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Phase II-Environmental Site Assessment

Proposed Mixed Use Development
137 Bay Street and 350 Sparks Street
Ottawa, Ontario

Prepared for

Morguard Investments Ltd.

June 26, 2015

Report: PE3548-1

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EXECUTIVE SUMMARY

Assessment

A Phase II-ESA was conducted for the property located at 137 Bay Street and the western portion of 350 Sparks Street, in the City of Ottawa, Ontario. The purpose of the Phase II-ESA was to address areas of potential environmental concern identified during the Phase I-ESA, prepared by Golder Associates in November 2014. Areas of potential environmental concern (APEC) on-site include:

- a former commercial auto body shop
- former auto dealership
- gasoline service station and vehicle repair shop
- the possible historical use of coal and oil as heating fuels by former buildings on the property
- other potentially contaminating activities include former underground storage tanks (located below Sparks Street and Queen Street) and a former brass foundry north of the subject site

The subsurface investigation consisted of drilling 8 boreholes across the subject property, two of which were located along the exterior, with the remainder in the lower parking levels. All boreholes were instrumented with a groundwater monitoring well installation.

Shallow bedrock was encountered during the drilling program with limited soil/fill materials. No apparent signs of impacts of deleterious substances were identified in the soil/fill encountered. Two soil samples were submitted for analysis of metals. All parameters were in compliance with the selected MOECC Table 7 standards.

Groundwater samples were collected from each groundwater monitoring well and submitted for analysis of metals, volatile organic compounds (VOCs), petroleum hydrocarbons (PHCs) and/or polycyclic aromatic hydrocarbons (PAHs). All parameters were in compliance with the selected MOECC site standards with three exceptions.

Sodium, chloroform and bromomethane were detected in concentrations exceeding the MOECC Table 7 standards in several boreholes, however these parameters are not considered to be a result of the potentially contaminating activities identified above.

Sodium may have migrated to the subsurface by means of vertical migration of surface water and within the building drainage system and basement level floor cracks from winter parking of vehicles in the lower parking garage. The sodium is expected to be a result of the use of salt during winter months for de-icing adjacent municipal roadways and vehicles in the parking garage.

Chloroform and bromomethane are both commonly observed in chlorinated municipal drinking water supply. The source of the chloroform and bromomethane is considered to be from the use of municipal water for the bedrock coring at each borehole location.

The chloroform and bromomethane may also be a result of current or historical leak of the municipal watermain in the right-of-way.

Recommendations

Consideration should be given to re-testing the groundwater from those monitoring wells where chloroform and bromomethane were identified in excess of the MOECC Table 7e standards to confirm our opinion of the suspected source.

It is our understanding that the subject site is to be redeveloped with new buildings and a third level of underground parking. During redevelopment, all monitoring wells no longer in use, should be abandoned according to Ontario Regulation 903. Further information can be provided upon request in this regard.

1.0 INTRODUCTION

At the request of Morguard Investments, Paterson Group (Paterson) conducted a Phase II-Environmental Site Assessment (ESA) of the property located at 137 Bay Street and the western portion of 350 Sparks Street, in the City of Ottawa, Ontario. The purpose of this Phase II-ESA was to address concerns identified in the Phase I-ESA, prepared by Golder Associates in 2014. The findings of the Phase II-ESA are presented in this report in a manner which complies with O.Reg. 153/04.

1.1 Site Description

Address:	137 Bay Street and 350 Sparks Street, Ottawa, Ontario.
Legal Description:	137 Bay Street: South Part of Lot 15, north side Queen Street, Plan 3922. 350 Sparks Street: Part of lots 12 to 14, part of lot 15, north Queen Street, south Spark Street, RP 4R473, parts 1 and 2, Plan 3922.
Parcel Identification Number:	04114-00002 and 04114-0003.
Location:	The subject property occupies the western portion of the city block, bounded by Sparks Street and Queen Street to the north and south, and Lyon Street and Bay Street to the east and west, in the City of Ottawa. Refer to Figure 1 - Key Plan, following the body of this report, for the site location.
Latitude and Longitude:	45° 25' 7.2" N, 75° 42' 21.5" W.
Configuration:	Rectangular.
Site Area:	0.58 hectares (approximate).

1.2 Property Ownership

The subject property is currently owned by Morguard Investments Ltd., and is represented by Mr. Brian Athey, who may be contacted at (905) 281-5823. The offices of Morguard Investments are located at 800-55 City Centre Drive, Mississauga, Ontario, L5B 1M3. Paterson was retained to complete this Phase II-ESA by Mr. Athey.

1.3 Current and Proposed Future Uses

It is our understanding that the western portion of the subject site will be demolished and reconstructed with a residential tower and a hotel with retail and restaurants at ground level.

1.4 Applicable Site Condition Standard

The site condition standards for the property were obtained from Table 7 of the document entitled “Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act”, prepared by the Ontario Ministry of the Environment and Climate Change (MOECC), April 2011. The Table 7 standards are applicable to the subject site. The MOECC Table 7 Standards are based on the following considerations:

- Coarse-grained soil condition
- Non-potable groundwater condition
- Residential land use (and commercial)
- Shallow soil conditions

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

At the time of the subsurface investigation, the subject site was occupied by a vacant 3 storey residential apartment (137 Bay Street) and two high rise buildings, used as a hotel and commercial/apartment rental units. The site is relatively flat, and is at grade with adjacent properties.

No areas of stressed vegetation were noted on the subject site. No rail lines or loading areas were observed at the subject site. No Areas of Natural or Scientific Interest (ANSIs) are present in the vicinity of the subject site.

The nearest water body to the subject site is the Ottawa River, located approximately 350 m north of the site.

2.2 Past Investigations

- "Phase I-Environmental Site Assessment, 137 Bay Street and 361 Queen Street, Ottawa, Ontario", prepared by Golder Associates, November 2014.

Golder Associates produced a Phase I-Environmental Site Assessment in November 2014. Based on a review of historical records, Golder identified the presence of areas of potential environmental concern (APEC) on the subject site as well as off-site (potentially contaminating activities, PCAs). Areas of potential environmental concern on the property included a former auto dealership, a service garage, a gasoline retail fuel outlet, and an auto body shop. It was also considered likely that the former buildings on-site were once heated with coal and diesel oil. Environmental concerns were also identified with the use of adjacent properties. These include a former gasoline service station northeast of the subject site (southwest corner of Lyon and Sparks Street), former underground storage tanks below Queen Street and Sparks Street, as well as a brass foundry located on the property north of the subject site.

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation conducted as a component of the Phase II-ESA consisted of drilling 8 boreholes on the subject property, all of which were instrumented with a groundwater monitoring well installation. All boreholes were drilled through overburden soils and cored into bedrock. Final borehole depths ranged from 4.5 to 16.2 m below surrounding grade.

3.2 Media Investigated

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

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

Based on information from the Urban Geology of the National Capital Region, published by NRCAN, and the subsurface investigations undertaken at the subject site, no overburden was encountered.

Overburden may be present below the building at 137 Bay Street. Bedrock encountered during the subsurface investigation consisted of grey limestone with shale beddings.

Contaminants of Potential Concern

The following CPCs were identified with respect to the Phase II-ESA property:

- Metals – this suite of parameters encompasses various metals for which MOE standards exist. Metals may be present in the soil matrix or dissolved in site groundwater.

  Metals were selected as CPCs for the Phase II-ESA property based on the presence of the former auto body shop on the subject property, and a former brass foundry north of the subject site. These activities would have had the potential to release metals into the groundwater and soil.

- Petroleum Hydrocarbons Fractions 1 through 4 (PHCs F_1-F_4) – this suite of parameters encompasses gasoline (Fraction 1), diesel and fuel oil (Fraction 2), and heavy oils (Fractions 3 and 4). PHCs F_1-F_4 were selected as CPCs for the Phase II-ESA property based on the presence of a former auto dealership, former gasoline service station and vehicle maintenance facility. Underground storage tanks were also located beneath Queen Street, and Sparks Street. PHCs may be present in the soil matrix, sorbed to soil particles, as well as in free or dissolved phase in the groundwater system. PHCs are generally considered to be LNAPLs – light non-aqueous phase liquids, indicating that when present in sufficient concentrations above the solubility limit, they will partition into a separate phase above the water table, due to their lower density.

- Volatile Organic Compounds (VOCs), including BTEX – this suite of parameters includes chlorinated solvents and degradation products (tetrachloroethylene, trichloroethylene, dichloroethylenes, and vinyl chloride) are associated with de-greasing, painting, and certain automotive chemicals, as well as chloroform, a byproduct of chlorine disinfection of municipally-treated water. Also included with VOCs are BTEX (benzene, toluene, ethylbenzene and xylenes) which is a suite of VOCs associated in part with gasoline. VOCs may be present in the soil matrix, or dissolved in the site groundwater. VOCs were selected as CPCs for the Phase II-ESA due to the former presence of an auto body shop, a former auto dealership with gasoline service station, former nearby underground storage tanks, and a former brass foundry.

- Polycyclic Aromatic Hydrocarbons (PAHs) – this suite of parameters encompasses various complex hydrocarbons, commonly associated with coal and/or combustion. PAHs may be present in the soil matrix below the building at 137 Bay Street, or dissolved in site groundwater. PAHs were selected as CPCs for the Phase II-ESA property based on the former potential use of coal and diesel oil as heating fuels in the past.

The majority of the property is occupied by multi-storey buildings with two to three levels of below grade parking garages. As such, very little soil is present on the property. The main mechanisms of contaminant transport within the site soils include physical transportation and leaching. Physical transportation includes any intentional or unintentional movement or distribution of soil by physical means.

The mechanisms of contaminant transport within the groundwater system include advection, dispersion, and diffusion. Generally, advection and dispersion will be the dominant mechanisms of contaminant transport in soils with higher hydraulic conductivities, such as sands, gravels, silts, and some glacial till soils, whereas diffusion will dominate in soils with lower hydraulic conductivity, such as clays. However based on the prevalence of limestone and shale bedrock below the property, it is expected that advection and diffusion will dominate if fissures in the rock are present.

Existing Buildings and Structures

At the time of the Phase II-ESA report, the property was occupied by a three storey building at 137 Bay Street. Two high rise buildings were located at 350 Sparks Street. The buildings were largely vacant at the time of the assessment.

Water Bodies

The Ottawa River is located approximately 350 m north of the subject site. No other water bodies are present within the Phase I-ESA study area.

Areas of Natural Significance

There are no areas of natural significance within the Phase I-ESA study area.

Drinking Water Wells

The subject site and surrounding properties within the Phase I-ESA study area are municipally serviced.

Records searched as part of the Phase I-ESA did not indicate the presence of water wells on the subject site. However, 17 water wells (monitoring wells) were identified within 250 m of the subject site.

Neighbouring Land Use

Neighbouring land use in the Phase I-ESA study area is commercial and residential.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

Potentially Contaminating Activities and Areas of Potential Environmental Concern at the subject site consist of the historical presence former commercial auto body shops, auto dealerships, gasoline service station, former underground storage tanks (off-site), a former brass foundry (off-site) and the former use of coal and diesel as part of previous heating systems.

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the Phase I-ESA is considered to be sufficient to conclude that there are areas of potential environmental concern on the subject site which have the potential to have impacted the subject site.

3.4 Deviations from Sampling and Analysis Plan

The Sampling and Analysis Plan for the Phase II-ESA is included in Appendix 1 of this report. No deviations were made from the sampling and analysis plan.

3.5 Impediments

No physical impediments or denial of access were encountered during the Phase II-Environmental Site Assessment.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation conducted on the subject property consisted of drilling 8 boreholes on the subject property, the majority placed within the basement of the commercial buildings. All boreholes were extended into bedrock, and each borehole was equipped with a groundwater monitoring well.

Borehole locations are shown on Drawing PE3548-1 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

Soil samples and rock core samples were obtained from the boreholes by means of grab samples or rock coring. The depths at which samples were obtained from the boreholes are shown as "**G**", for grab sample, "**SS**" for split spoon samples, and "**RC**" for rock core, on the List of Abbreviations, appended to this report.

Methods of minimizing cross-contamination between samples include the decontamination of sampling equipment between samples, obtaining undisturbed samples from boreholes, and the use of dedicated sampling equipment, as discussed in the Sampling and Analysis Plan, appended to this report.

Site soils consisted of fill (blast rock, crushed stone or sandy gravel with cobbles) underlain by grey limestone with shale bedding. Based on information collected during the drilling program, very little fill is present on the property and consists of back fill below slabs and foundations.

4.3 Field Screening Measurements

Due to the nature of the soil encountered during the drilling program, field screening measurements were not deemed as necessary.

4.4 Groundwater Monitoring Well Installation

Eight groundwater monitoring wells were installed during the drilling program. The monitoring wells consisted of 32 mm (1.25") in diameter PVC risers and screens. A sand pack consisting of silica sand was placed around the screen, and a bentonite seal was placed above the screen and extended to ground surface to minimize cross-contamination. Each well was finished with a flush-mount aluminium casing. Monitoring well construction details are provided on the Soil Profile and Test Data Sheets in Appendix 1. A summary of the monitoring well construction details is provided below in Table 1.

Table 1 - Monitoring Well Construction Details

Well ID	Ground Surface Elevation	Total Depth (m BGS)	Screened Interval (m BGS)	Sand Pack (m BGS)	Bentonite Seal (m BGS)	Casing Type
BH1	72.21	10.77	7.73 – 10.77	7.43 – 10.77	0 – 7.43	Flushmount
BH2	67.23	4.65	1.61 – 4.65	1.3 – 4.65	0 – 1.30	Flushmount
BH3	67.21	4.55	1.51 – 4.55	1.21 – 4.55	0 – 1.21	Flushmount
BH4	72.74	11.23	8.19 – 11.23	7.89 – 11.23	0 – 7.89	Flushmount
BH5	67.85	5.21	2.17 – 5.21	1.87 – 5.21	0 – 1.87	Flushmount
BH6	67.81	5.21	2.17 – 5.21	2.17 – 5.21	0 – 2.17	Flushmount
BH7	67.86	15.90	12.86 – 15.90	9.50 – 15.90	0 – 9.50	Flushmount
BH8	67.85	16.15	13.11 – 16.15	12.00 – 16.15	0 – 12.00	Flushmount

The groundwater monitoring wells were developed upon completion using a dedicated inertial lift pump. A minimum of three well volumes were removed from the wells.

4.5 Field Measurement of Water Quality Parameters

The field measurement of water quality parameters was not conducted as part of this Phase II-ESA program.

4.6 Groundwater Sampling

Groundwater sampling protocols were followed using the MOE document entitled "Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario", dated May 1996.

Groundwater samples were obtained from each monitoring well, using dedicated sampling equipment. Standing water was purged from each well prior to sampling. Samples were stored in coolers to reduce analyte volatilization during transportation. Details of our standard operating procedure for groundwater sampling are provided in the Sampling and Analysis Plan in Appendix 1.

4.7 Analytical Testing

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

Table 2 - Soil Samples Submitted

Sample ID	Sample Depth/ Stratigraphic Unit	Parameters Analyzed	Rationale
		Metals	
BH1-G1	0.07 – 0.20 m, fill	X	Assessment of fill material.
BH4-SS2	0.3 – 0.9 m, fill	X	Assessment of fill material.

Table 3 - Groundwater Samples Submitted

Sample ID	Screened Interval	Parameters Analyzed				Rationale
		Metals	PAHs	VOCs	BTEX, PHCs F_1-F_4	
BH1-GW1	7.73 - 10.77 m	X		X	X	To address former underground storage tanks along Sparks Street, and former brass foundry located north of the property.
BH2-GW1	1.61 - 4.65 m	X		X		To address former underground storage tanks along Sparks Street, and former brass foundry located north of the property.
BH3-GW1	1.51 - 4.55 m	X	X	X	X	To address former auto dealership with gasoline service station, former underground storage tanks along Sparks Street and former brass foundry north of the property.
BH4-GW1	8.19 - 11.23 m		X			To address former use of coal and oil as heating fuels on the property.
BH5-GW1	2.17 - 5.21 m			X		To address former commercial auto body shop.
BH6-GW1	2.17 - 5.21 m			X	X	To address former auto dealership, former gasoline service station.
BH7-GW1	12.86 – 15.90 m	X	X	X		To address former use of coal and oil as heating fuels on the property, particularly at 137 Bay Street.
BH8-GW1	13.11 - 16.15 m			X	X	To address former auto dealership, former gasoline service station.
DUP1 (BH5)	2.17 - 5.21 m			X		Duplicate of sample BH5-GW1.
Trip Blank				X		

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

4.8 Residue Management

Soil cuttings, purge water and fluids from equipment cleaning were managed on-site by Paterson.

4.9 Elevation Surveying

Groundwater surface elevations at the borehole locations were determined by Paterson personnel based on a geodetic elevation of a benchmark consisting of a brass monument located at the corner of Bay Street and Sparks Street. The geodetic elevation was established by Annis, O'Sullivan, Vollebekk Ltd. and is 71.21 m. The accuracy of this benchmark elevation was not verified by Paterson.

4.10 Quality Assurance and Quality Control Measures

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

5.0 REVIEW AND EVALUATION

5.1 Geology

Site geology details are provided in the Soil Profile and Test Data Sheets in Appendix 1. Generally, site soils consist of granular fill (i.e. crushed stone or blast rock) or brown cobbles/sand overlying limestone bedrock with shale beddings. The fill material varied in thickness between 0.5 to 2.8 m. Bedrock was encountered in all boreholes at depths ranging between 0.5 to 3.8 m below grade. Bedrock was cored in all boreholes.

Groundwater monitoring wells were installed to intercept the shallow unconfined aquifer at the subject site. Site stratigraphy, including geodetic elevations, is shown on Drawings PE3548-5 and PE3548-6 - Cross-Sections.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels from all groundwater monitoring wells were measured on June 10, 2015 prior to collecting groundwater samples, with the exception of BH4 and BH8 due to a device malfunction. Groundwater levels are summarized below in Table 4.

Table 4 - Groundwater Level Measurements

Borehole Location	Ground Surface Elevation (m)	Water Level Depth (m below grade)	Water Level Elevation (m ASL)	Date of Measurement
BH1-GW1	72.21	3.82	68.39	June 10, 2015
BH2-GW1	67.23	4.00	62.23	June 10, 2015
BH3-GW1	67.21	2.26	64.95	June 10, 2015
BH4-GW1	72.74	-	-	
BH5-GW1	67.85	2.63	65.22	June 10, 2015
BH6-GW1	67.81	4.13	63.68	June 10, 2015
BH7-GW1	67.86	10.35	57.51	June 10, 2015
BH8-GW1	67.85	-	-	

Based on the groundwater elevations from the June 10, 2015 monitoring event, groundwater contour mapping was completed for the upper unconfined aquifer. Based on the contour mapping, groundwater flow at the subject site is in an easterly direction. A horizontal hydraulic gradient of approximately 0.09 m/m was calculated.

No sheen was observed in any of the groundwater samples.

5.3 Fine-Medium Soil Texture

Based on field soil observations, fine-grained soil standards are not applicable to the subject site.

5.4 Soil - Field Screening

Due to the very limited recovery of soil from the subsurface investigation, field screening was not conducted.

5.5 Soil Quality

A total of 2 soil/fill samples were submitted for analysis of metals. The results of the analytical testing are presented below. The laboratory certificates of analysis are provided in Appendix 1.

Table 5
Analytical Test Results – Soil
Metals

Parameter	MDL (µg/g)	Soil Samples (µg/g)		MOECC Table 7 Residential Coarse
		BH1-G1	BH4-SS2	
Antimony	1.0	2.6	2.0	7.5
Arsenic	1.0	5.9	7.6	18
Barium	1.0	64.7	36.4	390
Beryllium	1.0	nd	nd	4
Boron	1.0	5.4	5.7	120
Cadmium	0.5	nd	nd	1.2
Chromium	1.0	12.1	7.3	160
Cobalt	1.0	5.9	5.4	22
Copper	1.0	25.8	8.7	140
Lead	1.0	120	33.0	120
Molybdenum	1.0	1.5	3.4	6.9
Nickel	1.0	13.3	12.3	100
Selenium	1.0	nd	nd	2.4
Silver	0.5	nd	nd	20
Thallium	1.0	nd	nd	1
Uranium	1.0	nd	nd	23
Vanadium	1.0	17.3	11.0	86
Zinc	1.0	80.5	15.2	340

Notes:
- MDL – Method Detection Limit
- Nd – not detected above the MDL
- **Bold** – Value exceeds selected MOECC Standard

No exceedances of the MOECC Table 7 standards were detected in any of the samples.

5.6 Groundwater Quality

Groundwater samples were collected from all monitoring wells installed as part of this Phase II-ESA. The groundwater samples were obtained from the screened intervals noted in Table 1, above. It is noted that samples analyzed for metals were field-filtered. The maximum concentration results of the analytical testing are presented below. A summary of the analytical test results are presented in summary tables in Appendix 1, as well as the laboratory Certificates of Analysis.

Table 6 - Maximum Concentrations – Groundwater – Metals

Parameter	Maximum Concentration (µg/L)	Borehole
Antimony	1.1	BH7-GW1
Arsenic	1	BH1-GW1/BH7-GW1
Barium	562	BH3-GW1
Boron	75	BH2-GW1/BH3-GW1
Chromium	23	BH1-GW1
Cobalt	32.4	BH3-GW1
Copper	60.5	BH2-GW1
Lead	0.1	BH3-GW1
Molybdenum	19.3	BH7-GW1
Nickel	31	BH3-GW1
Silver	0.2	BH1-GW1/BH2-GW1
Sodium	**5,480,000**	BH2-GW1
Thallium	0.3	BH2-GW1
Uranium	11.2	BH3-GW1
Vanadium	5.7	BH1-GW1
Zinc	57	BH7-GW1

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

Sodium was detected in groundwater Samples BH1-GW1, BH2-GW1 and BH3-GW1, in exceedance of MOECC Table 7 standards. All other metal parameters were detected in concentrations which comply with the Table 7 standards. The presence of sodium in the groundwater is considered to be a result of the use of road salt during winter de-icing activities on adjacent municipal roadways.

Table 7 - Maximum Concentrations – Groundwater – VOC		
Parameter	**Maximum Concentration (µg/L)**	**Borehole**
Bromomethane	**1.3**	BH8-GW1
Chloroform	**16.9**	BH8-GW1
Notes: ▪ **Bold** – Value exceeds MOECC Table 7 standards		

Chloroform was detected in groundwater Samples BH3-GW1, BH5-GW1, BH8-GW1 and DUP in concentrations exceeding the MOECC Table 7 standards. Sample DUP was collected as a duplicate sample from BH5. Bromomethane was also detected in excess of the MOECC Table 7 standard in Sample BH8-GW1. The chloroform and bromomethane detected in the groundwater samples is considered to be a result of the use of municipal drinking water during the rock coring process.

None of the groundwater samples submitted for analysis of PHCs were found to contain parameters in excess of the laboratory detection limits. All PHC parameter concentrations are in compliance with MOECC Table 7 standards.

Table 8 - Maximum Concentrations – Groundwater – PAH		
Parameter	**Maximum Concentration (µg/L)**	**Borehole**
Naphthalene	0.30	BH7-GW1
Notes: ▪ **Bold** – Value exceeds MOECC Table 7 standards		

With the exception of naphthalene in Sample BH7-GW1, none of the analytical parameters were detected above laboratory detection limits. All concentrations are in compliance with MOECC Table 7 standards.

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of this Phase II ESA were handled in accordance with the Analytical Protocol with respect to holding time, preservation method, storage requirement, and container type.

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

A duplicate groundwater sample and a trip blank were obtained during the field portion of the Phase II-ESA. The duplicate groundwater sample (DUP) was collected from the groundwater monitoring well at BH5. Chloroform was detected in both groundwater samples, on the same order of magnitude. The samples are considered to be within acceptable QA/QC parameters.

The trip blank submitted for analysis did not contain any parameter concentrations.

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

5.8 Phase II Conceptual Site Model

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

Site Description

Potentially Contaminating Activities and Areas of Potential Environmental Concern

As per column A of Table 2, outlined in Ontario Regulation 153/04 and amended by O.Reg 279/11, potentially contaminating activities identified on the subject property and/or within the Phase I-ESA study area include the following:

- Commercial auto body shop (Item 10)
- Gasoline and associated products storage in fixed tanks (Item 28)
- Storage, maintenance, fuelling, and repair of equipment, vehicles and material used to maintain transportation systems (Item 52)
- Metal treatment, coating, plating and finishing (Item 33)

All of the above Potentially Contaminating Activities were considered to result in Areas of Potential Environmental Concern.

Potential contaminants of concern associated with the aforementioned APECs include PHCs, VOC, PAHs and metals. Based on the analytical test results, the limited fill material on-site does not appear to have been impacted by the former uses of the property. Similarly, groundwater does not appear to have been impacted by past uses, although certain contaminants were identified in excess of the site standards. These include sodium, chloroform and bromomethane. Elevated sodium is considered to be a result of the use of salt for winter road treatment on adjacent municipal roadways. Chloroform and bromomethane are considered to be a result of the use of municipally treated water for rock coring purposes.

Subsurface Structures and Utilities

Natural gas lines travel along Sparks Street and Queen Street. Hydro also travels along Sparks and Queen Streets, as well as along Bay Street. Inside the building, no services other than drain pipes were observed.

Physical Setting

Site Stratigraphy

The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is illustrated on Drawings PE3548-5 and PE3548-6 - Cross-Sections. Stratigraphy consists of:

- Fill, consisting of crushed stone, blast rock or brown sand. Groundwater was not encountered within the fill layer.
- Limestone bedrock, encountered at depths varying from 0.5 to 16.2 m below respective grades (exterior or parking garage). This is the deepest unit investigated. Groundwater was observed in the bedrock in all groundwater monitoring wells.

Hydrogeological Characteristics

Groundwater was encountered in the bedrock unit, which is interpreted to function as a local unconfined aquifer at the subject site.

Groundwater levels were measured at the subject site on June 10, 2015. Groundwater was encountered at depths varying between 2.3 and 10.4 m below sea level. Groundwater levels from two monitoring wells could not measured at the time of sampling.

Based on the groundwater elevations from the groundwater monitoring event, groundwater contour mapping was completed and the horizontal hydraulic gradient at the subject site was calculated. Groundwater flow at the subject site is in an easterly direction, with a hydraulic gradient of 0.09 m/m.

Regionally, the groundwater flow direction is suspected to be in a northern direction, towards the Ottawa River; however the local groundwater flow direction may be artificially altered based on deep foundations of large buildings in the area of the subject site.

Approximate Depth to Bedrock

Depth to bedrock at the subject site varies between approximately 0.5 and 16.2 m grade.

Approximate Depth to Water Table

Depth to water table at the subject site varies between approximately 2.3 and 10.4 m below grade.

Sections 41 and 43.1 of the Regulation

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

Section 43.1 of the Regulation applies to the subject site in that the subject site has little to no overburden material.

Fill Placement

Fill material was identified on the subject property during the Phase II-ESA. It generally consists of crushed rock, blast rock, or sand, which is considered to be backfill used during previous development.

Proposed Buildings and Other Structures

Future development plans for the subject property include the construction of a residential tower, and a hotel with small retail and restaurants.

Existing Buildings and Structures

At the time of the Phase I-ESA, the property was occupied by a three storey residential building (137 Bay Street) and two high rise buildings (used as a hotel and offices).

Water Bodies

The Ottawa River is located just outside of the study area, at approximately 350 m to the north.

Areas of Natural Significance

No areas of natural significance are present on the subject site or within the Phase II-ESA study area.

Environmental Condition

Areas Where Contaminants are Present

Based on the results of analytical testing at the subject site, contaminants were present only in site groundwater in concentrations greater than MOECC Table 7 standards at the locations shown on Drawing PE3548-2 – Analytical Testing Plan, PE3548-5 and PE3548-6 - Cross-Sections A-A' and B-B'. Contaminant concentrations and locations with respect to the Phase II ESA property are shown on the above noted figures.

Types of Contaminants

Contaminants were not identified in the soils. Sodium, chloroform and bromomethane were identified in the groundwater.

Contaminated Media

Sodium, chloroform and bromomethane were identified in groundwater samples in excess of MOECC Table 7 standards.

What is Known About Areas Where Contaminants are Present

The above noted contaminants are considered to be the result of sources other than the APECs identified earlier in this report. The elevated sodium concentrations are considered to be the result of the use of salt on adjacent roadways during winter de-icing activities. Chloroform, and its associated chlorination by-product bromomethane, were identified in the groundwater from three monitoring wells and are suspected to have originated from the use of municipally treated drinking water in the bedrock coring process. These concentrations are expected to dissipate in the near future and do not pose a concern to the subject site.

Distribution of Contaminants

The vertical and horizontal distribution of groundwater contaminants are shown on Drawings PE3548-5 and PE3548-6. No contaminants were identified in the soil samples.

Discharge of Contaminants

The discharge of contaminants is considered to be associated with sources other than the APECs identified previously in this report.

- Metals

Sodium was identified in the groundwater at three monitoring wells at concentrations in excess of MOECC Table 7 standards. The elevated sodium concentrations are the result of de-icing activities on adjacent municipal roadways and sidewalks during winter. Sodium is expected to have infiltrated beneath the building by vertical groundwater infiltration and due to vehicle underground parking garage in the winter months (slush saturated with de-icing salts on vehicles).

- Volatile Organic Compounds

Chloroform and bromomethane were identified in groundwater samples. These chemical components are expected to be associated with treated municipal water, which was utilized during the bedrock coring process.

Migration of Contaminants

The elevated sodium concentrations were identified in the groundwater at three monitoring well locations along Sparks Street, one placed on the exterior, and two within the basement parking garage. The sodium is expected to be migrating onto the subject property from adjacent roadways and sidewalks, from the use of salt during winter de-icing activities.

Climatic and Meteorological Conditions

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

Due to the fact that the majority of the site was covered by structures, the possibility of precipitation infiltration is significantly reduced,

but may be accelerated by building drainage systems. Sodium may be more likely to infiltrate during spring months, following the snow thaw.

Potential for Vapour Intrusion

The potential for vapour intrusion at the subject site is considered to be minimal. Metals, including sodium, would not readily volatilize from the groundwater and chloroform and bromomethane are not considered to be representative contaminants of the subject property.

Contaminant Transport Diagram

A summary of contaminant transport processes at the subject site, including sources, receptors, and exposure pathways, is provided in Drawing PE3548-4 - Contaminant Transport, appended to this report.

Due to the fact that the subject site is occupied almost entirely by structures (and between two and three levels of underground parking), it is considered unlikely that there are any potential human health receptors. No drinking water wells are located in the area.

Traditionally, potential ecological receptors include plants whose root structures intercept contaminated soil, burrowing wildlife, and groundwater/surface water receptors down gradient of the subject site at groundwater discharge points. Since the property was occupied by structures, no significant plants or wildlife is expected to be present on site. Additionally, due to the dense urban landscape, no significant receptors are expected to be present down gradient of the subject site. The nearest water body is the Ottawa River, approximately 350 m to the north of the site. Based on the significant distance between the site and the River, as well as the presence of several large building between the two, and the relatively low concentrations of contaminants in the groundwater, the impacted groundwater on the subject site is not expected to have adverse impacts on the nearby Ottawa River.

6.0 CONCLUSIONS

Assessment

A Phase II-ESA was conducted for the property located at 137 Bay Street and the western portion of 350 Sparks Street, in the City of Ottawa, Ontario. The purpose of the Phase II-ESA was to address areas of potential environmental concern identified during the Phase I-ESA, prepared by Golder Associates in November 2014. Areas of potential environmental concern on-site include a former commercial auto body shop, former auto dealership, gasoline service station and vehicle repair shop as well as the possible historical use of coal and oil as heating fuels by former buildings on the property. Other potentially contaminating activities include former underground storage tanks (located below Sparks Street and Queen Street) and a former brass foundry north of the subject site.

The subsurface investigation consisted of drilling eight (8) boreholes across the subject property, two (2) of which were located along the exterior, with the remainder in the lower parking levels. All boreholes were instrumented with groundwater monitoring wells.

Shallow bedrock was encountered during the drilling program with limited soil/fill materials. No apparent signs of impacts of deleterious substances were identified in the soil/fill encountered. Two (2) soil samples were submitted for analysis of metals. All parameters were in compliance with the selected MOECC Table 7 standards.

Groundwater samples were collected from each monitoring well and submitted for analytical testing of metals, volatile organic compounds (VOCs), petroleum hydrocarbons (PHCs) and/or polycyclic aromatic hydrocarbons (PAHs). All parameters were in compliance with the selected MOECC Table 7 standards with the exception of three parameters at specific locations.

Sodium, chloroform and bromomethane were detected in concentrations exceeding the MOECC Table 7 standards in several boreholes. However, these parameters are not considered to be a result of the potentially contaminating activities identified above. Sodium may have migrated to the subsurface by surface infiltration and the perimeter drainage system of the building. Furthermore, vehicle parking in the winter months within the lower parking level will also contribute to The sodium is expected to be a result of the use of rock salt during winter months for de-icing activities on municipal roads and sidewalks.

Chloroform and bromomethane are both commonly observed by-products of the chlorinated municipal drinking water supply. The source of the chloroform and bromomethane is considered to be from the municipal water used for the bedrock coring at each borehole location. The chloroform and bromomethane may also be a result of a nearby current or historical leak of the municipal watermains.

Recommendations

Retesting of Monitoring Wells

Consideration should be given to retesting the groundwater monitoring wells where chloroform and bromomethane were identified in excess of the MOECC Table 7 standards to confirm our opinion of the suspected source.

Decommissioning of Monitoring Wells

It is our understanding that the subject site is to be redeveloped with new buildings. During redevelopment, all monitoring wells no longer in use, should be abandoned according to Ontario Regulation 903. Further information can be provided upon request in this regard.

7.0 STATEMENT OF LIMITATIONS

This Phase II-Environmental Site Assessment report has been prepared in general accordance with O.Reg. 153/04 as amended by O.Reg. 269/11, and meets the requirements of CSA Z769-00. The conclusions presented herein are based on information gathered from a limited sampling and testing program. The test results represent conditions at specific test locations at the time of the field program.

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

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

This report was prepared for the sole use of Morguard Investments Ltd. Permission and notification from Morguard Investments Ltd. and Paterson will be required to release this report to any other party.

Paterson Group Inc.

Adrian Menyhart, B.Eng.

Carlos P. Da Silva, P.Eng., QP_{ESA}

Report Distribution

- Morguard Investments (3 copies)
- Paterson Group (1 copy)

References

'Phase One Environmental Site Assessment, 137 Bay Street and 361 Queen Street, Ottawa, Ontario', prepared by Golder Associates, dated November, 2014.

'Sampling and Analysis Plan, 137 Bay Street and 350 Sparks Street, Ottawa, Ontario', prepared by Paterson Group Inc., dated June 2015.

'Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act', Ontario Ministry of the Environment, April 15, 2011.

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE3548-1 – TEST HOLE LOCATION PLAN

DRAWING PE3548-2 – ANALYTICAL TESTING PLAN

DRAWING PE3548-3 - GROUNDWATER CONTOUR PLAN

DRAWING PE3548-4 - CONTAMINANT DISTRIBUTION DIAGRAM

DRAWING PE3548-5- CROSS-SECTION A-A'

DRAWING PE3548-6- CROSS-SECTION B-B'

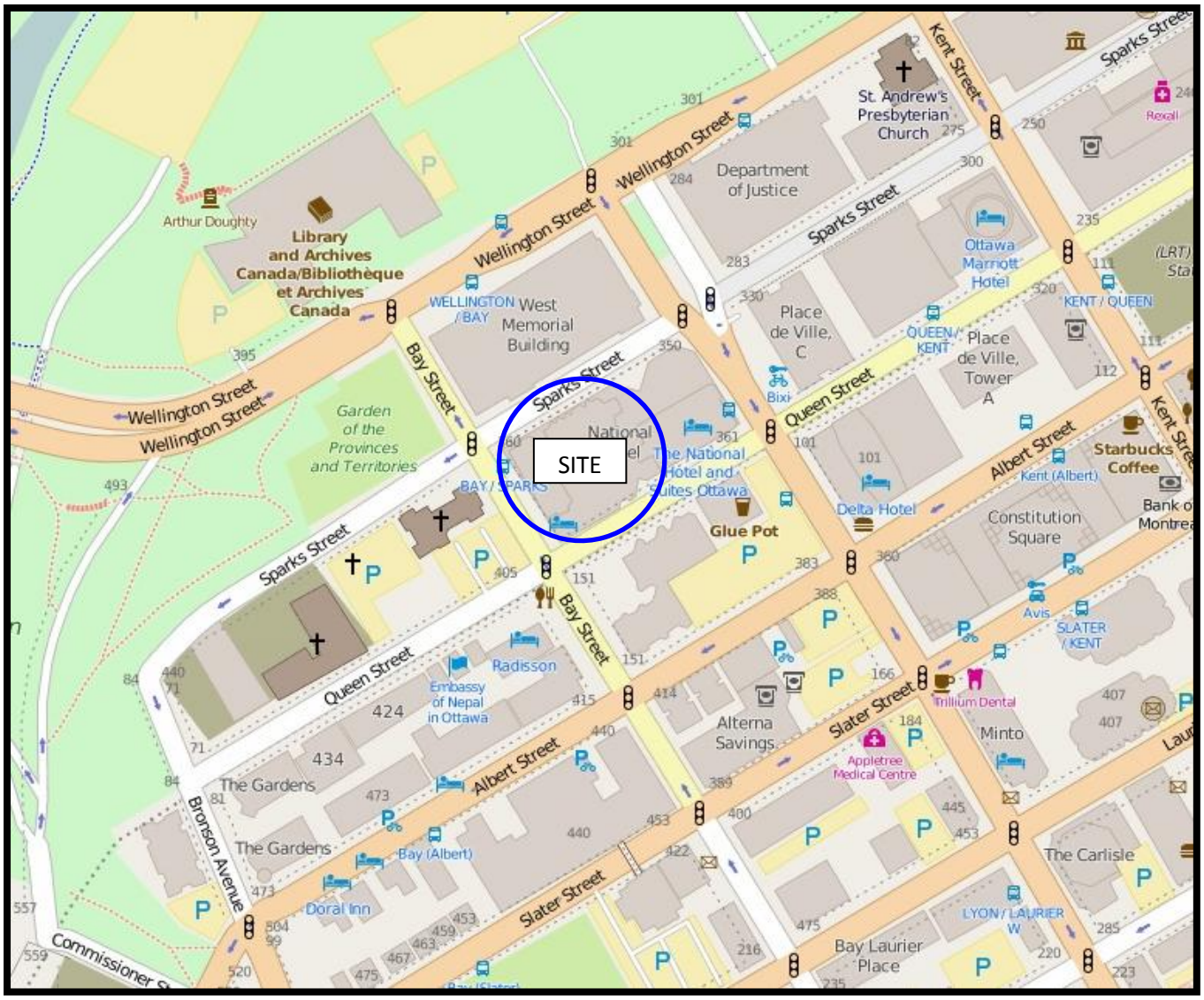
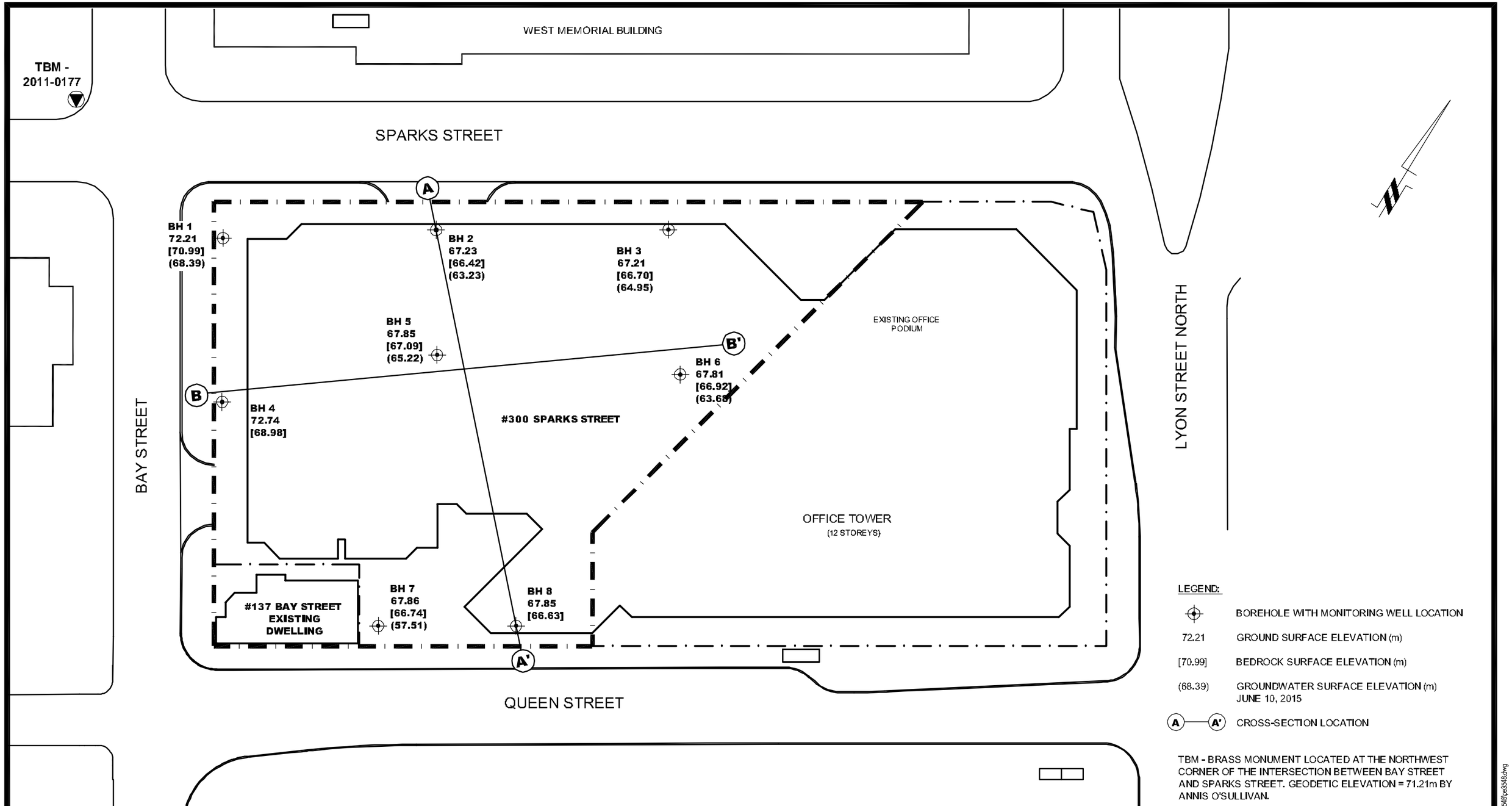


FIGURE 1

KEY PLAN



LEGEND:

- ⊕ BOREHOLE WITH MONITORING WELL LOCATION
- 72.21 GROUND SURFACE ELEVATION (m)
- [70.99] BEDROCK SURFACE ELEVATION (m)
- (68.39) GROUNDWATER SURFACE ELEVATION (m) JUNE 10, 2015
- A — A' CROSS-SECTION LOCATION

TBM - BRASS MONUMENT LOCATED AT THE NORTHWEST CORNER OF THE INTERSECTION BETWEEN BAY STREET AND SPARKS STREET. GEODETIC ELEVATION = 71.21m BY ANNIS O'SULLIVAN.

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NO.	REVISIONS	DATE	INITIAL

MORGAURD INVESTMENTS LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
137 BAY STREET AND 350 SPARKS STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:500	Date: 06/2015
Drawn by: MPG	Report No.: PE3548-1
Checked by: AM	Drawing No.: PE3548-1
Approved by: MSD	Revision No.:

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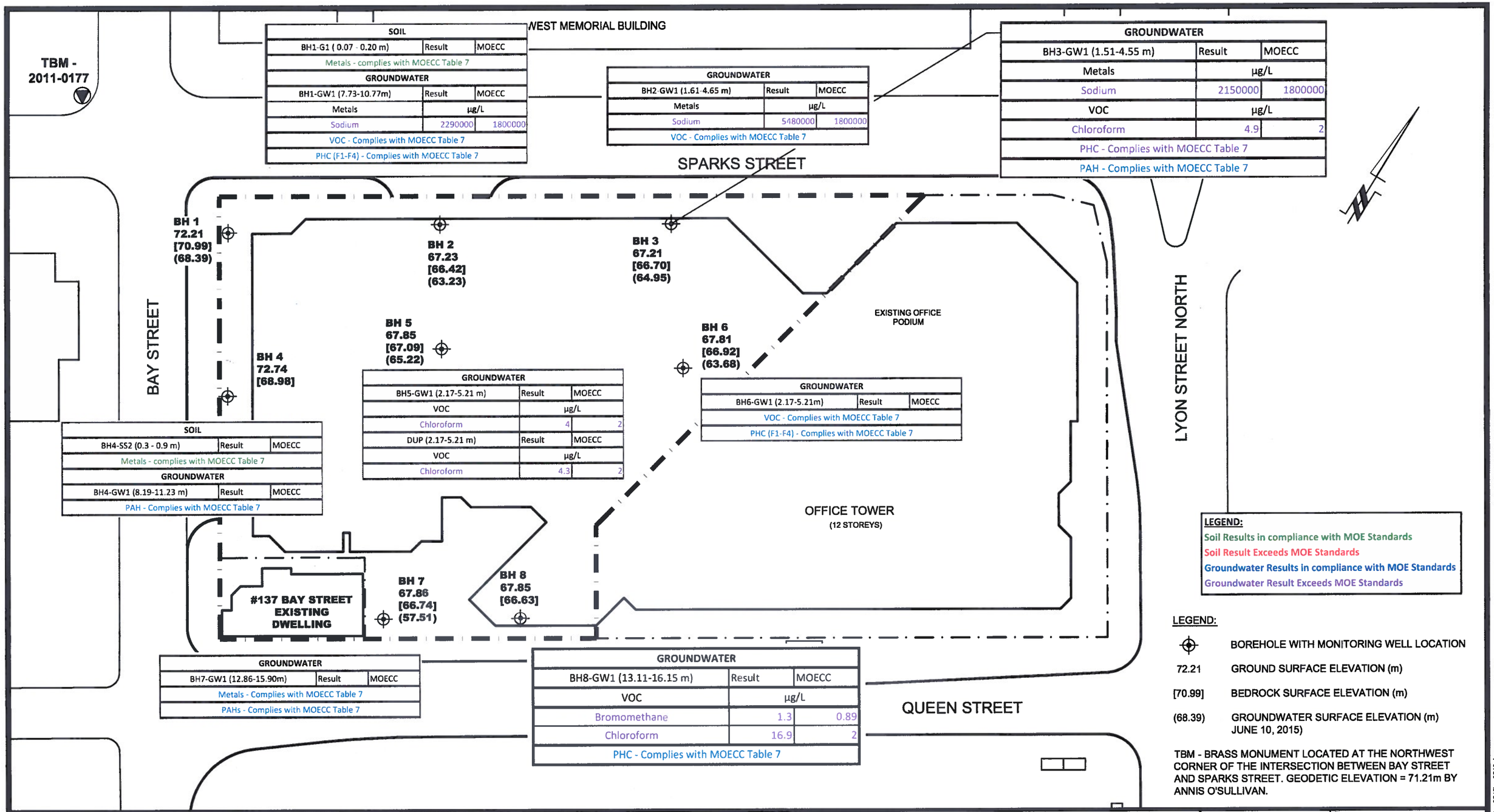

SOIL		
BH1-G1 (0.07 - 0.20 m)	Result	MOECC
Metals - complies with MOECC Table 7		
GROUNDWATER		
BH1-GW1 (7.73-10.77m)	Result	MOECC
Metals	µg/L	
Sodium	2290000	1800000
VOC - Complies with MOECC Table 7		
PHC (F1-F4) - Complies with MOECC Table 7		

GROUNDWATER		
BH2-GW1 (1.61-4.65 m)	Result	MOECC
Metals	µg/L	
Sodium	5480000	1800000
VOC - Complies with MOECC Table 7		

GROUNDWATER		
BH3-GW1 (1.51-4.55 m)	Result	MOECC
Metals	µg/L	
Sodium	2150000	1800000
VOC	µg/L	
Chloroform	4.9	2
PHC - Complies with MOECC Table 7		
PAH - Complies with MOECC Table 7		

SOIL		
BH4-SS2 (0.3 - 0.9 m)	Result	MOECC
Metals - complies with MOECC Table 7		
GROUNDWATER		
BH4-GW1 (8.19-11.23 m)	Result	MOECC
PAH - Complies with MOECC Table 7		

GROUNDWATER		
BH5-GW1 (2.17-5.21 m)	Result	MOECC
VOC	µg/L	
Chloroform	4	2
DUP (2.17-5.21 m)	Result	MOECC
VOC	µg/L	
Chloroform	4.3	2

GROUNDWATER		
BH6-GW1 (2.17-5.21m)	Result	MOECC
VOC - Complies with MOECC Table 7		
PHC (F1-F4) - Complies with MOECC Table 7		

GROUNDWATER		
BH7-GW1 (12.86-15.90m)	Result	MOECC
Metals - Complies with MOECC Table 7		
PAHs - Complies with MOECC Table 7		

GROUNDWATER		
BH8-GW1 (13.11-16.15 m)	Result	MOECC
VOC	µg/L	
Bromomethane	1.3	0.89
Chloroform	16.9	2
PHC - Complies with MOECC Table 7		

LEGEND:

Soil Results in compliance with MOE Standards

Soil Result Exceeds MOE Standards

Groundwater Results in compliance with MOE Standards

Groundwater Result Exceeds MOE Standards

LEGEND:

⊕ BOREHOLE WITH MONITORING WELL LOCATION

72.21 GROUND SURFACE ELEVATION (m)

[70.99] BEDROCK SURFACE ELEVATION (m)

(68.39) GROUNDWATER SURFACE ELEVATION (m) JUNE 10, 2015)

TBM - BRASS MONUMENT LOCATED AT THE NORTHWEST CORNER OF THE INTERSECTION BETWEEN BAY STREET AND SPARKS STREET. GEODETIC ELEVATION = 71.21m BY ANNIS O'SULLIVAN.

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137 BAY STREET AND 350 SPARKS STREET

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN

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Drawn by: MPG	Report No.: PE3548-1
Checked by: AM	Drawing No.: PE3548-2
Approved by: MSD	Revision No.:

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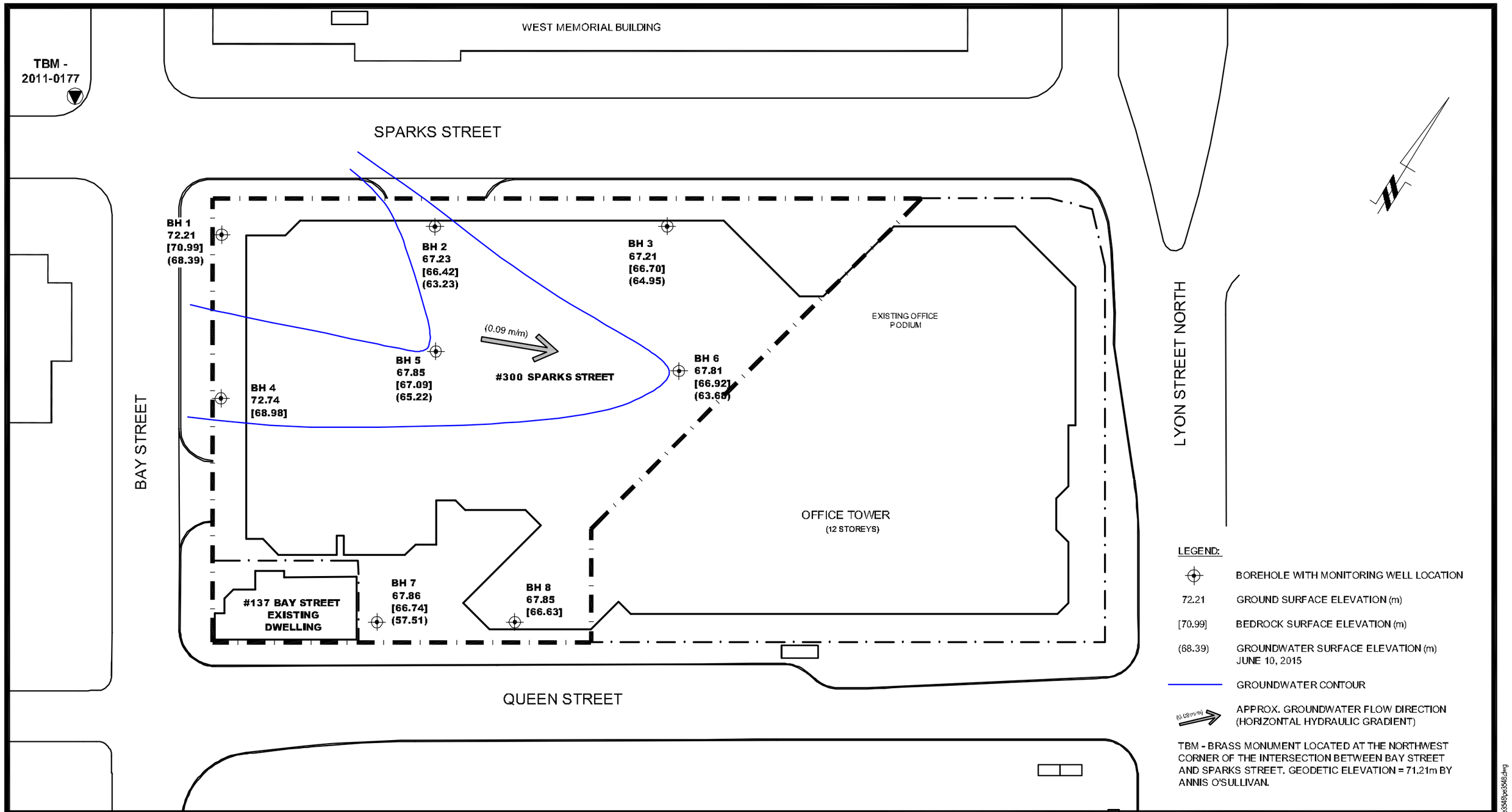

LEGEND:

- ⊕ BOREHOLE WITH MONITORING WELL LOCATION
- 72.21 GROUND SURFACE ELEVATION (m)
- [70.99] BEDROCK SURFACE ELEVATION (m)
- (68.39) GROUNDWATER SURFACE ELEVATION (m) JUNE 10, 2015
- GROUNDWATER CONTOUR
- (0.09 m/m) APPROX. GROUNDWATER FLOW DIRECTION (HORIZONTAL HYDRAULIC GRADIENT)

TBM - BRASS MONUMENT LOCATED AT THE NORTHWEST CORNER OF THE INTERSECTION BETWEEN BAY STREET AND SPARKS STREET. GEODETIC ELEVATION = 71.21m BY ANNIS O'SULLIVAN.

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
137 BAY STREET AND 350 SPARKS STREET

OTTAWA, ONTARIO

Title:

GROUNDWATER CONTOUR PLAN

Scale: 1:500	Date: 06/2015
Drawn by: MPG	Report No.: PE3548-1
Checked by: AM	Drawing No.: PE3548-3
Approved by: MSD	Revision No.:

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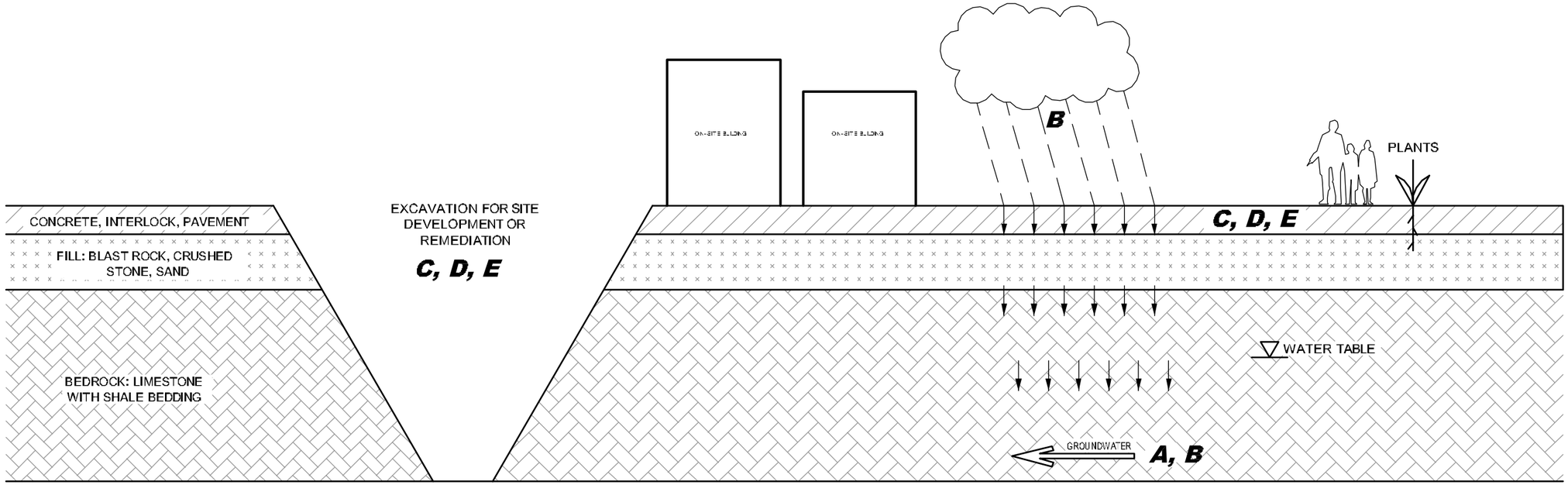

NARRATIVE NOTES:

A CONTAMINANT RELEASE MECHANISMS

No contaminants were identified in the site soils in excess of site standards.

Contaminants in the groundwater included metals and VOCs. The only metal parameter identified in the groundwater in exceedance of site standards is sodium. No apparent sources of sodium were identified during the Phase I-ESA. The elevated sodium concentration may due to natural deposits within the limestone bedrock.

VOCs were chosen as a contaminant of potential concern based on the presence of various automotive-retaled activities on the subject site. Chloroform, a parameter in the VOC group, was identified in four (4) of the groundwater samples in excess of the MOECC site standards. Chloroform is used to treat water n municipal distribution systems, which is the same water used for the rock coring process. The chloroform concentration is not considered to be representative of the site groundwater. Bromomethane was identified in one groundwater sample in excess of MOECC site standards. The potential source of the bromomethane is unknown.

B CONTAMINANT TRANSPORT PATHWAYS

The contaminants identified are not considered to be representative of the groundwater on-site, or, may be naturally occurring. They are not subjected to transport pathways.

C HUMAN AND ECOLOGICAL RECEPTORS

1. HUMAN RECEPTORS - Humans are not considered to be potential receptors of the groundwater.
2. ECOLOGICAL RECEPTORS - Fauna and flora are not considered to be potential receptors of the groundwater contaminants identified. The site being almost entirely occupied by structures and parking area, trees and vegetation are not susceptible to the identified groundwater. Animals are not considered receptors due to the shallow bedrock.

D RECEPTOR EXPOSURE POINTS

No significant exposure points exist, for humans or ecological receptors, due to the shallow bedrock and the developed nature of the property. Furthermore, the subject site and local area are supplied by municipal drinking water.

E ROUTES OF EXPOSURE

No significant routes of exposure exist, for humans or ecological receptors, due to the shallow bedrock and the developed nature of the property.

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
137 BAY STREET AND 350 SPARKS STREET

OTTAWA, ONTARIO

Title:

CONTAMINANT DISTRIBUTION DIAGRAM

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Drawn by: MPG	Report No.: PE3548-1
Checked by: AM	Drawing No.: PE3548-4
Approved by: MSD	Revision No.:

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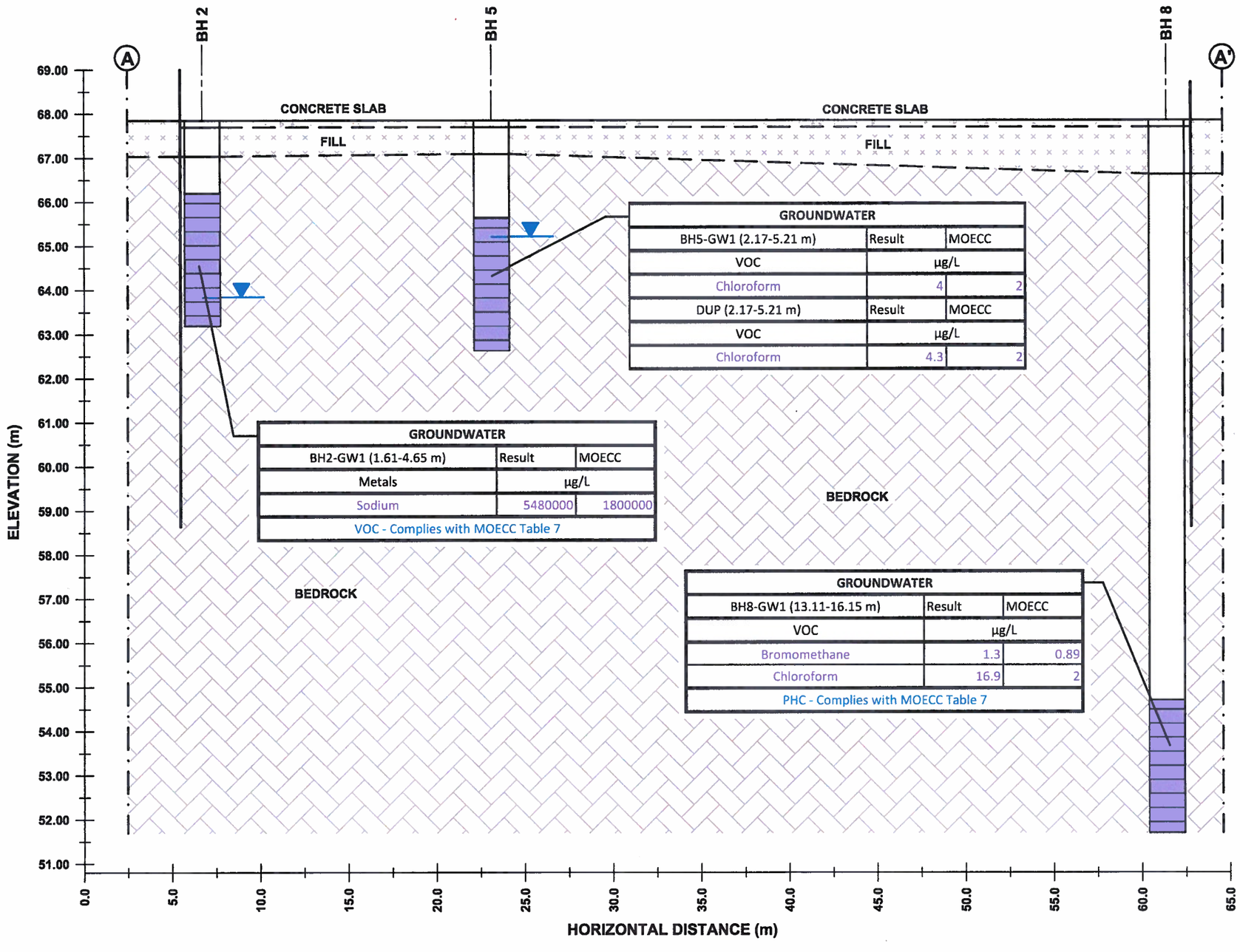

GROUNDWATER		
BH5-GW1 (2.17-5.21 m)	Result	MOECC
VOC	µg/L	
Chloroform	4	2
DUP (2.17-5.21 m)	Result	MOECC
VOC	µg/L	
Chloroform	4.3	2

GROUNDWATER		
BH2-GW1 (1.61-4.65 m)	Result	MOECC
Metals	µg/L	
Sodium	5480000	1800000
VOC - Complies with MOECC Table 7		

GROUNDWATER		
BH8-GW1 (13.11-16.15 m)	Result	MOECC
VOC	µg/L	
Bromomethane	1.3	0.89
Chloroform	16.9	2
PHC - Complies with MOECC Table 7		

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
137 BAY STREET AND 350 SPARKS STREET

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A'

Scale: As shown	Date: 06/2015
Drawn by: MPG	Report No.: PE3548-1
Checked by: AM	Drawing No.: PE3548-5
Approved by: MSD	Revision No.:

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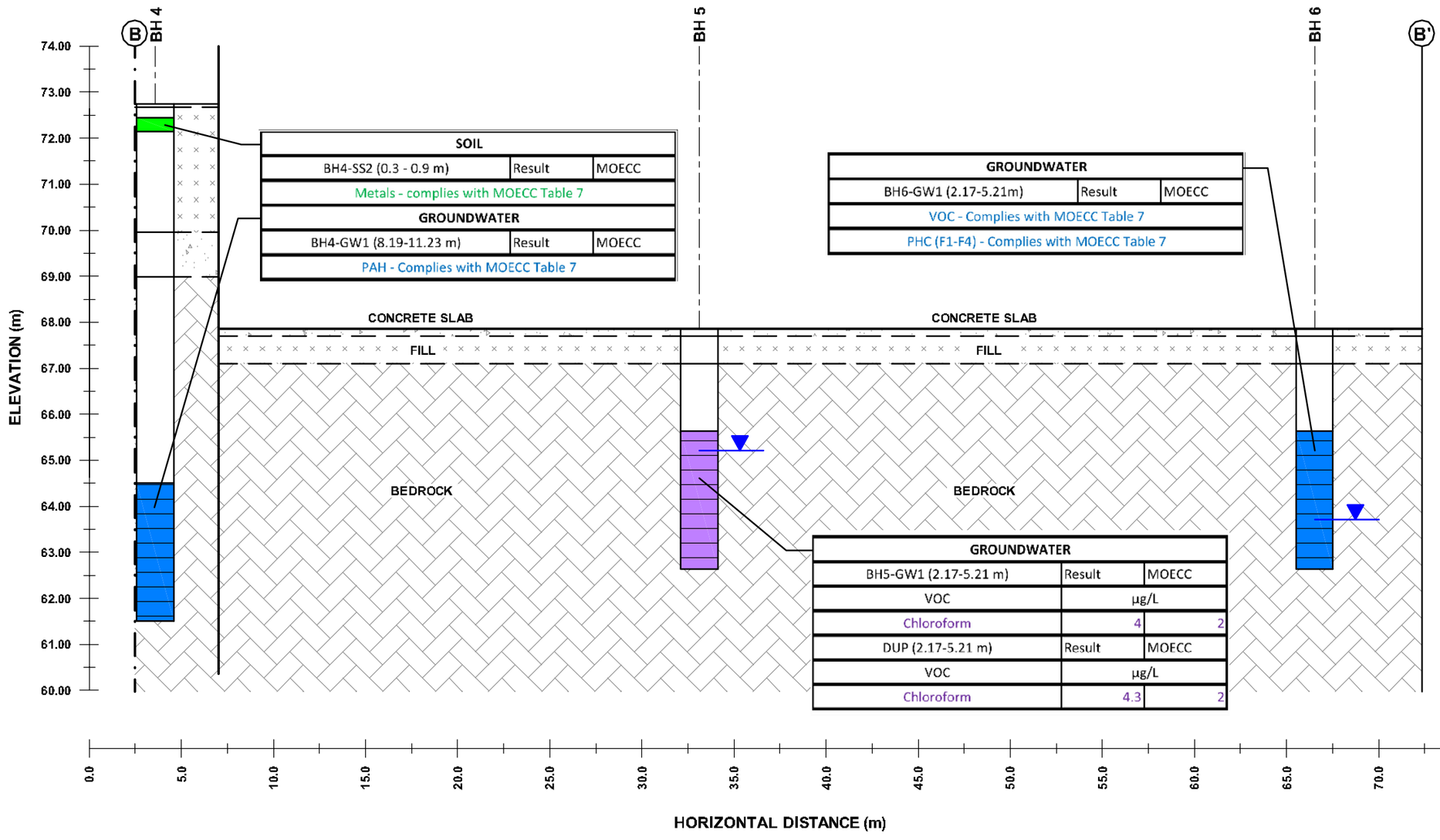

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137 BAY STREET AND 350 SPARKS STREET

OTTAWA, ONTARIO

Title:

CROSS-SECTION B-B'

Scale: As shown	Date: 06/2015
Drawn by: MPG	Report No.: PE3548-1
Checked by: AM	Drawing No.: PE3548-6
Approved by: MSD	Revision No.:

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APPENDIX 1

SAMPLING AND ANALYSIS PLAN

SOIL PROFILE AND TEST DATA SHEETS

ANALYTICAL TEST RESULTS – SUMMARY TABLES

LABORATORY CERTIFICATES OF ANALYSIS

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

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patersongroup

Sampling & Analysis Plan

Phase II ESA
137 Bay Street and 350 Sparks Street
Ottawa, Ontario

Prepared For

Morguard Investments Ltd.

May, 2015

Report: PE3548-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by Morguard Investments Ltd. to conduct a Phase II Environmental Site Assessment (ESA) for the property located at 137 Bay Street and a portion of 350 Sparks Street, Ottawa, Ontario. Based on findings from a Phase I ESA conducted by Golder Associates, a subsurface investigation program, consisting of borehole drilling, was developed.

Borehole	Location & Rationale	Proposed Depth & Rationale
BH1	To assess former USTs below Sparks St. and former brass foundry located north of the subject site.	Intercept water table for groundwater monitoring well installation.
BH2	To address former underground storage tanks along Sparks Street, and former brass foundry located north of the property.	Intercept water table for groundwater monitoring well installation.
BH3	To address former auto dealership with gasoline service station, former underground storage tanks along Sparks Street and former brass foundry north of the property.	Intercept water table for groundwater monitoring well installation.
BH4	To address former use of coal and oil as heating fuels on the property.	Intercept water table for groundwater monitoring well installation.
BH5	To address former commercial auto body shop on-site (central).	Intercept water table for groundwater monitoring well installation.
BH6	To address former auto dealership, former gasoline service station on-site.	Intercept water table for groundwater monitoring well installation.
BH7	To address former use of coal and oil as heating fuels on the property, particularly at 137 Bay Street.	Intercept water table for groundwater monitoring well installation.
BH8	To address former auto dealership, former gasoline service station.	Intercept water table for groundwater monitoring well installation.

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

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

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

Soil quality at geotechnical boreholes will be screened using visual and olfactory screening methods. If contamination is suspected, soil samples will be submitted to vapour screening and soil samples may be analyzed.

2.0 ANALYTICAL TESTING PROGRAM

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

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

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

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

- At least one groundwater monitoring well should be installed in a stratigraphic unit below the suspected contamination, where said stratigraphic unit is water-bearing.
- Parameters analyzed should be consistent with the Contaminants of Concern identified in the Phase I ESA and with the contaminants identified in the soil samples.

3.0 STANDARD OPERATING PROCEDURES

3.1 Environmental Drilling Procedure

Purpose

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

Equipment

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

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

Determining Borehole Locations

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

After drilling is completed a plan with the borehole locations must be provided. Distances and orientations of boreholes with respect to site features (buildings, roadways, etc.) must be provided.

Distances should be measured using a measuring tape or wheel rather than paced off. Ground surface elevations at each borehole should be surveyed relative to a geodetic benchmark, if one is available, or a temporary site benchmark which can be tied in at a later date if necessary.

Drilling Procedure

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

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

Spoon Washing Procedure

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

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

- Rinse with distilled water, a spray bottle works well.

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

Screening Procedure

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

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

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

3.2 Monitoring Well Installation Procedure

Equipment

- 1.5 m x 50 mm threaded sections of Schedule 40 PVC slotted well screen (1.5 m x 31 mm if installing in cored hole in bedrock)
- 1.5 m x 50 mm threaded sections of Schedule 40 PVC riser pipe (1.5 m x 31 mm if installing in cored hole in bedrock)
- Threaded end-cap
- Slip-cap or J-plug
- Asphalt cold patch or concrete
- Silica Sand
- Bentonite chips (Holeplug)
- Steel flushmount casing

Procedure

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

- Backfill remainder of borehole with holeplug or with auger cuttings (if contamination is not suspected).
- Install flushmount casing. Seal space between flushmount and borehole annulus with concrete, cold patch, or holeplug to match surrounding ground surface.

3.3 Monitoring Well Sampling Procedure

Equipment

- Water level metre or interface probe on hydrocarbon/LNAPL sites
- Spray bottles containing water and methanol to clean water level tape or interface probe
- Peristaltic pump
- Polyethylene tubing for peristaltic pump
- Flexible tubing for peristaltic pump
- Latex or nitrile gloves (depending on suspected contaminant)
- 5/16” Allen key and/or 9/16” socket wrench to remove well caps
- Graduated bucket with volume measurements
- pH/Temperature/Conductivity combo pen
- Laboratory-supplied sample bottles

Sampling Procedure

- Locate well and use socket wrench or Allan key to open metal flush mount protector cap. Remove plastic well cap.
- Measure water level, with respect to existing ground surface, using water level meter or interface probe. If using interface probe on suspected NAPL site, measure the thickness of free product.
- Measure total depth of well.
- Clean water level tape or interface probe using methanol and water. Change gloves between wells.
- Calculate volume of standing water within well and record.
- Insert polyethylene tubing into well and attach to peristaltic pump. Turn on peristaltic pump and purge into graduated bucket. Purge at least three well volumes of water from the well. Measure and record field chemistry. Continue to purge, measuring field chemistry after every well volume purged, until appearance or field chemistry stabilizes.

- Note appearance of purge water, including colour, opacity (clear, cloudy, silty), sheen, presence of LNAPL, and odour. Note any other unusual features (particulate matter, effervescence (bubbling) of dissolved gas, etc.).
- Fill required sample bottles. If sampling for metals, attach 75-micron filter to discharge tube and filter metals sample. If sampling for VOCs, use low flow rate to ensure continuous stream of non-turbulent flow into sample bottles. Ensure no headspace is present in VOC vials.
- Replace well cap and flushmount casing cap.

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

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

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

5.0 DATA QUALITY OBJECTIVES

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

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

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

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

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

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

These considerations are discussed in the body of the report.

6.0 PHYSICAL IMPEDIMENTS TO SAMPLING & ANALYSIS PLAN

Physical impediments to the Sampling and Analysis plan may include:

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

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

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
137 Bay Street and 350 Sparks Street
Ottawa, Ontario

DATUM TBM - Brass monument located at the northwest corner of the intersection of Bay Street and Sparks Street. Geodetic elevation = 71.21m as provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

FILE NO. PE3548

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** May 20, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	72.21
Brick interlock 0.06		G	1				
		G	2				
FILL: Blast rock 1.22		RC	1	88	0	1	71.21
		RC	2	71	0		
		RC	3	99	54	2	70.21
		RC	4	98	78	3	69.21
		RC	5	95	82	4	68.21
BEDROCK: Grey limestone with shale beddings		RC	6	100	99	5	67.21
						6	66.21
		RC	7	100	99	7	65.21
						8	64.21
		RC	8	98	96		
- shale lenses by 9.15m depth						9	63.21
		RC	9	91	95		
		RC	10	95	50	10	62.21
10.77 End of Borehole							
(GWL @ 3.82m-June 10, 2015)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

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REMARKS

FILE NO. PE3548

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** May 19, 2015

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE								
Concrete slab	0.11		G	1			0	67.23
FILL: Crushed stone	0.24		RC	1				
FILL: Blast rock trace granulars	0.81		RC	2	100	100	1	66.23
			RC	3	79	73		
			RC	4			2	65.23
BEDROCK: Limestone with shale beddings			RC	5	100	96		
							3	64.23
			RC	6	100	90		
							4	63.23
	4.65							
End of Borehole								
(GWL @ 4.00m-June 10, 2015)								

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

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REMARKS

FILE NO. PE3548

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** May 6, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	67.21
Concrete 0.13		G	1				
FILL: Crushed stone 0.36		RC	1	33			
FILL: Blast rock 0.51		RC	2	100	28	1	66.21
		RC	3	100	82	2	65.21
BEDROCK: Grey limestone with shale beddings		RC	4	100	56	3	64.21
		RC	5	100	83	4	63.21
4.55 End of Borehole							
(GWL @ 2.26m-June 10, 2015)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

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SOIL PROFILE AND TEST DATA

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REMARKS

FILE NO. PE3548

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** May 19, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	72.74
Pavement structure 0.06		G	1				
		SS	2	54	13	1	71.74
FILL: Brown cobbles and sand with crushed stone		SS	3	12	8		
		SS	4	33	6	2	70.74
		SS	5	33	10		
2.79		SS	6		+ 50		
Concrete		RC	1	100		3	69.74
3.76		RC	2	78	61	4	68.74
		RC	3	100	98	5	67.74
		RC	4	100	96	6	66.74
BEDROCK: Grey limestone with trace shale beddings		RC	5	93	100	7	65.74
		RC	6	100	95	8	64.74
		RC	7	96	95	9	63.74
		RC	8	95	55	10	62.74
11.23						11	61.74
End of Borehole							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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REMARKS

FILE NO. PE3548

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** May 11, 2015

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE								
Concrete slab	0.15		G	1			0	67.85
FILL: Crushed stone	0.38		RC	1	50			
FILL: Blast rock	0.76		RC	2			1	66.85
			RC	3	100	88	2	65.85
BEDROCK: Grey limestone with shale beddings			RC	4	100	94	3	64.85
			RC	5	100	93	4	63.85
			RC	6	100	70	5	62.85
	5.21							
End of Borehole								
(GWL @ 2.63m-June 10, 2015)								

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
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REMARKS

FILE NO. PE3548

HOLE NO. BH 6

BORINGS BY CME 55 Power Auger **DATE** May 11, 2015

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE								
Concrete slab	0.15		G	1			0	67.81
FILL: Crushed stone	0.30		RC	1	13			
FILL: Blast rock	0.89		RC	2	100	0	1	66.81
			RC	3	100	28		
			RC	4	100	84	2	65.81
BEDROCK: Grey limestone with shale beddings			RC	5	100	54	3	64.81
			RC	6	100	90	4	63.81
			RC	7	100	49		
	5.21						5	62.81
End of Borehole								
(GWL @ 4.13m-June 10, 2015)								

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

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REMARKS

FILE NO. PE3548

HOLE NO. BH 7

BORINGS BY CME 55 Power Auger **DATE** May 12, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	67.86
Concrete slab 0.13		G	1				
FILL: Crushed stone 0.25		RC	1	27			
FILL: Blast rock 1.12		RC	2	71	100	1	66.86
		RC	3	88	0		
		RC	4	81	62		
		RC	5	100	100	2	65.86
		RC	6	100	100		
		RC	7	100	100		
		RC	8	75	0	3	64.86
		RC	9	82	61		
		RC	10	100	73		
		RC	11	100	94	4	63.86
		RC	12	100	100	5	62.86
		RC	13	100	97		
		RC	14	100	100	6	61.86
BEDROCK: Grey limestone with shale beddings		RC	15	100	100	7	60.86
						8	59.86
		RC	16	100	96	9	58.86
		RC	17	100	30		
		RC	18	100	98	10	57.86
		RC	19	100	100	11	56.86
		RC	20	100	100	12	55.86
		RC	21	100	100	13	54.86
		RC	22	100	100	14	53.86
		RC	23	100	100	15	52.86
15.90		RC	24	100	88		
End of Borehole							
(GWL @ 10.35m-June 10, 2015)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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REMARKS

FILE NO. PE3548

HOLE NO. BH 8

BORINGS BY CME 55 Power Auger **DATE** May 5, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	67.85
Concrete slab 0.15		G	1				
FILL: Crushed stone 0.41		RC	2	21	52	1	66.85
FILL: Blast rock 1.22		RC	3	100	100	2	65.85
		RC	4	100	90	3	64.85
		RC	5	100	100	4	63.85
		RC	6	100	89	5	62.85
		RC	7	100	86	6	61.85
						7	60.85
BEDROCK: Grey limestone with shale beddings		RC	8	98	77	8	59.85
		RC	9	100	86	9	58.85
		RC	10	100	71	10	57.85
		RC	11	100	90	11	56.85
		RC	12	100	97	12	55.85
		RC	13	100	92	13	54.85
		RC	14	100	57	14	53.85
16.15						15	52.85
End of Borehole						16	51.85

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

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

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

CONSOLIDATION TEST

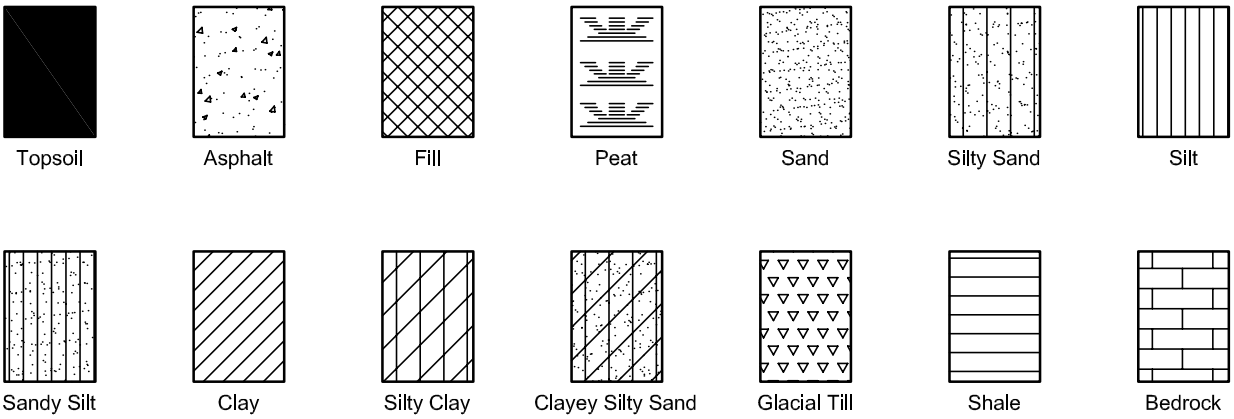
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

PERMEABILITY TEST

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

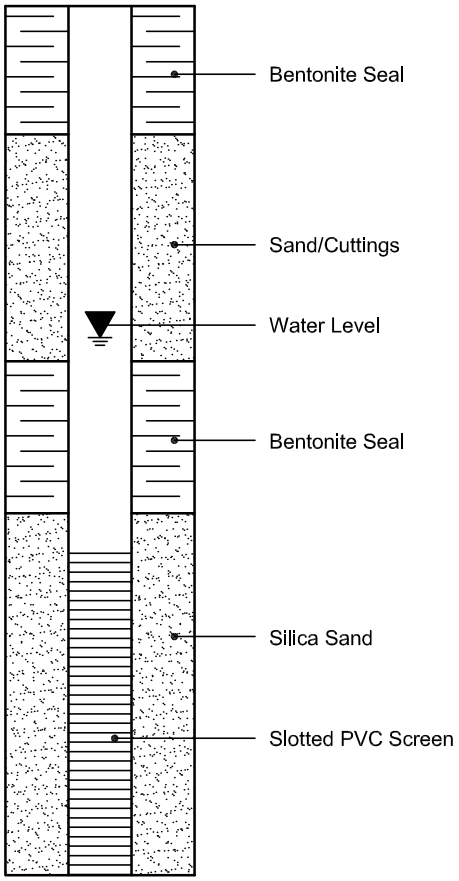
SYMBOLS AND TERMS (continued)

STRATA PLOT



MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION

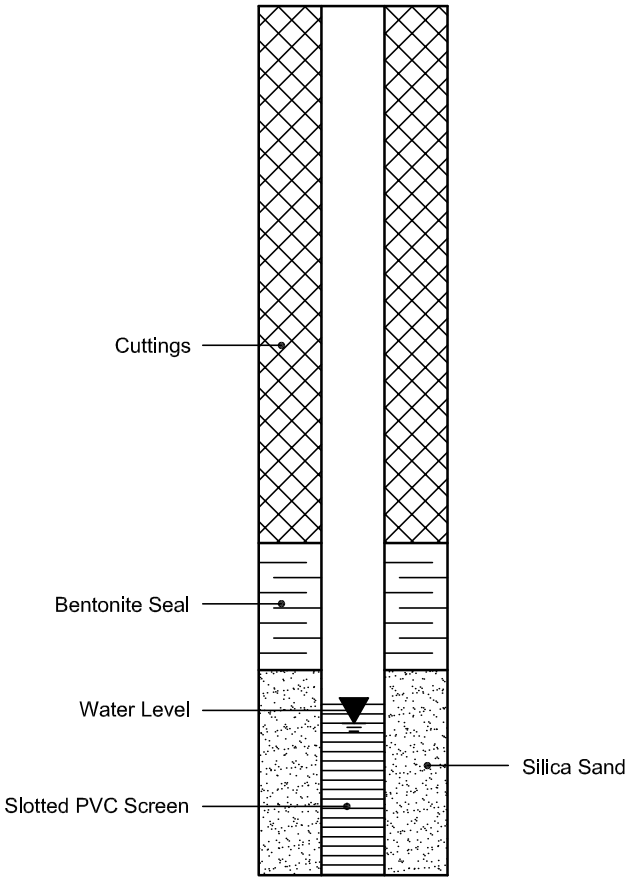


Table 1: Analytical Test Results - Soil - Metals

Parameter	Units	MDL	Regulation	Sample	
				BH1-G1	BH4-SS2
Sample Date (m/d/y)			**Reg 153/04 (2011)-Table 7 Residential, coarse**	**05/20/2015 09:00 AM**	**05/19/2015 09:00 AM**
Physical Characteristics					
% Solids	% by Wt.	0.1		92.7	93.0
General Inorganics					
pH	pH Units	0.05		N/A	8.08
Metals					
Antimony	ug/g dry	1.0	7.5 ug/g dry	2.6	2.0
Arsenic	ug/g dry	1.0	18 ug/g dry	5.9	7.6
Barium	ug/g dry	1.0	390 ug/g dry	64.7	36.4
Beryllium	ug/g dry	1.0	4 ug/g dry	ND (1.0)	ND (1.0)
Boron	ug/g dry	1.0	120 ug/g dry	5.4	5.7
Cadmium	ug/g dry	0.5	1.2 ug/g dry	ND (0.5)	ND (0.5)
Chromium	ug/g dry	1.0	160 ug/g dry	12.1	7.3
Cobalt	ug/g dry	1.0	22 ug/g dry	5.9	5.4
Copper	ug/g dry	1.0	140 ug/g dry	25.8	8.7
Lead	ug/g dry	1.0	120 ug/g dry	120	33.0
Molybdenum	ug/g dry	1.0	6.9 ug/g dry	1.5	3.4
Nickel	ug/g dry	1.0	100 ug/g dry	13.3	12.3
Selenium	ug/g dry	1.0	2.4 ug/g dry	ND (1.0)	ND (1.0)
Silver	ug/g dry	0.5	20 ug/g dry	ND (0.5)	ND (0.5)
Thallium	ug/g dry	1.0	1 ug/g dry	ND (1.0)	ND (1.0)
Uranium	ug/g dry	1.0	23 ug/g dry	ND (1.0)	ND (1.0)
Vanadium	ug/g dry	1.0	86 ug/g dry	17.3	11.0
Zinc	ug/g dry	1.0	340 ug/g dry	80.5	15.2

Notes:

Bold: Value exceeds MOECC Table 7 standard.

Table 2: Analytical Test Results - Groundwater - Metals

Parameter	Units	MDL	Regulation	Sample									
				BH1-GW1	BH2-GW1	BH3-GW1	BH4-GW1	BH5-GW1	BH6-GW1	BH7-GW1	BH8-GW1	DUP	Trip Blank
Sample Date (m/d/y)			**Reg 153/04 (2011)-Table 7 Non-Potable Groundwater, coarse**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/09/2015 11:59 PM**
Metals													
Mercury	ug/L	0.1	0.1 ug/L	ND (0.1)	ND (0.1)	ND (0.1)	N/A	N/A	N/A	ND (0.1)	N/A	N/A	N/A
Antimony	ug/L	0.5	16000 ug/L	0.7	0.7	0.8	N/A	N/A	N/A	1.1	N/A	N/A	N/A
Arsenic	ug/L	1	1500 ug/L	1	ND (1)	ND (1)	N/A	N/A	N/A	1	N/A	N/A	N/A
Barium	ug/L	1	23000 ug/L	137	375	562	N/A	N/A	N/A	275	N/A	N/A	N/A
Beryllium	ug/L	0.5	53 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	N/A	N/A	ND (0.5)	N/A	N/A	N/A
Boron	ug/L	10	36000 ug/L	69	75	75	N/A	N/A	N/A	66	N/A	N/A	N/A
Cadmium	ug/L	0.1	2.1 ug/L	ND (0.1)	ND (0.1)	ND (0.1)	N/A	N/A	N/A	ND (0.1)	N/A	N/A	N/A
Chromium	ug/L	1	640 ug/L	23	21	17	N/A	N/A	N/A	10	N/A	N/A	N/A
Chromium (VI)	ug/L	10	110 ug/L	ND (10)	ND (10)	ND (10)	N/A	N/A	N/A	ND (10)	N/A	N/A	N/A
Cobalt	ug/L	0.5	52 ug/L	ND (0.5)	3.8	32.4	N/A	N/A	N/A	ND (0.5)	N/A	N/A	N/A
Copper	ug/L	0.5	69 ug/L	3.4	60.5	28.0	N/A	N/A	N/A	8.1	N/A	N/A	N/A
Lead	ug/L	0.1	20 ug/L	ND (0.1)	ND (0.1)	0.1	N/A	N/A	N/A	ND (0.1)	N/A	N/A	N/A
Molybdenum	ug/L	0.5	7300 ug/L	17.1	15.8	5.7	N/A	N/A	N/A	19.3	N/A	N/A	N/A
Nickel	ug/L	1	390 ug/L	5	20	31	N/A	N/A	N/A	2	N/A	N/A	N/A
Selenium	ug/L	1	50 ug/L	ND (1)	ND (1)	ND (1)	N/A	N/A	N/A	ND (1)	N/A	N/A	N/A
Silver	ug/L	0.1	1.2 ug/L	0.2	0.2	ND (0.1)	N/A	N/A	N/A	ND (0.1)	N/A	N/A	N/A
Sodium	ug/L	200	1800000 ug/L	**2290000**	**5480000**	**2150000**	N/A	N/A	N/A	293000	N/A	N/A	N/A
Thallium	ug/L	0.1	400 ug/L	ND (0.1)	0.3	ND (0.1)	N/A	N/A	N/A	ND (0.1)	N/A	N/A	N/A
Uranium	ug/L	0.1	330 ug/L	1.5	4.5	11.2	N/A	N/A	N/A	0.5	N/A	N/A	N/A
Vanadium	ug/L	0.5	200 ug/L	5.7	2.7	3.4	N/A	N/A	N/A	2.8	N/A	N/A	N/A
Zinc	ug/L	5	890 ug/L	5	11	8	N/A	N/A	N/A	57	N/A	N/A	N/A

Notes:
Bold: Value exceeds MOECC Table 7 standard.

Table 3: Analytical Test Results - Groundwater - VOCs

Parameter	Units	MDL	Regulation	Sample									
				BH1-GW1	BH2-GW1	BH3-GW1	BH4-GW1	BH5-GW1	BH6-GW1	BH7-GW1	BH8-GW1	DUP	Trip Blank
Sample Date (m/d/y)			Reg 153/04 (2011)-Table 7 Non-Potable Groundwater, coarse	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/09/2015 11:59 PM
Volatile Organic Compounds													
Acetone	ug/L	5.0	100000 ug/L	ND (5.0)	ND (5.0)	ND (5.0)	N/A	ND (5.0)	ND (5.0)	N/A	ND (5.0)	ND (5.0)	ND (5.0)
Benzene	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Bromodichloromethane	ug/L	0.5	67000 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Bromoform	ug/L	0.5	5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Bromomethane	ug/L	0.5	0.89 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	**1.3**	ND (0.5)	ND (0.5)
Carbon Tetrachloride	ug/L	0.2	0.2 ug/L	ND (0.2)	ND (0.2)	ND (0.2)	N/A	ND (0.2)	ND (0.2)	N/A	ND (0.2)	ND (0.2)	ND (0.2)
Chlorobenzene	ug/L	0.5	140 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Chloroform	ug/L	0.5	2 ug/L	ND (0.5)	1.6	**4.9**	N/A	**4.0**	0.8	N/A	**16.9**	**4.3**	ND (0.5)
Dibromochloromethane	ug/L	0.5	65000 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Dichlorodifluoromethane	ug/L	1.0	3500 ug/L	ND (1.0)	ND (1.0)	ND (1.0)	N/A	ND (1.0)	ND (1.0)	N/A	ND (1.0)	ND (1.0)	ND (1.0)
1,2-Dichlorobenzene	ug/L	0.5	150 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,3-Dichlorobenzene	ug/L	0.5	7600 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,4-Dichlorobenzene	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,1-Dichloroethane	ug/L	0.5	11 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,2-Dichloroethane	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,1-Dichloroethylene	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
cis-1,2-Dichloroethylene	ug/L	0.5	1.6 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
trans-1,2-Dichloroethylene	ug/L	0.5	1.6 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,2-Dichloropropane	ug/L	0.5	0.58 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
cis-1,3-Dichloropropylene	ug/L	0.5		ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
trans-1,3-Dichloropropylene	ug/L	0.5		ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,3-Dichloropropene, total	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,2-Dibromoethane	ug/L	0.2	0.2 ug/L	ND (0.2)	ND (0.2)	ND (0.2)	N/A	ND (0.2)	ND (0.2)	N/A	ND (0.2)	ND (0.2)	ND (0.2)
Ethylbenzene	ug/L	0.5	54 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Hexane	ug/L	1.0	5 ug/L	ND (1.0)	ND (1.0)	ND (1.0)	N/A	ND (1.0)	ND (1.0)	N/A	ND (1.0)	ND (1.0)	ND (1.0)
Methyl Ethyl Ketone (2-Butanone)	ug/L	5.0	21000 ug/L	ND (5.0)	ND (5.0)	ND (5.0)	N/A	ND (5.0)	ND (5.0)	N/A	ND (5.0)	ND (5.0)	ND (5.0)
Methyl Isobutyl Ketone	ug/L	5.0	5200 ug/L	ND (5.0)	ND (5.0)	ND (5.0)	N/A	ND (5.0)	ND (5.0)	N/A	ND (5.0)	ND (5.0)	ND (5.0)
Methyl tert-butyl ether	ug/L	2.0	15 ug/L	ND (2.0)	ND (2.0)	ND (2.0)	N/A	ND (2.0)	ND (2.0)	N/A	ND (2.0)	ND (2.0)	ND (2.0)
Methylene Chloride	ug/L	5.0	26 ug/L	ND (5.0)	ND (5.0)	ND (5.0)	N/A	ND (5.0)	ND (5.0)	N/A	ND (5.0)	ND (5.0)	ND (5.0)
Styrene	ug/L	0.5	43 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,1,1,2-Tetrachloroethane	ug/L	0.5	1.1 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,1,2,2-Tetrachloroethane	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Tetrachloroethylene	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Toluene	ug/L	0.5	320 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,1,1-Trichloroethane	ug/L	0.5	23 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
1,1,2-Trichloroethane	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Trichloroethylene	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Trichlorofluoromethane	ug/L	1.0	2000 ug/L	ND (1.0)	ND (1.0)	ND (1.0)	N/A	ND (1.0)	ND (1.0)	N/A	ND (1.0)	ND (1.0)	ND (1.0)
Vinyl Chloride	ug/L	0.5	0.5 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
m/p-Xylene	ug/L	0.5		ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
o-Xylene	ug/L	0.5		ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)
Xylenes, total	ug/L	0.5	72 ug/L	ND (0.5)	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	N/A	ND (0.5)	ND (0.5)	ND (0.5)

Notes:

Bold: Value exceeds MOECC Table 7 standard.

Table 4: Analytical Test Results - Groundwater - PHCs

Parameter	Units	MDL	Regulation	Sample									
				BH1-GW1	BH2-GW1	BH3-GW1	BH4-GW1	BH5-GW1	BH6-GW1	BH7-GW1	BH8-GW1	DUP	Trip Blank
Sample Date (m/d/y)			**Reg 153/04 (2011)-Table 7 Non-Potable Groundwater, coarse**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/10/2015 09:00 AM**	**06/09/2015 11:59 PM**
PHC													
F1 PHCs (C6-C10)	ug/L	25	420 ug/L	ND (25)	N/A	ND (25)	N/A	N/A	ND (25)	N/A	ND (25)	N/A	N/A
F2 PHCs (C10-C16)	ug/L	100	150 ug/L	ND (100)	N/A	ND (100)	N/A	N/A	ND (100)	N/A	ND (100)	N/A	N/A
F3 PHCs (C16-C34)	ug/L	100	500 ug/L	ND (100)	N/A	ND (100)	N/A	N/A	ND (100)	N/A	ND (100)	N/A	N/A
F4 PHCs (C34-C50)	ug/L	100	500 ug/L	ND (100)	N/A	ND (100)	N/A	N/A	ND (100)	N/A	ND (100)	N/A	N/A
F1 + F2 PHCs	ug/L	125		ND (125)	N/A	ND (125)	N/A	N/A	ND (125)	N/A	ND (125)	N/A	N/A
F3 + F4 PHCs	ug/L	200		ND (200)	N/A	ND (200)	N/A	N/A	ND (200)	N/A	ND (200)	N/A	N/A

Notes:
Bold: Value exceeds MOECC Table 7 standard.

Table 5: Analytical Test Results - Groundwater - PAHs

Parameter	Units	MDL	Regulation	Sample									
				BH1-GW1	BH2-GW1	BH3-GW1	BH4-GW1	BH5-GW1	BH6-GW1	BH7-GW1	BH8-GW1	DUP	Trip Blank
Sample Date (m/d/y)			Reg 153/04 (2011)-Table 7 Non-Potable Groundwater, coarse	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/10/2015 09:00 AM	06/09/2015 11:59 PM
PAH													
Acenaphthene	ug/L	0.05	17 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Acenaphthylene	ug/L	0.05	1 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Anthracene	ug/L	0.01	1 ug/L	N/A	N/A	ND (0.01)	ND (0.01)	N/A	N/A	ND (0.01)	N/A	N/A	N/A
Benzo[a]anthracene	ug/L	0.01	1.8 ug/L	N/A	N/A	ND (0.01)	ND (0.01)	N/A	N/A	ND (0.01)	N/A	N/A	N/A
Benzo[a]pyrene	ug/L	0.01	0.81 ug/L	N/A	N/A	ND (0.01)	ND (0.01)	N/A	N/A	ND (0.01)	N/A	N/A	N/A
Benzo[b]fluoranthene	ug/L	0.05	0.75 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Benzo[g,h,i]perylene	ug/L	0.05	0.2 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Benzo[k]fluoranthene	ug/L	0.05	0.4 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Chrysene	ug/L	0.05	0.7 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Dibenzo[a,h]anthracene	ug/L	0.05	0.4 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Fluoranthene	ug/L	0.01	44 ug/L	N/A	N/A	ND (0.01)	ND (0.01)	N/A	N/A	ND (0.01)	N/A	N/A	N/A
Fluorene	ug/L	0.05	290 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Indeno[1,2,3-cd]pyrene	ug/L	0.05	0.2 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
1-Methylnaphthalene	ug/L	0.05	1500 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
2-Methylnaphthalene	ug/L	0.05	1500 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Methylnaphthalene (1&2)	ug/L	0.10	1500 ug/L	N/A	N/A	ND (0.10)	ND (0.10)	N/A	N/A	ND (0.10)	N/A	N/A	N/A
Naphthalene	ug/L	0.05	7 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	0.30	N/A	N/A	N/A
Phenanthrene	ug/L	0.05	380 ug/L	N/A	N/A	ND (0.05)	ND (0.05)	N/A	N/A	ND (0.05)	N/A	N/A	N/A
Pyrene	ug/L	0.01	5.7 ug/L	N/A	N/A	ND (0.01)	ND (0.01)	N/A	N/A	ND (0.01)	N/A	N/A	N/A

Notes:
Bold: Value exceeds MOECC Table 7 standard.

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Certificate of Analysis

Paterson Group Consulting Engineers
154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Sean Moggridge

Phone: (613) 226-7381
Fax: (613) 226-6344

Client PO: 17212
Project: PE3548
Custody: 105138

Report Date: 11-Jun-2015
Order Date: 4-Jun-2015
Order #: 1523330

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

Paracel ID	Client ID
1523330-01	BH1-G1
1523330-02	BH4-SS2

Approved By: Mark Foto

Mark Foto, M.Sc. For Dale Robertson, BSc
Laboratory Director

Certificate of Analysis

Report Date: 11-Jun-2015
Order Date:4-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17212 Project Description: PE3548

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
MOE Metals by ICP-OES, soil Reg 153	based on MOE E3470, ICP-OES	5-Jun-15	5-Jun-15
pH	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	8-Jun-15	9-Jun-15
Solids, %	Gravimetric, calculation	5-Jun-15	5-Jun-15

PARACEL LABORATORIES LTD.

Order #: 1523330

Certificate of Analysis

Report Date: 11-Jun-2015
Order Date:4-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17212

Project Description: PE3548

	Client ID:	BH1-G1	BH4-SS2	-	-
	Sample Date:	20-May-15	19-May-15	-	-
	Sample ID:	1523330-01	1523330-02	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	92.7	93.0	-	-
General Inorganics					
pH	0.05 pH Units	-	8.08	-	-
Metals					
Antimony	1.0 ug/g dry	2.6	2.0	-	-
Arsenic	1.0 ug/g dry	5.9	7.6	-	-
Barium	1.0 ug/g dry	64.7	36.4	-	-
Beryllium	1.0 ug/g dry	<1.0	<1.0	-	-
Boron	1.0 ug/g dry	5.4	5.7	-	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	-	-
Chromium	1.0 ug/g dry	12.1	7.3	-	-
Cobalt	1.0 ug/g dry	5.9	5.4	-	-
Copper	1.0 ug/g dry	25.8	8.7	-	-
Lead	1.0 ug/g dry	120	33.0	-	-
Molybdenum	1.0 ug/g dry	1.5	3.4	-	-
Nickel	1.0 ug/g dry	13.3	12.3	-	-
Selenium	1.0 ug/g dry	<1.0	<1.0	-	-
Silver	0.5 ug/g dry	<0.5	<0.5	-	-
Thallium	1.0 ug/g dry	<1.0	<1.0	-	-
Uranium	1.0 ug/g dry	<1.0	<1.0	-	-
Vanadium	1.0 ug/g dry	17.3	11.0	-	-
Zinc	1.0 ug/g dry	80.5	15.2	-	-

Certificate of Analysis

Report Date: 11-Jun-2015
Order Date:4-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17212 Project Description: PE3548

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	1.0	ug/g						
Boron	ND	1.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium	ND	1.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	1.0	ug/g						
Lead	ND	1.0	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	1.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.5	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	1.0	ug/g						
Zinc	ND	1.0	ug/g						

Certificate of Analysis

Report Date: 11-Jun-2015
Order Date:4-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17212 Project Description: PE3548

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	7.56	0.05	pH Units	7.57			0.1	10	
Metals									
Antimony	ND	1.0	ug/g dry	ND				30	
Arsenic	4.14	1.0	ug/g dry	3.82			8.0	30	
Barium	102	1.0	ug/g dry	102			0.1	30	
Beryllium	ND	1.0	ug/g dry	ND			0.0	30	
Boron	18.8	1.0	ug/g dry	19.1			1.4	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	13.2	1.0	ug/g dry	13.4			1.3	30	
Cobalt	4.75	1.0	ug/g dry	4.73			0.4	30	
Copper	20.5	1.0	ug/g dry	20.5			0.1	30	
Lead	13.6	1.0	ug/g dry	12.9			5.8	30	
Molybdenum	1.76	1.0	ug/g dry	1.87			6.4	30	
Nickel	10.7	1.0	ug/g dry	10.9			2.4	30	
Selenium	ND	1.0	ug/g dry	1.20			0.0	30	
Silver	ND	0.5	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND				30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	18.4	1.0	ug/g dry	18.5			0.5	30	
Zinc	45.8	1.0	ug/g dry	45.1			1.7	30	
Physical Characteristics									
% Solids	79.3	0.1	% by Wt.	84.9			6.7	25	

Certificate of Analysis

Report Date: 11-Jun-2015
Order Date:4-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17212 Project Description: PE3548

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Metals									
Antimony	166		ug/L	ND	133	70-130			QM-07
Arsenic	219		ug/L	76.5	114	70-130			
Barium	2100		ug/L	2030	52.9	70-130			QM-07
Beryllium	129		ug/L	2.55	101	70-130			
Boron	494		ug/L	382	89.5	70-130			
Cadmium	121		ug/L	2.47	94.8	70-130			
Chromium	369		ug/L	267	81.4	70-130			
Cobalt	196		ug/L	94.7	81.0	70-130			
Copper	521		ug/L	409	89.6	70-130			
Lead	364		ug/L	257	85.2	70-130			
Molybdenum	151		ug/L	37.4	90.7	70-130			
Nickel	313		ug/L	219	75.1	70-130			
Selenium	105		ug/L	24.0	64.7	70-130			QM-07
Silver	140		ug/L	0.61	112	70-130			
Thallium	109		ug/L	ND	86.9	70-130			
Uranium	43.7		ug/L	ND	34.9	70-130			QM-07
Vanadium	475		ug/L	371	83.3	70-130			
Zinc	124		ug/L	ND	99.4	70-130			

Certificate of Analysis

Report Date: 11-Jun-2015
Order Date:4-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17212 Project Description: PE3548

Qualifier Notes:

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.

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

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Chain of Custody
(Lab Use Only)
№ 105138

Client Name: PATERSON GROUP INC.	Project Reference: PE3548
Contact Name: SEAN MOGGRIDGE	Quote #
Address: 154 COLONNADE ROAD SOUTH	PO # 17212
Telephone: (613) 226-7381	Email Address: SMOGGRIDGE@PATERSONGROUP.CA

TAT: [X] Regular [ ] 3 Day [ ] 2 Day [ ] 1 Day
Date Required: ______

Criteria: [X] O. Reg. 153/04 (As Amended) Table 7 [ ] 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: 1923330

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)						
1	BH1-G1	S		2	MAY 20/15					X						120	+VCA		
2	BH4-SS2	S		2	MAY 19/15		X			X							✓		
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			

X Cancelled PHC F1-F4/Btex on BH4-SS2 ∴ Holding time exceeded. per Sean. DBlossom.

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): [signature]	Received by Driver/Depot: [signature]	Received at Lab: DBlossom	Verified By: [signature]
Relinquished By (Print): SEAN MOGGRIDGE	Date/Time: 04/06/15 2:40 PM	Date/Time: June 4, 15 3:50	Date/Time: June 4, 15 4:18
Date/Time: June 3, 2015 4:30 PM	Temperature: ___ °C	Temperature: 16.7 °C	pH Verified [ ] By: ______

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Sean Moggridge

Phone: (613) 226-7381
Fax: (613) 226-6344

Client PO: 17204
Project: PE3548
Custody: 104871

Report Date: 22-Jun-2015
Order Date: 12-Jun-2015
Revised Report **Order #: 1524493**

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

Paracel ID	Client ID
1524493-01	BH1-GW1
1524493-02	BH2-GW1
1524493-03	BH3-GW1
1524493-04	BH4-GW1
1524493-05	BH5-GW1
1524493-06	BH6-GW1
1524493-07	BH7-GW1
1524493-08	BH8-GW1
1524493-09	DUP
1524493-10	Trip Blank-15D1701

Approved By: 

Mark Foto, M.Sc. For Dale Robertson, BSc
Laboratory Director

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204 Project Description: PE3548

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Chromium, hexavalent	MOE E3056 - colourimetric	16-Jun-15	16-Jun-15
Mercury by CVAA	EPA 245.1 - Cold Vapour AA	17-Jun-15	17-Jun-15
Metals, ICP-MS	EPA 200.8 - ICP-MS	16-Jun-15	16-Jun-15
PHC F1	CWS Tier 1 - P&T GC-FID	15-Jun-15	16-Jun-15
PHC F2 - F4	CWS Tier 1 - GC-FID, extraction	16-Jun-15	16-Jun-15
REG 153: PAHs by GC-MS	EPA 625 - GC-MS, extraction	17-Jun-15	18-Jun-15
REG 153: VOCs by P&T GC/MS	EPA 624 - P&T GC-MS	15-Jun-15	16-Jun-15

PARACEL LABORATORIES LTD.

Order #: 1524493

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204

Project Description: PE3548

	Client ID:	BH1-GW1	BH2-GW1	BH3-GW1	BH4-GW1
	Sample Date:	10-Jun-15	10-Jun-15	10-Jun-15	10-Jun-15
	Sample ID:	1524493-01	1524493-02	1524493-03	1524493-04
	MDL/Units	Water	Water	Water	Water
Metals					
Mercury	0.1 ug/L	<0.1	<0.1	<0.1	-
Antimony	0.5 ug/L	0.7	0.7	0.8	-
Arsenic	1 ug/L	1	<1	<1	-
Barium	1 ug/L	137	375	562	-
Beryllium	0.5 ug/L	<0.5	<0.5	<0.5	-
Boron	10 ug/L	69	75	75	-
Cadmium	0.1 ug/L	<0.1	<0.1	<0.1	-
Chromium	1 ug/L	23	21	17	-
Chromium (VI)	10 ug/L	<10	<10	<10	-
Cobalt	0.5 ug/L	<0.5	3.8	32.4	-
Copper	0.5 ug/L	3.4	60.5	28.0	-
Lead	0.1 ug/L	<0.1	<0.1	0.1	-
Molybdenum	0.5 ug/L	17.1	15.8	5.7	-
Nickel	1 ug/L	5	20	31	-
Selenium	1 ug/L	<1	<1	<1	-
Silver	0.1 ug/L	0.2	0.2	<0.1	-
Sodium	200 ug/L	2290000	5480000	2150000	-
Thallium	0.1 ug/L	<0.1	0.3	<0.1	-
Uranium	0.1 ug/L	1.5	4.5	11.2	-
Vanadium	0.5 ug/L	5.7	2.7	3.4	-
Zinc	5 ug/L	5	11	8	-
Volatiles					
Acetone	5.0 ug/L	<5.0	<5.0	<5.0	-
Benzene	0.5 ug/L	<0.5	<0.5	<0.5	-
Bromodichloromethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Bromoform	0.5 ug/L	<0.5	<0.5	<0.5	-
Bromomethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Carbon Tetrachloride	0.2 ug/L	<0.2	<0.2	<0.2	-
Chlorobenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
Chloroform	0.5 ug/L	<0.5	1.6	4.9	-
Dibromochloromethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Dichlorodifluoromethane	1.0 ug/L	<1.0	<1.0	<1.0	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	<0.5	-

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204

Project Description: PE3548

	Client ID:	BH1-GW1	BH2-GW1	BH3-GW1	BH4-GW1
	Sample Date:	10-Jun-15	10-Jun-15	10-Jun-15	10-Jun-15
	Sample ID:	1524493-01	1524493-02	1524493-03	1524493-04
	MDL/Units	Water	Water	Water	Water
1,3-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1-Dichloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
1,2-Dichloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,2-Dichloropropane	0.5 ug/L	<0.5	<0.5	<0.5	-
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	<0.5	<0.5	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,3-Dichloropropene, total	0.5 ug/L	<0.5	<0.5	<0.5	-
Ethylbenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
Ethylene dibromide (dibromoethan	0.2 ug/L	<0.2	<0.2	<0.2	-
Hexane	1.0 ug/L	<1.0	<1.0	<1.0	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	<5.0	<5.0	-
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	<5.0	<5.0	-
Methyl tert-butyl ether	2.0 ug/L	<2.0	<2.0	<2.0	-
Methylene Chloride	5.0 ug/L	<5.0	<5.0	<5.0	-
Styrene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Tetrachloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
Toluene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Trichloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
Trichlorofluoromethane	1.0 ug/L	<1.0	<1.0	<1.0	-
Vinyl chloride	0.5 ug/L	<0.5	<0.5	<0.5	-
m,p-Xylenes	0.5 ug/L	<0.5	<0.5	<0.5	-
o-Xylene	0.5 ug/L	<0.5	<0.5	<0.5	-
Xylenes, total	0.5 ug/L	<0.5	<0.5	<0.5	-
4-Bromofluorobenzene	Surrogate	118%	116%	119%	-
Dibromofluoromethane	Surrogate	118%	119%	111%	-
Toluene-d8	Surrogate	93.3%	95.8%	96.2%	-

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204

Project Description: PE3548

	Client ID:	BH1-GW1	BH2-GW1	BH3-GW1	BH4-GW1
	Sample Date:	10-Jun-15	10-Jun-15	10-Jun-15	10-Jun-15
	Sample ID:	1524493-01	1524493-02	1524493-03	1524493-04
	MDL/Units	Water	Water	Water	Water
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	-	<25	-
F2 PHCs (C10-C16)	100 ug/L	<100	-	<100	-
F3 PHCs (C16-C34)	100 ug/L	<100	-	<100	-
F4 PHCs (C34-C50)	100 ug/L	<100	-	<100	-
F1 + F2 PHCs	125 ug/L	<125	-	<125	-
F3 + F4 PHCs	200 ug/L	<200	-	<200	-
Semi-Volatiles					
Acenaphthene	0.05 ug/L	-	-	<0.05	<0.05
Acenaphthylene	0.05 ug/L	-	-	<0.05	<0.05
Anthracene	0.01 ug/L	-	-	<0.01	<0.01
Benzo [a] anthracene	0.01 ug/L	-	-	<0.01	<0.01
Benzo [a] pyrene	0.01 ug/L	-	-	<0.01	<0.01
Benzo [b] fluoranthene	0.05 ug/L	-	-	<0.05	<0.05
Benzo [g,h,i] perylene	0.05 ug/L	-	-	<0.05	<0.05
Benzo [k] fluoranthene	0.05 ug/L	-	-	<0.05	<0.05
Chrysene	0.05 ug/L	-	-	<0.05	<0.05
Dibenzo [a,h] anthracene	0.05 ug/L	-	-	<0.05	<0.05
Fluoranthene	0.01 ug/L	-	-	<0.01	<0.01
Fluorene	0.05 ug/L	-	-	<0.05	<0.05
Indeno [1,2,3-cd] pyrene	0.05 ug/L	-	-	<0.05	<0.05
1-Methylnaphthalene	0.05 ug/L	-	-	<0.05	<0.05
2-Methylnaphthalene	0.05 ug/L	-	-	<0.05	<0.05
Methylnaphthalene (1&2)	0.10 ug/L	-	-	<0.10	<0.10
Naphthalene	0.05 ug/L	-	-	<0.05	<0.05
Phenanthrene	0.05 ug/L	-	-	<0.05	<0.05
Pyrene	0.01 ug/L	-	-	<0.01	<0.01
2-Fluorobiphenyl	Surrogate	-	-	79.2%	75.3%
Terphenyl-d14	Surrogate	-	-	95.8%	97.8%

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204

Project Description: PE3548

	Client ID:	BH5-GW1	BH6-GW1	BH7-GW1	BH8-GW1
	Sample Date:	10-Jun-15	10-Jun-15	10-Jun-15	10-Jun-15
	Sample ID:	1524493-05	1524493-06	1524493-07	1524493-08
	MDL/Units	Water	Water	Water	Water
Metals					
Mercury	0.1 ug/L	-	-	<0.1	-
Antimony	0.5 ug/L	-	-	1.1	-
Arsenic	1 ug/L	-	-	1	-
Barium	1 ug/L	-	-	275	-
Beryllium	0.5 ug/L	-	-	<0.5	-
Boron	10 ug/L	-	-	66	-
Cadmium	0.1 ug/L	-	-	<0.1	-
Chromium	1 ug/L	-	-	10	-
Chromium (VI)	10 ug/L	-	-	<10	-
Cobalt	0.5 ug/L	-	-	<0.5	-
Copper	0.5 ug/L	-	-	8.1	-
Lead	0.1 ug/L	-	-	<0.1	-
Molybdenum	0.5 ug/L	-	-	19.3	-
Nickel	1 ug/L	-	-	2	-
Selenium	1 ug/L	-	-	<1	-
Silver	0.1 ug/L	-	-	<0.1	-
Sodium	200 ug/L	-	-	293000	-
Thallium	0.1 ug/L	-	-	<0.1	-
Uranium	0.1 ug/L	-	-	0.5	-
Vanadium	0.5 ug/L	-	-	2.8	-
Zinc	5 ug/L	-	-	57	-
Volatiles					
Acetone	5.0 ug/L	<5.0	<5.0	-	<5.0
Benzene	0.5 ug/L	<0.5	<0.5	-	<0.5
Bromodichloromethane	0.5 ug/L	<0.5	<0.5	-	<0.5
Bromoform	0.5 ug/L	<0.5	<0.5	-	<0.5
Bromomethane	0.5 ug/L	<0.5	<0.5	-	1.3
Carbon Tetrachloride	0.2 ug/L	<0.2	<0.2	-	<0.2
Chlorobenzene	0.5 ug/L	<0.5	<0.5	-	<0.5
Chloroform	0.5 ug/L	4.0	0.8	-	16.9
Dibromochloromethane	0.5 ug/L	<0.5	<0.5	-	<0.5
Dichlorodifluoromethane	1.0 ug/L	<1.0	<1.0	-	<1.0
1,2-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	<0.5

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204

Project Description: PE3548

	Client ID:	BH5-GW1	BH6-GW1	BH7-GW1	BH8-GW1
	Sample Date:	10-Jun-15	10-Jun-15	10-Jun-15	10-Jun-15
	Sample ID:	1524493-05	1524493-06	1524493-07	1524493-08
	MDL/Units	Water	Water	Water	Water
1,3-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	<0.5
1,4-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	<0.5
1,1-Dichloroethane	0.5 ug/L	<0.5	<0.5	-	<0.5
1,2-Dichloroethane	0.5 ug/L	<0.5	<0.5	-	<0.5
1,1-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	<0.5
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	<0.5
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	<0.5
1,2-Dichloropropane	0.5 ug/L	<0.5	<0.5	-	<0.5
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	<0.5	-	<0.5
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	<0.5	-	<0.5
1,3-Dichloropropene, total	0.5 ug/L	<0.5	<0.5	-	<0.5
Ethylbenzene	0.5 ug/L	<0.5	<0.5	-	<0.5
Ethylene dibromide (dibromoethar	0.2 ug/L	<0.2	<0.2	-	<0.2
Hexane	1.0 ug/L	<1.0	<1.0	-	<1.0
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	<5.0	-	<5.0
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	<5.0	-	<5.0
Methyl tert-butyl ether	2.0 ug/L	<2.0	<2.0	-	<2.0
Methylene Chloride	5.0 ug/L	<5.0	<5.0	-	<5.0
Styrene	0.5 ug/L	<0.5	<0.5	-	<0.5
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	-	<0.5
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	-	<0.5
Tetrachloroethylene	0.5 ug/L	<0.5	<0.5	-	<0.5
Toluene	0.5 ug/L	<0.5	<0.5	-	<0.5
1,1,1-Trichloroethane	0.5 ug/L	<0.5	<0.5	-	<0.5
1,1,2-Trichloroethane	0.5 ug/L	<0.5	<0.5	-	<0.5
Trichloroethylene	0.5 ug/L	<0.5	<0.5	-	<0.5
Trichlorofluoromethane	1.0 ug/L	<1.0	<1.0	-	<1.0
Vinyl chloride	0.5 ug/L	<0.5	<0.5	-	<0.5
m,p-Xylenes	0.5 ug/L	<0.5	<0.5	-	<0.5
o-Xylene	0.5 ug/L	<0.5	<0.5	-	<0.5
Xylenes, total	0.5 ug/L	<0.5	<0.5	-	<0.5
4-Bromofluorobenzene	Surrogate	118%	120%	-	117%
Dibromofluoromethane	Surrogate	112%	118%	-	119%

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204

Project Description: PE3548

	Client ID:	BH5-GW1	BH6-GW1	BH7-GW1	BH8-GW1
	Sample Date:	10-Jun-15	10-Jun-15	10-Jun-15	10-Jun-15
	Sample ID:	1524493-05	1524493-06	1524493-07	1524493-08
	MDL/Units	Water	Water	Water	Water
Toluene-d8	Surrogate	94.0%	97.2%	-	95.7%
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	-	<25	-	<25
F2 PHCs (C10-C16)	100 ug/L	-	<100	-	<100
F3 PHCs (C16-C34)	100 ug/L	-	<100	-	<100
F4 PHCs (C34-C50)	100 ug/L	-	<100	-	<100
F1 + F2 PHCs	125 ug/L	-	<125	-	<125
F3 + F4 PHCs	200 ug/L	-	<200	-	<200
Semi-Volatiles					
Acenaphthene	0.05 ug/L	-	-	<0.05	-
Acenaphthylene	0.05 ug/L	-	-	<0.05	-
Anthracene	0.01 ug/L	-	-	<0.01	-
Benzo [a] anthracene	0.01 ug/L	-	-	<0.01	-
Benzo [a] pyrene	0.01 ug/L	-	-	<0.01	-
Benzo [b] fluoranthene	0.05 ug/L	-	-	<0.05	-
Benzo [g,h,i] perylene	0.05 ug/L	-	-	<0.05	-
Benzo [k] fluoranthene	0.05 ug/L	-	-	<0.05	-
Chrysene	0.05 ug/L	-	-	<0.05	-
Dibenzo [a,h] anthracene	0.05 ug/L	-	-	<0.05	-
Fluoranthene	0.01 ug/L	-	-	<0.01	-
Fluorene	0.05 ug/L	-	-	<0.05	-
Indeno [1,2,3-cd] pyrene	0.05 ug/L	-	-	<0.05	-
1-Methylnaphthalene	0.05 ug/L	-	-	<0.05	-
2-Methylnaphthalene	0.05 ug/L	-	-	<0.05	-
Methylnaphthalene (1&2)	0.10 ug/L	-	-	<0.10	-
Naphthalene	0.05 ug/L	-	-	0.30	-
Phenanthrene	0.05 ug/L	-	-	<0.05	-
Pyrene	0.01 ug/L	-	-	<0.01	-
2-Fluorobiphenyl	Surrogate	-	-	71.4%	-
Terphenyl-d14	Surrogate	-	-	86.8%	-

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204

Project Description: PE3548

	Client ID:	DUP	Trip Blank-15D1701	-	-
	Sample Date:	10-Jun-15	09-Jun-15	-	-
	Sample ID:	1524493-09	1524493-10	-	-
	MDL/Units	Water	Water	-	-
Volatiles					
Acetone	5.0 ug/L	<5.0	<5.0	-	-
Benzene	0.5 ug/L	<0.5	<0.5	-	-
Bromodichloromethane	0.5 ug/L	<0.5	<0.5	-	-
Bromoform	0.5 ug/L	<0.5	<0.5	-	-
Bromomethane	0.5 ug/L	<0.5	<0.5	-	-
Carbon Tetrachloride	0.2 ug/L	<0.2	<0.2	-	-
Chlorobenzene	0.5 ug/L	<0.5	<0.5	-	-
Chloroform	0.5 ug/L	4.3	<0.5	-	-
Dibromochloromethane	0.5 ug/L	<0.5	<0.5	-	-
Dichlorodifluoromethane	1.0 ug/L	<1.0	<1.0	-	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	-
1,3-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	-
1,1-Dichloroethane	0.5 ug/L	<0.5	<0.5	-	-
1,2-Dichloroethane	0.5 ug/L	<0.5	<0.5	-	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	-
1,2-Dichloropropane	0.5 ug/L	<0.5	<0.5	-	-
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	-	-
Ethylbenzene	0.5 ug/L	<0.5	<0.5	-	-
Ethylene dibromide (dibromoethar	0.2 ug/L	<0.2	<0.2	-	-
Hexane	1.0 ug/L	<1.0	<1.0	-	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	<5.0	-	-
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	<5.0	-	-
Methyl tert-butyl ether	2.0 ug/L	<2.0	<2.0	-	-
Methylene Chloride	5.0 ug/L	<5.0	<5.0	-	-
Styrene	0.5 ug/L	<0.5	<0.5	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	-	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	-	-
Tetrachloroethylene	0.5 ug/L	<0.5	<0.5	-	-

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204

Project Description: PE3548

	Client ID:	DUP	Trip Blank-15D1701	-	-
	Sample Date:	10-Jun-15	09-Jun-15	-	-
	Sample ID:	1524493-09	1524493-10	-	-
	MDL/Units	Water	Water	-	-
Toluene	0.5 ug/L	<0.5	<0.5	-	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	<0.5	-	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	<0.5	-	-
Trichloroethylene	0.5 ug/L	<0.5	<0.5	-	-
Trichlorofluoromethane	1.0 ug/L	<1.0	<1.0	-	-
Vinyl chloride	0.5 ug/L	<0.5	<0.5	-	-
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-Bromofluorobenzene	Surrogate	114%	118%	-	-
Dibromofluoromethane	Surrogate	118%	119%	-	-
Toluene-d8	Surrogate	94.8%	93.0%	-	-

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204 Project Description: PE3548

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						
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	*15.5*		*ug/L*		*77.3*	*50-140*			
Surrogate: Terphenyl-d14	*19.9*		*ug/L*		*99.5*	*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						

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204 Project Description: PE3548

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chlorobenzene	ND	0.5	ug/L						
Chloroform	ND	0.5	ug/L						
Dibromochloromethane	ND	0.5	ug/L						
Dichlorodifluoromethane	ND	1.0	ug/L						
1,2-Dichlorobenzene	ND	0.5	ug/L						
1,3-Dichlorobenzene	ND	0.5	ug/L						
1,4-Dichlorobenzene	ND	0.5	ug/L						
1,1-Dichloroethane	ND	0.5	ug/L						
1,2-Dichloroethane	ND	0.5	ug/L						
1,1-Dichloroethylene	ND	0.5	ug/L						
cis-1,2-Dichloroethylene	ND	0.5	ug/L						
trans-1,2-Dichloroethylene	ND	0.5	ug/L						
1,2-Dichloropropane	ND	0.5	ug/L						
cis-1,3-Dichloropropylene	ND	0.5	ug/L						
trans-1,3-Dichloropropylene	ND	0.5	ug/L						
1,3-Dichloropropene, total	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Ethylene dibromide (dibromoethane	ND	0.2	ug/L						
Hexane	ND	1.0	ug/L						
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L						
Methyl Isobutyl Ketone	ND	5.0	ug/L						
Methyl tert-butyl ether	ND	2.0	ug/L						
Methylene Chloride	ND	5.0	ug/L						
Styrene	ND	0.5	ug/L						
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L						
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L						
Tetrachloroethylene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
1,1,1-Trichloroethane	ND	0.5	ug/L						
1,1,2-Trichloroethane	ND	0.5	ug/L						
Trichloroethylene	ND	0.5	ug/L						
Trichlorofluoromethane	ND	1.0	ug/L						
Vinyl chloride	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: 4-Bromofluorobenzene	*35.6*		*ug/L*		*111*	*50-140*			
Surrogate: Dibromofluoromethane	*29.3*		*ug/L*		*91.7*	*50-140*			
Surrogate: Toluene-d8	*33.8*		*ug/L*		*106*	*50-140*			

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204 Project Description: PE3548

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	319	25	ug/L	286			10.9	30	
Metals									
Mercury	ND	0.1	ug/L	ND			0.0	20	
Antimony	0.73	0.5	ug/L	0.87			18.2	20	
Arsenic	1.1	1	ug/L	1.2			4.2	20	
Barium	23.8	1	ug/L	23.8			0.1	20	
Beryllium	ND	0.5	ug/L	ND			0.0	20	
Boron	25	10	ug/L	26			2.0	20	
Cadmium	ND	0.1	ug/L	ND			0.0	20	
Chromium (VI)	ND	10	ug/L	ND				20	
Chromium	8.1	1	ug/L	8.8			7.8	20	
Cobalt	ND	0.5	ug/L	ND			0.0	20	
Copper	1.82	0.5	ug/L	1.82			0.0	20	
Lead	ND	0.1	ug/L	ND			0.0	20	
Molybdenum	1.88	0.5	ug/L	2.21			15.8	20	
Nickel	1.5	1	ug/L	1.5			3.3	20	
Selenium	2.3	1	ug/L	2.6			9.9	20	
Silver	0.16	0.1	ug/L	0.18			15.2	20	
Sodium	15800	200	ug/L	15600			0.8	20	
Thallium	ND	0.1	ug/L	ND			0.0	20	
Uranium	ND	0.1	ug/L	ND			0.0	20	
Vanadium	2.59	0.5	ug/L	2.77			6.9	20	
Zinc	13	5	ug/L	14			7.4	20	
Volatiles									
Acetone	ND	5.0	ug/L	ND				30	
Benzene	132	0.5	ug/L	126			5.2	30	
Bromodichloromethane	ND	0.5	ug/L	ND				30	
Bromoform	ND	0.5	ug/L	ND				30	
Bromomethane	ND	0.5	ug/L	ND				30	
Carbon Tetrachloride	ND	0.2	ug/L	ND				30	
Chlorobenzene	ND	0.5	ug/L	ND				30	
Chloroform	ND	0.5	ug/L	ND				30	
Dibromochloromethane	ND	0.5	ug/L	ND				30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND				30	
1,2-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,1-Dichloroethane	ND	0.5	ug/L	ND				30	
1,2-Dichloroethane	ND	0.5	ug/L	ND				30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND				30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
1,2-Dichloropropane	ND	0.5	ug/L	ND				30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
Ethylbenzene	610	0.5	ug/L	593			2.7	30	
Ethylene dibromide (dibromoethane	ND	0.2	ug/L	ND				30	
Hexane	ND	1.0	ug/L	32.2			0.0	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	

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204 Project Description: PE3548

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
Tetrachloroethylene	ND	0.5	ug/L	ND				30	
Toluene	40.9	0.5	ug/L	36.5			11.4	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	652	0.5	ug/L	610			6.7	30	
o-Xylene	6.88	0.5	ug/L	5.73			18.2	30	
Surrogate: 4-Bromofluorobenzene	*29.4*		*ug/L*	*ND*	*92.0*	*50-140*			
Surrogate: Dibromofluoromethane	*31.2*		*ug/L*	*ND*	*97.3*	*50-140*			
Surrogate: Toluene-d8	*40.7*		*ug/L*	*ND*	*127*	*50-140*			

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204 Project Description: PE3548

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1700	25	ug/L	ND	84.8	68-117			
F2 PHCs (C10-C16)	1100	100	ug/L	ND	60.9	60-140			
F3 PHCs (C16-C34)	3050	100	ug/L	ND	82.0	60-140			
F4 PHCs (C34-C50)	2140	100	ug/L	ND	86.4	60-140			
Metals									
Mercury	3.18	0.1	ug/L	ND	106	78-137			
Antimony	53.0		ug/L	0.87	104	80-120			
Arsenic	61.6		ug/L	1.2	121	80-120			QM-07
Barium	75.1		ug/L	23.8	103	80-120			
Beryllium	53.4		ug/L	0.02	107	80-120			
Boron	71		ug/L	26	90.0	80-120			
Cadmium	49.9		ug/L	ND	99.8	80-120			
Chromium (VI)	191	10	ug/L	ND	95.5	70-130			
Chromium	57.9		ug/L	8.8	98.3	80-120			
Cobalt	48.4		ug/L	0.07	96.7	80-120			
Copper	50.5		ug/L	1.82	97.3	80-120			
Lead	49.1		ug/L	ND	98.2	80-120			
Molybdenum	46.4		ug/L	2.21	88.5	80-120			
Nickel	50.2		ug/L	1.5	97.4	80-120			
Selenium	59.5		ug/L	2.6	114	80-120			
Silver	49.1		ug/L	0.18	97.7	80-120			
Sodium	929		ug/L	ND	92.9	80-120			
Thallium	49.2		ug/L	ND	98.6	80-120			
Uranium	52.2		ug/L	ND	105	80-120			
Vanadium	52.5		ug/L	2.77	99.4	80-120			
Zinc	62		ug/L	14	96.8	80-120			
Semi-Volatiles									
Acenaphthene	4.25	0.05	ug/L	ND	85.1	50-140			
Acenaphthylene	3.50	0.05	ug/L	ND	69.9	50-140			
Anthracene	3.73	0.01	ug/L	ND	74.7	50-140			
Benzo [a] anthracene	3.27	0.01	ug/L	ND	65.4	50-140			
Benzo [a] pyrene	3.21	0.01	ug/L	ND	64.2	50-140			
Benzo [b] fluoranthene	3.54	0.05	ug/L	ND	70.8	50-140			
Benzo [g,h,i] perylene	3.66	0.05	ug/L	ND	73.1	50-140			
Benzo [k] fluoranthene	4.97	0.05	ug/L	ND	99.3	50-140			
Chrysene	4.61	0.05	ug/L	ND	92.2	50-140			
Dibenzo [a,h] anthracene	3.34	0.05	ug/L	ND	66.9	50-140			
Fluoranthene	4.09	0.01	ug/L	ND	81.7	50-140			
Fluorene	3.70	0.05	ug/L	ND	73.9	50-140			
Indeno [1,2,3-cd] pyrene	3.71	0.05	ug/L	ND	74.2	50-140			
1-Methylnaphthalene	4.60	0.05	ug/L	ND	92.1	50-140			
2-Methylnaphthalene	4.89	0.05	ug/L	ND	97.9	50-140			
Naphthalene	3.91	0.05	ug/L	ND	78.2	50-140			
Phenanthrene	3.34	0.05	ug/L	ND	66.7	50-140			
Pyrene	4.28	0.01	ug/L	ND	85.6	50-140			
Surrogate: 2-Fluorobiphenyl	*16.8*		*ug/L*		*83.9*	*50-140*			
Volatiles									

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204 Project Description: PE3548

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Acetone	79.2	5.0	ug/L	ND	79.2	50-140			
Benzene	36.6	0.5	ug/L	ND	91.6	50-140			
Bromodichloromethane	33.9	0.5	ug/L	ND	84.6	50-140			
Bromoform	30.5	0.5	ug/L	ND	76.3	50-140			
Bromomethane	27.5	0.5	ug/L	ND	68.8	50-140			
Carbon Tetrachloride	32.8	0.2	ug/L	ND	82.0	50-140			
Chlorobenzene	33.4	0.5	ug/L	ND	83.5	50-140			
Chloroform	31.5	0.5	ug/L	ND	78.8	50-140			
Dibromochloromethane	32.0	0.5	ug/L	ND	79.9	50-140			
Dichlorodifluoromethane	29.4	1.0	ug/L	ND	73.4	50-140			
1,2-Dichlorobenzene	34.9	0.5	ug/L	ND	87.2	50-140			
1,3-Dichlorobenzene	35.6	0.5	ug/L	ND	89.1	50-140			
1,4-Dichlorobenzene	35.5	0.5	ug/L	ND	88.8	50-140			
1,1-Dichloroethane	33.2	0.5	ug/L	ND	82.9	50-140			
1,2-Dichloroethane	31.4	0.5	ug/L	ND	78.5	50-140			
1,1-Dichloroethylene	31.9	0.5	ug/L	ND	79.8	50-140			
cis-1,2-Dichloroethylene	34.7	0.5	ug/L	ND	86.6	50-140			
trans-1,2-Dichloroethylene	34.4	0.5	ug/L	ND	86.0	50-140			
1,2-Dichloropropane	33.7	0.5	ug/L	ND	84.2	50-140			
cis-1,3-Dichloropropylene	34.2	0.5	ug/L	ND	85.5	50-140			
trans-1,3-Dichloropropylene	33.7	0.5	ug/L	ND	84.2	50-140			
Ethylbenzene	32.7	0.5	ug/L	ND	81.6	50-140			
Ethylene dibromide (dibromoethane	32.7	0.2	ug/L	ND	81.8	50-140			
Hexane	33.7	1.0	ug/L	ND	84.2	50-140			
Methyl Ethyl Ketone (2-Butanone)	76.6	5.0	ug/L	ND	76.6	50-140			
Methyl Isobutyl Ketone	88.5	5.0	ug/L	ND	88.5	50-140			
Methyl tert-butyl ether	93.3	2.0	ug/L	ND	93.3	50-140			
Methylene Chloride	25.0	5.0	ug/L	ND	62.6	50-140			
Styrene	34.2	0.5	ug/L	ND	85.4	50-140			
1,1,1,2-Tetrachloroethane	30.4	0.5	ug/L	ND	76.0	50-140			
1,1,2,2-Tetrachloroethane	32.4	0.5	ug/L	ND	81.0	50-140			
Tetrachloroethylene	32.1	0.5	ug/L	ND	80.4	50-140			
Toluene	34.9	0.5	ug/L	ND	87.4	50-140			
1,1,1-Trichloroethane	32.3	0.5	ug/L	ND	80.8	50-140			
1,1,2-Trichloroethane	35.2	0.5	ug/L	ND	88.1	50-140			
Trichloroethylene	34.3	0.5	ug/L	ND	85.7	50-140			
Trichlorofluoromethane	31.2	1.0	ug/L	ND	78.0	50-140			
Vinyl chloride	33.6	0.5	ug/L	ND	83.9	50-140			
m,p-Xylenes	70.3	0.5	ug/L	ND	87.9	50-140			
o-Xylene	35.8	0.5	ug/L	ND	89.4	50-140			

Certificate of Analysis

Report Date: 22-Jun-2015
Order Date:12-Jun-2015

Client: **Paterson Group Consulting Engineers**
Client PO: 17204 Project Description: PE3548

Qualifier Notes:

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:

Revision 1 - This report includes revised VOC data.

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.

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Client Name: Paterson Group	Project Reference: PE3546	TAT: [X] Regular [ ] 3 Day
Contact Name: Sean Moggridge	Quote #	[ ] 2 Day [ ] 1 Day
Address: 154 Colonnade	PO # ~~17854~~ 17204	Date Required:
Telephone: 613-226-7381	Email Address: smoggridge@patersongroup.ca	

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

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

Required Analyses

Paracel Order Number: 1524493

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)
1	BH1 - GW1	GW		6	June 10/15		X	X		X	X	X	
2	BH2 - GW1	GW		5	June 10/15			X		X	X	X	
3	BH3 - GW1	GW		7	June 10/15		X	X	X	X	X	X	
4	BH4 - GW1	GW		1	June 10/15				X				
5	BH5 - GW1	GW		2	June 10/15			X					
6	BH6 - GW1	GW		3	June 10/15		X	X					
7	BH7 - GW1	GW		4	June 10/15				X	X	X	X	
8	BH8 - GW1	GW		3	June 10/15		X	X					
9	DUP	GW		2	June 10/15			X					
10	TRIP BLANK - 15D1701	GW		2	June 9/15			X					

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): Mike B.	Received by Driver/Depot: M. Jeffrey	Received at Lab: SUNEETA DOKMAI	Verified By: D. Charlebois
Relinquished By (Print):	Date/Time: 12/06/15 3:45PM	Date/Time: JUN 10, 2015 05:30	Date/Time: June 12 5:58
Date/Time:	Temperature: ____ °C	Temperature: 16.4 °C	pH Verified [ ] By: