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Phase II Environmental Site Assessment

444 Bronson Avenue
Ottawa, Ontario

Prepared For

TC United Group

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Report: PE4060-2

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EXECUTIVE SUMMARY

Assessment

A Phase II ESA was conducted for the property at 444 Bronson Avenue in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APEC) on the Phase II Property. The Phase II ESA field work was conducted prior to the December 2017 Phase I ESA, with borehole locations selected based on the findings of previous investigations, however, the Phase II ESA is considered to have addressed the majority of the APECs identified.

The subsurface investigation consisted of the placement of four (4) boreholes, two (2) of which were constructed with groundwater monitoring well installations. Soil samples were obtained from the boreholes and screened using visual observations and combustible vapour measurements. A total of 3 soil samples were submitted for laboratory analysis of a combination of benzene, toluene, ethylbenzene and xylenes (BTEX) and petroleum hydrocarbons (PHCs, F_1-F_4). Petroleum hydrocarbon (PCH) fractions F_2 and F_3 concentrations exceeding MECP Table 7 standards were identified in the fill material on the southern portion of the Phase II Property, east of the subject building.

Groundwater samples obtained from two (2) monitoring wells, BH1-17 and BH3-17, were analysed for BTEX or volatile organic compound (VOCs) and PHCs. Based on the results of the analytical testing, parameter concentrations were not identified above the method detection limits with one exception. A concentration of chloroform (2.6µg/L) marginally exceeding the MECP Table 7 standard of 2 µg/L was identified in the groundwater recovered from BH1-17. The chloroform is considered to be the result of using municipal groundwater during the rock coring process, for the installation of the groundwater monitoring wells. The chloroform is expected to have dissipated by now and is not considered to be contaminant of concern. The groundwater is considered to be in compliance with MECP Table 7 standards based on 2017 data.

Conclusion

Based on the findings of the Phase II ESA to date, fill material impacted with PHC F_2 and F_3 concentrations exceeding MECP Table 7 standards is present on the southern portion of the Phase II Property. It is our understanding that the Phase II Property is to be redeveloped with a 6-storey mixed-used building with a basement level.

As noted previously, the Phase II ESA did not fully assess all APECs identified in the Phase I ESA. It is recommended that a supplemental Phase II ESA be conducted to fully assess the APECs identified in the Phase I ESA and determine the groundwater flow direction beneath the Phase II Property, in accordance with O.Reg 153/04, as amended.

Once a supplemental Phase II ESA has been conducted, it is recommended that an environmental site remediation program, involving the removal of all impacted fill material, be completed concurrently with the site redevelopment. Prior to offsite disposal at a licenced landfill site, a leachate analysis of a representative sample of contaminated soil must be conducted in accordance with Ontario Regulation 347/558.

It is also recommended that Paterson personnel be onsite during construction activities to direct the excavation and segregation of impacted soil and to conduct confirmatory sampling as required.

It is expected that groundwater monitoring wells will be abandoned in accordance with O.Reg.903, at the time of construction excavation.

1.0 INTRODUCTION

At the request of TC United Group, Paterson Group (Paterson) conducted a Phase II Environmental Site Assessment (ESA) for the property addressed 444 Bronson Avenue, in the City of Ottawa, Ontario. Past environmental investigations were conducted for the property prior to the 2011 Ministry of the Environment, Conservation and Parks (MECP) Standards; the purpose of this Phase II ESA was to confirm the quality of the soil and groundwater, in general accordance with Ontario Regulation 347/558, as amended.

1.1 Site Description

Address:	444 Bronson Avenue, Ottawa, ON
Legal Description:	Part of Lot 138, Registered Plan 3459 in the City of Ottawa.
Property Identification Numbers:	04109-0387
Location:	The Phase II Property is situated on the west side of Bronson Avenue, between Gladstone Avenue and Florence Street. The subject site is shown on Figure 1 - Key Plan following the body of this report.
Latitude and Longitude:	45° 25' 02" N, 75° 41' 49" W
Configuration:	Rectangular
Site Area:	0.04 hectares (approximate)

1.2 Property Ownership

The subject property is currently owned by TC United Group. Paterson was retained to complete this Phase II ESA by Mr. Billy Triantafilos, with TC United Group, the offices of which are located at 800 Industrial Avenue, Ottawa, Ontario. Mr. Triantafilos can be reached by telephone at (514) 206-9999.

1.3 Current and Proposed Future Uses

The Phase II Property is currently occupied by a vacant 1-storey commercial building with a slab-on-grade foundation. The remainder of the site is used for parking. It is our understanding that the proposed development will consist of a 6-storey residential building with ground-floor commercial units and a basement level.

1.4 Applicable Site Condition Standard

The site condition standards for the property were obtained from Table 7 of the document entitled "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", prepared by the Ontario Ministry of the Environment, Conservation and Parks (MECP), April 2011. The MECP selected Table 7 Standards are based on the following considerations:

- ❒ Coarse-grained soil conditions;
- ❒ Shallow soil conditions;
- ❒ Non-potable groundwater conditions; and
- ❒ Residential land use.

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The Phase II Property is located in an urban area surrounded by various sized commercial and residential structures. The Phase II Property is at a similar grade as the adjacent properties. Site topography slopes slightly down towards the south and east, while the regional topography slopes down to the north or northwest. Site drainage consists primarily of sheet flow to an on-site catch basin as well as catch basins situated along Bronson Avenue. The Phase II Property is situated within a municipally serviced area.

2.2 Past Investigations

Subsurface investigations were carried out for the Phase II Property in 2003. Based on the findings of the investigations, petroleum hydrocarbon (PHC) concentrations exceeding the 1997 Table B criteria were identified at BH3 (2003). The impacted soil was considered to be associated with a reported furnace oil spill on the adjacent property to the north (440 Bronson Avenue). Boreholes placed during the 2003 investigation are located on Drawing PE4060-3 – Test Hole Location Plan.

Concentrations of BTEX and total petroleum hydrocarbons (diesel range organics) were identified in the groundwater at BH3. The BTEX parameters identified were in compliance with the 1997 Table B criteria, however standard values for petroleum hydrocarbons in groundwater were not provided by the MECP at this time.

A soil remediation program was subsequently carried out in the vicinity of BH3 in 2008. Based on the confirmatory sampling completed subsequent to the remediation program, the soil on the Phase II Property was considered to be in compliance with the 2004 MECP Table 6 standards applicable at the time. The approximate extent of the former excavation is present on Drawing PE4060-3 – Test Hole Location Plan.

An additional subsurface investigation was conducted in June of 2017 upon the sale of the property, the findings of which are presented in this report. A Phase I ESA was later conducted by Paterson in December of 2017. Based on the findings of the Phase I ESA, several historical on- and off-site potentially contaminating activities (PCAs) were considered to result in areas of potential environmental concern (APECs) on the Phase I and Phase II Property, as presented in Table 1.

The June 2017 Phase II ESA is considered to have addressed the APECs identified in the Phase I ESA, with the exception of APEC 3 related to fill material.

Table 1
Area of Potential Environmental Concern

Area of Potential Environmental Concern	Location of Area of Potential Environmental Concern with respect to Phase I Property	Potentially Contaminating Activity	Location of PCA (on-site or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil, and/or Sediment)
APEC 1	Southwestern portion of the Phase I Property	PCA 52 – Storage, maintenance, fuelling and repair of equipment, vehicles and material used to maintain transportation systems	On-site	BTEX/PHCs (F_1-F_4), VOCs	Soil, Groundwater

Table 1 Continued
Area of Potential Environmental Concern

Area of Potential Environmental Concern	Location of Area of Potential Environmental Concern with respect to Phase I Property	Potentially Contaminating Activity	Location of PCA (on-site or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil, and/or Sediment)
APEC 2	East of the subject building	PCA 30 - Importation of Fill Material of Unknown Quality	On-site	Metals	Soil (Fill Material)
APEC 3	Northeastern portion of Phase I Property	PCA 28 – Gasoline and associated products storage in fixed tanks	Off-site	BTEX/PHCs (F_1-F_4)	Soil, Groundwater
APEC 4	Southern portion of Phase I Property	PCA 52 - Storage, maintenance, fuelling and repair of equipment, vehicles and material used to maintain transportation systems	Off-site	BTEX/PHCs (F_1-F_4), VOCs	Soil, Groundwater

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation conducted as a component of this Phase II ESA consisted of drilling five (5) boreholes, two (2) of which were completed with groundwater monitoring wells. Boreholes were drilled to depths ranging from approximately 1.2 to 6.3m below grade. It should be noted that BH1 and BH3 were cored into the bedrock to intercept the groundwater table.

3.2 Media Investigated

During the subsurface investigation, soil samples and groundwater samples were obtained and submitted for laboratory analysis. The rationale for sampling and analyzing these media is based on the Contaminants of Potential Concern identified in the Phase I ESA and observations made during the sampling program.

Contaminants of potential concern for soil include benzene, ethylbenzene, toluene and xylene (BTEX), petroleum hydrocarbons (PHCs, F_1-F_4) and metals. Contaminants of potential concern for groundwater include BTEX/PHCs and VOCs.

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

The Geological Survey of Canada website on the Urban Geology of the National Capital Area was consulted as part of this assessment. Based on this information, bedrock in the area of the site consists of interbedded limestone and shale of the Verulam Formation. Overburden soils are shown as plain till with a drift thickness on the order of 1 to 2m below grade. Previous subsurface investigations support the reported geological conditions.

Based on regional topography, the groundwater flow in the immediate vicinity of the Phase I Property is expected to be in a northerly direction, towards the Ottawa River.

Existing Buildings and Structures

The Phase I Property is occupied by a one-storey, vacant commercial building, situated on the western portion of the subject land. The building is constructed with a slab-on-grade foundation and concrete block or brick walls. The roof is flat tar and gravel style.

The building is provided with natural gas-fired heating equipment located on the roof-top. The building was reportedly constructed in 1976. No other buildings or above-grade structures were present on the Phase I Property.

Water Bodies

There are no water bodies on the Phase I Property or within the Phase I Study Area. The closest significant water body is the Ottawa River located approximately 1.5km to the north of the Phase I Property.

Areas of Natural Significance

No areas of natural significance were identified on the Phase I Property or within the Phase I Study Area.

Drinking Water Wells

According to the MECP well mapping database, there are no domestic well records for the Phase I Property or for the surrounding properties in the Phase I Study Area.

Monitoring Wells

There are currently two monitoring wells on the Phase I Property. A total of 18 monitoring well records were identified on the MECP mapping website, for several properties within the Phase I Study Area. Two monitoring well abandonment records were also identified.

Neighbouring Land Use

Neighbouring land use in the Phase I Study Area is currently residential, commercial and parkland or community.

Potential Contaminating Activities and Areas of Potential Environmental Concern

As presented in Table 1 in Section 2.2 of this report, two on-site PCAs and two off-site PCAs are considered to have resulted in four APECs on the Phase I Property.

Contaminants of Potential Concern

As noted in Table 1, CPCs associated with the APECs identified in this Phase I ESA include BTEX, PHCs (F_1-F_4), VOCs and metals in the soil and/or groundwater beneath the Phase I Property.

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the preparation of this Phase I ESA is considered to be sufficient to conclude that there are areas of potential environmental concern on the Phase I Property.

The presence of potentially contaminating activities was confirmed by a variety of independent sources, and as such, the conclusions of this report are not affected by uncertainty which may be present with respect to the individual sources.

3.4 Deviations from Sampling and Analysis Plan

The Sampling and Analysis Plan for this project is included in Appendix 1 of this report. Water quality parameters including temperature, pH, electrical conductivity, and total dissolved solids were not measured in the field at the time of the groundwater sampling event. Otherwise, there were no deviations from the Sampling and Analysis Plan.

3.5 Impediments

Borehole locations were limited based on the location of the water and sewer services as well as the subject building. No other impediments were encountered.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation was conducted on June 28, 2017. The subsurface investigation consisted of the drilling five (5) boreholes across the Phase II Property, two (2) of which were completed with groundwater monitoring well installations. The boreholes were placed to address the aforementioned areas of potential environmental concern and to provide coverage of the proposed building foundations. The boreholes were drilled under full-time supervision of Paterson personnel, with a truck mounted CME 55 power auger drill rig provided by George Downing Estate Drilling of Hawkesbury, Ontario. Borehole locations are shown on Drawing PE4060-3 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

A total of 11 soil samples were obtained from the boreholes by means of split spoon sampling and the sampling of shallow soils directly from auger flights. Bedrock was cored at two locations (BH1 and BH3) to intercept the groundwater table. Rock core samples were collected with the use of coring equipment. The depths at which split spoon, auger flight and rock core samples were obtained from the boreholes are shown as "**SS**", "**AU**" and "**RC**" respectively on the Soil Profile and Test Data Sheets, appended to this report.

Site soils generally consist of a pavement structure overlying fill material, underlain by limestone bedrock. The fill material generally consisted of brown silty sand and gravel to depths ranging from 0.76 to 2.1m below ground surface. Occasional brick fragments were identified at BH3. Practical auger refusal was encountered on inferred bedrock beneath the layer of fill. In Boreholes 1 and 3, where diamond drilling was conducted, limestone bedrock was confirmed. The bedrock deposit was observed to have horizontal bedding planes, occasional vertical fractures and shale seams.

Further details regarding the soil profile are provided on Soil Profile and Test Data Sheets in Appendix 1.

4.3 Field Screening Measurements

All soil samples collected underwent a preliminary screening procedure, which included visual screening for colour and evidence of deleterious fill, as well as screening with an RKI Eagle Gastech Tanktector with methane elimination and calibrated to hexane.

The combustible soil vapours were measured by inserting the analyzer probe into the nominal headspace above the soil sample. Samples were then agitated and the peak readings recorded. The vapour readings were less than 25ppm and not indicative of lighter fraction petroleum hydrocarbons. It should be noted that the gastech is not as reliable in detecting heavier, less volatile hydrocarbon compounds such as waste oil. Vapour readings are noted on the Soil Profile and Test Data Sheets in Appendix 1.

Soil samples were selected for analysis based on and combination of visual appearance, location, and vapour readings.

4.4 Groundwater Monitoring Well Installation

Two (2) groundwater monitoring wells were installed on the Phase II Property during the 2017 investigation, in BH1-17 and BH3-17. As noted previously, an additional monitoring well (BH3) was previously installed on the property during a Phase II ESA conducted in 2003. The monitoring wells consisted of 32 mm diameter Schedule 40 threaded PVC risers and screens.

Construction details of 2017 monitoring wells are listed below in Table 2 and are also presented on the Soil Profile and Test Data Sheets provided in Appendix 1.

Table 2
Monitoring Well Construction Details

Well ID	Ground Surface Elevation	Total Depth (m BGS)	Screened Interval (m BGS)	Sand Pack (m BGS)	Bentonite Seal (m BGS)	Casing Type
BH1-17	98.85	5.69	2.69-5.69	2.25-5.69	0.3-2.25	Flushmount
BH3-17	98.71	6.32	3.32-6.32	2.80-6.32	0.3-2.80	Flushmount

4.5 Field Measurement of Water Quality Parameters

Groundwater sampling was conducted at BH1-17 and BH3-17 on July 4, 2017. It should be noted that BH3 (2003) could not be located at the time of the sampling event. At this time, water quality parameters were not measured in the field.

4.6 Groundwater Sampling

Groundwater sampling protocols were followed using the MECP document entitled “Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario”, dated May 1996. Groundwater samples were obtained from monitoring wells BH1-17 and BH3-17 using dedicated sampling equipment. Standing water was purged from each well prior to sampling. Samples were stored in coolers to reduce analyte volatilization during transportation. Details of our standard operating procedure for groundwater sampling are provided in the Sampling and Analysis Plan in Appendix 1.

4.7 Analytical Testing

Based on the guidelines outlined in the Sampling and Analysis Plan appended to this report, the following soil and groundwater samples were submitted for analysis:

Table 3
Soil Samples Analysed

Sample ID	Sample Depth / Stratigraphic Unit	Parameters Analysed		Rationale
		BTEX	PHC (F_1-F_4)	
BH1-SS3	1.52-1.75m; Fill	X	X	To assess potential BTEX and PHC impacts associated with any former on-site automotive services and the existing service garage on the adjacent property to the south. Sample selected based on visual/olfactory observations, vapour screening and/or depth in relation to water table.
BH2-AU1	0.05-0.60m; Fill	X	X	To assess potential BTEX and PHC impacts associated with any former on-site automotive services and residual impacts from the former remedial excavation. Sample selected based on visual/olfactory observations, vapour screening and/or depth in relation to water table.
BH3-AU1	0.05-0.60m; Fill	X	X	To assess potential BTEX and PHC impacts associated with residual impacts from the former remedial excavation. Sample selected based on visual/olfactory observations, vapour screening and/or depth in relation to water table.

Notes:
- ❒ BHs are identified as BH1-17 through BH4-17 on the drawings, however have been labelled as shown in this table for laboratory analysis.

Table 4
Groundwater Samples Analysed

Sample ID	Screened Interval/ Stratigraphic Unit	Parameters Analysed			Rationale
		BTEX	PHC (F_1-F_4)	VOCs	
BH1-GW1	2.69-5.69m; Limestone bedrock		X	X	To assess potential groundwater impacts within APECs identified during Phase I ESA.
BH3-GW1	3.32-6.32m; Limestone bedrock	X	X	X	

Notes:
BHs are identified as BH1-17 through BH4-17 on the drawings, however have been labelled as shown in this table for laboratory analysis.

Paracel Laboratories (Paracel), of Ottawa, Ontario, performed the laboratory analysis on the samples submitted for analytical testing. Paracel is a member of the Standards Council of Canada/Canadian Association for Laboratory Accreditation (SCC/CALA). Paracel is accredited and certified by SCC/CALA for specific tests registered with the association.

4.8 Residue Management

All excavated soil, purge water and fluids from equipment cleaning were retained on-site.

4.9 Elevation Surveying

An elevation survey of all borehole locations was completed by Paterson at the time of the subsurface investigation. All borehole elevations are relative to the top spindle of a fire hydrant located on the east side of Bronson Avenue, north of the Phase II Property, in front of 421 Bronson Avenue. The assumed elevation is 100.00m above sea level (asl).

4.10 Quality Assurance and Quality Control Measures

A summary of quality assurance and quality control (QA/QC) measures, including sampling containers, preservation, labelling, handling, and custody, equipment cleaning procedures, and field quality control measurements is provided in the Sampling and Analysis Plan in Appendix 1.

5.0 REVIEW AND EVALUATION

5.1 Geology

Site soils generally consist of a pavement structure overlying fill material, underlain by limestone bedrock. The fill material generally consisted of brown silty sand and gravel to depths ranging from 0.76 to 2.1m below ground surface. Occasional brick fragments were identified at BH3-17. Practical auger refusal was encountered on inferred bedrock beneath the layer of fill at depths ranging from approximately 1.19 to 1.75m below grade. In BH1-17 and BH3-17, where diamond drilling was conducted, limestone bedrock was confirmed. The bedrock deposit was observed to have horizontal bedding planes, occasional vertical fractures and shale seams. Site stratigraphy is shown on Drawings PE4060-6,7 - Cross-Section A-A' and PE4060-8,9 – Cross-Section B-B'.

Groundwater was encountered near the interface of the overburden and the bedrock, at depths ranging from approximately 1.31 to 1.33m below existing grade.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured during the groundwater sampling event on July 4, 2017, using an electronic water level meter. Groundwater levels are summarized in Table 5. All measurements are relative to the fire hydrant located on the east side of Bronson Avenue, north of the Phase II Property.

Table 5
Groundwater Level Measurements

Borehole Location	Ground Surface Elevation (m)	Water Level Depth (m below grade)	Water Level Elevation (m ASL)	Date of Measurement
BH1-17	98.85	1.33	97.52	July 4, 2017
BH3-17	98.71	1.31	97.4	

The groundwater elevation measured in BH3 (2003) during the previous Phase II ESA was 1.6m below grade. Although it is not possible to conduct groundwater contour mapping with the available information, it appears as though the groundwater flow beneath the Phase II Property is in a northerly direction. Based on the regional topography and other subsurface investigations conducted in the vicinity of the Phase II Property, the regional groundwater flow is considered to be towards the north or northwest. Groundwater surface elevations are shown on Drawing PE4060-3 – Test Hole Location Plan.

5.3 Fine-Coarse Soil Texture

Based on field soil observations, fine-grained soil standards are not applicable to the Phase II Property. The more stringent standards for coarse-grained soil have therefore been selected.

5.4 Soil: Field Screening

Field screening of the soil samples collected during drilling resulted in combustible vapour readings of less than 25ppm. Field screening results of each individual soil sample are provided on the Soil Profile and Test Data Sheets appended to this report. It is noted that these readings are not indicative of significant levels of volatile organic compounds, although higher-fraction hydrocarbons may not be as readily detectable by gatechtors.

5.5 Soil Quality

A total of 3 soil samples were submitted for analytical testing of a combination of benzene, toluene, ethylbenzene and xylene (BTEX) and petroleum hydrocarbons (PHC, F_1-F_4). The results of the analytical testing are presented below in Table 6. The laboratory certificates of analysis are provided in Appendix 1.

Table 6
Analytical Test Results
Soil – BTEX, Petroleum Hydrocarbons (PHCs, F_1-F_4)

Parameter	MDL (µg/g)	Soil Samples (µg/g) June 28, 2017			MECP Table 7 Residential Coarse Standards
		BH1-SS3 (1.52-1.75m)	BH2-AU1 (0.05-0.60m)	BH3-AU1 (0.05-0.60m)	
Benzene	0.02	nd	nd	nd	0.21
Toluene	0.05	nd	0.12	0.08	2.3
Ethylbenzene	0.05	nd	nd	nd	2
Xylenes	0.05	nd	0.26	0.16	3.1
PHC F1	7	nd	nd	nd	55
PHC F2	4	**324**	14	7	98
PHC F3	8	**355**	88	82	300
PHC F4	6	166[1]	159[1]	142[1]	2,800
PHC F4G	50	818	1,130	1,400	2,800

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- 1 - GC-FID signal did not return to baseline by C50
- **Bold** – Value exceeds MECP Table 7 standards

Toluene and xylene parameters were identified at concentrations below the MECP Table 7 standards in soil Samples BH2-AU1 and BH3-AU1. Otherwise BTEX parameters were not identified in the samples analyzed. Petroleum hydrocarbon fractions F_2, F_3, F_4 and F_{4G} were identified in each of the samples analyzed; PHC F_1 concentrations were not detected above the laboratory method detection limits. All identified PHC concentrations were in compliance with the MECP Table 7 standards, with the exception of the F_2 (324µg/g) and F_3 (355µg/g) concentrations identified in Sample BH1-SS3.

The maximum concentrations of analyzed parameters in the soil at the site are summarized below in Table 7.

Table 7
Maximum Concentrations – Soil

Parameter	Maximum Concentration (µg/g)	Borehole	Depth Interval (m BGS)
Toluene	0.12	BH2-AU1	0.05-0.60
Xyelenes	0.26	BH2-AU1	0.05-0.60
PHC F2	**324**	BH1-SS3	1.52-1.75
PHC F3	**355**		
PHC F4	166		
PCH F4G	1,400	BH3-AU1	0.05-0.60

Notes:
- **Bold** – Value exceeds MECP Table 7 standards

All other parameter concentrations were below laboratory detection limits. It should be noted that 2003 hydrocarbon results were not analysed in accordance with the O.Reg.153/04, as amended, and cannot be compared to the 2011 Table 7 standards.

5.6 Groundwater Quality

Groundwater samples from monitoring wells installed in BH1 and BH3 were submitted for laboratory analysis of VOC or BTEX and PHC (F_1-F_4) parameters. The results of the analytical testing are presented below in Tables 8 and 9. The laboratory certificates of analysis are provided in Appendix 1. No free product was observed in the monitoring wells at the time of the sampling event. No hydrocarbon sheen or odours were noted on the purge water at the time of the sampling event.

Table 8
Analytical Test Results
Groundwater – BTEX, PHCs (F_1-F_4)

Parameter	MDL (µg/L)	Groundwater Samples (µg/L) July 4, 2017		MECP Table 7 Standards (µg/L)
		BH1-GW1 (2.69-5.69m)	BH3-GW1 (3.32-6.32)	
Benzene	0.5	nd	nd	0.5
Toluene	0.5	nd	nd	320
Ethylbenzene	0.5	nd	nd	54
Xylenes	0.5	nd	nd	72
PHCs F1	25	nd	nd	420
PHCs F2	100	nd	nd	150
PHCs F3	100	nd	nd	500
PHCs F4	100	nd	nd	500

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL

There were no BTEX or PHC parameters detected above method detection limits, in either of the groundwater samples submitted for analysis. The results are in compliance with the MECP Table 7 standards.

Table 9
Analytical Test Results
Groundwater – VOCs

Parameter	MDL (µg/L)	Groundwater Samples (µg/L) July 4, 2017	MECP Table 7 Standards (µg/L)
		BH1-GW1 (2.69-5.69m)	
Acetone	5.0	nd	10,000
Benzene	0.5	nd	0.5
Bromodichloromethane	0.5	nd	67,000
Bromoform	0.5	nd	5
Bromomethane	0.5	nd	0.89
Carbon Tetrachloride	0.2	nd	0.2
Chlorobenzene	0.5	nd	140
Chloroethane	1.0	nd	nv
Chloroform	0.5	**2.6**	2
Chloromethane	3.0	nd	nv
Dibromochloromethane	0.5	nd	65,000
Dichlorodifluoromethane	1.0	nd	3,500
1,2-Dibromoethane	0.2	nd	nv
1,2-Dichlorobenzene	0.5	nd	150
1,3-Dichlorobenzene	0.5	nd	7,600
1,4-Dichlorobenzene	0.5	nd	0.5
1,1-Dichloroethane	0.5	nd	11
1,2-Dichloroethane	0.5	nd	0.5
1,1-Dichloroethylene	0.5	nd	0.5
cis-1,2-Dichloroethylene	0.5	nd	1.6
trans-1,2-Dichloroethylene	0.5	nd	1.6
1,2-Dichloropropane	0.5	nd	0.58
1,3-Dichloropropene	0.5	nd	0.5
Ethylbenzene	0.5	nd	54
Hexane	1.0	nd	5
Methyl Ethyl Ketone	5.0	nd	21,000
Methyl Butyl Ketone	10.0	nd	nv
Methyl Isobutyl Ketone	5.0	nd	5,200
Methyl tert-butyl Ether	2.0	nd	15
Methylene Chloride	5.0	nd	26
Styrene	0.5	nd	43
1,1,1,2-Tetrachloroethane	0.5	nd	1.1
1,1,2,2-Tetrachloroethane	0.5	nd	0.5
Tetrachloroethylene	0.5	nd	0.5
Toluene	0.5	nd	320
1,1,1-Trichloroethane	0.5	nd	23
1,1,2-Trichloroethane	0.5	nd	0.5
Trichloroethylene	0.5	nd	0.5
Trichlorofluoromethane	1.0	nd	2,000
1,3,5-Trimethylbenzene	0.5	nd	nv
Vinyl Chloride	0.5	nd	0.5
Xylenes	0.5	nd	72

Notes:
- MDL – Method Detection Limit;
- nd – not detected above the MDL
- **Bold** – Value exceeds selected MOE standards
- nv – No value for MOECC standards

With the exception of chloroform in groundwater Sample BH1-GW1, there were no VOC parameters detected above method detection limits in any of the groundwater samples submitted for analytical testing. The chloroform concentration (2.6 µg/L) identified in the groundwater recovered from BH1, is marginally above the MECP Table 7 standard of 2µg/L. The chloroform concentration is considered to have resulted from the use of municipal water during the rock coring process and is not considered to represent a concern to the Phase II Property. The concentration is expected to have dissipated by now.

The maximum final concentrations of analyzed parameters in the groundwater at the site are summarized below in Table 10.

Table 10
Maximum Concentrations – Groundwater

Parameter	Maximum Concentration (µg/L)	Borehole	Depth Interval (m BGS)
Chloroform	**2.6**	BH1-GW1	2.69-5.69

Notes:
- **Bold** – Value exceeds MECP Table 7 standards

All other parameter concentrations were not detected above the laboratory detection limits. With the exception of the chloroform concentration noted above, all of the groundwater results comply with the MECP Table 7 standards. As discussed previously, the chloroform is considered to have resulted from the use of municipal water during the rock coring process. The concentration is expected to have dissipated by now and the chloroform is not considered to represent a concern to the Phase II Property.

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of the 2017 sampling event were handled in accordance with the Analytical Protocol with respect to holding time, preservation method, storage requirement, and container type.

As per Subsection 47(3) of O.Reg. 153/04 as amended by O.Reg. 269/11, a Certificate of Analysis has been received for each sample submitted for analysis and all Certificates of Analysis are appended to this report.

As noted on laboratory certificate of analysis (Order #1726308) the GC-FID signal did not return to baseline by C50 for each of the soil samples analysed for PHCs. The F4G (gravimetric) concentration was therefore reported.

A laboratory QC qualifier for these samples indicated that the duplicate results exceeded the RPD limits due to the non-homogeneous matrix.

The qualifiers were not considered to be concerns based on other QC data. Overall, the quality of the field data collected during this Phase II ESA is considered to be sufficient to meet the overall objectives of this assessment.

5.8 Phase II Conceptual Site Model

The following section has been prepared in general accordance with the requirements O.Reg. 153/04, as amended, made under the Environmental Protection Act. Conclusions and recommendations are discussed in a subsequent section.

Site Description

Potentially Contaminating Activity and Areas of Potential Environmental Concern

As per Table 1 in Section 2.2, PCA's considered to result in APECs on the Phase II Property include:

- Item 28, Table 2, O.Reg. 153/04 as amended by O.Reg. 269/11: "Gasoline and associated products storage in fixed tanks" – this PCA was identified based a previous remedial excavation associated with a reported fuel spill on the adjacent property to the north (440 Bronson Avenue);
- Item 30, Table 2, O.Reg. 153/04 as amended by O.Reg. 269/11: "Importation of Fill Material of Unknown Quality" - this PCA was identified based on fill identified during previous subsurface investigations; and
- Item 52, Table 2, O.Reg. 153/04 as amended by O.Reg. 269/11: "Storage, maintenance, fuelling and repair of equipment, vehicles and material used to maintain transportation systems" – this PCA was identified based on the past use of the subject structure as an appraisal facility for automobiles that had been in accidents and based on the existing automotive service garage on the adjacent property to the south.

Chemicals of potential concern identified in association with the aforementioned APECs include BTEX, VOCs, PHCs and metals in the soil and/or groundwater. It should be noted that metals were not analysed as part of this investigation.

Subsurface Structures and Utilities

Based on underground service locates completed prior to the subsurface investigation, buried utilities on the Phase II Property include municipal water and sewer services, as well as a natural gas service. The approximate locations of the buried utility services are shown on Drawing: PE4060-3 – Test Hole Location Plan. A catch basin is present on the property, otherwise no other subsurface structures are present.

Physical Setting

Site Stratigraphy

The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is illustrated on Drawings PE4060-6,7 - Cross-Section A-A' and PE4060-8,9 – Cross-Section B-B'. Stratigraphy generally consists of:

- Pavement structure ranging from 10 to 350mm in depth and consisting of asphaltic concrete underlain by a granular base (sand and gravel).
- Fill ranging in depth from approximately 0.76 to 1.75m below ground surface and generally consisting of brown silty sand with gravel. Construction debris (brick fragments) noted at BH3.
- Practical auger refusal was encountered on inferred bedrock beneath the layer of fill at depths ranging from approximately 1.19 to 1.75m below grade. In BH1 and BH3, where diamond drilling was conducted, limestone bedrock was confirmed. This is the deepest unit investigated. Groundwater was encountered in this stratigraphic unit.

Hydrogeological Characteristics

Groundwater was encountered near the interface of the overburden and the bedrock beneath the Phase II Property. This unit is interpreted to function as a local aquifer at the subject site.

Water levels were measured at the subject site on July 4, 2017. Water levels are summarized above in Section 5.2 of this report and are shown on Drawings PE4060-6,7 and PE4060-8,9 – Cross Sections A-A` and B-B`.

Based on the information available in combination with the regional topography and information in our files, groundwater flow beneath the site is expected to be in a northerly or northwesterly direction. Groundwater contour mapping was not completed during the current assessment.

Approximate Depth to Bedrock

Practical auger refusal on inferred bedrock was identified in all boreholes at depths ranging from approximately 1.19 to 1.75m below grade. In BH1 and BH3 where bedrock was confirmed, bedrock was determined to be present at 1.75 and 1.3m below grade respectively.

Approximate Depth to Water Table

Depth to water table at the Phase II Property varies between approximately 1.31 and 1.33m below existing grade.

Sections 41 and 43.1 of the Regulation

Section 41 of the Regulation (Site Condition Standards, Environmentally Sensitive Areas) does not apply to the Phase II Property.

While the Phase II Property does not include a water body, is not adjacent to a water body and does not include land that is within 30m of a water body, Section 43.1 of the Regulation does apply to the Phase II Property, in that there is less than 2m of overburden across the site.

Fill Placement

Fill material was identified across the Phase II Property and generally consisted of silty sand and gravel to depths ranging from approximately 0.76 to 1.5m below grade. Occasional fragments of brick were identified in the fill material at BH3 during the current investigation, while occasional fragments of asphalt, concrete, wood and brick were identified in the fill material at boreholes placed during the 2003 investigation.

Proposed Buildings and Other Structures

It is our understanding that the site is to be redeveloped with a 6-storey mixed-used building with one basement level.

Existing Buildings and Structures

The Phase II Property is occupied by a one-storey, vacant commercial building, situated on the western portion of the subject land. No other buildings or above-grade structures were present on the Phase II Property.

Water Bodies

There are no water bodies on the Phase II Property or within the 250m study area.

Areas of Natural Significance

No areas of natural significance are present on the Phase II Property or within the 250m study area.

Environmental Condition

Areas Where Contaminants are Present

Based on screening and analytical test results obtained to date, PHC F_2 and F_3 concentrations exceeding MECP Table 7 standards were identified in the fill material at BH1. A chloroform concentration marginally exceeding the MECP Table 3 standards was identified in the groundwater recovered from BH1; the chloroform concentration is considered to have resulted from the use of municipal groundwater during the rock coring process and is not considered to be a contaminant of concern. Otherwise the groundwater was in compliance with MECP Table 7 standards. Analytical test results are presented in plan view on Drawings PE4060-4 and 5 – Analytical Testing Plans.

Types of Contaminants

The following parameters were identified in the fill material at concentrations exceeding the MECP Table 7 standards:

- PHC, F_2 and F_3.

All other PHC and BTEX parameters detected in the fill material were in compliance with the MECP Table 7 standards.

Contaminated Media

Based on the results of the Phase II ESA, some of the fill material is impacted with PHC F_2 and F_3 concentrations exceeding MECP Table 7 standards. Groundwater on the subject site is considered to be in compliance with the MECP Table 7 standards.

What Is Known About Areas Where Contaminants Are Present

Impacted fill is present on the south-central portion of the property east of the subject building, in the vicinity of BH1. Analytical test results exceeding the MECP Table 7 standards are presented on Drawing PE4060-4.

Distribution and Migration of Contaminants

The PHC impacts are considered to be limited to the fill material. Based on analytical testing of the groundwater at BH1, PHC parameters were not detected. Therefore PHC impacts are not considered to have extended into the bedrock.

Contaminant distribution is presented in both plan view and cross-section, on Drawings PE4060-4, PE4060-6 and PE4060-8.

Discharge of Contaminants

The PHC concentrations are considered to have been discharged directly to the ground surface through improper disposal of possible chemicals previously used on site, or via small releases from parked vehicles.

Climatic and Meteorological Conditions

In general, climatic and meteorological conditions have the potential to affect contaminant distribution. Two (2) ways by which climatic and meteorological conditions may affect contaminant distribution include the downward leaching of contaminants by means of the infiltration of precipitation, and the migration of contaminants via groundwater levels and/or flow, which may fluctuate seasonally.

Due to the Phase II Property having been covered largely by asphaltic concrete and a building structure, precipitation and infiltration are not considered to have significantly contributed to the migration of the identified parameters. Based on analytical testing of the groundwater which is present in the bedrock, impacts are considered to be confined to the fill material.

Potential for Vapour Intrusion

Given the low combustible vapour readings, the potential for vapour intrusion within the existing building (currently vacant) is considered to be negligible.

6.0 CONCLUSIONS

Assessment

A Phase II ESA was conducted for the property at 444 Bronson Avenue in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APEC) on the Phase II Property. The Phase II ESA field work was conducted prior to the December 2017 Phase I ESA, with borehole locations selected based on the findings of previous investigations, however, the Phase II ESA is considered to have addressed the majority of the APECs identified.

The subsurface investigation consisted of the placement of four (4) boreholes, two (2) of which were constructed with groundwater monitoring well installations. Soil samples were obtained from the boreholes and screened using visual observations and combustible vapour measurements. A total of 3 soil samples were submitted for laboratory analysis of a combination of benzene, toluene, ethylbenzene and xylenes (BTEX) and petroleum hydrocarbons (PHCs, F_1-F_4). Petroleum hydrocarbon (PCH) fractions F_2 and F_3 concentrations exceeding MECP Table 7 standards were identified in the fill material on the southern portion of the Phase II Property, east of the subject building.

Groundwater samples obtained from two (2) monitoring wells, BH1-17 and BH3-17, were analysed for BTEX or volatile organic compound (VOCs) and PHCs. Based on the results of the analytical testing, parameter concentrations were not identified above the method detection limits with one exception. A concentration of chloroform (2.6µg/L) marginally exceeding the MECP Table 7 standard of 2 µg/L was identified in the groundwater recovered from BH1-17. The chloroform is considered to be the result of using municipal groundwater during the rock coring process, for the installation of the groundwater monitoring wells. The chloroform is expected to have dissipated by now and is not considered to be contaminant of concern. The groundwater is considered to be in compliance with MECP Table 7 standards based on 2017 data.

Conclusion

Based on the findings of the Phase II ESA to date, fill material impacted with PHC F_2 and F_3 concentrations exceeding MECP Table 7 standards is present on the southern portion of the Phase II Property. It is our understanding that the Phase II Property is to be redeveloped with a 6-storey mixed-used building with a basement level.

As noted previously, the Phase II ESA did not fully assess all APECs identified in the Phase I ESA. It is recommended that a supplemental Phase II ESA be conducted to fully assess the APECs identified in the Phase I ESA and determine the groundwater flow direction beneath the Phase II Property, in accordance with O.Reg 153/04, as amended.

Once a supplemental Phase II ESA has been conducted, it is recommended that an environmental site remediation program, involving the removal of all impacted fill material, be completed concurrently with the site redevelopment. Prior to offsite disposal at a licenced landfill site, a leachate analysis of a representative sample of contaminated soil must be conducted in accordance with Ontario Regulation 347/558.

It is also recommended that Paterson personnel be onsite during construction activities to direct the excavation and segregation of impacted soil and to conduct confirmatory sampling as required.

It is expected that groundwater monitoring wells will be abandoned in accordance with O.Reg.903, at the time of construction excavation.

7.0 STATEMENT OF LIMITATIONS

This Phase II - Environmental Site Assessment report has been prepared in general accordance with O.Reg. 153/04 as amended, and the requirements of CSA Z769-00. The conclusions presented herein are based on information gathered from a limited sampling and testing program. The test results represent conditions at specific test locations at the time of the field program.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes themselves.

Should any conditions be encountered at the subject site and/or historical information that differ from our findings, we request that we be notified immediately in order to allow for a reassessment.

This report was prepared for the sole use of TC United Group and notification from TC United Group and Paterson Group will be required to release this report to any other party.

Paterson Group Inc.

Karyn Munch, P.Eng., QP_{ESA}

Mark S. D'Arcy, P.Eng., QP_{ESA}

Report Distribution:

- ❒ TC United Group
- ❒ Paterson Group

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE4060-3 – TEST HOLE LOCATION PLAN

DRAWING PE4060-4 – ANALYTICAL TESTING PLAN – SOIL

DRAWING PE4060-5 – ANALYTICAL TESTING PLAN – GROUNDWATER

DRAWING PE4060-6 – CROSS SECTION A-A` – SOIL

DRAWING PE4060-7 – CROSS SECTION A-A` – GROUNDWATER

DRAWING PE4060-8 – CROSS SECTION B-B`- SOIL

DRAWING PE4060-9 – CROSS SECTION B-B`- GROUNDWATER

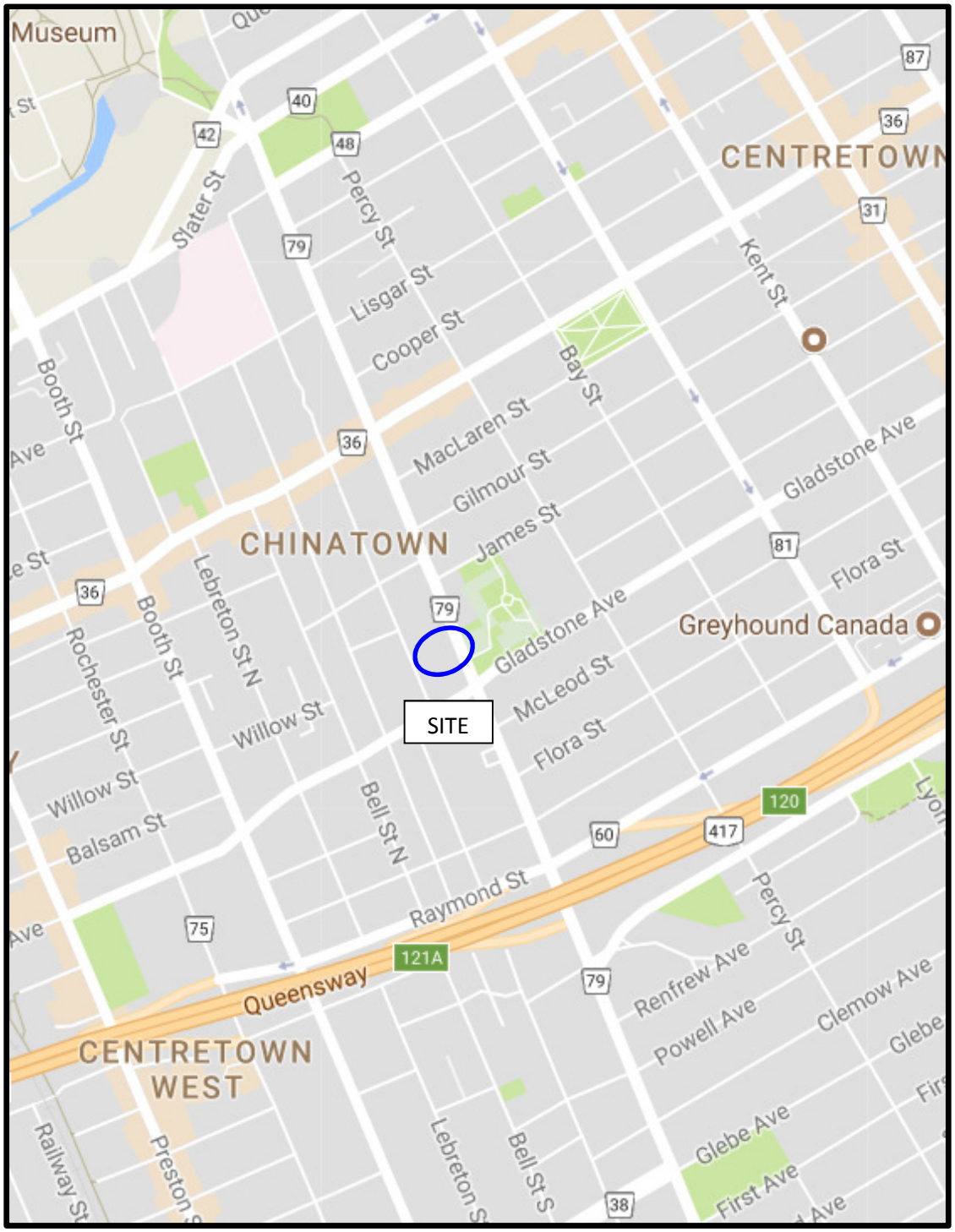

FIGURE 1

KEY PLAN

#267 CAMBRIDGE STREET N.
RESIDENTIAL

#440 BRONSON AVENUE
RESIDENTIAL

#271 CAMBRIDGE STREET N.
RESIDENTIAL

#273 CAMBRIDGE STREET N.
RESIDENTIAL

#275 CAMBRIDGE STREET N.
RESIDENTIAL

#448 BRONSON AVENUE
MIDAS AUTO SERVICE EXPERTS

PRIVATE GARAGE

#444 BRONSON AVENUE

APPROXIMATE AREA OF 2008
REMEDIAL EXCAVATION

BH 5-17
98.92

BH 3

BH 4

BH 5

BH 3-17
98.71
[97.41]
(97.40)

ASPHALT CUT

APPROXIMATE LOCATION
OF MUNICIPLA WATER
AND SEWER SERVICES

BH 2-17
98.84

BH 9

ASPHALTIC
CONCRETE

BH 4-17
98.67

BH 6

BH 8

BH 7

BH 1-17
98.85
[97.10]
(97.52)

GAS GAS GAS GAS GAS GAS GAS GAS GAS GAS GAS

NATURAL GAS
CONNECTION

FORMER
NATURAL
GAS LINE

NATURAL
GAS LINE

BRONSON AVENUE

#435 BRONSON AVENUE
McNABB ARENA AND COMMUNITY CENTRE

LEGEND:

- BOREHOLE WITH MONITORING WELL LOCATION, 2017
- BOREHOLE LOCATION, 2017
- BOREHOLE WITH MONITORING WELL LOCATION, PREVIOUS INVESTIGATION, 2003
- BOREHOLE LOCATION, PREVIOUS INVESTIGATION, 2003
- 98.85 GROUND SURFACE ELEVATION (m)
- [97.10] BEDROCK SURFACE ELEVATION (m)
- (97.52) GROUNDWATER SURFACE ELEVATION (m)
- A—A' CROSS-SECTION LOCATION

TBM - TOP SPINDLE OF FIRE HYDRANT LOCATED IN FRONT OF 421 BRONSON AVENUE. ASSUMED ELEVATION = 100.00m.

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NO.	REVISIONS	DATE	INITIAL
0			

TC UNITED

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
444 BRONSON AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:150	Date: 04/2019
Drawn by: RCG	Report No.: PE4060-2
Checked by: KM	Dwg. No.: PE4060-3
Approved by: MSD	Revision No.: 0

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#267 CAMBRIDGE STREET N.
RESIDENTIAL

#271 CAMBRIDGE STREET N.
RESIDENTIAL

#273 CAMBRIDGE STREET N.
RESIDENTIAL

#275 CAMBRIDGE STREET N.
RESIDENTIAL

PRIVATE GARAGE

#444 BRONSON AVENUE

#448 BRONSON AVENUE
MIDAS AUTO SERVICE EXPERTS

#435 BRONSON AVENUE
McNABB ARENA AND COMMUNITY CENTRE

BRONSON AVENUE

BH3-AU1 (0.05-0.6m) June 28, 2017
BTEX and PHCs comply with MECP Table 7 Standards

BH3-G9 (0.25-0.4m) Jan.15, 2003

Parameter	Result	MECP (µg/g)
TPH (ho)	9,600	5,000

BTEX and TPH (g/d) comply with 1997 MECP Table B

BH4-G1 (0.25-0.4m) Feb.17, 2003
TPH(g/d) and TPH (ho) comply with 1997 MECP Table B

BH5-G1 (0.6-0.76m) Feb.17, 2003
TPH(g/d) and TPH (ho) comply with 1997 MECP Table B

APPROXIMATE AREA OF 2008 REMEDIAL EXCAVATION

BH 5-17
98.92

BH 3

BH 4

BH 5

BH 3-17
98.71
[97.41]
(97.40)

ASPHALT CUT

APPROXIMATE LOCATION OF MUNICIPLA WATER AND SEWER SERVICES

BH 2-17
98.84

BH 9

ASPHALTIC CONCRETE

BH 4-17
98.67

BH 6

BH 8

BH 7

BH 1-17
98.85
[97.10]
(97.52)

NATURAL GAS CONNECTION

NATURAL GAS LINE

FORMER NATURAL GAS LINE

BH2-AU1 (0.05-0.6m) June 28, 2017
BTEX and PHCs comply with MECP Table 7 Standards

BH9-G1 (0.0.45-0.6m) Feb.17, 2003
TPH(g/d) and TPH (ho) comply with 1997 MECP Table B

BH6-G2 (0.6-0.76m) Feb.17, 2003
TPH(g/d) and TPH (ho) comply with 1997 MECP Table B

BH1-SS3 (1.6-1.75m) June 28, 2017

Parameter	Result	MOECC (µg/g)
PHC F2	324	98
PHC F3	355	300

BTEX and PHC F1, F4 comply with MECP Table 7 Standards

BH7-G2 (0.45-0.8m) Feb.17, 2003
TPH(g/d) and TPH (ho) comply with 1997 MECP Table B

LEGEND:

SOIL PARAMETERS COMPLY WITH MECP TABLE 7 STANDARDS OR 1997 TABLE B CRITERIA

SOIL PARAMETERS EXCEED MECP TABLE 7 STANDARDS OR 1997 TABLE B CRITERIA

- BOREHOLE WITH MONITORING WELL LOCATION, 2017
- BOREHOLE LOCATION, 2017
- BOREHOLE WITH MONITORING WELL LOCATION, PREVIOUS INVESTIGATION, 2003
- BOREHOLE LOCATION, PREVIOUS INVESTIGATION, 2003
- 98.85 GROUND SURFACE ELEVATION (m)
- [97.10] BEDROCK SURFACE ELEVATION (m)
- (97.52) GROUNDWATER SURFACE ELEVATION (m)

TBM - TOP SPINDLE OF FIRE HYDRANT LOCATED IN FRONT OF 421 BRONSON AVENUE. ASSUMED ELEVATION = 100.00m.

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
444 BRONSON AVENUE

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - SOIL

Scale: 1:150	Date: 04/2019
Drawn by: RCG	Report No.: PE4060-2
Checked by: KM	Dwg. No.: PE4060-4
Approved by: MSD	Revision No.: 0

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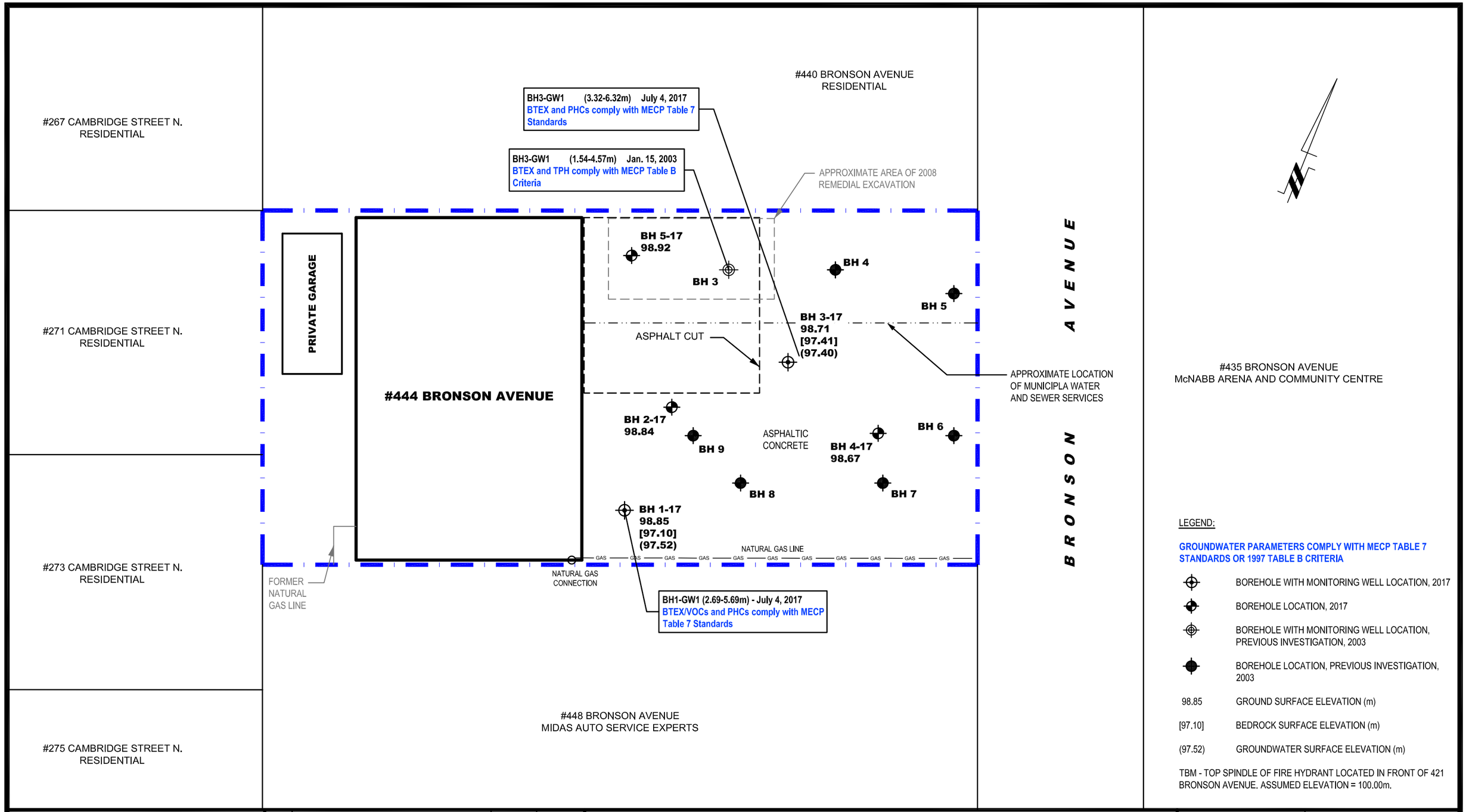

LEGEND:

GROUNDWATER PARAMETERS COMPLY WITH MECP TABLE 7 STANDARDS OR 1997 TABLE B CRITERIA

⊕	BOREHOLE WITH MONITORING WELL LOCATION, 2017
⊕	BOREHOLE LOCATION, 2017
⊕	BOREHOLE WITH MONITORING WELL LOCATION, PREVIOUS INVESTIGATION, 2003
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, 2003
98.85	GROUND SURFACE ELEVATION (m)
[97.10]	BEDROCK SURFACE ELEVATION (m)
(97.52)	GROUNDWATER SURFACE ELEVATION (m)

TBM - TOP SPINDLE OF FIRE HYDRANT LOCATED IN FRONT OF 421 BRONSON AVENUE, ASSUMED ELEVATION = 100.00m.

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
444 BRONSON AVENUE

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - GROUNDWATER

Scale: 1:150	Date: 04/2019
Drawn by: RCG	Report No.: PE4060-2
Checked by: KM	Dwg. No.: PE4060-5
Approved by: MSD	Revision No.: 0

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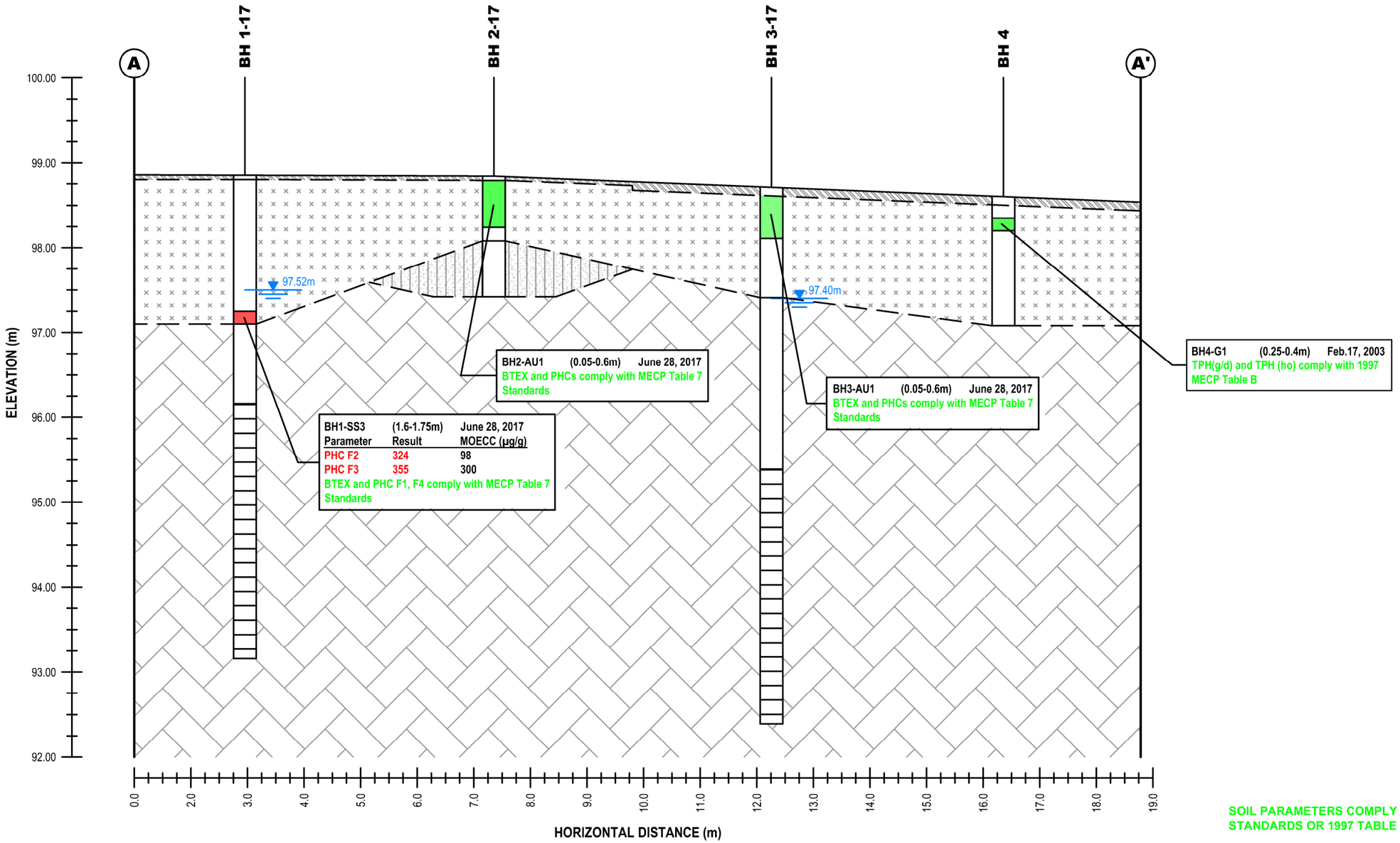

SOIL PARAMETERS COMPLY WITH MECP TABLE 7 STANDARDS OR 1997 TABLE B CRITERIA

SOIL PARAMETERS EXCEED MECP TABLE 7 STANDARDS

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
444 BRONSON AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A' - SOIL

Scale: AS SHOWN	Date: 04/2019
Drawn by: MPG	Report No.: PE4060-2
Checked by: KM	PE4060-6
Approved by: MSD	Revision No.:

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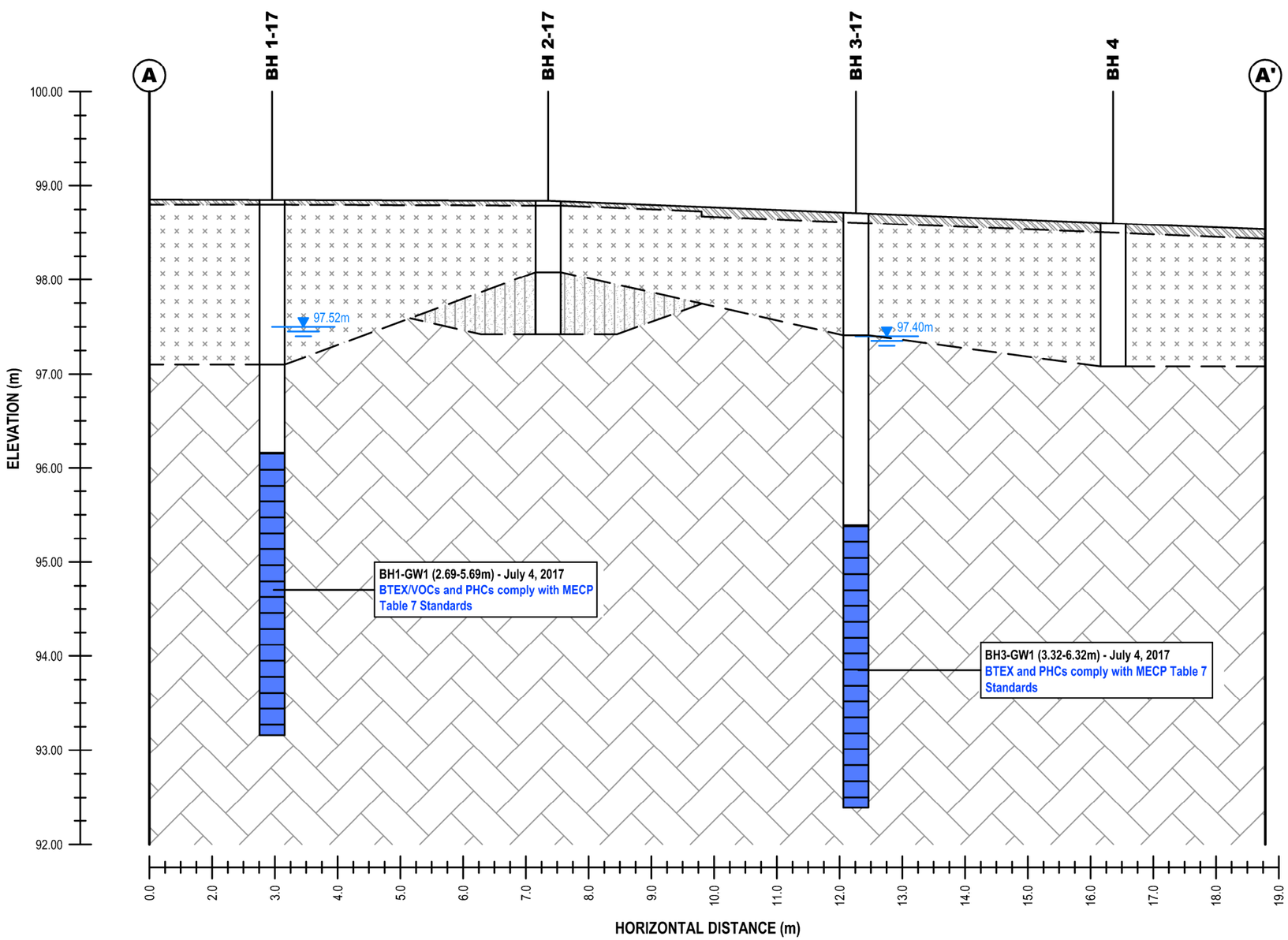

GROUNDWATER PARAMETERS COMPLY WITH MECP TABLE 7 STANDARDS

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
444 BRONSON AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A' - GROUNDWATER

Scale: AS SHOWN	Date: 04/2019
Drawn by: MPG	Report No.: PE4060-2
Checked by: KM	PE4060-7
Approved by: MSD	Revision No.:

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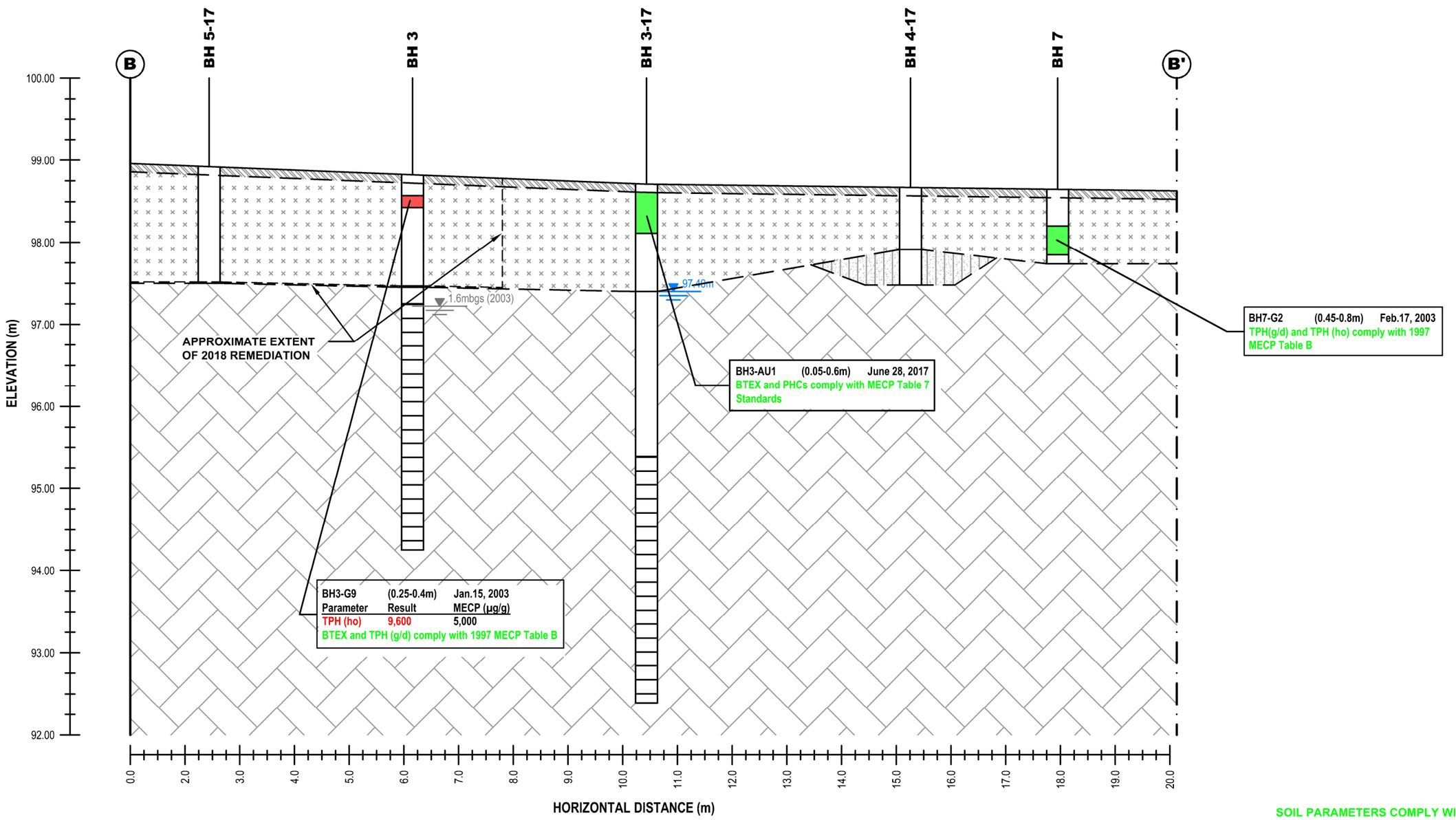

SOIL PARAMETERS COMPLY WITH MECP TABLE 7 STANDARDS OR 1997 TABLE B CRITERIA

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
444 BRONSON AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION B-B' - SOIL

Scale: AS SHOWN	Date: 04/2019
Drawn by: MPG	Report No.: PE4060-2
Checked by: KM	PE4060-8
Approved by: MSD	Revision No.:

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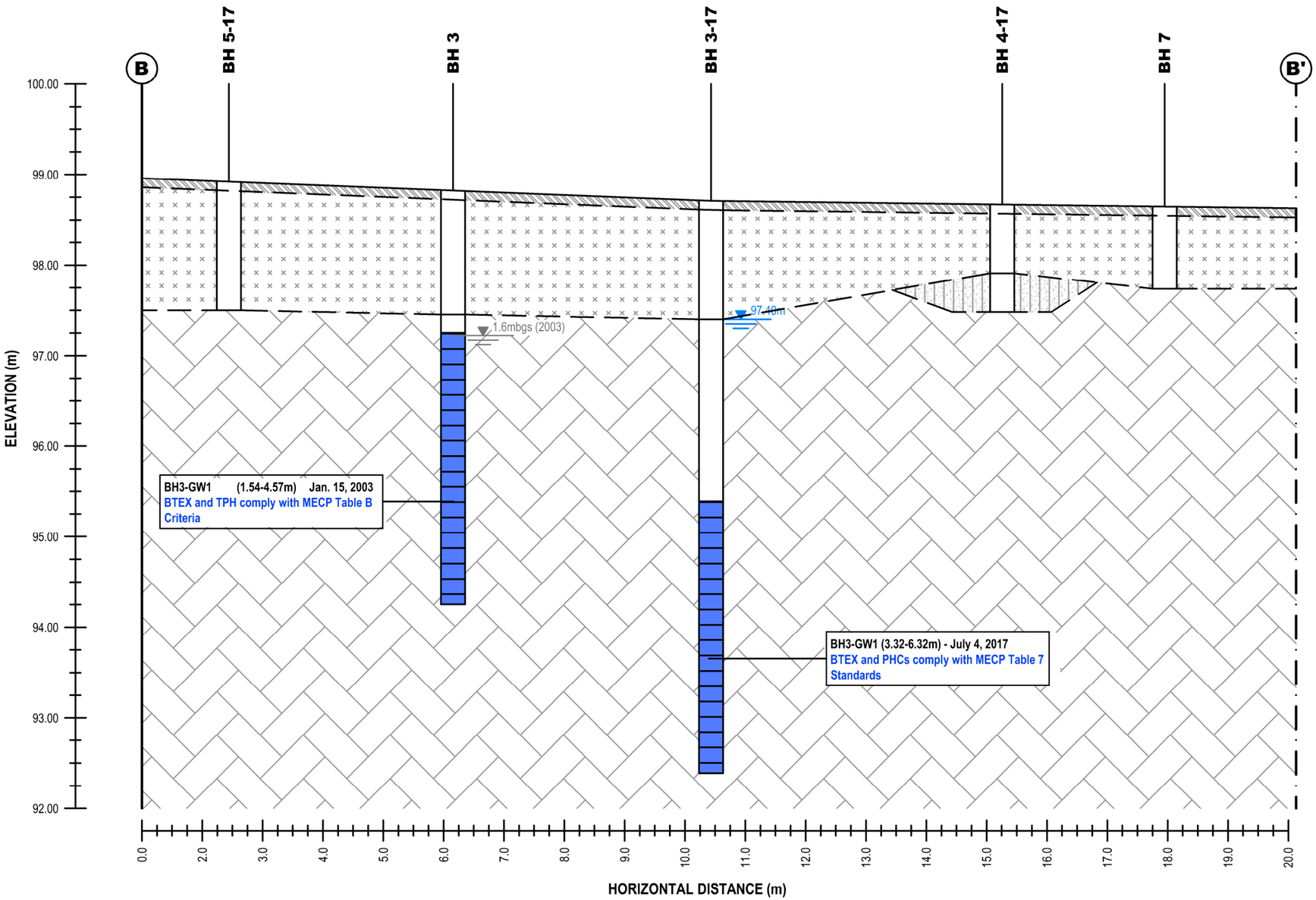

GROUNDWATER PARAMETERS COMPLY WITH MECP TABLE 7 STANDARDS OR 1997 TABLE B CRITERIA

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
444 BRONSON AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION B-B' - GROUNDWATER

Scale: AS SHOWN	Date: 04/2019
Drawn by: MPG	Report No.: PE4060-2
Checked by: KM	PE4060-9
Approved by: MSD	Revision No.:

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APPENDIX 1

SAMPLING AND ANALYSIS PLAN

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LABORATORY CERTIFICATES OF ANALYSIS

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Paterson Group Inc.

Consulting Engineers
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Sampling & Analysis Plan

Phase II Environmental Site Assessment
444 Bronson Avenue
Ottawa, Ontario

Prepared For

TC United Group

June 2017

Report: PE4060-SAP

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1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by TC United Group to conduct a Phase II Environmental Site Assessment (ESA) for the property addressed 444 Bronson Avenue in the City of Ottawa, Ontario. A subsurface investigation program, consisting of borehole drilling, was developed based on previous environmental reports prepared by Paterson. The purposes of the Phase II ESA was to provide a current assessment of the soil and groundwater conditions beneath the subject land.

Borehole	Location & Rationale	Proposed Depth & Rationale
BH1	Place borehole as close as possible to garage bays, to address potential soil and groundwater impacts associated with possible historical automotive works (former automotive appraisal center). Also placed to address potential impacts from the existing automotive service garage on the adjacent property to the south.	Drill to intercept water table for monitoring well installation.
BH2	Place borehole to provide additional coverage of potential impacts from former automotive appraisal works and assess the potential for poor quality fill material in vicinity of a former building foundation.	Drill to auger refusal on inferred bedrock surface.
BH3	Place borehole to address potential soil and groundwater impacts associated with historical fuel spill on adjacent property to the north and to address potential for poor quality fill material in vicinity of former building foundation.	Drill to intercept water table for monitoring well installation.
BH4	Place borehole to provide site coverage and delineation of any impacts that may be identified.	Drill to auger refusal on inferred bedrock surface.
BH5	Place borehole to address potential soil impacts associated with historical fuel spill on adjacent property to the north and to confirm quality of soil within the former remedial excavation.	Drill to auger refusal on inferred bedrock surface.

Borehole locations are shown on the Test Hole Location Plan appended to the main report.

At each borehole, split-spoon samples of overburden soils will be obtained at 0.76 m (2'6") intervals until practical refusal to augering. All soil samples will be retained, and samples will be selected for submission following a preliminary screening analysis.

Following borehole drilling, monitoring wells will be installed in selected boreholes (as above) for the measurement of water levels and the collection of groundwater samples.

2.0 ANALYTICAL TESTING PROGRAM

The analytical testing program for soil at the subject site is based on the following general considerations:

- ❒ At least one sample from each borehole should be submitted, in order to delineate the horizontal extent of contamination across the site.

- ❒ At least one sample from each stratigraphic unit should be submitted, in order to delineate the vertical extent of contamination at the site.

- ❒ In boreholes where there is visual or olfactory evidence of contamination, or where organic vapour meter or photoionization detector readings indicate the presence of contamination, the 'worst-case' sample from each borehole should be submitted for comparison with MECPsite condition standards.

- ❒ In boreholes with evidence of contamination as described above, a sample should be submitted from the stratigraphic unit below the 'worst-case' sample to determine whether the contaminant(s) have migrated downward.

- ❒ Parameters analyzed should be consistent with the Contaminants of Potential Concern identified in the Phase I ESA.

The analytical testing program for groundwater at the subject site is based on the following general considerations:

- ❒ Groundwater monitoring wells should be installed in all boreholes with visual or olfactory evidence of soil contamination, in stratigraphic units where soil contamination was encountered, where those stratigraphic units are at or below the water table (i.e. a water sample can be obtained).

- ❒ Groundwater monitoring well screens should straddle the water table at sites where the contaminants of concern are suspected to be LNAPLs.

- ❒ At least one groundwater monitoring well should be installed in a stratigraphic unit below the suspected contamination, where said stratigraphic unit is water-bearing.

- ❒ Parameters analyzed should be consistent with the Contaminants of Concern identified in the Phase I ESA and with the contaminants identified in the soil samples.

3.0 STANDARD OPERATING PROCEDURES

3.1 Environmental Drilling Procedure

Purpose

The purpose of environmental boreholes is to identify and/or delineate contamination within the soil and/or to install groundwater monitoring wells in order to identify contamination within the groundwater.

Equipment

The following is a list of equipment that is in addition to regular drilling equipment stated in the geotechnical drilling SOP:

- ❒ glass soil sample jars
- ❒ two buckets
- ❒ cleaning brush (toilet brush works well)
- ❒ dish detergent
- ❒ methyl hydrate
- ❒ water (if not available on site - water jugs available in trailer)
- ❒ latex or nitrile gloves (depending on suspected contaminant)
- ❒ RKI Eagle organic vapour meter or MiniRae photoionization detector (depending on contamination suspected)

Determining Borehole Locations

If conditions on site are not as suspected, and planned borehole locations cannot be drilled, **call the office to discuss**. Alternative borehole locations will be determined in conversation with the field technician and supervising engineer.

After drilling is completed a plan with the borehole locations must be provided. Distances and orientations of boreholes with respect to site features (buildings, roadways, etc.) must be provided. Distances should be measured using a measuring tape or wheel rather than paced off. Ground surface elevations at each borehole should be surveyed relative to a fire hydrant located on south side of Lisgar Street (300 Lisgar Street), with geodetic elevation of 72.57m above sea level (asl).

Drilling Procedure

The actual drilling procedure for environmental boreholes is the same as geotechnical boreholes (see SOP for drilling and sampling) with a few exceptions as follows:

- ❒ Continuous split spoon samples (every 0.6 m or 2') or semi-continuous (every 0.76 m or 2'6") are required.
- ❒ Make sure samples are well sealed in plastic bags with no holes prior to screening and are kept cool but unfrozen.
- ❒ If sampling for VOCs, BTEX, or PHCs F1, a soil core from each soil sample which may be analyzed must be taken and placed in the laboratory-provided methanol vial.
- ❒ Note all and any odours or discolouration of samples.
- ❒ Split spoon samplers must be washed between samples.
- ❒ If obvious contamination is encountered, continue sampling until vertical extent of contamination is delineated.
- ❒ As a general rule, environmental boreholes should be deep enough to intercept the groundwater table (unless this is impossible/impractical - call project manager to discuss).
- ❒ If at all possible, soil samples should be submitted to a preliminary screening procedure on site, either using a RKI Eagle, PID, etc. depending on type of suspected contamination.

Spoon Washing Procedure

All sampling equipment (spilt spoons, etc.) must be washed between samples in order to prevent cross contamination of soil samples.

- ❒ Obtain two buckets of water (preferably hot if available)
- ❒ Add a small amount of dish soap to one bucket
- ❒ Scrub spoons with brush in soapy water, inside and out, including tip
- ❒ Rinse in clean water
- ❒ Apply a small amount of methyl hydrate to the inside of the spoon. (A spray bottle or water bottle with a small hole in the cap works well)
- ❒ Allow to dry (takes seconds)
- ❒ Rinse with distilled water, a spray bottle works well.

The methyl hydrate eliminates any soap residue that may be on the spoon, and is especially important when dealing with suspected VOCs.

Screening Procedure

The RKI Eagle is used to screen most soil samples, particularly where petroleum hydrocarbon contamination is suspected. The MiniRae is used when VOCs are suspected, however it also can be useful for detecting petroleum. These tools are for screening purposes only and cannot be used in place of laboratory testing. Vapour results obtained from the RKI Eagle and the PID are relative and must be interpreted.

Screening equipment should be calibrated on an approximately monthly basis, more frequently if heavily used.

- ❒ Samples should be brought to room temperature; this is specifically important in colder weather. Soil must not be frozen.
- ❒ Turn instrument on and allow to come to zero - calibrate if necessary.
- ❒ If using RKI Eagle, ensure instrument is in methane elimination mode unless otherwise directed.
- ❒ Ensure measurement units are ppm (parts per million) initially. RKI Eagle will automatically switch to %LEL (lower explosive limit) if higher concentrations are encountered.
- ❒ Break up large lumps of soil in the sample bag, taking care not to puncture bag.
- ❒ Insert probe into soil bag, creating a seal with your hand around the opening.
- ❒ Gently manipulate soil in bag while observing instrument readings.
- ❒ Record the highest value obtained in the first 15 to 25 seconds.
- ❒ Make sure to indicate scale (ppm or LEL); also note which instrument was used (RKI Eagle 1 or 2, or MiniRae).
- ❒ Jar samples and refrigerate as per Sampling and Analysis Plan.

3.2 Monitoring Well Installation Procedure

Equipment

- ❒ 5' x 2" [1.52 m x 50 mm] threaded sections of Schedule 40 PVC slotted well screen (5' x 1 ¼" [1.52 m x 32 mm] if installing in cored hole in bedrock)
- ❒ 5' x 2" [1.52 m x 50 mm] threaded sections of Schedule 40 PVC riser pipe (5' x 1 ¼" [1.52 m x 32 mm] if installing in cored hole in bedrock)
- ❒ Threaded end-cap
- ❒ Slip-cap or J-plug
- ❒ Asphalt cold patch or concrete
- ❒ Silica Sand
- ❒ Bentonite chips (Holeplug)
- ❒ Steel flushmount casing

Procedure

- ❒ Drill borehole to required depth, using drilling and sampling procedures described above.
- ❒ If borehole is deeper than required monitoring well, backfill with bentonite chips to required depth. This should only be done on wells where contamination is not suspected, in order to prevent downward migration of contamination.
- ❒ Only one monitoring well should be installed per borehole.
- ❒ Monitoring wells should not be screened across more than one stratigraphic unit to prevent potential migration of contaminants between units.
- ❒ Where LNAPLs are the suspected contaminants of concern, monitoring wells should be screened straddling the water table in order to capture any free product floating on top of the water table.
- ❒ Thread the end cap onto a section of screen. Thread second section of screen if required. Thread risers onto screen. Lower into borehole to required depth. Ensure slip-cap or J-plug is inserted to prevent backfill materials entering well.
- ❒ As drillers remove augers, backfill borehole annulus with silica sand until the level of sand is approximately 0.3 m above the top of the screen.
- ❒ Backfill with holeplug until at least 0.3 m of holeplug is present above the top of the silica sand.
- ❒ Backfill remainder of borehole with holeplug or with auger cuttings (if contamination is not suspected).
- ❒ Install flushmount casing. Seal space between flushmount and borehole annulus with concrete, cold patch, or holeplug to match surrounding ground surface.

3.3 Monitoring Well Sampling Procedure

Equipment

- ❒ Water level metre or interface probe on hydrocarbon/LNAPL sites
- ❒ Spray bottles containing water and methanol to clean water level tape or interface probe
- ❒ Peristaltic pump
- ❒ Polyethylene tubing for peristaltic pump
- ❒ Flexible tubing for peristaltic pump
- ❒ Latex or nitrile gloves (depending on suspected contaminant)
- ❒ Allen keys and/or 9/16" socket wrench to remove well caps
- ❒ Graduated bucket with volume measurements
- ❒ pH/Temperature/Conductivity combo pen
- ❒ Laboratory-supplied sample bottles

Sampling Procedure

- ❒ Locate well and use socket wrench or Allan key to open metal flush mount protector cap. Remove plastic well cap.
- ❒ Measure water level, with respect to existing ground surface, using water level meter or interface probe. If using interface probe on suspected NAPL site, measure the thickness of free product.
- ❒ Measure total depth of well.
- ❒ Clean water level tape or interface probe using methanol and water. Change gloves between wells.
- ❒ Calculate volume of standing water within well and record.
- ❒ Insert polyethylene tubing into well and attach to peristaltic pump. Turn on peristaltic pump and purge into graduated bucket. Purge at least three well volumes of water from the well. Measure and record field chemistry. Continue to purge, measuring field chemistry after every well volume purged, until appearance or field chemistry stabilizes.
- ❒ Note appearance of purge water, including colour, opacity (clear, cloudy, silty), sheen, presence of LNAPL, and odour. Note any other unusual features (particulate matter, effervescence (bubbling) of dissolved gas, etc.).
- ❒ Fill required sample bottles. If sampling for metals, attach 75-micron filter to discharge tube and filter metals sample. If sampling for VOCs, use low flow rate to ensure continuous stream of non-turbulent flow into sample bottles. Ensure no headspace is present in VOC vials.
- ❒ Replace well cap and flushmount casing cap.

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The QA/QC program for this Phase II ESA is as follows:

- ❒ All non-dedicated sampling equipment (split spoons) will be decontaminated according to the SOPs listed above.

- ❒ All groundwater sampling equipment is dedicated (polyethylene and flexible peristaltic tubing is replaced for each well).

- ❒ Where groundwater samples are to be analyzed for VOCs, one laboratory-provided trip blank will be submitted for analysis with every laboratory submission.

- ❒ Approximately one (1) field duplicate will be submitted for every ten (10) samples submitted for laboratory analysis. A minimum of one (1) field duplicate per project will be submitted. Field duplicates will be submitted for soil and groundwater samples.

- ❒ Where combo pens are used to measure field chemistry, they will be calibrated on an approximately monthly basis, according to frequency of use.

5.0 DATA QUALITY OBJECTIVES

The purpose of setting data quality objectives (DQOs) is to ensure that the level of uncertainty in data collected during the Phase II ESA is low enough that decision-making is not affected, and that the overall objectives of the investigation are met.

The quality of data is assessed by comparing field duplicates with original samples. If the relative percent difference (RPD) between the duplicate and the sample is within 20%, the data are considered to be of sufficient quality so as not to affect decision-making. The RPD is calculated as follows:

$$RPD = \left| \frac{x_1 - x_2}{(x_1 + x_2)/2} \right| \times 100\%$$

Where x_1 is the concentration of a given parameter in an original sample and x_2 is the concentration of that same parameter in the field duplicate sample.

For the purpose of calculating the RPD, it is desirable to select field duplicates from samples for which parameters are present in concentrations above laboratory detection limits, i.e. samples which are expected to be contaminated. If parameters are below laboratory detection limits for selected samples or duplicates, the RPD may be calculated using a concentration equal to one half (0.5 x) the laboratory detection limit.

It is also important to consider data quality in the overall context of the project. For example, if the DQOs are not met for a given sample, yet the concentrations of contaminants in both the sample and the duplicate exceed the MOE site remediation standards by a large margin, the decision-making usefulness of the sample may not be considered to be impaired. The proximity of other samples which meet the DQOs must also be considered in developing the Phase II Conceptual Site Model; often there are enough data available to produce a reliable Phase II Conceptual Site Model even if DQOs are not met for certain individual samples.

These considerations are discussed in the body of the report.

6.0 PHYSICAL IMPEDIMENTS TO SAMPLING & ANALYSIS PLAN

Physical impediments to the Sampling and Analysis plan may include:

- ❒ The location of underground utilities
- ❒ Poor recovery of split-spoon soil samples
- ❒ Insufficient groundwater volume for groundwater samples
- ❒ Breakage of sampling containers following sampling or while in transit to the laboratory
- ❒ Elevated detection limits due to matrix interference (generally related to soil colour or presence of organic material)
- ❒ Elevated detection limits due to high concentrations of certain parameters, necessitating dilution of samples in laboratory
- ❒ Drill rig breakdowns
- ❒ Winter conditions
- ❒ Other site-specific impediments

Site-specific impediments to the Sampling and Analysis plan are discussed in the body of the Phase II ESA report.

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
440-444 Bronson Avenue
Ottawwa, Ontario

DATUM TBM - Top spindle of fire hydrant located in front of 421 Bronson Avenue. Assumed elevation = 100.00m.

FILE NO. PE4060

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** June 28, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Asphaltic concrete 0.05						0	98.85
FILL: Crushed stone with silt and sand 0.28		AU	1				
FILL: Brown silty sand with crushed stone, some clay and gravel		SS	2	83	8	1	97.85
- grey by 1.2m depth		SS	3	56	50+		
1.75						2	96.85
		RC	1	97	62		
						3	95.85
BEDROCK: Grey limestone with shale seams		RC	2	100	95	4	94.85
		RC	3	100	90	5	93.85
5.69							
End of Borehole							
(GWL @ 1.33m - July 4, 2017)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
440-444 Bronson Avenue
Ottawwa, Ontario

DATUM TBM - Top spindle of fire hydrant located in front of 421 Bronson Avenue. Assumed elevation = 100.00m.

FILE NO. PE4060

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** June 28, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
Asphaltic concrete 0.05						0	98.84		
FILL: Crushed stone with silt and sand 0.20		AU	1						
FILL: Brown silty sand with gravel, some crushed stone 0.76									
Compact, brown **SILTY SAND**		SS	2	75	13	1	97.84		
1.42									
End of Borehole									
Practical refusal to augering at 1.42m depth									

Lower Explosive Limit % scale: 20 40 60 80

RKI Eagle Rdg. (ppm) scale: 100 200 300 400 500

▲ Full Gas Resp. △ Methane Elim.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
440-444 Bronson Avenue
Ottawwa, Ontario

DATUM TBM - Top spindle of fire hydrant located in front of 421 Bronson Avenue. Assumed elevation = 100.00m.

FILE NO. PE4060

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** June 28, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.71
Asphaltic concrete 0.10		AU	1				
FILL: Brown silty sand with crushed stone and brick, some asphalt and organics		SS	2	4	50+	1	97.71
1.30							
		RC	1	100	85	2	96.71
						3	95.71
BEDROCK: Grey limestone with shale semas		RC	2	100	100	4	94.71
		RC	3	100	88	5	93.71
		RC	4	100	100	6	92.71
6.32							
End of Borehole							
(GWL @ 1.31m - July 4, 2017)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
440-444 Bronson Avenue
Ottawwa, Ontario

DATUM TBM - Top spindle of fire hydrant located in front of 421 Bronson Avenue. Assumed elevation = 100.00m.

FILE NO. PE4060

REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** June 28, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
Asphaltic concrete 0.10						0	98.67		
FILL: Crushed stone with silt and sand 0.25		AU	1						
FILL: Brown silty sand, some gravel and crushed stone, trace brick 0.76									
Loose, brown **SILTY SAND,** some gravel 1.19		SS	2	53	50+	1	97.67		
End of Borehole									
Practical refusal to augering at 1.19m depth									

Photo Ionization Detector: ○ Lower Explosive Limit % — 20 40 60 80

RKI Eagle Rdg. (ppm) — 100 200 300 400 500

▲ Full Gas Resp. △ Methane Elim.

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
440-444 Bronson Avenue
Ottawwa, Ontario

DATUM TBM - Top spindle of fire hydrant located in front of 421 Bronson Avenue. Assumed elevation = 100.00m.

FILE NO. PE4060

REMARKS

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** June 28, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: ● Volatile Organic Rdg. (ppm) / ○ Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
Asphaltic concrete 0.10						0	98.92		
FILL: Crushed stone with sand		AU	1						
		SS	2	50	12	1	97.92		
1.42									
End of Borehole									
Practical refusal to augering at 1.42m depth									

Photo Ionization Detector: ○ Lower Explosive Limit % — 20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

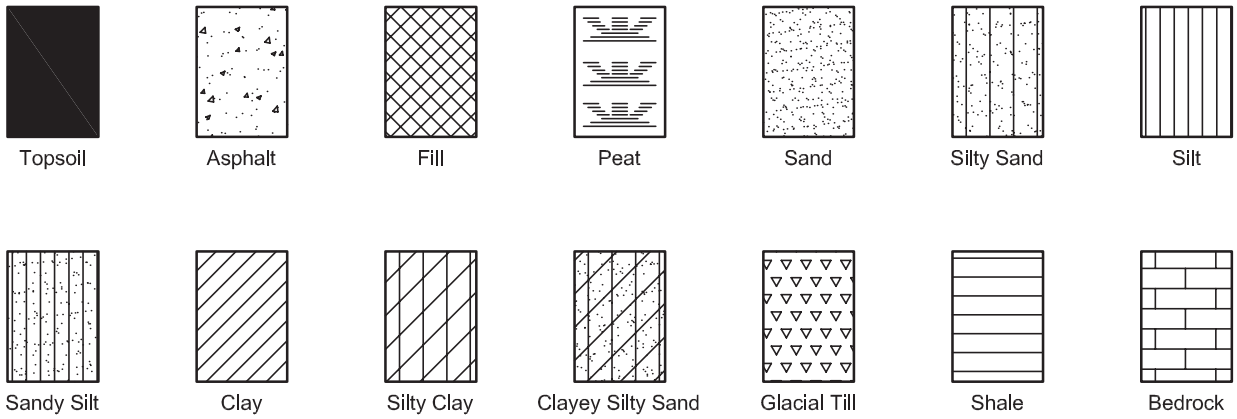
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

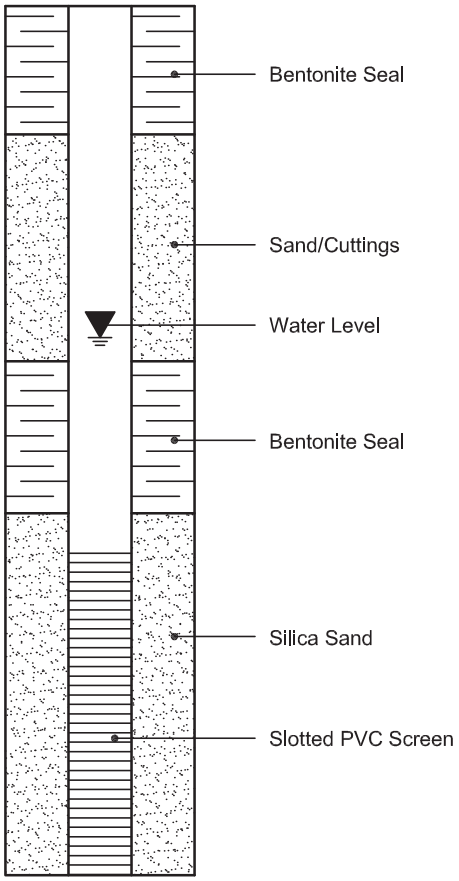
SYMBOLS AND TERMS (continued)

STRATA PLOT

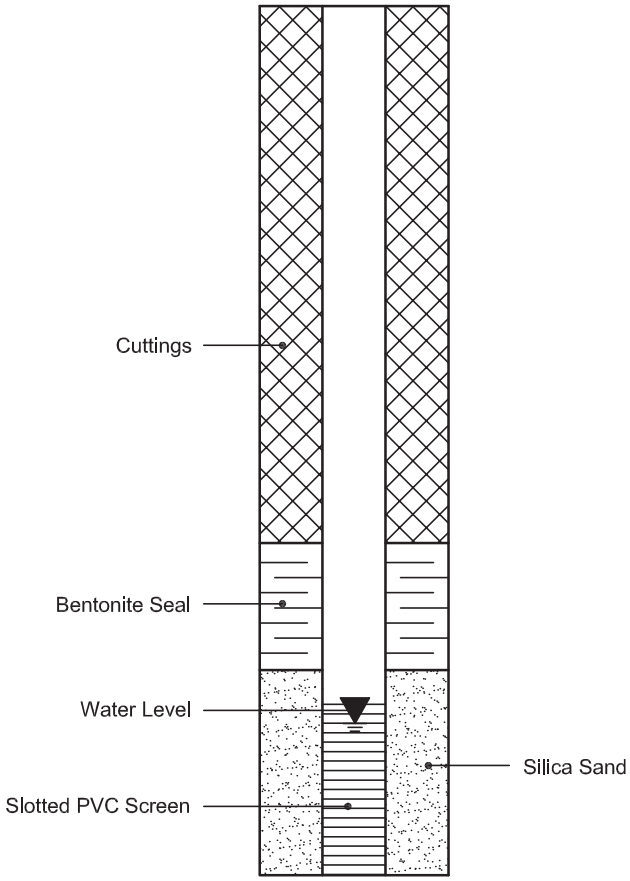


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Eric Leveque

Client PO: 22016
Project: PE4060
Custody: 113642

Report Date: 5-Jul-2017
Order Date: 28-Jun-2017

Order #: 1726308

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

Paracel ID	Client ID
1726308-01	BH1-SS3
1726308-02	BH2-AU1
1726308-03	BH3-AU1

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 22016

Report Date: 05-Jul-2017
Order Date: 28-Jun-2017
Project Description: PE4060

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	3-Jul-17	4-Jul-17
PHC F1	CWS Tier 1 - P&T GC-FID	3-Jul-17	4-Jul-17
PHC F4G (gravimetric)	CWS Tier 1 - Extraction Gravimetric	5-Jul-17	5-Jul-17
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	28-Jun-17	30-Jun-17
Solids, %	Gravimetric, calculation	30-Jun-17	30-Jun-17

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 22016

Report Date: 05-Jul-2017

Order Date: 28-Jun-2017

Project Description: PE4060

	Client ID:	BH1-SS3	BH2-AU1	BH3-AU1	-
	Sample Date:	28-Jun-17	28-Jun-17	28-Jun-17	-
	Sample ID:	1726308-01	1726308-02	1726308-03	-
	MDL/Units	Soil	Soil	Soil	-
Physical Characteristics					
% Solids	0.1 % by Wt.	95.3	92.3	88.8	-
Volatiles					
Benzene	0.02 ug/g dry	<0.02	<0.02	<0.02	-
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Toluene	0.05 ug/g dry	<0.05	0.12	0.08	-
m,p-Xylenes	0.05 ug/g dry	<0.05	0.15	0.10	-
o-Xylene	0.05 ug/g dry	<0.05	0.11	0.06	-
Xylenes, total	0.05 ug/g dry	<0.05	0.26	0.16	-
Toluene-d8	Surrogate	94.8%	98.0%	98.2%	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	<7	-
F2 PHCs (C10-C16)	4 ug/g dry	324	14	7	-
F3 PHCs (C16-C34)	8 ug/g dry	355	88	82	-
F4 PHCs (C34-C50)	6 ug/g dry	166 [1]	159 [1]	142 [1]	-
F4G PHCs (gravimetric)	50 ug/g dry	818	1130	1400	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
F4G PHCs (gravimetric)	ND	50	ug/g						
Volatiles									
Benzene	ND	0.02	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
m,p-Xylenes	ND	0.05	ug/g						
o-Xylene	ND	0.05	ug/g						
Xylenes, total	ND	0.05	ug/g						
Surrogate: Toluene-d8	*3.44*		*ug/g*		*108*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND				40	
F2 PHCs (C10-C16)	8	4	ug/g dry	9			5.4	30	
F3 PHCs (C16-C34)	176	8	ug/g dry	324			59.2	30	
F4 PHCs (C34-C50)	597	6	ug/g dry	980			48.5	30	
Physical Characteristics									
% Solids	73.0	0.1	% by Wt.	72.7			0.3	25	
Volatiles									
Benzene	ND	0.02	ug/g dry	ND				50	
Ethylbenzene	ND	0.05	ug/g dry	ND				50	
Toluene	ND	0.05	ug/g dry	ND				50	
m,p-Xylenes	ND	0.05	ug/g dry	ND				50	
o-Xylene	ND	0.05	ug/g dry	ND				50	
Surrogate: Toluene-d8	*1.72*		*ug/g dry*		*97.1*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	191	7	ug/g		95.5	80-120			
F2 PHCs (C10-C16)	116	4	ug/g	9	104	60-140			
F3 PHCs (C16-C34)	427	8	ug/g	324	48.3	60-140			QM-4X
F4 PHCs (C34-C50)	126	6	ug/g		102	80-120			
F4G PHCs (gravimetric)	830	50	ug/g		83.0	80-120			
Volatiles									
Benzene	3.22	0.02	ug/g		80.6	60-130			
Ethylbenzene	3.98	0.05	ug/g		99.4	60-130			
Toluene	3.78	0.05	ug/g		94.4	60-130			
m,p-Xylenes	7.85	0.05	ug/g		98.2	60-130			
o-Xylene	3.92	0.05	ug/g		98.0	60-130			
Surrogate: Toluene-d8	*3.23*		*ug/g*		*101*	*50-140*			

Qualifier Notes:

Sample Qualifiers :

1 : GC-FID signal did not return to baseline by C50

QC Qualifiers :

QM-4X : The spike recovery was outside of QC acceptance limits due to elevated analyte concentration.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

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

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

Paracel ID: 1726308

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Chain of Custody (Lab Use Only)
№ 113642

Page 1 of 1

Client Name: Paterson Group.	Project Reference: PE4066	**Turnaround Time:**	
Contact Name: Eric Lavigne	Quote #	☐ 1 Day	☐ 3 Day
Address: 154 Colonnade Rd. S.	PO # 22016	☐ 2 Day	☒ Regular
Telephone: 613-226-7381	Email Address: elavigne@patersongroup.ca	Date Required:	

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

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

Required Analyses

Paracel Order Number: 1726308

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	
1	BH1-SS3	S		2	28.6.17	Am	X							- 120ml 1 Vial -
2	BH2-AU1	S		2	↓	↓	X							↓
3	BH3-AU1	S		2	↓	↓	X							
4														
5														
6														
7														
8														
9														
10														

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): Ryan Phaneuf	Received by Driver/Depot: Front Desk	Received at Lab: SUMMERPORN DOKMAI	Verified By:
Relinquished By (Print): Ryan Phaneuf	Date/Time: 28/06/17 3:40	Date/Time: JUN 28 2017 05:14	Date/Time: 06/28/17 5:32
Date/Time: June 28.17 / 3pm.	Temperature: °C	Temperature: 23.4 °C	pH Verified [ ] By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Eric Leveque

Client PO: 20648
Project: PE4060
Custody: 113550

Report Date: 7-Jul-2017
Order Date: 5-Jul-2017

Order #: 1727164

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

Paracel ID	Client ID
1727164-01	BH1-GW1
1727164-02	BH3-GW1

Approved By:

Dale Robertson, BSc
Laboratory Director

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	7-Jul-17	7-Jul-17
PHC F1	CWS Tier 1 - P&T GC-FID	6-Jul-17	7-Jul-17
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	6-Jul-17	7-Jul-17
REG 153: VOCs by P&T GC/MS	EPA 624 - P&T GC-MS	6-Jul-17	7-Jul-17

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 20648

Report Date: 07-Jul-2017

Order Date: 5-Jul-2017

Project Description: PE4060

	Client ID:	BH1-GW1	BH3-GW1	-	-
	Sample Date:	04-Jul-17	04-Jul-17	-	-
	Sample ID:	1727164-01	1727164-02	-	-
	MDL/Units	Water	Water	-	-
Volatiles					
Acetone	5.0 ug/L	<5.0	-	-	-
Benzene	0.5 ug/L	<0.5	-	-	-
Bromodichloromethane	0.5 ug/L	<0.5	-	-	-
Bromoform	0.5 ug/L	<0.5	-	-	-
Bromomethane	0.5 ug/L	<0.5	-	-	-
Carbon Tetrachloride	0.2 ug/L	<0.2	-	-	-
Chlorobenzene	0.5 ug/L	<0.5	-	-	-
Chloroform	0.5 ug/L	2.6	-	-	-
Dibromochloromethane	0.5 ug/L	<0.5	-	-	-
Dichlorodifluoromethane	1.0 ug/L	<1.0	-	-	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,3-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,1-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,2-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
1,2-Dichloropropane	0.5 ug/L	<0.5	-	-	-
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
1,3-Dichloropropene, total	0.5 ug/L	<0.5	-	-	-
Ethylbenzene	0.5 ug/L	<0.5	-	-	-
Ethylene dibromide (dibromoethan	0.2 ug/L	<0.2	-	-	-
Hexane	1.0 ug/L	<1.0	-	-	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	-	-	-
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	-	-	-
Methyl tert-butyl ether	2.0 ug/L	<2.0	-	-	-
Methylene Chloride	5.0 ug/L	<5.0	-	-	-
Styrene	0.5 ug/L	<0.5	-	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-
Tetrachloroethylene	0.5 ug/L	<0.5	-	-	-
Toluene	0.5 ug/L	<0.5	-	-	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	-	-	-

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 20648

Report Date: 07-Jul-2017

Order Date: 5-Jul-2017

Project Description: PE4060

	Client ID:	BH1-GW1	BH3-GW1	-	-
	Sample Date:	04-Jul-17	04-Jul-17	-	-
	Sample ID:	1727164-01	1727164-02	-	-
	MDL/Units	Water	Water	-	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	-	-	-
Trichloroethylene	0.5 ug/L	<0.5	-	-	-
Trichlorofluoromethane	1.0 ug/L	<1.0	-	-	-
Vinyl chloride	0.5 ug/L	<0.5	-	-	-
m,p-Xylenes	0.5 ug/L	<0.5	-	-	-
o-Xylene	0.5 ug/L	<0.5	-	-	-
Xylenes, total	0.5 ug/L	<0.5	-	-	-
4-Bromofluorobenzene	Surrogate	98.1%	-	-	-
Dibromofluoromethane	Surrogate	94.2%	-	-	-
Toluene-d8	Surrogate	116%	-	-	-
Benzene	0.5 ug/L	-	<0.5	-	-
Ethylbenzene	0.5 ug/L	-	<0.5	-	-
Toluene	0.5 ug/L	-	<0.5	-	-
m,p-Xylenes	0.5 ug/L	-	<0.5	-	-
o-Xylene	0.5 ug/L	-	<0.5	-	-
Xylenes, total	0.5 ug/L	-	<0.5	-	-
Toluene-d8	Surrogate	-	113%	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	<25	-	-
F2 PHCs (C10-C16)	100 ug/L	<100	<100	-	-
F3 PHCs (C16-C34)	100 ug/L	<100	<100	-	-
F4 PHCs (C34-C50)	100 ug/L	<100	<100	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L						
F2 PHCs (C10-C16)	ND	100	ug/L						
F3 PHCs (C16-C34)	ND	100	ug/L						
F4 PHCs (C34-C50)	ND	100	ug/L						
Volatiles									
Acetone	ND	5.0	ug/L						
Benzene	ND	0.5	ug/L						
Bromodichloromethane	ND	0.5	ug/L						
Bromoform	ND	0.5	ug/L						
Bromomethane	ND	0.5	ug/L						
Carbon Tetrachloride	ND	0.2	ug/L						
Chlorobenzene	ND	0.5	ug/L						
Chloroform	ND	0.5	ug/L						
Dibromochloromethane	ND	0.5	ug/L						
Dichlorodifluoromethane	ND	1.0	ug/L						
1,2-Dichlorobenzene	ND	0.5	ug/L						
1,3-Dichlorobenzene	ND	0.5	ug/L						
1,4-Dichlorobenzene	ND	0.5	ug/L						
1,1-Dichloroethane	ND	0.5	ug/L						
1,2-Dichloroethane	ND	0.5	ug/L						
1,1-Dichloroethylene	ND	0.5	ug/L						
cis-1,2-Dichloroethylene	ND	0.5	ug/L						
trans-1,2-Dichloroethylene	ND	0.5	ug/L						
1,2-Dichloropropane	ND	0.5	ug/L						
cis-1,3-Dichloropropylene	ND	0.5	ug/L						
trans-1,3-Dichloropropylene	ND	0.5	ug/L						
1,3-Dichloropropene, total	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Ethylene dibromide (dibromoethane	ND	0.2	ug/L						
Hexane	ND	1.0	ug/L						
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L						
Methyl Isobutyl Ketone	ND	5.0	ug/L						
Methyl tert-butyl ether	ND	2.0	ug/L						
Methylene Chloride	ND	5.0	ug/L						
Styrene	ND	0.5	ug/L						
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L						
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L						
Tetrachloroethylene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
1,1,1-Trichloroethane	ND	0.5	ug/L						
1,1,2-Trichloroethane	ND	0.5	ug/L						
Trichloroethylene	ND	0.5	ug/L						
Trichlorofluoromethane	ND	1.0	ug/L						
Vinyl chloride	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: 4-Bromofluorobenzene	*76.5*		*ug/L*		*95.6*	*50-140*			
Surrogate: Dibromofluoromethane	*74.6*		*ug/L*		*93.3*	*50-140*			
Surrogate: Toluene-d8	*92.2*		*ug/L*		*115*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Volatiles									
Acetone	ND	5.0	ug/L	ND				30	
Benzene	ND	0.5	ug/L	ND				30	
Bromodichloromethane	ND	0.5	ug/L	ND				30	
Bromoform	ND	0.5	ug/L	ND				30	
Bromomethane	ND	0.5	ug/L	ND				30	
Carbon Tetrachloride	ND	0.2	ug/L	ND				30	
Chlorobenzene	ND	0.5	ug/L	ND				30	
Chloroform	ND	0.5	ug/L	ND				30	
Dibromochloromethane	ND	0.5	ug/L	ND				30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND				30	
1,2-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,1-Dichloroethane	ND	0.5	ug/L	ND				30	
1,2-Dichloroethane	ND	0.5	ug/L	ND				30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND				30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
1,2-Dichloropropane	ND	0.5	ug/L	ND				30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Ethylene dibromide (dibromoethane	ND	0.2	ug/L	ND				30	
Hexane	ND	1.0	ug/L	ND				30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND				30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND				30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND				30	
Methylene Chloride	ND	5.0	ug/L	ND				30	
Styrene	ND	0.5	ug/L	ND				30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
Tetrachloroethylene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND				30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND				30	
Trichloroethylene	ND	0.5	ug/L	ND				30	
Trichlorofluoromethane	ND	1.0	ug/L	ND				30	
Vinyl chloride	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: 4-Bromofluorobenzene	*78.4*		*ug/L*		*98.0*	*50-140*			
Surrogate: Dibromofluoromethane	*73.7*		*ug/L*		*92.1*	*50-140*			
Surrogate: Toluene-d8	*91.9*		*ug/L*		*115*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 20648

Report Date: 07-Jul-2017
Order Date: 5-Jul-2017
Project Description: PE4060

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1990	25	ug/L		99.3	68-117			
F2 PHCs (C10-C16)	1790	100	ug/L		99.3	60-140			
F3 PHCs (C16-C34)	3480	100	ug/L		93.6	60-140			
F4 PHCs (C34-C50)	3210	100	ug/L		129	60-140			
Volatiles									
Acetone	93.3	5.0	ug/L		93.3	50-140			
Benzene	28.4	0.5	ug/L		71.1	60-130			
Bromodichloromethane	29.2	0.5	ug/L		73.1	60-130			
Bromoform	36.9	0.5	ug/L		92.2	60-130			
Bromomethane	27.7	0.5	ug/L		69.3	50-140			
Carbon Tetrachloride	28.2	0.2	ug/L		70.4	60-130			
Chlorobenzene	35.5	0.5	ug/L		88.8	60-130			
Chloroform	27.8	0.5	ug/L		69.5	60-130			
Dibromochloromethane	35.5	0.5	ug/L		88.8	60-130			
Dichlorodifluoromethane	28.5	1.0	ug/L		71.2	50-140			
1,2-Dichlorobenzene	39.2	0.5	ug/L		98.0	60-130			
1,3-Dichlorobenzene	38.8	0.5	ug/L		96.9	60-130			
1,4-Dichlorobenzene	38.0	0.5	ug/L		95.1	60-130			
1,1-Dichloroethane	28.4	0.5	ug/L		71.1	60-130			
1,2-Dichloroethane	28.5	0.5	ug/L		71.2	60-130			
1,1-Dichloroethylene	28.2	0.5	ug/L		70.5	60-130			
cis-1,2-Dichloroethylene	27.6	0.5	ug/L		69.0	60-130			
trans-1,2-Dichloroethylene	28.2	0.5	ug/L		70.6	60-130			
1,2-Dichloropropane	30.0	0.5	ug/L		75.0	60-130			
cis-1,3-Dichloropropylene	32.8	0.5	ug/L		81.9	60-130			
trans-1,3-Dichloropropylene	32.8	0.5	ug/L		81.9	60-130			
Ethylbenzene	39.2	0.5	ug/L		98.0	60-130			
Ethylene dibromide (dibromoethane	36.8	0.2	ug/L		92.1	60-130			
Hexane	44.4	1.0	ug/L		111	60-130			
Methyl Ethyl Ketone (2-Butanone)	74.9	5.0	ug/L		74.9	50-140			
Methyl Isobutyl Ketone	84.3	5.0	ug/L		84.3	50-140			
Methyl tert-butyl ether	76.2	2.0	ug/L		76.2	50-140			
Methylene Chloride	45.0	5.0	ug/L		113	60-130			
Styrene	40.9	0.5	ug/L		102	60-130			
1,1,1,2-Tetrachloroethane	36.7	0.5	ug/L		91.8	60-130			
1,1,2,2-Tetrachloroethane	41.5	0.5	ug/L		104	60-130			
Tetrachloroethylene	34.0	0.5	ug/L		84.9	60-130			
Toluene	35.6	0.5	ug/L		89.0	60-130			
1,1,1-Trichloroethane	28.8	0.5	ug/L		72.1	60-130			
1,1,2-Trichloroethane	28.9	0.5	ug/L		72.2	60-130			
Trichloroethylene	28.2	0.5	ug/L		70.6	60-130			
Trichlorofluoromethane	28.4	1.0	ug/L		70.9	60-130			
Vinyl chloride	27.2	0.5	ug/L		68.0	50-140			
m,p-Xylenes	74.9	0.5	ug/L		93.7	60-130			
o-Xylene	37.2	0.5	ug/L		93.1	60-130			
Surrogate: 4-Bromofluorobenzene	*79.8*		*ug/L*		*99.8*	*50-140*			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

Paracel ID: 1727164

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Chain of Custody (Lab Use Only) Nº 113550

Page 1 of 1

Client Name: Paterson Group	Project Reference: PE4060	**Turnaround Time:**	
Contact Name: Eric Leveque	Quote #	☐ 1 Day	☐ 3 Day
Address: 154 Colonnade Rd S.	PO # 20648	☑ 2 Day	☐ Regular
Telephone: 613-226-7381	Email Address: eleveque@patersongroup.ca.	Date Required:	

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

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

Required Analyses

Paracel Order Number: 1727164

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	PHC (F1-F4)						
1	BH1-GW1	GW		3	July 4, 2017			✓						✓						✓
2	BH3-GW1	GW		3	July 4, 2017		✓													✓
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments: * WE NEED RESULTS FRIDAY AFTERNOON !! E.L.

Method of Delivery: Paracel

Relinquished By (Sign):	Received by Driver/Depot: A. Fraser	Received at Lab:	Verified By:
Relinquished By (Print): ERIN ARDLEY	Date/Time: 05/07/17 10:50	Date/Time: 07/05/17 12:35pm	Date/Time: 07/05/17 12:42pm
Date/Time: July 4, 2017	Temperature: °C AM	Temperature: 18.5 °C	pH Verified [ ] By: