderate	Severe	Density of Distress (Extent of Occurrence, %): Intermittent <20	Frequent 20-50	Extensive >50	DMI
			(wi)	1	2	3	1	2	3	
Surface Defects	Ravelling	1	3.0			X		X		15.0
	Flushing	2	0.5							0.0
	Potholes	3	1.0			X			X	6.0
	Pavement Edge Breaks	4	1.5			X			X	9.0
	Manholes & Catchbasins	5	1.0							0.0
Surface Deformations	Rippling and Shoving	6	1.0							0.0
	Wheel Track Rutting	7	3.0			X			X	18.0
	Distortion	8	1.0							0.0
	Utility Trenches	9	1.0							0.0
Cracking	Longitudinal	10	1.0			X			X	6.0
	Transverse	11	1.0			X			X	6.0
	Pavement Edge	12	1.0			X			X	6.0
	Map	13	1.5							0.0
	Alligator	14	3.0			X			X	18.0

Ride Comfort Rating (RCR) from 0-10: 2.5 **TOTAL DMI** 6.0

Back-calculated PCI Value: 20

Shoulder Distress Manifestation			Severity of Distress: Right Slight	Right Moderate	Right Severe	Left Slight	Left Moderate	Left Severe	Density of Distress (Extent of Occurrence, %): Right <20	Right 20-50	Right >50	Left <20	Left 20-50	Left >50
Dominant Type		Distress												
Paved Full		Pavement Edge												
		Paved Shoulder Separation												
Paved Partial		Cracking												
		Breakup and Potholes												
Surface Treated														
		Distortion												
Primed		Pavement Edge Curb Separation												

Maintenance Treatment

Pavement	Extent of Occurrence, % <20 (1)	20-50 (2)	>50 (3)	Shoulder	Extent of Occurrence, % <20 (1)	20-50 (2)	>50 (3)
Manual Patching	X			Manual Patching			
Machine Patching				Manual Spray Patching			
Manual Spray Patching				Manual Chip Seal			
Manual Chip Seal				Crack Rout & Seal			
Machine Chip Seal							
Fog Seal							
Surface Treatment							
Manual Burn & Seal							
Crack Rout & Seal							

Distress comments (Items not covered above):

Pavement is in very poor condition.

Other Comments (e.g. subsections, additional contracts):

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FLEXIBLE PAVEMENT CONDITION EVALUATION FORM (MUNICIPALITIES)

Queen Street West (Section 2 of 2)

Road No. (Street): Queen Street West **Location From:** Osprey Mills Drive **To:** James Street

Section Length: 0.35 **(Km)** **Survey Date:** Mar-20 **Traffic Direction:** B (B (Both Directions); N (North); S (South); E (East); W (West))

Contract No: **Work Project No:** 25174 **Class:** M (F: Freeway, C: Connecting Link, A: Major Arterial, M: Minor Arterial, R: Residential)

Pavement Condition Rating: 95 **Riding Condition Rating:** 9.5 **Evaluated by:** Randy Pomerleau

10 Excellent (X) 8 Good 6 Fair 4 Poor 2 Very Poor 0

Pavement Distress Manifestation			Weighting	Severity of Distress: Slight	Moderate	Severe	Density of Distress (Extent of Occurrence, %): Intermittent <20	Frequent 20-50	Extensive >50	DMI
			(wi)	1	2	3	1	2	3	
Surface Defects	Ravelling	1	3.0							0.0
	Flushing	2	0.5							0.0
	Potholes	3	1.0							0.0
	Pavement Edge Breaks	4	1.5							0.0
	Manholes & Catchbasins	5	1.0	X			X			2.0
Surface Deformations	Rippling and Shoving	6	1.0							0.0
	Wheel Track Rutting	7	3.0							0.0
	Distortion	8	1.0							0.0
	Utility Trenches	9	1.0							0.0
Cracking	Longitudinal	10	1.0	X			X			2.0
	Transverse	11	1.0							0.0
	Pavement Edge	12	1.0	X			X			2.0
	Map	13	1.5							0.0
	Alligator	14	3.0							0.0

Ride Comfort Rating (RCR) from 0-10: 9.5 **TOTAL DMI** 9.7

Back-calculated PCI Value: 96

Shoulder Distress Manifestation			Severity of Distress: Right Slight	Right Moderate	Right Severe	Left Slight	Left Moderate	Left Severe	Density of Distress (Extent of Occurrence, %): Right <20	Right 20-50	Right >50	Left <20	Left 20-50	Left >50
Dominant Type		Distress												
Paved Full		Pavement Edge												
		Paved Shoulder Separation												
Paved Partial		Cracking												
		Breakup and Potholes												
Surface Treated														
		Distortion												
Primed		Pavement Edge Curb Separation												

Maintenance Treatment						
Pavement	Extent of Occurrence, %: <20	20-50	>50	Shoulder	Extent of Occurrence, %: <20	20-50	>50
	1	2	3		1	2	3
Manual Patching				Manual Patching			
Machine Patching				Manual Spray Patching			
Manual Spray Patching				Manual Chip Seal			
Manual Chip Seal				Crack Rout & Seal			
Machine Chip Seal							
Fog Seal							
Surface Treatment							
Manual Burn & Seal							
Crack Rout & Seal							

Distress comments (Items not covered above):

Pavement is in excellent condition.

Other Comments (e.g. subsections, additional contracts):

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FLEXIBLE PAVEMENT CONDITION EVALUATION FORM (MUNICIPALITIES)

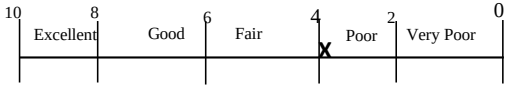
Main Street North

Road No. (Street): Main Street North **Location From:** Mary Street **To:** Highpoint Side Road

Section Length: 1.6 **(Km)** **Survey Date:** Mar-20 **Traffic Direction:** B (B (Both Directions); N (North); S (South); E (East); W (West))

Contract No: **Work Project No:** 25174 **Class:** M (F: Freeway, C: Connecting Link, A: Major Arterial, M: Minor Arterial, R: Residential)

Pavement Condition Rating: 45 **Riding Condition Rating:** 4.5 **Evaluated by:** Randy Pomerleau



Pavement Distress Manifestation			Weighting	Severity of Distress: Slight	Severity of Distress: Moderate	Severity of Distress: Severe	Density of Distress (Extent of Occurrence, %): Intermittent <20	Density of Distress: Frequent 20-50	Density of Distress: Extensive >50	DMI
			(wi)	1	2	3	1	2	3	DMI
Surface Defects	Ravelling	1	3.0			X			X	18.0
	Flushing	2	0.5							0.0
	Potholes	3	1.0			X		X		5.0
	Pavement Edge Breaks	4	1.5			X			X	9.0
	Manholes & Catchbasins	5	1.0							0.0
Surface Deformations	Rippling and Shoving	6	1.0							0.0
	Wheel Track Rutting	7	3.0			X			X	18.0
	Distortion	8	1.0							0.0
	Utility Trenches	9	1.0							0.0
Cracking	Longitudinal	10	1.0		X				X	5.0
	Transverse	11	1.0			X			X	6.0
	Pavement Edge	12	1.0			X			X	6.0
	Map	13	1.5		X		X			4.5
	Alligator	14	3.0			X			X	18.0

Ride Comfort Rating (RCR) from 0-10: 4.5 **TOTAL DMI** 5.7

Back-calculated PCI Value: 39

Shoulder Distress Manifestation			Severity of Distress: Right Slight	Right Moderate	Right Severe	Left Slight	Left Moderate	Left Severe	Density of Distress (Extent of Occurrence, %): Right <20	Right 20-50	Right >50	Left <20	Left 20-50	Left >50
Dominant Type		Distress												
Paved Full		Pavement Edge												
		Paved Shoulder Separation												
Paved Partial		Cracking												
		Breakup and Potholes												
Surface Treated														
		Distortion												
Primed		Pavement Edge Curb Separation												

Maintenance Treatment						
Pavement	Extent of Occurrence, %: <20	20-50	>50	Shoulder	Extent of Occurrence, %: <20	20-50	>50
	1	2	3		1	2	3
Manual Patching	X			Manual Patching			
Machine Patching				Manual Spray Patching			
Manual Spray Patching				Manual Chip Seal			
Manual Chip Seal				Crack Rout & Seal			
Machine Chip Seal							
Fog Seal							
Surface Treatment							
Manual Burn & Seal							
Crack Rout & Seal							

Distress comments (Items not covered above):

Severe Pavement Edge Breaks and Alligator Cracking Extensively throughout roadway.

Other Comments (e.g. subsections, additional contracts):

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Appendix D

Pavement Core Logs and Typical Photographs

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Queen Street West and Main Street North
Village of Alton - Caledon, ON
Pavement Core Log

Queen Street West

Station	Direction	Lane	Asphalt Layer Thickness(mm)		Crack Depth	Crack Width	Comments
			Surface	Total			
10+075	WB	Lane	55	55			
10+150	EB	Lane	60	60			
10+225	WB	Lane	45	45			
10+300	EB	Lane	65	65			
10+367	WB	Lane	85	85			
10+450	EB	Lane	80	80			
10+548	WB	Lane	80	80			
10+600	EB	Lane	90	90			

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Queen Street West and Main Street North
Village of Alton - Caledon, ON
Pavement Core Log

Main Street North

Station	Direction	Lane	Asphalt Layer Thickness(mm)		Crack Depth	Crack Width	Comments
			Surface	Total			
20+075	SB	Lane	65	65			
20+150	NB	Lane	60	60			
20+225	SB	Lane	70	70			
20+300	NB	Lane	60	60			
20+375	SB	Lane	45	45			
20+450	NB	Lane	35	35			
20+522	SB	Lane	45	45	0 45	2 2	
20+600	NB	Lane	35	35	0 35	4 2	Rutting OWP: 25mm
20+675	SB	Lane	35	35			Rutting OWP: 10mm
20+750	NB	Lane	45	45			
20+825	SB	Lane	70	70			
20+900	NB	Lane	45	45			
20+975	SB	Lane	40	40			
21+050	NB	Lane	45	45			Rutting OWP: 15mm
21+125	SB	Lane	35	35			
21+200	NB	Lane	30	30			Rutting OWP: 35mm
21+275	SB	Lane	35	35			Rutting OWP: 10mm
21+350	NB	Lane	30	30			Rutting OWP: 25mm
21+425	SB	Lane	55	55			
21+500	NB	Lane	45	45			

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Queen Street West and Main Street North

Village of Alton - Caledon, ON

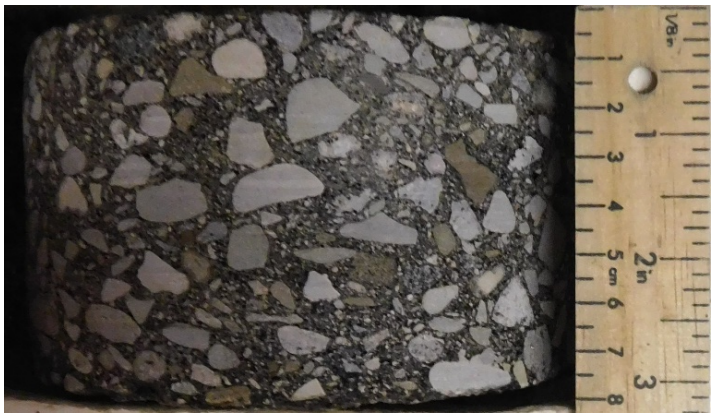
Pavement Core Photographs

Pavement Core Photo #1
Queen Street West Station
10+075 – WB Lane

Layer	Thickness (mm)
Surface	55
Total	**55**

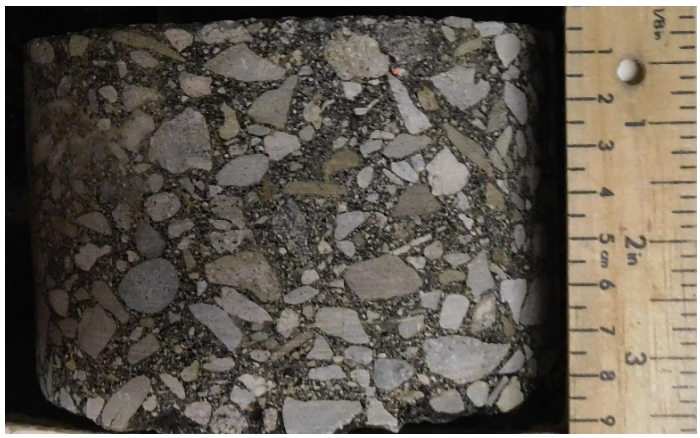
Pavement Core Photo #2
Queen Street West Station
10+300 – EB Lane

Layer	Thickness (mm)
Surface	65
Total	**65**



Pavement Core Photo #3
Queen Street West Station
10+450 – EB Lane

Layer	Thickness (mm)
Surface	80
Total	**80**



Pavement Core Photo #4
Queen Street West
Station 10+600 – EB Lane

Layer	Thickness (mm)
Surface	90
Total	**90**

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Queen Street West and Main Street North
Village of Alton - Caledon, ON
Pavement Core Photographs

Pavement Core Photo #5

Main Street North
Station 20+150 – NB Lane

Layer	Thickness (mm)
Surface	60
Total	**60**

Pavement Core Photo #6

Main Street North
Station 20+522 – SB Lane

Layer	Thickness (mm)
Surface	45
Total	**45**

Crack Depth (mm)	Crack Width (mm)
0	2
45	2

Pavement Core Photo #7

Main Street North
Station 20+600 – NB Lane

Layer	Thickness (mm)
Surface	35
Total	**35**

Crack Depth (mm)	Crack Width (mm)
0	4
35	2

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Queen Street West and Main Street North
Village of Alton - Caledon, ON
Pavement Core Photographs

Pavement Core Photo #8

Main Street North
Station 20+750 – NB Lane

Layer	Thickness (mm)
Surface	45
Total	**45**

Pavement Core Photo #9

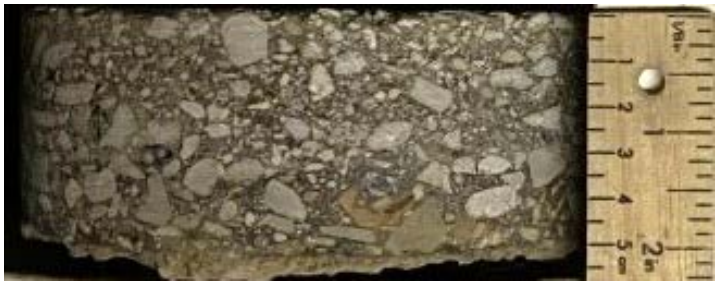
Main Street North
Station 20+975 – SB Lane

Layer	Thickness (mm)
Surface	40
Total	**40**

Pavement Core Photo #10

Main Street North
Station 21+200 – NB Lane

Layer	Thickness (mm)
Surface	30
Total	**30**



Pavement Core Photo #11

Main Street North
Station 21+425 – SB Lane

Layer	Thickness (mm)
Surface	55
Total	**55**

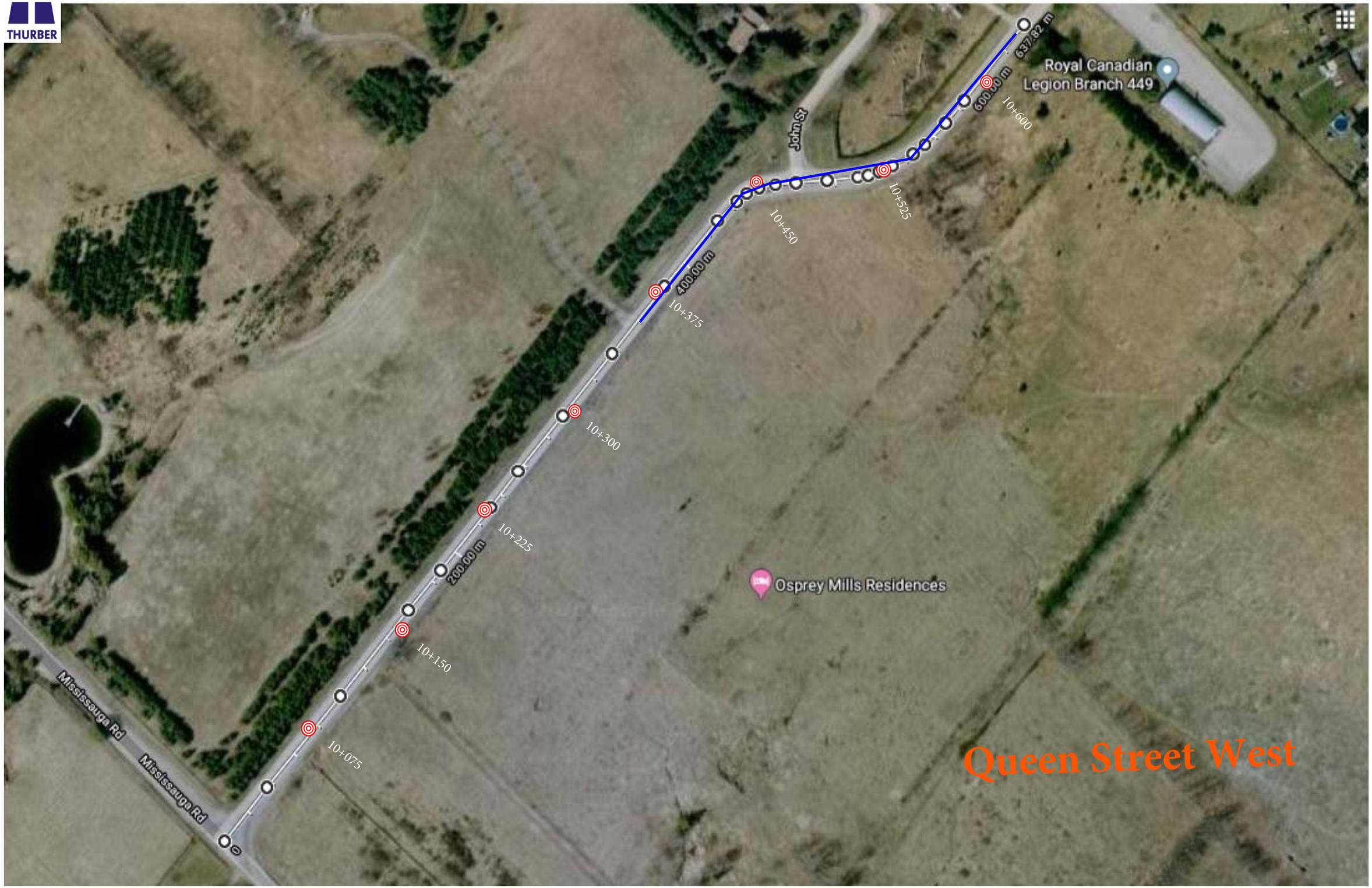
THURBER

Appendix E

Borehole Plan and Field Logs

Alton Village - Town of Caledon Borehole Investigation
BH Location Plan

THURBER



Alton Village - Town of Caledon Borehole Investigation
BH Location Plan

Alton Village - Town of Caledon Borehole Investigation
BH Location Plan

Alton Village - Town of Caledon Borehole Investigation
BH Location Plan

Alton Village - Town of Caledon Borehole Investigation
BH Location Plan

Alton Village - Town of Caledon Borehole Investigation
BH Location Plan

Queen Street West and Main Street North
Village of Alton - Caledon, ON
Borehole Logs

May 08, 2020

Queen Street West

Station 10+075 WB 1.4m LT CL Lane

0 - 55	Asph	
55 - 350	Br Sa(y) Cr Gr Tr Si	Moist
		w @ 0.2m = 7%
		Percent Passing 4.75 mm = 42%
		75 µm = 10%
		Acceptable Granular A
350 - 800	Br Sa(y) Gr Some Si	Moist
		w @ 0.6m = 3%
		Percent Passing 4.75 mm = 48%
		75 µm = 11%
		Acceptable Granular A
800 - 1.5	Br Si(y) Sa Some Cl	Moist
		w @ 1.2m = 13%
		Percent Passing 4.75 mm = 97%
		75 µm = 51%
		5 µm = 15%
		Frost Susceptibility = LSFH
		Soil Erodibility = 0.24
		W_L = 17%
		W_P = 12%
		P_I = 5%
		MTC Soil Classification = CL-ML
	Very Severe Pavement Edge Breaks and Alligator Cracking	

Station 10+150 EB 1.5m RT CL Lane

0 - 60	Asph	
60 - 220	Br Sa(y) Cr Gr Tr Si	Moist
220 - 560	Br Sa(y) Gr Some Si	Moist
560 - 1.5	Br Si(y) Sa Some Cl	Moist
1.5 - 2.1	Br Si(y) Sa Some Cl (Compact)	Moist
	Nvalue=16 blows / 300mm	
	Very Severe Pavement Edge Breaks and Alligator Cracking	

Station 10+225 WB 1.4m LT CL Lane

0 - 45	Asph	
45 - 400	Br Sa(y) Cr Gr Tr Si	Moist
400 - 700	Br Sa(y) Gr Some Si	Moist
700 - 1.5	Br Si(y) Sa Some Cl	Moist
	Very Severe Pavement Edge Breaks and Alligator Cracking	

Station 10+300 EB 1.4m RT CL Lane

0 - 65	Asph	
65 - 400	Br Sa(y) Cr Gr Tr Si	Moist
400 - 900	Br Sa(y) Gr Some Si	Moist
900 - 1.5	Br Si(y) Sa Some Cl	Moist

Station 10+367 WB 1.6m LT CL

0 - 85	Asph	
85 - 450	Br Sa(y) Cr Gr Tr Si	Moist
450 - 900	Br Sa(y) Gr Some Si	Moist
900 - 1.5	Br Si(y) Sa Some Cl	Moist
1.5 - 2.1	Br Si(y) Sa Some Cl (Compact)	Dry
	Nvalue=12 blows / 300mm	

Station 10+450 EB 1.4m RT CL Lane

0 - 80	Asph	
80 - 400	Br Sa(y) Cr Gr Tr Si	Moist
400 - 700	Br Sa(y) Gr Some Si	Moist
700 - 1.1	Br Sa(y) Gr Some Si	Moist
1.1 - 1.5	Br Si(y) Sa Some Cl	Moist

Station 10+548 WB 1.6m LT CL Lane

0 - 80	Asph	
80 - 430	Br Sa(y) Cr Gr Tr Si	Moist
430 - 1.5	Br Sa(y) Gr Some Si	Moist

Station 10+600 EB 2.1m RT CL Lane

0 - 90	Asph	
90 - 425	Br Sa(y) Cr Gr Tr Si	Moist
425 - 1.4	Br Sa(y) Gr Some Si	Moist
1.4 - 1.5	Br Si(y) Sa Some Cl	Moist

Main Street North

Station 20+075 SB 1.2m LT CL Lane

0 - 65	Asph	
65 - 200	Br Sa W Cr Gr W RAP	Moist
200 - 550	Br Gr(y) Sa Some RAP	Moist
550 - 1.5	Br Sa Some Si Tr Cl Tr Gr	Moist

Station 20+150 NB 1.5m RT CL Lane

0 - 60	Asph	
60 - 400	Dk Br Sa(y) Cr Gr Tr Si	Moist
400 - 600	Br Sa W Cr Gr Tr Si	Moist
600 - 800	Dk Br Sa W Cr Gr Tr Si	Moist
800 - 1.5	Br Sa Some Si Tr Cl Tr Gr	Moist
		w @ 1.2m = 15%
		Percent Passing 4.75 mm = 98%
		75 µm = 22%
		5 µm = 9%
		Frost Susceptibility = LSFH
		Soil Erodibility = 0.05

Station 20+225 SB 1.3m LT CL Lane

0 - 70	Asph	
70 - 375	Br Sa W Cr Gr W RAP	Moist
375 - 1.2	Br Sa Some Si Tr Cl Tr Gr	Moist
1.2 - 1.7	Br Sa Some Si Tr Cl Occ Cob	Moist
1.7 -	NFP (Poss Blds or Cob)	Moist

Note: Boreholes offsets referenced from centreline.

Queen Street West and Main Street North
Village of Alton - Caledon, ON
Borehole Logs

May 08, 2020

Station 20+300	NB 1.5m RT CL	Lane
0 - 60	Asph	
60 - 400	Dk Br Sa(y) Cr Gr Tr Si	Moist
400 - 900	Br Sa W Cr Gr Tr Si	Moist
900 - 1.5	Br Si(y) Sa Some Cl	Moist

Station 20+375	SB 1.3m LT CL	Lane
0 - 45	Asph	
45 - 300	Br Sa(y) Cr Gr Tr Si	Moist
		w @ 0.2m = 10%
		Percent Passing 4.75 mm = 43%
		75 µm = 7%
		Acceptable Granular A
300 - 700	Br Sa W Cr Gr Some Si	Moist
		w @ 0.5m = 8%
		Percent Passing 4.75 mm = 72%
		75 µm = 16%
		Slightly Finer Than Granular B, Type I
700 - 1.5	Br Si(y) Sa Some Cl	Moist
		w @ 1.1m = 10%
		Percent Passing 4.75 mm = 100%
		75 µm = 45%
		5 µm = 11%
		Frost Susceptibility = LSFH
		Soil Erodibility = 0.24

Station 20+450	NB 1.5m RT CL	Lane
0 - 35	Asph	
35 - 410	Br Sa(y) Cr Gr Tr Si	Moist
410 - 950	Br Sa W Cr Gr Tr Si	Moist
950 - 1.5	Br Si(y) Sa Some Cl	Moist
1.5 - 2.1	Br/Gry Si(y) Sa Some Cl (Compact)	Moist
	Nvalue=13 blows / 300mm	

Station 20+522	SB 1.3m LT CL	Lane
0 - 45	Asph	
45 - 450	Br Sa(y) Cr Gr Tr Si	Moist
450 - 1.1	Br Sa W Cr Gr Tr Si	Moist
1.1 - 1.5	Br Si(y) Sa Some Cl	Moist
	Very Severe Pavement Edge Breaks and Alligator Cracking	

Station 20+600	NB 1.5m RT CL	Lane
0 - 35	Asph	
35 - 480	Br Sa(y) Cr Gr Tr Si	Moist
480 - 1	Br Sa W Cr Gr Tr Si	Moist
1 - 1.5	Br Si(y) Sa Some Cl	Moist
	Severe Alligator Cracking in OWP	

Station 20+675	SB 1.3m LT CL	Lane
0 - 35	Asph	
35 - 450	Br Sa W Cr Gr Tr Si	Moist
450 - 1.5	Br Si(y) Sa Some Cl	Moist
	Alligator Cracking in OWP	

Station 20+750	NB 1.5m RT CL	Lane
0 - 45	Asph	
45 - 250	Br Sa(y) Cr Gr Tr Si	Moist
250 - 550	Br Sa W Cr Gr Tr Si	Moist
550 - 1.5	Br Sa Some Si Tr Cl Tr Gr	Moist

Station 20+825	SB 1m LT CL	Lane
0 - 70	Asph	Dry
	Core only due to traffic control restrictions	

Station 20+900	NB 1.5m RT CL	Lane
0 - 45	Asph	
45 - 400	Br Sa and Cr Gr Tr Si	Moist
400 - 910	Br Sa W Cr Gr Tr Si	Moist
910 - 1.5	Br Si(y) Sa Some Cl	Moist

Station 20+975	SB 1.3m LT CL	Lane
0 - 40	Asph	
40 - 400	Br Sa and Cr Gr Tr Si	Moist
400 - 1.5	Br Sa Some Si Tr Cl Tr Gr	Moist

Station 21+050	NB 1m RT CL	Lane
0 - 45	Asph	
45 - 350	Br Sa and Cr Gr Tr Si	Moist
350 - 850	Br Sa W Cr Gr Tr Si	Moist
850 - 1.5	Br Si(y) Sa Some Cl	Moist
1.5 - 1.8	Br Si(y) Sa Some Cl	Moist
1.8 -	NFP (Poss Blds or Cob)	
	Alligator cracking in OWP	

Station 21+125	SB 1.1m LT CL	Lane
0 - 35	Asph	
35 - 360	Br Sa and Cr Gr Tr Si	Moist
360 - 1	Br Sa W Cr Gr Tr Si	Moist
1 - 1.5	Br Si(y) Sa Some Cl	Moist
1.5 - 2.1	Br Si(y) Sa Some Cl (Loose)	Moist
	Nvalue=6 blows / 300mm	

Station 21+200	NB 1m RT CL	Lane
0 - 30	Asph	
30 - 200	Br Sa and Cr Gr Tr Si	Moist
200 - 920	Br Sa W Cr Gr Tr Si	Moist
920 - 1.5	Br Si(y) Sa Some Cl	Moist
	Severe Alligator Cracking in OWP	

Note: Boreholes offsets referenced from centreline.

Borehole Logs

May 08, 2020

Station 21+275	**SB 1.2m LT CL**	**Lane**	
0 - 35	Asph		
35 - 300	Br Cr Gr and Sa Tr Si	Moist	
300 - 580	Br Sa W Cr Gr Tr Si	Moist	
580 - 900	Br Sa Some Si Tr Cl Tr Gr	Moist	
900 - 1.5	Br/Red Si(y) Sa Some Cl	Moist	
	Severe Alligator Cracking in OWP		
Station 21+350	**NB 1.2m RT CL**	**Lane**	
0 - 30	Asph		
30 - 310	Br Sa and Cr Gr Tr Si	Moist	
310 - 700	Br Sa W Cr Gr Tr Si	Moist	
700 - 1.5	Br Si(y) Sa Some Cl	Moist	
	Severe Alligator Cracking in OWP		
Station 21+425	**SB 1.5m LT CL**	**Lane**	
0 - 55	Asph		
55 - 380	Br Sa and Cr Gr Tr Si	Moist	
380 - 1.5	Br/Red Sa W Cr Gr Some Si	Moist	
Station 21+500	**NB 1.5m RT CL**	**Lane**	
0 - 45	Asph		
45 - 350	Br Sa and Cr Gr Tr Si	Moist	
			w @ 0.2m = 9%
			Percent Passing 4.75 mm = 54%
			75 µm = 9%
			Acceptable Granular A
350 - 650	Br Sa W Cr Gr Tr Si	Moist	
650 - 1.1	Br Si(y) Sa Some Cl	Moist	
			w @ 0.9m = 16%
			Percent Passing 4.75 mm = 99%
			75 µm = 52%
			5 µm = 14%
			Frost Susceptibility = LSFH
			Soil Erodibility = 0.25
			W_L = 21%
			W_P = 15%
			P_I = 6%
			MTC Soil Classification = CL-ML
1.1 - 1.5	Br Sa(y) Gr Some Si	Moist	

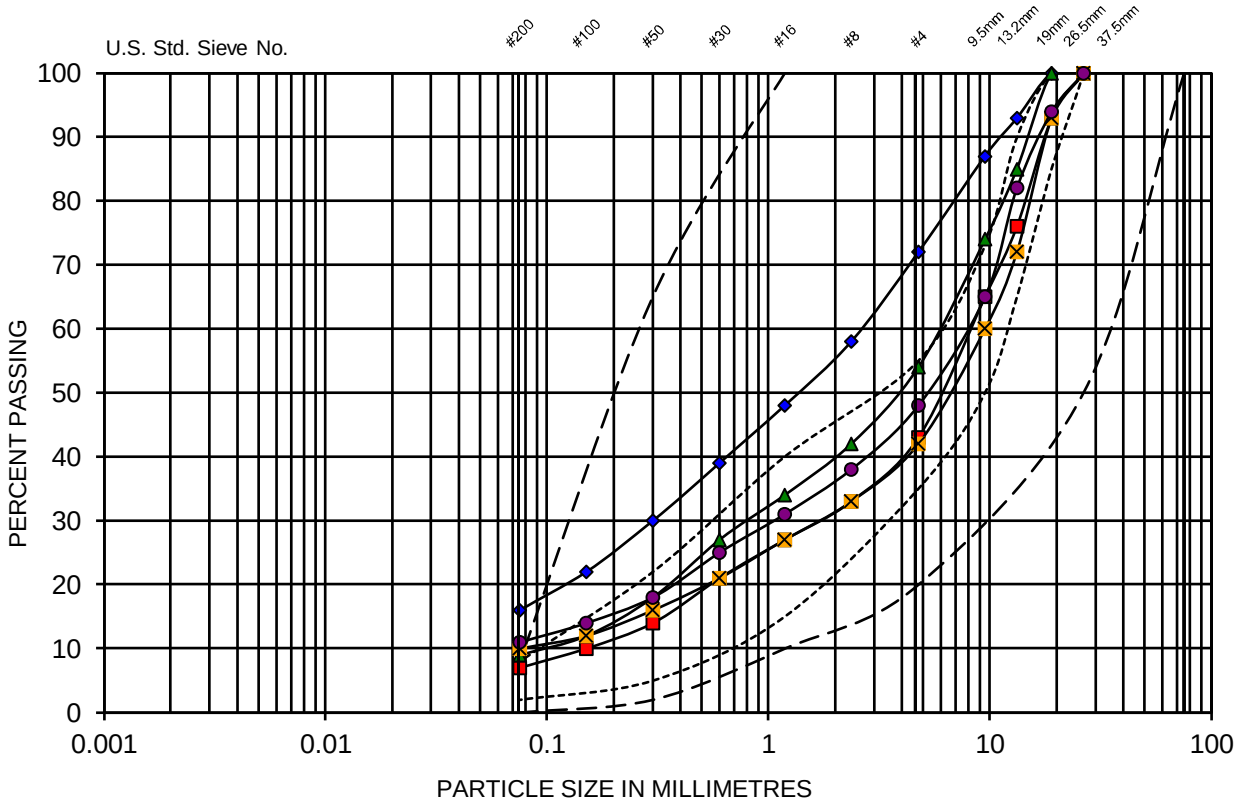
Note: Boreholes offsets referenced from centreline.

THURBER

Appendix F

Laboratory Test Results

Main Street North and Queen Street West
GRAIN SIZE DISTRIBUTION



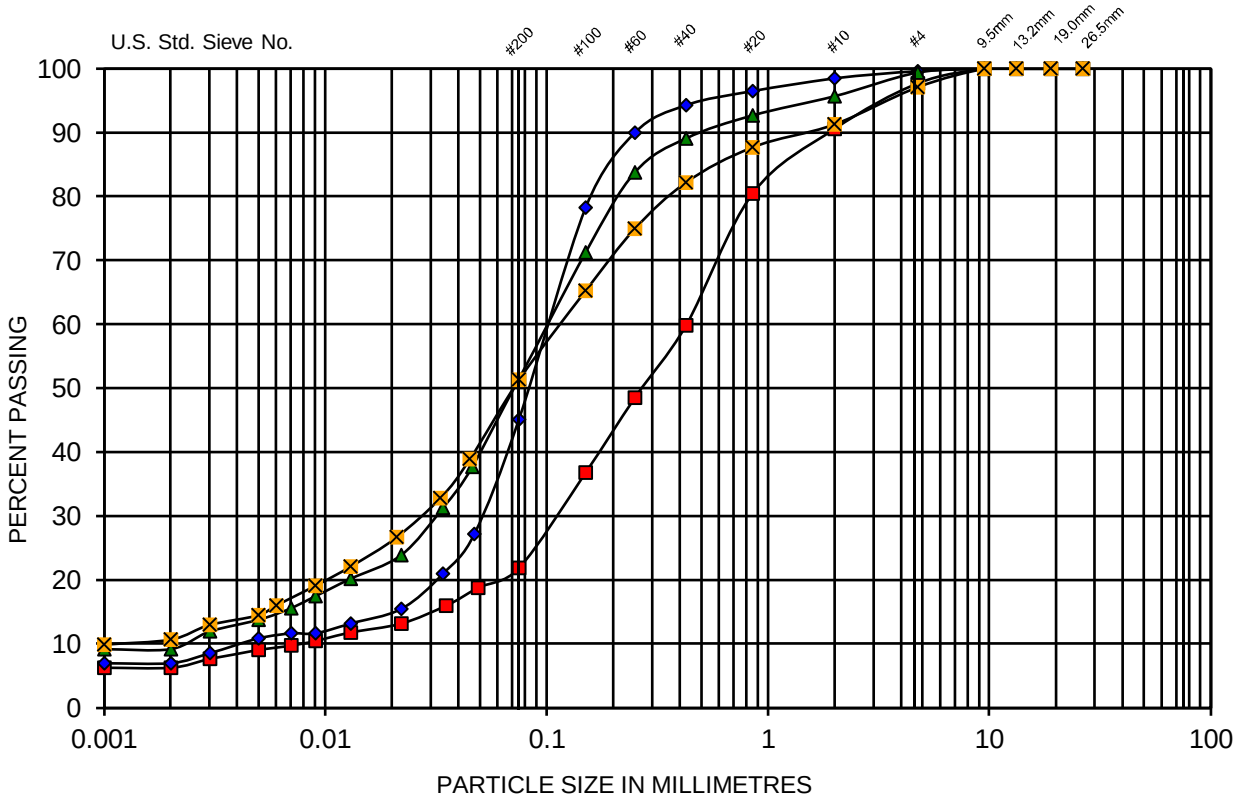
SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	Cob Size
FINE GRAINED	SAND			GRAVEL		

Legend

- Granular A - OPSS Specification Limits
- Granular B, Type I - OPSS Specification Limits
- Main Street North - 20+375 - SB Lane - 45-300
- Main Street North - 20+375 - SB Lane - 300-700
- Main Street North - 21+500 - NB Lane - 45-350
- Queen Street West - 10+075 - WB Lane - 55-350
- Queen Street West - 10+075 - WB Lane - 350-800

THURBER

Main Street North and Queen Street West
PARTICLE SIZE DISTRIBUTION

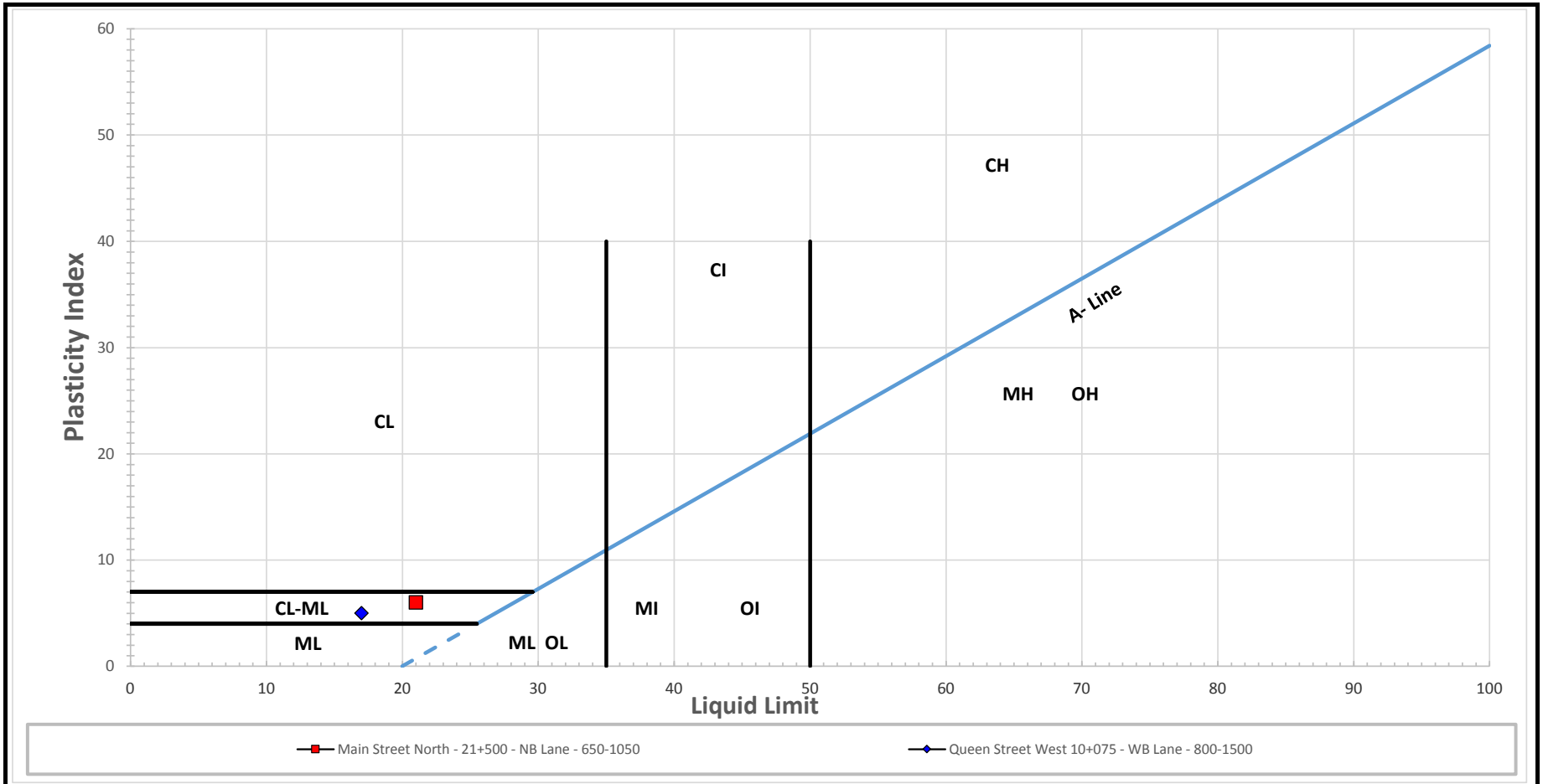


SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	Cob Size
FINE GRAINED	SAND			GRAVEL		

Legend

- Main Street North - 20+150 - NB Lane - 800-1500
- Main Street North - 20+375 - SB Lane - 700-1500
- Main Street North - 21+500 - NB Lane - 650-1050
- Queen Street West - 10+075 - WB Lane - 800-1500

THURBER



THURBER

Atterberg Limit Determination (LS-703 & 704)

Main Street North and Queen Street West

Figure No. 1

Project No.: 25174

THURBER

Appendix G

Environmental Test Lab Results

Thurber Engineering Ltd. (Oakville)
ATTN: RANDY POMERLEAU
2010 Winston Park Drive
Unit 103
Oakville ON L6H 5R7

Date Received: 25-MAR-20
Report Date: 08-MAY-20 13:53 (MT)
Version: FINAL REV. 2

Client Phone: 905-829-8666

Certificate of Analysis

Lab Work Order #: L2431628

Project P.O. #: NOT SUBMITTED
Job Reference: 25174
C of C Numbers:
Legal Site Desc:

Comments: ADDITIONAL 08-APR-20 10:14

08-MAY-20 Report type revisions to compare to Table 1 and Table 2 RPI Coarse as per client request. A.Overholster

Amanda Overholster
Account Manager

Summary of Guideline Exceedances

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use						
L2431628-1	M02- MAIN ST NORTH- NB LANE- 20+	Saturated Paste Extractables	SAR	13.1	2.4	SAR
		Metals	Cobalt (Co)	42.9	21	ug/g
		Hydrocarbons	F2 (C10-C16)	<100	10	ug/g
			F3 (C16-C34)	700	240	ug/g
			F4 (C34-C50)	3100	120	ug/g
			F4G-SG (GHH-Silica)	8270	120	ug/g
L2431628-2	M02- MAIN ST NORTH- NB LANE- 20+	Saturated Paste Extractables	SAR	16.3	2.4	SAR
L2431628-3	M10- MAIN ST NORTH- NB LANE- 20+	Physical Tests	Conductivity	0.713	0.57	mS/cm
		Saturated Paste Extractables	SAR	48.0	2.4	SAR
		Metals	Silver (Ag)	0.65	0.5	ug/g
L2431628-4	M10- MAIN ST NORTH- NB LANE- 20+	Physical Tests	Conductivity	0.990	0.57	mS/cm
		Saturated Paste Extractables	SAR	62.0	2.4	SAR
L2431628-5	M17- MAIN ST NORTH- SB LANE- 21+	Physical Tests	Conductivity	1.40	0.57	mS/cm
		Saturated Paste Extractables	SAR	55.7	2.4	SAR
L2431628-6	M17- MAIN ST NORTH- SB LANE- 21+	Physical Tests	Conductivity	1.38	0.57	mS/cm
		Saturated Paste Extractables	SAR	76.3	2.4	SAR
L2431628-7	M13- MAIN ST NORTH- SB LANE- 20+	Physical Tests	Conductivity	0.854	0.57	mS/cm
		Saturated Paste Extractables	SAR	38.6	2.4	SAR
L2431628-8	Q02- QUEEN ST WEST- EB LANE- 10+	Physical Tests	Conductivity	0.845	0.57	mS/cm
		Saturated Paste Extractables	SAR	54.7	2.4	SAR
L2431628-9	Q02- QUEEN ST WEST- EB LANE- 10+	Physical Tests	Conductivity	0.926	0.57	mS/cm
		Saturated Paste Extractables	SAR	38.5	2.4	SAR
L2431628-10	Q08- QUEEN ST WEST- EB LANE- 10+	Saturated Paste Extractables	SAR	14.4	2.4	SAR
		Metals	Silver (Ag)	1.83	0.5	ug/g
L2431628-11	Q08- QUEEN ST WEST- EB LANE- 10+	Saturated Paste Extractables	SAR	11.9	2.4	SAR
L2431628-12	M03- MAIN ST NORTH- SB LANE-20+2	Physical Tests	Conductivity	0.602	0.57	mS/cm
		Saturated Paste Extractables	SAR	34.0	2.4	SAR
		Hydrocarbons	F2 (C10-C16)	<100	10	ug/g
			F3 (C16-C34)	740	240	ug/g
			F4 (C34-C50)	2970	120	ug/g
			F4G-SG (GHH-Silica)	8440	120	ug/g
Ontario Regulation 153/04 - April 15, 2011 Standards - T2-Soil-Res/Park/Inst. Property Use (Coarse)						

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Summary of Guideline Exceedances

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Ontario Regulation 153/04 - April 15, 2011 Standards - T2-Soil-Res/Park/Inst. Property Use (Coarse)						
L2431628-1	M02- MAIN ST NORTH- NB LANE- 20+	Saturated Paste Extractables	SAR	13.1	5	SAR
		Metals	Cobalt (Co)	42.9	22	ug/g
		Hydrocarbons	F2 (C10-C16)	<100	98	ug/g
			F3 (C16-C34)	700	300	ug/g
			F4 (C34-C50)	3100	2800	ug/g
			F4G-SG (GHH-Silica)	8270	2800	ug/g
L2431628-2	M02- MAIN ST NORTH- NB LANE- 20+	Saturated Paste Extractables	SAR	16.3	5	SAR
L2431628-3	M10- MAIN ST NORTH- NB LANE- 20+	Physical Tests	Conductivity	0.713	0.7	mS/cm
		Saturated Paste Extractables	SAR	48.0	5	SAR
L2431628-4	M10- MAIN ST NORTH- NB LANE- 20+	Physical Tests	Conductivity	0.990	0.7	mS/cm
		Saturated Paste Extractables	SAR	62.0	5	SAR
L2431628-5	M17- MAIN ST NORTH- SB LANE- 21+	Physical Tests	Conductivity	1.40	0.7	mS/cm
		Saturated Paste Extractables	SAR	55.7	5	SAR
L2431628-6	M17- MAIN ST NORTH- SB LANE- 21+	Physical Tests	Conductivity	1.38	0.7	mS/cm
		Saturated Paste Extractables	SAR	76.3	5	SAR
L2431628-7	M13- MAIN ST NORTH- SB LANE- 20+	Physical Tests	Conductivity	0.854	0.7	mS/cm
		Saturated Paste Extractables	SAR	38.6	5	SAR
L2431628-8	Q02- QUEEN ST WEST- EB LANE- 10+	Physical Tests	Conductivity	0.845	0.7	mS/cm
		Saturated Paste Extractables	SAR	54.7	5	SAR
L2431628-9	Q02- QUEEN ST WEST- EB LANE- 10+	Physical Tests	Conductivity	0.926	0.7	mS/cm
		Saturated Paste Extractables	SAR	38.5	5	SAR
L2431628-10	Q08- QUEEN ST WEST- EB LANE- 10+	Saturated Paste Extractables	SAR	14.4	5	SAR
L2431628-11	Q08- QUEEN ST WEST- EB LANE- 10+	Saturated Paste Extractables	SAR	11.9	5	SAR
L2431628-12	M03- MAIN ST NORTH- SB LANE-20+2	Saturated Paste Extractables	SAR	34.0	5	SAR
		Hydrocarbons	F2 (C10-C16)	<100	98	ug/g
			F3 (C16-C34)	740	300	ug/g
			F4 (C34-C50)	2970	2800	ug/g
			F4G-SG (GHH-Silica)	8440	2800	ug/g

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Physical Tests - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	L2431628-1	L2431628-2	L2431628-3	L2431628-4	L2431628-5	L2431628-6	L2431628-7	L2431628-8	L2431628-9
				Sample Date	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20
				Sample ID	M02- MAIN ST NORTH- NB LANE- 20+150- 60MM-400MM	M02- MAIN ST NORTH- NB LANE- 20+150- 400MM-600MM	M10- MAIN ST NORTH- NB LANE- 20+750- 45MM-250MM	M10- MAIN ST NORTH- NB LANE- 20+750- 250MM-550MM	M17- MAIN ST NORTH- SB LANE- 21+275- 35MM-300MM	M17- MAIN ST NORTH- SB LANE- 21+275- 300MM-580MM	M13- MAIN ST NORTH- SB LANE- 20+975- 400MM- 1500MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 60MM-220MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 200MM-560MM
Conductivity	mS/cm	0.57	0.7		0.279	0.332	0.713	0.990	1.40	1.38	0.854	0.845	0.926
% Moisture	%	-	-		7.93	4.22	6.01	4.64	8.58	4.10	6.96	9.03	5.59
pH	pH units	-	-		8.14	8.11	8.22	8.10	8.01	8.03	8.03	8.01	8.01

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Physical Tests - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2431628-10 Sample Date: 12-MAR-20 Sample ID: Q08- QUEEN ST WEST- EB LANE- 10+600- 95MM-425MM	Lab ID: L2431628-11 Sample Date: 12-MAR-20 Sample ID: Q08- QUEEN ST WEST- EB LANE- 10+600- 425MM- 1350MM	Lab ID: L2431628-12 Sample Date: 12-MAR-20 Sample ID: M03- MAIN ST NORTH- SB LANE-20+225- 70MM-375MM
Conductivity	mS/cm	0.57	0.7	0.301	0.381	0.602
% Moisture	%	-	-	7.79	6.71	8.75
pH	pH units	-	-	8.02	8.08	7.87

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Cyanides - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	L2431628-1	L2431628-2	L2431628-3	L2431628-4	L2431628-5	L2431628-6	L2431628-7	L2431628-8	L2431628-9
				Sample Date	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20
				Sample ID	M02- MAIN ST NORTH- NB LANE- 20+150- 60MM-400MM	M02- MAIN ST NORTH- NB LANE- 20+150- 400MM-600MM	M10- MAIN ST NORTH- NB LANE- 20+750- 45MM-250MM	M10- MAIN ST NORTH- NB LANE- 20+750- 250MM-550MM	M17- MAIN ST NORTH- SB LANE- 21+275- 35MM-300MM	M17- MAIN ST NORTH- SB LANE- 21+275- 300MM-580MM	M13- MAIN ST NORTH- SB LANE- 20+975- 400MM- 1500MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 60MM-220MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 200MM-560MM
Cyanide, Weak Acid Diss	ug/g	0.051	0.051		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Cyanides - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2431628-10 Sample Date: 12-MAR-20 Sample ID: Q08- QUEEN ST WEST- EB LANE- 10+600- 95MM-425MM	Lab ID: L2431628-11 Sample Date: 12-MAR-20 Sample ID: Q08- QUEEN ST WEST- EB LANE- 10+600- 425MM- 1350MM	Lab ID: L2431628-12 Sample Date: 12-MAR-20 Sample ID: M03- MAIN ST NORTH- SB LANE-20+225- 70MM-375MM
Cyanide, Weak Acid Diss	ug/g	0.051	0.051	<0.050	<0.050	<0.050

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Saturated Paste Extractables - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	L2431628-1	L2431628-2	L2431628-3	L2431628-4	L2431628-5	L2431628-6	L2431628-7	L2431628-8	L2431628-9
				Sample Date	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20
				Sample ID	M02- MAIN ST NORTH- NB LANE- 20+150- 60MM-400MM	M02- MAIN ST NORTH- NB LANE- 20+150- 400MM-600MM	M10- MAIN ST NORTH- NB LANE- 20+750- 45MM-250MM	M10- MAIN ST NORTH- NB LANE- 20+750- 250MM-550MM	M17- MAIN ST NORTH- SB LANE- 21+275- 35MM-300MM	M17- MAIN ST NORTH- SB LANE- 21+275- 300MM-580MM	M13- MAIN ST NORTH- SB LANE- 20+975- 400MM- 1500MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 60MM-220MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 200MM-560MM
SAR	SAR	2.4	5		13.1 SAR:M	16.3 SAR:M	48.0 SAR:M	62.0 SAR:M	55.7 SAR:M	76.3 SAR:M	38.6 SAR:M	54.7 SAR:M	38.5 SAR:M
Calcium (Ca)	mg/L	-	-		1.36	1.31	0.64	0.77	1.78	0.95	1.49	0.72	1.81
Magnesium (Mg)	mg/L	-	-		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Sodium (Na)	mg/L	-	-		55.4	67.7	139	197	270	270	171	168	188

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Saturated Paste Extractables - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	Sample Date	Sample ID
				L2431628-10	12-MAR-20	Q08- QUEEN ST WEST- EB LANE- 10+600- 95MM-425MM
				L2431628-11	12-MAR-20	Q08- QUEEN ST WEST- EB LANE- 10+600- 425MM- 1350MM
				L2431628-12	12-MAR-20	M03- MAIN ST NORTH- SB LANE-20+225- 70MM-375MM
SAR	SAR	2.4	5	14.4 SAR:M	11.9 SAR:M	34.0 SAR:M
Calcium (Ca)	mg/L	-	-	1.30	2.82	0.95
Magnesium (Mg)	mg/L	-	-	<0.50	<0.50	<0.50
Sodium (Na)	mg/L	-	-	59.8	72.4	120

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Metals - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	L2431628-1	L2431628-2	L2431628-3	L2431628-4	L2431628-5	L2431628-6	L2431628-7	L2431628-8	L2431628-9
Lab ID				L2431628-1	L2431628-2	L2431628-3	L2431628-4	L2431628-5	L2431628-6	L2431628-7	L2431628-8	L2431628-9
Sample Date				12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20
Sample ID				M02- MAIN ST NORTH- NB LANE- 20+150- 60MM-400MM	M02- MAIN ST NORTH- NB LANE- 20+150- 400MM-600MM	M10- MAIN ST NORTH- NB LANE- 20+750- 45MM-250MM	M10- MAIN ST NORTH- NB LANE- 20+750- 250MM-550MM	M17- MAIN ST NORTH- SB LANE- 21+275- 35MM-300MM	M17- MAIN ST NORTH- SB LANE- 21+275- 300MM-580MM	M13- MAIN ST NORTH- SB LANE- 20+975- 400MM-1500MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 60MM-220MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 200MM-560MM
Antimony (Sb)	ug/g	1.3	7.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Arsenic (As)	ug/g	18	18	2.0	2.3	3.7	3.0	3.7	2.8	1.8	5.3	3.7
Barium (Ba)	ug/g	220	390	23.6	16.8	32.1	52.5	29.1	29.6	16.7	96.6	51.7
Beryllium (Be)	ug/g	2.5	4	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Boron (B)	ug/g	36	120	<5.0	<5.0	5.8	<5.0	5.2	<5.0	<5.0	7.0	<5.0
Boron (B), Hot Water Ext.	ug/g	36	1.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)	ug/g	1.2	1.2	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chromium (Cr)	ug/g	70	160	6.6	7.5	9.4	8.6	8.2	7.4	7.5	11.3	10.8
Cobalt (Co)	ug/g	21	22	42.9	3.9	13.7	5.7	19.0	4.1	2.8	16.5	6.3
Copper (Cu)	ug/g	92	140	17.6	13.8	25.9	41.4	19.1	19.2	10.2	70.2	52.6
Lead (Pb)	ug/g	120	120	6.0	6.3	41.3	13.3	16.7	7.8	2.8	8.6	9.9
Mercury (Hg)	ug/g	0.27	0.27	<0.0050	0.0077	0.0087	0.0063	0.0135	0.0055	0.0054	0.0118	0.0145
Molybdenum (Mo)	ug/g	2	6.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nickel (Ni)	ug/g	82	100	6.6	5.7	8.9	9.1	6.9	6.3	5.3	12.0	9.2
Selenium (Se)	ug/g	1.5	2.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Silver (Ag)	ug/g	0.5	20	0.48	<0.20	0.65	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Thallium (Tl)	ug/g	1	1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	ug/g	2.5	23	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium (V)	ug/g	86	86	17.8	20.4	19.7	16.5	18.4	18.2	15.9	21.0	19.1
Zinc (Zn)	ug/g	290	340	20.5	18.6	103	44.1	88.0	34.7	13.8	46.5	33.7

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Metals - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2431628-10 Sample Date: 12-MAR-20 Sample ID: Q08- QUEEN ST WEST- EB LANE- 10+600- 95MM-425MM	Lab ID: L2431628-11 Sample Date: 12-MAR-20 Sample ID: Q08- QUEEN ST WEST- EB LANE- 10+600- 425MM- 1350MM	Lab ID: L2431628-12 Sample Date: 12-MAR-20 Sample ID: M03- MAIN ST NORTH- SB LANE-20+225- 70MM-375MM
Antimony (Sb)	ug/g	1.3	7.5	<1.0	<1.0	<1.0
Arsenic (As)	ug/g	18	18	4.0	3.3	2.8
Barium (Ba)	ug/g	220	390	88.7	53.5	22.9
Beryllium (Be)	ug/g	2.5	4	<0.50	<0.50	<0.50
Boron (B)	ug/g	36	120	6.3	<5.0	<5.0
Boron (B), Hot Water Ext.	ug/g	36	1.5	<0.10	<0.10	<0.10
Cadmium (Cd)	ug/g	1.2	1.2	0.76	<0.50	<0.50
Chromium (Cr)	ug/g	70	160	12.3	7.9	9.1
Cobalt (Co)	ug/g	21	22	16.8	3.5	11.3
Copper (Cu)	ug/g	92	140	33.8	15.4	18.3
Lead (Pb)	ug/g	120	120	7.2	5.5	6.2
Mercury (Hg)	ug/g	0.27	0.27	0.0109	0.0093	0.0759
Molybdenum (Mo)	ug/g	2	6.9	<1.0	<1.0	<1.0
Nickel (Ni)	ug/g	82	100	10.0	5.7	7.0
Selenium (Se)	ug/g	1.5	2.4	<1.0	<1.0	<1.0
Silver (Ag)	ug/g	0.5	20	1.83	<0.20	<0.20
Thallium (Tl)	ug/g	1	1	<0.50	<0.50	<0.50
Uranium (U)	ug/g	2.5	23	<1.0	<1.0	<1.0
Vanadium (V)	ug/g	86	86	19.7	14.3	22.6
Zinc (Zn)	ug/g	290	340	35.2	46.1	25.5

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Speciated Metals - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	L2431628-1	L2431628-2	L2431628-3	L2431628-4	L2431628-5	L2431628-6	L2431628-7	L2431628-8	L2431628-9
				Sample Date	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20
				Sample ID	M02- MAIN ST NORTH- NB LANE- 20+150- 60MM-400MM	M02- MAIN ST NORTH- NB LANE- 20+150- 400MM-600MM	M10- MAIN ST NORTH- NB LANE- 20+750- 45MM-250MM	M10- MAIN ST NORTH- NB LANE- 20+750- 250MM-550MM	M17- MAIN ST NORTH- SB LANE- 21+275- 35MM-300MM	M17- MAIN ST NORTH- SB LANE- 21+275- 300MM-580MM	M13- MAIN ST NORTH- SB LANE- 20+975- 400MM- 1500MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 60MM-220MM	Q02- QUEEN ST WEST- EB LANE- 10+150- 200MM-560MM
Chromium, Hexavalent	ug/g	0.66	8		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

Speciated Metals - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	Sample Date	Sample ID
				L2431628-10	12-MAR-20	Q08- QUEEN ST WEST- EB LANE- 10+600- 95MM-425MM
				L2431628-11	12-MAR-20	Q08- QUEEN ST WEST- EB LANE- 10+600- 425MM- 1350MM
				L2431628-12	12-MAR-20	M03- MAIN ST NORTH- SB LANE-20+225- 70MM-375MM
Chromium, Hexavalent	ug/g	0.66	8	<0.20	<0.20	<0.20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Hydrocarbons - SOIL

		Guide Limits							
Lab ID				L2431628-1	L2431628-5	L2431628-8	L2431628-9	L2431628-10	L2431628-12
Sample Date				12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20	12-MAR-20
Sample ID				M02- MAIN ST NORTH- NB LANE- 20+150-60MM-400MM	M17- MAIN ST NORTH- SB LANE- 21+275-35MM-300MM	Q02- QUEEN ST WEST- EB LANE- 10+150-60MM-220MM	Q02- QUEEN ST WEST- EB LANE- 10+150-200MM-560MM	Q08- QUEEN ST WEST- EB LANE- 10+600-95MM-425MM	M03- MAIN ST NORTH- SB LANE-20+225-70MM-375MM
Analyte	**Unit**	**#1**	**#2**						
F1 (C6-C10)	ug/g	25	55	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
F2 (C10-C16)	ug/g	10	98	<100 DLM	<10	<10	<10	<10	<100 DLM
F3 (C16-C34)	ug/g	240	300	700 DLM	<50	<50	<50	<50	740 DLM
F4 (C34-C50)	ug/g	120	2800	3100 DLM	<50	<50	<50	61	2970 DLM
F4G-SG (GHH-Silica)	ug/g	120	2800	8270					8440
Total Hydrocarbons (C6-C50)	ug/g	-	-	3800	<72	<72	<72	<72	3710
Chrom. to baseline at nC50		-	-	NO	YES	YES	YES	YES	NO
Surrogate: 2-Bromobenzotrifluoride	%	-	-	111.2	111.1	89.3	97.1	100.5	110.6
Surrogate: 3,4-Dichlorotoluene	%	-	-	68.7	85.6	95.8	91.4	96.4	72.3

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
SAR:M	Reported SAR represents a maximum value. Actual SAR may be lower if both Ca and Mg were detectable.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
B-HWS-R511-WT	Soil	Boron-HWE-O.Reg 153/04 (July 2011)	HW EXTR, EPA 6010B

A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CN-WAD-R511-WT	Soil	Cyanide (WAD)-O.Reg 153/04 (July 2011)	MOE 3015/APHA 4500CN I-WAD

The sample is extracted with a strong base for 16 hours, and then filtered. The filtrate is then distilled where the cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CR-CR6-IC-WT	Soil	Hexavalent Chromium in Soil	SW846 3060A/7199

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 7199, published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-HS-511-WT Soil F1-O.Reg 153/04 (July 2011) E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F2-F4-511-WT Soil F2-F4-O.Reg 153/04 (July 2011) CCME Tier 1

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F4G-ADD-511-WT Soil F4G SG-O.Reg 153/04 (July 2011) MOE DECPH-E3398/CCME TIER 1

F4G, gravimetric analysis, is determined if the chromatogram does not return to baseline at or before C50. A soil sample is extracted with a solvent mix, the solvent is evaporated and the weight of the residue is determined.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

HG-200.2-CVAA-WT Soil Mercury in Soil by CVAAS EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MET-200.2-CCMS-WT Soil Metals in Soil by CRC ICPMS EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). For tests intended to support Ontario regulations, the <2mm fraction is ground to pass through a 0.355 mm sieve. Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

SAR-R511-WT	Soil	SAR-O.Reg 153/04 (July 2011)	SW846 6010C

A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2431628 Report Date: 08-MAY-20

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-HWS-R511-WT	**Soil**							
Batch R5045410								
WG3300717-4 DUP		**L2431602-1**						
Boron (B), Hot Water Ext.		0.10	<0.10	RPD-NA	ug/g	N/A	30	30-MAR-20
WG3300717-6 IRM		**WT SAR4**						
Boron (B), Hot Water Ext.			105.0		%		70-130	30-MAR-20
WG3300717-3 LCS								
Boron (B), Hot Water Ext.			98.5		%		70-130	30-MAR-20
WG3300717-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	30-MAR-20
Batch R5045412								
WG3300718-4 DUP		**L2431631-9**						
Boron (B), Hot Water Ext.		<0.10	<0.10	RPD-NA	ug/g	N/A	30	30-MAR-20
WG3300718-5 IRM		**WT SAR4**						
Boron (B), Hot Water Ext.			97.6		%		70-130	30-MAR-20
WG3300718-3 LCS								
Boron (B), Hot Water Ext.			97.2		%		70-130	30-MAR-20
WG3300718-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	30-MAR-20
CN-WAD-R511-WT	**Soil**							
Batch R5046388								
WG3299050-3 DUP		**L2431447-3**						
Cyanide, Weak Acid Diss		<0.050	<0.050	RPD-NA	ug/g	N/A	35	30-MAR-20
WG3299050-2 LCS								
Cyanide, Weak Acid Diss			84.8		%		80-120	30-MAR-20
WG3299050-1 MB								
Cyanide, Weak Acid Diss			<0.050		ug/g		0.05	30-MAR-20
WG3299050-4 MS		**L2431447-3**						
Cyanide, Weak Acid Diss			98.8		%		70-130	30-MAR-20
CR-CR6-IC-WT	**Soil**							
Batch R5045011								
WG3299053-4 CRM		**WT-SQC012**						
Chromium, Hexavalent			90.5		%		70-130	30-MAR-20
WG3299053-3 DUP		**L2431447-3**						
Chromium, Hexavalent		<0.20	<0.20	RPD-NA	ug/g	N/A	35	30-MAR-20
WG3299053-2 LCS								
Chromium, Hexavalent			93.0		%		80-120	30-MAR-20
WG3299053-1 MB								
Chromium, Hexavalent			<0.20		ug/g		0.2	30-MAR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-WT	**Soil**							
Batch R5045509								
WG3300720-4 DUP		**WG3300720-3**						
Conductivity		1.03	0.935		mS/cm	9.2	20	30-MAR-20
WG3300720-2 IRM		**WT SAR4**						
Conductivity			101.8		%		70-130	30-MAR-20
WG3300891-1 LCS								
Conductivity			100.2		%		90-110	30-MAR-20
WG3300720-1 MB								
Conductivity			<0.0040		mS/cm		0.004	30-MAR-20
Batch R5045526								
WG3300721-4 DUP		**WG3300721-3**						
Conductivity		0.393	0.408		mS/cm	3.7	20	30-MAR-20
WG3300721-2 IRM		**WT SAR4**						
Conductivity			95.6		%		70-130	30-MAR-20
WG3300893-1 LCS								
Conductivity			99.6		%		90-110	30-MAR-20
WG3300721-1 MB								
Conductivity			<0.0040		mS/cm		0.004	30-MAR-20
F1-HS-511-WT	**Soil**							
Batch R5041768								
WG3299088-4 DUP		**WG3299088-3**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	30	27-MAR-20
WG3299088-2 LCS								
F1 (C6-C10)			97.0		%		80-120	27-MAR-20
WG3299088-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	27-MAR-20
Surrogate: 3,4-Dichlorotoluene			90.8		%		60-140	27-MAR-20
WG3299088-6 MS		**L2431481-1**						
F1 (C6-C10)			91.6		%		60-140	27-MAR-20
F2-F4-511-WT	**Soil**							
Batch R5047925								
WG3299007-3 DUP		**WG3299007-5**						
F2 (C10-C16)		<10	<10	RPD-NA	ug/g	N/A	30	01-APR-20
F3 (C16-C34)		267	292		ug/g	8.9	30	01-APR-20
F4 (C34-C50)		610	715		ug/g	16	30	01-APR-20
WG3299007-2 LCS								
F2 (C10-C16)			123.8	LCS-H	%		80-120	30-MAR-20
F3 (C16-C34)			122.8	LCS-H	%		80-120	30-MAR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F2-F4-511-WT	**Soil**							
Batch R5047925								
WG3299007-2 LCS								
F4 (C34-C50)			120.6	LCS-H	%		80-120	30-MAR-20
WG3299007-1 MB								
F2 (C10-C16)			<10		ug/g		10	30-MAR-20
F3 (C16-C34)			<50		ug/g		50	30-MAR-20
F4 (C34-C50)			<50		ug/g		50	30-MAR-20
Surrogate: 2-Bromobenzotrifluoride			95.0		%		60-140	30-MAR-20
WG3299007-4 MS		**WG3299007-5**						
F2 (C10-C16)			111.9		%		60-140	30-MAR-20
F3 (C16-C34)			91.1		%		60-140	30-MAR-20
F4 (C34-C50)			N/A	MS-B	%		-	30-MAR-20
Batch R5048106								
WG3301864-3 DUP		**WG3301864-5**						
F2 (C10-C16)		26	43	J	ug/g	17	20	01-APR-20
F3 (C16-C34)		68	68		ug/g	0.2	30	01-APR-20
F4 (C34-C50)		55	58		ug/g	6.1	30	01-APR-20
WG3301864-2 LCS								
F2 (C10-C16)			114.9		%		80-120	01-APR-20
F3 (C16-C34)			116.1		%		80-120	01-APR-20
F4 (C34-C50)			110.4		%		80-120	01-APR-20
WG3301864-1 MB								
F2 (C10-C16)			<10		ug/g		10	01-APR-20
F3 (C16-C34)			<50		ug/g		50	01-APR-20
F4 (C34-C50)			<50		ug/g		50	01-APR-20
Surrogate: 2-Bromobenzotrifluoride			102.4		%		60-140	01-APR-20
WG3301864-4 MS		**WG3301864-5**						
F2 (C10-C16)			109.7		%		60-140	01-APR-20
F3 (C16-C34)			114.7		%		60-140	01-APR-20
F4 (C34-C50)			112.2		%		60-140	01-APR-20
Batch R5049488								
WG3302203-3 DUP		**WG3302203-5**						
F2 (C10-C16)		<10	<10	RPD-NA	ug/g	N/A	30	02-APR-20
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	30	02-APR-20
F4 (C34-C50)		<50	<50	RPD-NA	ug/g	N/A	30	02-APR-20
WG3302203-2 LCS								
F2 (C10-C16)			103.2		%		80-120	02-APR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F2-F4-511-WT	**Soil**							
Batch R5049488								
WG3302203-2 LCS								
F3 (C16-C34)			104.1		%		80-120	02-APR-20
F4 (C34-C50)			104.4		%		80-120	02-APR-20
WG3302203-1 MB								
F2 (C10-C16)			<10		ug/g		10	02-APR-20
F3 (C16-C34)			<50		ug/g		50	02-APR-20
F4 (C34-C50)			<50		ug/g		50	02-APR-20
Surrogate: 2-Bromobenzotrifluoride			90.0		%		60-140	02-APR-20
WG3302203-4 MS		**WG3302203-5**						
F2 (C10-C16)			103.2		%		60-140	02-APR-20
F3 (C16-C34)			106.4		%		60-140	02-APR-20
F4 (C34-C50)			105.9		%		60-140	02-APR-20
F4G-ADD-511-WT	**Soil**							
Batch R5048926								
WG3302456-2 LCS								
F4G-SG (GHH-Silica)			83.6		%		60-140	31-MAR-20
WG3302456-1 MB								
F4G-SG (GHH-Silica)			<250		ug/g		250	31-MAR-20
HG-200.2-CVAA-WT	**Soil**							
Batch R5044949								
WG3300712-2 CRM		**WT-CANMET-TILL2**						
Mercury (Hg)			120.6		%		70-130	30-MAR-20
WG3300712-6 DUP		**WG3300712-5**						
Mercury (Hg)		0.0081	0.0096		ug/g	16	40	30-MAR-20
WG3300712-3 LCS								
Mercury (Hg)			108.5		%		80-120	30-MAR-20
WG3300712-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	30-MAR-20
Batch R5044950								
WG3300711-2 CRM		**WT-CANMET-TILL2**						
Mercury (Hg)			121.7		%		70-130	30-MAR-20
WG3300711-6 DUP		**WG3300711-5**						
Mercury (Hg)		0.0275	0.0253		ug/g	8.3	40	30-MAR-20
WG3300711-3 LCS								
Mercury (Hg)			110.0		%		80-120	30-MAR-20
WG3300711-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	30-MAR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5046266								
WG3300711-2 CRM		**WT-CANMET-TILL2**						
Antimony (Sb)			97.0		%		70-130	31-MAR-20
Arsenic (As)			104.4		%		70-130	31-MAR-20
Barium (Ba)			105.0		%		70-130	31-MAR-20
Beryllium (Be)			96.8		%		70-130	31-MAR-20
Boron (B)			3.4		mg/kg		0-8.6	31-MAR-20
Cadmium (Cd)			94.4		%		70-130	31-MAR-20
Chromium (Cr)			99.8		%		70-130	31-MAR-20
Cobalt (Co)			98.9		%		70-130	31-MAR-20
Copper (Cu)			98.0		%		70-130	31-MAR-20
Lead (Pb)			99.6		%		70-130	31-MAR-20
Molybdenum (Mo)			101.5		%		70-130	31-MAR-20
Nickel (Ni)			100.4		%		70-130	31-MAR-20
Selenium (Se)			0.41		mg/kg		0.15-0.55	31-MAR-20
Silver (Ag)			0.27		mg/kg		0.16-0.36	31-MAR-20
Thallium (Tl)			99.1		%		70-130	31-MAR-20
Uranium (U)			93.9		%		70-130	31-MAR-20
Vanadium (V)			101.8		%		70-130	31-MAR-20
Zinc (Zn)			96.1		%		70-130	31-MAR-20
WG3300711-6 DUP		**WG3300711-5**						
Antimony (Sb)		0.17	0.16		ug/g	6.2	30	31-MAR-20
Arsenic (As)		3.50	3.48		ug/g	0.6	30	31-MAR-20
Barium (Ba)		101	98.1		ug/g	2.7	40	31-MAR-20
Beryllium (Be)		0.72	0.71		ug/g	1.6	30	31-MAR-20
Boron (B)		10.6	9.8		ug/g	7.5	30	31-MAR-20
Cadmium (Cd)		0.145	0.147		ug/g	1.4	30	31-MAR-20
Chromium (Cr)		25.1	24.8		ug/g	1.2	30	31-MAR-20
Cobalt (Co)		9.78	9.71		ug/g	0.7	30	31-MAR-20
Copper (Cu)		19.5	19.6		ug/g	0.6	30	31-MAR-20
Lead (Pb)		13.5	13.9		ug/g	2.9	40	31-MAR-20
Molybdenum (Mo)		0.43	0.46		ug/g	6.5	40	31-MAR-20
Nickel (Ni)		23.0	22.8		ug/g	1.1	30	31-MAR-20
Selenium (Se)		<0.20	<0.20	RPD-NA	ug/g	N/A	30	31-MAR-20
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	31-MAR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5046266								
WG3300711-6 DUP		**WG3300711-5**						
Thallium (Tl)		0.157	0.152		ug/g	3.0	30	31-MAR-20
Uranium (U)		0.582	0.594		ug/g	2.1	30	31-MAR-20
Vanadium (V)		34.9	34.0		ug/g	2.7	30	31-MAR-20
Zinc (Zn)		63.1	64.0		ug/g	1.3	30	31-MAR-20
WG3300711-4 LCS								
Antimony (Sb)			110.3		%		80-120	31-MAR-20
Arsenic (As)			103.2		%		80-120	31-MAR-20
Barium (Ba)			107.2		%		80-120	31-MAR-20
Beryllium (Be)			100.5		%		80-120	31-MAR-20
Boron (B)			100.6		%		80-120	31-MAR-20
Cadmium (Cd)			101.7		%		80-120	31-MAR-20
Chromium (Cr)			101.7		%		80-120	31-MAR-20
Cobalt (Co)			98.7		%		80-120	31-MAR-20
Copper (Cu)			97.4		%		80-120	31-MAR-20
Lead (Pb)			104.5		%		80-120	31-MAR-20
Molybdenum (Mo)			106.7		%		80-120	31-MAR-20
Nickel (Ni)			97.7		%		80-120	31-MAR-20
Selenium (Se)			104.3		%		80-120	31-MAR-20
Silver (Ag)			103.1		%		80-120	31-MAR-20
Thallium (Tl)			105.4		%		80-120	31-MAR-20
Uranium (U)			97.4		%		80-120	31-MAR-20
Vanadium (V)			105.5		%		80-120	31-MAR-20
Zinc (Zn)			96.9		%		80-120	31-MAR-20
WG3300711-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	31-MAR-20
Arsenic (As)			<0.10		mg/kg		0.1	31-MAR-20
Barium (Ba)			<0.50		mg/kg		0.5	31-MAR-20
Beryllium (Be)			<0.10		mg/kg		0.1	31-MAR-20
Boron (B)			<5.0		mg/kg		5	31-MAR-20
Cadmium (Cd)			<0.020		mg/kg		0.02	31-MAR-20
Chromium (Cr)			<0.50		mg/kg		0.5	31-MAR-20
Cobalt (Co)			<0.10		mg/kg		0.1	31-MAR-20
Copper (Cu)			<0.50		mg/kg		0.5	31-MAR-20
Lead (Pb)			<0.50		mg/kg		0.5	31-MAR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5046266								
WG3300711-1 MB								
Molybdenum (Mo)			<0.10		mg/kg		0.1	31-MAR-20
Nickel (Ni)			<0.50		mg/kg		0.5	31-MAR-20
Selenium (Se)			<0.20		mg/kg		0.2	31-MAR-20
Silver (Ag)			<0.10		mg/kg		0.1	31-MAR-20
Thallium (Tl)			<0.050		mg/kg		0.05	31-MAR-20
Uranium (U)			<0.050		mg/kg		0.05	31-MAR-20
Vanadium (V)			<0.20		mg/kg		0.2	31-MAR-20
Zinc (Zn)			<2.0		mg/kg		2	31-MAR-20
Batch R5046306								
WG3300712-2 CRM		**WT-CANMET-TILL2**						
Antimony (Sb)			92.7		%		70-130	31-MAR-20
Arsenic (As)			96.6		%		70-130	31-MAR-20
Barium (Ba)			103.3		%		70-130	31-MAR-20
Beryllium (Be)			89.0		%		70-130	31-MAR-20
Boron (B)			3.5		mg/kg		0-8.6	31-MAR-20
Cadmium (Cd)			87.4		%		70-130	31-MAR-20
Chromium (Cr)			94.5		%		70-130	31-MAR-20
Cobalt (Co)			91.9		%		70-130	31-MAR-20
Copper (Cu)			91.4		%		70-130	31-MAR-20
Lead (Pb)			94.4		%		70-130	31-MAR-20
Molybdenum (Mo)			92.8		%		70-130	31-MAR-20
Nickel (Ni)			93.0		%		70-130	31-MAR-20
Selenium (Se)			0.36		mg/kg		0.15-0.55	31-MAR-20
Silver (Ag)			0.24		mg/kg		0.16-0.36	31-MAR-20
Thallium (Tl)			96.2		%		70-130	31-MAR-20
Uranium (U)			86.4		%		70-130	31-MAR-20
Vanadium (V)			96.7		%		70-130	31-MAR-20
Zinc (Zn)			89.5		%		70-130	31-MAR-20
WG3300712-6 DUP		**WG3300712-5**						
Antimony (Sb)		0.26	0.28		ug/g	4.1	30	31-MAR-20
Arsenic (As)		10.5	10.5		ug/g	0.6	30	31-MAR-20
Barium (Ba)		13.2	13.4		ug/g	1.2	40	31-MAR-20
Beryllium (Be)		0.13	0.12		ug/g	5.2	30	31-MAR-20
Boron (B)		13.1	12.6		ug/g	3.9	30	31-MAR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5046306								
WG3300712-6 DUP		**WG3300712-5**						
Cadmium (Cd)		0.451	0.406		ug/g	11	30	31-MAR-20
Chromium (Cr)		5.14	5.29		ug/g	2.9	30	31-MAR-20
Cobalt (Co)		2.72	2.82		ug/g	3.7	30	31-MAR-20
Copper (Cu)		9.71	9.65		ug/g	0.7	30	31-MAR-20
Lead (Pb)		24.0	24.1		ug/g	0.3	40	31-MAR-20
Molybdenum (Mo)		1.10	1.11		ug/g	1.6	40	31-MAR-20
Nickel (Ni)		5.16	5.24		ug/g	1.5	30	31-MAR-20
Selenium (Se)		<0.20	<0.20	RPD-NA	ug/g	N/A	30	31-MAR-20
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	31-MAR-20
Thallium (Tl)		0.095	0.090		ug/g	4.6	30	31-MAR-20
Uranium (U)		0.338	0.343		ug/g	1.3	30	31-MAR-20
Vanadium (V)		6.36	6.44		ug/g	1.3	30	31-MAR-20
Zinc (Zn)		135	128		ug/g	5.2	30	31-MAR-20
WG3300712-4 LCS								
Antimony (Sb)			107.2		%		80-120	31-MAR-20
Arsenic (As)			101.7		%		80-120	31-MAR-20
Barium (Ba)			108.5		%		80-120	31-MAR-20
Beryllium (Be)			95.9		%		80-120	31-MAR-20
Boron (B)			95.4		%		80-120	31-MAR-20
Cadmium (Cd)			98.3		%		80-120	31-MAR-20
Chromium (Cr)			99.4		%		80-120	31-MAR-20
Cobalt (Co)			97.4		%		80-120	31-MAR-20
Copper (Cu)			95.5		%		80-120	31-MAR-20
Lead (Pb)			104.1		%		80-120	31-MAR-20
Molybdenum (Mo)			104.6		%		80-120	31-MAR-20
Nickel (Ni)			96.0		%		80-120	31-MAR-20
Selenium (Se)			103.2		%		80-120	31-MAR-20
Silver (Ag)			100.5		%		80-120	31-MAR-20
Thallium (Tl)			104.4		%		80-120	31-MAR-20
Uranium (U)			96.6		%		80-120	31-MAR-20
Vanadium (V)			104.2		%		80-120	31-MAR-20
Zinc (Zn)			94.5		%		80-120	31-MAR-20
WG3300712-1 MB								
							0.1	

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5046306								
WG3300712-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	31-MAR-20
Arsenic (As)			<0.10		mg/kg		0.1	31-MAR-20
Barium (Ba)			<0.50		mg/kg		0.5	31-MAR-20
Beryllium (Be)			<0.10		mg/kg		0.1	31-MAR-20
Boron (B)			<5.0		mg/kg		5	31-MAR-20
Cadmium (Cd)			<0.020		mg/kg		0.02	31-MAR-20
Chromium (Cr)			<0.50		mg/kg		0.5	31-MAR-20
Cobalt (Co)			<0.10		mg/kg		0.1	31-MAR-20
Copper (Cu)			<0.50		mg/kg		0.5	31-MAR-20
Lead (Pb)			<0.50		mg/kg		0.5	31-MAR-20
Molybdenum (Mo)			<0.10		mg/kg		0.1	31-MAR-20
Nickel (Ni)			<0.50		mg/kg		0.5	31-MAR-20
Selenium (Se)			<0.20		mg/kg		0.2	31-MAR-20
Silver (Ag)			<0.10		mg/kg		0.1	31-MAR-20
Thallium (Tl)			<0.050		mg/kg		0.05	31-MAR-20
Uranium (U)			<0.050		mg/kg		0.05	31-MAR-20
Vanadium (V)			<0.20		mg/kg		0.2	31-MAR-20
Zinc (Zn)			<2.0		mg/kg		2	31-MAR-20
MOISTURE-WT	**Soil**							
Batch R5039407								
WG3298994-3 DUP		**L2430109-1**						
% Moisture		22.5	21.9		%	2.7	20	26-MAR-20
WG3298994-2 LCS								
% Moisture			100.5		%		90-110	26-MAR-20
WG3298994-1 MB								
% Moisture			<0.25		%		0.25	26-MAR-20
PH-WT	**Soil**							
Batch R5043282								
WG3299055-1 DUP		**L2431447-1**						
pH		7.57	7.54	J	pH units	0.03	0.3	27-MAR-20
WG3299317-1 LCS								
pH			6.99		pH units		6.9-7.1	27-MAR-20
SAR-R511-WT	**Soil**							

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SAR-R511-WT	**Soil**							
Batch R5045414								
WG3300721-4 DUP		**WG3300721-3**						
Calcium (Ca)		7.75	7.77		mg/L	0.3	30	30-MAR-20
Sodium (Na)		64.4	62.0		mg/L	3.8	30	30-MAR-20
Magnesium (Mg)		2.47	2.46		mg/L	0.4	30	30-MAR-20
WG3300721-2 IRM		**WT SAR4**						
Calcium (Ca)			99.9		%		70-130	30-MAR-20
Sodium (Na)			98.1		%		70-130	30-MAR-20
Magnesium (Mg)			97.9		%		70-130	30-MAR-20
WG3300721-5 LCS								
Calcium (Ca)			104.7		%		80-120	30-MAR-20
Sodium (Na)			103.8		%		80-120	30-MAR-20
Magnesium (Mg)			101.4		%		80-120	30-MAR-20
WG3300721-1 MB								
Calcium (Ca)			<0.50		mg/L		0.5	30-MAR-20
Sodium (Na)			<0.50		mg/L		0.5	30-MAR-20
Magnesium (Mg)			<0.50		mg/L		0.5	30-MAR-20
Batch R5045416								
WG3300720-4 DUP		**WG3300720-3**						
Calcium (Ca)		11.1	10.9		mg/L	1.8	30	30-MAR-20
Sodium (Na)		214	227		mg/L	5.9	30	30-MAR-20
Magnesium (Mg)		10.5	9.62		mg/L	8.7	30	30-MAR-20
WG3300720-2 IRM		**WT SAR4**						
Calcium (Ca)			100.9		%		70-130	30-MAR-20
Sodium (Na)			97.7		%		70-130	30-MAR-20
Magnesium (Mg)			98.9		%		70-130	30-MAR-20
WG3300720-5 LCS								
Calcium (Ca)			104.0		%		80-120	30-MAR-20
Sodium (Na)			102.2		%		80-120	30-MAR-20
Magnesium (Mg)			101.0		%		80-120	30-MAR-20
WG3300720-1 MB								
Calcium (Ca)			<0.50		mg/L		0.5	30-MAR-20
Sodium (Na)			<0.50		mg/L		0.5	30-MAR-20
Magnesium (Mg)			<0.50		mg/L		0.5	30-MAR-20

Quality Control Report

Workorder: L2431628 Report Date: 08-MAY-20

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
LCS-H	Lab Control Sample recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

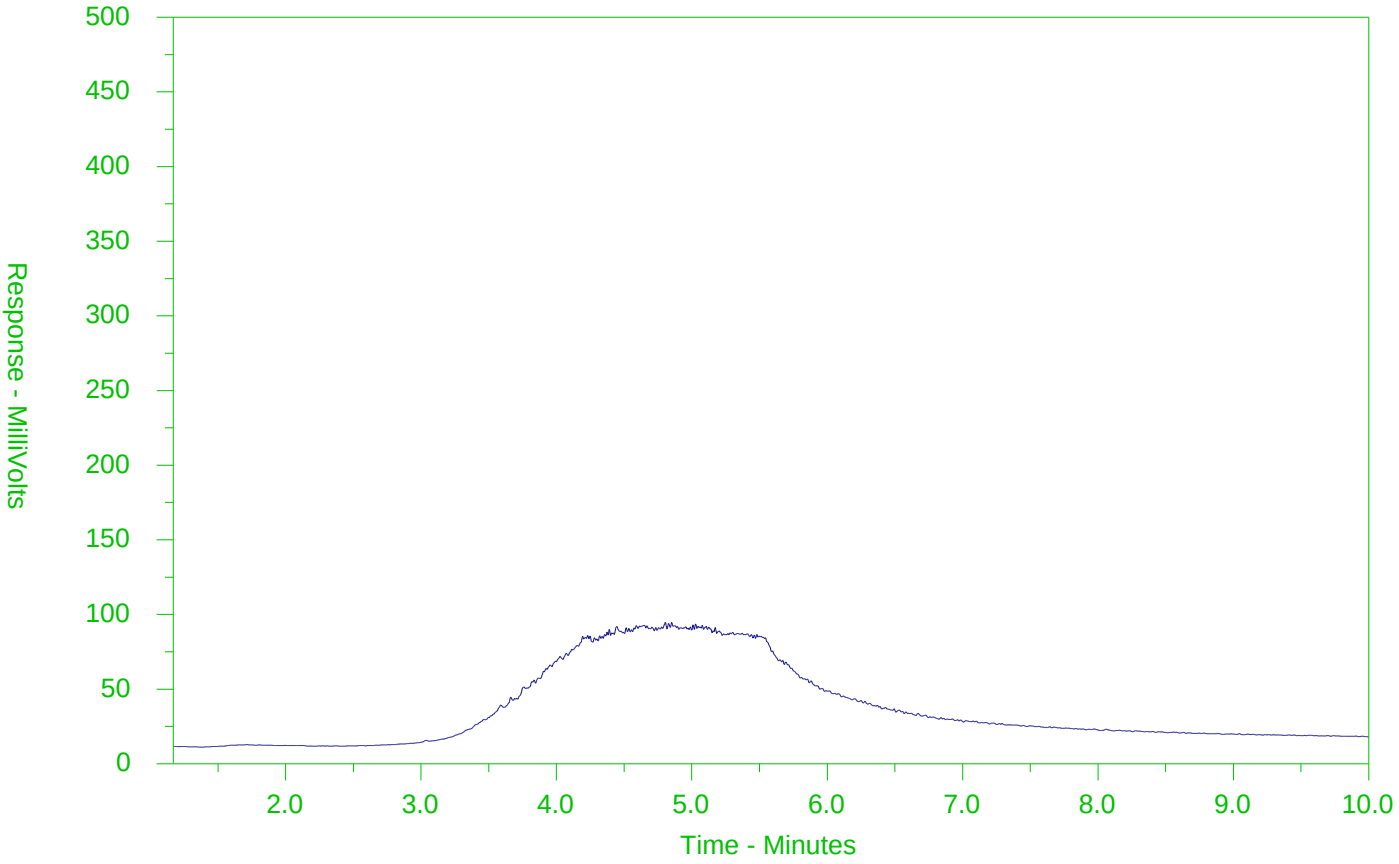
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2431628-1
Client Sample ID: M02- MAIN ST NORTH- NB LANE- 20+150- 60MM-400MM



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

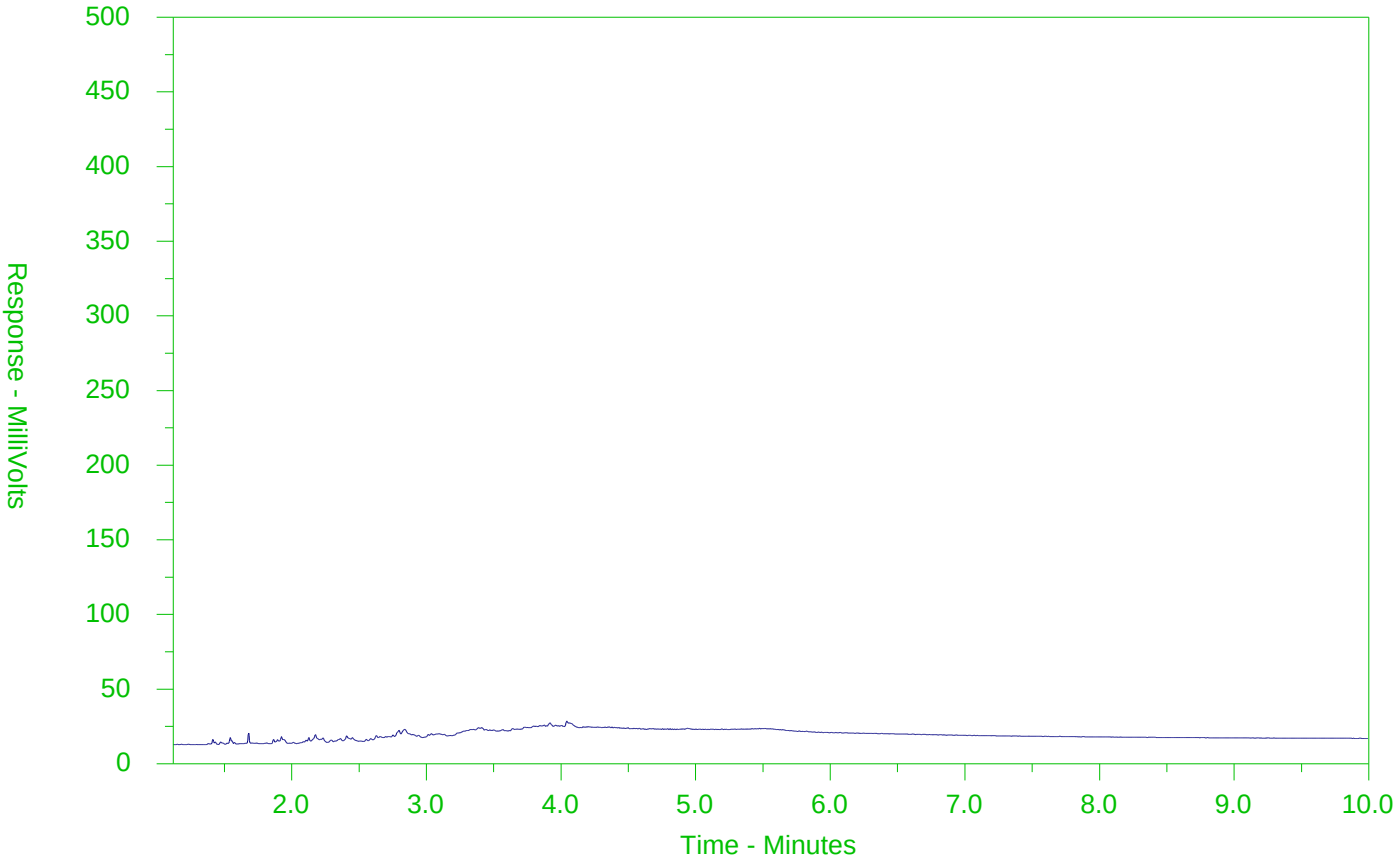
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2431628-5
Client Sample ID: M17- MAIN ST NORTH- SB LANE- 21+275- 35MM-300MM



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →	← Motor Oils/Lube Oils/Grease →		
←Diesel/Jet Fuels→			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

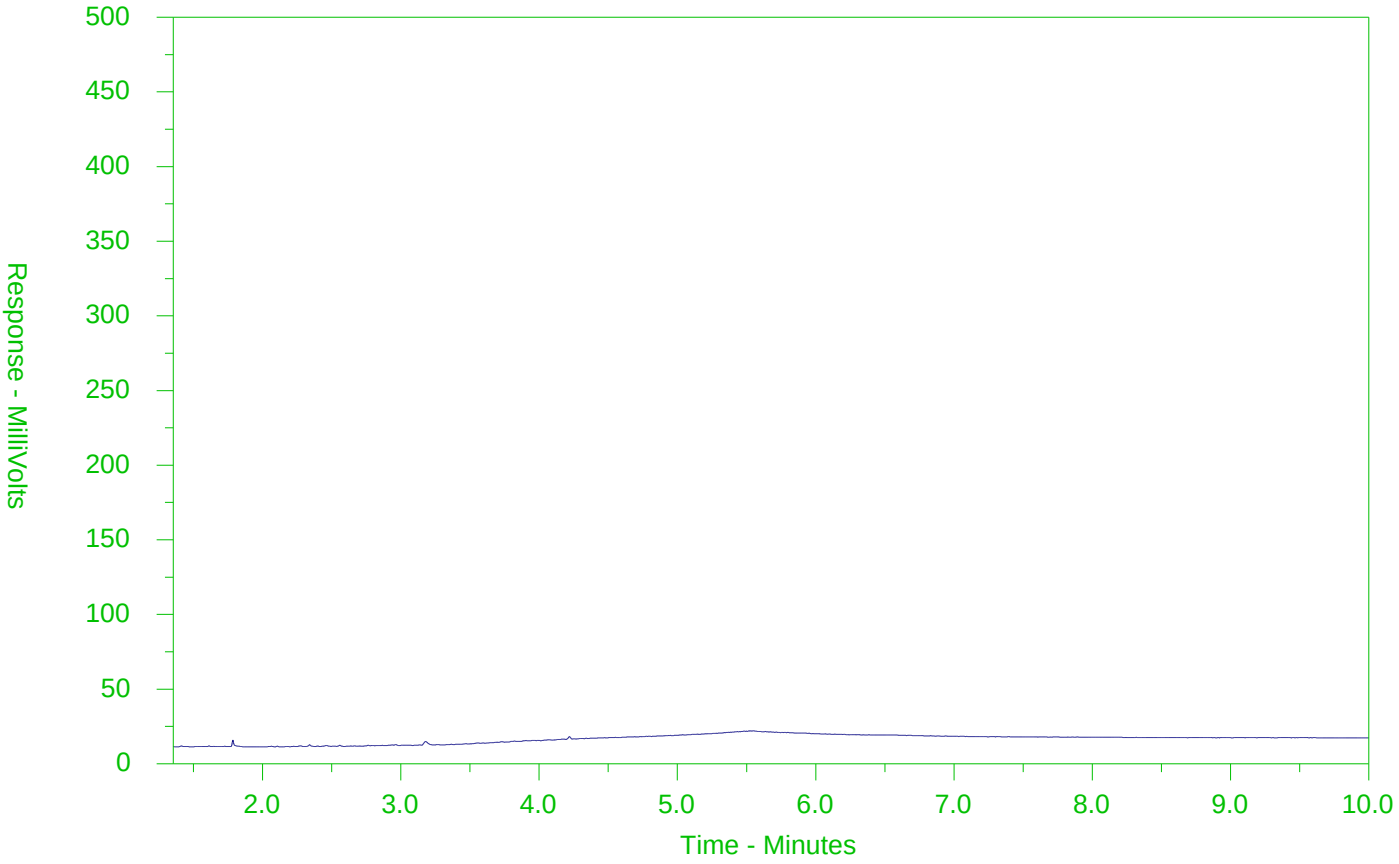
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2431628-8
Client Sample ID: Q02- QUEEN ST WEST- EB LANE- 10+150- 60MM-220MM



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

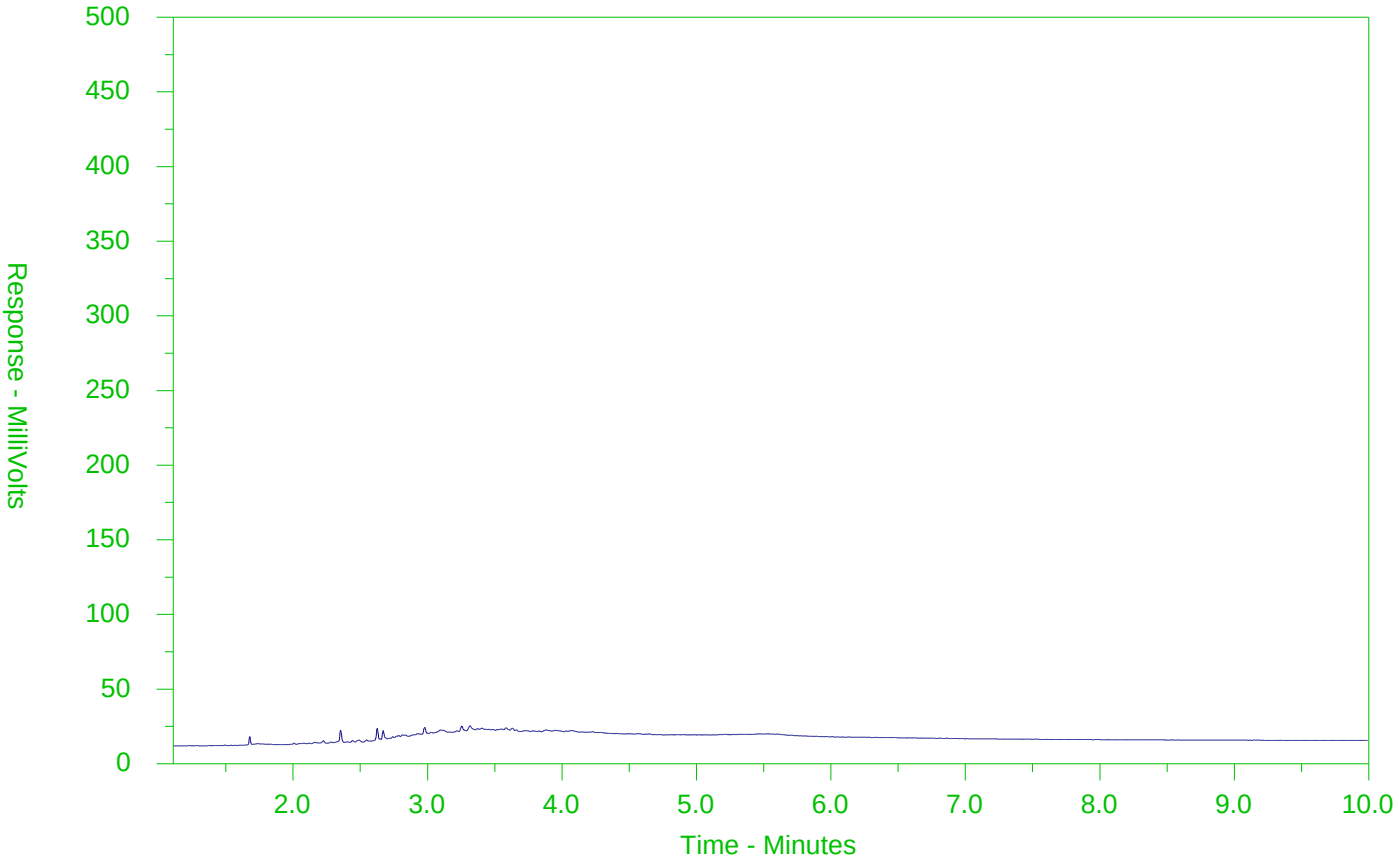
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2431628-9
Client Sample ID: Q02- QUEEN ST WEST- EB LANE- 10+150- 200MM-560MM



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
←Diesel/Jet Fuels→			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

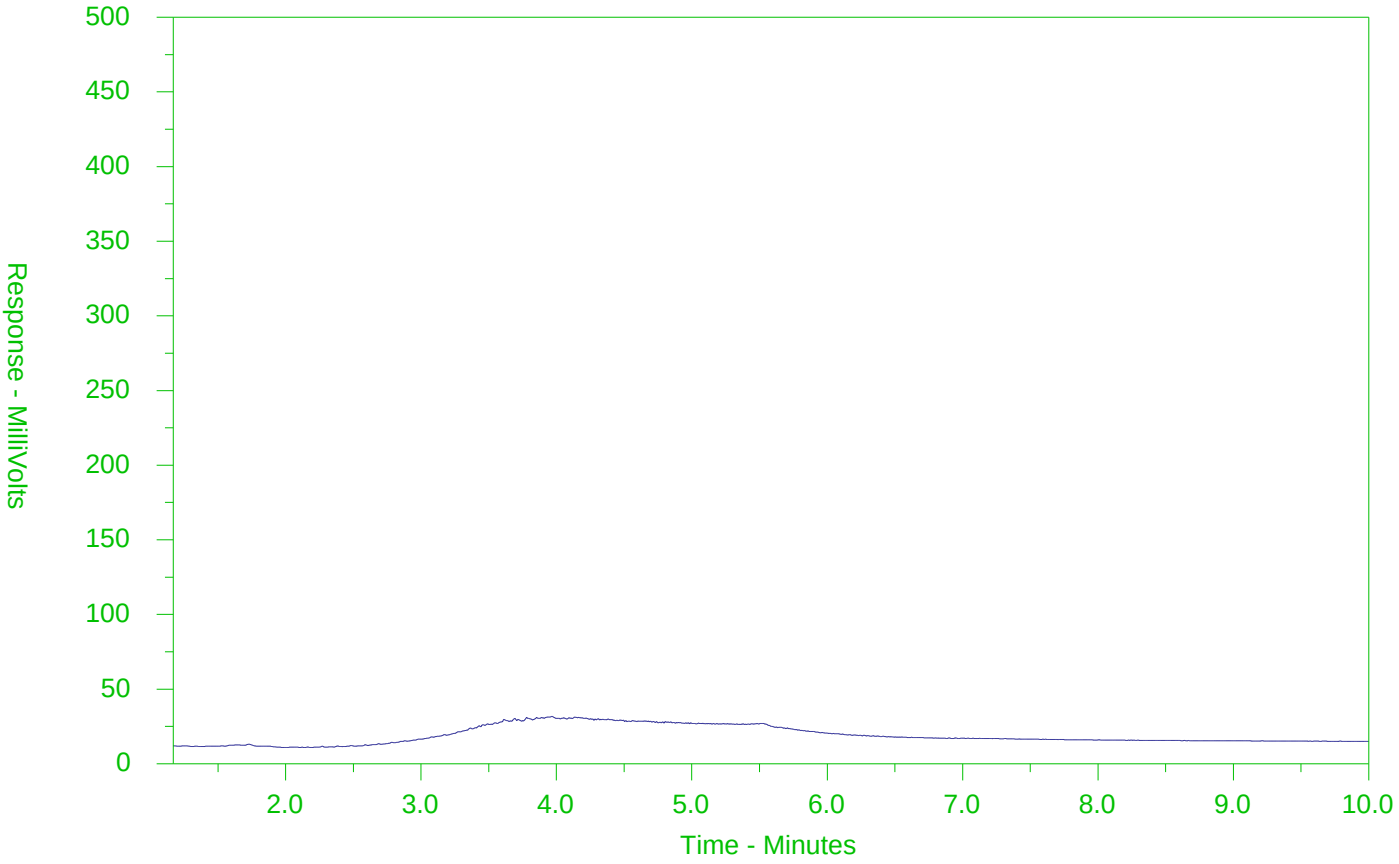
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2431628-10
Client Sample ID: Q08- QUEEN ST WEST- EB LANE- 10+600- 95MM-425MM



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

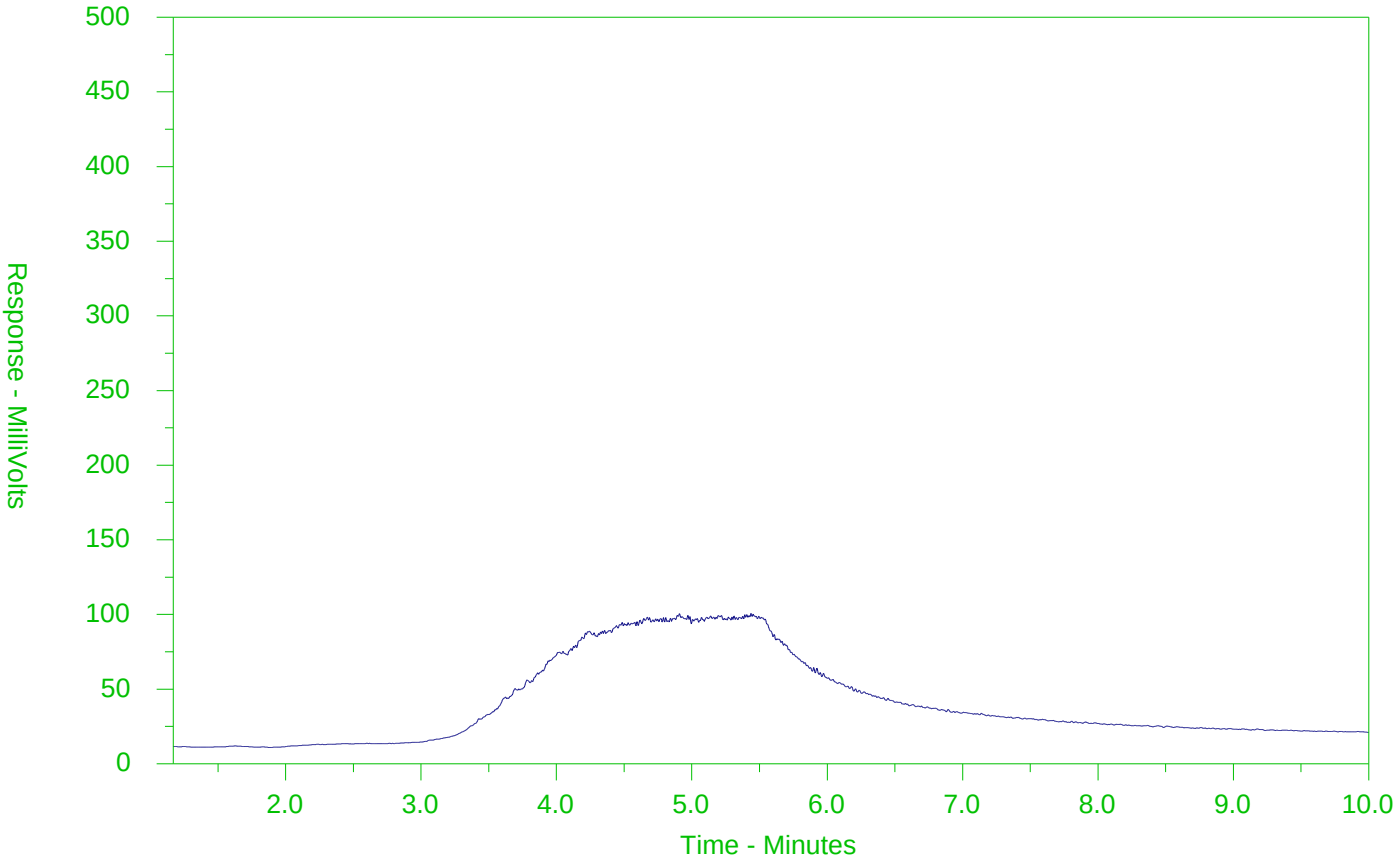
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2431628-12
Client Sample ID: M03- MAIN ST NORTH- SB LANE-20+225- 70MM-375MM



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

12

L2431628-COFC

mber: 17 -

Page 1 of 2

Chain of Custody (COC) / Analy Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Report To	Contact and company name below will appear on the final report
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau
Phone:	905 829 8666 ext. 5245
	Company address below will appear on the final report
Street:	103, 2010 Winston Park Drive
City/Province:	Oakville ON
Postal Code:	L6H 5R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax rpomerleau@thurber.ca
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax accountingON@thurber.ca
Email 2

Project Information

ALS Account # / Quote #:	
Job #:	25174
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only): L2431628RD **ALS Contact:** **Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): ☐ 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%]

EMERGENCY: ☐ 1 Business day [E - 100%] ☐ Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS: MOISTURE-WT	R511-INORGANICS-P-WT	F1-F4-P-WT	INORGANICS-TCLP-P-WT	VOC-TCLP-P-WT	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	M02 - Main St North - NB Lane - 20+150 - 60mm - 400mm	12 Mar 20		250mL Jar	R	R	R				
	M02 - Main St North - NB Lane - 20+150 - 400mm - 600mm				R	R					
	M10 - Main St North - NB Lane - 20+750 - 45mm - 250mm				R	R					
	M10 - Main St North - NB Lane - 20+750 - 250mm - 550mm				R	R					
	M17 - Main St North - SB Lane - 21+275 - 35mm - 300mm				R	R	R				
	M17 - Main St North - SB Lane - 21+275 - 300mm - 580mm				R	R					
	M13 - Main St North - SB Lane - 20+975 - 400mm - 1500mm				R	R					
	M09 - Main St North - SB Lane - 20+675 - 450mm - 1500mm	12 Mar 20						R	R		
	Q02 - Queen St West - EB Lane - 10+150 - 60mm - 220mm				R	R	R				
	Q02 - Queen St West - EB Lane - 10+150 - 220mm - 560mm				R	R	R				
	Q08 - Queen St West - EB Lane - 10+600 - 95mm - 425mm				R	R	R				
	Q08 - Queen St West - EB Lane - 10+600 - 425mm - 1350mm				R	R					

250mL Jar

250ml Jar
125mL Jar
2methanol vials

250mL Jar
125mL Jar with zero headspace

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
	16.3 16.9

SHIPMENT RELEASE (client use)			**INITIAL SHIPMENT RECEPTION (lab use only)**			**FINAL SHIPMENT RECEPTION (lab use only)**		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: WP	Date: 3-25-2020	Time: 1810

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

www.alsglobal.com

Chain of Custody (COC) / An Request Form

L2431628-COFC

: Number: 17 -

Canada Toll Free: 1 800 668 9

Report To	Contact and company name below will appear on the final report
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau
Phone:	905 829 8666 ext. 5245
	Company address below will appear on the final report
Street:	103, 2010 Winston Park Drive
City/Province:	Oakville ON
Postal Code:	L6H 5R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax rpomerleau@thurber.ca
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax accountingON@thurber.ca
Email 2

Project Information

ALS Account # / Quote #:	
Job #:	25174
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only): L2431628RD
ALS Contact: Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	MOISTURE-WT	R511-INORGANICS-P-WT	F1-F4 P-WT	INORGANICS-TCLP-P-WT	VOC-TCLP-P-WT	Absbestos Testing	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	M03 -Main St North - SB Lane - 20+225 - 70mm - 375mm					R	R	R					
	M04 - Main St North - NB Lane - 20+300 - 0mm - 60mm (asphalt)										R		
	M18 - Main St North - NB Lane - 21+350 - 0mm - 30mm (asphalt)										R		
	M11 - Main St North - SB Lane - 20+825 - 0mm - 70mm (asphalt)										R		
	Q02 - Queen St West - EB Lane - 10+150 - 0mm - 60mm (asphalt)										R		

Core Cylinders

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
	16.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
							3-25-2020	1810

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Thurber Engineering Ltd. (Oakville)
ATTN: RANDY POMERLEAU
2010 Winston Park Drive
Unit 103
Oakville ON L6H 5R7

Date Received: 25-MAR-20
Report Date: 08-MAY-20 13:57 (MT)
Version: FINAL REV. 2

Client Phone: 905-829-8666

Certificate of Analysis

Lab Work Order #: L2431635

Project P.O. #: NOT SUBMITTED
Job Reference: 25174
C of C Numbers:
Legal Site Desc:

Comments: 08-MAY-20 Report type revision to compare to O. Reg. 347 as per client request. - A.Overholster

Amanda Overholster
Account Manager

ANALYTICAL REPORT

Summary of Guideline Exceedances

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit

Federal & Provincial Waste Regulations (MAR, 2008) - Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

(No parameter exceedances)

ANALYTICAL REPORT

Sample Preparation - WASTE

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2431635-1 Sample Date: 25-MAR-20 Sample ID: M09- MAIN ST NORTH- SB LANE -20+675-450MM-1500MM
Initial pH	pH units	-	-	10.03
Final pH	pH units	-	-	5.80

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

TCLP Extractables - WASTE

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2431635-1 Sample Date: 25-MAR-20 Sample ID: M09- MAIN ST NORTH- SB LANE -20+675-450MM-1500MM
Cyanide, Weak Acid Diss	mg/L	20	-	<0.10
Fluoride (F)	mg/L	150.0	-	<10
Nitrate and Nitrite as N	mg/L	1000	-	<4.0
Nitrate-N	mg/L	-	-	<2.0
Nitrite-N	mg/L	-	-	<2.0

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

TCLP Metals - WASTE

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2431635-1 Sample Date: 25-MAR-20 Sample ID: M09- MAIN ST NORTH- SB LANE -20+675-450MM-1500MM
Arsenic (As)	mg/L	2.5	-	<0.050
Barium (Ba)	mg/L	100	-	<0.50
Boron (B)	mg/L	500	-	<2.5
Cadmium (Cd)	mg/L	0.5	-	<0.0050
Chromium (Cr)	mg/L	5.0	-	<0.050
Lead (Pb)	mg/L	5.0	-	<0.025
Mercury (Hg)	mg/L	0.1	-	<0.00010
Selenium (Se)	mg/L	1.0	-	<0.025
Silver (Ag)	mg/L	5.0	-	<0.0050
Uranium (U)	mg/L	10	-	<0.25

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

TCLP VOCs - WASTE

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2431635-1 Sample Date: 25-MAR-20 Sample ID: M09- MAIN ST NORTH- SB LANE -20+675-450MM-1500MM
1,1-Dichloroethylene	mg/L	1.4	-	<0.025
1,2-Dichlorobenzene	mg/L	20.0	-	<0.025
1,2-Dichloroethane	mg/L	0.5	-	<0.025
1,4-Dichlorobenzene	mg/L	0.5	-	<0.025
Benzene	mg/L	0.5	-	<0.025
Carbon tetrachloride	mg/L	0.5	-	<0.025
Chlorobenzene	mg/L	8	-	<0.025
Chloroform	mg/L	10	-	<0.10
Dichloromethane	mg/L	5.0	-	<0.50
Methyl Ethyl Ketone	mg/L	200.0	-	<1.0
Tetrachloroethylene	mg/L	3	-	<0.025
Trichloroethylene	mg/L	5	-	<0.025
Vinyl chloride	mg/L	0.2	-	<0.050
Surrogate: 4-Bromofluorobenzene	%	-	-	94.5

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

Volatile Organic Compounds - WASTE

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2431635-1 Sample Date: 25-MAR-20 Sample ID: M09- MAIN ST NORTH- SB LANE -20+675-450MM-1500MM
Surrogate: 1,4-Difluorobenzene	%	-	-	98.4

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.

F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	EPA 1631E

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 1631E).

LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311

Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 6020B

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020B).

N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260

A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Reference Information

WT ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2431635 Report Date: 08-MAY-20

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CN-TCLP-WT	**Waste**							
Batch R5041928								
WG3299856-3 DUP		**L2431444-1**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	50	27-MAR-20
WG3299856-2 LCS								
Cyanide, Weak Acid Diss			103.6		%		70-130	27-MAR-20
WG3299856-1 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	27-MAR-20
WG3299856-4 MS		**L2431444-1**						
Cyanide, Weak Acid Diss			105.8		%		50-140	27-MAR-20
F-TCLP-WT	**Waste**							
Batch R5042546								
WG3299292-3 DUP		**L2430638-2**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	26-MAR-20
WG3299292-2 LCS								
Fluoride (F)			91.1		%		70-130	26-MAR-20
WG3299292-1 MB								
Fluoride (F)			<10		mg/L		10	26-MAR-20
WG3299292-4 MS		**L2430638-2**						
Fluoride (F)			85.0		%		50-150	26-MAR-20
HG-TCLP-WT	**Waste**							
Batch R5042100								
WG3299889-3 DUP		**L2431078-2**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	27-MAR-20
WG3299889-2 LCS								
Mercury (Hg)			87.7		%		70-130	27-MAR-20
WG3299889-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	27-MAR-20
WG3299889-4 MS		**L2431078-2**						
Mercury (Hg)			92.5		%		50-140	27-MAR-20
MET-TCLP-WT	**Waste**							
Batch R5042090								
WG3299871-4 DUP		**WG3299871-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	27-MAR-20
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	27-MAR-20
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	50	27-MAR-20
Barium (Ba)		0.56	0.57		mg/L	2.2	50	27-MAR-20
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	27-MAR-20
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	27-MAR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5042090								
WG3299871-4 DUP		**WG3299871-3**						
Lead (Pb)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	27-MAR-20
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	27-MAR-20
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	50	27-MAR-20
WG3299871-2 LCS								
Silver (Ag)			100.7		%		70-130	27-MAR-20
Arsenic (As)			105.8		%		70-130	27-MAR-20
Boron (B)			96.4		%		70-130	27-MAR-20
Barium (Ba)			106.1		%		70-130	27-MAR-20
Cadmium (Cd)			102.3		%		70-130	27-MAR-20
Chromium (Cr)			104.0		%		70-130	27-MAR-20
Lead (Pb)			102.9		%		70-130	27-MAR-20
Selenium (Se)			103.0		%		70-130	27-MAR-20
Uranium (U)			101.6		%		70-130	27-MAR-20
WG3299871-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	27-MAR-20
Arsenic (As)			<0.050		mg/L		0.05	27-MAR-20
Boron (B)			<2.5		mg/L		2.5	27-MAR-20
Barium (Ba)			<0.50		mg/L		0.5	27-MAR-20
Cadmium (Cd)			<0.0050		mg/L		0.005	27-MAR-20
Chromium (Cr)			<0.050		mg/L		0.05	27-MAR-20
Lead (Pb)			<0.025		mg/L		0.025	27-MAR-20
Selenium (Se)			<0.025		mg/L		0.025	27-MAR-20
Uranium (U)			<0.25		mg/L		0.25	27-MAR-20
WG3299871-5 MS		**WG3299871-3**						
Silver (Ag)			126.9		%		50-140	27-MAR-20
Arsenic (As)			119.9		%		50-140	27-MAR-20
Boron (B)			108.9		%		50-140	27-MAR-20
Barium (Ba)			129.7		%		50-140	27-MAR-20
Cadmium (Cd)			112.4		%		50-140	27-MAR-20
Chromium (Cr)			118.0		%		50-140	27-MAR-20
Lead (Pb)			111.9		%		50-140	27-MAR-20
Selenium (Se)			117.5		%		50-140	27-MAR-20
Uranium (U)			110.3		%		50-140	27-MAR-20
N2N3-TCLP-WT	**Waste**							

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
N2N3-TCLP-WT	**Waste**							
Batch R5042546								
WG3299292-3 DUP		**L2430638-2**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	26-MAR-20
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	26-MAR-20
WG3299292-2 LCS								
Nitrate-N			99.8		%		70-130	26-MAR-20
Nitrite-N			103.6		%		70-130	26-MAR-20
WG3299292-1 MB								
Nitrate-N			<2.0		mg/L		2	26-MAR-20
Nitrite-N			<2.0		mg/L		2	26-MAR-20
WG3299292-4 MS		**L2430638-2**						
Nitrate-N			99.1		%		50-150	26-MAR-20
Nitrite-N			100.8		%		50-150	26-MAR-20
VOC-TCLP-WT	**Waste**							
Batch R5043517								
WG3299141-1 LCS								
1,1-Dichloroethylene			94.0		%		70-130	28-MAR-20
1,2-Dichlorobenzene			100.9		%		70-130	28-MAR-20
1,2-Dichloroethane			104.4		%		70-130	28-MAR-20
1,4-Dichlorobenzene			101.6		%		70-130	28-MAR-20
Benzene			103.9		%		70-130	28-MAR-20
Carbon tetrachloride			96.2		%		60-140	28-MAR-20
Chlorobenzene			100.1		%		70-130	28-MAR-20
Chloroform			102.6		%		70-130	28-MAR-20
Dichloromethane			97.8		%		70-130	28-MAR-20
Methyl Ethyl Ketone			115.8		%		50-150	28-MAR-20
Tetrachloroethylene			90.4		%		70-130	28-MAR-20
Trichloroethylene			97.3		%		70-130	28-MAR-20
Vinyl chloride			111.9		%		60-130	28-MAR-20
WG3299141-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	28-MAR-20
1,2-Dichlorobenzene			<0.025		mg/L		0.025	28-MAR-20
1,2-Dichloroethane			<0.025		mg/L		0.025	28-MAR-20
1,4-Dichlorobenzene			<0.025		mg/L		0.025	28-MAR-20
Benzene			<0.025		mg/L		0.025	28-MAR-20
Carbon tetrachloride			<0.025		mg/L		0.025	28-MAR-20

Quality Control Report

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R5043517								
WG3299141-2 MB								
Chlorobenzene			<0.025		mg/L		0.025	28-MAR-20
Chloroform			<0.10		mg/L		0.1	28-MAR-20
Dichloromethane			<0.50		mg/L		0.5	28-MAR-20
Methyl Ethyl Ketone			<1.0		mg/L		1	28-MAR-20
Tetrachloroethylene			<0.025		mg/L		0.025	28-MAR-20
Trichloroethylene			<0.025		mg/L		0.025	28-MAR-20
Vinyl chloride			<0.050		mg/L		0.05	28-MAR-20
Surrogate: 1,4-Difluorobenzene			98.3		%		70-130	28-MAR-20
Surrogate: 4-Bromofluorobenzene			95.4		%		70-130	28-MAR-20
WG3299141-3 MS		**L2431038-2**						
1,1-Dichloroethylene			96.9		%		50-140	28-MAR-20
1,2-Dichlorobenzene			100.8		%		50-140	28-MAR-20
1,2-Dichloroethane			99.7		%		50-140	28-MAR-20
1,4-Dichlorobenzene			106.1		%		50-140	28-MAR-20
Benzene			103.8		%		50-140	28-MAR-20
Carbon tetrachloride			98.2		%		50-140	28-MAR-20
Chlorobenzene			100.1		%		50-140	28-MAR-20
Chloroform			101.6		%		50-140	28-MAR-20
Dichloromethane			95.8		%		50-140	28-MAR-20
Methyl Ethyl Ketone			107.0		%		50-140	28-MAR-20
Tetrachloroethylene			94.7		%		50-140	28-MAR-20
Trichloroethylene			99.6		%		50-140	28-MAR-20
Vinyl chloride			115.0		%		50-140	28-MAR-20

Quality Control Report

Workorder: L2431635 Report Date: 08-MAY-20

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

L2431635-COFC

17 -

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Report To	Contact and company name below will appear on the final report
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau
Phone:	905 829 8666 ext. 5245
	Company address below will appear on the final report
Street:	103, 2010 Winston Park Drive
City/Province:	Oakville ON
Postal Code:	L6H 5R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	rpomerleau@thurber.ca
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	accountingON@thurber.ca
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	25174	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): L2431635 R0 | ALS Contact: | Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS: MOISTURE-WT	R511-INORGANICS-P-WT	F1-F4-P-WT	INORGANICS-TCLP-P-WT	VOC-TCLP-P-WT	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	M02 - Main St North - NB Lane - 20+150 - 60mm - 400mm				R	R	R				
	M02 - Main St North - NB Lane - 20+150 - 400mm - 600mm				R	R					
	M10 - Main St North - NB Lane - 20+750 - 45mm - 250mm				R	R					
	M10 - Main St North - NB Lane - 20+750 - 250mm - 550mm				R	R					
	M17 - Main St North - SB Lane - 21+275 - 35mm - 300mm				R	R	R				
	M17 - Main St North - SB Lane - 21+275 - 300mm - 580mm				R	R					
	M13 - Main St North - SB Lane - 20+975 - 400mm - 1500mm				R	R					
	M09 - Main St North - SB Lane - 20+675 - 450mm - 1500mm							R	R		
	Q02 - Queen St West - EB Lane - 10+150 - 60mm - 220mm				R	R	R				
	Q02 - Queen St West - EB Lane - 10+150 - 220mm - 560mm				R	R	R				
	Q08 - Queen St West - EB Lane - 10+600 - 95mm - 425mm				R	R	R				
	Q08 - Queen St West - EB Lane - 10+600 - 425mm - 1350mm				R	R					

250mL Jar

250ml Jar
125mL Jar
2methanol vials

250mL Jar
125mL Jar with zero headspace

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human consumption/ use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				16.3	16.9		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
						[illegible]	3-25-2020	1810

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Thurber Engineering Ltd. (Oakville)
ATTN: RANDY POMERLEAU
2010 Winston Park Drive
Unit 103
Oakville ON L6H 5R7

Date Received: 15-APR-20
Report Date: 22-APR-20 12:34 (MT)
Version: FINAL

Client Phone: 905-829-8666

Certificate of Analysis

Lab Work Order #: L2437214

Project P.O. #: NOT SUBMITTED
Job Reference: 25174
C of C Numbers:
Legal Site Desc:

Amanda Overholster
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2437214-1 Q07-QUEEN STREET WEST- 10+075-WB LANE- 0-80MM Sampled By: CLIENT on 15-APR-20 Matrix:							
Asbestos/Quartz/Other Fibres							
Asbestos By Point Count	< .1		0.10	%		21-APR-20	R5059066
Other Non Fibrous: Filler and Tar	100		1.0	%		21-APR-20	R5059066
Report Remarks : No asbestos fibres were observed.							
L2437214-2 Q04-QUEEN STREET WEST- 10+300-EB LANE- 0-65MM Sampled By: CLIENT on 15-APR-20 Matrix:							
Asbestos/Quartz/Other Fibres							
Asbestos By Point Count	< .1		0.10	%		21-APR-20	R5059066
Other Non Fibrous: Filler and Tar	100		1.0	%		21-APR-20	R5059066
Report Remarks : No asbestos fibres were observed.							
L2437214-3 M20-MAIN ST NORTH- 21+500-NR LANE- 0-45MM Sampled By: CLIENT on 15-APR-20 Matrix:							
Asbestos/Quartz/Other Fibres							
Asbestos By Point Count	< .1		0.10	%		21-APR-20	R5059066
Other Non Fibrous: Filler and Tar	100		1.0	%		21-APR-20	R5059066
Report Remarks : No asbestos fibres were observed.							
L2437214-4 M07-MAIN ST NORTH- 20+522-SB LANE- 0-45MM Sampled By: CLIENT on 15-APR-20 Matrix:							
Asbestos/Quartz/Other Fibres							
Asbestos By Point Count	< .1		0.10	%		21-APR-20	R5059066
Other Non Fibrous: Filler and Tar	100		1.0	%		21-APR-20	R5059066
Report Remarks : No asbestos fibres were observed.							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ASBESTOS-PTCT-WP	Bulk	Quantitation of asbestos by point count	EPA/600/R-93/116

Bulk samples are examined under a stereoscopic microscope. Individual fibers or fibre bundles are mounted in refractive index liquids and are observed under a polarized light microscope with a special dispersion staining objective. The dispersion staining colours are compared to reference samples of known asbestiforms.

Polarized microscopy is not a definitive technique for negative results for non-friable organically bound material (i.e.floor tiles).

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2437214 Report Date: 22-APR-20

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed

Quality Control Report

Workorder: L2437214 Report Date: 22-APR-20

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2437214-COFC

COC Number: 17 -

Page 2 of

Report To	Contact and company name below will appear on the final report
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau
Phone:	905 829 8666 ext. 5245
	Company address below will appear on the final report
Street:	103, 2010 Winston Park Drive
City/Province:	Oakville ON
Postal Code:	L6H 5R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax rpomerleau@thurber.ca
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax accountingON@thurber.ca
Email 2

Project Information

ALS Account # / Quote #:
Job #: 25174
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#
Major/Minor Code: Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only): L2437214RD

ALS Contact: **Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

NUMBER OF CONTAINERS

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Absbestos Testing	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Q07 - Queen St West - 10+075 - WB Lane - 0-80mm				R		
	Q04 - Queen St West - 10+300 - EB Lane - 0-65mm				R		
	M20 - Main St North - 21+500 - NB Lane - 0-45mm				R		
	M07 - Main St North - 20+522 - SB Lane - 0-45mm				R		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☑ NO

Are samples for human consumption/ use?
☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				16.1			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
							4-15-2020	1710

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

THURBER

Appendix H

Falling Weight Deflectometer Test Results

THURBER

Queen Street West
Village of Alton, Caledon, Ontario
Falling Weight Deflectometer Analysis

Station (km)	Direction	Normalized Deflection (μm)	M_R (MPa)	E_P (MPa)	SN_{Eff} (mm)
10+000	EB	702	24	225	99
10+050	EB	535	34	289	107
10+100	EB	659	36	219	98
10+150	EB	878	21	176	91
10+200	EB	597	35	248	102
10+250	EB	546	44	263	104
10+300	EB	576	35	261	104
10+350	EB	529	30	305	109
10+400	EB	308	59	502	129
10+450	EB	439	45	318	178
10+500	EB	287	63	492	206
10+550	EB	358	56	388	190
10+600	EB	362	47	398	192
10+650	EB	346	57	408	194
10+700	EB	397	43	362	186
	Minimum	**287**	**21**	**176**	**91**
	Maximum	**878**	**63**	**502**	**206**
	Average	**501**	**42**	**323**	**139**

10+025	WB	724	17	219	107
10+075	WB	523	43	275	115
10+125	WB	846	23	177	99
10+175	WB	759	25	197	103
10+225	WB	681	31	214	106
10+275	WB	627	27	245	111
10+325	WB	688	29	203	165
10+375	WB	472	32	309	189
10+425	WB	482	36	295	187
10+475	WB	368	53	379	203
10+525	WB	347	58	399	206
10+575	WB	313	56	454	215
10+625	WB	347	51	409	208
10+675	WB	326	49	443	214
10+715	WB	307	72	446	214
	Minimum	**307**	**23**	**177**	**99**
	Maximum	**846**	**72**	**454**	**215**
	Average	**549**	**37**	**293**	**154**

THURBER

Main Street North Village of Alton, Caledon, Ontario
Falling Weight Deflectometer Analysis

Station (km)	Direction	Normalized Deflection (μm)	M_R (MPa)	E_P (MPa)	SN_{Eff} (mm)
20+050	NB	1023	23	137	98
20+100	NB	702	28	210	113
20+150	NB	644	31	226	116
20+200	NB	686	23	224	116
20+250	NB	740	32	190	109
20+300	NB	683	23	229	116
20+350	NB	671	24	232	117
20+400	NB	609	34	237	118
20+450	NB	596	32	249	120
20+500	NB	523	32	295	127
20+550	NB	632	41	219	115
20+600	NB	717	31	200	111
20+650	NB	1065	23	131	97
20+700	NB	843	21	180	107
20+750	NB	591	43	236	118
20+800	NB	1012	14	159	103
20+850	NB	617	29	245	119
20+900	NB	735	25	203	112
20+950	NB	777	26	187	109
21+000	NB	690	27	214	114
21+050	NB	750	27	194	110
21+100	NB	667	30	219	115
21+150	NB	994	16	156	102
21+200	NB	646	23	244	119
21+250	NB	544	36	272	123
21+300	NB	540	37	274	123
21+350	NB	785	25	184	108
21+400	NB	514	37	289	126
21+450	NB	793	22	190	109
21+500	NB	1111	14	141	99
21+540	NB	488	41	298	127
	Minimum	**488**	**14**	**131**	**97**
	Maximum	**1111**	**43**	**298**	**127**
	Average	**722**	**28**	**215**	**113**

THURBER

Main Street North Village of Alton, Caledon, Ontario
Falling Weight Deflectometer Analysis

Station (km)	Direction	Normalized Deflection (μm)	M_R (MPa)	E_P (MPa)	SN_{Eff} (mm)
20+025	SB	97	18	167	130
20+075	SB	95	18	190	136
20+120	SB	92	28	270	153
20+175	SB	113	32	240	147
20+225	SB	118	25	176	132
20+270	SB	122	19	151	126
20+271	SB	138	17	153	126
20+272	SB	67	15	141	123
20+273	SB	88	15	131	120
20+274	SB	77	14	122	117
20+275	SB	74	13	110	113
20+325	SB	82	27	165	130
20+375	SB	77	28	198	138
20+425	SB	84	24	176	132
20+475	SB	81	25	156	127
20+525	SB	74	26	211	141
20+575	SB	80	26	205	139
20+625	SB	86	30	219	142
20+675	SB	64	19	143	124
20+725	SB	90	28	210	140
20+775	SB	115	32	228	144
20+825	SB	115	35	363	169
20+875	SB	106	35	242	147
20+925	SB	96	27	213	141
20+975	SB	99	35	225	144
21+025	SB	110	35	240	147
21+075	SB	126	23	176	132
21+125	SB	131	31	214	141
21+175	SB	113	19	122	117
21+225	SB	94	25	180	133
21+275	SB	94	36	247	148
21+325	SB	73	27	175	132
21+375	SB	104	37	177	132

THURBER

Main Street North

Village of Alton, Caledon, Ontario

Falling Weight Deflectometer Analysis

Station (km)	Direction	Normalized Deflection (μm)	M_R (MPa)	E_P (MPa)	SN_{Eff} (mm)
21+425	SB	72	31	183	134
21+475	SB	1129	18	124	118
21+525	SB	928	28	146	125
	Minimum	**64**	**13**	**110**	**113**
	Maximum	**1,129**	**37**	**363**	**169**
	Average	**147**	**26**	**189**	**135**

THURBER

Appendix I

AASHTO Pavement Design Analysis

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Thurber Engineering Ltd.

Flexible Structural Design Module

Queen Street West Rehabilitation
Mississauga Road to James Street
Flexible Pavement Design Analysis _ Resurfacing

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	216,399
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	85 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	15,000 kPa
Stage Construction	1
Calculated Design Structural Number	98 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	508
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6.4 %
Average Initial Truck Factor (ESALs/truck)	1.5
Annual Truck Factor Growth Rate	2 %
Annual Truck Volume Growth Rate	0 %
Growth	Compound
Total Calculated Cumulative ESALs	216,399

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Asphalt	0.42	1	80	3.75	34
2	Existing Granular Base	0.13	0.95	220	3.75	27
3	Existing Granular Subbase	0.13	0.9	400	3.75	47
Total	-	-	-	700	-	108

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	New Asphalt	0.42	1	-	50	2,500,000	3.75	79	33
2	Existing Granular Base	0.13	0.95	250	-	275,000	3.75	250	31
3	Existing Granular Sub...	0.13	0.9	400	-	200,000	3.75	400	47
Total	-	-	-	-	-	-	-	729	111

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Thurber Engineering Ltd.

Flexible Structural Design Module

Queen Street West Rehabilitation
Mississauga Road to James Street
Expanded Asphalt Stabilization with New Asphalt Overlay

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	216,399
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	85 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	15,000 kPa
Stage Construction	1
Calculated Design Structural Number	98 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	508
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6.4 %
Average Initial Truck Factor (ESALs/truck)	1.5
Annual Truck Factor Growth Rate	2 %
Annual Truck Volume Growth Rate	0 %
Growth	Compound
Total Calculated Cumulative ESALs	216,399

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Asphalt	0.42	1	50	3.75	21
2	AC Stabilization	0.25	1	100	3.75	25
3	Existing Granular Base	0.13	0.95	150	3.75	19
4	Existing Granular Subbase	0.13	0.9	400	3.75	47
Total	-	-	-	700	-	111

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	New Asphalt	0.42	1	50	50	2,700,000	3.75	50	21
2	AC Stabilization	0.25	1	-	50	1,250,000	3.75	50	13
3	Existing Granular Base	0.13	0.95	150	-	275,000	3.75	150	19
4	Existing Granular Sub...	0.13	0.9	400	-	200,000	3.75	400	47
Total	-	-	-	-	-	-	-	650	99

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Computer Software Product
Thurber Engineering Ltd.

Flexible Structural Design Module

Queen Street West Rehabilitation
Mississauga Road to James Street
Flexible Pavement Design Analysis _ Pavement Reconstruction

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	216,399
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	85 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	15,000 kPa
Stage Construction	1
Calculated Design Structural Number	98 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	508
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	6.4 %
Average Initial Truck Factor (ESALs/truck)	1.5
Annual Truck Factor Growth Rate	2 %
Annual Truck Volume Growth Rate	0 %
Growth	Compound
Total Calculated Cumulative ESALs	216,399

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Asphalt	0.42	1	80	3.75	34
2	New Granular Base	0.14	1	200	3.75	28
3	New Granular Subbase	0.09	1	400	3.75	36
Total	-	-	-	680	-	98

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	New Asphalt	0.42	1	-	50	2,500,000	3.75	79	33
2	New Granular Base	0.14	1	200	-	275,000	3.75	200	28
3	New Granular Subbase	0.09	1	-	300	200,000	3.75	410	37
Total	-	-	-	-	-	-	-	689	98

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Flexible Structural Design Module

Main Street North Rehabilitation
Mary Street to Highpoint Side Road
Flexible Pavement Design Analysis _ Resurfacing

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	683,154
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	85 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	15,000 kPa
Stage Construction	1
Calculated Design Structural Number	116 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	2,701
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	3.8 %
Average Initial Truck Factor (ESALs/truck)	1.5
Annual Truck Factor Growth Rate	2 %
Annual Truck Volume Growth Rate	0 %
Growth	Compound
Total Calculated Cumulative ESALs	683,154

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Asphalt	0.42	1	100	3.75	42
2	Existing Granular Base	0.13	0.95	150	3.75	19
3	Existing Granular Subbase	0.13	0.9	500	3.75	59
Total	-	-	-	750	-	119

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	New Asphalt	0.42	1	-	50	2,500,000	3.75	97	41
2	Existing Granular Base	0.13	0.95	200	-	275,000	3.75	200	25
3	Existing Granular Sub...	0.13	0.9	500	-	200,000	3.75	500	59
Total	-	-	-	-	-	-	-	797	124

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Flexible Structural Design Module

Main Street North Rehabilitation
Mary Street to Highpoint Side Road
Expanded Asphalt Stabilization with New Asphalt Overlay

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	683,154
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	85 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	15,000 kPa
Stage Construction	1
Calculated Design Structural Number	116 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	2,701
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	3.8 %
Average Initial Truck Factor (ESALs/truck)	1.5
Annual Truck Factor Growth Rate	2 %
Annual Truck Volume Growth Rate	0 %
Growth	Compound
Total Calculated Cumulative ESALs	683,154

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Asphalt	0.42	1	50	3.75	21
2	AC Stabilization	0.25	1	100	3.75	25
3	Existing Granular Base	0.13	0.95	100	3.75	12
4	Existing Granular Subbase	0.13	0.9	500	3.75	59
Total	-	-	-	750	-	117

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	New Asphalt	0.42	1	50	50	2,700,000	3.75	50	21
2	AC Stabilization	0.25	1	-	50	1,250,000	3.75	95	24
3	Existing Granular Base	0.13	0.95	100	-	275,000	3.75	100	12
4	Existing Granular Sub...	0.13	0.9	500	-	200,000	3.75	500	59
Total	-	-	-	-	-	-	-	745	116

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DARWin Pavement Design and Analysis System

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Thurber Engineering Ltd.

Flexible Structural Design Module

Main Street North Rehabilitation
Mary Street to Highpoint Side Road
Flexible Pavement Design Analysis_Pavement Reconstruction

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	683,154
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	85 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	15,000 kPa
Stage Construction	1
Calculated Design Structural Number	116 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	2,701
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	3.8 %
Average Initial Truck Factor (ESALs/truck)	1.5
Annual Truck Factor Growth Rate	2 %
Annual Truck Volume Growth Rate	0 %
Growth	Compound
Total Calculated Cumulative ESALs	683,154

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Asphalt	0.42	1	100	3.75	42
2	New Granular Base	0.14	1	200	3.75	28
3	New Granular Subbase	0.09	1	525	3.75	47
Total	-	-	-	825	-	117

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	New Asphalt	0.42	1	-	50	2,500,000	3.75	97	41
2	New Granular Base	0.14	1	200	-	275,000	3.75	200	28
3	New Granular Subbase	0.09	1	-	300	200,000	3.75	525	47
Total	-	-	-	-	-	-	-	822	116