

APPENDIX 6

GEOTECHNICAL INVESTIGATIONS REPORT



**GEOTECHNICAL INVESTIGATION
REGIONAL ROAD 81 ROAD AND DRAINAGE IMPROVEMENTS
KING STREET (RR81) – BETWEEN GREELANE AVENUE AND LINCOLN AVENUE
TOWN OF LINCOLN, ONTARIO**

Submitted To:

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Submitted by:

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**September 2016
TG163020**



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APPENDIX 'A'

Figure 1 - Site Location Plan
Figure 2a to 2d - Borehole Location Plan
Explanation of Borehole Log
Record of Borehole Logs

APPENDIX 'B'

Certificates of Analysis

APPENDIX 'C'

Photographic Record of Pavement Distress



1. AUTHORIZATION

Authorization to proceed with this geotechnical investigation was received from Mr. Jeff Jaeger, P.Eng. – President of Kerry T. Howe Engineering Ltd., in a signed Professional Service Agreement dated June 1st, 2016.

2. INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure ('Amec Foster Wheeler'), a division of Amec Foster Wheeler Americas Limited, has carried out a geotechnical investigation for the road and drainage improvements of King Street (RR81) located in Lincoln, Ontario. The site limits are shown on the Site Location Plan appended as Figure 1.

Amec Foster Wheeler was retained to conduct a geotechnical investigation to obtain subsurface information relating to the project site by means of sampled boreholes. The data gathered from the investigation was used to perform analysis and provide geotechnical engineering recommendations.

2.1 Site and Project Description

Amec Foster Wheeler understands that the Regional Municipality of Niagara is undertaking the road and drainage improvements of King Street (RR81) between Greenlane Avenue and Lincoln Avenue in the Town of Lincoln. The length of road way included in this assignment is approximately 2.1 km. At the time of writing the report, the inverts for the watermain and storm sewer were not available. For the purpose of this report, it is assumed that the invert of the watermain will be at 1.7 m below existing grade, and the inverts for the storm and sanitary sewers will be approximately 3.0 m to 3.5 below existing grade..

The purpose of this geotechnical investigation was carried out to provide information on the subsurface materials, and groundwater conditions, and to provide geotechnical recommendations pertaining to open-cut excavations, subgrade preparation, bedding recommendations, groundwater conditions, drainage requirements and temporary excavation support. Recommendations pertaining to road rehabilitation and reconstruction will also be given, including the consideration of milling / paving, pulverization, hot-in-place recycling, base repairs and a new design based on 20 year life using traffic data supplied by the Client. Please note that the slope stability analysis mentioned in the proposal was not conducted due to the site conditions.

The findings of the investigation, together with Amec Foster Wheeler's comments and recommendations, are presented in this report. The anticipated construction conditions are also discussed but only to the extent that they may influence the design methods. Any construction methods discussed express Amec Foster Wheeler's opinions only and are not intended to direct



contractors on how to carry out the construction. Contractors should also be aware that the data and the interpretation presented in this report may not be sufficient to assess all the factors that may have an effect on construction.

This report was prepared with the condition that the design would be in accordance with applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practices.

Further, the recommendations and opinions expressed in this report are only applicable to the proposed project as described above.

The content of this report is based on the available information for this project at the time of writing. When detailed design information is available regarding design invert, Amec Foster Wheeler should be retained to confirm the recommendations stated in the report. There should also be ongoing liaison with Amec Foster Wheeler during both the design and construction phases of the project to confirm that the recommendations in this report have been interpreted and implemented correctly. Also, if any further clarifications and/or elaborations concerning the geotechnical aspects of this project are needed, Amec Foster Wheeler should be contacted immediately.

2.2 Geological Setting

Preliminary Map P764 and P993, Geological Series, Quaternary Geology of the Niagara Area and Grimsby Area, Southern Ontario indicates that the site limits lie partly within an area of Halton Till and partly within the Queenston Shale. The subsurface soils typically consist of clayey silt till to silty clay till. Bedrock of the Queenston formation underlies the till strata. The subsurface conditions encountered during this investigation generally conform with the regional geology.

3. METHOD OF INVESTIGATION

3.1 Field Investigation

Prior to drilling, a pre-start safety meeting was held with all field personnel. One site visit was carried out to assess the areas for investigation in order to prepare a work schedule and traffic control plan as per the Ontario Traffic Manual (OTM) - Book 7 (Temporary Conditions), January 2014 and the Occupational Health and Safety Act.

The fieldwork was completed during the period of July 19th and 22nd, 2016. It was initially proposed to advance 22 boreholes, but 2 boreholes (BH-4 and BH-5) were omitted due to an unlocatable watermain and existing culvert and one borehole (BH-22) on Greenlane Avenue could not be drilled due to the ongoing road construction. All the boreholes were drilled to depths between 4.6 to 5.2 m below existing grade.



The locations of the boreholes are shown on the Borehole Location Plan, on Figures 2a to 2g.

Prior to carrying out any fieldwork, the appropriate utility companies were notified to carry out underground service clearances at the borehole locations.

The boreholes were advanced using truck mounted drilling equipment equipped with 150 mm solid stem augers, and designed for soil sampling purposes and operated by a specialist drilling contractor retained by Amec Foster Wheeler. In-situ testing was carried out in the boreholes to determine the relative density/consistency of the soils, in accordance with the requirements of the Standard Penetration Test (SPT) according to ASTM D1586.

Upon recovery, all of the samples retrieved were examined and placed in appropriate containers and returned to Amec Foster Wheeler's laboratory for further examination and moisture content testing. Amec Foster Wheeler personnel supervised the fieldwork, performed preliminary sample identification and prepared field borehole logs.

Groundwater conditions were noted during and upon completion of the drilling. No long term monitoring of water infiltration was performed. Upon completion of drilling, the boreholes were backfilled with accordance with the general requirements of the Ministry of Environment and Climate Change (MOECC) Regulation 903, as ammended.

3.2 Soil Sample Collection

Soil samples were returned to Amec Foster Wheeler's laboratory for visual examination and moisture content determination. In addition, two (2) samples of the native soils were tested for pH / Sulphate content to determine the soil's aggressiveness to buried concrete structures.

All soil samples will be stored for three months following the issuance of this report. The samples will then be discarded unless Amec Foster Wheeler is instructed otherwise.

3.3 Environmental Sample Collection and Analysis

Amec Foster Wheeler completed an Environmental Soil Quality Testing Program (the Investigation) as part of the Geotechnical Investigation. The details of the drilling program, including borehole locations and drilling methodology are presented in the geotechnical investigation sections of this report. A representative soil sample was collected from each split spoon in each of the nineteen (19) boreholes drilled during the geotechnical investigation from surface or below the pavement structure to termination of the borehole and composited by the laboratory for analytical testing.

All soil samples were collected in accordance with strict environmental sampling protocols to minimize loss of volatile organics and to ensure reliable and representative results. Disposable



nitrile gloves were used and replaced between the handling of successive samples. All soil sampling equipment (split spoons, open tube samplers, stainless steel trowels, shovels, spatulas, etc.) was thoroughly decontaminated between soil sample locations to prevent potential cross-contamination. Decontamination activities included:

- Physical removal of any adhered debris;
- Wash/scrub in Alconox™ soap solution;
- Distilled water rinse;
- Methanol rinse; and
- Air dry.

Nineteen (19) composite soil/fill samples were submitted for analysis of metals including hydrides and mercury, pH, Sodium Adsorption Ratio (SAR), free cyanide and Electrical Conductivity (EC) at Paracel Laboratories Ltd., an ISO 17025-accredited laboratory located in Ottawa, Ontario. Additionally, two (2) composite soil/fill samples were submitted for pH and Sulphate (anions).

No petroleum-like or other chemical odours or staining were noted in the soil samples recovered during the Investigation.

The results of the laboratory analysis were compared to Tables 1 and 3 of Ontario's "*Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*", dated April 15, 2011 as per O. Reg. 153/04 as amended (hereinafter referred to as the Site Condition Standards [SCS]).

4. GENERAL SUBSURFACE CONDITIONS

Descriptions of the soil conditions encountered at each location during this investigation can be found on the Record of Boreholes BH-1 through to BH-3, and BH-6 through to BH-21 in **Appendix A**. It should be noted that the inferred soil conditions are based on soils encountered at the borehole locations, which may vary between and beyond the locations. The following is a brief summary of those conditions.

Pavement Structure

The hot mix thickness encountered from the boreholes investigation ranged from 230 to 300 mm, underlain by 200 mm to 510 mm of granular fill.

Fill

Fills were encountered underlying the pavement structure in all of the boreholes. The fills extended to depths ranging from 0.8 m to 2.7 m below existing grade.

The fills were comprised of brown silty sand fill and dark brown clayey silt fills. SPT testing gave



'N' values ranging from 4 blows to 22 blows for 0.3 m of penetration for the silty sand fill, indicating a very loose to compact state of compactness. SPT testing gave 'N' values ranging from 5 blows to 16 blows for 0.3 m of penetration for the clayey silt fill, indicating firm to very stiff consistencies. Laboratory moisture contents were between 3 % and 21 %.

Clayey Silt Till

Reddish brown clayey silt till was encountered underlying the fills in all of the boreholes. This deposit extended to a minimum depth of 1.4 m and to the borehole termination depth of 5.2 m in boreholes BH-1 to BH-3.

The clayey silt till contained traces to some gravel and sand. SPT testing gave 'N' values ranging from 9 blows to 56 blows for 0.3 m, indicating stiff to hard consistencies. Natural moisture contents for the clayey silt till samples were between 10 % and 25 %.

Weathered Shale

Reddish brown weathered shale was encountered underlying the clayey silt till in all of the boreholes, with the exception of BH-1 to BH-3. The boreholes where shale was encountered were terminated in the shale.

SPT testing gave 'N' values greater than 50 blows for penetrations between 0.03 m and 0.15 m. Natural moisture contents of the shale samples were between 4 % and 14 %.

Groundwater

All boreholes were open and dry upon completion, with the exception of borehole BH-11, where the water level was at 6.3 m below road grade upon completion of drilling. No piezometers were installed in the boreholes. It should be noted that the groundwater table is expected to fluctuate seasonally and in response of weather events.

5. DISCUSSION AND RECOMMENDATIONS

5.1 General

It is understood that the Regional Municipality of Niagara is undertaking the design and reconstruction of Regional Road 81 (King Street) between Greenlane Avenue and Lincoln Avenue in the Town of Lincoln. At the time of writing the report, the inverts for the watermain and storm sewer were not available. For the purpose of this report, it is assumed that the invert of the watermain will be at 1.7 m below existing grade, and the inverts for the storm and sanitary sewers will be approximately 3.0 m to 3.5 below existing grade..

5.2 Trench Base Conditions

The native soils are considered competent subgrade materials for support of the watermain and



sewers. In areas where fill was encountered at the invert depth, in particular at boreholes BH-2, BH-3, BH-7, BH-11 and BH-20, the fill should be removed and replaced with suitably compacted material. Otherwise, there is the possibility of settlement of the pipe supported on this fill, which could result in differential settlement between pipe sections, resulting in damage to the pipe.

5.3 Trench Excavations & Groundwater during Construction

Provided groundwater conditions during construction are similar to those encountered during the investigation, no major groundwater problems are anticipated for the construction that is proposed. Some inflows may occur from water perched within the granular base, or from more permeable seams within the clayey silt till and weathered shale deposits. It is not anticipated that the inflows will be severe enough to necessitate the installation of dewatering system. Furthermore, the expected inflows will gradually decrease as the perched water drains from the granular fills.

The inflows can probably be controlled by pumping from properly filtered sumps located at the base of the excavation.

Surface water should be directed away from the open excavations. Stockpiles of the excavated soils should not be placed adjacent to the edge of the open excavations. No heavy construction equipment should be allowed to work near the edge of any excavation.

Excavation through the fills and native clayey silt till can be completed using conventional excavation equipment. However, excavation within the weathered shale bedrock is expected to require the use of large excavation equipment with rock teeth. Line drilling to expedite rock excavation may be necessary if hard limestone layers are present within the shale bedrock.

All excavations must comply with the Occupational Health & Safety Act and Regulations for Construction Projects ('Act'). Based on criteria outlined in the Act, all fill materials should be considered to be Type 3 soils, and possibly degrading to Type 4 if any soil fills are encountered that are saturated. The native clayey silt till and weathered shale are considered to be Type 2 soil.

The sides of any trench must be sloped as outlined in the Act. In general, temporary trench slopes of 1 vertical to 1 horizontal are expected to remain stable. However, shallower excavation side slopes may be required if excessively soft, loose or saturated materials are encountered.

Unsupported excavations deeper than 1.2 m may be constructed with side slopes as discussed above. However, unsupported excavations may not be practical within the existing roadway allowance and temporary excavation support will likely be required. A trench liner box could be used to provide temporary excavation support.

The use of a trench liner box would be an appropriate construction method from the perspective of worker safety. However, this technique does not provide for a tight soil support and consequently, some caving of the vertically cut excavation sides should be anticipated from beneath the edges of the pavement, which will increase pavement restoration costs. However, if total road reconstruction is proposed, this may not be a significant consideration. It is important to extend the trench box above the ground surface to provide a barrier against any potential caving within the trench box, or slope the upper portions of the excavation.

The trench box is normally pulled ahead into the next section of excavation, after the pipe and bedding have been placed. The trench box may have to be lifted out and around existing services, at various points along the alignment.

5.4 Bedding and Pipe Cover

The existing undisturbed, native soils encountered at the borehole locations will provide adequate subgrade support for the proposed services. Where fills or very loose to loose native soils are encountered at the trench base, or where disturbance of the trench base has occurred such as due to ground water seepage or construction traffic, such materials should be sub-excavated and replaced with select granular fill compacted to at least 95% of Standard Proctor Maximum Dry Density (SPMDD).

Bedding and cover for the watermain and sewers must be constructed in accordance with the Region of Niagara and Ontario Provincial Standard Specifications. In general, the bedding and cover should consist of OPSS 1010 Granular "A" material. Bedding should be placed in maximum 150 mm thick loose lift and cover material should be placed in maximum 300 mm thick lifts. Bedding and cover material should be compacted to 100% SPMDD. The cover material should be placed to at least 300 mm above the top of the pipe.

In the case of saturated subgrade, the use of clear stone gravel or HL4 coarse aggregate properly wrapped in a geotextile filter fabric with sufficient overlap at the seams, may be considered. It is recommended that the seams be stitched to prevent separation of the geotextile panels at the seams.

5.5 Trench Backfill

The trench section between the top of the pipe cover to the finished subgrade elevation should be backfilled with Select Subgrade materials excavated from the trench, placed in thin layers (not exceeding 300 mm) and compacted to at least 95% of SPMDD. For the upper 0.5 metres below finished subgrade, the degree of compaction should be increased to 98% of SPMDD.

Under travelled roadways, the top portion of the trench, within 1.5 m bgs, should be replaced with new pavement structure consisting of non-frost susceptible materials such as Granular "B"



subbase, Granular "A" base and asphaltic concrete as per the project design requirements. If the clayey silt soils are used as backfill, consideration should be given to delaying the placement of the surface asphalt layer to allow for settlement of these fine-grained materials to occur.

The moisture content of the existing fill materials and cohesionless native soils is generally near the optimum and therefore these materials are considered suitable as Select Subgrade Materials.

Wet or saturated soils should be avoided for backfill material. If the excavated materials are allowed to dry too much during summer construction, judicious addition of water may be required to facilitate and achieve the required compaction. Backfilled materials should be placed within $3\pm$ % of optimum moisture content. The excavated shale should not be used as trench backfill within the roadway allowance, but may be used as backfill in non-settlement sensitive areas, such as landscaped areas.

5.6 Structural Adequacy of Existing Pavement for Construction and Widening

It is difficult to predict the structural adequacy of the existing pavement to withstand loading due to construction activities. Generally, traffic during construction will be the heaviest that a pavement structure will be subjected to.

Localized areas of pavement breakup can be expected from construction activities. Where heavy equipment is operating (or left standing) next to the edge of trenches, there could be loss of soil from below the edge of the pavement and localized pavement breakage.

It should also be noted that heavy truck traffic across an exposed road subgrade can severely disturb the subgrade soils under wet weather conditions.

5.7 Pavement Consideration for Trench Reinstatement

After placement of the trench backfill as described in Section 5.4, the pavement structure should match the granular base / subbase as well as two lifts of asphaltic concrete, which include positive drainage.

All materials should be in compliance with OPS specifications. The asphaltic concrete should be compacted in accordance with the regulations of the MTO's Standard Document.

Where the new pavement meets existing pavements, a step joint should be constructed as follows:

- Saw cut and remove existing asphalt full depth a minimum of 300 mm back from the limits of new pavement;

- Mill surface of existing asphalt within 300 mm of saw cut by 40 mm deep to allow surface course of new pavement to extend over onto existing base courses; and
- The granular materials should be compacted to 100% SPMDD as per American Society for Testing and Material's Number D698. The placing, spreading and rolling of the asphaltic concrete should be in accordance with Ontario Provincial Standard Specifications Form 310, or equivalent.

5.8 Soil Aggressiveness to Buried Concrete Structures

Two (2) samples of the native soil were tested for pH / sulphate content to determine the aggressiveness of the soils to buried concrete structures. The results of these samples can be found in **Appendix B** and are summarized in the following table.

Sample	Depth of Sample (metres)	Soil Description	PH	Sulphate Content (ug/g)
BH-7 / SS5	3.0 to 3.6	Weathered Shale	7.53	43
BH-17 / SS5	3.0 to 3.6	Clayey Silt Till / Weathered Shale	7.84	59

The measured water soluble sulphate in soils was between 636 and 203µg/g (0.004 to 0.006 %) in the selected boreholes. Table 3 of CSA A23.1-09 (R2014) describes the degree of sulphate exposure for concrete as being moderate for soils having sulphate concentrations of between 0.10 and 0.20%, severe for values between 0.20 and 2.0%, and very severe for values over 2.0%. The use of special sulphate resistant cements is therefore **NOT** considered necessary based on these results.

Therefore, in accordance with Table 6 of CSA A23.1-09, Type GU Portland cement may be used for concrete.

It should be noted that soil and groundwater conditions across the site may vary and further chemical testing should be carried out if deemed necessary. In addition, chemical testing of the excavated and/or relocated soils should be carried out at a minimum frequency to confirm the quality of the soils.

6. PAVEMENT CONDITION SURVEY

Amec Foster Wheeler completed a visual pavement condition survey for any distress. Overall, the existing asphaltic concrete surface was in 'Poor to Fair Condition', with the exception of the section of King Street between Greenlane Avenue and Lincoln Avenue (with the exception of the new asphalt construction near Greenlane Avenue). The pavement condition reflects its age and lack of recent routine/systematic maintenance that has resulted in the pavement condition progressively deteriorating with time. The identification and classification of the pavement distresses was carried out in accordance with MTO's Manual for Condition Rating of Flexible Pavements (SP024), August 1980.



King Street (RR81) is an urban 2-lane cross-section road oriented east-west and classified as a collector road and under the jurisdiction of Niagara Region.

A summary of the pavement condition survey including predominant surface defects, surface deformation and cracking is presented in table below and described by schematic #1 and detailed in Appendix C with selected photographs showing the existing condition of the investigated road section.

SCHEMATIC #1

Excellent	Adequate
Good / Satisfactory	
Fair	Degraded
Poor	Unsatisfactory
Very Poor	
Serious	
Failed	

Table – Existing Pavement Assessment of King Street

Section	Predominant Distress	2016 Pavement Condition Rating
From Greenlane Avenue to Thirty Road	- Centreline Cracking (Single, Multiple & Alligator) Extensive / Severe - Midlane Cracking - Frequent to Extensive/Moderate to Severe, - Pavement Edge Cracking (Single, Multiple, & Alligator) - Frequent to Extensive/Moderate to Severe, - Transverse Cracking (Single & Multiple & Alligator) - Frequent to Extensive/Moderate to Severe - New asphalt construction by Greelane Avenue	Poor
From Thirty Road to Mountainview Road	- Ravelling & Aggregate Loss – Few / Moderate - Centreline Cracking (Single, Multiple) Extensive / Severe - Midlane Cracking (Single, Multiple) Frequent / Moderate to severe - Transverse Cracking Few / Moderate	Poor to Fair
From Mountainview Road to Lincoln Avenue	- Ravelling & Aggregate Loss – Few / Moderate - Centreline Cracking (Single, Multiple) Extensive / Severe - Midlane Cracking (Single, Multiple) Frequent / Moderate to severe - Transverse Cracking Few / Moderate	Poor to Fair

7. PAVEMENT DESIGN FOR NEW CONSTRUCTION

7.1 Existing Pavement Structure

To assess the existing pavement structure, in-situ GBEs (Granular Base Equivalency) have been estimated from the borehole data using the following equivalent factors (based on Table 3.5 of MTO Design Manual). The following Table presents a summary of the record of boreholes, existing GBE and subgrade soils.

Table - Summary of Boreholes and Soil Stratigraphy for Roadway

Section	Pavement Condition	Total Existing Thickness (mm)		Existing GBE (mm)	Predominant Subgrade Soils
		Asphalt	Granular		
Section: King Street (RR81) between Greenlane Avenue to Lincoln Avenue					
King Street (RR81) between Greenlane Avenue and Lincoln Avenue	Poor / Poor to Fair	Range (230-300) Av. 290 mm	Range (200-510) Av. 300 mm	Range (456-694) Av. 550 mm	Clayey Silt Fill / Clayey Silt Till

7.2 Existing and Forecasted Traffic Data

The traffic data represented in average annual daily traffic (AADT), percent of commercial vehicles and growth rate was not provided at the time of issuing the pavement design. Therefore, the equivalent single axle loads (ESALs) was assumed to be 5,000,000 for King Street in Lincoln and considered a major collector and minor arterial road.

After reviewing the field data and laboratory test results, the minimum pavement structural design for Roadway is presented in Table 7.1, as determined in accordance with the 1993 American Association of State Highway and Transportation Officials ('AASHTO') Guide for the Design of Pavement Structures, using the Darwin Software Program.

The AASHTO Pavement Design is considered to be a function of estimated future traffic in both directions (ESALs), reliability (R), which is a function of road classification, overall standard deviation (S_o), resilient modulus (M_r), as well as initial and terminal serviceability (P_o , P_t). From these parameters, the structure number (SN) is calculated. The SN is defined in the AASHTO Guide as a number which provides a measure of the pavement strength and thickness needed to avoid overstressing the subgrade.

Table 7.1 - Recommended Minimum Structural Pavement Design

Material Description	AASHTO'93 Darwin Analysis		Niagara Region Roadway Design Standards
	King Street ESALs 5.0 X 10 ⁶		
Hot Mix Asphalt Concrete	170 mm		170 mm HL3HS - 50mm HL8HS – 60+60 mm
Granular Base 'A'	150 mm	450 mm	Granular A Crushed limestone 525 mm
Granular Subbase 'B' Type II	300 mm		
Design Structure Number (DSN) mm	132 mm		n/a
Selected Structure Number (SSN) mm	134 mm (ok)		n/a
Total Pavement Thickness (mm)	620 mm		695 mm
Granular Base Equivalency (GBE) mm	n/a		Min GBE = 865 mm
Notes:			

The AASHTO pavement structural design is less in granular thickness and hot mix compared to the current Niagara Region Roadway Design Standards. **Therefore, it is recommended using the Niagara Region Roadway Design Standards for this section of roadway** as follows:

King Street - HMA		PGAC	Traffic Category
Type	Thickness (mm)		
HL 3 (HS) /SP 12.5FC2 mm	50 mm	64-28	C
HL 8 (HS) /SP 19.0 mm	60 mm	64-28	C
HL 8 (HS) /SP 19.0 mm	60 mm	64-28	C
Total HMA	170 mm		
Gran A	525 mm		
Total Pavement Thickness (mm)	695 mm		

The subgrade should be dry and well prepared and compacted to between 98 and 100% of Standard Proctor Maximum Dry Density (SPMDD). Also, the subgrade should have adequate subdrainage. In wet weather conditions, the pavement design should be re-evaluated by the Geotechnical Engineer.

7.3 Recommendations and Construction Features for Pavement

7.3.1 Reconstruction of King Street and Improvements

Pavement recommendations for reconstruction of King Street are presented in Sections 7.3.2 to 7.3.5. The granular thicknesses of the intersection improvements is a minimum thickness and should match the adjacent existing pavement granular thickness to promote positive lateral drainage. Also, the thicknesses can be increased depending on grading requirements.

Full depth excavation, as required and commencing from the existing edge of pavement, will be required to accommodate the proposed design thickness. The excavated granular materials from the shoulder can be re-used as fill material for subgrade for the widening/embankment, provided it is not contaminated. New Granular B subbase should be added and compacted, followed by new Granular A base material. Both base and subbase can vary in thickness to match the adjacent existing pavement granular in order to promote positive lateral drainage.

The Granular A base course should be compacted, and overlain with 2 lifts of HL 8(HS) or SP19.0 mm binder course, and 1 lift of HL 3 (HS) or SP12.5 FC2 surface course, as per Table 7.3. Installation of subdrain is recommended, if lateral drainage of the existing subgrade is not possible.

7.3.2 Hot Mixes and PGAC Type

The following Marshall or Superpave hot mixes should be used on King Street:

HL 3 (HS) or 12.5 FC2 surface course mix and HL 8 (HS) or SP 19.0 mm binder course should be used to provide the roadway with high durability.

Material Specification should be as per OPSS 1150 or Marshall Mixes and OPSS 1151 for Superpave and Stone Mastic Asphalt mixtures. For aggregates, the material specification should be as per SP No.110F12.

7.3.3 Subgrade / Road Base Preparation and Compaction

The pavement structural design recommended for roads is applicable, provided the subgrade is prepared under dry weather conditions, proof-rolled with a heavy rubber-tired vehicle (such as a grader or loaded dump truck) in the presence of the geotechnical consultant. Any loose, soft or unstable areas, if detected during proof-rolling, must be sub-excavated, replaced with approved granular materials and compacted. Any additional engineered fill, if required, should be placed in thin layers not exceeding 200 mm and compacted to a minimum of 98% of SPMDD. Granular materials should be placed in thin layers not exceeding approximately 200 mm, within $\pm 3\%$ of its optimum moisture content, and thoroughly compacted to a minimum of 100 % of SPMDD.

The subgrade should be provided with adequate drainage. If wet weather conditions prevail at the time of construction, adjustments to this design may be required, i.e. if the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material may be required. The need for additional sub-base material is best determined during construction.

All granular base and sub-base materials must be compacted to at least 100% of SPMDD.

7.3.4 Drainage

Prior to completing the intersection improvements, it is recommended that adequate drainage be provided both laterally and longitudinally along the length of the project.

To meet the design requirements for the pavement life, the road subgrade and granular courses should be well drained at all times. This can be accomplished by ensuring proper grading of the subgrade and positive lateral drainage of the granular base daylighting at the ditch. Alternatively, full-length perforated subdrain pipes of 100 or 150 mm diameter should be installed along the road, below the roadbed level, to ensure effective drainage in accordance with OPSD 216.021. The sub-drain pipes, if used, should be wrapped in suitable knitted sock geotextile with an FOS of 500 μ m according to OPSS 1860, and surrounded by a minimum drainage zone of 19 mm size clear stone of minimum 150 mm thickness. A minimum slope of 2% should be maintained across the paved sections (finished road surface) to ensure proper surface drainage. New pavement should slope towards the gutter/ditch.

7.3.5 In-Situ Compaction for Hot Mix

In all areas, asphaltic concrete should be compacted as per OPSS 310, Table 10. It should be noted that the granular base and sub-base materials should be compacted to minimum 100 % SPMDD.

Field Quality Assurance: Plate samples of loose hot mix should be obtained for each paving day, and extraction/gradation and full hot mix compliance testing should be carried out on these samples. The finished surface shall be true to required profile and cross-section within 6 mm from required elevations and thickness. The surface shall show no depressions or bumps exceeding 3 mm under a 3.0 m long straight edge, placed parallel to the road centre line.

8. ENVIRONMENTAL TEST RESULTS & CONSIDERATIONS

The results of the laboratory analysis are summarized as follows:

- The reported values of pH were within the acceptable range.



- The reported concentrations of free cyanide were not detected above the laboratory method detection limit (MDL) in any of the samples which is also below the Table 1 SCS.
- The reported concentrations for EC exceeded the Table 1 SCS in 17 of the 19 samples that were analyzed (Composites BH-1 to BH-3, Composites BH-7 to BH-9, Composites BH-11 to BH-21), which ranged from 691 microSiemens per centimetre ($\mu\text{S}/\text{cm}$) in BH-12 to 2,480 $\mu\text{S}/\text{cm}$ in BH-13. The reported concentrations of EC still exceeded the Table 3 SCS (industrial/commercial/community property use, medium fine texture) in samples Composites BH-2, BH-9, BH-11, BH-13, BH-14 and BH-15.
- The reported values for SAR exceed the Table 1 SCS in 18 of the 19 samples that were analyzed (Composites BH-1 to BH-3, and Composites BH-7 to BH-21), which ranged from 3.41 in BH-10 to 18.5 in BH-14. The reported values for SAR still exceeded the Table 3 SCS (industrial/commercial/community property use, medium fine texture) for Composites BH-2, BH-3, BH-8 and BH-14.
- The reported concentrations of metals including hydrides and mercury were below the Table 1 SCS in 11 of the 19 samples that were analyzed. Concentrations of uranium in Composites BH-8, BH-9, BH-12, BH-15, BH-17, BH-19 and BH-21 exceeded the Table 1 SCS. Additionally, the reported concentration of total boron did not meet Table 1 SCS in Composite BH-6. However, the reported concentrations of metals including hydrides and mercury in all samples were below the Table 3 SCS (industrial/commercial/community property use, medium fine texture).

All laboratory certificates of analyses are included in **Appendix B**.

Based on the results of the analytical testing, the following are options for removal/disposal of excess soil/fill material if required during the development project:

- Any permitted receiver site that will accept the material that meets the Table 3 SCS for metals, but exceeds Table 3 SCS for EC and SAR.
- The excess material (with the exceptions of areas represented by Composites 6, 8, 9, 12, 15, 17, 19 and 21, which have Table 1 SCS metals exceedances) could be disposed of at a quarry for reclamation purposes. The material would have to be accepted by the quarry prior to transportation. This option is based on a draft policy of the Ministry of Natural Resources (A.R. 6.00.03) referring to the importation of inert fill for the purpose of rehabilitation. Additional testing would be required for acceptance at the quarry, for example, Walker's Quarry in Vineland, Ontario.
- The excess material could be landfilled at a Ministry of the Environment and Climate Change (MOECC) licensed landfill. Ontario Regulation 347, as amended by Ontario Regulation 558, Toxicity Characteristic Leaching Procedure (TCLP) testing for heavy



metals, VOCs and Polychlorinated Biphenyls (PCBs) would be required to classify the soil as hazardous or non-hazardous for disposal at MOE-approved landfill sites.

- Should the material be deemed geotechnically suitable, the material can remain on-Site.

If any soil/fill materials that appear to be impacted are encountered during excavation activities, Amec Foster Wheeler recommends that the materials be sampled prior to shipment in order to ensure it meets the receiver's requirements and/or to determine if they should be removed for landfill disposal and replaced with clean fill materials.



9. CLOSURE

The Report Limitations (Geotechnical and Environmental) on the following pages are an integral part of this report. The geotechnical aspects of the final design drawings and specifications should be reviewed by this office to confirm that the intent of this report has been met. During construction, sufficient subgrade inspections and materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes and to monitor conformance to the pertinent project specifications.

We trust that this report is complete within our present terms of reference. If you have any questions, please do not hesitate to contact our office.

Yours truly,

Amec Foster Wheeler Environment & Infrastructure

Prepared By:

A handwritten signature in blue ink, appearing to read "Rod de Castro".

Rod de Castro, P.Eng.
Geotechnical Engineer

A handwritten signature in black ink, appearing to read "Hoda Seddik".

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Kevin Haines, B.Eng.
E.I.T, Environmental Scientist

Reviewed by:

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Ty Garde, M. Eng, P.Eng.
Ontario West Geotechnical Leader

Reviewed by

A handwritten signature in black ink, appearing to read "Patrick Shriner".

:

Patrick Shriner, P.Geo.
Associate, Environmental Geoscientist



REPORT LIMITATIONS - Geotechnical

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during the construction to confirm that the subsurface conditions across the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

The comments made in this report relating to potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The benchmark and elevations mentioned in this report were obtained strictly for use by this office in the geotechnical design of the project. They should not be used by any other party for any other purpose.

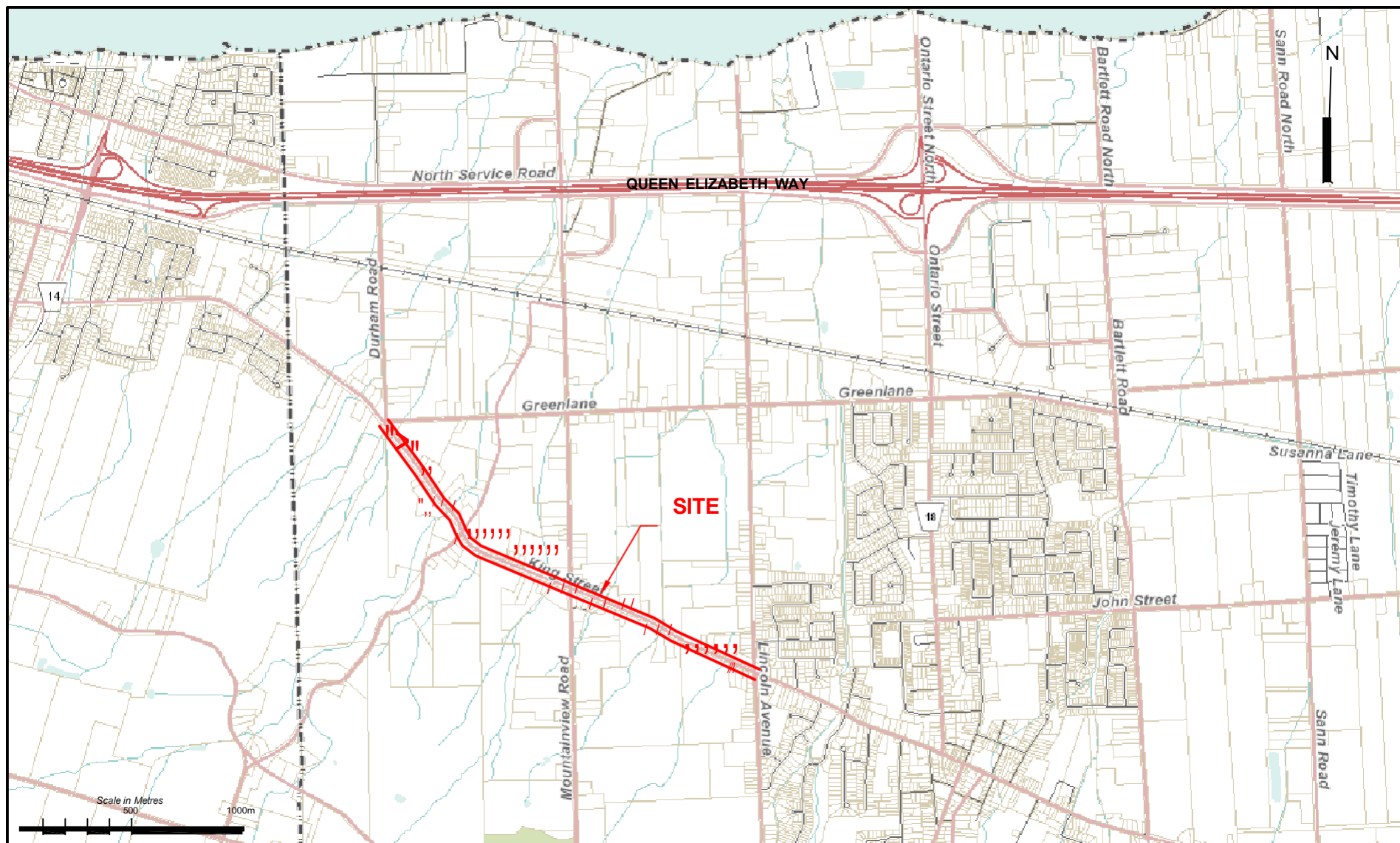
Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Amec Foster Wheeler Americas Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions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



REPORT LIMITATIONS - Environmental

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:
 - (a) The Standard Terms and Conditions which form a part of our June 1st, 2016 Professional Services Contract;
 - (b) The Scope of Services;
 - (c) Time and Budgetary limitations as described in our Contract; and,
 - (d) The Limitations stated herein.
2. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.
3. The conclusions presented in this report were based, in part, on visual observations of the site and attendant structures. Our conclusions cannot and are not extended to include those portions of the site or structures which were not reasonably available, in Amec Foster Wheeler's opinion, for direct observation.
4. The environmental conditions at the site were assessed, within the limitations set out above, having due regard for applicable environmental regulations as of the date of the inspection. A review of compliance by past owners or occupants of the site with any applicable local, provincial or federal by-laws, orders-in-council, legislative enactments and regulations was not performed.
5. The site history research included obtaining information from third parties and employees or agents of the owner. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report.
6. Where testing was performed, it was carried out in accordance with the terms of our contract providing for testing. Other substances, or different quantities of substances testing for, may be present on site and may be revealed by different of other testing not provided for in our contract.
7. Because of the limitations referred to above, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, Amec Foster Wheeler must be notified in order that it may determine if modifications to the conclusions in the report are necessary.
8. The utilization of Amec Foster Wheeler's services during the implementation of any remedial measures will allow Amec Foster Wheeler to observe compliance with the conclusions and recommendations contained in the report. Amec Foster Wheeler's involvement will also allow for changes to be made as necessary to suit field conditions as they are encountered.
9. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or in part, or any reliance thereon, or decisions made based on any information of conclusions in the report, is the sole responsibility of such third party. Amec Foster Wheeler accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.
10. This report is not to be given over to any third party for any purpose whatsoever without the written permission of Amec Foster Wheeler.
11. Provided that the report is still reliable, and less than 12 months old, Amec Foster Wheeler will issue a third-party reliance letter to parties client identifies in writing, upon payment of the then current fee for such letters. All third parties relying on Amec Foster Wheeler's report, by such reliance agree to be bound by our proposal and Amec Foster Wheeler's standard reliance letter. AMEC's standard reliance letter indicates that in no event shall Amec Foster Wheeler be liable for any damages, howsoever arising, relating to third-party reliance on Amec Foster Wheeler's report. No reliance by any party is permitted without such agreement.

APPENDIX A



REFERENCE: Base plan provided by NIAGARA NAVIGATOR, <https://maps-beta.niagararegion.ca/Navigator/>

FOR ILLUSTRATION PURPOSES ONLY, ALL LOCATIONS APPROXIMATE.

CLIENT: Kerry T. Howe Engineering Ltd. Amee Foster Wheeler Environment & Infrastructure 3300 Merrillville Hwy, Unit 5 Thorold, Ontario 	LEGEND: Site Location	OWN BY: DN CHK'D BY: MP DATUM: NAD83 PROJECTION: UTM Zone 17 SCALE: As Shown	PROJECT: GEOTECHNICAL INVESTIGATION REGIONAL ROAD 81 (KING STREET) ROAD & DRAINAGE IMPROVEMENTS BETWEEN GREENLANE and LINCOLN AVENUE TOWN OF LINCOLN, ONTARIO TITLE: SITE LOCATION PLAN	REV. NO.: A DATE: JULY 2016 PROJECT NO.: TG163020 NO.: FIGURE 1
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REFERENCE: Base plan provided by NIAGARA NAVIGATOR, <https://maps-beta.niagararegion.ca/Navigator/>

FOR ILLUSTRATION PURPOSES ONLY, ALL LOCATIONS APPROXIMATE.

CLIENT: Kerry T. Howe Engineering Ltd.		LEGEND:  BH-1 Borehole Location	OWN BY: DN	PROJECT: GEOTECHNICAL INVESTIGATION REGIONAL ROAD 81 (KING STREET) ROAD & DRAINAGE IMPROVEMENTS BETWEEN GREENLANE and LINCOLN AVENUE TOWN OF LINCOLN, ONTARIO	REV. NO.: A
			CHK'D BY: MP		DATE: JULY 2016
Amee Foster Wheeler Environment & Infrastructure 3300 Merrillville Hwy, Unit 5 Thorold, Ontario			DATUM: NAD83	TITLE: BOREHOLE LOCATION PLAN	PROJECT NO.: TG163020
			PROJECTION: UTM Zone 17		NO.:
			SCALE: As Shown		FIGURE 2a



REFERENCE: Base plan provided by NIAGARA NAVIGATOR, <https://maps-beta.niagararegion.ca/Navigator/>

FOR ILLUSTRATION PURPOSES ONLY, ALL LOCATIONS APPROXIMATE.

CLIENT:		LEGEND: BH-1  Borehole Location H-4  Omitted Borehole due to unlocatable utilities	OWN BY:		PROJECT: GEOTECHNICAL INVESTIGATION REGIONAL ROAD 81 (KING STREET) ROAD & DRAINAGE IMPROVEMENTS BETWEEN GREENLANE and LINCOLN AVENUE TOWN OF LINCOLN, ONTARIO TITLE: BOREHOLE LOCATION PLAN	REV. NO.: A
Kerry T. Howe Engineering Ltd. Amee Foster Wheeler Environment & Infrastructure 3300 Merrillville Hwy, Unit 5 Thorold, Ontario 			DN			DATE: JULY 2016
			CHK'D BY:			PROJECT NO.: TG163020
			MP			
			DATUM:			
			NAD83			
PROJECTION:		UTM Zone 17	NO.: FIGURE 2b			
SCALE:						
		As Shown				



CLIENT:		LEGEND:		OWN BY:		PROJECT:		REV. NO.: A	
Kerry T. Howe Engineering Ltd.		4BH-1 Borehole Location		DN		GEOTECHNICAL INVESTIGATION REGIONAL ROAD 81 (KING STREET) ROAD & DRAINAGE IMPROVEMENTS BETWEEN GREENLANE and LINCOLN AVENUE TOWN OF LINCOLN, ONTARIO		DATE:	
				CHK'D BY:				JULY 2016	
				MP				PROJECT NO.:	
				DATUM:					
Amee Foster Wheeler Environment & Infrastructure 3300 Merrillville Hwy, Unit 5 Thorold, Ontario				NAD83		TITLE:		NO.:	
				PROJECTION:					
				UTM Zone 17					
				SCALE:		BOREHOLE LOCATION PLAN		FIGURE 2c	
				As Shown					



CLIENT: Kerry T. Howe Engineering Ltd. Amee Foster Wheeler Environment & Infrastructure 3300 Merrillville Hwy, Unit 5 Thorold, Ontario	LEGEND: BH-1  Borehole Location	OWN BY: DN	PROJECT: GEOTECHNICAL INVESTIGATION REGIONAL ROAD 81 (KING STREET) ROAD & DRAINAGE IMPROVEMENTS BETWEEN GREENLANE and LINCOLN AVENUE TOWN OF LINCOLN, ONTARIO	REV. NO.: A
		CHK'D BY: MP		DATE: JULY 2016
		DATUM: NAD83	TITLE: BOREHOLE LOCATION PLAN	PROJECT NO.: TG163020
		PROJECTION: UTM Zone 17 SCALE: As Shown		NO.: FIGURE 2d



CLIENT: Kerry T. Howe Engineering Ltd. Amee Foster Wheeler Environment & Infrastructure 3300 Merrillville Hwy, Unit 5 Thorold, Ontario 	LEGEND: BH-1  Borehole Location	OWN BY: DN CHK'D BY: MP DATUM: NAD83 PROJECTION: UTM Zone 17 SCALE: As Shown	PROJECT: GEOTECHNICAL INVESTIGATION REGIONAL ROAD 81 (KING STREET) ROAD & DRAINAGE IMPROVEMENTS BETWEEN GREENLANE and LINCOLN AVENUE TOWN OF LINCOLN, ONTARIO TITLE: BOREHOLE LOCATION PLAN	REV. NO.: A DATE: JULY 2016 PROJECT NO.: TG163020 NO.: FIGURE 2e



CLIENT: Kerry T. Howe Engineering Ltd. Amee Foster Wheeler Environment & Infrastructure 3300 Merrillville Hwy, Unit 5 Thorold, Ontario	LEGEND:  BH-1 Borehole Location	OWN BY: DN	PROJECT: GEOTECHNICAL INVESTIGATION REGIONAL ROAD 81 (KING STREET) ROAD & DRAINAGE IMPROVEMENTS BETWEEN GREENLANE and LINCOLN AVENUE TOWN OF LINCOLN, ONTARIO	REV. NO.: A
		CHK'D BY: MP		DATE: JULY 2016
		DATUM: NAD83	TITLE: BOREHOLE LOCATION PLAN	PROJECT NO.: TG163020
		PROJECTION: UTM Zone 17 SCALE: As Shown		NO.: FIGURE 2f

EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

SOIL LITHOLOGY

Elevation and Depth

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

Lithology Plot

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

Description

This column gives a description of the soil strata, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *Modified Unified Soil Classification System*.

The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows (*Ref. Canadian Foundation Engineering Manual*):

Compactness of		Consistency of		Undrained Shear Strength	
<u>Cohesionless</u>	<u>SPT N-Value</u>	<u>Cohesive Soils</u>	<u>kPa</u>	<u>psf</u>	
<u>Soils</u>					
Very loose	0 to 4	Very soft	0 to 12	0 to 250	
Loose	4 to 10	Soft	12 to 25	250 to 500	
Compact	10 to 30	Firm	25 to 50	500 to 1000	
Dense	30 to 50	Stiff	50 to 100	1000 to 2000	
Very Dense	> 50	Very stiff	100 to 200	2000 to 4000	
		Hard	Over 200	Over 4000	

Soil Sampling

Sample types are abbreviated as follows:

SS	Split Spoon	TW	Thin Wall Open (Pushed)	RC	Rock Core
AS	Auger Sample	TP	Thin Wall Piston (Pushed)	WS	Washed Sample

Additional information provided in this section includes sample numbering, sample recovery and numerical testing results.

Field and Laboratory Testing

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

Instrumentation Installation

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section. Water levels, if measured during fieldwork, are also plotted. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors.

Comments

This column is used to describe non-standard situations or notes of interest.

MODIFIED * UNIFIED CLASSIFICATION SYSTEM FOR SOILS						
*The soil of each stratum is described using the Unified Soil Classification System (Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S Army. Vol. 1 March 1953.) modified slightly so that an inorganic clay of "medium plasticity" is recognized.						
MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4; C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM	SILTY GRAVELS, GRAVEL-SAND- SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 4	
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 7	
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6; C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP	POORLY GRADED GRAVELS, GRAVEL- SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 4	
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 7	
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50\%$	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS		
		$30\% < W_L < 50\%$	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50\%$	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G SF IS A MIXTURE OF SAND WITH SILT OR CLAY	
		$W_L > 50\%$	OH	ORGANIC CLAYS OF HIGH PLASTICITY		
	HIGH ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	
SOIL COMPONENTS						
FRACTION	U.S STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS			
GRAVEL	COARSE	PASSING	RETAINED	PERCENT	DESCRIPTOR	
		76 mm	19 mm	35-50	AND	
	FINE	19 mm	4.75 mm	20-35	Y/EY	
SAND	COARSE	4.75 mm	2.00 mm	10-20	SOME	
	MEDIUM	2.00 mm	425 µm	1-10	TRACE	
	FINE	425 µm	75 µm			
FINES (SILT OR CLAY BASED ON PLASTICITY)		75 µm				
OVERSIZED MATERIAL						
ROUNDED OR SUBROUNDED: COBBLES 76 mm TO 200 mm BOULDERS > 200 mm				NOT ROUNDED: ROCK FRAGMENTS > 76 mm ROCKS > 0.76 CUBIC METRE IN VOLUME		

Plasticity Chart for Soil Passing 425 Micron Sieve

Note 1: Soils are classified and described according to their engineering properties and behaviour.

Note 2: The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual.

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Project Number: **TG163020**

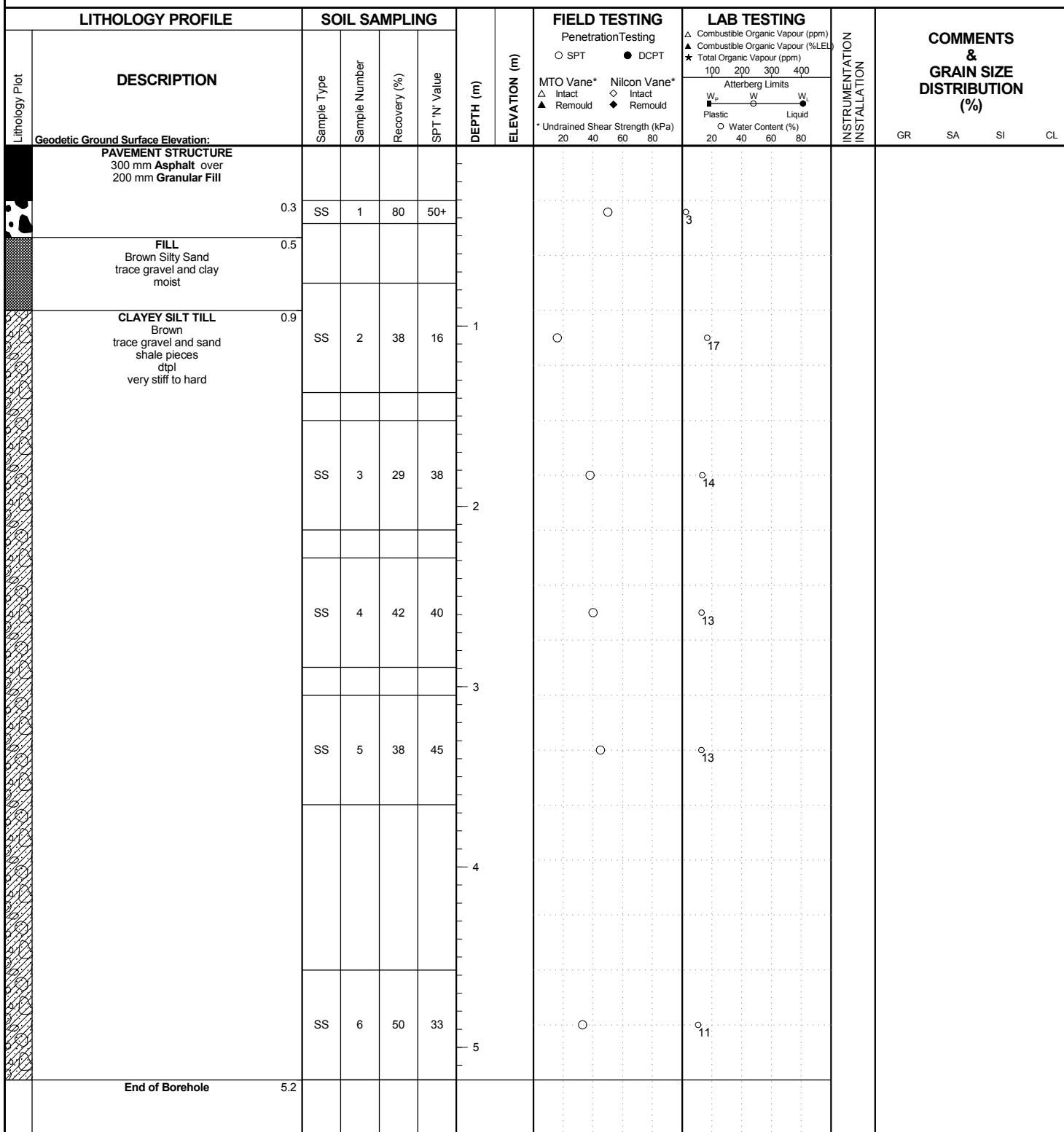
Project Client: **Kerry T. Howe Engineering Ltd.**

Project Name: **GI - Road and Drainage Improvements**

Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**

Drilling Location: **4781720N; 621405E**

Drilling Method:	150 mm Solid Stem Augers		
Drilling Machine:	Truck Mounted Drill		
Date Started:	21 Jul 16	Date Completed:	21 Jul 16
Logged by:	DN	Compiled by:	DN
Reviewed by:	MP	Revision No.:	0, 1/9/16



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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 31

Page: 1 of 1

RECORD OF BOREHOLE No. 2

Project Number: TG163020
 Project Client: Kerry T. Howe Engineering Ltd.
 Project Name: GI - Road and Drainage Improvements
 Project Location: Regional Road 81 (King Street), Lincoln, Ontario
 Drilling Location: 4781659N; 621444E

Drilling Method: 150 mm Solid Stem Augers
 Drilling Machine: Truck Mounted Drill
 Date Started: 22 Jul 16 Date Completed: 22 Jul 16
 Logged by: DN Compiled by: DN
 Reviewed by: MP Revision No.: 0, 1/9/16



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Δ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 250 mm Asphalt over 330 mm Granular Fill										
	0.3										
	SS 1 67 32										
	FILL Brown Silty Sand trace gravel and clay moist compact to loose										
	0.6										
	SS 2 25 11										
	SS 3 13 8										
	FILL Brown Clayey Silt mottled trace gravel and sand apl stiff										
	2.3										
	SS 4 54 10										
	CLAYEY SILT TILL Brown trace gravel and sand shale pieces dtp very stiff to hard										
	2.7										
	SS 5 54 25										
	SS 6 42 35										
	End of Borehole										
	5.2										

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∞ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 31

Page: 1 of 1

RECORD OF BOREHOLE No. 3

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4781555N; 621517E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **21 Jul 16** Date Completed: **21 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Δ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 300 mm Asphalt over 230 mm Granular Fill										
	0.3	SS	1	67	50+			○	1		
	FILL Brown Silty Sand trace gravel and clay moist loose										
	0.5										
		SS	2	33	7	1		○	12		
		SS	3	21	4	2		○	12		
	FILL Brown Clayey Silt mottled trace gravel and sand apl stiff										
	2.4	SS	4	33	6	3		○	21		
		SS	5	50	5			○	25		
	CLAYEY SILT TILL Brown trace gravel and sand shale pieces dtp very stiff										
	3.5										
		SS	6	50	17	5		○	15		
	End of Borehole					5.2					

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∇ Groundwater depth encountered on completion of drilling: **4.4 m**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 6

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4781386N; 621638E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **22 Jul 16** Date Completed: **22 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value			Penetration Testing			
								○ SPT ● DCPT			
Geodetic Ground Surface Elevation:								MTO Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould	△ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400		
								* Undrained Shear Strength (kPa) 20 40 60 80	Atterberg Limits W _p W W _L Plastic Liquid ○ Water Content (%) 20 40 60 80		
	PAVEMENT STRUCTURE 250 mm Asphalt over 230 mm Granular Fill										
	0.3	SS	1	100	50+				2		
	FILL Brown Silty Sand trace gravel and clay moist										
	0.5										
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpI stiff	SS	2	42	14	1			16		
	WEATHERED SHALE Reddish brown moist very dense										
	1.4	SS	3	100	50/10			50 10	10		

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☐ No freestanding groundwater measured in open borehole on completion of drilling.

☐ Cave in depth after removal of augers: 3.8 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 7

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4781278N; 621738E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **20 Jul 16** Date Completed: **20 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation: PAVEMENT STRUCTURE 300 mm Asphalt over 300 mm Granular Fill										
	0.3	SS	1	56	62						
	0.6	SS	2	33	10	1					
	FILL dark brown and brown Clayey Silt mottled trace gravel and sand apl										
	2.2	SS	3	21	8	2					
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpf stiff										
	3.4	SS	4	42	12	3					
	WEATHERED SHALE Reddish brown moist very dense										
	4.6	SS	5	53	50/13	4					
	End of Borehole										
	4.6	SS	6	100	50/8						

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☐ No freestanding groundwater measured in open borehole on completion of drilling.

☐ Cave in depth after removal of augers: **4.3 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 8

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4781254N; 621781E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **20 Jul 16** Date Completed: **20 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 300 mm Asphalt over 250 mm Granular Fill										
	0.3										
	FILL reddish brown and brown Clayey Silt mottled trace gravel and sand apl	SS	1	44	33			○	2		
	0.6										
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpl stiff	SS	2	44	14	1		○	16		
	0.9										
	WEATHERED SHALE Reddish brown moist very dense	SS	3	64	50/13	1.7		50 13	9		
	2										
	3										
	SS	4	100	50/13				50 13	8		
	3										
	SS	5	100	50/13				50 13	8		
	End of Borehole					3.2					

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☐ No freestanding groundwater measured in open borehole on completion of drilling.

☐ Cave in depth after removal of augers: 2.7 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 9

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4781229N; 621857E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **20 Jul 16** Date Completed: **20 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT	MTO Vane* ▲ Intact ◆ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Lab Testing ▲ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80	
	Geodetic Ground Surface Elevation:										GR SA SI CL
	PAVEMENT STRUCTURE 300 mm Asphalt over 200 mm Granular Fill										
	0.3	SS	1	55	50+			○	○ ₄		
	FILL dark brown and brown Clayey Silt mottled trace gravel and sand apl firm										
	0.5	SS	2	42	7	1		○	○ ₁₆		
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpl very stiff										
	1.6	SS	3	38	30	2		○	○ ₁₃		
		SS	4	35	50/13			50 ○ ₁₃	○ ₁₁		
	WEATHERED SHALE Reddish brown moist very dense										
	2.6										
	End of Borehole	SS	5	100	50/15	3		50 ○ ₁₅	○ ₉		
	3.2										

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∞ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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Project Number: **TG163020**

Project Client: **Kerry T. Howe Engineering Ltd.**

Project Name: **GI - Road and Drainage Improvements**

Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**

Drilling Location: **4781189N; 621843E**

Drilling Method:	150 mm Solid Stem Augers		
Drilling Machine:	Truck Mounted Drill		
Date Started:	20 Jul 16	Date Completed:	20 Jul 16
Logged by:	DN	Compiled by:	DN
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▽ No freestanding groundwater measured in open borehole on completion of drilling.

■ Cave in depth after removal of augers: 2.7 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 11

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4781142N; 622069E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **20 Jul 16** Date Completed: **20 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Δ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 300 mm Asphalt over 300 mm Granular Fill										
	0.3	SS	1	100	50+			○	○ ₃		
	FILL Brown Clayey Silt mottled trace gravel and sand dtpl very stiff to stiff										
	0.7	SS	2	25	24	1		○	○ ₇		
		SS	3	38	9	2		○	○ ₁₉		
	CLAYEY SILT TILL Reddish brown some gravel and sand wet seams at 3.0 m ± apl very stiff										
	2.4	SS	4	46	10			○	○ ₁₉		
						3					
		SS	5	42	19			○	○ ₁₄		
	WEATHERED SHALE Reddish brown moist very dense										
	3.8					4					
								■			
	End of Borehole	SS	6	100	50/8			○ ₅₀ ○ ₈	○ ₆		
	4.6										

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∇ No freestanding groundwater measured in open borehole on completion of drilling. ■ Cave in depth after removal of augers: 4.4 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 12

Project Number: TG163020
 Project Client: Kerry T. Howe Engineering Ltd.
 Project Name: GI - Road and Drainage Improvements
 Project Location: Regional Road 81 (King Street), Lincoln, Ontario
 Drilling Location: 4781112N; 622126E

Drilling Method: 150 mm Solid Stem Augers
 Drilling Machine: Truck Mounted Drill
 Date Started: 20 Jul 16 Date Completed: 20 Jul 16
 Logged by: DN Compiled by: DN
 Reviewed by: MP Revision No.: 0, 1/9/16



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 300 mm Asphalt over 300 mm Granular Fill										
	0.3	SS	1	39	42			○	○ ₃		
	FILL Brown Silty Sand trace gravel moist										
	0.6										
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpI very stiff	SS	2	42	21	1		○	○ ₁₂		
	0.9										
	WEATHERED SHALE Reddish brown moist very dense	SS	3	100	50/15			50 ○ 15	○ ₁₀		
	1.4										
						2					
		SS	4	59	50/13			50 ○ 13	○ ₈		
						3		50 ○ 10	○ ₇		
	End of Borehole	SS	5	100	50/10						
	3.1										

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☐ No freestanding groundwater measured in open borehole on completion of drilling. ☐ Cave in depth after removal of augers: 2.7 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 13

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4781064N; 622220E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **19 Jul 16** Date Completed: **19 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Δ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 230 mm Asphalt over 430 mm Granular Fill										
	0.2	SS	1	50	66						
	FILL dark brown and brown Clayey Silt mottled trace gravel and sand apl firm	SS	2	46	8	1					
	0.7										
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpl hard	SS	3	38	38	2					
	1.4										
	WEATHERED SHALE Reddish brown moist very dense	SS	4	38	65	3					
	2.6										
		SS	5	100	50/10	3					
	End of Borehole	SS	6	100	50/5	4.6					
	4.6										

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☐ No freestanding groundwater measured in open borehole on completion of drilling. ☐ Cave in depth after removal of augers: 4.3 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 14

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4781045N; 622299E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **21 Jul 16** Date Completed: **21 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 300 mm Asphalt over 230 mm Granular Fill										
	FILL dark brown and brown Clayey Silt mottled trace gravel and sand apl stiff	SS	1	33	37			○	○ ₃		
		SS	2	33	13	1		○	○ ₁₆		
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtp very stiff	SS	3	21	23	2		○	○ ₁₄		
		SS	4	33	26	3		○	○ ₁₆		
		SS	5	33	27	4		○	○ ₁₇		
	WEATHERED SHALE Reddish brown moist very dense	SS	6	100	50/13			○ ₅₀ ○ ₁₃	○ ₆		
	End of Borehole										

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☐ No freestanding groundwater measured in open borehole on completion of drilling. ☐ Cave in depth after removal of augers: 4.4 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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Project Number: **TG163020**

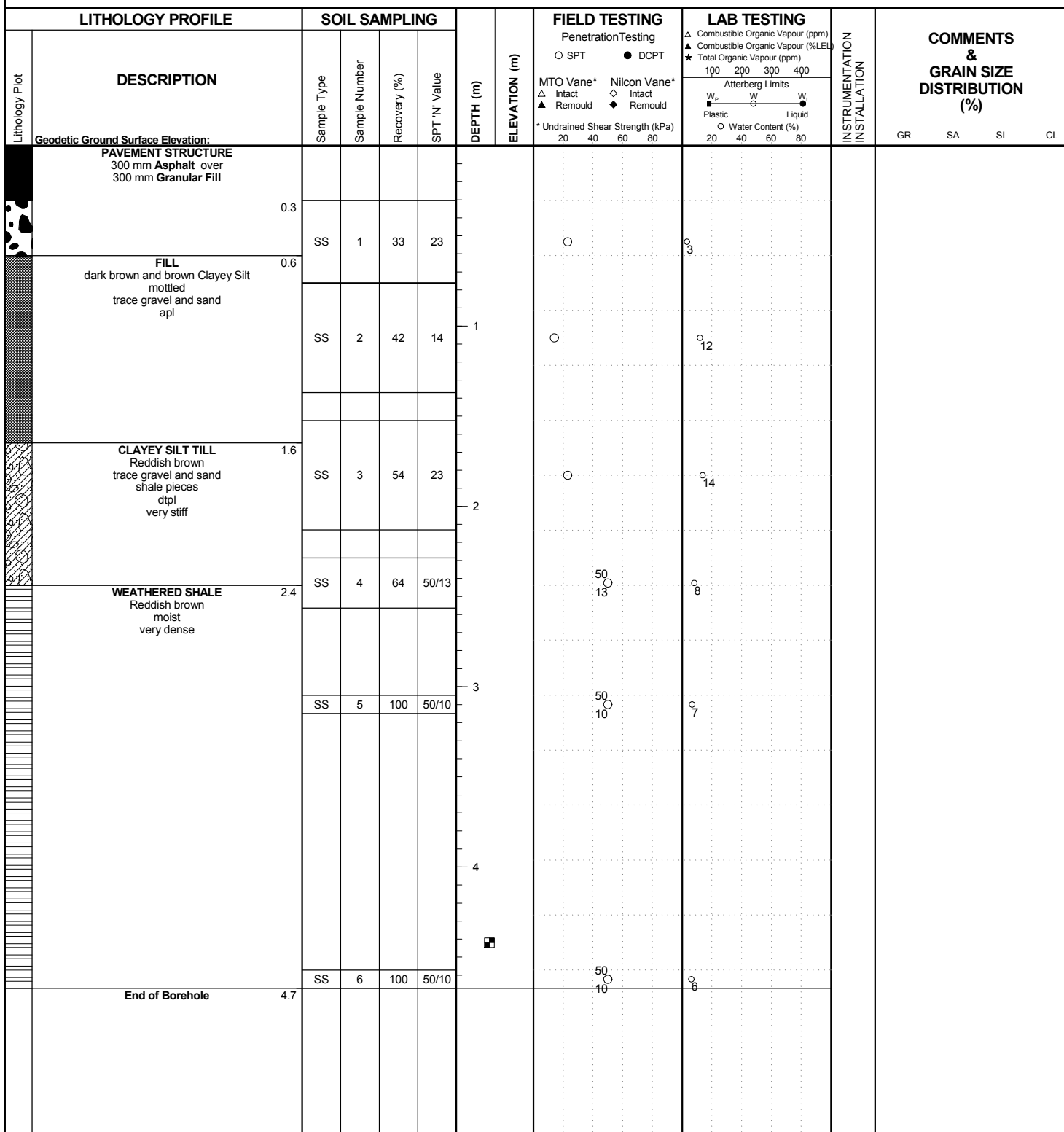
Project Client: **Kerry T. Howe Engineering Ltd.**

Project Name: **GI - Road and Drainage Improvements**

Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**

Drilling Location: **4780999N; 622415E**

Drilling Method:	150 mm Solid Stem Augers		
Drilling Machine:	Truck Mounted Drill		
Date Started:	19 Jul 16	Date Completed:	19 Jul 16
Logged by:	DN	Compiled by:	DN
Reviewed by:	MP	Revision No.:	0, 1/9/16



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▽ No freestanding groundwater measured in open borehole on completion of drilling.

■ Cave in depth after removal of augers: 4.4 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. 16

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4780958N; 622501E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **21 Jul 16** Date Completed: **21 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Δ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation: PAVEMENT STRUCTURE 300 mm Asphalt over 300 mm Granular Fill										
	0.3										
	FILL Reddish brown Silty Sand trace gravel and clay moist compact	SS	1	44	40			○	○ ₃		
	0.6										
		SS	2	38	14	1		○	○ ₃		
	1.4										
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpi	SS	3	35	50/13			○ ₅₀ ○ ₁₃	○ ₁₃		
	1.8										
	WEATHERED SHALE Reddish brown moist very dense					2					
						3					
		SS	4	45	63			○	○ ₁₁		
						4					
		AS	5						○ ₆		
	4.6										
	End of Borehole										

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∞ No freestanding groundwater measured in open borehole on completion of drilling.

■ Cave in depth after removal of augers: 4.3 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 31

Page: 1 of 1

Project Number: **TG163020**

Project Client: **Kerry T. Howe Engineering Ltd.**

Project Name: **GI - Road and Drainage Improvements**

Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**

Drilling Location: **4780929N; 622564E**

Drilling Method:	150 mm Solid Stem Augers		
Drilling Machine:	Truck Mounted Drill		
Date Started:	19 Jul 16	Date Completed:	19 Jul 16
Logged by:	DN	Compiled by:	DN
Reviewed by:	MP	Revision No.:	0, 1/9/16



LITHOLOGY PROFILE		SOIL SAMPLING			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value
	Geodetic Ground Surface Elevation:				
	PAVEMENT STRUCTURE 300 mm Asphalt over 230 mm Granular Fill				
	FILL dark brown and brown Clayey Silt mottled trace gravel and sand apl firm	SS	1	44	33
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpI very stiff	SS	2	29	7
	WEATHERED SHALE Reddish brown moist very dense	SS	3	38	22
		SS	4	100	50/15
		SS	5	100	50/5
		SS	6	100	50/3
	End of Borehole				

FIELD TESTING

Penetration Testing

- O SPT ● DCPT

MTO Vane* Nilcon Vane*

- △ Intact ◊ Intact
- ▲ Remould ◆ Remould

* Undrained Shear Strength (kPa)

20 40 60 80

LAB TESTING

- △ Combustible Organic Vapour (ppm)
- ▲ Combustible Organic Vapour (%LEL)
- ★ Total Organic Vapour (ppm)

Atterberg Limits

W_p W L

Plastic Liquid

○ Water Content (%)

20 40 60 80

**COMMENTS &
GRAIN SIZE DISTRIBUTION (%)**

GR SA SI CL

**Amec Foster Wheeler
Environment & Infrastructure**

3300 Merrittville Hwy, Unit 5
Thorold, Ontario L2V 4Y6
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Fax: (905) 687-6620
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▽ No freestanding groundwater measured in open borehole on completion of drilling.

■ Cave in depth after removal of augers: 4.3 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 31

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RECORD OF BOREHOLE No. 18

Project Number: TG163020
 Project Client: Kerry T. Howe Engineering Ltd.
 Project Name: GI - Road and Drainage Improvements
 Project Location: Regional Road 81 (King Street), Lincoln, Ontario
 Drilling Location: 4780867N; 622664E

Drilling Method: 150 mm Solid Stem Augers
 Drilling Machine: Truck Mounted Drill
 Date Started: 21 Jul 16 Date Completed: 21 Jul 16
 Logged by: DN Compiled by: DN
 Reviewed by: MP Revision No.: 0, 1/9/16



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT	MTO Vane* ▲ Intact ◆ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Nilcon Vane* ▲ Intact ◆ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 300 mm Asphalt over 510 mm Granular Fill	SS	1	100	50+	0.3		○		○ ₃	
	FILL Brown Silty Sand trace gravel and clay apl	SS	2	23	22	0.8	1	○		○ ₇	
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpi	SS	3	47	50/13	1.4		○ ₅₀ ○ ₁₃		○ ₁₄	
	WEATHERED SHALE Reddish brown moist very dense					1.8	2				
		SS	4	100	50/13		3	○ ₅₀ ○ ₁₃		○ ₈	
		AS	5				4			○ ₇	
	End of Borehole					4.6					

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☐ No freestanding groundwater measured in open borehole on completion of drilling. ☐ Cave in depth after removal of augers: 4.3 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 31
 Page: 1 of 1

Project Number: **TG163020**

Project Client: **Kerry T. Howe Engineering Ltd.**

Project Name: **GI - Road and Drainage Improvements**

Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**

Drilling Location: **4780820N; 622773E**

Drilling Method:	150 mm Solid Stem Augers		
Drilling Machine:	Truck Mounted Drill		
Date Started:	19 Jul 16	Date Completed:	19 Jul 16
Logged by:	DN	Compiled by:	DN
Reviewed by:	MP	Revision No.:	0, 1/9/16

[illegible]

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⚠ No freestanding groundwater measured in open borehole on completion of drilling.

■ Cave in depth after removal of augers: 4.4 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 31

Page: 1 of 1

RECORD OF BOREHOLE No. 20

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4780779N; 622853E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **21 Jul 16** Date Completed: **21 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Δ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation:										
	PAVEMENT STRUCTURE 300 mm Asphalt over 510 mm Granular Fill										
	0.3	SS	1	36	50+			○	○ ₂		
	FILL dark brown and brown Clayey Silt mottled trace gravel and sand apl stiff										
	0.8	SS	2	29	9	1		○	○ ₁₂		
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtp hard										
	2.2	SS	3	25	8	2		○	○ ₁₇		
	WEATHERED SHALE Reddish brown moist very dense										
	3.2	SS	4	38	31	3		○	○ ₁₃		
	End of Borehole										
	4.6	SS	5	41	50/13	4		50 ○ 13	○ ₁₂		
		AS	6						○ ₈		

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∞ No freestanding groundwater measured in open borehole on completion of drilling.

■ Cave in depth after removal of augers: 4.3 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 31

Page: 1 of 1

RECORD OF BOREHOLE No. 21

Project Number: **TG163020**
 Project Client: **Kerry T. Howe Engineering Ltd.**
 Project Name: **GI - Road and Drainage Improvements**
 Project Location: **Regional Road 81 (King Street), Lincoln, Ontario**
 Drilling Location: **4780739N; 622959E**

Drilling Method: **150 mm Solid Stem Augers**
 Drilling Machine: **Truck Mounted Drill**
 Date Started: **19 Jul 16** Date Completed: **19 Jul 16**
 Logged by: **DN** Compiled by: **DN**
 Reviewed by: **MP** Revision No.: **0, 1/9/16**



LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* ▲ Intact ▲ Intact △ Remould △ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Lab Testing ▲ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ★ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits W _p W _L W _u Plastic Liquid ○ Water Content (%) 20 40 60 80		
	Geodetic Ground Surface Elevation: PAVEMENT STRUCTURE 300 mm Asphalt over 300 mm Granular Fill	SS	1	0							
	FILL dark brown and brown Clayey Silt mottled trace gravel and clay apl stiff	SS	2	0	13	1		○	○ ₄		
	CLAYEY SILT TILL Reddish brown trace gravel and sand shale pieces dtpl hard	SS	3	50	46	2		○	○ ₁₆		
	WEATHERED SHALE Reddish brown moist very dense	SS	4	100	50/13	3		50 13	○ ₇		
		SS	5	100	50/13	3		50 13	○ ₇		
		SS	6	0	50/13	4		50 13	○ ₇		
	End of Borehole					4.7					

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∞ No freestanding groundwater measured in open borehole on completion of drilling.

■ Cave in depth after removal of augers: **4.3 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 31

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APPENDIX B

Certificate of Analysis

Amec Foster Wheeler (Thorold)

3300 Merrittville Hwy. Unit 5
Thorold, ON L2V 4Y6
Attn: Deanna Gemmell

Client PO:
Project: TG163020
Custody: 26455/26594/595/454/29179/29180/181/29226

Report Date: 27-Jul-2016
Order Date: 21-Jul-2016

Order #: 1630315

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1630315-01	Composite BH-7
1630315-02	Composite BH-8
1630315-03	Composite BH-9
1630315-04	Composite BH-10
1630315-05	Composite BH-11
1630315-06	Composite BH-12
1630315-07	Composite BH-13
1630315-08	Composite BH-15
1630315-09	Composite BH-17
1630315-10	Composite BH-19
1630315-11	Composite BH-21

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Amec Foster Wheeler (Thorold)
Client PO:

Report Date: 27-Jul-2016

Order Date: 21-Jul-2016

Project Description: TG163020

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Conductivity	MOE E3138 - probe @25 °C, water ext	23-Jul-16	23-Jul-16
Cyanide, free	MOE E3015 - Auto Colour, water extraction	22-Jul-16	27-Jul-16
Mercury by CVAA	EPA 7471B - CVAA, digestion	25-Jul-16	25-Jul-16
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	22-Jul-16	23-Jul-16
REG 153: Metals by ICP/OES, soil	based on MOE E3470, ICP-OES	25-Jul-16	25-Jul-16
SAR	Calculation	25-Jul-16	27-Jul-16
Solids, %	Gravimetric, calculation	26-Jul-16	26-Jul-16

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 27-Jul-2016

Order Date: 21-Jul-2016

Project Description: TG163020

Client ID:	Composite BH-7	Composite BH-8	Composite BH-9	Composite BH-10
Sample Date:	20-Jul-16	20-Jul-16	20-Jul-16	20-Jul-16
Sample ID:	1630315-01	1630315-02	1630315-03	1630315-04
MDL/Units	Soil	Soil	Soil	Soil

Physical Characteristics

% Solids	0.1 % by Wt.	89.0	91.0	88.7	90.2
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General Inorganics

SAR	0.01 N/A	9.30	13.5	6.92	3.41
Conductivity	5 uS/cm	1320	1270	1500	528
Cyanide, free	0.03 ug/g dry	<0.03	<0.03	<0.03	<0.03
pH	0.05 pH Units	7.68	7.75	7.67	7.43

Metals

Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Arsenic	1.0 ug/g dry	5.3	5.0	4.0	5.1
Barium	1.0 ug/g dry	99.7	119	95.1	120
Beryllium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Boron	1.0 ug/g dry	22.9	22.1	21.7	22.7
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	20.6	20.7	19.1	23.5
Cobalt	1.0 ug/g dry	11.5	11.3	11.0	12.1
Copper	1.0 ug/g dry	10.1	9.9	8.5	10.0
Lead	1.0 ug/g dry	8.5	10.9	9.3	11.9
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Molybdenum	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Nickel	1.0 ug/g dry	25.0	25.0	23.7	26.5
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Silver	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Uranium	1.0 ug/g dry	2.3	2.8	2.9	2.5
Vanadium	1.0 ug/g dry	26.8	26.2	24.5	28.2
Zinc	1.0 ug/g dry	49.9	52.3	46.1	72.4

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 27-Jul-2016

Order Date: 21-Jul-2016

Project Description: TG163020

	Client ID:	Composite BH-11	Composite BH-12	Composite BH-13	Composite BH-15
	Sample Date:	20-Jul-16	20-Jul-16	20-Jul-16	20-Jul-16
	Sample ID:	1630315-05	1630315-06	1630315-07	1630315-08
	MDL/Units	Soil	Soil	Soil	Soil

Physical Characteristics

% Solids	0.1 % by Wt.	86.6	91.0	90.1	91.2
----------	--------------	------	------	------	------

General Inorganics

SAR	0.01 N/A	11.2	7.94	11.9	10.5
Conductivity	5 uS/cm	1580	691	2480	1660
Cyanide, free	0.03 ug/g dry	<0.03	<0.03	<0.03	<0.03
pH	0.05 pH Units	7.39	7.68	7.76	7.75

Metals

Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Arsenic	1.0 ug/g dry	4.0	4.9	3.6	4.8
Barium	1.0 ug/g dry	70.2	90.6	94.1	83.9
Beryllium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Boron	1.0 ug/g dry	21.9	25.6	26.2	23.7
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	20.7	21.5	20.5	21.3
Cobalt	1.0 ug/g dry	10.9	11.8	11.1	12.0
Copper	1.0 ug/g dry	15.9	9.1	7.4	8.2
Lead	1.0 ug/g dry	14.6	8.5	8.2	11.0
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Molybdenum	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Nickel	1.0 ug/g dry	24.4	26.3	24.4	26.2
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Silver	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Uranium	1.0 ug/g dry	2.3	2.6	2.3	2.7
Vanadium	1.0 ug/g dry	26.5	31.5	27.5	25.7
Zinc	1.0 ug/g dry	80.3	53.1	46.9	51.7

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 27-Jul-2016

Order Date: 21-Jul-2016

Project Description: TG163020

Client ID:	Composite BH-17	Composite BH-19	Composite BH-21	-
Sample Date:	20-Jul-16	20-Jul-16	20-Jul-16	-
Sample ID:	1630315-09	1630315-10	1630315-11	-
MDL/Units	Soil	Soil	Soil	-

Physical Characteristics

% Solids	0.1 % by Wt.	90.4	91.5	90.9	-
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General Inorganics

SAR	0.01 N/A	5.34	4.18	5.29	-
Conductivity	5 uS/cm	930	1310	1040	-
Cyanide, free	0.03 ug/g dry	<0.03	<0.03	<0.03	-
pH	0.05 pH Units	7.64	7.86	7.85	-

Metals

Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Arsenic	1.0 ug/g dry	4.5	5.3	5.1	-
Barium	1.0 ug/g dry	102	97.9	95.5	-
Beryllium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Boron	1.0 ug/g dry	20.8	22.0	27.4	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	-
Chromium	1.0 ug/g dry	23.1	22.9	22.2	-
Cobalt	1.0 ug/g dry	12.7	13.1	12.3	-
Copper	1.0 ug/g dry	8.2	8.2	6.7	-
Lead	1.0 ug/g dry	9.6	11.4	10.4	-
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	-
Molybdenum	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Nickel	1.0 ug/g dry	28.0	28.6	27.8	-
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Silver	0.5 ug/g dry	<0.5	<0.5	<0.5	-
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Uranium	1.0 ug/g dry	3.0	3.0	3.0	-
Vanadium	1.0 ug/g dry	26.4	27.3	28.1	-
Zinc	1.0 ug/g dry	54.1	55.7	55.4	-

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 27-Jul-2016

Order Date: 21-Jul-2016

Project Description: TG163020

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
---------	--------	-----------------	-------	---------------	------	------------	-----	-----------	-------

General Inorganics

Conductivity	ND	5	uS/cm						
Cyanide, free	ND	0.03	ug/g						

Metals

Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	1.0	ug/g						
Boron	ND	1.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium	ND	1.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	1.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	1.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.5	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	1.0	ug/g						
Zinc	ND	1.0	ug/g						

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 27-Jul-2016

Order Date: 21-Jul-2016

Project Description: TG163020

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
SAR	14.0	0.01	N/A	13.5			3.4	200	
Conductivity	1260	5	uS/cm	1270			0.2	6.2	
Cyanide, free	ND	0.03	ug/g dry	ND				35	
pH	7.27	0.05	pH Units	7.27			0.0	10	
Metals									
Antimony	ND	1.0	ug/g dry	ND				30	
Arsenic	5.02	1.0	ug/g dry	5.30			5.4	30	
Barium	105	1.0	ug/g dry	99.7			5.5	30	
Beryllium	ND	1.0	ug/g dry	ND			0.0	30	
Boron	24.1	1.0	ug/g dry	22.9			5.4	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	21.7	1.0	ug/g dry	20.6			5.1	30	
Cobalt	11.9	1.0	ug/g dry	11.5			3.0	30	
Copper	10.6	1.0	ug/g dry	10.1			4.8	30	
Lead	9.09	1.0	ug/g dry	8.52			6.4	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	26.7	1.0	ug/g dry	25.0			6.8	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.5	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND				30	
Uranium	2.78	1.0	ug/g dry	2.27			20.0	30	
Vanadium	28.3	1.0	ug/g dry	26.8			5.3	30	
Zinc	51.5	1.0	ug/g dry	49.9			3.1	30	
Physical Characteristics									
% Solids	91.7	0.1	% by Wt.	88.2			3.8	25	

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 27-Jul-2016

Order Date: 21-Jul-2016

Project Description: TG163020

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Cyanide, free	0.297	0.03	ug/g	ND	98.9	70-130			
Metals									
Antimony	230		ug/L	ND	92.0	70-130			
Arsenic	322		ug/L	106	86.3	70-130			
Barium	2200		ug/L	1990	82.4	70-130			
Beryllium	199		ug/L	1.22	79.1	70-130			
Boron	675		ug/L	457	87.2	70-130			
Cadmium	196		ug/L	1.79	77.8	70-130			
Chromium	601		ug/L	413	75.2	70-130			
Cobalt	415		ug/L	230	74.1	70-130			
Copper	410		ug/L	202	83.2	70-130			
Lead	359		ug/L	170	75.3	70-130			
Mercury	1.29	0.1	ug/g	ND	86.1	70-130			
Molybdenum	208		ug/L	12.9	78.0	70-130			
Nickel	681		ug/L	499	72.7	70-130			
Selenium	164		ug/L	4.38	63.8	70-130			QM-07
Silver	190		ug/L	0.89	75.5	70-130			
Thallium	184		ug/L	18.1	66.4	70-130			QM-07
Uranium	233		ug/L	45.5	74.9	70-130			
Vanadium	744		ug/L	536	83.2	70-130			
Zinc	212		ug/L	ND	84.9	70-130			

Certificate of Analysis
Client: Amec Foster Wheeler (Thorold)
Client PO:

Report Date: 27-Jul-2016

Order Date: 21-Jul-2016

Project Description: TG163020

Qualifier Notes:***QC Qualifiers :***

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

Client Name: <i>Ance</i>	Project Reference: <i>TG 163020</i>	TAT: ☒ Regular ☐ 3 Day
Contact Name: <i>Deanna Gennell</i>	Quote # <i>Ties 2</i>	☐ 2 Day ☐ 1 Day
Address: <i>5-8300 Merrivale Hwy Thred ON L2V 4K6</i>	PO #	Date Required: _____
Telephone: <i>905 687 6616</i>	Email Address: <i>deanna.gennell@ance.com</i>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + n-oxides	Hg	EC	SPR	cyanide (green)	PH						
Sample ID/Location Name					Date	Time												
1	BH 7-2d 250ml+250ml	S		2	July 20/16	11:40												
2	7-2c 250ml			1		L	X	X	X	X	X	X	Composite BH-7 (7-2c, 7-4c, 7-5c + 7-6c)					
3	7-4d 250ml+250ml			2		11:25												
4	7-4c 250ml			1		L	X	X	X	X	X	X						
5	7-5c			1		11:40	X	X	X	X	X	X						
6	7-6c			1		12:05	X	X	X	X	X	X						
7	BH 8-2d 250ml+250ml			2		12:40							See page 2					
8	8-2c 250ml			1		12:40	X	X	X	X	X	X						
9	8-3d 250ml+250ml			2		12:45												
10	8-3c 250ml			1		L	X	X	X	X	X	X						

Comments: *Governed by SW 0.7603* Please composite selected samples, one
Hold samples for future analysis composite sample per Borehole.

Method of Delivery:

P/LUP

Relinquished By (Sign): <i>[Signature]</i>	Received by Driver/Depot: <i>Diagara</i>	Received at Lab: <i>SUNEPORN DOKMAI</i>	Verified By: <i>[Signature]</i>
Relinquished By (Print): <i>Paul G. G. G.</i>	Date/Time: <i>July 16 14:00</i>	Date/Time: <i>July 22 2016 11:30</i>	Date/Time: <i>July 22/16 12:32</i>
Date/Time: <i>July 21/16</i>	Temperature: <i>20.6°C</i>	Temperature: <i>10.4°C</i>	pH Verified ☒ By: <i>NA</i>

Client Name: <i>Amce</i>	Project Reference: <i>TG-163020</i>	TAT: ☒ Regular [] 3 Day
Contact Name: <i>Deanna Gemmell</i>	Quote # <i>Ties 2</i>	[] 2 Day [] 1 Day
Address: <i>5-3306 Merrittville Hwy Shred ON L2V 4K6</i>	PO #	Date Required: _____
Telephone: <i>905 687 6611</i>	Email Address: <i>deanna.gemmell@amcelincan</i>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 [] RSC Filing [] O. Reg. 558/00 [] PWQO [] CCME [] SUB (Storm) [] SUB (Sanitary) Municipality: _____ [] Other: _____

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrides	Hg	EC	SPR	cyanide (free)	pH							
Sample ID/Location Name					Date	Time													
1	BH-8-4c 250ml	S		1	July 20th	100	X	X	X	X	X	X	2 Composite BH-8 (8-2c, 8-3c, 8-4c 8-5c)						
2	8-5c ↓			1		115	X	X	X	X	X	X							
3	BH-9-2d 250ml + 250ml			2		10:10													
4	9-2c 250ml			1		↓	X	X	X	X	X	X	3 Composite BH-9 (9-2c, 9-3c, 9-4c 9-5c)						
5	9-3d 250ml + 250ml			2		10:15													
6	9-3c 250ml			1		↓	X	X	X	X	X	X							
7	9-4c ↓			1		10:25	X	X	X	X	X	X							
8	9-5c ↓			1		10:35	X	X	X	X	X	X							
9	BH-10-2d 250ml + 250ml			2		10:45													
10	10-2c 250ml	1/1		1	✓	E	X	X	X	X	X	X	→ See Page 3						

Comments: *see pg 1*

Method of Delivery:
PIUP

Relinquished By (Sign): <i>[Signature]</i>	Received by Driver/Depot: <i>Niagara</i>	Received at Lab: <i>SUMTEPORN</i>	Verified By: <i>[Signature]</i>
Relinquished By (Print): <i>Mike Sedel</i>	Date/Time: <i>July 20/16 14:28</i>	Date/Time: <i>July 22/16 11:20</i>	Date/Time: <i>July 22/16 12:32</i>
Date/Time: <i>July 20/16</i>	Temperature: <i>26.6 °C</i>	Temperature: <i>10.4 °C</i>	pH Verified ☒ By: <i>AA</i>

Client Name: <i>Amec</i>	Project Reference: <i>TG-163020</i>	TAT: ☒ Regular ☐ 3 Day
Contact Name: <i>Deema Gemmell</i>	Quote #: <i>Tier 2</i>	☐ 2 Day ☐ 1 Day
Address: <i>5-3300 Merrittville Hwy, Thred ON L2V 4K6</i>	PO #	Date Required: _____
Telephone: <i>905 887 0116</i>	Email Address: <i>deemagemmell@amec.com</i>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrides	Hg	EC	SAR	cyanide (Free)	pH							
Sample ID/Location Name					Date	Time													
1	BH 10-3d 250ml+1 vial	5		2	July 20/16	1:55													
2	10-3c 250ml			1	↓	↓	X	X	X	X	X	X	} Composite BH-10 (10-2c, 10-3c, 10-4c + 10-5c)						
3	10-4c ↓			1	↓	2:05	X	X	X	X	X	X							
4	10-5c ↓			1	↓	2:15	X	X	X	X	X	X							
5	BH 11-2d 250ml+ 2 vial			2		9:10							} Composite BH-11 (11-2c, 11-3c, 11-4c + 11-5c + 11-6c)						
6	11-2c 250ml			1	↓	↓	X	X	X	X	X	X							
7	11-3d 250ml+ 2 vial			2	↓	9:13													
8	11-3c 250ml			1	↓	↓	X	X	X	X	X	X	} 11-5c + 11-6c						
9	11-4d 250ml+ 1 vial			2	↓	9:25													
10	11-4c 250ml			1	↓	↓	X	X	X	X	X	X							

Comments: <i>see 081</i>	Method of Delivery: <i>P/LUP</i>
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Relinquished By (Sign): <i>[Signature]</i>	Received by Driver/Depot: <i>Niagara Blomeniee</i>	Received at Lab: <i>SUMEPORN POKMA</i>	Verified By: <i>[Signature]</i>
Relinquished By (Print): <i>Mark Seckel</i>	Date/Time: <i>21 July 16 14:45</i>	Date/Time: <i>JUL 22 2016 11:30</i>	Date/Time: <i>JUL 22 16 12:32</i>
Date/Time: <i>July 21/16</i>	Temperature: <i>26.6°C</i>	Temperature: <i>10.4°C</i>	pH Verified ☒ By: <i>NA</i>

Client Name: <i>Amei</i>	Project Reference: <i>16168020</i>	TAT: ☒ Regular ☐ 3 Day
Contact Name: <i>Deanna Gennett</i>	Quote # <i>Tier 2</i>	☐ 2 Day ☐ 1 Day
Address: <i>5-3300 Marchmont Hwy Thrd</i>	PO #	Date Required: _____
Telephone: <i>905 687 6616</i>	Email Address: <i>deanna.gennett@amei.ca</i>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

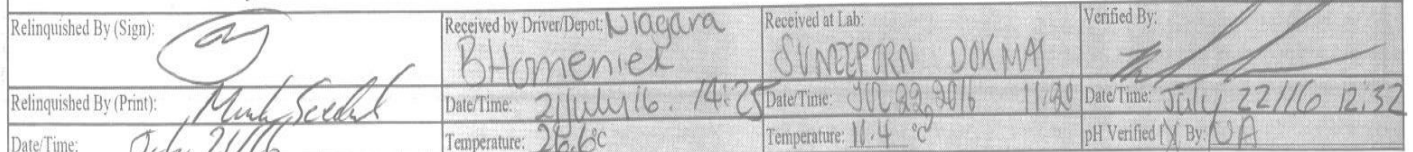
Parcel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + nutrients	Hg	EC	SAR	cyanide (free)	pH						
Sample ID/Location Name					Date	Time												
1	BH 11-5C 250ml	S		1	J. 1/20	930	X	X	X	X	X	X	} See page 3 (Composite 11)					
2	11-6C ↓			1		945	X	X	X	X	X	X						
3	BH 12-2d 250ml + 1vial			2		315												
4	12-2C ↓			1		320	X	X	X	X	X	X	} Composite BH 12 (12-2C, 12-3C, 12-4C + 12-5C)					
5	12-3C 250ml + 1vial			2		330												
6	12-3C 250ml			1		330	X	X	X	X	X	X						
7	12-4C ↓			1		330	X	X	X	X	X	X						
8	12-5C ↓			1		345	X	X	X	X	X	X						
9	BH 13-2d 250ml + 1vial			2		245												
10	13-2C 250ml	C		1		245	X	X	X	X	X	X	→ See page 5					

Comments: *seeps 1*

Method of Delivery:

Pickup

Relinquished By (Sign): <i>[Signature]</i>	Received by Driver/Depot: <i>Niagara Blomenier</i>	Received at Lab: <i>Sumerborn DAKMA</i>	Verified By: <i>[Signature]</i>
Relinquished By (Print): <i>Mike S. [Signature]</i>	Date/Time: <i>21 July 16 14:45</i>	Date/Time: <i>July 22, 2016 11:20</i>	Date/Time: <i>July 22/16 12:32</i>
Date/Time: <i>July 24/16</i>	Temperature: <i>26.6°C</i>	Temperature: <i>10.4°C</i>	pH Verified ☒ By: <i>[Signature]</i>



Client Name: <u>Amec</u>	Project Reference: <u>TE163020</u>	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required: _____
Contact Name: <u>Deanna Gernell</u>	Quote # <u>T102</u>	
Address: <u>5-3300 Merivale Rd. #100</u> <u>ON L2W 4L6</u>	PO #	
Telephone: <u>905 687 6616</u>	Email Address: <u>deanna.gernell@amec.com</u>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number: 1630315			Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrides	Hg	EC	SPR	cyanide free	pH						
Sample ID/Location Name						Date	Time												
1	BH 15-5c 250ml		5		1	July 21	120	X	X	X	X	X	X	} See page 5					
2	15-6c ↓				1		204	X	X	X	X	X	X						
3	BH 17-2d 250ml + 1vid				2		1120												
4	17-2c 250ml				1		↓	X	X	X	X	X	X	} Composite BH-17 (17-2c, 17-3c, 17-4c, 17-5c, 17-6c)					
5	17-3c 250ml + 1vid				2		1130												
6	17-3c 250ml				1		↓	X	X	X	X	X	X						
7	17-4c ↓				1		1140	X	X	X	X	X	X						
8	17-5c ↓				1		1205	X	X	X	X	X	X						
9	17-6c ↓				1		1205	X	X	X	X	X	X						
10	BH 14-2d 250ml + 1vid				2		1015												

Comments: <u>see pg 1</u>	Method of Delivery: <u>PUP</u>
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Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>Niagara</u> <u>BHomenice</u>	Received at Lab: <u>SUNEERPN</u> <u>DOXMAJ</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>Paul Sedick</u>	Date/Time: <u>21 July 16 11:45</u>	Date/Time: <u>JUL 22 2016 11:30</u>	Date/Time: <u>July 22/16 12:32</u>
Date/Time: <u>July 21/16</u>	Temperature: <u>26.6°C</u>	Temperature: <u>10.4°C</u>	pH Verified ☒ By: <u>NA</u>

Client Name: <i>Amec</i>	Project Reference: <i>T66320</i>	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required: _____
Contact Name: <i>Deanna Gemmill</i>	Quote # <i>Tier 2</i>	
Address: <i>5-3300 Flemington Ave Shawville ON L7C 4E8</i>	PO #	
Telephone: <i>905 687 6666</i>	Email Address: <i>deanna.gemmill@amec.com</i>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydroxides	Hg	EC	SAR	cyanide (free)	pH							
Sample ID/Location Name					Date	Time													
1	BH 19-2c 250ml	S		1	July 20/16	1015	X	X	X	X	X	X	Composite BH-19 (19-2c, 19-3Ac, 19-4c, 19-5c, 19-6c + 19-3Ac)						
2	19-3Ad 250ml + 1ml			2		1020													
3	19-3Ac 250ml			1		L	X	X	X	X	X	X							
4	19-4c			1		1030	X	X	X	X	X	X							
5	19-5c			1		1040	X	X	X	X	X	X							
6	19-6c	C		1		1055	X	X	X	X	X	X							
7	BH 19-3b 250ml + 1ml			2		1020													
8	19-3b 250ml			1		1020	X	X	X	X	X	X							
9	BH 21-3d 250ml + 1ml			2		910													
10	21-3c 250ml	C		1		L	X	X	X	X	X	X	- See Page 8						

Comments:

suaps!

Method of Delivery:

PUP

Relinquished By (Sign): <i>[Signature]</i>	Received by Driver/Depot: <i>Niagara BHomenick</i>	Received at Lab: <i>SUNEPORN DOK MA</i>	Verified By: <i>[Signature]</i>
Relinquished By (Print): <i>Mark Seibel</i>	Date/Time: <i>21 June 16 14:45</i>	Date/Time: <i>July 22, 2016 17:30</i>	Date/Time: <i>July 22/16 12:32</i>
Date/Time: <i>July 21/16</i>	Temperature: <i>26.5</i>	Temperature: <i>10.4 °C</i>	pH Verified By: <i>NA</i>

Client Name: <i>Amec</i>	Project Reference: <i>TE163020</i>	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required: _____
Contact Name: <i>Deanna Semmler</i>	Quote: <i>T152</i>	
Address: <i>53300 Merrittville Dr Shred on 122 486</i>	PO #	
Telephone: <i>905 687 6008</i>	Email Address: <i>deanna.semmler@amec.com</i>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + nutrients	Hg	EC	SAR	copper (free)	pH						
Sample ID/Location Name					Date	Time												
1	BH 21-4d 250ml + 250ml	↓		2	July 20/16	920												
2	21-4c 250ml	↓		1	↓	920	X	X	X	X	X	X	2 Composite BH-2					
3	21-5c	↓		1	↓	925	X	X	X	X	X	X	3 (21-3c, 21-4c					
4	21-6c	↓		1	↓	940	X	X	X	X	X	X	) 21-5c + 21-6c)					
5																		
6																		
7																		
8																		
9																		
10																		

Comments:

Method of Delivery:

P149

Relinquished By (Sign): <i>[Signature]</i>	Received by Driver/Depot: <i>Niagara</i> <i>BHomenica</i>	Received at Lab: <i>SUNEPORN DOK MAI</i>	Verified By: <i>[Signature]</i>
Relinquished By (Print): <i>Mary Seibel</i>	Date/Time: <i>21 July 16 14:45</i>	Date/Time: <i>July 22, 2016 11:20</i>	Date/Time: <i>July 22/16 12:32</i>
Date/Time: <i>July 21/16</i>	Temperature: <i>26.6 °C</i>	Temperature: <i>10.4 °C</i>	pH Verified By: <i>NA</i>

Certificate of Analysis

Amec Foster Wheeler (Thorold)

3300 Merrittville Hwy. Unit 5
Thorold, ON L2V 4Y6
Attn: Deanna Gemmell

Client PO:
Project: TG163020
Custody: 109029/26518

Report Date: 28-Jul-2016
Order Date: 22-Jul-2016

Order #: 1630396

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1630396-01	Composite BH-2
1630396-02	Composite BH-6

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Amec Foster Wheeler (Thorold)
Client PO:

Report Date: 28-Jul-2016

Order Date: 22-Jul-2016

Project Description: TG163020

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Conductivity	MOE E3138 - probe @25 °C, water ext	26-Jul-16	26-Jul-16
Cyanide, free	MOE E3015 - Auto Colour, water extraction	25-Jul-16	27-Jul-16
Mercury by CVAA	EPA 7471B - CVAA, digestion	26-Jul-16	26-Jul-16
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	25-Jul-16	26-Jul-16
REG 153: Metals by ICP/OES, soil	based on MOE E3470, ICP-OES	26-Jul-16	26-Jul-16
SAR	Calculation	26-Jul-16	27-Jul-16
Solids, %	Gravimetric, calculation	26-Jul-16	26-Jul-16

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 28-Jul-2016

Order Date: 22-Jul-2016

Project Description: TG163020

Client ID:	Composite BH-2	Composite BH-6	-	-
Sample Date:	22-Jul-16	22-Jul-16	-	-
Sample ID:	1630396-01	1630396-02	-	-
MDL/Units	Soil	Soil	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	88.0	92.1	-	-
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General Inorganics

SAR	0.01 N/A	12.2	2.39	-	-
Conductivity	5 uS/cm	1580	342	-	-
Cyanide, free	0.03 ug/g dry	<0.03	<0.03	-	-
pH	0.05 pH Units	7.76	7.74	-	-

Metals

Antimony	1.0 ug/g dry	<1.0	<1.0	-	-
Arsenic	1.0 ug/g dry	6.6	7.6	-	-
Barium	1.0 ug/g dry	101	109	-	-
Beryllium	1.0 ug/g dry	<1.0	<1.0	-	-
Boron	1.0 ug/g dry	11.4	36.9	-	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	-	-
Chromium	1.0 ug/g dry	20.2	26.3	-	-
Cobalt	1.0 ug/g dry	10.7	14.7	-	-
Copper	1.0 ug/g dry	37.3	19.9	-	-
Lead	1.0 ug/g dry	12.0	14.2	-	-
Mercury	0.1 ug/g dry	<0.1	<0.1	-	-
Molybdenum	1.0 ug/g dry	<1.0	1.1	-	-
Nickel	1.0 ug/g dry	21.8	30.8	-	-
Selenium	1.0 ug/g dry	<1.0	<1.0	-	-
Silver	0.5 ug/g dry	<0.5	<0.5	-	-
Thallium	1.0 ug/g dry	<1.0	<1.0	-	-
Uranium	1.0 ug/g dry	<1.0	<1.0	-	-
Vanadium	1.0 ug/g dry	29.8	30.3	-	-
Zinc	1.0 ug/g dry	53.0	56.1	-	-

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 28-Jul-2016

Order Date: 22-Jul-2016

Project Description: TG163020

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
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General Inorganics

Conductivity	ND	5	uS/cm						
Cyanide, free	ND	0.03	ug/g						

Metals

Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	1.0	ug/g						
Boron	ND	1.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium	ND	1.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	1.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	1.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.5	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	1.0	ug/g						
Zinc	ND	1.0	ug/g						

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 28-Jul-2016

Order Date: 22-Jul-2016

Project Description: TG163020

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
SAR	3.31	0.01	N/A	3.21			3.1	200	
Conductivity	950	5	uS/cm	955			0.4	6.2	
Cyanide, free	ND	0.03	ug/g dry	ND				35	
pH	7.88	0.05	pH Units	7.88			0.0	10	
Metals									
Antimony	ND	1.0	ug/g dry	ND				30	
Arsenic	6.42	1.0	ug/g dry	6.55			2.1	30	
Barium	99.3	1.0	ug/g dry	101			1.4	30	
Beryllium	ND	1.0	ug/g dry	ND			0.0	30	
Boron	10.4	1.0	ug/g dry	11.4			9.6	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	19.7	1.0	ug/g dry	20.2			2.9	30	
Cobalt	10.6	1.0	ug/g dry	10.7			1.5	30	
Copper	36.6	1.0	ug/g dry	37.3			1.8	30	
Lead	11.7	1.0	ug/g dry	12.0			2.9	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	22.0	1.0	ug/g dry	21.8			1.1	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.5	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND				30	
Vanadium	28.9	1.0	ug/g dry	29.8			2.8	30	
Zinc	53.1	1.0	ug/g dry	53.0			0.3	30	
Physical Characteristics									
% Solids	91.7	0.1	% by Wt.	88.2			3.8	25	

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 28-Jul-2016

Order Date: 22-Jul-2016

Project Description: TG163020

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Cyanide, free	0.307	0.03	ug/g	ND	102	70-130			
Metals									
Antimony	271		ug/L	ND	108	70-130			
Arsenic	373		ug/L	131	96.8	70-130			
Barium	2140		ug/L	2010	48.9	70-130			QM-07
Beryllium	243		ug/L	1.06	96.6	70-130			
Boron	474		ug/L	228	98.4	70-130			
Cadmium	244		ug/L	ND	98.3	70-130			
Chromium	619		ug/L	405	85.8	70-130			
Cobalt	436		ug/L	215	88.5	70-130			
Copper	971		ug/L	745	90.1	70-130			
Lead	440		ug/L	240	79.9	70-130			
Mercury	1.44	0.1	ug/g	ND	96.2	70-130			
Molybdenum	233		ug/L	11.8	88.6	70-130			
Nickel	651		ug/L	436	86.0	70-130			
Selenium	234		ug/L	12.6	88.7	70-130			
Silver	239		ug/L	6.03	93.0	70-130			
Thallium	197		ug/L	16.9	72.0	70-130			
Uranium	263		ug/L	ND	105	70-130			
Vanadium	813		ug/L	595	87.2	70-130			
Zinc	1250		ug/L	1060	74.9	70-130			

Certificate of Analysis
Client: Amec Foster Wheeler (Thorold)
Client PO:

Report Date: 28-Jul-2016

Order Date: 22-Jul-2016

Project Description: TG163020

Qualifier Notes:

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

Client Name: Ameo Foster Wheeler	Project Reference: T 9163020	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required: _____
Contact Name: Deanna Gemmell	Quote # Tier 2	
Address: 3300 Marritville Highway, Thorold, Ontario	PO #	
Telephone: 905-687-6616	Email Address: deanna.gemmell@amer.com	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: ☒ S (Soil/Sed.) ☐ GW (Ground Water) ☐ SW (Surface Water) ☐ SS (Storm/Sanitary Sewer) ☐ P (Paint) ☐ A (Air) ☐ O (Other)

Required Analyses

Paracel Order Number: 1630396					Matrix	Air Volume	# of Containers	Sample Taken		PHCs F1-F4+BTEX	VOCs	PAHs	Metals As Cd Cr Cu Pb Se V Zn	Hg	CrVI	B (HWS)	EC	SAR	Cyanide Free	H					
Sample ID/Location Name								Date	Time																
1	BH 2-2d				S		2	July 23/16	9:00																
2	BH 2-2c						1		9:05				X	X			X	X	X	X					
3	BH 2-4d						2		9:15																
4	BH 2-4c						1		9:15				X	X			X	X	X	X					
5	BH 2-5d						2		9:20																
6	BH 2-5c						1		9:20				X	X			X	X	X	X					
7	BH 2-6c						1		9:25				X	X			X	X	X	X					
8	BH 6-2d						2		9:50																
9	BH 6-2c						1		9:50				X	X			X	X	X	X					
10	BH 6-3d				+		2	+	9:55																

Composite
BH 2
(2-2c, 2-4c
2-5c+2-6c)

→ see page 2

Comments: Governed by the terms + conditions of the agreement # SVA07-003.

Method of Delivery:

Please composite 1 sample per borehole, 2 samples total

per Ben. SC.

P/WUP

Relinquished By (Sign): [Signature]	Received by Driver/Depot: NIagara	Received at Lab: Mike	Verified By: [Signature]
Relinquished By (Print): Deanna Gemmell	Date/Time: 22 July 16 15:00	Date/Time: 23-July-16 11:35	Date/Time: July 23/16 01:20
Date/Time: July 22/16	Temperature: 29.4°C	Temperature: 18.9°C	pH Verified [] By: NA

Client Name: <u>Ame Foster Wheeler</u>	Project Reference: <u>TG163020</u>	TAT: ☒ Regular ☐ 3 Day
Contact Name: <u>Deanna Gemmell</u>	Quote # <u>Tier 2</u>	☐ 2 Day ☐ 1 Day
Address: <u>3300 Merrittville Highway, Thorold, Ontario</u>	PO #	Date Required:
Telephone: <u>905-687-6616</u>	Email Address: <u>deanna.gemmell@amec.com</u>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ☐ Other:

Matrix Type: ☒ Soil/Sed ☐ GW (Ground Water) ☐ SW (Surface Water) ☐ SS (Storm Sanitary Sewer) ☐ P (Paint) ☐ A (Air) ☐ O (Other)

Required Analyses

Parcel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrides	EC	SAR	organic (free)	Hg	pH								
Sample ID/Location Name					Date	Time														
1	BH-6-3c	S		1	July 22/16	10:10	X	X	X	X	X	X	} Composite BH6 (6-2c, 6-3c + 6-4c)							
2	BH6-4c	↓		1	↓	10:10	X	X	X	X	X	X								
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments: See page 1

Method of Delivery:

PUP

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>Nagana</u>	Received at Lab: <u>Mike</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>Deanna Gemmell</u>	Date/Time: <u>22 July 16 1500</u>	Date/Time: <u>23 July 16 11:35</u>	Date/Time: <u>26 July 16 16:20</u>
Date/Time: <u>July 22/16</u>	Temperature: <u>29.4°C</u>	Temperature: <u>16.9°C</u>	PH Verified ☐ By: <u>NA</u>

Certificate of Analysis

Amec Foster Wheeler (Thorold)

3300 Merrittville Hwy. Unit 5
Thorold, ON L2V 4Y6
Attn: Deanna Gemmell

Client PO:
Project: TG163020
Custody: 26455/29180

Report Date: 3-Aug-2016
Order Date: 29-Jul-2016

Order #: 1631367

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1631367-01	BH7-5c
1631367-02	BH17-5c

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis

Client: Amec Foster Wheeler (Thorold)

Client PO:

Report Date: 03-Aug-2016

Order Date: 29-Jul-2016

Project Description: TG163020

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	2-Aug-16	2-Aug-16
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	2-Aug-16	2-Aug-16
Solids, %	Gravimetric, calculation	29-Jul-16	29-Jul-16

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 03-Aug-2016
 Order Date: 29-Jul-2016
 Project Description: TG163020

Client ID:	BH7-5c	BH17-5c	-	-
Sample Date:	20-Jul-16	20-Jul-16	-	-
Sample ID:	1631367-01	1631367-02	-	-
MDL/Units	Soil	Soil	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	88.1	93.8	-	-
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General Inorganics

pH	0.05 pH Units	7.53	7.84	-	-
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Anions

Sulphate	5 ug/g dry	43	59	-	-
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Certificate of Analysis

Report Date: 03-Aug-2016

Client: Amec Foster Wheeler (Thorold)

Order Date: 29-Jul-2016

Client PO:

Project Description: TG163020

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
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Anions

Sulphate	ND	5	ug/g						
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Certificate of Analysis
Client: Amec Foster Wheeler (Thorold)
Client PO:

Report Date: 03-Aug-2016
Order Date: 29-Jul-2016
Project Description: TG163020

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Sulphate	38.8	5	ug/g dry	39.8			2.7	20	
General Inorganics									
pH	7.63	0.05	pH Units	7.63			0.0	10	
Physical Characteristics									
% Solids	93.4	0.1	% by Wt.	93.3			0.1	25	

Certificate of Analysis

Report Date: 03-Aug-2016

Client: Amec Foster Wheeler (Thorold)

Order Date: 29-Jul-2016

Client PO:

Project Description: TG163020

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions Sulphate	137	5	ug/g	39.8	97.3	78-111			

Certificate of Analysis
Client: Amec Foster Wheeler (Thorold)
Client PO:

Report Date: 03-Aug-2016
Order Date: 29-Jul-2016
Project Description: TG163020

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

Client Name: Amec Project Reference: TG 163020
Contact Name: Deanna Gennelle Quote # Tier 2
Address: 5-8300 Merrivale Hwy. Threlton PO #
ON L2V 4K6
Telephone: 905 687 6676 Email Address: deanna.gennelle@amec.ca

TAT: ☒ Regular ☐ 3 Day
☐ 12 Day ☐ 1 Day
Date Required: _____

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm Sanitary Sewer) P (Paint) A (Air) O (Other):

Required Analyses

Parcel Order Number: 1631367
1630315

Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrocarbons	Hg	EC	SAR	cyanide (free)	pH	sulphate
				Date	Time							
1 BH 7-2d 250ml (+ 100ml)	S		2	July 29/16	11:10							
2 7-2c 250ml			1		L	X	X	X	X	X	X	
3 7-4d 250ml (+ 100ml)			2		11:25							
4 7-4c 250ml			1		L	X	X	X	X	X	X	
5 7-5c			1		11:40	X	X	X	X	X	X	
6 7-6c			1		12:05	X	X	X	X	X	X	
7 BH 8-2d 250ml (+ 100ml)			2		12:40							
8 8-2c 250ml			1		12:40	X	X	X	X	X	X	
9 8-3d 250ml (+ 100ml)			2		12:45							
10 8-3c 250ml			1		L	X	X	X	X	X	X	

Revised
July 29/16
RS

Composite BH-7
(7-2c, 7-4c, 7-5c +
7-6c)

See page 2

Comments: Governed by SML 0.7603
Hold samples for future analysis

Please composite selected samples, one composite sample per Borehole.

Method of Delivery:

Pickup

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>Diagara</u>	Received at Lab: <u>SUNEPORN DOKMAT</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>Paul Gennelle</u>	Date/Time: <u>July 16 14:17</u>	Date/Time: <u>July 22 2016 11:30</u>	Date/Time: <u>July 22/16 12:32</u>
Date/Time: <u>July 21/16</u>	Temperature: <u>26.6</u>	Temperature: <u>10.4</u>	pH Verified By: <u>[Signature]</u>

July 29/16 12:00

Client Name: Amec
Contact Name: Deanna Gernell
Address: 5-3300 Merivale Rd. #100
ON L2W 4G6
Telephone: 905 687 6616

Project Reference: 76183020
Quote #: T152
PO #:
Email Address: deanna.gernell@amec.com

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ☐ Other:

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number: 1631367.
163035

Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrides	Hg	EC	SPR	cyanide free	pH	Sulphate
				Date	Time							
1 BH 15-5c 250ml	S		1	July 21	120	X	X	X	X	X	X	
2 15-6c			1		204	X	X	X	X	X	X	
3 BH 17-2d 250ml + 1vid			2		1120							
4 17-2c 250ml			1			X	X	X	X	X	X	
5 17-3d 250ml + 1vid			2		1130							
6 17-3c 250ml			1			X	X	X	X	X	X	
7 17-4c			1		1140	X	X	X	X	X	X	
8 17-5c			1		1150	X	X	X	X	X	X	
9 17-6c			1		1205	X	X	X	X	X	X	
10 BH 14-2d 250ml + 1vid			2		1015							

Comments: see os

Method of Delivery:

PUP

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>BNHomeniec</u>	Received at Lab: <u>SUNEPPORN DOKMA</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>Paul Sedes</u>	Date/Time: <u>21 July 16 11:45</u>	Date/Time: <u>July 22 2016 11:30</u>	Date/Time: <u>July 22 16 12:32</u>
Date/Time: <u>July 21/16</u>	Temperature: <u>26.6°C</u>	Temperature: <u>10.4°C</u>	pH Verified ☒ By: <u>NA</u>

July 29/16 12:00

Certificate of Analysis

Amec Foster Wheeler (Thorold)

3300 Merrittville Hwy. Unit 5
Thorold, ON L2V 4Y6
Attn: Deanna Gemmell

Client PO:
Project: TG163020
Custody: 30771/772/773/774/775/776

Report Date: 9-Aug-2016
Order Date: 3-Aug-2016

Order #: 1632130

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1632130-01	Composite BH-1
1632130-02	Composite BH-3
1632130-03	Composite BH-14
1632130-04	Composite BH-16
1632130-05	Composite BH-18
1632130-06	Composite BH-20

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Amec Foster Wheeler (Thorold)
Client PO:

Report Date: 09-Aug-2016
Order Date: 3-Aug-2016
Project Description: TG163020

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Conductivity	MOE E3138 - probe @25 °C, water ext	5-Aug-16	5-Aug-16
Cyanide, free	MOE E3015 - Auto Colour, water extraction	4-Aug-16	5-Aug-16
Mercury by CVAA	EPA 7471B - CVAA, digestion	8-Aug-16	8-Aug-16
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	6-Aug-16	6-Aug-16
REG 153: Metals by ICP/OES, soil	based on MOE E3470, ICP-OES	8-Aug-16	8-Aug-16
SAR	Calculation	8-Aug-16	8-Aug-16
Solids, %	Gravimetric, calculation	6-Aug-16	6-Aug-16

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 09-Aug-2016
 Order Date: 3-Aug-2016
 Project Description: TG163020

	Client ID:	Composite BH-1	Composite BH-3	Composite BH-14	Composite BH-16
	Sample Date:	21-Jul-16	21-Jul-16	21-Jul-16	21-Jul-16
	Sample ID:	1632130-01	1632130-02	1632130-03	1632130-04
	MDL/Units	Soil	Soil	Soil	Soil

Physical Characteristics

% Solids	0.1 % by Wt.	88.8	86.1	87.2	90.3
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General Inorganics

SAR	0.01 N/A	5.22	13.0	18.5	4.90
Conductivity	5 uS/cm	1340	1330	2460	707
Cyanide, free	0.03 ug/g dry	<0.03 [1]	<0.03 [1]	<0.03 [1]	<0.03 [1]
pH	0.05 pH Units	7.79	7.77	7.65	7.71

Metals

Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Arsenic	1.0 ug/g dry	5.8	7.2	3.2	3.9
Barium	1.0 ug/g dry	114	106	95.6	76.8
Beryllium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Boron	1.0 ug/g dry	10.8	10.3	27.2	25.1
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	19.7	21.7	22.7	22.2
Cobalt	1.0 ug/g dry	10.7	11.1	12.8	12.3
Copper	1.0 ug/g dry	32.4	49.9	8.9	9.4
Lead	1.0 ug/g dry	9.1	14.3	10.7	9.7
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Molybdenum	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Nickel	1.0 ug/g dry	20.7	22.3	26.0	25.4
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Silver	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Uranium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Vanadium	1.0 ug/g dry	26.8	29.7	27.9	38.1
Zinc	1.0 ug/g dry	44.2	59.8	53.8	53.1

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 09-Aug-2016
 Order Date: 3-Aug-2016
 Project Description: TG163020

Client ID:	Composite BH-18	Composite BH-20	-	-
Sample Date:	21-Jul-16	21-Jul-16	-	-
Sample ID:	1632130-05	1632130-06	-	-
MDL/Units	Soil	Soil	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	91.1	88.5	-	-
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General Inorganics

SAR	0.01 N/A	4.08	4.73	-	-
Conductivity	5 uS/cm	734	782	-	-
Cyanide, free	0.03 ug/g dry	<0.03 [1]	<0.03 [1]	-	-
pH	0.05 pH Units	7.82	7.62	-	-

Metals

Antimony	1.0 ug/g dry	<1.0	<1.0	-	-
Arsenic	1.0 ug/g dry	3.7	4.2	-	-
Barium	1.0 ug/g dry	73.6	99.1	-	-
Beryllium	1.0 ug/g dry	<1.0	<1.0	-	-
Boron	1.0 ug/g dry	29.2	23.0	-	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	-	-
Chromium	1.0 ug/g dry	23.3	21.8	-	-
Cobalt	1.0 ug/g dry	12.9	12.8	-	-
Copper	1.0 ug/g dry	6.9	12.0	-	-
Lead	1.0 ug/g dry	9.4	11.1	-	-
Mercury	0.1 ug/g dry	<0.1	<0.1	-	-
Molybdenum	1.0 ug/g dry	<1.0	<1.0	-	-
Nickel	1.0 ug/g dry	27.5	26.0	-	-
Selenium	1.0 ug/g dry	<1.0	<1.0	-	-
Silver	0.5 ug/g dry	<0.5	<0.5	-	-
Thallium	1.0 ug/g dry	<1.0	<1.0	-	-
Uranium	1.0 ug/g dry	<1.0	<1.0	-	-
Vanadium	1.0 ug/g dry	26.9	27.3	-	-
Zinc	1.0 ug/g dry	47.7	49.1	-	-

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 09-Aug-2016
 Order Date: 3-Aug-2016
 Project Description: TG163020

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
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General Inorganics

Conductivity	ND	5	uS/cm						
Cyanide, free	ND	0.03	ug/g						

Metals

Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	1.0	ug/g						
Boron	ND	1.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium	ND	1.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	1.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	1.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.5	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	1.0	ug/g						
Zinc	ND	1.0	ug/g						

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 09-Aug-2016
 Order Date: 3-Aug-2016
 Project Description: TG163020

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
SAR	12.9	0.01	N/A	13.0			0.6	200	
Conductivity	1330	5	uS/cm	1330			0.4	6.2	
Cyanide, free	ND	0.03	ug/g dry	ND				35	
pH	7.62	0.05	pH Units	7.62			0.0	10	
Metals									
Antimony	1.00	1.0	ug/g dry	ND			0.0	30	
Arsenic	5.79	1.0	ug/g dry	5.80			0.2	30	
Barium	117	1.0	ug/g dry	114			2.3	30	
Beryllium	ND	1.0	ug/g dry	ND			0.0	30	
Boron	10.6	1.0	ug/g dry	10.8			1.7	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	20.0	1.0	ug/g dry	19.7			1.6	30	
Cobalt	10.8	1.0	ug/g dry	10.7			0.3	30	
Copper	31.3	1.0	ug/g dry	32.4			3.3	30	
Lead	9.33	1.0	ug/g dry	9.14			2.1	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	21.2	1.0	ug/g dry	20.7			2.0	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.5	ug/g dry	ND			0.0	30	
Thallium	1.08	1.0	ug/g dry	ND			0.0	30	
Uranium	2.10	1.0	ug/g dry	ND			0.0	30	
Vanadium	26.8	1.0	ug/g dry	26.8			0.2	30	
Zinc	42.8	1.0	ug/g dry	44.2			3.2	30	
Physical Characteristics									
% Solids	86.4	0.1	% by Wt.	86.3			0.1	25	

Certificate of Analysis
 Client: Amec Foster Wheeler (Thorold)
 Client PO:

Report Date: 09-Aug-2016
 Order Date: 3-Aug-2016
 Project Description: TG163020

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Cyanide, free	0.215	0.03	ug/g	ND	71.6	70-130			
Metals									
Antimony	258		ug/L	ND	103	70-130			
Arsenic	349		ug/L	116	93.3	70-130			
Barium	2450		ug/L	2290	65.7	70-130			QM-07
Beryllium	221		ug/L	3.01	87.3	70-130			
Boron	440		ug/L	216	89.5	70-130			
Cadmium	218		ug/L	ND	88.1	70-130			
Chromium	589		ug/L	394	77.7	70-130			
Cobalt	411		ug/L	215	78.5	70-130			
Copper	868		ug/L	648	88.2	70-130			
Lead	390		ug/L	183	83.0	70-130			
Mercury	1.47	0.1	ug/g	ND	98.0	70-130			
Molybdenum	215		ug/L	7.32	83.2	70-130			
Nickel	613		ug/L	415	79.1	70-130			
Selenium	216		ug/L	ND	86.2	70-130			
Silver	0.00		ug/L	0.65	-0.261	70-130			
Thallium	208		ug/L	ND	83.3	70-130			
Uranium	270		ug/L	ND	108	70-130			
Vanadium	740		ug/L	535	81.8	70-130			
Zinc	1030		ug/L	883	60.5	70-130			QM-07

Certificate of Analysis
Client: Amec Foster Wheeler (Thorold)
Client PO:

Report Date: 09-Aug-2016
Order Date: 3-Aug-2016
Project Description: TG163020

Qualifier Notes:***Sample Qualifiers :***

1 : This analysis was conducted after the accepted holding time had been exceeded.

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

Client Name: <u>Amer Foster Wheeler</u>	Project Reference: <u>TA1163030</u>	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required: _____
Contact Name: <u>Deanna Gemmell</u>	Quote # <u>Tier 2</u>	
Address: <u>3300 Veritville Hwy</u> <u>Thorsby, ON, L0V 4Y6</u>	PO # _____	
Telephone: <u>(905) 687-0606</u>	Email Address: <u>deanna.gemmell@amerf.com</u>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Parcel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrides	Hg	EC	SAR	cyanide (free)	pH						
Sample ID/Location Name					Date	Time												
1	BH-1-2C	S		1	July 21/16	2:50	X	X	X	X	X	X	Composite BH-1 (1-2c, 1-3c, 1-4c, 1-5c + 1-6c)					-1 X 250ml
2	BH-1-3C			1		2:55	X	X	X	X	X	X						
3	BH-1-4C			1		3:00	X	X	X	X	X	X						
4	BH-1-5C			1		3:05	X	X	X	X	X	X						
5	BH-1-6C			1		3:10	X	X	X	X	X	X						
6																		
7	BH-1-2D			2		2:50												
8	BH-1-3D	+		2		2:55												
9																		

-1 x 250 mL

Composite BH-1
(1-2C, 1-3C, 1-4C,
1-5C + 1-6C)

Comments: Proceed with cyanide analysis regardless of hold times as per Deanna-RS Aug 4/16
Governed by the terms + conditions of the agreement SNA07-003.
Please composite samples, one sample per borehole (6 samples total)

Method of Delivery:

PUP

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>Niagara</u> <u>BHomenier</u>	Received at Lab: <u>SUNREPORN</u> <u>DOK MA</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>Deanna Gemmell</u>	Date/Time: <u>3 Aug 16 11:24</u>	Date/Time: <u>AUG 04 2016 10:22</u>	Date/Time: <u>Aug 4/16 11:58</u>
Date/Time: <u>Aug 3/16</u>	Temperature: <u>15.6 °C</u>	Temperature: <u>9.9 °C</u>	pH Verified ☒ By: <u>NA</u>

Client Name: <u>Ameo Foster Wheeler</u>	Project Reference: <u>T6163030</u>	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required: _____
Contact Name: <u>Deanna Gemmell</u>	Quote # <u>Tier 2</u>	
Address: <u>3300 Meriville Hwy</u> <u>Thorold, ON, L2V 4Y6</u>	PO # _____	
Telephone: <u>905-687-6616</u>	Email Address: <u>deanna.gemmell@amef.com</u>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrides	inorganics (pH, EC, SAR)	Cyanide free	Hg										
Sample ID/Location Name					Date	Time														
1	BH3-2C	S		1	July 21/16	1:55	X	X	X	X	Composite BH-3 (3-2C, 3-3C, 3-4C, 3-5C + 3-6C)									
2	BH3-3C			1		2:00	X	X	X	X										
3	BH3-4C			1		2:05	X	X	X	X										
4	BH3-5C			1		2:10	X	X	X	X										
5	BH3-6C			1		2:15	X	X	X	X										
6	BH3-2D			2		1:55					- 1 x 250 ml -									
7	BH3-3D			2		2:00														
8	BH3-4D			2		2:05														
9	BH3-5D			2		2:10														
10	BH3-6D			2		2:15														

- 1 x 250 ml -

Composite BH-3
(3-2C, 3-3C, 3-4C, 3-5C)
+ 3-6C

Comments: See page 1

Method of Delivery:
Pickup

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>Niagara</u> <u>BHomeniee</u>	Received at Lab: <u>SUMMITURN</u> <u>DOK MHI</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>Deanna Gemmell</u>	Date/Time: <u>3 Aug 16</u> <u>11:24</u>	Date/Time: <u>AUG 04, 2016</u> <u>10:22</u>	Date/Time: <u>Aug 4/16</u> <u>11:58</u>
Date/Time: <u>Aug 3/16</u>	Temperature: <u>15.6 °C</u>	Temperature: <u>9.9 °C</u>	pH Verified ☒ By: <u>NA</u>

Client Name: Amer Foster Wheeler
Contact Name: Deanna Gemmell
Address: 3300 Merrittville Hwy
Thorold, ON, L2V 4Y6
Telephone: (905) 687-6666

Project Reference: T6163020

Quote #: Tier 2

PO #

Email Address:

deanna.gemmell@amer.com

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CEME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ☐ Other:

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Parcel Order Number:

1632130

Sample ID/Location Name

		Matrix	Air Volume	# of Containers	Sample Taken		metals + n-nitrides	organics (ph.ec.sar)	cyanoide (free)	Hg.									
					Date	Time													
1	BH14-2C	S		1	July 21/16	9:10	X	X	X	X									
2	BH14-3C			1		9:15	X	X	X	X									
3	BH14-4C			1		9:20	X	X	X	X									
4	BH14-5C			1		9:25	X	X	X	X									
5	BH14-6C			1		9:30	X	X	X	X									
6	BH14-2D			2		9:10													
7	BH14-3D			2		9:15													
8	BH14-4D			2		9:20													
9																			
10																			

- 2 x 250mL

Composite BH-14
(14-2C, 14-3C, 14-4C
14-5C + 14-6C)

Comments: See page 1

Method of Delivery:

D/CUP

Relinquished By (Sign):

Received by Driver/Depot: Niagara
B. Homencuk

Received at Lab: SUPERIOR DOX MAI

Verified By:

Relinquished By (Print): Deanna Gemmell

Date/Time: 3 AUG 16 11:24

Date/Time: AUG 4 2016 11:29

Date/Time: Aug 4/16 11:58

Date/Time: Aug 3/16

Temperature: 15.6 °C

Temperature: 9.9 °C

pH Verified ☒ By: NA

Client Name: Amer Foster Wheeler	Project Reference: BH163000	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required:
Contact Name: Deanna Gemmell	Quote #: Tier 2	
Address: 3300 Meriville Hwy Thorold, ON. L2V 4V6	PO #	
Telephone: (905) 687-6061	Email Address: deanna.gemmell@amer.com	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ☐ Other:

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Parcel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrides	organics (pH, EC, SAR)	cyanide (free)	Hg										
Sample ID/Location Name					Date	Time														
1	BH16-2C	S		1	July 21/16	10:05	X	X	X	X	Composite BH16 (16-2C, 16-3C, 16-4C)									
2	BH16-3C			1		10:10	X	X	X	X										
3	BH16-4C			1		10:15	X	X	X	X										
4																				
5	BH16-2D			2		10:05														
6	BH16-3D	+		2	+	10:10														
7																				
8																				
9																				
10																				

Comments: See page 1

Method of Delivery:

P/UP

Relinquished By (Sign):	Received by Driver/Depot: Niagara B Homeneria	Received at Lab: SUMEPARN DOXMA	Verified By:
Relinquished By (Print): Deanna Gemmell	Date/Time: 3 Aug 16 11:24	Date/Time: AUG 4 2016 10:58	Date/Time: Aug 4/16 11:58
Date/Time: Aug 3/16	Temperature: 5.6 °C	Temperature: 9.9 °C	pH Verified: X By: NA

Client Name: <u>Amer Foster Wheeler</u>	Project Reference: <u>T6163030</u>	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required: _____
Contact Name: <u>Deanna Gemmell</u>	Quote # <u>Tier 2</u>	
Address: <u>3300 Meriville Hwy</u> <u>Thorold, ON L2V 4Y6</u>	PO # _____	
Telephone: <u>(905) 687-6606</u>	Email Address: <u>deanna.gemmell@amer.com</u>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCM ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Parcel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrocarbons	Inorganics (ph, & sars)	cyanide (free)	Hg.										
Sample ID/Location Name					Date	Time														
1	BH18-3C	S		1	JUN 21/16	11:05	X	X	X	X	Composite BH-18									
2	BH18-4C			1		11:10	X	X	X	X	S (18-3C + 18-4C)									
3																				
4	BH18-3D			2		11:05														
5																				
6																				
7																				
8																				
9																				
10																				

Comments: See page 1

Method of Delivery:

PIUP

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>Niagara</u> <u>B Homenick</u>	Received at Lab: <u>SUNEPORN</u> <u>DOXMAI</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>Deanna Gemmell</u>	Date/Time: <u>3 AUG 16 11:24</u>	Date/Time: <u>AUG 04 2016 10:22</u>	Date/Time: <u>AUG 4/16 11:58</u>
Date/Time: <u>AUG 3/16</u>	Temperature: <u>15.6 °C</u>	Temperature: <u>9.9 °C</u>	pH Verified ☒ By: <u>AJA</u>

Client Name: <u>Amer Foster Wheeler</u>	Project Reference: <u>T6163020</u>	Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular Date Required: _____
Contact Name: <u>Deanna Gemmell</u>	Quote # <u>Tier 2</u>	
Address: <u>3300 Merrittville Hwy</u> <u>Thorold, ON, L2V 4Y6</u>	PO # _____	
Telephone: <u>(905) 687-6616</u>	Email Address: <u>deanna.gemmell@amer.com</u>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 1 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number: <u>163 2130</u>		Matrix	Air Volume	# of Containers	Sample Taken		metals + hydrocarbons	inorganics (pH, EC, SOD)	cyanide (free)	Hg								
Sample ID/Location Name					Date	Time												
1	BH20-2C	S		1	July 21/16	12:05	X	X	X	X								
2	BH20-3C			1		12:10	X	X	X	X								
3	BH20-4C			1		12:15	X	X	X	X								
4	BH20-5C			1		12:20	X	X	X	X								
5																		
6	BH20-2D			2		12:05												
7	BH20-3D			2		12:10												
8	BH20-4D			2		12:15												
9																		
10																		

Comments: See page 1

Method of Delivery:

D/UP

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>Niagara</u>	Received at Lab: <u>SUNDEPORN DOKMA</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>Deanna Gemmell</u>	Date/Time: <u>3 AUG 16 11:24</u>	Date/Time: <u>AUG 04 2016 10:22</u>	Date/Time: <u>AUG 4/16 11:58</u>
Date/Time: <u>AUG 3/16</u>	Temperature: <u>15.6°C</u>	Temperature: <u>9.9°C</u>	pH Verified ☒ By: <u>NA</u>

APPENDIX C

APPENDIX C - PHOTOGRAPHIC RECORD

PROJECT NO. TG163020

PROJECT GI - Proposed Road and Drainage Improvements

LOCATION King Street (RR81) b/w Greenlane Avenue and Lincoln Avenue
Town of Lincoln, Ontario



PHOTOGRAPH

1

Description

King Street - between Greenlane Avenue and Thirty Road (by BH-1)
• Poor Condition



PHOTOGRAPH

2

Description

King Street - between Greenlane Avenue and Thirty Road (by BH-6)
• Poor Condition

APPENDIX C - PHOTOGRAPHIC RECORD

PROJECT NO. TG163020

PROJECT GI - Proposed Road and Drainage Improvements

LOCATION King Street (RR81) b/w Greenlane Avenue and Lincoln Avenue
Town of Lincoln, Ontario



PHOTOGRAPH

3

Description

King Street - between Thirty Road and Mountainview Road (by BH-8)
• Poor to Fair Condition



PHOTOGRAPH

4

Description

King Street - between Thirty Road and Mountainview Road (by BH-10)
• Poor to Fair Condition

APPENDIX C - PHOTOGRAPHIC RECORD

PROJECT NO. TG163020

PROJECT GI - Proposed Road and Drainage Improvements

LOCATION King Street (RR81) b/w Greenlane Avenue and Lincoln Avenue
Town of Lincoln, Ontario

PHOTOGRAPH

5



Description

King Street - between
Mountainview Road and Lincoln
Avenue (by BH-17)
• Poor Condition

PHOTOGRAPH

6



Description

King Street - between
Mountainview Road and Lincoln
Avenue (by BH-19)
• Poor Condition