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GEOTECHNICAL INVESTIGATION REPORT

Cedar Shore Estates, 589 King Street West, Town of Cobourg, Ontario

Submitted to:
Mr. Willaim McCrae
CIMA Canada Inc.
55 King Street East
Bowmanville, ON
L1C 1N4

REPORT

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Table of Contents

FIGURES

APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd (Golder) is pleased to submit this report which presents the results of the geotechnical investigation carried out for the proposed Cedar Shore Estates (The Cedars) residential subdivision to be located at 589 King Street West in the Town of Cobourg, Ontario, as shown in the key plan on Figure 1.

The purpose of the investigation is to obtain information on the general subsurface soil and groundwater conditions at the site by means of a limited number of boreholes. Based on our interpretation of the borehole data, this report provides geotechnical recommendations for planning and design of the proposed residential development at the site.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location, elevation, or if the project is not initiated within eighteen months of the date of the report, Golder should be given an opportunity to confirm that the recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report" which are included in Appendix A. The reader’s attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2.0 SITE AND PROJECT DESCRIPTION

The site is located at 589 King Street West in Cobourg, Ontario, as shown on Figure 1. The site is approximately 8 acres and is predominantly covered with a variety of deciduous and coniferous trees. There is a 2-storey detached family house and 1-storey detached coach house presently located in the south east corner. The site is bounded by Lake Ontario to the south, single family units and Maher Street to the east, a single family unit to the west, and King Street to the north. The site has a generally flat elevation, with localized low areas and is on the tableland approximately 4 m higher than the lake.

According to published information, the site is within the physiographic region of southern Ontario known as the Iroquois Plain and consists predominantly of drumlins and sandy soils (Map P.2715, Chapman and Putnam, 1984). Surficial geologic mapping in the vicinity of the site indicates fine textured glaciolacustrine deposits of silt and clay (Surficial Geology of Southern Ontario, Ontario Geological Survey, 2010).

3.0 INVESTIGATION PROCEDURES

The preliminary field work for this investigation was carried out on September 24, 2015 at which time five boreholes were advanced (15-1 to 15-5) using a track mounted drill rig. Three additional boreholes (16-1 to 16-3) were advanced on November 7 and 11, 2016 on King Street West and Maher Street using a truck mounted drill rig. All boreholes were advanced using hollow stem augers. The locations of the boreholes from the 2015 and 2016 investigations are shown on the Borehole Location Plan, Figure 1. The drill rigs were supplied and operated by a specialist drilling contractor, subcontracted to Golder. Bedrock was cored in select boreholes using rotary diamond drilling techniques while retrieving NQ sized core.

Standard Penetration Testing (SPT) and sampling were carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment advanced using an automatic hammer in accordance with ASTM D1586. A field vane shear test was carried out in cohesive soils for determination of undrained shear strengths (ASTM D2573) using Standard ‘N’ size vanes. The results of the in-situ field tests (i.e., SPT ‘N’-values and undrained shear strength from the field vanes) as presented on the Record of Borehole sheets and in Section 4.0 are uncorrected.

The boreholes were advanced to between 4.3 m and 8.1 m depth including 0.3 m and 3 m of bedrock coring in Boreholes 16-1 and 16-2, respectively. The remaining boreholes were backfilled in accordance with the current environmental regulations upon completion of drilling.

The groundwater conditions were noted in the open boreholes during drilling and 50 mm diameter PVC monitoring wells using above ground steel casings were installed in Boreholes 15-1 to 15-5 to allow for further monitoring of groundwater levels. Ontario Regulation (O.Reg.) 903 as amended, of the Ontario Water Resources Act requires that monitoring wells are properly abandoned/decommissioned by qualified and licensed personnel. Golder will decommission the wells and submit a well abandonment record to the Ministry of Environment and Climate Change (MOECC).

The field work for this investigation was monitored by a member of our engineering staff who also determined the approximate borehole locations in the field, logged the boreholes and cared for the recovered samples. All the soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, selective classification testing and natural water content testing.

Surveying of the boreholes and the monitoring wells was arranged by CIMA. The location of the boreholes was provided in NAD 83 UTM co-ordinate system as shown on Figure 1. A summary of the borehole locations and geodetic ground surface elevations are presented on the Record of Boreholes and summarized in the table below:

Borehole	Northing	Easting	Ground Surface Elevation (m)
15-1	4 871 018.99	725 530.66	80.78
15-2	4 870 955.50	725 518.45	80.69
15-3	4 870 861.99	725 538.94	80.01
15-4	4 870 854.72	725 476.69	79.89
15-5	4 870 805.68	725 558.04	79.60
16-1	4 871 020.60	725 461.72	80.93
16-2	4 871 047.90	725 547.66	81.35
16-3	4 871 014.78	725 591.81	80.64

4.0 SUBSURFACE CONDITIONS

The following provides a discussion of the soil and groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing; the details of which are shown on the Record of Borehole sheets following the text of this report. Method of Soil Classification and Symbols and Terms Used on Record of Borehole sheets are provided following the text of this report to assist in the interpretation of the borehole records. It should be noted that the boundaries between the strata on the Record of Borehole sheets have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes.

The following is a summarized account of the subsurface conditions encountered in the boreholes, followed by more detailed descriptions of the major soil strata and groundwater conditions encountered in the boreholes drilled at the site.

Underlying topsoil or road base fill, the soil conditions encountered in the boreholes generally consisted of shallow deposits of sand, silty sand, sandy silt and silt underlain by a deposit of silty clay. All boreholes encountered a deposit of clayey sand below the silty clay deposit. All boreholes were terminated due to auger refusal on inferred bedrock and bedrock was proven by coring in two boreholes. The groundwater level at the site is shallow and ranged from about 1.2 m to 2.2 m below the ground surface.

4.1 Topsoil and Organic Materials

Topsoil was encountered at the ground surface in boreholes 15-1 to 15-5. The topsoil thickness ranged from 150 mm to 460 mm.

Silty clay with organic inclusions was encountered below the topsoil in Borehole 15-2 extending to a depth of approximately 0.7 m below ground surface. One SPT ‘N’ value measured partially within the silty clay with organic inclusions layer is 9 blows per 0.3 m of penetration, suggesting a stiff consistency. The natural water content measured on one sample of the silty clay with organic inclusions was about 19 percent.

4.2 Fill

80 mm of asphalt was encountered in Boreholes 16-1 and 16-2 on King Street West. 150 mm of asphalt was encountered in Borehole 16-3 on Maher Street. Gravelly sand, silty sand and clayey sand road base / subbase fill was encountered in Boreholes 16-1 to 16-3 underneath the asphalt extending to between 1.4 and 2.1 m depth below road grade. A hydrocarbon odour was detected within the gravelly sand fill in Borehole 16-2 from 0.8 m to 1.2 m below ground surface. SPT ‘N’ values measured within the fill range from 7 blows to 21 blows per 0.3 m of penetration, indicating a loose to compact state of compactness. The natural water contents measured on samples of the fill ranges from about 2 to 13 percent

4.3 Sand, Silty Sand, Sandy Silt, Silt

Deposits of sand, silty sand and sandy silt were encountered beneath the topsoil in Boreholes 15-1 to 15-5 and beneath the fill in Borehole 16-3, and extended to between 0.9 m and 2.9 m below ground surface. In Borehole 15-4, a deposit of grey silt containing some sand to sandy, was encountered below the sand and extended to 4.0 m below ground surface. SPT ‘N’ values measured within the sand, silty sand and sandy silt deposits range from 4 blows to 25 blows per 0.3 m of penetration, indicating a loose to compact state of compactness. SPT ‘N’ values measured within the silt range from 25 blows to 74 blows per 0.3 m of penetration indicating the silt is in a compact to very dense state in this localized area. The natural water contents measured on samples of the sand, silty sand and sandy silt deposits range from about 6 percent to 21 percent. The natural water contents measured on samples of the silt range from about 13 percent to 18 percent. Grain size distribution curves of three samples of sandy silt are shown on Figure 2.

4.4 Silty Clay

A deposit of grey silty clay was encountered below the sandy silt, silty sand or fill deposits in Boreholes 15-1 to 15-3, 15-5, 16-1 and 16-2 and extended to between 0.9 m and 4.0 m below ground surface. SPT ‘N’ values measured within the silty clay deposit range from 5 blows to 15 blows per 0.3 m of penetration. A single in-situ shear vane test carried out within the silty clay deposit in Borehole 15-2 measured an undrained shear strength of greater than 100 kPa. The results of the SPT and vane tests suggest that the silty clay has a stiff consistency. The natural water contents of samples of the silty clay deposit range from about 19 percent to 31 percent. A grain size distribution curve of one sample of the silty clay deposit is shown on Figure 3. A plasticity chart showing the results of Atterberg limits testing performed on three samples of the silty clay is shown on Figure 4. The results indicated the samples are classified as silty clay of intermediate plasticity (CI).

4.5 Clayey Sand

A deposit of non-cohesive clayey sand was encountered beneath the silty clay, silt or sandy silt in all boreholes. All the boreholes were terminated within the clayey sand deposit due to auger refusal on inferred bedrock. SPT ‘N’ values measured within the clayey sand deposit range from 2 blows to 44 blows per 0.3 m of penetration indicating a very loose to dense state of compactness. For SPT testing where the split spoon came in contact with the inferred bedrock surface and did not penetrate the full sampler depth, the ‘N’ values were greater than 50 blows suggesting the deposit may be very dense immediately above the bedrock surface. The natural water contents measured on samples of the clayey sand samples range from about 6 percent to 20 percent. Grain size distribution curves of two samples of clayey sand are shown on Figure 5.

4.6 Bedrock

All the boreholes were terminated due to auger refusal on inferred bedrock. Boreholes 16-1 and 16-2 confirmed bedrock by coring 0.3 m and 3.0 m, respectively. The ground surface and bedrock surface elevations are presented in the table below. It should be noted that refusal may indicate the presence of the bedrock surface; however it could also reflect the presence of gravel, cobbles or boulders.

Borehole	Ground Surface Elevation (m)	Depth to Bedrock (m)	Bedrock Surface Elevation (m)	Determination
15-1	80.78	5.33	75.45	Auger refusal
15-2	80.69	5.79	74.90	Auger refusal
15-3	80.01	5.18	74.83	Auger refusal
15-4	79.89	4.88	75.01	Auger refusal
15-5	79.60	4.65	74.95	Auger refusal
16-1	80.93	6.12	74.81	Bedrock Coring
16-2	81.35	5.11	76.24	Bedrock Coring
16-3	80.64	4.27	76.34	Auger refusal

The bedrock core retrieved from Boreholes 16-1 and 16-2 consists of limestone with shale inclusions. The Rock Quality Designation (RQD) in the 0.3 m core run in Borehole 16-1 was 0 percent and the rock core retrieved was highly fractured and very poor quality. In Borehole 16-2, the RQD ranges from 57 percent to 74 percent, indicating a fair rock quality as per Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006). Unconfined compressive strength (UCS) testing on one selected bedrock core sample returned a compressive strength of 35 MPa, indicating the limestone sample is medium strong in accordance with CFEM.

4.7 Groundwater

Groundwater observations and measurements are shown in detail on the Record of Borehole sheets following the text of this report. The groundwater levels measured in the monitoring wells installed in the boreholes were at depths ranging from 1.2 m to 2.2 m below existing ground surface (Elevation 77.4 m to 79.6 m) on October 8, 2015 and at depths ranging from 2.3 m to 3.2 m (Elevation 76.4 m to 78.5 m) on November 18, 2016.

Groundwater seepage was observed during drilling operations in all boreholes at depths ranging from 0.7 m to 4.3 m below ground surface (Elevation 75.7 m to 79.6 m). At the conclusion of drilling, groundwater was also observed in Boreholes 15-1 to 15-5 at depths ranging from 0.6 m to 4.9 m below ground surface (Elevation 75.1 m to 80.2 m). Boreholes 16-1 to 16-3 were open and dry upon completion of drilling.

It should be noted that the observations and readings shown on the Record of Borehole sheets reflect the groundwater conditions encountered in the boreholes during or shortly after the field investigation and some seasonal fluctuations should be anticipated. Given the proximity to Lake Ontario, groundwater levels may be influenced by the lake water levels and drainage.

Single-well response tests were performed on November 18, 2016 in four monitoring wells at the site. The results for monitoring wells 15-1, 15-2 and 15-3 were analysed using the method of Hvorslev (1951) to provide an estimate of the horizontal hydraulic conductivity of the soil adjacent to the test interval. The results for monitoring well 15-5 were analyzed using the method of Bouwer and Rice (1976) due to the water level in the well being drawn down to the screen during testing.

The results of groundwater level measurements and single-well response testing are provided in the following table.

Well ID	Geologic Unit of Screened Interval	Groundwater Level		Date of Measurement	Hydraulic Conductivity (m/s)
		Depth* (m)	Elevation (m)		
15-1	Clayey Sand	1.18 2.27	79.60 78.51	October 8, 2015 November 18, 2016	$3x10^{-6}$
15-2	Clayey Sand	1.18 2.43	79.51 78.27	October 8, 2015 November 18, 2016	$8x10^{-6}$
15-3	Clayey Sand	1.49 2.53	78.52 77.48	October 8, 2015 November 18, 2016	$3x10^{-6}$
15-4	Clayey Sand	1.43	78.46	October 8, 2015	Not measured
15-5	Clayey Sand	2.17 3.22	77.43 76.38	October 8, 2015 November 18, 2016	$8x10^{-6}$

* depth below existing ground surface

The results of the single-well response test analyses indicate that the hydraulic conductivity (K) of the clayey sand deposit ranges between approximately 3×10^{-6} m/s and 8×10^{-6} m/s and a summary of the hydraulic conductivity analysis from each rising head test is provided in Appendix B.

The hydraulic conductivity of the bedrock at the site was not tested. Published geological mapping indicates that the Lindsay Formation is present in the area of the site, and published values of hydraulic conductivity (The Hydrogeology of Southern Ontario, MOE 2003) indicate a geometric mean hydraulic conductivity for bedrock of the Lindsay Formation of approximately $2x10^{-5}$ m/s.

5.0 DISCUSSION AND RECOMMENDATIONS

This section of the report provides geotechnical information for the planning and design aspects of the project based on our interpretation of the borehole data and on our understanding of the project requirements. The information in this portion of the report is provided for the guidance of the design engineers and professionals. Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

5.1 Topsoil Stripping and Reuse

The following geotechnical comments are provided regarding topsoil stripping and reuse at the site:

- Consideration may be given to selective stripping operations, consisting of road allowances and building envelopes (including driveways).
- Outside of road allowances and building envelopes, the topsoil may be buried and/or reused as general lot fill to raise grades subject to approval from the governing agency. The primary factor controlling methane generation is the organic carbon content of the topsoil. The loss on ignition (LOI) test provides an indication of the organic carbon content of the sample. Generally, an LOI value of less than 20 percent is considered to be acceptable in terms of methane generation potential. If topsoil is to be reused as general lot fill to raise grades, then LOI testing should be carried out, but is not mandatory.
- Where the topsoil is used as general lot fill, its thickness should be limited to about 1.5 m. The topsoil fill should be placed in maximum 300 mm loose lifts and uniformly compacted to 95 percent of Standard Proctor Maximum Dry Density (SPMDD). To have any success in placing topsoil as lot grading fill, it must be placed at or very close to its optimum water content to achieve workability and adequate compaction, in order to minimize post-construction settlements and/or lateral movements (e.g. of fences, etc.).

5.2 Engineered Fill

Based on the grading plan provided by CIMA, it is understood that generally a grade raise of between 0.3 m and 1.2 m will be required across the site. We recommend that engineered fill be used to establish the general site grading. Prior to placing engineered fill at the site, all topsoil, any existing septic systems, wells, old foundations and fill must first be removed from the development area. The exposed native subgrade area(s) should then be heavily proofrolled in conjunction with an inspection by the geotechnical engineer, to confirm that the exposed soils are native, undisturbed and competent, and have been adequately cleaned of ponded water and all disturbed, loosened, softened, organic and other deleterious material. Remedial work (i.e., further sub-excavation and replacement) should be carried out as directed by the geotechnical engineer.

Materials for reuse as engineered fill must be approved by Golder prior to placement. In this regard, excavated native soils from the site, free of significant amounts of organics and other deleterious materials, may be reused as engineered fill. Based on the measured natural water contents, the majority of the native non-cohesive sandy/silty soils are generally near or above their estimated laboratory optimum moisture contents for compaction. The gravelly sand road base encountered in Boreholes 16-1 to 16-3 are generally below their laboratory optimum moisture content. However, the cohesive silty clay soils below the local groundwater table are expected to be wet of their laboratory optimum moisture contents. These soils will likely require some drying prior to placement. Such fine grained soils may be difficult to adequately dry and may be considered for reuse as non-structural fill (i.e. in landscaping areas). It should also be noted that due to the fine-grained nature of the predominant clayey and silty subsoils, their workability is sensitive to moisture conditions and some difficulty would be expected in achieving adequate compaction during wet weather.

Imported materials to be used for engineered fill must be approved by Golder at the source(s), prior to hauling to the site. In this regard, imported sandy materials which generally meet the requirements for Ontario Provincial Standard Specifications OPSS.PROV 1010 (Aggregates) Select Subgrade Material (SSM) would be suitable for use as engineered fill. In any event, the approved materials for engineered fill should be placed in maximum 300 mm loose lifts and uniformly compacted to at least 98 percent of Standard Proctor Maximum Dry Density

(SPMDD) throughout outside building envelopes and 100 percent of SMPDD within the building envelope. The placement of engineered fill should be monitored by Golder on a full-time basis during placement.

The engineered fill footprint should extend to a minimum of 1 m outside the building envelope (in all directions) plus an equivalent of the depth of the engineered fill all around. Engineered fill slopes and any native cut slopes that will become permanent slopes at the development, if any, should be 2H:1V or flatter, and should be covered with topsoil and sodded or otherwise treated to reduce surface erosion. Maintenance will be required over the first several years until the vegetative mat has taken root.

The final surface of the engineered fill should be protected as necessary from construction traffic, and should be sloped to provide positive drainage for surface water during and following the construction period. During periods of freezing weather, additional soil cover should be placed above final subgrade to provide for frost protection. Prior to placing any additional engineered fill, the surface of the existing engineered fill must be re-inspected by the geotechnical engineer.

5.3 Site Servicing

It is our understanding that the proposed site servicing consists of a 200 mm diameter PVC watermain, a 300 mm to 750 mm diameter concrete storm sewer and a 200 mm diameter PVC sanitary sewer.

The proposed watermain will originate from the intersection of King Street and proposed Street A, where it will be connected to the existing 300 mm diameter watermain on the north side of King Street. The watermain will continue south where it will link to the proposed watermain originating from the west end of proposed Street B. The watermain will continue east along Street B, then turn south and continue along the proposed asphalt pathway and eventually connect to the existing 200 mm diameter watermain on Monk Street. The proposed watermain will require excavations ranging from 1.4 m to 2.5 m below the existing ground surface. Based on the servicing plan, profile drawings provided and results of the investigation, the founding soils for the proposed watermain at these elevations will generally consist of clayey sand with isolated locations of silt and silty clay.

The proposed storm sewer will originate from the north end of proposed Street A and slope towards the south where it will connect to the proposed storm sewer on proposed Street B. The storm sewer will continue east on proposed Street B, then turn south along the proposed asphalt pathway and drain into Lake Ontario. The proposed storm sewer will require excavations ranging from 3.1 m to 4.0 m below the existing ground surface. Based on the servicing plan, profile drawings provided and results of the investigation, the founding soils for the proposed storm sewer at these depths will generally consist of silt and silty clay material, with isolated locations of clayey sand. It should be noted that an excavation of approximately 5.2 m is required at the oil and grit separator location where the storm sewer runs along the proposed asphalt pathway. Bedrock excavation up to 1.0 m may be required at this location.

The proposed sanitary sewer will originate from proposed Street B and slope towards proposed Street A from both sides of Street B. The sanitary sewer will continue north along the centreline of proposed Street A and turn east on King Street West. The sanitary sewer will then continue south along Maher Street and connect to the existing 200 mm diameter sanitary sewer at the intersection of Maher Street and Maher Crescent. The proposed storm sewer will require excavations ranging from 2.0 m to 2.5 m along proposed Street B and from 2.5 m to 4.5 m along proposed Street A. Based on the servicing plan, profile drawings provided and results of the investigation, the founding soils for the proposed sanitary sewer at these elevations will generally consist of silt and silty clay material, with isolated locations of clayey sand. Along King Street West and Maher Street, excavations will be required ranging from 4.5 m to 5.5 m below the existing ground surface. At these elevations, the sanitary sewer will predominantly be founded on clayey sand or bedrock. Bedrock excavation up to about 0.5 m may be required at these locations.

The native soils and properly constructed engineered fills are considered to be suitable for supporting the pipes, provided the integrity of the base of the trench can be maintained during construction. The suitability of the existing materials to support the pipes, should be further assessed during construction. This assessment will require inspection during construction by qualified geotechnical personnel to determine the suitability of the materials for supporting the pipes.

5.3.1 Groundwater Control

For shallow excavations for underground services up to about 2.5 m in depth, groundwater control during excavation can be handled, if required, by pumping from properly constructed and filtered sumps located at the base of the excavation. The groundwater conditions encountered at the site suggest perched groundwater may be present within the silty sand to sand deposits above the silty clay deposit. Depending on the conditions at the time of excavation, some difficulty may be encountered controlling the water seepage from this stratum. Further, a confined clayey sand deposit was encountered typically beneath the silty clay. For excavations below 2.5 m to the maximum excavation depth of 5.5 m, some form of positive and pro-active groundwater controls (depressurization) will be required in addition to pumping from sumps, prior to excavating. The groundwater level should be drawn down to 1 m below the invert of the pipes. Where bedrock is encountered at the base of the excavation, the water level should be drawn down to the bedrock surface and sump pumping used in the base. The design of dewatering systems, as may be required, are entirely the responsibility of the contractor.

It is recommended a “public digging” (i.e. test pitting) be carried out during the tender stage, to allow prospective bidders to assess the subsurface conditions and determine the type of groundwater control required, consistent with their equipment capabilities and the actual groundwater conditions at that time. The locations of the test pits should be determined in consultation with the geotechnical engineer.

For construction dewatering that exceeds a rate of 50 m^3/day (50,000 L/day), but less than 400 m^3/day (400,000 L/day), a MOECC Environmental Activity and Sector Registration (EASR) is required, and must be supported by a Water Taking Plan. For pumping that exceeds 400 m^3/day (400,000 L/day), a MOECC Permit To Take Water (PTTW) would be required.

The actual rate of groundwater inflow to the excavations will depend on many factors including the contractor’s schedule and rate of excavation, the size of the excavation, the number of working areas being excavated at one time, and the time of year at which the excavation is made. Also, there may be instances where significant volumes of precipitation, surface runoff and/or groundwater may collect in an open excavation, and must be pumped out.

Based on the drawings provided by CIMA, the proposed local sewers and the oil and grit separator will have inverts ranging from about 3.5 m to 5.5 m depth below existing ground surface. The groundwater levels measured across the site ranged from 1.2 m to 3.2 m below ground surface. Assuming that the groundwater level would need to be lowered to about 1 m below the bottom of sewer trenches during construction (unless bedrock is encountered), up to 4.5 m of groundwater level lowering (i.e., 5.5 m below ground surface) would be required during construction, with the greatest amount of groundwater level lowering anticipated near the oil and grit separator.

Assuming that a single trench excavation 15 m long by 3 m wide would be open at one time during construction of site services, and based on the groundwater levels and the hydraulic conductivity measured at groundwater monitors installed within the clayey sand deposit, and the assumed bedrock hydraulic conductivity for the bedrock, it is not likely that construction dewatering would exceed 400 m^3/day (400,000 L/day) under normal operation.

Therefore it is recommended that an EASR be registered for this project. Supporting information for this application will be provided in a separate Water Taking Plan.

The low permeability soils and relatively shallow depth to groundwater are not well suited to Low Impact Development (LID) measures such as infiltration galleries, soakaway pits, etc., but may be a feasible for small or localized areas. LID measures focused on run-off filtration, quality improvement with some minor infiltration enhancement (naturalized areas, vegetative strips, swales etc.) would be of greater benefit at the site. Given the low infiltration potential and shallow water table, these features would need to be designed with proper drainage controls such that water during storm events can overflow/drain to a traditional storm water system. LIDs at the site should be used to complement, not replace traditional storm water facilities with minor and major conveyance capabilities.

5.3.2 Excavations

5.3.2.1 Soil Excavations

All excavations at the site should be carried out in accordance with the Occupational Health and Safety Act and Regulations (OHSA) for Construction Projects. Prior to placing engineered fill or concrete footings at the site, all of the topsoil within the limits of the engineered fill and/or footing must first be stripped. The area(s) must then be inspected by Golder to confirm that the exposed soils are native, undisturbed and competent, and have been adequately cleaned of ponded water and all disturbed, loosened, softened, organic and other deleterious material.

For shallower servicing excavations, it is anticipated that the trench excavations will consist of conventional temporary open cuts, with side slopes not steeper than 1H:1V, with or without the use of trench boxes. However, depending upon the construction procedures adopted by the contractor, actual groundwater seepage conditions, the success of the contractor’s groundwater control methods and weather conditions at the time of construction, some flattening and/or blanketing of the slopes may be required. Care should be taken to direct surface runoff away from the open excavations and all excavations should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. According to OHSA, the shallow gravelly sand fill materials below the road, native loose to compact non-cohesive silty / sandy soils, stiff silty clay and loose to dense clayey sands would be classified as Type 3 soils after dewatering. Along Maher Street, the very loose clayey sand encountered in Borehole 16-3 is considered to be a Type 4 soil.

Excavation up to 5.5 m are required for the sanitary sewer along King St. West and Maher St. The use of conventional temporary open cuts for 5.5 m deep excavations, even with 1 horizontal to 1 vertical (1H:1V) side slopes, will result in a surface width of over 11 m, which is wider than the road allowance and encroaches into the existing services. The slide slopes of excavations at these locations may be steepened to limit the extent of the excavation, provided that some form of trench support system such as a trench box system is utilized. It must be emphasized that a trench liner box provides protection for construction personnel but does not provide any lateral support for the adjacent excavation walls, underground services or existing structures. In the case of trench box excavation work the tolerance of any structure founded above a 1 horizontal to 1 vertical line projected up from the base of the excavation should be assessed prior to construction. Any voids between the excavation wall and the trench liner box should be filled immediately to minimize the potential for loss of ground and support of adjacent utilities, roadway pavements and the like. Further, it is suggested that the trench excavation be carried out in short sections with the support system installed immediately upon completion of excavation. The excavated material should always be placed well back from the edge of the excavation to minimize surcharge loading near the excavation crest. In addition, steepened excavations should be left open for as short a duration as possible and completely backfilled at the end of each working day. Care should be taken to direct surface runoff away from the open excavations and all excavations should be carried out in accordance with the OHSA.

If adjacent structures or services are deemed susceptible to damage from construction induced settlement, then excavation support using a strutted soldier pile and lagging wall should be considered for which further geotechnical input would be required. It is therefore imperative that any underground services or existing structures adjacent to the excavations be accurately located prior to construction and adequate support provided where required. If required to support adjacent services or structures, shoring could consist of braced soldier pile and lagging, braced sheet piles or potentially a slide rail system designed by a Professional Engineer including assessment of the potential for basal heave if excavations extend into and below the silty clay deposits. If shoring is implemented at the site, the requirements of OPSS.PROV 539 should be followed. Design of temporary works will be entirely the responsibility of the contractor. Based on the proposed elevations of the services and measured groundwater levels, basal instability may occur in the silty clay or clayey sand deposits, depending on the groundwater control measures implemented and the depth of excavation and the geometry of the trench.

Due to the depths of excavations required for the utilities, it is recommended that the contractor be required to submit a detailed work plan for dewatering, excavation and backfilling for review by the geotechnical engineer prior to commencing work to ensure that their proposed methods are suitable for limiting future subsidence.

Erosion protection should be provided at the outlet of the storm sewer outlet. Sufficient setback or buffer from Lake Ontario will also be required for erosion protection. We assume that erosion protection measures will be designed by CIMA.

5.3.2.2 Rock Excavation

As noted in Section 5.3 above, excavation of up to about 0.5 m of bedrock will be required in some of the deeper pipe sections along King Street and Maher Street. It is unlikely that drilling and blasting will be permitted. For very shallow excavations (typically less than 1 m) in the limestone bedrock, it may be possible to excavate with an excavator and hoe ram. Where mechanical excavations are to be carried out adjacent to sensitive structures (i.e. where settlement or vibrations are a consideration) the walls of the trench excavations should be line drilled to limit overbreak. Overbreak or over-excavation will often occur in hard, horizontally bedded rock masses with near vertical joints, as the rock will tend to break in slabs, which, depending on the joint orientation, may break off outside the excavation lines.

Based on the Record of Borehole sheets, the groundwater level recorded in the boreholes was above the bedrock surface. Groundwater inflow into excavation in rock should be anticipated and will generally require pumping from filtered sump pumps to keep excavations dry enough for working. The flow of water into the excavation through the bedrock will largely be controlled by the fractures or joints in the rock mass (i.e. fracture flow).

Should blasting be permitted, we should be contacted to provide additional recommendations for controlled blasting including vibration limits for sensitive adjacent structures and utilities, blasting methods and pre- and post-blast surveys.

5.3.3 Pipe Bedding and Cover

The bedding for sewers and watermain should be compatible with the type and class of pipe, the surrounding soil and anticipated loading conditions and should be designed in accordance with the Regional and Municipal standards. Where granular bedding is deemed to be acceptable, it should consist of at least 150 mm of OPSS.PROV 1010 (Aggregates) Granular 'A' or 19 mm crusher run limestone material. Clear stone should never be used as bedding for pipes. Depending upon the design invert elevations and success of the contractor's groundwater control methods, a thicker bedding layer, 300 to 450 mm, may be required at some locations where wet/soft or loose soil conditions are present, such as those found in Borehole 15-4 as well as in the clayey sand soils, to facilitate the pipe installations.

We also recommend that a non-woven geotextile be placed between the native soil and the bottom of the granular bedding. The geotextile should meet the specifications for OPSS 1860 (Geotextiles) Class II, and have a fabric opening size (FOS) not greater than 212 µm.

From the springline to 300 mm above the obvert of the pipe, sand cover may be used. All bedding and cover materials should be placed in maximum 150 mm loose lifts and should be uniformly compacted to at least 98 percent of SPMDD.

5.3.4 Trench Backfill (Engineered Fill)

Trench backfill material should be treated as engineered fill. The excavated soils from the site will vary from non-cohesive sands, silts and clayey sand and cohesive silty clay. The majority of the native soils that are anticipated to be excavated during underground service installation are generally near or above their estimated laboratory optimum moisture contents for compaction. The excavated materials at suitable water contents may be reused as trench backfill provided they are free of significant amounts of topsoil, organics or other deleterious material, and are placed and compacted as outlined below. Some drying of the wetter of the silty clay and clayey sand deposits below the local groundwater table may be required prior to placement. It should also be noted that due to the predominantly fine-grained, silty/clayey nature of the majority of the native soils, some difficulty would be expected in achieving adequate compaction during wet weather. All topsoil and organic materials should be wasted or used for landscaping purposes. All oversized cobbles and boulders (i.e. greater than 150 mm in size) should be removed from the backfill.

Imported materials to be used as engineered fill must be approved by Golder at the source(s), prior to hauling to the site. In this regard, imported sandy materials which meet the requirements for OPSS.PROV 1010 SSM would be suitable for use as engineered fill. In any event, the approved materials for engineered fill should be placed in maximum 300 mm loose lifts and uniformly compacted to at least 98 percent of SPMDD throughout. The placement and compaction of engineered fill should be monitored by qualified geotechnical personnel on a full-time basis during placement.

Normal post-construction settlement of the compacted trench backfill should be anticipated, with the majority of such settlement taking place within about six months following the completion of trench backfilling operations. This settlement will be reflected at the ground surface and in pavement construction areas, may be compensated for where necessary by placing additional granular material prior to asphalt paving. However, since it is anticipated that the asphalt binder course will be placed shortly following the completion of trench backfilling operations, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of asphalt (i.e. padding). In any event, it is recommended that the surface course asphalt should not be placed over the binder course asphalt (across the full road width) for at least twelve months. Post-construction settlement of the restored ground surface in any boulevard/ditch trench areas is also expected and should be topped-up and re-landscaped, as required.

It is recommended that, where the utility trench encounters high permeability non-cohesive soils, trench plugs should be constructed to prevent preferential water flow through the granular bedding and trench backfill. These clay plugs could be constructed using excavated cohesive material or manufactured clay plugs. The need for and frequency of trench plugs must be evaluated in the field during construction. As such, it should be included in the contract as a provisional item.

5.4 Soil Bulking

Soil bulking is the increase in total volume of soil over the volume of the same material in the undisturbed state. Bulking of native soils occurs when they are excavated from undisturbed ground. It should be noted that due to the variability of the soils on the site, the actual soil bulking factor can be best determined when the final site grading plan is available and a series of additional laboratory and in-situ field tests are completed on the proposed "cut" soils. However, for initial design purposes and considering the predominant native silty/clayey soils at this site, bulking of about 10 percent (increase in total volume) would be expected after excavation and prior to re-compaction. After re-compaction, bulking of about 5 percent would be expected.

5.5 Pavement Design

5.5.1 Streets A and B

It is understood that Street A and Street B will be constructed within the proposed residential development. The cross section provided indicates that the proposed streets will be constructed as an urban local road. Based on the proposed profiles, it appears that the grade of site is generally levelled with the adjacent developed areas and significant grade changes are not anticipated. If the grade is to be raised by more than about 0.5 m for construction of the streets, preloading should be considered prior to final paving to reduce post-construction settlements and related maintenance activities.

Based on the results of the geotechnical investigation, topsoil was encountered in all five boreholes (15-1 to 15-5) advanced and the thickness measured ranged from 150 mm to 460 mm, with an average of 280 mm. Clayey fills with organic inclusions was encountered in borehole 15-2 at the depth from 0.5 m to 0.7 m. If encountered within the footprint of the streets, the topsoil should be stripped full depth, and clayey fills with organic layer be removed completely, regardless of the depth.

Soils with high silt content were encountered in Borehole 15-1, 15-2, 15-4, and 15-5 and are considered to be highly frost susceptible. It is recommended that the silty soils, if encountered within the frost depth (1.3 m below proposed road/ground surface) and under the footprint of the street, be removed and replaced with Selected Subgrade Materials (SSM). The removed material may be reused as site grading fills in non-settlement sensitive areas, away from the proposed structures.

Based on the results of the geotechnical investigation and our understanding of the project, the recommended new pavement structure for the preliminary design of Street A and Street B is as follows:

Material		**Thickness of Pavement Elements (mm)**
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40
	HL 8 Binder Course	50
Granular Material (OPSS 1010)	Granular A	150
	Granular B	400
Prepared and Approved Subgrade		

It is our understanding that traffic information for the proposed development is not available at this time. As such, the pavement recommendations presented in this report are only conceptual. Golder should be given an opportunity to update the pavement designs once the traffic information and design criteria are finalized. It should be noted that based on the final traffic information provided, the updated pavements designs may differ significantly than the designs provided in this report.

In order to preserve the integrity of the pavement and given the highly frost susceptible soils at the site, continuous subdrains should be placed at the edge of pavement along both sides of the roads. The pavement drainage system should consist of a 150 mm diameter wrapped perforated pipe, placed inside a 300 mm by 300 mm trench and surrounded by clean free draining sand, such as concrete sand. The drain invert should be at approximately 250 mm below the bottom of the granular subbase and should be sloped to drain to the catchbasins.

5.5.2 King Street West and Maher Crescent

It is our understanding that a section of King Street West and Maher Crescent may have to be excavated within project limits to allow for the installation of a sanitary sewer along the two streets.

The following strategy is recommended for the pavement restoration over the proposed sanitary sewer:

- After installation and backfilling of the sanitary sewer, place new Granular B subbase material such that top of the new Granular B material matches the bottom of the existing Granular A material at the adjacent locations. Compact the Granular B subbase material to 100 percent of the material’s SPMDD;
- Place new Granular A base material such that top of the new Granular A matches the bottom of the existing hot mix asphalt (HMA) at the adjacent locations. Compact the Granular A to 100 percent of the material’s SPMDD; and
- Pave with new HMA to match the thickness of the existing HMA in the adjacent areas (approximately 100 mm). HL 8 base course asphalt shall be used for the lower lift asphalt layers (minimum lift thickness of 50 mm and maximum of 75 mm). HL 3 surface course asphalt shall be used for the top lift (40 – 50 mm thickness). NOTE: The surface course asphalt should be milled to create a step joint and asphalt to be reinstated in accordance with OPSD 509.010.

5.5.3 General Recommendations

The subgrade should be graded to the desired crossfall and proofrolled prior to placement of any granular materials. Loose or soft areas identified by proofrolling should be sub-excavated and replaced with SSM, and compacted to provide a stable uniform subgrade. The remedial work should be carried out on any disturbed, softened or poorly performing zones, as directed by the geotechnical engineer. The fill material should be compacted to a minimum of 98 percent of the material’s SPMDD within 1 m below subgrade level.

The granular subbase and base materials should be uniformly compacted to 100 percent of the SPMDD. The asphalt materials should be compacted to minimum of 92 percent of their Marshall Relative Densities (MRD), as measured in the field using a nuclear density gauge.

It should be noted that in some cases, even though the compaction requirements have been met, the subgrade strength may not be adequate to support heavy construction loading especially during wet weather or where backfill materials wet of optimum have been placed. In this regard, the granular subbase thickness may not be sufficient for a construction haul road and additional subbase (in the order of 300 mm) may be required. In any event, the subgrade should be proofrolled and inspected by Golder prior to placing the subbase and additional material placed, as required.

Where new pavement abuts existing pavement (e.g. at the development limits), proper transverse joints should be constructed to key the new asphalt into adjacent existing surface. The existing asphalt edge should be provided with a proper sawcut edge prior to keying in the new asphalt. It should be ensured that any undermining or broken edges resulting from the construction activities are removed by the sawcut.

5.6 Residential House Foundations and Permanent Dewatering

Based on the results of this investigation, residential houses with or without basements may be founded on conventional shallow spread and/or continuous strip footings bearing in the native, undisturbed stiff silty clay deposits or compact sand, silty sand, sandy silt or clayey sand deposits at or below Elevation 79.0 m. Footing below this elevation are likely to be below the prevailing groundwater levels at the site. Alternatively, to raise the footings above the groundwater table, engineered fill may be placed above this subgrade material.

Foundations for residential structures, with a minimum width of 450 mm for strip footings and a minimum width of 1000 mm for square footings, founded on competent native soils may be design using a factored geotechnical resistance at Ultimate Limit States (ULS) of 150 kPa and a geotechnical reaction at Serviceability Limit States (SLS) of 100 kPa (for a total settlement of 25 mm and differential settlement of 19 mm). The existing topsoil or surficial deposits containing organics or loose sand, silty sand or sandy silt are not suitable for supporting building foundations and should be removed from the building envelopes and replaced with engineered fill as required.

Footings bearing in engineered fill over approved subgrade, if utilized at the site, with a minimum width of 450 mm for strip footings and a minimum width of 1000 mm for square footings, may be designed using a factored geotechnical resistance at ULS of 200 kPa and a geotechnical reaction at SLS of 125 kPa (for a total settlement of 25 mm and differential settlement of 19 mm). In general, for any houses placed wholly or in part on engineered fill, it is recommended that the foundations be provided with nominal reinforcement, consisting of reinforcing steel at the top and bottom of the foundation walls. However, once the final thicknesses and extent of engineered fill are known, the need for and design of any reinforcement can be determined on a lot-by-lot basis by the builder's structural engineer, in consultation with the geotechnical engineer.

All foundation excavations at the site should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The founding materials are susceptible to disturbance by construction activity especially during wet weather and care should be taken to preserve the integrity of the materials as bearing strata. Prior to pouring concrete for the footings, the foundation excavations should be inspected by the geotechnical engineer to confirm that the footings are founded within an undisturbed and competent bearing stratum that has been cleaned of ponded water and all disturbed, softened, loosened, organic and other deleterious material. It is essential that footings founded on engineered fill be inspected by the geotechnical engineer prior to pouring concrete. If the concrete for the footings cannot be placed immediately after excavation and inspection, a working mat of lean concrete could be placed in the excavation to protect the integrity of the engineered fill / native soils.

The perimeter house basement walls should be backfilled with a free draining, non-frost susceptible granular material carefully placed and compacted in lifts not exceeding 300 mm thickness and should be designed using a lateral earth pressure coefficient of 0.5 and a unit weight of backfill of 21 kN/m^3. Alternatively, where site excavated material is to be reused for all backfill, an approved geocomposite drainage system must be used directly against the wall. The composite drain must withstand the design horizontal earth pressures used for basement wall design, and should be connected to the basement level under slab drainage system.

Based on the grading plan, basement elevations and the proposed grade raises between about 0.3 m and 1.2 m in the lot areas, the proposed basement elevations are expected to be at or just below the highest measured groundwater levels. Given the proximity of the site to Lake Ontario and groundwater levels, permanent groundwater drainage (i.e., waterproofing) will be required for some houses. Waterproofing measures such as membranes, water stops, subdrains or a combination thereof, will need to be installed on lots where basements are built within silty sands below the groundwater table. Subdrains below the basement floor slab can be surrounded by 19 mm clear stone placed over a non-woven geotextile (OPSS 1860 (Geotextiles) Class II, with a fabric opening size (FOS) not greater than 212 µm) and concrete placed directly over the clear stone. Subdrains adjacent to the outside base of the walls or footings must be wrapped in sand fill meeting the specification for OPSS.PROV 1002 Concrete Fine Aggregate. The location, spacing, number and details of subdrains or other waterproofing measures must be determined by Golder during construction. The drainage system should discharge to the storm sewer. The upper 0.3 m of backfill should be clayey material to provide a relatively impermeable cap and should be sloped away from the house.

Where spread footings are constructed at different elevations, the difference in elevation between the individual footings should not be greater than one half the clear distance between the footings. In addition, the lower footings should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevation of the upper footings can be adjusted accordingly. Stepped strip footings should be constructed in accordance with the Ontario Building Code, Section 9.15.3.8.

All exterior footings and footings in unheated areas should be provided with at least 1.3 m of soil cover after final grading in order to minimize the potential for damage due to frost action. In addition, the bearing soil and fresh concrete must be protected from freezing during cold weather construction.

5.7 Environmental Testing

During the geotechnical drilling program, Golder collected soil samples from each road borehole to assist with characterization for excess soil disposal. Golder’s preliminary information regarding the chemical quality of the subsurface soils at the site is based on six soil samples (16-1 SA2, 16-1 SA5, 16-2 SA1, 16-2 SA3, 16-3 SA4 and 16-3 SA5) that were submitted to SGS Canada Inc. (SGS) for analysis of one or more of the following parameters: metals and inorganics, petroleum hydrocarbons (PHC) and volatile organic compounds (VOC). Each submission was composed of discreet soil samples collected by Golder staff from Boreholes 16-1, 16-2 and 16-3 on November 7, 2016.

At the time of the sampling, olfactory evidence of environmental impact (i.e. PHC-like odour) was recorded at the sampling location 16-2 SA2 (0.8-1.2 m below ground surface). However, Golder was unable to collect a sample at this location due to low recovery in the sampling spoon. The following table provides a summary of the sample IDs, type of soil (i.e., fill or native), the depth of each sample and the parameters tested for each sample. For a summary of subsurface conditions observed, please refer to Record of Borehole Sheets.

BH/Sample ID	Fill/Native	Soil Sample Depth (m below ground surface)	Parameters
16-1 SA2	Native	0.76 – 1.22	Metals and inorganics
16-1 SA5	Native	3.05 – 3.51	PHC and VOC
16-2 SA1	Native	0.15 – 0.61	Metals and inorganics, PHC
16-2 SA3	Native	1.52 – 1.98	VOC
16-3 SA4	Native	2.29 – 2.90	PHC and VOC

BH/Sample ID	Fill/Native	Soil Sample Depth (m below ground surface)	Parameters
16-3 SA5	Native	3.35 – 3.51	Metals and inorganics

5.7.1 Soil Analytical Results

The soil sample analytical results were compared to the Ontario Ministry of the Environment and Climate Change (MOECC) *"Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act"*, April 15, 2011, Table 1 Full Depth Background Site Condition Standards for Residential / Parkland / Institutional / Industrial / Commercial / Community Property Use ("MOECC Table 1 Standards") and Table 2 Full Depth Generic Site Condition Standards in a Potable Ground Water Condition for Residential / Parkland / Institutional Property Use ("MOECC Table 2 Standards").

A summary of the soil analytical results and the MOECC Table 1 Standards is provided on the Laboratory Certificates of Analysis, included in Appendix C.

Based on the results of the soil sample analyses and comparison to the MOECC Table 1 Standards, the following soil samples were reported above the MOECC Table 1 Standards:

- Sodium Adsorption Ratio (SAR) was reported to be 3.3 at 16-1 SA2, 4.6 at 16-2 SA1 and 3.7 at 16-3 SA5, all above the MOECC Table 1 Standard of 2.4;
- Molybdenum was reported to be 4.6 ug/g at 16-2 SA1, above the MOECC Table 1 Standard of 2 ug/g;
- PHC F1 was reported to be 55 ug/g at 16-2 SA1, above the MOECC Table 1 Standard of 25 ug/g;
- PHC F2 was reported to be 240 ug/g at 16-2 SA1, above the MOECC Table 1 Standard of 10 ug/g;
- PHC F3 was reported to be 534 ug/g at 16-2 SA1, above the MOECC Table 1 Standard of 240 ug/g;
- PHC F4 was reported to be 2000 ug/g at 16-2 SA1, above the MOECC Table 1 Standard of 120 ug/g; and
- Gravimetric Heavy Hydrocarbons was reported to be 8570 ug/g at 16-2 SA1, above the MOECC Table 1 Standard of 120 ug/g.

Based on the results of the soil sample analyses and the MOECC Table 2 Standards comparison, the following soil sample was reported above the MOECC Table 2 Standards:

- PHC F2 was reported to be 240 ug/g at 16-2 SA1, above the MOECC Table 2 Standard of 150 ug/g;
- Gravimetric Heavy Hydrocarbons was reported to be 8570 ug/g at 16-2 SA1, above the MOECC Table 2 Standard of 5600 ug/g.

All other soil samples submitted for analysis meet MOECC Table 1 Standards and MOECC Table 2 Standards for the parameter tested.

5.7.2 Summary of Analytical Results and Soil Disposal Options

A total of six soil samples from the roadway boreholes were submitted to SGS for analytical testing, three of which exceeded the MOECC Table 1 Standards, and one of which exceeded the MOECC Table 2 Standards, as summarized above.

If excess soil materials generated during construction vary in composition from the samples tested by Golder, additional testing is recommended to determine their suitability for disposal/reuse. Note that the excess soil reuse options as discussed herein are limited to the environmental quality of the soil.

It should be noted that environmental testing was conducted on soil samples from boreholes drilled within the roadway only. Environmental sampling and testing of the soils from within the lot boundaries was not carried out and may differ from reported values for this investigation. No exceedances were reported in the native soil samples tested as part of this borehole investigation, although additional testing may be required within the lot boundaries if olfactory or visual evidence of contamination is noted during excavation.

Elevated SAR values in soils beneath roadways and parking lots are often attributable to the application of de-icing salts. Although the levels identified are above one or more of the MOECC Standards, some receivers may consider accepting these materials, depending on their intended land use. For example, they may be considered environmentally suitable for re-use as road base materials. Available analytical data pertaining to this material should be forwarded to the potential receiver for review. Written authorization, indicating that this data was received and reviewed, and that the receiver accepts the excavated material, should be provided to the Site representative by the potential receiver. Please note that receiving sites may be subject to filling or other land use restrictions which could affect the importation and placement of fill on their sites. An assessment of the appropriateness for individual sites to accept and place fill material is beyond the scope of this work program and has not been investigated or addressed.

Disposal at a MOECC licensed landfill is recommended for soils with parameter concentrations that exceed one or more of the MOECC Standards. The environmental testing as part of this report was to primarily assist with soil characterization for disposal purposes. In order to further assess the extent of PHC impacts at the site additional site investigation is recommended.

Further, movement of soil to a site that has a Record of Site Condition on file with the MOECC may require that specific testing protocols are followed and that the material must satisfy the applicable MOECC Standards. If excess soil materials vary from the samples tested by Golder, additional testing is recommended to determine suitability for disposal/reuse. Note that the excess soil reuse options are based on the environmental quality of the soil and not based on the geotechnical suitability of soil.

6.0 MONITORING AND TESTING

The geotechnical aspects of the final design drawings and specifications should be reviewed by this office prior to construction, to confirm that the intent of this report has been met. During construction, full-time engineered fill monitoring, sufficient foundation inspections, subgrade inspections and in-situ 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.

Report Signature Page

We trust that this report provides sufficient geotechnical engineering information to finalize the development plans and proceed with the detail design of this project. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

GOLDER ASSOCIATES LTD.

LICENSED PROFESSIONAL ENGINEER
S. E. M. POOT
90471921
5/10/17
PROVINCE OF ONTARIO

Imran Khalid, B.Eng.
Geotechnical EIT

Sarah E. M. Poot, P.Eng.
Associate/Senior Geotechnical Engineer

IK/SEMP/ik/jnh/nh/

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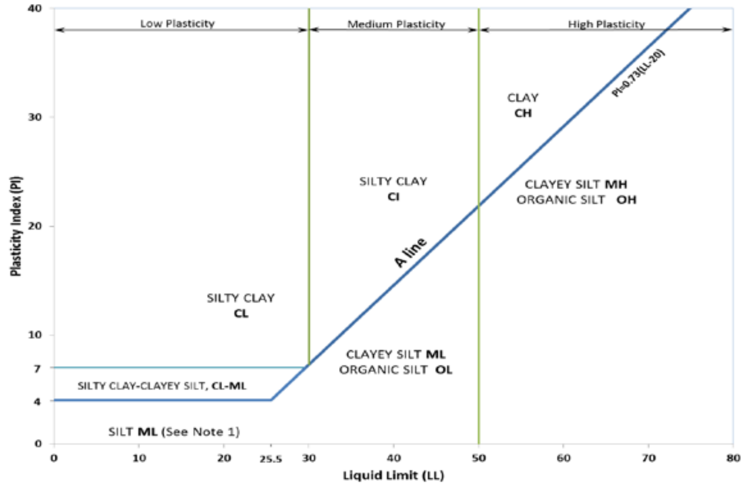
METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10}xD_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.

Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.

For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.

For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL, SAND and CLAY)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.).

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
FS	Foil sample
GS	Grab Sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size
TP	Thin-walled, piston – note size
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\,\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma$ - u)
σ'_{vo}	initial effective overburden stress
σ_1, σ_2, σ_3	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u, s_u	undrained shear strength (ϕ = 0 analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes:
1 $\tau = c' + \sigma' \tan \phi'$
2 shear strength = (compressive strength)/2

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

PROJECT: 1404019

RECORD OF BOREHOLE: 15-1

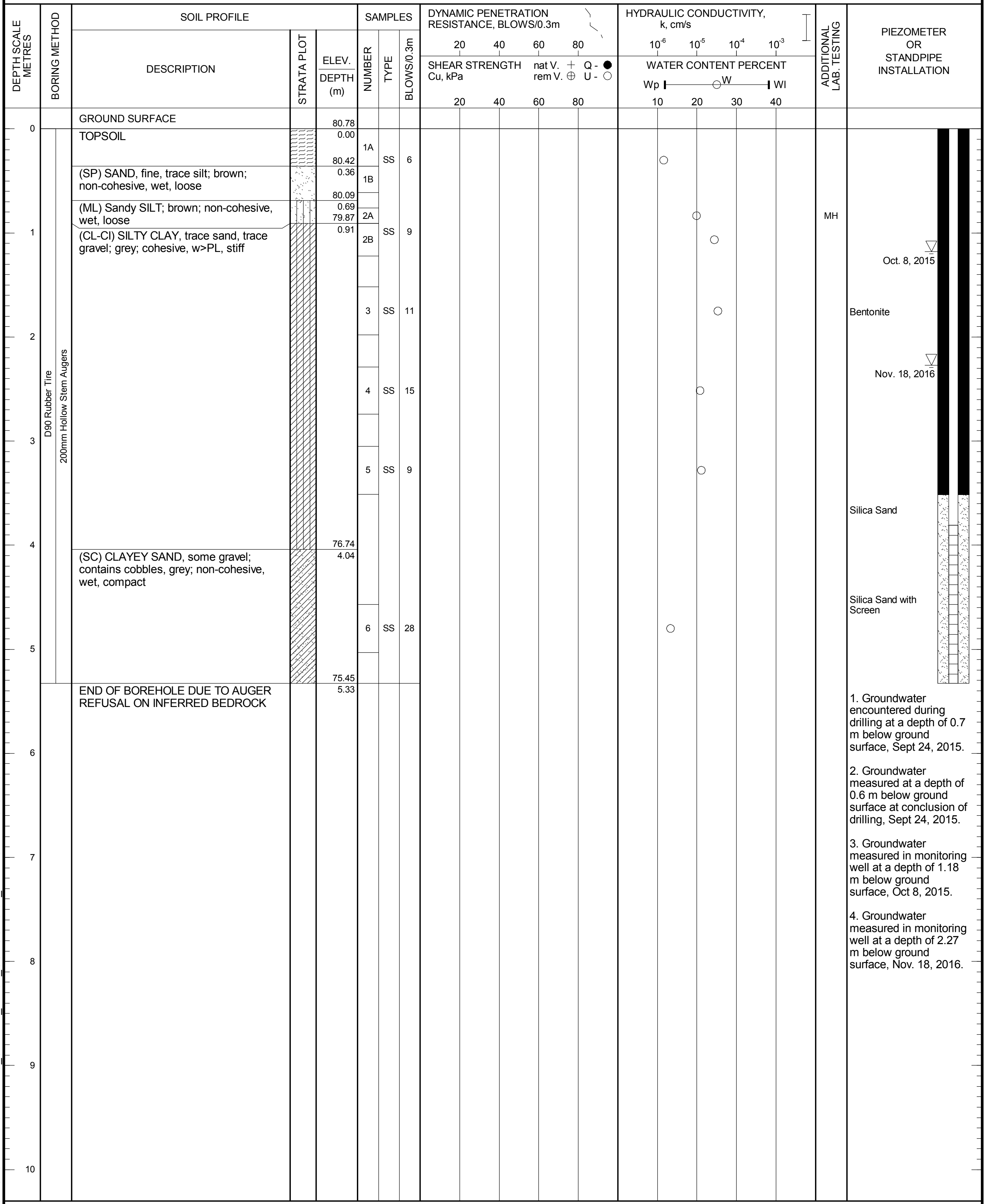
SHEET 1 OF 1

LOCATION: N 4871018.99; E 725530.66

BORING DATE: September 24, 2015

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	80.78
TOPSOIL	0.00
(SP) SAND, fine, trace silt; brown; non-cohesive, wet, loose	80.42 0.36
(ML) Sandy SILT; brown; non-cohesive, wet, loose	80.09 0.69
(CL-CI) SILTY CLAY, trace sand, trace gravel; grey; cohesive, w>PL, stiff	79.87 0.91
(SC) CLAYEY SAND, some gravel; contains cobbles, grey; non-cohesive, wet, compact	76.74 4.04
END OF BOREHOLE DUE TO AUGER REFUSAL ON INFERRED BEDROCK	75.45 5.33

NUMBER	TYPE	BLOWS/0.3m
1A	SS	6
1B		
2A	SS	9
2B		
3	SS	11
4	SS	15
5	SS	9
6	SS	28

1. Groundwater encountered during drilling at a depth of 0.7 m below ground surface, Sept 24, 2015.

2. Groundwater measured at a depth of 0.6 m below ground surface at conclusion of drilling, Sept 24, 2015.

3. Groundwater measured in monitoring well at a depth of 1.18 m below ground surface, Oct 8, 2015.

4. Groundwater measured in monitoring well at a depth of 2.27 m below ground surface, Nov. 18, 2016.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JZL

CHECKED: EW

PROJECT: 1404019

RECORD OF BOREHOLE: 15-2

SHEET 1 OF 1

LOCATION: N 4870955.50; E 725518.45

BORING DATE: September 24, 2015

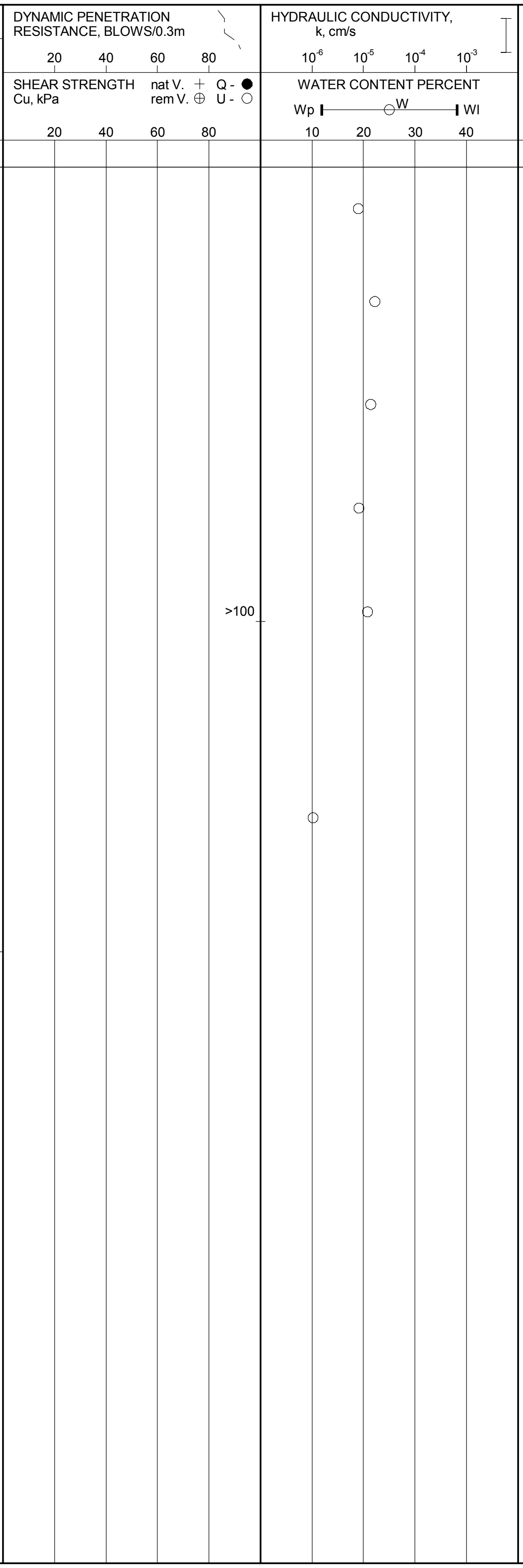
DATUM: Geodetic

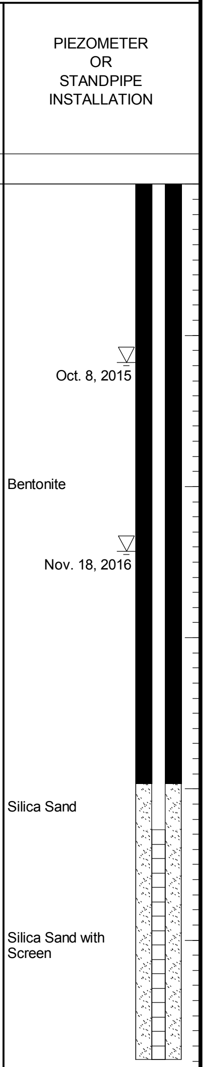
HAMMER TYPE: AUTOMATIC

BORING METHOD: D90 Rubber Tire; 200mm Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	80.69
TOPSOIL	0.00
(CL) Sandy SILTY CLAY, trace gravel; organic inclusions, brown; cohesive, w>PL, stiff	80.23 0.46
(ML) Sandy SILT; brown to grey at 1.7 m; non-cohesive, wet, compact	80.00 0.69
(CL-CI) SILTY CLAY; grey; cohesive, w>PL, firm	77.79 2.90
(SC) CLAYEY SAND, trace gravel; grey; non-cohesive, wet, compact	76.65 4.04
END OF BOREHOLE DUE TO AUGER REFUSAL ON INFERRED BEDROCK	74.90 5.79

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	9	
2	SS	16	MH
3	SS	13	MH
4	SS	17	
5	SS	5	
6	SS	19	





NOTES:

1. Borehole moved 1.5 m east to complete insitu vane test at 3.4 m depth.

1. Groundwater encountered during drilling at a depth of 0.9 m below ground surface, Sept 24, 2015.

2. Groundwater measured at a depth of 0.9 m below ground surface at conclusion of drilling, Sept 24, 2015.

3. Groundwater measured in monitoring well at a depth of 1.18 m below ground surface, Oct 8, 2015.

4. Groundwater measured in monitoring well at a depth of 2.43 m below ground surface, Nov. 18, 2016.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JZL

CHECKED: EW

PROJECT: 1404019

LOCATION: N 4870861.99; E 725538.94

RECORD OF BOREHOLE: 15-3

BORING DATE: September 24, 2015

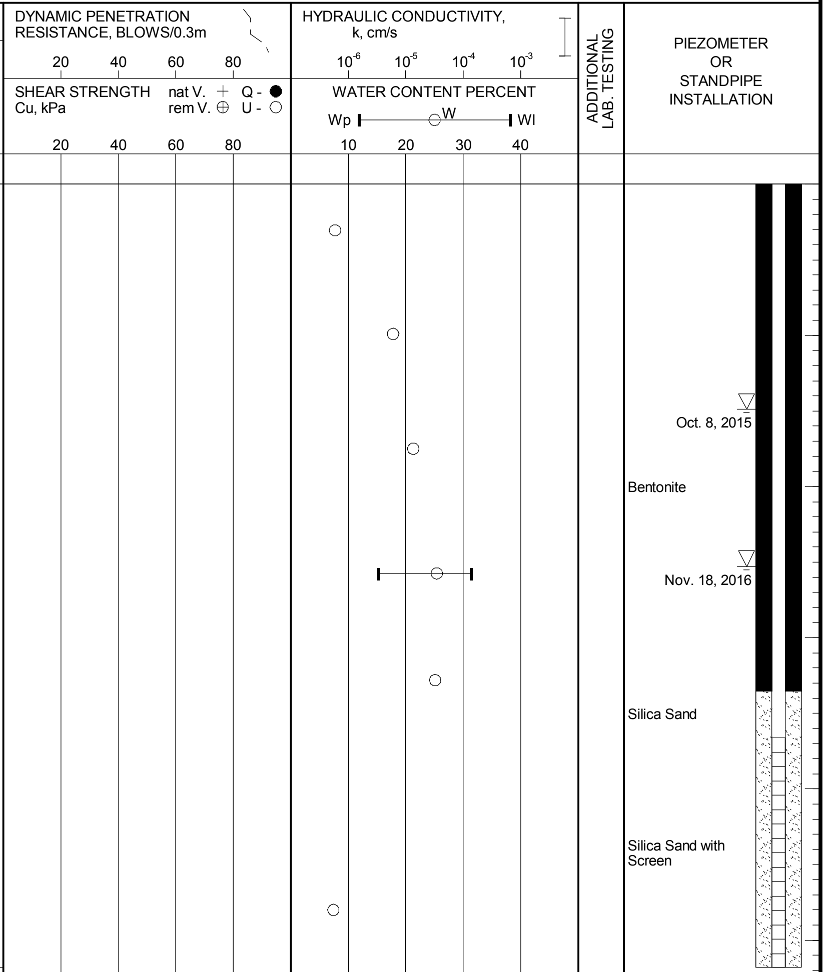
SHEET 1 OF 1

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

BORING METHOD: D90 Rubber Tire; 200mm Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	80.01			
TOPSOIL	0.00			
(SM) SILTY SAND, fine, trace gravel; brown; non-cohesive, moist to wet at 0.7 m, loose to compact	0.15	1	SS	5
		2	SS	18
		3	SS	25
(CI) SILTY CLAY, trace fine sand, trace gravel; grey; cohesive, w>PL, stiff	77.60 2.41	4	SS	11
		5	SS	8
(SC) CLAYEY SAND; trace gravel; grey; non-cohesive, wet, dense	75.97 4.04	6	SS	44
END OF BOREHOLE DUE TO AUGER REFUSAL ON INFERRED BEDROCK	74.83 5.18			



1. Groundwater encountered during drilling at a depth of 0.7 m below ground surface, Sept 24, 2015.

2. Groundwater measured at a depth of 4.9 m below ground surface at conclusion of drilling, Sept 24, 2015.

3. Groundwater measured in monitoring well at a depth of 1.49 m below ground surface, Oct 8, 2015.

4. Groundwater measured in monitoring well at a depth of 2.53 m below ground surface, Nov. 18, 2016.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JZL

CHECKED: EW

PROJECT: 1404019

LOCATION: N 4870854.72; E 725476.69

RECORD OF BOREHOLE: 15-4

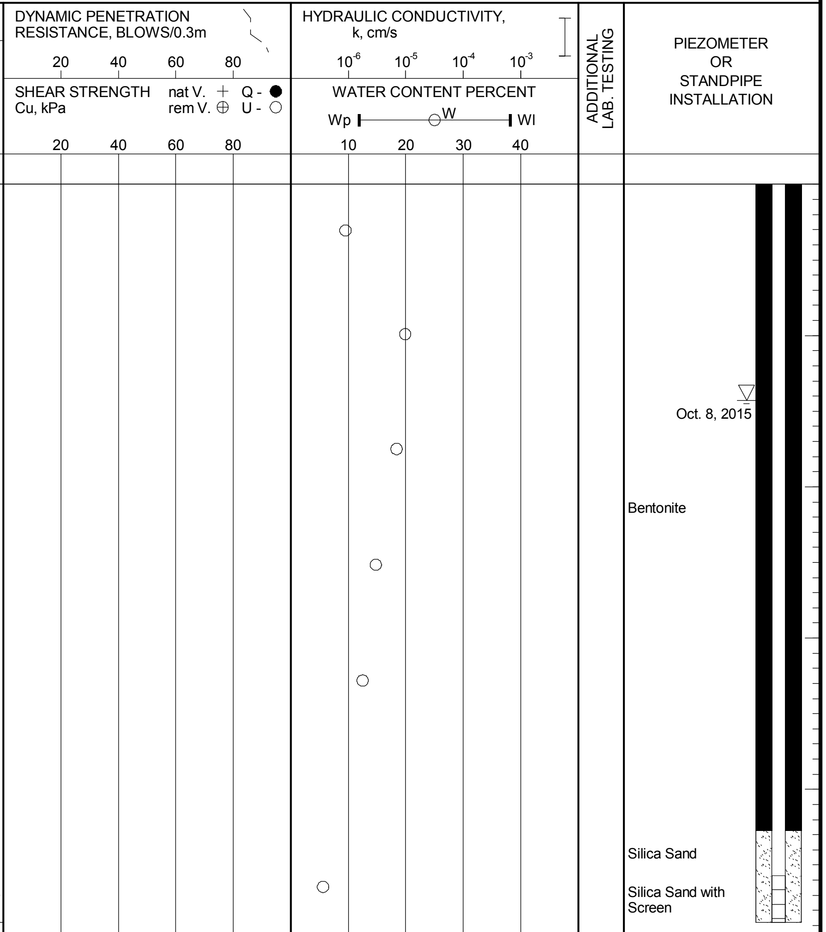
BORING DATE: September 24, 2015

SHEET 1 OF 1

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
		GROUND SURFACE		79.89			
0	D90 Rubber Tire 200mm Hollow Stem Augers	TOPSOIL		0.00			
		(SP) SAND, medium to fine, trace silt; brown; non-cohesive, moist to wet, loose to compact		79.59 0.30	1 2		5 11
1		(ML) SILT, some sand to sandy; grey; non-cohesive, wet, dense to very dense		78.52 1.37	3 4 5		25 44 74
4		(SC) CLAYEY SAND, some gravel; grey; non-cohesive, wet, very dense		75.85 4.04	6		50/ 0.15
5		END OF BOREHOLE DUE TO AUGER REFUSAL ON INFERRED BEDROCK		75.01 4.88			



1. Groundwater encountered during drilling at a depth of 1.0 m below ground surface, Sept 24, 2015.

2. Groundwater measured at a depth of 1.0 m below ground surface at conclusion of drilling, Sept 24, 2015.

3. Groundwater measured in monitoring well at a depth of 1.43 m below ground surface, Oct 8, 2015.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JZL

CHECKED: EW

PROJECT: 1404019

LOCATION: N 4870805.68; E 725558.04

RECORD OF BOREHOLE: 15-5

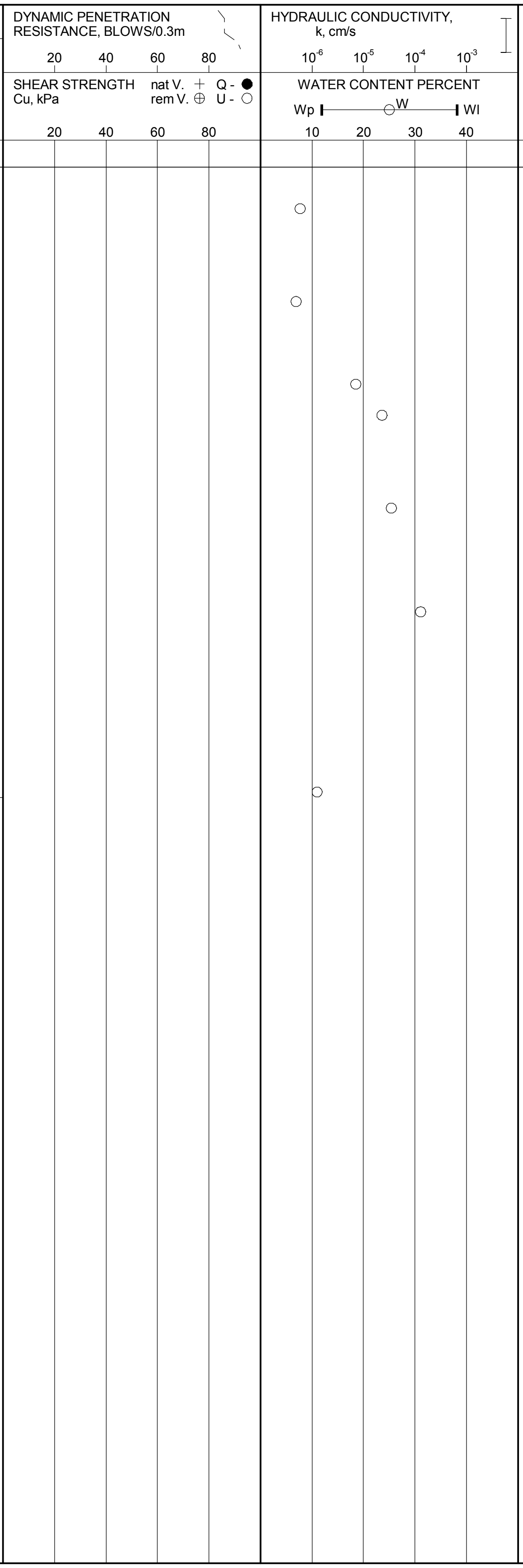
BORING DATE: September 24, 2015

SHEET 1 OF 1

DATUM: Geodetic

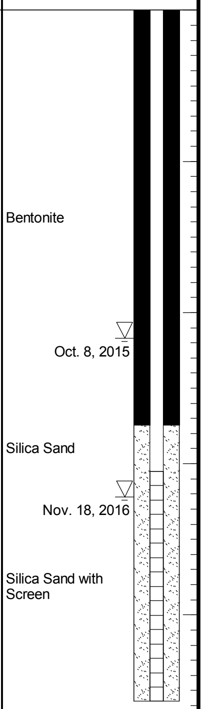
HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		79.60			
0	D90 Rubber Tire 200mm Hollow Stem Augers	TOPSOIL		0.00			
		(SP) SAND, medium to fine, trace silt, trace gravel; brown; non-cohesive, moist, loose to compact		0.15	1	SS	4
1					2	SS	10
		(ML) Sandy SILT, trace clay; brown; non-cohesive, moist, loose		78.23 1.37	3A	SS	9
		(CL-CI) SILTY CLAY; grey; cohesive, w>PL; stiff		77.92 1.68	3B		
2					4	SS	13
3					5	SS	11
4		(SC) CLAYEY SAND, some gravel, grey, non-cohesive, wet		75.56 4.04			
		END OF BOREHOLE DUE TO AUGER REFUSAL ON INFERRED BEDROCK		74.95 4.65	6	SS	50/ 0.08



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



1. Groundwater encountered during drilling at a depth of 4.3 m below ground surface, Sept 24, 2015.

2. Groundwater measured at a depth of 4.3 m below ground surface at conclusion of drilling, Sept 24, 2015.

3. Groundwater measured in monitoring well at a depth of 2.17 m below ground surface, Oct 8, 2015.

4. Groundwater measured in monitoring well at a depth of 3.22 m below ground surface, Nov. 18, 2016.

DEPTH SCALE

1 : 50

LOGGED: JZL

CHECKED: EW

PROJECT: 1404019

LOCATION: N 4871020.60; E 725461.72

RECORD OF BOREHOLE: 16-1

BORING DATE: November 7, 2016

SHEET 1 OF 1

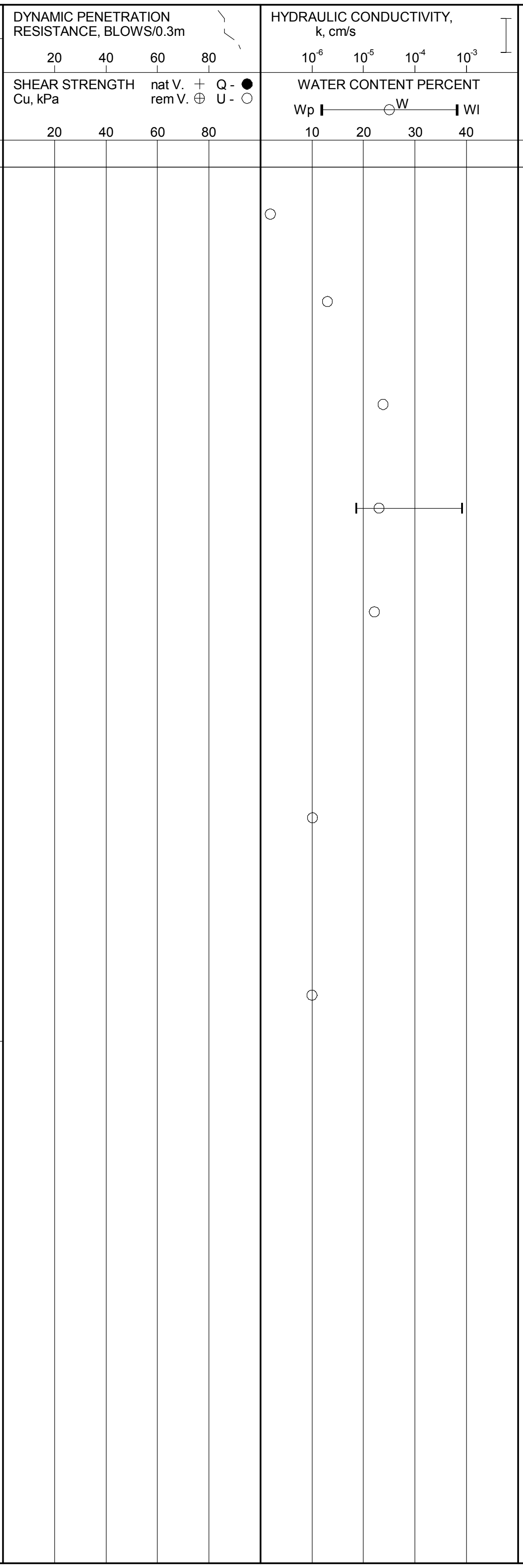
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME 55 Power Augering; 200 mm O.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	80.93				
ASPHALT	0.00				
FILL - (SW) Gravelly SAND, trace silt; brown; non-cohesive, moist	0.08	1	AS		
FILL - (SM) SILTY SAND, trace gravel, organic inclusions; brown to black; non-cohesive, moist, loose	80.24 0.69	2	SS	9	
(CI) SILTY CLAY; brown; cohesive, w>PL, stiff	79.56 1.37	3	SS	12	
		4	SS	10	
		5	SS	11	
(SC) CLAYEY SAND, some gravel; grey; non-cohesive, moist, loose	76.89 4.04	6	SS	9	MH
LIMESTONE (BEDROCK)	74.81 6.12	7	SS	50/ 0.02	
Bedrock cored from a depth of 6.12 m to 6.45 m below ground surface. Refer to Record of Drillhole 16-1 for bedrock coring details.	74.48 6.45				
END OF BOREHOLE					



PIEZOMETER OR STANDPIPE INSTALLATION

1. Groundwater encountered during drilling at a depth of 2.2 m below ground surface, November 7, 2016.

2. Borehole open and dry upon completion of drilling.

DEPTH SCALE

1 : 50

LOGGED: IK

CHECKED: SEMP

PROJECT: 1404019

RECORD OF DRILLHOLE: 16-1

SHEET 1 OF 1

LOCATION: N 4871020.6 ;E 725461.7

INCLINATION: -90° AZIMUTH: ---

DRILLING DATE: November 7, 2016

DRILL RIG: CME 55

DRILLING CONTRACTOR: Tri Phase

DATUM: Geodetic

JN - Joint
FLT - Fault
SHR- Shear
VN - Vein
CJ - Conjugate

BD- Bedding
FO- Foliation
CO- Contact
OR- Orthogonal
CL - Cleavage

PL - Planar
CU- Curved
UN- Undulating
ST - Stepped
IR - Irregular

PO- Polished
K - Slickensided
SM- Smooth
Ro - Rough
MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	COLOUR % RETURN	FLUSH	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.3 m 5 10 15 20	DISCONTINUITY DATA B Angle 0 90 180 270	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-6} 10^{-5} 10^{-4} 10^{-3}	Diametral Point Load Index (MPa) 2 4 6	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		Refer to Record of Borehole 16-1		74.81																		
		BEDROCK - Limestone with Shale inclusions		6.12 74.48																		
		END OF DRILLHOLE		6.45																		
7																						
8																						
9																						
10																						
11																						
12																						
13																						
14																						
15																						
16																						

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: IK
CHECKED: SEMP

PROJECT: 1404019

LOCATION: N 4871047.90; E 725547.66

RECORD OF BOREHOLE: 16-2

BORING DATE: November 7, 2016

SHEET 1 OF 1

DATUM: Geodetic

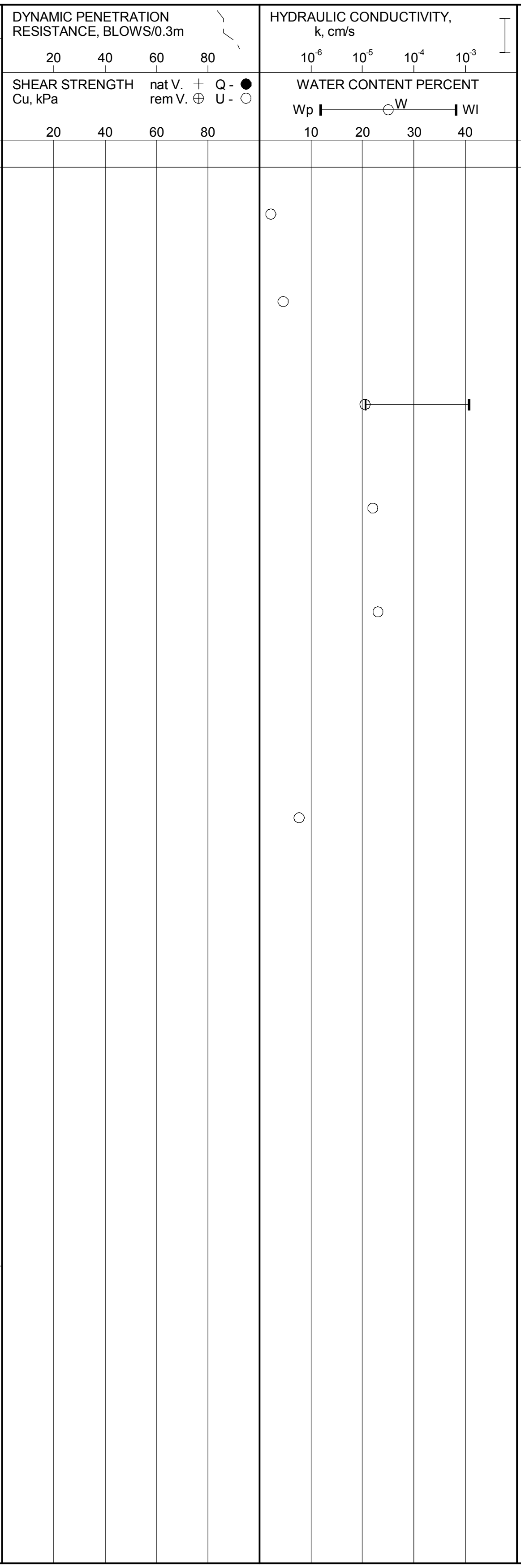
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME 55 Power Augering
200 mm O.D. Hollow Stem Augers (0 to 8.11 m)

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	81.35
ASPHALT	0.00
FILL - (SW) Gravelly SAND, trace silt; brown, trace asphalt; non-cohesive, moist to compact - Hydrocarbon odour from a depth of about 0.8 m to 1.2 m below ground surface	0.08
(CI) SILTY CLAY; brown; cohesive, w>PL to w~PL, stiff - Becomes grey at a depth of about 2.9 m below ground surface	79.98 1.37
(SC) CLAYEY SAND, some gravel; grey; non-cohesive, moist, compact	77.31 4.04
LIMESTONE (BEDROCK) Bedrock cored from a depth of 5.11 m to 8.11 m below ground surface. Refer to Record of Drillhole 16-2 for bedrock coring details.	76.24 5.11
END OF BOREHOLE	73.24 8.11

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	15	
3	SS	10	MH
4	SS	13	
5	SS	14	
6	SS	22	



PIEZOMETER OR STANDPIPE INSTALLATION

UCS = 35 MPa from 5.22 m to 5.45 m

1. Groundwater encountered during drilling at a depth of 3.4 m below ground surface, November 7, 2016.

2. Borehole open and dry upon completion of drilling.

DEPTH SCALE

1 : 50

LOGGED: IK

CHECKED: SEMP

PROJECT: 1404019

RECORD OF DRILLHOLE: 16-2

SHEET 1 OF 1

LOCATION: N 4871047.9 ;E 725547.7

DRILLING DATE: November 11, 2016

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

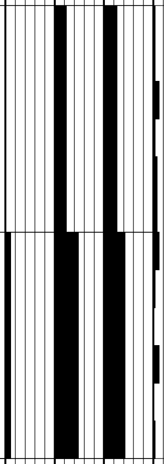
DRILLING CONTRACTOR: Tri Phase

JN - Joint	BD- Bedding	PL - Planar	PO- Polished
FLT - Fault	FO- Foliation	CU- Curved	K - Slickensided
SHR- Shear	CO- Contact	UN- Undulating	SM- Smooth
VN - Vein	OR- Orthogonal	ST - Stepped	Ro - Rough
CJ - Conjugate	CL - Cleavage	IR - Irregular	MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH COLOUR % RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.3 m 5 10 15 20	DISCONTINUITY DATA B Angle 0 90 180 270	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-6} 10^{-5} 10^{-4} 10^{-3}	Diametral Point Load Index (MPa) 2 4 6	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		Refer to Record of Borehole 16-2																			
6 7 8		BEDROCK - Limestone with Shale inclusions, grey, medium strong		76.24 5.11																	UCS = 35 MPa from 5.22 m to 5.45 m
9 10 11 12 13 14 15		END OF DRILLHOLE		73.24 8.11																	



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: IK

CHECKED: SEMP

PROJECT: 1404019

RECORD OF BOREHOLE: 16-3

SHEET 1 OF 1

LOCATION: N 4871014.78; E 725591.81

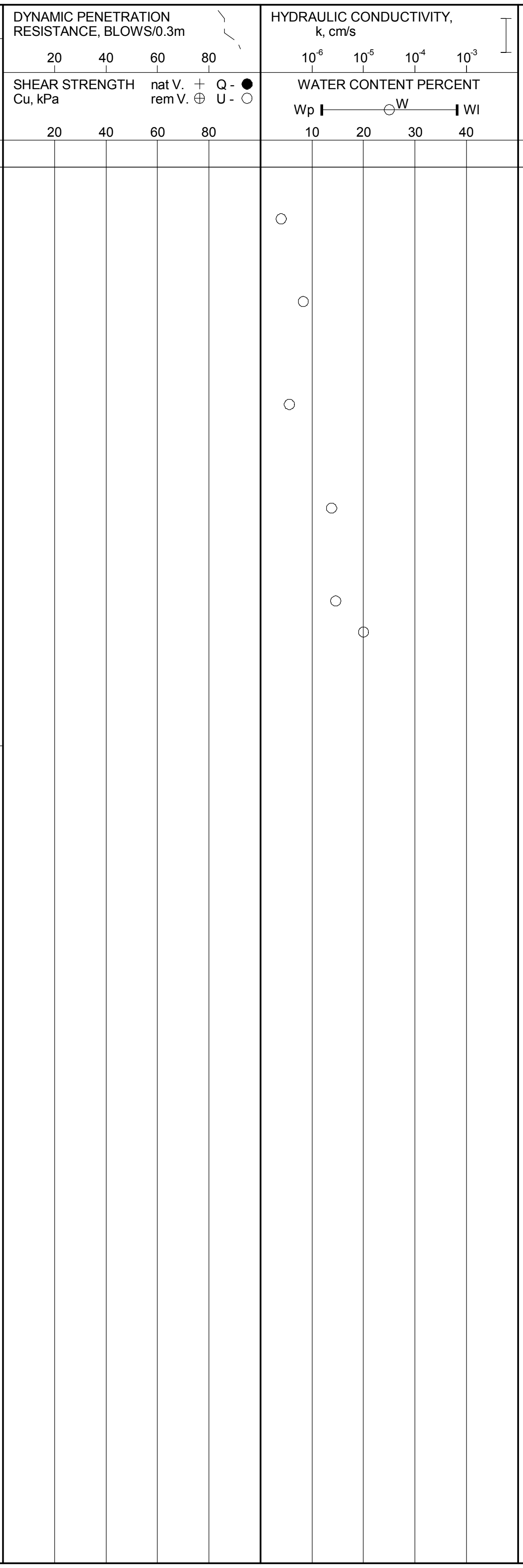
BORING DATE: November 7, 2016

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		80.64					
0	CME 55 Power Augering 200 mm O.D. Hollow Stem Augers	ASPHALT	■	0.00					
		FILL - (SW) Gravelly SAND, trace silt; brown; non-cohesive, moist	▨	0.15	1	AS	--		
1		FILL - (SC) CLAYEY SAND, some gravel; brown; non-cohesive, moist, loose to compact	▨	79.95 0.69	2 3	SS SS	21 7		
2		(ML) Sandy SILT, trace gravel; brown; non-cohesive, moist, loose to very loose		78.51 2.13	4	SS	4		
3		(SC) CLAYEY SAND, trace gravel; grey; non-cohesive, moist to wet, very loose		77.74 2.90	5A 5B	SS	2	MH	
4		END OF BOREHOLE DUE TO AUGER REFUSAL ON INFERRED BEDROCK		76.37 4.27					1. Groundwater encountered during drilling at a depth of 3.42.2 m below ground surface, November 7, 2016. 2. Borehole open and dryupon completion of drilling.
5									
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

LOGGED: IK

CHECKED: SEMP

S:\Clients\CIMA\King_Street_West_Cobourg\99_PROJ\1404019\40_PROD\0005_Geotech\1404019-0005-BG-0001.mxd

LEGEND

⌖ Borehole Location

▭ Property Boundary

0 50 100

1:1,250 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

BASE DATA - ATLAS OF CANADA, NATURAL RESOURCES CANADA, 2011. MNR LIO, OBTAINED 2015 PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015

BASE IMAGERY - ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

BASE PLAN - DEVELOPMENT SITE PLAN "CEDARS SHORE ESTATES" 589 KING STREET WEST, DATED 06/24/15, RFA PLANNING CONSULTANT INC.

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CIMA CANADA INC.

PROJECT
GEOTECHNICAL INVESTIGATION
589 KING STREET WEST, COBOURG, ONTARIO

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-06-17
DESIGNED	JT
PREPARED	JT
REVIEWED	IK
APPROVED	SEMP

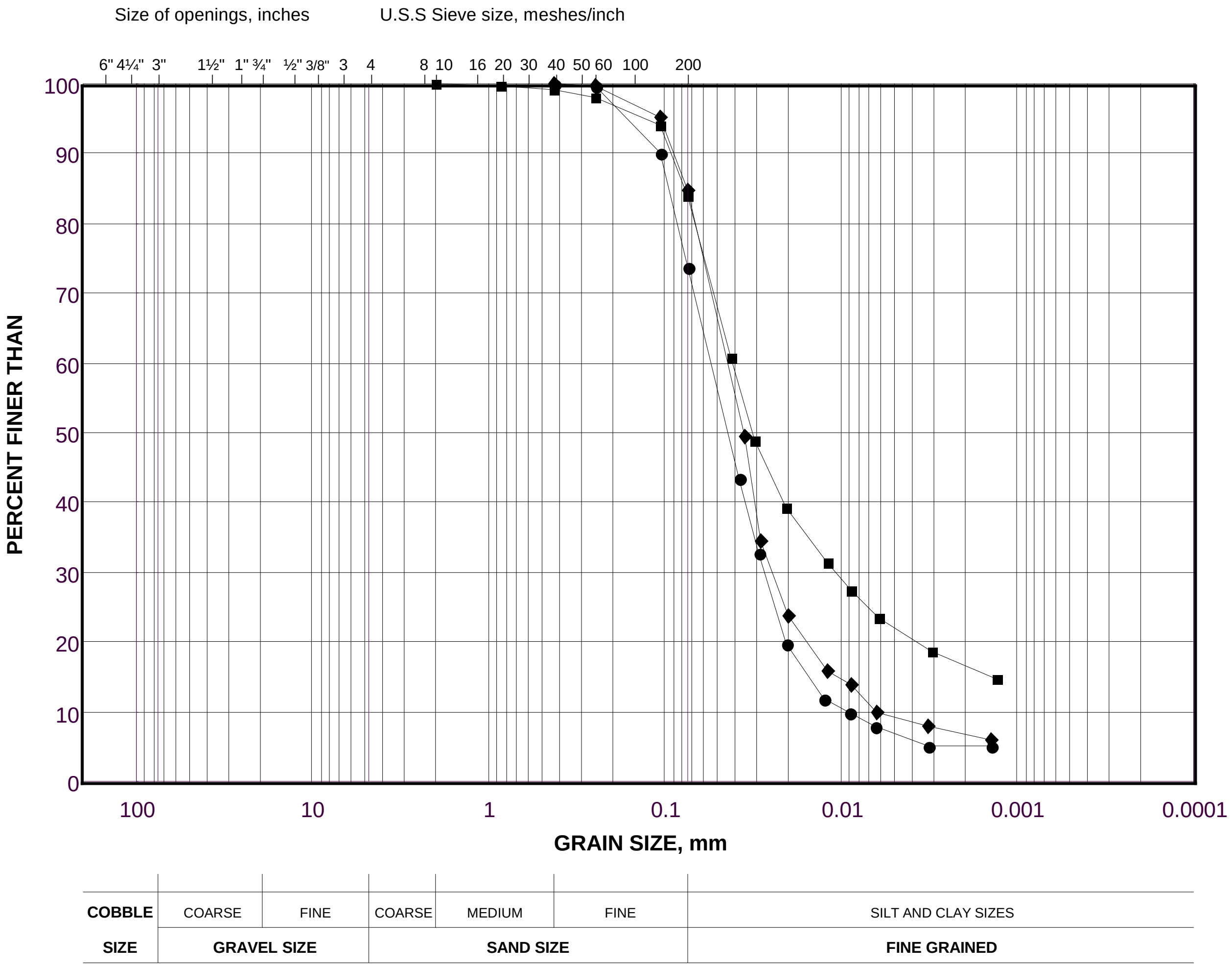
PROJECT NO.	CONTROL	REV.	FIGURE
1404019			**1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

GRAIN SIZE DISTRIBUTION

(ML) sandy SILT

FIGURE 2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	15-2	2	0.8 - 1.2
■	15-1	2A	0.8 - 0.9
◆	15-2	3	1.5 - 2.0

Project Number: 14-04019

Checked By: IK

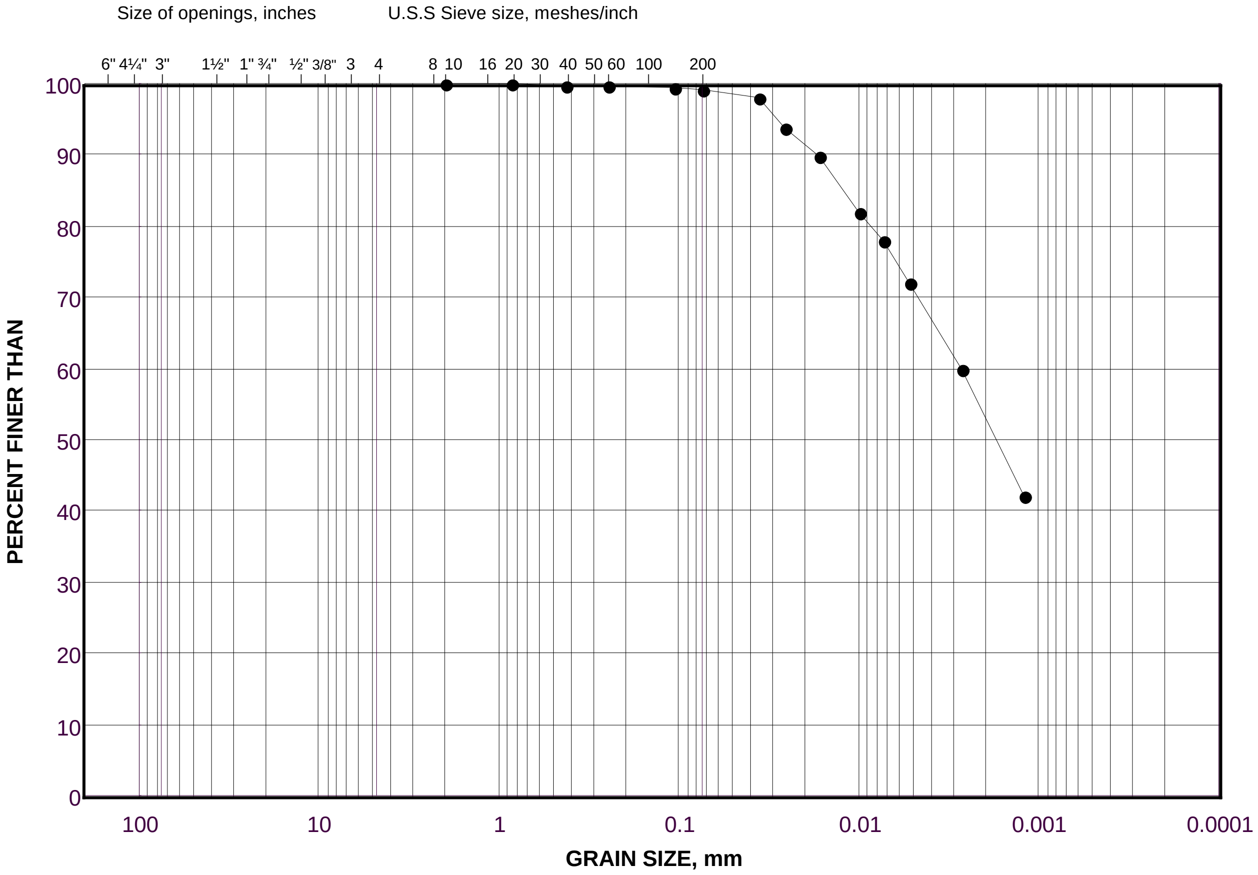
Golder Associates

Date: 02-Feb-17

GRAIN SIZE DISTRIBUTION

(CI) SILTY CLAY

FIGURE 3



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

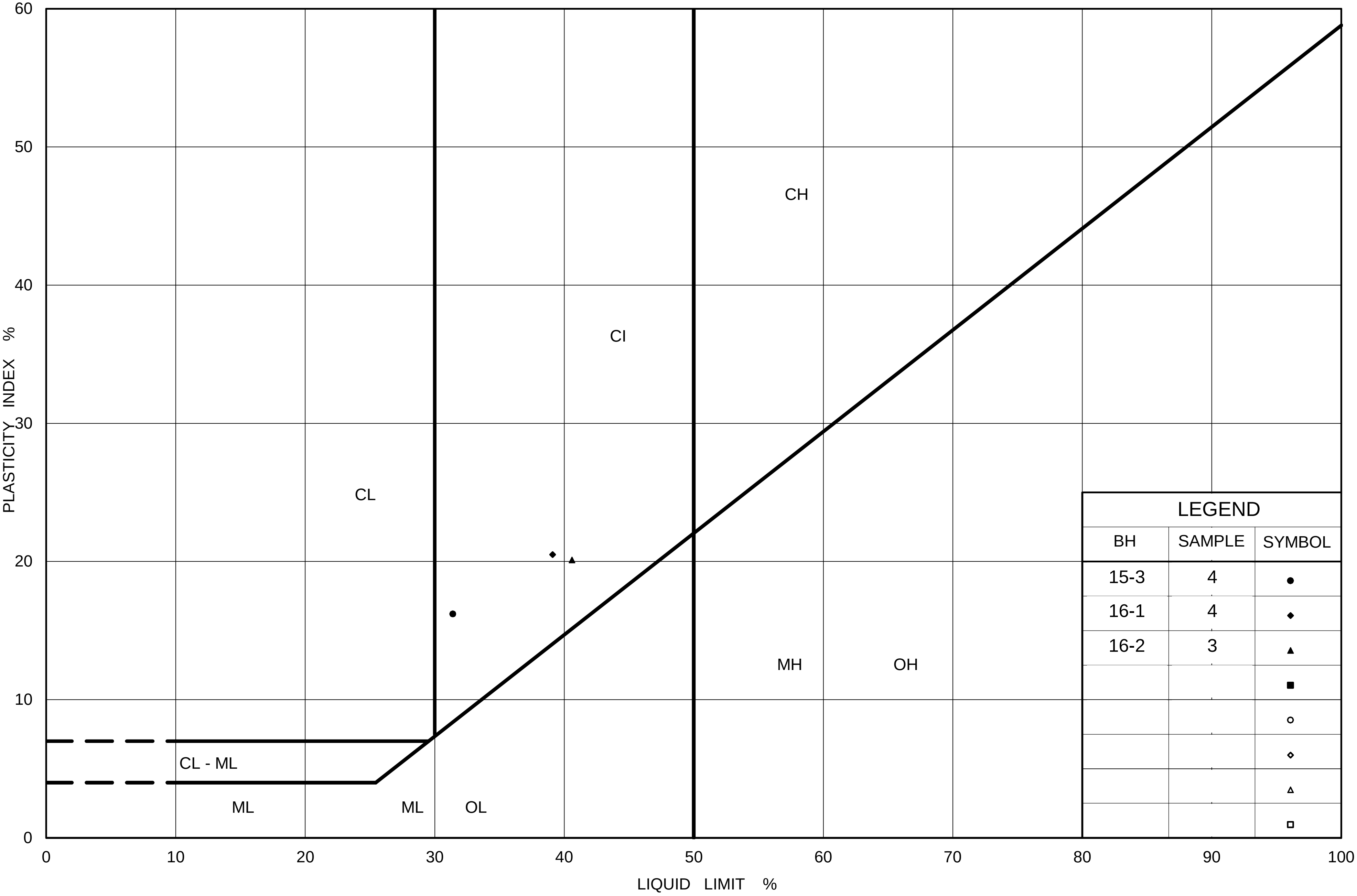
SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	16-2	3	1.7 - 2.1

Project Number: 14-04019

Checked By: IK

Golder Associates

Date: 21-Dec-16



Golder Associates

PLASTICITY CHART

(CI) SILTY CLAY

Figure No 4

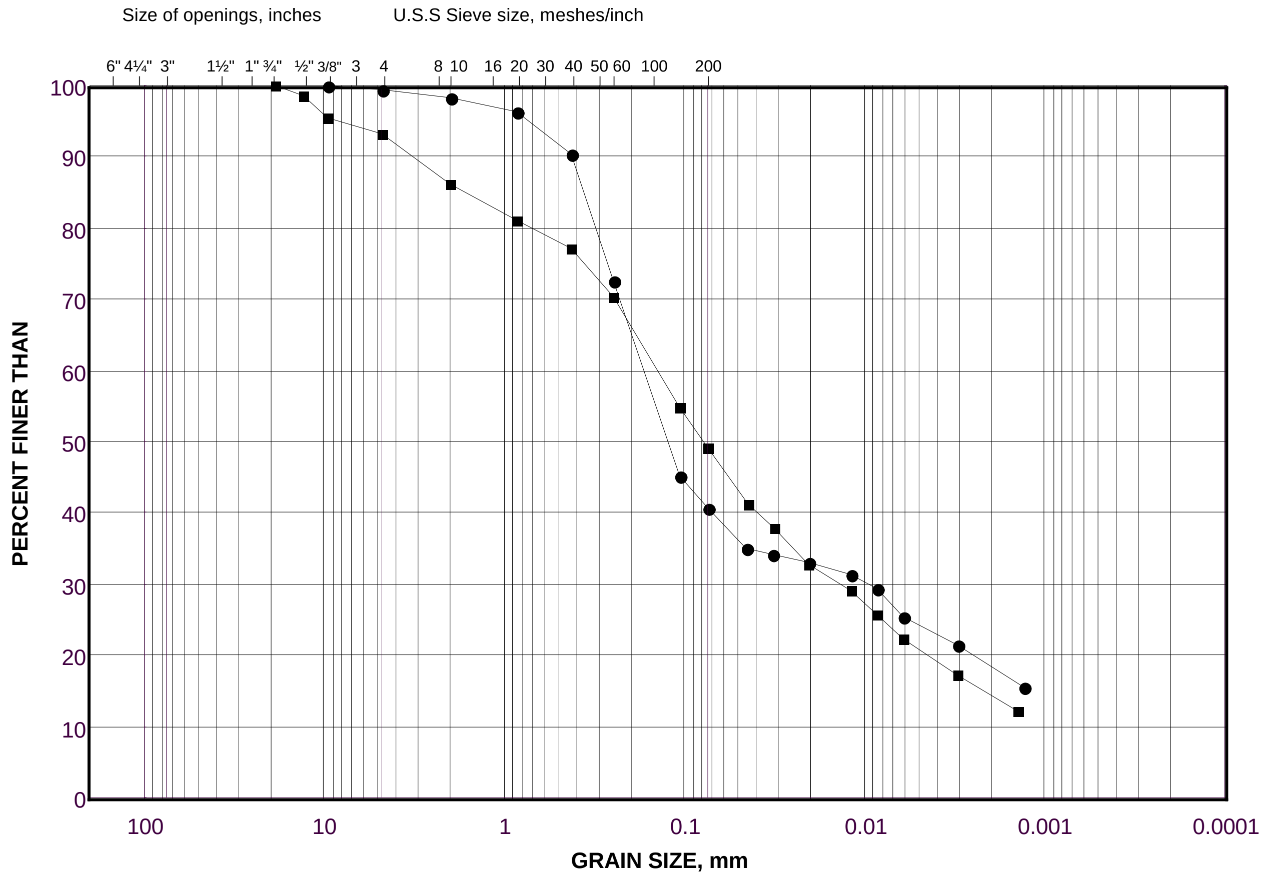
Project No. 14-04019

Checked By: IK

GRAIN SIZE DISTRIBUTION

(SC) CLAYEY SAND

FIGURE 5



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	16-3	5A	3.0 - 3.4
■	16-1	6	3.8 - 4.3

Project Number: 14-04019

Checked By: IK

Golder Associates

Date: 02-Feb-17

APPENDIX A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX B

In-Situ Hydrogeological Testing Results

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 15-1

INTERVAL (metres below ground surface)

Top of Interval = 4.04
Bottom of Interval = 5.33

$$K = \frac{r_c^{\,2}}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1+\left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{\left(t_2 - t_1\right)}\right]$$

where K = (m/sec)

where:

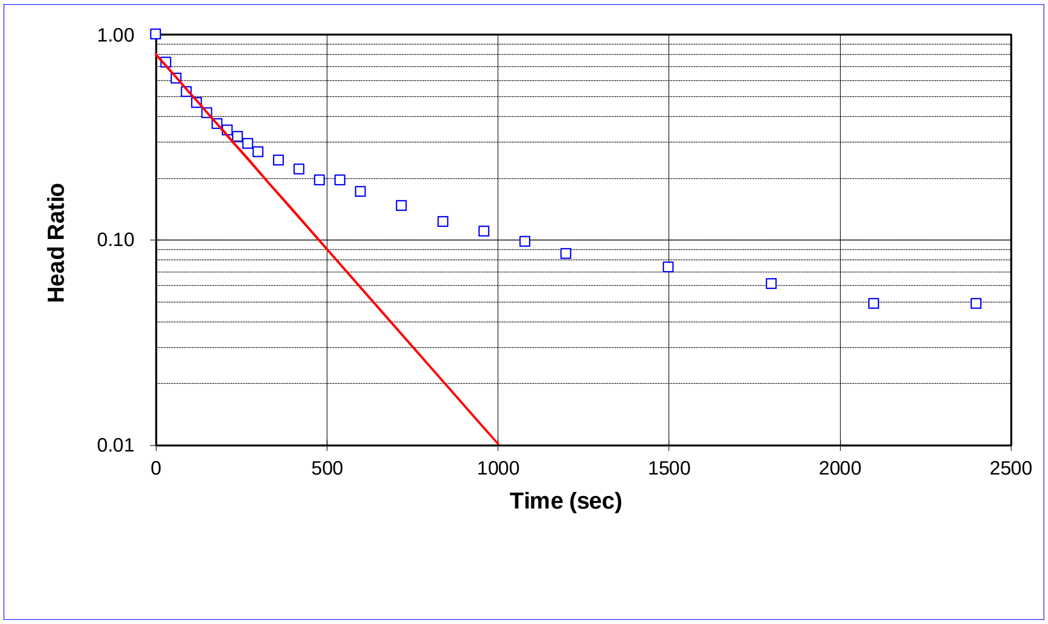
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c = 2.5E-02
R_e = 1.0E-01
L_e = 1.3
t_1 = 0
t_2 = 500
h_1/h_0 = 0.80
h_2/h_0 = 0.09

RESULTS

K= 3E-06 m/sec
K= 3E-04 cm/sec



Project Name: King St Development, Cobourg
Project No.: 1404019
Test Date: 11/18/2016

Analysis By: CAMC
Checked By: BTB
Analysis Date: 11/22/2016

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 15-2

INTERVAL (metres below ground surface)

Top of Interval = 4.28
Bottom of Interval = 5.79

$$K = \frac{r_c^{\,2}}{2L_e} \ln\left[\frac{L_e}{2R_e} + \sqrt{1+\left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{\left(t_2 - t_1\right)}\right]$$

where K = (m/sec)

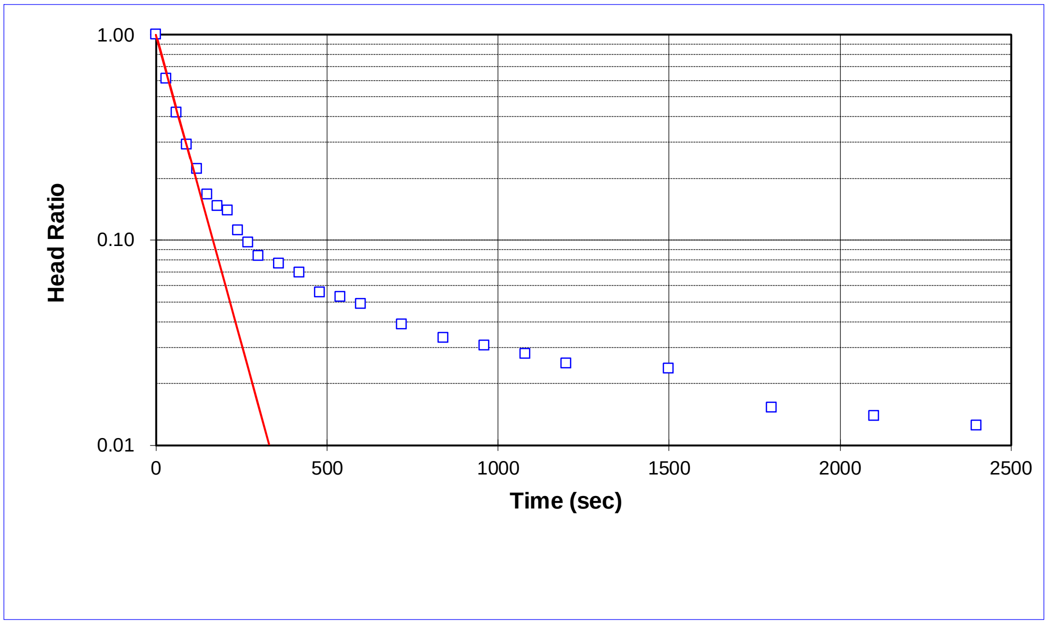
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c = 2.5E-02
R_e = 1.0E-01
L_e = 1.5
t_1 = 0
t_2 = 100
h_1/h_0 = 1.00
h_2/h_0 = 0.25

RESULTS

K=	8E-06	m/sec
K=	8E-04	cm/sec



Project Name:	King St Development, Cobourg	Analysis By:	CAMC
Project No.:	1404019	Checked By:	BTB
Test Date:	11/18/2016	Analysis Date:	11/21/2016

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 15-3

INTERVAL (metres below ground surface)

Top of Interval = 4.04
Bottom of Interval = 5.18

$$K = \frac{r_c^{\,2}}{2L_e} \ln\left[\frac{L_e}{2R_e} + \sqrt{1+\left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

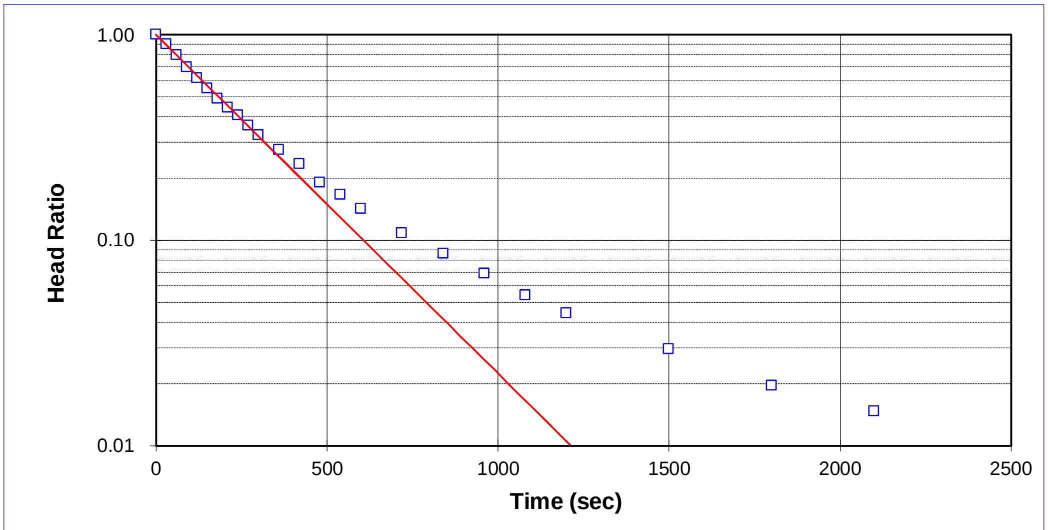
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c = 2.5E-02
R_e = 1.0E-01
L_e = 1.1
t_1 = 0
t_2 = 500
h_1/h_0 = 1.00
h_2/h_0 = 0.15

RESULTS

K= 3E-06 m/sec
K= 3E-04 cm/sec



Project Name: King St Development, Cobourg
Project No.: 1404019
Test Date: 11/18/2016

Analysis By: CAMC
Checked By: BTB
Analysis Date: 11/22/2016

Golder Associates Ltd.

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 15-5

INTERVAL (metres below ground surface)

Top of Interval =	4.04
Bottom of Interval =	4.57

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where K=m/sec

where:

r_c = casing radius (metres);

R_e = effective radius (metres);

L_e = length of screened interval (metres);

r_w = radial distance to undisturbed aquifer (metres)

y_0 = initial drawdown (metres)

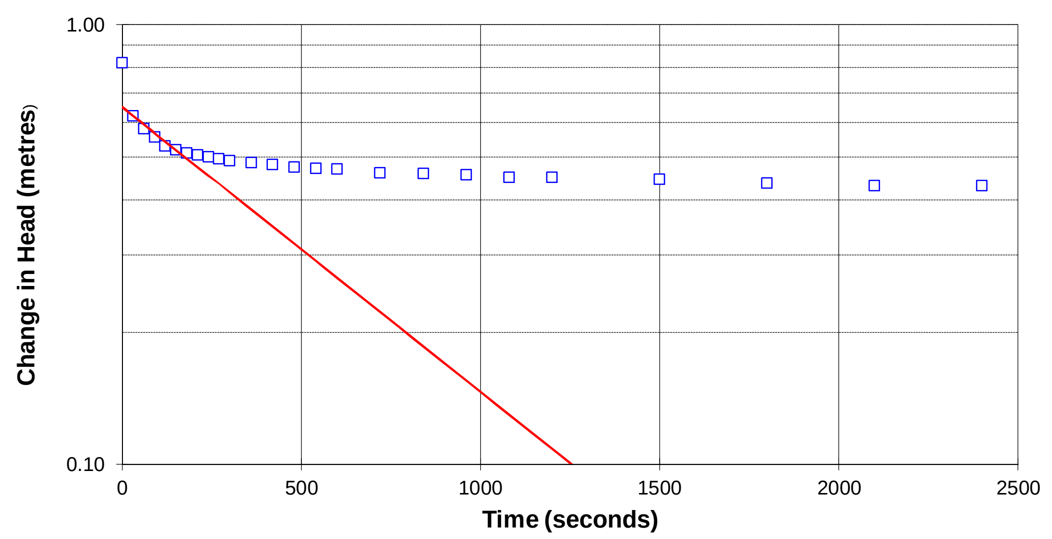
y_t = drawdown (metres) at time t (seconds)

INPUT PARAMETERS

r_c =	0.06
r_w =	0.10
L_e =	0.53
$ln(R_e/r_w)$	1.53
y_0 =	0.65
y_t =	0.56
t =	100.0

RESULTS

K=	8E-06	m/sec
K=	8E-04	cm/sec



Project Name: King St Development, Cobourg
Project No.: 1404019
Test Date: 11/18/16

Analysis By: CAMC
Checked By: BTB
Analysis Date: 11/21/2016

Golder Associates Ltd.

APPENDIX C

Soil Analytical Results

FINAL REPORT

CA14267-NOV16 R

1404019 CIMA

Prepared for

Golder Associates Ltd

FINAL REPORT

First Page

CLIENT DETAILS

Client	Golder Associates Ltd	Project Specialist	Deanna Edwards, B.Sc, C.Chem
		Laboratory	SGS Canada Inc.
Address	100 Scotia Crt Whitby, ON L1N 8Y6.	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Devon Witheridge	Telephone	705-652-2000
Telephone	905-723-2727	Facsimile	705-652-6365
Facsimile	905-723-2182	Email	deanna.edwards@sgs.com
Email	dwitheridge@golder.com	SGS Reference	CA14267-NOV16
Project	1404019 CIMA	Received	11/15/2016
Order Number		Approved	11/22/2016
Samples	Soil (6)	Report Number	CA14267-NOV16 R
		Date Reported	11/22/2016

LABORATORY DETAILS

COMMENTS

CCME Method Compliance: Analyses were conducted using analytical procedures that comply with the Reference Method for the CWS for Petroleum Hydrocarbons in Soil and have been validated for use at the SGS laboratory, Lakefield, ON site.

Quality Compliance: Instrument performance / calibration quality criteria were met and extraction and analysis limits for holding times were met.

nC6 and nC10 response factors within 30% of response factor for toluene: YES
nC10, nC16 and nC34 response factors within 10% of the average response for the three compounds: YES
C50 response factors within 70% of nC10 + nC16 + nC34 average: YES
Linearity is within 15%: YES

F4G - gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
The results for F4 and F4G are both reported and the greater of the two values is to be used in application to the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

Temperature of Sample upon Receipt 4 degrees C
Cooling Agent Present
Custody Seal Not Present

SIGNATORIES

Deanna Edwards, B.Sc, C.Chem

Deanna Edwards

TABLE OF CONTENTS

RESULTS

		Sample Number	8	9	10	11	
		Sample Name	16-1 SA2	16-1 SA5	16-2 SA1	16-2 SA3	
		Sample Matrix	Soil	Soil	Soil	Soil	
		Sampled By	Imran Khalid	Imran Khalid	Imran Khalid	Imran Khalid	
		Sample Date	07/11/2016	07/11/2016	07/11/2016	07/11/2016	
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**L1**

L1 = REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	Units	RL	Result	Result	Result	Result	L1
Conductivity	mS/cm	0.002	0.35	---	0.27	---	0.57

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Parameter	Units	RL	Result	Result	Result	Result	L1
Free Cyanide	µg/g	0.05	0.05	---	< 0.05	---	0.051

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-[ENV]IC-LAK-AN-008

Parameter	Units	RL	Result	Result	Result	Result	L1
Chromium VI	µg/g	0.2	< 0.2	---	< 0.2	---	0.66

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	Units	RL	Result	Result	Result	Result	L1
Mercury	µg/g	0.05	< 0.05	---	< 0.05	---	0.27

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	Units	RL	Result	Result	Result	Result	L1
SAR Calcium	mg/L	0.09	15	---	6.0	---	
SAR Magnesium	mg/L	0.02	0.70	---	0.41	---	
SAR Sodium	mg/L	0.15	48	---	43	---	

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Parameter	Units	RL	Result	Result	Result	Result	L1
Barium	µg/g	0.01	23	---	36	---	220
Beryllium	µg/g	0.02	0.22	---	0.15	---	2.5
Boron	µg/g	1	3	---	4	---	36
Cadmium	µg/g	0.02	0.13	---	0.07	---	1.2
Chromium	µg/g	0.5	6.8	---	59	---	70
Cobalt	µg/g	0.01	1.7	---	2.9	---	21
Copper	µg/g	0.1	3.6	---	8.0	---	92
Lead	µg/g	0.1	5.0	---	12	---	120
Molybdenum	µg/g	0.1	0.2	---	4.0	---	2
Nickel	µg/g	0.1	3.9	---	9.7	---	82
Silver	µg/g	0.01	0.02	---	0.02	---	0.5
Thallium	µg/g	0.02	0.03	---	0.07	---	1
Uranium	µg/g	0.002	0.36	---	0.37	---	2.5
Vanadium	µg/g	3	15	---	19	---	86
Zinc	µg/g	0.7	18	---	23	---	290

RESULTS

		Sample Number	8	9	10	11	
		Sample Name	16-1 SA2	16-1 SA5	16-2 SA1	16-2 SA3	
		Sample Matrix	Soil	Soil	Soil	Soil	
		Sampled By	Imran Khalid	Imran Khalid	Imran Khalid	Imran Khalid	
		Sample Date	07/11/2016	07/11/2016	07/11/2016	07/11/2016	
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**L1**

L1 = REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED

Metals in Soil - Aqua-regia/ICP-MS (continued)

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Parameter	Units	RL	8	9	10	11	L1
Antimony	µg/g	0.8	< 0.8	---	< 0.8	---	1.3
Arsenic	µg/g	0.5	0.7	---	1.6	---	18
Selenium	µg/g	0.7	< 0.7	---	0.8	---	1.5

Moisture

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	Units	RL	8	9	10	11	L1
Moisture Content	%	-	11.3	23.5	2.6	19.2	

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	Units	RL	8	9	10	11	L1
CCME F1 (C6-C10)	µg/g	10	---	< 10	55	---	25
CCME F1-BTEX (C6-C10)	µg/g	10	---	< 10	---	---	

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	Units	RL	8	9	10	11	L1
CCME F2 (C10-C16)	µg/g	10	---	< 10	240	---	10
CCME F3 (C16-C34)	µg/g	50	---	< 50	534	---	240
CCME F4 (C34-C50)	µg/g	50	---	< 50	2000	---	120
Chromatogram returned to baseline at nC50	Yes / No	-	---	YES	NO	---	

Petroleum Hydrocarbons (F4G)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	Units	RL	8	9	10	11	L1
CCME F4G-sg (GHH)	µg/g	200	---	---	8570	---	120

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	Units	RL	8	9	10	11	L1
pH	no unit	0.05	7.24	---	7.91	---	

Sodium adsorption ratio (SAR)

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-021

Parameter	Units	RL	8	9	10	11	L1
Sodium Adsorption Ratio	---	0.2	3.3	---	4.6	---	2.4

Volatile Organics

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	Units	RL	8	9	10	11	L1
Acetone	µg/g	0.5	---	< 0.5	---	< 0.5	0.5
Bromomethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05

RESULTS

Sample Number			8	9	10	11	
Sample Name			16-1 SA2	16-1 SA5	16-2 SA1	16-2 SA3	
Sample Matrix			Soil	Soil	Soil	Soil	
Sampled By			Imran Khalid	Imran Khalid	Imran Khalid	Imran Khalid	
Sample Date			07/11/2016	07/11/2016	07/11/2016	07/11/2016	
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**L1**

L1 = REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED

Volatile Organics (continued)

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	Units	RL	Result	Result	Result	Result	L1
Carbon tetrachloride	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Chlorobenzene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Chloroform	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,2-Dichlorobenzene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,3-Dichlorobenzene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,4-Dichlorobenzene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Dichlorodifluoromethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,1-Dichloroethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,2-Dichloroethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,1-Dichloroethylene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
trans-1,2-Dichloroethylene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
cis-1,2-Dichloroethylene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,2-Dichloropropane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
cis-1,3-dichloropropene	µg/g	0.03	---	< 0.03	---	< 0.03	
trans-1,3-dichloropropene	µg/g	0.03	---	< 0.03	---	< 0.03	
1,3-dichoropropene (total)	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Ethylenedibromide	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
n-Hexane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Methyl ethyl ketone	µg/g	0.5	---	< 0.5	---	< 0.5	0.5
Methyl isobutyl ketone	µg/g	0.5	---	< 0.5	---	< 0.5	0.5
Methyl-t-butyl Ether	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Methylene Chloride	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Styrene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Tetrachloroethylene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,1,1,2-Tetrachloroethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,1,2,2-Tetrachloroethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,1,1-Trichloroethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
1,1,2-Trichloroethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Trichloroethylene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Trichlorofluoromethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.25
Vinyl Chloride	µg/g	0.02	---	< 0.02	---	< 0.02	0.02
Benzene	µg/g	0.02	---	< 0.02	---	< 0.02	0.02
Ethylbenzene	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Toluene	µg/g	0.05	---	< 0.05	---	< 0.05	0.2
Xylene (total)	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
m/p-xylene	µg/g	0.05	---	< 0.05	---	< 0.05	
o-xylene	µg/g	0.05	---	< 0.05	---	< 0.05	

RESULTS

Sample Number	8	9	10	11
Sample Name	16-1 SA2	16-1 SA5	16-2 SA1	16-2 SA3
Sample Matrix	Soil	Soil	Soil	Soil
Sampled By	Imran Khalid	Imran Khalid	Imran Khalid	Imran Khalid
Sample Date	07/11/2016	07/11/2016	07/11/2016	07/11/2016

L1 = REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED

Volatile Organics (continued)

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	Units	RL	Result	Result	Result	Result	L1
Bromodichloromethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Bromoform	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Dibromochloromethane	µg/g	0.05	---	< 0.05	---	< 0.05	0.05
Surr 1,2-Dichloroethane-d4	Surr Rec %	-	---	102	---	98	
Surr 4-Bromofluorobenzene	Surr Rec %	-	---	105	---	104	
Surr 2-Bromo-1-Chloropropane	Surr Rec %	-	---	90	---	87	

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-[ENV] SPE-LAK-AN-003

Parameter	Units	RL	Result	Result	Result	Result	L1
Water Soluble Boron	µg/g	0.5	< 0.5	---	< 0.5	---	

RESULTS

Sample Number	12	13
Sample Name	16-3 SA4	16-3 SA5
Sample Matrix	Soil	Soil
Sampled By	Imran Khalid	Imran Khalid
Sample Date	07/11/2016	07/11/2016

Parameter	Units	RL	Result	Result	L1

L1 = REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	Units	RL	Result	Result	L1
Conductivity	mS/cm	0.002	---	0.33	0.57

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Parameter	Units	RL	Result	Result	L1
Free Cyanide	µg/g	0.05	---	< 0.05	0.051

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-[ENV]IC-LAK-AN-008

Parameter	Units	RL	Result	Result	L1
Chromium VI	µg/g	0.2	---	< 0.2	0.66

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	Units	RL	Result	Result	L1
Mercury	µg/g	0.05	---	< 0.05	0.27

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	Units	RL	Result	Result	L1
SAR Calcium	mg/L	0.09	---	11	
SAR Magnesium	mg/L	0.02	---	1.8	
SAR Sodium	mg/L	0.15	---	49	

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Parameter	Units	RL	Result	Result	L1
Barium	µg/g	0.01	---	69	220
Beryllium	µg/g	0.02	---	0.25	2.5
Boron	µg/g	1	---	6	36
Cadmium	µg/g	0.02	---	0.05	1.2
Chromium	µg/g	0.5	---	11	70
Cobalt	µg/g	0.01	---	3.5	21
Copper	µg/g	0.1	---	6.2	92
Lead	µg/g	0.1	---	3.5	120
Molybdenum	µg/g	0.1	---	0.3	2
Nickel	µg/g	0.1	---	9.1	82
Silver	µg/g	0.01	---	0.02	0.5
Thallium	µg/g	0.02	---	0.07	1
Uranium	µg/g	0.002	---	0.44	2.5
Vanadium	µg/g	3	---	18	86
Zinc	µg/g	0.7	---	20	290

RESULTS

Sample Number	12	13		
Sample Name	16-3 SA4	16-3 SA5		
Sample Matrix	Soil	Soil		
Sampled By	Imran Khalid	Imran Khalid		
Sample Date	07/11/2016	07/11/2016		

L1 = REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED

Metals in Soil - Aqua-regia/ICP-MS (continued)

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Parameter	Units	RL	Result	Result	L1
Antimony	µg/g	0.8	---	< 0.8	1.3
Arsenic	µg/g	0.5	---	1.2	18
Selenium	µg/g	0.7	---	< 0.7	1.5

Moisture

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	Units	RL	Result	Result	L1
Moisture Content	%	-	10.9	21.2	

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	Units	RL	Result	Result	L1
CCME F1 (C6-C10)	µg/g	10	< 10	---	25
CCME F1-BTEX (C6-C10)	µg/g	10	< 10	---	

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	Units	RL	Result	Result	L1
CCME F2 (C10-C16)	µg/g	10	< 10	---	10
CCME F3 (C16-C34)	µg/g	50	< 50	---	240
CCME F4 (C34-C50)	µg/g	50	< 50	---	120
Chromatogram returned to baseline at nC50	Yes / No	-	YES	---	

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	Units	RL	Result	Result	L1
pH	no unit	0.05	---	7.77	

Sodium adsorption ratio (SAR)

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-021

Parameter	Units	RL	Result	Result	L1
Sodium Adsorption Ratio	---	0.2	---	3.7	2.4

Volatile Organics

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	Units	RL	Result	Result	L1
Acetone	µg/g	0.5	< 0.5	---	0.5
Bromomethane	µg/g	0.05	< 0.05	---	0.05
Carbon tetrachloride	µg/g	0.05	< 0.05	---	0.05
Chlorobenzene	µg/g	0.05	< 0.05	---	0.05
Chloroform	µg/g	0.05	< 0.05	---	0.05
1,2-Dichlorobenzene	µg/g	0.05	< 0.05	---	0.05

RESULTS

		Sample Number	12	13	
		Sample Name	16-3 SA4	16-3 SA5	
		Sample Matrix	Soil	Soil	
		Sampled By	Imran Khalid	Imran Khalid	
		Sample Date	07/11/2016	07/11/2016	
Parameter	**Units**	**RL**	**Result**	**Result**	**L1**

L1 = REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED

Volatile Organics (continued)

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	Units	RL	Result	Result	L1
1,3-Dichlorobenzene	µg/g	0.05	< 0.05	---	0.05
1,4-Dichlorobenzene	µg/g	0.05	< 0.05	---	0.05
Dichlorodifluoromethane	µg/g	0.05	< 0.05	---	0.05
1,1-Dichloroethane	µg/g	0.05	< 0.05	---	0.05
1,2-Dichloroethane	µg/g	0.05	< 0.05	---	0.05
1,1-Dichloroethylene	µg/g	0.05	< 0.05	---	0.05
trans-1,2-Dichloroethylene	µg/g	0.05	< 0.05	---	0.05
cis-1,2-Dichloroethylene	µg/g	0.05	< 0.05	---	0.05
1,2-Dichloropropane	µg/g	0.05	< 0.05	---	0.05
cis-1,3-dichloropropene	µg/g	0.03	< 0.03	---	
trans-1,3-dichloropropene	µg/g	0.03	< 0.03	---	
1,3-dichoropropene (total)	µg/g	0.05	< 0.05	---	0.05
Ethylenedibromide	µg/g	0.05	< 0.05	---	0.05
n-Hexane	µg/g	0.05	< 0.05	---	0.05
Methyl ethyl ketone	µg/g	0.5	< 0.5	---	0.5
Methyl isobutyl ketone	µg/g	0.5	< 0.5	---	0.5
Methyl-t-butyl Ether	µg/g	0.05	< 0.05	---	0.05
Methylene Chloride	µg/g	0.05	< 0.05	---	0.05
Styrene	µg/g	0.05	< 0.05	---	0.05
Tetrachloroethylene	µg/g	0.05	< 0.05	---	0.05
1,1,1,2-Tetrachloroethane	µg/g	0.05	< 0.05	---	0.05
1,1,2,2-Tetrachloroethane	µg/g	0.05	< 0.05	---	0.05
1,1,1-Trichloroethane	µg/g	0.05	< 0.05	---	0.05
1,1,2-Trichloroethane	µg/g	0.05	< 0.05	---	0.05
Trichloroethylene	µg/g	0.05	< 0.05	---	0.05
Trichlorofluoromethane	µg/g	0.05	< 0.05	---	0.25
Vinyl Chloride	µg/g	0.02	< 0.02	---	0.02
Benzene	µg/g	0.02	< 0.02	---	0.02
Ethylbenzene	µg/g	0.05	< 0.05	---	0.05
Toluene	µg/g	0.05	< 0.05	---	0.2
Xylene (total)	µg/g	0.05	< 0.05	---	0.05
m/p-xylene	µg/g	0.05	< 0.05	---	
o-xylene	µg/g	0.05	< 0.05	---	
Bromodichloromethane	µg/g	0.05	< 0.05	---	0.05
Bromoform	µg/g	0.05	< 0.05	---	0.05
Dibromochloromethane	µg/g	0.05	< 0.05	---	0.05
Surr 1,2-Dichloroethane-d4	Surr Rec %	-	99	---	

RESULTS

		Sample Number	12	13
		Sample Name	16-3 SA4	16-3 SA5
		Sample Matrix	Soil	Soil
		Sampled By	Imran Khalid	Imran Khalid
		Sample Date	07/11/2016	07/11/2016

L1 = REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED

Volatile Organics (continued)

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	Units	RL	Result	Result	L1
Surr 4-Bromofluorobenzene	Surr Rec %	-	104	---	
Surr 2-Bromo-1-Chloropropane	Surr Rec %	-	88	---	

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-[ENV] SPE-LAK-AN-003

Parameter	Units	RL	Result	Result	L1
Water Soluble Boron	μg/g	0.5	---	< 0.5	

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	REG153 / SOIL / FINE - TABLE 1 - Residential/Parkland - UNDEFINED L1
16-1 SA2				
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	---	3.3	2.40
16-2 SA1				
F1 (C6 to C10)	CCME Tier 1	μg/g	55	25
F2 (C10 to C16)	CCME Tier 1	μg/g	240	10
F3 (C16 to C34)	CCME Tier 1	μg/g	534	240
F4 (C34 to C50)	CCME Tier 1	μg/g	2000	120
Gravimetric Heavy Hydrocarbons	CCME Tier 1	μg/g	8570	120
Molybdenum	EPA 3050/EPA 200.8	μg/g	4.0	2
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	---	4.6	2.40
16-3 SA5				
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	---	3.7	2.40

HOLDING TIME SUMMARY

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Sample Name	QC Batch Reference	Sample Number	Sampled	Received	Extracted/ Prepared	Analysed	Holding Time	Approved
16-1 SA2	EWL0319-NOV16	8	11/07/2016	11/15/2016	11/17/2016	11/21/2016	12/07/2016	11/21/2016
16-2 SA1	EWL0319-NOV16	10	11/07/2016	11/15/2016	11/17/2016	11/21/2016	12/07/2016	11/21/2016
16-3 SA5	EWL0319-NOV16	13	11/07/2016	11/15/2016	11/17/2016	11/21/2016	12/07/2016	11/21/2016

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Sample Name	QC Batch Reference	Sample Number	Sampled	Received	Extracted/ Prepared	Analysed	Holding Time	Approved
16-1 SA2	SKA5051-NOV16	8	11/07/2016	11/15/2016	11/17/2016	11/18/2016	11/21/2016	11/21/2016
16-2 SA1	SKA5051-NOV16	10	11/07/2016	11/15/2016	11/17/2016	11/18/2016	11/21/2016	11/21/2016
16-3 SA5	SKA5051-NOV16	13	11/07/2016	11/15/2016	11/17/2016	11/18/2016	11/21/2016	11/21/2016

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-[ENV]IC-LAK-AN-008

Sample Name	QC Batch Reference	Sample Number	Sampled	Received	Extracted/ Prepared	Analysed	Holding Time	Approved
16-1 SA2	DIO0231-NOV16	8	11/07/2016	11/15/2016	11/16/2016	11/16/2016	12/07/2016	11/17/2016
16-2 SA1	DIO0231-NOV16	10	11/07/2016	11/15/2016	11/16/2016	11/16/2016	12/07/2016	11/17/2016
16-3 SA5	DIO0231-NOV16	13	11/07/2016	11/15/2016	11/16/2016	11/16/2016	12/07/2016	11/17/2016

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Sample Name	QC Batch Reference	Sample Number	Sampled	Received	Extracted/ Prepared	Analysed	Holding Time	Approved
16-1 SA2	EHG0022-NOV16	8	11/07/2016	11/15/2016	11/16/2016	11/17/2016	12/05/2016	11/17/2016
16-2 SA1	EHG0022-NOV16	10	11/07/2016	11/15/2016	11/16/2016	11/17/2016	12/05/2016	11/17/2016
16-3 SA5	EHG0022-NOV16	13	11/07/2016	11/15/2016	11/16/2016	11/17/2016	12/05/2016	11/17/2016

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Sample Name	QC Batch Reference	Sample Number	Sampled	Received	Extracted/ Prepared	Analysed	Holding Time	Approved
16-1 SA2	ESG0071-NOV16	8	11/07/2016	11/15/2016	11/17/2016	11/18/2016	05/06/2017	11/18/2016
16-2 SA1	ESG0071-NOV16	10	11/07/2016	11/15/2016	11/17/2016	11/18/2016	05/06/2017	11/18/2016
16-3 SA5	ESG0071-NOV16	13	11/07/2016	11/15/2016	11/17/2016	11/18/2016	05/06/2017	11/18/2016

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Sample Name	QC Batch Reference	Sample Number	Sampled	Received	Extracted/ Prepared	Analysed	Holding Time	Approved
16-1 SA2	EMS0065-NOV16	8	11/07/2016	11/15/2016	11/16/2016	11/17/2016	05/06/2017	11/17/2016
16-2 SA1	EMS0065-NOV16	10	11/07/2016	11/15/2016	11/16/2016	11/17/2016	05/06/2017	11/17/2016
16-3 SA5	EMS0065-NOV16	13	11/07/2016	11/15/2016	11/16/2016	11/17/2016	05/06/2017	11/17/2016

Moisture

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Sample Name	QC Batch Reference	Sample Number	Sampled	Received	Extracted/ Prepared	Analysed	Holding Time	Approved
16-1 SA2	GCM0208-NOV16	8	11/07/2016	11/15/2016	11/16/2016	11/17/2016	01/06/2017	11/18/2016
16-1 SA5	GCM0208-NOV16	9	11/07/2016	11/15/2016	11/16/2016	11/17/2016	01/06/2017	11/18/2016
16-2 SA1	GCM0208-NOV16	10	11/07/2016	11/15/2016	11/16/2016	11/17/2016	01/06/2017	11/18/2016
16-2 SA3	GCM0223-NOV16	11	11/07/2016	11/15/2016	11/16/2016	11/17/2016	01/06/2017	11/18/2016
16-3 SA4	GCM0208-NOV16	12	11/07/2016	11/15/2016	11/16/2016	11/17/2016	01/06/2017	11/18/2016

HOLDING TIME SUMMARY

Sample Name	QC Batch Reference	Sample Number	Sampled	Received	Extracted/ Prepared	Analysed	Holding Time	Approved

Moisture (continued)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

16-3 SA5	GCM0208-NOV16	13	11/07/2016	11/15/2016	11/16/2016	11/17/2016	01/06/2017	11/18/2016

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

16-1 SA5	GCM0220-NOV16	9	11/07/2016	11/15/2016	11/16/2016	11/17/2016	11/21/2016	11/21/2016
16-2 SA1	GCM0220-NOV16	10	11/07/2016	11/15/2016	11/16/2016	11/17/2016	11/21/2016	11/21/2016
16-3 SA4	GCM0220-NOV16	12	11/07/2016	11/15/2016	11/16/2016	11/17/2016	11/21/2016	11/21/2016

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

16-1 SA5	GCM0198-NOV16	9	11/07/2016	11/15/2016	11/16/2016	11/17/2016	11/21/2016	11/22/2016
16-2 SA1	GCM0198-NOV16	10	11/07/2016	11/15/2016	11/16/2016	11/17/2016	11/21/2016	11/22/2016
16-3 SA4	GCM0198-NOV16	12	11/07/2016	11/15/2016	11/16/2016	11/17/2016	11/21/2016	11/22/2016

Petroleum Hydrocarbons (F4G)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

16-2 SA1	GCM0255-NOV16	10	11/07/2016	11/15/2016	11/16/2016	11/17/2016	11/21/2016	11/22/2016

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

16-1 SA2	ARD0070-NOV16	8	11/07/2016	11/15/2016	11/21/2016	11/21/2016	12/07/2016	11/21/2016
16-2 SA1	ARD0070-NOV16	10	11/07/2016	11/15/2016	11/21/2016	11/21/2016	12/07/2016	11/21/2016
16-3 SA5	ARD0070-NOV16	13	11/07/2016	11/15/2016	11/21/2016	11/21/2016	12/07/2016	11/21/2016

Sodium adsorption ratio (SAR)

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-021

16-1 SA2		8	11/07/2016	11/15/2016	11/17/2016	11/18/2016	05/06/2017	11/18/2016
16-2 SA1		10	11/07/2016	11/15/2016	11/17/2016	11/18/2016	05/06/2017	11/18/2016
16-3 SA5		13	11/07/2016	11/15/2016	11/17/2016	11/18/2016	05/06/2017	11/18/2016

Volatile Organics

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

16-1 SA5	GCM0217-NOV16	9	11/07/2016	11/15/2016	11/17/2016	11/17/2016	11/21/2016	11/21/2016
16-2 SA3	GCM0217-NOV16	11	11/07/2016	11/15/2016	11/17/2016	11/17/2016	11/21/2016	11/21/2016
16-3 SA4	GCM0217-NOV16	12	11/07/2016	11/15/2016	11/17/2016	11/17/2016	11/21/2016	11/21/2016

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-[ENV] SPE-LAK-AN-003

16-1 SA2	ESG0062-NOV16	8	11/07/2016	11/15/2016	11/16/2016	11/17/2016	05/06/2017	11/17/2016
16-2 SA1	ESG0062-NOV16	10	11/07/2016	11/15/2016	11/16/2016	11/17/2016	05/06/2017	11/17/2016
16-3 SA5	ESG0062-NOV16	13	11/07/2016	11/15/2016	11/16/2016	11/17/2016	05/06/2017	11/17/2016

HOLDING TIME SUMMARY

FINAL REPORT

QC SUMMARY

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0319-NOV16	mS/cm	0.0020	<0.002	0	10	99	90	110	NA		

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA5051-NOV16	µg/g	0.050	<0.05	ND	20	95	80	120	114	75	125

Hexavalent Chromium by IC

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-[ENV]IC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0231-NOV16	µg/g	0.20	<0.2	ND	20	98	80	120	95	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EHG0022-NOV16	µg/g	0.050	<0.05	ND	20	102	80	120	75	70	130

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
SAR Calcium	ESG0071-NOV16	mg/L	0.090	<0.09	5	20	98	80	120	83	70	130
SAR Magnesium	ESG0071-NOV16	mg/L	0.020	<0.02	7	20	93	80	120	89	70	130
SAR Sodium	ESG0071-NOV16	mg/L	0.150	<0.15	7	20	91	80	120	87	70	130

QC SUMMARY

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0065-NOV16	µg/g	0.010	<0.01	6	20	101	70	130	103	70	130
Arsenic	EMS0065-NOV16	µg/g	0.50	<0.5	16	20	106	70	130	112	70	130
Barium	EMS0065-NOV16	µg/g	0.010	<0.01	6	20	99	70	130	111	70	130
Beryllium	EMS0065-NOV16	µg/g	0.020	<0.02	5	20	103	70	130	102	70	130
Boron	EMS0065-NOV16	µg/g	1	<1	14	20	101	70	130	87	70	130
Cadmium	EMS0065-NOV16	µg/g	0.020	<0.02	2	20	100	70	130	111	70	130
Cobalt	EMS0065-NOV16	µg/g	0.010	<0.01	5	20	100	70	130	100	70	130
Chromium	EMS0065-NOV16	µg/g	0.50	<0.5	17	20	99	70	130	114	70	130
Copper	EMS0065-NOV16	µg/g	0.10	<0.1	2	20	99	70	130	100	70	130
Molybdenum	EMS0065-NOV16	µg/g	0.10	<0.1	19	20	100	70	130	122	70	130
Nickel	EMS0065-NOV16	µg/g	0.10	<0.1	3	20	100	70	130	110	70	130
Lead	EMS0065-NOV16	µg/g	0.10	<0.1	3	20	103	70	130	107	70	130
Antimony	EMS0065-NOV16	µg/g	0.80	<0.8	ND	20	102	70	130	NV	70	130
Selenium	EMS0065-NOV16	µg/g	0.70	<0.7	ND	20	97	70	130	103	70	130
Thallium	EMS0065-NOV16	µg/g	0.020	<0.02	1	20	100	70	130	109	70	130
Uranium	EMS0065-NOV16	µg/g	0.0020	<0.002	0	20	99	70	130	NV	70	130
Vanadium	EMS0065-NOV16	µg/g	3	<3	11	20	102	70	130	116	70	130
Zinc	EMS0065-NOV16	µg/g	0.70	<0.7	2	20	102	70	130	106	70	130

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
CCME F1 (C6-C10)	GCM0220-NOV16	µg/g	10	<10	ND	30	100	80	120	103	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
CCME F2 (C10-C16)	GCM0198-NOV16	µg/g	10	< 10	ND	30	104	80	120	125	60	140
CCME F3 (C16-C34)	GCM0198-NOV16	µg/g	50	< 50	ND	30	104	80	120	125	60	140
CCME F4 (C34-C50)	GCM0198-NOV16	µg/g	50	< 50	ND	30	104	80	120	125	60	140

Petroleum Hydrocarbons (F4G)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
CCME F4G-sg (GHH)	GCM0255-NOV16	µg/g	200	<200	NA	30	102	80	120	NA	60	140

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	ARD0070-NOV16	no unit	0.050		0	20	100	80	120			

FINAL REPORT

QC SUMMARY

Volatile Organics

Method: EPA 5035A/5030B/8260C I Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
1,1,1,2-Tetrachloroethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	89	60	130	99	50	140
1,1,1-Trichloroethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	88	60	130	98	50	140
1,1,2,2-Tetrachloroethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	82	60	130	94	50	140
1,1,2-Trichloroethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	86	60	130	98	50	140
1,1-Dichloroethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	79	60	130	87	50	140
1,1-Dichloroethylene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	86	60	130	98	50	140
1,2-Dichlorobenzene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	91	60	130	102	50	140
1,2-Dichloroethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	87	60	130	99	50	140
1,2-Dichloropropane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	78	60	130	86	50	140
1,3-Dichlorobenzene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	92	60	130	100	50	140
1,4-Dichlorobenzene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	91	60	130	99	50	140
Acetone	GCM0217-NOV16	µg/g	0.50	< 0.5	ND	50	84	50	140	116	50	140
Benzene	GCM0217-NOV16	µg/g	0.020	< 0.02	ND	50	82	60	130	90	50	140
Bromodichloromethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	88	60	130	98	50	140
Bromoform	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	95	60	130	108	50	140
Bromomethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	89	50	140	76	50	140
Carbon tetrachloride	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	91	60	130	100	50	140
Chlorobenzene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	87	60	130	95	50	140
Chloroform	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	85	60	130	94	50	140
cis-1,2-Dichloroethylene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	86	60	130	95	50	140

QC SUMMARY

Volatile Organics (continued)

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
cis-1,3-dichloropropene	GCM0217-NOV16	µg/g	0.030	< 0.03	ND	50	84	60	130	91	50	140
Dibromochloromethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	93	60	130	107	50	140
Dichlorodifluoromethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	68	50	140	69	50	140
Ethylbenzene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	84	60	130	90	50	140
Ethylenedibromide	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	88	60	130	101	50	140
n-Hexane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	84	60	130	82	50	140
m/p-xylene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	86	60	130	92	50	140
Methyl ethyl ketone	GCM0217-NOV16	µg/g	0.50	< 0.5	ND	50	74	50	140	94	50	140
Methyl isobutyl ketone	GCM0217-NOV16	µg/g	0.50	< 0.5	ND	50	76	50	140	95	50	140
Methyl-t-butyl Ether	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	88	60	130	106	50	140
Methylene Chloride	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	74	60	130	82	50	140
o-xylene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	86	60	130	93	50	140
Styrene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	87	60	130	96	50	140
Tetrachloroethylene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	95	60	130	103	50	140
Toluene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	86	60	130	93	50	140
trans-1,2-Dichloroethylene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	79	60	130	86	50	140
trans-1,3-dichloropropene	GCM0217-NOV16	µg/g	0.030	< 0.03	ND	50	91	60	130	99	50	140
Trichloroethylene	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	85	60	130	92	50	140
Trichlorofluoromethane	GCM0217-NOV16	µg/g	0.050	< 0.05	ND	50	97	50	140	109	50	140
Vinyl Chloride	GCM0217-NOV16	µg/g	0.020	< 0.02	ND	50	82	50	140	91	50	140

FINAL REPORT

QC SUMMARY

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-[ENV] SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Water Soluble Boron	ESG0062-NOV16	µg/g	0.50	<0.5	ND	20	96	80	120	109	70	130

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS

SGS Environmental Services - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

No:

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Dave Mat
Received Date (mm/dd/yyyy): 11/15/2016 (mm\dd\yy)
Received Time: 12:30
Received By (signature):
Custody Seal Present: ☐
Custody Seal Intact: ☐ No Seal
Cooling Agent Present: ☑
Temperature Upon Receipt (°C) 4.0 1x3
LAB LIMS #: NOV. 14267

REPORT INFORMATION

Company: Golder Associates
Contact: Devon Witheridge
Address: 100 Scotia Crt,
Whitby, ON
Phone: 905 723 2727
Fax:
Email: DWitheridge@Golder.com →

INVOICE INFORMATION

☒ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email: and Eric_Wainsky@Golder.com

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 1404019
Site Location/ID: CIMA

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 3pm or on weekends : TAT begins the next business day

RUSH TAT (Additional Charges May Apply) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

DRINKING WATER SAMPLES (POTABLE WATER FOR HUMAN CONSUMPTION) MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153 (2011):
☒ Table 1 ☒ Res/Park Soil Texture:
☐ Table 2 ☐ Ind/Com ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ Medium
☐ Table ☒ Fine

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☒ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	metals + inorganics	PHC	VOC	COMMENTS: Field Filtered (F) Preserved (P)
1	16-1 SA2								
2	16-1 SA5	Nov7/16		2	S	X			
3	16-2 SA1	Nov7/16		2	S		X	X	
4	16-2 SA3	Nov7/16		4	S	X	X		
5	16-3 SA4	Nov7/16		2	S			X	
6	16-3 SA5	Nov7/16		4	S		X	X	
7		Nov 7/16		2	S	X			
8									
9									
10									

Observations/Comments/Special Instructions

Sampled By (NAME): Imran Khalid Signature: Date: __/__/__ (mm/dd/yy) Pink Copy - Client

Relinquished by (NAME): Jake Kettela Signature: Date: 11/15/16 (mm/dd/yy) Yellow & White Copy - SGS

20:00 AT

Revision #: 1.0
Date of Issue: 01 June, 2014

SGS

SAMPLE INTEGRITY REPORT

Project Number: 1404019

SGS Sample ID NOV: 14267

Date / Time Sampled 11/07/16

Client Sample ID See CofC

ONTARIO REGULATION 153/04

	ALL
Sample Submission General Sample Integrity Violations	
Temperature >10 C upon receipt if not sampled same day	☐
No evidence of cooling trend initiated if sampled same day	☐
Chain of Custody not submitted	☐
Chain of Custody incomplete	☐
Chain of Custody not signed / dated	☐
Chain of Custody not a current version	☐
Bottles / Samples listed on CoC but not received	☐
Bottles / Samples received but not listed on the CoC	☐
Sample container received empty	☐

	16-2 SS3 (2 methanol vials field - no soil jar for moisture)	16-1 SS2	16-3 SS5				
Sample Specific Sample Integrity Violations							
Sample received past hold time	☐	☐	☐	☐	☐	☐	☐
Incorrect preservation (including no preservation where required)	☐	☐	☐	☐	☐	☐	☐
Headspace present in VOC vial (aqueous)	☐	☐	☐	☐	☐	☐	☐
Sample(s) received frozen	☐	☐	☐	☐	☐	☐	☐
Bottle(s) broken or damaged in transport	☐	☐	☐	☐	☐	☐	☐
Discrepancy between sample label and chain of custody	☐	☐	☐	☐	☐	☐	☐
Analysis requirements absent / unclear	☐	☐	☐	☐	☐	☐	☐
Missing or incorrect sample label(s)	☐	☐	☐	☐	☐	☐	☐
Inappropriate sample container used	☐	☐	☐	☐	☐	☐	☐
Insufficient number of bottles received	☑	☐	☐	☐	☐	☐	☐
Insufficient sample volume	☑	☑	☑	☐	☐	☐	☐
Sample contains multiple phases	☐	☐	☐	☐	☐	☐	☐
Sediment Log							
Groundwater samples contain visible sediment / particulate	☐	☐	☐	☐	☐	☐	☐
Groundwater contains greater than 1cm of sediment / particulate matter in bottle	☐	☐	☐	☐	☐	☐	☐

Additional Comments/Remarks:

No issues upon receipt ☐ Initials: AL

limited Sample

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
100 Scotia Court
Whitby, Ontario, L1N 8Y6
Canada
T: +1 (905) 723 2727

Golder Associates