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Phase II Environmental Site Assessment

910 March Road
Ottawa, Ontario

Prepared For

Wexcom Developments (March Rd.) Ltd.

November 11, 2019

Report: PE4760-2

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EXECUTIVE SUMMARY

Assessment

A Phase II ESA was conducted for the property addressed 910 March Road, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address the areas of environmental concern (APECs) that were identified on the Phase II Property during the Phase I ESA.

The Phase II ESA was carried out in conjunction with a Geotechnical Investigation and consisted of drilling nine (9) boreholes across the Phase II Property, three (3) of which were constructed with groundwater monitoring well installations.

The soil profile generally consisted of topsoil, followed by a silty clay layer. Boreholes were terminated at a maximum depth of 4.7m below the ground surface. Soil samples were obtained from the boreholes and screened using combustible vapour measurements (BH5 to BH7) along with visual and olfactory observations.

Based on the screening results in combination with sample depth and location, three (3) soil samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX) and petroleum hydrocarbons (PHCs, F_1-F_4). No BTEX or PHC parameters were identified above the laboratory detection limit in the soil samples analyzed. All of the soil results are in compliance with the MECP Table 8 Commercial Standards for coarse grain soils.

Groundwater samples from monitoring wells installed in BH5, BH6 and BH7 were recovered and analyzed for BTEX and PHCs. No free-phase product was observed on the groundwater at any of the monitoring well locations during the groundwater sampling event.

No BTEX or PHC parameters were identified above the laboratory detection limits in the groundwater samples analyzed. The groundwater results are in compliance with the MECP Table 8 Standards.

Based on the findings of the Phase II ESA, **no further environmental investigation is required.**

Recommendations

If the monitoring wells installed on the subject site are not going to be used in the future, or will be destroyed during site redevelopment, they should be abandoned according to Ontario Regulation 903.

1.0 INTRODUCTION

At the request of Wexcom Developments (March Rd.) Limited, Paterson Group (Paterson) conducted a Phase II Environmental Site Assessment for the property addressed 910 March Road, in the City of Ottawa, Ontario, herein referred to as the Phase II Property. The purpose of this Phase II ESA was to address areas of potential environmental concern (APECs) identified on the Phase II Property, during the Phase I ESA conducted by Paterson in October 2019.

1.1 Site Description

Address:	910 March Road, Ottawa, Ontario
Legal Description:	Part of Lots 11 and 12, Part 1 of Registered Pan 4R24361, March Concession 4, in the City of Ottawa.
Property Identification Number (PIN):	04527-0840
Location:	The Phase II Property is located on the east side of March Road, approximately 86 m north of the Maxwell Bridge Road and March Road intersection, in the City of Ottawa, Ontario. For the purposes of this report, March Road is assumed to run in a north-south direction. The subject site is shown on Figure 1 – Key Plan, in the Figures section.
Latitude and Longitude:	45° 21' 35.47" N, 75° 56' 10.25" W
Zoning:	DR – Development Reserve Zone designated on the southern portion of the site and RU – Rural Zone designated on the northern portion of the site, with a floodplain overlay along Shirley's Brook and its tributary, which transect the north-eastern and northern portions of the Phase I Property in an approximate north-south direction, while its tributary runs in an approximate east-west direction, parallel to the northern property boundary.
Configuration:	Irregular
Area:	2.72 hectares (approximately)

1.2 Property Ownership

Paterson was retained to complete this Phase II ESA by Mr. Michael Foley of Wexcom Developments (March Rd.) Limited, the current property owner. Mr. Foley can be reached by telephone at (905) 385-4514.

1.3 Current and Proposed Future Uses

The Phase II Property is currently an uninhabited residence and farmstead. It is our understanding that the proposed site development for the Phase II Property includes a retail fuel outlet, two (2) restaurants and a hotel with associated parking spaces. The footprint of the development will cover the majority of the site, with a 20 m offset from Shirley's Brook and its tributary along the northern and eastern property boundary and 5 m offset from the tributary located to the abutting south.

1.4 Applicable Site Condition Standard

The site condition standards for the property were obtained from Table 8 of the document entitled "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", prepared by the Ministry of the Environment, Conservation and Parks (MECP), April 2011. The selected MECP Table 8 Standards are based on the following considerations:

- Coarse-grained soil conditions
- Generic site conditions for use within 30 m of a water body
- Potable groundwater conditions
- Residential/Parkland/Institutional/Industrial/Commercial land use

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

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The Phase II Property is situated in a suburban setting, consisting of commercial, agricultural and residential land use. Adjacent and neighbouring properties consist of a residential development to the east, commercial to the south and residential dwellings and vacant lands the north and west.

The Phase II Property consists of an uninhabited residence/farmstead. The majority of the site is grass covered land with some trees along the northern and eastern property boundaries and an asphaltic concrete paved laneway fronting March Road, which leads to a residential dwelling constructed with a stone and mortar foundation with a basement level and an attached garage. Several outbuildings and sheds of either slab-on-grade or wood pier construction occupied the central portion of the site. Several storage containers, trailers, sheet metal and farm equipment occupy the remainder of the site.

The majority of the site (central portion) is relatively flat and at the grade of March Road and slopes slightly down to the north, east and south towards the Shirley's Brook and its tributaries. Site drainage consists primarily of infiltration with some runoff into the aforementioned bodies of water on-site as well as a tributary located to the immediate south of the Phase II Property.

The regional topography slopes down in a southernly direction towards Shirley's Brook.

2.2 Past Investigations

A Phase I-ESA was completed by Paterson in October 2019 in general accordance with the Ontario Regulation (O.Reg.) 153/04, as amended. The Phase I ESA identified a historical potentially contaminating activity (PCA) and existing PCAs on-site that resulted in areas of potential environmental concern (APECs) on the Phase I Property:

- PCA 1: *Item 28, "Gasoline and Associated Products Storage in Fixed Tanks"* – this PCA was identified based on the presence of a former underground storage tank situated on the southwest side of the residential dwelling on the Phase I Property.
- PCA 2: *Item 28, "Gasoline and Associated Products Storage in Fixed Tanks"* – this PCA was identified based on the presence of an empty

above ground storage tank situated on the west side of the storage shed located east of the residential dwelling on the Phase I Property.

- ❒ PCA 3: *Item 28, "Gasoline and Associated Products Storage in Fixed Tanks"* – this PCA was identified based on the presence of three (3) empty above ground storage tanks situated inside the northeastern storage shed on the Phase I Property.

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

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation was conducted on October 15, 2019, in conjunction with a Geotechnical Investigation. The field program consisted of drilling nine (9) boreholes, three (3) of which were instrumented with groundwater monitoring wells for environmental purposes. Boreholes were drilled to depths ranging from approximately 1.93 to 4.67m below the ground surface (mbgs).

3.2 Media Investigated

During the subsurface investigation, soil samples and groundwater samples were obtained and submitted for laboratory analysis. The rationale for sampling and analyzing this media is based on the Contaminants of Potential Concern (CPCs) identified in the Phase I ESA. These CPCs include benzene, toluene, ethylbenzene, xylenes (BTEX) and petroleum hydrocarbons (PHC, F_1-F_4) in soil an/or groundwater.

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

Based on our geotechnical investigation, the profile generally encountered on the Phase I Property consisted of a layer topsoil underlain by a hard to stiff brown silty clay, followed by a compact to dense glacial till and/or inferred bedrock at depths varying between 1.9 and 4.7 mbgs.

According to the Geological Survey of Canada website, bedrock in the area of the site consists of interbedded sandstone and dolomite of the March Formation. Overburden soils are reported to consist of offshore marine sediments with erosional terraces or bedrock, with drift thicknesses between 5 and 10m.

The regional topography slopes down in a southeasterly direction. The local groundwater flow beneath the Phase I Property is inferred to be in a south-easterly direction towards Shirley's Brook.

Subsurface Structures and Utilities

Historical subsurface structures including the UST and associated structures with the heating oil furnace may have affected contaminant distribution at the Phase I Property.

Presently, the Phase I Property is serviced by a private well and septic system with above ground electricity service from March Road. Underground natural gas and electrical services are present on-site. The presence of underground electrical and natural gas lines is not considered to have an affect on contaminant distribution or transport.

The approximate locations of above and below ground services, are shown on Drawing PE4760-3 –Test Hole Location Plan.

Existing Buildings and Structures

The Phase I Property is occupied by seven (7) structures that include a residential dwelling and private shed, a small vacant cabin, and four (4) barn-like structures. The residential dwelling is currently uninhabited. The workshop is used intermittently by the current landowner.

Water Bodies and Areas of Natural Significance

Shirley's Brook transects the northeastern portion of the Phase I Property in an approximate north-south direction, while its tributary runs in an approximate east-west direction, parallel to the northern property boundary and drains into Shirley's Brook.

Drinking Water Wells

Based on the MECP well records search, two (2) potable water wells were identified on the Phase I Property. Presently, the Phase II Property as well as lands to the north and west area rely on potable water wells.

Neighbouring Land Use

Neighbouring land use in the Phase I Study Area is primarily residential and agricultural or vacant land. A commercial development (various restaurants, retail and service establishments) is present on the properties to the south.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

The following PCAs, as per Table 2, O.Reg. 153/04, as amended, that represented APECs on the Phase I Property are presented in Table 1.

TABLE 1: Areas of Potential Environmental Concern

Area of Potential Environmental Concern (APEC)	Location of APEC on Phase I Property	Potentially Contaminating Activity (PCA)	Location of PCA (on-site or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Soil and/or Groundwater)
APEC 1: Presence of a former UST	Central west portion of the Phase I Property	Item 28: Gasoline and associated product storage in fixed tanks	On-site	BTEX, PHC (F_1-F_4)	Soil and Groundwater
APEC 2: Presence of an empty AST	Central portion of the Phase I Property	Item 28: Gasoline and associated product storage in fixed tanks	On-site	BTEX, PHC (F_1-F_4)	Soil and Groundwater
APEC 3: Presence of three (3) ASTs	Central east portion of the Phase I Property	Item 28: Gasoline and associated product storage in fixed tanks	On-site	BTEX, PHC (F_1-F_4)	Soil and Groundwater

No other PCAs were identified on or off-site that would result in an APEC on the Phase I Property.

Contaminants of Potential Concern (CPCs)

Based on the APECs identified on the Phase II Property, the contaminants of potential concern (CPCs) in the soil and groundwater include benzene, ethylbenzene, toluene and xylenes (BTEX), and petroleum hydrocarbons (PHCs, Fractions F_1-F_4).

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the preparation of this Phase I ESA is considered to be sufficient to conclude that there are potentially contaminating activities (PCAs) on-site, which have resulted in areas of potential environmental concern (APECs) on the Phase I Property. The presence of PCAs was confirmed by a variety of independent sources, including, observations made during the site visit and a personal interview. As such, the conclusions of this report are not affected by uncertainty which may be present with respect to the individual sources.

3.4 Deviations from Sampling and Analysis Plan

The Sampling and Analysis Plan for this project is included in Appendix 1 of this report.

3.5 Impediments

No physical impediments were encountered during the Phase II ESA program.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation, completed in conjunction with a Geotechnical Investigation, was conducted on October 15, 2019. The field program consisted of drilling nine (9) boreholes on the Phase II Property.

The boreholes were drilled to a maximum depth of 4.67 m below the existing grade. Three (3) boreholes were completed as groundwater monitoring wells (BH5 through BH7) to access the groundwater table.

The boreholes (BH1 through BH3) were placed to address the aforementioned APECs, as presented in Table 1, as well as completed for geotechnical purposes. The boreholes were drilled using a track mounted drill rig provided by George Downing Estate Drilling Ltd. of Hawkesberry, Ontario, under the full-time supervision of Paterson personnel. The borehole locations are indicated on the attached Drawing PE4760-3 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

A total of thirty-eight (38) soil samples were obtained from the boreholes by means of grab sampling from auger flights and split spoon sampling. Split spoon samples were taken at approximate 0.76 m intervals. The depths at which auger samples and split spoon samples were obtained from the boreholes are shown as "**AU**" and "**SS**" on the Soil Profile and Test Data Sheets appended to this report.

The soil stratigraphy at the borehole locations generally consisted of topsoil underlain by a hard to stiff brown silty clay. Practical refusal at augering or inferred bedrock was encountered at depths varying between 1.9 and 4.7 mbgs.

4.3 Field Screening Measurements

An RKI Eagle gastech with methane elimination and calibrated to hexane was used to measure the combustible vapour concentrations in the headspace of the soil samples recovered from BH5, BH6 and BH7. The results of the vapour survey are discussed in Subsection 5.4 and are available on the Soil Profile & Test Data sheets in Appendix 1.

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

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

To measure the soil vapours, the analyser probe is inserted into the nominal headspace above the soil sample. A gastech calibrated to hexane was used for this purpose. The sample is agitated/manipulated gently as the measurement is taken. The peak reading registered within the first 15 seconds is 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 ranged from less than 5 to 10 ppm and were not considered to be indicative of lighter fraction petroleum hydrocarbon compounds. Vapour readings are noted on the Soil Profile and Test Data Sheets in Appendix 1.

No visual or olfactory indications of potential hydrocarbons, or visual indications of deleterious fill material, were identified in the soil samples. Soil samples were selected based on a combination of the results of the vapour screening, visual screening, sample depth and/or sample location.

4.4 Groundwater Monitoring Well Installation

Three (3) groundwater monitoring wells were installed on the Phase II Property as part of the subsurface investigation. The monitoring wells consisted of 50 mm diameter, Schedule 40 threaded PVC risers and screens. Monitoring well construction details are listed below in Table 2 and are also presented on the Soil Profile and Test Data Sheets provided in Appendix 1.

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

TABLE 2: Monitoring Well Construction Details

Well ID	Ground Surface Elevation	Total Depth (m BGS)	Screened Interval (m BGS)	Sand Pack (m BGS)	Bentonite Seal (m BGS)	Casing Type
BH5	77.27	2.29	0.79-2.29	0.69-2.29	0.16-0.69	None
BH6	77.83	2.54	1.04-2.54	0.76-2.54	0.16-0.76	None
BH7	78.80	2.23	0.74-2.23	0.55-2.23	0.16-0.55	None

4.5 Field Measurement of Water Quality Parameters

Groundwater samples were collected on October 18, 2019. The water levels were the only parameter measured in the field.

4.6 Groundwater Sampling

Groundwater sampling protocols were followed using the MECP document entitled “Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario”, dated May 1996. Groundwater samples were obtained from each monitoring well, using dedicated sampling equipment. Standing water was purged from each well prior to sampling.

Samples were stored in coolers to reduce analyte volatilization during transportation. Details of our standard operating procedure for groundwater sampling are provided in the Sampling and Analysis Plan in Appendix 1.

4.7 Analytical Testing

Based on the guidelines outlined in the Sampling and Analysis Plan in Appendix 1, the soil and groundwater samples submitted for analytical testing are presented in Tables 3 and 4.

TABLE 3: Soil Samples Submitted and Analyzed Parameters

Sample ID	Sample Depth or Stratigraphic Unit	Parameters Analyzed		Rationale
		PHCs (F1-F4)	BTEX	
October 15, 2019				
BH5-SS2	0.76-1.37m Silty clay	X	X	Assess potential impact in the soil due to possible fuel oil storage.
BH6-SS4	2.27-2.54m Silty clay	X	X	Assess potential impact in the soil due to possible fuel oil storage.
BH7-SS3	1.52-2.13m Silty clay	X	X	Assess potential impact in the soil due to the presence of a former UST.
DUP	1.52-2.13m Silty clay	X	X	Assess potential impact in the soil due to the presence of a former UST.

TABLE 4: Groundwater Samples Submitted and Analyzed Parameters

Sample ID	Screened Interval (m)	Parameters Analyzed		Rationale
		PHCs (F1-F4)	BTEX	
October 18, 2019				
BH5-GW1	0.79-2.29	X	X	Assess potential impact in the groundwater due to possible fuel oil storage.
BH6-GW1	1.04-2.54	X	X	Assess potential impact in the groundwater due to possible fuel oil storage.
BH7-GW1	0.74-2.23	X	X	Assess potential impact in the groundwater due to the presence of a former UST.

Paracel Laboratories (Paracel), of Ottawa, Ontario, performed the laboratory analysis on the samples submitted for analytical testing. Paracel is a member of the Standards Council of Canada/Canadian Association for Laboratory

Accreditation (SCC/CALA). Paracel is accredited and certified by SCC/CALA for specific tests registered with the association.

4.8 Residue Management

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

4.9 Elevation Surveying

The borehole locations were selected by Paterson for both environmental and geotechnical purposes. Boreholes were located and surveyed in the field by Paterson. The benchmark (BM) was taken from the top of the grate of a catch basin located near the southwest corner of the Phase I Property. The geodetic datum was measured 78.58 m, as per the survey plan prepared by Stantec Geomatic Limited in July 2017.

The locations and elevations of the boreholes are presented on Drawing PE4760-3 – Test Hole Location Plan, appended to this report.

4.10 Quality Assurance and Quality Control Measures

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

5.0 REVIEW AND EVALUATION

5.1 Geology

Site soils generally consist of topsoil followed by native silty clay. A layer of granular fill was identified beneath the topsoil at BH6 and BH9 to depths ranging from approximately0.46 to 0.84 mbgs. The boreholes were terminated at depths ranging from 1.9 and 4.7 mbgs.

Groundwater was encountered within the overburden at depths ranging from approximately 1.57 to 2.22 mbgs. Site geology details are provided in the Soil Profile and Test Data Sheets provided in Appendix 1.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured during the groundwater sampling event on October 18, 2019, using an electronic water level meter. Groundwater levels are summarized below in Table 5.

TABLE 5: Groundwater Level Measurements

Borehole Location	Ground Surface Elevation (m)	Water Level Depth (m below grade)	Water Level Elevation (m ASL)	Date of Measurement
BH5	77.27	1.57	75.70	October 18, 2019
BH6	77.83	2.22	75.61	October 18, 2019
BH7	78.80	2.05	76.75	October 18, 2019

Based on the groundwater elevations measured during the sampling event, groundwater contour mapping was completed. Groundwater contours are shown on Drawing PE4760-4 – Groundwater Contour Plan. Based on the contour mapping, groundwater flow at the Phase II Property is in a southeasterly direction. A horizontal hydraulic gradient of approximately 0.04 m/m was calculated.

5.3 Fine-Course Soil Texture

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

5.4 Soil: Field Screening

Field screening of the soil samples collected from BH5 through BH7 resulted in vapour readings ranging from 0 to 10 ppm.

No obvious visual or olfactory indications of potential contamination were identified in any of the soil samples recovered. The field screening results of each individual soil sample (BH5 to BH7) are provided on the Soil Profile and Test Data Sheets, appended to this report.

Boreholes BH1 through BH4 and BH8 and BH9 were not screened for combustible vapours, as they were drilled for geotechnical purposes.

No obvious visual or olfactory indications of potential contamination were identified in any of the soil samples recovered. The field screening results of each individual soil sample (BH5 to BH7) are provided on the Soil Profile and Test Data Sheets, appended to this report.

5.5 Soil Quality

Three (3) soil samples from BH5 to BH7 were submitted for BTEX and PHC (F_1-F_4) analyses. The results of the analytical testing are presented in Table 6. The laboratory certificate of analysis is provided in Appendix 1.

TABLE 6: Analytical Test Results – Soil – BTEX and PHC (F_1-F_4)

Parameter	MDL (µg/g)	Soil Samples (µg/g) October 15, 2019			MECP Table 8 Standards (µg/g)
		BH5-SS2	BH6-SS4	BH7-SS3	
Benzene	0.02	nd	nd	nd	0.02
Ethylbenzene	0.05	nd	nd	nd	0.05
Toluene	0.05	nd	nd	nd	0.2
Xylenes (total)	0.05	nd	nd	nd	0.05
PHC F_1	7	nd	nd	nd	25
PHC F_2	4	nd	nd	nd	10
PHC F_3	8	nd	nd	nd	240
PHC F_4	6	nd	nd	nd	120

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Underlined and BOLD** – Parameter exceeds the selected MECP standards

No detectable BTEX or PHC concentrations were identified in any of the soil samples analyzed. All test results are in compliance with the MECP Table 8 Standards for commercial land use. The analytical results for BTEX and PHC parameters tested in soil are shown on Drawing PE4760-5– Analytical Testing Plan – Soil.

5.6 Groundwater Quality

Groundwater samples from monitoring wells installed in BH5, BH6 and BH7 were submitted for laboratory analysis of BTEX and PHC (F_1-F_4) parameters. The groundwater samples were obtained from the screened intervals noted on Table 2.

The results of the analytical testing are presented in Table 8. The laboratory certificates of analysis are provided in Appendix 1.

TABLE 7: Analytical Test Results – Groundwater – BTEXs and PHCs

Parameter	MDL (µg/L)	Groundwater Samples (µg/L) October 18, 2019			MECP Table 8 Standards (µg/L)
		BH5-GW1	BH6-GW1	BH7-GW1	
Benzene	0.5	nd	nd	nd	5
Ethylbenzene	0.5	nd	nd	nd	0.36
Toluene	0.5	nd	nd	nd	22

TABLE 7: Analytical Test Results – Groundwater – BTEXs and PHCs					
Parameter	MDL (µg/L)	Groundwater Samples (µg/L) October 18, 2019			MECP Table 8 Standards (µg/L)
		BH5-GW1	BH6-GW1	BH7-GW1	
Xylenes (total)	0.5	nd	nd	nd	300
PHC F_1	25	nd	nd	nd	420
PHC F_2	100	nd	nd	nd	150
PHC F_3	100	nd	nd	nd	500
PHC F_4	100	nd	nd	nd	500

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

No detectable BTEX of PHC concentrations were identified in the groundwater samples analyzed. All test results are in compliance with the MECP Table 8 Standards.

Analytical results of groundwater sampled with respect to borehole locations are shown on Drawing PE4760-6– Analytical Testing Plan – Groundwater.

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of the October 15 and October 18, 2019 sampling events were handled in accordance with the Analytical Protocol with respect to preservation method, storage requirement, and container type.

As per the O.Reg 153/04, as amended, a duplicate soil sample, DUP was obtained at BH7-SS3 on October 15, 2019 and analyzed for BTEX parameters. No parameter concentrations were detected above the laboratory method detection limits, and therefore, there is no relative percent different (RPD) for the original and the duplicate sample.

Overall, the quality of the field data collected during this Phase II-ESA is considered to be sufficient to meet the overall objectives of this assessment.

5.8 Phase II Conceptual Site Model

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

Site Description

Potentially Contaminating Activity and Areas of Potential Environmental Concern

As indicated in Section 2.2 of this report, one historical PCA and two (2) existing PCAs have resulted in APECs on the Phase II Property:

- PCA 1: *Item 28, "Gasoline and Associated Products Storage in Fixed Tanks"* – this PCA was identified based on the presence of a former underground storage tank situated on the southwest side of the residential dwelling on the Phase I Property.
- PCA 2: *Item 28, "Gasoline and Associated Products Storage in Fixed Tanks"* – this PCA was identified based on the presence of an empty above ground storage tank situated on the west side of the storage shed located east of the residential dwelling on the Phase I Property.
- PCA 3: *Item 28, "Gasoline and Associated Products Storage in Fixed Tanks"* – this PCA was identified based on the presence of three (3) empty above ground storage tanks situated inside the northeastern storage shed on the Phase I Property.

A summary of the PCAs that represent APECs on the Phase II Property, as well as the contaminants of potential concern (CPCs) are presented in Table 8.

TABLE 8: Areas of Potential Environmental Concern

Area of Potential Environmental Concern (APEC)	Location of APEC on Phase I Property	Potentially Contaminating Activity (PCA)	Location of PCA (on-site or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Soil and/or Groundwater)
APEC 1: Presence of a former UST	Central west portion of the Phase I Property	Item 28: Gasoline and associated product storage in fixed tanks	On-site	BTEX, PHC (F_1-F_4)	Soil and Groundwater

TABLE 8: Areas of Potential Environmental Concern

Area of Potential Environmental Concern (APEC)	Location of APEC on Phase I Property	Potentially Contaminating Activity (PCA)	Location of PCA (on-site or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Soil and/or Groundwater)
APEC 2: Presence of an empty AST	Central portion of the Phase I Property	Item 28: Gasoline and associated product storage in fixed tanks	On-site	BTEX, PHC (F_1-F_4)	Soil and Groundwater
APEC 3: Presence of three (3) ASTs	Central east portion of the Phase I Property	Item 28: Gasoline and associated product storage in fixed tanks	On-site	BTEX, PHC (F_1-F_4)	Soil and Groundwater

The rationale for identifying the above APECs were based on a personal interview and the site investigation.

Contaminants of Potential Concern

Contaminants of Potential Concern (CPCs) on the Phase II Property include BTEX and PHCs (fractions F1 through F4) in soil and groundwater.

Subsurface Structures and Utilities

Historical subsurface structures including the UST and line associated with the heating oil furnace may have affected contaminant distribution at the Phase II Property.

The Phase II Property is presently serviced by a private well and septic system with above ground electricity service from March Road. Below ground natural gas services and underground electrical services are present on-site. The presence of underground electrical lines is not considered to have an affect on contaminant distribution or transport.

Physical Setting

Site Stratigraphy

The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is illustrated on Drawings PE4760-7 – Cross-section A-A' – Soil and PE4760-8 – Cross-section A-A' – Groundwater. The site stratigraphy consists of:

- Topsoil was encountered in BH1 through BH8, ranging from 0.13 to 0.36m thick. Groundwater was not encountered in this layer.
- Granular fill material consisting of crushed stones and/or sand with gravel with some organics was encountered at BH9 and BH6 and extended to depths of 0.84 and 0.46 mbgs. Groundwater was not encountered in this layer.
- Silty clay was identified beneath the topsoil or granular fill material on inferred bedrock. All boreholes were terminated in this unit at depths ranging from 1.9 to 4.7 mbgs. Groundwater was encountered in this layer.

Hydrogeological Characteristics

Groundwater at the Phase II Property was encountered in the native silty clay layer. During the most recent groundwater monitoring event, groundwater flow was measured in a southeasterly direction, towards the Shirley's Brook and its tributary, with a hydraulic gradient of 0.04 m/m. Groundwater contours are shown on Drawing PE4760-4–Groundwater Contour Plan.

Approximate Depth to Water Table

Depth to the water table at the subject site varies between approximately 1.57 to 2.22 mbgs.

Well records for the Phase II Property indicated that the deepest aquifer was reached at approximately 25 mbgs in bedrock (interbedded limestone and sandstone).

Approximate Depth to Bedrock

Bedrock was not confirmed during the drilling program. All boreholes were completed in native silty clay and reached refusal at depths ranging between 1.9 to 4.7 mbgs, where dense glacial till and/or inferred bedrock was reached. Based on the geological map, the overburden thickness in the immediate area is estimated to be on the order of 5 to 10 m.

Well records for the immediate area of the Phase II Property indicated that the site is situated on a clay deposit, followed by bedrock encountered at approximately 1.8 mbgs.

Sections 41 and 43.1 of the Regulation

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

Section 43.1 of the Regulation does apply to the Phase II Property as the subject land includes part of a water body on-site.

Fill Placement

Based on the findings of the subsurface investigation, crush stone/granular fill material was encountered at BH6 and BH9. No concerns were noted with the crush stone material.

Existing Buildings and Structures

The Phase I Property is occupied by seven (7) structures that include a residential dwelling and private shed, a small vacant cabin, and four (4) barn-like structures.

Proposed Buildings and Other Structures

The proposed development for the Phase II Property includes all slab-on-grade commercial buildings: a retail fuel outlet, two (2) restaurants and a hotel. The footprint of the development will cover the majority of the site, with a 20 m offset from Shirley's Brook and its tributary along the northern and eastern property boundary and a 5 m offset from the tributary located to the abutting south property boundary.

Areas of Natural Significance

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

Water Bodies

The Phase II Property is situated in a designated floodplain overlying Shirley's Brook and its tributary, which transect the north-eastern and northern portions of the Phase I Property in an approximate north-south direction, while its tributary runs in an approximate east-west direction, parallel to the northern property boundary.

Environmental Condition

Areas Where Contaminants are Present

Based on the analytical results, soil and groundwater are in compliance with the MECP Table 8 Standards for commercial land use.

Types of Contaminants

Based on the analytical results for soil and groundwater, there are no contaminants present on or beneath the Phase II Property.

Contaminated Media

Based on the findings of the Phase II ESA, no contaminated media is present on or beneath the Phase II Property.

What Is Known About Areas Where Contaminants Are Present

No contaminants exceeding MECP Table 8 Standards are present in the soil or groundwater on or beneath the Phase II Property.

Distribution and Migration of Contaminants

Based on the findings of the Phase II ESA, the distribution and migration of contaminants is not considered to have occurred on the Phase II Property.

Discharge of Contaminants

Based on the findings of the Phase II ESA, no contaminants have been discharged on the Phase II Property.

Climatic and Meteorological Conditions

No contaminants are present in the soil or groundwater beneath the Phase II Property and therefore climatic and meteorological conditions are not considered to have contributed to contaminant transport.

Potential for Vapour Intrusion

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

6.0 CONCLUSIONS

Assessment

A Phase II ESA was conducted for the property addressed 910 March Road, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address the areas of environmental concern (APECs) that were identified on the Phase II Property during the Phase I ESA.

The Phase II ESA was carried out in conjunction with a Geotechnical Investigation and consisted of drilling nine (9) boreholes across the Phase II Property, three (3) of which were constructed with groundwater monitoring well installations.

The soil profile generally consisted of topsoil, followed by a silty clay layer. Boreholes were terminated at a maximum depth of 4.7m below the ground surface. Soil samples were obtained from the boreholes and screened using combustible vapour measurements (BH5 to BH7) along with visual and olfactory observations.

Based on the screening results in combination with sample depth and location, three (3) soil samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX) and petroleum hydrocarbons (PHCs, F_1-F_4). No BTEX or PHC parameters were identified above the laboratory detection limit in the soil samples analyzed. All of the soil results are in compliance with the MECP Table 8 Commercial Standards for coarse grain soils.

Groundwater samples from monitoring wells installed in BH5, BH6 and BH7 were recovered and analyzed for BTEX and PHCs. No free-phase product was observed on the groundwater at any of the monitoring well locations during the groundwater sampling event.

No BTEX or PHC parameters were identified above the laboratory detection limits in the groundwater samples analyzed. The groundwater results are in compliance with the MECP Table 8 Standards.

Based on the findings of the Phase II ESA, **no further environmental investigation is required.**

Recommendations

If the monitoring wells installed on the subject site are not going to be used in the future, or will be destroyed during site redevelopment, they should be abandoned according to Ontario Regulation 903.

7.0 STATEMENT OF LIMITATIONS

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

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

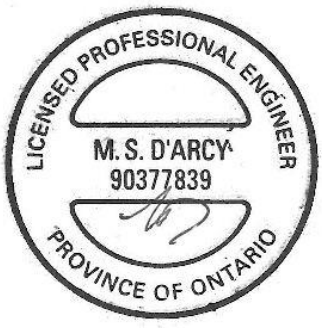
Should any conditions be encountered at the subject site and/or historical information that differ from our findings, we request that we be notified immediately in order to allow for a reassessment.

This report was prepared for the sole use of Wexcom Developments (March Rd.) Limited. Notification from Wexcom Developments (March Rd.) Limited and Paterson Group will be required to release this report to any other party.

Paterson Group Inc.

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

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



Report Distribution:

- Wexcom Developments (March Rd.) Limited
- Paterson Group

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE4760-3 – TEST HOLE LOCATION PLAN

DRAWING PE4760-4 – GROUNDWATER CONTOUR PLAN

DRAWING PE4760-5 – ANALYTICAL TESTING PLAN – SOIL

DRAWING PE4760-6 – ANALYTICAL TESTING PLAN – GROUNDWATER

DRAWING PE4760-7 – CROSS-SECTION A – A' – SOIL

DRAWING PE4760-8 – CROSS-SECTION A – A' – GROUNDWATER

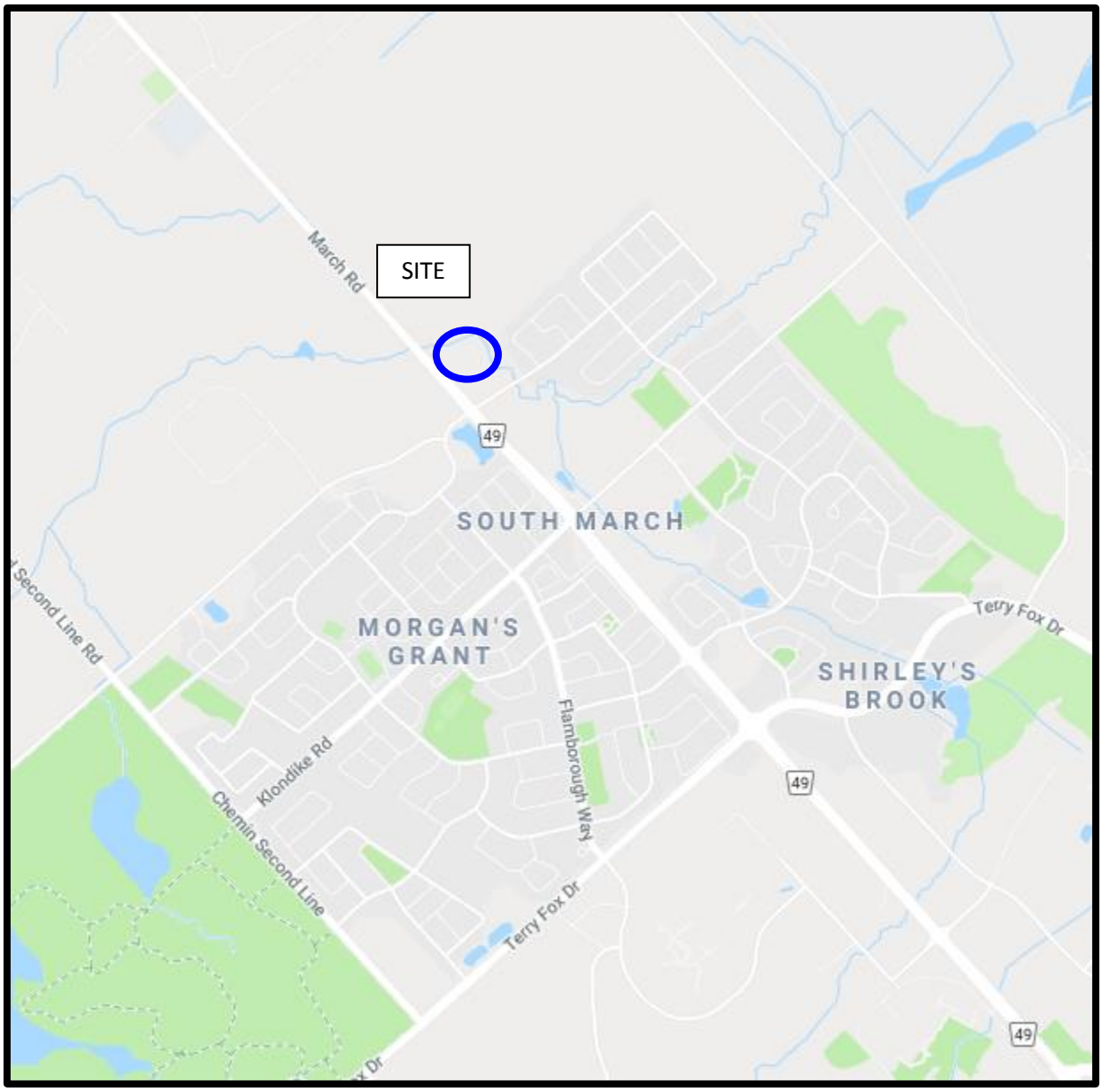
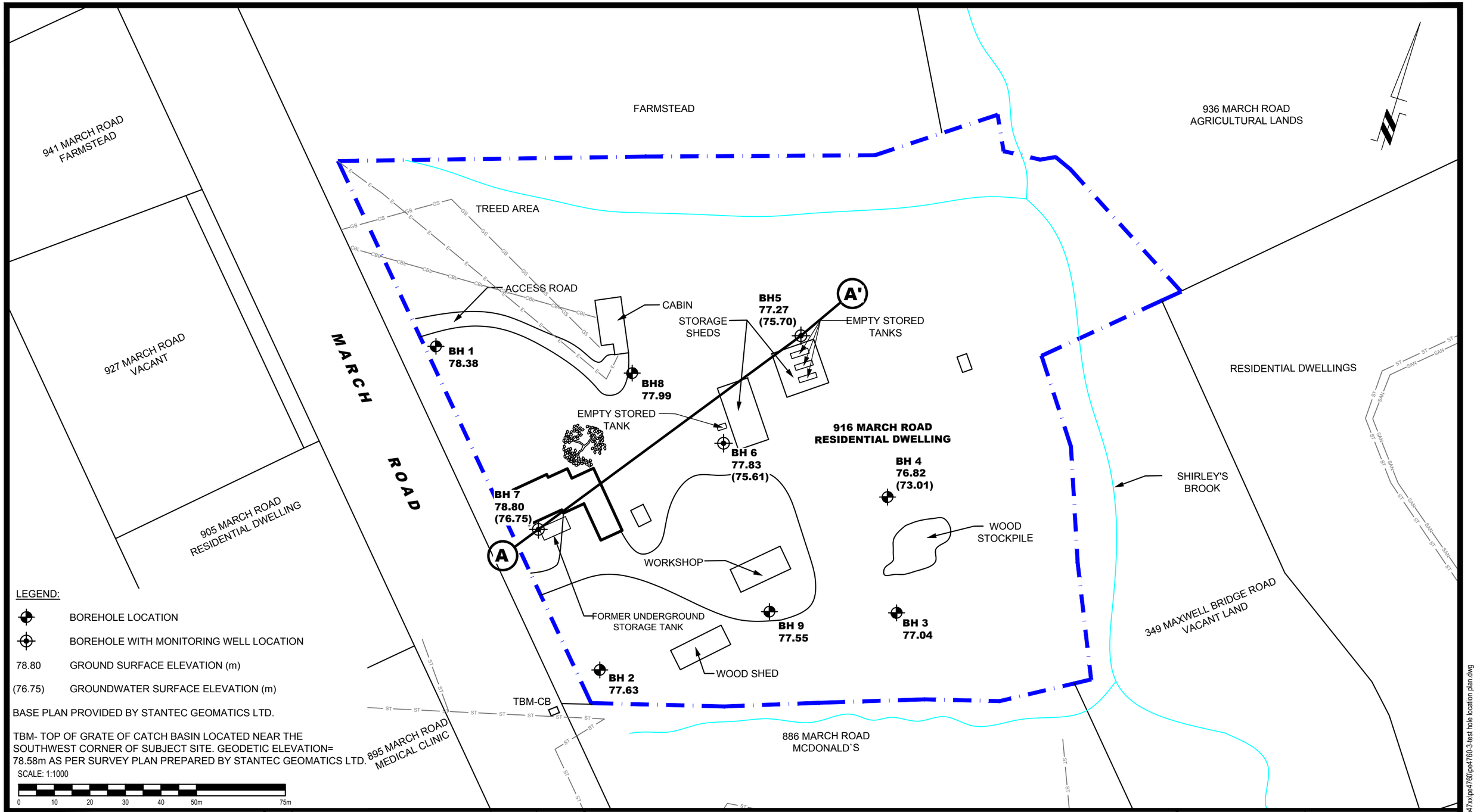


FIGURE 1

KEY PLAN



LEGEND:

- BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION
- 78.80 GROUND SURFACE ELEVATION (m)
- (76.75) GROUNDWATER SURFACE ELEVATION (m)

BASE PLAN PROVIDED BY STANTEC GEOMATICS LTD.

TBM- TOP OF GRATE OF CATCH BASIN LOCATED NEAR THE SOUTHWEST CORNER OF SUBJECT SITE. GEODETIC ELEVATION= 78.58m AS PER SURVEY PLAN PREPARED BY STANTEC GEOMATICS LTD.

SCALE: 1:1000

0 10 20 30 40 50m 75m

patersongroup
consulting engineers

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Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

WEXCOM DEVELOPMENTS (MARCH ROAD) LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
910 MARCH ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 10/2019
Drawn by: YA	Report No.: PE4760-2
Checked by: MW	Dwg. No.: PE4760-3
Approved by: MSD	Revision No.:

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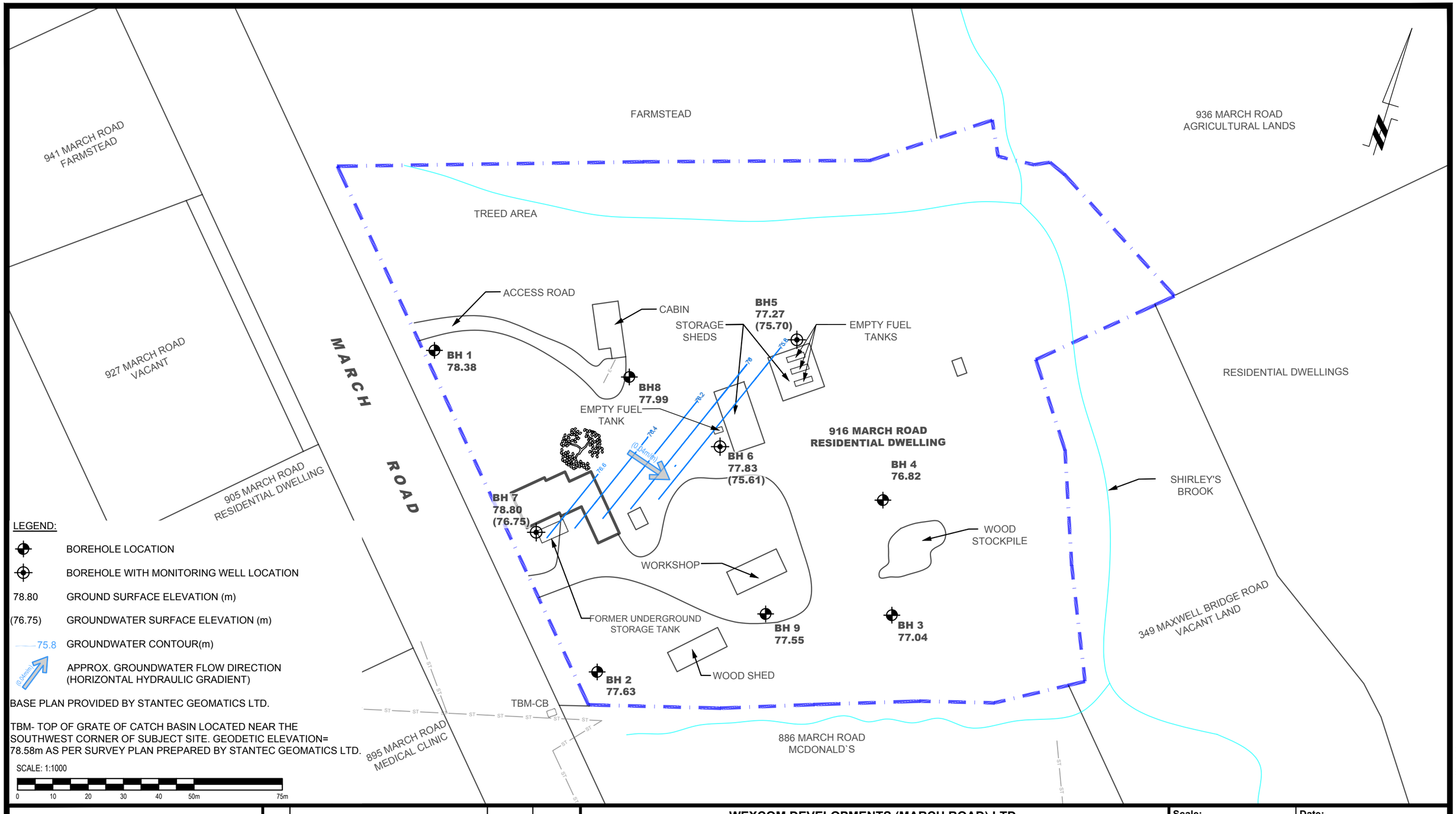

LEGEND:

- BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION
- 78.80 GROUND SURFACE ELEVATION (m)
- (76.75) GROUNDWATER SURFACE ELEVATION (m)
- 75.8 GROUNDWATER CONTOUR(m)
- (0.04m/m) APPROX. GROUNDWATER FLOW DIRECTION (HORIZONTAL HYDRAULIC GRADIENT)

BASE PLAN PROVIDED BY STANTEC GEOMATICS LTD.

TBM- TOP OF GRATE OF CATCH BASIN LOCATED NEAR THE SOUTHWEST CORNER OF SUBJECT SITE. GEODETIC ELEVATION= 78.58m AS PER SURVEY PLAN PREPARED BY STANTEC GEOMATICS LTD.

SCALE: 1:1000

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WEXCOM DEVELOPMENTS (MARCH ROAD) LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
910 MARCH ROAD

OTTAWA, ONTARIO

Title:

GROUNDWATER CONTOUR PLAN

Scale: 1:1000	Date: 10/2019
Drawn by: RCG	Report No.: PE4760-2
Checked by: MW	Dwg. No.: PE4760-4
Approved by: MSD	Revision No.:

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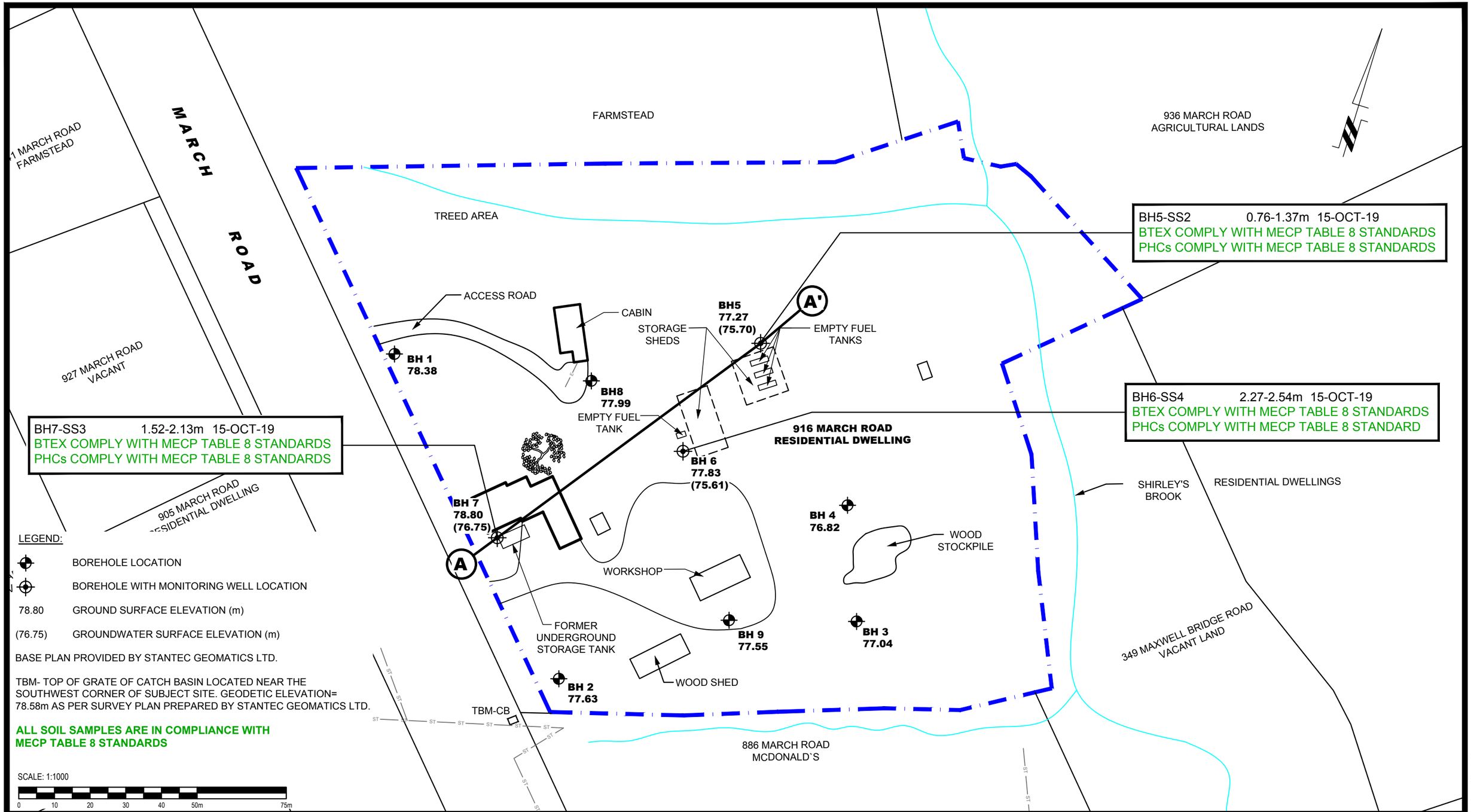

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ALL SOIL SAMPLES ARE IN COMPLIANCE WITH MECP TABLE 8 STANDARDS

SCALE: 1:1000

0 10 20 30 40 50m 75m

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WEXCOM DEVELOPMENTS (MARCH ROAD) LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
910 MARCH ROAD

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - SOIL

Scale: 1:1000	Date: 10/2019
Drawn by: RCG	Report No.: PE4760-2
Checked by: MW	Dwg. No.: PE4760-5
Approved by: MSD	Revision No.:

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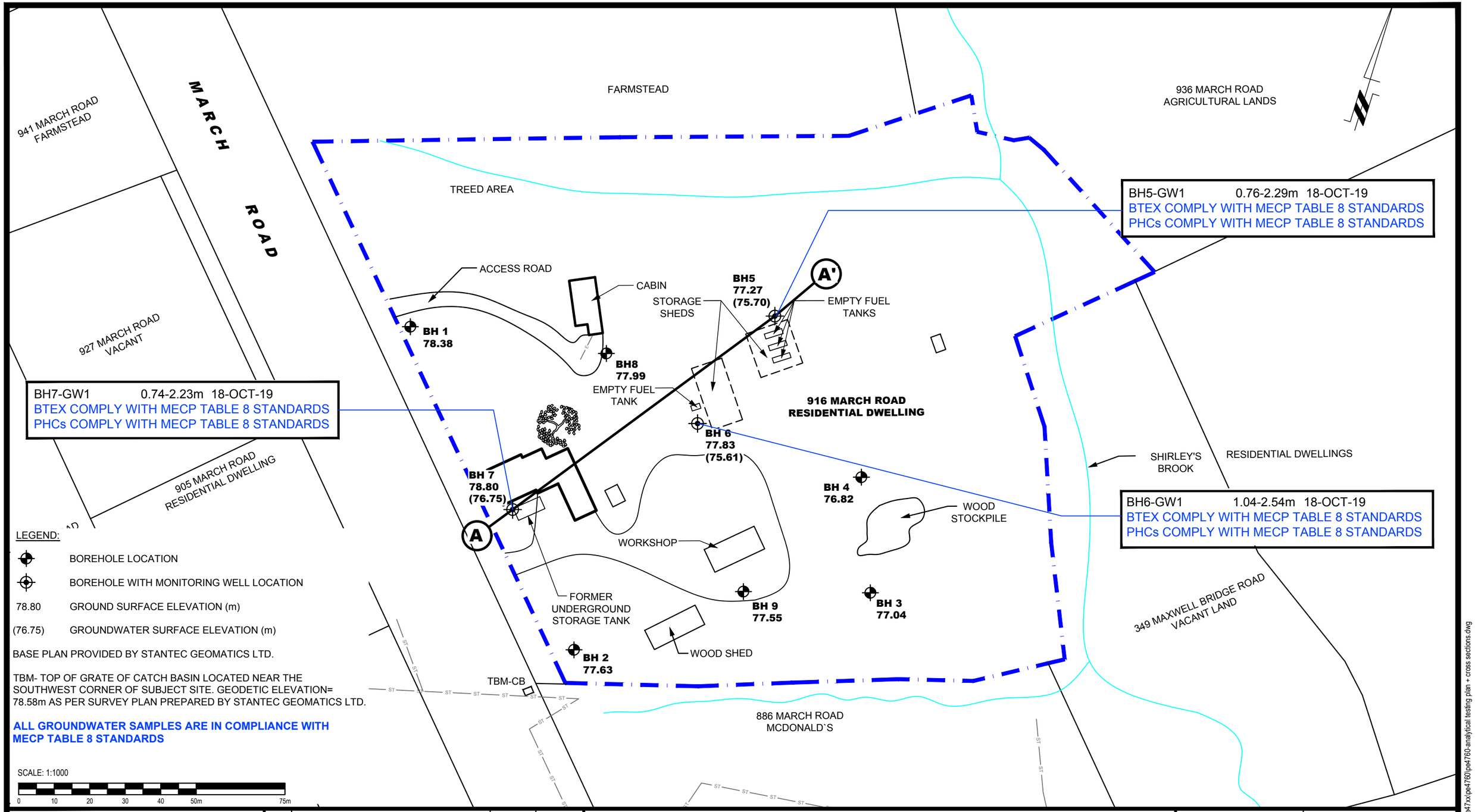

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ALL GROUNDWATER SAMPLES ARE IN COMPLIANCE WITH MECP TABLE 8 STANDARDS

SCALE: 1:1000

0 10 20 30 40 50m 75m

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WEXCOM DEVELOPMENTS (MARCH ROAD) LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
910 MARCH ROAD

OTTAWA, ONTARIO

Title: **ANALYTICAL TESTING PLAN - GROUNDWATER**

Scale: 1:1000	Date: 10/2019
Drawn by: RCG	Report No.: PE4760-2
Checked by: MW	Dwg. No.: PE4760-6
Approved by: MSD	Revision No.:

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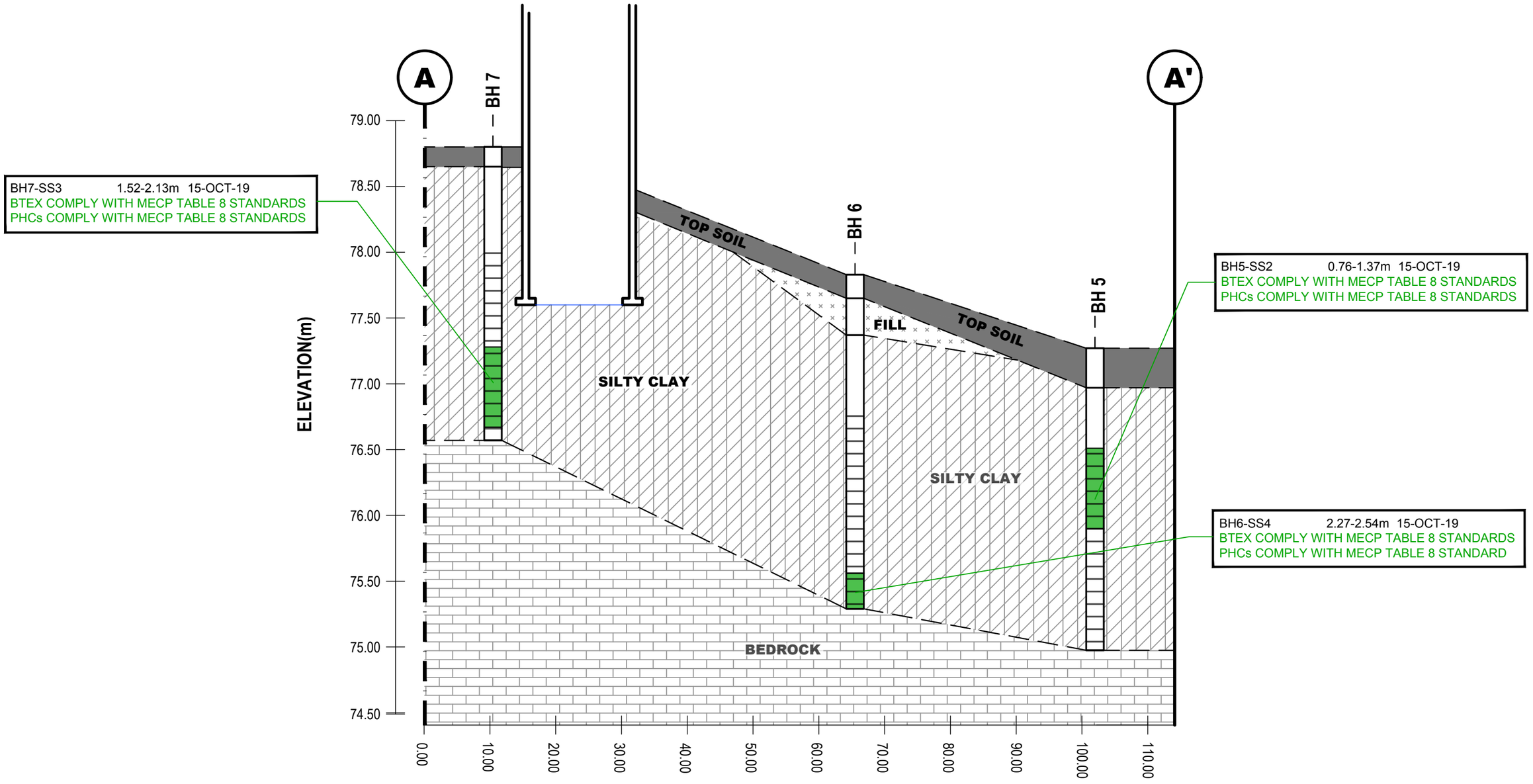

ALL SOIL SAMPLES ARE IN COMPLIANCE WITH MECP TABLE 8 STANDARDS

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WEXCOM DEVELOPMENTS (MARCH ROAD) LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
910 MARCH ROAD

OTTAWA, ONTARIO

Title:

CROSS SECTION A-A - SOIL

Scale: AS SHOWN	Date: 10/2019
Drawn by: RCG	Report No.: PE4760-2
Checked by: MW	Dwg. No.: PE4760-7
Approved by: MSD	Revision No.:

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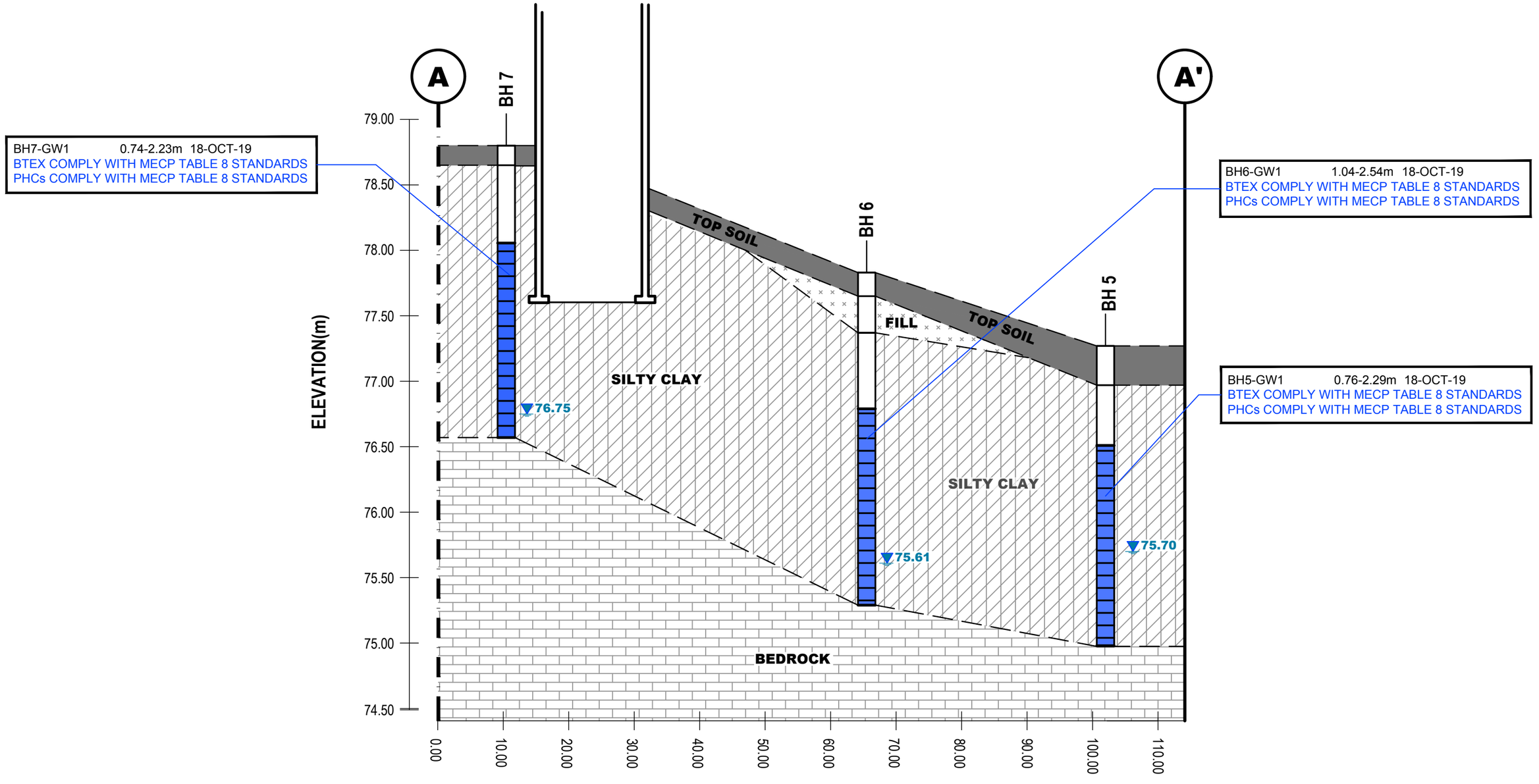

ALL GROUNDWATER SAMPLES ARE IN COMPLIANCE WITH MECP TABLE 8 STANDARDS

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NO.	REVISIONS	DATE	INITIAL

WEXCOM DEVELOPMENTS (MARCH ROAD) LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
910 MARCH ROAD

OTTAWA, ONTARIO

Title:

CROSS SECTION A-A - GROUNDWATER

Scale: AS SHOWN	Date: 10/2019
Drawn by: RCG	Report No.: PE4760-2
Checked by: MW	Dwg. No.: PE4760-8
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
910 March Road
Ottawa, Ontario

Prepared For

Wexcom Developments (March Rd.) Ltd.

October 2019

Report: PE4760-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by Mr. Michael Foley of Wexcom Developments to conduct a Phase II Environmental Site Assessment (ESA) for the property addressed 910 March Road, in the City of Ottawa, Ontario.

The Phase II ESA was carried out to address area of potential environmental concerns on the central portion of the Phase II Property, resulting from a former underground storage tank (UST) and empty aboveground storage tanks on the Phase II Property. The following subsurface investigation program was developed to identify and delineate potential concerns. A Geotechnical Investigation was conducted concurrently with the environmental subsurface investigation.

Borehole	Location & Rationale	Proposed Depth & Rationale
BH1	Place on the northwestern property boundary of the site for geotechnical purposes.	Borehole to be advanced until auger it reaches practical refusal.
BH2	Place on the southwestern corner of the property site for geotechnical purposes.	Borehole to be advanced until auger it reaches practical refusal.
BH3	Place on the southeast portion of the property for geotechnical purposes.	Borehole to be advanced until auger it reaches practical refusal.
BH4	Place on the central east portion of the site for geotechnical purposes.	Borehole to be advanced until auger it reaches practical refusal.
BH5	Place on the northeastern portion of the property to assess the potential impact of stored fuel oil tanks.	Borehole to be advanced to install a groundwater monitoring well.
BH6	Place on the central portion of the property to assess the potential impact of a stored fuel oil tank.	Borehole to be advanced to install a groundwater monitoring well.
BH7	Place on the central west portion of the property to assess the potential impact of a former UST nest.	Borehole to be advanced to install a groundwater monitoring well.
BH8	Place on the central portion of the site for geotechnical purposes.	Borehole to be advanced until auger it reaches practical refusal.
BH9	Place on the central east portion of the site for geotechnical purposes.	Borehole to be advanced until auger it reaches practical refusal.

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

Following borehole drilling, monitoring wells will be installed in selected boreholes (as above) for the measurement of water levels and the collection of groundwater samples. Borehole locations are shown on the Test Hole Location Plan appended to the main report.

2.0 ANALYTICAL TESTING PROGRAM

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

- ❒ At least one sample from each borehole should be submitted, in order to delineate the horizontal extent of contamination across the site.
- ❒ At least one sample from each stratigraphic unit should be submitted, in order to delineate the vertical extent of contamination at the site.
- ❒ In boreholes where there is visual or olfactory evidence of contamination, or where organic vapour meter or photoionization detector readings indicate the presence of contamination, the 'worst-case' sample from each borehole should be submitted for comparison with MOECC site condition standards.
- ❒ In boreholes with evidence of contamination as described above, a sample should be submitted from the stratigraphic unit below the 'worst-case' sample to determine whether the contaminant(s) have migrated downward.
- ❒ Parameters analyzed should be consistent with the Contaminants of Potential Concern identified in the Phase I ESA.

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

- ❒ Groundwater monitoring wells should be installed in all boreholes with visual or olfactory evidence of soil contamination, in stratigraphic units where soil contamination was encountered, where those stratigraphic units are at or below the water table (i.e. a water sample can be obtained).
- ❒ Groundwater monitoring well screens should straddle the water table at sites where the contaminants of concern are suspected to be LNAPLs.
- ❒ At least one groundwater monitoring well should be installed in a stratigraphic unit below the suspected contamination, where said stratigraphic unit is water-bearing.

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

3.0 STANDARD OPERATING PROCEDURES

3.1 Environmental Drilling Procedure

Purpose

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

Equipment

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

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

Determining Borehole Locations

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

After drilling is completed a plan with the borehole locations must be provided. Distances should be measured using a measuring tape or wheel rather than paced off. The geodetic datum was measured 78.58m, as per the survey plan prepared by Stantec Geomatic Limited in July 2017.

Drilling Procedure

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

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

Spoon Washing Procedure

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

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

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

Screening Procedure

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

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

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

3.2 Monitoring Well Installation Procedure

Equipment

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

Procedure

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

3.3 Monitoring Well Sampling Procedure

Equipment

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

Sampling Procedure

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

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

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

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

5.0 DATA QUALITY OBJECTIVES

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

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

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

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

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

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

These considerations are discussed in the body of the report.

6.0 PHYSICAL IMPEDIMENTS TO SAMPLING & ANALYSIS PLAN

Physical impediments to the Sampling and Analysis plan may include:

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

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Prop. Commercial Development - 910 March Road
Ottawa, Ontario

DATUM BM - Top of grate of catch basin located near the southwest corner of subject site. Geodetic elevation = 78.58m, as per survey plan prepared by Stantec Geomatics Ltd.

REMARKS

FILE NO. PE4760

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
TOPSOIL with organics and silty clay, some sand 0.20		AU	1			0	78.38		
Hard to very stiff, brown **SILTY CLAY**		SS	2	100	14	1	77.38		
		SS	3	100	50+				
1.93 End of Borehole									
Practical refusal to augering at 1.93m depth									

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

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
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Ottawa, Ontario

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REMARKS

FILE NO. PE4760

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector ● Volatile Organic Rdg. (ppm) / ○ Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
TOPSOIL with organics and silty clay, some sand 0.13		AU	1			0	77.63		
Hard to very stiff, brown **SILTY CLAY**		SS	2	100	9	1	76.63		
		SS	3	100	9	2	75.63		
2.62		SS	4	100	5				
Very stiff, brown **SILTY CLAY** with sand, gravel, cobbles, occasional boulders		SS	5	71	16	3	74.63		
3.50									
Stiff, grey **SILTY CLAY,** trace sand - increasing sand and gravel with depth		SS	6	54	6	4	73.63		
4.67		SS	7	75	50+				
End of Borehole Practical refusal to augering at 4.67m depth									

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

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Prop. Commercial Development - 910 March Road
Ottawa, Ontario

DATUM BM - Top of grate of catch basin located near the southwest corner of subject site. Geodetic elevation = 78.58m, as per survey plan prepared by Stantec Geomatics Ltd.

REMARKS

FILE NO. PE4760

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
TOPSOIL with organics, silty sand and gravel		AU	1			0	77.04		
0.28									
		SS	2	88	12	1	76.04		
Hard to stiff, brown **SILTY CLAY**		SS	3	92	8	2	75.04		
		SS	4	96	4				
- trace sand and gravel by 2.7m depth						3	74.04		
- increasing gravel with depth, occasional cobbles and boulders		SS	5	100	6				
3.68									
End of Borehole									
Practical refusal to augering at 3.68m depth									

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.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Prop. Commercial Development - 910 March Road
Ottawa, Ontario

DATUM BM - Top of grate of catch basin located near the southwest corner of subject site. Geodetic elevation = 78.58m, as per survey plan prepared by Stantec Geomatics Ltd.

REMARKS

FILE NO. PE4760

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
TOPSOIL with organics, some sand and gravel		AU	1			0	76.82		
0.36									
Hard to very stiff, brown **SILTY CLAY**		SS	2	100	17	1	75.82		
		SS	3	67	9	2	74.82		
2.29									
GLACIAL TILL: Very stiff, brown clayey silt to silty clay with sand and gravel, occasional cobbles and boulders		SS	4	62	11	3	73.82		
		SS	5	64	50+				
3.81									
End of Borehole									
Practical refusal to augering at 3.81m depth									

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.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Prop. Commercial Development - 910 March Road
Ottawa, Ontario

DATUM BM - Top of grate of catch basin located near the southwest corner of subject site. Geodetic elevation = 78.58m, as per survey plan prepared by Stantec Geomatics Ltd.

REMARKS

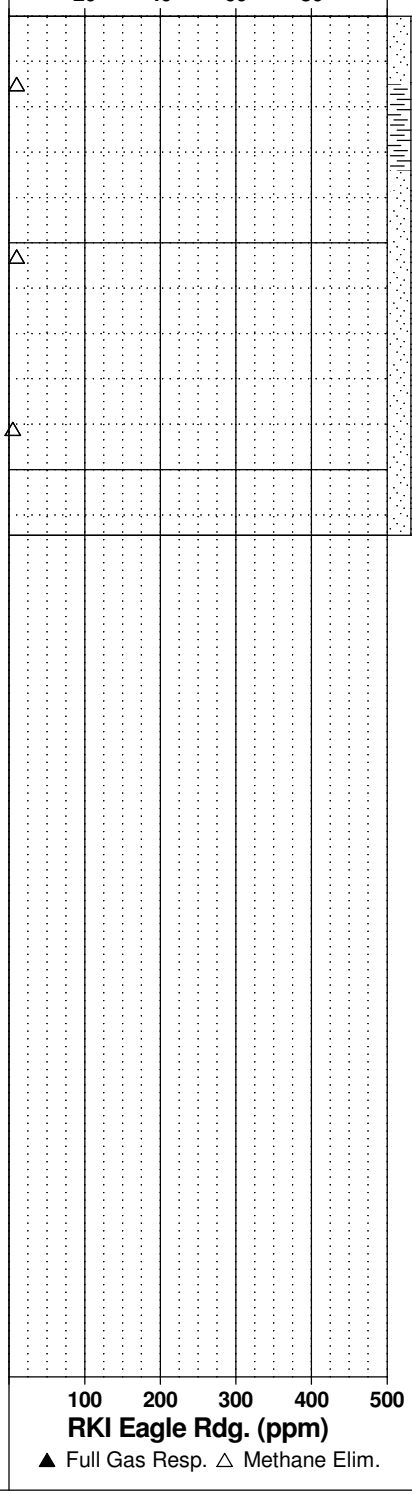
FILE NO. PE4760

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	77.27
TOPSOIL with organics, some silty clay		AU	1				
0.30							
Hard to stiff, brown **SILTY CLAY**							
- some sand, trace gravel by 0.9m depth		SS	2	83	6	1	76.27
- increasing sand and gravel with depth							
		SS	3	75	9	2	75.27
2.29							
End of Borehole							
Practical refusal to augering at 2.29m depth							
(GWL @ 1.57m - Oct. 18, 2019)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)
○ **Lower Explosive Limit %**



Monitoring Well Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Prop. Commercial Development - 910 March Road
Ottawa, Ontario

DATUM BM - Top of grate of catch basin located near the southwest corner of subject site. Geodetic elevation = 78.58m, as per survey plan prepared by Stantec Geomatics Ltd.

REMARKS

FILE NO. PE4760

HOLE NO. BH 6

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.18						0	77.83
FILL: Crushed stone with sand, topsoil and organics 0.46		AU	1				
Hard to very stiff, brown **SILTY CLAY**		SS	2	79	18	1	76.83
		SS	3	100	15	2	75.83
2.54		SS	4	78	50+		
End of Borehole Practical refusal to augering at 2.54m depth (GWL @ 2.22 - Oct. 18, 2019)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

△

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Prop. Commercial Development - 910 March Road
Ottawa, Ontario

DATUM BM - Top of grate of catch basin located near the southwest corner of subject site. Geodetic elevation = 78.58m, as per survey plan prepared by Stantec Geomatics Ltd.

REMARKS

FILE NO. PE4760

HOLE NO. BH 7

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
TOPSOIL with organics, some sand and gravel 0.15		AU	1			0	78.80		
Hard to very stiff, brown **SILTY CLAY**		SS	2	54	16	1	77.80		
- trace sand and gravel by 1.7m depth		SS	3		12	2	76.80		
2.23									
End of Borehole									
Practical refusal to augering at 2.23m depth									
(GWL @ 2.05m - Oct. 18, 2019)									

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

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Prop. Commercial Development - 910 March Road
Ottawa, Ontario

DATUM BM - Top of grate of catch basin located near the southwest corner of subject site. Geodetic elevation = 78.58m, as per survey plan prepared by Stantec Geomatics Ltd.

REMARKS

FILE NO. PE4760

HOLE NO. BH 8

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
TOPSOIL with organic, some sand, trace gravel 0.25		AU	1			0	77.99		
Hard to very stiff, brown **SILTY CLAY**		SS	2	100	14	1	76.99		
- trace sand by 1.5m depth		SS	3	100	8	2	75.99		
2.29 End of Borehole									
Practical refusal to augering at 2.29m depth									

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.

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
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REMARKS

FILE NO. PE4760

HOLE NO. BH 9

BORINGS BY CME 55 Power Auger **DATE** 2019 October 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector ● Volatile Organic Rdg. (ppm) / ○ Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE						0	77.55		
FILL: Crushed stone		AU	1						
0.46									
FILL: Brown sand with gravel									
0.84		SS	2	83	9	1	76.55		
Hard to very stiff, brown **SILTY CLAY**		SS	3	100	14	2	75.55		
2.69		SS	4	100	11				
GLACIAL TILL: Hard to very stiff, brown silty clay with sand, gravel, occasional cobbles and boulders		SS	5	42	29	3	74.55		
3.81									
End of Borehole									
Practical refusal to augering at 3.81m depth									

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

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

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

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their "sensitivity". The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

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

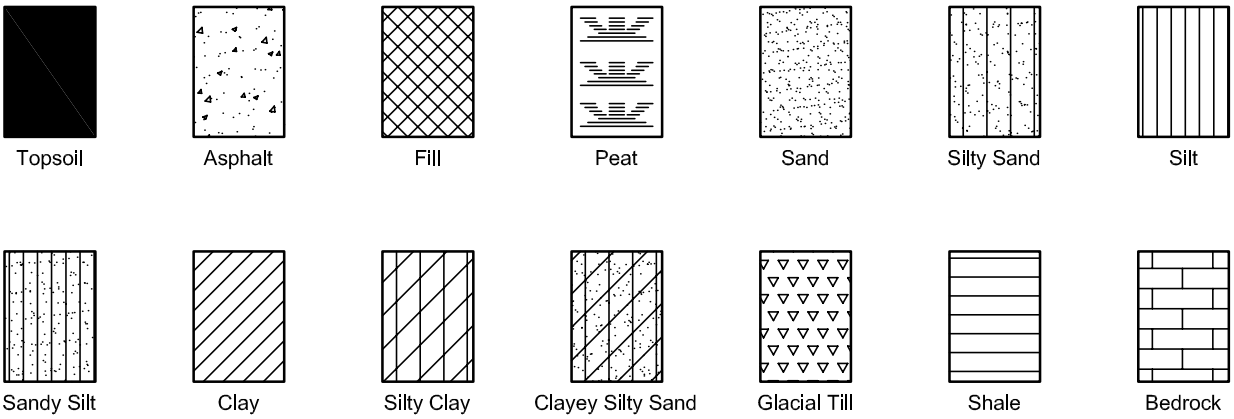
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

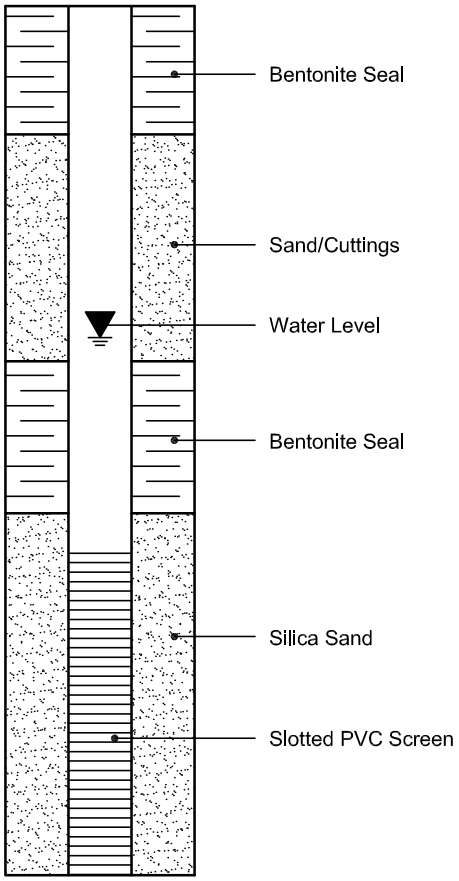
SYMBOLS AND TERMS (continued)

STRATA PLOT

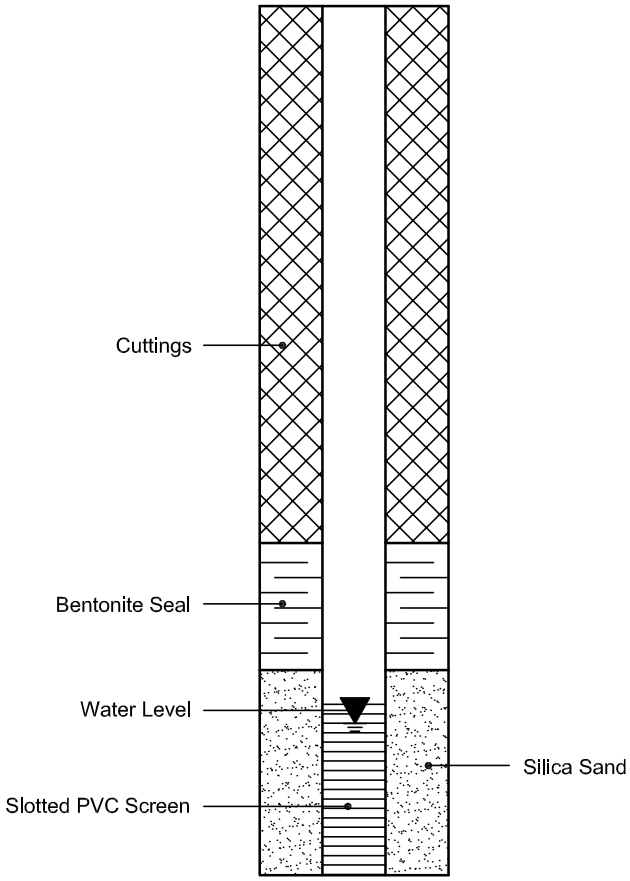


MONITORING WELL AND PIEZOMETER CONSTRUCTION

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: Mark D'Arcy

Client PO: 28357
Project: PE4760
Custody: 51078

Report Date: 21-Oct-2019
Order Date: 16-Oct-2019

Order #: 1942223

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

Paracel ID	Client ID
1942223-01	BH5-SS2
1942223-02	BH6-SS4
1942223-03	BH7-SS3
1942223-04	DUP

Approved By:

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 28357

Report Date: 21-Oct-2019
Order Date: 16-Oct-2019
Project Description: PE4760

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	18-Oct-19	20-Oct-19
PHC F1	CWS Tier 1 - P&T GC-FID	18-Oct-19	20-Oct-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	17-Oct-19	18-Oct-19
Solids, %	Gravimetric, calculation	17-Oct-19	17-Oct-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 28357

Report Date: 21-Oct-2019

Order Date: 16-Oct-2019

Project Description: PE4760

	Client ID:	BH5-SS2	BH6-SS4	BH7-SS3	DUP
	Sample Date:	15-Oct-19 09:00	15-Oct-19 09:00	15-Oct-19 09:00	15-Oct-19 09:00
	Sample ID:	1942223-01	1942223-02	1942223-03	1942223-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	80.6	75.9	76.5	78.3
Volatiles					
Benzene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Toluene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
o-Xylene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Toluene-d8	Surrogate	107%	111%	111%	109%
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	<7	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	-
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	-
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	-

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 28357

Report Date: 21-Oct-2019
Order Date: 16-Oct-2019
Project Description: PE4760

Method Quality Control: Blank

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

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND				40	
F2 PHCs (C10-C16)	ND	4	ug/g dry	ND				30	
F3 PHCs (C16-C34)	659	8	ug/g dry	472			33.1	30	QR-04
F4 PHCs (C34-C50)	137	6	ug/g dry	115			17.5	30	
Physical Characteristics									
% Solids	87.2	0.1	% by Wt.	87.5			0.4	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	*3.69*		*ug/g dry*		*109*	*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)	192	7	ug/g		96.0	80-120			
F2 PHCs (C10-C16)	94	4	ug/g	ND	91.3	60-140			
F3 PHCs (C16-C34)	1090	8	ug/g	472	245	60-140			QM-06
F4 PHCs (C34-C50)	352	6	ug/g	115	149	60-140			QM-06
Volatiles									
Benzene	3.15	0.02	ug/g		78.8	60-130			
Ethylbenzene	4.52	0.05	ug/g		113	60-130			
Toluene	4.70	0.05	ug/g		118	60-130			
m,p-Xylenes	8.49	0.05	ug/g		106	60-130			
o-Xylene	4.20	0.05	ug/g		105	60-130			
Surrogate: Toluene-d8	*2.48*		*ug/g*		*77.4*	*50-140*			

Qualifier Notes:

QC Qualifiers :

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

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

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

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

CCME PHC additional information:

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

PARACEL LABORATORIES LTI

Paracel ID: 1942223

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
1942223	№ 51078

Client Name: Paterson	Project Ref: PE4760	Page 1 of 1
Contact Name: Mark D'Arcy	Quote #:	
Address: 154 Colonnade R.d South	PO #: 28357	Turnaround Time: ☐ 1 day ☐ 3 day ☐ 2 day ☑ Regular
Telephone:	E-mail: mdarcy@patersongroup.ca	Date Required:

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

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

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken: Date	Sample Taken: Time	Required Analysis: PHCs (F1-F4) + BTEX	Required Analysis: BTEX										
1	BH5-SS2	S		2	Oct. 15/19		✓										12 metals + lydrides	✓
2	BH6-SS4	↓		↓	↓		✓										↓	✓
3	BH7-SS3						✓											✓
4	DUP							✓										✓
5																		
6																		
7																		
8																		
9																		
10																		

Comments:

Method of Delivery: Paracel

Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab: Suneetpam Dekmai	Verified By:
Relinquished By (Print): Mark St Pierre	Date/Time: 16/10/19 1:40	Date/Time: OCT 16, 2019 02:25	Date/Time: 16 Oct 19 14:58
Date/Time:	Temperature: °C FH	Temperature: 13.6 °C	pH Verified: ☐ By: NA

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Certificate of Analysis

Paterson Group Consulting Engineers

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

Client PO: 28426
Project: PE4760
Custody: 51083

Report Date: 23-Oct-2019
Order Date: 21-Oct-2019

Order #: 1943108

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

Paracel ID	Client ID
1943108-01	BH5-GW1
1943108-02	BH6-GW1
1943108-03	BH7-GW1

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 28426

Report Date: 23-Oct-2019
Order Date: 21-Oct-2019
Project Description: PE4760

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	23-Oct-19	23-Oct-19
PHC F1	CWS Tier 1 - P&T GC-FID	22-Oct-19	23-Oct-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	21-Oct-19	23-Oct-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 28426

Report Date: 23-Oct-2019

Order Date: 21-Oct-2019

Project Description: PE4760

	Client ID:	BH5-GW1	BH6-GW1	BH7-GW1	-
	Sample Date:	18-Oct-19 12:20	18-Oct-19 11:15	18-Oct-19 10:30	-
	Sample ID:	1943108-01	1943108-02	1943108-03	-
	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	89.5%	87.6%	89.4%	-
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: 28426

Report Date: 23-Oct-2019
Order Date: 21-Oct-2019
Project Description: PE4760

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	*73.3*		*ug/L*		*91.7*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Volatiles									
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	*74.0*		*ug/L*		*92.4*	*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)	1860	25	ug/L		92.8	68-117			
F2 PHCs (C10-C16)	1310	100	ug/L		82.0	60-140			
F3 PHCs (C16-C34)	3290	100	ug/L		83.9	60-140			
F4 PHCs (C34-C50)	2430	100	ug/L		97.8	60-140			
Volatiles									
Benzene	46.9	0.5	ug/L		117	60-130			
Ethylbenzene	34.4	0.5	ug/L		86.0	60-130			
Toluene	38.5	0.5	ug/L		96.3	60-130			
m,p-Xylenes	71.8	0.5	ug/L		89.8	60-130			
o-Xylene	33.4	0.5	ug/L		83.4	60-130			
Surrogate: Toluene-d8	*66.3*		*ug/L*		*82.9*	*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.
- When reported, data for F4G has been processed using a silica gel cleanup.

PARACEL LABORATORIES

Paracel ID: 1943108

aurent Blvd.
o K1G 4J8
947
acellabs.com
abs.com

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
1943108	№ 51083

Client Name: Paterson Group
Project Ref: PE4760
Page 1 of 1

Contact Name: Mark D'Arcy
Quote #:

Address: 154 Colonnade Rd. S.
PO #: 28426

Telephone: 613-226-7381
E-mail: mwitteman@patersongroup.ca
mdarcy@patersongroup.ca

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

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

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

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Required Analysis: PHCs F1-F4	Required Analysis: BTEX
1	BH5-GW1	GW		3	Oct. 18, 19	12:20 PM	X	X
2	BH6-GW1	↓		3	↓	11:15 AM	X	X
3	BH7-GW1	↓		3	↓	10:30 AM	X	X
4								
5								
6								
7								
8								
9								
10								

Comments:

Method of Delivery: Paracel

Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab:	Verified By:
N. Sullivan	A. Trouse	Jvmeeparm Dahmani	
Relinquished By (Print): Nick Sullivan	Date/Time: 21/10/19 11 30 AM	Date/Time: Oct 21, 2019 09.14	Date/Time: 10-21-19 15:02
Date/Time: Oct. 18, 2019	Temperature: °C	Temperature: 13.4 °C	pH Verified: ☐ By: