PHASE TWO ENVIRONMENTAL SITE ASSESSMENT

PROPOSED STUDENT RESIDENCE - CARLETON UNIVERSITY, OTTAWA

AUGUST 24, 2020

ORIGINAL

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ORIGINAL

PROJECT NO.: 191-12948-00
DATE: AUGUST 24, 2020

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August 24, 2020

Original

CARLETON UNIVERSITY
1125 Colonel By Drive
Ottawa, Ontario
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Attention: Dawn Blackman, Senior Project Manager

Dear Madam:

Subject: Phase Two Environmental Site Assessment - Proposed Student Residence, Carleton University

We are pleased to forward our revised report documenting the results of the Phase Two Environmental Site Assessment Update completed at the above-noted property. Revisions reflect recent discussions with the Ontario Ministry of the Environment, Conservation and Parks pertaining to the filing of a Record of Site Condition.

We trust that this information is sufficient for your current needs.

Please do not hesitate to contact the undersigned should you have any questions or require further assistance.

Yours sincerely,

Adrian Menyhart, P.Eng., ing.,
QPESA
Environmental Engineer

WSP ref.: 191-12948-00

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This limitations statement is considered an integral part of this report.

CONTRIBUTORS

CARLETON UNIVERSITY

Senior Project Manager	Dawn Blackman

WSP

Senior Environmental Engineer	Natalia Codoban
Environmental Engineer/Project Manager	Adrian Menyhart

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EXECUTIVE SUMMARY

WSP Canada Inc. (WSP) was retained by Ms. Dawn Blackman of Carleton University to conduct a Phase Two Environmental Site Assessment (ESA) at a portion of the Ottawa campus in Ottawa, Ontario (herein referred to as the "subject site" or the "Phase Two Property"), following the recommendations of the Phase One ESA completed by WSP Canada Inc. in November 2019 (revised August 2020). The subject site is being proposed for the future site of a student residence. Based on discussion with the Ontario Ministry of the Environment, Conservation and Parks, the filing of a Record of Site Condition will be required.

The Site is an irregular-shaped parcel of land with an area of approximately 1.2 hectares. It is located near the Campus Avenue and University Drive intersection, towards the north end of the Ottawa campus. The subject site skirts the Leeds residence and the Stormont Dundas residence. Based on the Phase One ESA completed for the Site, the subject site was first developed with a farmstead in the early 1900's, but has been used for temporary parking, access laneway and landscaped areas since the 1960's.

Based on the findings of the Phase One ESA, two potential contaminating activities (PCAs) contributing to the areas of potential environmental concern (APECs) included: PCA 30 Importation of fill material of unknown quality and PCA 46 rail yard, tracks and spurs. These PCAs resulted in two APECs at the subject, as follows: APEC1, east side of subject site, and APEC2, the east side of subject site. Investigation was recommended to assess the soil and groundwater conditions at the APECs. The potential contaminants of concern (PCOCs) associated with the APECs include metals, petroleum hydrocarbon compounds (PHCs), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs). The PCOCs associated with each APEC are as follows:

Table 0-1 Potential Environmental Concern and Potential Contaminant of Concern

POTENTIALLY CONTAMINATING ACTIVITY	POTENTIAL CONTAMINANTS OF CONCERN
PCA 30: Fill Material of Unknown Quality	Metals, PHCs, VOCs, PAHs
PCA 46. Rail yards, tracks and spurs	Metals, PHC, PAHs

Between October 23 and October 28, 2019, 10 environmental and geotechnical boreholes (three of which were completed as monitoring wells) were advanced to maximum depths ranging between 7.6 m and 12.6 m below grade. Three (3) boreholes were cored to depths between 15.5 and 19.3 m below grade

Based on the information collected in this Phase Two ESA, WSP provides the following findings:

Subsurface Condition

- Based on the findings of the drilling investigation, the soil stratigraphy, with increasing depth, beneath the Phase Two subject site generally consisted of a layer of asphalt or topsoil, underlain by fill consisting of silty sand and gravel, silty clay and sand and gravel. Part of the sand and gravel fill layer is considered to be reworked native soils, either from the subject site or from areas off-site. Fill material was noted to extend to depths between 3.8 m and 7.6 m below grade. Beneath the fill layer, was native silty sand and gravel (glacial till). Bedrock was cored at three (3) borehole locations, to final depths of 15.5, 18.6 and 19.3 m below grade, at BH19-8, BH19-7 and BH19-2, respectively.

For the purposes of this assessment, the analytical results have been compared to the 2011 MECP Table 3 for full depth generic site conditions in a non-potable groundwater condition.

Soil Condition

- All soils were found to be in compliance with MECP Table 3 standards, with the exception of vanadium at borehole BH19-4, which was identified in the upper fill material.

Groundwater Condition

- All groundwater samples were found to be in compliance with MECP Table 3 standards, and is not considered to have been adversely impacted by historical activities.

Recommendations

Based on the findings of the Phase Two ESA, vanadium is present within a small area of the subject site, related to poor quality fill material. Given the scope of the proposed redevelopment of the site, the soils in the vicinity of the vanadium exceedance should be excavated and disposed of at a licensed landfill facility as part of site excavation works. It is recommended that WSP be present at the time of excavation, such that confirmatory samples can be collected following remedial excavation works.

Prior to site redevelopment, all three (3) groundwater monitoring wells must be decommissioned as per Ontario Regulation 903.

1 INTRODUCTION

1.1 BACKGROUND

WSP Canada Inc. (WSP) was retained by Ms. Dawn Blackman, Senior Project Manager with Carleton University, to conduct a Phase Two Environmental Site Assessment (ESA) for a portion of the Ottawa Campus, located at 1125 Colonel By Drive. The Phase Two subject site (herein is referred to as the "subject site") is located north of the Stormont and Dundas residence, and east of the Leeds residence, and bordered to the east by Campus Avenue. The location of the Phase Two Property is shown in **Figure 1**.

A Phase Two ESA was recommended to be carried out by WSP following completion of a Phase One ESA, prepared for the same subject site on November 5, 2019. The Phase One ESA identified two (2) areas of potential environmental concern (APECs) related to the importation of potentially impacted fill material at the subject site, and the presence of railway lines (former and present) to the east of the subject site. Locations of APEC-1 and APEC-2 and the 250-m Phase One ESA study area are shown in **Figure 1**.

1.2 SITE DESCRIPTION AND PROPERTY OWNERSHIP

The subject site is situated within the larger legal property known municipally as 1125 Colonel By Drive (refer to **Figure 1**), bearing the following legal description:

Nepean Concession B, Rideau Front, Part of Lots L, M, and N, of Registered Plan 4R196, Part 4

PINs Part of 04087-0065 (LT) and Part of 04087-0068 (LT).

The subject site is irregular in shape and is approximately 0.7 hectare in area. The subject site consists of landscaped lands, laneway and a temporary parking area. No buildings are present on the site.

A preliminary survey sketch was provided to WSP for review. The site was surveyed by Fairhall, Moffatt and Woodland Limited on November 6, 2019. The sketch is included in **Appendix A**.

The current Site Owner is Carleton University. The Owner's Representative for this project is Ms. Dawn Blackman.

1.3 CURRENT AND PROPOSED FUTURE USES

Based on the Phase One ESA completed for the Site, the subject site was first developed with a farmstead in the early 1900's, but has been used as temporary parking, access laneway and landscaped areas since the 1960's, all used by the residences. The proposed redevelopment will consist of a new student residence, and, as such, the filing of an RSC would not be required, as the land use within the University property will not be changing.

1.4 APPLICABLE SITE CONDITION STANDARDS

Soil and groundwater analytical results for this Phase Two ESA were compared to standards identified in the Ministry of the Environment, Conservation and Parks (MECP) publication, "*Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*," published on April 15, 2011 (hereinafter referred to as the "MECP SCS").

This selection of the applicable standard was applied based on the following:

- The proposed land use is residential (i.e. student residence);
- The water supply is the municipal water supplied by the City of Ottawa;
- The Phase Two Property is not considered to be environmentally sensitive as per Section 41 of Ontario Regulation (O. Reg.) 153/04; and
- The Phase Two Property is not a shallow soil property based on overburden thickness, or a property that includes all or

part of a water body or is adjacent to a water body or includes land that is within 30 meters of a water body, as per Section 43.1 of O. Reg. 153/04.

Based on the factors listed above, the MECP SCS listed in Table 3, Full Generic SCS in a Non-Potable Groundwater Water Condition. The applicable land use and soil texture would be residential, parkland, and institutional (RPI) property use for coarse-textured soils.

In the scope of the proposed redevelopment project of the subject site, it is anticipated that a large amount of soil will be excavated from the site, and will require disposal off-site. For soil management purposes, analytical results tables also included a comparison to MECP Table 1 Full Depth Background Site Condition Standards, which represent background standards in Ontario.

2 BACKGROUND INFORMATION

2.1 PHYSICAL SETTING

Based on Ministry of Energy, Northern Development and Mines mapping (accessed via Ontario Geological Survey (OGS) Earth, published by the Ontario Ministry of Natural Development, Mines and Forestry), the regional surficial geology on-site is clay plains, however, past investigations conducted in the study area have identified presence of fill material, underlined by till.

Based on physiography maps available through the OGS earth website (Chapman and Putnam, 1984), the Phase Two ESA Property is situated within clay plains of the St. Lawrence Lowlands.

According to bedrock maps provided by the OGS Earth website, bedrock in the area of the subject site consists of shale of the Billings Formation. Past investigations prepared by SPL Consultants (now WSP) in January 2013 and April 2013 identified depths to bedrock of approximately 12 to 13 m below grade at the subject site.

As part of the Phase One ESA site reconnaissance, a visual inspection of adjacent lands located within the Phase One Study Area was conducted from the boundary of the Site and from publicly accessible areas to identify any potentially contaminating activities. At the time of the Phase One ESA Site reconnaissance, adjacent land uses within the Phase One Study Area consisted of institutional and residential uses (university campus setting).

2.1.1 WATER BODIES AND AREAS OF NATURAL SIGNIFICANCE

The Rideau Canal is situated approximately 170 m to the west of the subject site, and an unevaluated wetland is located approximately 70 m to the west (see **Figure 1**).

There are no areas of natural significance registered within the subject site or Phase One ESA study area.

2.1.2 TOPOGRAPHY AND SURFACE WATER DRAINAGE

Topographic mapping available through the Natural Resources of Canada Website, Atlas of Canada Toporama, was reviewed. The surface topography in the area of the subject site is generally flat, with no significant topographic features. The mapping data shows a railway line to the east of the subject site, and several large buildings further to the south (off-site). The Rideau Canal is located to the west, and the Rideau River is located to the east.

Surface water drainage on-site is considered to occur through surface run-off to catch basins (along Campus Avenue and the parking areas), surface run-off to a storm grate located within the landscaped area, and through infiltration within grass covered areas.

2.2 PAST INVESTIGATIONS

SPL Consultants Limited (now WSP), conducted a Phase One ESA and Phase Two ESA for a portion of land immediately to the north of the Subject Site, however, the north end of the subject site overlaps south end of the former ESA study area.

The Phase One ESA, prepared by SPL in 2013, indicated that the land has been owned by Carleton University since the 1950's, and that the former property consisted of marshland, which had been filled to raise the grade. Fill is expected to be present between 5 to 6 meters below the ground. Impacted soil (with hydrocarbons, and polycyclic aromatic hydrocarbons) was identified on parts of that property. The SPL report also identified a landfill to the southeast of the 2012 Subject Site, with soil impacts identified by others in the past.

SPL later conducted a Phase Two ESA, in April 2013, for the same portion of land studied in for the Phase One ESA. SPL advanced 10 boreholes on the site (four of which were instrumented with monitoring wells). One borehole2 fell within the current Subject Site. Soils analysed from the borehole did not identify any exceedances of the applicable MECP Table 2 site condition standards, however, fill material was noted to extend to approximately 6 m below surrounding grade. In general, the Phase

Two ESA identified presence of fill with traces of wood, brick and slag. MECP Table 2 standards were selected based on various factors, including the potential presence of potable groundwater use. Based on a review of well records, a drilled well was located north of the subject site; the record indicated that the purposes of the well was for cooling associated with the University, and as such is not considered to be a potable source.

The nearest monitoring well installed as part of this 2013 investigation (located approximately 20 to 25 m north of the current subject site) had identified presence of several polycyclic aromatic hydrocarbon parameters above the site standard for groundwater.

A geotechnical report by Houle Chevrier in 2011 was prepared for the parking lot located immediately north of the Subject Site. The south end of their study area overlaps with the north end of the present Subject Site. One borehole was identified in this overlapped area, and fill material was identified in that borehole. Other boreholes drilled during the Houle Chevrier study identified fill material in all 12 boreholes (located across their subject site), and elevated concentrations of hydrocarbon and polycyclic aromatic hydrocarbon parameters in the fill (at a borehole located north of the subject site).

Other reports prepared for areas to the north, and northeast of the Subject Site also identified fill material of poor quality at depths extending to approximately 6 m below grade. Fill material located along the former and current railway line appeared to be impacted in many places, as evidenced by traces of wood, brick, ash, mortar and coal.

2.3 POTENTIAL CONTAMINANTS OF CONCERN

The areas of potential environmental concerns at the subject site and their associated potential contaminants of concern as identified in the Phase One ESAs are summarized as follows:

Table 2-1 Potential Environmental Concerns and Potential Contaminants of Concern

POTENTIALLY CONTAMINATING ACTIVITY	POTENTIAL CONTAMINANTS OF CONCERN
APEC1: Fill material (PCA30: Importation of Fill Material of Unknown Quality)	Metals, Petroleum Hydrocarbons, Volatile Organic Compounds, Polycyclic Aromatic Hydrocarbons.
APEC2: Railway lines (PCA 46. Rail yards, tracks and spurs)	Metals, Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons

Based on the identification of these PCAs, a Phase Two ESA was completed to further investigate these concerns and address any data gaps from previous ESA foe the subject site.

3 SCOPE OF THE INVESTIGATION

3.1 OVERVIEW OF THE SITE INVESTIGATION

The Phase Two ESA was conducted in general accordance with the general and specific objectives outlined in O. Reg. 153/04, as amended. The sampling methods complied with the requirements established by the MECP in the Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario, 1997 and technical updates provided to support regulatory amendments. Previous investigations provided an initial information base for the Phase Two Property; however, newer data were required to meet the requirements of O. Reg. 153/04. The tasks completed for the Phase Two ESA included:

- Preparation of a sampling and analysis plan (SAP) for the investigation to identify the required sampling of soil and groundwater in relation to the PCAs and APECs identified in the Phase One ESA for the Phase Two Property;
- During the drilling investigation, advancing 10 environmental/geotechnical boreholes of which three (3) were considered environmental boreholes, and completed as 51 mm monitoring wells to a maximum depth of 7.9 meter below the ground surface (mBGS) on the Phase Two Property between October 22 to October 26, 2019;
- Collection of groundwater samples from the three monitoring wells on November 4, 2019;
- Submitting soil and groundwater samples to a qualified laboratory for laboratory analysis of contaminant of Potential Concern (COPCs), including quality assurance/quality control (QA/QC) duplicates. Soil samples submitted were selected based on field observations and screened with a photoionization device (PID) and combustible gas indicator (CGI), to characterize the vertical and lateral extents of impacts. QA/QC duplicate samples were collected at a frequency of a minimum of 10% throughout the field program, in compliance with regulatory requirements; and
- Comparing results of analysis for soil and groundwater to the MECP Table 3 SCS.

3.2 MEDIA INVESTIGATED

Soil and groundwater at the APECs identified in the Phase One ESA were investigated as part of the Phase Two ESA investigation for the subject site. A SAP was developed by WSP prior to the field investigations, which outlined the proposed sample locations, analytical sampling, and rationale for sampling and analysis at each location. Sample locations are shown on **Figure 2** and the SAP is provided in **Appendix B**.

Sediment, as defined in O.Reg.153, is not present onsite. Therefore, samples of sediment were not collected during this Phase Two ESA.

3.3 PHASE ONE CONCEPTUAL SITE MODEL

A Phase One Conceptual Site Model (CSM) was developed in the Phase One ESA for the subject site. Two (2) APECs with potential for impacts to soil and/or groundwater have been identified on the Phase One Property and are presented as **Figure 1**.

Based on the review of records, interviews, and the site reconnaissance completed as part of the Phase One ESA, WSP identified two (2) PCAs for the subject site, including:

- 30. Importation of Fill of Unknown Quality
- 46. Rail Yards, Tracks and Spurs

Based on the above information, three APECs were identified for the Phase One Property:

APEC1: Central to Eastern portion of the subject site – Historical photos show the importation and storage of fill material of unknown quality. Poor quality fill material was identified on other areas of the Carleton University property. Filling appears to have been concentrated to the eastern side of the site.

APEC2: Eastern portion of the subject site – A railway line was formerly located at grade (immediately off-site to the east) from as early as the 1920's until the 1960's, when the line was shifted to a trench immediately adjacent to it. The railway lines (both older and newer) are located off-site to the east and are considered to have created an APEC along the eastern side

of the property.

Other PCAs, including a former landfill were identified within the Phase One Study Area, however, these activities were determined to not result in an APEC due to the nature of the landfill operation and the down-gradient location of the landfill, relative to the Phase One Property.

Information considered for the development of the Phase One CSM was gathered by WSP from numerous sources (i.e., historical aerial photographs, environmental database searches, physical setting sources, historical reports, interviews and a site reconnaissance), which reduces the potential for not identifying a former property use or PCA.

3.3.1 POTENTIAL ENVIRONMENTAL CONCERNS AND POTENTIAL CONTAMINANTS OF CONCERN

The potential environmental concerns at the Phase One Property and their associated potential contaminants of concern are summarized in Section 0 and Table 2-1.

3.3.2 IMPACT OF UNDERGROUND UTILITIES

Underground utility trenches, typically backfilled with permeable granular materials, have the potential to affect contaminant distribution and transport. Utilities servicing the subject site (natural gas, water, sewer, and hydro) may be a concern for contaminant transport on the subject site. Adjacent underground utilities may also affect local migration of contaminants in the subsurface.

3.3.3 GEOLOGICAL AND HYDROGEOLOGICAL INFORMATION

The Phase One Property slopes slightly to the southwest.

The inferred groundwater flow direction is anticipated to be towards the Rideau Canal to the west, or the Rideau River to the southeast.

Geological records indicate bedrock at the subject site consists consisting mainly of shale.

3.4 DEVIATIONS FROM SAMPLING AND ANALYSIS PLAN

The Phase Two ESA was conducted in general accordance with the sampling and analysis plan completed for the Phase Two ESA investigation, attached as **Appendix** B.

3.5 IMPEDIMENTS

Physical impediments encountered during the investigation included the presence of various subsurface utilities. As a result, certain boreholes were shifted slightly from locations established prior to the field work. The impediments are not considered to have altered the quality of the subsurface conditions or interpretation of results for this investigation.

4 INVESTIGATION METHOD

4.1 GENERAL

All methods used to complete the Phase Two ESA were in accordance with O. Reg. 153/04 and WSP Standard Operating Procedures (SOPs), and generally accepted industry practices.

4.2 DRILLING AND EXCAVATING

A WSP field representative inspected the subject site and identified the preferred borehole locations as per the SAP during each investigation program. The borehole and test pit location plan and cross-sections are depicted in **Figure 3**. The groundwater elevation contours based on the recent groundwater monitoring data are presented in **Figure 4**.

WSP arranged for the public and private service locates to be completed at the subject site, through Ontario One Call (ON1Call) and USL-1, respectively. Borehole drilling and well installation was completed during the week of October 21, 2019, by MECP's licensed drillers Marathon Underground and CCC Geotechnical and Environmental Drilling Ltd., both of Ottawa, Ontario. The drilling was completed using CME55 or CME75 drilling equipment. All drilling operations were conducted under full-time WSP supervision.

Between October 22, and October 26, 2019, 12 boreholes (BH19-1 to BH19-10) were drilled on-site using hollow-auger drilling equipment. The boreholes served for both environmental purposes as well as geotechnical purposes (geotechnical report presented under a separate cover). The majority of the boreholes were advanced to auger refusal, between 7.6 and 12.6 m below surrounding grade. Three of these boreholes were cored into bedrock, to depths between 15.5 and 19.3 mBGS. Boreholes BH19-4, BH19-6 and BH19-10 were considered to be of environmental importance, based on their locations within APECs. As such, these were instrumented with monitoring wells. Due to their auger depths and the anticipated groundwater levels, BH19-6 and BH19-10 were backfilled using slough and bentonite, such that the well screens intercept the groundwater table.

The borehole logs are included in **Appendix C**.

4.3 SOIL SAMPLING

Soil samples from the boreholes were collected and handled by WSP in accordance with generally accepted sampling and handling procedures used by the environmental consulting industry, WSP SOPs, and in general accordance with O. Reg. 153/04 and the guidelines provided by the MECP's Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario.

During the drilling program, soil samples were collected through continuous sampling in conjunction with standard auger drilling. Samples were collected from split spoons (SS), or rock cores (CORE). All non-dedicated equipment used at the environmental sampling locations was brushed, washed, and rinsed prior to being reused during the sampling program. Disposable nitrile gloves were used during sample collection and changed between each sample to minimize the potential for cross-contamination. Soil samples were described in the field by WSP field staff and observations were recorded in a dedicated field book.

Representative soil samples were conveyed directly into laboratory-supplied jars and methanol-preserved vials and were stored in a cooler at a temperature between 1 and 10°C. Samples selected for laboratory analysis were handled under standard chain of custody procedures and maintained on ice until received at the laboratory. The soil samples selected for laboratory analysis were considered representative of worst-case conditions, based on field screening results and visual and olfactory observations.

The soil sampling and analysis plan is provided in **Appendix B**.

4.4 FIELD SCREENING MEASUREMENTS

All soil samples recovered from the environmental boreholes were field screened for combustible and organic vapours using a RKI Eagle Type 2 with photoionization detector (PID) and combustible gas detector (CGD); the majority of the soil samples from remaining boreholes were also screened. The RKI Eagle Type 2 was rented from an specialist equipment rental supplier, Maxim Environmental and Safety Inc. (Maxim). Soil samples were also examined in the field for lithology as well as for aesthetic evidence of impacts (i.e., staining and odours).

Measurements were collected from each sample at the environmental borehole locations, as well as other borehole locations, where possible. All readings were below 15 ppm, and no reading were indicative of significant potential environmental concerns.

The PID was equipped with a 10.6 electron-volt (eV) lamp, which was calibrated with a known concentration of isobutylene. This instrument detects VOCs that emit below an ionization potential of 10.6 eV, which includes a wide range of chemicals such as solvents and fuels. The detection limit of the instrument ranges from 0 to 15,000 ppm and accuracy is +/- 10% for VOCs in the range of 0 and 2,000 ppm and +/- 20% of the reading above 2,000 ppm. The resolution of this instrument is 0.1 ppm for VOCs in the range of 0 and 1,000 ppm and 1 ppm for readings above 1,000 ppm. The PID provides an indication of total organic contamination in soil but does not measure concentrations of individual contaminants.

The CGI detects combustible vapours such as those associated with fuels. This instrument measures total combustible gases, calibrated to a known concentration of hexane. The instrument was operated in the methane elimination mode. The detection limit of the instrument ranges from 0 to 11,000 ppm (i.e., 100 % LEL of hexane). The CGI has an accuracy of 25 ppm below 1,000 ppm and 5% of the lower explosive limit (LEL) between 1,000 ppm and 100% LEL. As with the PID, it provides an indication of contamination but not specific chemical concentrations.

4.5 GROUNDWATER: MONITORING WELL INSTALLATION

As indicated in **Section 4.2**, three (3) boreholes were instrumented with a monitoring well, constructed as follows:

- Each monitoring well was constructed using 51 mm diameter well screens and PVC riser pipe;
- The screened interval was 3.05 m long with a No. 10 slot size screen;
- Sand pack, consisting of No. 2 silica sand, was placed around the well screen and the sand pack was extended to 0.3 m above the top of the screen;
- A bentonite seal was then placed around the PVC riser pipe up to within 0.3 m of the ground surface; and,
- The monitoring wells were completed with monument protective covers, with the exception of BH19-4, which was installed within flushmount casing.

The monitoring wells were completed in accordance with O. Reg. 903, by licenced well technicians from Marathon Underground.

4.6 GROUNDWATER: FIELD MEASUREMENT OF WATER QUALITY PARAMETERS

The groundwater prior to sampling was assessed using a YSI 556 handheld multi-parameter instrument, which measures pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), oxidation-reduction potential (ORP), and total dissolved solids (TDSs). These field groundwater quality measurements were obtained after the removal of each well volume and were recorded in a dedicated field book. The instrument is calibrated by Maxim, with certificate of calibration available to WSP upon rental events.

4.7 GROUNDWATER: MONITORING AND SAMPLING

Groundwater levels were measured using a groundwater level (Solinst Dipper T-2) prior to purging and sampling activities. The

monitoring data is presented in **Table 1** and the inferred groundwater elevation contours based on the November 4th 2019, groundwater monitoring elevations are presented in **Figure 4**.

Wells were developed by WSP by purging three well volumes or to dry (whichever occurred first) using intertia pump Waterra, and samples were collected from all five newly-installed wells. Water was sampled using a peristaltic pump using low-flow sampling techniques due to the high sediment content in wells BH19-6 and BH19-10. Groundwater was conveyed directly into dedicated laboratory-supplied bottles, stored at a temperature below 10°C, and maintained on ice prior to submittal to the laboratory.

4.8 SEDIMENT SAMPLING

As there are no surface water bodies on the Phase Two Property, no sediment was sampled as part of this investigation.

4.9 ANALYTICAL TESTING

Samples were submitted for chemical analysis to Paracel Laboratories, located in Ottawa, Ontario. Paracel Laboratories is a laboratory certified by the Canadian Association for Laboratory Accreditation (CALA).

4.10 RESIDUE MANAGEMENT PRACTICES

Excess soil cuttings from drilling operations were collected and contained in drums for removal off-site pending the laboratory results. Purged water collected from groundwater sampling was stored in the drums with the soil. All the drummed soil will be removed in conjunction with site redevelopment.

4.11 ELEVATION SURVEYING

The ground surface elevations of the completed monitoring wells were surveyed by Fairhall, Moffatt and Woodland Limited. Geodetic elevations of the ground surfaces at borehole locations was provided to WSP in a preliminary survey sketch, which was conducted on November 6, 2019. Note that elevation is missing for borehole BH19-8, due to surveyor field error.

The ground surface elevations are included on the borehole logs in **Appendix C**.

4.12 QUALITY ASSURANCE AND QUALITY CONTROL MEASURES

Quality assurance (QA) and quality control (QC) of the soil samples was monitored and maintained in a number of ways:

- The field investigation was completed using WSP's standard operating procedures for soil and groundwater sampling;
- Samples were given unique identifications as they were collected, typically identifying the project number, date, sample location and depth. The sample numbers were recorded in field notes for each location;
- All non-dedicated sampling and monitoring equipment (e.g. interface probe) was cleaned using Alconox™ and distilled water following each use;
- A chain-of-custody form was filled out for the samples prior to submitting the samples to the laboratory. The chain-of-custody documented sample movement from collection to receipt at the laboratory and provided sample identification, requested analysis and conditions of samples upon arrival at the laboratory (e.g., temperature, container status, etc.);
- Soil samples were randomly selected by the WSP field staff for duplicate testing. The number of QC samples submitted is equivalent to a minimum of 10% of the total number of samples submitted; and,
- Samples were randomly selected by the laboratory for QA checks. Generally, one sample for every ten samples submitted is checked. For each parameter, there is an acceptable upper and lower limit for the measured concentration of the parameter. Measured concentrations of analysed samples must fall within the upper and lower acceptable limits in order for the sample to be valid. If a result exceeds the upper or lower acceptable limits, the sample must be re-analysed.

The duplicate samples collected during this Phase Two ESA is summarized in Table 4-1.

Table 4-1 Summary of Parameters Analyzed (Duplicate Samples)

MEDIA	SAMPLE IDS (DUPLICATE IDS)	PARAMETER ANALYZED
Soil	BH19-6-DUP (duplicate sample of BH19-6-SS3)	PAH
Groundwater	DUP (duplicate sample of BH19-4)	PHC, PAH, Metals

5 REVIEW AND EVALUATION

5.1 GEOLOGY

A brief summary of the subsurface conditions encountered at the subject site is presented below. Borehole logs are included in **Appendix C**. The borehole log stratigraphy was used to create a north-south and east-west cross-sections for the subject site, provided as **Figures 5** and **6**.

Based on the findings of the drilling investigation, the soil stratigraphy, beneath the Phase Two subject site generally consisted of a layer of asphalt or topsoil, underlain by fill consisting of silty sand to silty sand and gravel, with occasional presence of silty clay fill. The sand and gravel fill layer is considered to be reworked native soils, either from the subject site or from areas immediately off-site. Fill material was noted to extend to depths ranging between 3.8 m and 7.6 mBGS. Beneath the fill layer, there was native silty sand and gravel till (glacial till), with some fragments of rock.

Bedrock was cored at three (3) borehole locations, to final depths of 15.5, 18.6 and 19.3 mBGS, at BH19-8, BH19-7 and BH19-2, respectively. Descriptions of the subsurface soil conditions at each borehole location are provided on the borehole logs (**Appendix C**).

5.2 GROUNDWATER: ELEVATIONS AND FLOW DIRECTION

A summary of the measured groundwater levels, well screen details, and calculated groundwater elevations are presented in **Table 1**. The groundwater levels measured on November 4, 2019 are also presented as groundwater elevation contours (see **Figure 4**). Based on groundwater elevations, the inferred groundwater flow direction at the subject site is in an eastern direction, towards the railway.

5.3 GROUNDWATER: HYDRAULIC GRADIENTS

The calculated horizontal hydraulic gradient was 0.01, based on groundwater levels measured on November 4, 2019 between the monitoring wells at BH19-4, BH19-6 and BH19-10.

The vertical hydraulic gradient cannot be calculated using existing wells onsite, however the vertical hydraulic flow direction is anticipated to be in a downward direction.

5.4 SOIL TEXTURE

Based on field observations and the high sand and gravel content, the subsurface soil conditions are classified as coarse textured. Therefore, the guidelines chosen for the Phase Two ESA are MECP SCS listed in Table 3, Full Generic SCS in a Non-Potable Groundwater Water Condition. The applicable land use and soil texture would be residential, parkland, and institutional (RPI) property use for coarse-textured soils.

5.5 SOIL: FIELD SCREENING

Soil headspace combustible and organic vapour concentrations recorded during the field screening procedures collected from environmental boreholes during this Phase Two ESA ranged from 0 to 5 ppm (CGD)/15 ppm (PID). The readings are recorded on the logs presented in **Appendix C**.

5.6 SOIL QUALITY

A summary of the soil samples submitted for laboratory analyses, including details of sampling location and depths is presented below

in Table 5-1:

Table 5-1 Summary of Soil Samples

BOREHOLE ID	SAMPLE ID	DEPTH (MBGS)	DATE	PARAMETERS				APEC #
				Metals	PHCs	VOCs	PAHs	
BH12-3	SS2	0.8 – 1.4	1-Dec-12	✓				1,2
BH12-3	SS4	1.8 – 2.4	1-Dec-12				✓	1,2
BH12-3	SS5	2.4 - 3.1	1-Dec-12		✓			1,2
BH12-3	SS8	6.1 – 6.7	1-Dec-12	✓				1,2
BH12-3	SS10	9.1 – 9.8	1-Dec-12			✓		1,2
BH19-2	SS5	2.3 - 2.9	23-Oct-19	✓	✓	✓	✓	1
BH19-4	SS2	1.8 - 2.4	28-Oct-19	✓	✓	✓	✓	1
BH19-6	SS3	1.5 - 2.1	24-Oct-19	✓	✓	✓	✓	1,2
BH19-6	DUP	1.5 - 2.1	24-Oct-19				✓	1,2
BH19-6	SS8	5.3 - 5.9	24-Oct-19		✓	✓	✓	1,2
BH19-8	SS8	5.3 - 5.9	24-Oct-19	✓	✓	✓	✓	1
BH19-10	SS8	5.3 - 5.9	24-Oct-19	✓	✓	✓	✓	1,2
BH19-10	SS10	6.9 - 7.5	24-Oct-19	✓		✓		1,2

The soil analysis results from the present investigation are presented in **Tables 4** to **7** and are discussed below.

Soil samples, with corresponding number of QA/QC samples, collected from the boreholes were submitted to the laboratory and analyzed for the following PCOCs: metals, PHCs, VOCs, and/or PAHs. One sample was also submitted for analysis of Toxicity Characteristic Leaching Procedure (TCLP), for evaluation of possible landfill disposal options.

The Laboratory Certificates of Analysis for the soil analysis completed during the present investigation are provided in **Appendix D**.

5.6.1 METALS

The soil analytical results for metals are summarized in **Table 4.** All soils and results that exceeded the MECP Table 3 SCS are presented in Table 5-2. Further comparison to MECP Table 1 standards is included in **Table 4**:

Table 5-2 Metals Exceedances Greater Than MECP Table 3 SCS in Soil

Sample ID	MECP Table 3 SCS	BH19-4-SS2
Sample Depth (mbgs)		0 – 1.2
Description of Material		Fill (silty sand)
Vanadium	86	104

All units in µg/g
- - values met the MECP Table 3 SCS
NA – not analyzed
104 - Analytical result greater than the MECP Table 3 SCS

All other analytical results were found to be in compliance with MECP Table 3 standards.

5.6.2 PETROLEUM HYDROCARBONS (PHCS)

No exceedances of MECP Table 3 SCS were identified in the soil samples submitted for PHC analysis. One sample BH19-2-SS5 exceeded MECP Table 1 SCS for F1(C6 to C10) and F4 (C34 to C50). The soil analytical results for PHCs are summarized in **Table 5.**

5.6.3 VOLATILE ORGANIC COMPOUNDS (VOCS)

No exceedances of MECP Table 3 SCS were identified in the soil samples submitted for VOC analysis. The soil analytical results for VOCs are summarized in **Table 6.**

5.6.4 POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)

No exceedances of MECP Table 3 SCS were identified in the soil samples submitted for PAH analysis. The soil analytical results for PAHs are summarized in **Table 7.**

5.6.5 TCLP

One composite sample, created by WSP using fill material from samples BH19-4-SS2, BH19-6-SS3 and BH19-10-SS8 was submitted for analysis. Based on a comparison with Ontario Regulation 558, Schedule 4, the soil material is not considered to be hazardous waste. C of As are included in **Appendix D-2**.

5.7 GROUNDWATER QUALITY

A summary of the groundwater samples submitted for laboratory analysis, including details of sampling location and screened depths is presented below in Table 5-3:

Table 5-3 Summary of Groundwater Samples

MONITORING WELL ID	SCREENED INTERVAL (MBGS)	DATE	PARAMETERS				APEC #
			Metals	PHCs	VOCs	PAHs	
BH19-4	4.5 - 7.5	Nov 4 2019	✓	✓	✓	✓	1,2
BH19-4 (DUP)	4.5 - 7.5	Nov 4 2019	✓	✓	✓	✓	1,2
BH19-6	4.6 - 7.9	Nov 4 2019	✓	✓	✓	✓	1,2
BH19-10	4.6 - 7.6	Nov 4 2019	✓	✓	✓	✓	1,2

Groundwater samples, including QA/QC samples were submitted to the laboratory and analyzed for the following PCOCs: Metals, PHCs, VOCs, and PAHs.

Summaries of the analytical results for each analyzed parameter are provided in **Tables 8** to **11** and are discussed below.

The Laboratory Certificates of Analysis for the groundwater analysis completed during the Phase Two ESA are provided in **Appendix D-3**.

5.7.1 METALS

No exceedances of MECP Table 3 SCS were identified in the groundwater samples submitted for metals analysis. The groundwater analytical results for metals are summarized in **Table 8.**

5.7.2 PETROLEUM HYDROCARBONS (PHCS)

No exceedances of MECP Table 3 SCS were identified in the groundwater samples submitted for PHC analysis. The groundwater analytical results for PHCs are summarized in **Table 9.**

5.7.3 VOLATILE ORGANIC COMPOUNDS (VOCS)

No exceedances of MECP Table 3 SCS were identified in the groundwater samples submitted for VOC analysis. The groundwater analytical results for VOCs are summarized in **Table 10.**

5.7.4 POLYCYLIC AROMATIC HYDROCARBONS (PAHS)

No exceedances of MECP Table 3 SCS were identified in the groundwater samples submitted for PAHs analysis. The groundwater analytical results for PAHs are summarized in **Table 11.**

5.8 SEDIMENT QUALITY

No sediment sampling was conducted as part of this investigation.

5.9 QUALITY ASSURANCE AND QUALITY CONTROL RESULTS

Field duplicate samples were assessed as part of the QA/QC program during the Phase Two ESA. A minimum of one field duplicate sample was collected and analyzed for every ten samples for both soil and one field duplicate on each day of groundwater sampling. Field duplicate samples were evaluated based on the relative percent difference (RPD) in parameter concentrations. Where measured parameter concentrations were greater than five times the laboratory reportable detection limit (RDL), a RPD of less than 50% for soils and less than 30% for groundwater with the exception of certain parameters (see

Table 5-4 below) was deemed acceptable; for concentrations less than five times the RDL, the RPD could not be reliably calculated. A summary of the required performance standard for soil and groundwater sample homogeneity for QA/QC comparisons of the original to its duplicate sample is provided in Table 5-4.

Table 5-4 Required Performance Standards for Soil and Groundwater for QA/QC

REQUIRED QA/QC PARAMETER	REQUIRED PERFORMANCE STANDARD
Petroleum hydrocarbons	RPD should be ≤ 30% for water and ≤ 40% for soils
Polycyclic aromatic hydrocarbons	RPD should be ≤ 30% for water and ≤ 40% for soils
Volatile organic compounds	RPD should be ≤ 30% for water and ≤50% for soils
Hexavalent chromium	RPD should be ≤ 20% for water and ≤ 35% for soils

REQUIRED QA/QC PARAMETER	REQUIRED PERFORMANCE STANDARD
Mercury	RPD should be ≤ 20% for water and ≤ 30% for soils
Metals, Hydrid metals, boron hot water soluble (BHWS)	RPD should be ≤ 20% for water and ≤ 30% for soils. BHWS ≤ 30% water and ≤40% soils

A summary of the field duplicates for soil and groundwater samples exceeding the acceptable RPDs are shown in Table 5-5.

Table 5-5 Summary of Soil and Groundwater QA/QC control Results

DATE SAMPLED	SAMPLE ID	FIELD DUPLICATE ID	MEDIA SAMPLED	RPD EXCEEDING REQUIRED STANDARDS
2019-10-24	BH19-6-SS3	BH19-6-DUP	Soil – PAHs	Benzo(b)fluoranthene, RPD = 42%
2019-11-04	BH19-4	DUP	GW – Metals, PHCs,BTEX,PAHs	No exceedances reported.

The only RPD exceedances was identified in a soil sample submitted for PAH analysis. The detected RPD consisted on only a marginal exceedance of the required standard, likely due to the heterogeneity of the fill material, and is not considered to affect the interpretation of the results.

Paracel Laboratories carried out internal QA/QC measures including process recoveries, blanks, and replicate samples. The laboratory QA/QC results are provided on the Certificates of Analysis in **Appendix D**; the results were acceptable and, therefore, suitable for consideration of the results in the interpretation of site conditions.

With respect to subsection 47(3) of O. Reg. 153/04, all certificates of analysis of analytical reports received pursuant to clause 47(2)(b) of the regulation comply with subsection 47(3), a certificate of analysis of analytical report has been received for each sample submitted for analysis, and all certificates of analysis or analytical reports received have been included in full in **Appendix D**.

5.10 PHASE TWO CONCEPTUAL SITE MODEL

Through analysis and interpretation of the Phase One ESA, Phase One CSM, and field data gathered during this Phase Two ESA, a Phase Two Conceptual Site Model was developed, which also included the following figures:

FIGURE 1 PHASE ONE CONCEPTUAL SITE MODEL

FIGURE 2 PHASE ONE SITE PLAN

FIGURE 3 BOREHOLE AND CROSS-SECTION LOCATION PLAN

Plan view of all environmental sample locations, and location of cross-sections

FIGURE 4 GROUNDWATER CONTOURS

Inferred groundwater contour prepared based on groundwater levels measured in on-site monitoring wells on November 4, 2019.

FIGURE 5 STRATIGRAPHIC CROSS-SECTION A-A'

Stratigraphy shown parallel to groundwater flow. Extent of contamination shown is based on excavation completed at the time of remediation.

FIGURE 6 STRATIGRAPHIC CROSS-SECTION B-B'

Stratigraphy shown perpendicular to groundwater flow. Extent of contamination shown is based on excavation completed at the time of remediation.

FIGURE 7 ANALYTICAL TESTING PLAN - SOIL

Plan view of all the soil samples collected and submitted for metals, PHCs, VOCs, and PAHs. This plan also identifies suspected areas of vanadium impacts.

FIGURE 8 ANALYTICAL TESTING PLAN - GROUNDWATER

Plan view of all the groundwater samples collected and submitted for metals, PHCs, VOCs, and PAHs.

FIGURE 9 CONCEPTUAL SITE MODEL FOR HUMAN RECEPTORS

Conceptual Site Model showing the source, contaminant release mechanism, exposure routes and human receptors based on the site condition.

FIGURE 10 CONCEPTUAL SITE MODEL FOR ECOLOGICAL RECEPTORS

Conceptual Site Model showing the source, contaminant release mechanism, exposure routes and ecological receptors based on the site condition.

Based on information obtained as part of the Phase One ESA, it was concluded that two areas of potential environmental concern (APECs) associated with past activities/operations exist at the Site. The table of APECs, prepared in accordance with clause 16(2)(a), Schedule D, O. Reg. 153/04, is summarized in **Table 5-6**.

Table 5-6 Summary of Areas of Potential Concern

AREAS OF POTENTIAL ENVIRONMENTAL CONCERN (APEC)	LOCATION OF APEC ON PHASE TWO PROPERTY	POTENTIALLY CONTAMINATING ACTIVITY (PCA)	LOCATION OF PCA ON-SITE OR OFF-SITE)	CONTAMINANT(S) OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED (GROUNDWTER AND/OR SOIL)
APEC 1	Central portion side of subject site.	30. Fill Material of Unknown Quality	On-site	Metals, PHCs, VOCs, PAHs	Soil and Groundwater
APEC 2	East portion of subject site.	46. Rail yards, tracks and spurs	Off site	Metals, PHCs, PAHs	Soil and Groundwater

PHC – Petroleum hydrocarbons, including benzene, toluene, ethylbenzene and xylenes
VOCs – volatile organic compounds
PAHs – polycyclic aromatic hydrocarbons

5.10.1 PCAS AND APECS

5.10.1.1 *AREAS WHERE POTENTIALLY CONTAMINATING ACTIVITY HAS OCCURRED*

One on-site PCA and one off-site PCA were identified as Areas of Potential Environmental Concern on the subject site. These are related to the historical importation of fill material of unknown quality, and the presence of a historical and current rail line to the east of the subject site.

5.10.1.2 *AREAS OF POTENTIAL ENVIRONMENTAL CONCERN*

There are two APECs where PCAs may have affected the soil and/or groundwater at the Phase Two Property:

- APEC 1 (Eastern portion of the Subject Site): The importation and storage of fill material of unknown quality from historical commercial operations at the site has the potential to impact soil at the subject site;
- APEC 2 (Central and Eastern portion of the Subject Site): A railway line was formerly located at grade from as early as the 1920's until the 1960's, when the line was shifted to a trench immediately adjacent to it. The rail lines (both older and newer) are located offsite to the east.

5.10.1.3 *SUBSURFACE STRUCTURES AND UTILITIES*

Underground utilities can affect contaminant distribution and transport. Trenches excavated to install utility services, and the associated granular backfill may provide preferential pathways for horizontal contaminant migration in the shallow subsurface.

Based on utility drawings made available by Carleton University, as well as public and private locates obtained by WSP during the Phase Two ESA investigation, service lines were located at various locations on the subject site, including sanitary and storm sewers, natural gas lines, electrical conduits and water lines. As there are no identified groundwater impacts on the Phase Two Property, subsurface utilities are not anticipated to contribute to contaminant migration.

5.10.2 PHYSICAL SETTING

5.10.2.1 STRATIGRAPHY FROM GROUND SURFACE TO THE DEEPEST AQUIFER OR AQUITARD INVESTIGATED

Based on the findings of the drilling investigation, the soil stratigraphy, with increasing depth, beneath the Phase Two subject site generally consisted of a layer of asphalt or topsoil, underlain by fill consisting of silty sand to silty sand and gravel, with occasional presence of silty clay fill. The sand and gravel fill layer is considered to be reworked native soils, either from the subject site or from areas immediately off-site. Fill material was noted to extend to depths ranging between 3.8 m and 7.6 mBGS. Beneath the fill layer, there was native silty sand and gravel till (glacial till). Bedrock was cored at three (3) borehole locations, to final depths of 15.5, 18.6 and 19.3 mBGS, at BH19-8, BH19-7 and BH19-2, respectively.

Stratigraphic cross section is presented in **Figures 5** and **6.** Stratigraphic cross-sections A-A' and B-B' depict the subsurface condition oriented parallel and perpendicular to groundwater flow.

The groundwater elevation contours based on recent groundwater monitoring shown on **Figure 4**.

5.10.2.2 HYDROGEOLOGICAL CHARACTERISTICS

The results of the groundwater monitoring indicated that the primary near surface water table resides within the fill material (at boreholes BH19-4 and BH19-10), and within the glacial till layer, at BH19-6. No visual, olfactory or analytical evidence of impact was noted in the groundwater. The groundwater elevation contours based on recent groundwater monitoring in the wells are included in **Figure 4.** The average horizontal hydraulic gradient was calculated to be 0.01, using the groundwater elevation measured on November 4, 2019.

5.10.2.3 APPROXIMATE DEPTH TO BEDROCK

Inferred bedrock was encountered between 7.6 m and 12.6 mBGS (based on refusal to auger advancement). Bedrock was cored at BH19-2, BH19-7 and BH19-8, where bedrock was encountered at 11.4, 11.8 and10.7 mBGS (respectively). Bedrock consisted of shale and limestone.

5.10.2.4 APPROXIMATE DEPTH TO WATER TABLE

Within the subject site, groundwater was observed to range between 4.5 m and 6.7 mBGS (elevations of 60.23 and 59.55 m).

5.10.2.5 SECTION 41 OR 43.1 OF THE REGULATION

Section 41 of O. Reg. 153/04 does not apply to the Site based on the following:

- Section 41(1)(a) does not apply as the Site is not (i) within an area of natural significance, nor does it (ii) include or is adjacent to an area of natural significance or part of such an area, nor does it (iii) include land that is within 30 metres of an area of natural significance or part of such an area;

Section 43.1 of O. Reg. 153/04 does not apply to the Site based on the following:

- Section 43.1(a) does not apply to the Site – The Site is not a shallow soil site, as defined in Section 43.1(3); overburden thickness is greater than 7.6 metres based on the drilling investigation completed onsite.

Based on the factors listed above, the MECP SCS Table 3 SCS would apply to the Phase Two Property.

5.10.2.6 SOIL BROUGHT FROM ANOTHER PROPERTY

Fill material of unknown quality imported for on-site grading was identified as a PCA on-site. The quality of this fill material was assessed.

The fill material was found to be in compliance with site standards, with one exception: vanadium was encountered above the site standards at BH19-4.

5.10.2.7 *PROPOSED BUILDINGS AND STRUCTURES*

The subject site is intended to be developed with a student residence building.

5.10.3 CONTAMINANT PRESENCE ONSITE

5.10.3.1 *AREAS WHERE A CONTAMINANT IS PRESENT*

Soil with contaminant concentrations greater than the Table 3 SCS was present in a localised location at BH19-4. Soil was marginally impacted with vanadium, a metals parameter.

5.10.3.2 *ASSOCIATED CONTAMINANTS*

Based on the initial Phase Two ESA, the associated contaminants in soil onsite was limited to vanadium. No other contaminants were identified on the subject site.

5.10.3.3 *ASSOCIATED MEDIUM*

Contaminants were only found in soil. No contaminants were identified in groundwater.

5.10.3.4 *WHAT IS KNOWN ABOUT THE AREAS OF ENVIRONMENTAL IMPACT*

Soil with contaminant concentrations greater than the Table 3 SCS was present in the fill material (silty clay) at BH19-4.

5.10.3.5 *HORIZONTAL DISTRIBUTION OF CONTAMINANTS*

The horizontal distribution of vanadium in soil is presented in **Figure 5** and vertical distribution of vanadium in soil is presented in cross-section **Figures 7**.

The area of impact is limited to an area surrounding BH19-4.

5.10.3.6 *REASON FOR DISCHARGE*

The majority of the imported fill material identified at the subject site was found to be compliant with the applicable site condition standards. The vanadium exceedance may be related to naturally occurring vanadium in silty clay fill, as there were no real sources of vanadium at the subject site, however, vanadium was not encountered within other fill samples.

5.10.3.7 *MIGRATION OF CONTAMINANTS*

Figure 5 provides delineation of the vanadium in plan view. Vanadium was the only contaminant identified on the subject site, and only limited to one soil sample, collected from BH19-4. All metals parameters in groundwater were found to be in compliance with site standards at that borehole monitoring well location, specifically, vanadium was not detected above laboratory detection limits.

As such, the on-site contaminant, vanadium, is not considered to have migrated vertically or horizontally with any significant distance and is considered to be localised around the upper fill material at BH19-4.

5.10.3.8 *CLIMATIC OR METEOROLOGICAL CONDITIONS*

Climatic or meteorological conditions are not considered to affect migration of the vanadium, as the borehole/monitoring well was installed within a asphalt-covered surface. Infiltration through the asphalt would be considered negligible.

5.10.3.9 *SOIL VAPOUR INTRUSION*

Soil vapour intrusion is not considered to be a concern with respect to the identified contaminant due to the fact that metals do not readily volatilize and that as part of site redevelopment works, much of the shallow fill material where vanadium was identified would likely be removed from the property.

5.10.4 CONTAMINANT DISTRIBUTION

5.10.4.1 LATERAL AND VERTICAL DISTRIBUTION OF A CONTAMINANT

Cross-sections that include the required information are provided as:

- Figure 5 Cross-section A-A'

Plan view figures that indicate the horizontal distribution of contaminants are provided as:

- Figure 7 Analytical Testing Plan – Soil.

5.10.5 PHASE TWO CSM

The subject site had no building onsite and the area where impacted soil was paved. The release mechanisms and transport pathways for human and ecological receptors are discussed herein and are shown in **Figures 9** and **10**.

5.10.5.1 THE RELEASE MECHANISMS AND CONTAMINANT TRANSPORT PATHWAY

The release mechanisms and transport pathway for the contaminants (vanadium) include:

- Ingestion and skin contact with contaminated soil during excavation works; and
- Wind Erosion – for airborne particles for metals.

5.10.5.2 THE HUMAN AND ECOLOGICAL RECEPTOR

The potential human and ecological receptors exposed to the COCs include:

Human (onsite):

- Site worker, construction workers and utilities workers;

Ecological:

- Soil organism.

As the contamination is limited to soil only, and that soils in that area are asphalt-covered, exposure to on-site and offsite receptor is limited.

5.10.5.3 RECEPTOR EXPOSURE POINTS AND ROUTES OF EXPOSURE

5.10.5.3.1 HUMAN RECEPTOR

Exposure point and complete exposure pathways for on-site human receptors include:

- Onsite - soil ingestion, dermal contact (soil skin contact), and inhalation of particulate matter and vapours both outdoor and indoor air; and
- Offsite - inhalation of particulate matter and vapours both outdoor and indoor air.

These would only be applicable if the soils are uncovered.

5.10.5.3.2 ECOLOGICAL RECEPTOR

Exposure point and complete exposure pathways for on-site ecological receptors include infiltration and adsorption to soil via the following:

- Root and volatilized contaminants update for terrestrial plants;
- Direct update via dermal contact and inhalation of volatilized contaminants for soil invertebrates;
- Ingestion, vapour and soil inhalation of plant and invertebrates effected by impacted soil for birds, mammals and amphibians; and
- Ingestion, vapour and soil inhalation of contaminants for birds, mammals and amphibians.

Impact to ecological receptors is considered to be minimal, due to the fact that impacted soils are currently asphalt-covered.

6 CONCLUSIONS

6.1 SUMMARY OF PHASE TWO ESA INVESTIGATION FINDINGS

The following assessments were completed at the Phase Two Property where soil and groundwater samples were collected and submitted for laboratory analysis for the PCOCs, including metals, PHCs, PAHs and VOCs as identified during the Phase One ESA.

Between October 23 and October 28, 2019, 12 environmental and geotechnical boreholes (three of which were completed as monitoring wells) were advanced to maximum depths ranging between 7.6 m and 12.6 mBGS. Three (3) boreholes were cored to depths between 15.5 and 19.3 mBGS.

Based on the information collected in this Phase Two ESA, WSP provides the following findings:

Subsurface Condition

- Based on the findings of the drilling investigation, the soil stratigraphy, beneath the Phase Two subject site generally consisted of a layer of asphalt or topsoil, underlain by fill consisting of silty sand to silty sand and gravel, with occasional presence of silty clay fill. Part of the sand and gravel fill layer is considered to be reworked native soils, either from the subject site or from areas off-site. Fill material was noted to extend to depths between 3.8 m and 7.6 mBGS. Beneath the fill layer, there was native silty sand and gravel till (glacial till). Bedrock was cored at three (3) borehole locations, to final depths of 15.5, 18.6 and 19.3 mBGS, at BH19-8, BH19-7 and BH19-2, respectively.

For the purposes of this assessment, the analytical results have been compared to the 2011 MECP Table 3 for full depth generic site conditions in a non-potable groundwater condition.

Soil Condition

- All soils were found to be in compliance with MECP Table 3 standards, with the exception of vanadium at borehole BH19-4, which was identified in the upper fill material.

Groundwater Condition

- All groundwater samples were found to be in compliance with MECP Table 3 standards and is not considered to have been adversely impacted by historical activities.

6.2 RECOMMENDATIONS

Based on the findings of the Phase Two ESA, vanadium is present within a small area of the subject site, related to poor quality fill material. Given the scope of the proposed redevelopment of the site, the soils in the vicinity of the vanadium exceedance should be excavated and disposed of at a licensed landfill facility as part of site excavation works. It is recommended that WSP be present at the time of excavation, such that confirmatory samples can be collected following remedial excavation works.

Prior to site redevelopment, all three (3) groundwater monitoring wells must be decommissioned as per Ontario Regulation 903.

7 QUALIFICATIONS OF ASSESSORS

7.1 WSP CANADA INC.

WSP is a leading, full-service engineering company that has seen successful growth in the past decade with a Canadian contingent of approximately 8,000 people making a significant contribution to our 34,000 global staff, based in more than 500 offices, across 40 countries. WSP employs about 450 environment staff in Ontario including Professional Engineers, Professional Geoscientists, Biologists and Certified Technicians. The firm provides services to transform the built environment and restore the natural environment, and its expertise ranges from environmental remediation to urban planning, from engineering iconic buildings to designing sustainable transport networks, and from developing the energy sources of the future to enabling new ways of extracting essential resources.

7.2 QUALIFIED PERSON

Natalia Codoban, M.Eng., P.Eng, QP_{ESA} –Senior Hydrogeologist/Senior Env. Engineer

Natalia is a Senior Hydrogeologist / Environmental Engineer and Project Manager with over 14 years of experience in the environmental consulting field. She has academic background in Earth / Environmental Sciences and Geology and Environmental Engineering. She is a Professional Engineer in good standing and is a QP_{ESA}. Natalia has provided expertise to numerous Phase One and Phase Two ESAs, Contamination Overview Studies, landfill studies, hydrogeological investigations, and modelling groundwater flow and contaminant transport migration. Natalia reviewed the Phase Two ESA for this project.

Adrian Menyhart, P.Eng., ing. QP_{ESA} – Environmental Engineer/Project Manager

Adrian Menyhart is a Project Manager in the Ottawa, Ontario office of WSP Canada Inc. He has experience in conducting Phase One and Two Environmental Site Assessments on numerous residential, commercial, and industrial properties throughout Ontario and Quebec, from the conception stages, sampling programs, and reporting. Adrian has also successfully submitted several Record of Site Condition with the Ontario Ministry of the Environment, Conservation and Parks. Adrian managed completion of the Phase One ESA and Phase Two ESA and prepared ESA reports for this project.

7.3 SIGNATURES

This Phase Two ESA was conducted by the undersigned Qualified Person in general accordance with the requirements of O. Reg. 153/04.

Adrian Menyhart, P.Eng., ing., QP_{ESA}

Project Engineer, Environment

Natalia Codoban, M.Eng., P.Eng., QP_{ESA}

Senior Environmental Engineer, Environment

8 REFERENCES

- Chapman, L.J., and D.F. Putnam. 1984. The Physiography of Southern Ontario; Ontario Geological Survey. Special Volume 2. 270 p. Accompanied by Map P.2715 (coloured), scale 1:600 000.
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- Ontario Geological Survey. 2011. 1:250,000 Scale Bedrock Geology of Ontario; Ontario Geological Survey, Miscellaneous Release Data 126-Revision 1.
- SPL Consultants Limited, January 10, 2013. Phase One Environmental Site Assessment, North Property Development, Carleton University, Ottawa, Ontario. Draft report.
- SPL Consultants Limited, April 3, 2013. Phase Two Environmental Site Assessment, North Property Development, Carleton University, 1125 Colonel By Drive, Ottawa, Ontario.

Table 1 Monitoring Well Installation and Groundwater Levels

Monitoring Well ID			BH19-4	BH19-6	BH19-10
Installed By			WSP	WSP	WSP
Installation Date			28-Oct-19	24-Oct-19	24-Oct-19
Well Status			Active	Active	Active
Well Inner Diameter		(mm)	50	50	50
Casing Type (Flushmount / Monument)			Flushmount	Monument	Monument
Ground Surface Elevation		(masl)	64.740	66.440	65.400
Bottom of Concrete Seal/Top of Bentonite Seal		(mbgs)	0.3	0.3	0.3
		(masl)	64.44	66.14	65.1
Bottom of Bentonite Seal/Top of Sand Pack		(mbgs)	3.5	3.5	4.3
		(masl)	61.2	62.9	61.1
Top of Well Screen		(mbgs)	4.6	4.9	4.6
		(masl)	60.1	61.5	60.8
Screen Length		(m)	3.0	3.0	3.0
Bottom of Screen		(mbgs)	7.5	7.9	7.6
		(masl)	57.2	58.5	57.8
04-Nov-19	Depth of GW	(mbgs)	4.5	6.7	5.9
	GW Elevation	(masl)	60.2	59.8	59.6

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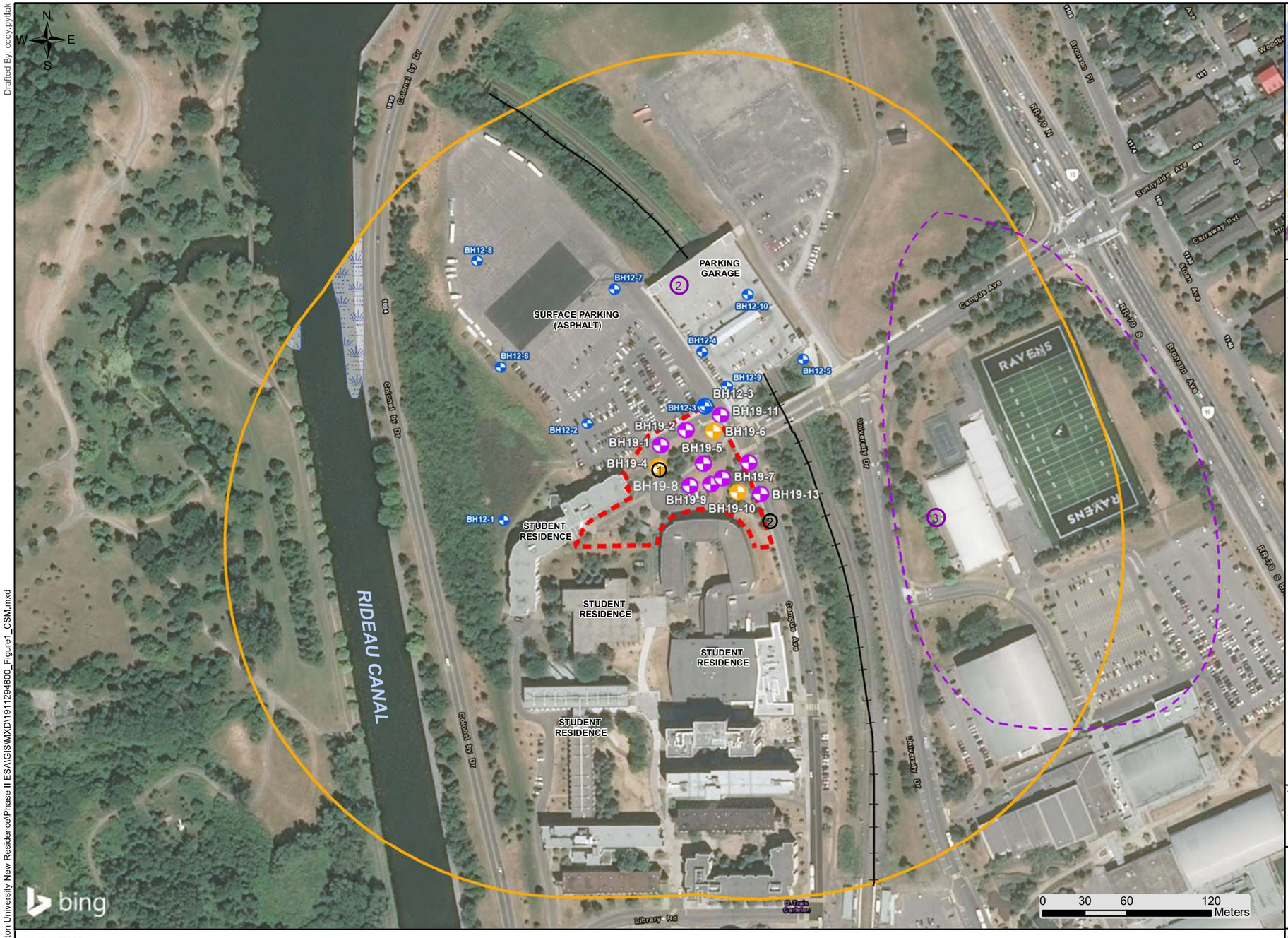

Potentially Contaminating Activities (PCAs) Resulting in Areas of Potential Environmental Concern

PCA1/APEC1: Importation and storage of fill material of unknown quality (on-site)
**Item 30: Importation of Fill Material of Unknown Quality*

PCA2/APEC2: Railway lines (former and present), located east of the site (off-site)
**Item 46: Rail Yards, Tracks and Spurs*

Potentially Contaminating Activities (PCAs) Not Resulting in Areas of Potential Environmental Concern

PCA3: Former landfill (off-site)
**Item 58: Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners*

PCA2/APEC2: Railway lines (former and present), located east of the site (off-site)
**Item 46: Rail Yards, Tracks and Spurs*

** As defined in Table 2 of Ontario Regulation 153/04: Records of Site Condition*

LEGEND

- Site Boundary
- 250 m Study Area
- Borehole (SPL, 2013)
- Monitoring Well (WSP, 2019)
- Borehole (WSP, 2019)
- Unevaluated Wetlands (MNRF)
- Railway
- APEC 1
- APEC 2
- PCA

TITLE

PHASE TWO CONCEPTUAL SITE MODEL

PROJECT

PHASE TWO ENVIRONMENTAL SITE ASSESSMENT
CARLETON UNIVERSITY
1125 COLONEL DR.
OTTAWA, ONTARIO

CLIENT

CARLETON UNIVERSITY

PROJECT NO	SOURCE	REVIEWED BY
191-12948-00	**BING / ESRI MAPS, OTTAWA OPEN DATA, GeoOttawa, LIO, MNRF**	**AM**
	DATE **MARCH 2020**	FIGURE **1**

Drafted By: cody.pytlak

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Potentially Contaminating Activities (PCAs) Resulting in Areas of Potential Environmental Concern

PCA1/APEC1: Importation and storage of fill material of unknown quality (on-site)
**Item 30: Importation of Fill Material of Unknown Quality*

PCA2/APEC2: Railway lines (former and present), located east of the site (off-site)
**Item 46: Rail Yards, Tracks and Spurs*

** As defined in Table 2 of Ontario Regulation 153/04: Records of Site Condition*

LEGEND

- Site Boundary
- Borehole (SPL, 2013)
- Monitoring Well (WSP, 2019)
- Borehole (WSP, 2019)
- Unevaluated Wetlands (MNRF)
- APEC 1
- APEC 2
- PCA

TITLE
PHASE TWO SITE PLAN

PROJECT
PHASE TWO ENVIRONMENTAL SITE ASSESSMENT
CARLETON UNIVERSITY
1125 COLONEL By DR.
OTTAWA, ONTARIO

CLIENT
CARLETON UNIVERSITY

PROJECT NO	SOURCE	REVIEWED BY
191-12948-00	**BING / ESRI MAPS, OTTAWA OPEN DATA, GeoOttawa, LIO, MNRF**	**AM**
	DATE **MARCH 2020**	FIGURE **2**

Drafted By: cody.pytlak

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Potentially Contaminating Activities (PCAs) Resulting in Areas of Potential Environmental Concern

PCA1/APEC1: Importation and storage of fill material of unknown quality (on-site)
**Item 30: Importation of Fill Material of Unknown Quality*

PCA2/APEC2: Railway lines (former and present), located east of the site (off-site)
**Item 46: Rail Yards, Tracks and Spurs*

** As defined in Table 2 of Ontario Regulation 153/04: Records of Site Condition*

LEGEND

- Site Boundary
- Unevaluated Wetlands (MNRF)
- Monitoring Well (WSP, 2019)
- Borehole (WSP, 2019)
- Borehole (SPL, 2013)
- Cross Sections
- APEC 1
- APEC 2

TITLE
BOREHOLE AND CROSS-SECTION LOCATION PLAN

PROJECT
PHASE TWO ENVIRONMENTAL SITE ASSESSMENT
CARLETON UNIVERSITY
1125 COLONEL By DR.
OTTAWA, ONTARIO

CLIENT
CARLETON UNIVERSITY

PROJECT NO	SOURCE	REVIEWED BY
191-12948-00	**BING / ESRI MAPS, OTTAWA OPEN DATA, GeoOttawa, LIO, MNRF**	**AM**
	DATE **MARCH 2020**	FIGURE **3**

Drafted By: cody.pytlak

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Potentially Contaminating Activities (PCAs) Resulting in Areas of Potential Environmental Concern

PCA1/APEC1: Importation and storage of fill material of unknown quality (on-site)
**Item 30: Importation of Fill Material of Unknown Quality*

PCA2/APEC2: Railway lines (former and present), located east of the site (off-site)
**Item 46: Rail Yards, Tracks and Spurs*

** As defined in Table 2 of Ontario Regulation 153/04: Records of Site Condition*

LEGEND

- Site Boundary
- Unevaluated Wetlands (MNRF)
- Monitoring Well (WSP, 2019)*
- Borehole (WSP, 2019)
- Borehole (SPL, 2013)
- Groundwater Contours (m)
- APEC 1
- APEC 2

*Geodetic Groundwater elevations, Nov. 4, 2019 (based on Preliminary survey sketch prepared by Fairhall, Moffatt, Woodland Ltd.)

TITLE	**GROUNDWATER CONTOURS**
PROJECT	**PHASE TWO ENVIRONMENTAL SITE ASSESSMENT CARLETON UNIVERSITY 1125 COLONEL By DR. OTTAWA, ONTARIO**
CLIENT	**CARLETON UNIVERSITY**

PROJECT NO	SOURCE	REVIEWED BY
191-12948-00	**BING / ESRI MAPS, OTTAWA OPEN DATA, GeoOttawa, LIO, MNRF**	**AM**
WSP	DATE **MARCH 2020**	FIGURE **4**

Drafted By: cody.pytlak

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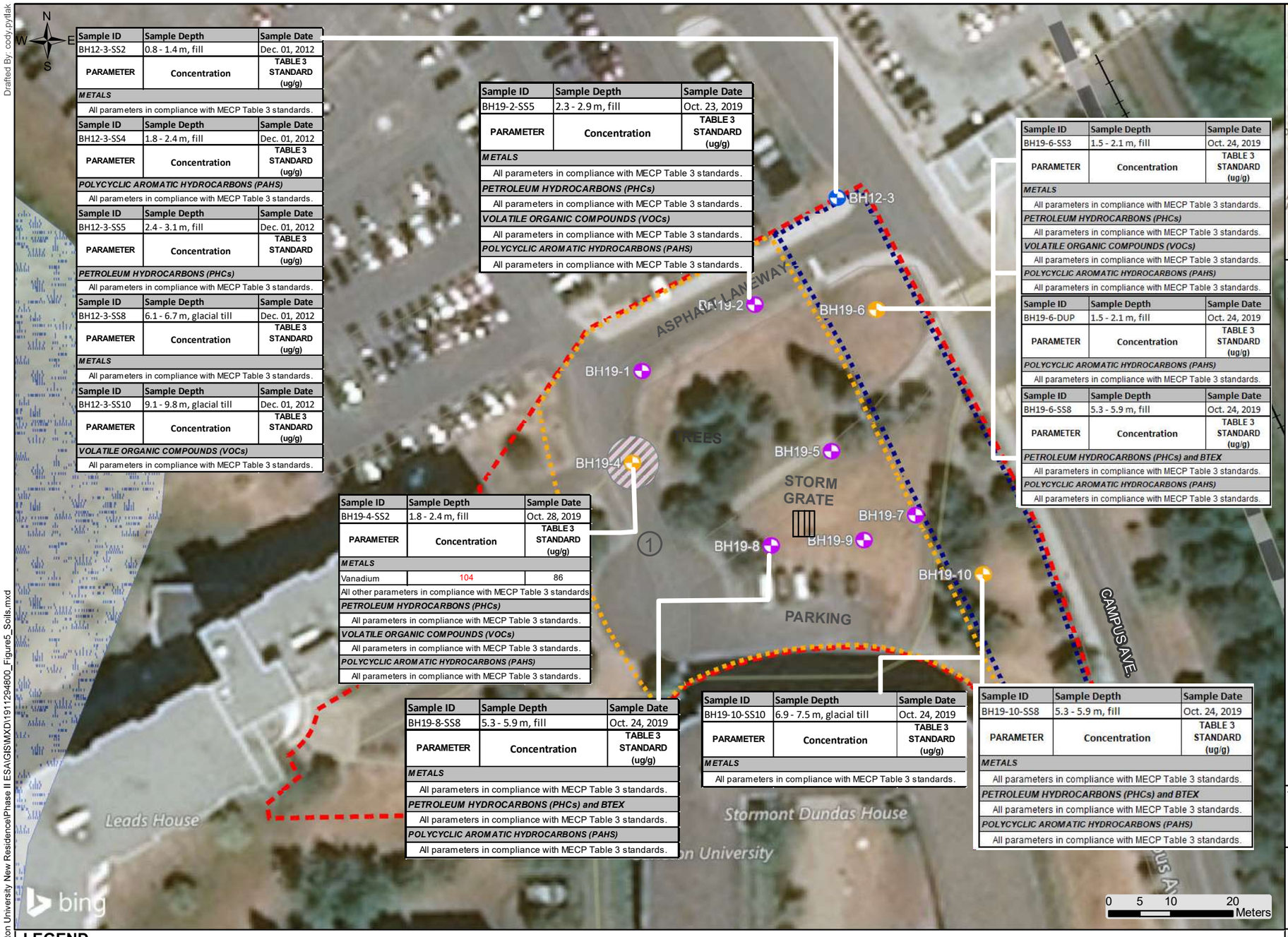


Sample ID	Sample Depth	Sample Date
BH12-3-SS2	0.8 - 1.4 m, fill	Dec. 01, 2012
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
METALS		
All parameters in compliance with MECP Table 3 standards.		
Sample ID	**Sample Depth**	**Sample Date**
BH12-3-SS4	1.8 - 2.4 m, fill	Dec. 01, 2012
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		
Sample ID	**Sample Depth**	**Sample Date**
BH12-3-SS5	2.4 - 3.1 m, fill	Dec. 01, 2012
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
PETROLEUM HYDROCARBONS (PHCs)		
All parameters in compliance with MECP Table 3 standards.		
Sample ID	**Sample Depth**	**Sample Date**
BH12-3-SS8	6.1 - 6.7 m, glacial till	Dec. 01, 2012
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
METALS		
All parameters in compliance with MECP Table 3 standards.		
Sample ID	**Sample Depth**	**Sample Date**
BH12-3-SS10	9.1 - 9.8 m, glacial till	Dec. 01, 2012
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
VOLATILE ORGANIC COMPOUNDS (VOCs)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Sample Depth	Sample Date
BH19-2-SS5	2.3 - 2.9 m, fill	Oct. 23, 2019
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
METALS		
All parameters in compliance with MECP Table 3 standards.		
PETROLEUM HYDROCARBONS (PHCs)		
All parameters in compliance with MECP Table 3 standards.		
VOLATILE ORGANIC COMPOUNDS (VOCs)		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Sample Depth	Sample Date
BH19-4-SS2	1.8 - 2.4 m, fill	Oct. 28, 2019
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
METALS		
Vanadium	104	86
All other parameters in compliance with MECP Table 3 standards		
PETROLEUM HYDROCARBONS (PHCs)		
All parameters in compliance with MECP Table 3 standards.		
VOLATILE ORGANIC COMPOUNDS (VOCs)		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Sample Depth	Sample Date
BH19-8-SS8	5.3 - 5.9 m, fill	Oct. 24, 2019
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
METALS		
All parameters in compliance with MECP Table 3 standards.		
PETROLEUM HYDROCARBONS (PHCs) and BTEX		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Sample Depth	Sample Date
BH19-10-SS10	6.9 - 7.5 m, glacial till	Oct. 24, 2019
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
METALS		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Sample Depth	Sample Date
BH19-6-SS3	1.5 - 2.1 m, fill	Oct. 24, 2019
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
METALS		
All parameters in compliance with MECP Table 3 standards.		
PETROLEUM HYDROCARBONS (PHCs)		
All parameters in compliance with MECP Table 3 standards.		
VOLATILE ORGANIC COMPOUNDS (VOCs)		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Sample Depth	Sample Date
BH19-6-DUP	1.5 - 2.1 m, fill	Oct. 24, 2019
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Sample Depth	Sample Date
BH19-6-SS8	5.3 - 5.9 m, fill	Oct. 24, 2019
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
PETROLEUM HYDROCARBONS (PHCs) and BTEX		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Sample Depth	Sample Date
BH19-10-SS8	5.3 - 5.9 m, fill	Oct. 24, 2019
PARAMETER	**Concentration**	**TABLE 3 STANDARD (ug/g)**
METALS		
All parameters in compliance with MECP Table 3 standards.		
PETROLEUM HYDROCARBONS (PHCs) and BTEX		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Potentially Contaminating Activities (PCAs) Resulting in Areas of Potential Environmental Concern

PCA1/APEC1: Importation and storage of fill material of unknown quality (on-site)
**Item 30: Importation of Fill Material of Unknown Quality*

PCA2/APEC2: Railway lines (former and present), located east of the site (off-site)
**Item 46: Rail Yards, Tracks and Spurs*

** As defined in Table 2 of Ontario Regulation 153/04: Records of Site Condition*

LEGEND

- Site Boundary
- Unevaluated Wetlands (MNRF)
- Monitoring Well (WSP, 2019)
- Borehole (WSP, 2019)
- Borehole (SPL, 2013)
- PCA
- APEC 1
- APEC 2
- Area of Vanadium Impacted Fill Material

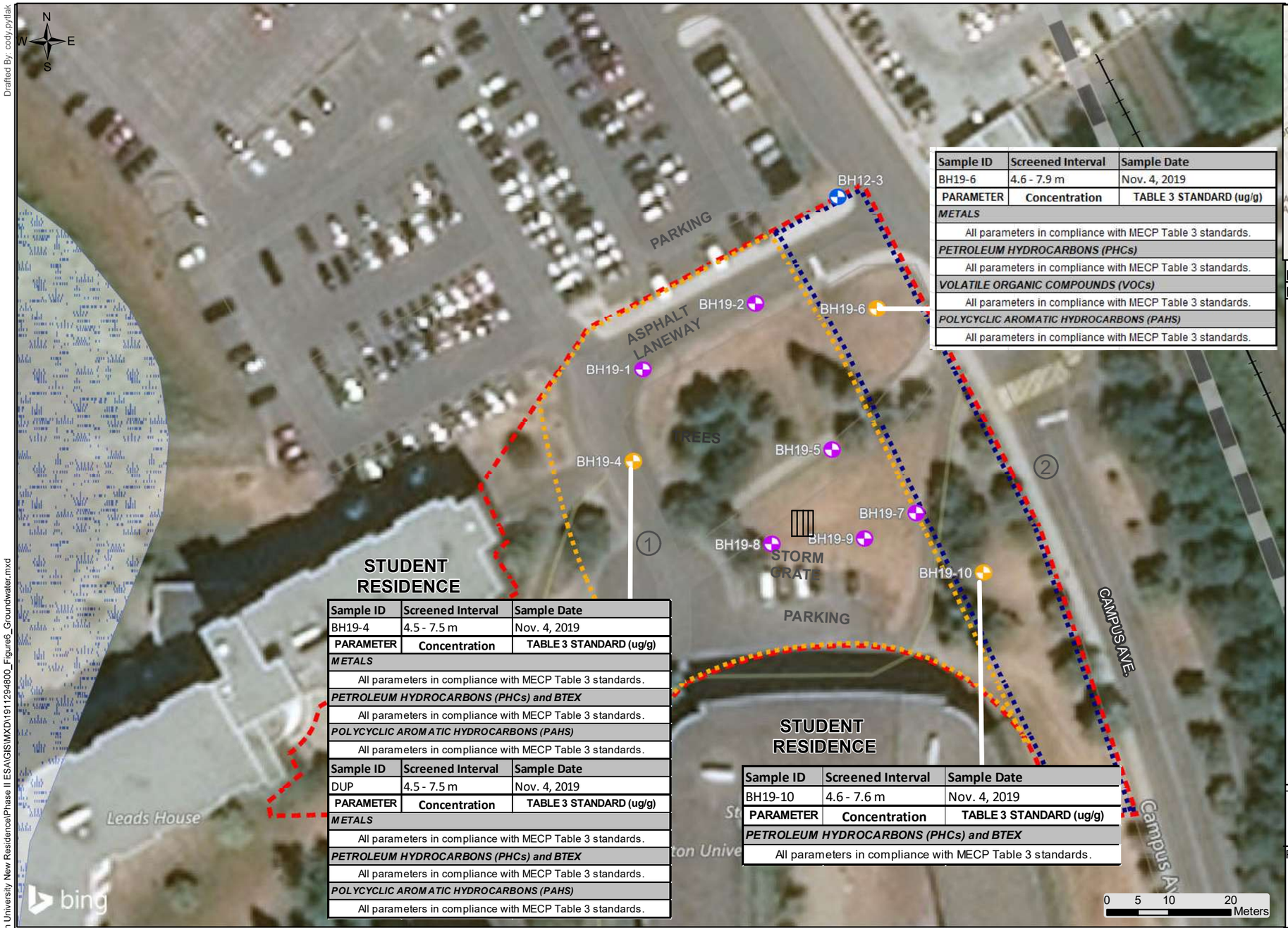
TITLE
ANALYTICAL TESTING PLAN SOIL

PROJECT
PHASE TWO ENVIRONMENTAL SITE ASSESSMENT
CARLETON UNIVERSITY
1125 COLONEL By DR.
OTTAWA, ONTARIO

CLIENT
CARLETON UNIVERSITY

PROJECT NO	SOURCE	REVIEWED BY
191-12948-00	**BING / ESRI MAPS, OTTAWA OPEN DATA, GeoOttawa, LIO, MNRF**	**AM**
	DATE **MARCH 2020**	FIGURE **5**

Drafted By: cody.pytlak



Sample ID	Screened Interval	Sample Date
BH19-6	4.6 - 7.9 m	Nov. 4, 2019
PARAMETER	Concentration	TABLE 3 STANDARD (ug/g)
METALS		
All parameters in compliance with MECP Table 3 standards.		
PETROLEUM HYDROCARBONS (PHCs)		
All parameters in compliance with MECP Table 3 standards.		
VOLATILE ORGANIC COMPOUNDS (VOCs)		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Screened Interval	Sample Date
BH19-4	4.5 - 7.5 m	Nov. 4, 2019
PARAMETER	Concentration	TABLE 3 STANDARD (ug/g)
METALS		
All parameters in compliance with MECP Table 3 standards.		
PETROLEUM HYDROCARBONS (PHCs) and BTEX		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		
Sample ID	Screened Interval	Sample Date
DUP	4.5 - 7.5 m	Nov. 4, 2019
PARAMETER	Concentration	TABLE 3 STANDARD (ug/g)
METALS		
All parameters in compliance with MECP Table 3 standards.		
PETROLEUM HYDROCARBONS (PHCs) and BTEX		
All parameters in compliance with MECP Table 3 standards.		
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)		
All parameters in compliance with MECP Table 3 standards.		

Sample ID	Screened Interval	Sample Date
BH19-10	4.6 - 7.6 m	Nov. 4, 2019
PARAMETER	Concentration	TABLE 3 STANDARD (ug/g)
PETROLEUM HYDROCARBONS (PHCs) and BTEX		
All parameters in compliance with MECP Table 3 standards.		

Potentially Contaminating Activities (PCAs) Resulting in Areas of Potential Environmental Concern

PCA1/APEC1: Importation and storage of fill material of unknown quality (on-site)
**Item 30: Importation of Fill Material of Unknown Quality*

PCA2/APEC2: Railway lines (former and present), located east of the site (off-site)
**Item 46: Rail Yards, Tracks and Spurs*

** As defined in Table 2 of Ontario Regulation 153/04: Records of Site Condition*

LEGEND

- Site Boundary
- Unevaluated Wetlands (MNRF)
- Monitoring Well (WSP, 2019)
- Borehole (WSP, 2019)
- Borehole (SPL, 2013)
- APEC 1
- APEC 2

TITLE
ANALYTICAL TESTING PLAN GROUNDWATER

PROJECT
PHASE TWO ENVIRONMENTAL SITE ASSESSMENT
CARLETON UNIVERSITY
1125 COLONEL By DR.
OTTAWA, ONTARIO

CLIENT
CARLETON UNIVERSITY

PROJECT NO	SOURCE	REVIEWED BY
191-12948-00	BING / ESRI MAPS, OTTAWA OPEN DATA, GeoOttawa, LIO, MNRF	AM
	DATE: MARCH 2020	FIGURE: 6

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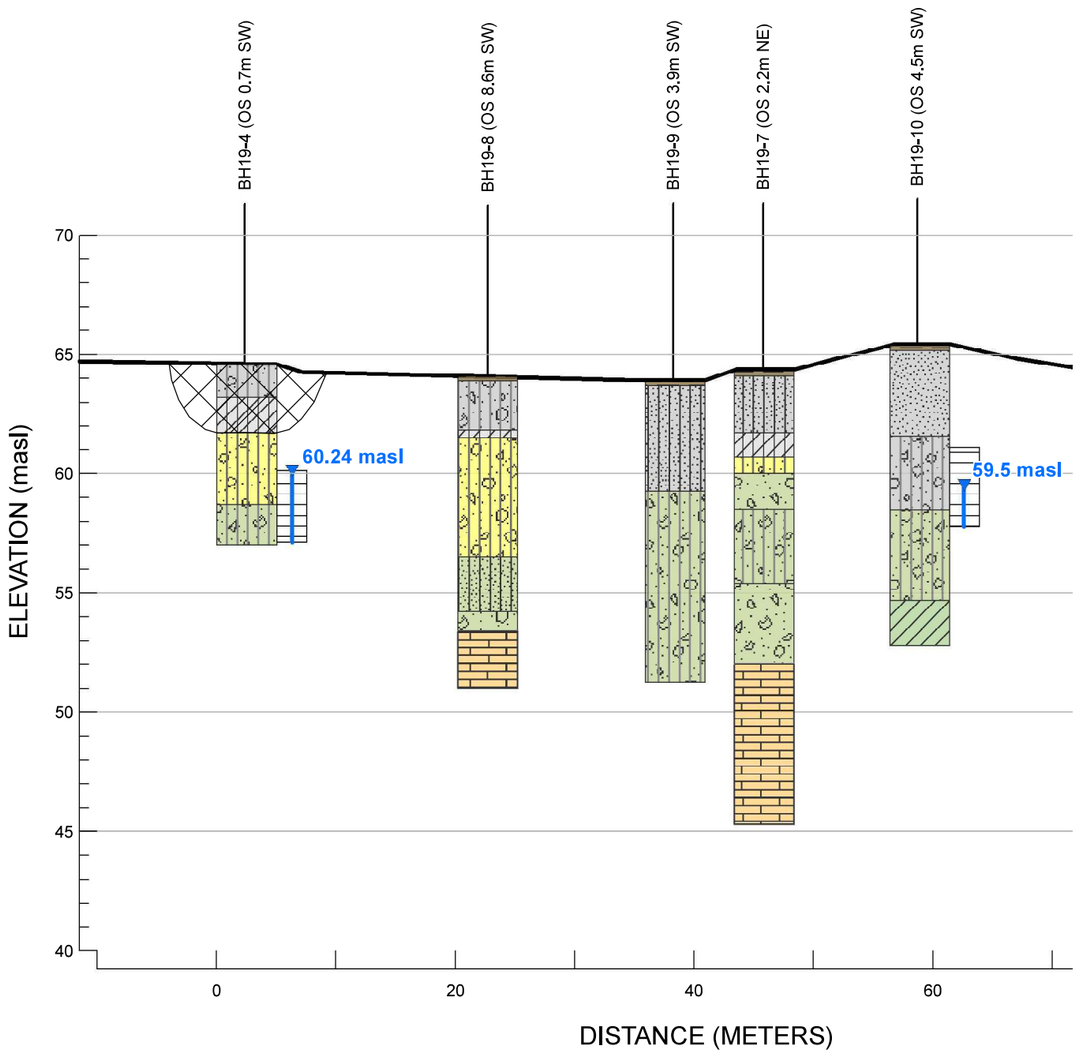
LOOKING NORTH EAST

A
NORTH WEST

A'
SOUTH EAST



LEGEND

- GROUND SURFACE
- MONITORING WELL SCREENS
- GROUNDWATER ELEVATION
- VANADIUM IMPACTED FILL MATERIAL
- ASPHALT / CONCRETE
- TOPSOIL
- SAND (FILL)
- SILTY SAND (FILL)
- SILTY SAND (GLACIAL TILL)
- SILTY SAND AND GRAVEL
- SILTY SAND AND GRAVEL
- SILTY SAND AND GRAVEL
- SILTY CLAY (FILL)
- ROCK FRAGMENTS / GRAVEL SIZED ROCK FRAGMENTS
- GLACIAL TILL INFERRED
- LIMESTONE

Meters
0 20 40 60 80

SCALE AS SHOWN
2X VERTICAL EXAGGERATION

wsp

CARLETON UNIVERSITY
1125 COLONEL By DR.
OTTAWA, ONTARIO

CROSS SECTION A - A'

DATE:
NOVEMBER 2019

PROJECT:
191-12948-00

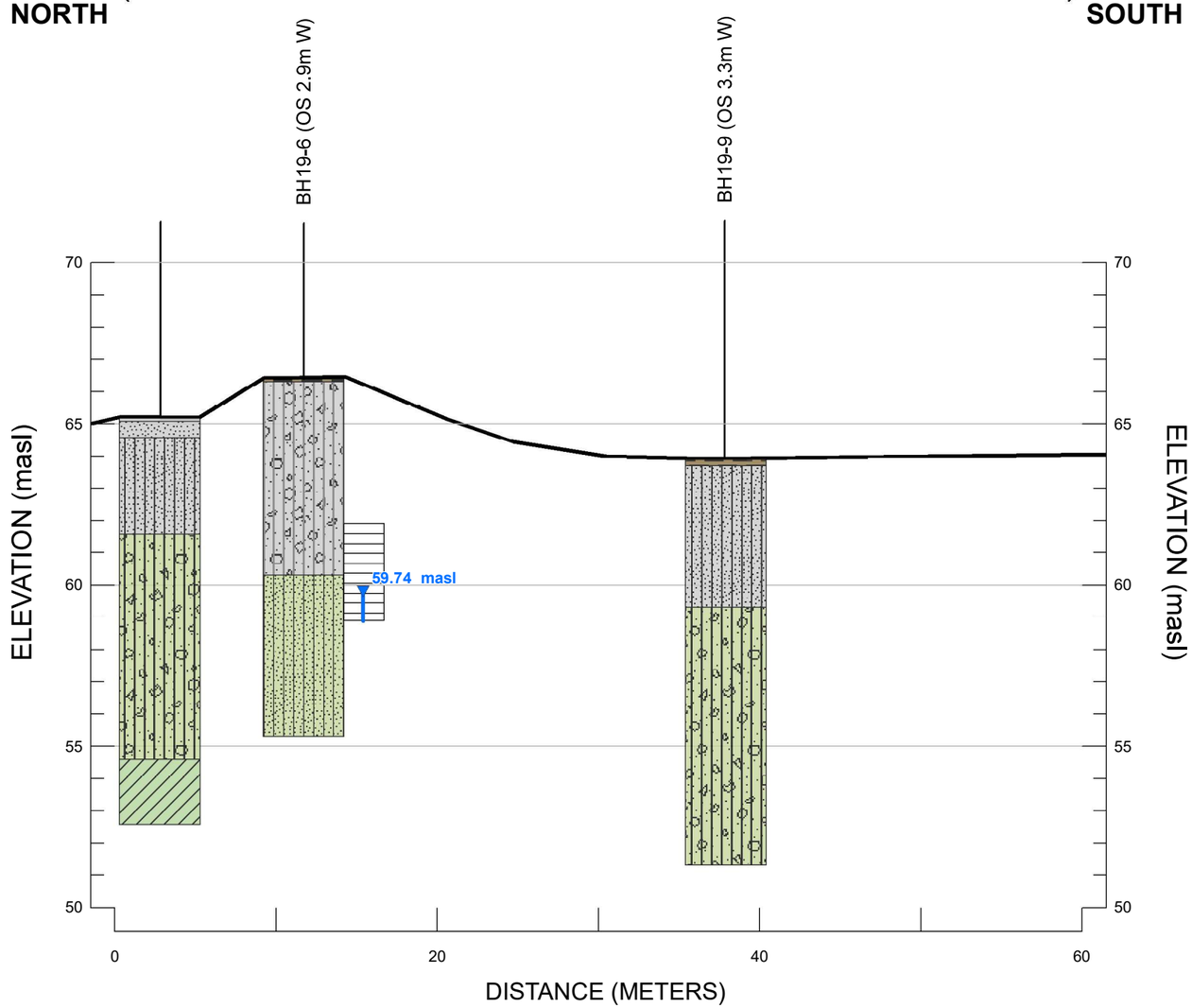
FIGURE
5

\\caott1dat01.gcg.local\SPL Ottawa\Projects\191-12948-00 - Carleton University New Residence\Phase II ESA\GIS\MXD\Figure 5 Cross Section A-A'.mxd

LOOKING EAST

B NORTH

B' SOUTH



LEGEND

- GROUND SURFACE
- MONITORING WELL SCREENS
- GROUNDWATER ELEVATION
- ASPHALT
- TOPSOIL
- SAND
- SILTY SAND (FILL)
- SILTY SAND (GLACIAL TILL)
- SILTY SAND AND GRAVEL
- SILTY SAND AND GRAVEL
- GLACIAL TILL INFERED

0 20 40 60 80 Meters

SCALE AS SHOWN
2X VERTICAL EXAGGERATION

wsp

CARLETON UNIVERSITY
1125 COLONEL By DR.
OTTAWA, ONTARIO

CROSS SECTION B - B'

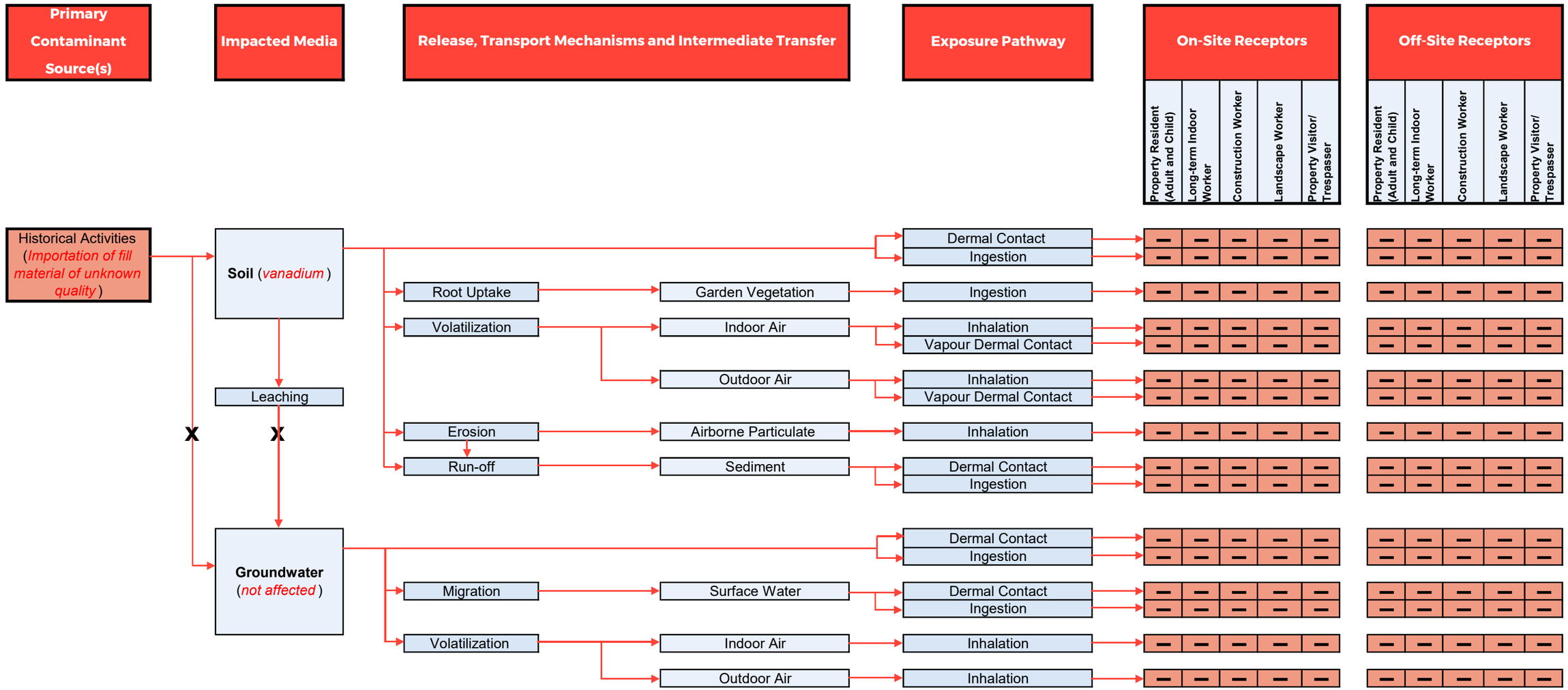
DATE: NOVEMBER 2019

PROJECT: 191-12948-00

FIGURE 6

\\caott1dat01.gcg.local\SPL Ottawa\Projects\191-12948-00 - Carleton University New Residence\Phase II ESA\GIS\MXD\Figure 6 Cross Section B-B'.mxd

CONTAMINANT TRANSPORT DIAGRAM - HUMAN HEALTH EXPOSURE

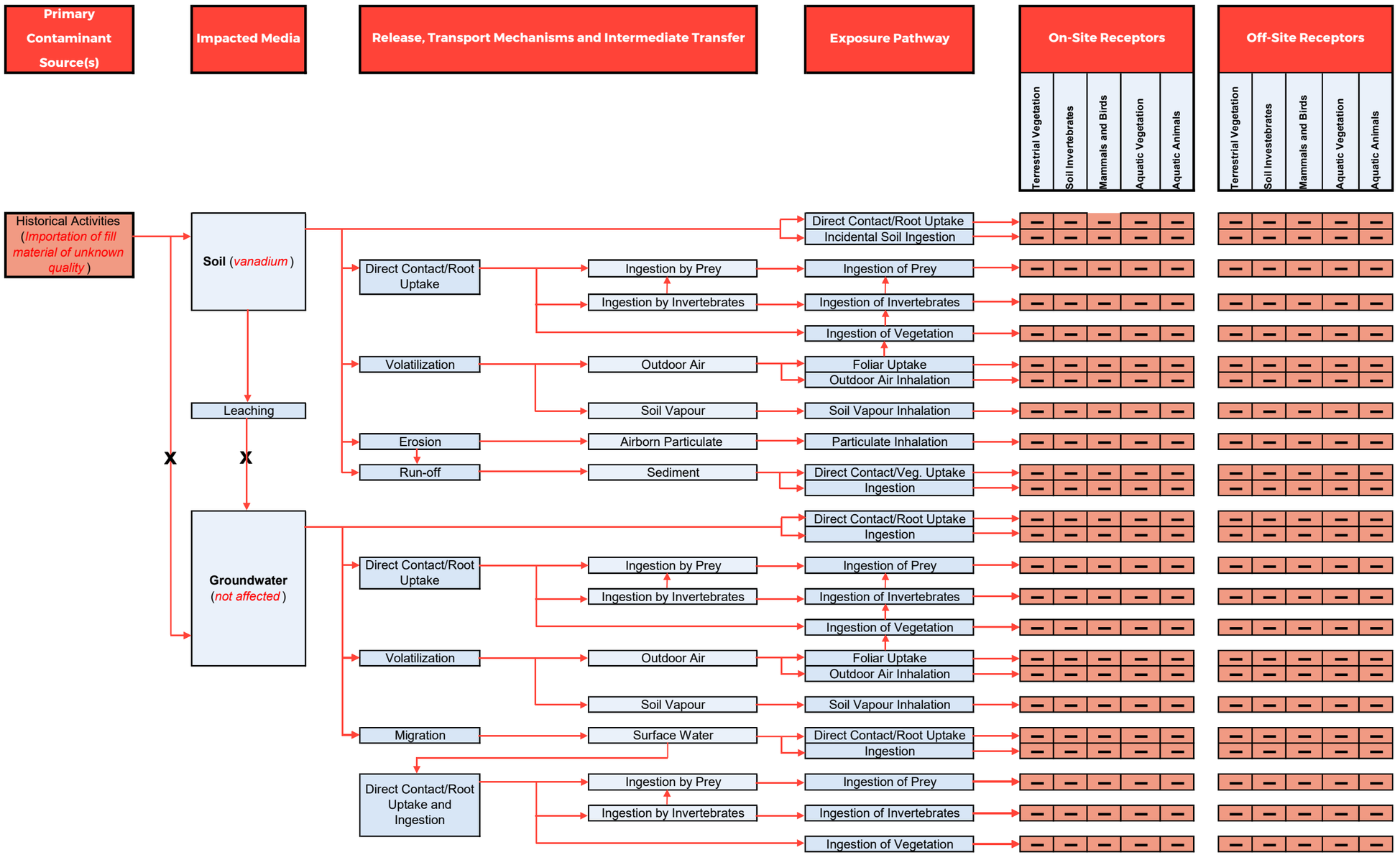


LEGEND:

[▬] - NO Receptor considered to be present and/or Pathway Incomplete
[▲] - Receptor is considered to be present and Pathway Complete
X - Exposure Pathway considered blocked

Project No.: *191-12948-00*		**Figure No.: 9**
Project: ***Proposed Student Residence, Carleton University***		
Date: *November 2019*	**Drawn:** *AM*	**Approved:** *NC*

CONTAMINANT TRANSPORT DIAGRAM - ECOLOGICAL EXPOSURE



LEGEND:

[▬] - NO Receptor considered to be present and/or Pathway Incomplete
[▲] - Receptor is considered to be present and Pathway Complete
X→ - Exposure Pathway considered blocked (*indicate* Risk Management *and/or* Remediation) *(To be Shown after completion of Remediation/Risk Assessment)*

Project No.: *191-12948-00*		**Figure No.:** 10
Project: *Proposed Student Residence, Carleton University*		
Date: *November 2019*	**Drawn:** *AM*	**Approved:** *NC*

Table 2 Summary of Soil Samples Submitted for Chemical Analysis

Borehole	Sample	Depth	Date	Parameters				APEC #
		m		Metals	PHCs	VOCs	PAHs	
BH19-2	SS5	2.3 - 2.9	23-Oct-19	✓	✓	✓	✓	1
BH19-4	SS2	1.8 - 2.4	28-Oct-19	✓	✓	✓	✓	1
BH19-6	SS3	1.5 - 2.1	24-Oct-19	✓	✓	✓	✓	1,2
BH19-6	DUP	1.5 - 2.1	24-Oct-19			✓		1,2
BH19-6	SS8	5.3 - 5.9	24-Oct-19		✓	✓	✓	1,2
BH19-8	SS8	5.3 - 5.9	24-Oct-19	✓	✓	✓	✓	1
BH19-10	SS8	5.3 - 5.9	24-Oct-19	✓	✓	✓	✓	1,2
BH19-10	SS10	6.9 - 7.5	24-Oct-19	✓				1,2
BH12-3	SS2	0.89 - 1.4	1-Dec-12	✓				1
BH12-3	SS4	1.8 - 2.4	1-Dec-12				✓	1
BH12-3	SS5	2.4 - 3.1	1-Dec-12		✓			1
BH12-3	SS8	6.1 - 6.7	1-Dec-12	✓				1
BH12-3	SS10	9.1 - 9.8	1-Dec-12			✓		1

Table 3 Summary of Groundwater Samples Submitted for Chemical Analysis

Monitoring Well ID	Screened Interval (mbgs)	Date	Parameters				APEC #
			Metals	PHCs	VOCs	PAHs	
BH19-4	4.5 - 7.5	Nov 4 2019	✓	✓	✓	✓	1,2
BH19-4 (DUP)	4.5 - 7.5	Nov 4 2019	✓	✓	✓	✓	1,2
BH19-6	4.6 - 7.9	Nov 4 2019	✓	✓	✓	✓	1,2
BH19-10	4.6 - 7.6	Nov 4 2019		✓	✓		1,2

Table 4 Soil Analytical Results - Metals

Parameter	Table 3 RPI CT	Table 1 RPIICC	BH19-2-SS5	BH19-4-SS2	BH19-6-SS3	BH19-8-SS8	BH19-10-SS8	BH19-10-SS10
Date of Collection			Oct 23, 2019	28-Oct-19	Oct 24, 2019	Oct 24, 2019	Oct 24, 2019	Oct 24, 2019
Date Reported			Oct 31, 2019	Nov 01, 2019	Oct 31, 2019	Nov 08, 2019	Nov 08, 2019	Nov 08, 2019
Sampling Depth (mbgs)			2.3 - 2.9	1.8 - 2.4	1.5 - 2.1	5.3 - 5.9	5.3 - 5.9	6.9 - 7.5
Antimony	7.5	1.3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Arsenic	18	18	3.6	3.9	1.7	1.9	4.4	2.2
Barium	390	220	197	**359**	48.2	152	123	54.9
Beryllium	4	2.5	0.6	0.7	<0.5	<0.5	<0.5	<0.5
Boron	120	36	9.6	6.5	5.7	11.5	7.8	7.5
Cadmium	1.2	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	160	70	59.1	**118**	12.9	14.5	20.3	14.7
Chromium VI	8	0.66	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cobalt	22	21	12.6	**21.5**	3.2	6.3	6.8	6.4
Copper	140	92	29.8	54.3	9.7	12.5	18.5	11.8
Lead	120	120	11.9	16.3	14.6	4.4	61.4	4.2
Mercury	0.27	0.27	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	6.9	2	1	<1.0	<1.0	<1.0	**2.6**	1.1
Nickel	100	82	33.8	62.8	6.3	12.3	14.9	10.6
Selenium	2.4	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Silver	20	0.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Thallium	1	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium	86	86	<1.0	104	<1.0	1.1	<1.0	<1.0
Zinc	340	290	62.9	121	20.3	26	25.9	24.7

104 Concentration exceeds MECP Table 3 site standard

1 Concentrations exceeds MECP Table 1 background standard

Table 4 Soil Analytical Results - Metals

Parameter		BH12-3-SS2	BH12-3-SS8
Date of Collection	Table 3 RPI CT	Dec 01, 2012	Dec 01, 2012
Date Reported		Dec 10, 2012	Dec 10, 2012
Sampling Depth (mbgs)		0.8 - 1.4	6.1 - 6.7
Antimony	7.5	<1.0	<1.0
Arsenic	18	6.1	<1.0
Barium	390	31.3	32
Beryllium	4	<0.5	<0.5
Boron	120	-	-
Cadmium	1.2	<0.5	<0.5
Chromium	160	9.3	16.9
Chromium VI	8	<0.2	<0.2
Cobalt	22	5.8	2.6
Copper	140	8.5	7.8
Lead	120	13.9	2.5
Mercury	0.27	0.013	< 0.01
Molybdenum	6.9	3.8	<1.0
Nickel	100	11.3	4.5
Selenium	2.4	<1.0	<1.0
Silver	20	<0.2	<0.2
Thallium	1	<0.5	<0.5
Vanadium	86	16.1	17.2
Zinc	340	11.6	11.3

Table 5 Soil Analytical Results - PHCs & BTEX

Parameter			BH19-2-SS5	BH19-4-SS2	BH19-6-SS3	BH19-6-SS8	BH19-8-SS8	BH19-10-SS8
Date of Collection	Table 3 RPI CT	Table 1 RPIICC	Oct 23, 2019	28-Oct-91	Oct 24, 2019	Oct 24, 2019	Oct 24, 2019	Oct 24, 2019
Date Reported			Oct 31, 2019	Nov 01, 2019	Oct 31, 2019	Nov 08, 2019	Nov 08, 2019	Nov 08, 2019
Sampling Depth (mbgs)			2.3 - 2.9	1.8 - 2.4	1.5 - 2.1	5.3 - 5.9	5.3 - 5.9	5.3 - 5.9
Benzene	0.21	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Toluene	2.3	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	2	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Xylenes	3.1	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 to C10) minus BTEX	55	7	<7	<7	**27**	<7	<7	<7
F2 (C10 to C16)	98	4	<4	<4	<4	<4	<4	<4
F3 (C16 to C34)	300	8	<8	<8	75	<8	<8	<8
F4 (C34 to C50)	2800	6	<6	<6	**123**	<6	<6	<6

104 Concentration exceeds MECP Table 3 site standard

1 Concentrations exceeds MECP Table 1 background standard

Table 5 Soil Analytical Results - PHCs & BTEX

Parameter		BH12-3-SS5
Date of Collection	Table 3 RPI CT	Dec 01, 2012
Date Reported		Dec 10, 2012
Sampling Depth (mbgs)		2.4 - 3.1
Benzene	0.21	-
Toluene	2.3	-
Ethylbenzene	2	-
Total Xylenes	3.1	-
F1 (C6 to C10) minus BTEX	55	<5
F2 (C10 to C16)	98	<10
F3 (C16 to C34)	300	117
F4 (C34 to C50)	2800	<50

Table 6 Soil Analytical Results - VOCs

Parameter			BH19-2-SS5	BH19-4-SS2	BH19-6-SS3	BH19-10-SS8
Date of Collection	Table 3 RPI CT	Table 1 RPIICC	Oct 23, 2019	28-Oct-91	Oct 24, 2019	Oct 24, 2019
Date Reported			Oct 31, 2019	Nov 01, 2019	Oct 31, 2019	Nov 08, 2019
Sampling Depth (mbgs)			2.3 - 2.9	1.8 - 2.4	1.5 - 2.1	5.3 - 5.9
Acetone	16	0.5	<0.50	<0.50	<0.50	<0.50
Benzene	0.21	0.02	<0.02	<0.02	<0.02	<0.02
Bromodichloromethane	13	0.05	<0.05	<0.05	<0.05	<0.05
Bromoform	0.27	0.05	<0.05	<0.05	<0.05	<0.05
Bromomethane	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Chlorobenzene	2.4	0.05	<0.05	<0.05	<0.05	<0.05
Chloroform	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Dibromochloromethane	9.4	0.05	<0.05	<0.05	<0.05	<0.05
Dichlorobenzene, 1,2-	3.4	0.05	<0.05	<0.05	<0.05	<0.05
Dichlorobenzene, 1,3-	4.8	0.05	<0.05	<0.05	<0.05	<0.05
Dichlorobenzene, 1,4-	0.083	0.05	<0.05	<0.05	<0.05	<0.05
Dichlorodifluoromethane	16	0.05	<0.05	<0.05	<0.05	<0.05
Dichloroethane, 1,1-	3.5	0.05	<0.05	<0.05	<0.05	<0.05
Dichloroethane, 1,2-	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Dichloroethylene, 1,1-	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Dichloroethylene, cis- 1,2-	3.4	0.05	<0.05	<0.05	<0.05	<0.05
Dichloroethylene, trans- 1,2-	0.084	0.05	<0.05	<0.05	<0.05	<0.05
Dichloropropane, 1,2-	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Dichloropropene, 1,3-	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	2	0.05	<0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Hexane, n-	2.8	0.05	<0.05	<0.05	<0.05	<0.05
Methyl Ethyl Ketone	16	0.5	<0.50	<0.50	<0.50	<0.50
Methyl Isobutyl Ketone	1.7	0.5	<0.50	<0.50	<0.50	<0.50
Methyl tert-butyl ether	0.75	0.05	<0.05	<0.05	<0.05	<0.05
Methylene Chloride	0.1	0.05	<0.05	<0.05	<0.05	<0.05
Styrene	0.7	0.05	<0.05	<0.05	<0.05	<0.05
Tetrachloroethane, 1,1,1,2-	0.058	0.05	<0.05	<0.05	<0.05	<0.05
Tetrachloroethane, 1,1,2,2-	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Tetrachloroethylene	0.28	0.05	<0.05	<0.05	<0.05	<0.05
Toluene	2.3	0.2	<0.05	<0.05	<0.05	<0.05
Trichloroethane, 1,1,1-	0.38	0.05	<0.05	<0.05	<0.05	<0.05
Trichloroethane, 1,1,2-	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Trichloroethylene	0.061	0.05	<0.05	<0.05	<0.05	<0.05
Trichlorofluoromethane	4	0.25	<0.05	<0.05	<0.05	<0.05
Vinyl Chloride	0.02	0.02	<0.02	<0.02	<0.02	<0.02
Xylene Mixture	3.1	0.05	<0.05	<0.05	<0.05	<0.05
		104	Concentration exceeds MECP Table 3 site standard			
		1	Concentrations exceeds MECP Table 1 background standard			

Table 6 Soil Analytical Results - VOCs

Parameter		BH12-3-SS10
Date of Collection	Table 3 RPI CT	Dec 01, 2012
Date Reported		Dec 10, 2012
Sampling Depth (mbgs)		9.1 - 9.8
Acetone	16	<0.50
Benzene	0.21	<0.02
Bromodichloromethane	13	<0.05
Bromoform	0.27	<0.05
Bromomethane	0.05	<0.05
Carbon Tetrachloride	0.05	<0.05
Chlorobenzene	2.4	<0.05
Chloroform	0.05	<0.05
Dibromochloromethane	9.4	<0.05
Dichlorobenzene, 1,2-	3.4	<0.05
Dichlorobenzene, 1,3-	4.8	<0.05
Dichlorobenzene, 1,4-	0.083	<0.05
Dichlorodifluoromethane	16	<0.05
Dichloroethane, 1,1-	3.5	<0.05
Dichloroethane, 1,2-	0.05	<0.05
Dichloroethylene, 1,1-	0.05	<0.05
Dichloroethylene, cis- 1,2-	3.4	<0.05
Dichloroethylene, trans- 1,2-	0.084	<0.05
Dichloropropane, 1,2-	0.05	<0.05
Dichloropropene, 1,3-	0.05	<0.05
Ethylbenzene	2	<0.05
Ethylene Dibromide	0.05	<0.05
Hexane, n-	2.8	<0.05
Methyl Ethyl Ketone	16	<0.50
Methyl Isobutyl Ketone	1.7	<0.50
Methyl tert-butyl ether	0.75	<0.05
Methylene Chloride	0.1	<0.05
Styrene	0.7	<0.05
Tetrachloroethane, 1,1,1,2-	0.058	<0.05
Tetrachloroethane, 1,1,2,2-	0.05	<0.05
Tetrachloroethylene	0.28	<0.05
Toluene	2.3	<0.2
Trichloroethane, 1,1,1-	0.38	<0.05
Trichloroethane, 1,1,2-	0.05	<0.05
Trichloroethylene	0.061	<0.05
Trichlorofluoromethane	4	<0.05
Vinyl Chloride	0.02	<0.02
Xylene Mixture	3.1	<0.05

Table 7 Soil Analytical Results - PAHs

Parameter	Table 3 RPI CT	Table 1 RPIICC	BH19-2-SS5	BH19-4-SS2	BH19-6-SS3	BH19-6-DUP	BH19-6-SS8	BH19-8-SS8
Date of Collection			Oct 23, 2019	Oct 28, 2019	Oct 24, 2019	Oct 24, 2019	Oct 24, 2019	Oct 24, 2019
Date Reported			Oct 31, 2019	Nov 01, 2019	Oct 31, 2019	Oct 31, 2019	Nov 08, 2019	Nov 08, 2019
Sampling Depth (mbgs)			2.3 - 2.9	1.8 - 2.4	1.5 - 2.1	1.5 - 2.1	5.3 - 5.9	5.3 - 5.9
Acenaphthene	7.9	0.072	<0.02	0.02	0.02	0.04	<0.02	<0.02
Acenaphthylene	0.15	0.093	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	0.67	0.16	0.03	0.05	0.04	0.1	<0.02	<0.02
Benz(a)anthracene	0.5	0.36	0.05	0.07	0.09	0.2	<0.02	<0.02
Benzo(a)pyrene	0.3	0.3	0.04	0.05	0.08	0.16	<0.02	<0.02
Benzo(b/j)fluoranthene	0.78	0.47	0.06	0.06	0.13	0.2	<0.02	<0.02
Benzo(ghi)perylene	6.6	0.68	0.03	0.03	0.05	0.13	<0.02	<0.02
Benzo(k)fluoranthene	0.78	0.48	0.03	0.03	0.06	0.11	<0.02	<0.02
Chrysene	7	2.8	0.07	0.07	0.1	0.2	<0.02	<0.02
Dibenz(a,h)anthracene	0.1	0.1	<0.02	<0.02	<0.02	0.03	<0.02	<0.02
Fluoranthene	0.69	0.56	0.14	0.19	0.21	0.46	<0.02	<0.02
Fluorene	62	0.12	<0.02	0.02	0.02	0.05	<0.02	<0.02
Indeno(1,2,3-cd)pyrene	0.38	0.23	0.02	0.03	0.05	0.1	<0.02	<0.02
1-Methylnaphthalene	0.99	0.59	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
2-Methylnaphthalene	0.99	0.59	<0.02	0.04	<0.02	0.02	<0.02	<0.02
Naphthalene	0.6	0.09	<0.01	0.03	0.02	0.02	<0.01	<0.01
Phenanthrene	6.2	0.69	0.09	0.16	0.16	0.38	<0.02	<0.02
Pyrene	78	1	0.11	0.15	0.16	0.37	<0.02	<0.02
Methylnaphthalene, 2-(1-)	0.99	0.59	<0.04	0.06	<0.04	<0.04	<0.04	<0.04
			104	Concentration exceeds MECP Table 3 site standard				
			1	Concentrations exceeds MECP Table 1 background standard				

Table 7 Soil Analytical Results - PAHs

Parameter		BH19-10-SS8	BH12-3-SS4
Date of Collection	Table 3 RPI CT	Oct 24, 2019	Dec 01, 2012
Date Reported		Nov 08, 2019	Dec 10, 2019
Sampling Depth (mbgs)		5.3 - 5.9	1.8 - 2.4
Acenaphthene	7.9	<0.02	0.253
Acenaphthylene	0.15	<0.02	<0.05
Anthracene	0.67	<0.02	0.13
Benz(a)anthracene	0.5	<0.02	0.314
Benzo(a)pyrene	0.3	<0.02	0.279
Benzo(b/j)fluoranthene	0.78	<0.02	0.28
Benzo(ghi)perylene	6.6	<0.02	0.167
Benzo(k)fluoranthene	0.78	<0.02	0.251
Chrysene	7	<0.02	0.337
Dibenz(a,h)anthracene	0.1	<0.02	<0.05
Fluoranthene	0.69	<0.02	0.671
Fluorene	62	<0.02	0.14
Indeno(1,2,3-cd)pyrene	0.38	<0.02	0.186
1-Methylnaphthalene	0.99	<0.02	0.177
2-Methylnaphthalene	0.99	<0.02	0.111
Naphthalene	0.6	<0.01	0.388
Phenanthrene	6.2	<0.02	<0.05
Pyrene	78	<0.02	0.511
Methylnaphthalene, 2-(1-)	0.99	<0.04	0.288

Table 8 Groundwater Analytical Results - Metals

Parameter		BH19-4	DUP	BH19-6
Date of Collection	Table 3 RPI CT	Nov 04, 2019	Nov 04, 2019	Nov 04, 2019
Date Reported		Nov 12, 2019	Nov 12, 2019	Nov 12, 2019
Screened Depth (mbgs)		4.5 - 7.5	4.5 - 7.5	4.6 - 7.9
Antimony	7.5	<0.5	<0.5	<0.5
Arsenic	18	<1	<1	<1
Barium	390	181	184	236
Beryllium	4	<0.5	<0.5	<0.5
Boron	120	72	71	55
Cadmium	1.2	<0.1	<0.1	<0.1
Chromium	160	<1	<1	<1
Chromium VI	8	<10	<10	<10
Cobalt	22	<0.5	<0.5	0.9
Copper	140	<0.5	<0.5	0.5
Lead	120	<0.1	<0.1	<0.1
Mercury	0.27	<0.1	<0.1	<0.1
Molybdenum	6.9	0.7	0.5	3.3
Nickel	100	<1	<1	2
Selenium	2.4	<1	<1	<1
Silver	20	<0.1	<0.1	<0.1
Thallium	1	<0.1	<0.1	<0.1
Uranium	23	0.2	0.1	0.3
Vanadium	86	<0.5	<0.5	<0.5
Zinc	340	6	<5	<5
Sodium	NA	402000	397000	651000

Table 9 Groundwater Analytical Results - PHCs&BTEX

Parameter		BH19-4	DUP	BH19-6	BH19-10
Date of Collection	Table 3 RPI CT	Nov 04, 2019	Nov 04, 2019	Nov 04, 2019	Nov 04, 2019
Date Reported		Nov 12, 2019	Nov 12, 2019	Nov 12, 2019	Nov 12, 2019
Screened Depth (mbgs)		4.5 - 7.5	4.5 - 7.5	4.6 - 7.9	4.6 - 7.6
Benzene	0.21	<0.5	<0.5	<0.5	<0.5
Toluene	2.3	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	2	<0.5	<0.5	<0.5	<0.5
Xylene Mixture	3.1	<0.5	<0.5	<0.5	<0.5
F1 (C6 to C10) minus BTEX	55	<25	<25	<25	<25
F2 (C10 to C16)	98	<100	<100	<100	<100
F3 (C16 to C34)	300	<100	<100	<100	<100
F4 (C34 to C50)	2800	<100	<100	<100	<100

Table 10 Groundwater Analytical Results - VOCs

Parameter		BH19-6	BH19-10
Date of Collection	Table 3 RPI CT	Nov 04, 2019	Nov 04, 2019
Date Reported		Nov 12, 2019	Nov 12, 2019
Screened Depth (mbgs)		4.6 - 7.9	4.6 - 7.6
Acetone	16	<5.0	<5.0
Benzene	0.21	<0.5	<0.5
Bromodichloromethane	13	<0.5	<0.5
Bromoform	0.27	<0.5	<0.5
Bromomethane	0.05	<0.5	<0.5
Carbon Tetrachloride	0.05	<0.2	<0.2
Chlorobenzene	2.4	<0.5	<0.5
Chloroform	0.05	<0.5	<0.5
Dibromochloromethane	9.4	<0.5	<0.5
Dichlorobenzene, 1,2-	3.4	<0.5	<0.5
Dichlorobenzene, 1,3-	4.8	<0.5	<0.5
Dichlorobenzene, 1,4-	0.083	<0.5	<0.5
Dichlorodifluoromethane	16	<1.0	<1.0
Dichloroethane, 1,1-	3.5	<0.5	<0.5
Dichloroethane, 1,2-	0.05	<0.5	<0.5
Dichloroethylene, 1,1-	0.05	<0.5	<0.5
Dichloroethylene, cis- 1,2-	3.4	<0.5	<0.5
Dichloroethylene, trans- 1,2-	0.084	<0.5	<0.5
Dichloropropane, 1,2-	0.05	<0.5	<0.5
Dichloropropene, 1,3-	0.05	<0.5	<0.5
Ethylbenzene	2	<0.5	<0.5
Ethylene Dibromide	0.05	<0.2	<0.2
Hexane, n-	2.8	<1.0	<1.0
Methyl Ethyl Ketone	16	<5.0	<5.0
Methyl Isobutyl Ketone	1.7	<5.0	<5.0
Methyl tert-butyl ether	0.75	<2.0	<2.0
Methylene Chloride	0.1	<5.0	<5.0
Styrene	0.7	<0.5	<0.5
Tetrachloroethane, 1,1,1,2-	0.058	<0.5	<0.5
Tetrachloroethane, 1,1,2,2-	0.05	<0.5	<0.5
Tetrachloroethylene	0.28	<0.5	<0.5
Toluene	2.3	<0.5	<0.5
Trichloroethane, 1,1,1-	0.38	<0.5	<0.5
Trichloroethane, 1,1,2-	0.05	<0.5	<0.5
Trichloroethylene	0.061	<0.5	<0.5
Trichlorofluoromethane	4	<1.0	<1.0
Vinyl Chloride	0.02	<0.5	<0.5
Xylene Mixture	3.1	<0.5	<0.5

Table 11 Groundwater Analytical Results - PAHs

Parameter		BH19-4	DUP	BH19-6
Date of Collection	Table 3 RPI CT	Nov 04, 2019	Nov 04, 2019	Nov 04, 2019
Date Reported		Nov 12, 2019	Nov 12, 2019	Nov 12, 2019
Screened Depth (mbgs)		4.5 - 7.5	4.5 - 7.5	4.6 - 7.9
Acenaphthene	7.9	<0.05	<0.05	<0.05
Acenaphthylene	0.15	<0.05	<0.05	<0.05
Anthracene	0.67	<0.01	<0.01	<0.01
Benz(a)anthracene	0.5	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.3	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.78	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	6.6	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	0.78	<0.05	<0.05	<0.05
Chrysene	7	<0.05	<0.05	<0.05
Dibenz(a,h)anthracene	0.1	<0.05	<0.05	<0.05
Fluoranthene	0.69	<0.01	<0.01	<0.01
Fluorene	62	<0.05	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	0.38	<0.05	<0.05	<0.05
Methyl Naphthalene, 2-and 1-	0.99	<0.10	<0.10	<0.10
Naphthalene	0.6	<0.05	<0.05	<0.05
Phenanthrene	6.2	<0.05	<0.05	<0.05
Pyrene	78	<0.01	<0.01	<0.01

Table 12 Summary of Maximum Concentrations in Soil

Group	Parameter	Table 3 RPI CT	Maximum Concentration	Location
Metals	Arsenic	18	6.1	BH12-3-SS2
	Barium	390	359	BH19-4-SS2
	Beryllium	4	0.7	BH19-4-SS2
	Boron	120	11.5	BH19-8-SS8
	Chromium	160	118	BH19-4-SS2
	Cobalt	22	21.5	BH19-4-SS2
	Copper	140	54.3	BH19-4-SS2
	Lead	120	61.4	BH19-10-SS8
	Mercury	0.27	0.013	BH12-3-SS2
	Molybdenum	6.9	3.8	BH12-3-SS2
	Nickel	100	62.8	BH19-4-SS2
	Vanadium	86	104	BH19-4-SS2
	Zinc	340	121	BH19-4-SS2
PHCs	F1 (C6 to C10) minus BTEX	55	27	BH19-6-SS3
	F3 (C16 to C34)	300	117	BH12-3-SS5
	F4 (C34 to C50)	2800	123	BH19-6-SS3
PAHs	Acenaphthene	7.9	0.253	BH12-3-SS4
	Anthracene	0.67	0.13	BH12-3-SS4
	Benz(a)anthracene	0.5	0.314	BH12-3-SS4
	Benzo(a)pyrene	0.3	0.279	BH12-3-SS4
	Benzo(b/j)fluoranthene	0.78	0.28	BH12-3-SS4
	Benzo(ghi)perylene	6.6	0.167	BH12-3-SS4
	Benzo(k)fluoranthene	0.78	0.251	BH12-3-SS4
	Chrysene	7	0.337	BH12-3-SS4
	Dibenz(a,h)anthracene	0.1	0.03	BH19-6-DUP
	Fluoranthene	0.69	0.671	BH12-3-SS4
	Fluorene	62	0.14	BH12-3-SS4
	Indeno(1,2,3-cd)pyrene	0.38	0.186	BH12-3-SS4
	1-Methylnaphthalene	0.99	0.177	BH12-3-SS4
PAHs	2-Methylnaphthalene	0.99	0.111	BH12-3-SS4
	Naphthalene	0.6	0.388	BH12-3-SS4
	Phenanthrene	6.2	0.38	BH19-6-DUP
	Pyrene	78	0.511	BH12-3-SS4
	Methylnaphthalene, 2-(1-)	0.99	0.288	BH12-3-SS4

All other parameters below laboratory detection limits

Table 13 Summary of Maximum Concentrations in Groundwater

Group	Parameter	Table 3 RPI CT	Maximum Concentration	Location
Metals	Barium	390	236	BH19-6
	Boron	120	72	BH19-4
	Cobalt	22	0.9	BH19-6
	Copper	140	0.5	BH19-6
	Molybdenum	6.9	3.3	BH19-6
	Nickel	100	2	BH19-6
	Uranium	23	0.3	BH19-6
	Zinc	340	6	BH19-4
	Sodium	NA	651000	BH19-6

All other parameters below laboratory detection limits

APPENDIX

A PLAN OF SURVEY OF PHASE TWO PROPERTY

SKETCH SHOWING
BOREHOLE AND MONITORING WELL LOCATIONS

FOR
NEW STUDENT RESIDENCE
CARLETON UNIVERSITY
CITY OF OTTAWA

SCALE 1 : 200

0 5 10 20 metres

FAIRHALL, MOFFATT & WOODLAND LIMITED
ONTARIO LAND SURVEYORS

NOTE:

ELEVATIONS SHOWN HEREON ARE REFERRED TO GEODETIC DATUM (CGVD28).

DATE OF SURVEY: NOVEMBER 06, 2019

- CB – CATCH BASIN
- WMH – WATER MANHOLE
- MH – MANHOLE
- WV – WATER VALVE
- FH – FIRE HYDRANT
- BHOL – BORE HOLE
- (W) – MONITORING WELL
- – SIGN
- – BOLLARD
- LS – LAMP STANDARD
- – CONIFEROUS TREE
- – DECIDUOUS TREE

JOB BENCH MARK #2
BOLT ON LAMP STANDARD
BASE ELEV. = 65.92

JOB BENCH MARK #1
BOLT ON LAMP STANDARD
BASE ELEV. = 63.36

Parking Garage (Concrete Notes)
Overhang
Pillar
Curb
Grass
Concrete Island
Bottom of Bank
Top of Bank
65.27 BHOL
65.61 BHOL
66.44 (W)
65.51 BHOL
64.74 (W)
64.54 BHOL
64.29 BHOL
63.90 BHOL
65.40 (W)
64.40 BHOL
C.B
MH
LS

APPENDIX

B SAMPLING AND ANALYSIS PLAN

Soil								
Sample Location	**Proposed Borehole Depth (mbgs)**	**Type**	**Reg 153 Metals and Inorganics (1 x 250 ml jar)**	**Reg 153 VOCs (1 x methanol vial and 1 x 120 ml jar)**	**Reg 153 PAHs (1 x 250 ml jar)**	**Reg 153 PHC F1-F4 and BTEX (1 x 120 ml jar and x 1 methanol vial)**	**Comments / Sampling Rationale**	**APEC #**
			Submit	**Submit**	**Submit**	**Submit**		
BH19-2-SS5	11.4 (to bedrock)	BH	1	1	1	1	Hydrocarbon odour noted during field program.	**1,2**
BH19-4-SS2	7.6	BH	1	1	1	1	Assessment of upper fill material.	**1,2**
BH19-6-SS3	11.1	BH	1	1	1 (plus 1 dup)	1	Assessment of upper fill material.	**1,2**
BH19-6-SS8	11.1	BH		1	1	1	Assessment of deeper fill/native interface.	**1,2**
BH19-8-SS8	15.5		1	1	1	1	Assessment of deeper fill material.	**1**
BH19-10-SS8	12.6	BH	1	1	1	1	Sample with 10 ppm vapour reading.	**1,2**
BH19-10-SS10	12.6	BH	1	1			Assessment of native material.	**1,2**
Blind Field Duplicates					**1**			
TOTALS			**6**	**7**	**6**	**6**		

Sample Location	APEC	Groundwater					Environmental Investigation Notes
		Monitoring Well Depth (mbgs)	Reg 153 Metals and Inorganics	Reg 153 VOCs	PAHs	Reg 153 PHC F1-F4	
BH19-4	APEC1	7.5	1 (plus 1 dup)		1 (plus 1 dup)	1 (plus 1 dup)	Water may be silty. Develop/purge wells one week before sampling. Sample using peristaltic pump, at a low flow rate to avoid silty water.
BH19-6	APEC1, APEC2	7.9	1	1	1	1	
BH19-10	APEC1, APEC2	7.6		1		1	
Blind Field Duplicates			1		1	1	
TOTALS			2	2	2	3	

APPENDIX

C BOREHOLE LOGS

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE 12-3

PROJECT: Carleton University Northern Property Development
CLIENT: Carleton University
PROJECT LOCATION: Parking Lots P-6 and P-7
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Hollow Stem Auger/Coring
Diameter: 203mm/N size core
Date: Dec/01/2012

REF. NO.: 1405-710/720
ENCL NO.:

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (50 100 150 200 250)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
65.6											
0.0 / 65.0	Topsoil, some sand, some gravel, organics, brown, frozen, stiff (Fill)		1	SS	9		Sand				
0.6 / 63.8	Silty Sand, gravelly, trace organics, brown, damp, compact (Fill)		2	SS	15		65				24 48 28
			3	SS	24		64				
1.8 / 62.6	Silty Sand and Gravel, trace brick and slag fragments, moist, compact (Fill)		4	SS	20						44 26 30
			5	SS	14		63				28 43 29
3.0 / 61.0	Silty Clay, trace sand, grey, firm (Fill)		6	SS	7		Cuttings				
4.6 / 59.5	Silty Sand and Gravel, brown, moist, compact (Fill)		7	SS	26		61				
							60				
							W. L. 195.5 m Dec 18, 2012				
6.1 / 58.0	Gravel and Sand, trace silt, brown, wet, very dense (Till)		8	SS	54		59				52 38 10
7.6 / 56.5	Silty sand, trace gravel, brown, wet, compact (Till)		9	SS	13		58 Bentonite				
							57				
9.1	Silty Sand, some gravel, brown, wet, dense (Till)		10	SS	33		56				19 59 22

Continued Next Page

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

SPL SOIL LOG CARLETON UNIVERSITY NORTH PROPERTY DEVELOPMENT.GPJ SPL.GDT 3/4/13

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE 12-3

PROJECT: Carleton University Northern Property Development
CLIENT: Carleton University
PROJECT LOCATION: Parking Lots P-6 and P-7
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Hollow Stem Auger/Coring
Diameter: 203mm/N size core
Date: Dec/01/2012

REF. NO.: 1405-710/720
ENCL NO.:

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (50 100 150 200 250)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
54.9	Silty Sand, some gravel, brown, wet, dense (Till)						Sand Screen					
10.7	Silty Sand, trace gravel, grey, wet, compact (Till)		11	SS	17				○			1 83 16
53.6	- Auger Refusal at 12.0 m. Switched to coring.						54					
12.0	Fresh to slightly weathered, very closely bedded shale with limestone partings. Completely fractured. TCR = 39% SCR = 31% RQD = 0%		RC 1	CORE			53					
52.0							Bentonite					
13.6	Fresh to slightly weathered, very closely bedded shale with limestone partings. Completely fractured. TCR = 93% SCR = 16% RQD = 16%		RC 2	CORE			52					
51.0							51					
14.6	END OF BOREHOLE											

Waterlevels:

Date	Depth
Dec 18th, 2012	6.0 m

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

SPL SOIL LOG CARLETON UNIVERSITY NORTH PROPERTY DEVELOPMENT.GPJ SPL.GDT 3/4/13

BOREHOLE DRILLING RECORD : 19-01

Prepared by:
Reviewed by:

Date (Start): **2019-10-23**
Date (End): **2019-10-23**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367595.99354 mE
Y = 5027711.34136 mN
Surface Elevation: 65.51 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: CCC
Drilling Equipment: CME 850
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Auger Sample

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
		Ground surface.												
0.08 65.43		**ASPHALT-** 80 mm				AS								
0.5		**SILTY SAND AND GRAVEL,** trace clay, brown, moist, loose to compact (FILL)												0.5
1.0			I - 0, H - 0			SS	25	3 4 3 3	SS1					1.0
1.5			I - 0, H - 0			SS	25	5 4 24 13	SS2					1.5
2.0														2.0
2.30 63.21		**SILTY CLAY,** grey, moist, stiff (FILL)	I - 0, H - 0			SS	75	4 2 3 3	SS3					2.5
3.0			I - 0, H - 0			SS	60	WH 1 1 1	SS4					3.0
3.5														3.5
3.80 61.71		**SAND AND GRAVEL,** cobbles and boulder infered, some silt, brown, moist, very dense	I - 0, H - 0			SS	75	4 31 50/100 mm	SS5					4.0
4.5														4.5
5.0			I - 0, H - 0			SS	50	13 50/150 mm	SS6					5.0
5.5			I - 0, H - 0			SS	0	50/75 mm	SS7					5.5
6.0														6.0
6.10 59.41		**SILTY SAND AND GRAVEL,** trace clay, grey, moist (GLACIAL TILL)	I - 0, H - 0			SS	50	WH 9 11 9	SS8					6.5
		- wet below 6.8 m												
7.0			I - 0, H - 0			SS	66	2 7 8 11	SS9					7.0
7.5														7.5
8.0			I - 0, H - 0			SS	50	6 11 15	SS10					8.0

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

BOREHOLE DRILLING RECORD : 19-01

Prepared by:
Reviewed by:

Date (Start): **2019-10-23**
Date (End): **2019-10-23**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367595.99354 mE
Y = 5027711.34136 mN
Surface Elevation: 65.51 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: CCC
Drilling Equipment: CME 850
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Auger Sample

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
		PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Inorganics	Inorganic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Phenol. C.	Phenolic Compounds	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
VOC	Volatil Organic Compounds (MAH & CAH)	HWR	Leacheate Tests (Haz. Waste Reg.)
Diox. & Fur.	Dioxins & Furans		
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
								12						
8.5		**SILTY SAND AND GRAVEL**, trace clay, grey, moist (GLACIAL TILL)	I - 0, H - 0			SS	40	27 10 14 11	SS11					
9.0														
9.5			I - 0, H - 0			SS	75	3 7 8 9	SS12					
10.0														
10.5 *55.01*		***END OF BOREHOLE*** *1) Auguer refusal at 10.5 m in depth* End of borehole at 10.50 m.												
11.0														
11.5														
12.0														
12.5														
13.0														
13.5														
14.0														
14.5														
15.0														
15.5														
16.0														

BOREHOLE DRILLING RECORD : 19-02

Prepared by:
Reviewed by:

Date (Start): **2019-10-23**
Date (End): **2019-10-23**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367614.35896 mE
Y = 5027722.24575 mN
Surface Elevation: 65.61 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: CCC
Drilling Equipment: CME 850
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

DEPTH ELEVATION (m)	GEOLOGY / LITHOLOGY: LITHOLOGY	GEOLOGY / LITHOLOGY: DESCRIPTION	OBSERVATIONS: VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	OBSERVATIONS: ODOUR (F M P)	OBSERVATIONS: VISUAL (D S)	SAMPLES: SAMPLE TYPE	SAMPLES: % RECOVERY	SAMPLES: N (Blow/6")	SAMPLES: NUMBER	SAMPLES: ANALYSIS	SAMPLES: DUPLICATE	MONITORING WELL: DIAGRAM	MONITORING WELL: DESCRIPTION	REMARKS
		Ground surface.												
0.08 / 65.53		**ASPHALT-** 75 mm												
		SILTY SAND AND GRAVEL, trace clay, brown, moist, loose to very dense (FILL)				AS								
			I - 0, H - 0			SS	60	3 8 50/125 mm	SS1					
			I - 0, H - 0			SS	10	31 6 3 6	SS2					
			I - 0, H - 15			SS	75	4 3 2 3	SS3					
3.05 / 62.56		**SILTY CLAY,** grey, moist, stiff (FILL)	I - 0, H - 0			SS	50	1 1 2 2	SS4	Metals PHCs F1-F4 VOC PAH				
		- rock fragments below 3.8 m in depth	I - 0, H - 15			SS	60	3 2 6 32	SS5					
4.60 / 61.01		**SAND AND GRAVEL,** cobbles and boulder infered, some silt, brown, moist, very dense	I - 0, H - 0			SS	40	10 36 50/75 mm	SS6					
			I - 0, H - 0			SS	10	50 50/75 mm	SS7					
			I - 0, H - 0			SS	100	5 4 16 16	SS8					
6.90 / 58.71		**SILTY SAND AND GRAVEL,** trace clay, grey, moist (GLACIAL TILL)	I - 0, H - 0			SS	100	11 15 17 16	SS9					

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

BOREHOLE DRILLING RECORD : 19-02

Prepared by:
Reviewed by:

Date (Start): **2019-10-23**
Date (End): **2019-10-23**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367614.35896 mE
Y = 5027722.24575 mN
Surface Elevation: 65.61 m *(Geodetic)*
Top of PVC Elevation:

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Drilling Equipment: CME 850
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
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Inorganics	Inorganic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Phenol. C.	Phenolic Compounds	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
VOC	Volatil Organic Compounds (MAH & CAH)	HWR	Leacheate Tests (Haz. Waste Reg.)
Diox. & Fur.	Dioxins & Furans		
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexaine (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	DIAGRAM	DESCRIPTION	REMARKS
8.5		**SILTY SAND AND GRAVEL**, trace clay, grey, moist (GLACIAL TILL)	I - 0, H - 0			SS	100	10 17 16 15	SS10					8.5
9.0														9.0
9.5														9.5
10.0			I - 0, H - 0			SS	100	11 18 28 26	SS11					10.0
10.5														10.5
11.0														11.0
11.40 *54.21*														
11.5		**SHALE**, black, fresh												11.5
12.0														12.0
12.5														12.5
13.0														13.0
13.5														13.5
14.0		←*Run 1: 14.1 m - 14.6 m* *TCR - 100%* *SCR - 45%* *RQD- 25%*												14.0
14.5														14.5
15.0		*Run 2: 14.6 m - 16.5 m* *TCR - 66%* *SCR - 17%* *RQD- 0%*												15.0
15.5														15.5
16.0														16.0

BOREHOLE DRILLING RECORD : 19-02

Prepared by:
Reviewed by:

Date (Start): **2019-10-23**
Date (End): **2019-10-23**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367614.35896 mE
Y = 5027722.24575 mN
Surface Elevation: 65.61 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: CCC
Drilling Equipment: CME 850
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
		PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Inorganics	Inorganic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Phenol. C.	Phenolic Compounds	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
VOC	Volatil Organic Compounds (MAH & CAH)	HWR	Leacheate Tests (Haz. Waste Reg.)
Diox. & Fur.	Dioxins & Furans		
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	OBSERVATIONS: VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLES: SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL: DIAGRAM	DESCRIPTION	REMARKS
16.20 *49.41*		**LIMESTONE** with shale partings, fresh to slightly weathered, grey Run 3: 16.2 m - 17.8 m TCR - 87% SCR - 87% RQD- 87% Run 4: 17.8 m - 19.3 m TCR - 100% SCR - 100% RQD- 100%												
19.30 *46.31*	Refusal	***END OF BOREHOLE*** *1) Auger refusal at 14.1 m in depth. Switch to NQ coring.* *2) Coring completed at 19.3 m in depth.* End of borehole at 19.30 m.												

MONITORING WELL DRILLING RECORD : 19-04

Prepared by:
Reviewed by:

Date (Start): **2019-10-25**
Date (End): **2019-10-25**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367594.58573 mE
Y = 5027696.52546 mN
Surface Elevation: 64.74 m *(Geodetic)*
Top of PVC Elevation: 64.66 m *(Geodetic)*

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method:

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

Water Level
Free Phase

DEPTH ELEVATION (m)	GEOLOGY / LITHOLOGY: LITHOLOGY	GEOLOGY / LITHOLOGY: DESCRIPTION	OBSERVATIONS: VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	OBSERVATIONS: ODOUR (F M P)	OBSERVATIONS: VISUAL (D S)	SAMPLES: SAMPLE TYPE	SAMPLES: % RECOVERY	SAMPLES: N (Blow/6")	SAMPLES: NUMBER	SAMPLES: ANALYSIS	SAMPLES: DUPLICATE	MONITORING WELL: DIAGRAM	MONITORING WELL: DESCRIPTION	REMARKS
		Ground surface.												
0.04 64.70		**ASPHALT-** 38 mm												
		SILTY GRAVELLY SAND, light brown, damp to moist, compact (FILL)				GRAB								
1.35 63.39		**SILTY CLAY,** trace sand, trace organics, grey, moist (FILL)	I - 0, H - 0			SS	67	6 6 5 5	SS1				Bentonite Riser	
			I - 0, H - 0			SS	100	1 2 2 3	SS2	Metals PHCs F1-F4 VOC PAH				
2.90 61.84		**SILTY SAND AND GRAVEL,** to gravelly, cobbles and boulder infered, brown, moist, dense to very dense	I - 0, H - 0			SS	75	5 6 15 14	SS3				Cuttings and Bentonite	
			I - 0, H - 0			SS	67	22 19 40 50/100 mm	SS4				Bentonite	
			I - 0, H - 0			SS	21	50 50/75 mm	SS5				Sand	
			I - 0, H - 0			SS	42	29 28 15 12	SS6				Screen	
5.90 58.84		**SILTY SAND AND GRAVEL,** trace clay, grey, wet, compact to very dense (GLACIAL TILL)	I - 0, H - 0			SS	54	4 4 20 16	SS7				SCREEN Diam.: 51 mm Open.: 0.25 mm Length: 3.05 m WATER Depth: 4.51 m Elev.: 60.15 m Date: 2019-11-04	
			I - 0, H - 0			SS	38	3 4 8 10	SS8					
7.60 57.14		***END OF BOREHOLE*** *1) SPT refusal at 7.6 m in depth*	I - 0, H - 0			SS	4	50/75 mm	SS9					

MONITORING WELL DRILLING RECORD : **19-04**

Prepared by:
Reviewed by:

Date (Start): **2019-10-25**
Date (End): **2019-10-25**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367594.58573 mE
Y = 5027696.52546 mN
Surface Elevation: 64.74 m *(Geodetic)*
Top of PVC Elevation: 64.66 m *(Geodetic)*

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method:

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
Inorganics	Inorganic Compounds	PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Phenol. C.	Phenolic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
VOC	Volatil Organic Compounds (MAH & CAH)	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
Diox. & Fur.	Dioxins & Furans	HWR	Leacheate Tests (Haz. Waste Reg.)
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	GEOLOGY / LITHOLOGY: LITHOLOGY	GEOLOGY / LITHOLOGY: DESCRIPTION	OBSERVATIONS: VAPOR CONC. I - Isobutylene (ppm) H - Hexalene (ppm)	OBSERVATIONS: ODOUR (F M P)	OBSERVATIONS: VISUAL (D S)	SAMPLES: SAMPLE TYPE	SAMPLES: % RECOVERY	SAMPLES: N (Blow/6")	SAMPLES: NUMBER	SAMPLES: ANALYSIS	SAMPLES: DUPLICATE	MONITORING WELL: DIAGRAM	MONITORING WELL: DESCRIPTION	REMARKS
		2) 37.5 mm monitoring well installed at 7.5 m in depth *3) DATE — WATER LEVEL* *Nov 4, 2019 — 4.5 m*												
		End of borehole at 7.60 m.												

8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0

BOREHOLE DRILLING RECORD : 19-05

Prepared by:
Reviewed by:

Date (Start): **2019-10-22**
Date (End): **2019-10-22**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367626.86549 mE
Y = 5027698.39369 mN
Surface Elevation: 64.54 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

▽ Water Level ▼ Free Phase

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
		Ground surface.												
0.20 64.34		**TOPSOIL**	I - 0, H - 0			SS	21	6 6 5 5	SS1					
0.5		**SAND and GRAVEL (to gravelly),** dark brown, moist, very dense (FILL)												0.5
1.0			I - 0, H - 0			SS	83	45 40 30 26	SS2					1.0
1.50 63.04														
1.5		**SILTY SAND,** brown, moist (FILL)	I - 0, H - 0			SS	46	5 6 4 5	SS3					1.5
1.80 62.74		**SILTY SAND,** with organics, dark brown, moist (FILL)												
2.0														2.0
2.30 62.24		**SILTY CLAY,** mixed with organics, some sand, dark brown, moist, firm (FILL)	I - 0, H - 0			SS	92	2 1 3 3	SS4					
2.5														2.5
3.05 61.49		**SAND and GRAVEL,** some silt to silty, brown, moist, compact to very dense	I - 0, H - 0			SS	38	6 4 8 20	SS5					
3.0														3.0
3.5														3.5
4.0			I - 0, H - 0			SS	67	20 42 43 46	SS6					4.0
4.5														4.5
5.0			I - 0, H - 0			SS	21	35 50/50 mm	SS7					5.0
5.30 59.24		**SILTY SAND AND GRAVEL,** trace clay, grey, wet (GLACIAL TILL)	I - 0, H - 0			SS	67	7 8 9 16	SS8					
5.5														5.5
6.0														6.0
6.5			I - 0, H - 0			SS	67	48 18 12 21	SS9					6.5
7.0			I - 0, H - 0			SS	33	10 16 22 37	SS10					7.0
7.5														7.5
8.0			I - 0, H - 0			SS	46	25 18 29	SS11					8.0

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

BOREHOLE DRILLING RECORD : 19-05

Prepared by:
Reviewed by:

Date (Start): 2019-10-22
Date (End): 2019-10-22

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367626.86549 mE
Y = 5027698.39369 mN
Surface Elevation: 64.54 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
		PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Inorganics	Inorganic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Phenol. C.	Phenolic Compounds	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
VOC	Volatil Organic Compounds (MAH & CAH)	HWR	Leacheate Tests (Haz. Waste Reg.)
Diox. & Fur.	Dioxins & Furans		
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
		SILTY SAND AND GRAVEL, trace clay, grey, wet (GLACIAL TILL)						50/150 mm						
8.5														8.5
9.0			I - 0, H - 0			SS	58	34 17 25 30	SS12					9.0
9.5														9.5
10.0														10.0
10.5														10.5
11.0														11.0
11.30 / 53.24		***END OF BOREHOLE***												
11.5		*1) Auguer refusal at 11.3 m in depth*												11.5
12.0		End of borehole at 11.30 m.												12.0
12.5														12.5
13.0														13.0
13.5														13.5
14.0														14.0
14.5														14.5
15.0														15.0
15.5														15.5
16.0														16.0

MONITORING WELL DRILLING RECORD : 19-06

Prepared by:
Reviewed by:

Date (Start): **2019-10-24**
Date (End): **2019-10-24**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367633.97251 mE
Y = 5027721.49501 mN
Surface Elevation: 66.44 m *(Geodetic)*
Top of PVC Elevation: 67.24 m *(Geodetic)*

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

▽ Water Level ▼ Free Phase

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	DIAGRAM	DESCRIPTION	REMARKS
		Ground surface.												
0.13 66.32		**TOPSOIL -** 125 mm	I - 0, H - 0			SS	71	4 10 12 30	SS1					
		SILTY SAND AND GRAVEL, brown, moist, loose to compact (FILL)												
			I - 0, H - 0			SS	75	13 15 11 21	SS2					
			I - 0, H - 0			SS	71	7 10 10 9	SS3	Metals PHCs F1-F4 VOC PAH	DUP		Bentonite	
			I - 0, H - 0			SS	71	8 7 7 6	SS4				Riser	
			I - 0, H - 0			SS	42	7 9 12 8	SS5					
			I - 0, H - 0			SS	50	19 6 5 5	SS6				Sand	
			I - 0, H - 0			SS	38	2 2 3 2	SS7					
			I - 0, H - 0			SS	63	3 6 11 9	SS8	PHCs F1-F4 VOC PAH			Screen	
6.10 60.34		**SILTY SAND,** some gravel to gravelly, trace clay, grey, wet, compact to very dense (GLACIAL TILL)	I - 0, H - 0			SS	42	9 11 50/75 mm	SS9				SCREEN Diam.: 51 mm Open.: 0.25 mm Length: 3.05 m WATER Depth: 6.69 m Elev.: 60.55 m Date: 2019-11-04	
			I - 0, H - 0			SS	29	16 50/125 mm	SS10					
			I - 0, H - 0			SS	58	3 10 13	SS11					

MONITORING WELL DRILLING RECORD : **19-06**

Prepared by:
Reviewed by:

Date (Start): **2019-10-24**
Date (End): **2019-10-24**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367633.97251 mE
Y = 5027721.49501 mN
Surface Elevation: 66.44 m *(Geodetic)*
Top of PVC Elevation: 67.24 m *(Geodetic)*

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
		PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Inorganics	Inorganic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Phenol. C.	Phenolic Compounds	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
VOC	Volatil Organic Compounds (MAH & CAH)	HWR	Leacheate Tests (Haz. Waste Reg.)
Diox. & Fur.	Dioxins & Furans		
CAH	Chlorinated Aliphatic Hydrocarbons		

▽ Water Level ▼ Free Phase

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
								16						
8.5		**SILTY SAND,** some gravel to gravelly, trace clay, grey, wet, compact to very dense (GLACIAL TILL)												
9.0			I - 0, H - 0			SS	83	9 12 13 15	SS12					
9.5														
10.0														
10.5			I - 0, H - 0			SS	13	50/75 mm	SS13					
11.0		***END OF BOREHOLE***												
11.10 / *55.34*		*1) Auguer refusal at 11.1 m in depth* *2) 37.5 mm monitoring well installed at 7.9 m in depth* *3) DATE — WATER LEVEL* *Nov 4, 2019 — 6.7 m* End of borehole at 11.10 m.												
11.5														
12.0														
12.5														
13.0														
13.5														
14.0														
14.5														
15.0														
15.5														
16.0														

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

BOREHOLE DRILLING RECORD : 19-07

Prepared by:
Reviewed by:

Date (Start): 2019-10-27
Date (End): 2019-10-27

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367640.47871 mE
Y = 5027688.21778 mN
Surface Elevation: 64.29 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

Water Level
Free Phase

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
		Ground surface.												
0.15 64.14		**TOPSOIL -** 150 mm				SS	2	3 6 5 7	SS1					
0.5		**SILTY SAND** gravelly to trace gravel, brown, moist, dense to very dense (FILL)				SS	54	29 35 23 22	SS2					
1.0						SS	79	5 8 27 17	SS3					
1.5														
2.0														
2.30 61.99														
2.5		**SILTY SAND** with organics, dark brown, moist (FILL)				SS	8	7 3 4 4	SS4					
2.60 61.69														
3.0		**SILTY CLAY,** with gravel, trace sand, trace organics, grey, moist (FILL)												
3.05 61.24						SS	58	12 9 11 15	SS5					
3.5		**SILTY SAND AND GRAVEL,** brown, moist, compact												
3.80 60.49														
4.0		**ROCK FRAGMENTS**				SS	46	49 40 56 59	SS6					
4.5														
5.0						SS	38	3 38 49 28	SS7					
5.30 58.99														
5.5		**SILTY SAND AND GRAVEL,** trace clay, grey, wet, compact to very dense (GLACIAL TILL)				SS	33	13 32 14 8	SS8					
6.0														
6.5						SS	8	9 12 21 17	SS9					
7.0														
7.5						SS	58	28 26 12 5	SS10					
8.0														
						SS	29	5 11 12	SS11					

BOREHOLE DRILLING RECORD : 19-07

Prepared by:
Reviewed by:

Date (Start): 2019-10-27
Date (End): 2019-10-27

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367640.47871 mE
Y = 5027688.21778 mN
Surface Elevation: 64.29 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level
Free Phase

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

DEPTH ELEVATION (m)	GEOLOGY / LITHOLOGY: LITHOLOGY	GEOLOGY / LITHOLOGY: DESCRIPTION	OBSERVATIONS: VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	OBSERVATIONS: ODOUR (F M P)	OBSERVATIONS: VISUAL (D S)	SAMPLES: SAMPLE TYPE	SAMPLES: % RECOVERY	SAMPLES: N (Blow/6")	SAMPLES: NUMBER	SAMPLES: ANALYSIS	SAMPLES: DUPLICATE	MONITORING WELL: DIAGRAM	MONITORING WELL: DESCRIPTION	REMARKS
								18						
8.40 / 55.89		**ROCK FRAGMENTS,**(Shale fragments with occasional granite fragments) (GLACIAL TILL)				SS	29	16 17 17 12	SS12					
						SS	8	3 6 10 5	SS13					
						SS	21	15 15 16 10	SS14					
						SS	29	9 21 17 16	SS15					
						SS	33	11 50 50	SS16					
11.80 / 52.49		**LIMESTONE** with shale partings, fresh to slightly weathered, grey *Run 1: 11.8 m - 12.4 m* *TCR - 9"* *Run 2: 12.4 m - 13.8 m* *TCR - 34%*				CORE								
		Run 3: 13.8 m - 15.4 m *TCR - 55"* *RQD - 91%*				CORE								
		Run 4: 15.4 m - 17.0 m *TCR - 100%* *RQD - 33%*				CORE								

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

BOREHOLE DRILLING RECORD : 19-07

Prepared by:
Reviewed by:

Date (Start): **2019-10-27**
Date (End): **2019-10-27**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367640.47871 mE
Y = 5027688.21778 mN
Surface Elevation: 64.29 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
Inorganics	Inorganic Compounds	PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Phenol. C.	Phenolic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
VOC	Volatil Organic Compounds (MAH & CAH)	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
Diox. & Fur.	Dioxins & Furans	HWR	Leacheate Tests (Haz. Waste Reg.)
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	OBSERVATIONS: ODOUR (F M P)	OBSERVATIONS: VISUAL (D S)	SAMPLES: SAMPLE TYPE	SAMPLES: % RECOVERY	SAMPLES: N (Blow/6")	SAMPLES: NUMBER	SAMPLES: ANALYSIS	SAMPLES: DUPLICATE	MONITORING WELL: DIAGRAM	MONITORING WELL: DESCRIPTION	REMARKS
		LIMESTONE with shale partings, fresh to slightly weathered, grey												
		Run 5: 17.0 m - 17.4 m *TCR - 100%* *RQD - 67%*				CORE								
		Run 6: 17.4 m - 18.6 m *TCR - 100%* *RQD - 97%*				CORE								
18.60 *45.69*	Refusal	*End of borehole* End of borehole at 18.60 m.												

16.5 17.0 17.5 18.0 18.5 19.0 19.5 20.0 20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

BOREHOLE DRILLING RECORD : 19-08

Prepared by:
Reviewed by:

Date (Start): **2019-10-24**
Date (End): **2019-10-24**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = mE
Y = mN
Surface Elevation: m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

Water Level
Free Phase

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
		Ground surface.												
0.18		**TOPSOIL -** 175 mm	I - 0, H - 0			SS	79	3 7 8 26	SS1					
		SILTY SAND AND GRAVEL (to gravelly), dark brown, moist, compact (FILL)												
0.5														0.5
			I - 0, H - 0			SS	58	20 14 12 13	SS2					
1.0														1.0
1.5			I - 0, H - 0			SS	54	8 15 7 2	SS3					1.5
2.0														2.0
2.30														
2.5		**SILTY CLAY,** moist, firm (FILL)	I - 0, H - 0			SS	38	4 4 4 6	SS4					2.5
2.60		**SILTY SAND and GRAVEL (rock fragments),** brown, wet, compact to very dense												
3.0														3.0
			I - 0, H - 0			SS	46	5 19 28 50	SS5					
3.5														3.5
4.0			I - 0, H - 0			SS	54	15 57 66 62	SS6					4.0
4.5														4.5
			I - 0, H - 0			SS	25	5 22 10 7	SS7					
5.0														5.0
			I - 0, H - 0			SS	42	6 19 10 11	SS8	Metals PHCs F1-F4 VOC PAH				
5.5														5.5
6.0														6.0
			I - 0, H - 0			SS	8	17 13 18 16	SS9					
6.5														6.5
7.0			I - 0, H - 0			SS	58	44 55	SS10					7.0
7.5														7.5
7.60														
			I - 0, H - 0			SS	21	32 43 38	SS11					
8.0														8.0

BOREHOLE DRILLING RECORD : 19-08

Prepared by:
Reviewed by:

Date (Start): **2019-10-24**
Date (End): **2019-10-24**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = mE
Y = mN
Surface Elevation: m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
Inorganics	Inorganic Compounds	PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Phenol. C.	Phenolic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
VOC	Volatil Organic Compounds (MAH & CAH)	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
Diox. & Fur.	Dioxins & Furans	HWR	Leacheate Tests (Haz. Waste Reg.)
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
								46						
8.5		**SILTY SAND,** some gravel to gravelly, trace clay, grey, wet, compact to very dense (GLACIAL TILL)	I - 0, H - 0			SS	13	14 15 14 25	SS12					
9.0														
9.5			I - 0, H - 0			SS	75	15 27 31 36	SS13					
9.90														
10.0		**GRAVEL SIZED ROCK FRAGMENTS,** trace to some sand, sized fragments,	I - 0, H - 0			SS	17	11 55 98 46	SS14					
10.5														
10.70														
11.0		**LIMESTONE** with shale partings, fresh to slightly weathered, grey Run1: 10.7 m - 11.9 m TCR - 40% RQD - 7%				CORE								
11.5														
12.0		←*Run 2: 11.9 - 12.5*				CORE								
12.5		←*Run 3: 12.5 m - 13.9 m*				CORE								
13.0														
13.5														
14.0		←*Run 4: 13.9 m - 15.5 m*				CORE								
14.5														
15.0														
15.50		←***END OF BOREHOLE***												
15.5	Refusal	*1) Auguer refusal at 10.7 m in depth.*												
16.0														

BOREHOLE DRILLING RECORD : 19-08

Prepared by:
Reviewed by:

Date (Start): **2019-10-24**
Date (End): **2019-10-24**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = mE
Y = mN
Surface Elevation: m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: Water
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level
Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
Inorganics	Inorganic Compounds	PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Phenol. C.	Phenolic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
VOC	Volatil Organic Compounds (MAH & CAH)	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
Diox. & Fur.	Dioxins & Furans	HWR	Leacheate Tests (Haz. Waste Reg.)
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	GEOLOGY / LITHOLOGY: LITHOLOGY	GEOLOGY / LITHOLOGY: DESCRIPTION	OBSERVATIONS: VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	OBSERVATIONS: ODOUR (F M P)	OBSERVATIONS: VISUAL (D S)	SAMPLES: SAMPLE TYPE	SAMPLES: % RECOVERY	SAMPLES: N (Blow/6")	SAMPLES: NUMBER	SAMPLES: ANALYSIS	SAMPLES: DUPLICATE	MONITORING WELL: DIAGRAM	MONITORING WELL: DESCRIPTION	REMARKS
16.5		*Switch to NQ coring* *2) Borehole terminated at 15.5 m in depth*												
		End of borehole at 15.50 m.												
17.0														
17.5														
18.0														
18.5														
19.0														
19.5														
20.0														
20.5														
21.0														
21.5														
22.0														
22.5														
23.0														
23.5														
24.0														

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

BOREHOLE DRILLING RECORD : 19-09

Prepared by:
Reviewed by:

Date (Start): **2019-10-22**
Date (End): **2019-10-22**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367632.18573 mE
Y = 5027684.16079 mN
Surface Elevation: 63.9 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

Water Level
Free Phase

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
		Ground surface.												
0.20 *63.70*		**TOPSOIL -** 200 mm				SS	63	1 3 5 10	SS1					
		SILTY SAND, with possible boulder/cobble, some gravel, trace clay, brown, moist. loose to dense (FILL)				SS	50	36 32 19 20	SS2					
						SS	50	12 9 5 5	SS3					
						SS	50	1 8 9 18	SS4					
						SS	100	28 36 37 28	SS5					
						SS	33	21 50/75 mm	SS6					
4.60 *59.30*		**SILTY SAND AND GRAVEL,** trace clay, grey, wet, loose to very dense (GLACIAL TILL)				SS	50	5 7 12 15	SS7					
						SS	8	1 1 1 1	SS8					
						SS	50	2 6 8 6	SS9					
						SS	50	WH 2 3	SS10					

BOREHOLE DRILLING RECORD : 19-09

Prepared by:
Reviewed by:

Date (Start): **2019-10-22**
Date (End): **2019-10-22**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367632.18573 mE
Y = 5027684.16079 mN
Surface Elevation: 63.9 m *(Geodetic)*
Top of PVC Elevation:

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

▽ Water Level ▼ Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
		PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Inorganics	Inorganic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Phenol. C.	Phenolic Compounds	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
VOC	Volatil Organic Compounds (MAH & CAH)	HWR	Leacheate Tests (Haz. Waste Reg.)
Diox. & Fur.	Dioxins & Furans		
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
								4						
8.5		**SILTY SAND AND GRAVEL**, trace clay, grey, wet, loose to very dense (GLACIAL TILL)				SS	8	5 6 11 11	SS11					
9.0														
9.5						SS	13	4 6 4 3	SS12					
10.0						SS	79	8 10 8 18	SS13					
10.5														
11.0						SS	79	9 19 25 31	SS14					
11.5						SS	71	15 23 38 39	SS15					
12.0														
12.5						SS	100	16 20 22 50	SS16					
12.60 *51.30*		***END OF BOREHOLE***												
13.0		*1) Auguer refusal at 12.6 m in depth*												
13.5		End of borehole at 12.60 m.												
14.0														
14.5														
15.0														
15.5														
16.0														

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

MONITORING WELL DRILLING RECORD : **19-10**

WSP

Prepared by:
Reviewed by:

Date (Start): **2019-10-22**
Date (End): **2019-10-22**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367651.57696 mE
Y = 5027678.51017 mN
Surface Elevation: 65.4 m *(Geodetic)*
Top of PVC Elevation: 66.25 m *(Geodetic)*

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

Water Level ▽ Free Phase

CHEMICAL ANALYSIS
PCB Poly-Chlorinated Biphenyls
BTEX Benzene, Toluene, Ethylbenzene, Xylene
Inorganics Inorganic Compounds
Phenol. C. Phenolic Compounds
VOC Volatil Organic Compounds (MAH & CAH)
Diox. & Fur. Dioxins & Furans
CAH Chlorinated Aliphatic Hydrocarbons
SVOC Semi Volatile Organic Compounds
PAH Polycyclic Aromatic Hydrocarbons
PH C_{10}-C_{50} Petroleum Hydrocarbons C_{10}-C_{50}
PH F1-F4 Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
Metals Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
HWR Leacheate Tests (Haz. Waste Reg.)

DEPTH / ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
		Ground surface.												
0.15 / 65.25		**TOPSOIL -** 150 mm	I - 0, H - 0			SS	83	1 4 7 15	SS1					
		SAND, some silty to silty, trace gravel to gravelly, brown, moist. compact to dense (FILL)												
			I - 0, H - 0			SS	92	15 15 22 14	SS2					
			I - 0, H - 0			SS	67	7 8 8 10	SS3				Bentonite	
			I - 0, H - 0			SS	92	8 20 13 8	SS4				Riser	
			I - 0, H - 0			SS	13	17 13 6 13	SS5					
3.80 / 61.60		**SILTY SAND AND GRAVEL** trace clay, grey, wet, loose to very dense (FILL) *- Metalic fragments noted at 3.8 m in depth*	I - 0, H - 0			SS	67	25 39 50/125 mm	SS6				Sand	
			I - 3, H - 10			SS	46	32 50/100 mm	SS7					
			I - 3, H - 10			SS	71	8 17 18 14	SS8	Metals PHCs F1-F4 VOC PAH			Screen	
			I - 0, H - 0			SS	58	5 6 3 5	SS9				SCREEN Diam.: 51 mm Open.: 0.25 mm Length: 3.05 m WATER Depth: 5.85 m Elev.: 60.40 m Date: 2019-11-04	
6.90 / 58.50		**SILTY SAND AND GRAVEL** trace clay, grey, wet, loose to compact (GLACIAL TILL)	I - 0, H - 0			SS	13	3 2 7 7	SS10	Metals VOC				
			I - 0, H - 0			SS	25	14 3 3	SS11					

MONITORING WELL DRILLING RECORD : **19-10**

Prepared by:
Reviewed by:

Date (Start): **2019-10-22**
Date (End): **2019-10-22**

Project Name: **Carleton University New Residence**
Site: **Carleton University**
Sector:
Client: **Carleton University**

Project Number: **191-12948-00**
Geographic Coordinates: X = 367651.57696 mE
Y = 5027678.51017 mN
Surface Elevation: 65.4 m *(Geodetic)*
Top of PVC Elevation: 66.25 m *(Geodetic)*

Drilling Company: Marathon
Drilling Equipment: CME 55
Drilling Method: Hollow Stem Auger
Borehole Diameter: 203 mm
Drilling Fluid: None
Sampling Method: Split Spoon

ODOUR
F - Light
M - Medium
P - Persistent

VISUAL
D - Disseminated Product
S - Saturated with Product

SAMPLE TYPE
DC - Diamond Corer
SS - Split Spoon
MA - Manual Auger
DP - Direct Push
ST - Shelby Tube
TU - DT32 Liner
MC - Macro Core Liner

▽ Water Level ▼ Free Phase

CHEMICAL ANALYSIS

PCB	Poly-Chlorinated Biphenyls	SVOC	Semi Volatile Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, Xylene	PAH	Polycyclic Aromatic Hydrocarbons
Inorganics	Inorganic Compounds	PH C_{10}-C_{50}	Petroleum Hydrocarbons C_{10}-C_{50}
Phenol. C.	Phenolic Compounds	PH F1-F4	Petroleum Hydrocarbons F1-F4 (C_{10}-C_{50})
VOC	Volatil Organic Compounds (MAH & CAH)	Metals	Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Silver, Tin, Zinc.
Diox. & Fur.	Dioxins & Furans	HWR	Leacheate Tests (Haz. Waste Reg.)
CAH	Chlorinated Aliphatic Hydrocarbons		

DEPTH ELEVATION (m)	LITHOLOGY	DESCRIPTION	VAPOR CONC. I - Isobutylene (ppm) H - Hexane (ppm)	ODOUR F M P	VISUAL D S	SAMPLE TYPE	% RECOVERY	N (Blow/6")	NUMBER	ANALYSIS	DUPLICATE	MONITORING WELL DIAGRAM	MONITORING WELL DESCRIPTION	REMARKS
		SILTY SAND AND GRAVEL, trace clay, grey, wet, loose to compact (GLACIAL TILL)						50/50 mm						
			I - 1, H - 0			SS	100	1 6 13 35	SS12					
10.70 *54.70*		- Glacial TIll Inferred												
12.60 *52.80*		***END OF BOREHOLE***												
		1) Augering ended at 10.7 m due to flowing sands. Switch to DCPT. *2) DCPT Refusal at 12.6 m in depth* *3) 37.5 mm monitoring well installed at 7.6 m in depth* *4) DATE Nov 4, 2019 WATER LEVEL 5.9 m*												
		End of borehole at 12.60 m.												

Projet : ENVIRO - CARLETON UNIVERSITY NEW RESIDENCE.GPJ Type rapport : WSP_EN_WELL-ENVIRONMENTAL Data Template : WSP_TEMPLATE_GEOTECH.GDT 2019-11-27

APPENDIX

D CERTIFICATES OF ANALYSIS

APPENDIX

D-1 SOIL

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Certificate of Analysis

WSP Canada Inc. (Ottawa)

2611 Queensview Dr
Ottawa, ON K2B 8K2
Attn: Adrian Menyhart

Client PO:
Project: 191-12948-00
Custody: 119297

Report Date: 31-Oct-2019
Order Date: 25-Oct-2019

Order #: 1943704

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

Paracel ID	Client ID
1943704-01	BH19-2-SS5
1943704-02	BH19-6-SS3
1943704-03	BH19-10-SS8
1943704-04	BH19-6-DUP

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 31-Oct-2019
Order Date: 25-Oct-2019
Project Description: 191-12948-00

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	24-Oct-19	28-Oct-19
Mercury by CVAA	EPA 7471B - CVAA, digestion	28-Oct-19	28-Oct-19
PHC F1	CWS Tier 1 - P&T GC-FID	29-Oct-19	30-Oct-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	25-Oct-19	30-Oct-19
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	28-Oct-19	28-Oct-19
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	23-Oct-19	29-Oct-19
REG 153: VOCs by P&T GC/MS	EPA 8260 - P&T GC-MS	29-Oct-19	30-Oct-19
Solids, %	Gravimetric, calculation	28-Oct-19	28-Oct-19

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 31-Oct-2019
Order Date: 25-Oct-2019
Project Description: 191-12948-00

	Client ID:	BH19-2-SS5	BH19-6-SS3	BH19-10-SS8	BH19-6-DUP
	Sample Date:	23-Oct-19 09:00	24-Oct-19 09:00	23-Oct-19 09:00	24-Oct-19 09:00
	Sample ID:	1943704-01	1943704-02	1943704-03	1943704-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	84.4	92.1	90.6	92.4
Metals					
Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Arsenic	1.0 ug/g dry	3.6	1.7	4.4	-
Barium	1.0 ug/g dry	197	48.2	123	-
Beryllium	0.5 ug/g dry	0.6	<0.5	<0.5	-
Boron	5.0 ug/g dry	9.6	5.7	7.8	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	-
Chromium	5.0 ug/g dry	59.1	12.9	20.3	-
Chromium (VI)	0.2 ug/g dry	<0.2	<0.2	<0.2	-
Cobalt	1.0 ug/g dry	12.6	3.2	6.8	-
Copper	5.0 ug/g dry	29.8	9.7	18.5	-
Lead	1.0 ug/g dry	11.9	14.6	61.4	-
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	-
Molybdenum	1.0 ug/g dry	1.0	<1.0	2.6	-
Nickel	5.0 ug/g dry	33.8	6.3	14.9	-
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Silver	0.3 ug/g dry	<0.3	<0.3	<0.3	-
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Uranium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Vanadium	10.0 ug/g dry	62.9	20.3	25.9	-
Zinc	20.0 ug/g dry	64.7	<20.0	30.5	-
Volatiles					
Acetone	0.50 ug/g dry	<0.50	<0.50	<0.50	-
Benzene	0.02 ug/g dry	<0.02	<0.02	<0.02	-
Bromodichloromethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Bromoform	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Bromomethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Carbon Tetrachloride	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Chlorobenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Chloroform	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Dibromochloromethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Dichlorodifluoromethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,2-Dichlorobenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,3-Dichlorobenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	-

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 31-Oct-2019
Order Date: 25-Oct-2019
Project Description: 191-12948-00

	Client ID:	BH19-2-SS5	BH19-6-SS3	BH19-10-SS8	BH19-6-DUP
	Sample Date:	23-Oct-19 09:00	24-Oct-19 09:00	23-Oct-19 09:00	24-Oct-19 09:00
	Sample ID:	1943704-01	1943704-02	1943704-03	1943704-04
	MDL/Units	Soil	Soil	Soil	Soil
1,4-Dichlorobenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,1-Dichloroethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,2-Dichloroethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,1-Dichloroethylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
cis-1,2-Dichloroethylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
trans-1,2-Dichloroethylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,2-Dichloropropane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
cis-1,3-Dichloropropylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
trans-1,3-Dichloropropylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,3-Dichloropropene, total	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Ethylene dibromide (dibromoethan	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Hexane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Methyl Ethyl Ketone (2-Butanone)	0.50 ug/g dry	<0.50	<0.50	<0.50	-
Methyl Isobutyl Ketone	0.50 ug/g dry	<0.50	<0.50	<0.50	-
Methyl tert-butyl ether	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Methylene Chloride	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Styrene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,1,1,2-Tetrachloroethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,1,2,2-Tetrachloroethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Tetrachloroethylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Toluene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,1,1-Trichloroethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
1,1,2-Trichloroethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Trichloroethylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Trichlorofluoromethane	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Vinyl chloride	0.02 ug/g dry	<0.02	<0.02	<0.02	-
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	<0.05	-
o-Xylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	<0.05	-
4-Bromofluorobenzene	Surrogate	104%	104%	107%	-
Dibromofluoromethane	Surrogate	64.8%	67.7%	67.8%	-
Toluene-d8	Surrogate	110%	111%	112%	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	27	<7	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	-

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 31-Oct-2019
Order Date: 25-Oct-2019
Project Description: 191-12948-00

	Client ID:	BH19-2-SS5	BH19-6-SS3	BH19-10-SS8	BH19-6-DUP
	Sample Date:	23-Oct-19 09:00	24-Oct-19 09:00	23-Oct-19 09:00	24-Oct-19 09:00
	Sample ID:	1943704-01	1943704-02	1943704-03	1943704-04
	MDL/Units	Soil	Soil	Soil	Soil
F3 PHCs (C16-C34)	8 ug/g dry	<8	75	<8	-
F4 PHCs (C34-C50)	6 ug/g dry	<6	123	<6	-
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	<0.02	0.02	<0.02	0.04
Acenaphthylene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Anthracene	0.02 ug/g dry	0.03	0.04	<0.02	0.10
Benzo [a] anthracene	0.02 ug/g dry	0.05	0.09	<0.02	0.20
Benzo [a] pyrene	0.02 ug/g dry	0.04	0.08	<0.02	0.16
Benzo [b] fluoranthene	0.02 ug/g dry	0.06	0.13	<0.02	0.20
Benzo [g,h,i] perylene	0.02 ug/g dry	0.03	0.05	<0.02	0.13
Benzo [k] fluoranthene	0.02 ug/g dry	0.03	0.06	<0.02	0.11
Chrysene	0.02 ug/g dry	0.07	0.10	<0.02	0.20
Dibenzo [a,h] anthracene	0.02 ug/g dry	<0.02	<0.02	<0.02	0.03
Fluoranthene	0.02 ug/g dry	0.14	0.21	<0.02	0.46
Fluorene	0.02 ug/g dry	<0.02	0.02	<0.02	0.05
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	0.02	0.05	<0.02	0.10
1-Methylnaphthalene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
2-Methylnaphthalene	0.02 ug/g dry	<0.02	<0.02	<0.02	0.02
Methylnaphthalene (1&2)	0.04 ug/g dry	<0.04	<0.04	<0.04	<0.04
Naphthalene	0.01 ug/g dry	<0.01	0.02	<0.01	0.02
Phenanthrene	0.02 ug/g dry	0.09	0.16	<0.02	0.38
Pyrene	0.02 ug/g dry	0.11	0.16	<0.02	0.37
2-Fluorobiphenyl	Surrogate	77.8%	84.1%	66.6%	76.0%
Terphenyl-d14	Surrogate	89.5%	110%	93.2%	71.1%

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	ug/g						
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g						
Acenaphthylene	ND	0.02	ug/g						
Anthracene	ND	0.02	ug/g						
Benzo [a] anthracene	ND	0.02	ug/g						
Benzo [a] pyrene	ND	0.02	ug/g						
Benzo [b] fluoranthene	ND	0.02	ug/g						
Benzo [g,h,i] perylene	ND	0.02	ug/g						
Benzo [k] fluoranthene	ND	0.02	ug/g						
Chrysene	ND	0.02	ug/g						
Dibenzo [a,h] anthracene	ND	0.02	ug/g						
Fluoranthene	ND	0.02	ug/g						
Fluorene	ND	0.02	ug/g						
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g						
1-Methylnaphthalene	ND	0.02	ug/g						
2-Methylnaphthalene	ND	0.02	ug/g						
Methylnaphthalene (1&2)	ND	0.04	ug/g						
Naphthalene	ND	0.01	ug/g						
Phenanthrene	ND	0.02	ug/g						
Pyrene	ND	0.02	ug/g						
Surrogate: 2-Fluorobiphenyl	*1.26*		*ug/g*		*94.1*	*50-140*			
Surrogate: Terphenyl-d14	*1.47*		*ug/g*		*110*	*50-140*			
Volatiles									
Acetone	ND	0.50	ug/g						
Benzene	ND	0.02	ug/g						
Bromodichloromethane	ND	0.05	ug/g						
Bromoform	ND	0.05	ug/g						
Bromomethane	ND	0.05	ug/g						
Carbon Tetrachloride	ND	0.05	ug/g						
Chlorobenzene	ND	0.05	ug/g						
Chloroform	ND	0.05	ug/g						
Dibromochloromethane	ND	0.05	ug/g						
Dichlorodifluoromethane	ND	0.05	ug/g						

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,2-Dichlorobenzene	ND	0.05	ug/g						
1,3-Dichlorobenzene	ND	0.05	ug/g						
1,4-Dichlorobenzene	ND	0.05	ug/g						
1,1-Dichloroethane	ND	0.05	ug/g						
1,2-Dichloroethane	ND	0.05	ug/g						
1,1-Dichloroethylene	ND	0.05	ug/g						
cis-1,2-Dichloroethylene	ND	0.05	ug/g						
trans-1,2-Dichloroethylene	ND	0.05	ug/g						
1,2-Dichloropropane	ND	0.05	ug/g						
cis-1,3-Dichloropropylene	ND	0.05	ug/g						
trans-1,3-Dichloropropylene	ND	0.05	ug/g						
1,3-Dichloropropene, total	ND	0.05	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Ethylene dibromide (dibromoethane	ND	0.05	ug/g						
Hexane	ND	0.05	ug/g						
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g						
Methyl Isobutyl Ketone	ND	0.50	ug/g						
Methyl tert-butyl ether	ND	0.05	ug/g						
Methylene Chloride	ND	0.05	ug/g						
Styrene	ND	0.05	ug/g						
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g						
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g						
Tetrachloroethylene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
1,1,1-Trichloroethane	ND	0.05	ug/g						
1,1,2-Trichloroethane	ND	0.05	ug/g						
Trichloroethylene	ND	0.05	ug/g						
Trichlorofluoromethane	ND	0.05	ug/g						
Vinyl chloride	ND	0.02	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: 4-Bromofluorobenzene	*3.38*		*ug/g*		*106*	*50-140*			
Surrogate: Dibromofluoromethane	*2.64*		*ug/g*		*82.6*	*50-140*			
Surrogate: Toluene-d8	*3.44*		*ug/g*		*107*	*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)	ND	8	ug/g dry	ND				30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Metals									
Antimony	1.2	1.0	ug/g dry	ND			0.0	30	
Arsenic	5.0	1.0	ug/g dry	5.3			7.4	30	
Barium	97.2	1.0	ug/g dry	104			6.9	30	
Beryllium	0.9	0.5	ug/g dry	0.8			12.4	30	
Boron	9.3	5.0	ug/g dry	9.6			2.7	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium (VI)	ND	0.2	ug/g dry	ND				35	
Chromium	34.3	5.0	ug/g dry	37.7			9.4	30	
Cobalt	7.5	1.0	ug/g dry	8.0			5.8	30	
Copper	16.3	5.0	ug/g dry	17.9			9.4	30	
Lead	10.6	1.0	ug/g dry	12.4			15.8	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	20.0	5.0	ug/g dry	21.8			8.6	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.3	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	36.3	10.0	ug/g dry	39.6			8.8	30	
Zinc	65.2	20.0	ug/g dry	68.8			5.3	30	
Physical Characteristics									
% Solids	92.3	0.1	% by Wt.	93.0			0.8	25	
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g dry	ND			0.0	40	
Acenaphthylene	ND	0.02	ug/g dry	ND			0.0	40	
Anthracene	0.026	0.02	ug/g dry	ND			0.0	40	
Benzo [a] anthracene	0.065	0.02	ug/g dry	0.032			69.1	40	QR-01
Benzo [a] pyrene	0.053	0.02	ug/g dry	0.028			62.4	40	QR-01
Benzo [b] fluoranthene	0.078	0.02	ug/g dry	0.041			62.2	40	QR-01
Benzo [g,h,i] perylene	0.037	0.02	ug/g dry	0.021			53.0	40	QR-01
Benzo [k] fluoranthene	0.038	0.02	ug/g dry	0.020			60.4	40	QR-01
Chrysene	0.074	0.02	ug/g dry	0.035			72.3	40	QR-01
Dibenzo [a,h] anthracene	ND	0.02	ug/g dry	ND			0.0	40	
Fluoranthene	0.151	0.02	ug/g dry	0.068			76.5	40	QR-01
Fluorene	ND	0.02	ug/g dry	ND			0.0	40	
Indeno [1,2,3-cd] pyrene	0.032	0.02	ug/g dry	ND			0.0	40	
1-Methylnaphthalene	ND	0.02	ug/g dry	ND			0.0	40	
2-Methylnaphthalene	ND	0.02	ug/g dry	ND			0.0	40	
Naphthalene	ND	0.01	ug/g dry	ND			0.0	40	
Phenanthrene	0.111	0.02	ug/g dry	0.040			93.3	40	QR-01
Pyrene	0.127	0.02	ug/g dry	0.059			72.6	40	QR-01
Surrogate: 2-Fluorobiphenyl	*1.34*		*ug/g dry*		*89.1*	*50-140*			
Surrogate: Terphenyl-d14	*1.45*		*ug/g dry*		*96.6*	*50-140*			
Volatiles									
Acetone	ND	0.50	ug/g dry	ND				50	
Benzene	ND	0.02	ug/g dry	ND				50	
Bromodichloromethane	ND	0.05	ug/g dry	ND				50	
Bromoform	ND	0.05	ug/g dry	ND				50	
Bromomethane	ND	0.05	ug/g dry	ND				50	
Carbon Tetrachloride	ND	0.05	ug/g dry	ND				50	
Chlorobenzene	ND	0.05	ug/g dry	ND				50	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chloroform	ND	0.05	ug/g dry	ND				50	
Dibromochloromethane	ND	0.05	ug/g dry	ND				50	
Dichlorodifluoromethane	ND	0.05	ug/g dry	ND				50	
1,2-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,3-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,4-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,1-Dichloroethane	ND	0.05	ug/g dry	ND				50	
1,2-Dichloroethane	ND	0.05	ug/g dry	ND				50	
1,1-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
cis-1,2-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
trans-1,2-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
1,2-Dichloropropane	ND	0.05	ug/g dry	ND				50	
cis-1,3-Dichloropropylene	ND	0.05	ug/g dry	ND				50	
trans-1,3-Dichloropropylene	ND	0.05	ug/g dry	ND				50	
Ethylbenzene	ND	0.05	ug/g dry	ND				50	
Ethylene dibromide (dibromoethane	ND	0.05	ug/g dry	ND				50	
Hexane	ND	0.05	ug/g dry	ND				50	
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g dry	ND				50	
Methyl Isobutyl Ketone	ND	0.50	ug/g dry	ND				50	
Methyl tert-butyl ether	ND	0.05	ug/g dry	ND				50	
Methylene Chloride	ND	0.05	ug/g dry	ND				50	
Styrene	ND	0.05	ug/g dry	ND				50	
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g dry	ND				50	
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g dry	ND				50	
Tetrachloroethylene	ND	0.05	ug/g dry	ND				50	
Toluene	ND	0.05	ug/g dry	ND				50	
1,1,1-Trichloroethane	ND	0.05	ug/g dry	ND				50	
1,1,2-Trichloroethane	ND	0.05	ug/g dry	ND				50	
Trichloroethylene	ND	0.05	ug/g dry	ND				50	
Trichlorofluoromethane	ND	0.05	ug/g dry	ND				50	
Vinyl chloride	ND	0.02	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: 4-Bromofluorobenzene	*4.57*		*ug/g dry*		*111*	*50-140*			
Surrogate: Dibromofluoromethane	*3.01*		*ug/g dry*		*73.0*	*50-140*			
Surrogate: Toluene-d8	*4.62*		*ug/g dry*		*112*	*50-140*			

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 31-Oct-2019
Order Date: 25-Oct-2019
Project Description: 191-12948-00

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	196	7	ug/g		97.9	80-120			
F2 PHCs (C10-C16)	78	4	ug/g	ND	82.5	60-140			
F3 PHCs (C16-C34)	199	8	ug/g	ND	85.7	60-140			
F4 PHCs (C34-C50)	149	6	ug/g	ND	102	60-140			
Metals									
Antimony	46.1		ug/L	ND	91.8	70-130			
Arsenic	57.2		ug/L	2.1	110	70-130			
Barium	98.7		ug/L	41.7	114	70-130			
Beryllium	56.1		ug/L	ND	111	70-130			
Boron	49.5		ug/L	ND	91.3	70-130			
Cadmium	54.4		ug/L	ND	108	70-130			
Chromium (VI)	0.1		mg/L	ND	58.0	70-130			QM-05
Chromium	73.8		ug/L	15.1	117	70-130			
Cobalt	52.7		ug/L	3.2	99.0	70-130			
Copper	60.4		ug/L	7.2	106	70-130			
Lead	54.0		ug/L	5.0	98.1	70-130			
Mercury	1.70	0.1	ug/g	ND	113	70-130			
Molybdenum	48.5		ug/L	ND	96.6	70-130			
Nickel	63.1		ug/L	8.7	109	70-130			
Selenium	53.5		ug/L	ND	106	70-130			
Silver	45.2		ug/L	ND	90.3	70-130			
Thallium	47.3		ug/L	ND	94.4	70-130			
Uranium	52.0		ug/L	ND	103	70-130			
Vanadium	74.8		ug/L	15.9	118	70-130			
Zinc	80.2		ug/L	27.5	105	70-130			
Semi-Volatiles									
Acenaphthene	0.181	0.02	ug/g	ND	96.1	50-140			
Acenaphthylene	0.160	0.02	ug/g	ND	85.3	50-140			
Anthracene	0.179	0.02	ug/g	ND	95.2	50-140			
Benzo [a] anthracene	0.203	0.02	ug/g	0.032	91.3	50-140			
Benzo [a] pyrene	0.177	0.02	ug/g	0.028	79.3	50-140			
Benzo [b] fluoranthene	0.283	0.02	ug/g	0.041	129	50-140			
Benzo [g,h,i] perylene	0.171	0.02	ug/g	0.021	79.8	50-140			
Benzo [k] fluoranthene	0.231	0.02	ug/g	0.020	112	50-140			
Chrysene	0.258	0.02	ug/g	0.035	119	50-140			
Dibenzo [a,h] anthracene	0.159	0.02	ug/g	ND	84.8	50-140			
Fluoranthene	0.233	0.02	ug/g	0.068	88.2	50-140			
Fluorene	0.174	0.02	ug/g	ND	92.8	50-140			
Indeno [1,2,3-cd] pyrene	0.150	0.02	ug/g	ND	79.6	50-140			
1-Methylnaphthalene	0.182	0.02	ug/g	ND	96.7	50-140			
2-Methylnaphthalene	0.203	0.02	ug/g	ND	108	50-140			
Naphthalene	0.184	0.01	ug/g	ND	97.7	50-140			
Phenanthrene	0.210	0.02	ug/g	0.040	90.4	50-140			
Pyrene	0.237	0.02	ug/g	0.059	94.5	50-140			
Surrogate: 2-Fluorobiphenyl	*1.27*		*ug/g*		*84.3*	*50-140*			
Volatiles									
Acetone	7.54	0.50	ug/g		75.4	50-140			
Benzene	2.79	0.02	ug/g		69.7	60-130			
Bromodichloromethane	2.48	0.05	ug/g		62.0	60-130			
Bromoform	3.95	0.05	ug/g		98.6	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Bromomethane	2.91	0.05	ug/g		72.7	50-140			
Carbon Tetrachloride	2.85	0.05	ug/g		71.2	60-130			
Chlorobenzene	3.59	0.05	ug/g		89.8	60-130			
Chloroform	2.46	0.05	ug/g		61.5	60-130			
Dibromochloromethane	3.98	0.05	ug/g		99.6	60-130			
Dichlorodifluoromethane	2.04	0.05	ug/g		51.0	50-140			
1,2-Dichlorobenzene	3.01	0.05	ug/g		75.3	60-130			
1,3-Dichlorobenzene	3.04	0.05	ug/g		76.0	60-130			
1,4-Dichlorobenzene	3.31	0.05	ug/g		82.7	60-130			
1,1-Dichloroethane	2.90	0.05	ug/g		72.6	60-130			
1,2-Dichloroethane	2.46	0.05	ug/g		61.6	60-130			
1,1-Dichloroethylene	2.88	0.05	ug/g		72.0	60-130			
cis-1,2-Dichloroethylene	2.59	0.05	ug/g		64.8	60-130			
trans-1,2-Dichloroethylene	2.92	0.05	ug/g		73.1	60-130			
1,2-Dichloropropane	3.55	0.05	ug/g		88.8	60-130			
cis-1,3-Dichloropropylene	2.85	0.05	ug/g		71.2	60-130			
trans-1,3-Dichloropropylene	2.72	0.05	ug/g		67.9	60-130			
Ethylbenzene	3.56	0.05	ug/g		89.0	60-130			
Ethylene dibromide (dibromoethane	3.04	0.05	ug/g		76.0	60-130			
Hexane	2.76	0.05	ug/g		68.9	60-130			
Methyl Ethyl Ketone (2-Butanone)	7.38	0.50	ug/g		73.8	50-140			
Methyl Isobutyl Ketone	6.36	0.50	ug/g		63.6	50-140			
Methyl tert-butyl ether	8.97	0.05	ug/g		89.7	50-140			
Methylene Chloride	3.16	0.05	ug/g		78.9	60-130			
Styrene	3.54	0.05	ug/g		88.4	60-130			
1,1,1,2-Tetrachloroethane	4.21	0.05	ug/g		105	60-130			
1,1,2,2-Tetrachloroethane	3.79	0.05	ug/g		94.8	60-130			
Tetrachloroethylene	3.40	0.05	ug/g		85.0	60-130			
Toluene	3.72	0.05	ug/g		93.1	60-130			
1,1,1-Trichloroethane	2.60	0.05	ug/g		64.9	60-130			
1,1,2-Trichloroethane	2.72	0.05	ug/g		68.0	60-130			
Trichloroethylene	2.95	0.05	ug/g		73.6	60-130			
Trichlorofluoromethane	3.38	0.05	ug/g		84.5	50-140			
Vinyl chloride	2.96	0.02	ug/g		74.1	50-140			
m,p-Xylenes	7.42	0.05	ug/g		92.8	60-130			
o-Xylene	3.73	0.05	ug/g		93.3	60-130			

Qualifier Notes:

QC Qualifiers :

QM-05 : The spike recovery was outside acceptance limits for the matrix spike due to matrix interference.

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

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 LTD.

TRR

Paracel ID: 1943704

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300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
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Chain of Custody
(Lab Use Only)
Nº 119297

Page 1 of 1

Client Name: WSP CANADA INC	Project Reference: 191-12948-00
Contact Name: ADRIAN MENYHART	Quote #
Address: 2611 QUEENSVIEW DR	PO # STANDING OFFER
Telephone: 343-961-1429	Email Address: adrian.menyhart@wsp.com

Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☑ Regular
Date Required:

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

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

Paracel Order Number:

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Date	Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)								
1	BH19-2-SS5	S		2	OCT 23 '19		✓	✓	✓	✓	✓	✓	✓								✓
2	BH19-6-SS3	↓		↓	OCT 24 '19		✓	✓	✓	✓	✓	✓									✓
3	BH19-10-SS8	↓		↓	OCT 23 '19		✓	✓	✓	✓	✓	✓									✓
4	BH19-10-SS12 * HOLD	↓		↓	OCT 23 '19		✓	✓													✓
5	BH19-6-DUP	↓		↓	OCT 24 '19				✓												✓
6																					
7																					
8																					
9																					
10																					

Comments: 1297.254h.208.

Method of Delivery: Swift

Relinquished By (Sign): [signature]	Received by Driver/Depot:	Received at Lab: Juneeporn Dokmai	Verified By: [signature]
Relinquished By (Print): ADRIAN MENYHART	Date/Time:	Date/Time: OCT 25, 2019 03.17	Date/Time: 10-25-19 15:2[illegible]
Date/Time: OCT 25 2019	Temperature: °C	Temperature: 17.9 °C	pH Verified [ ] By:

B. M—.

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Certificate of Analysis

WSP Canada Inc. (Ottawa)

2611 Queensview Dr
Ottawa, ON K2B 8K2
Attn: Adrian Menyhart

Client PO:
Project: 191-12948-00
Custody: 124106

Report Date: 8-Nov-2019
Order Date: 1-Nov-2019

Order #: 1944618

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

Paracel ID	Client ID
1944618-01	BH19-6-SS8
1944618-02	BH19-8-SS8
1944618-03	BH19-10-SS10

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 08-Nov-2019
Order Date: 1-Nov-2019
Project Description: 191-12948-00

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	5-Nov-19	6-Nov-19
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	4-Nov-19	7-Nov-19
Mercury by CVAA	EPA 7471B - CVAA, digestion	5-Nov-19	5-Nov-19
PHC F1	CWS Tier 1 - P&T GC-FID	5-Nov-19	6-Nov-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	5-Nov-19	7-Nov-19
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	5-Nov-19	5-Nov-19
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	4-Nov-19	6-Nov-19
Solids, %	Gravimetric, calculation	5-Nov-19	5-Nov-19

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 08-Nov-2019
Order Date: 1-Nov-2019
Project Description: 191-12948-00

	Client ID:	BH19-6-SS8	BH19-8-SS8	BH19-10-SS10	-
	Sample Date:	24-Oct-19 09:00	24-Oct-19 09:00	24-Oct-19 09:00	-
	Sample ID:	1944618-01	1944618-02	1944618-03	-
	MDL/Units	Soil	Soil	Soil	-
Physical Characteristics					
% Solids	0.1 % by Wt.	93.7	93.5	91.5	-
Metals					
Antimony	1.0 ug/g dry	-	<1.0	<1.0	-
Arsenic	1.0 ug/g dry	-	1.9	2.2	-
Barium	1.0 ug/g dry	-	152	54.9	-
Beryllium	0.5 ug/g dry	-	<0.5	<0.5	-
Boron	5.0 ug/g dry	-	11.5	7.5	-
Cadmium	0.5 ug/g dry	-	<0.5	<0.5	-
Chromium	5.0 ug/g dry	-	14.5	14.7	-
Chromium (VI)	0.2 ug/g dry	-	<0.2	<0.2	-
Cobalt	1.0 ug/g dry	-	6.3	6.4	-
Copper	5.0 ug/g dry	-	12.5	11.8	-
Lead	1.0 ug/g dry	-	4.4	4.2	-
Mercury	0.1 ug/g dry	-	<0.1	<0.1	-
Molybdenum	1.0 ug/g dry	-	<1.0	1.1	-
Nickel	5.0 ug/g dry	-	12.3	10.6	-
Selenium	1.0 ug/g dry	-	<1.0	<1.0	-
Silver	0.3 ug/g dry	-	<0.3	<0.3	-
Thallium	1.0 ug/g dry	-	<1.0	<1.0	-
Uranium	1.0 ug/g dry	-	1.1	<1.0	-
Vanadium	10.0 ug/g dry	-	26.0	24.7	-
Zinc	20.0 ug/g dry	-	<20.0	<20.0	-
Volatiles					
Benzene	0.02 ug/g dry	<0.02	<0.02	-	-
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	-	-
Toluene	0.05 ug/g dry	<0.05	<0.05	-	-
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	-	-
o-Xylene	0.05 ug/g dry	<0.05	<0.05	-	-
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	-	-
Toluene-d8	Surrogate	112%	110%	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	-	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	-	-
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	-	-
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	-	-

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 08-Nov-2019
Order Date: 1-Nov-2019
Project Description: 191-12948-00

	Client ID:	BH19-6-SS8	BH19-8-SS8	BH19-10-SS10	-
	Sample Date:	24-Oct-19 09:00	24-Oct-19 09:00	24-Oct-19 09:00	-
	Sample ID:	1944618-01	1944618-02	1944618-03	-
	MDL/Units	Soil	Soil	Soil	-
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	<0.02	<0.02	-	-
Acenaphthylene	0.02 ug/g dry	<0.02	<0.02	-	-
Anthracene	0.02 ug/g dry	<0.02	<0.02	-	-
Benzo [a] anthracene	0.02 ug/g dry	<0.02	<0.02	-	-
Benzo [a] pyrene	0.02 ug/g dry	<0.02	<0.02	-	-
Benzo [b] fluoranthene	0.02 ug/g dry	<0.02	<0.02	-	-
Benzo [g,h,i] perylene	0.02 ug/g dry	<0.02	<0.02	-	-
Benzo [k] fluoranthene	0.02 ug/g dry	<0.02	<0.02	-	-
Chrysene	0.02 ug/g dry	<0.02	<0.02	-	-
Dibenzo [a,h] anthracene	0.02 ug/g dry	<0.02	<0.02	-	-
Fluoranthene	0.02 ug/g dry	<0.02	<0.02	-	-
Fluorene	0.02 ug/g dry	<0.02	<0.02	-	-
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	<0.02	<0.02	-	-
1-Methylnaphthalene	0.02 ug/g dry	<0.02	<0.02	-	-
2-Methylnaphthalene	0.02 ug/g dry	<0.02	<0.02	-	-
Methylnaphthalene (1&2)	0.04 ug/g dry	<0.04	<0.04	-	-
Naphthalene	0.01 ug/g dry	<0.01	<0.01	-	-
Phenanthrene	0.02 ug/g dry	<0.02	<0.02	-	-
Pyrene	0.02 ug/g dry	<0.02	<0.02	-	-
2-Fluorobiphenyl	Surrogate	91.4%	101%	-	-
Terphenyl-d14	Surrogate	121%	133%	-	-

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 08-Nov-2019
Order Date: 1-Nov-2019
Project Description: 191-12948-00

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	ug/g						
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g						
Acenaphthylene	ND	0.02	ug/g						
Anthracene	ND	0.02	ug/g						
Benzo [a] anthracene	ND	0.02	ug/g						
Benzo [a] pyrene	ND	0.02	ug/g						
Benzo [b] fluoranthene	ND	0.02	ug/g						
Benzo [g,h,i] perylene	ND	0.02	ug/g						
Benzo [k] fluoranthene	ND	0.02	ug/g						
Chrysene	ND	0.02	ug/g						
Dibenzo [a,h] anthracene	ND	0.02	ug/g						
Fluoranthene	ND	0.02	ug/g						
Fluorene	ND	0.02	ug/g						
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g						
1-Methylnaphthalene	ND	0.02	ug/g						
2-Methylnaphthalene	ND	0.02	ug/g						
Methylnaphthalene (1&2)	ND	0.04	ug/g						
Naphthalene	ND	0.01	ug/g						
Phenanthrene	ND	0.02	ug/g						
Pyrene	ND	0.02	ug/g						
Surrogate: 2-Fluorobiphenyl	*0.982*		*ug/g*		*73.6*	*50-140*			
Surrogate: Terphenyl-d14	*1.33*		*ug/g*		*99.6*	*50-140*			
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	*3.43*		*ug/g*		*107*	*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)	ND	8	ug/g dry	ND				30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Metals									
Antimony	2.1	1.0	ug/g dry	2.0			4.6	30	
Arsenic	1.6	1.0	ug/g dry	1.3			22.0	30	
Barium	23.5	1.0	ug/g dry	21.6			8.4	30	
Beryllium	ND	0.5	ug/g dry	0.5			0.0	30	
Boron	8.0	5.0	ug/g dry	7.3			9.4	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium (VI)	ND	0.2	ug/g dry	ND				35	
Chromium	10.4	5.0	ug/g dry	9.4			10.0	30	
Cobalt	4.2	1.0	ug/g dry	3.9			5.6	30	
Copper	9.3	5.0	ug/g dry	8.6			7.6	30	
Lead	3.0	1.0	ug/g dry	2.7			9.1	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	7.7	5.0	ug/g dry	6.9			11.4	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	0.4	0.3	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	17.9	10.0	ug/g dry	16.2			9.7	30	
Zinc	ND	20.0	ug/g dry	ND			0.0	30	
Physical Characteristics									
% Solids	86.1	0.1	% by Wt.	85.6			0.6	25	
Semi-Volatiles									
Acenaphthene	ND	0.40	ug/g dry	ND				40	
Acenaphthylene	ND	0.40	ug/g dry	ND			0.0	40	
Anthracene	ND	0.40	ug/g dry	ND			0.0	40	
Benzo [a] anthracene	ND	0.40	ug/g dry	ND			0.0	40	
Benzo [a] pyrene	ND	0.40	ug/g dry	ND			0.0	40	
Benzo [b] fluoranthene	ND	0.40	ug/g dry	ND			0.0	40	
Benzo [g,h,i] perylene	ND	0.40	ug/g dry	ND			0.0	40	
Benzo [k] fluoranthene	ND	0.40	ug/g dry	ND			0.0	40	
Chrysene	ND	0.40	ug/g dry	ND			0.0	40	
Dibenzo [a,h] anthracene	ND	0.40	ug/g dry	ND			0.0	40	
Fluoranthene	ND	0.40	ug/g dry	ND			0.0	40	
Fluorene	ND	0.40	ug/g dry	ND			0.0	40	
Indeno [1,2,3-cd] pyrene	ND	0.40	ug/g dry	ND			0.0	40	
1-Methylnaphthalene	ND	0.40	ug/g dry	ND			0.0	40	
2-Methylnaphthalene	ND	0.40	ug/g dry	ND			0.0	40	
Naphthalene	ND	0.20	ug/g dry	ND			0.0	40	
Phenanthrene	ND	0.40	ug/g dry	ND			0.0	40	
Pyrene	ND	0.40	ug/g dry	ND			0.0	40	
Surrogate: 2-Fluorobiphenyl	*1.25*		*ug/g dry*		*88.4*	*50-140*			
Surrogate: Terphenyl-d14	*1.39*		*ug/g dry*		*98.6*	*50-140*			
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	*3.91*		*ug/g dry*		*112*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	192	7	ug/g		95.8	80-120			
F2 PHCs (C10-C16)	84	4	ug/g	ND	98.8	60-140			
F3 PHCs (C16-C34)	240	8	ug/g	ND	115	60-140			
F4 PHCs (C34-C50)	172	6	ug/g	ND	130	60-140			
Metals									
Antimony	40.8		ug/L	ND	80.0	70-130			
Arsenic	45.8		ug/L	ND	90.7	70-130			
Barium	51.9		ug/L	8.6	86.5	70-130			
Beryllium	50.1		ug/L	ND	99.8	70-130			
Boron	45.4		ug/L	ND	85.0	70-130			
Cadmium	46.4		ug/L	ND	92.7	70-130			
Chromium (VI)	0.1		mg/L	ND	70.5	70-130			
Chromium	52.5		ug/L	ND	97.5	70-130			
Cobalt	49.3		ug/L	1.6	95.5	70-130			
Copper	51.2		ug/L	ND	95.4	70-130			
Lead	43.3		ug/L	1.1	84.5	70-130			
Mercury	1.41	0.1	ug/g	ND	94.1	70-130			
Molybdenum	51.2		ug/L	ND	102	70-130			
Nickel	50.2		ug/L	ND	94.8	70-130			
Selenium	47.0		ug/L	ND	93.5	70-130			
Silver	45.2		ug/L	ND	90.2	70-130			
Thallium	43.7		ug/L	ND	87.2	70-130			
Uranium	45.3		ug/L	ND	90.2	70-130			
Vanadium	57.7		ug/L	ND	102	70-130			
Zinc	53.0		ug/L	ND	95.0	70-130			
Semi-Volatiles									
Acenaphthene	0.161	0.02	ug/g		96.4	50-140			
Acenaphthylene	0.136	0.02	ug/g		81.3	50-140			
Anthracene	0.164	0.02	ug/g		98.5	50-140			
Benzo [a] anthracene	0.158	0.02	ug/g		94.5	50-140			
Benzo [a] pyrene	0.130	0.02	ug/g		77.8	50-140			
Benzo [b] fluoranthene	0.206	0.02	ug/g		124	50-140			
Benzo [g,h,i] perylene	0.138	0.02	ug/g		82.9	50-140			
Benzo [k] fluoranthene	0.187	0.02	ug/g		112	50-140			
Chrysene	0.193	0.02	ug/g		116	50-140			
Dibenzo [a,h] anthracene	0.140	0.02	ug/g		84.0	50-140			
Fluoranthene	0.163	0.02	ug/g		97.6	50-140			
Fluorene	0.166	0.02	ug/g		99.6	50-140			
Indeno [1,2,3-cd] pyrene	0.119	0.02	ug/g		71.3	50-140			
1-Methylnaphthalene	0.151	0.02	ug/g		90.4	50-140			
2-Methylnaphthalene	0.166	0.02	ug/g		99.9	50-140			
Naphthalene	0.160	0.01	ug/g		95.9	50-140			
Phenanthrene	0.170	0.02	ug/g		102	50-140			
Pyrene	0.167	0.02	ug/g		100	50-140			
Surrogate: 2-Fluorobiphenyl	*1.40*		*ug/g*		*105*	*50-140*			
Volatiles									
Benzene	2.53	0.02	ug/g		63.2	60-130			
Ethylbenzene	4.29	0.05	ug/g		107	60-130			
Toluene	4.46	0.05	ug/g		111	60-130			
m,p-Xylenes	8.79	0.05	ug/g		110	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o-Xylene	4.37	0.05	ug/g		109	60-130			

Qualifier Notes:

Login Qualifiers :

Container(s) - Labeled improperly/insufficient information -
Applies to samples: BH19-8-SS8, BH19-10-SS10

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.

PARAC LABORATORIES

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Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
1944618	Nº 124106

Client Name: WSP CANADA INC

Contact Name: ADRIAN MENYHART

Address: 2611 QUEENSVIEW DRIVE

Telephone: 343-961-1429

Project Ref: 191-12948-00

Quote #: 19-029

PO #:

E-mail: adrian.menyhart@wsp.com

Page 1 of 1

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	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	Required Analysis
1	BH19-6-SS8	S		3	Oct 24		/		/					250mL + 1 vial
2	BH19-8-SS8			2			/		/	/	/	/		↓
3	BH19-10-SS10			1						/	/	/		120mL
4														
5														
6														
7														
8														
9														
10														

Comments: No.2 Date on Jar + vial read as Oct 23, 2019.
No.3 Date read as Oct 23, 2019

Method of Delivery: Parcel

Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab:	Verified By:
Relinquished By (Print): ADRIAN MENYHART	Date/Time: 01/11/19 3:00	Date/Time: Nov 01, 2019 04:53	Date/Time: 11-1-19 17:24
Date/Time: 01 Nov 2019	Temperature: °C PH	Temperature: 18.9 °C	pH Verified: ☐ By:

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Certificate of Analysis

WSP Canada Inc. (Ottawa)

2611 Queensview Dr
Ottawa, ON K2B 8K2
Attn: Adrian Menyhart

Client PO:
Project: 191-12948-00
Custody: 124408

Report Date: 1-Nov-2019
Order Date: 28-Oct-2019

Order #: 1944109

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

Paracel ID	Client ID
1944109-01	BH19-4-SS2

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 01-Nov-2019
Order Date: 28-Oct-2019
Project Description: 191-12948-00

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	29-Oct-19	29-Oct-19
Mercury by CVAA	EPA 7471B - CVAA, digestion	29-Oct-19	29-Oct-19
PHC F1	CWS Tier 1 - P&T GC-FID	29-Oct-19	30-Oct-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	28-Oct-19	30-Oct-19
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	29-Oct-19	29-Oct-19
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	28-Oct-19	1-Nov-19
REG 153: VOCs by P&T GC/MS	EPA 8260 - P&T GC-MS	29-Oct-19	30-Oct-19
Solids, %	Gravimetric, calculation	29-Oct-19	29-Oct-19

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 01-Nov-2019
Order Date: 28-Oct-2019
Project Description: 191-12948-00

	Client ID:	BH19-4-SS2	-	-	-
	Sample Date:	28-Oct-19 13:20	-	-	-
	Sample ID:	1944109-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	64.6	-	-	-
Metals					
Antimony	1.0 ug/g dry	<1.0	-	-	-
Arsenic	1.0 ug/g dry	3.9	-	-	-
Barium	1.0 ug/g dry	359	-	-	-
Beryllium	0.5 ug/g dry	0.7	-	-	-
Boron	5.0 ug/g dry	6.5	-	-	-
Cadmium	0.5 ug/g dry	<0.5	-	-	-
Chromium	5.0 ug/g dry	118	-	-	-
Chromium (VI)	0.2 ug/g dry	<0.2	-	-	-
Cobalt	1.0 ug/g dry	21.5	-	-	-
Copper	5.0 ug/g dry	54.3	-	-	-
Lead	1.0 ug/g dry	16.3	-	-	-
Mercury	0.1 ug/g dry	<0.1	-	-	-
Molybdenum	1.0 ug/g dry	<1.0	-	-	-
Nickel	5.0 ug/g dry	62.8	-	-	-
Selenium	1.0 ug/g dry	<1.0	-	-	-
Silver	0.3 ug/g dry	<0.3	-	-	-
Thallium	1.0 ug/g dry	<1.0	-	-	-
Uranium	1.0 ug/g dry	<1.0	-	-	-
Vanadium	10.0 ug/g dry	104	-	-	-
Zinc	20.0 ug/g dry	121	-	-	-
Volatiles					
Acetone	0.50 ug/g dry	<0.50	-	-	-
Benzene	0.02 ug/g dry	<0.02	-	-	-
Bromodichloromethane	0.05 ug/g dry	<0.05	-	-	-
Bromoform	0.05 ug/g dry	<0.05	-	-	-
Bromomethane	0.05 ug/g dry	<0.05	-	-	-
Carbon Tetrachloride	0.05 ug/g dry	<0.05	-	-	-
Chlorobenzene	0.05 ug/g dry	<0.05	-	-	-
Chloroform	0.05 ug/g dry	<0.05	-	-	-
Dibromochloromethane	0.05 ug/g dry	<0.05	-	-	-
Dichlorodifluoromethane	0.05 ug/g dry	<0.05	-	-	-
1,2-Dichlorobenzene	0.05 ug/g dry	<0.05	-	-	-
1,3-Dichlorobenzene	0.05 ug/g dry	<0.05	-	-	-

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 01-Nov-2019
Order Date: 28-Oct-2019
Project Description: 191-12948-00

	Client ID:	BH19-4-SS2	-	-	-
	Sample Date:	28-Oct-19 13:20	-	-	-
	Sample ID:	1944109-01	-	-	-
	MDL/Units	Soil	-	-	-
1,4-Dichlorobenzene	0.05 ug/g dry	<0.05	-	-	-
1,1-Dichloroethane	0.05 ug/g dry	<0.05	-	-	-
1,2-Dichloroethane	0.05 ug/g dry	<0.05	-	-	-
1,1-Dichloroethylene	0.05 ug/g dry	<0.05	-	-	-
cis-1,2-Dichloroethylene	0.05 ug/g dry	<0.05	-	-	-
trans-1,2-Dichloroethylene	0.05 ug/g dry	<0.05	-	-	-
1,2-Dichloropropane	0.05 ug/g dry	<0.05	-	-	-
cis-1,3-Dichloropropylene	0.05 ug/g dry	<0.05	-	-	-
trans-1,3-Dichloropropylene	0.05 ug/g dry	<0.05	-	-	-
1,3-Dichloropropene, total	0.05 ug/g dry	<0.05	-	-	-
Ethylbenzene	0.05 ug/g dry	<0.05	-	-	-
Ethylene dibromide (dibromoethan	0.05 ug/g dry	<0.05	-	-	-
Hexane	0.05 ug/g dry	<0.05	-	-	-
Methyl Ethyl Ketone (2-Butanone)	0.50 ug/g dry	<0.50	-	-	-
Methyl Isobutyl Ketone	0.50 ug/g dry	<0.50	-	-	-
Methyl tert-butyl ether	0.05 ug/g dry	<0.05	-	-	-
Methylene Chloride	0.05 ug/g dry	<0.05	-	-	-
Styrene	0.05 ug/g dry	<0.05	-	-	-
1,1,1,2-Tetrachloroethane	0.05 ug/g dry	<0.05	-	-	-
1,1,2,2-Tetrachloroethane	0.05 ug/g dry	<0.05	-	-	-
Tetrachloroethylene	0.05 ug/g dry	<0.05	-	-	-
Toluene	0.05 ug/g dry	<0.05	-	-	-
1,1,1-Trichloroethane	0.05 ug/g dry	<0.05	-	-	-
1,1,2-Trichloroethane	0.05 ug/g dry	<0.05	-	-	-
Trichloroethylene	0.05 ug/g dry	<0.05	-	-	-
Trichlorofluoromethane	0.05 ug/g dry	<0.05	-	-	-
Vinyl chloride	0.02 ug/g dry	<0.02	-	-	-
m,p-Xylenes	0.05 ug/g dry	<0.05	-	-	-
o-Xylene	0.05 ug/g dry	<0.05	-	-	-
Xylenes, total	0.05 ug/g dry	<0.05	-	-	-
4-Bromofluorobenzene	Surrogate	103%	-	-	-
Dibromofluoromethane	Surrogate	107%	-	-	-
Toluene-d8	Surrogate	107%	-	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	-	-	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	-	-	-

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 01-Nov-2019
Order Date: 28-Oct-2019
Project Description: 191-12948-00

	Client ID:	BH19-4-SS2	-	-	-
	Sample Date:	28-Oct-19 13:20	-	-	-
	Sample ID:	1944109-01	-	-	-
	MDL/Units	Soil	-	-	-
F3 PHCs (C16-C34)	8 ug/g dry	<8	-	-	-
F4 PHCs (C34-C50)	6 ug/g dry	<6	-	-	-
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	0.02	-	-	-
Acenaphthylene	0.02 ug/g dry	<0.02	-	-	-
Anthracene	0.02 ug/g dry	0.05	-	-	-
Benzo [a] anthracene	0.02 ug/g dry	0.07	-	-	-
Benzo [a] pyrene	0.02 ug/g dry	0.05	-	-	-
Benzo [b] fluoranthene	0.02 ug/g dry	0.06	-	-	-
Benzo [g,h,i] perylene	0.02 ug/g dry	0.03	-	-	-
Benzo [k] fluoranthene	0.02 ug/g dry	0.03	-	-	-
Chrysene	0.02 ug/g dry	0.07	-	-	-
Dibenzo [a,h] anthracene	0.02 ug/g dry	<0.02	-	-	-
Fluoranthene	0.02 ug/g dry	0.19	-	-	-
Fluorene	0.02 ug/g dry	0.02	-	-	-
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	0.03	-	-	-
1-Methylnaphthalene	0.02 ug/g dry	0.02	-	-	-
2-Methylnaphthalene	0.02 ug/g dry	0.04	-	-	-
Methylnaphthalene (1&2)	0.04 ug/g dry	0.06	-	-	-
Naphthalene	0.01 ug/g dry	0.03	-	-	-
Phenanthrene	0.02 ug/g dry	0.16	-	-	-
Pyrene	0.02 ug/g dry	0.15	-	-	-
2-Fluorobiphenyl	Surrogate	56.4%	-	-	-
Terphenyl-d14	Surrogate	58.8%	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	ug/g						
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g						
Acenaphthylene	ND	0.02	ug/g						
Anthracene	ND	0.02	ug/g						
Benzo [a] anthracene	ND	0.02	ug/g						
Benzo [a] pyrene	ND	0.02	ug/g						
Benzo [b] fluoranthene	ND	0.02	ug/g						
Benzo [g,h,i] perylene	ND	0.02	ug/g						
Benzo [k] fluoranthene	ND	0.02	ug/g						
Chrysene	ND	0.02	ug/g						
Dibenzo [a,h] anthracene	ND	0.02	ug/g						
Fluoranthene	ND	0.02	ug/g						
Fluorene	ND	0.02	ug/g						
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g						
1-Methylnaphthalene	ND	0.02	ug/g						
2-Methylnaphthalene	ND	0.02	ug/g						
Methylnaphthalene (1&2)	ND	0.04	ug/g						
Naphthalene	ND	0.01	ug/g						
Phenanthrene	ND	0.02	ug/g						
Pyrene	ND	0.02	ug/g						
Surrogate: 2-Fluorobiphenyl	*1.19*		*ug/g*		*89.2*	*50-140*			
Surrogate: Terphenyl-d14	*1.42*		*ug/g*		*106*	*50-140*			
Volatiles									
Acetone	ND	0.50	ug/g						
Benzene	ND	0.02	ug/g						
Bromodichloromethane	ND	0.05	ug/g						
Bromoform	ND	0.05	ug/g						
Bromomethane	ND	0.05	ug/g						
Carbon Tetrachloride	ND	0.05	ug/g						
Chlorobenzene	ND	0.05	ug/g						
Chloroform	ND	0.05	ug/g						
Dibromochloromethane	ND	0.05	ug/g						
Dichlorodifluoromethane	ND	0.05	ug/g						

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,2-Dichlorobenzene	ND	0.05	ug/g						
1,3-Dichlorobenzene	ND	0.05	ug/g						
1,4-Dichlorobenzene	ND	0.05	ug/g						
1,1-Dichloroethane	ND	0.05	ug/g						
1,2-Dichloroethane	ND	0.05	ug/g						
1,1-Dichloroethylene	ND	0.05	ug/g						
cis-1,2-Dichloroethylene	ND	0.05	ug/g						
trans-1,2-Dichloroethylene	ND	0.05	ug/g						
1,2-Dichloropropane	ND	0.05	ug/g						
cis-1,3-Dichloropropylene	ND	0.05	ug/g						
trans-1,3-Dichloropropylene	ND	0.05	ug/g						
1,3-Dichloropropene, total	ND	0.05	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Ethylene dibromide (dibromoethane	ND	0.05	ug/g						
Hexane	ND	0.05	ug/g						
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g						
Methyl Isobutyl Ketone	ND	0.50	ug/g						
Methyl tert-butyl ether	ND	0.05	ug/g						
Methylene Chloride	ND	0.05	ug/g						
Styrene	ND	0.05	ug/g						
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g						
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g						
Tetrachloroethylene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
1,1,1-Trichloroethane	ND	0.05	ug/g						
1,1,2-Trichloroethane	ND	0.05	ug/g						
Trichloroethylene	ND	0.05	ug/g						
Trichlorofluoromethane	ND	0.05	ug/g						
Vinyl chloride	ND	0.02	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: 4-Bromofluorobenzene	*9.34*		*ug/g*		*117*	*50-140*			
Surrogate: Dibromofluoromethane	*8.56*		*ug/g*		*107*	*50-140*			
Surrogate: Toluene-d8	*8.22*		*ug/g*		*103*	*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)	137	4	ug/g dry	120			13.2	30	
F3 PHCs (C16-C34)	218	8	ug/g dry	188			14.8	30	
F4 PHCs (C34-C50)	155	6	ug/g dry	148			5.0	30	
Metals									
Antimony	2.1	1.0	ug/g dry	ND			0.0	30	
Arsenic	ND	1.0	ug/g dry	1.1			0.0	30	
Barium	37.1	1.0	ug/g dry	47.4			24.3	30	
Beryllium	ND	0.5	ug/g dry	ND			0.0	30	
Boron	5.5	5.0	ug/g dry	5.6			1.1	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium (VI)	ND	0.2	ug/g dry	ND				35	
Chromium	8.7	5.0	ug/g dry	10.4			17.0	30	
Cobalt	2.6	1.0	ug/g dry	3.3			24.7	30	
Copper	5.5	5.0	ug/g dry	6.9			23.3	30	
Lead	2.9	1.0	ug/g dry	3.7			22.1	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	5.9	5.0	ug/g dry	7.1			19.6	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.3	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	12.6	10.0	ug/g dry	14.7			15.2	30	
Zinc	ND	20.0	ug/g dry	ND			0.0	30	
Physical Characteristics									
% Solids	80.6	0.1	% by Wt.	80.4			0.2	25	
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g dry	ND				40	
Acenaphthylene	ND	0.02	ug/g dry	ND				40	
Anthracene	0.027	0.02	ug/g dry	ND			0.0	40	
Benzo [a] anthracene	ND	0.02	ug/g dry	ND			0.0	40	
Benzo [a] pyrene	ND	0.02	ug/g dry	ND			0.0	40	
Benzo [b] fluoranthene	ND	0.02	ug/g dry	ND			0.0	40	
Benzo [g,h,i] perylene	ND	0.02	ug/g dry	ND				40	
Benzo [k] fluoranthene	ND	0.02	ug/g dry	ND				40	
Chrysene	ND	0.02	ug/g dry	ND			0.0	40	
Dibenzo [a,h] anthracene	ND	0.02	ug/g dry	ND				40	
Fluoranthene	0.027	0.02	ug/g dry	0.027			0.3	40	
Fluorene	ND	0.02	ug/g dry	ND				40	
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g dry	ND				40	
1-Methylnaphthalene	ND	0.02	ug/g dry	ND				40	
2-Methylnaphthalene	ND	0.02	ug/g dry	ND				40	
Naphthalene	ND	0.01	ug/g dry	ND				40	
Phenanthrene	0.025	0.02	ug/g dry	0.025			1.5	40	
Pyrene	0.022	0.02	ug/g dry	0.023			2.4	40	
Surrogate: 2-Fluorobiphenyl	*0.896*		*ug/g dry*		*52.0*	*50-140*			
Surrogate: Terphenyl-d14	*0.967*		*ug/g dry*		*56.1*	*50-140*			
Volatiles									
Acetone	ND	0.50	ug/g dry	ND				50	
Benzene	ND	0.02	ug/g dry	ND				50	
Bromodichloromethane	ND	0.05	ug/g dry	ND				50	
Bromoform	ND	0.05	ug/g dry	ND				50	
Bromomethane	ND	0.05	ug/g dry	ND				50	
Carbon Tetrachloride	ND	0.05	ug/g dry	ND				50	
Chlorobenzene	ND	0.05	ug/g dry	ND				50	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chloroform	ND	0.05	ug/g dry	ND				50	
Dibromochloromethane	ND	0.05	ug/g dry	ND				50	
Dichlorodifluoromethane	ND	0.05	ug/g dry	ND				50	
1,2-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,3-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,4-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,1-Dichloroethane	ND	0.05	ug/g dry	ND				50	
1,2-Dichloroethane	ND	0.05	ug/g dry	ND				50	
1,1-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
cis-1,2-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
trans-1,2-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
1,2-Dichloropropane	ND	0.05	ug/g dry	ND				50	
cis-1,3-Dichloropropylene	ND	0.05	ug/g dry	ND				50	
trans-1,3-Dichloropropylene	ND	0.05	ug/g dry	ND				50	
Ethylbenzene	ND	0.05	ug/g dry	ND				50	
Ethylene dibromide (dibromoethane	ND	0.05	ug/g dry	ND				50	
Hexane	ND	0.05	ug/g dry	ND				50	
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g dry	ND				50	
Methyl Isobutyl Ketone	ND	0.50	ug/g dry	ND				50	
Methyl tert-butyl ether	ND	0.05	ug/g dry	ND				50	
Methylene Chloride	ND	0.05	ug/g dry	ND				50	
Styrene	ND	0.05	ug/g dry	ND				50	
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g dry	ND				50	
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g dry	ND				50	
Tetrachloroethylene	ND	0.05	ug/g dry	ND				50	
Toluene	ND	0.05	ug/g dry	ND				50	
1,1,1-Trichloroethane	ND	0.05	ug/g dry	ND				50	
1,1,2-Trichloroethane	ND	0.05	ug/g dry	ND				50	
Trichloroethylene	ND	0.05	ug/g dry	ND				50	
Trichlorofluoromethane	ND	0.05	ug/g dry	ND				50	
Vinyl chloride	ND	0.02	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: 4-Bromofluorobenzene	*8.69*		*ug/g dry*		*99.5*	*50-140*			
Surrogate: Dibromofluoromethane	*9.37*		*ug/g dry*		*107*	*50-140*			
Surrogate: Toluene-d8	*9.52*		*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)	178	7	ug/g		88.9	80-120			
F2 PHCs (C10-C16)	193	4	ug/g	120	84.1	60-140			
F3 PHCs (C16-C34)	387	8	ug/g	188	93.3	60-140			
F4 PHCs (C34-C50)	276	6	ug/g	148	94.6	60-140			
Metals									
Antimony	42.7		ug/L	ND	85.3	70-130			
Arsenic	47.1		ug/L	ND	93.2	70-130			
Barium	70.4		ug/L	19.0	103	70-130			
Beryllium	52.4		ug/L	ND	105	70-130			
Boron	46.0		ug/L	ND	87.6	70-130			
Cadmium	50.0		ug/L	ND	100	70-130			
Chromium (VI)	4.5	0.2	ug/g		90.5	70-130			
Chromium	57.3		ug/L	ND	106	70-130			
Cobalt	50.6		ug/L	1.3	98.5	70-130			
Copper	53.5		ug/L	ND	102	70-130			
Lead	46.2		ug/L	1.5	89.5	70-130			
Mercury	1.22	0.1	ug/g	ND	81.5	70-130			
Molybdenum	48.5		ug/L	ND	96.8	70-130			
Nickel	53.7		ug/L	ND	102	70-130			
Selenium	49.3		ug/L	ND	98.4	70-130			
Silver	46.0		ug/L	ND	92.0	70-130			
Thallium	47.7		ug/L	ND	95.3	70-130			
Uranium	46.0		ug/L	ND	91.9	70-130			
Vanadium	57.5		ug/L	ND	103	70-130			
Zinc	57.6		ug/L	ND	99.4	70-130			
Semi-Volatiles									
Acenaphthene	0.137	0.02	ug/g	ND	63.6	50-140			
Acenaphthylene	0.120	0.02	ug/g	ND	55.8	50-140			
Anthracene	0.139	0.02	ug/g	ND	64.5	50-140			
Benzo [a] anthracene	0.131	0.02	ug/g	ND	61.0	50-140			
Benzo [a] pyrene	0.118	0.02	ug/g		70.6	50-140			
Benzo [b] fluoranthene	0.164	0.02	ug/g	ND	76.1	50-140			
Benzo [g,h,i] perylene	0.114	0.02	ug/g		68.6	50-140			
Benzo [k] fluoranthene	0.138	0.02	ug/g	ND	64.0	50-140			
Chrysene	0.170	0.02	ug/g	ND	79.0	50-140			
Dibenzo [a,h] anthracene	0.116	0.02	ug/g		69.6	50-140			
Fluoranthene	0.154	0.02	ug/g	0.027	58.9	50-140			
Fluorene	0.126	0.02	ug/g	ND	58.7	50-140			
Indeno [1,2,3-cd] pyrene	0.116	0.02	ug/g		69.6	50-140			
1-Methylnaphthalene	0.131	0.02	ug/g	ND	60.7	50-140			
2-Methylnaphthalene	0.141	0.02	ug/g	ND	65.4	50-140			
Naphthalene	0.131	0.01	ug/g	ND	60.8	50-140			
Phenanthrene	0.157	0.02	ug/g	0.025	61.5	50-140			
Pyrene	0.154	0.02	ug/g	0.023	60.7	50-140			
Surrogate: 2-Fluorobiphenyl	*0.959*		*ug/g*		*55.7*	*50-140*			
Volatiles									
Acetone	8.99	0.50	ug/g		89.9	50-140			
Benzene	3.54	0.02	ug/g		88.6	60-130			
Bromodichloromethane	3.98	0.05	ug/g		99.4	60-130			
Bromoform	3.69	0.05	ug/g		92.3	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Bromomethane	2.53	0.05	ug/g		63.3	50-140			
Carbon Tetrachloride	3.65	0.05	ug/g		91.3	60-130			
Chlorobenzene	3.91	0.05	ug/g		97.8	60-130			
Chloroform	3.96	0.05	ug/g		99.1	60-130			
Dibromochloromethane	3.70	0.05	ug/g		92.5	60-130			
Dichlorodifluoromethane	3.57	0.05	ug/g		89.3	50-140			
1,2-Dichlorobenzene	3.83	0.05	ug/g		95.7	60-130			
1,3-Dichlorobenzene	4.02	0.05	ug/g		100	60-130			
1,4-Dichlorobenzene	3.97	0.05	ug/g		99.2	60-130			
1,1-Dichloroethane	4.04	0.05	ug/g		101	60-130			
1,2-Dichloroethane	3.95	0.05	ug/g		98.7	60-130			
1,1-Dichloroethylene	3.26	0.05	ug/g		81.5	60-130			
cis-1,2-Dichloroethylene	3.68	0.05	ug/g		92.0	60-130			
trans-1,2-Dichloroethylene	3.27	0.05	ug/g		81.8	60-130			
1,2-Dichloropropane	3.79	0.05	ug/g		94.8	60-130			
cis-1,3-Dichloropropylene	3.53	0.05	ug/g		88.1	60-130			
trans-1,3-Dichloropropylene	3.67	0.05	ug/g		91.8	60-130			
Ethylbenzene	4.15	0.05	ug/g		104	60-130			
Ethylene dibromide (dibromoethane	3.43	0.05	ug/g		85.6	60-130			
Hexane	3.85	0.05	ug/g		96.3	60-130			
Methyl Ethyl Ketone (2-Butanone)	9.19	0.50	ug/g		91.9	50-140			
Methyl Isobutyl Ketone	7.32	0.50	ug/g		73.2	50-140			
Methyl tert-butyl ether	6.38	0.05	ug/g		63.8	50-140			
Methylene Chloride	3.14	0.05	ug/g		78.6	60-130			
Styrene	3.83	0.05	ug/g		95.7	60-130			
1,1,1,2-Tetrachloroethane	4.13	0.05	ug/g		103	60-130			
1,1,2,2-Tetrachloroethane	3.34	0.05	ug/g		83.5	60-130			
Tetrachloroethylene	3.39	0.05	ug/g		84.6	60-130			
Toluene	3.72	0.05	ug/g		92.9	60-130			
1,1,1-Trichloroethane	3.53	0.05	ug/g		88.1	60-130			
1,1,2-Trichloroethane	2.96	0.05	ug/g		74.1	60-130			
Trichloroethylene	3.19	0.05	ug/g		79.7	60-130			
Trichlorofluoromethane	3.21	0.05	ug/g		80.4	50-140			
Vinyl chloride	4.40	0.02	ug/g		110	50-140			
m,p-Xylenes	7.79	0.05	ug/g		97.4	60-130			
o-Xylene	4.17	0.05	ug/g		104	60-130			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

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

Paracel ID: 1944109

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Paracel Order Number (Lab Use Only): 1944108-TCLP / 1944109-Bulk

Chain Of Custody (Lab Use Only)

№ 124408

Client Name: WSP Canada Inc	Project Ref: 191-12948-00
Contact Name: Adrian Merghart	Quote #:
Address: 2611 Queensview Dr	PO #: 19-029
	E-mail: Adrian.Merghart@wsp.com
Telephone: 343-961-1429	

Page 1 of 1

Turnaround Time

☐ 1 day ☐ 3 day
☐ 2 day ☒ Regular

Date Required: ________

Regulation 153/04

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

Other Regulation

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

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

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	TCLP		
1	BH19-4-SS2	S		2	Oct.28	1:20pm	/	/	/	/	/	/			250mL+1 vial	/
2	TCLP	S		1	Oct.28	1:35pm								/	250mL	/
3																
4																
5																
6																
7																
8																
9																
10																

Comments: * [illegible] REG 558 [illegible] PAH [illegible] VOC + TPH as PHC F1-F4.

Method of Delivery: Paracel

Relinquished By (Sign): [illegible]	Received By Driver/Depot: [illegible]	Received at Lab: Suneeporn Dokmai	Verified By: [illegible]
Relinquished By (Print): Adrian Merghart	Date/Time: 28/10/19 3:40 PM	Date/Time: Oct 28, 2019 05.20	Date/Time: 1-22-19 17:34
Date/Time: Oct 28 2019	Temperature: °C	Temperature: 13.6 °C	pH Verified: ☐ By:

APPENDIX

D-2 TCLP

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Certificate of Analysis

WSP Canada Inc. (Ottawa)

2611 Queensview Dr
Ottawa, ON K2B 8K2
Attn: Adrian Menyhart

Client PO:
Project: 191-12948-00
Custody: 124408

Report Date: 4-Nov-2019
Order Date: 28-Oct-2019

Order #: 1944108

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

Paracel ID	Client ID
1944108-01	TCLP

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 04-Nov-2019
Order Date: 28-Oct-2019
Project Description: 191-12948-00

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Flashpoint	ASTM D93 - Pensky-Martens Closed Cup	29-Oct-19	29-Oct-19
Metals, ICP-MS	TCLP EPA 6020 - Digestion - ICP-MS	30-Oct-19	30-Oct-19
REG 558 - Cyanide	MOE E3015- Auto Colour	30-Oct-19	30-Oct-19
REG 558 - Fluoride	EPA 340.2 - ISE	30-Oct-19	30-Oct-19
REG 558 - Mercury by CVAA	EPA 7470A - Cold Vapour AA	30-Oct-19	30-Oct-19
REG 558 - NO3/NO2	EPA 300.1 - IC	30-Oct-19	30-Oct-19
REG 558 - PAHs	EPA 625 - GC-MS	31-Oct-19	1-Nov-19
REG 558 - VOCs	EPA 624 - P&T GC-MS	31-Oct-19	1-Nov-19
Solids, %	Gravimetric, calculation	29-Oct-19	29-Oct-19

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 04-Nov-2019
Order Date: 28-Oct-2019
Project Description: 191-12948-00

	Client ID:	TCLP	-	-	-
	Sample Date:	28-Oct-19 13:35	-	-	-
	Sample ID:	1944108-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	92.9	-	-	-
Flashpoint	℃	>70	-	-	-
EPA 1311 - TCLP Leachate Inorganics					
Fluoride	0.05 mg/L	0.23	-	-	-
Nitrate as N	1 mg/L	<1	-	-	-
Nitrite as N	1 mg/L	<1	-	-	-
Cyanide, free	0.02 mg/L	<0.02	-	-	-
EPA 1311 - TCLP Leachate Metals					
Arsenic	0.05 mg/L	<0.05	-	-	-
Barium	0.05 mg/L	1.13	-	-	-
Boron	0.05 mg/L	<0.05	-	-	-
Cadmium	0.01 mg/L	<0.01	-	-	-
Chromium	0.05 mg/L	<0.05	-	-	-
Lead	0.05 mg/L	<0.05	-	-	-
Mercury	0.005 mg/L	<0.005	-	-	-
Selenium	0.05 mg/L	<0.05	-	-	-
Silver	0.05 mg/L	<0.05	-	-	-
Uranium	0.05 mg/L	<0.05	-	-	-
EPA 1311 - TCLP Leachate Volatiles					
Benzene	0.005 mg/L	<0.005	-	-	-
Carbon Tetrachloride	0.005 mg/L	<0.005	-	-	-
Chlorobenzene	0.004 mg/L	<0.004	-	-	-
Chloroform	0.006 mg/L	<0.006	-	-	-
1,2-Dichlorobenzene	0.004 mg/L	<0.004	-	-	-
1,4-Dichlorobenzene	0.004 mg/L	<0.004	-	-	-
1,2-Dichloroethane	0.005 mg/L	<0.005	-	-	-
1,1-Dichloroethylene	0.006 mg/L	<0.006	-	-	-
Methyl Ethyl Ketone (2-Butanone)	0.30 mg/L	<0.30	-	-	-
Methylene Chloride	0.04 mg/L	<0.04	-	-	-
Tetrachloroethylene	0.005 mg/L	<0.005	-	-	-
Trichloroethylene	0.004 mg/L	<0.004	-	-	-
Vinyl chloride	0.005 mg/L	<0.005	-	-	-
4-Bromofluorobenzene	Surrogate	107%	-	-	-
Dibromofluoromethane	Surrogate	87.4%	-	-	-
Toluene-d8	Surrogate	97.8%	-	-	-
EPA 1311 - TCLP Leachate Organics					

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 04-Nov-2019
Order Date: 28-Oct-2019
Project Description: 191-12948-00

	Client ID:	TCLP	-	-	-
	Sample Date:	28-Oct-19 13:35	-	-	-
	Sample ID:	1944108-01	-	-	-
	MDL/Units	Soil	-	-	-
Benzo [a] pyrene	0.0001 mg/L	<0.0001	-	-	-
Terphenyl-d14	Surrogate	119%	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
EPA 1311 - TCLP Leachate Inorganics									
Fluoride	ND	0.05	mg/L						
Nitrate as N	ND	1	mg/L						
Nitrite as N	ND	1	mg/L						
Cyanide, free	ND	0.02	mg/L						
EPA 1311 - TCLP Leachate Metals									
Arsenic	ND	0.05	mg/L						
Barium	ND	0.05	mg/L						
Boron	ND	0.05	mg/L						
Cadmium	ND	0.01	mg/L						
Chromium	ND	0.05	mg/L						
Lead	ND	0.05	mg/L						
Mercury	ND	0.005	mg/L						
Selenium	ND	0.05	mg/L						
Silver	ND	0.05	mg/L						
Uranium	ND	0.05	mg/L						
EPA 1311 - TCLP Leachate Organics									
Benzo [a] pyrene	ND	0.0001	mg/L						
Surrogate: Terphenyl-d14	*0.21*		*mg/L*		*106*	*37.1-155.6*			
EPA 1311 - TCLP Leachate Volatiles									
Benzene	ND	0.005	mg/L						
Carbon Tetrachloride	ND	0.005	mg/L						
Chlorobenzene	ND	0.004	mg/L						
Chloroform	ND	0.006	mg/L						
1,2-Dichlorobenzene	ND	0.004	mg/L						
1,4-Dichlorobenzene	ND	0.004	mg/L						
1,2-Dichloroethane	ND	0.005	mg/L						
1,1-Dichloroethylene	ND	0.006	mg/L						
Methyl Ethyl Ketone (2-Butanone)	ND	0.30	mg/L						
Methylene Chloride	ND	0.04	mg/L						
Tetrachloroethylene	ND	0.005	mg/L						
Trichloroethylene	ND	0.004	mg/L						
Vinyl chloride	ND	0.005	mg/L						
Surrogate: 4-Bromofluorobenzene	*0.719*		*mg/L*		*105*	*83-134*			
Surrogate: Dibromofluoromethane	*0.671*		*mg/L*		*97.5*	*78-124*			
Surrogate: Toluene-d8	*0.685*		*mg/L*		*99.6*	*76-118*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
EPA 1311 - TCLP Leachate Inorganics									
Fluoride	0.11	0.05	mg/L	0.11			7.8	20	
Nitrate as N	ND	1	mg/L	ND				20	
Nitrite as N	ND	1	mg/L	ND				20	
Cyanide, free	ND	0.02	mg/L	ND				20	
EPA 1311 - TCLP Leachate Metals									
Arsenic	ND	0.05	mg/L	ND			0.0	29	
Barium	0.381	0.05	mg/L	0.373			2.1	34	
Boron	0.050	0.05	mg/L	ND			0.0	33	
Cadmium	ND	0.01	mg/L	ND			0.0	33	
Chromium	ND	0.05	mg/L	ND			0.0	32	
Lead	ND	0.05	mg/L	ND			0.0	32	
Mercury	ND	0.005	mg/L	ND			0.0	30	
Selenium	ND	0.05	mg/L	ND			0.0	28	
Silver	ND	0.05	mg/L	ND			0.0	28	
Uranium	ND	0.05	mg/L	ND			0.0	27	
Physical Characteristics									
% Solids	80.6	0.1	% by Wt.	80.4			0.2	25	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
EPA 1311 - TCLP Leachate Inorganics									
Fluoride	0.69	0.05	mg/L	0.11	114	70-130			
Nitrate as N	11	1	mg/L	ND	107	81-112			
Nitrite as N	9	1	mg/L	ND	90.4	76-107			
Cyanide, free	0.054	0.02	mg/L	ND	109	60-136			
EPA 1311 - TCLP Leachate Metals									
Arsenic	49.3		ug/L	0.211	98.2	83-119			
Barium	87.3		ug/L	37.3	100	83-116			
Boron	45.8		ug/L	4.83	82.0	71-128			
Cadmium	49.5		ug/L	0.185	98.6	78-119			
Chromium	57.3		ug/L	0.306	114	80-124			
Lead	42.2		ug/L	0.896	82.7	77-126			
Mercury	0.0327	0.005	mg/L	ND	109	70-130			
Selenium	41.8		ug/L	0.196	83.2	81-125			
Silver	42.6		ug/L	0.104	85.0	70-128			
Uranium	46.6		ug/L	0.751	91.7	70-131			
EPA 1311 - TCLP Leachate Organics									
Benzo [a] pyrene	0.0466	0.0001	mg/L		93.2	39-123			
Surrogate: Terphenyl-d14	*0.22*		*mg/L*		*109*	*37.1-155.6*			
EPA 1311 - TCLP Leachate Volatiles									
Benzene	44.8		ug/L		112	55-141			
Carbon Tetrachloride	27.9		ug/L		69.8	49-149			
Chlorobenzene	35.9		ug/L		89.8	64-137			
Chloroform	33.2		ug/L		83.1	58-138			
1,2-Dichlorobenzene	40.4		ug/L		101	60-150			
1,4-Dichlorobenzene	39.1		ug/L		97.8	63-132			
1,2-Dichloroethane	26.8		ug/L		66.9	50-140			
1,1-Dichloroethylene	38.4		ug/L		95.9	43-153			
Methyl Ethyl Ketone (2-Butanone)	75.0		ug/L		75.0	26-153			
Methylene Chloride	33.3		ug/L		83.3	58-149			
Tetrachloroethylene	37.5		ug/L		93.8	51-145			
Trichloroethylene	46.9		ug/L		117	52-135			
Vinyl chloride	37.5		ug/L		93.7	31-159			

Qualifier Notes:

Login Qualifiers :

Sample - F1/BTEX/VOCs (soil) not submitted according to Reg. 153/04, Amended 2011 - not field preserved
Applies to samples: TCLP

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.

PARACEL LABORATORIES

Paracel ID: 1944108

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Paracel Order Number (Lab Use Only): 1944108-TCLP / 1944109-Bulk

Chain Of Custody

(Lab Use Only)

№ 124408

Page 1 of 1

Client Name: WSP Canada Inc	Project Ref: 191-12948-00
Contact Name: Adrian Meryhart	Quote #:
Address: 2611 Queensview Rd Dr	PO #: 19-029
	E-mail: Adrian.Meryhart@wsp.com
Telephone: 343-961-1429	

Turnaround Time

☐ 1 day ☐ 3 day

☐ 2 day ☒ Regular

Date Required:

Regulation 153/04

☐ Table 1 ☐ Res/Park ☐ Med/Fine

☐ Table 2 ☐ Ind/Comm ☒ Coarse

☑ Table 3 ☐ Agri/Other

☐ Table ___

For RSC: ☐ Yes ☑ No

Other Regulation

☒ REG 558 ☐ PWQO

☐ CCME ☐ MISA

☐ SU - Sani ☐ SU - Storm

Mun: ___

☐ Other:

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

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Date	Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	TCLP *					
1	BH19-4-SS2	S		2	Oct.28	1:20pm	/	/	/	/	/	/				250ml+1 vial			
2	TCLP	S		1	Oct.28	1:35pm								/		250ml			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			

Comments:
* Flushpoint, REG 558: MET. +INORG, 558: PAH, 558: VOC + TPH AS PHC F1-F4

Method of Delivery: Paracel

Relinquished By (Sign): [signature]	Received By Driver/Depot: M. DEOUSE	Received at Lab: Suneeporn Dohmai	Verified By: [signature]
Relinquished By (Print): ADRIAN MERYHART	Date/Time: 28/10/19 3:40 PM	Date/Time: Oct 28, 2019 05.20	Date/Time: 1-23-19 17:34
Date/Time: Oct 28 2019	Temperature: °C	Temperature: 13.6 °C	pH Verified: ☐ By:

Revision 3.0

Chain of Custody (Env.) xlsx

APPENDIX

D-3 GROUNDWATER

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Certificate of Analysis

WSP Canada Inc. (Ottawa)

2611 Queensview Dr
Ottawa, ON K2B 8K2
Attn: Adrian Menyhart

Client PO:
Project: 191-12948-00
Custody: 124027

Report Date: 12-Nov-2019
Order Date: 5-Nov-2019

Order #: 1945295

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

Paracel ID	Client ID	Paracel ID	Client ID
1945295-01	BH19-6		
1945295-02	BH19-4		
1945295-03	BH19-10		
1945295-04	DUP		

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 12-Nov-2019
Order Date: 5-Nov-2019
Project Description: 191-12948-00

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	8-Nov-19	8-Nov-19
Chromium, hexavalent - water	MOE E3056 - colourimetric	7-Nov-19	7-Nov-19
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	6-Nov-19	7-Nov-19
Metals, ICP-MS	EPA 200.8 - ICP-MS	6-Nov-19	6-Nov-19
PHC F1	CWS Tier 1 - P&T GC-FID	7-Nov-19	8-Nov-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	12-Nov-19	10-Nov-19
REG 153: PAHs by GC-MS	EPA 625 - GC-MS, extraction	6-Nov-19	8-Nov-19
REG 153: VOCs by P&T GC/MS	EPA 624 - P&T GC-MS	7-Nov-19	8-Nov-19

Summary of Exceedances

(If this page is blank then there are no exceedances)

Only those criteria that a sample exceeds will be highlighted in red

Regulatory Comparison:

Paracel Laboratories has provided regulatory guidelines on this report for informational purposes only and makes no representations or warranties that the data is accurate or reflects the current regulatory values. The user is advised to consult with the appropriate official regulations to evaluate compliance. Sample results that are highlighted have exceeded the selected regulatory limit. Calculated uncertainty estimations have not been applied for determining regulatory exceedances. Regulatory limts displayed in brackets, (), applies to medium and fine textured soils.

Criteria:

Client ID	Analyte	MDL / Units	Result	Reg 153/04 (2011)-Table 3 Non-Potable Groundwater

PARACEL LABORATORIES LTD.

Order #: 1945295

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 12-Nov-2019
Order Date: 5-Nov-2019
Project Description: 191-12948-00

	Client ID:	BH19-6	BH19-4	BH19-10	DUP	Criteria:	
	Sample Date:	04-Nov-2019	04-Nov-2019	04-Nov-2019	04-Nov-2019		
	Sample ID:	1945295-01	1945295-02	1945295-03	1945295-04	Reg 153/04 (2011)-Table 3 Non-Potable Groundwater	
	Matrix:	Water	Water	Water	Water		
	MDL/Units						
Metals							
Mercury	0.1 ug/L	<0.1	<0.1	-	<0.1	0.29	ug/L
Antimony	0.5 ug/L	<0.5	<0.5	-	<0.5	20,000	ug/L
Arsenic	1 ug/L	<1	<1	-	<1	1,900	ug/L
Barium	1 ug/L	236	181	-	184	29,000	ug/L
Beryllium	0.5 ug/L	<0.5	<0.5	-	<0.5	67	ug/L
Boron	10 ug/L	55	72	-	71	45,000	ug/L
Cadmium	0.1 ug/L	<0.1	<0.1	-	<0.1	2.7	ug/L
Chromium	1 ug/L	<1	<1	-	<1	810	ug/L
Chromium (VI)	10 ug/L	<10	<10	-	<10	140	ug/L
Cobalt	0.5 ug/L	0.9	<0.5	-	<0.5	66	ug/L
Copper	0.5 ug/L	0.5	<0.5	-	<0.5	87	ug/L
Lead	0.1 ug/L	<0.1	<0.1	-	<0.1	25	ug/L
Molybdenum	0.5 ug/L	3.3	0.7	-	0.5	9,200	ug/L
Nickel	1 ug/L	2	<1	-	<1	490	ug/L
Selenium	1 ug/L	<1	<1	-	<1	63	ug/L
Silver	0.1 ug/L	<0.1	<0.1	-	<0.1	1.5	ug/L
Sodium	200 ug/L	651000	402000	-	397000	2,300,000	ug/L
Thallium	0.1 ug/L	<0.1	<0.1	-	<0.1	510	ug/L
Uranium	0.1 ug/L	0.3	0.2	-	0.1	420	ug/L
Vanadium	0.5 ug/L	<0.5	<0.5	-	<0.5	250	ug/L
Zinc	5 ug/L	<5	6	-	<5	1,100	ug/L
Volatiles							
Acetone	5.0 ug/L	<5.0	-	<5.0	-	130,000	ug/L

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 12-Nov-2019
Order Date: 5-Nov-2019
Project Description: 191-12948-00

	Client ID:	BH19-6	BH19-4	BH19-10	DUP	Criteria:	
	Sample Date:	04-Nov-2019	04-Nov-2019	04-Nov-2019	04-Nov-2019		
	Sample ID:	1945295-01	1945295-02	1945295-03	1945295-04	Reg 153/04 (2011)-Table 3 Non-Potable Groundwater	
	Matrix:	Water	Water	Water	Water		
	MDL/Units						
Benzene	0.5 ug/L	<0.5	-	<0.5	-	44	ug/L
Bromodichloromethane	0.5 ug/L	<0.5	-	<0.5	-	85,000	ug/L
Bromoform	0.5 ug/L	<0.5	-	<0.5	-	380	ug/L
Bromomethane	0.5 ug/L	<0.5	-	<0.5	-	5.6	ug/L
Carbon Tetrachloride	0.2 ug/L	<0.2	-	<0.2	-	0.79	ug/L
Chlorobenzene	0.5 ug/L	<0.5	-	<0.5	-	630	ug/L
Chloroform	0.5 ug/L	<0.5	-	<0.5	-	2.4	ug/L
Dibromochloromethane	0.5 ug/L	<0.5	-	<0.5	-	82,000	ug/L
Dichlorodifluoromethane	1.0 ug/L	<1.0	-	<1.0	-	4,400	ug/L
1,2-Dichlorobenzene	0.5 ug/L	<0.5	-	<0.5	-	4,600	ug/L
1,3-Dichlorobenzene	0.5 ug/L	<0.5	-	<0.5	-	9,600	ug/L
1,4-Dichlorobenzene	0.5 ug/L	<0.5	-	<0.5	-	8	ug/L
1,1-Dichloroethane	0.5 ug/L	<0.5	-	<0.5	-	320	ug/L
1,2-Dichloroethane	0.5 ug/L	<0.5	-	<0.5	-	1.6	ug/L
1,1-Dichloroethylene	0.5 ug/L	<0.5	-	<0.5	-	1.6	ug/L
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	<0.5	-	1.6	ug/L
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	<0.5	-	1.6	ug/L
1,2-Dichloropropane	0.5 ug/L	<0.5	-	<0.5	-	16	ug/L
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	<0.5	-		
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	<0.5	-		
1,3-Dichloropropene, total	0.5 ug/L	<0.5	-	<0.5	-	5.2	ug/L
Ethylbenzene	0.5 ug/L	<0.5	-	<0.5	-	2,300	ug/L
Ethylene dibromide (dibromoeth	0.2 ug/L	<0.2	-	<0.2	-	0.25	ug/L

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 12-Nov-2019
Order Date: 5-Nov-2019
Project Description: 191-12948-00

	Client ID:	BH19-6	BH19-4	BH19-10	DUP	Criteria:	
	Sample Date:	04-Nov-2019	04-Nov-2019	04-Nov-2019	04-Nov-2019		
	Sample ID:	1945295-01	1945295-02	1945295-03	1945295-04	Reg 153/04 (2011)-Table 3 Non-Potable Groundwater	
	Matrix:	Water	Water	Water	Water		
	MDL/Units						
Hexane	1.0 ug/L	<1.0	-	<1.0	-	51	ug/L
Methyl Ethyl Ketone (2-Butanon	5.0 ug/L	<5.0	-	<5.0	-	470,000	ug/L
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	-	<5.0	-	140,000	ug/L
Methyl tert-butyl ether	2.0 ug/L	<2.0	-	<2.0	-	190	ug/L
Methylene Chloride	5.0 ug/L	<5.0	-	<5.0	-	610	ug/L
Styrene	0.5 ug/L	<0.5	-	<0.5	-	1,300	ug/L
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	-	<0.5	-	3.3	ug/L
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	-	<0.5	-	3.2	ug/L
Tetrachloroethylene	0.5 ug/L	<0.5	-	<0.5	-	1.6	ug/L
Toluene	0.5 ug/L	<0.5	-	<0.5	-	18,000	ug/L
1,1,1-Trichloroethane	0.5 ug/L	<0.5	-	<0.5	-	640	ug/L
1,1,2-Trichloroethane	0.5 ug/L	<0.5	-	<0.5	-	4.7	ug/L
Trichloroethylene	0.5 ug/L	<0.5	-	<0.5	-	1.6	ug/L
Trichlorofluoromethane	1.0 ug/L	<1.0	-	<1.0	-	2,500	ug/L
Vinyl chloride	0.5 ug/L	<0.5	-	<0.5	-	0.5	ug/L
m,p-Xylenes	0.5 ug/L	<0.5	-	<0.5	-		
o-Xylene	0.5 ug/L	<0.5	-	<0.5	-		
Xylenes, total	0.5 ug/L	<0.5	-	<0.5	-	4,200	ug/L
4-Bromofluorobenzene	Surrogate	112%	-	112%	-		
Dibromofluoromethane	Surrogate	111%	-	109%	-		
Toluene-d8	Surrogate	96.9%	-	97.9%	-		
Benzene	0.5 ug/L	-	<0.5	-	<0.5	44	ug/L
Ethylbenzene	0.5 ug/L	-	<0.5	-	<0.5	2,300	ug/L
Toluene	0.5 ug/L	-	<0.5	-	<0.5	18,000	ug/L

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 12-Nov-2019
Order Date: 5-Nov-2019
Project Description: 191-12948-00

	Client ID:	BH19-6	BH19-4	BH19-10	DUP	Criteria:	
	Sample Date:	04-Nov-2019	04-Nov-2019	04-Nov-2019	04-Nov-2019		
	Sample ID:	1945295-01	1945295-02	1945295-03	1945295-04	Reg 153/04 (2011)-Table 3 Non-Potable Groundwater	
	Matrix:	Water	Water	Water	Water		
	MDL/Units						
m,p-Xylenes	0.5 ug/L	-	<0.5	-	<0.5		
o-Xylene	0.5 ug/L	-	<0.5	-	<0.5		
Xylenes, total	0.5 ug/L	-	<0.5	-	<0.5	4,200	ug/L
Toluene-d8	Surrogate	-	97.9%	-	97.5%		
Hydrocarbons							
F1 PHCs (C6-C10)	25 ug/L	<25	<25	<25	<25	750	ug/L
F2 PHCs (C10-C16)	100 ug/L	<100	<100	<100 [1]	<100	150	ug/L
F3 PHCs (C16-C34)	100 ug/L	<100	<100	<100 [1]	<100	500	ug/L
F4 PHCs (C34-C50)	100 ug/L	<100	<100	<100 [1]	<100	500	ug/L
Semi-Volatiles							
Acenaphthene	0.05 ug/L	<0.05	<0.05	-	<0.05	600	ug/L
Acenaphthylene	0.05 ug/L	<0.05	<0.05	-	<0.05	1.8	ug/L
Anthracene	0.01 ug/L	<0.01	<0.01	-	<0.01	2.4	ug/L
Benzo [a] anthracene	0.01 ug/L	<0.01	<0.01	-	<0.01	4.7	ug/L
Benzo [a] pyrene	0.01 ug/L	<0.01	<0.01	-	<0.01	0.81	ug/L
Benzo [b] fluoranthene	0.05 ug/L	<0.05	<0.05	-	<0.05	0.75	ug/L
Benzo [g,h,i] perylene	0.05 ug/L	<0.05	<0.05	-	<0.05	0.2	ug/L
Benzo [k] fluoranthene	0.05 ug/L	<0.05	<0.05	-	<0.05	0.4	ug/L
Chrysene	0.05 ug/L	<0.05	<0.05	-	<0.05	1	ug/L
Dibenzo [a,h] anthracene	0.05 ug/L	<0.05	<0.05	-	<0.05	0.52	ug/L
Fluoranthene	0.01 ug/L	<0.01	<0.01	-	<0.01	130	ug/L
Fluorene	0.05 ug/L	<0.05	<0.05	-	<0.05	400	ug/L
Indeno [1,2,3-cd] pyrene	0.05 ug/L	<0.05	<0.05	-	<0.05		
1-Methylnaphthalene	0.05 ug/L	<0.05	<0.05	-	<0.05	1,800	ug/L

Certificate of Analysis

Client: WSP Canada Inc. (Ottawa)

Client PO:

Report Date: 12-Nov-2019

Order Date: 5-Nov-2019

Project Description: 191-12948-00

	Client ID:	BH19-6	BH19-4	BH19-10	DUP	Criteria:	
	Sample Date:	04-Nov-2019	04-Nov-2019	04-Nov-2019	04-Nov-2019		
	Sample ID:	1945295-01	1945295-02	1945295-03	1945295-04	Reg 153/04 (2011)-Table 3 Non-Potable Groundwater	
	Matrix:	Water	Water	Water	Water		
	MDL/Units						
2-Methylnaphthalene	0.05 ug/L	<0.05	<0.05	-	<0.05	1,800	ug/L
Methylnaphthalene (1&2)	0.10 ug/L	<0.10	<0.10	-	<0.10	1,800	ug/L
Naphthalene	0.05 ug/L	<0.05	<0.05	-	<0.05	1,400	ug/L
Phenanthrene	0.05 ug/L	<0.05	<0.05	-	<0.05	580	ug/L
Pyrene	0.01 ug/L	<0.01	<0.01	-	<0.01	68	ug/L
2-Fluorobiphenyl	Surrogate	80.9%	85.3%	-	79.4%		
Terphenyl-d14	Surrogate	110%	120%	-	112%		

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						
Metals									
Mercury	ND	0.1	ug/L						
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	1	ug/L						
Beryllium	ND	0.5	ug/L						
Boron	ND	10	ug/L						
Cadmium	ND	0.1	ug/L						
Chromium (VI)	ND	10	ug/L						
Chromium	ND	1	ug/L						
Cobalt	ND	0.5	ug/L						
Copper	ND	0.5	ug/L						
Lead	ND	0.1	ug/L						
Molybdenum	ND	0.5	ug/L						
Nickel	ND	1	ug/L						
Selenium	ND	1	ug/L						
Silver	ND	0.1	ug/L						
Sodium	ND	200	ug/L						
Thallium	ND	0.1	ug/L						
Uranium	ND	0.1	ug/L						
Vanadium	ND	0.5	ug/L						
Zinc	ND	5	ug/L						
Semi-Volatiles									
Acenaphthene	ND	0.05	ug/L						
Acenaphthylene	ND	0.05	ug/L						
Anthracene	ND	0.01	ug/L						
Benzo [a] anthracene	ND	0.01	ug/L						
Benzo [a] pyrene	ND	0.01	ug/L						
Benzo [b] fluoranthene	ND	0.05	ug/L						
Benzo [g,h,i] perylene	ND	0.05	ug/L						
Benzo [k] fluoranthene	ND	0.05	ug/L						
Chrysene	ND	0.05	ug/L						
Dibenzo [a,h] anthracene	ND	0.05	ug/L						
Fluoranthene	ND	0.01	ug/L						
Fluorene	ND	0.05	ug/L						
Indeno [1,2,3-cd] pyrene	ND	0.05	ug/L						

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1-Methylnaphthalene	ND	0.05	ug/L						
2-Methylnaphthalene	ND	0.05	ug/L						
Methylnaphthalene (1&2)	ND	0.10	ug/L						
Naphthalene	ND	0.05	ug/L						
Phenanthrene	ND	0.05	ug/L						
Pyrene	ND	0.01	ug/L						
Surrogate: 2-Fluorobiphenyl	*19.2*		*ug/L*		*96.1*	*50-140*			
Surrogate: Terphenyl-d14	*22.3*		*ug/L*		*112*	*50-140*			
Volatiles									
Acetone	ND	5.0	ug/L						
Benzene	ND	0.5	ug/L						
Bromodichloromethane	ND	0.5	ug/L						
Bromoform	ND	0.5	ug/L						
Bromomethane	ND	0.5	ug/L						
Carbon Tetrachloride	ND	0.2	ug/L						
Chlorobenzene	ND	0.5	ug/L						
Chloroform	ND	0.5	ug/L						
Dibromochloromethane	ND	0.5	ug/L						
Dichlorodifluoromethane	ND	1.0	ug/L						
1,2-Dichlorobenzene	ND	0.5	ug/L						
1,3-Dichlorobenzene	ND	0.5	ug/L						
1,4-Dichlorobenzene	ND	0.5	ug/L						
1,1-Dichloroethane	ND	0.5	ug/L						
1,2-Dichloroethane	ND	0.5	ug/L						
1,1-Dichloroethylene	ND	0.5	ug/L						
cis-1,2-Dichloroethylene	ND	0.5	ug/L						
trans-1,2-Dichloroethylene	ND	0.5	ug/L						
1,2-Dichloropropane	ND	0.5	ug/L						
cis-1,3-Dichloropropylene	ND	0.5	ug/L						
trans-1,3-Dichloropropylene	ND	0.5	ug/L						
1,3-Dichloropropene, total	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Ethylene dibromide (dibromoethane	ND	0.2	ug/L						
Hexane	ND	1.0	ug/L						
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L						
Methyl Isobutyl Ketone	ND	5.0	ug/L						
Methyl tert-butyl ether	ND	2.0	ug/L						
Methylene Chloride	ND	5.0	ug/L						
Styrene	ND	0.5	ug/L						
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L						
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L						
Tetrachloroethylene	ND	0.5	ug/L						

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Toluene	ND	0.5	ug/L						
1,1,1-Trichloroethane	ND	0.5	ug/L						
1,1,2-Trichloroethane	ND	0.5	ug/L						
Trichloroethylene	ND	0.5	ug/L						
Trichlorofluoromethane	ND	1.0	ug/L						
Vinyl chloride	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: 4-Bromofluorobenzene	*86.2*		*ug/L*		*108*	*50-140*			
Surrogate: Dibromofluoromethane	*83.6*		*ug/L*		*105*	*50-140*			
Surrogate: Toluene-d8	*79.2*		*ug/L*		*99.0*	*50-140*			
Benzene	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: Toluene-d8	*79.2*		*ug/L*		*99.0*	*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	
Metals									
Mercury	ND	0.1	ug/L	ND			0.0	20	
Antimony	ND	0.5	ug/L	ND			0.0	20	
Arsenic	ND	1	ug/L	ND			0.0	20	
Barium	64.1	1	ug/L	61.8			3.6	20	
Beryllium	ND	0.5	ug/L	ND			0.0	20	
Boron	82	10	ug/L	86			5.0	20	
Cadmium	ND	0.1	ug/L	ND			0.0	20	
Chromium (VI)	ND	10	ug/L	ND			0.0	20	
Chromium	ND	1	ug/L	ND			0.0	20	
Cobalt	ND	0.5	ug/L	ND			0.0	20	
Copper	1.10	0.5	ug/L	1.13			2.8	20	
Lead	0.13	0.1	ug/L	ND			0.0	20	
Molybdenum	ND	0.5	ug/L	ND			0.0	20	
Nickel	ND	1	ug/L	ND			0.0	20	
Selenium	1.4	1	ug/L	1.4			2.4	20	
Silver	ND	0.1	ug/L	ND			0.0	20	
Sodium	63700	200	ug/L	69900			9.2	20	
Thallium	ND	0.1	ug/L	ND			0.0	20	
Uranium	0.4	0.1	ug/L	0.4			12.7	20	
Vanadium	ND	0.5	ug/L	ND			0.0	20	
Zinc	ND	5	ug/L	ND			0.0	20	
Volatiles									
Acetone	ND	5.0	ug/L	ND				30	
Benzene	ND	0.5	ug/L	ND				30	
Bromodichloromethane	ND	0.5	ug/L	ND				30	
Bromoform	ND	0.5	ug/L	ND				30	
Bromomethane	ND	0.5	ug/L	ND				30	
Carbon Tetrachloride	ND	0.2	ug/L	ND				30	
Chlorobenzene	ND	0.5	ug/L	ND				30	
Chloroform	ND	0.5	ug/L	ND				30	
Dibromochloromethane	ND	0.5	ug/L	ND				30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND				30	
1,2-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,1-Dichloroethane	ND	0.5	ug/L	ND				30	
1,2-Dichloroethane	ND	0.5	ug/L	ND				30	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1-Dichloroethylene	ND	0.5	ug/L	ND				30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
1,2-Dichloropropane	ND	0.5	ug/L	ND				30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Ethylene dibromide (dibromoethane	ND	0.2	ug/L	ND				30	
Hexane	ND	1.0	ug/L	ND				30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND				30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND				30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND				30	
Methylene Chloride	ND	5.0	ug/L	ND				30	
Styrene	ND	0.5	ug/L	ND				30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
Tetrachloroethylene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND				30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND				30	
Trichloroethylene	ND	0.5	ug/L	ND				30	
Trichlorofluoromethane	ND	1.0	ug/L	ND				30	
Vinyl chloride	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: 4-Bromofluorobenzene	*87.4*		ug/L		*109*	*50-140*			
Surrogate: Dibromofluoromethane	*53.1*		ug/L		*66.4*	*50-140*			
Surrogate: Toluene-d8	*78.9*		ug/L		*98.7*	*50-140*			
Benzene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: Toluene-d8	*78.9*		ug/L		*98.7*	*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)	1690	25	ug/L		84.6	68-117			
F2 PHCs (C10-C16)	1560	100	ug/L		97.3	60-140			
F3 PHCs (C16-C34)	4050	100	ug/L		103	60-140			
F4 PHCs (C34-C50)	3230	100	ug/L		130	60-140			
Metals									
Mercury	2.98	0.1	ug/L	ND	99.4	70-130			
Antimony	45.8		ug/L	ND	91.1	80-120			
Arsenic	49.6		ug/L	ND	98.9	80-120			
Barium	106		ug/L	61.8	88.3	80-120			
Beryllium	50.4		ug/L	ND	101	80-120			
Boron	123		ug/L	86	73.1	80-120			QM-07
Cadmium	45.2		ug/L	ND	90.4	80-120			
Chromium (VI)	179	10	ug/L	ND	89.5	70-130			
Chromium	56.8		ug/L	ND	113	80-120			
Cobalt	51.1		ug/L	ND	102	80-120			
Copper	49.0		ug/L	1.13	95.7	80-120			
Lead	42.7		ug/L	ND	85.1	80-120			
Molybdenum	49.6		ug/L	ND	98.8	80-120			
Nickel	48.4		ug/L	ND	96.4	80-120			
Selenium	46.7		ug/L	1.4	90.6	80-120			
Silver	43.6		ug/L	ND	87.1	80-120			
Sodium	9540		ug/L		95.4	80-120			
Thallium	36.7		ug/L	ND	73.3	80-120			QM-07
Uranium	40.9		ug/L	0.4	81.0	80-120			
Vanadium	58.2		ug/L	ND	116	80-120			
Zinc	47		ug/L	ND	90.4	80-120			
Semi-Volatiles									
Acenaphthene	4.90	0.05	ug/L		98.1	50-140			
Acenaphthylene	4.28	0.05	ug/L		85.5	50-140			
Anthracene	4.18	0.01	ug/L		83.6	50-140			
Benzo [a] anthracene	3.98	0.01	ug/L		79.6	50-140			
Benzo [a] pyrene	3.41	0.01	ug/L		68.2	50-140			
Benzo [b] fluoranthene	5.59	0.05	ug/L		112	50-140			
Benzo [g,h,i] perylene	3.44	0.05	ug/L		68.8	50-140			
Benzo [k] fluoranthene	5.98	0.05	ug/L		120	50-140			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chrysene	4.64	0.05	ug/L		92.8	50-140			
Dibenzo [a,h] anthracene	3.81	0.05	ug/L		76.3	50-140			
Fluoranthene	4.26	0.01	ug/L		85.2	50-140			
Fluorene	4.16	0.05	ug/L		83.2	50-140			
Indeno [1,2,3-cd] pyrene	3.18	0.05	ug/L		63.7	50-140			
1-Methylnaphthalene	4.73	0.05	ug/L		94.6	50-140			
2-Methylnaphthalene	5.23	0.05	ug/L		105	50-140			
Naphthalene	5.46	0.05	ug/L		109	50-140			
Phenanthrene	3.95	0.05	ug/L		79.0	50-140			
Pyrene	4.30	0.01	ug/L		86.1	50-140			
Surrogate: 2-Fluorobiphenyl	*20.4*		*ug/L*		*102*	*50-140*			
Volatiles									
Acetone	68.7	5.0	ug/L		68.7	50-140			
Benzene	31.2	0.5	ug/L		78.0	60-130			
Bromodichloromethane	32.4	0.5	ug/L		81.1	60-130			
Bromoform	31.1	0.5	ug/L		77.8	60-130			
Bromomethane	31.0	0.5	ug/L		77.4	50-140			
Carbon Tetrachloride	27.7	0.2	ug/L		69.2	60-130			
Chlorobenzene	35.3	0.5	ug/L		88.2	60-130			
Chloroform	31.2	0.5	ug/L		78.1	60-130			
Dibromochloromethane	31.0	0.5	ug/L		77.6	60-130			
Dichlorodifluoromethane	40.7	1.0	ug/L		102	50-140			
1,2-Dichlorobenzene	37.8	0.5	ug/L		94.6	60-130			
1,3-Dichlorobenzene	39.2	0.5	ug/L		97.9	60-130			
1,4-Dichlorobenzene	37.2	0.5	ug/L		93.0	60-130			
1,1-Dichloroethane	28.8	0.5	ug/L		71.9	60-130			
1,2-Dichloroethane	30.5	0.5	ug/L		76.2	60-130			
1,1-Dichloroethylene	26.2	0.5	ug/L		65.6	60-130			
cis-1,2-Dichloroethylene	28.2	0.5	ug/L		70.6	60-130			
trans-1,2-Dichloroethylene	25.7	0.5	ug/L		64.2	60-130			
1,2-Dichloropropane	35.2	0.5	ug/L		88.0	60-130			
cis-1,3-Dichloropropylene	35.9	0.5	ug/L		89.8	60-130			
trans-1,3-Dichloropropylene	34.6	0.5	ug/L		86.5	60-130			
Ethylbenzene	33.8	0.5	ug/L		84.4	60-130			
Ethylene dibromide (dibromoethane	39.8	0.2	ug/L		99.5	60-130			
Hexane	49.0	1.0	ug/L		122	60-130			
Methyl Ethyl Ketone (2-Butanone)	78.0	5.0	ug/L		78.0	50-140			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Methyl Isobutyl Ketone	59.5	5.0	ug/L		59.5	50-140			
Methyl tert-butyl ether	58.9	2.0	ug/L		58.9	50-140			
Methylene Chloride	28.5	5.0	ug/L		71.2	60-130			
Styrene	41.9	0.5	ug/L		105	60-130			
1,1,1,2-Tetrachloroethane	37.0	0.5	ug/L		92.4	60-130			
1,1,2,2-Tetrachloroethane	43.0	0.5	ug/L		108	60-130			
Tetrachloroethylene	37.6	0.5	ug/L		93.9	60-130			
Toluene	34.1	0.5	ug/L		85.2	60-130			
1,1,1-Trichloroethane	30.2	0.5	ug/L		75.5	60-130			
1,1,2-Trichloroethane	28.2	0.5	ug/L		70.4	60-130			
Trichloroethylene	29.0	0.5	ug/L		72.4	60-130			
Trichlorofluoromethane	36.1	1.0	ug/L		90.2	60-130			
Vinyl chloride	40.1	0.5	ug/L		100	50-140			
m,p-Xylenes	70.1	0.5	ug/L		87.6	60-130			
o-Xylene	34.8	0.5	ug/L		86.9	60-130			
Benzene	31.2	0.5	ug/L		78.0	60-130			
Ethylbenzene	33.8	0.5	ug/L		84.4	60-130			
Toluene	34.1	0.5	ug/L		85.2	60-130			
m,p-Xylenes	70.1	0.5	ug/L		87.6	60-130			
o-Xylene	34.8	0.5	ug/L		86.9	60-130			

PARACEL LABORATORIES LTD.

Order #: 1945295

Certificate of Analysis
Client: WSP Canada Inc. (Ottawa)
Client PO:

Report Date: 12-Nov-2019
Order Date: 5-Nov-2019
Project Description: 191-12948-00

Qualifier Notes:

Sample Qualifiers :

1 : Sample decanted prior to analysis due to sediments.

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

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 ID: 1945295

PARACEL LABORATORIES LTD.

Paracel Order Number (Lab Use Only): 1945295

Chain Of Custody (Lab Use Only) № 124027

Page 1 of 1

Client Name: WSP Canada Inc	Project Ref: ~~12~~ 191-12948-00
Contact Name: Adrian Meryhart	Quote #: 19-039
Address: 2611 Queensview Dr. Ottawa ON	PO #:
	E-mail: Adrian.Meryhart@wsp.com
Telephone: 343-961-1429	

Turnaround Time

☐ 1 day ☐ 3 day
☐ 2 day ☒ Regular

Date Required:

Regulation 153/04

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

Other Regulation

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

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

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)						
1	BH19-6	GW		7	Nov 4, 2019	13:40	X	X	X	X	X	X							
2	BH19-4	GW		7	11	16:00	X	X	X	X	X	X							
3	BH19-10	GW		3	11	17:30	X	X											
4	DUP	GW		7	11	16:00	X	X	X	X	X	X							
5																			
6																			
7																			
8																			
9																			
10																			

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): [signature]	Received By Driver/Depot: T. Bowie	Received at Lab: Sunneparm Dekmai	Verified By: [signature]
Relinquished By (Print): Adrian Meryhart	Date/Time: 05/11/19 2:05	Date/Time: Nov 05, 2019 05:15	Date/Time: 11/05/19 19:15
Date/Time: Nov 5 2019	Temperature: °C	Temperature: 5.9 °C	pH Verified: ☐ By: B.S

Revision 3.0

Chain of Custody (Env) xlsx