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Phase II Environmental Site Assessment

20 Mark Avenue
Ottawa, Ontario

Prepared For

Manor Park Management

July 25, 2018

Report: PE4368-2

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EXECUTIVE SUMMARY

Assessment

A Phase II ESA was conducted for the property addressed 20 Mark Avenue, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APECs) on the Phase I and Phase II Property. The subsurface investigation was carried out in conjunction with a Geotechnical Investigation and consisted of drilling three (3) boreholes, all of which were constructed with groundwater monitoring wells.

Soil samples were obtained from the boreholes and screened using visual observations and organic vapour measurements. A total of four (4) soil samples were submitted for laboratory analysis of a combination of benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs, F_1-F_4), polycyclic aromatic hydrocarbons (PAHs) and metals. Several PAH and metal parameters exceeding MOECP Table 3 standards were identified in the fill material while petroleum hydrocarbon fractions F1 and F2 were identified on the southwestern portion of the Phase II Property, at concentrations exceeding the MOECP Table 3 standards.

Groundwater samples from monitoring wells installed in BH1, BH2 and BH3 were recovered and analysed for BTEX and PHC parameters. No contaminant concentrations were identified above the laboratory method detection limits. The groundwater is in compliance with the MOECP Table 3 standards.

Conclusion

Based on the findings of the Phase II ESA, fill material impacted with PAH and metal concentrations exceeding MOECP Table 3 standards is present on the Phase II Property. Soil impacted with PHC (F1 and F2) concentrations is also present on the Phase II Property. It is our understanding that the subject site is to be redeveloped with a multi-storey residential building with a slab-on-grade construction.

It is our recommendation that an environmental site remediation program, involving the removal of all impacted soil, be completed concurrently with the site redevelopment.

Prior to offsite disposal at a licenced landfill site, a leachate analysis of a representative sample of contaminated soil must be conducted in accordance with Ontario Regulation 347/558.

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

It is expected that groundwater monitoring wells will be abandoned in accordance with O.Reg.903, at the time of construction excavation. It is recommended that the integrity of the monitoring wells be maintained, prior to future construction, for possible future groundwater monitoring purposes.

1.0 INTRODUCTION

At the request of Manor Park Management, Paterson Group (Paterson) conducted a Phase II Environmental Site Assessment of 20 Mark Avenue, in the City of Ottawa, Ontario. It should be noted that the Phase II Property forms part of a larger residential property addressed 20 through 80 Mark Avenue. The purpose of this Phase II ESA has been to address areas of potential environmental concern (APECs) identified on the Phase II Property, during the Phase I ESA conducted by Paterson in July, 2018.

1.1 Site Description

Address:	20 Mark Avenue, Ottawa, Ontario.
Legal Description:	Part of Lot 6, Block 1, Registered Plan 29, Formerly City of Vanier, City of Ottawa
Property Identification Number:	04236-0175
Location:	The subject site is located on the south side of Mark Avenue, approximately 35m east of North River Road, in the City of Ottawa. The subject site is shown on Figure 1 - Key Plan following the body of this report.
Latitude and Longitude:	45° 26' 07" N, 75° 40' 11" W
Configuration:	Rectangular (approximate)
Site Area:	815m^2 (approximate)

1.2 Property Ownership

The current registered property owner is 1479151 Ontario Inc. Paterson was retained to complete this Phase II ESA by Mr. Anand Aggarwal of Manor Park Management. The Manor Park Management offices are located at 231 Brittany Drive, Suite D, in Ottawa, Ontario. Mr. Aggarwal can be contacted by telephone at 613-745-6881.

1.3 Current and Proposed Future Uses

The Phase II Property is currently occupied by a paved parking lot associated with the residential apartment building on the adjacent property to the east (30 Mark Avenue), as well as small landscaped or treed areas. It is our understanding that the Phase II Property will be redeveloped with a multi-storey residential building with a slab-on-grade construction.

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 Ontario Ministry of the Environment, Conservation and Parks (MOECP), April 2011. The MOECP selected Table 3 Standards are based on the following considerations:

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

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The Phase II Property is located in an urban area surrounded by various sized residential and commercial structures. Site topography slopes slightly down towards the north and west. The Phase II Property is at a similar grade as the adjacent properties, with the exception of the adjacent property to the south which is approximately 0.5 to 1.0m higher. A retaining wall is present along the south property boundary. Site drainage consists primarily of sheet flow to catch basins situated on Mark Avenue as well as some surficial infiltration within the landscaped areas. The Phase II Property is situated within a municipally serviced area.

2.2 Past Investigations

Paterson has previously completed a Phase I-II ESA (2012) for the larger residential property, of which the current Phase II Property comprises the western portion. One borehole (BH6) was placed on the southwestern portion of the subject land. The borehole was cored into the bedrock to a depth of 5.84m below grade and completed with a monitoring well installation.

A soil sample collected from an approximate depth of 2.28 to 2.29m below grade was analysed for benzene, toluene, ethylbenzene and xylenes (BTEX) and petroleum hydrocarbons (PHCs, F_1 to F_4). Based on the analytical test results, the soil was in compliance with the Ministry of the Environment, Conservation and Parks (MOECP) Table 3 standards. Groundwater was not assessed at the time of the 2012 investigation, as the borehole was dry.

Based on the July 2018 Phase I ESA conducted by Paterson for the subject land, several historical on- or off-site potentially contaminating activities (PCAs) were considered to result in areas of potential environmental concern (APECs) on the Phase I and Phase II Property, as presented in Table 1.

Table 1
Area of Potential Environmental Concern

Area of Potential Environmental Concern	Location of Area of Potential Environmental Concern with respect to Phase I Property	Potentially Contaminating Activity	Location of PCA (on-site or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil, and/or Sediment)
APEC 1	Potentially across the Phase I Area	Item 30 – Importation of Fill Material of Unknown Quality	On-site	PAHs Metals	Soil (Fill Material)
APEC 2	Southwestern portion of the Phase I Property	Item 28 – Gasoline and Associated Products Storage in Fixed Tanks	Off-site	BTEX PHCs (F_1-F_4)	Soil, Groundwater
APEC 3	Southern portion of the Phase I Property	Item 52 – Storage, maintenance, fuelling and repair of equipment, vehicles, and material used to maintain transportation systems	Off-site	BTEX PHCs (F_1-F_4)	Soil, Groundwater

A Phase II ESA was recommended to address the aforementioned APECs.

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation was conducted during the interim of July 9 through July 10, 2018, in conjunction with a Geotechnical Investigation. The field program consisted of drilling three (3) boreholes, each of which was completed with a groundwater monitoring well installation. Boreholes were drilled to depths ranging from approximately 8.30 to 8.41m below grade.

3.2 Media Investigated

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

Contaminants of concern for soil and groundwater include petroleum hydrocarbons (PHCs, fractions F_1-F_4), benzene, toluene, ethylbenzene and xylenes (BTEX); polynuclear aromatic hydrocarbons (PAHs) and metals are contaminants of concern in the soil (fill material).

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

The Geological Survey of Canada website on the Urban Geology of the National Capital Area was consulted as part of this assessment. Based on this information, the bedrock in the area of the subject site consists of shale of the Billings Formation. Overburden soils are shown as glacial till, with a drift thickness on the order of 2 to 5 m. The findings of the recent (July 2018) subsurface investigation on the Phase I Property confirms the reported geological conditions.

The regional groundwater flow is expected to be towards to the west, towards the Rideau River.

Buildings and Structures

There are no buildings or structures on the Phase I Property. The majority of the Phase I Property consists of a paved parking lot, with landscaped or treed areas along the north, west and southern property limits.

Water Bodies

No water bodies are present on the Phase I Property. The closest water body is the Rideau River, located approximately 50m west of the subject land, within the Phase I ESA Study Area.

Areas of Natural Significance

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

Drinking Water Wells

The MOECC online interactive well record mapping system was accessed on June 28, 2018. No domestic potable well records were identified for the Phase I Property or for any properties within the Phase I Study Area.

Monitoring Well Records

Records of 18 monitoring wells were identified for the following properties: 307 Montgomery Street, 42 Montreal Road, 50 Selkirk Street, River Road and Wayling Avenue, North River Road, 90 to 92 Montreal Road and 285 Palace Road. Two additional records for apparent monitoring wells were also identified, however the records do not provide any information. Based on the interactive mapping system, these records are for the properties located at 2 Montreal Road and 25 Montreal Road and were installed in 2014.

Neighbouring Land Use

Neighbouring land use in the Phase I Study Area consists of residential and commercial land use.

Potentially Contaminating Activities (PCAs) and Areas of Potential Environmental Concern (APECs)

Existing or historical PCAs that are considered to have resulted in three (3) APECs on the Phase I Property are presented in Table 1 in Section 2.2 of this report. Other historical or existing off-site PCAs identified within the Phase I-ESA study area are presented on Drawing PE4368-2 – Surrounding Land Use Plan appended to the Phase I ESA. Based on their separation distances and/or orientations with respect to the Phase I Property, these PCAs are not considered to represent APECs on the Phase I Property.

Contaminants of Potential Concern (CPCs)

CPCs associated with the APECs identified on the Phase I Property include BTEX, PHCs, VOCs and metals in the groundwater and/or soil.

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the preparation of the Phase I-ESA is considered to be sufficient to conclude that there are PCAs on the Phase I Property and within the Phase I Study Area which may have impacted the subject site. The presence of PCAs was confirmed by a variety of independent sources, and as such, the conclusions of this report are not affected by uncertainty which may be present with respect to the individual sources.

3.4 Deviations from Sampling and Analysis Plan

The Sampling and Analysis Plan for this project is included in Appendix 1 of this report. There were no deviations from the Sampling and Analysis Plan.

3.5 Impediments

Physical impediments encountered during the field portion of the Phase II ESA include the tree canopy and buried utilities which prevented the placement of BH2 closer to the southwest corner of the Phase II Property. No other physical impediments were encountered.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation was conducted on July 9 and July 10, 2018, in conjunction with a Geotechnical Investigation, and consisted of drilling three (3) boreholes on the Phase II Property. All of the boreholes were cored into the bedrock and completed with groundwater monitoring wells to access the groundwater table. The boreholes were placed to address the aforementioned areas of potential environmental concern (APECs) and to provide coverage of the site from a geotechnical perspective. The boreholes were drilled with a truck mounted CME 55 power auger drill rig. The truck mounted drill rig was provided by George Downing Estate Drilling of Hawkesbury, Ontario. Borehole locations are shown on Drawing PE4368-3 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

A total of twenty-three (23) soil samples and eight (8) rock core samples were obtained from the boreholes by means of sampling from shallow auger flights, split spoon sampling and rock coring. The depths at which auger samples, split spoon samples and rock core samples were obtained from the boreholes are shown as "**AU**", "**SS**" and "**RC**" on the Soil Profile and Test Data Sheets, appended to this report.

Site soils consist of a pavement structure underlain by fill material and native glacial till followed by shale bedrock. Fill material associated with the pavement structure consisted of crushed stone with silt and sand extending to depths ranging from approximately 0.38 to 0.69m below grade. Fill material present beneath the pavement structure extended to depths ranging from approximately 0.91 to 1.68m below grade and generally consisted of silty sand with crushed stone, gravel or clay. Trace fragments of possible ash and coal were identified in the fill material at BH1. The native glacial till consists of dark brown silty clay with sand, gravel and occasional shale fragments which increase with depth. Shale bedrock was encountered at depths between approximately 4.6 and 6.2m below grade.

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 a soil vapour screening with an RKI Eagle gas detector with methane elimination and calibrated to hexane.

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 parts per million (ppm) scale is used to measure concentrations of hydrocarbon vapours that are too low to register on the Lower Explosive Limit (LEL) scale. The explosive point, 100% LEL, represents the leanest mixture which will burn (or explode) if ignited.

The combustible vapour readings were found to range from less than 5 ppm to 45ppm and were not considered to be indicative of volatile hydrocarbon compounds. Vapour readings are noted on the Soil Profile and Test Data Sheets in Appendix 1.

No obvious visual or olfactory indications of potential hydrocarbons were identified in the soil samples. Based on the vapour screening and visual or olfactory observations, a soil sample was selected from BH2, closest to the retail fuel outlet at 1 Montreal Road, from just above the bedrock.

4.4 Groundwater Monitoring Well Installation

Three (3) groundwater monitoring wells were installed on the Phase II Property, in BH1, BH2 and BH3. 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.

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	56.96	8.30	6.80-8.30	6.40-6.80	0.30-6.40	Flushmount
BH2	56.89	8.40	5.40-8.40	5.0-5.40	0.30-5.0	Flushmount
BH3	56.65	8.41	6.91-8.41	6.61-6.91	0.30-6.61	Flushmount

4.5 Field Measurement of Water Quality Parameters

Groundwater sampling was conducted at BH1, BH2 and BH3 on July 17, 2018. At this time, water quality parameters were measured in the field using a multi-parameter analyzer. Parameters measured in the field included temperature, pH and electrical conductivity.

Field parameters were measured after each well volume purged. Wells were purged prior to sampling until at least three well volumes had been removed or the field parameters were relatively stable. Stabilized field parameter values are summarized in Table 3.

Table 3
Field Measurement of Water Quality Parameters – July 17, 2018

Parameter	BH1	BH2	BH3
Temperature (°C)	15.9	15.4	15.0
pH	6.92	6.82	6.89
Electrical Conductivity (µS/cm)	263	324	325

4.6 Groundwater Sampling

Groundwater sampling protocols were followed using the MOECC 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 appended to this report, the following soil and groundwater samples were submitted for analysis:

Table 4: Soil Samples Submitted

Sample ID	Sample Depth / Stratigraphic Unit	Parameters Analyzed			Rationale
		BTEX and PHCs (F_1-F_4)	PAHs	Metals	
BH1-SS2	0.76-1.37m; Fill		X	X	Assessment of visually impacted fill material.
BH2-AU1	0.08-1.0m; Fill			X	Delineation of visually impacted fill material.
BH2-SS6	3.05-3.66m; Native Glacial Till	X			Assessment of potential BTEX and PHC impacts in the soil resulting from the existing retail fuel outlet and possible former automotive service garage at 1 Montreal Road.
BH3-SS2	1.52-2.13m; Native Glacial Till			X	Delineation of visually impacted fill material.

Table 5: Groundwater Samples Submitted			
Sample ID	Screened Interval/ Stratigraphic Unit	Parameters Analyzed	Rationale
		BTEX and PHCs (F_1-F_4)	
BH1-GW1	6.80-8.30m; Bedrock	X	Assessment of potential groundwater impacts from the existing retail fuel outlet and possible former automotive service garage at 1 Montreal Road.
BH2-GW1	5.40-8.40; Bedrock	X	Assessment of potential groundwater impacts from the existing retail fuel outlet and possible former automotive service garage at 1 Montreal Road; delineation of potential impacts identified in BH1.
BH3-GW1	5.13-8.13 m; Bedrock	X	Delineation of potential impacts identified in BH1 and BH2.

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

4.8 Residue Management

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

4.9 Elevation Surveying

An elevation survey of all borehole locations was completed by Paterson at the time of the subsurface investigation. All borehole elevations are relative to the top spindle of the fire hydrant on the north side of Mark Avenue, with geodetic elevation 57.691m above sea level (m asl), as provided by Fairhall, Moffett and Woodland Ltd.

4.10 Quality Assurance and Quality Control Measures

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

5.0 REVIEW AND EVALUATION

5.1 Geology

Site soils generally consist of a pavement structure over fill material, underlain by native glacial till, followed by shale bedrock. Site stratigraphy is shown on Drawing PE4368-7 – Cross-Section A-A' and Drawing PE4368-8 – Cross-Section B-B'.

Groundwater was encountered within the bedrock at depths ranging from approximately 6.58 to 6.87m below existing grade.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured during the groundwater sampling event on July 17, 2018, using an electronic water level meter. Groundwater levels are summarized below in Table 6. All borehole elevations are relative to the top spindle of the fire hydrant on the north side of Mark Avenue, with geodetic elevation 57.691m above sea level (m asl), as provided by Fairhall, Moffett and Woodland Ltd.

Table 6: Groundwater Level Measurements

Borehole Location	Ground Surface Elevation (m)	Water Level Depth (m below grade)	Water Level Elevation (m ASL)	Date of Measurement
BH1	56.96	6.87	50.09	July 17, 2018
BH2	56.89	6.82	50.07	July 17, 2018
BH3	56.65	6.58	50.07	July 17, 2018

Based on the groundwater elevations measured during the July 2018 sampling event, groundwater contour mapping was completed. Groundwater contours are shown on Drawing PE4368-4 - Groundwater Contour Plan. Based on the contour mapping, groundwater flow beneath the Phase II Property appears to flow towards the southeast. A horizontal hydraulic gradient of approximately 0.0012 m/m was calculated.

5.3 Fine-Coarse Soil Texture

Based on field soil observations, fine-grained soil standards are not applicable to the Phase II Property.

5.4 Soil: Field Screening

Field screening of the soil samples collected during drilling resulted in combustible vapour readings ranging from less than 5ppm to 45ppm. No visual or olfactory indications of potential contamination were identified in the soil samples at the time of the field program. 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

A total of four (4) soil samples were submitted for analysis of a combination of PHCs (F1-F4), BTEX, PAHs and metals. The results of the analytical testing are presented below in Tables 7, 8 and 9. The laboratory certificates of analysis are provided in Appendix 1. The 2012 results are also provided in the table for information purposes.

Table 7: Analytical Test Results – Soil (BTEX and PHCs (F1-F4)

Parameter	MDL (µg/g)	Soil Samples (µg/g)		MOECP Table 3 Residential Standards (µg/g)
		May 8, 2012	July 9, 2018	
		BH6-SS3 (2.28-2.89m)	BH2-SS6 (3.81-4.41m)	
Benzene	0.02	nd	nd	0.21
Ethylbenzene	0.05	nd	0.24	2.3
Toluene	0.05	nd	nd	2
Xylenes (Total)	0.05	0.07	2.08	3.1
PHC F1	7	17	**76**	55
PHC F2	4	nd	**213**	98
PHC F3	8	nd	178	300
PHC F4	6	nd	nd	2,800

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds MOECC Table 3 standards

Concentrations of PHC F_1 and F_2 exceeding the MOECP Table 3 standards were identified in soil Sample BH2-SS6. The remaining BTEX and PHC concentrations identified in the soil sample were in compliance with MOECP Table 3 standards. Xylenes and PHC F_1 were identified in soil Sample BH6-SS3, collected in 2012, at concentrations below the MOECP Table 3 standards. No other parameters concentrations were identified above the laboratory method detection limits.

Table 8
Analytical Test Results – Soil (PAHs)

Parameter	MDL (µg/g)	Soil Sample (µg/g) July 9, 2018	MOECP Table 3 Residential (µg/g)
		BH1-SS2 (0.76-1.37m)	
Acenaphthene	0.02	0.03	7.9
Acenaphthylene	0.02	0.10	0.15
Anthracene	0.02	0.22	0.67
Benzo[a]anthracene	0.02	**0.61**	0.5
Benzo[a]pyrene	0.02	**0.61**	0.3
Benzo[b]fluoranthene	0.02	0.66	0.78
Benzo[g,h,i]perylene	0.02	0.32	6.6
Benzo[k]fluoranthene	0.02	0.36	0.78
Chrysene	0.02	0.65	7
Dibenzo[a,h]anthracene	0.02	0.09	0.1
Fluoranthene	0.02	**1.50**	0.69
Fluorene	0.02	0.03	62
Indeno[1,2,3-cd]pyrene	0.02	0.32	0.38
1-Methylnaphthalene	0.02	0.03	0.99
2-Methylnaphthalene	0.02	0.03	0.99
Methylnaphthalene (1&2)	0.04	0.05	0.99
Naphthalene	0.01	0.03	0.6
Phenanthrene	0.02	0.70	6.2
Pyrene	0.02	1.22	78

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold** – Value exceeds MOECC Table 3 standards

Concentrations of benzo[a]pyrene, benzo[b]fluoranthene and fluoranthene were identified in soil Sample BH1-SS2, at concentrations exceeding the MOECP Table 3 standards. Other PAH parameters were identified at concentrations below the MOECP Table 3 standards, or were not identified above the method detection limit.

Table 9
Analytical Test Results – Soil (Metals)

Parameter	MDL (µg/g)	Soil Samples (µg/g)			MOECP Table 3 Residential Standards (µg/g)
		July 9, 2018		July 10, 2018	
		BH1-SS2 (0.76-1.37m)	BH2-AU1 (0.08-1.0m)	BH3-SS2 (0.76-1.37m)	
Antimony	1.0	nd	nd	nd	7.5
Arsenic	1.0	4.6	4.2	5.8	18
Barium	1.0	135	186	102	390
Beryllium	1.0	nd	nd	nd	4
Boron	1.0	nd	nd	nd	120
Cadmium	0.5	0.5	nd	0.6	1.2
Chromium	1.0	25.9	26.4	21.9	160
Cobalt	1.0	9.0	7.6	17.1	22
Copper	1.0	25.9	29.6	49.4	140
Lead	1.0	66.4	**195**	29.0	120
Molybdenum	1.0	2.7	1.3	5.4	6.9
Nickel	1.0	25.3	23.5	59.5	100
Selenium	1.0	nd	nd	nd	2.4
Silver	0.5	nd	nd	nd	20
Thallium	1.0	nd	nd	nd	1
Uranium	1.0	nd	nd	3.0	23
Vanadium	1.0	32.9	27.3	41.5	86
Zinc	1.0	101	158	96.3	340

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold** – Value exceeds MOECC Table 3 standards

Metal parameters were identified in each of the soil samples submitted for analytical testing. The concentration of lead identified in soil Sample BH2-AU1 exceeds the MOECP Table 3 standard. The remaining parameters identified in this sample are in compliance with the MOECP Table 3 standards.

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

Table 10: Maximum Concentrations – Soil			
Parameter	**Maximum Concentration (µg/g)**	**Borehole**	**Depth Interval (m BGS)**
Ethylbenzene	0.24	BH2	3.81-4.41
Xylenes (Total)	2.08		
PHC F1	**76**		
PHC F2	**213**		
PHC F3	178		
Acenaphthene	0.03	BH1	0.76-1.37
Acenaphthylene	0.10		
Anthracene	0.22		
Benzo[a]anthracene	**0.61**		
Benzo[a]pyrene	**0.61**		
Benzo[b]fluoranthene	0.66		
Benzo[g,h,i]perylene	0.32		
Benzo[k]fluoranthene	0.36		
Chrysene	0.65		
Dibenzo[a,h]anthracene	0.09		
Flouranthene	**1.50**		
Fluorene	0.03		
Indeno[1,2,3-cd]pyrene	0.32		
1-Methylnaphthalene	0.03		
2-Methylnaphthalene	0.03		
Methylnaphthalene (1&2)	0.05		
Naphthalene	0.03		
Phenanthrene	0.70		
Pyrene	1.22		
Arsenic	5.8	BH3	0.76-1.37
Barium	186	BH2	0.08-1.0
Chromium	26.4		
Cobalt	17.1	BH3	0.76-1.37
Copper	49.4		
Lead	**195**	BH2	0.08-1.0
Molybdenum	5.4	BH3	0.76-1.37
Nickel	59.5		
Uranium	3.0		
Vanadium	41.5		
Zinc	158	BH2	0.08-1.0

Notes:
- **Bold and Underlined** – Value exceeds MOECC Table 3 standards

All other parameter concentrations were below laboratory detection limits.

5.6 Groundwater Quality

Groundwater samples from monitoring wells installed in BH1, BH2 and BH3 were submitted for laboratory analysis of BTEX and PHC parameters. The groundwater samples were obtained from the screened intervals noted on Table 2. The results of the analytical testing are presented below in Table 11. The laboratory certificates of analysis are provided in Appendix 1.

Table 11: Analytical Test Results – Groundwater (BTEX and PHCs (F1-F4))

Parameter	MDL (µg/L)	Groundwater Samples (µg/L) July 17, 2018			MOECP Table 3 Standards (µg/L)
		BH1-GW1 (6.80-8.30)	BH2-GW1 (5.40-8.40)	BH3-GW1 (6.91-8.41)	
Benzene	0.5	nd	nd	nd	44
Ethylbenzene	0.5	nd	nd	nd	2,300
Toluene	0.5	nd	nd	nd	18,000
Xylenes	0.5	nd	nd	nd	4,200
PHC F1	25	nd	nd	nd	750
PHC F2	100	nd	nd	nd	150
PHC F3	100	nd	nd	nd	500
PHC F4	100	nd	nd	nd	500

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

No BTEX or PHC parameters were detected above the laboratory method detection limits in any of the groundwater samples submitted for analytical testing. The results are considered to be in compliance with the MOECP Table 3 standards.

A petroleum hydrocarbon sheen was observed on the water initially purged from BH2; once the initial well volume was purged, the water was clear with no hydrocarbon sheen. No free phase hydrocarbons or hydrocarbon sheen were noted on the groundwater recovered from BH1 and BH3.

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of the April 2018 sampling event were handled in accordance with the Analytical Protocol with respect to holding time, preservation method, storage requirement, and container type.

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

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 accordance with the requirements of O.Reg. 269/11 amending O.Reg. 153/04 - Record of Site Condition regulation, made under the Environmental Protection Act. Conclusions and recommendations are discussed in a subsequent section.

Site Description

Potentially Contaminating Activity and Areas of Potential Environmental Concern

As indicated in the Phase I-ESA report and Section 2.2 of this report, the following PCAs are considered to result in APECs on the Phase I and Phase II Property:

- Item 28 – Gasoline and Associated Products Storage in Fixed Tanks – based on the presence of a retail fuel outlet at 1 Montreal Road, adjacent to the southwest of the subject land, from as early as 1940.
- Item 30 – Fill Material of Unknown Quality – potentially impacted fill material was identified during the Phase II ESA field program.
- Item 52 – Storage, maintenance, fuelling and repair of equipment, vehicles, and material used to maintain transportation systems – based on the 1956 FIP and aerial photographs, the property at 1 Montreal Road was considered to be historically occupied by an automotive service garage.

Contaminants of potential concern associated with the aforementioned PCAs include a combination of PHCs (F1-F4), BTEX, PAHs and/or metals, in the groundwater and/or soil.

Subsurface Structures and Utilities

Underground service locates were completed prior to the subsurface investigation. Underground utilities on the Phase II Property include natural gas, which services the adjacent residential building to the east, as well as buried telephone and cable conduits. No private wells or septic systems are present on the Phase II Property or within the Phase I Study Area. Approximate locations of buried services are shown on Drawing PE4368-1 – Site Plan appended to the Phase I ESA.

Physical Setting

Site Stratigraphy

The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is illustrated on Drawings PE4368-7 and 8 - Cross-Section A-A' and B-B'. Stratigraphy consists of:

- Pavement structure consisting of approximately 0.06 to 0.10m of asphaltic concrete over crushed stone with silt and sand, extending to depths ranging from approximately 0.38 to 0.69m below grade. The site had not been paved at the time BH6 was drilled in 2012. At this time, brown silty sand with crushed stone and gravel was present from ground surface to a depth of approximately 0.20m below grade.

- Fill material generally consisting of brown silty sand with crushed stone, gravel and clay, was identified at each borehole location, extending to depths ranging from approximately 0.91 to 1.68m below grade. It should be noted that possible fragments of possible ash and coal were identified in the material at BH1.

- Glacial till consisting of dark brown silty clay with gravel and occasional shale fragments was identified beneath the fill material. Shale fragments were noted to increase with depth. Glacial till extended to depths ranging from approximately 4.95 to 6.15m below grade.

- Heavily fractured black shale bedrock was identified beneath the glacial till. More competent shale was identified at depth. Groundwater was identified in this stratigraphic unit.

Hydrogeological Characteristics

Groundwater at the Phase II Property was encountered within the bedrock. This unit is interpreted to function as a local aquifer at the subject site.

Water levels were measured at the subject site on July 17 2018, at depths ranging from 6.58 to 6.87m below grade. Based on the groundwater elevations measured during this monitoring event, groundwater contour mapping was completed and the horizontal hydraulic gradient for the subject site was calculated. Groundwater flow at the subject site was in a southeasterly direction, with a hydraulic gradient of approximately 0.0012 m/m. Based on the topography and proximity of the Rideau River, the regional groundwater flow is interpreted to be in a northwesterly direction.

Approximate Depth to Bedrock

Bedrock was encountered at depths ranging from approximately 4.95 to 6.15m below grade.

Approximate Depth to Water Table

Depth to water table at the subject site varies between approximately 6.58 to 6.87m below existing grade.

Sections 41 and 43.1 of the Regulation

Section 41 of the Regulation (Site Condition Standards, Environmentally Sensitive Areas) does not apply to the subject site.

Section 43.1 of the Regulation does not apply to the subject site in that the subject site is not a Shallow Soil Property.

Fill Placement

Fill material was identified across the Phase II Property beneath the pavement structure and extending to depths of approximately 0.91 to 1.68m below grade. The upper fill is suspected to have been placed on the subject site at some time between 2014 and 2017, when the property was paved. Fragments of possible coal and ash were identified in the fill material at BH1.

Proposed Buildings and Other Structures

It is our understanding that the Phase II Property will be redeveloped with a multi-storey residential building with a slab-on-grade construction.

Existing Buildings and Structures

There are no buildings or structures currently present on the Phase II Property.

Water Bodies

There are no water bodies on the subject land or within 250m of the Phase II Property.

Areas of Natural Significance

No areas of natural significance are present on or within the vicinity of the Phase II Property.

Environmental Condition

Areas Where Contaminants are Present

Based on visual screening and analytical test results, metals and/or PAH impacted fill material is present at BH1 and BH2. Based on the nature of fill material, pockets of impacted fill material may be present across the Phase II Property. Concentrations of PHC F_1 and PHC F_2 exceeding the MOECP Table 3 standards were identified in the native soil or upper levels of weathered shale bedrock on the southeastern portion of the Phase II Property. Groundwater was determined to be in compliance with the MOECP Table 3 standards. Analytical test results are shown on Drawings PE4368-5A, B, C and PE4258-6 – Analytical Testing Plans.

Types of Contaminants

Based on the PCAs resulting in APECs on the Phase II Property and current analytical testing, contaminants of concern in the soil include the following: PHCs, F1 and F2, PAHs (benzo[a]anthracene, benzo[a]pyrene, fluoranthene) and lead.

As noted previously, the groundwater at the Phase II Property is clean; no contaminants of concern were detected above the laboratory method detection limits.

Contaminated Media

Based on the results of the Phase II ESA, the fill material at BH1 and BH2 is impacted with lead or PAHs, while native soil at BH2 is impacted with PHC F_1 and F_2 concentrations exceeding the MOECP Table 3 standards. Groundwater samples obtained from the Phase II Property were in compliance with the selected MOECP standards.

What Is Known About Areas Where Contaminants Are Present

It is possible impacted pockets of fill material will be present across the site, outside of the borehole locations, based on the non-homogeneous nature of the fill material. Native soil, just above the shale bedrock, is impacted with PHCs at BH2, on the southwestern portion of the Phase II Property. Analytical test results exceeding the MOECC Table 3 standards are presented on Drawings PE4368-5A-C Analytical Testing Plans (Soil).

Distribution and Migration of Contaminants

As previously noted, impacted fill material is expected to be present in pockets across the site, outside of the borehole locations (BH1 and BH2) where lead and PAH impacts were identified at concentrations exceeding the MOECP Table 3 standards. Based on their low solubilities and low mobility, it is anticipated that the PAH and metal impacts are contained to the fill material.

The PHC (F_1 and F_2) impacts identified at BH2 appear to extend to the shale bedrock. The impacts are not considered to have horizontally migrated a significant distance or vertically migrated through the more competent bedrock as no contaminant concentrations were identified in the groundwater recovered from BH1, BH2 or BH3.

Please refer to Drawings PE4368-7 and PE4368-8 – Cross Sections A-A' and B-B' which depict the anticipated vertical distribution of contaminants based on the available information to date.

Discharge of Contaminants

Metal and PAH concentrations are considered to have been directly discharged to the fill material through historical infilling or historical storage/management of coal (and resulting ash) for heating purposes.

The PHC impacted soil is considered to have resulted from off-site fuel releases on the adjacent property to the southwest (existing retail fuel outlet and former automotive service garage).

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. Leaching is not considered an issue since the impacted fill material is considered to have been imported to the Phase II Property for grading purposes prior to paving and therefore has been covered with the pavement structure.

The fluctuation of groundwater levels is not considered to have significantly affected contaminant transport as the groundwater beneath the Phase II Property is in compliance with MOECC Table 3 standards.

Potential for Vapour Intrusion

There are no building structures currently present on the Phase II Property and therefore no potential for vapour intrusion. All impacted soil will removed from the subject land in conjunction with future redevelopment and therefore no future potential for vapour intrusion exists.

6.0 CONCLUSIONS

Assessment

A Phase II ESA was conducted for the property addressed 20 Mark Avenue, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APECs) on the Phase I and Phase II Property. The subsurface investigation was carried out in conjunction with a Geotechnical Investigation and consisted of drilling three (3) boreholes, all of which were constructed with groundwater monitoring wells.

Soil samples were obtained from the boreholes and screened using visual observations and organic vapour measurements. A total of four (4) soil samples were submitted for laboratory analysis of a combination of benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs, F_1-F_4), polycyclic aromatic hydrocarbons (PAHs) and metals. Several PAH and metal parameters exceeding MOECP Table 3 standards were identified in the fill material while petroleum hydrocarbon fractions F1 and F2 were identified on the southwestern portion of the Phase II Property, at concentrations exceeding the MOECP Table 3 standards.

Groundwater samples from monitoring wells installed in BH1, BH2 and BH3 were recovered and analysed for BTEX and PHC parameters. No contaminant concentrations were identified above the laboratory method detection limits. The groundwater is in compliance with the MOECP Table 3 standards.

Conclusion

Based on the findings of the Phase II ESA, fill material impacted with PAH and metal concentrations exceeding MOECP Table 3 standards is present on the Phase II Property. Soil impacted with PHC (F1 and F2) concentrations is also present on the Phase II Property. It is our understanding that the subject site is to be redeveloped with a multi-storey residential building with a slab-on-grade construction.

It is our recommendation that an environmental site remediation program, involving the removal of all impacted soil, be completed concurrently with the site redevelopment.

Prior to offsite disposal at a licenced landfill site, a leachate analysis of a representative sample of contaminated soil must be conducted in accordance with Ontario Regulation 347/558.

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

It is expected that groundwater monitoring wells will be abandoned in accordance with O.Reg.903, at the time of construction excavation. It is recommended that the integrity of the monitoring wells be maintained, prior to future construction, for possible future groundwater monitoring purposes.

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 by O.Reg. 269/11, 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 Manor Park Management and notification from Manor Park Management and Paterson Group will be required to release this report to any other party.

Paterson Group Inc.

Karyn Munch, P.Eng.

Mark S. D'Arcy, P.Eng.

Report Distribution:

- Manor Park Management
- Paterson Group

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE4368-3 – TEST HOLE LOCATION PLAN

DRAWING PE4368-4 - GROUNDWATER CONTOUR PLAN

DRAWING PE4368-5A – ANALYTICAL TESTING PLAN – SOIL (METALS)

DRAWING PE4368-5B – ANALYTICAL TESTING PLAN – SOIL (BTEX & PHC)

DRAWING PE4368-5C– ANALYTICAL TESTING PLAN – SOIL (PAHs)

DRAWING PE4368-6 – ANALYTICAL TESTING PLAN – GROUNDWATER

DRAWING PE4368-7A – CROSS-SECTION A-A' – SOIL (METALS)

DRAWING PE4368-7B – CROSS-SECTION A-A' – SOIL (BTEX & PHC)

DRAWING PE4368-7C – CROSS-SECTION A-A' – SOIL (PAHs)

DRAWING PE4368-7D– CROSS-SECTION A-A' – GROUNDWATER

DRAWING PE4368-8A – CROSS-SECTION B-B' – SOIL (METALS)

DRAWING PE4368-8B – CROSS-SECTION B-B' – SOIL (BTEX & PHC)

DRAWING PE4368-8C – CROSS-SECTION B-B' – GROUNDWATER

DRAWING PE4368-9 – CONTAMINANT TRANSPORT DIAGRAM

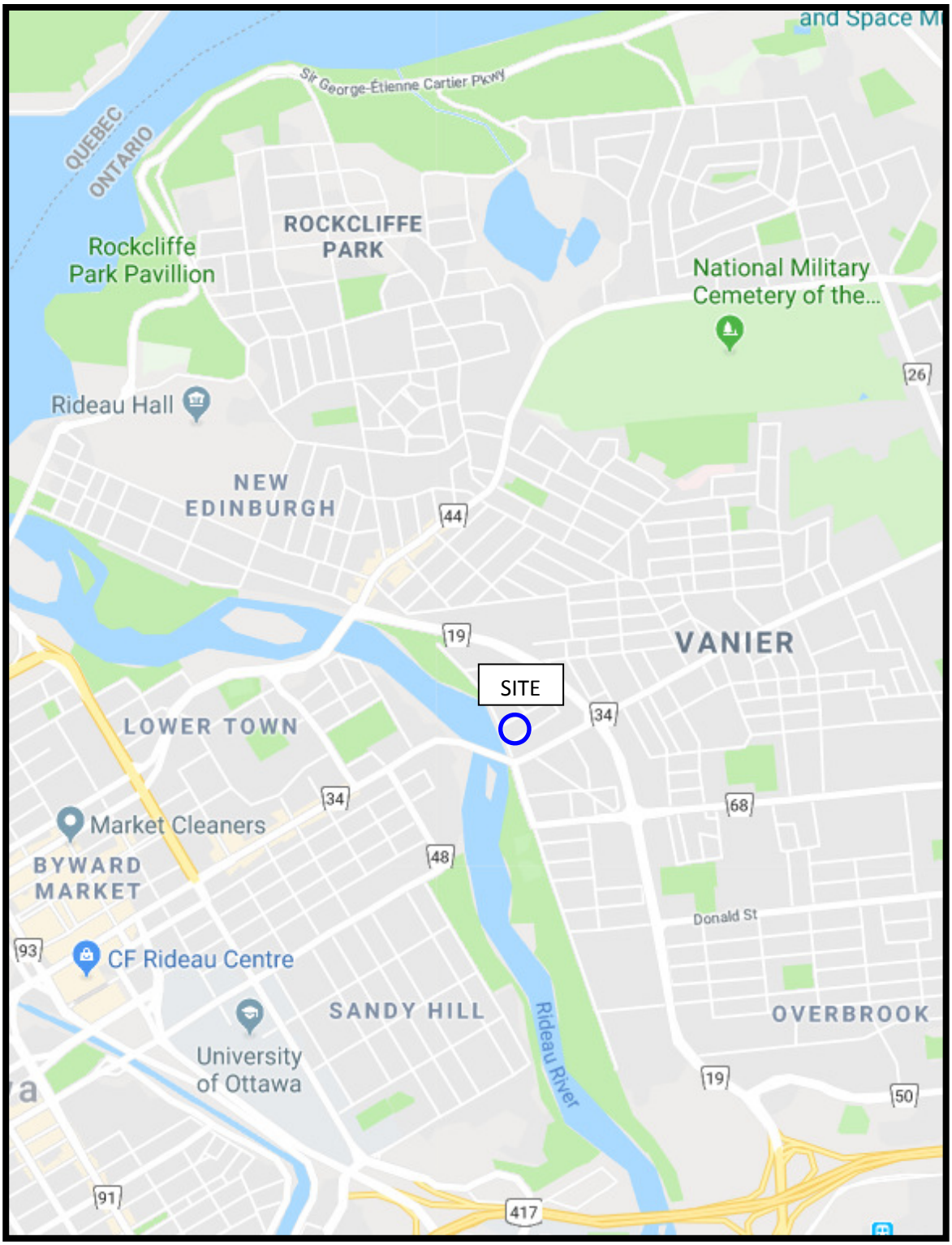
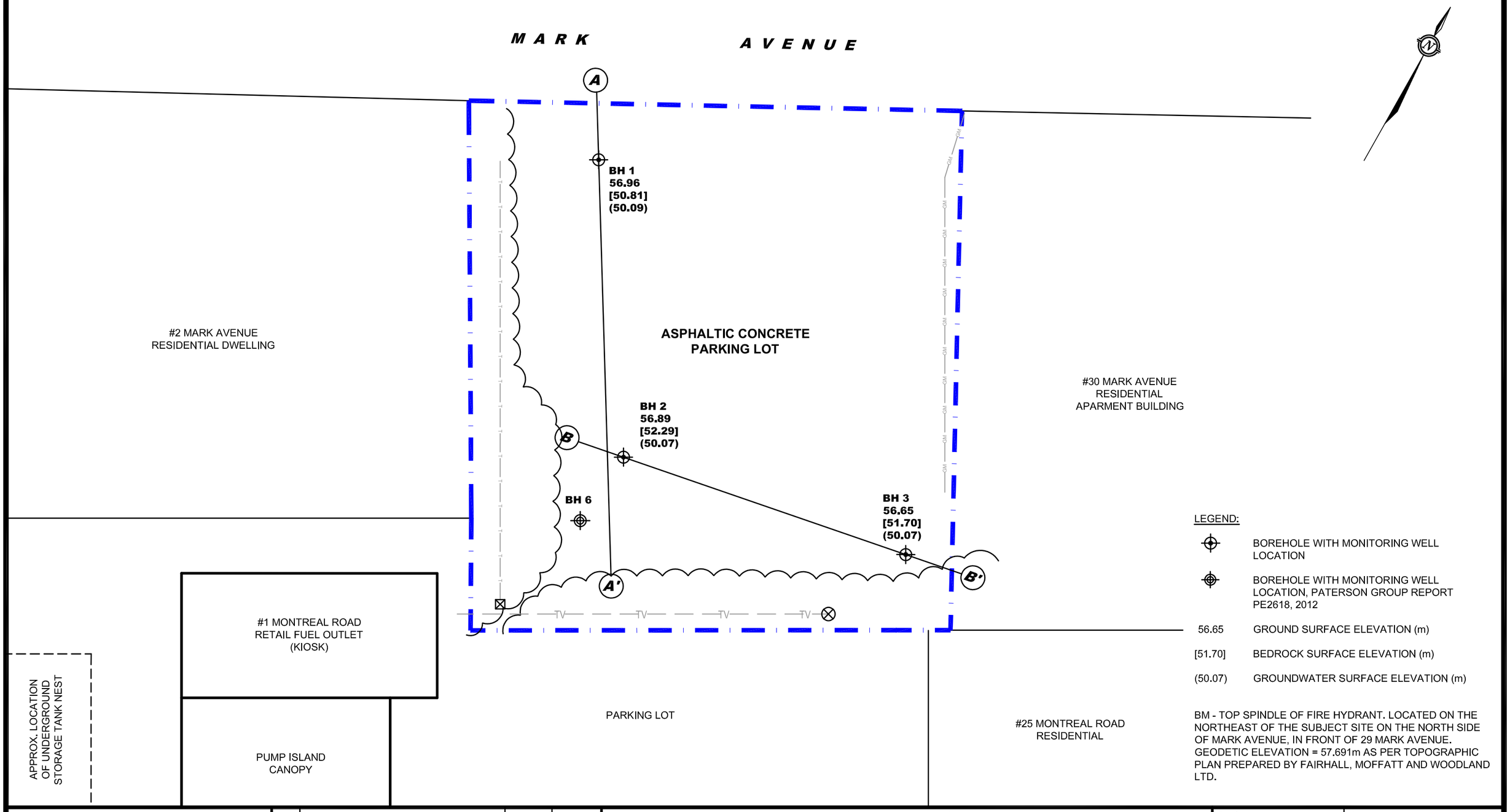


FIGURE 1

KEY PLAN



LEGEND:

- BOREHOLE WITH MONITORING WELL LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION, PATERSON GROUP REPORT PE2618, 2012
- 56.65 GROUND SURFACE ELEVATION (m)
- [51.70] BEDROCK SURFACE ELEVATION (m)
- (50.07) GROUNDWATER SURFACE ELEVATION (m)

BM - TOP SPINDLE OF FIRE HYDRANT. LOCATED ON THE NORTHEAST OF THE SUBJECT SITE ON THE NORTH SIDE OF MARK AVENUE, IN FRONT OF 29 MARK AVENUE. GEODETIC ELEVATION = 57.691m AS PER TOPOGRAPHIC PLAN PREPARED BY FAIRHALL, MOFFATT AND WOODLAND LTD.

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NO.	REVISIONS	DATE	INITIAL
0			

MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:200	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-3
Approved by: MSD	Revision No.: 0

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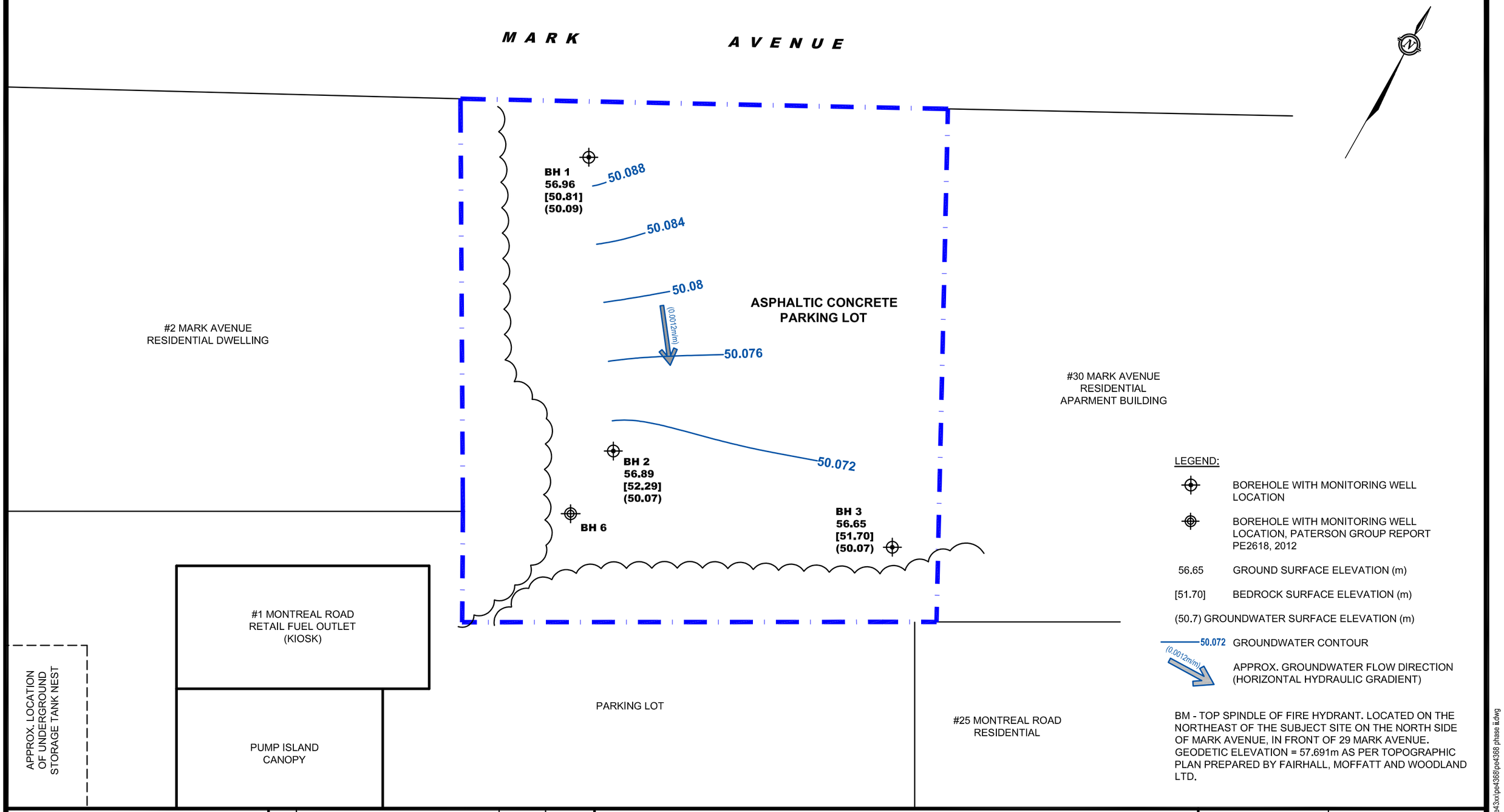

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

GROUNDWATER CONTOUR PLAN

Scale: 1:200	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-4
Approved by: MSD	Revision No.: 0

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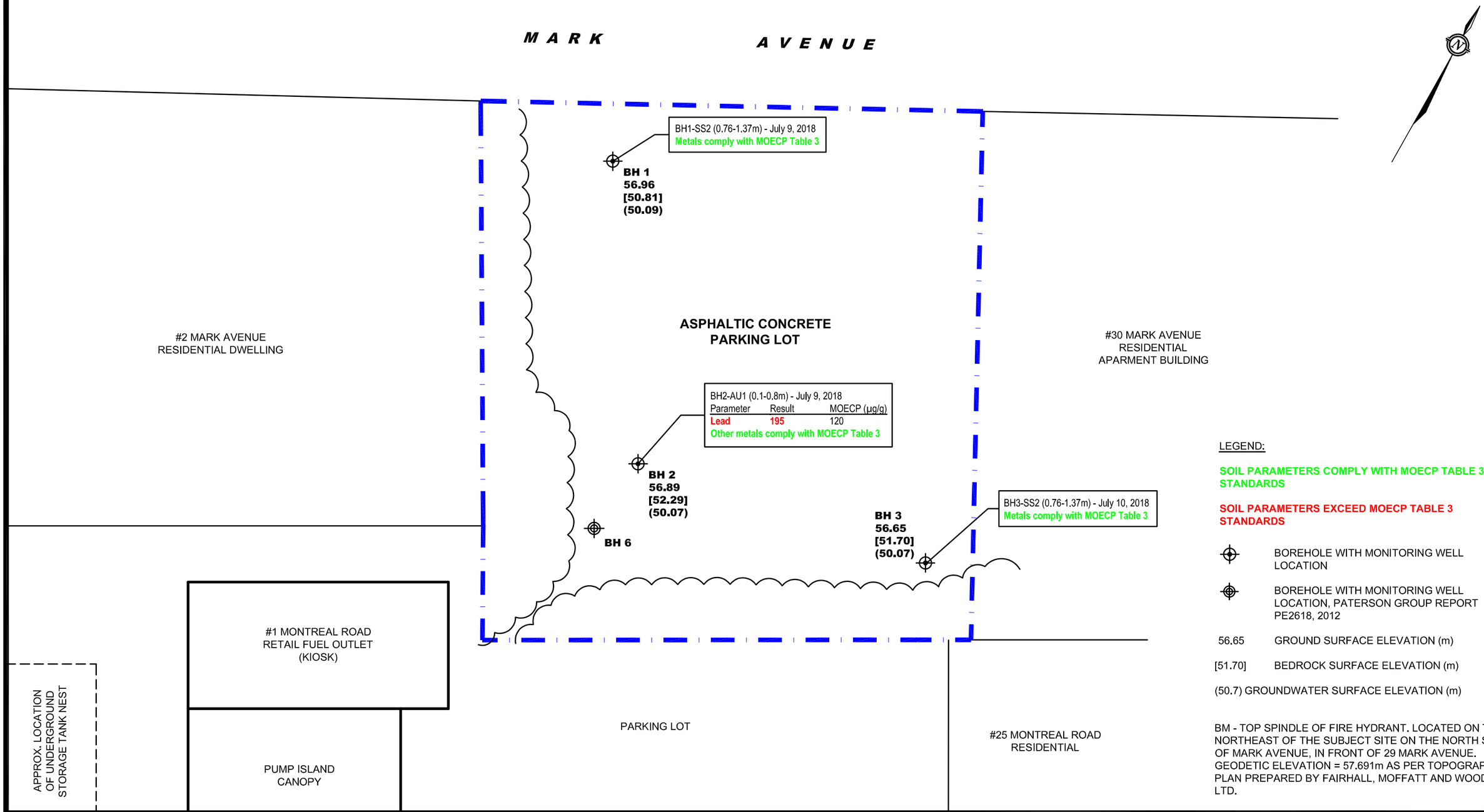

LEGEND:

SOIL PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

SOIL PARAMETERS EXCEED MOECP TABLE 3 STANDARDS

- BOREHOLE WITH MONITORING WELL LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION, PATERSON GROUP REPORT PE2618, 2012
- 56.65 GROUND SURFACE ELEVATION (m)
- [51.70] BEDROCK SURFACE ELEVATION (m)
- (50.7) GROUNDWATER SURFACE ELEVATION (m)

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title: ANALYTICAL TESTING PLAN - SOIL (METALS)

Scale: 1:200	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-5A
Approved by: MSD	Revision No.: 0

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MARK AVENUE

BH 1
56.96
[50.81]
(50.09)

ASPHALTIC CONCRETE
PARKING LOT

BH2-SS6 (3.81-4.41m) - July 9, 2018

Parameter	Result	MOECP (µg/g)
PHC F1	76	55
PHC F2	213	98

BTEX and PHC F3, F4 comply with MOECP Table 3

BH 2
56.89
[52.29]
(50.07)

BH 3
56.65
[51.70]
(50.07)

BH 6

BH6-SS3 (2.28-2.89m) - May 8, 2012
BTEX and PHCs comply with MOECP Table 3

#2 MARK AVENUE
RESIDENTIAL DWELLING

#30 MARK AVENUE
RESIDENTIAL
APARMENT BUILDING

#1 MONTREAL ROAD
RETAIL FUEL OUTLET
(KIOSK)

APPROX. LOCATION
OF UNDERGROUND
STORAGE TANK NEST

PUMP ISLAND
CANOPY

PARKING LOT

#25 MONTREAL ROAD
RESIDENTIAL

LEGEND:

SOIL PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

SOIL PARAMETERS EXCEED MOECP TABLE 3 STANDARDS

BOREHOLE WITH MONITORING WELL LOCATION

BOREHOLE WITH MONITORING WELL LOCATION, PATERSON GROUP REPORT PE2618, 2012

56.65 GROUND SURFACE ELEVATION (m)

[51.70] BEDROCK SURFACE ELEVATION (m)

(50.7) GROUNDWATER SURFACE ELEVATION (m)

BM - TOP SPINDLE OF FIRE HYDRANT. LOCATED ON THE NORTHEAST OF THE SUBJECT SITE ON THE NORTH SIDE OF MARK AVENUE, IN FRONT OF 29 MARK AVENUE. GEODETIC ELEVATION = 57.691m AS PER TOPOGRAPHIC PLAN PREPARED BY FAIRHALL, MOFFATT AND WOODLAND LTD.

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:
ANALYTICAL TESTING PLAN - SOIL (BTEX & PHC)

Scale: 1:200	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-5B
Approved by: MSD	Revision No.: 0

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MARK AVENUE

BH 1
56.96
[50.81]
(50.09)

BH1-SS2 (0.76-1.37m) - July 9, 2018

Parameter	Result	MOECP (µg/g)
Benzo[a]anthracene	0.61	0.5
Benzo[a]pyrene	0.61	0.3
Fluoranthene	1.5	0.69
Other PAHs comply with MOECP Table 3		

ASPHALTIC CONCRETE PARKING LOT

#2 MARK AVENUE
RESIDENTIAL DWELLING

#30 MARK AVENUE
RESIDENTIAL
APARMENT BUILDING

BH 2
56.89
[52.29]
(50.07)

BH 6

BH 3
56.65
[51.70]
(50.07)

#1 MONTREAL ROAD
RETAIL FUEL OUTLET
(KIOSK)

APPROX. LOCATION OF UNDERGROUND STORAGE TANK NEST

PUMP ISLAND CANOPY

PARKING LOT

#25 MONTREAL ROAD
RESIDENTIAL

LEGEND:

SOIL PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

SOIL PARAMETERS EXCEED MOECP TABLE 3 STANDARDS

BOREHOLE WITH MONITORING WELL LOCATION

BOREHOLE WITH MONITORING WELL LOCATION, PATERSON GROUP REPORT PE2618, 2012

56.65 GROUND SURFACE ELEVATION (m)

[51.70] BEDROCK SURFACE ELEVATION (m)

(50.7) GROUNDWATER SURFACE ELEVATION (m)

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - SOIL (PAH)

Scale: 1:200	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-5C
Approved by: MSD	Revision No.: 0

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MARK AVENUE

BH1-GW1 (6.80-8.30m) - July 17, 2018
BTEX and PHCs comply with MOECP Table 3

BH 1
56.96
[50.81]
(50.09)

#2 MARK AVENUE
RESIDENTIAL DWELLING

ASPHALTIC CONCRETE
PARKING LOT

#30 MARK AVENUE
RESIDENTIAL
APARMENT BUILDING

BH2-GW1 (5.40-8.40m) - July 17, 2018
BTEX and PHCs comply with MOECP Table 3

BH3-GW1 (6.91-8.41m) - July 17, 2018
BTEX and PHCs comply with MOECP Table 3

BH 2
56.89
[52.29]
(50.07)

BH 6

BH 3
56.65
[51.70]
(50.07)

#1 MONTREAL ROAD
RETAIL FUEL OUTLET
(KIOSK)

APPROX. LOCATION
OF UNDERGROUND
STORAGE TANK NEST

PUMP ISLAND
CANOPY

PARKING LOT

#25 MONTREAL ROAD
RESIDENTIAL

LEGEND:

GROUNDWATER PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

- BOREHOLE WITH MONITORING WELL LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION, PATERSON GROUP REPORT PE2618, 2012
- 56.65 GROUND SURFACE ELEVATION (m)
- [51.70] BEDROCK SURFACE ELEVATION (m)
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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:
ANALYTICAL TESTING PLAN - GROUNDWATER

Scale: 1:200	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-6
Approved by: MSD	Revision No.: 0

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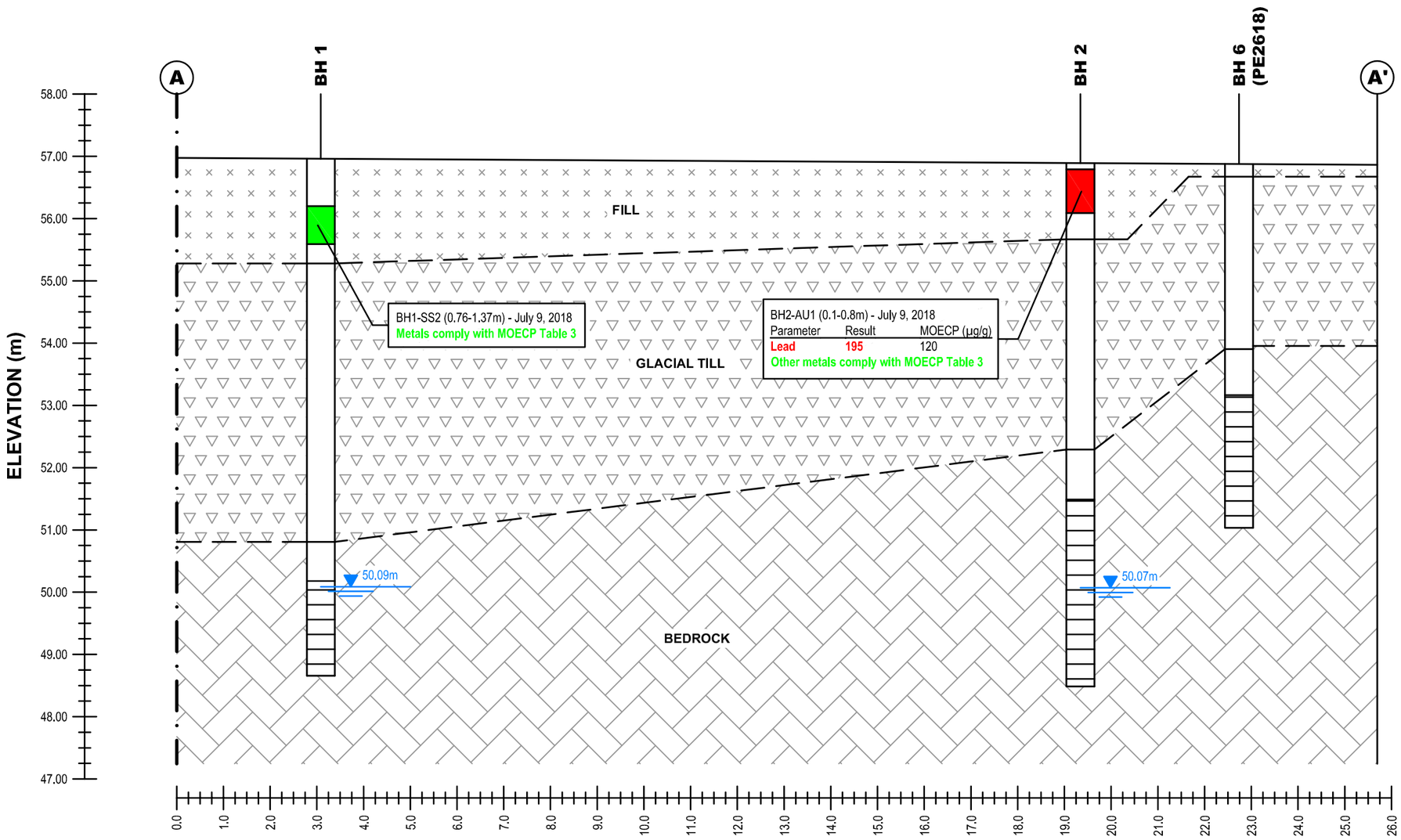

SOIL PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

SOIL PARAMETERS EXCEED MOECP TABLE 3 STANDARDS

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0			

MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A' - SOIL (METALS)

Scale: AS SHOWN	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-7A
Approved by: MSD	Revision No.: 0

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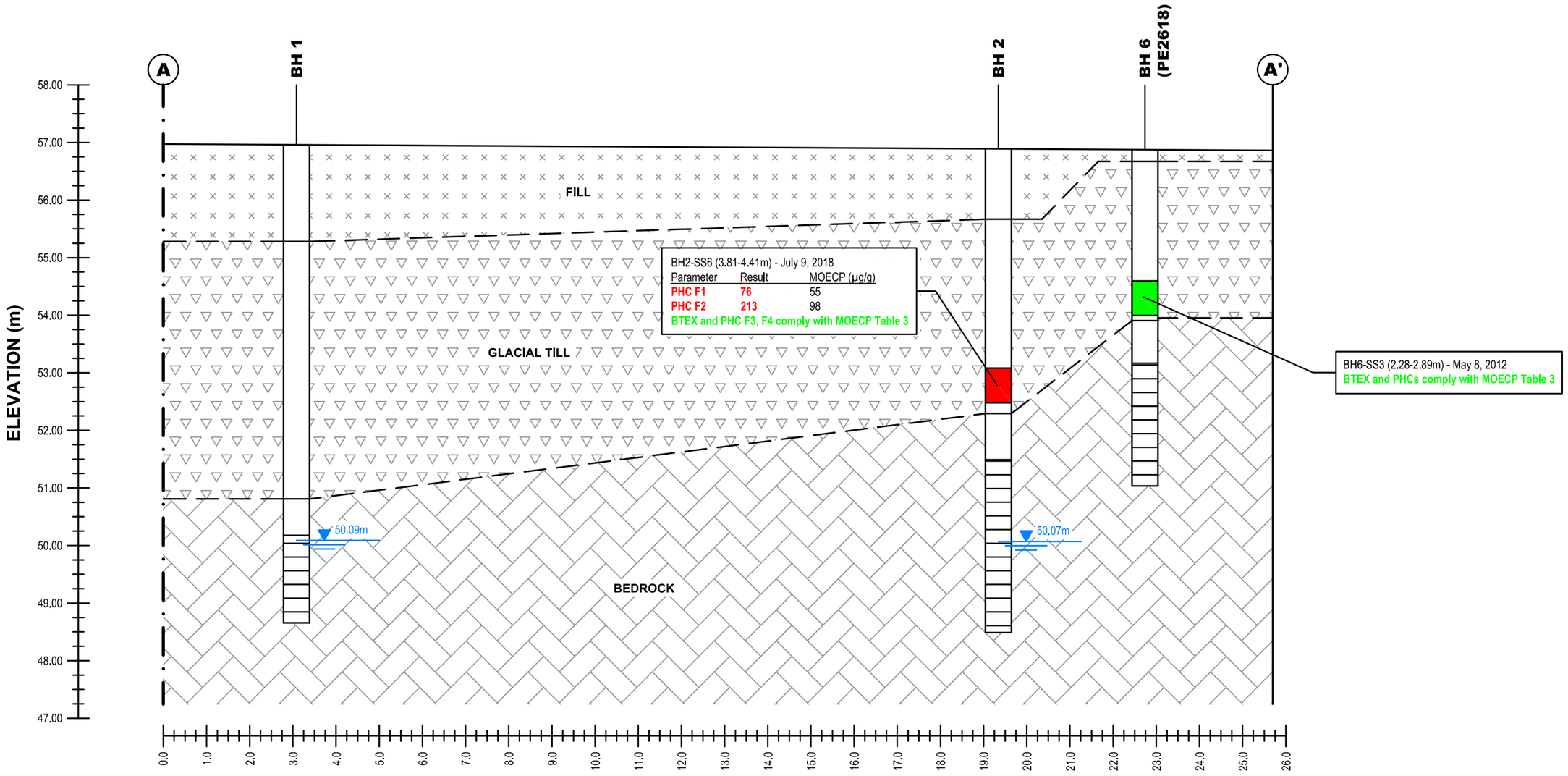

SOIL PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

SOIL PARAMETERS EXCEED MOECP TABLE 3 STANDARDS

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consulting engineers

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NO.	REVISIONS	DATE	INITIAL
0			

MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A' - SOIL (BTEX & PHC)

Scale: AS SHOWN	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-7B
Approved by: MSD	Revision No.: 0

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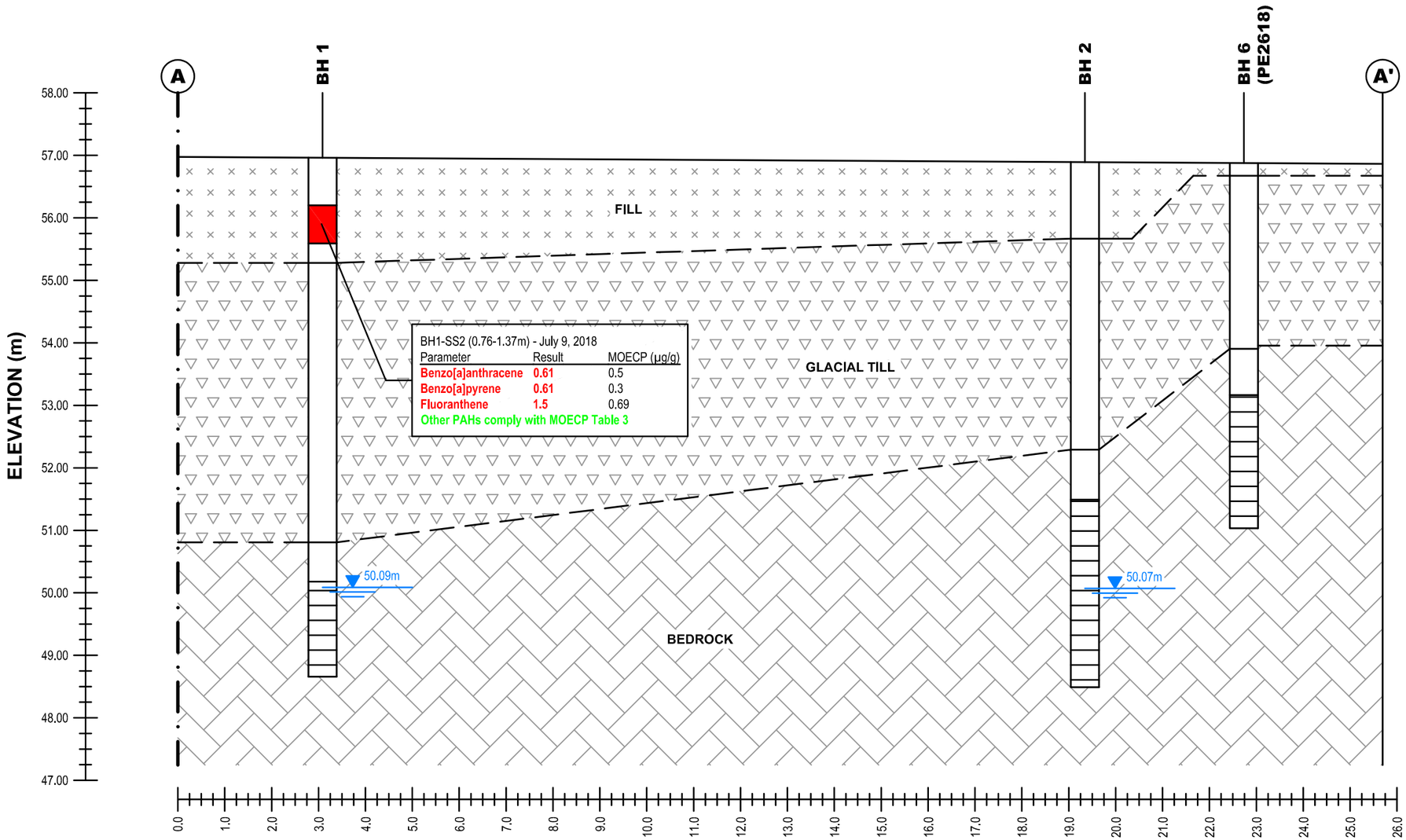

SOIL PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

SOIL PARAMETERS EXCEED MOECP TABLE 3 STANDARDS

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A' - SOIL (PAH)

Scale: AS SHOWN	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-7C
Approved by: MSD	Revision No.: 0

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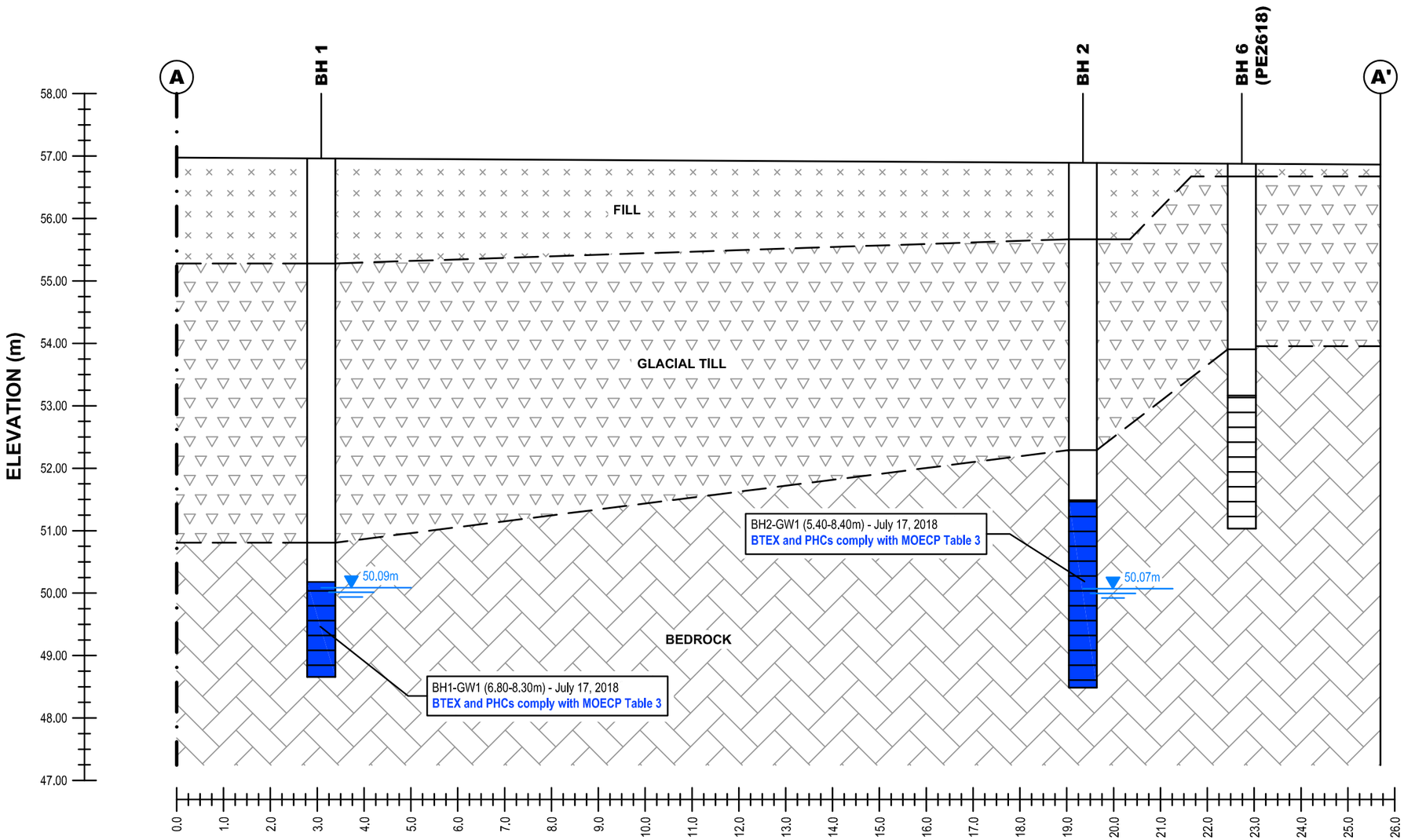

GROUNDWATER PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A' - GROUNDWATER

Scale: AS SHOWN	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-7D
Approved by: MSD	Revision No.: 0

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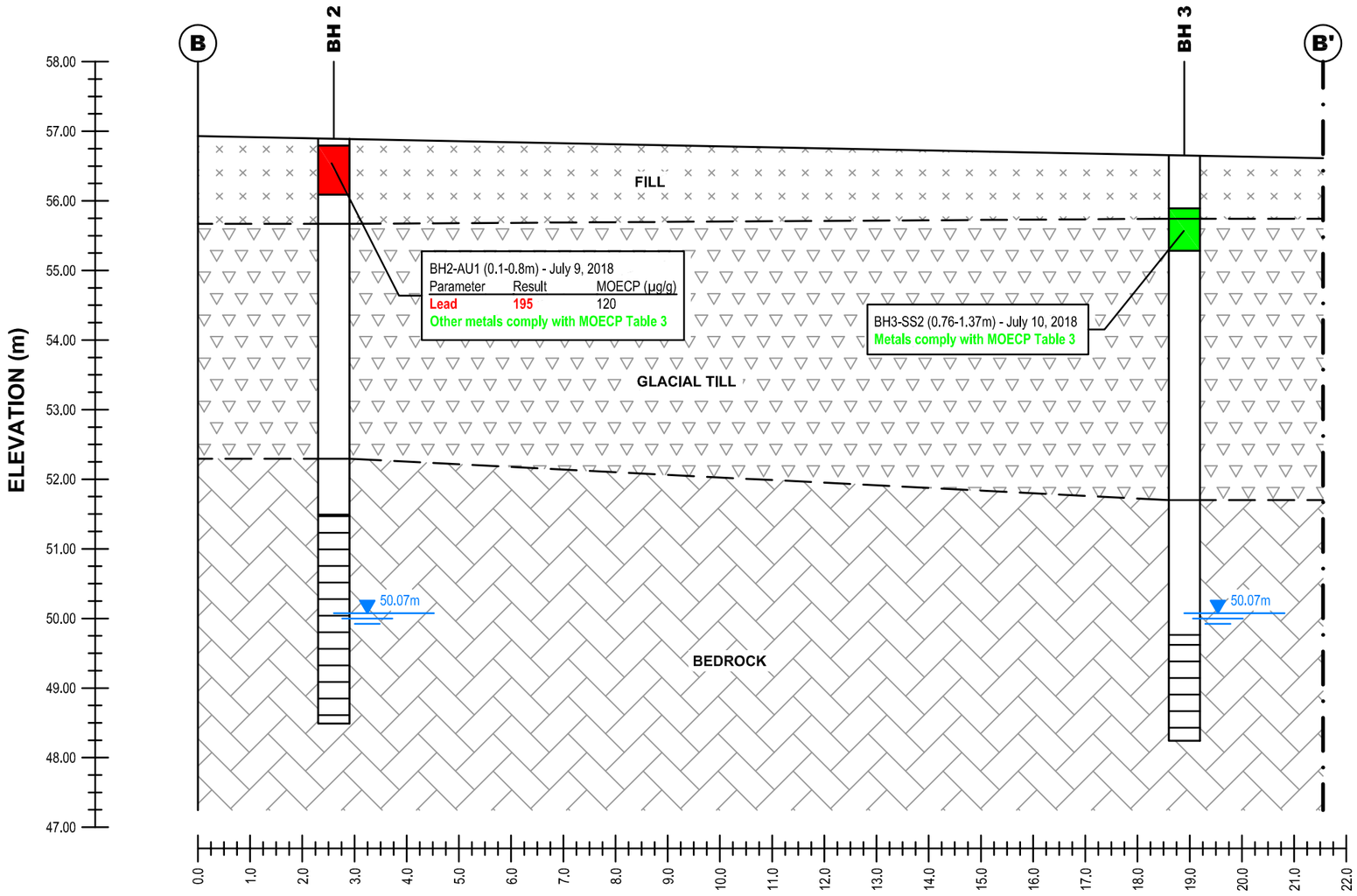

SOIL PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE
OTTAWA, ONTARIO

Title:

CROSS-SECTION B-B' - SOIL (METALS)

Scale: AS SHOWN	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-8A
Approved by: MSD	Revision No.: 0

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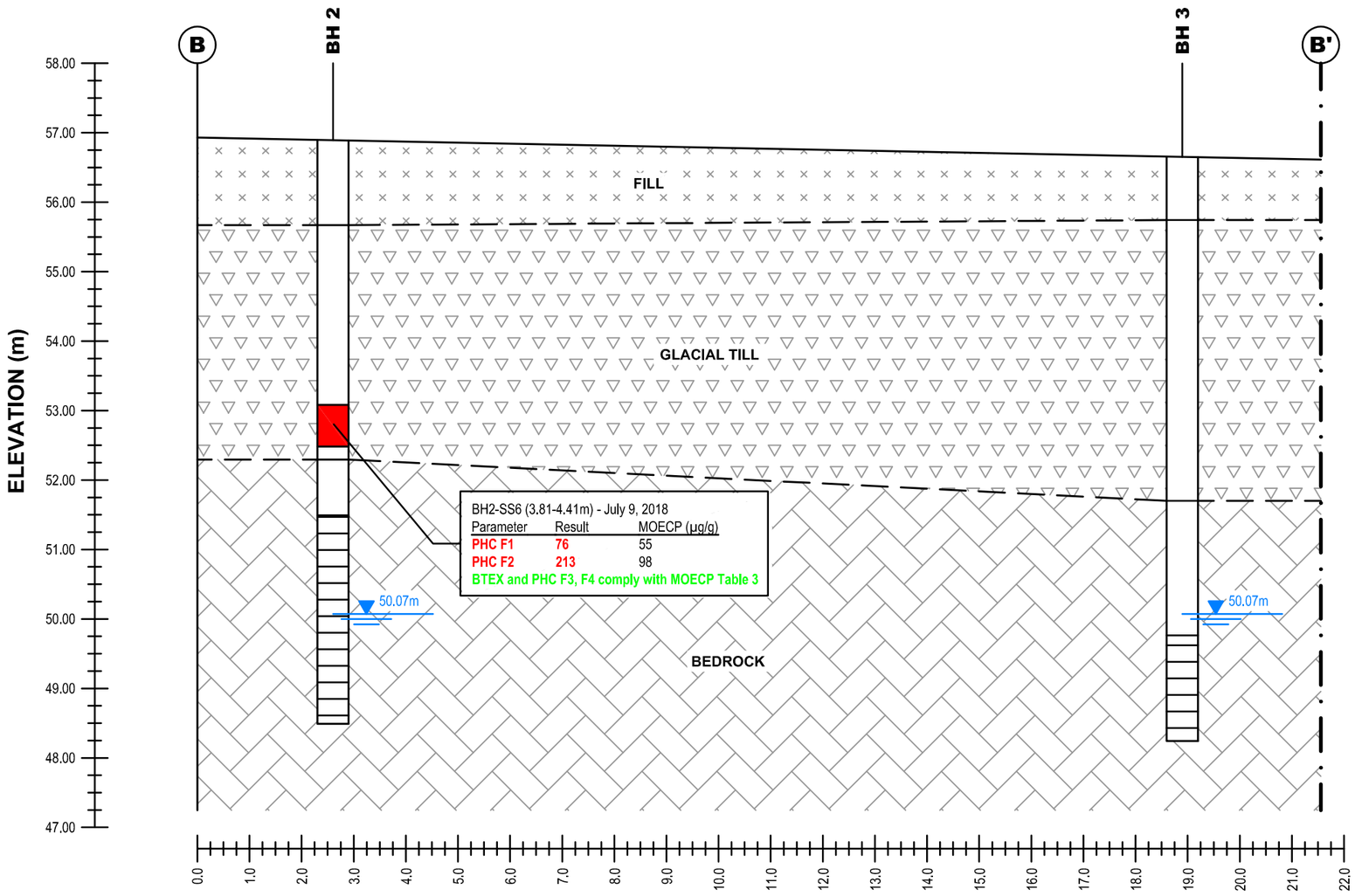

SOIL PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

SOIL PARAMETERS EXCEED MOECP TABLE 3 STANDARDS

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION B-B' - SOIL (BTEX & PHC)

Scale: AS SHOWN	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-8B
Approved by: MSD	Revision No.: 0

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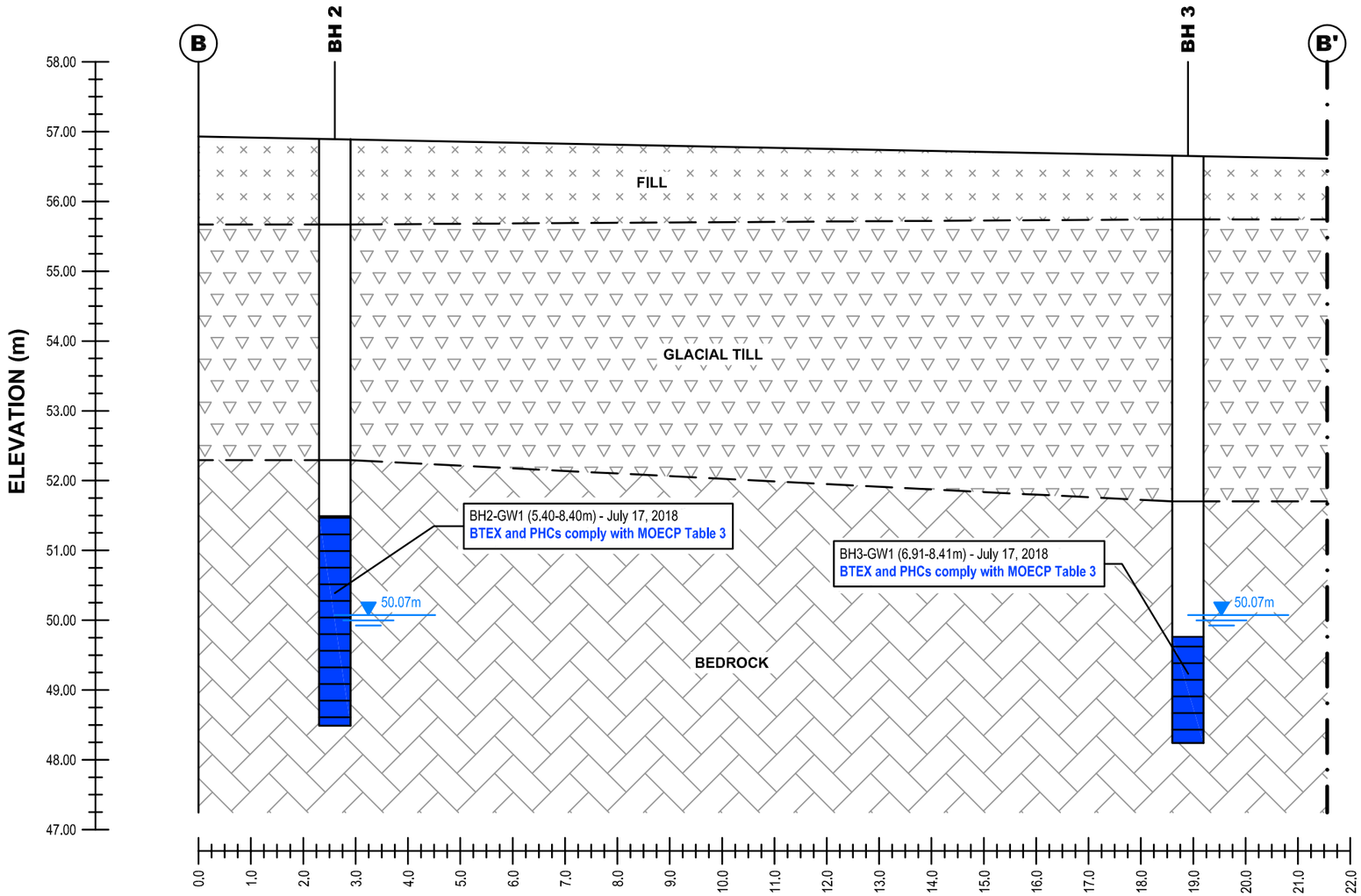

GROUNDWATER PARAMETERS COMPLY WITH MOECP TABLE 3 STANDARDS

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MANOR PARK MANAGEMENT

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION B-B' - GROUNDWATER

Scale: AS SHOWN	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-8C
Approved by: MSD	Revision No.: 0

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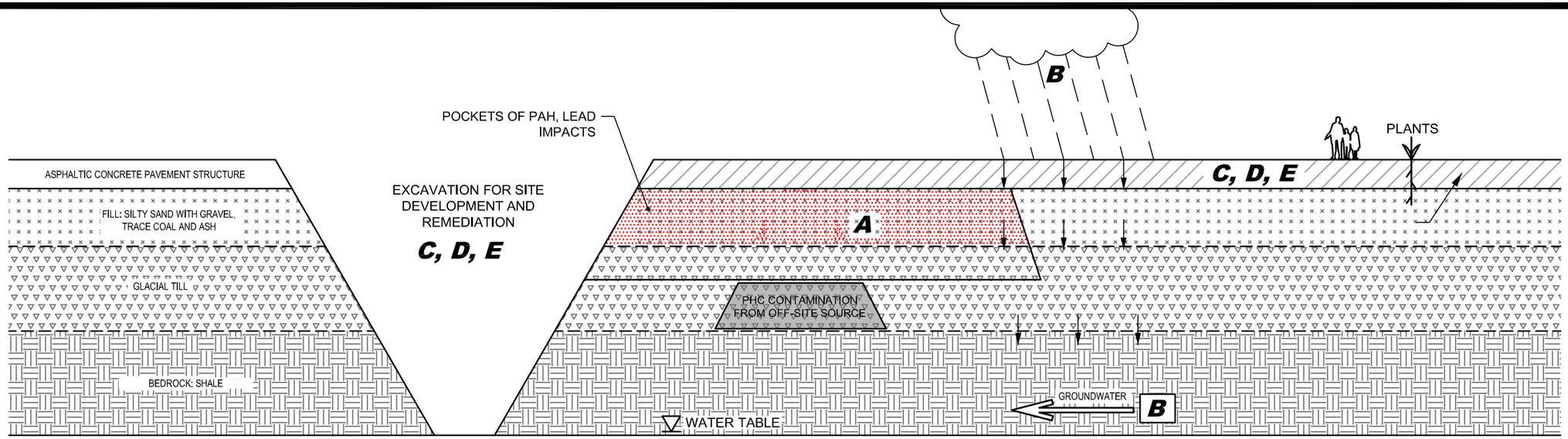

CONTAMINANT RELEASE MECHANISMS

A Fill material impacted with lead and PAH parameters exceeding MOECP Table 3 standards, was identified on the Phase II Property and is expected to be present in pockets outside the borehole locations. Both lead and PAH impacts are considered to have been directly discharged to off-site sites through historical infilling or historical storage/management of coal (and resulting ash) for heating purposes, and subsequently placed on the Phase II Property for grading purposes.
PHC impacted soil is considered to have resulted from an off-site release, possibly from leaks or spills associated with the retail fuel outlet or historical automotive service garage at 1 Montreal Road.

CONTAMINANT TRANSPORT PATHWAYS

B **PHYSICAL TRANSPORT** - A potential contaminant transport pathway is the physical transport from one location to another of contamined soil, either intentionally or unintentionally, by earth moving equipment, vehicle traffic, or pedestrian traffic. Based on observations during the Phase I and Phase II ESA, physical transport of contaminants on the Phase II Property is considered to be negligible.
PRECIPITATION/INFILTRATION/LEACHING - Precipitation and infiltration are not considered to have significant contribution to the migration of the identified parameters beneath the subject land, based on the low solubilities of lead and PAHs in water. PHC impacts are present within the native glacial till just above the shale bedrock.
DIFFUSION AND DISPERSION - Upon entering the groundwater table, contaminants will move from an area of greater concentration toward an area where it is less concentration as long as a concentration gradient exists (diffusion). When groundwater travels through bedrock it moves at different velocities resulting in mixing and dilution of the contmainion at the advancing edge of flow (dispersion). These processes are not considered to have contributed to contaminant migration, as the groundwater beneath the Phase II Property was determined to be in compliance with the MOECP Table 3 standards.

HUMAN AND ECOLOGICAL RECEPTORS

C **HUMAN RECEPTORS** - Although the majority of the subjet site is open to the general public, it is covered in asphalt, which greatly reduces the chances for humans to act as receptors. Potential human receptors are limited to construction works and environmental professionals who may contact the soil during site remediation or redevelopment.
ECOLOGICAL RECEPTORS - Traditionally ecological receptors include plants and wildlife which may come into contact with the contaminated soil. The site is located in a residential area where ecological receptors are expected. The potential for off-site migration of contaminant concentrations, is considered negligible as the groundwater beneath the Phase II Property is in compliance with MOECP Table 3.

RECEPTOR EXPOSURE POINTS

D **HUMAN RECEPTORS** - Exposure points for humans consist of remedial excavation or excavation for redevelopment.
ECOLOGICAL RECEPTORS - Ecological receptor points may be present in the general vicinity of the site given the residential neighborhood to the north and west of the Phase II Property.

ROUTES OF EXPOSURE

E **HUMAN RECEPTORS** - Routes of exposure for human receptors (construction workers and environmental professionals) include dermal contact and accidental ingestion.
ECOLOGICAL RECEPTORS - Routes of exposure for ecological receptors include ingestion and dermal contact.

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0			

MANOR PARK MANAGEMENT
PHASE II - ENVIRONMENTAL SITE ASSESSMENT
20 MARK AVENUE
OTTAWA, ONTARIO
Title:
CONTAMINANT DISTRIBUTION DIAGRAM

Scale: N.T.S.	Date: 07/2018
Drawn by: MPG	Report No.: PE4368-2
Checked by: KM	Dwg. No.: PE4368-9
Approved by: MSD	Revision No.:

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APPENDIX 1

SAMPLING AND ANALYSIS PLAN

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LABORATORY CERTIFICATES OF ANALYSIS

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

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patersongroup

Sampling & Analysis Plan

Phase II Environmental Site Assessment
20 Mark Avenue
Ottawa, Ontario

Prepared For

Manor Park Management

July 2018

Report: PE4368-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by Manor Park Management to conduct a Phase II Environmental Site Assessment (ESA) 20 Mark Avenue, in the City of Ottawa, Ontario. Based on a previous Phase I-II ESA (2012) and a more recent Phase I ESA (2018) completed by Paterson for the subject property, a subsurface investigation program, consisting of borehole drilling, was developed. A geotechnical investigation was conducted concurrently with the environmental subsurface investigation.

Borehole	Location & Rationale	Proposed Depth & Rationale
BH1	Place borehole as close as possible to the southwest corner of the Phase II Property to address potential for soil and groundwater impacts resulting from the retail fuel outlet at 1 Montreal Road.	Core into bedrock to at least 8m depth for monitoring well installation, to address potential groundwater impacts. Previous borehole installed at 6m depth was dry.
BH2	Place borehole as close as possible to south property line to address potential for soil and groundwater impacts from possible former automotive service garage at 1 Montreal Road and to delineate potential impacts identified in BH1.	Core into bedrock to at least 8m depth for monitoring well installation to address potential groundwater impacts.
BH3	Place borehole close to north property to delineate potential impacts identified in BH1 and/or to identify potential for off-site migration of any impacts identified on the Phase I Property.	Core into bedrock to at least 8m depth for monitoring well installation to address potential groundwater impacts.

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

Drilling Procedure

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

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

Spoon Washing Procedure

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

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

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

Screening Procedure

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

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

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

3.2 Monitoring Well Installation Procedure

Equipment

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

Procedure

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

3.3 Monitoring Well Sampling Procedure

Equipment

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

Sampling Procedure

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

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

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

- ❒ All non-dedicated sampling equipment (split spoons) will be decontaminated according to the SOPs listed above.
- ❒ All groundwater sampling equipment is dedicated (polyethylene and flexible peristaltic tubing is replaced for each well).
- ❒ Where groundwater samples are to be analyzed for VOCs, one laboratory-provided trip blank will be submitted for analysis with every laboratory submission.
- ❒ Approximately one (1) field duplicate will be submitted for every ten (10) samples submitted for laboratory analysis. A minimum of one (1) field duplicate per project will be submitted. Field duplicates will be submitted for soil and groundwater samples
- ❒ Where combo pens are used to measure field chemistry, they will be calibrated on an approximately monthly basis, according to frequency of use.

5.0 DATA QUALITY OBJECTIVES

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

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

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

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

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

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

These considerations are discussed in the body of the report.

6.0 PHYSICAL IMPEDIMENTS TO SAMPLING & ANALYSIS PLAN

Physical impediments to the Sampling and Analysis plan may include:

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

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
20 Mark Avenue
Ottawa, Ontario

DATUM BM - Top spindle of fire hydrant. Geodetic elevation = 57.691m as per topographic plan prepared by Fairhall, Moffatt and Woodland Ltd.

FILE NO. PE4368

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** July 9, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	56.96
Asphaltic concrete 0.08							
FILL: Brown silty sand with crushed stone 0.69		AU	1				
FILL: Brown silty sand with crushed stone, clay, gravel, trace ash and coal 1.68		SS	2	33	8	1	55.96
		SS	3	83	17	2	54.96
		SS	4	50	19		
		SS	5	38	28	3	53.96
GLACIAL TILL: Dark brown silty clay with sand, gravel, occasional shale fragments		SS	6	42	15	4	52.96
- shale fragments increasing with depth		SS	7	100	23	5	51.96
		SS	8	61	50+		
6.15		SS	9	100	50+	6	50.96
BEDROCK: Heavily fractured to fractured, black shale		RC	1	100	0		
- increasing strength with depth						7	49.96
- 50mm thick mud seam at 6.2m depth - 75mm thick mud seam at 6.4m depth		RC	2	100	41	8	48.96
8.30							
End of Borehole							
(GWL @ 6.87m - July 17, 2018)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
20 Mark Avenue
Ottawa, Ontario

DATUM BM - Top spindle of fire hydrant. Geodetic elevation = 57.691m as per topographic plan prepared by Fairhall, Moffatt and Woodland Ltd.

FILE NO. PE4368

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** July 9, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Asphaltic concrete 0.06						0	56.89
FILL: Brown silty sand with gravel, trace crushed stone 0.38		AU	1				
FILL: Brown silty sand, trace gravel 1.22		SS	2	42	14	1	55.89
		SS	3	54	66	2	54.89
GLACIAL TILL: Dark brown silty clay with sand, gravel, occasional shale fragments		SS	4	62	60		
- shale fragments increasing with depth		SS	5	54	86	3	53.89
		SS	6	58	51	4	52.89
4.60		SS	7	0	50+		
		RC	1	100	22	5	51.89
BEDROCK: Heavily fractured to fractured, black shale		RC	2	100	55	6	50.89
- increasing strength with depth							
- 100mm thick mud seam at 4.7m and 6.65m depths -125mm thick mud seam at 5.3m depth						7	49.89
		RC	3	100	67	8	48.89
8.40							
End of Borehole							
(GWL @ 6.82m - July 17, 2018)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
20 Mark Avenue
Ottawa, Ontario

DATUM BM - Top spindle of fire hydrant. Geodetic elevation = 57.691m as per topographic plan prepared by Fairhall, Moffatt and Woodland Ltd.

FILE NO. PE4368

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** July 10, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Asphaltic concrete 0.10						0	56.65
FILL: Brown silty sand with crushed stone and gravel 0.60		AU	1				
FILL: Brown silty sand with clay 0.91		SS	2	67	24	1	55.65
		SS	3	75	31	2	54.65
GLACIAL TILL: Dark brown silty clay with sand, gravel, occasional shale fragments		SS	4	83	20		
- shale fragments increasing with depth		SS	5	62	61	3	53.65
		SS	6	54	25	4	52.65
4.95		SS	7	60	50+		
		RC	1	100	55	5	51.65
BEDROCK: Heavily fractured to fractured, black shale		RC	2	100	37	6	50.65
- increasing in strength with depth						7	49.65
		RC	3	100	45	8	48.65
8.41							
End fo Borehole							
(GWL @ 6.58m - July 17, 2018)							

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

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

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

CONSOLIDATION TEST

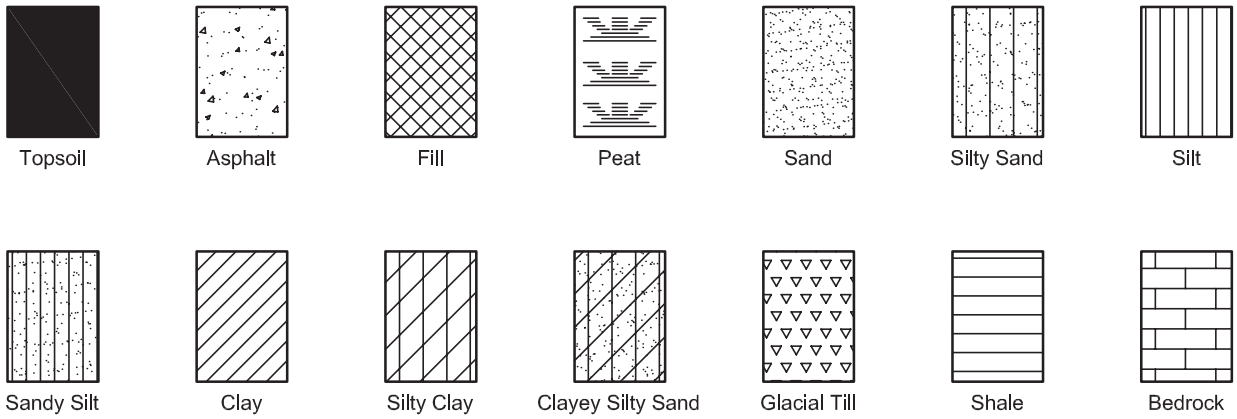
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

PERMEABILITY TEST

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

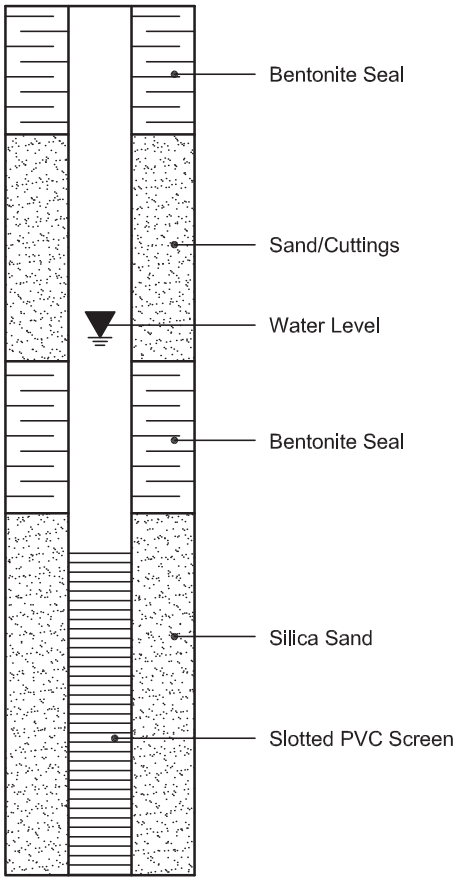
SYMBOLS AND TERMS (continued)

STRATA PLOT

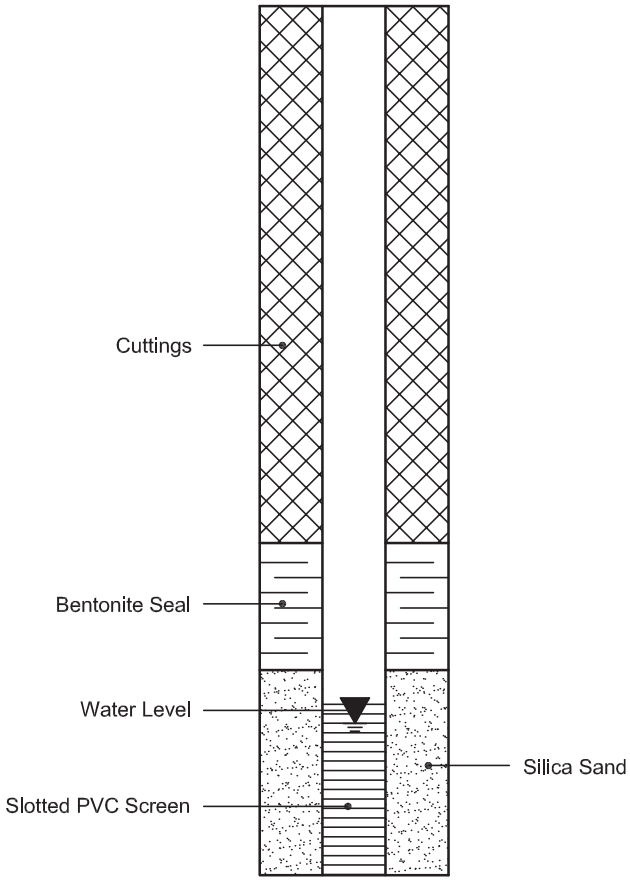


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Karyn Munch

Client PO: 24122
Project: PE4368
Custody: 118656

Report Date: 20-Jul-2018
Order Date: 16-Jul-2018

Order #: 1829084

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

Paracel ID	Client ID
1829084-01	BH1-SS2
1829084-02	BH2-AU1
1829084-03	BH3-SS2

Approved By:

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24122

Report Date: 20-Jul-2018
Order Date: 16-Jul-2018
Project Description: PE4368

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	18-Jul-18	19-Jul-18
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	17-Jul-18	19-Jul-18
Solids, %	Gravimetric, calculation	20-Jul-18	20-Jul-18

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24122

Report Date: 20-Jul-2018

Order Date: 16-Jul-2018

Project Description: PE4368

	Client ID:	BH1-SS2	BH2-AU1	BH3-SS2	-
	Sample Date:	07/09/2018 09:00	07/09/2018 09:00	07/10/2018 09:00	-
	Sample ID:	1829084-01	1829084-02	1829084-03	-
	MDL/Units	Soil	Soil	Soil	-
Physical Characteristics					
% Solids	0.1 % by Wt.	87.0	93.6	90.2	-
Metals					
Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Arsenic	1.0 ug/g dry	4.6	4.2	5.8	-
Barium	1.0 ug/g dry	135	186	102	-
Beryllium	0.5 ug/g dry	<0.5	<0.5	<0.5	-
Boron	5.0 ug/g dry	<5.0	<5.0	<5.0	-
Cadmium	0.5 ug/g dry	0.5	<0.5	0.6	-
Chromium	5.0 ug/g dry	25.9	26.4	21.9	-
Cobalt	1.0 ug/g dry	9.0	7.6	17.1	-
Copper	5.0 ug/g dry	25.9	29.6	49.4	-
Lead	1.0 ug/g dry	66.4	195	29.0	-
Molybdenum	1.0 ug/g dry	2.7	1.3	5.4	-
Nickel	5.0 ug/g dry	25.3	23.5	59.5	-
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Silver	0.3 ug/g dry	<0.3	<0.3	<0.3	-
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Uranium	1.0 ug/g dry	<1.0	<1.0	3.0	-
Vanadium	10.0 ug/g dry	32.9	27.3	41.5	-
Zinc	20.0 ug/g dry	101	158	96.3	-
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	0.03	-	-	-
Acenaphthylene	0.02 ug/g dry	0.10	-	-	-
Anthracene	0.02 ug/g dry	0.22	-	-	-
Benzo [a] anthracene	0.02 ug/g dry	0.61	-	-	-
Benzo [a] pyrene	0.02 ug/g dry	0.61	-	-	-
Benzo [b] fluoranthene	0.02 ug/g dry	0.66	-	-	-
Benzo [g,h,i] perylene	0.02 ug/g dry	0.32	-	-	-
Benzo [k] fluoranthene	0.02 ug/g dry	0.36	-	-	-
Chrysene	0.02 ug/g dry	0.65	-	-	-
Dibenzo [a,h] anthracene	0.02 ug/g dry	0.09	-	-	-
Fluoranthene	0.02 ug/g dry	1.50	-	-	-
Fluorene	0.02 ug/g dry	0.03	-	-	-
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	0.32	-	-	-
1-Methylnaphthalene	0.02 ug/g dry	0.03	-	-	-

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24122

Report Date: 20-Jul-2018

Order Date: 16-Jul-2018

Project Description: PE4368

	Client ID:	BH1-SS2	BH2-AU1	BH3-SS2	-
	Sample Date:	07/09/2018 09:00	07/09/2018 09:00	07/10/2018 09:00	-
	Sample ID:	1829084-01	1829084-02	1829084-03	-
	MDL/Units	Soil	Soil	Soil	-
2-Methylnaphthalene	0.02 ug/g dry	0.03	-	-	-
Methylnaphthalene (1&2)	0.04 ug/g dry	0.05	-	-	-
Naphthalene	0.01 ug/g dry	0.03	-	-	-
Phenanthrene	0.02 ug/g dry	0.70	-	-	-
Pyrene	0.02 ug/g dry	1.22	-	-	-
2-Fluorobiphenyl	Surrogate	131%	-	-	-
Terphenyl-d14	Surrogate	97.1%	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
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						
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g						
Acenaphthylene	ND	0.02	ug/g						
Anthracene	ND	0.02	ug/g						
Benzo [a] anthracene	ND	0.02	ug/g						
Benzo [a] pyrene	ND	0.02	ug/g						
Benzo [b] fluoranthene	ND	0.02	ug/g						
Benzo [g,h,i] perylene	ND	0.02	ug/g						
Benzo [k] fluoranthene	ND	0.02	ug/g						
Chrysene	ND	0.02	ug/g						
Dibenzo [a,h] anthracene	ND	0.02	ug/g						
Fluoranthene	ND	0.02	ug/g						
Fluorene	ND	0.02	ug/g						
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g						
1-Methylnaphthalene	ND	0.02	ug/g						
2-Methylnaphthalene	ND	0.02	ug/g						
Methylnaphthalene (1&2)	ND	0.04	ug/g						
Naphthalene	ND	0.01	ug/g						
Phenanthrene	ND	0.02	ug/g						
Pyrene	ND	0.02	ug/g						
Surrogate: 2-Fluorobiphenyl	*1.32*		*ug/g*		*99.0*	*50-140*			
Surrogate: Terphenyl-d14	*1.14*		*ug/g*		*85.2*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Metals									
Antimony	ND	1.0	ug/g dry	ND			0.0	30	
Arsenic	ND	1.0	ug/g dry	ND			0.0	30	
Barium	58.0	1.0	ug/g dry	61.1			5.3	30	
Beryllium	ND	0.5	ug/g dry	ND			0.0	30	
Boron	ND	5.0	ug/g dry	ND			0.0	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	11.7	5.0	ug/g dry	12.8			9.0	30	
Cobalt	4.2	1.0	ug/g dry	4.5			7.4	30	
Copper	10.3	5.0	ug/g dry	9.9			4.6	30	
Lead	14.1	1.0	ug/g dry	14.9			5.6	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	9.2	5.0	ug/g dry	10.3			11.1	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.3	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	20.0	10.0	ug/g dry	21.2			6.1	30	
Zinc	42.0	20.0	ug/g dry	43.7			4.0	30	
Physical Characteristics									
% Solids	95.1	0.1	% by Wt.	95.1			0.0	25	
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g dry	ND				40	
Acenaphthylene	ND	0.02	ug/g dry	ND				40	
Anthracene	ND	0.02	ug/g dry	ND				40	
Benzo [a] anthracene	ND	0.02	ug/g dry	ND				40	
Benzo [a] pyrene	ND	0.02	ug/g dry	ND				40	
Benzo [b] fluoranthene	ND	0.02	ug/g dry	ND				40	
Benzo [g,h,i] perylene	ND	0.02	ug/g dry	ND				40	
Benzo [k] fluoranthene	ND	0.02	ug/g dry	ND				40	
Chrysene	ND	0.02	ug/g dry	ND			0.0	40	
Dibenzo [a,h] anthracene	ND	0.02	ug/g dry	ND				40	
Fluoranthene	ND	0.02	ug/g dry	ND				40	
Fluorene	ND	0.02	ug/g dry	ND				40	
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g dry	ND				40	
1-Methylnaphthalene	ND	0.02	ug/g dry	ND				40	
2-Methylnaphthalene	ND	0.02	ug/g dry	ND				40	
Naphthalene	ND	0.01	ug/g dry	ND				40	
Phenanthrene	ND	0.02	ug/g dry	ND				40	
Pyrene	ND	0.02	ug/g dry	ND				40	
Surrogate: 2-Fluorobiphenyl	*1.57*		*ug/g dry*		*110*	*50-140*			
Surrogate: Terphenyl-d14	*1.17*		*ug/g dry*		*81.8*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Metals									
Antimony	35.8		ug/L	ND	71.7	70-130			
Arsenic	37.4		ug/L	ND	74.4	70-130			
Barium	67.1		ug/L	24.4	85.3	70-130			
Beryllium	39.8		ug/L	ND	79.7	70-130			
Boron	46.0		ug/L	ND	91.3	70-130			
Cadmium	36.2		ug/L	ND	72.3	70-130			
Chromium	45.1		ug/L	5.1	80.0	70-130			
Cobalt	42.6		ug/L	1.8	81.6	70-130			
Copper	43.2		ug/L	ND	78.5	70-130			
Lead	48.4		ug/L	6.0	84.9	70-130			
Molybdenum	36.6		ug/L	ND	72.9	70-130			
Nickel	43.7		ug/L	ND	79.2	70-130			
Selenium	40.6		ug/L	ND	81.0	70-130			
Silver	36.2		ug/L	ND	72.4	70-130			
Thallium	43.9		ug/L	ND	87.7	70-130			
Uranium	45.8		ug/L	ND	91.2	70-130			
Vanadium	49.4		ug/L	ND	81.8	70-130			
Zinc	55.0		ug/L	ND	75.0	70-130			
Semi-Volatiles									
Acenaphthene	0.157	0.02	ug/g	ND	87.8	50-140			
Acenaphthylene	0.147	0.02	ug/g	ND	82.0	50-140			
Anthracene	0.149	0.02	ug/g	ND	83.1	50-140			
Benzo [a] anthracene	0.132	0.02	ug/g	ND	73.6	50-140			
Benzo [a] pyrene	0.114	0.02	ug/g	ND	63.8	50-140			
Benzo [b] fluoranthene	0.193	0.02	ug/g	ND	108	50-140			
Benzo [g,h,i] perylene	0.117	0.02	ug/g	ND	65.5	50-140			
Benzo [k] fluoranthene	0.165	0.02	ug/g	ND	92.2	50-140			
Chrysene	0.158	0.02	ug/g	ND	88.6	50-140			
Dibenzo [a,h] anthracene	0.123	0.02	ug/g	ND	69.0	50-140			
Fluoranthene	0.144	0.02	ug/g	ND	80.6	50-140			
Fluorene	0.135	0.02	ug/g	ND	75.4	50-140			
Indeno [1,2,3-cd] pyrene	0.129	0.02	ug/g	ND	72.2	50-140			
1-Methylnaphthalene	0.187	0.02	ug/g	ND	104	50-140			
2-Methylnaphthalene	0.195	0.02	ug/g	ND	109	50-140			
Naphthalene	0.180	0.01	ug/g	ND	101	50-140			
Phenanthrene	0.150	0.02	ug/g	ND	83.8	50-140			
Pyrene	0.152	0.02	ug/g	ND	85.0	50-140			
Surrogate: 2-Fluorobiphenyl	*1.62*		*ug/g*		*114*	*50-140*			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

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.

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Page ___ of ___

Client Name: Paterson Group Inc.	Project Reference: PE4368
Contact Name: Karyn Munch	Quote #
Address: 154 Colonnade Rd S.	PO # 24122.
Telephone: 613-226-7381	Email Address: kmunch@patersongroup.ca

Turnaround Time:
☐ 1 Day ☐ 3 Day
☐ 2 Day ☒ Regular
Date Required: _____

Criteria: ☑ O. Reg. 153/04 (As Amended) Table 3 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

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

Required Analyses

Paracel Order Number: 1829084

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)							
1	BH1-SS2	S		1	July 9/18				✓	✓							-120ml-			✓
2	BH2-AU1	S		1	July 9/18					✓							↓			✓
3	BH3-SS2	S		1	July 9/18					✓										✓
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): KMunch.	Received by Driver/Depot: M. Louise	Received at Lab: Shipped DOKMM	Verified By:
Relinquished By (Print): KMunch.	Date/Time: 16/07/18 3:10 PM	Date/Time: July 16, 2018 03:45	Date/Time: 07/16/18 4:25pm
Date/Time: July 16, 2018.	Temperature: °C	Temperature: 18.5 °C	pH Verified [ ] By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Karyn Munch

Client PO: 24152
Project: PE4368
Custody: 118662

Report Date: 24-Jul-2018
Order Date: 23-Jul-2018

Order #: 1830132

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

Paracel ID	Client ID
1830132-01	BH2-SS6

Approved By:

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24152

Report Date: 24-Jul-2018
Order Date: 23-Jul-2018
Project Description: PE4368

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	23-Jul-18	23-Jul-18
PHC F1	CWS Tier 1 - P&T GC-FID	23-Jul-18	23-Jul-18
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	23-Jul-18	24-Jul-18
Solids, %	Gravimetric, calculation	24-Jul-18	24-Jul-18

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24152

Report Date: 24-Jul-2018

Order Date: 23-Jul-2018

Project Description: PE4368

	Client ID:	BH2-SS6	-	-	-
	Sample Date:	07/09/2018 17:00	-	-	-
	Sample ID:	1830132-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	94.2	-	-	-
Volatiles					
Benzene	0.02 ug/g dry	<0.02	-	-	-
Ethylbenzene	0.05 ug/g dry	0.24	-	-	-
Toluene	0.05 ug/g dry	<0.05	-	-	-
m,p-Xylenes	0.05 ug/g dry	1.73	-	-	-
o-Xylene	0.05 ug/g dry	0.35	-	-	-
Xylenes, total	0.05 ug/g dry	2.08	-	-	-
Toluene-d8	Surrogate	113%	-	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	76	-	-	-
F2 PHCs (C10-C16)	4 ug/g dry	213	-	-	-
F3 PHCs (C16-C34)	8 ug/g dry	178	-	-	-
F4 PHCs (C34-C50)	6 ug/g dry	<6	-	-	-

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24152

Report Date: 24-Jul-2018
Order Date: 23-Jul-2018
Project Description: PE4368

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	*2.52*		*ug/g*		*78.8*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24152

Report Date: 24-Jul-2018
Order Date: 23-Jul-2018
Project Description: PE4368

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)	ND	4	ug/g dry	ND				30	
F3 PHCs (C16-C34)	ND	8	ug/g dry	ND				30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Physical Characteristics									
% Solids	74.5	0.1	% by Wt.	74.9			0.5	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	*4.02*		*ug/g dry*		*108*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24152

Report Date: 24-Jul-2018
Order Date: 23-Jul-2018
Project Description: PE4368

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	195	7	ug/g		97.5	80-120			
F2 PHCs (C10-C16)	83	4	ug/g	ND	90.3	60-140			
F3 PHCs (C16-C34)	216	8	ug/g	ND	95.5	60-140			
F4 PHCs (C34-C50)	164	6	ug/g	ND	114	60-140			
Volatiles									
Benzene	2.81	0.02	ug/g		70.2	60-130			
Ethylbenzene	4.90	0.05	ug/g		123	60-130			
Toluene	4.71	0.05	ug/g		118	60-130			
m,p-Xylenes	9.31	0.05	ug/g		116	60-130			
o-Xylene	4.95	0.05	ug/g		124	60-130			
Surrogate: Toluene-d8	*3.27*		*ug/g*		*102*	*50-140*			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

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

CCME PHC additional information:

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

PARACEL LABORATORIES LTD.

Paracel ID: 1830132

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Chain of Custody
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№ 118662

Page ___ of ___

Client Name: Paterson Group	Project Reference: PE4368
Contact Name: Kayn Munch	Quote #
Address: 154 Colonnade Rd S.	PO # 24152
Telephone: 613-226-7381	Email Address: kmunch@patersongroup

Turnaround Time:
☒ 1 Day ☐ 3 Day
☐ 2 Day ☐ Regular
Date Required: _____

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 3 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

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

Required Analyses

Paracel Order Number: 1830132

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)							
1	BH2-SS6	S		2	July 9/18	5:00 pm	✓							- 120ml + jug -						✓
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): KMunch.	Received by Driver/Depot: T. Louise	Received at Lab: SUMMERSON DOKMAI
Relinquished By (Print): Kayn Munch	Date/Time: 23/07/18 4:00 pm	Date/Time: JUL 23, 2018 05:27
Date/Time: July 23, 2018	Temperature: °C	Temperature: 18.5 °C
		Verified By:
		Date/Time: July 23/18 5:36 pm
		pH Verified [ ] By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Karyn Munch

Client PO: 24126
Project: PE4368
Custody: 118659

Report Date: 24-Jul-2018
Order Date: 18-Jul-2018

Order #: 1829359

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

Paracel ID	Client ID
1829359-01	BH1-GW1
1829359-02	BH2-GW1
1829359-03	BH3-GW1

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24126

Report Date: 24-Jul-2018
Order Date: 18-Jul-2018
Project Description: PE4368

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	23-Jul-18	23-Jul-18
PHC F1	CWS Tier 1 - P&T GC-FID	22-Jul-18	23-Jul-18
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	19-Jul-18	22-Jul-18

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24126

Report Date: 24-Jul-2018

Order Date: 18-Jul-2018

Project Description: PE4368

	Client ID:	BH1-GW1	BH2-GW1	BH3-GW1	-
	Sample Date:	07/17/2018 09:00	07/17/2018 09:00	07/17/2018 09:00	-
	Sample ID:	1829359-01	1829359-02	1829359-03	-
	MDL/Units	Water	Water	Water	-
Volatiles					
Benzene	0.5 ug/L	<0.5	<0.5	<0.5	-
Ethylbenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
Toluene	0.5 ug/L	<0.5	<0.5	<0.5	-
m,p-Xylenes	0.5 ug/L	<0.5	<0.5	<0.5	-
o-Xylene	0.5 ug/L	<0.5	<0.5	<0.5	-
Xylenes, total	0.5 ug/L	<0.5	<0.5	<0.5	-
Toluene-d8	Surrogate	103%	103%	102%	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	<25	<25	-
F2 PHCs (C10-C16)	100 ug/L	<100	<100	<100	-
F3 PHCs (C16-C34)	100 ug/L	<100	<100	<100	-
F4 PHCs (C34-C50)	100 ug/L	<100	<100	<100	-

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24126

Report Date: 24-Jul-2018
Order Date: 18-Jul-2018
Project Description: PE4368

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									
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	*87.4*		*ug/L*		*109*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24126

Report Date: 24-Jul-2018
Order Date: 18-Jul-2018
Project Description: PE4368

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									
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	*81.2*		*ug/L*		*101*	*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)	2060	25	ug/L		103	68-117			
F2 PHCs (C10-C16)	1380	100	ug/L		86.4	60-140			
F3 PHCs (C16-C34)	3640	100	ug/L		92.9	60-140			
F4 PHCs (C34-C50)	2530	100	ug/L		102	60-140			
Volatiles									
Benzene	32.4	0.5	ug/L		81.1	60-130			
Ethylbenzene	35.3	0.5	ug/L		88.3	60-130			
Toluene	33.8	0.5	ug/L		84.5	60-130			
m,p-Xylenes	74.7	0.5	ug/L		93.3	60-130			
o-Xylene	35.7	0.5	ug/L		89.2	60-130			
Surrogate: Toluene-d8	*74.9*		*ug/L*		*93.7*	*50-140*			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

CCME PHC additional information:

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

Paracel ID: 1829359

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Page ___ of ___

Client Name: Paterson Group Inc.	Project Reference: PE4368
Contact Name: Karyn Murch	Quote #
Address: 154 Colonnade Rds.	PO # 24126
Telephone: 613-226-7381	Email Address: kmurch@patersongroup.ca

Turnaround Time:
☐ 1 Day ☐ 3 Day
☐ 2 Day ☒ Regular
Date Required: ___

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 3 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ___ ☐ Other: ___

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

Required Analyses

Paracel Order Number: 1829359

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken: Date	Sample Taken: Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)
1	BH1-GW1	GW		3	July 17/18		✓						
2	BH2-GW1	GW		3	July 17/18		✓						
3	BH3-GW1	GW		3	July 17/18		✓						
4													
5													
6													
7													
8													
9													
10													

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): K Murch	Received by Driver/Depot: T. Sousa	Received at Lab: Stittsville DOKMAI	Verified By:
Relinquished By (Print): Karyn Murch	Date/Time: 18/07/18 3:00 PM	Date/Time: July 19 2018 04:35	Date/Time: 19/7/18 9:24
Date/Time: 3:00 July 18, 2018	Temperature: °C	Temperature: 18.4 °C	pH Verified [ ] By: NA