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22 May 2020

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2019 Permeable Reactive Barrier – PlumeStop™ and ORC-A **File CG2430.1 E42**
Hounsfield Heights – 11th Avenue NW
Calgary, Alberta

This report documents the full-scale application of a Permeable Reactive Barrier (PRB) involving the injection of PlumeStop™ and Oxygen Release Compound-Advanced, which was carried out between 08 November 2019 and 10 December 2019. The PRB was installed along 11th Avenue NW, between 15th Street and 16A Street NW. For the purpose of this report, the term Site will be used to describe the area between 15th Street and 16A Street NW where the injections occurred.

A Site Location Plan is presented as Figure 1.

Background

In July 2012, Alberta Environment and Parks (AEP) issued a letter to Sears Canada Inc. (Sears) requesting that an Updated Site Management Plan be prepared to reflect the changes to their contaminant guidance documents implemented in 2007. Within the July 2012 letter, AEP requested that "additional remediation techniques to deal with the expanding dissolved phase plume" be considered. Prior to receiving this request from AEP, the site (Mall and Hounsfield Heights areas) was being managed under the 2006 Site Management Plan which included operating the Dual Phase Vapour Extraction (DPVE) system and monitoring natural attenuation as the primary remedial approaches for the Hounsfield Heights community.

As part of the 2014 Update Site Management Plan, Clifton on behalf of Sears, considered a variety of remedial approaches for application within the Hounsfield Heights community. One area within the community which became of increasing importance was south of 11th Avenue NW. This was due to a shallower water table and a thinning of the confining clay layer beneath the subsurface.

The Site, including 11th Avenue between 15th Street and 16A Street NW, transects the entire groundwater plume providing an optimal area for implementation of remedial measures that could address the expanding dissolved phase plume as it migrates to the south.

At the time of the 2014 Updated Site Management Plan, Clifton identified that a PRB would be an effective remedial approach to address the expanding dissolved phase plume to south. Clifton contacted Regenesis regarding their product PlumeStop™ to discuss an application along 11th Avenue to treat petroleum hydrocarbons (PHC) and 1,2 - DCA within the dissolved phase.

Remedial Technology

PlumeStop™ is a colloidal activated carbon reagent. The activated carbon particles in PlumeStop™ have a diameter of 1 – 2 µm, which allows it to suspend in liquid form. Research completed by Regenesis shows that the diameter of soil pore throats varies between 3 and 30 µm, which precludes other activated carbon particles (granular activated carbon and powdered activated carbon) from dispersing completely through the aquifer. PlumeStop™ can theoretically achieve wider distribution through the soil matrix using lower injection pressures.

The activated carbon is suspended in a colloidal biomatrix favorable for microbial colonization and growth. The PHCs and 1,2 - DCA sorb to the activated carbon, and microbes are drawn to the source of nutrition provided by both the PHCs and the biomatrix. Digestion of the PHCs by microbial activity reopens sorption sites on the activated carbon.

PlumeStop™ can be used to create a PRB that provides treatment of the dissolved phase PHCs as they migrate through the barrier. In addition to the PRB, an oxygen release compound can further promote the aerobic biodegradation of PHCs. Applying an oxygen release compound to the PRB is not required; however, is often used as a supplement to the PRB by creating an oxygen rich environment within the subsurface. During the time where oxygen concentrations are increased within the subsurface, aerobic biodegradation can proceed at a greater rate than under normal existing conditions. This will allow for the sorbed PHCs to be broken down more readily, reopening the sorption sites at a quicker rate. The oxygen release compound used by Regenesis goes under the trademarked name Oxygen Release Compound - Advanced (ORC-A). ORC-A is a white, odorless powder, which consists of a mixture of calcium hydroxide oxide, calcium hydroxide, monopotassium phosphate and dipotassium phosphate. The ORC-A is mixed with water and injected as a slurry to provide a slow controlled release of oxygen into the subsurface for up to 12 months.

The injection method for the PRB, whether including ORC-A, or not, follows a bottom-up approach. Direct push rods, in 1.52 m increments, are used to reach the maximum depth of the injection zone. Once set, the rods are connected via a hose to a pumping system which is used to inject the pre-mixed PlumeStop™ and/or ORC-A slurries. Once the desired amount of product has been injected, the direct push rods are raised to the next 1.52 m interval and the process is repeated until the entire injection zone has been completed.

Prior to completing the full-scale application, Clifton completed two PRB pilot studies along 11th Avenue NW. The first pilot study was completed in 2016 and used a combination of PlumeStop™ and ORC-A. The second pilot study, completed in 2018, was done without the addition of ORC-A to the PlumeStop™. Using ORC-A in the first pilot study, and not the second, allowed a comparison as to whether adding this compound would be beneficial during the full-scale application. Following the completion of the pilots scale studies, Clifton also performed an assessment of the subsurface PHC mass flux using Passive Flux Meters (PFMs) to help refine the full-scale application design.

A summary of the pilot studies and PFM assessment is provided in the following section.

Permeable Reactive Barrier Pilot Studies and Passive Flux Meter Assessment

Pilot Study 1

The first pilot study was conducted between 3-4th August 2016, along 11th Avenue NW between 15th Street and 16th Street NW, in an area with some of the highest reported benzene concentrations across the Site. Nine injection points were advanced, spaced over 21 metres along 11th Avenue NW, based on the estimated radius of influence of 2.4 m determined in the design verification test completed in March 2016. In total, 13,720 litres of PlumeStop ™ solution and 540 litres of ORC-A were injected into the subsurface. The injections were made at a depth range of 6.1 m to 8.8 m below ground surface (bgs).

Three down-gradient groundwater monitoring wells screened across three separate geological units (BH1982 - Unit 3, BH1939 - Unit 4, and BH1937- Unit 5) were used to assess remedial progress during the pilot study performance monitoring program.

Details of the down-gradient monitoring wells are provided below:

- Monitoring well BH1982 is screened in a sand layer (Unit 3) from a depth of 1.6 to 7.8 m bgs;
- Monitoring well BH1939 is screened in a clay layer (Unit 4) from a depth of 8.2 m to 8.6 m bgs; and
- Monitoring well BH1937 is screened across an alternating silt and clay layer with a sand lens (Unit 5) from a depth of 8.8 m to 13.7 m bgs.

All three monitoring wells are located approximately 3.5 m down-gradient of where the PRB was installed. The design radius of influence was approximately 3.05 m. The location of the performance monitoring wells are provided in Figure 2 of the attachments.

Monitoring wells BH1937, BH1939, and BH1982 were sampled prior to application and on a bi-weekly basis for three months following installation of the PRB to assess remedial progress. Following three months of bi-weekly sampling, performance sampling was then conducted on a monthly-basis for an additional three months. Following the six-month performance monitoring program, sampling of these wells was continued during the on-going semi-annual groundwater monitoring and sampling program. It should be noted that monitoring well BH1937 was removed from the performance sampling program after the bi-weekly events were completed as this well is screened below the injection zone and therefore contaminant reductions resulting from the PRB were not expected.

Benzene and 1,2-DCA concentrations were used as the primary indicators for contaminant reduction based on their prevalence throughout the Site. The results from the last sampling event completed prior to the 2016 pilot study, compared to the most recent sampling event completed, prior to the full-scale application, are presented in Table 1 of the attachments. The data from the first pilot study show a reduction in benzene and 1,2-DCA concentrations in monitoring wells BH1982 of 69.2% and 38.1%, respectively. Comparatively, monitoring well BH1939 showed reductions of benzene and 1,2-DCA concentrations of 99.7% and 47.9%, respectively.

Pilot Study 2

A second pilot study was conducted between 10-13th September 2018 on the western portion of 11th Avenue, adjacent to the intersection with 16th Street NW. This area was targeted as the reported benzene

concentrations are lower than the area of the first pilot study and more representative of the entire dissolved phase plume across 11th Avenue. A total of three injection points, spaced approximately 2.4 m apart, were used to inject a total mass of 2,173 kg of PlumeStop™ into the subsurface between depths of 7.6 m to 14.9 m bgs. This depth range of injection was almost entirely within stratigraphic Unit 3. Oxygen Release Compound - Advanced was not used during this pilot study due to the lower PHC concentrations in the nearest monitoring well.

One down-gradient groundwater monitoring well, BH1929, screened across Unit 3 was used to assess remedial progress during the pilot study performance monitoring program.

Details of the down-gradient monitoring well are provided below:

- Monitoring well BH1929 is screened in a sand layer (Unit 3) from a depth of 6.0 m to 15 m bgs;
- Monitoring well BH1929 was located approximately 3.0 m downgradient of where the PRB was installed.

The location of this performance monitoring well is provided in Figure 2 of the attachments.

Monitoring well BH1929 was sampled prior to the application and on a monthly basis for three months following installation of the PRB to assess remedial progress. Following the monthly sampling, performance sampling was then conducted during the on-going semi-annual groundwater monitoring and sampling program.

Benzene and 1,2-DCA concentrations were used as the primary indicators for contaminant reduction based on their prevalence throughout the Site. The results from the last sampling event completed prior to the second pilot study, to the most recent sampling event completed, prior to the full-scale application, are presented in Table 2 of the attachments. The data from the second pilot study show a reduction in benzene and 1,2-DCA concentrations in monitoring wells BH1929 of 92.4% and 72.2%, respectively.

Passive Flux Meters

In addition to the two pilot studies completed, in the Spring of 2019 PFMs were installed within three monitoring wells along 11th Avenue NW (BH1928, BH1936 and BH1937). Passive flux meters are a nylon mesh tube filled with a sorbent/tracer targeted to retain PHCs and 1,2-DCA as the dissolved phase plume migrates through them. The PFMs were left within the monitoring wells for approximately one month prior to removal. Analysis on the sorbent and residual tracer was then completed to estimate a mass flux of PHCs throughout the screened interval, as well as an estimated groundwater velocity. This data was used, along with the pilot study data, to finalize the full-scale remedial design in terms of depth of injection zone, radius of influence and volume of reagent required at each location along the PRB.

Results from the PFM assessment provided by EnviroFlux are attached in Appendix A. The monitoring well locations for the PFM assessment can be observed in Figure 2 of the attachments.

Remedial Design and Full-Scale Application

The objective of installing the PRB along 11th Avenue, as stated within the Revised Remediation Plan (2019), was to control the plume from expanding further to the south by reducing dissolved phase PHC and 1,2-DCA groundwater concentrations. Both pilot studies showed that PHCs and 1,2 – DCA could be reduced through the application of a PRB along 11th Avenue NW with a design radius of influence of 3.05 m between the injection points.

Following completion of both pilot studies as well as the PFM assessment, Clifton worked with Regenesis and InSitu Remediation Services Ltd. (ISRL) to design a full-scale application of the PRB along 11th Avenue NW. ISRL was the contractor, retained for performing the actual injection of the PRB.

Regenesis used the information obtained during the pilot studies as well as the PFM assessment to create an injection design-based geological cross-section along 11th Avenue. The geological cross-section identifies injection zone thicknesses and the PRB length from which the volume of reagent (PlumeStop™ and ORC-A) to treat the anticipated mass was calculated.The design-based geological cross-section is provided in Appendix B.

Upon completing the final design and obtaining the necessary City of Calgary permits, the full-scale application along 11th Avenue NW commenced on 05 November 2019 and was completed on 12 December 2019.

During this time, a total of 57 direct-push injection points were completed along 11th Avenue NW between 15th Street and 16A Street NW. The injections began at the intersection of 15th Street NW and 11th Avenue NW and proceeded to the west. The total length of the barrier was approximately 165 m and injection locations were approximately 3.05 m apart.

The injections were completed using a Geoprobe Model 7822, to inject 38,181 kg of PlumeStop™ and 8,370 kg of ORC-A. The injection zone thickness ranged from approximately 2.0 m to 9.5 m depending on the interpreted vertical extent of PHC impacts along 11th Avenue NW. The injections were completed using a bottom-up approach. Direct push rods were advanced to the maximum depth at each location. The PlumeStop™ was first injected, the rod was then flushed with water and then the ORC-A was injected. This process was followed in 1.52 m intervals until the enitre injection zone was completed. The barrier was vertically off-set at specific locations to adjust for the presence of buried utility lines. Each injection point was backfilled using hydrated bentonite pellets and cold-patch asphalt at the surface. Clifton field personnel marked each location with a survey pin and flagging to be picked up by Tronnes Geomatics Inc. on a bi-weekly basis.

Figure 2 of the attachments depicts the location of the 57 injection points across the Site along with the design raidus of influence of 3.05 m. An injection report prepared by ISRL is attached in Appendix C. The ISRL report details the volume of product, depth of injection and injection zone thickness for each location.

Performance Monitoring

Prior to the full-scale application, the following monitoring wells, located down-gradient of the PRB, were identifed as performance monitoring wells:

- BH1928, BH1929, BH1936, BH1937, BH1939, BH1954 and BH1982.

Four of these monitoring wells were used as performance wells during the previous two pilot studies, including BH1929, BH1937, BH1939 and BH1982. A Performance Monitoring Program was initiated in January 2020 following the outline presented within the Revised Remediation Plan (2019). The results from the Performance Monitoring Program will be provided and summarized within the semi-annual groundwater monitoring and sampling event reports, starting in the Spring of 2020.

Closure

This report was prepared by Clifton Associates Ltd. for the account of Sears Canada Inc. The material in it reflects Clifton Associates Ltd. best judgment available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Clifton Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Our conclusions and recommendations are preliminary and based upon the information obtained from the referenced subsurface exploration. The Site monitoring and associated laboratory testing indicate subsurface, groundwater and chemical conditions only at the specific locations and times investigated, only to the depth penetrated and only for the soil and chemical properties tested. The subsurface conditions may vary between the investigation points and with time. The subsurface interpretation provided is a professional opinion of conditions and not a certification of the site conditions. The nature and extent of subsurface variation may not become evident until construction or further investigation. If variations or other latent conditions do become evident, Clifton Associates Ltd. should be notified immediately so that we may re-evaluate our conclusions and recommendations.

This report has been prepared in accordance with generally accepted engineering practice common to the local area. No other warranty, expressed or implied is made.

No environmental site investigation or remediation can wholly eliminate uncertainty regarding environmental conditions in connection with a property. This investigation is intended to reduce, but not eliminate the uncertainty regarding environmental conditions. Conclusions regarding the condition of the site do not represent a warranty that all areas within the site and beneath structures are of the same quality as those sampled. Further, contamination could also exist in forms not indicated by the investigation. The work was based in part upon the environmental quality guidelines and regulations in effect when the work was begun. Future regulatory changes may require reassessment of the findings of this investigation.

Clifton Associates Ltd.

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Association of Professional Engineers
Geologists and Geophysicists of Alberta
Permit to Practice P4823

Attachments

Figures
Figure 1 – Site Location Plan
Figure 2 – Injection Point Location

Tables
Table 1 – Summary of Groundwater Analyses – Pilot Study 1
Table 2 – Summary of Groundwater Analyses – Pilot Study 2

Appendix A – EnviroFlux Passive Flux Meter Assessment
Appendix B – Design-Based Geological Cross-Section
Appendix C – ISRL Injection Report

Figures

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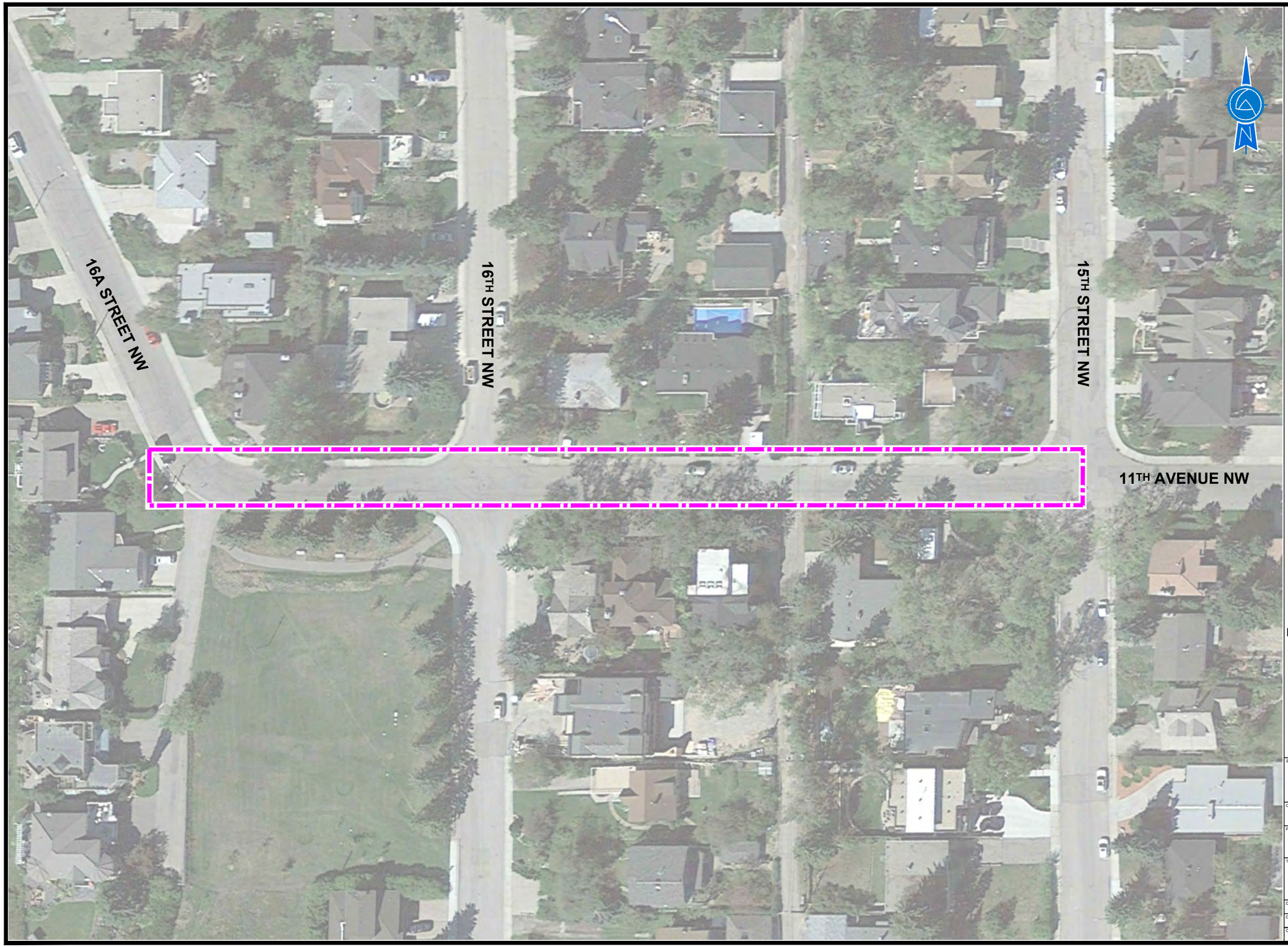

LEGEND:

SITE BOUNDARY

NOTES:

1. AERIAL PHOTOGRAPH PROVIDED BY GOOGLE EARTH PRO. AIR PHOTO DATE: AUGUST 22, 2015.

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1:750

ENGINEER

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CLIENT

SEARS

PROJECT

2019 PERMEABLE REACTIVE BARRIER
PLUMESTOP® AND ORC-A
HOUNSFIELD HEIGHTS - 11TH AVENUE NW
CALGARY, ALBERTA

TITLE

SITE LOCATION PLAN

DESIGNED		SCALE 1:750	DATE 2020-04-27
DRAWN	IW	PROJECT NO. CG2430.1 E42	FIG. 1
CHECKED	SD	FILE NO. CG2430.1-E42-01	

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LOT 1

16A STREET NW
16TH STREET NW
15TH STREET NW
11TH AVENUE N

BH1922
BH1956
BH1919
BH1928
BH1929
BH1938
BH1936
BH1982
BH1939
BH1937
BH732
BH1954
BH1981
BH912
BH1943
BH1979
BH1980
BH1941
BH2003
BH1955A
BH2006
BH1977
BH1944
BH2002

IP57
IP50
IP40
IP30
IP20
IP10
IP1

MH
CB2
CB4
CB5
CB6
CB8
CB9
MH9
MH8
MH18
MH17

LEGEND

- SITE BOUNDARY
- GROUNDWATER MONITORING WELL
- DAMAGED / DESTROYED MONITORING WELL
- DESIGN RADIUS OF INFLUENCE

UTILITY LINES & SYMBOLS

- NATURAL GAS LINE
- SANITARY SEWER
- STORM SEWER
- WATER
- CATCH BASIN
- FIRE HYDRANT
- LIGHT STANDARD
- MANHOLE
- UTILITY POLE

NOTES:

1. DRAWING COMPILED FROM PLANIMETRIC FILES SUPPLIED BY THE CITY OF CALGARY (INCLUDING U/G UTILITIES) & FROM SITE ASSESSMENT INFORMATION. ADDITIONAL REFERENCES FROM SEACOR ENVIRONMENTAL ENGINEERING INC., DRAWINGS 149-5A11.DWG, 149-5A8.DWG.
2. AERIAL PHOTOGRAPH PROVIDED BY GOOGLE EARTH PRO. AIR PHOTO DATE : AUGUST 22, 2015.

5 0 5 10 15 20 25
22"x34" (559mm x 864mm) DRAWING METERS 1:300

ENGINEER
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PROJECT
2019PERMEABLE REACTIVE BARRIER
PLUMESTOP™ AND ORC-A
HOUNSFIELD HEIGHTS - 11THAVENUE NW
CALGARY, ALBERTA

TITLE
INJECTION POINT LOCATION

DESIGNED	SCALE	DATE
	1:300	2020-05-22
DRAWN: IW	PROJECT NO.: CG2430.1 E42	FIG.: 2
CHECKED: SD	FILE NO.: CG2430.1-E42-02	

Tables

Table 1 - Summary of Groundwater Laboratory Analyses
PlumeStop Pilot Study 1

Sample ID	Sampling Depth (m bgs)	Sample Date	Unit	Benzene	1,2-Dichloroethane
BH1939	Bulk	1-Apr-15	4	**9.3**	**0.12**
	Bulk	11-Jun-15	4	**8.6**	**0.15**
	Bulk	21-Sep-15	4	**8.0**	-
	Bulk	20-Nov-15	4	**9.0**	-
	Bulk	17-May-16	4	**6.6**	**0.19**
	Injection				
	Bulk	5-Aug-16	4	**8.1**	**0.22**
	Bulk	19-Aug-16	4	**7.4**	**0.21**
	Bulk	2-Sep-16	4	**7.1**	**0.17**
	Bulk	16-Sep-16	4	**6.8**	**0.18**
	Bulk	3-Oct-16	4	**7.2**	**0.16**
	Bulk	13-Oct-16	4	**5.9**	**0.18**
	Bulk	28-Oct-16	4	**6.0**	**0.18**
	Bulk	10-Nov-16	4	**7.1**	**0.17**
	Bulk	25-Nov-16	4	**7.4**	**0.21**
	Bulk	12-Dec-16	4	**5.8**	**0.39**
	Bulk	21-Dec-16	4	**6.0**	**0.19**
	Bulk	6-Jan-17	4	**5.4**	**0.17**
	Bulk	9-Mar-17	4	**5.0**	**0.18**
	Bulk	19-Apr-17	4	**4.8**	**0.14**
	Bulk	17-May-17	4	**5.4**	**0.17**
	Bulk	10-Apr-18	4	**0.52**	**0.15**
	Bulk	18-Oct-18	4	**0.15**	**0.12**
	Bulk	31-May-19	4	**0.021**	**0.099**
BH1982	Bulk	1-Apr-15	3	**13.1**	**0.12**
	Bulk	11-Jun-15	3	**13.8**	**0.16**
	Bulk	21-Sep-15	3	**10.7**	-
	Bulk	20-Nov-15	3	**11.6**	-
	Bulk	17-May-16	3	**12.0**	**0.21**
	Injection (3-4 Aug 16)				
	Bulk	5-Aug-16	3	**5.7**	**0.092**
	Bulk	19-Aug-16	3	**9.6**	**0.18**
	Bulk	2-Sep-16	3	**6.9**	**0.12**
	Bulk	16-Sep-16	3	**6.3**	**0.12**
	Bulk	3-Oct-16	3	**5.3**	**0.09**
	Bulk	13-Oct-16	3	**2.8**	**0.072**
	Bulk	28-Oct-16	3	**4.4**	**0.095**
	Bulk	10-Nov-16	3	**5.2**	**0.099**
	Bulk	25-Nov-16	3	**3.1**	**0.073**
	Bulk	12-Dec-16	3	**2.7**	**0.065**
	Bulk	21-Dec-16	3	**2.6**	**0.056**
	Bulk	6-Jan-17	3	**4.2**	**0.091**
	Bulk	9-Mar-17	3	**4.8**	**0.11**
	Bulk	19-Apr-17	3	**4.7**	**0.087**
	Bulk	17-May-17	3	**6.6**	**0.13**
	Bulk	10-Apr-18	3	**5.9**	**0.11**
	Bulk	18-Oct-18	3	**3.2**	**0.068**
	Bulk	31-May-19	3	**3.7**	**0.13**
	Residential Guideline[2]			0.005	0.005

Notes:

1 Land Use abbreviations: C=Commercial; R=Residential; I=Industrial; N=Natural.

2 AEP 2019 Tier 1 Guidelines

Bold Indicates that the concentration did not meet the applicable guideline.

m bgs Meters below ground surface

\- Not analyzed.

All results in mg/L unless otherwise noted.

Testing was conducted by Bureau Veritas, Calgary, Alberta

Table 2 - Summary of Groundwater Laboratory Analyses
PlumeStop Pilot Study 2

Sample ID	Sampling Depth (m bgs)	Sample Date	Unit	Benzene	1,2-Dichloroethane
BH1929	8.53-10.06	4-May-15	3	**0.92**	**0.093**
	8.53-10.06	18-Jun-15	3	**0.681**	**0.075**
	8.53-10.06	3-Sep-15	3	**0.77**	**0.083**
	8.53-10.06	24-Nov-15	3	**0.664**	**0.090**
	8.53-10.06	13-May-16	3	**0.47**	**0.099**
	8.53-10.06	9-Nov-16	3	**0.31**	**0.084**
	8.53-10.06	15-May-17	3	**0.22**	**0.086**
	8.53-10.06	28-Mar-18	3	**0.10**	**0.048**
	8.53-10.06	20-Aug-18	3	**0.096**	**0.072**
	Injection (10-13 Sep 18)				
	8.53-10.06	28-Sep-18	3	<0.00040	<0.00050
	8.53-10.06	12-Oct-18	3	0.0002	0.00082
	8.53-10.06	8-Nov-18	3	**0.013**	**0.021**
	8.53-10.06	7-Dec-18	3	**0.052**	**0.034**
	8.53-10.06	29-May-19	3	**0.0073**	**0.02**
	Residential Guideline[2]			0.005	0.005

Notes:

1 Land Use abbreviations: C=Commercial; R=Residential; I=Industrial; N=Natural.

2 AEP 2019 Tier 1 Guidelines

Bold Indicates that the concentration did not meet the applicable guideline.

m bgs Meters below ground surface

\- Not analyzed.

All results in mg/L unless otherwise noted.

Testing was conducted by Bureau Veritas, Calgary, Alberta

Appendix A

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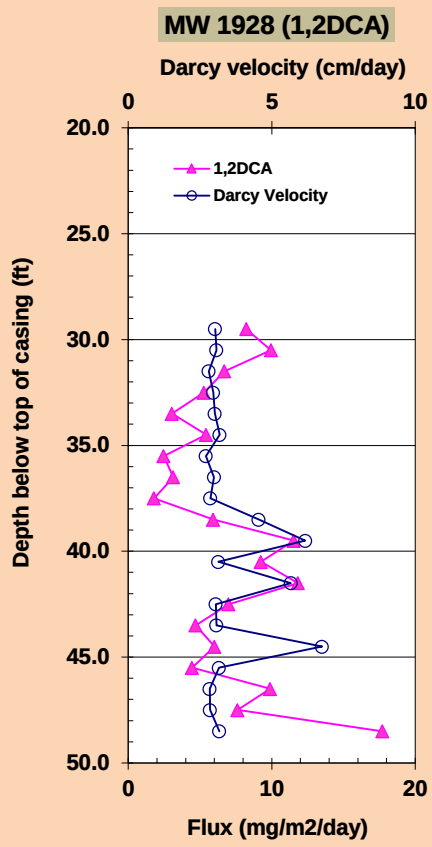
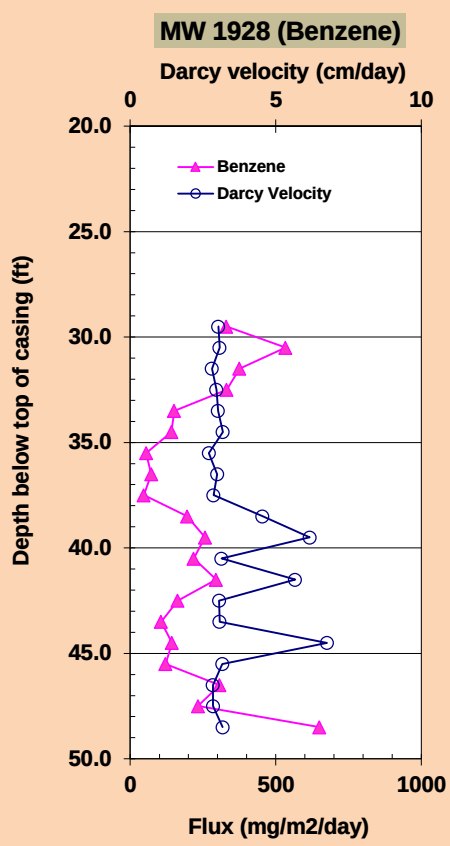
Table1. Summary of flux values for each well

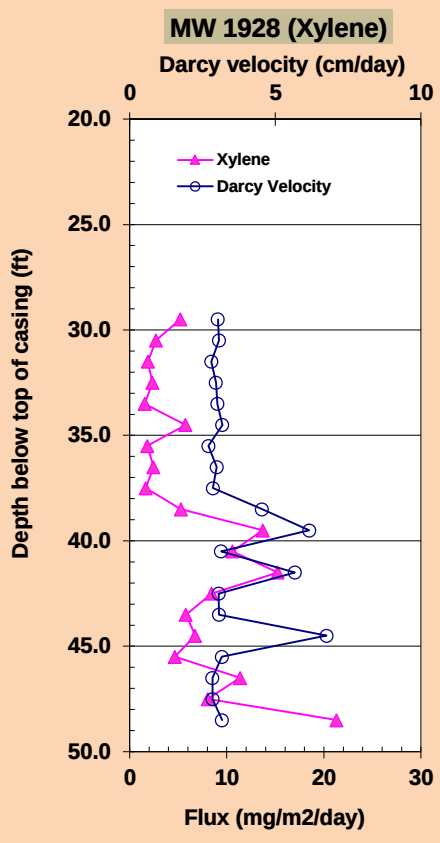
Well_ID	Sample_ID	Depth below top of well casing (ft)	Darcy Velocity (cm/day)	12DCA flux (mg/m^2/day)	Benzene flux (mg/m^2/day)	Xylene flux (mg/m^2/day)
MW 1928	1928-7-1	29.5	3.0	8.23	330.1	5.2
	1928-7-2	30.5	3.1	9.95	533.6	2.7
	1928-7-3	31.5	2.8	6.70	375.2	1.9
	1928-7-4	32.5	3.0	5.27	331.5	2.3
	1928-7-5	33.5	3.0	3.05	150.8	1.6
	1928-6-1	34.5	3.2	5.43	141.6	5.8
	1928-6-2	35.5	2.7	2.46	54.5	1.8
	1928-6-3	36.5	3.0	3.14	72.4	2.5
	1928-6-4	37.5	2.9	1.79	46.5	1.6
	1928-6-5	38.5	4.5	5.92	195.3	5.3
	1928-5-1	39.5	6.2	11.54	257.0	13.7
	1928-5-2	40.5	3.1	9.25	218.0	10.6
	1928-5-3	41.5	5.7	11.83	295.1	15.2
	1928-5-4	42.5	3.1	6.99	163.3	8.4
	1928-5-5	43.5	3.1	4.69	105.7	5.8
	1928-4-1	44.5	6.8	6.00	143.3	6.7
	1928-4-2	45.5	3.2	4.45	121.1	4.7
	1928-4-3	46.5	2.8	9.89	307.3	11.4
	1928-4-4	47.5	2.8	7.62	233.0	8.1
	1928-4-5	48.5	3.2	17.72	649.4	21.3
MW 1936	1936-12-3	25.5	2.4	0.00	0.0	0.0
	1936-12-4	26.5	2.6	0.98	1.6	0.0
	1936-12-5	27.5	3.0	1.71	2.1	0.0
	1936-11-1	28.5	2.4	2.20	2.0	0.0
	1936-11-2	29.5	2.6	1.54	2.9	0.0
	1936-11-3	30.5	2.7	1.99	2.7	0.0
	1936-11-4	31.5	2.6	2.08	3.0	0.0
	1936-11-5	32.5	3.0	2.09	3.5	0.0
	1936-10-1	33.5	3.3	3.93	9.2	0.0
	1936-10-2	34.5	2.6	1.81	4.5	0.0
	1936-10-3	35.5	3.0	2.23	4.9	0.0
	1936-10-4	36.5	3.1	3.13	7.9	0.0
	1936-10-5	37.5	3.0	1.38	4.1	0.0
	1936-9-1	38.5	3.4	1.12	3.3	0.0
	1936-9-2	39.5	2.5	0.98	1.8	0.0
	1936-9-3	40.5	2.6	0.66	1.2	0.0
	1936-9-4	41.5	2.4	0.47	0.6	0.0
	1936-9-5	42.5	2.4	0.38	0.8	0.0
	1936-8-1	43.5	4.2	1.76	1.3	0.0
	1936-8-2	44.5	2.9	0.94	1.0	0.0
	1936-8-3	45.5	3.2	0.75	1.2	0.0
	1936-8-4	46.5	3.3	0.53	0.9	0.0
	1936-8-5	47.5	3.8	0.31	0.9	0.0
MW 1937	1937-3-1	23.5	0.5	0.00	0.0	0.0
	1937-3-2	24.5	0.5	0.00	0.0	0.0
	1937-3-3	25.5	0.4	0.00	0.0	0.0
	1937-3-4	26.5	0.5	0.00	0.0	0.0
	1937-3-5	27.5	0.5	0.00	0.0	0.0
	1937-2-1	28.5	2.1	0.00	0.0	0.0
	1937-2-2	29.5	2.4	0.00	0.0	0.0
	1937-2-3	30.5	2.4	0.00	0.0	0.0
	1937-2-4	31.5	1.7	0.00	0.0	0.0
	1937-2-5	32.5	2.6	0.00	0.0	0.0
	1937-1-1	33.5	4.9	0.00	0.0	0.0
	1937-1-2	34.5	2.5	0.00	0.0	0.0
	1937-1-3	35.5	3.0	0.00	0.0	0.0
	1937-1-4	36.5	2.6	0.00	0.0	0.0
	1937-1-5	37.5	5.4	0.00	0.0	0.0

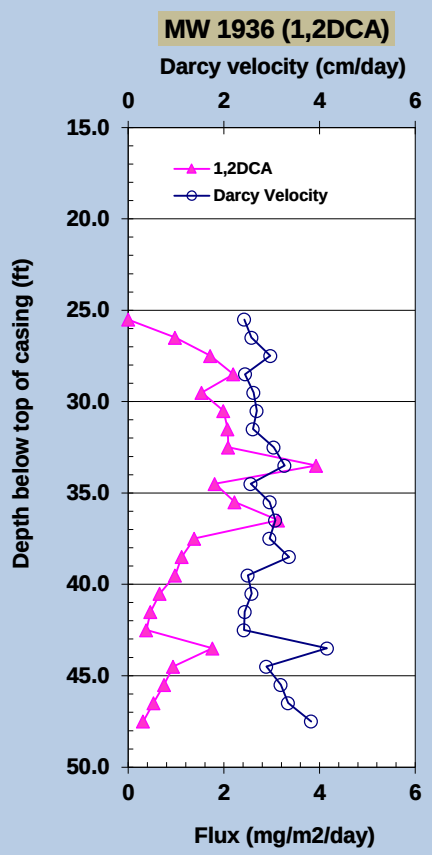
Table2. Summary of flux average contaminant concentration

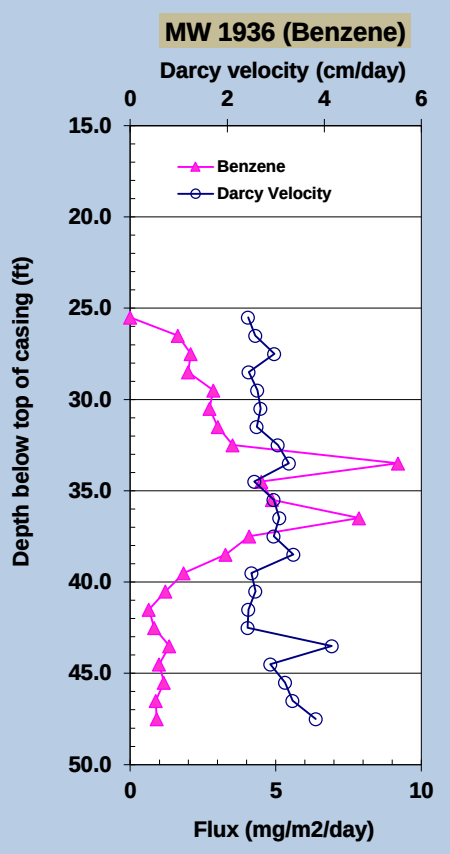
Well_ID	Sample_ID	Depth below top of well casing (ft)	Darcy Velocity (cm/day)	12DCA (ug/L)	Benzene (ug/L)	Xylene (ug/L)
MW 1928	1928-7-1	29.5	3.0	272	10903	172
	1928-7-2	30.5	3.1	324	17390	88
	1928-7-3	31.5	2.8	239	13384	67
	1928-7-4	32.5	3.0	178	11186	79
	1928-7-5	33.5	3.0	101	5004	52
	1928-6-1	34.5	3.2	171	4450	181
	1928-6-2	35.5	2.7	91	2014	67
	1928-6-3	36.5	3.0	105	2422	82
	1928-6-4	37.5	2.9	63	1628	58
	1928-6-5	38.5	4.5	130	4300	116
	1928-5-1	39.5	6.2	187	4167	222
	1928-5-2	40.5	3.1	295	6945	337
	1928-5-3	41.5	5.7	209	5207	269
	1928-5-4	42.5	3.1	229	5348	277
	1928-5-5	43.5	3.1	153	3446	189
	1928-4-1	44.5	6.8	89	2121	100
	1928-4-2	45.5	3.2	141	3829	147
	1928-4-3	46.5	2.8	348	10814	400
	1928-4-4	47.5	2.8	268	8189	283
	1928-4-5	48.5	3.2	558	20467	672
MW 1936	1936-12-3	25.5	2.4	0.0	0.0	0.0
	1936-12-4	26.5	2.6	38	63	0.0
	1936-12-5	27.5	3.0	58	70	0.0
	1936-11-1	28.5	2.4	90	81	0.0
	1936-11-2	29.5	2.6	59	109	0.0
	1936-11-3	30.5	2.7	74	101	0.0
	1936-11-4	31.5	2.6	80	116	0.0
	1936-11-5	32.5	3.0	69	116	0.0
	1936-10-1	33.5	3.3	120	281	0.0
	1936-10-2	34.5	2.6	71	176	0.0
	1936-10-3	35.5	3.0	75	165	0.0
	1936-10-4	36.5	3.1	102	256	0.0
	1936-10-5	37.5	3.0	47	138	0.0
	1936-9-1	38.5	3.4	33	97	0.0
	1936-9-2	39.5	2.5	39	74	0.0
	1936-9-3	40.5	2.6	26	47	0.0
	1936-9-4	41.5	2.4	19	26	0.0
	1936-9-5	42.5	2.4	16	34	0.0
	1936-8-1	43.5	4.2	42	32	0.0
	1936-8-2	44.5	2.9	32	34	0.0
	1936-8-3	45.5	3.2	23	36	0.0
	1936-8-4	46.5	3.3	16	26	0.0
	1936-8-5	47.5	3.8	8	24	0.0
MW 1937	1937-3-1	23.5	0.5	0.0	0.0	0.0
	1937-3-2	24.5	0.5	0.0	0.0	0.0
	1937-3-3	25.5	0.4	0.0	0.0	0.0
	1937-3-4	26.5	0.5	0.0	0.0	0.0
	1937-3-5	27.5	0.5	0.0	0.0	0.0
	1937-2-1	28.5	2.1	0.0	0.0	0.0
	1937-2-2	29.5	2.4	0.0	0.0	0.0
	1937-2-3	30.5	2.4	0.0	0.0	0.0
	1937-2-4	31.5	1.7	0.0	0.0	0.0
	1937-2-5	32.5	2.6	0.0	0.0	0.0
	1937-1-1	33.5	4.9	0.0	0.0	0.0
	1937-1-2	34.5	2.5	0.0	0.0	0.0
	1937-1-3	35.5	3.0	0.0	0.0	0.0
	1937-1-4	36.5	2.6	0.0	0.0	0.0
	1937-1-5	37.5	5.4	0.0	0.0	0.0

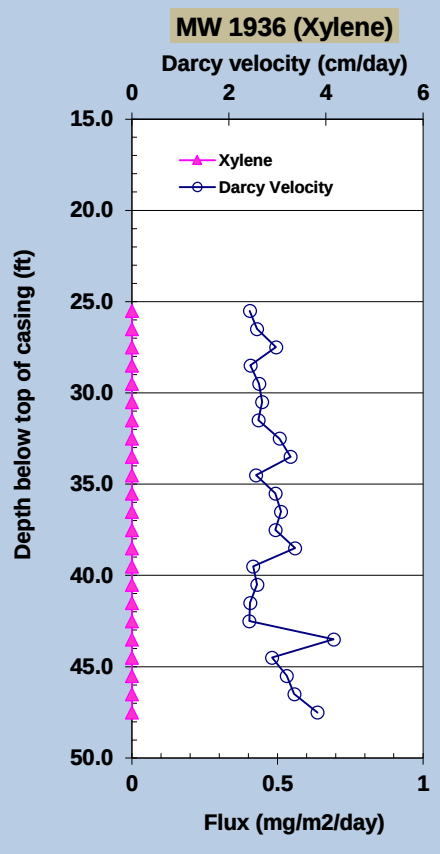

MW 1928 (1,2DCA)
Darcy velocity (cm/day)
0
5
10
1,2DCA
Darcy Velocity
Depth below top of casing (ft)
20.0
25.0
30.0
35.0
40.0
45.0
50.0
0
10
20
Flux (mg/m2/day)


MW 1928 (Benzene)
Darcy velocity (cm/day)
0
5
10
Benzene
Darcy Velocity
Depth below top of casing (ft)
20.0
25.0
30.0
35.0
40.0
45.0
50.0
0
500
1000
Flux (mg/m2/day)


MW 1928 (Xylene)
Darcy velocity (cm/day)
0
5
10
Xylene
Darcy Velocity
Depth below top of casing (ft)
20.0
25.0
30.0
35.0
40.0
45.0
50.0
0
10
20
30
Flux (mg/m2/day)


MW 1936 (1,2DCA)
Darcy velocity (cm/day)
0
2
4
6
1,2DCA
Darcy Velocity
Depth below top of casing (ft)
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
0
2
4
6
Flux (mg/m2/day)


MW 1936 (Benzene)
Darcy velocity (cm/day)
0
2
4
6
Benzene
Darcy Velocity
Depth below top of casing (ft)
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
0
5
10
Flux (mg/m2/day)


MW 1936 (Xylene)
Darcy velocity (cm/day)
0
2
4
6
Xylene
Darcy Velocity
Depth below top of casing (ft)
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
0
0.5
1
Flux (mg/m2/day)

MW 1937 (1,2DCA)
Darcy velocity (cm/day)
0
2
4
6
1,2DCA
Darcy Velocity
Depth below top of casing (ft)
15.0
20.0
25.0
30.0
35.0
40.0
0
0.5
1
Flux (mg/m2/day)

MW 1937 (Benzene)
Darcy velocity (cm/day)
0
2
4
6
Benzene
Darcy Velocity
Depth below top of casing (ft)
15.0
20.0
25.0
30.0
35.0
40.0
0
0.5
1
Flux (mg/m2/day)

MW 1937 (Xylene)
Darcy velocity (cm/day)
0
2
4
6
Xylene
Darcy Velocity
Depth below top of casing (ft)
15.0
20.0
25.0
30.0
35.0
40.0
0
0.5
1
Flux (mg/m2/day)

Table 3. Mass discharge per unit width for aquifer of each well

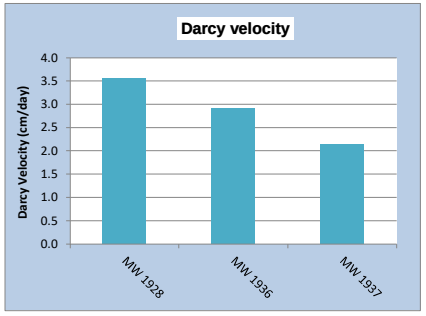
Well	Darcy Velocity (cm/day)	1,2DCA Discharge (mg/m/day)	Benzene Discharge (mg/m/day)	Xylene Discharge (mg/m/day)
MW 1928	3.6	43.26	1440.1	41.6
MW 1936	2.9	10.05	18.7	0.0
MW 1937	2.1	0.0	0.0	0.0

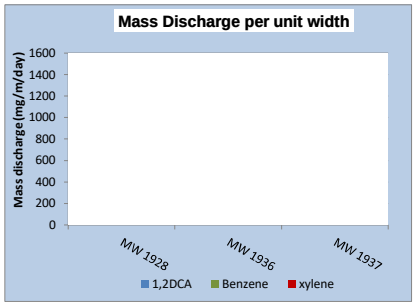
Table 4. Well average values of mass flux based on PFMs

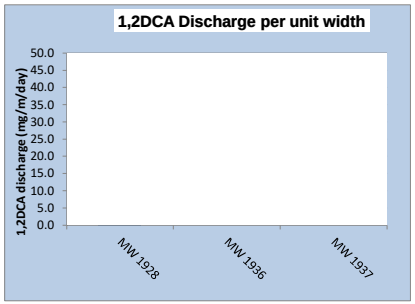
Well	Darcy Velocity (cm/day)	12DCA flux (mg/m^2/day)	Benzene flux (mg/m^2/day)	Xylene flux (mg/m^2/day)
MW 1928	3.6	7.10	236.2	6.8
MW 1936	2.9	1.43	2.7	0.0
MW 1937	2.1	0.00	0.0	0.0

Table 5. Flux average contaminant concentration on PFMs

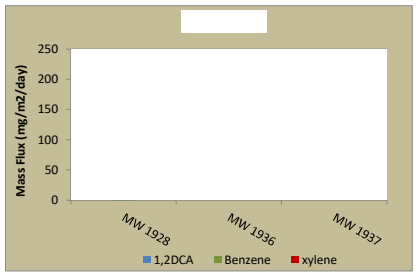
Well	Darcy Velocity (cm/day)	12DCA (ug/L)	Benzene (ug/L)	Xylene (ug/L)
MW 1928	3.6	207.5	7161	193
MW 1936	2.9	49.43	91.5	0.0
MW 1937	2.1	0.0	0.0	0.0

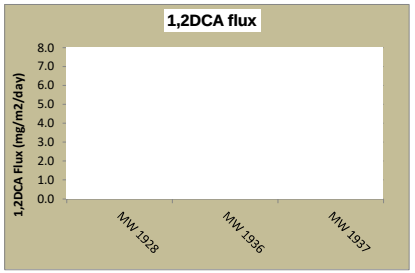


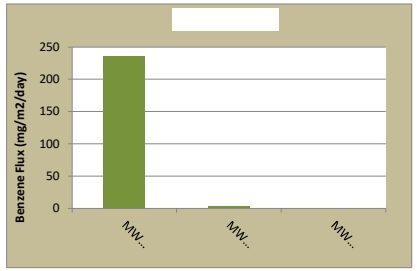

Mass Discharge per unit width
Mass discharge (mg/m/day)
1600
1400
1200
1000
800
600
400
200
0
MW 1928
MW 1936
MW 1937
1,2DCA
Benzene
xylene

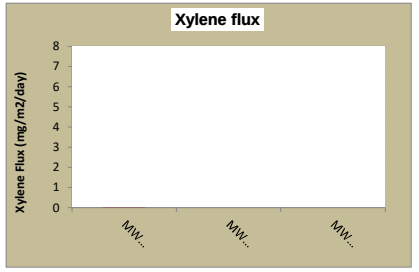

1,2DCA Discharge per unit width
1,2DCA discharge (mg/m/day)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
MW 1928
MW 1936
MW 1937

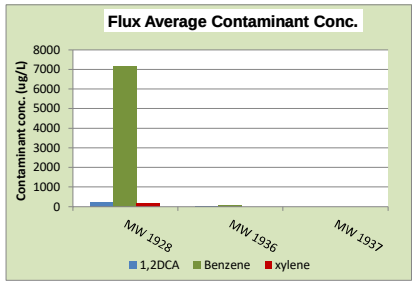

Benzene discharge (mg/m/day)

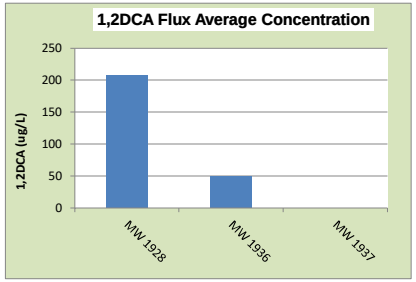

Mass Flux (mg/m2/day)
250
200
150
100
50
0
MW 1928
MW 1936
MW 1937
1,2DCA
Benzene
xylene

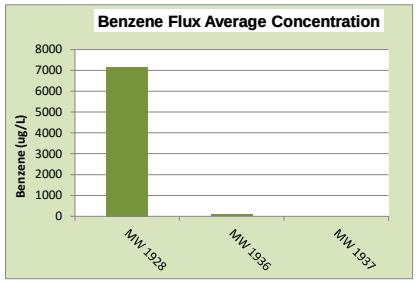

1,2DCA flux
1,2DCA Flux (mg/m2/day)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
MW 1928
MW 1936
MW 1937

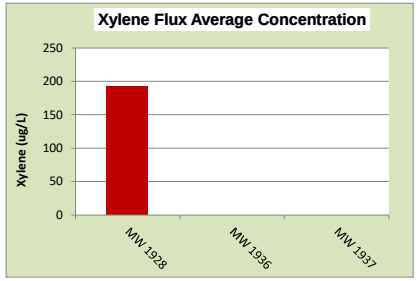

Benzene Flux (mg/m2/day)
250
200
150
100
50
0


Xylene flux
Xylene Flux (mg/m2/day)
8
7
6
5
4
3
2
1
0


Flux Average Contaminant Conc.
Contaminant conc. (ug/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
MW 1928
MW 1936
MW 1937
1,2DCA
Benzene
xylene


1,2DCA Flux Average Concentration
1,2DCA (ug/L)
250
200
150
100
50
0
MW 1928
MW 1936
MW 1937


Benzene Flux Average Concentration
Benzene (ug/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
MW 1928
MW 1936
MW 1937


Xylene Flux Average Concentration
Xylene (ug/L)
250
200
150
100
50
0
MW 1928
MW 1936
MW 1937

Appendix B

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Measurements:
Vertical Scale: 0.25 in = 5 ft
Horizontal Scale: 0.72 in = 50 ft

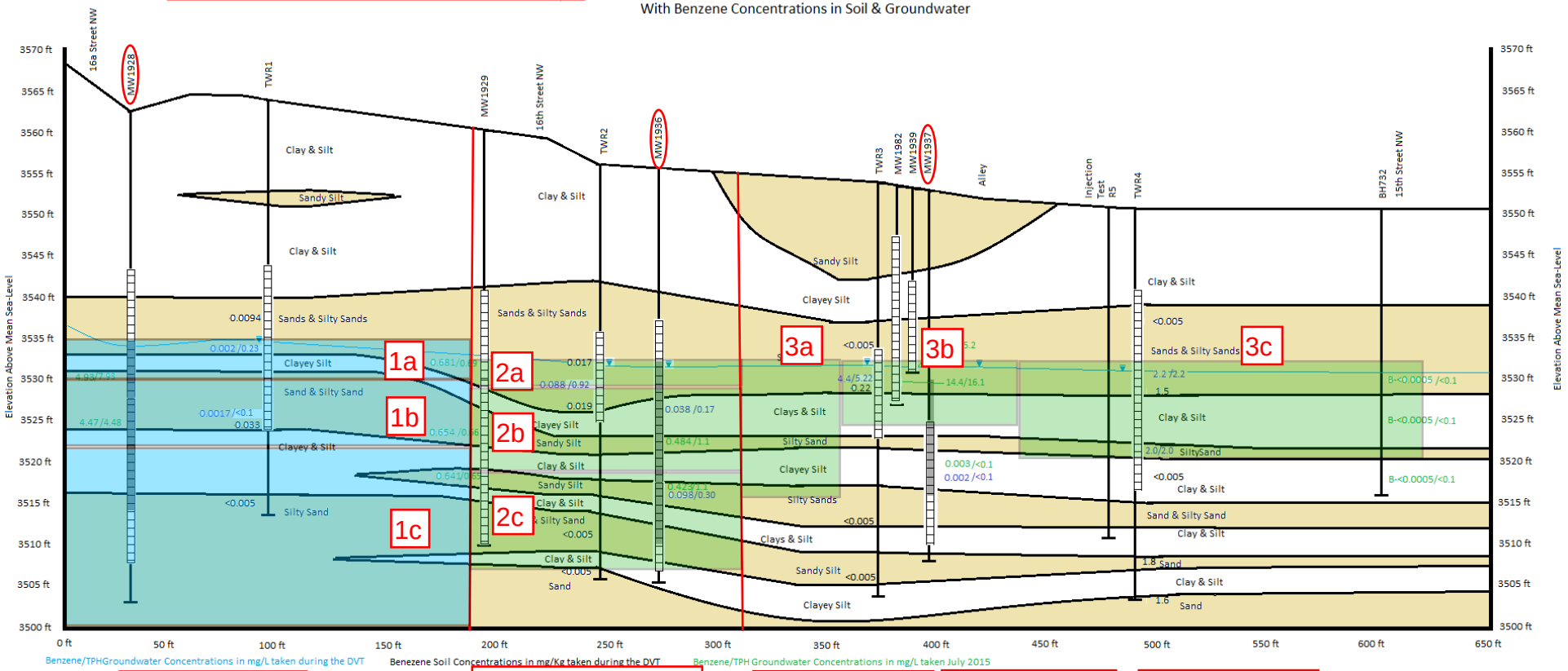
Clifton Associates - Houndsfield Heights
Project # BrG53336
July 12, 2019

A (West)

Geologic Cross Section

With Benzene Concentrations in Soil & Groundwater

A' (East)



Benzene/TPHGroundwater Concentrations in mg/L taken during the DVT

Benezene Soil Concentrations in mg/Kg taken during the DVT

Benzene/TPH Groundwater Concentrations in mg/L taken July 2015

Zone 1a:
180 ft width
29 to 34 ft bgs

Zone 1b:
180 ft width
34 to 43 ft bgs

Zone 1c:
180 ft width
43 to 66 ft bgs

Zone 2a:
120 ft width
25.5 to 27.5 ft bgs

Zone 2b:
120 ft width
27.5 to 38.5 ft bgs

Zone 2c:
120 ft width
38.5 to 47.5 ft bgs

Zone 3a:
45 ft width
24 to 40 ft bgs

Zone 3b:
80 ft width
22 to 30 ft bgs

Zone 3c:
180 ft width
20 to 32 ft bgs

Appendix C

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December 14, 2019

Stephen d'Abadie, M. Eng., P. Biol., PMP
Clifton Associates
2222 – 30th Avenue NE
Calgary, AB
T2E 7K9

SUBJECT: INJECTION SUMMARY
SEARS HOUNSFIELD HEIGHTS, CALGARY, ALBERTA

Stephen:

InSitu Remediation Services Ltd. (IRSL) is pleased to provide this letter summarizing the injection event completed at the above site from November 5 to December 12, 2019. The injection program involved the following:

- *Number of Injection Locations*: Fifty-seven (57) direct push locations
- *Method of Injection*: Direct push using a Geoprobe Model 7822
- *Reagents*: Colloidal Activated Carbon (PlumeStop and PlumeStop S) and oxygen-releasing compound (ORC)
- *Injection Pressure:* up to 85 psi
- *Injection Flow Rate:* up to 92.4 lpm
- *Water Source*: Delivered municipal water supply

Table 1 provides the volume of colloidal activated carbon and ORC solution injected at each location as well as the mass of reagents, injection depths, flow rates and injection pressures. A total of 29,277 kg of PlumeStop, 8,904 kg of PlumeStop S, and 8,370 kg of ORC was injected with 615,836 L of water during this program.

Minor daylighting and short circuiting of the solution occurred during the injection as noted in Table 1. The areas of daylighting and short circuiting seem to have been associated with historic boreholes/wells and investigation points. Measurements of the air quality prior to, during and post-injection indicated that the total organic vapour concentrations within the injection area were below the equipment detection limits. If you have any questions, please feel free to contact myself. Thank you for using IRSL, we value your business.

Sincerely

Rick McGregor, M.Sc., MBA, P. Geo.

Limitations

The information, approach and discussion provided in this document are based on information and observations recorded by IRSL at select observation and sampling locations at the Sears Hounsfield Heights site in Calgary, Alberta. Conditions observed on the Site or noted in documents may differ from time to time and may become apparent during future investigations. Observations are made for select sampling/observation points only and thus conditions between and beyond these points may be different. As a result, some conditions may not have been detected or anticipated at the time of this work and as such IRSL cannot be held responsible for environmental conditions at the Site.

The scope of this document is limited to the matters expressly covered. This letter is prepared for the sole benefit of Clifton Associates and may not be relied upon by any other person or entity without the written authorization of IRSL. Any use or reuse of this document including opinions, findings or conclusions represented herein by parties other than Clifton Associates is at the sole risk of those parties.

Table 1 - Injection Summary
65 Heward Avenue, Toronto, Ontario

Date	Injection Point	Bottom of Injection Interval (ftbgs)	PlumeStop or Equilivant (kg)	PlumeStop S (kg)	ORC (kg)	Water (kg)	Flow Rate (kgpm)	Pump Presssure (psi)
Zone 3C								
Novemberr 8 & 9, 2019	IP1	32.0	64.0	-	26.3	1878	25.5	44
		27.0	64.0	-	26.3	1878	24.0	44
		22.0	64.0	-	26.3	1878	24.0	44
Novemberr 5 & 7, 2019	IP2	32.0	64.0	-	26.3	1878	25.5	40
		27.0	64.0	-	26.3	1878	26.5	40
		22.0	64.0	-	26.3	1878	24.9	42
November 7 & 8, 2019	IP3	32.0	64.0	-	26.3	1878	23.7	46
		27.0	64.0	-	26.3	1878	24.9	46
		22.0	64.0	-	26.3	1878	23.7	46
November 9, 2019	IP4	32.0	64.0	-	26.3	1878	22.6	44
		27.0	64.0	-	26.3	1878	21.2	44
		22.0	64.0	-	26.3	1878	24.9	44
November 5, 2019	IP5	32.0	64.0	-	26.3	1878	25.5	30
		27.0	64.0	-	26.3	1878	26.8	30
		22.0	64.0	-	26.3	1878	27.3	25
November 8, 2019	IP6	32.0	64.0	-	26.3	1878	27.3	46
		27.0	64.0	-	26.3	1878	27.7	46
		22.0	64.0	-	26.3	1878	23.7	46
November 7, 2019	IP7	32.0	64.0	-	26.3	1878	24.6	44
		27.0	64.0	-	26.3	1878	25.2	44
		22.0	64.0	-	26.3	1878	25.6	44
November 8 & 9, 2019	IP8	32.0	64.0	-	26.3	1878	24.0	42
		27.0	64.0	-	26.3	1878	29.4	42
		22.0	64.0	-	26.3	1878	19.6	42
November 9 & 11, 2019	IP9	32.0	64.0	-	26.3	1878	24.9	42
		27.0	64.0	-	26.3	1878	18.2	42
		22.0	64.0	-	26.3	1878	24.0	42
November 11 & 12, 2019	IP10	32.0	64.0	-	26.3	1878	28.5	44
		27.0	64.0	-	26.3	1878	28.5	44
		22.0	64.0	-	26.3	1878	28.5	44
November 12, 2019	IP11	32.0	64.0	-	26.3	1878	25.6	44
		27*	64.0	-	26.3	1878	27.7	44
		22.0	64.0	-	26.3	1878	21.4	44
November 11 & 12, 2019	IP12	32.0	64.0	-	26.3	1878	27.0	42
		27.0	64.0	-	26.3	1878	20.5	42
		22.0	64.0	-	26.3	1878	39.4	42
November 12 & 13, 2019	IP13	32.0	64.0	-	26.3	1878	25.4	46
		27.0	64.0	-	26.3	1878	27.0	46
		22.0	64.0	-	26.3	1878	22.6	46
November 12, 2019	IP14	32.0	64.0	-	26.3	1878	27.7	46
		27.0	64.0	-	26.3	1878	27.0	46
		22.0	64.0	-	26.3	1878	27.3	46
November 12 & 13, 2019	IP15	32.0	64.0	-	26.3	1878	27.3	46
		27.0	64.0	-	26.3	1878	17.5	42
		22.0	64.0	-	26.3	1878	24.9	42
November 14, 2019	IP16	32.0	64.0	-	26.3	1878	17.7	38
		27.0	64.0	-	26.3	1878	21.2	38
		22.0	64.0	-	26.3	1878	20.7	42
November 13, 2019	IP17	32.0	64.0	-	26.3	1878	24.3	40
		27.0	64.0	-	26.3	1878	23.2	40
		22.0	64.0	-	26.3	1878	21.4	40
November 14 & 15, 2019	IP18	32.0	64.0	-	26.3	1878	22.6	42
		27.0	64.0	-	26.3	1878	20.5	42
		22.0	64.0	-	26.3	1878	27.0	46
Zone 3B								
November 13, 2019	IP19	30.0	68.0	-	26.7	2005	29.2	46
		24.0	68.0	-	26.7	2005	25.0	46
November 13, 2019	IP20	30.0	68.0	-	26.7	2005	17.5	42
		24.0	68.0	-	26.7	2005	20.0	42
November 13 & 15, 2019	IP21	30.0	68.0	-	26.7	2005	20.4	44
		24.0	68.0	-	26.7	2005	35.6	44
November 15, 2019	IP22	30.0	68.0	-	26.7	2005	21.2	46
		24.0	68.0	-	26.7	2005	17.4	46
November 15 & 18, 2019	IP23	30.0	68.0	-	26.7	2005	15.2	46
		24.0	68.0	-	26.7	2005	26.7	46
November 15, 2019	IP24	30.0	68.0	-	26.7	2005	19.3	44
		24.0*	68.0	-	26.7	2005	20.6	44
November 15, 2019	IP25	30.0*	68.0	-	26.7	2005	14.4	40
		24.0	68.0	-	26.7	2005	19.4	
November 18, 2019	IP26	30.0	68.0	-	26.7	2005	18.8	55
		24.0	68.0	-	26.7	2005	16.4	55
Zone 3A								
November 15 & 18, 2019	IP27	40.0	72.5	-	29.1	2718	16.8	40
		34.0	72.5	-	29.1	2718	18.2	50
		30.0	72.5	-	29.1	2718	20.6	52
November 18 & 19, 2019	IP28	40.0	72.5	-	29.1	2718	28.8	40
		34.0	72.5	-	29.1	2718	7.9	30
		30.0	72.5	-	29.1	2718	12.7	30
November 18 & 19, 2019	IP29	40.0*	72.5	-	29.1	2718	17.8	55
		34.0	72.5	-	29.1	2718	25.9	35
		30.0	72.5	-	29.1	2718	28.2	25
November 19 & 20, 2019	IP30	40.0*	72.5	-	29.1	2718	12.7	35
		34.0	72.5	-	29.1	2718	37.6	20
		30.0	72.5	-	29.1	2718	24.5	20
November 19 & 20, 2019	IP31	40.0	72.5	-	29.1	2718	30.0	45
		34.0	72.5	-	29.1	2718	23.6	30
		30.0	72.5	-	29.1	2718	28.2	40
Zones 2A, B & C								
November 23, 2019	IP32	47.5	53.0	-	28.0	2209	28.6	40
		42.0	53.0	-	28.0	2209	25.4	45
		38.5	136.0	-	34.1	2763	23.5	60
		32.0	136.0	-	34.1	2763	18.2	50
		28.5	30.3	-	13.7	1007	19.8	45
November 21 &22, 2019	IP33	47.5	53.0	-	28.0	2209	21.0	80
		42.0	53.0	-	28.0	2209	24.4	80
		38.5	136.0	-	34.1	2763	34.5	65
		33.0	136.0	-	34.1	2763	25.4	65
		28.5	30.3	-	13.7	1007	21.4	40
November 22 & 23, 2019	IP34	47.5	53.0	-	28.0	2209	34.7	35
		42.0	53.0	-	28.0	2209	34.7	25
		38.5	136.0	-	34.1	2763	29.0	25
		33.0	136.0	-	34.1	2763	35.3	25
		28.5	30.3	-	13.7	1007	21.1	20
November 21, 2019	IP35	47.5	53.0	-	28.0	2209	24.9	85
		42.0	53.0	-	28.0	2209	29.4	65
		38.5	136.0	-	34.1	2763	32.2	65
		33.0	136.0	-	34.1	2763	34.9	60
		28.5	30.3	-	13.7	1007	22.4	50
November 23, 2019	IP36	47.5	53.0	-	28.0	2209	25.2	65
		42.0	53.0	-	28.0	2209	24.1	60
		38.5	136.0	-	34.1	2763	25.5	60
		33.0	136.0	-	34.1	2763	22.7	60
		28.5	30.3	-	13.7	1007	21.4	65
November 22 & 23, 2019	IP37	47.5	53.0	-	28.0	2209	25.2	65
		42.0	53.0	-	28.0	2209	30.1	60
		38.5	136.0	-	34.1	2763	23.5	50
		33.0	136.0	-	34.1	2763	28.8	60
		28.5	30.3	-	13.7	1007	24.4	80
November 25 & 26, 2019	IP38	48.5	53.0	-	28.0	2209	33.7	70
		42.0	53.0	-	28.0	2209	41.6	25
		38.5	136.0	-	34.1	2763	34.9	20
		32.0	136.0	-	34.1	2763	24.2	40
		28.5	30.3	-	13.7	1007	9.7	35
November 25 & 26, 2019	IP39	48.5	53.0	-	28.0	2209	46.7	20
		42.0	53.0	-	28.0	2209	21.2	15
		38.5	136.0	-	34.1	2763	33.3	15
		32.0	136.0	-	34.1	2763	21.4	15
		28.5	30.3	-	13.7	1007	22.8	15
November 27, 2019	IP40	48.5	53.0	-	28.0	2209	26.6	55
		42.0	53.0	-	28.0	2209	18.9	50
		38.5	136.0	-	34.1	2763	27.9	50
		32.0	136.0	-	34.1	2763	26.4	45
		28.5	30.3	-	13.7	1007	26.3	40
November 25, 2019	IP41	48.5	53.0	-	28.0	2209	31.8	60
		42.0	53.0	-	28.0	2209	34.2	60
		38.5	136.0	-	34.1	2763	25.8	45
		32.0	136.0	-	34.1	2763	24.4	40
		28.5	30.3	-	13.7	1007	23.4	40
November 26, 2019	IP42	48.5	53.0	-	28.0	2209	26.9	70
		42.0	53.0	-	28.0	2209	30.5	50
		38.5	136.0	-	34.1	2763	31.5	50
		32.0	136.0	-	34.1	2763	18.1	45
		28.5	30.3	-	13.7	1007	22.4	40
November 27, 2019	IP43	48.5	53.0	-	28.0	2209	35.2	45
		42.0	53.0	-	28.0	2209	34.7	45
		38.5	136.0	-	34.1	2763	30.2	40
		32.0	136.0	-	34.1	2763	30.6	40
		28.5	30.3	-	13.7	1007	29.2	35

Table 1 - Injection Summary
65 Heward Avenue, Toronto, Ontario

Date	Injection Point	Bottom of Injection Interval (ftbgs)	PlumeStop or Equilivant (kg)	PlumeStop S (kg)	ORC (kg)	Water (kg)	Flow Rate (kgpm)	Pump Presssure (psi)
Zones 1A, B & C								
November 28, 30 & December 1, 2019	IP44	63.0	-	159.0	49.3	3635	27.3	46
		58.0	-	159.0	49.3	3635	41.3	46
		53.0	-	159.0	49.3	3635	32.5	60
		48.0	-	159.0	49.3	3635	24.5	60
		43.0	403.0	-	38.3	2518	41.1	60
		38.0	403.0	-	38.3	2518	19.9	60
		34.0	533.0	-	42.7	2725	8.7	60
December 1, 2 & 10, 2019	IP45	63.0	-	159.0	49.3	3635	31.8	60
		58.0	-	159.0	49.3	3635	51.8	60
		53.0		159.0	49.3	3635	32.6	62
		48.0		159.0	49.3	3635	63.0	62
		43.0	403.0	-	38.3	2518	82.2	60
		38.0*	403.0	-	38.3	466	64.7	60
		34.0	533.0	-	42.7	2725	48.5	64
November 28, 30 & December 1, 2019	IP46	63.0	-	159.0	49.3	3635	39.2	52
		58.0	-	159.0	49.3	3635	45.2	52
		53.0	-	159.0	49.3	3635	34.7	48
		48.0	-	159.0	49.3	3635	34.7	48
		43.0	403.0	-	38.3	2518	22.5	52
		38.0	403.0	-	38.3	2518	34.6	54
		34.0	533.0	-	42.7	2725	48.1	58
December 2, 3, 4 & 8, 2019	IP47	63.0	-	159.0	49.3	3635	48.5	60
		58.0	-	159.0	49.3	3635	63.0	60
		53.0	-	159.0	49.3	3635	65.0	60
		48.0	-	159.0	49.3	3635	49.9	54
		43.0	403.0	-	38.3	2518	10.3	32
		38.0	403.0	-	38.3	2518	23.3	42
		34.0	533.0	-	42.7	2725	45.8	52
December 1, 2 & 8, 2019	IP48	63.0	-	159.0	49.3	3635	51.2	56
		58.0	-	159.0	49.3	3635	64.0	58
		53.0	-	159.0	49.3	3635	65.1	58
		48.0	-	159.0	49.3	3635	47.4	58
		43.0	403.0	-	38.3	2518	92.5	56
		38.0*	403.0	-	38.3	2518	84.2	56
		34.0	533.0	-	42.7	2725	47.0	52
December 3 & 8, 2019	IP49	63.0	-	159.0	49.3	3635	19.4	62
		58.0*	-	159.0	49.3	3635	32.6	62
		53.0		159.0	49.3	3635	39.7	56
		48.0		159.0	49.3	3635	35.3	56
		43.0	403.0	-	38.3	2518	47.0	56
		38.0	403.0	-	38.3	2518	43.5	56
		34.0	533.0	-	42.7	2725	45.1	56
December 11, 2019	IP50	63.0	-	159.0	49.3	3635	43.7	56
		58.0	-	159.0	49.3	3635	41.8	56
		53.0	-	159.0	49.3	3635	42.7	56
		48.0	-	159.0	49.3	3635	40.5	56
		43.0	403.0	-	38.3	2518	43.5	60
		38.0	403.0	-	38.3	2518	46.3	60
		34.0	533.0	-	42.7	2725	46.5	60
December 9, 2019	IP51	63.0	-	159.0	49.3	3635	46.3	56
		58.0	-	159.0	49.3	3635	39.2	56
		53.0	-	159.0	49.3	3635	36.6	56
		48.0	-	159.0	49.3	3635	41.3	56
		43.0	403.0	-	38.3	2518	37.9	54
		38.0	403.0	-	38.3	2518	42.3	54
		34.0	533.0	-	42.7	2725	45.2	58
December 3 & 8, 2019	IP52	63.0	-	159.0	49.3	3635	46.3	28
		58.0	-	159.0	49.3	3635	36.5	28
		53.0	-	159.0	49.3	3635	34.6	48
		48.0	-	159.0	49.3	3635	33.1	48
		43.0	403.0	-	38.3	2518	42.9	48
		38.0	403.0	-	38.3	2518	37.0	48
		34.0	533.0	-	42.7	2725	39.2	48
December 8 & 9, 2019	IP53	63.0	-	159.0	49.3	3635	47.4	52
		58.0	-	159.0	49.3	3635	41.3	52
		53.0	-	159.0	49.3	3635	39.2	52
		48.0	-	159.0	49.3	3635	38.1	52
		43.0	403.0	-	38.3	2518	42.9	48
		38.0	403.0	-	38.3	2518	37.0	48
		34.0	533.0	-	42.7	2725	29.7	54
December 10, 2019	IP54	63.0	-	159.0	49.3	3635	43.7	62
		58.0	-	159.0	49.3	3635	41.8	62
		53.0	-	159.0	49.3	3635	42.7	62
		48.0	-	159.0	49.3	3635	40.5	62
		43.0	403.0	-	38.3	2518	44.2	62
		38.0	403.0	-	38.3	2518	48.5	62
		34.0	533.0	-	42.7	2725	52.6	62
December 11, 2019	IP55	63.0	-	159.0	49.3	3635	40.9	56
		58.0	-	159.0	49.3	3635	42.2	56
		53.0	-	159.0	49.3	3635	41.3	56
		48.0	-	159.0	49.3	3635	41.8	56
		43.0	403.0	-	38.3	2518	44.8	58
		38.0	403.0	-	38.3	2518	44.8	58
		34.0	533.0	-	42.7	2725	47.2	56
December 12, 2019	IP56	63.0	-	159.0	49.3	3635	39.2	56
		58.0	-	159.0	49.3	3635	41.8	56
		53.0	-	159.0	49.3	3635	42.7	56
		48.0	-	159.0	49.3	3635	40.5	56
		43.0	403.0	-	38.3	2518	42.3	56
		38.0	403.0	-	38.3	2518	47.0	56
		34.0	533.0	-	42.7	2725	47.2	54
December 10, 2019	IP57	63.0	-	159.0	49.3	3635	40.9	48
		58.0	-	159.0	49.3	3635	42.2	48
		53.0	-	159.0	49.3	3635	40.9	48
		48.0	-	159.0	49.3	3635	41.8	48
		43.0	403.0	-	38.3	2518	43.5	48
		38.0	403.0	-	38.3	2518	42.7	48
		34.0	533.0	-	42.7	2725	45.8	48
		-	29277.1	8904.0	8369.7	615836	-	-

* = indicates daylighting or short circuiting of the solution