

Se	Conc	n	Stand Dev	Ave	Diff b/w ave & mediar	St Dev/Square root of N	min	max	95th %ile	90th %ile	95th UCL	Norm Distribution	skewness	kurtosis	JB test stat	p-value																												
1	1.4	27	6.66	5.37	3.30	2.07	1.28	0.50	28.00	17.70	15.2	0.9679	2.07	4.41	41.18	1.14E-09																												
6.4	6.1	3.3	<div>Column f</div> <table><tr><td>Mean</td><td>5.367037037</td></tr><tr><td>Standard Error</td><td>1.282363138</td></tr><tr><td>Median</td><td>3.3</td></tr><tr><td>Mode</td><td>0.5</td></tr><tr><td>Standard Deviation</td><td>6.66354327</td></tr><tr><td>Sample Variance</td><td>44.40029088</td></tr><tr><td>Kurtosis</td><td>4.40731311</td></tr><tr><td>Skewness</td><td>2.072424235</td></tr><tr><td>Range</td><td>27.5</td></tr><tr><td>Minimum</td><td>0.5</td></tr><tr><td>Maximum</td><td>28</td></tr><tr><td>Sum</td><td>144.91</td></tr><tr><td>Count</td><td>27</td></tr><tr><td>Confidence Level(95.0%)</td><td>2.635935181</td></tr></table>														Mean	5.367037037	Standard Error	1.282363138	Median	3.3	Mode	0.5	Standard Deviation	6.66354327	Sample Variance	44.40029088	Kurtosis	4.40731311	Skewness	2.072424235	Range	27.5	Minimum	0.5	Maximum	28	Sum	144.91	Count	27	Confidence Level(95.0%)	2.635935181
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1.8																																												

[How to Perform a Normality Test in Excel \(Step-by-Step\) | statology.org/](#)

[How to Perform a Normality Test in Excel \(Step-by-Step\) | statistics.org](#)

**Cell:** G1

**Note:** Lachmuth, Cara ENV:EX:

If the diff b/w mean and median of data set with n samples is greater than Standard Deviation divided by the square root of n, then it cannot be assumed that the data come from a symmetric distribution (such as normal dist.)

**Cell:** C6

**Note:** Lachmuth, Cara ENV:EX:

To create table of descriptive statistics:

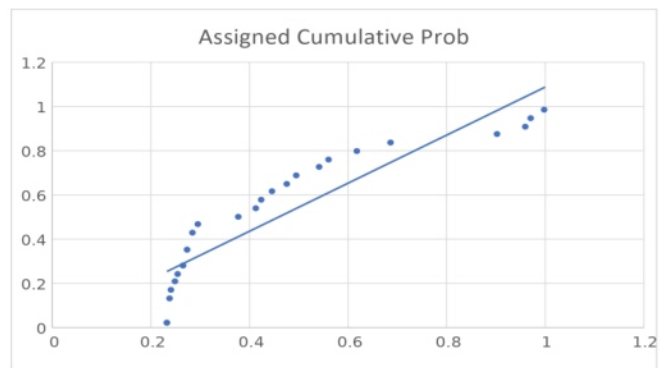
File > Options > Add-ins > Manage Excel Add-ins > select 'Analysis ToolPak' and 'Solver Add-in' > in Excel ribbon select 'Data' > click on 'Analyze Data' > click ok on 'Descriptive Statistics' > chose input range of data and output where you want table to be posted > select 'Summary Statistics' and 'Confidence Level of the Mean' > click ok > then calculate lower and higher (upper) Confidence Levels

**Cell:** G10

**Note:** Lachmuth, Cara ENV:EX:

Same as 95% UCLM

Se Conc	Ranks	Predictive Norm Cumulative Prob	Assigned Cumulative Prob
0.5	1	0.232567218	0.018518519
0.5	1	0.232567218	0.018518519
0.5	1	0.232567218	0.018518519
0.63	4	0.238570385	0.12962963
0.72	5	0.242775606	0.166666667
0.86	6	0.249396018	0.203703704
1	7	0.256111182	0.240740741
1.2	8	0.265865347	0.277777778
1.2	8	0.265865347	0.277777778
1.4	10	0.275804317	0.351851852
1.4	10	0.275804317	0.351851852
1.6	12	0.285922473	0.425925926
1.8	13	0.29621377	0.462962963
3.3	14	0.378200754	0.5
3.9	15	0.412871348	0.537037037
4.1	16	0.424595783	0.574074074
4.5	17	0.448235662	0.611111111
5	18	0.4780362	0.648148148
5.3	19	0.495986487	0.685185185
6.1	20	0.543794955	0.722222222
6.4	21	0.561597803	0.759259259
7.4	22	0.619853493	0.796296296
8.6	23	0.68622762	0.833333333
14	24	0.902441295	0.87037037
17	25	0.959578175	0.907407407
18	26	0.971012467	0.944444444
28	27	0.999658897	0.981481481



Area of Potential Environmental Concern	PCOCs in Soil	PCOCs in Groundwater	PCOCs in Vapour
#1: former aboveground storage tank farm, pump house, and former spur line	BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE, tetraethyl lead, 1,3,5-trimethylbenzene, butylbenzene, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs, MTBE, tetraethyl lead, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, methylcyclohexane, n-hexane, n-decane, naphthalene, 1,3,5-trimethylbenzene, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane, 1,3-butadiene
#2: former underground storage tank of unknown use and pump of unknown use	BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE, metals, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs, MTBE, metals, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, methylcyclohexane, n-hexane, n-decane, naphthalene, MTBE, 1,3,5-trimethylbenzene, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane, 1,3-butadiene
#3: former warehouse and loading and unloading area	BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE, metals, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs, MTBE, metals, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, methylcyclohexane, n-hexane, n-decane, naphthalene, MTBE, 1,3,5-trimethylbenzene, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane, 1,3-butadiene

Area of Potential Environmental Concern	PCOCs in Soil	PCOCs in Groundwater	PCOCs in Vapour
<b>#4:</b> former lumber yard and door and sash factory	None	BTEX, VPHw, VHw(6-10), LEPhw, EPhw(10-19), PAHs, chromium, arsenic, copper, beryllium, polychlorinated biphenyls, phenols	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, methylcyclohexane, isopropylbenzene, n-hexane, n-decane, naphthalene
<b>#5:</b> current Co-op gas station, current auto body garages, former auto body repair shop, and former car dealership	None	BTEX, VPHw, VHw(6-10), LEPhw, EPhw(10-19), PAHs, MTBE, metals, tetraethyl lead, VOCs, glycols, 1,3,5-trimethylbenzene, isopropylbenzene, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, methylcyclohexane, isopropylbenzene, n-hexane, n-decane, naphthalene, MTBE, VOCs, 1,2-dibromoethane, 1,3-butadiene
<b>#6:</b> current and former concrete plant	None	BTEX, VPHw, VHw(6-10), metals	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, methylcyclohexane, isopropylbenzene, n-hexane, n-decane
<b>#7:</b> current and former auto body repairs shops	None	BTEX, VPHw, VHw(6-10), LEPhw, EPhw(10-19), PAHs, MTBE, metals, tetraethyl lead, VOCs, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, methylcyclohexane, isopropylbenzene, n-hexane, n-decane, naphthalene, MTBE, VOCs, 1,2-dibromoethane, 1,3-butadiene

<b>#8:</b> former Western Canada Electrical Substation	None	BTEX, LEPHw, arsenic, barium, cadmium, copper, lead, mercury, zinc, chlorobenzene, 1,4-chlorobenzene, 1,2-dichloroethane, cis-dichloroethylene, trans-dichloroethylene, dichloromethane, 1,1,2,2-tetrachloroethane, tetrachloroethylene, trichloroethylene, polychlorinated biphenyls	BTEX, chlorobenzene, 1,4-chlorobenzene, 1,2-dichloroethane, cis-dichloroethylene, trans-dichloroethylene, dichloromethane, 1,1,2,2-tetrachloroethane, tetrachloroethylene, trichloroethylene
<b>#9:</b> 3004 39th Avenue and the Former Teen Junction Site	None	BTEX, VPHw, VHW(6-10), LEPHw, EPHw(10-19), PAHs	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-decane, naphthalene
<b>#10:</b> former Allied Growers and City of Vernon Municipal Buildings	None	polychlorinated biphenyls, pesticides	None

Caro's P4

1.5  
Date May 2, 3

- The Se conc. over standards seem to be clustered in 2 distinct areas, particularly near AEC #2 a former VST of unknown use & AEC #1 west side pump house
- Highest Se not associated with PHC
- Why were soil samples silt clay layer excluded from stats? Were these high Se conc.?
- What layer do they want to apply standard?

Q4 - did the additional metal data correspond to other metals being elevated at these sites?

pg. 12 spelling error wit should be with

Highest B44-28

Amere

68-18

adek emergency

**From:** Love, Sydney ENV:EX (Sydney.Love@gov.bc.ca)  
**To:** Lachmuth, Cara ENV:EX (Cara.Lachmuth@gov.bc.ca)  
**Subject:** RE: Protocol 4 Application for Site #25812  
**Sent:** 02/08/2023 23:30:42  
**Message Body:**

Hi,

Looks good to me! Only thing I might change is the word **finalize**...suggest changing to **continue**. Just want to keep the door open in case other questions arise!

Thanks,

Sydney

**From:** Lachmuth, Cara ENV:EX <Cara.Lachmuth@gov.bc.ca>  
**Sent:** Tuesday, February 7, 2023 2:03 PM  
**To:** Love, Sydney ENV:EX <Sydney.Love@gov.bc.ca>  
**Subject:** Protocol 4 Application for Site #25812

Hi Sydney,

Below, I've drafted an email to send to Isabel Londono at Parsons Inc. regarding questions I have on the P4 application. If you don't mind taking a quick look before I send it off, I would really appreciate it!

Thank you,

Cara

[Isabel.londono@parsons.com](mailto:Isabel.londono@parsons.com)

Hi Isabel,

Thank you for the Protocol 4 Application for background soil concentrations for selenium at Site #25812 in Vernon, B.C. I've reviewed the application and have the following questions:

- In the Application, I was unable to find a description of the ground cover and vegetation present on the Site. Please provide these details and if there is any obvious damage to vegetation in the reference areas.
- A soil sample included in the calculation of the background soil concentration (BH13 from 3 m depth) was sampled in 1999. Due to changes in laboratory methods since that time, it is unclear if the earlier data is directly comparable to samples collected more recently. Please provide details on the laboratory's methods of analysis for selenium in this 1999 sample versus the other more recent samples included in the calculation. It is noted that lab reports for soil analysis could not be found in the application.
- While the range of selenium concentrations in the sand stratigraphic layer between 0.9 and 3.8 mbgs is provided in the application, I could not find information on the range of selenium concentrations in other stratigraphic layers (e.g., silt and clay) compared to the sand layer. Please provide a statistical analysis that demonstrates this is a specific layer (i.e., one population) that is high in selenium concentrations (e.g., t-test, box plot). It needs to be clearly demonstrated how the high selenium concentrations at the Site are not hotspots but are native materials (i.e., background concentrations).
- It is unclear if other metals are also elevated in samples with high selenium concentrations. Please provide details on this.
- At the end of Section 7.2 of the application, it is unclear what is meant by "*However, all soil samples are statistically less than the proposed background concentrations as per Technical Guidance 2 and will be addressed under separate cover.*" Please provide additional information to clarify the intent of this sentence.

Once I have the information described above, I can finalize my review of the P4 Application.

Warm regards,

Cara

**Cara Lachmuth, MSc, RPBio** (she/her)

Senior Risk Assessment Officer

Land Remediation Section

Ministry of Environment and Climate Change Strategy

[cara.lachmuth@gov.bc.ca](mailto:cara.lachmuth@gov.bc.ca)

*I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples (Esquimalt and Songhees Nations) and the Metis Nation of Greater Victoria.*

**From:** (Jocelyne.Bright@parsons.com)

**To:** Lachmuth, Cara ENV:EX (Cara.Lachmuth@gov.bc.ca)

**Cc:** Peaden, Brooke R (brooke.r.peaden@esso.ca); Brianna.Patrician@parsons.com

**Subject:** RE: Protocol 4 Application for Site #25812 (10-582)

**Sent:** 03/07/2023 21:38:17

**Attachments:** 10-582 (1).JPG, 10-582 Selected Borehole Logs.pdf, Table 1 Soil Analytical Results - Background Selenium Concentrations and 95th Percentile Concentration.pdf, Table 2 Soil Analytical Results - Selenium in the Silty Clay Layer.pdf, Table 3 Soil Analytical Results - Selected Metals.pdf, 10-582 (2).JPG

**Message Body:**

**[EXTERNAL]** This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Sensitive

Hi Cara,

Thank you for your questions. I have copy/pasted your questions (in *italics*) and responded to each below (in blue).

1. *In the Application, I was unable to find a description of the ground cover and vegetation present on the Site. Please provide these details and if there is any obvious damage to vegetation in the reference areas.*
  - a. The property is currently an unpaved, vacant lot. The lot is grass covered with a couple of trees on the northern portion of the property outside of the reference areas. The vegetation on the property within the reference areas does not appear to be damaged. I have attached some photos for your reference.
2. *A soil sample included in the calculation of the background soil concentration (BH13 from 3 m depth) was sampled in 1999. Due to changes in laboratory methods since that time, it is unclear if the earlier data is directly comparable to samples collected more recently. Please provide details on the laboratory method of analysis for selenium in this 1999 sample versus the other more recent samples included in the calculation. It is noted that lab reports for soil analysis could not be found in the application.*
  - a. We have removed this sample from the dataset and rerun the statistics. The new proposed background standard would now be 17.8 ug/g.
3. *While the range of selenium concentrations in the sand stratigraphic layer between 0.9 and 3.8 mbgs is provided in the application, I could not find information on the range of selenium concentrations in other stratigraphic layers (e.g., silt and clay) compared to the sand layer. Please provide a statistical analysis that demonstrates this is a specific layer (i.e., one population) that is high in selenium concentrations (e.g., t-test, box plot). It needs to be clearly demonstrated how the high selenium concentrations at the Site are not hotspots but are native materials (i.e., background concentrations).*
  - a. A standard assessment of the various layers for potential contaminants of concern (PCOCs) (including metals) was completed. Samples were collected from the silt and clay layer, and I have attached a table summarizing the selenium results from these samples. As indicated in

the table, these results met standards.

- b. As illustrated on Drawing No. 10 of the P4 report, the selenium analyses included in the statistical analyses were located outside of areas impacted by historical operations. Soil samples exceeding concentrations for selenium were located outside of both historical facility footprints and petroleum hydrocarbon impacted areas. Additionally, these impacts were observed at depths up to 3.8 mbgs in areas that did not have subsurface facilities. The borehole logs associated with these sample locations document a sand layer that exists across the site and fill material was not observed during investigations that would have suggested this sand layer is not native to the site. The cross-section provided in the P4 report as Drawing No. 9 also indicates a continuous sand layer across the extent of the site. This sand layer was observed in boreholes advanced on the site as well as beneath the CN railway and beneath the city roadways. I have attached borehole logs for borehole locations on the CN property and roadways.
  - c. Student t-tests and box plots are tools used to understand normal populations. The population of selenium is realistically not part of a normal population since geologic formations are not generally normal in population; point source impacts are typically described via lognormal distributions; and widely dispersed point sources (area-wide fill) or naturally occurring background concentrations (which would vary randomly) would not be expected to show any normality in distribution. Rather our investigation relied on non-parametric tools and our population evaluation relied on a series of mutually supported, independent lines of evidence. The selenium-impacted soils were limited to a single stratigraphic layer that shared visual and grain-size characteristics across the extent of the area investigated. It was physically and stratigraphically distinct from the deeper silt and clay layers that differed in colour, grain size composition and chemical characteristics.
4. *It is unclear if other metals are also elevated in samples with high selenium concentrations. Please provide details on this.*
- a. A table summarizing the analytical results for additional metals analyses in samples analyzed for selenium is attached to this email for your reference. As indicated in the table, the analytical results for metals other than selenium met the applicable standards.
5. *At the end of Section 7.2 of the application, it is unclear what is meant by "However, all soil samples are statistically less than the proposed background concentrations as per Technical Guidance 2 and will be addressed under separate cover." Please provide additional information to clarify the intent of this sentence.*
- a. Per BCE Technical Guidance 2, a population is considered to meet standards if the 90<sup>th</sup> percentile concentration of that population is less than or equal to the applicable standard. This statement suggests that should the background standard proposed for selenium be approved, then the 90<sup>th</sup> percentile concentration of the population used to calculate this background concentration will meet the proposed background standard.

Hopefully this helps answer the questions you raised. If you need further information or have additional questions please do not hesitate to contact me.

Best regards,

Jocelyne Bright | 604-220-1825 | Parsons

**From:** Lachmuth, Cara ENV:EX <Cara.Lachmuth@gov.bc.ca>  
**Sent:** Wednesday, February 22, 2023 8:57 AM  
**To:** Bright, Jocelyne [NN-CA] <Jocelyne.Bright@parsons.com>  
**Subject:** [EXTERNAL] Protocol 4 Application for Site #25812

Good morning Jocelyne,

Thank you for the Protocol 4 Application for background soil concentrations for selenium at Site #25812 in Vernon, B.C. I've been reviewing the application and have the following questions:

- In the Application, I was unable to find a description of the ground cover and vegetation present on the Site. Please provide these details and if there is any obvious damage to vegetation in the reference areas.
- A soil sample included in the calculation of the background soil concentration (BH13 from 3 m depth) was sampled in 1999. Due to changes in laboratory methods since that time, it is unclear if the earlier data is directly comparable to samples collected more recently. Please provide details on the laboratory method of analysis for selenium in this 1999 sample versus the other more recent samples included in the calculation. It is noted that lab reports for soil analysis could not be found in the application.
- While the range of selenium concentrations in the sand stratigraphic layer between 0.9 and 3.8 mbgs is provided in the application, I could not find information on the range of selenium concentrations in other stratigraphic layers (e.g., silt and clay) compared to the sand layer. Please provide a statistical analysis that demonstrates this is a specific layer (i.e., one population) that is high in selenium concentrations (e.g., t-test, box plot). It needs to be clearly demonstrated how the high selenium concentrations at the Site are not hotspots but are native materials (i.e., background concentrations).
- It is unclear if other metals are also elevated in samples with high selenium concentrations. Please provide details on this.
- At the end of Section 7.2 of the application, it is unclear what is meant by "*However, all soil samples are statistically less than the proposed background concentrations as per Technical Guidance 2 and will be addressed under separate cover.*" Please provide additional information to clarify the intent of this sentence.

Once I have the information described above, I can continue my review of the P4 Application.

Warm regards,

Cara

**Cara Lachmuth, MSc, RPBio** (she/her)

Senior Risk Assessment Officer

Land Remediation Section

Ministry of Environment and Climate Change Strategy

[cara.lachmuth@gov.bc.ca](mailto:cara.lachmuth@gov.bc.ca)

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**SOIL ANALYTICAL RESULTS  
SELENIUM IN THE SILTY CLAY LAYER**

<b>SAMPLE LOCATIONS</b>	<b>BH30</b>	<b>BH66</b>	<b>BH67</b>	<b>BH69</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
Lab Sample ID	XW7679	ZW0113	ZW0468	ZW0120	Commercial Land Use
Sample Depth (mbgs)	3.5-3.8	4.0	4.3	3.7	
Date Sampled (yyyy/mm/dd)	2020/06/05	2021/05/20	2021/05/21	2021/05/20	
<b>PARAMETERS</b>					
Selenium	<0.5	<0.5	<0.5	0.81	1 <sup>S3</sup>

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results for all parameters reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

**TABLE 1**  
**SOIL ANALYTICAL RESULTS**  
**Background Selenium Concentrations and 95th Percentile Concentration**

Sample ID	Sample Depth (m)	Selenium Concentration (µg/g)	Stratigraphic Unit
BH29	0.6	1.40	Silt, some sand
BH30	0.9	6.40	Sand, trace silt, trace gravel
BH30	1.8	6.10	Sand, trace silt, trace gravel
BH30	2.4	3.30	Sand, gravelly, trace silt, trace gravel
BH31	0.9	1.60	Silt, some sand, trace gravel
BH33	0.6	0.72	Sand, trace gravel
BH35	0.9	1.20	Silt, sandy, trace gravel
BH39	1.2	0.50	Sand
BH44	0.9	28.00	Sand, silty
BH44	1.5-2.3	17.00	Sand, some silt, trace gravel
BH44	3.0-3.8	8.60	Sand, some silt, trace gravel
BH45	1.5-2.3	1.20	Sand, some silt
BH47	0.9	0.50	Sand, some silt
BH47	1.5-2.3	0.86	Sand, some gravel
BH47	2.3-3.0	1.40	Sand
BH55	0.9	0.50	Sand, some cobbles, some gravel
BH55	1.8	4.10	Sand, gravelly
BH58	0.9	5.30	Sand, trace cobbles, trace silt
BH58	1.8	5.00	Sand, trace silt
BH67	0.9	14.00	Sand, trace silt
BH67	1.8	4.50	Sand, trace cobbles, trace silt
BH67	3.0	7.40	Sand, some gravel, some cobbles
BH67	3.7	3.90	Sand, some gravel, some cobbles
BH68	0.9	18.00	Sand
BH70	0.9	0.63	Sand, trace silt
TH32	0.9	1.80	Sand, some gravel, trace silt

<b>Minimum Concentration (ug/g)</b>	<b>0.50</b>
<b>Maximum Concentration (ug/g)</b>	<b>28.0</b>
<b>Mean Concentration (ug/g)</b>	<b>5.54</b>
<b>Median Concentration (ug/g)</b>	<b>3.60</b>
<b>95th Percentile Concentration (ug/g)</b>	<b>17.8</b>

## Notes:

1. Duplicate samples with lowest concentrations were used
2. Concentrations <0.5 ug/g were entered as 0.5 ug/g



# BOREHOLE LOG

PROJECT: Environmental Site Assessment	REF. NO: 10-582	BOREHOLE NO: BH51
LOCATION: 2804 35 Avenue, Vernon, British Columbia	TPC ELEV.: 384.270 masl	START DATE: 2021/05/18
CLIENT: Imperial Oil Limited	GRADE ELEV.: 384.34 masl	COMPLETION DATE: 2021/05/20
BENCHMARK: Geodetic Control Monument 205898 ELEV: 399.408 masl	PAGE 1 of 1	

Depth (m)	STRATIGRAPHY DESCRIPTION	MATERIAL TYPE	SAMPLING				▲ SOIL VAPOUR CONCENTRATION (ppmv) 100 200 300 400	◆ SOIL VAPOUR CONCENTRATION (%LEL) 20 40 60 80	COMMENTS AND MONITORING WELL NOTES	MONITORING WELL	Depth (ft)
			NUMBER	SAMPLE TYPE	'N' VALUE	RECOVERY %					
0	SAND - brown, damp  - some gravel to 0.6 m    - some silt between 0.6 m and 1.2 m	SAND	1	G	-	-	▲				
1			2	G	-	-	▲				
	- some cobbles, some gravel, trace silt, moist below 1.2 m										
2	GRAVEL - brown, wet  - some cobbles, some sand to 2.4 m	GRAVEL	3	G	-	-	▲				
			4	G	-	-	▲				
	- gray, sandy, trace cobbles below 2.4 m										
3			5	SS	-	50	▲				
	- petroleum odour between 3.0 m and 3.7 m										
			6	SS	-	50	▲				
4	END OF HOLE AT 4.0 m		7	SS	-	50	▲				
5											

Potentiometric Depth on 2021/07/05

Monitoring Well installed to 4.0 m, 50 mm Dia. PVC Pipe, screened from 1.2 m to 4.0 m.

**PARSONS**

LOGGED BY: SC	DAYLIGHTING TO: 2.4 m	GAS METER TYPE: RKI Eagle
REVIEWED BY: ICL	EQUIPMENT: Hydro-Excavator/Track Mounted Auger	
DRAFTED BY: LAM	METHOD: Hydrovac/Hollow Stem Auger	BOREHOLE DIA.: 0.20 m

# BOREHOLE LOG

PROJECT: Environmental Site Assessment	REF. NO: 10-582	BOREHOLE NO: <b>BH52</b>
LOCATION: 2804 35 Avenue, Vernon, British Columbia	TPC ELEV.: 384.104 masl	START DATE: 2021/05/18
CLIENT: Imperial Oil Limited	GRADE ELEV.: 384.20 masl	COMPLETION DATE: 2021/05/20
BENCHMARK: Geodetic Control Monument 205898 ELEV: 399.408 masl	PAGE 1 of 1	

Depth (m)	STRATIGRAPHY DESCRIPTION	MATERIAL TYPE	SAMPLING				▲ SOIL VAPOUR CONCENTRATION (ppmv) 100 200 300 400	◆ SOIL VAPOUR CONCENTRATION (%LEL) 20 40 60 80	COMMENTS AND MONITORING WELL NOTES	MONITORING WELL	Depth (ft)
			NUMBER	SAMPLE TYPE	'N' VALUE	RECOVERY %					
0	SAND - brown, some silt, trace cobbles, damp										
	- gravelly below 0.6 m		1	G	-	-	▲				
			2	G	-	-	▲				
-1			3	G	-	-	▲				
	GRAVEL - brown, some sand, moist										
	- some silt to 1.8 m										
			4	G	-	-	▲				
	- cobbles between 1.8 m and 2.4 m										
	- sandy, wet below 1.8 m										
-2			5	G	-	-	▲				
	- trace cobbles below 2.4 m										
			6	SS	-	50	▲				10
-3											
	CLAY - brown, gray, silty, wet		7	SS	-	50	▲				
-4	END OF HOLE AT 4.0 m		8	SS	-	50	▲				
											15
5											

Potentiometric Depth on 2021/07/05

Monitoring Well installed to 4.0 m, 50 mm Dia. PVC Pipe, screened from 1.2 m to 4.0 m.

## PARSONS

LOGGED BY: DSP  
REVIEWED BY: ICL  
DRAFTED BY: LAM

DAYLIGHTING TO: 2.4 m

EQUIPMENT: Hydro-Excavator/Track Mounted Auger

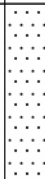
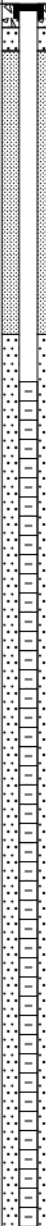


METHOD: Hydrovac/Hollow Stem Auger


GAS METER TYPE: RKI Eagle

BOREHOLE DIA.: 0.20 m

# BOREHOLE LOG

PROJECT: Environmental Site Assessment					REF. NO: 10-582					BOREHOLE NO: BH53				
LOCATION: 2804 35 Avenue, Vernon, British Columbia					TPC ELEV.: 383.991 masl					START DATE: 2021/05/18				
CLIENT: Imperial Oil Limited					GRADE ELEV.: 384.07 masl					COMPLETION DATE: 2021/05/20				
BENCHMARK: Geodetic Control Monument 205898 ELEV: 399.408 masl										PAGE 1 of 1				

Depth (m)	STRATIGRAPHY DESCRIPTION	MATERIAL TYPE	SAMPLING				▲ SOIL VAPOUR CONCENTRATION (ppmv)				◆ SOIL VAPOUR CONCENTRATION (%LEL)				COMMENTS AND MONITORING WELL NOTES	MONITORING WELL	Depth (ft)
			NUMBER	SAMPLE TYPE	'N' VALUE	RECOVERY %	SAMPLE NAME/ LAB ANALYSES										
0	SAND - brown, damp  - silty to 0.6 m															5	
	- gravelly, some cobbles, some silt, moist between 0.6 m and 1.8 m		1	G	-	-											
			2	G	-	-											
	- gravelly, silty, trace cobbles, wet, petroleum odour below 1.8 m		3	G	-	-	BH53-1.8m/BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE										
	GRAVEL - gray, sandy, trace cobbles, wet		4	G	-	-	BH53-2.4m/BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE										
			5	SS	-	50	BH53-3.0m/BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE										
	- petroleum odour at 3.0 m		6	SS	-	50											
	CLAY - brown, gray, silty, wet		7	SS	-	50	BH53-4.0m/BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE										
	END OF HOLE AT 4.0 m																
5																	



LOGGED BY: DSP

REVIEWED BY: ICL

DRAFTED BY: LAM

DAYLIGHTING TO: 2.4 m

EQUIPMENT: Hydro-Excavator/Track Mounted Auger

METHOD: Hydrovac/Hollow Stem Auger

GAS METER TYPE: RKI Eagle

BOREHOLE DIA.: 0.20 m

# BOREHOLE LOG

PROJECT: Environmental Site Assessment	REF. NO: 10-582	BOREHOLE NO: <b>BH72</b>
LOCATION: 2804 35 Avenue, Vernon, British Columbia	TPC ELEV.: 384.805 masl	START DATE: 2021/05/20
CLIENT: Imperial Oil Limited	GRADE ELEV.: 384.86 masl	COMPLETION DATE: 2021/05/20
BENCHMARK: Geodetic Control Monument 205898 ELEV: 399.408 masl	PAGE 1 of 1	

Depth (m)	STRATIGRAPHY DESCRIPTION	MATERIAL TYPE	SAMPLING				▲ SOIL VAPOUR CONCENTRATION (ppmv)	◆ SOIL VAPOUR CONCENTRATION (%LEL)	COMMENTS AND MONITORING WELL NOTES	MONITORING WELL	Depth (ft)
			NUMBER	SAMPLE TYPE	'N' VALUE	RECOVERY %					
0	SAND - brown - trace silt, damp to 1.2 m		1	G	-	-					
1	- moist between 1.2 m and 2.4 m		2	G	-	-					
2			3	G	-	-					
3	- wet below 2.4 m		4	G	-	-			Potentiometric Depth on 2021/07/05		
			5	SS	-	80					
	GRAVEL - gray, sandy, trace cobbles, wet		6	SS	-	80			Monitoring Well installed to 3.7 m, 25 mm Dia. PVC Pipe, screened from 1.5 m to 3.7 m.		
	END OF HOLE AT 3.7 m										
4											
5											
6											
7											
8											
9											
10											

**PARSONS**

LOGGED BY: SC/DSP

REVIEWED BY: ICL

DRAFTED BY: DJ

DAYLIGHTING TO: 2.4 m

EQUIPMENT: Hydro-Excavator/Track Mounted Auger

METHOD: Hydrovac/Hollow Stem Auger

GAS METER TYPE: RKI Eagle

BOREHOLE DIA.: 0.20 m

# BOREHOLE LOG

PROJECT: Environmental Site Assessment	REF. NO: 10-582	BOREHOLE NO: <b>BH78</b>
LOCATION: 2804 35 Avenue, Vernon, British Columbia	TPC ELEV.: 383.940 masl	START DATE: 2021/11/02
CLIENT: Imperial Oil Limited	GRADE ELEV.: 384.04 masl	COMPLETION DATE: 2021/11/03
BENCHMARK: Geodetic Control Monument 205898 ELEV: 399.408 masl	PAGE 1 of 1	

Depth (m)	STRATIGRAPHY DESCRIPTION	MATERIAL TYPE	SAMPLING				SAMPLE NAME/ LAB ANALYSES	▲ SOIL VAPOUR CONCENTRATION (ppmv)				◆ SOIL VAPOUR CONCENTRATION (%LEL)				COMMENTS AND MONITORING WELL NOTES	MONITORING WELL	Depth (ft)
			NUMBER	SAMPLE TYPE	'N' VALUE	RECOVERY %		100	200	300	400	20	40	60	80			
0	SAND - brown, damp - trace gravel to 1.2 m - some silt to 2.4 m		1	G	-	-												
1			2	G	-	-												
2	- gravelly between 1.2 m and 2.4 m - trace cobbles below 1.2 m		3	G	-	-												
			4	G	-	-												
	- some gravel, wet below 2.4 m		5	G	-	-												
3			6	G	-	-												
			7	G	-	-												
4			8	G	-	-												
5			9	G	-	-												
6			10	G	-	-	BH78-6.1 m/BTEX, VPHs, LEPHs, PAHs, MTBE											
7	END OF HOLE AT 7.0 m		11	G	-	-	BH78-7.0 m/BTEX, VPHs, LEPHs, PAHs, MTBE											
8																		
9																		
10																		

Potentiometric Depth on 2022/01/20

Monitoring Well installed to 7.0 m, 50 mm Dia. PVC Pipe, screened from 5.5 m to 7.0 m.

**PARSONS**

LOGGED BY: LMH  
REVIEWED BY: ICL  
DRAFTED BY: DJ

DAYLIGHTING TO: 2.4 m

EQUIPMENT: Hydro-Excavator/Truck Mounted Auger

METHOD: Hydrovac/Solid Stem Auger

GAS METER TYPE: RKI Eagle

BOREHOLE DIA.: 0.20 m

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH27</b>	<b>BH27 Duplicate</b>	<b>BH29</b>	<b>BH29 Duplicate</b>	<b>BH29</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>XV4945</b>	<b>XV4946</b>	<b>XV4947</b>	<b>XV4948</b>	<b>XV4949</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>2.4</b>	<b>2.4</b>	<b>0.6</b>	<b>0.6</b>	<b>1.8</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/05/27</b>	<b>2020/05/27</b>	<b>2020/05/27</b>	<b>2020/05/27</b>	<b>2020/05/27</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	14000	14000	-	25000 <sup>S1</sup>
Antimony	-	-	0.19	0.19	-	40 <sup>S2</sup>
Arsenic	5.4	2.1	3.1	3.2	1.6	10 <sup>S7</sup>
Barium	130	100	120	130	130	1500 <sup>S4</sup>
Beryllium	0.70	0.44	0.43	0.45	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	4.4	5.3	-	50000 <sup>S1</sup>
Cadmium	-	-	0.73	0.81	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	47	33	35	34	33	60 <sup>S7</sup>
Cobalt	-	-	9.8	11	-	25 <sup>S3</sup>
Copper	46	29	31	32	25	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	22000	22000	-	150000 <sup>S1</sup>
Lead	12	7.2	6.8	7.1	5.9	150 <sup>S6</sup>
Lithium	-	-	18	17	-	450 <sup>S1</sup>
Manganese	-	-	400	410	-	2000 <sup>S4</sup>
Mercury	-	-	<0.05	<0.05	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	1.3	1.4	-	150 <sup>S4</sup>
Nickel	-	-	29	31	-	90-250 <sup>pH,S4,S7</sup>
Selenium	-	-	1.4	1.6	-	4 <sup>*</sup>
Silver	-	-	0.24	0.27	-	40 <sup>S2</sup>
Sodium	-	-	230	240	-	NS
Strontium	-	-	48	52	-	150000 <sup>S1</sup>
Thallium	-	-	0.18	0.18	-	25 <sup>S2</sup>
Tin	-	-	0.39	0.45	-	300 <sup>S2</sup>
Tungsten	-	-	<0.5	<0.5	-	200 <sup>S1</sup>
Uranium	-	-	1.4	1.6	-	150 <sup>S3</sup>
Vanadium	-	-	44	45	-	300 <sup>S4</sup>
Zinc	83	61	80	85	55	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	2.1	2.3	-	NS
Sodium Ion (Soluble Sodium)	-	-	17	26	-	1000 <sup>S4</sup>
Soluble pH	8.2	8.5	8.4	8.3	8.2	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH30	BH30	BH30 Duplicate	BH30	BH30	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	XV4976	XV4950	XV4951	XV4977	XW7679	Commercial Land Use
Sample Depth (mbgs)	0.9	1.8	1.8	2.4	3.5-3.8	
Date Sampled (yyyy/mm/dd)	2020/05/27	2020/05/27	2020/05/27	2020/05/27	2020/06/05	
PARAMETERS						
Aluminum	17000	-	-	-	-	25000 <sup>S1</sup>
Antimony	0.22	-	-	-	-	40 <sup>S2</sup>
Arsenic	2.8	-	-	-	-	10 <sup>S7</sup>
Barium	190	-	-	-	-	1500 <sup>S4</sup>
Beryllium	0.55	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	21	-	-	-	-	50000 <sup>S1</sup>
Cadmium	0.50	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	44	-	-	-	-	60 <sup>S7</sup>
Cobalt	11	-	-	-	-	25 <sup>S3</sup>
Copper	29	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	24000	-	-	-	-	150000 <sup>S1</sup>
Lead	12	7.6	8.1	16	16	150 <sup>S6</sup>
Lithium	20	-	-	-	-	450 <sup>S1</sup>
Manganese	300	-	-	-	-	2000 <sup>S4</sup>
Mercury	<0.05	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	1.3	-	-	-	-	150 <sup>S4</sup>
Nickel	31	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<b>6.4</b>	<b>6.1</b>	<b>6.1</b>	3.3	<0.5	4*
Silver	0.22	-	-	-	-	40 <sup>S2</sup>
Sodium	250	-	-	-	-	NS
Strontium	120	-	-	-	110	150000 <sup>S1</sup>
Thallium	0.18	-	-	-	-	25 <sup>S2</sup>
Tin	0.80	-	-	-	-	300 <sup>S2</sup>
Tungsten	<0.5	-	-	-	-	200 <sup>S1</sup>
Uranium	3.5	-	-	-	-	150 <sup>S3</sup>
Vanadium	49	-	-	-	-	300 <sup>S4</sup>
Zinc	71	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	4.3	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	19	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.9	4.7	4.6	7.7	8.6	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH31	BH31	BH31	BH32	BH32 Duplicate	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	XV4978	XV4952	XW7721	XW7725	XW7726	Commercial Land Use
Sample Depth (mbgs)	0.9	2.4	2.9-3.2	2.4	2.4	
Date Sampled (yyyy/mm/dd)	2020/05/27	2020/05/27	2020/06/04	2020/06/02	2020/06/02	
PARAMETERS						
Aluminum	23000	-	-	-	-	25000 <sup>S1</sup>
Antimony	0.53	-	-	-	-	40 <sup>S2</sup>
Arsenic	4.6	2.0	-	-	-	10 <sup>S7</sup>
Barium	210	120	-	-	-	1500 <sup>S4</sup>
Beryllium	0.76	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	6.0	-	-	-	-	50000 <sup>S1</sup>
Cadmium	0.63	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	55	44	-	-	-	60 <sup>S7</sup>
Cobalt	17	-	-	-	-	25 <sup>S3</sup>
Copper	46	43	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	35000	-	-	-	-	150000 <sup>S1</sup>
Lead	21	9.2	17	7.1	8.3	150 <sup>S6</sup>
Lithium	26	-	-	-	-	450 <sup>S1</sup>
Manganese	560	-	-	-	-	2000 <sup>S4</sup>
Mercury	<0.05	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	1.1	-	-	-	-	150 <sup>S4</sup>
Nickel	47	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	1.6	-	-	-	-	4*
Silver	0.23	-	-	-	-	40 <sup>S2</sup>
Sodium	330	-	-	-	-	NS
Strontium	130	-	-	-	-	150000 <sup>S1</sup>
Thallium	0.26	-	-	-	-	25 <sup>S2</sup>
Tin	1.7	-	-	-	-	300 <sup>S2</sup>
Tungsten	<0.5	-	-	-	-	200 <sup>S1</sup>
Uranium	1.7	-	-	-	-	150 <sup>S3</sup>
Vanadium	63	-	-	-	-	300 <sup>S4</sup>
Zinc	110	87	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	6.7	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	18	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	8.6	7.5	7.9	8.6	8.5	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH32</b>	<b>BH32</b>	<b>BH33</b>	<b>BH33</b>	<b>BH33</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>XW7724</b>	<b>XW7723</b>	<b>XV4954</b>	<b>XV4956</b>	<b>XW7727</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>3.0-3.5</b>	<b>3.5-3.8</b>	<b>0.6</b>	<b>2.4</b>	<b>2.7-3.2</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/06/02</b>	<b>2020/06/02</b>	<b>2020/05/26</b>	<b>2020/05/26</b>	<b>2020/06/02</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	14000	-	-	250000 <sup>S1</sup>
Antimony	-	-	0.33	-	-	40 <sup>S2</sup>
Arsenic	-	-	3.7	-	-	10 <sup>S7</sup>
Barium	-	-	110	-	-	1500 <sup>S4</sup>
Beryllium	-	-	0.45	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	7.5	-	-	50000 <sup>S1</sup>
Cadmium	-	-	0.60	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	34	-	-	60 <sup>S7</sup>
Cobalt	-	-	10	-	-	25 <sup>S3</sup>
Copper	-	-	37	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	23000	-	-	150000 <sup>S1</sup>
Lead	4.6	4.6	16	13	4.3	150 <sup>S6</sup>
Lithium	-	-	17	-	-	450 <sup>S1</sup>
Manganese	-	-	430	-	-	2000 <sup>S4</sup>
Mercury	-	-	<0.05	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	1.3	-	-	150 <sup>S4</sup>
Nickel	-	-	31	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	-	-	0.72	-	-	4*
Silver	-	-	0.33	-	-	40 <sup>S2</sup>
Sodium	-	-	210	-	-	NS
Strontium	-	-	44	-	-	150000 <sup>S1</sup>
Thallium	-	-	0.18	-	-	25 <sup>S2</sup>
Tin	-	-	0.95	-	-	300 <sup>S2</sup>
Tungsten	-	-	<0.5	-	-	200 <sup>S1</sup>
Uranium	-	-	0.85	-	-	150 <sup>S3</sup>
Vanadium	-	-	46	-	-	300 <sup>S4</sup>
Zinc	-	-	86	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	3.6	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	13	-	-	1000 <sup>S4</sup>
Soluble pH	8.7	8.7	8.2	7.7	8.3	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH34<sup>c</sup></b>	<b>BH34</b>	<b>BH35</b>	<b>BH35</b>	<b>BH38</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>XV4957</b>	<b>XV4959</b>	<b>XV4960</b>	<b>XV4961</b>	<b>XW7756</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>0.9</b>	<b>2.4</b>	<b>0.9</b>	<b>1.8</b>	<b>1.8</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/05/26</b>	<b>2020/05/26</b>	<b>2020/05/26</b>	<b>2020/05/26</b>	<b>2020/06/01</b>	
<b>PARAMETERS</b>						
Aluminum	13000	-	16000	-	6500	250000 <sup>S1</sup>
Antimony	0.52	-	0.24	-	0.16	40 <sup>S2</sup>
Arsenic	3.5	-	3.9	-	2.8	10 <sup>S7</sup>
Barium	130	-	150	-	37	1500 <sup>S4</sup>
Beryllium	0.40	-	0.54	-	<0.2	1-350 <sup>pH,S4,S7</sup>
Boron	14	-	6.6	-	3.5	50000 <sup>S1</sup>
Cadmium	1.3	-	1.1	-	0.084	1-50 <sup>pH,S7</sup>
Chromium (Total)	37	-	41	-	20	60 <sup>S7</sup>
Cobalt	8.4	-	12	-	3.1	25 <sup>S3</sup>
Copper	28	-	40	-	12	75-300 <sup>pH,S4,S7</sup>
Iron	20000	-	27000	-	12000	150000 <sup>S1</sup>
Lead	61	7.0	17	6.1	12	150 <sup>S6</sup>
Lithium	15	-	21	-	9.8	450 <sup>S1</sup>
Manganese	320	-	300	-	97	2000 <sup>S4</sup>
Mercury	<0.05	-	<0.05	-	<0.05	75 <sup>S4,S6</sup>
Molybdenum	1.3	-	1.4	-	16	150 <sup>S4</sup>
Nickel	25	-	34	-	9.5	90-250 <sup>pH,S4,S7</sup>
Selenium	<b>9.6</b>	2.4	1.2	-	3.8	4*
Silver	0.16	-	0.38	-	0.1	40 <sup>S2</sup>
Sodium	220	-	250	3		NS
Strontium	76	-	130	-	180	150000 <sup>S1</sup>
Thallium	0.15	-	0.19	-	19	25 <sup>S2</sup>
Tin	11	-	1.4	-	0.1	300 <sup>S2</sup>
Tungsten	<0.5	-	0.56	1		200 <sup>S1</sup>
Uranium	2.6	-	1.2	-	0.2	150 <sup>S3</sup>
Vanadium	36	-	58	4	27	300 <sup>S4</sup>
Zinc	140	-	110	5	24	150-450 <sup>pH,S4,S7</sup>
Zirconium	4.4	-	2.5	-	1.1	NS
Sodium Ion (Soluble Sodium)	24	-	13	-	21	1000 <sup>S4</sup>
Soluble pH	7.5	7.1	8.1	7.6	3.2	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS**  
**SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH39</b>	<b>BH41</b>	<b>BH44<sup>c</sup></b>	<b>BH44</b>	<b>BH44</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>XW7758</b>	<b>YQ0292</b>	<b>YP9966</b>	<b>YQ0894</b>	<b>YQ0896</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>1.2</b>	<b>2.4</b>	<b>0.9</b>	<b>1.5-2.3</b>	<b>3.0-3.8</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/06/01</b>	<b>2020/10/07</b>	<b>2020/10/06</b>	<b>2020/10/07</b>	<b>2020/10/07</b>	
<b>PARAMETERS</b>						
Aluminum	8500	-	-	-	-	250000 <sup>S1</sup>
Antimony	0.10	-	-	-	-	40 <sup>S2</sup>
Arsenic	2.3	-	-	-	-	10 <sup>S7</sup>
Barium	48	-	-	-	-	1500 <sup>S4</sup>
Beryllium	0.22	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	7.9	-	-	-	-	50000 <sup>S1</sup>
Cadmium	0.24	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	23	-	-	-	-	60 <sup>S7</sup>
Cobalt	6.5	-	-	-	-	25 <sup>S3</sup>
Copper	16	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	17000	-	-	-	-	150000 <sup>S1</sup>
Lead	14	-	-	-	-	150 <sup>S6</sup>
Lithium	13	-	-	-	-	450 <sup>S1</sup>
Manganese	150	-	-	-	-	2000 <sup>S4</sup>
Mercury	<0.05	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	1.1	-	2.3	3.5	-	150 <sup>S4</sup>
Nickel	20	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<0.5	-	<b>28</b>	<b>17</b>	<b>8.6</b>	4*
Silver	0.17	-	-	-	-	40 <sup>S2</sup>
Sodium	170	-	-	-	-	NS
Strontium	27	44	-	58	30	150000 <sup>S1</sup>
Thallium	0.12	-	-	-	-	25 <sup>S2</sup>
Tin	0.28	-	-	-	-	300 <sup>S2</sup>
Tungsten	<0.5	-	-	-	-	200 <sup>S1</sup>
Uranium	0.74	-	-	-	-	150 <sup>S3</sup>
Vanadium	34	-	-	-	-	300 <sup>S4</sup>
Zinc	43	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	0.75	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	19	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	8.7	-	7.7	7.1	7.6	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH45<sup>c</sup></b>	<b>BH45</b>	<b>BH47</b>	<b>BH47</b>	<b>BH47<sup>c</sup></b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>YQ0891</b>	<b>YQ0893</b>	<b>YP9968</b>	<b>YQ0213</b>	<b>YQ0214</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>1.5-2.3</b>	<b>3.0-3.8</b>	<b>0.9</b>	<b>1.5-2.3</b>	<b>2.3-3.0</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/10/07</b>	<b>2020/10/07</b>	<b>2020/10/06</b>	<b>2020/10/08</b>	<b>2020/10/08</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	5.2	-	0.60	3.8	2.9	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	1.2	3	<0.5	0.86	1.4	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	42	22	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7	7.8	8.1	7	8.3	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

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\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH50<sup>c</sup></b>	<b>BH50</b>	<b>BH55</b>	<b>BH55</b>	<b>BH57</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>YQ0211</b>	<b>YQ0212</b>	<b>ZV5850</b>	<b>ZV5851</b>	<b>ZV5852</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>2.3-3.0</b>	<b>3.0-3.8</b>	<b>0.9</b>	<b>1.8</b>	<b>0.9</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/10/07</b>	<b>2020/10/07</b>	<b>2021/05/18</b>	<b>2021/05/18</b>	<b>2021/05/18</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	-	-	-	250000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	-	-	<0.5	<b>4.1</b>	4.0	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	47	120	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.4	8.4	8.4	4.6	7.7	NS

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pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH57 Duplicate	BH57	BH58	BH58	BH60	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	ZV5853	ZV5854	ZV5855	ZV5856	ZV5857	Commercial Land Use
Sample Depth (mbgs)	0.9	1.8	0.9	1.8	0.9	
Date Sampled (yyyy/mm/dd)	2021/05/18	2021/05/18	2021/05/18	2021/05/18	2021/05/18	
PARAMETERS						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	3.5	<b>4.3</b>	<b>5.3</b>	<b>5.0</b>	<b>11</b>	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.8	7.3	7.9	3.8	7.7	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

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**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH60	BH63	BH63	BH63	BH63 Duplicate	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	ZV5858	ZW0421	ZW0425	ZW0423	ZW0427	Commercial Land Use
Sample Depth (mbgs)	1.8	2.4	3.0	4.0	4.0	
Date Sampled (yyyy/mm/dd)	2021/05/18	2021/05/19	2021/05/19	2021/05/19	2021/05/19	
PARAMETERS						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	7.5	4.9	22	22	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<b>4.1</b>	-	-	-	-	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.1	8.2	8.1	8.1	8.3	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH64</b>	<b>BH64</b>	<b>BH66</b>	<b>BH66</b>	<b>BH66<sup>c</sup></b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>ZW0422</b>	<b>ZW0426</b>	<b>ZV5859</b>	<b>ZW0111</b>	<b>ZW0112</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>2.3-3.0</b>	<b>4.0</b>	<b>0.9</b>	<b>1.8</b>	<b>2.4</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2021/05/19</b>	<b>2021/05/19</b>	<b>2021/05/19</b>	<b>2021/05/20</b>	<b>2021/05/20</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	-	-	-	250000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	10	19	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	-	-	<b>6.8</b>	3.5	<b>5.4</b>	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.7	8.1	7.6	7.9	7.5	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH66	BH67	BH67 Duplicate	BH67	BH67	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	ZW0113	ZV5860	ZV5861	ZW0465	ZW0466	Commercial Land Use
Sample Depth (mbgs)	4.0	0.9	0.9	1.8	3.0	
Date Sampled (yyyy/mm/dd)	2021/05/20	2021/05/19	2021/05/19	2021/05/21	2021/05/21	
PARAMETERS						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<0.5	<b>14</b>	<b>15</b>	<b>4.5</b>	<b>7.4</b>	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	8.3	7.1	7	7.1	7.7	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH67	BH67	BH68	BH69 <sup>c</sup>	BH69 <sup>c</sup> Duplicate	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	ZW0467	ZW0468	ZV5862	ZW0114	ZW0115	Commercial Land Use
Sample Depth (mbgs)	3.7	4.3	0.9	0.9	0.9	
Date Sampled (yyyy/mm/dd)	2021/05/21	2021/05/21	2021/05/19	2021/05/19	2021/05/19	
PARAMETERS						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	3.9	<0.5	<b>18</b>	<b>6.4</b>	<b>5.9</b>	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.5	8.1	6.8	7.7	7.6	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH69</b>	<b>BH69<sup>c</sup></b>	<b>BH69</b>	<b>BH69 Duplicate</b>	<b>BH69</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>ZW0116</b>	<b>ZW0117</b>	<b>ZW0118</b>	<b>ZW0119</b>	<b>ZW0120</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>1.8</b>	<b>2.4</b>	<b>3.0</b>	<b>3.0</b>	<b>3.7</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2021/05/20</b>	<b>2021/05/20</b>	<b>2021/05/20</b>	<b>2021/05/20</b>	<b>2021/05/20</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<b>6.5</b>	<b>6.5</b>	<b>4.9</b>	<b>7.3</b>	0.81	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.3	6.7	7.9	7.8	8	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH70</b>	<b>TH32</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>ZW0430</b>	<b>YP9910</b>	
<b>Sample Depth (mbgs)</b>	<b>0.9</b>	<b>0.9</b>	<b>Commercial Land Use</b>
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2021/05/20</b>	<b>2020/10/06</b>	
<b>PARAMETERS</b>			
Aluminum	-	-	250000 <sup>S1</sup>
Antimony	-	-	40 <sup>S2</sup>
Arsenic	-	-	10 <sup>S7</sup>
Barium	-	-	1500 <sup>S4</sup>
Beryllium	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	50000 <sup>S1</sup>
Cadmium	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	60 <sup>S7</sup>
Cobalt	-	-	25 <sup>S3</sup>
Copper	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	150000 <sup>S1</sup>
Lead	-	-	150 <sup>S6</sup>
Lithium	-	-	450 <sup>S1</sup>
Manganese	-	-	2000 <sup>S4</sup>
Mercury	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	1.0	150 <sup>S4</sup>
Nickel	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	0.63	1.8	4*
Silver	-	-	40 <sup>S2</sup>
Sodium	-	-	NS
Strontium	-	-	150000 <sup>S1</sup>
Thallium	-	-	25 <sup>S2</sup>
Tin	-	-	300 <sup>S2</sup>
Tungsten	-	-	200 <sup>S1</sup>
Uranium	-	-	150 <sup>S3</sup>
Vanadium	-	-	300 <sup>S4</sup>
Zinc	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	1000 <sup>S4</sup>
Soluble pH	8.3	8.2	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

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mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard



**From:** Lachmuth, Cara ENV:EX (Cara.Lachmuth@gov.bc.ca)  
**To:** Love, Sydney ENV:EX (Sydney.Love@gov.bc.ca)  
**Subject:** Protocol 4 Application for Site #25812  
**Sent:** 02/07/2023 22:03:07  
**Message Body:**

Hi Sydney,

Below, I've drafted an email to send to Isabel Londono at Parsons Inc. regarding questions I have on the P4 application. If you don't mind taking a quick look before I send it off, I would really appreciate it!

Thank you,

Cara

[Isabel.londono@parsons.com](mailto:Isabel.londono@parsons.com)

Hi Isabel,

Thank you for the Protocol 4 Application for background soil concentrations for selenium at Site #25812 in Vernon, B.C. I've reviewed the application and have the following questions:

- In the Application, I was unable to find a description of the ground cover and vegetation present on the Site. Please provide these details and if there is any obvious damage to vegetation in the reference areas.
- A soil sample included in the calculation of the background soil concentration (BH13 from 3 m depth) was sampled in 1999. Due to changes in laboratory methods since that time, it is unclear if the earlier data is directly comparable to samples collected more recently. Please provide details on the laboratory's methods of analysis for selenium in this 1999 sample versus the other more recent samples included in the calculation. It is noted that lab reports for soil analysis could not be found in the application.
- While the range of selenium concentrations in the sand stratigraphic layer between 0.9 and 3.8 mbgs is provided in the application, I could not find information on the range of selenium concentrations in other stratigraphic layers (e.g., silt and clay) compared to the sand layer. Please provide a statistical analysis that demonstrates this is a specific layer (i.e., one population) that is high in selenium concentrations (e.g., t-test, box plot). It needs to be clearly demonstrated how the high selenium concentrations at the Site are not hotspots but are native materials (i.e., background concentrations).
- It is unclear if other metals are also elevated in samples with high selenium concentrations. Please provide details on this.
- At the end of Section 7.2 of the application, it is unclear what is meant by "*However, all soil samples are statistically less than the proposed background concentrations as per Technical Guidance 2 and will be addressed under separate cover.*" Please provide additional information to clarify the intent of this sentence.

Once I have the information described above, I can finalize my review of the P4 Application.

Warm regards,

Cara

**Cara Lachmuth, MSc, RPBio** (she/her)

Senior Risk Assessment Officer

Land Remediation Section

Ministry of Environment and Climate Change Strategy

[cara.lachmuth@gov.bc.ca](mailto:cara.lachmuth@gov.bc.ca)

*I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples (Esquimalt and Songhees Nations) and the Metis Nation of Greater Victoria.*

**From:** Lachmuth, Cara ENV:EX (Cara.Lachmuth@gov.bc.ca)  
**To:** Love, Sydney ENV:EX (Sydney.Love@gov.bc.ca)  
**Subject:** RE: P4 questions for you  
**Sent:** 02/15/2023 23:32:24  
**Message Body:**

Thanks, Sydney! The site # is 20753 (Jasen is the SDM).

**From:** Love, Sydney ENV:EX <Sydney.Love@gov.bc.ca>  
**Sent:** Wednesday, February 15, 2023 3:28 PM  
**To:** Lachmuth, Cara ENV:EX <Cara.Lachmuth@gov.bc.ca>  
**Subject:** RE: P4 questions for you

Hi Cara,

Yes that's not too surprising. Sometimes we'll get an acknowledgement email but not always. If you don't hear back in a couple of weeks, I'd follow back up (just a friendly, "hi, just checking if you got my previous email?" type thing).

Unfortunately there isn't a better quality image. Can you send me the site number, I'll do some sleuthing and see if I can figure it out.

Thanks,

Sydney

**From:** Lachmuth, Cara ENV:EX <[Cara.Lachmuth@gov.bc.ca](mailto:Cara.Lachmuth@gov.bc.ca)>  
**Sent:** Wednesday, February 15, 2023 3:06 PM  
**To:** Love, Sydney ENV:EX <[Sydney.Love@gov.bc.ca](mailto:Sydney.Love@gov.bc.ca)>  
**Subject:** P4 questions for you

Hi Sydney,

Last week on Feb. 8<sup>th</sup> I emailed the consultant with questions on the P4 for Site #25812 and I still haven't heard back from them. Is that normal? Just wondering how frequently you recommend I follow up with them. Also, I noticed Figure 1 (boundaries to determine regional background concentrations in soil) provided in P4 is low resolution and I'm wondering if there's a way to figure out which region a site is in that's more accurate? For example, my next assigned P4 review is in Lillooet but I cannot tell if that's in Region #2 or #3 from Figure 1.

Thank you,

Cara

**From:** Lachmuth, Cara ENV:EX (Cara.Lachmuth@gov.bc.ca)  
**To:** Fisher, Jody L ENV:EX (Jody.Fisher@gov.bc.ca)  
**Subject:** FW: 2023-02-01 Reassignment - Site ID 25812 - App ID 13218  
**Sent:** 04/18/2023 21:56:09  
**Message Body:**

Hi Jody,

Please find this this P4 application's technical memo and letter for your final review on the LAN here:

[Q:\EPD\EMB\General\CS Program\Sites\25812\P4 App 13218\2023-04-18 DRAFT\\_Site 25812-P4 Tech Memo.docx](Q:\EPD\EMB\General\CS Program\Sites\25812\P4 App 13218\2023-04-18 DRAFT_Site 25812-P4 Tech Memo.docx)

[Q:\EPD\EMB\General\CS Program\Sites\25812\P4 App 13218\2023-04-18 DRAFT\\_Site 25812-P4 Approval Letter for SDM.docx](Q:\EPD\EMB\General\CS Program\Sites\25812\P4 App 13218\2023-04-18 DRAFT_Site 25812-P4 Approval Letter for SDM.docx)

As discussed in the P4 meeting today, they are not required to produce statistics comparing concentrations to other stratigraphic units, and despite not having included statistics, I think the evidence provided for the layer is sufficient. Please let me know if you have any questions.

Thank you,  
Cara

**From:** Fisher, Jody L ENV:EX (Jody.Fisher@gov.bc.ca)  
**To:** Lachmuth, Cara ENV:EX (Cara.Lachmuth@gov.bc.ca)  
**Subject:** RE: 2023-02-01 Reassignment - Site ID 25812 - App ID 13218  
**Sent:** 05/04/2023 20:41:59  
**Message Body:**

Great, thanks Cara.

I've added a couple of edits to the [SDM letter](#) prior to finalizing. I thought that I'd run it by you to see if it makes sense from your perspective. If it does, I can sign this off this week. If not maybe we should have a mtg. with another P4 SDM.

I've attached an example that Sydney finalized before **s.22**

Let me know what you think.

*Jody*

**From:** Lachmuth, Cara ENV:EX <[Cara.Lachmuth@gov.bc.ca](mailto:Cara.Lachmuth@gov.bc.ca)>  
**Sent:** Wednesday, May 3, 2023 5:30 PM  
**To:** Fisher, Jody L ENV:EX <[Jody.Fisher@gov.bc.ca](mailto:Jody.Fisher@gov.bc.ca)>  
**Subject:** RE: 2023-02-01 Reassignment - Site ID 25812 - App ID 13218

Hi Jody,

Thanks for the review and the questions. I've provided responses in red text below.

Thanks,  
Cara

**From:** Fisher, Jody L ENV:EX <[Jody.Fisher@gov.bc.ca](mailto:Jody.Fisher@gov.bc.ca)>  
**Sent:** Wednesday, May 3, 2023 7:17 AM  
**To:** Lachmuth, Cara ENV:EX <[Cara.Lachmuth@gov.bc.ca](mailto:Cara.Lachmuth@gov.bc.ca)>  
**Subject:** RE: 2023-02-01 Reassignment - Site ID 25812 - App ID 13218

Hi Cara,

I've had a chance to review this technical memo and I have a few questions.

1. Clustered elevated Se in two distinct areas, near AEC#2 former UST of unknown use & AEC#1 near the pump house. Are other metals elevated at these locations? Any pattern here? The consultant provided additional info on this (see Table 3 attached), which shows that other metals sampled in these locations are below CSR standards; however, not all samples were analyzed for the entire suite of metals.
2. Why were the Se conc. from the silt clay layer excluded from the stats? Were these high Se conc.? The silt clay layer (~4.6 to 12.8 mbg) was excluded as it is below the sand stratigraphic layer (0.9 to 3.8 mbg), which is the layer they are seeking a background Se value for. They did not mix data from the different layers in the background calculation and limited the background calculation to the Se data from the sand layer. The consultant provided additional info on Se concentrations in the deeper silt clay layer (see Table 2 attached); the silt samples that were analyzed for Se were less than the CSR standard.
3. What layer do they hope to apply the standard to? To the sand stratigraphic layer, between 0.9 and 3.8 mbg. Sorry if that wasn't clear!
4. Question #4 response – additional metal data. Did you check these data to see if other metals

were elevated at the highest Se locations? Yes, I checked the metal data they provided and only selenium exceeded the CSR standards; however, not all samples were analyzed for the entire suite of metals.

5. Pg.12 technical memo – spelling ‘wit’ to ‘with’. Corrected, thanks for catching that.
6. Please consider these questions and book a meeting if you think it’s best to have a discussion. If the above makes sense to you and you don’t have any further questions, then I think we are good. But please let me know if you would like to discuss any of this.

Cheers,

*Jody*

**From:** Lachmuth, Cara ENV:EX <[Cara.Lachmuth@gov.bc.ca](mailto:Cara.Lachmuth@gov.bc.ca)>  
**Sent:** Tuesday, April 18, 2023 3:56 PM  
**To:** Fisher, Jody L ENV:EX <[Jody.Fisher@gov.bc.ca](mailto:Jody.Fisher@gov.bc.ca)>  
**Subject:** FW: 2023-02-01 Reassignment - Site ID 25812 - App ID 13218

Hi Jody,

Please find this this P4 application’s technical memo and letter for your final review on the LAN here:

<Q:\EPD\EMB\General\CS Program\Sites\25812\P4 App 13218\2023-04-18 DRAFT Site 25812-P4 Tech Memo.docx>

<Q:\EPD\EMB\General\CS Program\Sites\25812\P4 App 13218\2023-04-18 DRAFT Site 25812-P4 Approval Letter for SDM.docx>

As discussed in the P4 meeting today, they are not required to produce statistics comparing concentrations to other stratigraphic units, and despite not having included statistics, I think the evidence provided for the layer is sufficient. Please let me know if you have any questions.

Thank you,  
Cara

**From:** CSP Client Info ENV:EX (csp\_cio@Victoria1.gov.bc.ca)  
**To:** Isabel.Londono@parsons.com  
**Cc:** Jocelyne.Bright@parsons.com  
**Subject:** RE: New Parsons Contact - Site ID 25812, Application ID 13218 (Our job # 10-582)  
**Sent:** 07/21/2022 20:35:51  
**Attachments:** image001.jpg, image003.jpg  
**Message Body:**

Hello Isabel,

Thank you for the notification, I have updated the P4 application file with Jocelyn's contact information.

All the best,

**Julianna Louth** (*pronouns: she/her*)

**Contaminated Sites Services Analyst**

**For the Client Information Officer Inbox**

Ministry of Environment and Climate Change Strategy

Email: csp\_cio@Victoria1.gov.bc.ca | Visit the **NEW** [Apply for Services Webpage](#)

**From:** Isabel.Londono@parsons.com <Isabel.Londono@parsons.com>

**Sent:** July 20, 2022 10:19 AM

**To:** CSP Client Info ENV:EX <csp\_cio@Victoria1.gov.bc.ca>

**Cc:** Jocelyne.Bright@parsons.com

**Subject:** New Parsons Contact - Site ID 25812, Application ID 13218 (Our job # 10-582)

**[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.**

Sensitive

Good morning,

Please note that as of August 12, 2022<sup>s.22</sup> so please contact Jocelyne Bright for matters related to site ID 25812, including Application ID 13218 - Protocol 4 for the property located at 2804 - 35 Avenue in Vernon, British Columbia. Jocelyne's contact information is as follows:

Jocelyne Bright, P.Eng.  
#100, 9347 200A Street, Langley, BC V1M 0B3  
jocelyne.bright@parsons.com  
P: 604-220-1825

Thank you.

Isabel Londono, M.A.Sc., P.Eng.

100-9347 200A Street, Langley, BC, V1M 0B3  
isabel.londono@parsons.com - P: 604-513.1009  
PARSONS

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**From:** Lachmuth, Cara ENV:EX (Cara.Lachmuth@gov.bc.ca)  
**To:** Fisher, Jody L ENV:EX (Jody.Fisher@gov.bc.ca)  
**Subject:** RE: 2023-02-01 Reassignment - Site ID 25812 - App ID 13218  
**Sent:** 05/03/2023 23:29:54  
**Attachments:** Table 3 Soil Analytical Results - Selected Metals.pdf, Table 2 Soil Analytical Results - Selenium in the Silty Clay Layer.pdf  
**Message Body:**

Hi Jody,

Thanks for the review and the questions. I've provided responses in red text below.

Thanks,

Cara

**From:** Fisher, Jody L ENV:EX <Jody.Fisher@gov.bc.ca>  
**Sent:** Wednesday, May 3, 2023 7:17 AM  
**To:** Lachmuth, Cara ENV:EX <Cara.Lachmuth@gov.bc.ca>  
**Subject:** RE: 2023-02-01 Reassignment - Site ID 25812 - App ID 13218

Hi Cara,

I've had a chance to review this technical memo and I have a few questions.

1. Clustered elevated Se in two distinct areas, near AEC#2 former UST of unknown use & AEC#1 near the pump house. Are other metals elevated at these locations? Any pattern here? The consultant provided additional info on this (see Table 3 attached), which shows that other metals sampled in these locations are below CSR standards; however, not all samples were analyzed for the entire suite of metals.
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3. What layer do they hope to apply the standard to? To the sand stratigraphic layer, between 0.9 and 3.8 mbg. Sorry if that wasn't clear!

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5. Pg.12 technical memo – spelling 'wit' to 'with'. Corrected, thanks for catching that.
6. Please consider these questions and book a meeting if you think it's best to have a discussion. If the above makes sense to you and you don't have any further questions, then I think we are good. But please let me know if you would like to discuss any of this.

Cheers,

*Jody*

**From:** Lachmuth, Cara ENV:EX <[Cara.Lachmuth@gov.bc.ca](mailto:Cara.Lachmuth@gov.bc.ca)>  
**Sent:** Tuesday, April 18, 2023 3:56 PM  
**To:** Fisher, Jody L ENV:EX <[Jody.Fisher@gov.bc.ca](mailto:Jody.Fisher@gov.bc.ca)>  
**Subject:** FW: 2023-02-01 Reassignment - Site ID 25812 - App ID 13218

Hi Jody,

Please find this this P4 application's technical memo and letter for your final review on the LAN here:

[Q:\EPD\EMB\General\CS Program\Sites\25812\P4 App 13218\2023-04-18 DRAFT\\_Site 25812-P4 Tech Memo.docx](#)

[Q:\EPD\EMB\General\CS Program\Sites\25812\P4 App 13218\2023-04-18 DRAFT\\_Site 25812-P4 Approval Letter for SDM.docx](#)

As discussed in the P4 meeting today, they are not required to produce statistics comparing concentrations to other stratigraphic units, and despite not having included statistics, I think the evidence provided for the layer is sufficient. Please let me know if

you have any questions.

Thank you,

Cara

**From:** CSP Client Info ENV:EX <[csp\\_cio@Victoria1.gov.bc.ca](mailto:csp_cio@Victoria1.gov.bc.ca)>  
**Sent:** Wednesday, February 1, 2023 3:01 PM  
**To:** Lachmuth, Cara ENV:EX <[Cara.Lachmuth@gov.bc.ca](mailto:Cara.Lachmuth@gov.bc.ca)>  
**Cc:** Osachoff, Heather ENV:EX <[Heather.Osachoff@gov.bc.ca](mailto:Heather.Osachoff@gov.bc.ca)>; Nelson, Jasen ENV:EX <[Jasen.Nelson@gov.bc.ca](mailto:Jasen.Nelson@gov.bc.ca)>; Love, Sydney ENV:EX <[Sydney.Love@gov.bc.ca](mailto:Sydney.Love@gov.bc.ca)>; Yan, Peter ENV:EX <[Peter.Yan@gov.bc.ca](mailto:Peter.Yan@gov.bc.ca)>; Szefer, George A. ENV:EX <[George.Szefer@gov.bc.ca](mailto:George.Szefer@gov.bc.ca)>  
**Subject:** 2023-02-01 Reassignment - Site ID 25812 - App ID 13218

Hello Cara

This application has been reassigned for review of the P4 below. Jasen Nelson was the previous Caseworker. Sydney is still the SDM.

**Site ID**

**CATS Appl. No.**

**Site Address**

**Date Received**

**Service Requested**

**Casefile Reviewer**

**SDM**

**Site Risk**

**Link**

25812

13218

2804 - 35 AVENUE, VERNON, BC

2022-06-14

P4

**Cara**

**Sydney**

non high risk

See Notes in CATS

Gayla Andrews (*pronouns: she/her*)

for Client Information Officer

**Environmental Emergencies & Land Remediation Branch**

Ministry of Environment and Climate Change Strategy

525 Superior St., Victoria, BC V8V 0C5

[csp\\_cio@Victoria1.gov.bc.ca](mailto:csp_cio@Victoria1.gov.bc.ca)

**SOIL ANALYTICAL RESULTS**  
**SELENIUM IN THE SILTY CLAY LAYER**

<b>SAMPLE LOCATIONS</b>	<b>BH30</b>	<b>BH66</b>	<b>BH67</b>	<b>BH69</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
Lab Sample ID	XW7679	ZW0113	ZW0468	ZW0120	Commercial Land Use
Sample Depth (mbgs)	3.5-3.8	4.0	4.3	3.7	
Date Sampled (yyyy/mm/dd)	2020/06/05	2021/05/20	2021/05/21	2021/05/20	
<b>PARAMETERS</b>					
Selenium	<0.5	<0.5	<0.5	0.81	1 <sup>S3</sup>

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results for all parameters reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH27</b>	<b>BH27 Duplicate</b>	<b>BH29</b>	<b>BH29 Duplicate</b>	<b>BH29</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>XV4945</b>	<b>XV4946</b>	<b>XV4947</b>	<b>XV4948</b>	<b>XV4949</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>2.4</b>	<b>2.4</b>	<b>0.6</b>	<b>0.6</b>	<b>1.8</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/05/27</b>	<b>2020/05/27</b>	<b>2020/05/27</b>	<b>2020/05/27</b>	<b>2020/05/27</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	14000	14000	-	25000 <sup>S1</sup>
Antimony	-	-	0.19	0.19	-	40 <sup>S2</sup>
Arsenic	5.4	2.1	3.1	3.2	1.6	10 <sup>S7</sup>
Barium	130	100	120	130	130	1500 <sup>S4</sup>
Beryllium	0.70	0.44	0.43	0.45	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	4.4	5.3	-	50000 <sup>S1</sup>
Cadmium	-	-	0.73	0.81	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	47	33	35	34	33	60 <sup>S7</sup>
Cobalt	-	-	9.8	11	-	25 <sup>S3</sup>
Copper	46	29	31	32	25	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	22000	22000	-	150000 <sup>S1</sup>
Lead	12	7.2	6.8	7.1	5.9	150 <sup>S6</sup>
Lithium	-	-	18	17	-	450 <sup>S1</sup>
Manganese	-	-	400	410	-	2000 <sup>S4</sup>
Mercury	-	-	<0.05	<0.05	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	1.3	1.4	-	150 <sup>S4</sup>
Nickel	-	-	29	31	-	90-250 <sup>pH,S4,S7</sup>
Selenium	-	-	1.4	1.6	-	4 <sup>*</sup>
Silver	-	-	0.24	0.27	-	40 <sup>S2</sup>
Sodium	-	-	230	240	-	NS
Strontium	-	-	48	52	-	150000 <sup>S1</sup>
Thallium	-	-	0.18	0.18	-	25 <sup>S2</sup>
Tin	-	-	0.39	0.45	-	300 <sup>S2</sup>
Tungsten	-	-	<0.5	<0.5	-	200 <sup>S1</sup>
Uranium	-	-	1.4	1.6	-	150 <sup>S3</sup>
Vanadium	-	-	44	45	-	300 <sup>S4</sup>
Zinc	83	61	80	85	55	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	2.1	2.3	-	NS
Sodium Ion (Soluble Sodium)	-	-	17	26	-	1000 <sup>S4</sup>
Soluble pH	8.2	8.5	8.4	8.3	8.2	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH30	BH30	BH30 Duplicate	BH30	BH30	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	XV4976	XV4950	XV4951	XV4977	XW7679	Commercial Land Use
Sample Depth (mbgs)	0.9	1.8	1.8	2.4	3.5-3.8	
Date Sampled (yyyy/mm/dd)	2020/05/27	2020/05/27	2020/05/27	2020/05/27	2020/06/05	
PARAMETERS						
Aluminum	17000	-	-	-	-	25000 <sup>S1</sup>
Antimony	0.22	-	-	-	-	40 <sup>S2</sup>
Arsenic	2.8	-	-	-	-	10 <sup>S7</sup>
Barium	190	-	-	-	-	1500 <sup>S4</sup>
Beryllium	0.55	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	21	-	-	-	-	50000 <sup>S1</sup>
Cadmium	0.50	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	44	-	-	-	-	60 <sup>S7</sup>
Cobalt	11	-	-	-	-	25 <sup>S3</sup>
Copper	29	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	24000	-	-	-	-	150000 <sup>S1</sup>
Lead	12	7.6	8.1	16	16	150 <sup>S6</sup>
Lithium	20	-	-	-	-	450 <sup>S1</sup>
Manganese	300	-	-	-	-	2000 <sup>S4</sup>
Mercury	<0.05	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	1.3	-	-	-	-	150 <sup>S4</sup>
Nickel	31	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<b>6.4</b>	<b>6.1</b>	<b>6.1</b>	3.3	<0.5	4*
Silver	0.22	-	-	-	-	40 <sup>S2</sup>
Sodium	250	-	-	-	-	NS
Strontium	120	-	-	-	110	150000 <sup>S1</sup>
Thallium	0.18	-	-	-	-	25 <sup>S2</sup>
Tin	0.80	-	-	-	-	300 <sup>S2</sup>
Tungsten	<0.5	-	-	-	-	200 <sup>S1</sup>
Uranium	3.5	-	-	-	-	150 <sup>S3</sup>
Vanadium	49	-	-	-	-	300 <sup>S4</sup>
Zinc	71	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	4.3	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	19	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.9	4.7	4.6	7.7	8.6	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH31	BH31	BH31	BH32	BH32 Duplicate	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	XV4978	XV4952	XW7721	XW7725	XW7726	Commercial Land Use
Sample Depth (mbgs)	0.9	2.4	2.9-3.2	2.4	2.4	
Date Sampled (yyyy/mm/dd)	2020/05/27	2020/05/27	2020/06/04	2020/06/02	2020/06/02	
PARAMETERS						
Aluminum	23000	-	-	-	-	25000 <sup>S1</sup>
Antimony	0.53	-	-	-	-	40 <sup>S2</sup>
Arsenic	4.6	2.0	-	-	-	10 <sup>S7</sup>
Barium	210	120	-	-	-	1500 <sup>S4</sup>
Beryllium	0.76	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	6.0	-	-	-	-	50000 <sup>S1</sup>
Cadmium	0.63	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	55	44	-	-	-	60 <sup>S7</sup>
Cobalt	17	-	-	-	-	25 <sup>S3</sup>
Copper	46	43	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	35000	-	-	-	-	150000 <sup>S1</sup>
Lead	21	9.2	17	7.1	8.3	150 <sup>S6</sup>
Lithium	26	-	-	-	-	450 <sup>S1</sup>
Manganese	560	-	-	-	-	2000 <sup>S4</sup>
Mercury	<0.05	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	1.1	-	-	-	-	150 <sup>S4</sup>
Nickel	47	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	1.6	-	-	-	-	4*
Silver	0.23	-	-	-	-	40 <sup>S2</sup>
Sodium	330	-	-	-	-	NS
Strontium	130	-	-	-	-	150000 <sup>S1</sup>
Thallium	0.26	-	-	-	-	25 <sup>S2</sup>
Tin	1.7	-	-	-	-	300 <sup>S2</sup>
Tungsten	<0.5	-	-	-	-	200 <sup>S1</sup>
Uranium	1.7	-	-	-	-	150 <sup>S3</sup>
Vanadium	63	-	-	-	-	300 <sup>S4</sup>
Zinc	110	87	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	6.7	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	18	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	8.6	7.5	7.9	8.6	8.5	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH32</b>	<b>BH32</b>	<b>BH33</b>	<b>BH33</b>	<b>BH33</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>XW7724</b>	<b>XW7723</b>	<b>XV4954</b>	<b>XV4956</b>	<b>XW7727</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>3.0-3.5</b>	<b>3.5-3.8</b>	<b>0.6</b>	<b>2.4</b>	<b>2.7-3.2</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/06/02</b>	<b>2020/06/02</b>	<b>2020/05/26</b>	<b>2020/05/26</b>	<b>2020/06/02</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	14000	-	-	250000 <sup>S1</sup>
Antimony	-	-	0.33	-	-	40 <sup>S2</sup>
Arsenic	-	-	3.7	-	-	10 <sup>S7</sup>
Barium	-	-	110	-	-	1500 <sup>S4</sup>
Beryllium	-	-	0.45	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	7.5	-	-	50000 <sup>S1</sup>
Cadmium	-	-	0.60	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	34	-	-	60 <sup>S7</sup>
Cobalt	-	-	10	-	-	25 <sup>S3</sup>
Copper	-	-	37	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	23000	-	-	150000 <sup>S1</sup>
Lead	4.6	4.6	16	13	4.3	150 <sup>S6</sup>
Lithium	-	-	17	-	-	450 <sup>S1</sup>
Manganese	-	-	430	-	-	2000 <sup>S4</sup>
Mercury	-	-	<0.05	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	1.3	-	-	150 <sup>S4</sup>
Nickel	-	-	31	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	-	-	0.72	-	-	4*
Silver	-	-	0.33	-	-	40 <sup>S2</sup>
Sodium	-	-	210	-	-	NS
Strontium	-	-	44	-	-	150000 <sup>S1</sup>
Thallium	-	-	0.18	-	-	25 <sup>S2</sup>
Tin	-	-	0.95	-	-	300 <sup>S2</sup>
Tungsten	-	-	<0.5	-	-	200 <sup>S1</sup>
Uranium	-	-	0.85	-	-	150 <sup>S3</sup>
Vanadium	-	-	46	-	-	300 <sup>S4</sup>
Zinc	-	-	86	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	3.6	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	13	-	-	1000 <sup>S4</sup>
Soluble pH	8.7	8.7	8.2	7.7	8.3	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

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**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH34<sup>c</sup></b>	<b>BH34</b>	<b>BH35</b>	<b>BH35</b>	<b>BH38</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>XV4957</b>	<b>XV4959</b>	<b>XV4960</b>	<b>XV4961</b>	<b>XW7756</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>0.9</b>	<b>2.4</b>	<b>0.9</b>	<b>1.8</b>	<b>1.8</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/05/26</b>	<b>2020/05/26</b>	<b>2020/05/26</b>	<b>2020/05/26</b>	<b>2020/06/01</b>	
<b>PARAMETERS</b>						
Aluminum	13000	-	16000	-	6500	250000 <sup>S1</sup>
Antimony	0.52	-	0.24	-	0.16	40 <sup>S2</sup>
Arsenic	3.5	-	3.9	-	2.8	10 <sup>S7</sup>
Barium	130	-	150	-	37	1500 <sup>S4</sup>
Beryllium	0.40	-	0.54	-	<0.2	1-350 <sup>pH,S4,S7</sup>
Boron	14	-	6.6	-	3.5	50000 <sup>S1</sup>
Cadmium	1.3	-	1.1	-	0.084	1-50 <sup>pH,S7</sup>
Chromium (Total)	37	-	41	-	20	60 <sup>S7</sup>
Cobalt	8.4	-	12	-	3.1	25 <sup>S3</sup>
Copper	28	-	40	-	12	75-300 <sup>pH,S4,S7</sup>
Iron	20000	-	27000	-	12000	150000 <sup>S1</sup>
Lead	61	7.0	17	6.1	12	150 <sup>S6</sup>
Lithium	15	-	21	-	9.8	450 <sup>S1</sup>
Manganese	320	-	300	-	97	2000 <sup>S4</sup>
Mercury	<0.05	-	<0.05	-	<0.05	75 <sup>S4,S6</sup>
Molybdenum	1.3	-	1.4	-	16	150 <sup>S4</sup>
Nickel	25	-	34	-	9.5	90-250 <sup>pH,S4,S7</sup>
Selenium	<b>9.6</b>	2.4	1.2	-	3.8	4*
Silver	0.16	-	0.38	-	0.1	40 <sup>S2</sup>
Sodium	220	-	250	3		NS
Strontium	76	-	130	-	180	150000 <sup>S1</sup>
Thallium	0.15	-	0.19	-	19	25 <sup>S2</sup>
Tin	11	-	1.4	-	0.1	300 <sup>S2</sup>
Tungsten	<0.5	-	0.56	1		200 <sup>S1</sup>
Uranium	2.6	-	1.2	-	0.2	150 <sup>S3</sup>
Vanadium	36	-	58	4	27	300 <sup>S4</sup>
Zinc	140	-	110	5	24	150-450 <sup>pH,S4,S7</sup>
Zirconium	4.4	-	2.5	-	1.1	NS
Sodium Ion (Soluble Sodium)	24	-	13	-	21	1000 <sup>S4</sup>
Soluble pH	7.5	7.1	8.1	7.6	3.2	NS

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S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

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**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH39</b>	<b>BH41</b>	<b>BH44<sup>c</sup></b>	<b>BH44</b>	<b>BH44</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>XW7758</b>	<b>YQ0292</b>	<b>YP9966</b>	<b>YQ0894</b>	<b>YQ0896</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>1.2</b>	<b>2.4</b>	<b>0.9</b>	<b>1.5-2.3</b>	<b>3.0-3.8</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/06/01</b>	<b>2020/10/07</b>	<b>2020/10/06</b>	<b>2020/10/07</b>	<b>2020/10/07</b>	
<b>PARAMETERS</b>						
Aluminum	8500	-	-	-	-	250000 <sup>S1</sup>
Antimony	0.10	-	-	-	-	40 <sup>S2</sup>
Arsenic	2.3	-	-	-	-	10 <sup>S7</sup>
Barium	48	-	-	-	-	1500 <sup>S4</sup>
Beryllium	0.22	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	7.9	-	-	-	-	50000 <sup>S1</sup>
Cadmium	0.24	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	23	-	-	-	-	60 <sup>S7</sup>
Cobalt	6.5	-	-	-	-	25 <sup>S3</sup>
Copper	16	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	17000	-	-	-	-	150000 <sup>S1</sup>
Lead	14	-	-	-	-	150 <sup>S6</sup>
Lithium	13	-	-	-	-	450 <sup>S1</sup>
Manganese	150	-	-	-	-	2000 <sup>S4</sup>
Mercury	<0.05	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	1.1	-	2.3	3.5	-	150 <sup>S4</sup>
Nickel	20	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<0.5	-	<b>28</b>	<b>17</b>	<b>8.6</b>	4*
Silver	0.17	-	-	-	-	40 <sup>S2</sup>
Sodium	170	-	-	-	-	NS
Strontium	27	44	-	58	30	150000 <sup>S1</sup>
Thallium	0.12	-	-	-	-	25 <sup>S2</sup>
Tin	0.28	-	-	-	-	300 <sup>S2</sup>
Tungsten	<0.5	-	-	-	-	200 <sup>S1</sup>
Uranium	0.74	-	-	-	-	150 <sup>S3</sup>
Vanadium	34	-	-	-	-	300 <sup>S4</sup>
Zinc	43	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	0.75	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	19	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	8.7	-	7.7	7.1	7.6	NS

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c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

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\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH45<sup>c</sup></b>	<b>BH45</b>	<b>BH47</b>	<b>BH47</b>	<b>BH47<sup>c</sup></b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>YQ0891</b>	<b>YQ0893</b>	<b>YP9968</b>	<b>YQ0213</b>	<b>YQ0214</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>1.5-2.3</b>	<b>3.0-3.8</b>	<b>0.9</b>	<b>1.5-2.3</b>	<b>2.3-3.0</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/10/07</b>	<b>2020/10/07</b>	<b>2020/10/06</b>	<b>2020/10/08</b>	<b>2020/10/08</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	-	-	-	250000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	5.2	-	0.60	3.8	2.9	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	1.2	3	<0.5	0.86	1.4	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	42	22	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7	7.8	8.1	7	8.3	NS

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S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

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**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH50<sup>c</sup></b>	<b>BH50</b>	<b>BH55</b>	<b>BH55</b>	<b>BH57</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>YQ0211</b>	<b>YQ0212</b>	<b>ZV5850</b>	<b>ZV5851</b>	<b>ZV5852</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>2.3-3.0</b>	<b>3.0-3.8</b>	<b>0.9</b>	<b>1.8</b>	<b>0.9</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2020/10/07</b>	<b>2020/10/07</b>	<b>2021/05/18</b>	<b>2021/05/18</b>	<b>2021/05/18</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	-	-	-	250000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	-	-	<0.5	<b>4.1</b>	4.0	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	47	120	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.4	8.4	8.4	4.6	7.7	NS

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S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH57 Duplicate</b>	<b>BH57</b>	<b>BH58</b>	<b>BH58</b>	<b>BH60</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>ZV5853</b>	<b>ZV5854</b>	<b>ZV5855</b>	<b>ZV5856</b>	<b>ZV5857</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>0.9</b>	<b>1.8</b>	<b>0.9</b>	<b>1.8</b>	<b>0.9</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2021/05/18</b>	<b>2021/05/18</b>	<b>2021/05/18</b>	<b>2021/05/18</b>	<b>2021/05/18</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	3.5	<b>4.3</b>	<b>5.3</b>	<b>5.0</b>	<b>11</b>	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.8	7.3	7.9	3.8	7.7	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH60	BH63	BH63	BH63	BH63 Duplicate	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	ZV5858	ZW0421	ZW0425	ZW0423	ZW0427	Commercial Land Use
Sample Depth (mbgs)	1.8	2.4	3.0	4.0	4.0	
Date Sampled (yyyy/mm/dd)	2021/05/18	2021/05/19	2021/05/19	2021/05/19	2021/05/19	
PARAMETERS						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	7.5	4.9	22	22	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<b>4.1</b>	-	-	-	-	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.1	8.2	8.1	8.1	8.3	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH64</b>	<b>BH64</b>	<b>BH66</b>	<b>BH66</b>	<b>BH66<sup>c</sup></b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>ZW0422</b>	<b>ZW0426</b>	<b>ZV5859</b>	<b>ZW0111</b>	<b>ZW0112</b>	<b>Commercial Land Use</b>
<b>Sample Depth (mbgs)</b>	<b>2.3-3.0</b>	<b>4.0</b>	<b>0.9</b>	<b>1.8</b>	<b>2.4</b>	
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2021/05/19</b>	<b>2021/05/19</b>	<b>2021/05/19</b>	<b>2021/05/20</b>	<b>2021/05/20</b>	
<b>PARAMETERS</b>						
Aluminum	-	-	-	-	-	250000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	10	19	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	-	-	<b>6.8</b>	3.5	<b>5.4</b>	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.7	8.1	7.6	7.9	7.5	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH66	BH67	BH67 Duplicate	BH67	BH67	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	ZW0113	ZV5860	ZV5861	ZW0465	ZW0466	Commercial Land Use
Sample Depth (mbgs)	4.0	0.9	0.9	1.8	3.0	
Date Sampled (yyyy/mm/dd)	2021/05/20	2021/05/19	2021/05/19	2021/05/21	2021/05/21	
PARAMETERS						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<0.5	<b>14</b>	<b>15</b>	<b>4.5</b>	<b>7.4</b>	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	8.3	7.1	7	7.1	7.7	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH67	BH67	BH68	BH69 <sup>c</sup>	BH69 <sup>c</sup> Duplicate	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	ZW0467	ZW0468	ZV5862	ZW0114	ZW0115	Commercial Land Use
Sample Depth (mbgs)	3.7	4.3	0.9	0.9	0.9	
Date Sampled (yyyy/mm/dd)	2021/05/21	2021/05/21	2021/05/19	2021/05/19	2021/05/19	
PARAMETERS						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	3.9	<0.5	<b>18</b>	<b>6.4</b>	<b>5.9</b>	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.5	8.1	6.8	7.7	7.6	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

SAMPLE LOCATIONS	BH69	BH69 <sup>c</sup>	BH69	BH69 Duplicate	BH69	APPLICABLE STANDARDS <sup>a</sup>
Lab Sample ID	ZW0116	ZW0117	ZW0118	ZW0119	ZW0120	Commercial Land Use
Sample Depth (mbgs)	1.8	2.4	3.0	3.0	3.7	
Date Sampled (yyyy/mm/dd)	2021/05/20	2021/05/20	2021/05/20	2021/05/20	2021/05/20	
PARAMETERS						
Aluminum	-	-	-	-	-	25000 <sup>S1</sup>
Antimony	-	-	-	-	-	40 <sup>S2</sup>
Arsenic	-	-	-	-	-	10 <sup>S7</sup>
Barium	-	-	-	-	-	1500 <sup>S4</sup>
Beryllium	-	-	-	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	-	-	-	50000 <sup>S1</sup>
Cadmium	-	-	-	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	-	-	-	60 <sup>S7</sup>
Cobalt	-	-	-	-	-	25 <sup>S3</sup>
Copper	-	-	-	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	-	-	-	150000 <sup>S1</sup>
Lead	-	-	-	-	-	150 <sup>S6</sup>
Lithium	-	-	-	-	-	450 <sup>S1</sup>
Manganese	-	-	-	-	-	2000 <sup>S4</sup>
Mercury	-	-	-	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	-	-	-	-	150 <sup>S4</sup>
Nickel	-	-	-	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	<b>6.5</b>	<b>6.5</b>	<b>4.9</b>	<b>7.3</b>	0.81	4*
Silver	-	-	-	-	-	40 <sup>S2</sup>
Sodium	-	-	-	-	-	NS
Strontium	-	-	-	-	-	150000 <sup>S1</sup>
Thallium	-	-	-	-	-	25 <sup>S2</sup>
Tin	-	-	-	-	-	300 <sup>S2</sup>
Tungsten	-	-	-	-	-	200 <sup>S1</sup>
Uranium	-	-	-	-	-	150 <sup>S3</sup>
Vanadium	-	-	-	-	-	300 <sup>S4</sup>
Zinc	-	-	-	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	-	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	-	-	-	1000 <sup>S4</sup>
Soluble pH	7.3	6.7	7.9	7.8	8	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

c - Data accepted with qualifiers. See data quality review form

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

**SOIL ANALYTICAL RESULTS  
SELECTED METALS**

<b>SAMPLE LOCATIONS</b>	<b>BH70</b>	<b>TH32</b>	<b>APPLICABLE STANDARDS<sup>a</sup></b>
<b>Lab Sample ID</b>	<b>ZW0430</b>	<b>YP9910</b>	
<b>Sample Depth (mbgs)</b>	<b>0.9</b>	<b>0.9</b>	<b>Commercial Land Use</b>
<b>Date Sampled (yyyy/mm/dd)</b>	<b>2021/05/20</b>	<b>2020/10/06</b>	
<b>PARAMETERS</b>			
Aluminum	-	-	250000 <sup>S1</sup>
Antimony	-	-	40 <sup>S2</sup>
Arsenic	-	-	10 <sup>S7</sup>
Barium	-	-	1500 <sup>S4</sup>
Beryllium	-	-	1-350 <sup>pH,S4,S7</sup>
Boron	-	-	50000 <sup>S1</sup>
Cadmium	-	-	1-50 <sup>pH,S7</sup>
Chromium (Total)	-	-	60 <sup>S7</sup>
Cobalt	-	-	25 <sup>S3</sup>
Copper	-	-	75-300 <sup>pH,S4,S7</sup>
Iron	-	-	150000 <sup>S1</sup>
Lead	-	-	150 <sup>S6</sup>
Lithium	-	-	450 <sup>S1</sup>
Manganese	-	-	2000 <sup>S4</sup>
Mercury	-	-	75 <sup>S4,S6</sup>
Molybdenum	-	1.0	150 <sup>S4</sup>
Nickel	-	-	90-250 <sup>pH,S4,S7</sup>
Selenium	0.63	1.8	4*
Silver	-	-	40 <sup>S2</sup>
Sodium	-	-	NS
Strontium	-	-	150000 <sup>S1</sup>
Thallium	-	-	25 <sup>S2</sup>
Tin	-	-	300 <sup>S2</sup>
Tungsten	-	-	200 <sup>S1</sup>
Uranium	-	-	150 <sup>S3</sup>
Vanadium	-	-	300 <sup>S4</sup>
Zinc	-	-	150-450 <sup>pH,S4,S7</sup>
Zirconium	-	-	NS
Sodium Ion (Soluble Sodium)	-	-	1000 <sup>S4</sup>
Soluble pH	8.3	8.2	NS

a - Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 179/2021. Most conservative standard of all applicable numeric and matrix-based standards is shown.

pH - pH dependent standard (pH of sample is used to look up applicable standard)

S1 - Generic numerical soil standards to protect human health from Schedule 3.1, Part 2

S2 - Generic numerical soil standards to protect ecological health from Schedule 3.1, Part 3

S3 - Environmental protection standards for groundwater flow to surface water used by aquatic life from Schedule 3.1, Part 1

S4 - Environmental protection standards for toxicity to soil invertebrates and plants from Schedule 3.1, Part 1

S6 - Human health protection standards for intake of contaminated soil from Schedule 3.1, Part 1

S7 - Environmental protection standards for groundwater flow to surface water (freshwater) used by aquatic life from Schedule 3.1, Part 1

"-" - Not analyzed

NS - No standard

mbgs - Metres below ground surface

Results reported in micrograms per gram (µg/g) on a dry weight basis

**BOLD** - Exceeds referenced standard

\* - Protocol 4 Background Standard

April 18, 2023

**To:** Jody Fisher  
Senior Contaminated Sites Officer  
Land Remediation Section, Surrey

SITE No: 25812  
Application No: 13218

**From:** Cara Lachmuth  
Senior Risk Assessment Officer  
Land Remediation Section, Victoria

**Re:** **Protocol 4 Application for Local Background Soil Quality Determination for  
Selenium in Soil at 2804 35<sup>th</sup> Avenue, Vernon, British Columbia**  
**PID: 010-078-134**

## 1.0 Introduction

I have reviewed the Protocol 4 (P4) application for a determination of local background concentrations of selenium in soil, prepared by Parsons Inc. (Parsons) on behalf of Imperial Oil Ltd. (Imperial) for the property located at 2804 35<sup>th</sup> Avenue, Vernon, BC (the Site; Figure 1). The proponent is seeking a background decision under Option 2b of P4.

The application was received on June 14, 2022, and therefore was reviewed using Version 12 of P4. The Site is located in the Okanagan region (Region 8), as defined in P4.

**Figure 1. Site Location**



The following documents were reviewed as part of the subject application:

- *Background Soil Assessment, 2804 35<sup>th</sup> Avenue, Vernon, British Columbia. Location No. 88006343/SAP No. JW.00074.* Prepared for: Imperial Oil Limited. Prepared by: Parsons Inc. Dated May 25, 2022 (herein referred to as “Background Report”).
- *Summary of Site Condition* completed by Imperial Oil Ltd. Signed by Austin Oleksyn. Dated May 30, 2022.
- Email correspondence between Parsons Inc. (Jocelyne Bright) and ENV (Cara Lachmuth), dated March 7, 2023.

The Background Report summarizes the Site background information and rationale for the assertion that concentrations of selenium in soil at the Site are naturally occurring. Key Site description information is presented in Table 1, below.

**Table 1. Site Description**

CIVIC ADDRESS:	2804 - 35th Avenue Vernon, British Columbia
LEGAL DESCRIPTION(s):	Lot 1, Plan 6636, Section 34, Township 9, Osoyoos Division of Yale Land District
PARCEL IDENTIFIER NUMBER(s):	010-078-134
LATITUDE <sup>a</sup> :	50° 16' 1.43"
LONGITUDE <sup>a</sup> :	-119° 16' 8.51"
BC ENV FILE:	Unknown

a - coordinates obtained from Province of British Columbia 1989 TRIM map (82L 024), scale of 1:20 000

## 2.0 Site Background

Parsons provided the following background information for seeking out a P4 applications:

The Site is currently vacant, with all known bulk plant facilities decommissioned and removed (in 1987) and utility services cut and capped at the property lines.

The current and future land use at the Site is expected to be commercial; therefore, the CSR commercial land use (CL) soil standards are considered applicable to the Site. The CSR site-specific soil matrix factors applicable to the Site include the following:

- Human health protection for the intake of contaminated soils;
- Environmental protection for toxicity to soil invertebrates and plants; and
- Environmental protection for groundwater flow to surface water used by freshwater aquatic life.

The applicable CSR soil standards for the Reference Site is the same as the Site, with the same site-specific matrix factors based on the historical and expected commercial use of the Site.

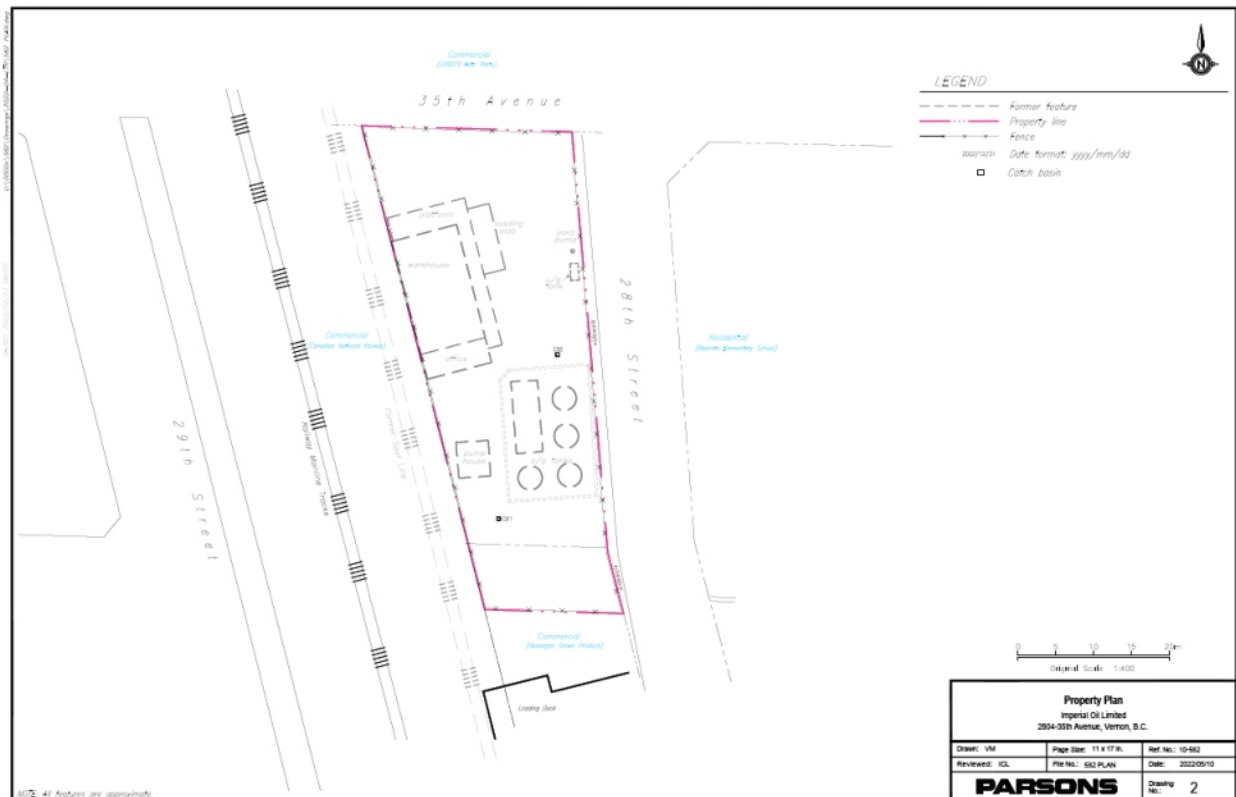
Between 1871 and 1922, the property was historically three separate lots owned by private individuals and companies. Between 1922 and 1945, the property was registered to the Corporation of the City of Vernon. In 1945 and 1947, McColl-Frontenac was listed as the registered owner of the three lots and in 1954, the three lots were amalgamated to reflect the current property. From 1947 to 1987, the property was operated as a bulk plant by McColl-Frontenac and Texaco. Since 1991 the property has been owned by Imperial.

The former facilities (Figure 2) associated with the bulk plant at the Site circa 1947 to 1987 included:

- Aboveground storage tanks of unknown volumes and unknown contents;
- An underground storage tank of unknown volume and unknown content;
- Pump house;
- Yard pump; and
- Warehouse with a loading and unloading area.

Additional fueling facilities may have been present; however, specific details are unknown.

**Figure 2.** Illustration of the former facilities (Property Plan) and surrounding land use at the Site

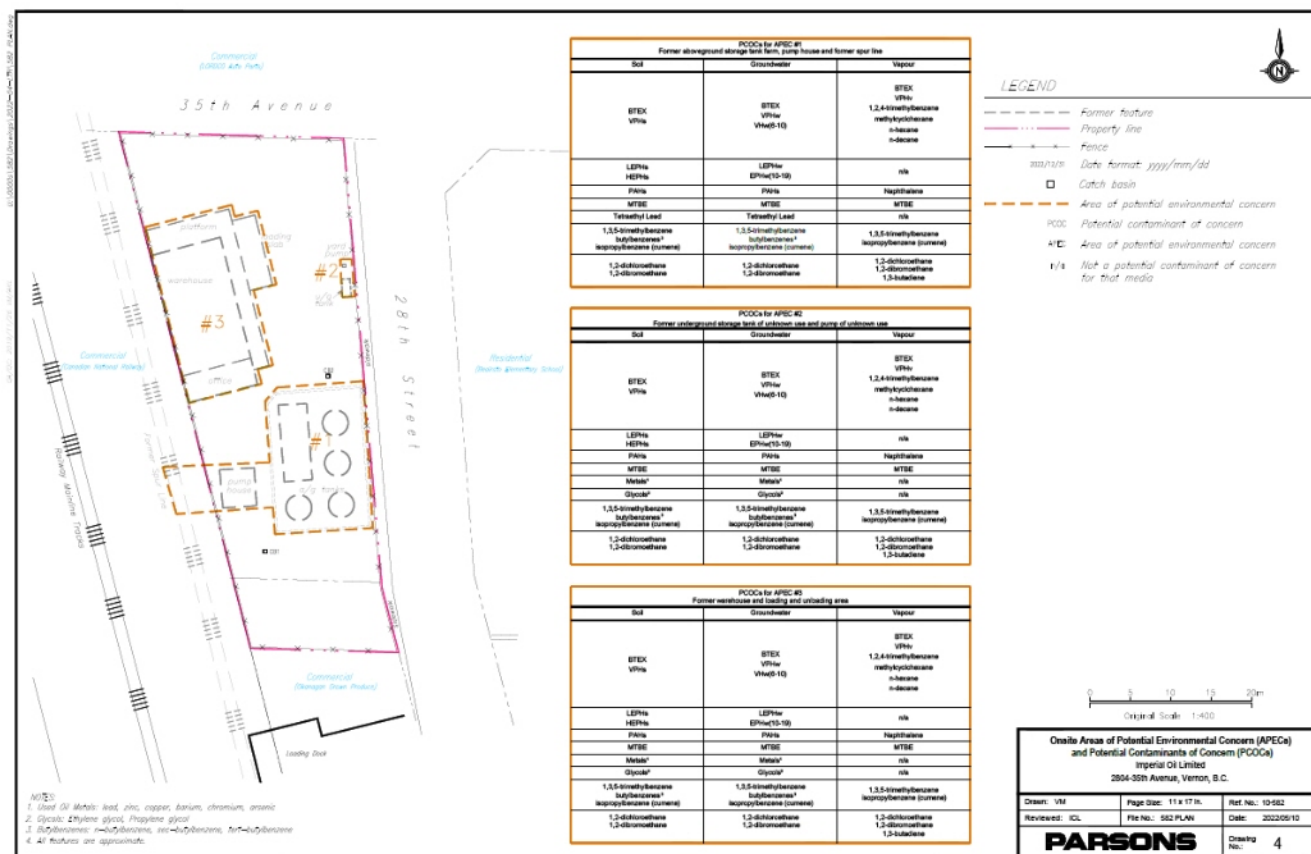


Three onsite Areas of Potential Environmental Concern (APEC) were identified during Site investigations (Figure 3). Selenium was not identified as a potential contaminant of concern (PCOC) in soil, groundwater, or vapour in any of the onsite APECs. The PCOCs in soil, groundwater, and vapour at onsite APECs are shown in Table 2.

**Table 2.** Potential Contaminants of Concern in Onsite Areas of Potential Environmental Concern

Area of Potential Environmental Concern	PCOCs in Soil	PCOCs in Groundwater	PCOCs in Vapour
<b>#1:</b> former aboveground storage tank farm, pump house, and former spur line	BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE, tetraethyl lead, 1,3,5-trimethylbenzene, butylbenzene, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs, MTBE, tetraethyl lead, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, methylcyclohexane, n-hexane, n-decane, naphthalene, 1,3,5-trimethylbenzene, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane, 1,3-butadiene
<b>#2:</b> former underground storage tank of unknown use and pump of unknown use	BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE, metals, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs, MTBE, metals, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, methylcyclohexane, n-hexane, n-decane, naphthalene, MTBE, 1,3,5-trimethylbenzene, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane, 1,3-butadiene
<b>#3:</b> former warehouse and loading and unloading area	BTEX, VPHs, LEPHs, HEPHs, PAHs, MTBE, metals, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs, MTBE, metals, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, methylcyclohexane, n-hexane, n-decane, naphthalene, MTBE, 1,3,5-trimethylbenzene, isopropylbenzene, 1,2-dichloroethane, 1,2-dibromoethane, 1,3-butadiene

**Figure 3.** Three onsite Areas of Potential Environmental Concern at the Site



Confirmed contaminants of concern in soil (other than selenium) at the Site have been delineated and will be addressed via risk assessment. A site-specific numerical soil standard evaluation was completed for toluene and xylenes under Protocol 2. Some contaminants in groundwater have been remediated via biodegradation and natural attenuation.

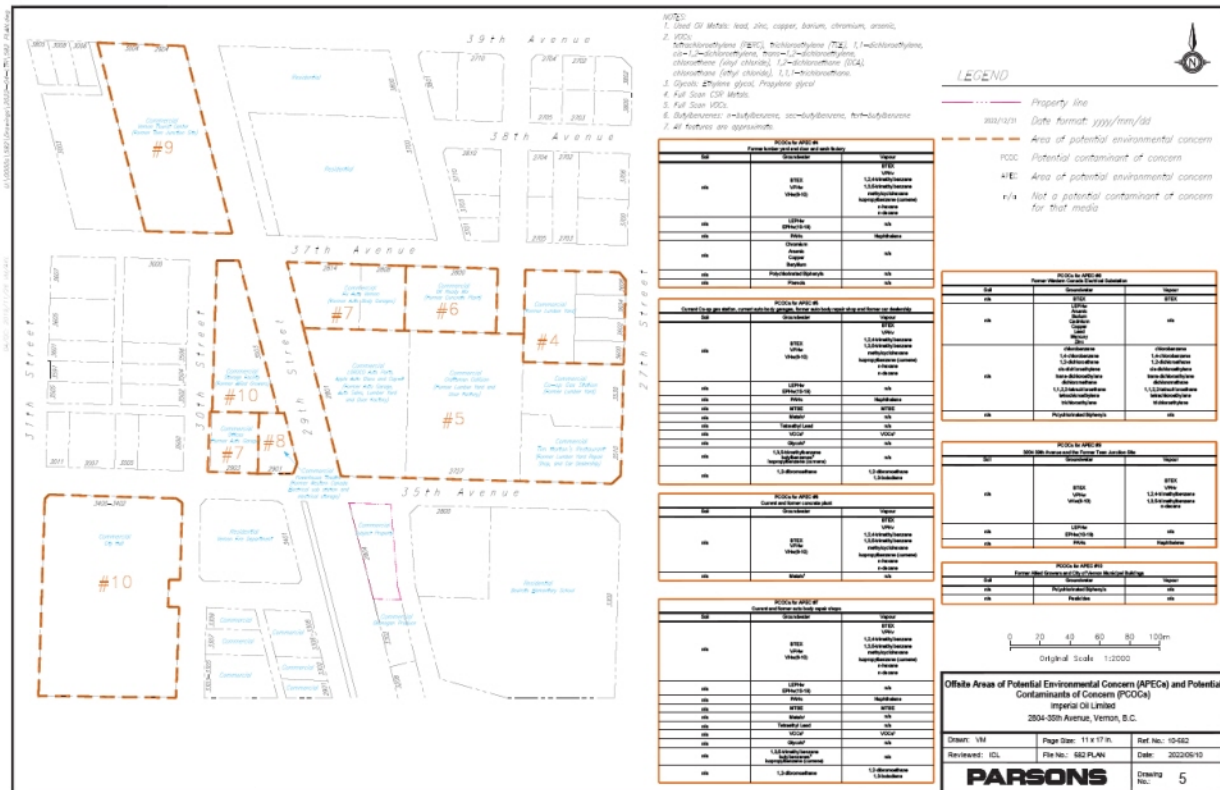
Seven offsite APECs were identified during site investigations (Figure 4). There were no PCOCs identified in soil in any of the offsite APECs. The PCOCs in groundwater and vapour at offsite APECs are shown in Table 3.

**Table 3.** Potential Contaminants of Concern in Offsite Areas of Potential Environmental Concern

Area of Potential Environmental Concern	PCOCs in Soil	PCOCs in Groundwater	PCOCs in Vapour
<b>#4:</b> former lumber yard and door and sash factory	None	BTEX, VPHw, VHW(6-10), LEPHw, EPHw(10-19), PAHs, chromium, arsenic, copper, beryllium, polychlorinated biphenyls, phenols	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, methylcyclohexane, isopropylbenzene, n-hexane, n-decane, naphthalene

<b>#5:</b> current Co-op gas station, current auto body garages, former auto body repair shop, and former car dealership	None	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs, MTBE, metals, tetraethyl lead, VOCs, glycols, 1,3,5-trimethylbenzene, isopropylbenzene, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, methylcyclohexane, isopropylbenzene, n-hexane, n-decane, naphthalene, MTBE, VOCs, 1,2-dibromoethane, 1,3-butadiene
<b>#6:</b> current and former concrete plant	None	BTEX, VPHw, VHw(6-10), metals	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, methylcyclohexane, isopropylbenzene, n-hexane, n-decane
<b>#7:</b> current and former auto body repairs shops	None	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs, MTBE, metals, tetraethyl lead, VOCs, glycols, 1,3,5-trimethylbenzene, butylbenzenes, isopropylbenzene, 1,2-dibromoethane	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, methylcyclohexane, isopropylbenzene, n-hexane, n-decane, naphthalene, MTBE, VOCs, 1,2-dibromoethane, 1,3-butadiene
<b>#8:</b> former Western Canada Electrical Substation	None	BTEX, LEPHw, arsenic, barium, cadmium, copper, lead, mercury, zinc, chlorobenzene, 1,4-chlorobenzene, 1,2-dichloroethane, cis-dichloroethylene, trans-dichloroethylene, dichloromethane, 1,1,2,2-tetrachloroethane, tetrachloroethylene, trichloroethylene, polychlorinated biphenyls	BTEX, chlorobenzene, 1,4-chlorobenzene, 1,2-dichloroethane, cis-dichloroethylene, trans-dichloroethylene, dichloromethane, 1,1,2,2-tetrachloroethane, tetrachloroethylene, trichloroethylene
<b>#9:</b> 3004 39th Avenue and the Former Teen Junction Site	None	BTEX, VPHw, VHw(6-10), LEPHw, EPHw(10-19), PAHs	BTEX, VPHv, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-decane, naphthalene
<b>#10:</b> former Allied Growers and City of Vernon Municipal Buildings	None	polychlorinated biphenyls, pesticides	None

**Figure 4.** Seven offsite Areas of Potential Environmental Concern near the Site



## Stratigraphy, Geology and Hydrogeology

Surficial geology in the vicinity of the Site (Geological Survey of Canada, Surficial Geology, Vernon, British Columbia, Map 1392A, 1974) predominantly consists of Quaternary fan deposits including poorly sorted gravel, sand, silt, and clay. Localized alluvium-fan complex including sand, gravel, silt and much and peat, and lacustrine deposits were documented.

Bedrock geology in the vicinity of the Site (Geological Survey of Canada, Geology, Vernon, British Columbia, Map 1059A, 1960) consists primarily of granitoid gneiss, augen gneiss, mica-sillimanite-garnet schist, quartzite, marble and hornblende gneiss, slate phyllite and limestone associated with the Monashee Group Rocks.

Stratigraphy beneath the Site (observed during intrusive investigations) consists primarily of sand generally observed from grade to approximately 4.6 metres below ground (mbg) overlying silt and clay to approximately 12.8 mbg. Sand was observed between 12.8 and 13.7 mbg (max depth investigated). Bedrock was not encountered.

Historical documentation (aerial photographs and historical plans) showed no evidence of the Site being built up with imported material of unknown origin.

The Site is generally flat and unpaved, with precipitation expected to infiltrate into the subsurface. The nearest surface water bodies to the Site include:

- BX Creek, approximately 530 m to the west/northwest of the Site; and
- Vernon Creek, approximately 820 m to the south/southwest of the Site.

Groundwater flow direction is expected to be to the south/southwest toward Vernon Creek. The average depth to the groundwater surface at the Site is approximately 2.2 mbg. There are four water wells (two up-gradient and two down-gradient of the Site) and no points of diversion located within a 500 m radius of the Site. None of the four wells are used as a drinking water source.

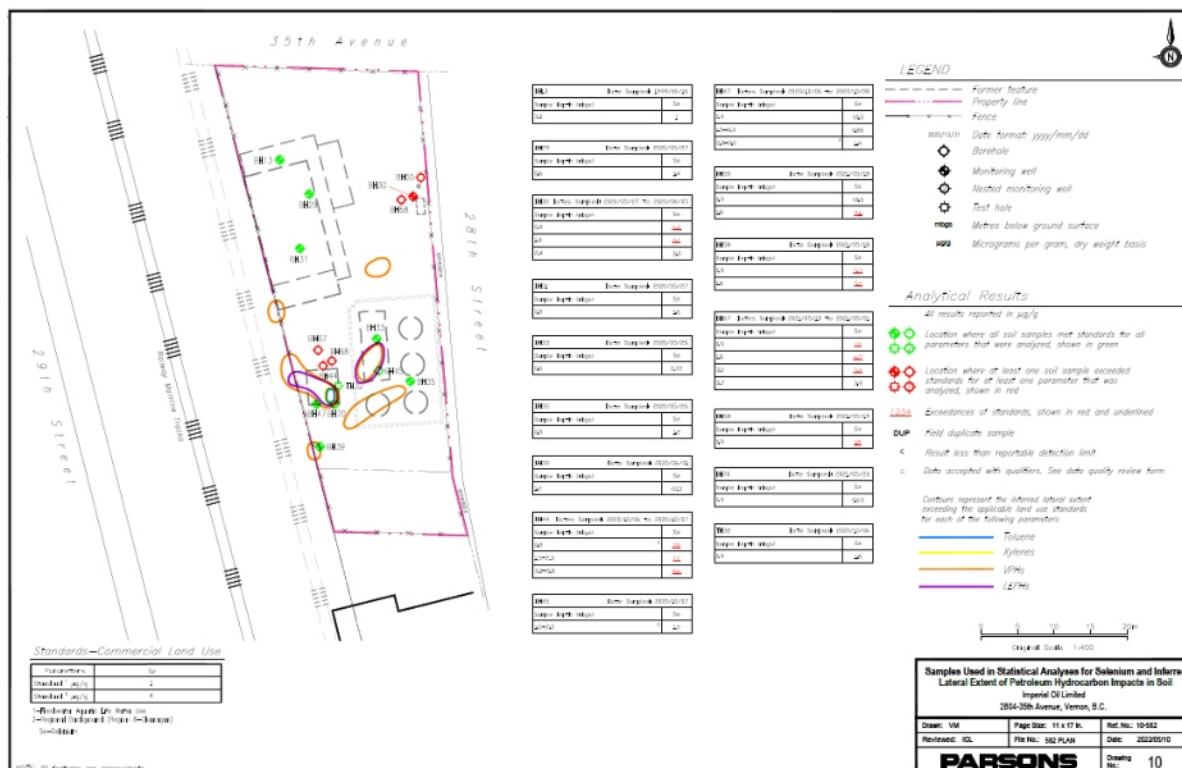
Groundwater contamination beneath the Site is currently not delineated in the downgradient direction, and due to the potential for migration within 50 m of Vernon Creek or direct discharge to the creek, freshwater aquatic life water use standards are applicable to the groundwater beneath the Site.

The online computer database maintained by the Water Management Branch of the Ministry of Environment and Climate Change Strategy indicates the Site resides above two aquifers: Aquifer No. 1152 and 1154. Aquifer No. 1152 (Vernon Unconfined Aquifer, II B) is too limited in saturated thickness to support a drinking water well at, and in the vicinity of, the Site. Aquifer No. 1154 (Vernon Unconfined Aquifer, II C) is protected by a natural confining unit beneath the Site (based on detailed assessment completed by Parsons). The geological unit represents an uncontaminated Type A natural confining layer, under Protocol 21, that protects any potential deeper aquifer.

### 3.0 Reference Site

Unimpacted areas beneath the Site were selected as the reference sites (Figure 5). The selected unimpacted areas were outside former facility footprints (as per historical drawings) and where petroleum hydrocarbon constituents in soil met CSR standards.

**Figure 5.** Reference site soil sampling locations for selenium and inferred lateral extent of petroleum hydrocarbon impacts in soil



#### 4.0 Rationale for Background Concentration and Reference Site

Parsons provided the following rationale for selection of the reference site and presence of background selenium:

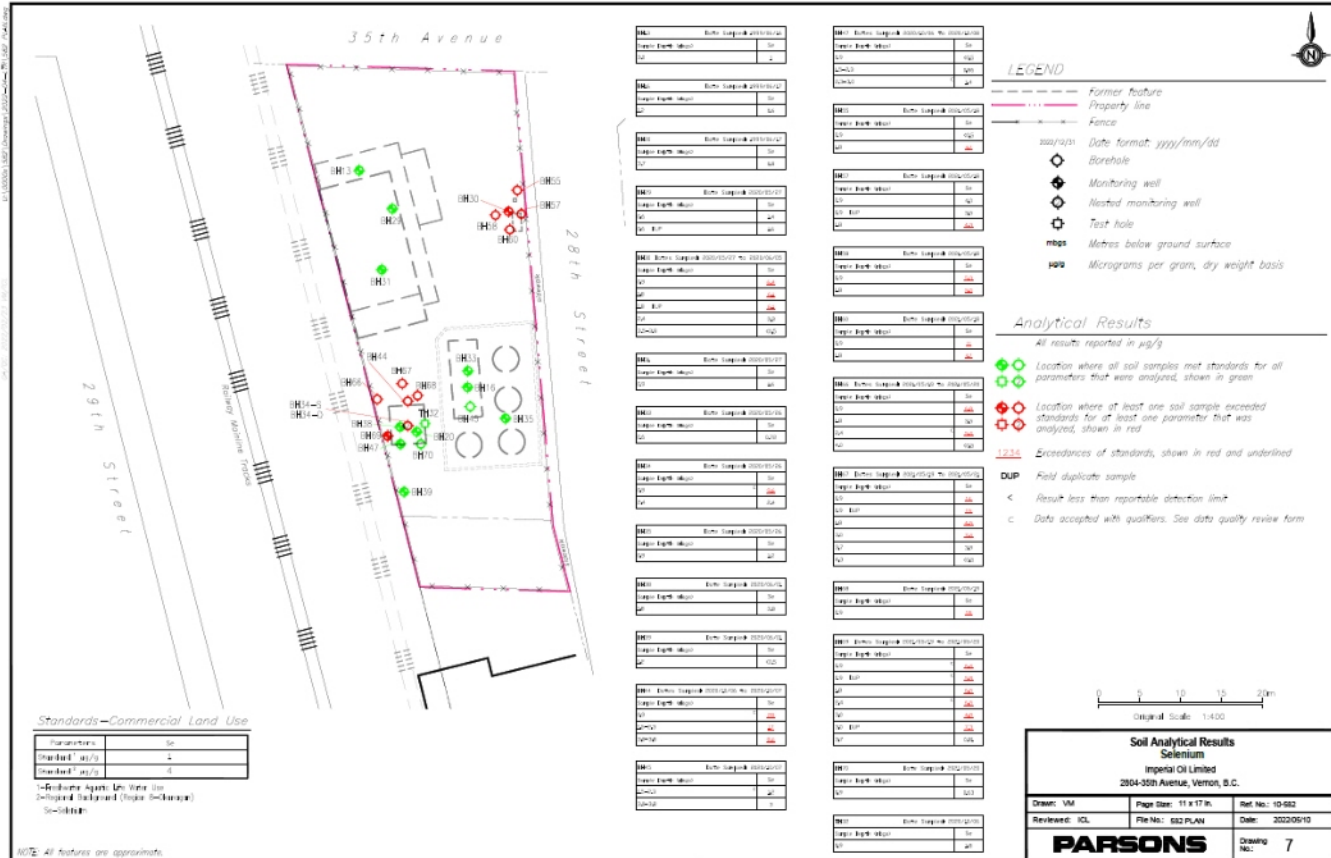
- APECs identified at the Site did not have selenium as an associated PCOC.
- Reference site samples were restricted to the sand stratigraphic layer (between 0.9 and 3.8 mbg) identified throughout the investigated area to satisfy P4 requirements for soil physical/chemical characteristics.
- The reference site is considered to share the same hydrology as impacted areas of the Site, given the lack of topographic variation across the Site.
- There is no evidence of imported material of unknown origin at the Site.
- The high levels of selenium in soil were identified in boreholes where petroleum hydrocarbon constituents or other PCOCs associated with the former operations were below applicable standards, except for samples BH34 at 0.9 mbg, BH66 at 2.4 mbg, and BH69 at 0.9 mbg. These three samples were not included in the background calculation. This suggests selenium concentrations are not influenced by petroleum hydrocarbon releases.
- Groundwater analytical results did not find concentrations that exceeded the applicable freshwater aquatic life water use standard for dissolved selenium.

#### 5.0 Derivation of Background Concentration

Selenium concentrations in soils collected from the sand layer ranged from less than 0.5 to 28 µg/g. Of the soil samples analyzed for selenium in the sand stratigraphic layer, 26 of them (including duplicate samples) exceeded the applicable CSR standard of 4 µg/g. The samples in exceedance of the CSR standard were localized to the sand stratigraphic layer between 0.9 and 3.8 mbg. The sample size was 27 soil samples that were analyzed for selenium, and the 95<sup>th</sup> percentile was calculated at the 95<sup>th</sup> confidence interval using Pro-UCL software. The Pro-UCL statistical output and data calculations are included in the attachments (Appendix F). Soil samples from the underlying silt and clay layer were excluded from the population used for the statistical analysis.

Due to the age of one of the samples originally included in the analysis (see the response to question 2 in Section 6.0 below), a sample was removed and the re-calculated 95<sup>th</sup> percentile concentration for selenium was **17.8 µg/g**. Two soil samples exceeded this proposed background concentration (BH44, 0.9 m, 28.0 µg/g; BH68, 0.9 m, 18.0 µg/g; Figure 6). However, all soil samples are statistically less than the proposed background concentrations as per Technical Guidance 2.

**Figure 6.** Soil analytical results for selenium at the Site



## 6.0 Review of Application

On February 22, 2023, the consultant for the Site (Jocelyne Bright) was contacted to obtain additional information; the questions and responses are provided below.

- In the Application, I was unable to find a description of the ground cover and vegetation present on the Site. Please provide these details and if there is any obvious damage to vegetation in the reference areas.
  - The property is currently an unpaved, vacant lot. The lot is grass covered with a couple of trees on the northern portion of the property outside of the reference areas. The vegetation on the property within the reference areas does not appear to be damaged. I have attached some photos for your reference.*
- A soil sample included in the calculation of the background soil concentration (BH13 from 3 m depth) was sampled in 1999. Due to changes in laboratory methods since that time, it is unclear if the earlier data is directly comparable to samples collected more recently. Please provide details on the laboratory method of analysis for selenium in this 1999 sample versus the other more recent samples included in the calculation. It is noted that lab reports for soil analysis could not be found in the application.
  - We have removed this sample from the dataset and rerun the statistics. The new proposed background standard would now be 17.8 ug/g.*

3. While the range of selenium concentrations in the sand stratigraphic layer between 0.9 and 3.8 mbgs is provided in the application, I could not find information on the range of selenium concentrations in other stratigraphic layers (e.g., silt and clay) compared to the sand layer. Please provide a statistical analysis that demonstrates this is a specific layer (i.e., one population) that is high in selenium concentrations (e.g., t-test, box plot). It needs to be clearly demonstrated how the high selenium concentrations at the Site are not hotspots but are native materials (i.e., background concentrations).
  - a. *A standard assessment of the various layers for potential contaminants of concern (PCOCs) (including metals) was completed. Samples were collected from the silt and clay layer, and I have attached a table summarizing the selenium results from these samples. As indicated in the table, these results met standards.*
  - b. *As illustrated on Drawing No. 10 of the P4 report, the selenium analyses included in the statistical analyses were located outside of areas impacted by historical operations. Soil samples exceeding concentrations for selenium were located outside of both historical facility footprints and petroleum hydrocarbon impacted areas. Additionally, these impacts were observed at depths up to 3.8 mbgs in areas that did not have subsurface facilities. The borehole logs associated with these sample locations document a sand layer that exists across the site and fill material was not observed during investigations that would have suggested this sand layer is not native to the site. The cross-section provided in the P4 report as Drawing No. 9 also indicates a continuous sand layer across the extent of the site. This sand layer was observed in boreholes advanced on the site as well as beneath the CN railway and beneath the city roadways. I have attached borehole logs for borehole locations on the CN property and roadways.*
  - c. *Student t-tests and box plots are tools used to understand normal populations. The population of selenium is realistically not part of a normal population since geologic formations are not generally normal in population; point source impacts are typically described via lognormal distributions; and widely dispersed point sources (area-wide fill) or naturally occurring background concentrations (which would vary randomly) would not be expected to show any normality in distribution. Rather our investigation relied on non-parametric tools and our population evaluation relied on a series of mutually supported, independent lines of evidence. The selenium-impacted soils were limited to a single stratigraphic layer that shared visual and grain-size characteristics across the extent of the area investigated. It was physically and stratigraphically distinct from the deeper silt and clay layers that differed in colour, grain size composition and chemical characteristics.*
4. It is unclear if other metals are also elevated in samples with high selenium concentrations. Please provide details on this.
  - a. *A table summarizing the analytical results for additional metals analyses in samples analyzed for selenium is attached to this email for your reference. As indicated in the table, the analytical results for metals other than selenium met the applicable standards.*
5. At the end of Section 7.2 of the application, it is unclear what is meant by “However, all soil samples are statistically less than the proposed background concentrations as per Technical Guidance 2 and will be addressed under separate cover.” Please provide additional information to clarify the intent of this sentence.
  - a. *Per BCE Technical Guidance 2, a population is considered to meet standards if the 90<sup>th</sup> percentile concentration of that population is less than or equal to the applicable standard. This statement suggests that should the background standard proposed for selenium be approved, then the 90<sup>th</sup>*

*percentile concentration of the population used to calculate this background concentration will meet the proposed background standard.*

I support the additional information provided on the Site and consider the information request as **Resolved**.

### Conclusions

It is my opinion that the calculated 95<sup>th</sup> percentile for the Site is an acceptable background estimate for the concentration of selenium within the sand stratigraphic layer (between 0.9 and 3.8 mbg) at the Site.

I believe Parsons has provided sufficient rationale and data for the approval of site-specific background concentrations for selenium in soil at the Site. Based on the evidence presented, I support the approval request for the following reasons:

- The reference site is unimpacted areas within native materials of the Site in question, with the same geographical characteristics, soil physical/chemical characteristics, hydrology and hydrogeology and soil sampling depth with the geological unit.
- Selenium was not identified as a PCOP on or off the Site.
- Sufficient samples were collected, and the statistical evaluation is adequate to characterize the 95<sup>th</sup> percentile of the dataset.
- The history of the reference area was reviewed at a level consistent with background concentrations and a preliminary site investigation.
- Elevated concentrations of selenium at the Site do not appear to follow any discernable pattern laterally or by depth.
- A similar background concentration for selenium has previously been accepted in the Province in Region #3 (Thompson-Nicola):
  - Site 12917 (1460 & 1550 Ord Rd., Kamloops): 8 µg/g

### **7.0 Recommendation**

It is my recommendation that the 95<sup>th</sup> percentile derived from the above-mentioned soil samples be accepted as a site-specific background concentration for selenium in the sand stratigraphic layer (i.e., 0.9 to 3.8 mbg) at the Site.

In accordance with P4, I recommend approval of the calculated background concentration in soil at the Site as follows:

Selenium: 17.8 µg/g

Prepared by:

Cara Lachmuth

Senior Risk Assessment Officer  
Land Remediation Section  
Ministry of Environment and Climate Change Strategy