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Phase II Environmental Site Assessment

455 McArthur Avenue
Ottawa, Ontario

Prepared For

Prestwick Building Corporation

January 13, 2020

Report: PE4808-2

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EXECUTIVE SUMMARY

Assessment

A Phase II ESA was conducted for the property addressed 455 McArthur Avenue in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address the area of environmental concern (APEC) that was identified on the Phase II Property during the Phase I ESA.

The Phase II ESA was carried out in conjunction with a Geotechnical Investigation and consisted of drilling three (3) boreholes on the Phase II Property, all of which were constructed with groundwater monitoring well installations.

The soil profile generally consisted of an asphaltic concrete pavement structure or topsoil, followed by a fill material, underlain by glacial till with traces of shale and terminated in shale bedrock at a maximum depth of 6.70 m below the ground surface. Soil samples were obtained from the boreholes and screened using vapour measurements along with visual and olfactory observations. No visual or olfactory evidence of deleterious materials or contamination were identified during the subsurface investigation.

Based on the screening results in combination with sample depth and location, three (3) soil samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX) and petroleum hydrocarbons (PHCs, F_1-F_4), and metals. BTEX, PHC and metal parameters were identified in the soil. All results were in compliance with the MECP Table 3 Residential Standards, with the exception of PHC (F1 fraction) in BH2-SS4, which was marginally in excess of the selected MECP Standards.

Groundwater samples were recovered and analyzed for BTEX, PHCs and/or VOCs. No free-phase product was observed on the groundwater at any of the monitoring well locations during the groundwater sampling events. No BTEX, PHC and VOC parameter concentrations were detected in the groundwater samples analyzed. All groundwater results are in compliance with the MECP Table 3 Standards.

Recommendations

Soil

Based on the findings of the Phase II ESA, soil on the northeast corner of the Phase II Property contains marginal PHC impacts. It is our recommendation that the impacted fill material be removed from the subject site during the redevelopment process. The excavation of the soil from the property should be monitored and confirmed by Paterson. Any impacted soil being removed from the property is to be disposed of at an approved waste disposal facility.

Monitoring Wells

If the monitoring wells installed on the subject site are not going to be used in the future, or will not be entirely removed, they should be abandoned according to Ontario Regulation 903. The wells will be registered with the MECP under this regulation.

1.0 INTRODUCTION

At the request of Prestwick Building Corporation, Paterson Group (Paterson) conducted a Phase II Environmental Site Assessment for the property addressed 455 McArthur Avenue, in the City of Ottawa, Ontario, herein referred to as the Phase II Property. The purpose of this Phase II ESA was to address areas of potential environmental concern (APECs) identified on the Phase II Property, during the Phase I ESA conducted by Paterson.

1.1 Site Description

Address:	455 McArthur Avenue, Ottawa, Ontario
Legal Description:	Part of Lot 146 West, McArthur North, on Plan 300, in the City of Ottawa.
Property Identification Number (PIN):	04244-0156
Location:	The Phase II Property is located on the north side of McArthur Avenue, 120m west of where McArthur Avenue transects with St. Laurent Boulevard, in the City of Ottawa, Ontario. Refer to Figure 1 - Key Plan in the Figures section following the text.
Latitude and Longitude:	45° 25' 58.48" N, 75° 38' 36.89" W
Zoning:	TM – Traditional Mainstreet Zone.
Configuration:	Rectangular
Area:	514m^2 (approximately)

1.2 Property Ownership

Paterson was retained to complete this Phase II ESA by Mr. Allan Bateman of Prestwick Building Corporation, the current property owner. Mr. Bateman can be reached by telephone at (613) 859-0933.

1.3 Current and Proposed Future Uses

The Phase II Property is currently occupied by a two (2) storey residential building and a private parking garage. It is our understanding that the proposed site redevelopment for the Phase II Property consists of a three (3) storey residential building with a basement level. The footprint of the development will cover the majority of the site and it will be municipally serviced with water and sewer.

1.4 Applicable Site Condition Standard

The site condition standards for the property were obtained from Table 3 of the document entitled "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", prepared by the Ministry of the Environment, Conservation and Parks (MECP), April 2011. The selected MECP Table 3 Standards are based on the following considerations:

- ❑ Coarse-grained soil conditions
- ❑ Full depth generic site condition
- ❑ Non-potable groundwater conditions
- ❑ Residential land use

These standards were selected based on the future land use of the subject site. Coarse-grained soil standards, which are considered conservative, were chosen to represent the current site conditions of the Phase II Property.

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The Phase II Property is situated in a mixed-use area, consisting of commercial and residential land use. Adjacent and neighbouring properties consist of residential to the north and south, commercial to the east and west.

The Phase II Property consists of a two (2) storey residential building constructed in the early 1950s. The majority of the site is asphaltic pave concrete along the eastern and northern sides of the property, while the southern side is landscaped. Site drainage typically occurs through sheet flow to catch basins located along McArthur Avenue.

The site topography is relatively flat and at the grade of McArthur Avenue. The regional topography slopes down in a westerly direction towards the Rideau River. Groundwater in the area is anticipated to flow in a westerly direction as well.

2.2 Past Investigations

A Phase I-ESA was completed by Paterson in December of 2019 in general accordance with the Ontario Regulation (O.Reg.) 153/04, as amended. The Phase I ESA identified an existing PCA off-site that resulted in an area of potential environmental concern (APEC) on the Phase I Property:

- APEC 1: Resulting from an existing off-site automotive repair garage situated immediately east of the Phase I Property (PCA 52, as per O.Reg 153/04, Table 2).

The existing PCA was verified through the historical review and site visit.

A Phase II ESA was recommended to address the aforementioned APEC on the northeast corner of the Phase I Property.

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation was conducted on November 29 and December 6, 2019, in conjunction with a Geotechnical Investigation. The field program consisted of drilling three (3) boreholes, all of which were instrumented with groundwater monitoring wells for environmental purposes. Boreholes were drilled to depths ranging from 4.57 to 6.1 m below the ground surface (mbgs).

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 this media is based on the Contaminants of Potential Concern (CPCs) identified in the Phase I ESA. These CPCs include benzene, toluene, ethylbenzene, xylenes (BTEX), petroleum hydrocarbons (PHC, F_1-F_4), volatile organic compounds (VOCs) and metals in soil and/or groundwater.

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

According the potable water well records, the stratigraphy in the general area consisted of plain till (soil), underlain by shale and sometimes limestone. Bedrock was encountered at approximately 3mbgs. All domestic wells were drilled to fresh water.

Based on information from the Geological Survey of Canada, the overburden in the area of the subject site consists of plain till with a drift thickness estimated to be on the order of 3 to 5 m. Bedrock in the area consists of shale.

Groundwater flow is interpreted to be in a southwesterly direction towards the Rideau River.

Subsurface Structures and Utilities

Underground utility services on the subject land include natural gas, electricity, water and sewer services. These services enter the Phase I Property from McArthur Avenue. Above ground service lines run from the northeast corner of the residence to the southeast corner of the private garage. The approximate locations of above and below ground services, are shown on Drawing PE4808-3 –Test Hole Location Plan.

Existing Buildings and Structures

The Phase I Property is occupied by a two (2)-storey residential building and a private parking garage. Both buildings were constructed with a poured concrete foundation and exteriors finished in red brick.

Water Bodies and Areas of Natural Significance

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

Potable Water Well Records

No potable wells were identified on the Phase I Property. Eight (8) domestic wells were identifed approximately 100 m or more away from the subject land. It is expected that these domestic wells have not been used since the area has been municipally serviced. However, no abandonment records regarding potable water wells were found for the Phase I Study Area.

Monitoring Well Records

According to the MECP online interactive well record mapping system, there are eight (8) monitoring wells were identifed on several at 440 and 450 McArthur Avenue, 800 and 815 St. Laurent Boulevard. Given the separation distances and orientation with respect to the subject land, these monitoring wells are not considered a potential concern to the Phase I Property.

Neighbouring Land Use

Neighbouring land use in the Phase I Study Area consists of a commercial and residential land use. The current use of the surrounding lands identifed one PCA on the adjacent property to the east; an automotive repair garage. Due to the proximity of the garage, this PCA represents an APEC on the Phase I Property.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

As per Table 2, O.Reg. 153/04, as amended, one potentially contaminating activity (PCA) is considered to result in an area of potential environmental concern (APEC) on the Phase I Property. The PCA that is considered to represent an APEC is listed in Table 1, along with the respective location and contaminants of potential concern (CPCs).

TABLE 1: Areas of Potential Environmental Concern

Area of Potential Environmental Concern	Location of Area of Potential Environmental Concern	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 (Resulting from an existing off-site automotive repair garage)	Northeast portion of the Phase I Property	PCA 52 – Storage, maintenance, fuelling and repairing of equipment, vehicles, and materials used to maintain transportation systems	Off-site	BTEX PHCs VOCs Metals	Soil, Groundwater

Several off-site PCAs were identified within the Phase I Study Area, however, based on separation distances and/or cross-gradient orientation with respect to the subject land, as groundwater is considered to flow in a northerly direction, other off-site PCAs are not considered to represent APECs on the Phase II Property.

Contaminants of Potential Concern

As per the APEC identifed in Table 1, the contaminants of potential concern (CPCs) present is soil and/or groundwater include:

- Benzene, ethylbenzene, toluene and xylenes (BTEX);
- Petroleum hydrocarbons (PHCs, Fractions F_1-F_4);
- Volatile Organic Compounds (VOCs); and
- Metals

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 is one off-site PCA that has resulted in an APEC on the Phase I Property. While several historical and/or existing PCAs were identifed within the study area during this assessment, they were not considered to generate areas of potential environment concerns to the Phase I Property, based on the separation distances and/or orientation (down or cross-gradient) with respect to the subject property.

A variety of independent sources were consulted as part of this assessment, 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.

3.5 Impediments

No physical impediments were encountered during the Phase II ESA program, aside from existing buildings and utility structures.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation, completed in conjunction with a Geotechnical Investigation, was conducted on November 29 and December 6, 2019. The field program consisted of drilling three (3) boreholes on the Phase II Property.

The boreholes were drilled to a maximum depth of 6.1 mbgs. All boreholes were completed as groundwater monitoring wells to access the groundwater table.

BH1 and BH2 were placed to address the aforementioned APEC as presented in Table 1, as well as completed for geotechnical purposes. One borehole (BH1) was completed using a truck mounted drill rig provided by Dowingin Drilling Ltd. of Ottawa, Ontario, while the remaining two (2) boreholes (BH2 and BH3) were completed using portable equipment provided by CCC Drilling Ltd. of Ottawa, Ontario, under the full-time supervision of Paterson personnel. The borehole locations are indicated on the attached Drawing PE4808-3 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

A total of eighteen (18) soil samples were obtained from the boreholes by means of grab sampling from auger flights and split spoon sampling. Split spoon samples were taken at approximate 0.76 m intervals. The depths at which auger samples and split spoon samples were obtained from the boreholes are shown as "**G**" and "**SS**" on the Soil Profile and Test Data Sheets appended to this report.

The soil stratigraphy at the borehole locations consisted of an asphaltic concrete paved structure or topsoil, underlain by a fill material/suspected reworked native soils, followed by glacial till with traces of shale and/or sand, followed by shale bedrock. Bedrock was encountered at depths varying between 1.82 to 3.05 mbgs.

4.3 Field Screening Measurements

All soil samples collected were subjected to a preliminary screening procedure, which included visual screening for colour and evidence of metals, as well as soil vapour screening with a MiniRAE 2000 Portable VOC Monitor.

The technical protocol was obtained from Appendix C of the MECP document entitled “Interim Guidelines for the Remediation of Petroleum Contamination at Operating Retail and Private Fuel Outlets in Ontario”, dated March 1992.

Soil samples recovered at the time of sampling were placed immediately into airtight plastic bags with nominal headspace. All lumps of soil inside the bags were broken by hand, and the soil was allowed to come to ambient temperature prior to conducting the vapour survey. Allowing the samples to stabilize to ambient temperature ensures consistency of readings between samples.

The soil vapours were measured by inserting the analyzer probe into the nominal headspace above the soil sample. Samples were then agitated/manipulated gently as the measurements were taken. The peak reading registered within the first 15 seconds was recorded as the vapour measurement.

The vapour readings were found to range from 1.1 ppm to 5.5 ppm. Vapour readings are noted on the Soil Profile and Test Data Sheets in Appendix 1.

No visual or olfactory odours were identified in the soil samples. Soil samples were selected based on a combination of the results of the vapour screening, visual and olfactory screening, sample depth and/or sample location.

4.4 Groundwater Monitoring Well Installation

Three (3) groundwater monitoring wells were installed on the Phase II Property as part of the subsurface investigation. The monitoring wells consisted of 32 mm diameter, Schedule 40 threaded PVC risers and screens. Monitoring well construction details are listed below in Table 2 and are also presented on the Soil Profile and Test Data Sheets provided in Appendix 1.

A summary of the monitoring well construction details is provided below in Table 2.

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	71.20	6.10	4.60-6.10	3.35-6.10	0.3-3.35	Flushmount
BH2	71.30	4.72	3.22-4.72	2.74-4.72	0.3-2.74	Flushmount
BH3	71.38	4.57	3.07-4.57	2.74-4.57	0.3-2.74	Flushmount

4.5 Field Measurement of Water Quality Parameters

Groundwater samples were collected on December 6 and December 11, 2019. The water levels were the only parameter measured in the field during the November sampling events.

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 each monitoring well, 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 in Appendix 1, the soil and groundwater samples submitted for analytical testing are presented in Tables 3 and 4.

TABLE 3: Soil Samples Submitted and Analyzed Parameters					
Sample ID	Sample Depth (m) and Stratigraphic Unit	Parameters Analyzed			Rationale
		PHCs (F1-F4)	BTEX	Metals	
November 29, 2019					
BH1-SS6	3.81-4.42 Weathered shale	X	X		Assess potential impact in the soil due to the automotive repair garage located on the adjacent property to the east.
December 6, 2019					
BH2-G1	0-0.025 Fill			X	Assess potential impact in the soil due to the automotive repair garage located on the adjacent property to the east.
BH2-SS4	1.52-2.13 Fill	X	X		Assess potential impact in the soil due to the automotive repair garage located on the adjacent property to the east.

TABLE 4: Groundwater Samples Submitted and Analyzed Parameters					
Sample ID	Screened Interval (m)	Parameters Analyzed			Rationale
		PHCs (F1-F4)	BTEX	VOC	
December 6, 2019					
BH1-GW1	4.60-6.10	X		X	Assess potential impact in the groundwater due to the automotive repair garage located on the adjacent property to the east.
December 11, 2019					
BH2-GW1	3.22-4.72	X		X	Assess potential impact in the groundwater due to the automotive repair garage located on the adjacent property to the east.
BH3-GW1	3.07-4.57	X	X		Assess potential impact in the groundwater due to the automotive repair garage located on the adjacent property to the east.

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

4.9 Elevation Surveying

The borehole locations were selected by Paterson for both environmental and geotechnical purposes. Boreholes were located and surveyed in the field by Paterson. The benchmark (BM) was taken from the top of the grate of a catch basin located on the northern side of McArthur Avenue. The geodetic datum was measured 71.06m.

The locations and elevations of the boreholes are presented on Drawing PE4808-3 – Test Hole Location Plan, appended to this report.

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 an asphaltic concrete pavement structure or topsoil, followed by fill material (reworked native soil), underlain by glacial till with some shale and traces of sand, followed by shale bedrock. Bedrock was encountered at depths ranging from 1.82 to 3.05 mbgs. The boreholes were terminated at depths ranging from 4.57 to 6.10 mbgs.

Groundwater was encountered within the bedrock at depths ranging from approximately 2.37 to 3.92 mbgs. Site geology details are provided in the Soil Profile and Test Data Sheets provided in Appendix 1.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured during the groundwater sampling events which occurred on December 6 and on December 11, 2019, using an electronic water level meter. Groundwater levels are summarized below in Table 5.

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	71.20	3.92	67.28	December 6, 2019
BH2	71.30	2.37	68.93	December 11, 2019
BH3	71.38	3.50	67.88	December 11, 2019

Based on the groundwater elevations measured during the sampling event, a groundwater contour plan was completed. The groundwater contour mapping is shown on Drawing PE4808-3 – Groundwater Contour Plan. Based on the contour mapping, groundwater flow beneath the Phase II Property is in a south/south-westerly direction. A horizontal hydraulic gradient of approximately 0.14 m/m was calculated.

5.3 Fine-Course Soil Texture

No grain size analysis was completed for the subject site. Coarse grained standards were chosen as a conservative approach.

5.4 Soil: Field Screening

Field screening of the soil samples collected resulted in vapour readings ranging from 1.1 to 5.5 ppm.

No visual or olfactory odours were identified in the soil samples. Soil samples were selected based on a combination of the results of the vapour screening, visual and olfactory screening, sample depth and/or sample location. The field screening results of each individual soil sample are provided on the Soil Profile and Test Data Sheets, appended to this report.

5.5 Soil Quality

Three (3) soil samples were submitted for BTEX, PHC (F_1-F_4) and metals analyses. The results of the analytical testing are presented in Tables 6 and 7. The laboratory certificate of analysis is provided in Appendix 1.

TABLE 6: Analytical Test Results – Soil – BTEX and PHC (F_1-F_4)				
Parameter	MDL (µg/g)	Soil Samples (µg/g)		MECP Table 3 Residential Standards (µg/g)
		November 29, 2019	December 6, 2019	
		BH1-SS6	BH2-SS4	
Benzene	0.02	nd	nd	0.21
Ethylbenzene	0.05	nd	nd	2
Toluene	0.05	nd	nd	2.3
Xylenes (total)	0.05	0.27	nd	3.1
PHC F_1	7	16	**70**	55
PHC F_2	4	94	17	98
PHC F_3	8	98	36	300
PHC F_4	6	10	nd	2800

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and underlined** – Parameter exceeds selected MECP Standards

Detectable BTEX and PHC concentrations were identified in the soil samples analyzed. The concentration of PHC, F2 fraction from BH2-SS4 marginally exceeded the selected MECP Table 3 Residential Standards. All other test results are in compliance with the selected standards.

TABLE 7: Analytical Test Results - Soil – Metals			
Parameter	MDL (µg/g)	Soil Samples (µg/g)	MECP Table 3 Residential Standards (µg/g)
		December 6, 2019	
		BH2-G1	
Antimony	1.0	nd	7.5
Arsenic	1.0	11.2	18
Barium	1.0	278	390
Beryllium	0.5	0.8	4
Boron	5.0	6.1	120
Cadmium	0.5	nd	1.2
Chromium	5.0	18.6	160
Cobalt	1.0	8.2	22
Copper	5.0	36.8	140
Lead	1.0	83.8	120
Molybdenum	1.0	2.4	6.9
Nickel	5.0	23.3	100
Selenium	1.0	nd	2.4
Silver	0.3	nd	20
Thallium	1.0	nd	1
Uranium	1.0	nd	23
Vanadium	10.0	29.7	86
Zinc	20.0	98.8	340

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

The metal results are in compliance with the MECP Table 3 Residential Standards.

The analytical results for BTEX, PHC and metals in soil with respect to borehole locations are shown on Drawing PE4808-4- Analytical Testing Plan – Soil.

The maximum concentrations of analyzed parameters in the soil at the site are summarized in Table 8.

Table 8: Maximum Concentrations – Soil

Parameter	Maximum Concentration (µg/g)	Soil Sample	Depth Interval (m BGS)
Xylenes (total)	0.27	BH1-SS6	3.81-4.42; shale
PHC F_1	**70**	BH2-SS4	1.52-2.13; sandy silt
PHC F_2	94	BH1-SS6	3.81-4.42; shale
PHC F_3	98		
PHC F_4	10		
Arsenic	11.2	BH2-G1	0-0.25; topsoil
Barium	278		
Beryllium	0.8		
Boron	6.1		
Chromium	18.6		
Cobalt	8.2		
Copper	36.8		
Lead	83.8		
Molybdenum	2.4		
Nickel	23.3		
Vanadium	29.7		
Zinc	98.8		

Notes:
- **Bold and Underlined** – Value exceeds the selected MECP Standards

The maximum BTEX and PAH parameter concentrations in the soil samples analyzed are in compliance with the selected standards, with the exception of the exceedance of PHC, fraction F1 in BH2-SS4. All other test results are in compliance with the selected MECP Table 3 Residential Standards. The remaining parameters were not detected above the laboratory method detection limits.

5.6 Groundwater Quality

Groundwater samples were submitted for laboratory analysis of PHC (F_1-F_4) and BTEX or VOC parameters. The groundwater samples were obtained from the screened intervals noted in Table 2.

The results of the analytical testing are presented in Tables 9 and 10. The laboratory certificates of analysis are provided in Appendix 1.

TABLE 9: Analytical Test Results – Groundwater – PHCs and/or BTEX

Parameter	MDL (µg/L)	Groundwater Samples (µg/L)			MECP Table 3 Residential Standards (µg/L)
		December 6, 2019	December 11, 2019		
		BH1-GW1	BH2-GW1	BH3-GW1	
Benzene	0.5	nd	nd	nd	44
Ethylbenzene	0.5	nd	nd	nd	1800
Toluene	0.5	nd	nd	nd	14000
Xylenes (total)	0.5	nd	nd	nd	3300
PHC F_1	25	nd	nd	nd	420
PHC F_2	100	nd	nd	nd	150
PHC F_3	100	nd	nd	nd	500
PHC F_4	100	nd	nd	nd	500

Notes:
- NA – Paramter not tested
- MDL – Method Detection Limit
- nd – not detected above the MDL
- BTEX parameters are included in the VOC group of parameters

No detectable BTEX or PHC concentrations were identified in the groundwater samples analyzed. All test results are in compliance with the MECP Table 3 Standards.

TABLE 10: Analytical Test Results – Groundwater – VOC				
Parameter	MDL (µg/L)	Groundwater Samples (µg/L)		MECP Table 3 Residential Standards (µg/L)
		December 6 & 11, 2019		
		BH1-GW1	BH2-GW1	
Acetone	5	nd	nd	130,000
Benzene	0.5	nd	nd	44
Bromodichloromethane	0.5	nd	nd	85,000
Bromoform	0.5	nd	nd	380
Bromomethane	0.5	nd	nd	5.6
Carbon Tetrachloride	0.2	nd	nd	0.79
Chlorobenzene	0.5	nd	nd	630
Chloroform	0.5	nd	nd	nv
Dibromochloromethane	0.5	nd	nd	2.4
Dichlorodifluoromethane	1	nd	nd	nv
1,2-Dichlorobenzene	0.5	nd	nd	82,000
1,3-Dichlorobenzene	0.5	nd	nd	4,400
1,4-Dichlorobenzene	0.5	nd	nd	0.25
1,1-Dichloroethane	0.5	nd	nd	4,600
1,2-Dichloroethane	0.5	nd	nd	9,600
1,1-Dichloroethylene	0.5	nd	nd	8
cis-1,2-Dichloroethylene	0.5	nd	nd	320
trans-1,2-Dichloroethylene	0.5	nd	nd	1.6
1,2-Dichloropropane	0.5	nd	nd	1.6
cis-1,3-Dichloropropylene	0.5	nd	nd	1.6
trans-1,3-Dichloropropylene	0.5	nd	nd	1.6
1,3-Dichloropropene, total	0.2	nd	nd	16
Ethylbenzene	1	nd	nd	5.2
Ethylene dibromide (dibromoethane, 1,2-)	5	nd	nd	2,300
Hexane	5	nd	nd	51
Methyl Ethyl Ketone (2-Butanone)	2	nd	nd	470,000
Methyl Isobutyl Ketone	5	nd	nd	140,000
Methyl tert-butyl ether	0.5	nd	nd	1900
Methylene Chloride	0.5	nd	nd	610
Styrene	0.5	nd	nd	1,300
1,1,1,2-Tetrachloroethane	0.5	nd	nd	3.4
1,1,2,2-Tetrachloroethane	0.5	nd	nd	3.2
Tetrachloroethylene	0.5	nd	nd	1.6
Toluene	0.5	nd	nd	18,000
1,1,1-Trichloroethane	0.5	nd	nd	640
1,1,2-Trichloroethane	1	nd	nd	4.7
Trichloroethylene	0.5	nd	nd	1.6
Trichlorofluoromethane	1	nd	nd	2,500
Vinyl Chloride	0.5	nd	nd	0.5
Xylenes, total	0.5	nd	nd	4,200

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

No VOC parameter concentrations were identifed in the groundwater samples analyzed. All VOC test results are in compliance with the selected MECP Table 3 Standards.

Analytical results of BTEX, PHC and VOCs in the groundwater with respect to borehole locations are shown on Drawing PE4808-5- Analytical Testing Plan – Groundwater.

No parameter concentrations in groundwater were detected above the laboratory method detection limits.

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of the November 29 through December 11, 2019 sampling events were handled in accordance with the Analytical Protocol with respect to preservation method, storage requirement, and container type.

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 of O.Reg. 153/04, as amended by 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 indicated in Section 2.2 of this report, PCA 52 was identifed at 457 McArthur Avenue, which resulted in an APEC on the Phase II Property:

- APEC 1: Resulting from an existing off-site automotive repair garage situated immediately east of the Phase I Property (PCA 52, as per O.Reg 153/04, Table 2).

The existing PCA was verified through the historical review and site visit.

Contaminants of Potential Concern

Based on the APEC identified on the Phase II Property, the contaminants of potential concern (CPCs) present in soil and/or groundwater include:

- Benzene, ethylbenzene, toluene and xylenes (BTEX);
- Petroleum hydrocarbons (PHCs, Fractions F_1-F_4);
- Volatile Organic Compounds (VOCs); and
- Metals

Subsurface Structures and Utilities

Underground utility services on the subject land include natural gas, electricity, water and sewer services. These services enter the Phase II Property from McArthur Avenue.

Drilling locations, particularly on the northeast corner of the Phase II Property were limited due to the above ground service lines running from the northeast corner of the residence to the southeast corner of the private garage.

The approximate locations of above and below ground services are shown on Drawing PE4808-3–Test Hole Location Plan.

Physical Setting

Site Stratigraphy

The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is illustrated on Drawings PE4808-5A–Cross-section A-A' – Soil and PE4808-5B–Cross-section A-A'– Groundwater. The site stratigraphy consists of:

- Asphaltic concrete with an approximate thickness of 0.04 m underlain by crush stone and gravel. Groundwater was not encountered in this layer.
- Fill material consisting off silty sand with reworked native soils was encountered in BH1 and BH2. Fill material consisting of trace of topsoil/organics was encountered in BH3 and extended to depths ranging from 1.07 to 2.74 mbgs. Groundwater was encountered in this layer at BH2.
- Glacial till consisting of silty clay with shale fragments was encountered in BH1 and BH3 and extended to depths ranging from 1.83 to 3.05 mbgs. Groundwater was not encountered in this layer.

- Shale bedrock was encountered in all boreholes and extended to depth ranging from 4.57 to 6.70 mbgs. Groundwater was encountered in this layer at BH1 and BH3.

Hydrogeological Characteristics

Groundwater at the Phase II Property was generally encountered in the shale bedrock ranging at depths of approximately 1.83 to 3.05 mbgs. Groundwater flow was measured in a south/southwesterly direction with a hydraulic gradient of 0.14 m/m. Groundwater contours are shown on Drawing PE4808-3–Test Hole Location Plan.

Approximate Depth to Water Table

Depth to the water table at the subject site varies between approximately 2.37 to 3.92 mbgs.

Approximate Depth to Bedrock

Bedrock was confirmed during the drilling program at depths ranging from 1.83 to 3.05 mbgs. All boreholes were completed in shale bedrock at depths ranging between 4.57 to 6.70 mbgs.

Well records for the immediate area of the Phase II Property indicated that the site is situated in an area consisting of plain till (soil), underlain by shale and sometimes limestone.

Sections 41 and 43.1 of the Regulation

Section 41 of the Regulation does not apply to the Phase II Property, in that the subject property is not within 30m of an environmentally sensitive area.

Section 43.1 of the Regulation does not apply to the Phase II Property as the subject land is not within 30 m of a natural body of water.

Fill Placement

Based on the findings of the subsurface investigation, the fill material encountered consisted of a mixture of silty sand with some gravel, crushed stones with traces of clay and/or organics. The upper fill was considered to be a gravel base for the asphalt while the lower fill was reworked native soil. No visual or olfactory evidence of deleterious materials or contamination were identified in the fill material.

Existing Buildings and Structures

The Phase I Property is occupied by a two (2)-storey residential building and a private parking garage. Both buildings were constructed with a poured concrete foundation and exteriors finished in red brick.

Proposed Buildings and Other Structures

The proposed development for the Phase II Property includes a three (3) storey residential building with a basement level. The footprint of the development will cover the majority of the site and it will be municipally serviced with water and sewer.

Water Bodies and Areas of Natural Significance

No water bodies or areas of natural significance were identifed on the Phase II Property or within the Phase I Study Area.

Environmental Condition

Areas Where Contaminants are Present

Based on the analytical results, the PHC (F1 fraction) in soil sample BH2-SS4 marginally exceeds the selected MECP Table 3 Standards, as shown on Drawing PE4808-4 – Analytical Testing Plan–Soil. It should be noted that soil sample BH2-SS4 exhibiting the F1 exceedance was retrieved at the approximate groundwater level, and the groundwater did not contain any PHC impact. Based on our findings, the extent of the F1 impact is considered o be relatively isolated to the northeast corner of the Phase II Property.

Types of Contaminants

Based on the analytical results for soil and groundwater, the contaminants of concern include PHCs, specifically the PHC (F1 fraction).

Contaminated Media

Based on the findings of the Phase II ESA, the fill material at location BH2 is impacted with PHC.

What Is Known About Areas Where Contaminants Are Present

Based on the subsurface investigation, a very limited area of the material appears to be impacted in the vicinity of BH2. No PHCs were identified in the groundwater.

Distribution and Migration of Contaminants

Based on the findings of the Phase II ESA, no significant distribution or migration of contaminants is considered to have occurred. The soil impact is considered to be limited at the northeast corner of the Phase II Property with no indications of groundwater impact on site. Based on the groundwater levels, vertical migration is not expected to have occurred.

Discharge of Contaminants

The PHC impact at BH2 is considered most likely to have resulted from an automotive leak on-site, and not the adjacent garage, since the groundwater is clean.

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.

Since the majority of the site is covered with buildings or asphaltic concrete and the groundwater is clean, climatic and meteorological conditions are not considered to have contributed to contaminant transport in the past.

Potential for Vapour Intrusion

Based on the findings of the Phase II ESA, there is no potential for vapour intrusion on the Phase II Property.

6.0 CONCLUSIONS

Assessment

A Phase II ESA was conducted for the property addressed 455 McArthur Avenue in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address the area of environmental concern (APEC) that was identified on the Phase II Property during the Phase I ESA.

The Phase II ESA was carried out in conjunction with a Geotechnical Investigation and consisted of drilling three (3) boreholes on the Phase II Property, all of which were constructed with groundwater monitoring well installations.

The soil profile generally consisted of an asphaltic concrete pavement structure or topsoil, followed by a fill material, underlain by glacial till with traces of shale and terminated in shale bedrock at a maximum depth of 6.70 m below the ground surface. Soil samples were obtained from the boreholes and screened using vapour measurements along with visual and olfactory observations. No visual or olfactory evidence of deleterious materials or contamination were identified during the subsurface investigation.

Based on the screening results in combination with sample depth and location, three (3) soil samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX) and petroleum hydrocarbons (PHCs, F_1-F_4), and metals. BTEX, PHC and metal parameters were identified in the soil. All results were in compliance with the MECP Table 3 Residential Standards, with the exception of PHC (F1 fraction) in BH2-SS4, which was marginally in excess of the selected MECP Standards.

Groundwater samples were recovered and analyzed for BTEX, PHCs and/or VOCs. No free-phase product was observed on the groundwater at any of the monitoring well locations during the groundwater sampling events. No BTEX, PHC and VOC parameter concentrations were detected in the groundwater samples analyzed. All groundwater results are in compliance with the MECP Table 3 Standards.

Recommendations

Soil

Based on the findings of the Phase II ESA, soil on the northeast corner of the Phase II Property contains marginal PHC impacts. It is our recommendation that the impacted fill material be removed from the subject site during the redevelopment process. The excavation of the soil from the property should be monitored and confirmed by Paterson. Any impacted soil being removed from the property is to be disposed of at an approved waste disposal facility.

Monitoring Wells

If the monitoring wells installed on the subject site are not going to be used in the future, or will not be entirely removed, they should be abandoned according to Ontario Regulation 903. The wells will be registered with the MECP under this regulation.

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 meets 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.

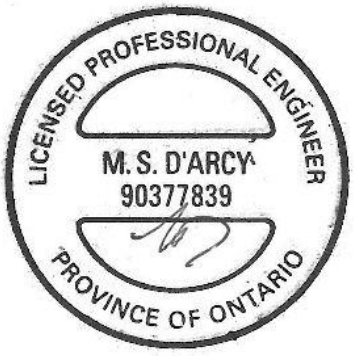
Should any conditions be encountered at the subject site and/or historical information that differ from our findings, we request that we be notified immediately in order to allow for a reassessment.

This report was prepared for the sole use of Prestwick Building Corporation. Notification from Prestwick Building Corporation and Paterson Group will be required to release this report to any other party.

Paterson Group Inc.

Mandy Witteman, B.Eng., M.A.Sc.

Mark D'Arcy, P.Eng., QP$_{ESA}$



Report Distribution:

- Prestwick Building Corporation
- Paterson Group

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE4808-3 – TEST HOLE LOCATION PLAN AND GROUNDWATER CONTOUR PLAN

DRAWING PE4808-4A – ANALYTICAL TESTING PLAN – SOIL

DRAWING PE4808-4B– ANALYTICAL TESTING PLAN – GROUNDWATER

DRAWING PE4808-5A – CROSS-SECTION A – A' – SOIL

DRAWING PE4808-5B– CROSS-SECTION A – A' – GROUNDWATER

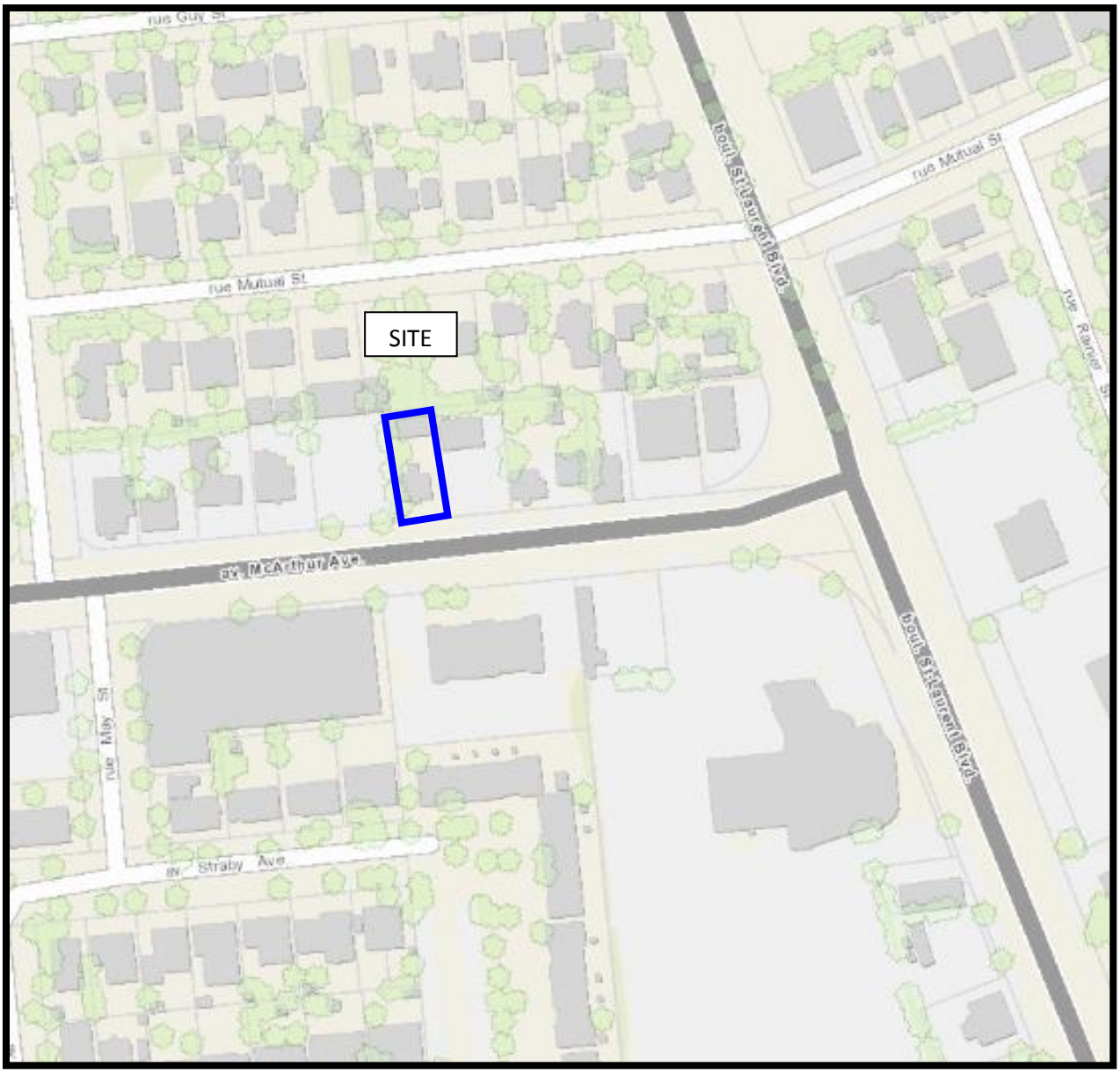


FIGURE 1

KEY PLAN

552 MUTUAL STREET
RESIDENTIAL DWELLING

457 MCARTHUR AVENUE
MCARTHUR'S MOTORS OTTAWA
(AUTO REPAIR GARAGE)

548 MUTUAL STREET
RESIDENTIAL DWELLING

538 MUTUAL STREET
RESIDENTIAL DWELLING

451 MCARTHUR AVENUE
PARKING LOT

456 MCARTHUR AVENUE
RESIDENTIAL APARTMENT BUILDING

MCARTHUR AVENUE

A

A'

BH 1
71.20
[68.15]
(67.28)

BH 2
71.30
[68.56]
(68.93)

BH 3
71.38
[69.55]
(67.88)

DRIVEWAY

ENTRANCE

CB-TBM

GARAGE

455 MCARTHUR AVENUE
RESIDENTIAL APARTMENT
BUILDING

ASPHALTIC CONCRETE
PARKING LOT

OHW

E

GS

68.6 68.4 68.2 68 67.8 67.6

68.2 68 67.8

(0.14m/m)

LEGEND:

- BOREHOLE WITH MONITORING WELL LOCATION
- 71.20 GROUND SURFACE ELEVATION (m)
- [68.15] BEDROCK SURFACE ELEVATION (m)
- (67.28) GROUNDWATER SURFACE ELEVATION (m)
- 97.7 GROUNDWATER CONTOUR(m)
- (0.06m/m) APPROXIMATE GROUNDWATER FLOW DIRECTION (HORIZONTAL HYDRAULIC GRADIENT)

TBM- TOP OF GRATE OF CATCH BASIN LOCATED ON THE NORTHERN SIDE OF MCARTHUR AVENUE. GEODETIC ELEVATION=71.06 m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
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NO.	REVISIONS	DATE	INITIAL

PRESTWICK BUILDING CORPORATION

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
455 MCARTHUR AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:150	Date: 01/2020
Drawn by: NFRV	Report No.: PE4808-2
Checked by: MW	Dwg. No.: PE4808-3
Approved by: MSD	Revision No.:

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552 MUTUAL STREET
RESIDENTIAL DWELLING

457 MCARTHUR AVENUE
MCARTHUR'S MOTORS OTTAWA
(AUTO REPAIR GARAGE)

BH1-SS6 3.81-4.42m 29-Nov-19
BTEX comply with MECP Table 3 Standards
PHCs comply with MECP Table 3 Standards

BH 1
71.20
[68.15]
(67.28)

A

A'

BH 2
71.30
[68.56]
(68.93)

DRIVEWAY

BH2-G1 0-0.025m 6-Dec-19
Metals comply with MECP Table 3 Standards

BH2-SS4	1.52-2.13m	6-Dec-19
Parameter	Results (µg/g)	Standard(µg/g)
F1 (PHC)	70	55

BTEX comply with MECP Table 3 Standards

GARAGE

455 MCARTHUR AVENUE
RESIDENTIAL APARTMENT BUILDING

CB-TBM

ENTRANCE

548 MUTUAL STREET
RESIDENTIAL DWELLING

ASPHALTIC CONCRETE
PARKING LOT

BH 3
71.38
[69.55]
(67.88)

451 MCARTHUR AVENUE
PARKING LOT

MCARTHUR AVENUE

456 MCARTHUR AVENUE
RESIDENTIAL APARTMENT BUILDING

538 MUTUAL STREET
RESIDENTIAL DWELLING

SOIL SAMPLES COMPLY WITH MECP TABLE 3 STANDARDS

SOIL SAMPLES EXCEED MECP TABLE 3 STANDARDS

LEGEND:

⊕	BOREHOLE WITH MONITORING WELL LOCATION
71.20	GROUND SURFACE ELEVATION (m)
[68.15]	BEDROCK SURFACE ELEVATION (m)
(67.28)	GROUNDWATER SURFACE ELEVATION (m)

TBM- TOP OF GRATE OF CATCH BASIN LOCATED ON THE NORTHERN SIDE OF MCARTHUR AVENUE. GEODETIC ELEVATION=71.06 m

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NO.	REVISIONS	DATE	INITIAL

PRESTWICK BUILDING CORPORATION

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
455 MCARTHUR AVENUE

OTTAWA, ONTARIO

Title:
ANALYTICAL TESTING PLAN-SOIL(BTEX, PHC, METALS)

Scale: 1:150	Date: 01/2020
Drawn by: YA	Report No.: PE4808-2
Checked by: MW	Dwg. No.: PE4808-4A
Approved by: MSD	Revision No.:

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552 MUTUAL STREET
RESIDENTIAL DWELLING

457 MCARTHUR AVENUE
MCARTHUR'S MOTORS OTTAWA
(AUTO REPAIR GARAGE)

BH2-GW1 3.22-4.72m 11-Dec-19
PHCs comply with MECP Table 3 Standards
VOCs comply with MECP Table 3 Standards

BH1-GW1 4.60-6.10m 6-Dec-19
PHCs comply with MECP Table 3 Standards
VOCs comply with MECP Table 3 Standards

BH 1
71.20
[68.15]
(67.28)

BH 2
71.30
[68.56]
(68.93)

A

A'

OHW

E

DRIVEWAY

GARAGE

455 MCARTHUR AVENUE
RESIDENTIAL APARTMENT BUILDING

ENTRANCE

CB-TBM

548 MUTUAL STREET
RESIDENTIAL DWELLING

ASPHALTIC CONCRETE
PARKING LOT

GS

BH 3
71.38
[69.55]
(67.88)

BH3-GW1 3.07-4.57m 11-Dec-19
PHCs comply with MECP Table 3 Standards
BTEX comply with MECP Table 3 Standards

451 MCARTHUR AVENUE
PARKING LOT

538 MUTUAL STREET
RESIDENTIAL DWELLING

MCARTHUR AVENUE

456 MCARTHUR AVENUE
RESIDENTIAL APARTMENT BUILDING

ALL GROUNDWATER SAMPLES COMPLY WITH MECP TABLE 3 STANDARDS

LEGEND:

⊕	BOREHOLE WITH MONITORING WELL LOCATION
71.20	GROUND SURFACE ELEVATION (m)
[68.15]	BEDROCK SURFACE ELEVATION (m)
(67.28)	GROUNDWATER SURFACE ELEVATION (m)

TBM- TOP OF GRATE OF CATCH BASIN LOCATED ON THE NORTHERN SIDE OF MCARTHUR AVENUE. GEODETIC ELEVATION=71.06 m

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NO.	REVISIONS	DATE	INITIAL

PRESTWICK BUILDING CORPORATION

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
455 MCARTHUR AVENUE

OTTAWA, ONTARIO

Title:
ANALYTICAL TESTING PLAN-GROUNDWATER (BTEX, PHC, AND VOC)

Scale: 1:150	**Date:** 01/2020
Drawn by: YA	**Report No.:** PE4808-2
Checked by: MW	**Dwg. No.:** PE4808-4B
Approved by: MSD	**Revision No.:**

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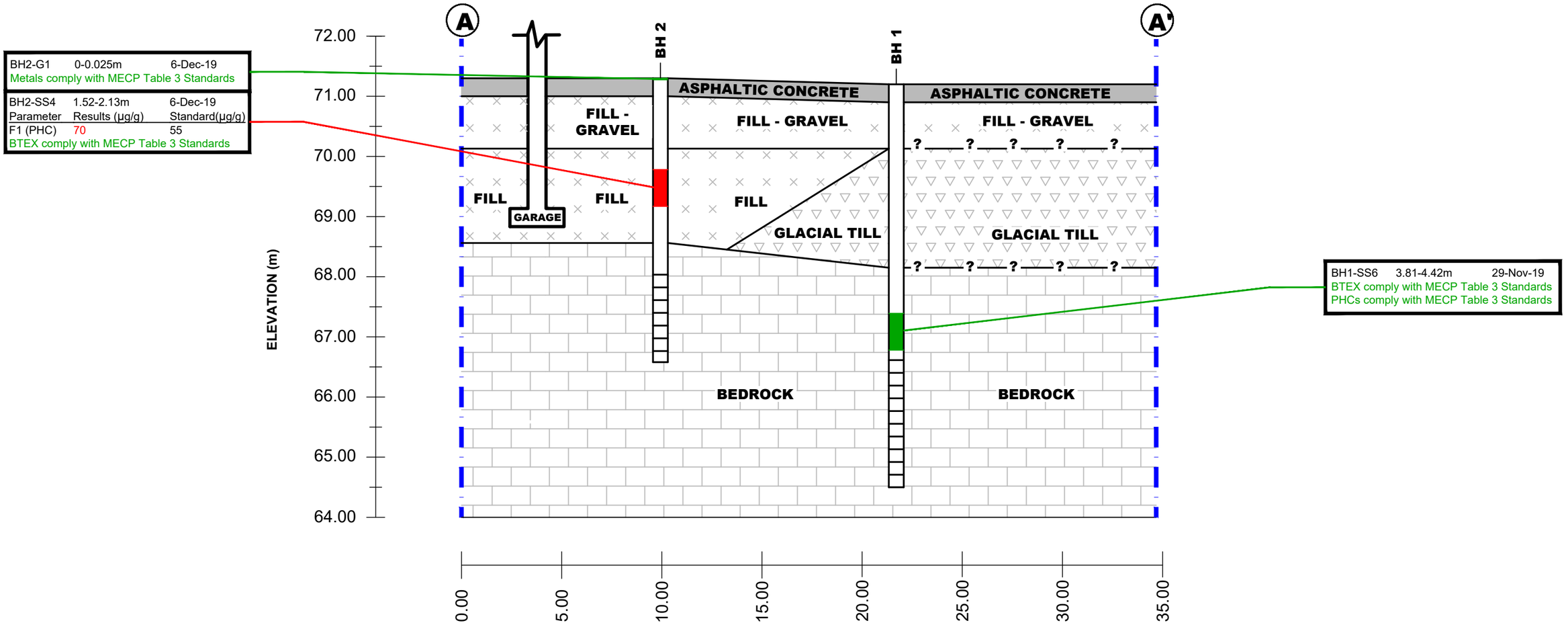

SOIL SAMPLES COMPLY WITH MECP TABLE 3 STANDARDS

SOIL SAMPLES EXCEED MECP TABLE 3 STANDARDS

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NO.	REVISIONS	DATE	INITIAL

PRESTWICK BUILDING CORPORATION

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
455 MCARTHUR AVENUE

OTTAWA, ONTARIO

Title:

CROSS SECTION A-A-SOIL (BTEX, PHC, METALS)

Scale: AS SHOWN	Date: 01/2020
Drawn by: YA	Report No.: PE4808-2
Checked by: MW	Dwg. No.: PE4808-5A
Approved by: MSD	Revision No.:

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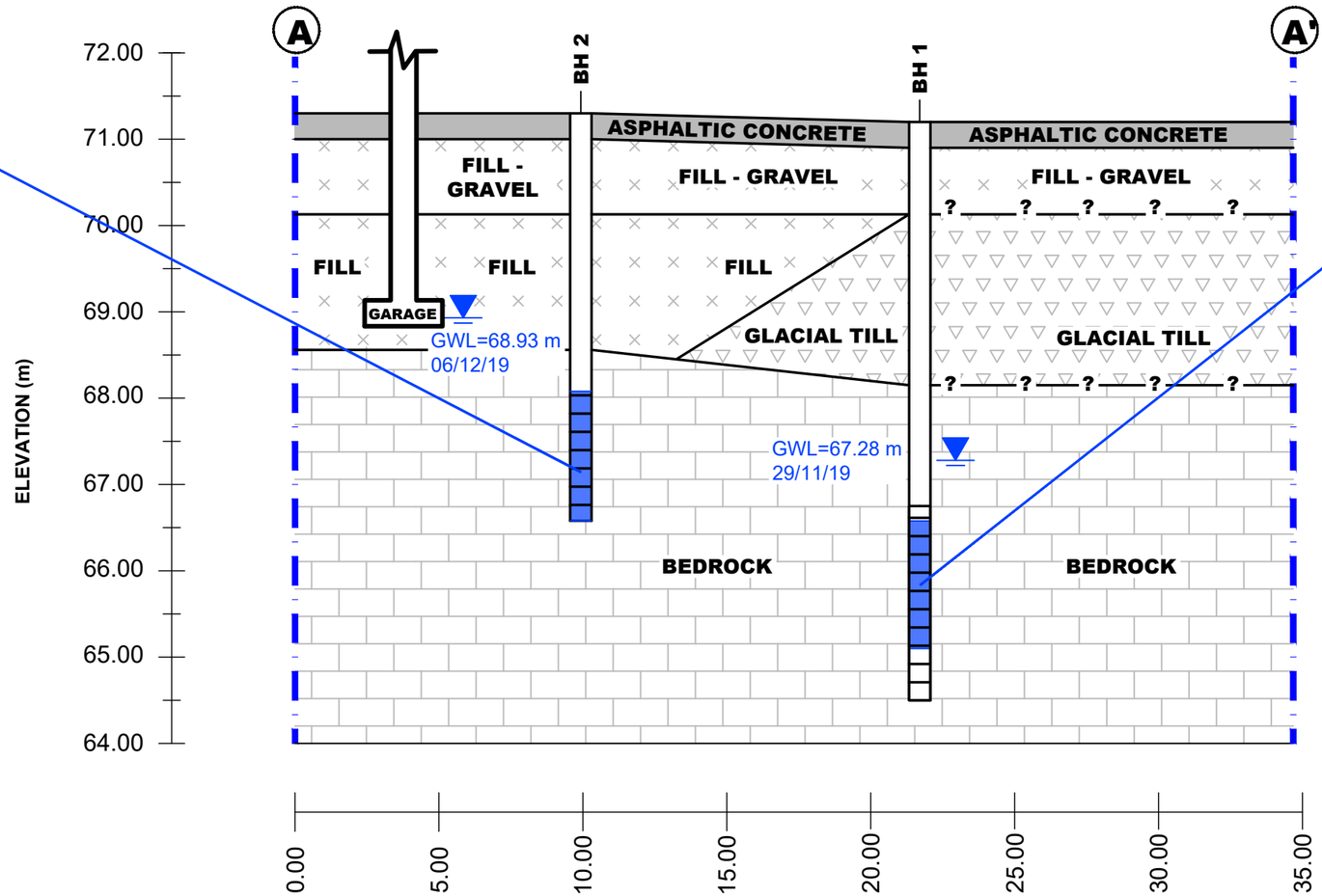
BH2-GW1 3.22-4.72m 11-Dec-19
PHCs comply with MECP Table 3 Standards
VOCs comply with MECP Table 3 Standards



BH1-GW1 4.60-6.10m 6-Dec-19
PHCs comply with MECP Table 3 Standards
VOCs comply with MECP Table 3 Standards

ALL GROUNDWATER SAMPLES COMPLY WITH MECP TABLE 3 STANDARDS

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NO.	REVISIONS	DATE	INITIAL

PRESTWICK BUILDING CORPORATION

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
455 MCARTHUR AVENUE

OTTAWA, ONTARIO

Title:
CROSS SECTION A-A-GROUNDWATER (BTEX, PHC, AND VOC)

Scale: AS SHOWN	Date: 01/2020
Drawn by: YA	Report No.: PE4808-2
Checked by: MW	Dwg. No.: PE4808-5B
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
455 McArthur Avenue
Ottawa, Ontario

Prepared For

Prestwick Building Corp.

November 2019

Report: PE4808-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson was retained by Allan Bateman of Prestwick Building Corporation, to conduct a Phase II Environmental Site Assessment (ESA) for the property addressed 455 McArthur Avenue, in the City of Ottawa, Ontario.

The Phase II ESA was carried out to address the areas of potential environmental concern on the Phase II Property. The following subsurface investigation program was developed. A Geotechnical Investigation was conducted concurrently with the environmental subsurface investigation.

Borehole	Location & Rationale	Proposed Depth & Rationale
BH1	Place on the eastern property boundary to assess the potential impact from the neighbouring garage.	Borehole to be advanced or cored into bedrock, approximately 5 mbgs to install monitoring well.
BH2	Place on the north-east corner assess the potential impact from the neighbouring garage.	Borehole to be advanced or cored into bedrock, approximately 5 mbgs to install monitoring well.
BH3	Place on the western property boundary for geotechnical purposes and delineate any potential impacts.	Borehole to be advanced or cored into bedrock, approximately 5 mbgs to install monitoring well.

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

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 MOECC site 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 should be measured using a measuring tape or wheel rather than paced off. Boreholes were located and surveyed in the field by Paterson. The benchmark (BM) was taken from the top of the grate of a catch basin located on the northern side of McArthur Avenue. The geodetic datum was measured 71.06m. The locations of the boreholes and elevations were measured by Paterson.

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 MECP 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.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
455 McArthur Avenue
Ottawa, Ontario

DATUM Geodetic

FILE NO. PE4808

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** 2019 November 29

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	71.20
Asphaltic concrete 0.04		AU	1				
FILL: Dark brown silty sand, some gravel, trace clay 1.07		SS	2	88	9	1	70.20
GLACIAL TILL: Dark brown sandy silt with shale fragments 2.29		SS	3	100	18	2	69.20
GLACIAL TILL: Brown silty clay with shale fragments, trace sand 3.05		SS	4	100	19	3	68.20
		SS	5	100	76		
		SS	6	100	50+	4	67.20
BEDROCK: Black shale		SS	7	67	50+		
		SS	8	0	50+	5	66.20
		SS	9	0	50+	6	65.20
6.70							
End of Borehole							
(GWL @ 3.92m - Dec. 6, 2019)							

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

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
455 McArthur Avenue
Ottawa, Ontario

DATUM Geodetic

FILE NO. PE4808

REMARKS

HOLE NO. BH 2

BORINGS BY Portable Drill **DATE** 2019 December 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	71.30
FILL: Brown silty sand, trace topsoil and asphalt (0.30)		AU	1				
FILL: Brown silty sand, trace gravel (0.60)		SS	2	71		1	70.30
FILL: Brown silty sand, some clay, trace gravel		SS	3	54			
		SS	4	83		2	69.30
(2.74)		SS	5	96			
BEDROCK: Very poor quality, black shale		RC	1	64	0	3	68.30
		RC	2	46	0	4	67.30
(4.72) End of Borehole							
(GWL @ 2.37m - Dec. 11, 2019)							

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

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
455 McArthur Avenue
Ottawa, Ontario

DATUM Geodetic

FILE NO. PE4808

REMARKS

HOLE NO. BH 3

BORINGS BY Portable Drill **DATE** 2019 November 29

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	71.38
FILL: Brown silty sand, trace topsoil, organics 0.30		AU	1				
		SS	2	92			
FILL: Brown silty sand, trace crushed stone						1	70.38
		SS	3	50			
1.52							
GLACIAL TILL: Brown silty sand with shale fragments 1.83		SS	4	100		2	69.38
		RC	1	35	0		
BEDROCK: Very poor quality, black shale						3	68.38
		RC	2	90	0	4	67.38
4.57							
End of Borehole							
(GWL @ 3.50m - Dec. 11, 2019)							

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

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 relative strength of cohesionless soils is the compactness condition, 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. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'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 shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

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 NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, 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, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water 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 at 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 x 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

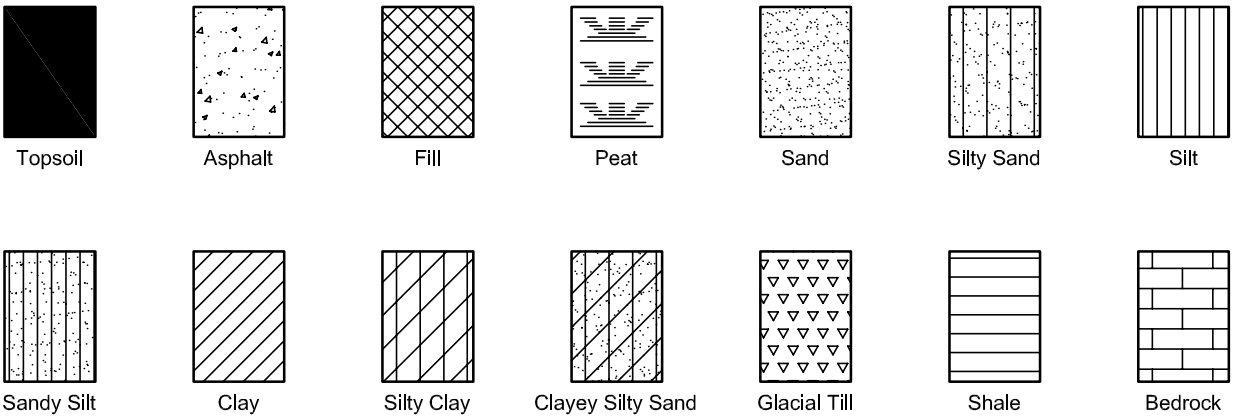
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

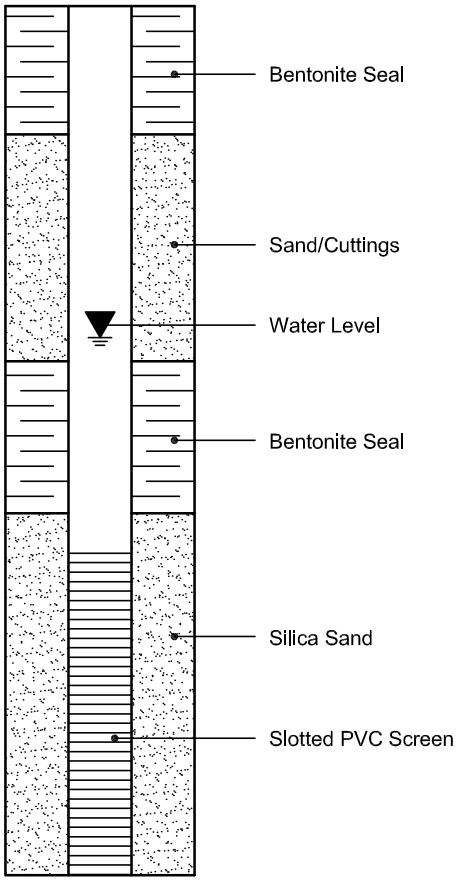
SYMBOLS AND TERMS (continued)

STRATA PLOT

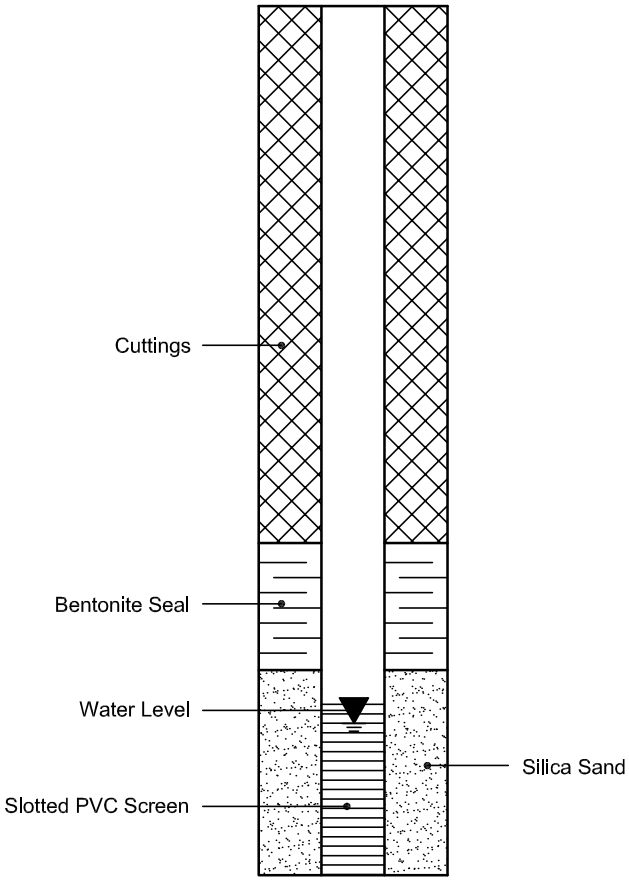


MONITORING WELL AND PIEZOMETER CONSTRUCTION

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: Mark D'Arcy

Client PO: 29213
Project: PE4808
Custody: 51742

Report Date: 10-Dec-2019
Order Date: 4-Dec-2019

Order #: 1949302

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

Paracel ID	Client ID
1949302-01	BH1-SS6

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 29213

Report Date: 10-Dec-2019
Order Date: 4-Dec-2019
Project Description: PE4808

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	9-Dec-19	10-Dec-19
PHC F1	CWS Tier 1 - P&T GC-FID	9-Dec-19	10-Dec-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	4-Dec-19	6-Dec-19
Solids, %	Gravimetric, calculation	5-Dec-19	5-Dec-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 29213

Report Date: 10-Dec-2019

Order Date: 4-Dec-2019

Project Description: PE4808

	Client ID:	BH1-SS6	-	-	-
	Sample Date:	29-Nov-19 09:00	-	-	-
	Sample ID:	1949302-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	85.7	-	-	-
Volatiles					
Benzene	0.02 ug/g dry	<0.02	-	-	-
Ethylbenzene	0.05 ug/g dry	<0.05	-	-	-
Toluene	0.05 ug/g dry	<0.05	-	-	-
m,p-Xylenes	0.05 ug/g dry	0.18	-	-	-
o-Xylene	0.05 ug/g dry	0.10	-	-	-
Xylenes, total	0.05 ug/g dry	0.27	-	-	-
Toluene-d8	Surrogate	90.6%	-	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	16	-	-	-
F2 PHCs (C10-C16)	4 ug/g dry	94	-	-	-
F3 PHCs (C16-C34)	8 ug/g dry	98	-	-	-
F4 PHCs (C34-C50)	6 ug/g dry	10	-	-	-

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						
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*		*107*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 29213

Report Date: 10-Dec-2019
Order Date: 4-Dec-2019
Project Description: PE4808

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)	29	4	ug/g dry	16			61.0	30	QR-04
F3 PHCs (C16-C34)	15	8	ug/g dry	ND			0.0	30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Physical Characteristics									
% Solids	86.0	0.1	% by Wt.	86.0			0.0	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	*4.10*		*ug/g dry*		*112*	*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)	177	7	ug/g		88.4	80-120			
F2 PHCs (C10-C16)	260	4	ug/g	16	262	60-140			QM-06
F3 PHCs (C16-C34)	284	8	ug/g	ND	124	60-140			
F4 PHCs (C34-C50)	165	6	ug/g	ND	114	60-140			
Volatiles									
Benzene	3.18	0.02	ug/g		79.6	60-130			
Ethylbenzene	3.81	0.05	ug/g		95.4	60-130			
Toluene	4.03	0.05	ug/g		101	60-130			
m,p-Xylenes	7.77	0.05	ug/g		97.1	60-130			
o-Xylene	3.87	0.05	ug/g		96.7	60-130			
Surrogate: Toluene-d8	*2.94*		*ug/g*		*92.0*	*50-140*			

Qualifier Notes:

Login Qualifiers :

Container(s) - Labeled improperly/insufficient information -
Applies to samples: BH1-SS6

QC Qualifiers :

QM-06 : Due to noted non-homogeneity of the QC sample matrix, the spike recoveries were out side the accepted range. Batch data accepted based on other QC.

QR-04 : Duplicate results exceeds RPD limits due to non-homogeneous matrix.

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.
- When reported, data for F4G has been processed using a silica gel cleanup.

PARA LABORATORI

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Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
1949302	Nº 51742

Client Name: Paterson Group	Project Ref: Pt 4808	Page __ of __
Contact Name: Mark D'Arcy	Quote #:	**Turnaround Time**
Address: 154 Colonnade RS.	PO #: 29213	☐ 1 day ☐ 3 day ☐ 2 day ☒ Regular
Telephone:	E-mail: mdarcy@patersongroup.ca	Date Required:

Regulation 153/04	Other Regulation
☐ Table 1 ☐ Res/Park ☐ Med/Fine	☐ REG 558 ☐ PWQO
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ CCME ☐ MISA
☐ Table 3 ☐ Agri/Other	☐ SU - Sani ☐ SU - Storm
☒ Table ___	Mun:
For RSC: ☐ Yes ☐ No	☐ Other:

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

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Required Analysis: BTEX + PHCs (F1-F4)
1	BH1-SS6	S		2	Nov 29		X
2							
3							
4							
5							
6							
7							
8							
9							
10							

Comments:

Method of Delivery: Par Rel

Relinquished By (Sign): N. Sullivan	Received By Driver/Depot: A. Flouse	Received at Lab: Jumeepam Dolma	Verified By:
Relinquished By (Print): Nick Sullivan	Date/Time: 04/12/19 2:45	Date/Time: Dec 04, 2019 05:07	Date/Time: 12-04-19 17:45
Date/Time: Dec. 4. 19	Temperature: °C FA.	Temperature: 11.9 °C	pH Verified: ☐ By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Mark D'Arcy

Client PO: 29277
Project: PE4808
Custody: 51755

Report Date: 13-Dec-2019
Order Date: 9-Dec-2019

Order #: 1950135

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

Paracel ID	Client ID
1950135-01	BH2-G1
1950135-02	BH2-SS4

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 29277

Report Date: 13-Dec-2019
Order Date: 9-Dec-2019
Project Description: PE4808

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	12-Dec-19	13-Dec-19
PHC F1	CWS Tier 1 - P&T GC-FID	12-Dec-19	13-Dec-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	11-Dec-19	13-Dec-19
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	11-Dec-19	11-Dec-19
Solids, %	Gravimetric, calculation	10-Dec-19	11-Dec-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 29277

Report Date: 13-Dec-2019

Order Date: 9-Dec-2019

Project Description: PE4808

	Client ID:	BH2-G1	BH2-SS4	-	-
	Sample Date:	06-Dec-19 09:00	06-Dec-19 09:00	-	-
	Sample ID:	1950135-01	1950135-02	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	79.9	86.3	-	-
Metals					
Antimony	1.0 ug/g dry	<1.0	-	-	-
Arsenic	1.0 ug/g dry	11.2	-	-	-
Barium	1.0 ug/g dry	278	-	-	-
Beryllium	0.5 ug/g dry	0.8	-	-	-
Boron	5.0 ug/g dry	6.1	-	-	-
Cadmium	0.5 ug/g dry	<0.5	-	-	-
Chromium	5.0 ug/g dry	18.6	-	-	-
Cobalt	1.0 ug/g dry	8.2	-	-	-
Copper	5.0 ug/g dry	36.8	-	-	-
Lead	1.0 ug/g dry	83.8	-	-	-
Molybdenum	1.0 ug/g dry	2.4	-	-	-
Nickel	5.0 ug/g dry	23.3	-	-	-
Selenium	1.0 ug/g dry	<1.0	-	-	-
Silver	0.3 ug/g dry	<0.3	-	-	-
Thallium	1.0 ug/g dry	<1.0	-	-	-
Uranium	1.0 ug/g dry	<1.0	-	-	-
Vanadium	10.0 ug/g dry	29.7	-	-	-
Zinc	20.0 ug/g dry	98.8	-	-	-
Volatiles					
Benzene	0.02 ug/g dry	-	<0.02	-	-
Ethylbenzene	0.05 ug/g dry	-	<0.05	-	-
Toluene	0.05 ug/g dry	-	<0.05	-	-
m,p-Xylenes	0.05 ug/g dry	-	<0.05	-	-
o-Xylene	0.05 ug/g dry	-	<0.05	-	-
Xylenes, total	0.05 ug/g dry	-	<0.05	-	-
Toluene-d8	Surrogate	-	103%	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	-	70	-	-
F2 PHCs (C10-C16)	4 ug/g dry	-	17	-	-
F3 PHCs (C16-C34)	8 ug/g dry	-	36	-	-
F4 PHCs (C34-C50)	6 ug/g dry	-	<6	-	-

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						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	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	*8.44*		*ug/g*		*105*	*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)	429	4	ug/g dry	852			66.1	30	QR-04
F3 PHCs (C16-C34)	282	8	ug/g dry	501			55.9	30	QR-04
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Metals									
Antimony	1.1	1.0	ug/g dry	ND			0.0	30	
Arsenic	3.8	1.0	ug/g dry	4.3			14.1	30	
Barium	99.4	1.0	ug/g dry	111			11.2	30	
Beryllium	ND	0.5	ug/g dry	0.6			0.0	30	
Boron	7.2	5.0	ug/g dry	8.0			10.1	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	27.8	5.0	ug/g dry	32.0			14.3	30	
Cobalt	7.3	1.0	ug/g dry	8.2			12.1	30	
Copper	39.7	5.0	ug/g dry	42.0			5.5	30	
Lead	30.6	1.0	ug/g dry	33.5			9.1	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	18.8	5.0	ug/g dry	20.6			9.1	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.3	ug/g dry	0.3			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	30.5	10.0	ug/g dry	35.9			16.1	30	
Zinc	96.9	20.0	ug/g dry	109			11.3	30	
Physical Characteristics									
% Solids	85.9	0.1	% by Wt.	85.3			0.7	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	*9.77*		*ug/g dry*		*105*	*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)	196	7	ug/g		98.2	80-120			
F2 PHCs (C10-C16)	559	4	ug/g	852	-338	60-140			QM-06
F3 PHCs (C16-C34)	545	8	ug/g	501	20.6	60-140			QM-06
F4 PHCs (C34-C50)	110	6	ug/g	ND	81.5	60-140			
Metals									
Antimony	45.3		ug/L	ND	89.9	70-130			
Arsenic	50.7		ug/L	1.7	98.0	70-130			
Barium	90.0		ug/L	44.5	91.0	70-130			
Beryllium	48.6		ug/L	ND	96.8	70-130			
Boron	46.1		ug/L	ND	85.8	70-130			
Cadmium	47.1		ug/L	ND	93.8	70-130			
Chromium	61.9		ug/L	12.8	98.2	70-130			
Cobalt	51.0		ug/L	3.3	95.4	70-130			
Copper	64.1		ug/L	16.8	94.5	70-130			
Lead	53.2		ug/L	13.4	79.5	70-130			
Molybdenum	47.1		ug/L	ND	93.5	70-130			
Nickel	54.5		ug/L	8.2	92.5	70-130			
Selenium	44.7		ug/L	ND	89.2	70-130			
Silver	38.0		ug/L	ND	75.7	70-130			
Thallium	44.0		ug/L	ND	87.9	70-130			
Uranium	46.5		ug/L	ND	92.5	70-130			
Vanadium	63.2		ug/L	14.3	97.6	70-130			
Zinc	89.7		ug/L	43.4	92.5	70-130			
Volatiles									
Benzene	3.26	0.02	ug/g		81.4	60-130			
Ethylbenzene	3.87	0.05	ug/g		96.8	60-130			
Toluene	4.65	0.05	ug/g		116	60-130			
m,p-Xylenes	8.14	0.05	ug/g		102	60-130			
o-Xylene	4.10	0.05	ug/g		102	60-130			
Surrogate: Toluene-d8	*8.48*		*ug/g*		*106*	*50-140*			

Qualifier Notes:

QC Qualifiers :

QM-06 : Due to noted non-homogeneity of the QC sample matrix, the spike recoveries were out side the accepted range. Batch data accepted based on other QC.

QR-04 : Duplicate results exceeds RPD limits due to non-homogeneous matrix.

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.
- When reported, data for F4G has been processed using a silica gel cleanup.

PAR LABORAT

Paracel ID: 1950135

d Office
2319 St. Laurent Blvd.
wa, Ontario K1G 4J8
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racel@paracellabs.com
w.paracellabs.com

Paracel Order Number (Lab Use Only)
1950135 - Soil
1950136 - water

Chain Of Custody (Lab Use Only)
№ 51755

Client Name: Paterson
Contact Name: Mark D'Arcy
Address: 154 Colonnade Rd South
Telephone: 613 - 224 - 7381

Project Ref: PE4808
Quote #:
PO #: 29277
E-mail: mdarcy@patersongroup.ca

Page 1 of 1

Turnaround Time
☐ 1 day ☐ 3 day
☐ 2 day ☒ Regular
Date Required:

Regulation 153/04
☐ Table 1 ☐ Res/Park ☐ Med/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other
☐ Table
For RSC: ☐ Yes ☒ No

Other Regulation
☐ REG 558 ☐ PWQO
☐ CCME ☐ MISA
☐ SU - Sani ☐ SU - Storm
Mun:
☐ Other:

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

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken: Date	Sample Taken: Time	Metals by ICP	PHC (F1-F4) + BTEX	PHC (F1-F4) + VOCs										
1	BH2-GW1	S		1	Dec. 6/2019		✓												
2	BH2-SS4	S		2	↓			✓										250mL	
3	BH1-GW1	GW		3	↓				✓									1L+60mL+2vial	
4																			
5																			
6																			
7																			
8																			
9																			
10																			

Comments:

Method of Delivery: Paracel

Relinquished By (Sign):	Received By Driver/Depot: A. Fraser	Received at Lab: Smithtown Dumai	Verified By:
Relinquished By (Print):	Date/Time: 09/12/19 2:00	Date/Time: Dec 09, 2019 05:1	Date/Time: 12-10-19 9AM
Date/Time:	Temperature: °C	Temperature: 12.9 °C	pH Verified: ☐ By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Mark D'Arcy

Client PO: 29287
Project: PE4808
Custody: 51761

Report Date: 17-Dec-2019
Order Date: 11-Dec-2019

Order #: 1950388

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

Paracel ID	Client ID
1950388-01	BH2-GW1
1950388-02	BH3-GW1

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 29287

Report Date: 17-Dec-2019
Order Date: 11-Dec-2019
Project Description: PE4808

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	14-Dec-19	14-Dec-19
PHC F1	CWS Tier 1 - P&T GC-FID	13-Dec-19	14-Dec-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	12-Dec-19	16-Dec-19
REG 153: VOCs by P&T GC/MS	EPA 624 - P&T GC-MS	13-Dec-19	14-Dec-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 29287

Report Date: 17-Dec-2019

Order Date: 11-Dec-2019

Project Description: PE4808

	Client ID:	BH2-GW1	BH3-GW1	-	-
	Sample Date:	11-Dec-19 09:00	11-Dec-19 09:00	-	-
	Sample ID:	1950388-01	1950388-02	-	-
	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	<0.5	-	-	-
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: 29287

Report Date: 17-Dec-2019

Order Date: 11-Dec-2019

Project Description: PE4808

	Client ID:	BH2-GW1	BH3-GW1	-	-
	Sample Date:	11-Dec-19 09:00	11-Dec-19 09:00	-	-
	Sample ID:	1950388-01	1950388-02	-	-
	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	115%	-	-	-
Dibromofluoromethane	Surrogate	105%	-	-	-
Toluene-d8	Surrogate	99.7%	-	-	-
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	-	100%	-	-
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	*92.9*		*ug/L*		*116*	*50-140*			
Surrogate: Dibromofluoromethane	*73.1*		*ug/L*		*91.3*	*50-140*			
Surrogate: Toluene-d8	*80.5*		*ug/L*		*101*	*50-140*			
Benzene	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Toluene	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: Toluene-d8	*80.5*		*ug/L*		*101*	*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	*94.3*		*ug/L*		*118*	*50-140*			
Surrogate: Dibromofluoromethane	*80.0*		*ug/L*		*100*	*50-140*			
Surrogate: Toluene-d8	*79.2*		*ug/L*		*99.0*	*50-140*			
Benzene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Toluene	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: Toluene-d8	*79.2*		*ug/L*		*99.0*	*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)	1720	25	ug/L		85.8	68-117			
F2 PHCs (C10-C16)	1760	100	ug/L		110	60-140			
F3 PHCs (C16-C34)	4290	100	ug/L		110	60-140			
F4 PHCs (C34-C50)	2400	100	ug/L		96.8	60-140			
Volatiles									
Acetone	119	5.0	ug/L		119	50-140			
Benzene	33.3	0.5	ug/L		83.3	60-130			
Bromodichloromethane	31.4	0.5	ug/L		78.4	60-130			
Bromoform	28.6	0.5	ug/L		71.6	60-130			
Bromomethane	50.3	0.5	ug/L		126	50-140			
Carbon Tetrachloride	33.8	0.2	ug/L		84.5	60-130			
Chlorobenzene	32.0	0.5	ug/L		80.0	60-130			
Chloroform	32.7	0.5	ug/L		81.8	60-130			
Dibromochloromethane	29.2	0.5	ug/L		72.9	60-130			
Dichlorodifluoromethane	33.0	1.0	ug/L		82.6	50-140			
1,2-Dichlorobenzene	29.0	0.5	ug/L		72.5	60-130			
1,3-Dichlorobenzene	28.8	0.5	ug/L		72.1	60-130			
1,4-Dichlorobenzene	29.8	0.5	ug/L		74.6	60-130			
1,1-Dichloroethane	32.6	0.5	ug/L		81.6	60-130			
1,2-Dichloroethane	30.1	0.5	ug/L		75.3	60-130			
1,1-Dichloroethylene	34.2	0.5	ug/L		85.5	60-130			
cis-1,2-Dichloroethylene	32.4	0.5	ug/L		80.9	60-130			
trans-1,2-Dichloroethylene	33.1	0.5	ug/L		82.7	60-130			
1,2-Dichloropropane	36.0	0.5	ug/L		90.0	60-130			
cis-1,3-Dichloropropylene	29.1	0.5	ug/L		72.6	60-130			
trans-1,3-Dichloropropylene	28.8	0.5	ug/L		71.9	60-130			
Ethylbenzene	31.4	0.5	ug/L		78.6	60-130			
Ethylene dibromide (dibromoethane	28.6	0.2	ug/L		71.6	60-130			
Hexane	38.7	1.0	ug/L		96.8	60-130			
Methyl Ethyl Ketone (2-Butanone)	60.7	5.0	ug/L		60.7	50-140			
Methyl Isobutyl Ketone	66.4	5.0	ug/L		66.4	50-140			
Methyl tert-butyl ether	70.8	2.0	ug/L		70.8	50-140			
Methylene Chloride	37.2	5.0	ug/L		93.1	60-130			
Styrene	29.7	0.5	ug/L		74.3	60-130			
1,1,1,2-Tetrachloroethane	30.0	0.5	ug/L		75.1	60-130			
1,1,2,2-Tetrachloroethane	29.6	0.5	ug/L		73.9	60-130			
Tetrachloroethylene	34.6	0.5	ug/L		86.4	60-130			
Toluene	32.5	0.5	ug/L		81.2	60-130			
1,1,1-Trichloroethane	32.0	0.5	ug/L		80.1	60-130			
1,1,2-Trichloroethane	31.2	0.5	ug/L		78.0	60-130			
Trichloroethylene	32.6	0.5	ug/L		81.4	60-130			
Trichlorofluoromethane	36.5	1.0	ug/L		91.3	60-130			
Vinyl chloride	30.1	0.5	ug/L		75.3	50-140			
m,p-Xylenes	66.4	0.5	ug/L		83.0	60-130			
o-Xylene	33.1	0.5	ug/L		82.7	60-130			
Surrogate: 4-Bromofluorobenzene	*84.0*		*ug/L*		*105*	*50-140*			
Benzene	33.3	0.5	ug/L		83.3	60-130			
Ethylbenzene	31.4	0.5	ug/L		78.6	60-130			
Toluene	32.5	0.5	ug/L		81.2	60-130			
m,p-Xylenes	66.4	0.5	ug/L		83.0	60-130			
o-Xylene	33.1	0.5	ug/L		82.7	60-130			

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.
- When reported, data for F4G has been processed using a silica gel cleanup.

PARAC LABORATORIE

Paracel ID: 1950388

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Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
1950388	№ 51761

Page 1 of 1

Client Name: Paterson	Project Ref: PE-1808
Contact Name: Mark D'Arcy	Quote #:
Address: 154 Colonnade Rd South	PO #: 29287
Telephone:	E-mail: mdarcy@patersongroup.ca

Turnaround Time

☐ 1 day ☐ 3 day
☐ 2 day ☒ Regular
Date Required: _____

Regulation 153/04

☐ Table 1 ☐ Res/Park ☐ Med/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other
☐ Table
For RSC: ☐ Yes ☒ No

Other Regulation

☐ REG 558 ☐ PWQO
☐ CCME ☐ MISA
☐ SU - Sani ☐ SU - Storm
Mun: _____
☐ Other:

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

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken: Date	Sample Taken: Time	PHC(F1-F4) + VOCs	PHC(F1-F4) + BTEX										
1	BH2-GW1	GW		3	Dec. 11/19		✓										4 VOCs - MS 203	
2	BH3-GW1	↓		↓	↓			✓										
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

Comments:

Method of Delivery: Paracel

Relinquished By (Sign):	Received By Driver/Depot: M. Jeause	Received at Lab: Juneepom Bhimai	Verified By:
Relinquished By (Print): Samuel Bérubé	Date/Time: 11/12/19 4 00	Date/Time: Dec 11, 2019 04.45	Date/Time: 12-11-19 17:17
Date/Time:	Temperature: °C PM	Temperature: 11.3 °C	pH Verified: ☐ By:

Revision 3.0