

Springer Creek Water Quality Monitoring Report

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Springer Creek

Water Quality Monitoring Report

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Springer Creek

Water Quality Monitoring Report

Introduction

Opus Petroleum Engineering Ltd has reviewed the water sample data on Springer Creek as shown by samples collected by volunteers, Denise Dufault and Daphne Fields, and analyzed by Jennifer Yeow of Passmore Labs and Richard Johnson of Opus Petroleum Engineering Ltd. This report summarizes the results and presents the data in graphical form as well as including all of the data in tabular form in the appendix.

Water sampling was begun December 18, 2013 and concluded July 29, 2017. The purpose was to provide a snapshot and baseline of water quality as shown by the conductivity, pH and turbidity of Springer Creek during that period.

Three metal analyses of water and one of sediment were also taken in 2017. These analyses and the report on them, prepared by Passmore Laboratory Ltd., are included in this report.

This report also provides additional hydrogeological data, showing how water quality data is a reflection of the hydrogeology of a watershed. This provides background for further studies that may be undertaken on Springer Creek such as are included in the recommendations.

Background

Springer Creek is located north-east of the Village of Slocan, B.C. and drains an area of 49.7 square kilometres. The creek runs through the Village and discharges into Slocan Lake east of the public beach and docks of the Village.

The creek derives its water from rainfall and melted snow and reflects changes in these both by flow volume and water quality. During May and June of each year high rainfall and



large quantities of water from melting snow create high flow volumes known as “freshette”. During freshette the amount of dissolved material (Total Dissolved Solids or TDS) drops, dramatically in Springer Creek. This is reflected by a decrease in the conductivity of the water. High water flow rates also often cause high turbidity from undissolved material.

This report describes those events as they are reflected in the water quality and the interpretation of those changes as they reflect the hydrogeology of the watershed.

Conclusions

This study found that:

1. Springer Creek water is very fresh and very responsive to rainfall events. This is interpreted to mean that there is very little porous material to hold up the flow of rain or snowmelt, compared to other valleys in the Slocan watershed.
2. The Springer Creek watershed appears to be stable with few signs of land movement picked up by the water sampling. This is shown by the lack of turbidity after some rainfall events.

Recommendations

The water in the aquifer that underlies Slocan Village is receiving recharge from Springer Creek. Opus recommends that:

1. A continuous flow measurement program be set up on Springer Creek.
2. That complete chemical analyses be performed at least twice a year.
3. That water samples be taken every two months as an ongoing water monitoring program, measuring conductivity, pH and turbidity.

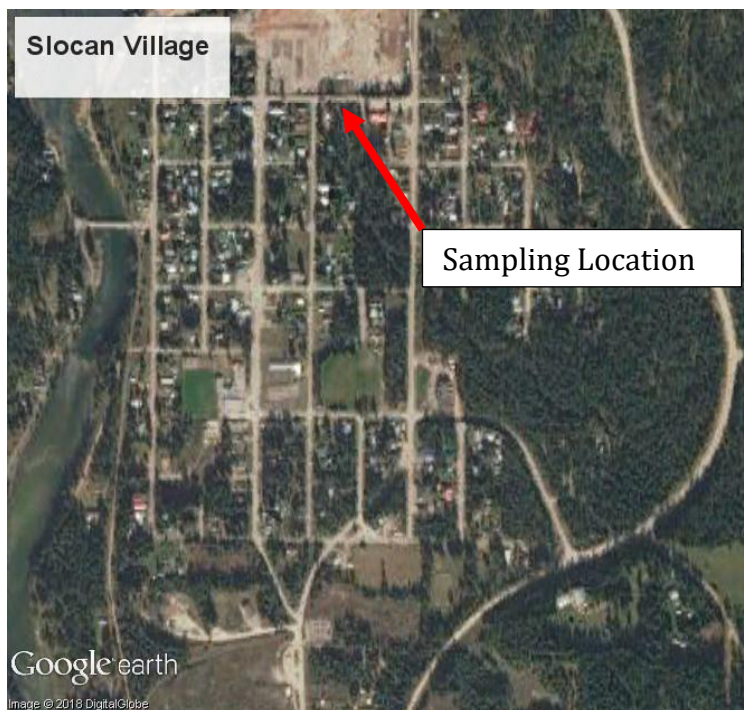
The Village of Slocan may have flow data on the creek.

Water Quality

Measurement of pH, turbidity and conductivity are the basic parameters that are easily measured on water samples. From these measurements much can be interpreted about the creek water and its watershed.

During the period December 18, 2013 to July 29, 2017 water samples were collected by Denise Dufault and sometimes Daphne Fields at the upstream side of the culvert under Delaney Street where Springer Creek flows under the street. The location is shown on the map to the right.

The volunteers recorded water temperature and air temperature as well as noting general information about the flow. The samples were then delivered to Jennifer Yeow at Passmore Laboratories during the first three years and to Richard Johnson during the last 1 ½ years, for measurement of conductivity, pH and turbidity. The complete database of these measurements is included in Appendix A.

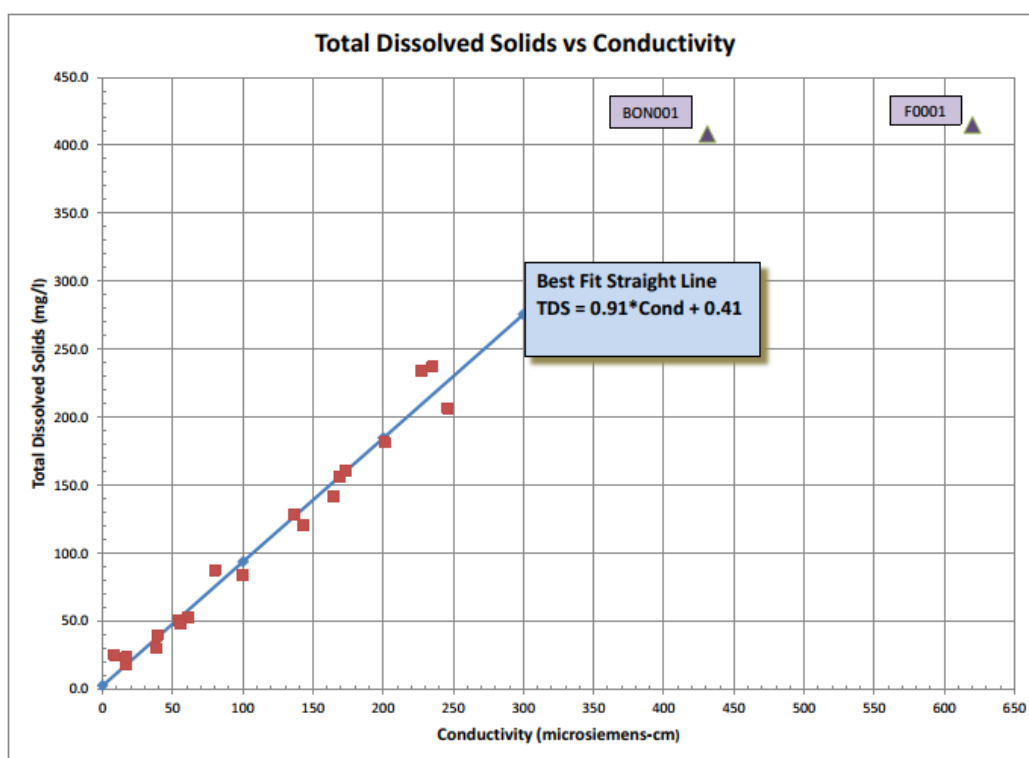


The samples used in this study were taken in clean plastic bottles with tight fitting lids. The bottles were usually 500 ml. and were nearly full. This latter point is important because water exposed to the atmosphere can have pH measurement that is different from a pH that is measured in the field. It has been this author's experience on numerous samples taken on creeks in the Red Mountain area, just south of Silverton, B.C., that the pH measured in the creek was not significantly different from the pH measured in the lab from the sample bottle several months later. The calibration of the pH instrument is far more important than the length of time between sampling and lab measurement.

The pH of a stream is usually stable in creeks in the Slocan watershed. Changes in pH usually indicate introduction of foreign substances such as chemicals from mining, road maintenance or other human sources.

Turbidity measures the amount of undissolved sediment in a sample. It is a direct indication of erosion, land movement or melted snow that has slid during the winter. Land movement can mean human created movement such as road building or tree clearing.

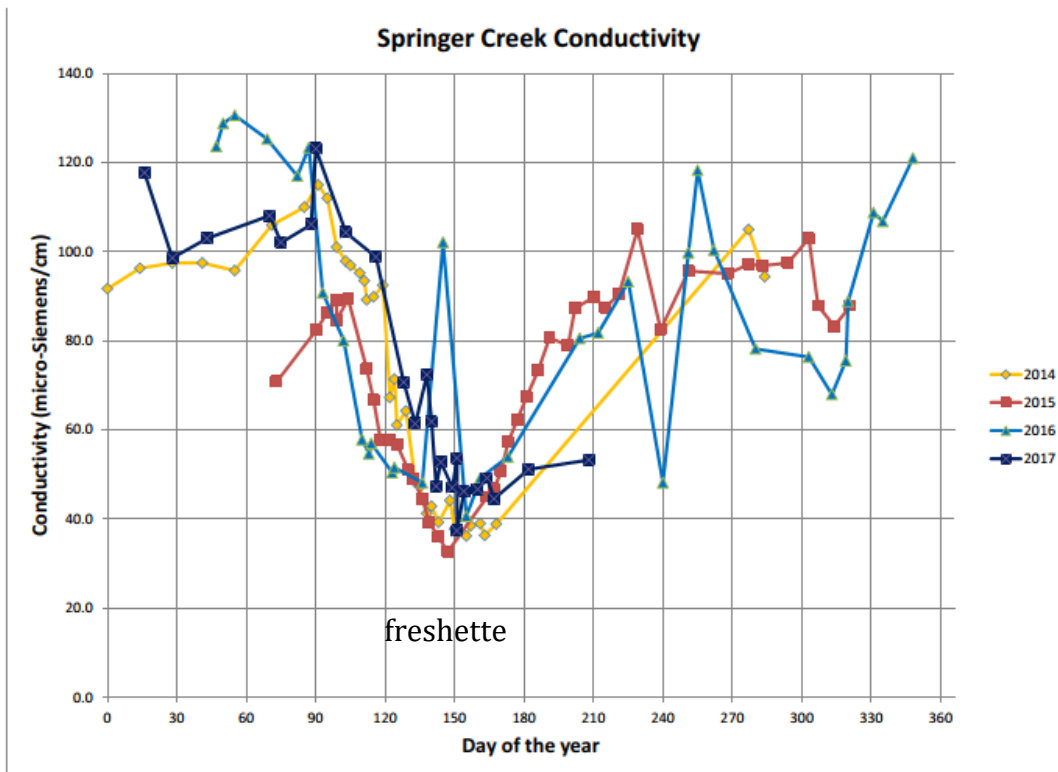
Conductivity measures the ability of water to conduct electricity. This measurement can be correlated to the amount of dissolved material in the water. When the water is very fresh, as it is in Springer Creek, the correlation between the conductivity and the Total Dissolved Solids (TDS) is effectively linear and can be interpreted from a graph or equation (Johnson, R. H., 2016). The following graph, taken from that report, shows the straight line correlation and allows one to determine the TDS, either graphically or from the equation.



The amount of dissolved solids in creeks in the Slocan watershed is a measure of the amount of time that the water was underground, in contact with soil and rock. The main components of the dissolved solids will be Calcium and Bicarbonate ions, based upon the previous work in the Slocan watershed by the author and described in the referenced report.

All conductivity values used in the body of this report are Specific Conductivity. Specific Conductivity is conductivity of the water sample corrected to 25 degrees Celcius. This is done because the conductivity of a water sample varies with the temperature of the sample when the measurement was taken.

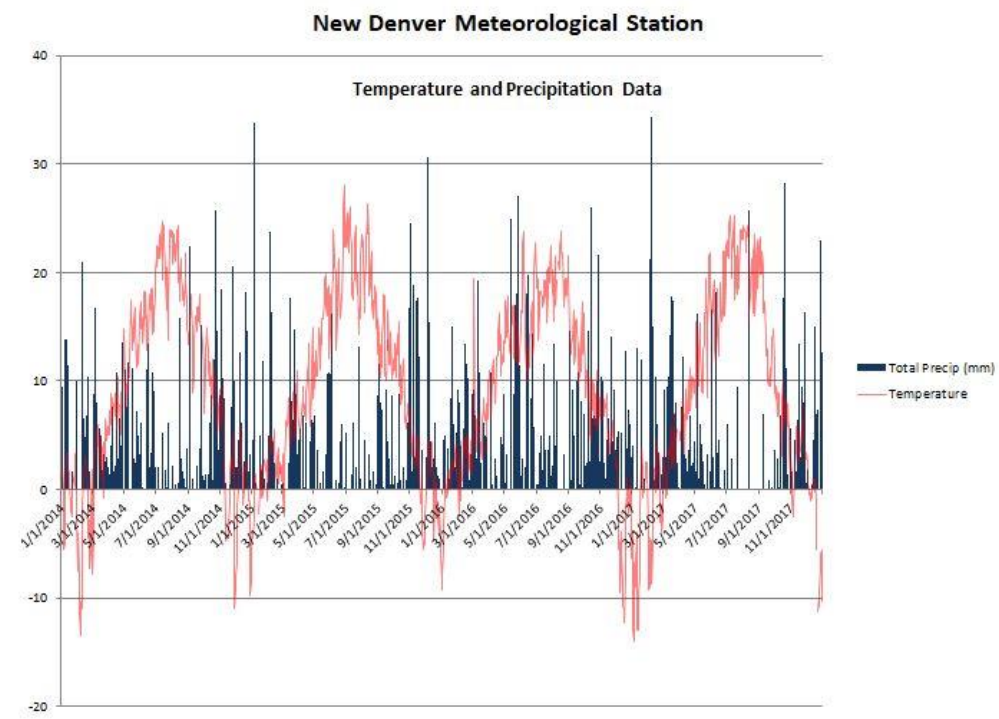
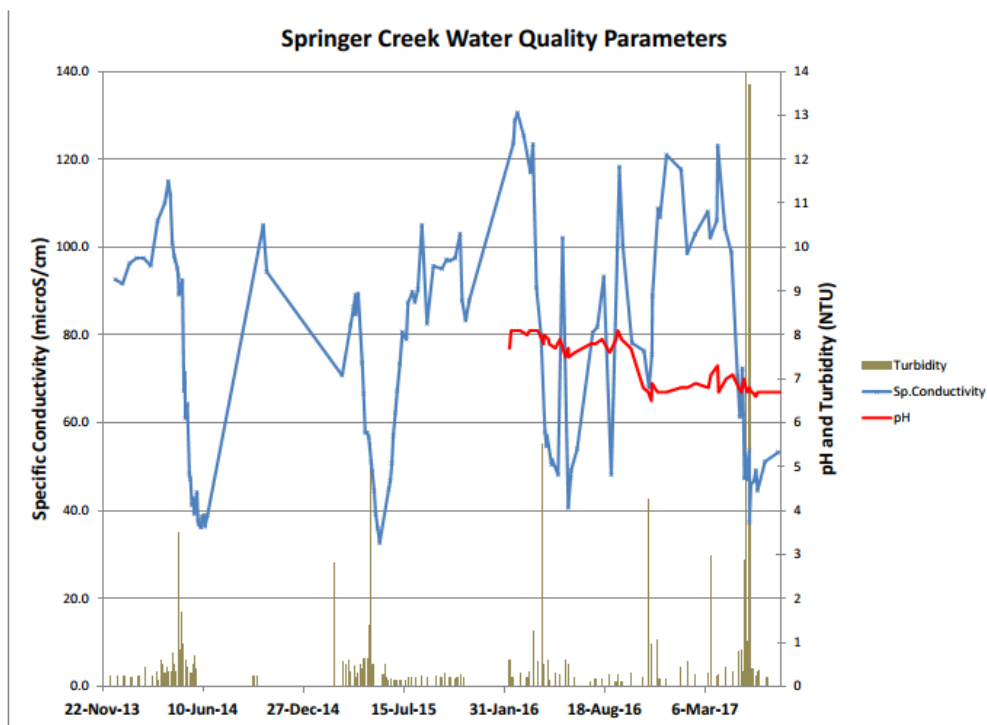
The following graph shows the conductivity during the monitoring period plotted on a yearly cycle. During spring freshette, which shows on the graph on either side of the 150 day vertical line, the conductivity drops to about 40 $\mu\text{S}/\text{cm}$. During the winter months the conductivity nears 100 $\mu\text{S}/\text{cm}$. Even though we do not have measured flows on the creek, the conductivity is showing that during the high flow freshette the meltwater and rainfall is rapidly reaching the sample location in Slokan, without remaining in contact with the soil and rock of the watershed.



The conductivity of the samples from Springer Creek is affected by the geology of the Springer Creek watershed. (See the Hydrogeology section later in this report.)

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The following graph shows the conductivity, pH and turbidity measurements during the sampling period of December 18, 2013 to July 29, 2017.



The lower graph shows the precipitation and temperature data from the nearest weather station as downloaded from the Government of Canada, Historical Climate Data site at: http://climate.weather.gc.ca/index_e.html Although the graphs do not line up exactly, one can see from the drop in conductivity during the summer of 2016 that these rain events were quickly reflected at the sampling point in Slocan, giving lower conductivity (i.e. higher flow rates) because of the lack of “holdup” in the watershed.

The pH measurements, shown as a red line on the graph, are relatively level. The obvious drop in pH is due to an instrument “zero” error which caused the later pH measurements to be offset by about 1 pH unit (The instrument read the pH about one unit too low). Comparing these results to other pH measurements on numerous creeks in the Slocan watershed, the author has not found the pH measurements to be useful other than to pick up human induced changes such as mine discharges, rather than changes in creek flow rates.

Turbidity measurements on samples from Springer Creek are shown on the graph and in Appendix A. There is an increase after rainfall events shown by the turbidity “spikes” that occur with every freshette. This is normal. The very high turbidities that showed up in the May 23, 2017 and May 30, 2017 may have indicated land movement in the water shed. The water level in the creek was noted as “very high” and “highest water ever”. (See page 2 in Appendix A for the values and water level notes.)

Water Chemistry

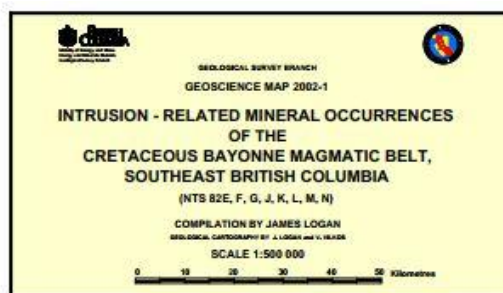
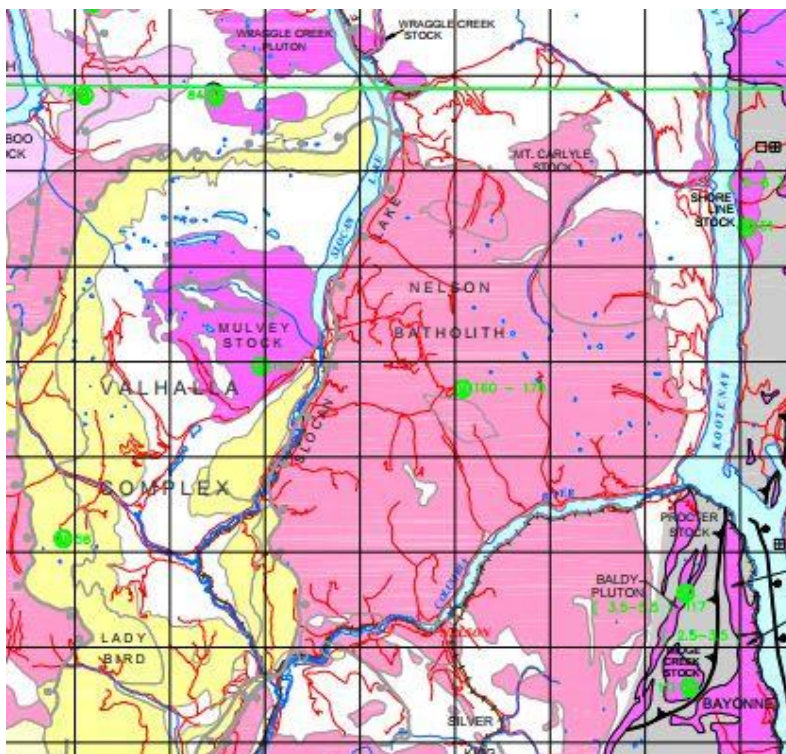
Water samples were taken from Springer Creek on June 2, August 7 and October 24, 2017. A sediment sample was also taken on October 24, 2017. The samples were shipped to CARO Analytical Services in Kelowna where complete metals analyses were run. A report by Jennifer Yeow on Passmore Laboratories was prepared, showing the results. This report has been included as Appendix B.

Hydrogeology

One can see from the map on the right that the Springer Creek watershed is almost completely underlain by granite of the Nelson Batholith. The surface extent of this intrusion runs from Silverton to Nelson, in the north-south direction. Its western edge exposure is marked by Slocan Lake and the Slocan River Valley. The granite is easily observed in the cliffs on the eastern side of Highway 6, north of the Village of Slocan, where it forms the massive cliffs known locally as “Cape Horn”.

Granite has no intrinsic matrix porosity so any water that resides within the bedrock in the Springer Creek watershed, is in cracks in the granite. As one can see from the exposure along Highway 6 there is very little water seeping from the cliffs so there is little water stored in granite fractures. This also explains why the flow in Springer Creek is controlled by the amount of rainfall and snowmelt. The Springer Creek valley does not have a lot of soil nor aquifer material so water from rain and snowmelt does not have much residence time in the valley before it flows out through the creek.

The following perspective shows the Springer Creek watershed, taken from Google Earth. The view is looking east-northeast. It shows the watershed to consist of a v-shaped valley flanked by rounded flanks. This is consistent with complete coverage and rock removal by a continental ice sheet with the creek incising the bedrock in the creek bed. The sharp bends in the creek as it reaches the main valley may be a reflection of the Slocan Lake fault. For more information on the geology of the area the reader is directed to Turner et al, 2009. See the Bibliography for complete reference.



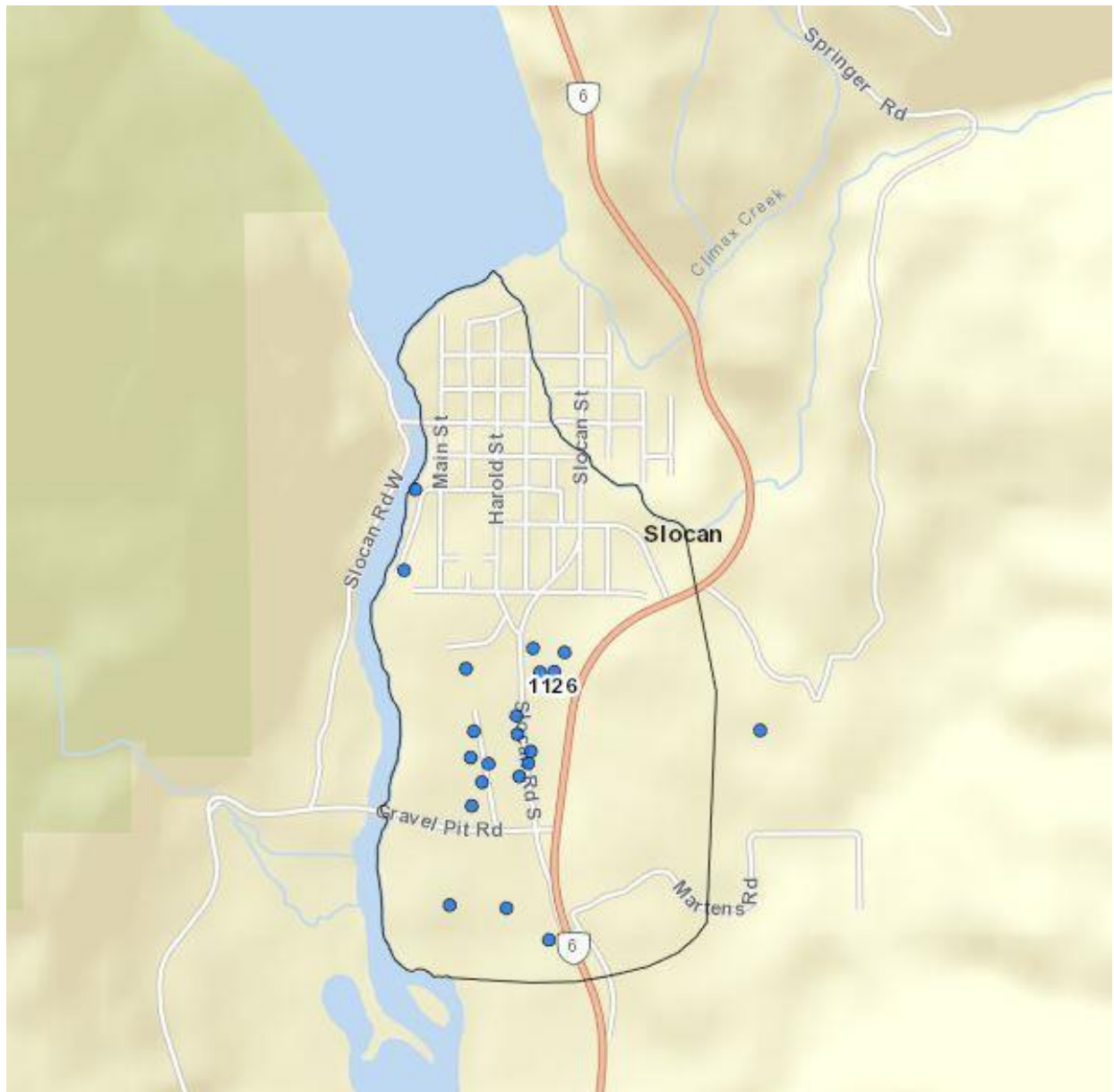
Close examination of the watershed from Google Earth satellite images shows very few areas of snow slide. This is due to the rounded nature of the valley flanks. The result is that the water sampling shows very few periods of high turbidity in Springer Creek.



When Springer Creek crosses under Highway 6 and enters the Village of Slocan it flows on top of the sands and gravels that make up the fluvial sediments that create the Slocan Village aquifer. This is an unconfined aquifer and Springer Creek flows along the top of the porous and permeable fluvial sediments that form the aquifer. These gravels, sands, silts and minor clays allow water to flow downward from Springer Creek, laterally from the subsurface of the bedrock to the east of the aquifer as well as from any cracks in the bedrock. Additionally, Slocan Lake and the Slocan River are in direct contact with the aquifer and flow can be either into or out of the aquifer depending upon the elevation of the water table in the aquifer. The flow will be toward the lake and river when recharge of the aquifer is high from the creek, bedrock and rain in the Village but there can be recharge from the lake, and therefore the river, when the water level in them is higher than the water table.

The aquifer is a potential water supply for the Village of Slocan.

The map on the following page is clipped from iMapBC. It shows the outline of the Slocan Village aquifer and the locations of water wells are shown as blue dots. The north eastern edge of the aquifer is shown on the map as being the edge of the aquifer but on the ground observation would indicate that the aquifer extends further to the north east.



Details on the aquifer and the wells can be downloaded from the iMapBC website. The link to the website is included in the bibliography.

Bibliography

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iMapBC link: <https://maps.gov.bc.ca/ess/hm/imap4m/>

Johnson, R.H., 2016, "*Using Stiff Diagrams to characterize Surface Water Samples*" Prepared for Slocan River Streamkeepers, Slocan Solutions Society, Slocan Lake Stewardship Society and BC Wildlife Federation under the Slocan Valley Wetlands Assessment and Mapping Project (SWAMP); included in Darcie et al., 2016.

Turner, R.J.W., 2009, "*GeoTour Guide for the West Kootenay, British Columbia*", Geological Survey of Canada Open File 6135, British Columbia Geological Survey Geofile 2009-06.
http://www.llbc.leg.bc.ca/public/pubdocs/bcdocs/456249/gf2009-6_wkootenay_geotour.pdf

Yeow, J, 2017, "*Water and Sediment Testing in Springer Creek*", Passmore Laboratory Ltd., Attached as Appendix B

Appendix A

To a report entitled
Springer Creek Water Quality Monitoring Report

Water Quality Data

Water Quality Monitoring Data
Water Source Springer Creek

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Date	Time	Weather	Air Temp	Water Temp	Conductivity			Measured Turbidity			Plot Turbidity	Susp Solids	pH
					Actual Cond.	Sample Temp.	Spec.Co nd.	Average	x-bar	RST			
			<u>Deq. C</u>	<u>Deq. C</u>	<u>uS/cm</u>	<u>Deq. C</u>	<u>uS/cm</u>	<u>NTU</u>	<u>NTU</u>	<u>NTU</u>	<u>NTU</u>		
18-Dec-13	3:30PM	Clear to overcast	0.0	-1.5			92.6				0.20		
1-Jan-14	3:30PM	Overcast	-3.0	-2.0			91.7				0.25		
15-Jan-14	4:15PM	Overcast	-1.0	-2.0			96.3				0.25		
29-Jan-14	5:00PM	Overcast	-1.0	-2.0			97.5				0.25		
12-Feb-14	5:00PM	Clear & sunny	0.0	-2.5			97.5				0.20		
26-Feb-14	5:00PM	Clear & few clouds	-3.5	-3.0			95.8				0.25		
12-Mar-14	4:30PM	Overcast	2.0	-1.0			106.0				0.45		
26-Mar-14	5:15PM		6.0	0.0			110.0				0.25		
2-Apr-14	6:30PM		4.5	0.5			115.0				0.35		
6-Apr-14	6:00PM	Sunny	8.0	1.5			112.0				0.15		
10-Apr-14	6:45PM	Small clouds	6.0	1.5			101.0				0.60	1.3	
14-Apr-14	4:10PM	Slightly overcast	4.0	3.0			97.9				0.50	<0.5	
16-Apr-14			6.0	1.5			96.9				0.30		
20-Apr-14		Slightly overcast	8.0	2.0			95.2				0.30		
22-Apr-14	3:45PM	Overcast	8.5	2.0			93.5				0.35		
23-Apr-14	5:00PM	Small clouds	5.0	2.0			89.2				0.45		
26-Apr-14	8:00 AM		6.5	2.0			89.9				0.35		
30-Apr-14	4:30PM		13.0	3.5			92.5				0.35		
3-May-14	8:00PM	Cloudy	3.5	1.0			67.3				0.75		
5-May-14	5:30PM	Slightly overcast	9.0	2.5			71.4				0.50		
6-May-14	7:30PM	Overcast	9.0	2.5			61.1				0.35		
14-May-14	8:00PM	Clear	8.5	3.0			48.3				3.50		
10-May-14	8:00PM	Blue Sky	6.0	2.5			64.3				0.35		
16-May-14		Overcast	14.0	3.0			47.3				0.70		
19-May-14	7:45PM	Fluffy clouds	9.0	3.0			41.3				0.85		
21-May-14	6:30PM	Sun	10.0	3.0			42.9				1.70	12	
24-May-14	8:45PM	Slightly overcast	14.0	3.0			39.3				0.95	8	
29-May-14	7:00PM	Overcast	8.0	3.0			44.2				0.60		
31-May-14	7:15PM	Sunny	10.0	4.0			37.8				0.45		
2-Jun-14		Clouds	9.0	3.5			36.9				0.40		
6-Jun-14	8:15PM	Clear	10.5	4.0			36.2				0.25		
8-Jun-14	8:30PM	Clouds	13.0	5.0			38.6				0.30		
12-Jun-14	8:30PM	Overcast	13.0	6.0			39.0				0.50		
14-Jun-14	9:00PM	Overcast	7.0	3.5			36.4				0.70	5.8	
19-Jun-14	8:00PM	Overcast	12.0	5.5			38.9				0.40		
8-Oct-14	6:30PM	Overcast	11.0	7.0			105.0				0.25		
15-Oct-14	5:00PM	Overcast	9.5	5.5			94.4				0.25		
14-Mar-15	7:00PM	Overcast, first rain	3.0	3.0			70.8				2.80	18.4	
31-Mar-15	4:15PM	Sunny	9.0	2.5			82.3				0.55	0.5	
6-Apr-15	5:00PM	Warm, overcast	8.0	2.0			86.4				0.50		
10-Apr-15	4:00PM	Overcast	13.0	3.0			89.1				0.45		
10-Apr-15	7:30PM	Clear, sunny	9.5	4.0			84.7				0.60	<0.5	
15-Apr-15		Clear, sunny	8.0	3.0			89.4				0.35		
23-Apr-15	5:00PM	Overcast	12.0	3.0			73.7				0.45		
26-Apr-15	6:30PM	Clear, sunny	13.0	3.0			66.7				0.20		
29-Apr-15	5:30PM	Sunny few clouds	15.0	4.0			57.8				0.30		
3-May-15	6:30PM	Blue sky	12.5	4.0			57.8				0.50		
6-May-15	7:00PM	Sunny, puffy clouds	10.0	4.0			56.8				0.40		
11-May-15	6:30PM	Sunny & cloud	13.0	5.0			51.0				0.65	4	
13-May-15	8:00PM	Overcast, rain	9.0	4.5			49.0				0.35		
17-May-15	6:00PM	Sunny w grey white clouds	14.0	5.5			44.6				0.65	5.1	
20-May-15	8:30PM	Blue sky light cloud	13.0	5.5			39.2				1.40	11.2	
24-May-15	6:30PM	Rain	11.0	5.0			36.0				5.55	4.8	
28-May-15	7:45PM	Sunny w clouds	13.0	6.0			32.7				0.50		
15-Jun-15	2:00PM	Sunny	19.0	7.5			45.0				0.25		
18-Jun-15	7:15PM	Overcast	17.0	9.0			46.8				0.25		
21-Jun-15		Sunny	19.0	8.0			50.8				0.50		
24-Jun-15		Overcast	19.0	10.0			57.2				0.20		
28-Jun-15	9:00PM	Overcast, water is low	23.0	14.0			62.3				0.15		
2-Jul-15	7:55PM		26.0	16.0			67.4				0.15		
7-Jul-15	6:15PM	Sunny & few clouds	29.0	14.0			73.4				0.15		
12-Jul-15	2:00PM	Sunny	22.0	14.0			80.7				0.15		
20-Jul-15	6:15PM	Sunny few clouds	22.0	12.0			79.0				0.15		
23-Jul-15	8:30PM	Clouds and overcast	24.0	14.0			87.3				0.15		
1-Aug-15	2:00PM	Sunny, clear, low water	25.0	12.0			89.8				0.15		
6-Aug-15	1:45PM	Sunny w clouds	16.0	10.0			87.5				0.20		
12-Aug-15	5:45PM	Sunny	23.0	15.0			90.4				0.20		
20-Aug-15	5:15PM	Sun, clear	24.0	13.0			105.0				0.20		
30-Aug-15	7:30PM	Clear, some cloud		11.0			82.6				0.25		
12-Sep-15	10:00AM	Sunny, clear, low water	15.0	9.0			95.7				0.20		
29-Sep-15		Sunny	14.0	6.0			95.1				0.25		
8-Oct-15		Overcast, warm	16.0	8.0			97.2				0.20		
14-Oct-15		Sunny, warm	10.0	2.0			96.9				0.30		

25-Oct-15	Sunny, cool, clear	10.0	3.0	97.5		0.20		
4-Nov-15								

103.0

0.15

Water Quality Monitoring Data
Water Source Springer Creek

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Date	Time	Weather	Air Temp <i>Deq. C</i>	Water Temp. <i>Deq. C</i>	Conductivity			Measured Turbidity			Plot Susp Turbidity Solids	pH
					Actual Cond. <i>uS/cm</i>	Sample Temp. <i>Deq. C</i>	Spec.Co nd. <i>uS/cm</i>	Average <i>NTU</i>	x-bar <i>NTU</i>	RST <i>NTU</i>		
8-Nov-15							87.9				0.20	
15-Nov-15							83.3				0.25	
22-Nov-15							87.9				0.20	
18-Feb-16	4:00PM	after rain	3.0	2.0	95.5	13.2	123.6	0.54	0.60	-	0.60	7.7
21-Feb-16	6:45PM	rainy	5.0	1.5	99.2	13.0	128.8	0.26	0.22	-	0.22	8.1
26-Feb-16	3:00PM	sunny	4.0	1.0	100.3	13.0	130.6	0.23	0.19	-	0.19	8.1
10-Mar-16	3:00PM	sunny	11.0	3.0	100.4	13.1	125.3	0.31	0.30	-	0.30	8.1
23-Mar-16	5:15PM	overcast	11.0	3.0	90.4	13.0	117.0	0.19	0.21	-	0.21	8.0
28-Mar-16	5:45PM		6.0	2.5	97.5	13.3	123.4	0.26	0.34	-	0.34	8.1
4-Apr-16	4:15PM	rainy (organic material)	9.0	3.0	70.1	13.1	90.8	0.96	1.27	-	1.27	8.1
13-Apr-16	1:00PM	sunny	12.0	4.0	61.5	12.9	80.1	0.31	0.56	-	0.56	8.1
21-Apr-16	4:00PM	water up 1 ft	14.0	4.5	44.7	13.0	57.9	5.07	5.51	-	5.51	7.9
24-Apr-16			8.0	4.0	42.2		54.7	0.53	0.49	-	0.49	7.8
25-Apr-16	7:30PM	sunny	11.0	4.0	44.3	13.3	57.0	0.32	0.30	-	0.30	8.0
4-May-16	7:30PM	rainy, high water	12.0	4.0	39.1	13.3	50.5	0.58	0.59	-	0.59	7.9
5-May-16	8:25PM	clear	10.0	4.0	40.2	13.3	51.6	0.15	0.14	-	0.14	7.8
17-May-16		flow lower	13.0	6.0	37.3	13.3	48.2	0.36	0.29	-	0.29	7.7
26-May-16	7:45PM	flow even lower	11.0	6.0	79.5	13.5	102.1	0.29	0.26	-	0.26	7.9
6-Jun-16	8:00PM	high water	13.0	8.0	31.6	13.7	40.7	0.42	0.58	-	0.58	7.5
11-Jun-16	6:30PM	water higher	10.0	6.5	37.1	13.5	47.5	0.22	0.50	-	0.50	7.7
12-Jun-16	7:00PM	sunny	11.0	6.5	38.4	13.6	49.2	0.20	0.18	-	0.18	7.5
24-Jun-16	7:00PM	after 2 days of rain	12.0	7.7	42.6	13.6	54.0	0.23	0.20	-	0.20	7.6
25-Jul-16	8:15PM	blue sky	18.0	13.0	63.1	13.8	80.6	0.31	0.12	-	0.12	7.8
3-Aug-16	5:30PM	rain last night	14.0	11.0	63.9	13.6	81.8	0.14	0.17	-	0.17	7.8
16-Aug-16	5:00PM	hot day	22.0	14.0	73.0	13.7	93.3	0.16	0.16	-	0.16	7.9
31-Aug-16	5:00PM	sunny	24.0	13.0	37.8	13.7	48.2	0.20	0.29	-	0.29	7.6
12-Sep-16	3:15PM	sunny	15.5	8.0	78.5	13.8	99.8	0.13	0.12	-	0.12	7.9
16-Sep-16		(wrong date?)			93.4	14.0	118.3	0.27	0.26	-	0.26	8.1
23-Sep-16	6:30PM	rainy	11.0	8.0	79.2	14.0	100.4	0.12	0.12	-	0.12	7.9
11-Oct-16	4:10PM	clear	7.5	5.0	61.8	14.0	78.2	0.35	0.31	-	0.31	7.7
4-Nov-16			5.0		66.2	18.1	76.4	0.23	0.19	-	0.19	6.8
14-Nov-16			7.0	1.0	63.0	21.2	68.0	4.69	4.24	-	4.24	6.7
20-Nov-16					73.7	23.7	75.6	1.06	0.96	-	0.96	6.5
21-Nov-16					76.2	17.7	88.9	0.37	0.35	-	0.35	6.9
2-Dec-16					90.3	16.1	108.8	0.89	1.05	-	1.05	6.7
6-Dec-16			-4.0	-4.0	99.3	17.2	106.8	0.21	0.17	-	0.17	6.7
19-Dec-16			-4.0	-3.0	98.8	15.4	121.0	0.13	0.16	-	0.16	6.7
17-Jan-17			-1.0		89.5	12.5	117.7	0.32	0.44	-	0.44	6.8
29-Jan-17			4.0		73.2	11.6	98.6	0.61	0.56	-	0.56	6.8
14-Feb-17			6.0		76.1	11.4	103.0	0.25	0.28	-	0.28	6.9
11-Mar-17			4.0	3.0	83.3	12.9	108.1	0.26	0.31	-	0.31	6.8
16-Mar-17			12.0		75.3	11.5	102.1	2.01	2.97	-	2.97	7.1
29-Mar-17		raining	6.0	4.0	80.7	12.2	106.1	0.31	0.26	-	0.26	7.3
31-Mar-17			11.0	4.0	110.0	19.5	123.1	0.43	0.20	-	0.20	6.7
14-Apr-17			11.0	4.0	77.3	11.5	104.3	0.43	0.43	-	0.43	7
27-Apr-17			11.0	4.0	69.5	9.4	98.8	0.62	0.35	-	0.35	7.1
9-May-17			12.0	6.0	60.7	16.3	70.7	0.96	0.80	-	0.80	6.8
14-May-17		water is up	12.0	4.0	54.2	19.1	61.4	0.99	0.83	-	0.83	6.7
19-May-17		water is up	15.0	6.0	69.1	23.3	72.4	0.19	0.36	-	0.36	7
21-May-17		water is up	15.0	4.0	62.2	25.4	61.8	3.66	2.87	-	2.87	6.9
23-May-17		water is very high	20.0	6.0	43.1	20.1	47.4	26.00	26.40	42.50	42.50	6.8
25-May-17		water is dropping	16.0	6.0	47.5	20.2	52.8	1.41	1.04	-	1.04	6.7
30-May-17		highest water ever	22.0	7.0	42.8	20.2	47.1	10.90	10.70	13.70	13.70	6.8
2-Jun-17			26.0	11.0	48.8	20.2	53.7	0.27	0.25	-	0.25	6.7
2-Jun-17			17.0	6.0	35.8	22.9	37.4	1.17	1.58	-	1.58	6.7
5-Jun-17			22.0	7.0	45.7	24.1	46.2	0.30	0.41	-	0.41	6.7
11-Jun-17			20.0	7.0	47.3	25.6	46.7	0.36	0.25	-	0.25	6.6
15-Jun-17			15.0	6.0	46.4	22.0	49.2	0.56	0.33	-	0.33	6.7
18-Jun-17			16.0	6.0	42.0	21.9	44.6	0.35	0.37	-	0.37	6.7
3-Jul-17			28.0	12.0	48.6	22.4	51.2	0.17	0.21	-	0.21	6.7
29-Jul-17			22.0	10.0	50.6	22.3	53.3	0.33	0.43	-	0.43	6.7

Appendix B

To a report entitled
Springer Creek Water Quality Monitoring Report

Water Chemistry Data

Client: Slocan River Streamkeepers, RDCK, City of Slocan

Re: Water and Sediment Testing in Springer Creek

Date: December 12, 2017

Samples of water were collected from Springer Creek on June 6, August 7th and October 24th and tested for metals. One sediment sample was collected on October 24th. The test results are reported below.

Sample Collection and Methods of Testing:

The samples were collected in the Springer Creek channel just above the Main Street bridge in Slocan City. Water samples were collected in bottles containing preservative. The samples were sent to CARO Analytical Services, Kelowna where they were tested in accordance with methods for the Examination of Water and Wastewater", 22st Edition. American Public Health Association. Metals were tested by ICPMS in water

Results of Testing:

A review of selected metals levels in mg/liter in the water samples are given:

Metal	June 2, 2017	August 8, 2017	October 24, 2017	Guideline
Aluminum	0.552	0.0211	0.0085	<0.1 (OG)
Arsenic	0.00055	<0.00050	<0.00050	0.01 (MAC)
Cadmium	0.000142	0.000090	0.000073	0.005(MAC)
Copper	0.00073	0.00036	<0.00040	< 1 (MAC)
Iron	0.734	0.013	<0.010	<0.3 (AO)
Lead	0.00233	<0.00010	<0.00020	0.01 (MAC)
Nickel	0.00056	<0.00020	<0.00040	N/A (MAC)
Zinc	0.0153	<0.0132	0.0137	<5 (AO)

MAC = Maximum allowable concentration (health concerns)

AO = Aesthetic objectives

OG = Operational objectives

< = less than

The review indicates two exceedances (Aluminum, June 2nd and Iron, June 2nd) Neither exceedance would be considered a health hazard. It is interesting to note that generally, we see measurable levels of metals in the Spring rather than Fall. This may be due to sediment released during freshet.

Water and Sediment Testing in Springer Creek cont.

Results of Testing:

One sample of sediment was taken in the Springer Creek channel (above the bridge) on October 24th.

It is useful to look at metals in sediment because they represent a historic view of levels and indicate possible impacts to aquatic life. The guidelines are taken from BC MOE Working Guidelines for Sediments and cited as LEL (lowest effect level).

A review of selected metals (mg/kg dry) in sediment:

Metal	October 24, 2017	Guideline
Aluminum	4,540	N/A
Arsenic	2.19	5.9
Cadmium	0.591	0.6
Copper	5.08	35.7
Iron	11,600	21,200
Lead	10.9	35
Manganese	215	460
Silver	0.21	0.5
Selenium	0.21	5
Nickel	4.39	16
Zinc	117	123

While Cadmium is close to the guidelines, all other metals are below the lowest effect level. In summary, it is likely no harmful effects to aquatic life from metals in the sediment will be observed in Springer Creek.

Respectfully Submitted

Jennifer Yeow
Passmore Laboratory

CERTIFICATE OF ANALYSIS

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ATTENTION Jennifer Yeow

WORK ORDER 7060827

PO NUMBER

RECEIVED / TEMP 2017-06-09 12:03 / 20°C

PROJECT Slocan

REPORTED 2017-06-15

PROJECT INFO

COC NUMBER No Number

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.



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Slocan

WORK ORDER REPORTED 7060827
2017-06-15

Analysis Description	Method Reference	Technique	Location
Hardness (as CaCO ₃) in Water	APHA 2340 B*	Calculation: 2.497 [total Ca] + 4.118 [total Mg] (Estimated)	N/A
Total Metals by ICPMS in Water	APHA 3030 E* / APHA 3125 B	HNO ₃ +HCl Hot Block Digestion / Inductively Coupled Plasma Mass Spectrometry (ICP-MS)	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Method Reference Descriptions:

APHA Standard Methods for the Examination of Water and Wastewater, 22nd Edition, American Public Health Association/American Water Works Association/Water Environment Federation

Glossary of Terms:

MRL	Method Reporting Limit
<	Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
AO	Aesthetic objective
MAC	Maximum acceptable concentration (health based)
OG	Operational guideline (treated water)
mg/L	Milligrams per litre

Standards / Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Feb 2017)

Website: http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom-eng.pdf

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

SAMPLE ANALYTICAL DATA

REPORTED TO PROJECT Passmore Laboratory Ltd
Slocan

WORK ORDER REPORTED 7060827
2017-06-15

Analyte	Result / Recovery	Standard / Guideline	MRL / Limits	Units	Prepared	Analyzed	Notes
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Sample ID: Springer Creek (7060827-01) [Water] Sampled: 2017-06-02 14:00

Calculated Parameters

Hardness, Total (as CaCO ₃)	17.2	N/A	0.500	mg/L	N/A	N/A	
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Total Metals

Aluminum, total	0.552	OG < 0.1	0.0050	mg/L	2017-06-12	2017-06-13	
Antimony, total	0.00010	MAC = 0.006	0.00010	mg/L	2017-06-12	2017-06-13	
Arsenic, total	0.00055	MAC = 0.01	0.00050	mg/L	2017-06-12	2017-06-13	
Barium, total	0.0134	MAC = 1	0.0050	mg/L	2017-06-12	2017-06-13	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2017-06-12	2017-06-13	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2017-06-12	2017-06-13	
Boron, total	< 0.004	MAC = 5	0.004	mg/L	2017-06-12	2017-06-13	
Cadmium, total	0.000142	MAC = 0.005	0.000010	mg/L	2017-06-12	2017-06-13	
Calcium, total	5.42	N/A	0.20	mg/L	2017-06-12	2017-06-13	
Chromium, total	0.00072	MAC = 0.05	0.00050	mg/L	2017-06-12	2017-06-13	
Cobalt, total	0.00023	N/A	0.00010	mg/L	2017-06-12	2017-06-13	
Copper, total	0.00073	AO ≤ 1	0.00020	mg/L	2017-06-12	2017-06-13	
Iron, total	0.734	AO ≤ 0.3	0.010	mg/L	2017-06-12	2017-06-13	
Lead, total	0.00233	MAC = 0.01	0.00010	mg/L	2017-06-12	2017-06-13	
Lithium, total	0.00155	N/A	0.00010	mg/L	2017-06-12	2017-06-13	
Magnesium, total	0.885	N/A	0.010	mg/L	2017-06-12	2017-06-13	
Manganese, total	0.0260	AO ≤ 0.05	0.00020	mg/L	2017-06-12	2017-06-13	
Molybdenum, total	0.00049	N/A	0.00010	mg/L	2017-06-12	2017-06-13	
Nickel, total	0.00056	N/A	0.00020	mg/L	2017-06-12	2017-06-13	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2017-06-12	2017-06-13	
Potassium, total	0.46	N/A	0.02	mg/L	2017-06-12	2017-06-13	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2017-06-12	2017-06-13	
Silicon, total	3.6	N/A	1.0	mg/L	2017-06-12	2017-06-13	
Silver, total	0.000097	N/A	0.000050	mg/L	2017-06-12	2017-06-13	
Sodium, total	0.73	AO ≤ 200	0.02	mg/L	2017-06-12	2017-06-13	
Strontium, total	0.0549	N/A	0.0010	mg/L	2017-06-12	2017-06-13	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2017-06-12	2017-06-13	
Tellurium, total	< 0.00020	N/A	0.00020	mg/L	2017-06-12	2017-06-13	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2017-06-12	2017-06-13	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2017-06-12	2017-06-13	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2017-06-12	2017-06-13	
Titanium, total	0.0167	N/A	0.0050	mg/L	2017-06-12	2017-06-13	
Uranium, total	0.000544	MAC = 0.02	0.000020	mg/L	2017-06-12	2017-06-13	
Vanadium, total	0.0015	N/A	0.0010	mg/L	2017-06-12	2017-06-13	
Zinc, total	0.0153	AO ≤ 5	0.0040	mg/L	2017-06-12	2017-06-13	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2017-06-12	2017-06-13	

APPENDIX 1: QUALITY CONTROL DATA

REPORTED TO Passmore Laboratory Ltd
PROJECT Slocan

WORK ORDER 7060827
REPORTED 2017-06-15

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk):** Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup):** Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS):** A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM):** A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Total Metals, Batch B7F0921

Blank (B7F0921-BLK1)

Prepared: 2017-06-12, Analyzed: 2017-06-13

Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00010	0.00010 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Beryllium, total	< 0.00010	0.00010 mg/L							
Bismuth, total	< 0.00010	0.00010 mg/L							
Boron, total	< 0.004	0.004 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00020	0.00020 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00010	0.00010 mg/L							
Lithium, total	< 0.00010	0.00010 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00020	0.00020 mg/L							
Phosphorus, total	< 0.050	0.050 mg/L							
Potassium, total	< 0.02	0.02 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Silicon, total	< 1.0	1.0 mg/L							
Silver, total	< 0.000050	0.000050 mg/L							
Sodium, total	< 0.02	0.02 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Sulfur, total	< 3.0	3.0 mg/L							
Tellurium, total	< 0.00020	0.00020 mg/L							
Thallium, total	< 0.000020	0.000020 mg/L							
Thorium, total	< 0.00010	0.00010 mg/L							
Tin, total	< 0.00020	0.00020 mg/L							
Titanium, total	< 0.0050	0.0050 mg/L							

APPENDIX 1: QUALITY CONTROL DATA

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Slocan

WORK ORDER REPORTED 7060827
2017-06-15

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Total Metals, Batch B7F0921, Continued

Blank (B7F0921-BLK1), Continued

Prepared: 2017-06-12, Analyzed: 2017-06-13

Uranium, total	< 0.000020	0.000020 mg/L							
Vanadium, total	< 0.0010	0.0010 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
Zirconium, total	< 0.00010	0.00010 mg/L							

Reference (B7F0921-SRM1)

Prepared: 2017-06-12, Analyzed: 2017-06-13

Aluminum, total	0.300	0.0050 mg/L	0.303		99	81-129			
Antimony, total	0.0505	0.00010 mg/L	0.0511		99	88-114			
Arsenic, total	0.118	0.00050 mg/L	0.118		100	88-114			
Barium, total	0.782	0.0050 mg/L	0.823		95	72-104			
Beryllium, total	0.0506	0.00010 mg/L	0.0496		102	76-131			
Boron, total	3.39	0.004 mg/L	3.45		98	75-121			
Cadmium, total	0.0502	0.000010 mg/L	0.0495		101	89-111			
Calcium, total	11.4	0.20 mg/L	11.6		98	86-121			
Chromium, total	0.247	0.00050 mg/L	0.250		99	89-114			
Cobalt, total	0.0384	0.00010 mg/L	0.0377		102	91-113			
Copper, total	0.509	0.00020 mg/L	0.486		105	91-115			
Iron, total	0.498	0.010 mg/L	0.488		102	77-124			
Lead, total	0.201	0.00010 mg/L	0.204		99	92-113			
Lithium, total	0.397	0.00010 mg/L	0.403		98	85-115			
Magnesium, total	3.84	0.010 mg/L	3.79		101	78-120			
Manganese, total	0.107	0.00020 mg/L	0.109		99	90-114			
Molybdenum, total	0.191	0.00010 mg/L	0.198		96	90-111			
Nickel, total	0.251	0.00020 mg/L	0.249		101	90-111			
Phosphorus, total	0.211	0.050 mg/L	0.227		93	85-115			
Potassium, total	7.28	0.02 mg/L	7.21		101	84-113			
Selenium, total	0.131	0.00050 mg/L	0.121		108	85-115			
Sodium, total	7.52	0.02 mg/L	7.54		100	82-123			
Strontium, total	0.367	0.0010 mg/L	0.375		98	88-112			
Thallium, total	0.0819	0.000020 mg/L	0.0805		102	91-114			
Uranium, total	0.0297	0.000020 mg/L	0.0306		97	85-120			
Vanadium, total	0.372	0.0010 mg/L	0.386		96	86-111			
Zinc, total	2.58	0.0040 mg/L	2.49		104	85-111			

CERTIFICATE OF ANALYSIS

REPORTED TO Passmore Laboratory Ltd
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ATTENTION Jennifer Yeow

WORK ORDER 7081129

PO NUMBER

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PROJECT Slocan

REPORTED 2017-08-18

PROJECT INFO

COC NUMBER No Number

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.



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Slocan

WORK ORDER REPORTED 7081129
2017-08-18

Analysis Description	Method Reference	Technique	Location
Hardness (as CaCO ₃) in Water	APHA 2340 B*	Calculation: 2.497 [total Ca] + 4.118 [total Mg] (Estimated)	N/A
Total Metals by ICPMS in Water	APHA 3030 E* / APHA 3125 B	HNO ₃ +HCl Hot Block Digestion / Inductively Coupled Plasma Mass Spectrometry (ICP-MS)	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Method Reference Descriptions:

APHA Standard Methods for the Examination of Water and Wastewater, 22nd Edition, American Public Health Association/American Water Works Association/Water Environment Federation

Glossary of Terms:

MRL Method Reporting Limit
 < Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
 AO Aesthetic objective
 MAC Maximum acceptable concentration (health based)
 OG Operational guideline (treated water)
 mg/L Milligrams per litre

Standards / Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Feb 2017)

Website: http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom-eng.pdf

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

SAMPLE ANALYTICAL DATA

REPORTED TO PROJECT Passmore Laboratory Ltd
Slocan

WORK ORDER REPORTED 7081129
2017-08-18

Analyte	Result / Recovery	Standard / Guideline	MRL / Limits	Units	Prepared	Analyzed	Notes
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Sample ID: Springer Creek (7081129-01) [Water] Sampled: 2017-08-07 13:10

Calculated Parameters

Hardness, Total (as CaCO ₃)	41.7	N/A	0.500	mg/L	N/A	N/A	
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Total Metals

Aluminum, total	0.0211	OG < 0.1	0.0050	mg/L	2017-08-15	2017-08-17	
Antimony, total	< 0.00010	MAC = 0.006	0.00010	mg/L	2017-08-15	2017-08-17	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2017-08-15	2017-08-17	
Barium, total	0.0136	MAC = 1	0.0050	mg/L	2017-08-15	2017-08-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Boron, total	< 0.0050	MAC = 5	0.0050	mg/L	2017-08-15	2017-08-17	
Cadmium, total	0.000090	MAC = 0.005	0.000010	mg/L	2017-08-15	2017-08-17	
Calcium, total	13.4	N/A	0.20	mg/L	2017-08-15	2017-08-17	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2017-08-15	2017-08-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Copper, total	0.00036	AO ≤ 1	0.00020	mg/L	2017-08-15	2017-08-17	
Iron, total	0.013	AO ≤ 0.3	0.010	mg/L	2017-08-15	2017-08-17	
Lead, total	< 0.00010	MAC = 0.01	0.00010	mg/L	2017-08-15	2017-08-17	
Lithium, total	0.00130	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Magnesium, total	1.96	N/A	0.010	mg/L	2017-08-15	2017-08-17	
Manganese, total	0.00070	AO ≤ 0.05	0.00020	mg/L	2017-08-15	2017-08-17	
Molybdenum, total	0.00134	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Nickel, total	< 0.00020	N/A	0.00020	mg/L	2017-08-15	2017-08-17	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2017-08-15	2017-08-17	
Potassium, total	0.67	N/A	0.10	mg/L	2017-08-15	2017-08-17	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2017-08-15	2017-08-17	
Silicon, total	3.7	N/A	1.0	mg/L	2017-08-15	2017-08-17	
Silver, total	< 0.000050	N/A	0.000050	mg/L	2017-08-15	2017-08-17	
Sodium, total	1.56	AO ≤ 200	0.10	mg/L	2017-08-15	2017-08-17	
Strontium, total	0.133	N/A	0.0010	mg/L	2017-08-15	2017-08-17	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2017-08-15	2017-08-17	
Tellurium, total	< 0.00020	N/A	0.00020	mg/L	2017-08-15	2017-08-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2017-08-15	2017-08-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2017-08-15	2017-08-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2017-08-15	2017-08-17	
Uranium, total	0.000517	MAC = 0.02	0.000020	mg/L	2017-08-15	2017-08-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2017-08-15	2017-08-17	
Zinc, total	0.0132	AO ≤ 5	0.0040	mg/L	2017-08-15	2017-08-17	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	

Sample ID: Lemon Creek (7081129-02) [Water] Sampled: 2017-08-07 13:30

Calculated Parameters

Hardness, Total (as CaCO ₃)	34.2	N/A	0.500	mg/L	N/A	N/A	
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Total Metals

SAMPLE ANALYTICAL DATA

REPORTED TO PROJECT Passmore Laboratory Ltd
Slocan

WORK ORDER REPORTED 7081129
2017-08-18

Analyte	Result / Recovery	Standard / Guideline	MRL / Limits	Units	Prepared	Analyzed	Notes
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Sample ID: Lemon Creek (7081129-02) [Water] Sampled: 2017-08-07 13:30, Continued

Total Metals, Continued

Aluminum, total	0.0147	OG < 0.1	0.0050	mg/L	2017-08-15	2017-08-17	
Antimony, total	< 0.00010	MAC = 0.006	0.00010	mg/L	2017-08-15	2017-08-17	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2017-08-15	2017-08-17	
Barium, total	0.0097	MAC = 1	0.0050	mg/L	2017-08-15	2017-08-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Boron, total	< 0.0050	MAC = 5	0.0050	mg/L	2017-08-15	2017-08-17	
Cadmium, total	0.000011	MAC = 0.005	0.000010	mg/L	2017-08-15	2017-08-17	
Calcium, total	11.5	N/A	0.20	mg/L	2017-08-15	2017-08-17	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2017-08-15	2017-08-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Copper, total	< 0.00020	AO ≤ 1	0.00020	mg/L	2017-08-15	2017-08-17	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2017-08-15	2017-08-17	
Lead, total	< 0.00010	MAC = 0.01	0.00010	mg/L	2017-08-15	2017-08-17	
Lithium, total	0.00115	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Magnesium, total	1.32	N/A	0.010	mg/L	2017-08-15	2017-08-17	
Manganese, total	0.00048	AO ≤ 0.05	0.00020	mg/L	2017-08-15	2017-08-17	
Molybdenum, total	0.00220	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Nickel, total	< 0.00020	N/A	0.00020	mg/L	2017-08-15	2017-08-17	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2017-08-15	2017-08-17	
Potassium, total	0.85	N/A	0.10	mg/L	2017-08-15	2017-08-17	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2017-08-15	2017-08-17	
Silicon, total	3.5	N/A	1.0	mg/L	2017-08-15	2017-08-17	
Silver, total	< 0.000050	N/A	0.000050	mg/L	2017-08-15	2017-08-17	
Sodium, total	1.51	AO ≤ 200	0.10	mg/L	2017-08-15	2017-08-17	
Strontium, total	0.0910	N/A	0.0010	mg/L	2017-08-15	2017-08-17	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2017-08-15	2017-08-17	
Tellurium, total	< 0.00020	N/A	0.00020	mg/L	2017-08-15	2017-08-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2017-08-15	2017-08-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2017-08-15	2017-08-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2017-08-15	2017-08-17	
Uranium, total	0.00190	MAC = 0.02	0.000020	mg/L	2017-08-15	2017-08-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2017-08-15	2017-08-17	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2017-08-15	2017-08-17	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2017-08-15	2017-08-17	

APPENDIX 1: QUALITY CONTROL DATA

REPORTED TO PROJECT Passmore Laboratory Ltd
Slocan

WORK ORDER REPORTED 7081129
2017-08-18

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk):** Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup):** Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS):** A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM):** A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Total Metals, Batch B7H1108

Blank (B7H1108-BLK1)

Prepared: 2017-08-15, Analyzed: 2017-08-17

Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00010	0.00010 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Beryllium, total	< 0.00010	0.00010 mg/L							
Bismuth, total	< 0.00010	0.00010 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00020	0.00020 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00010	0.00010 mg/L							
Lithium, total	< 0.00010	0.00010 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00020	0.00020 mg/L							
Phosphorus, total	< 0.050	0.050 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Silicon, total	< 1.0	1.0 mg/L							
Silver, total	< 0.000050	0.000050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Sulfur, total	< 3.0	3.0 mg/L							
Tellurium, total	< 0.00020	0.00020 mg/L							
Thallium, total	< 0.000020	0.000020 mg/L							
Thorium, total	< 0.00010	0.00010 mg/L							
Tin, total	< 0.00020	0.00020 mg/L							
Titanium, total	< 0.0050	0.0050 mg/L							

APPENDIX 1: QUALITY CONTROL DATA

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WORK ORDER REPORTED 7081129
2017-08-18

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Total Metals, Batch B7H1108, Continued									
Blank (B7H1108-BLK1), Continued					Prepared: 2017-08-15, Analyzed: 2017-08-17				
Uranium, total	< 0.000020	0.000020 mg/L							
Vanadium, total	< 0.0010	0.0010 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
Zirconium, total	< 0.00010	0.00010 mg/L							
LCS (B7H1108-BS1)					Prepared: 2017-08-15, Analyzed: 2017-08-17				
Aluminum, total	0.0222	0.0050 mg/L	0.0200		111	80-120			
Antimony, total	0.0189	0.00010 mg/L	0.0200		94	80-120			
Arsenic, total	0.0188	0.00050 mg/L	0.0200		94	80-120			
Barium, total	0.0182	0.0050 mg/L	0.0200		91	80-120			
Beryllium, total	0.0210	0.00010 mg/L	0.0200		105	80-120			
Bismuth, total	0.0208	0.00010 mg/L	0.0200		104	80-120			
Boron, total	0.0208	0.0050 mg/L	0.0200		104	80-120			
Cadmium, total	0.0194	0.000010 mg/L	0.0200		97	80-120			
Calcium, total	2.04	0.20 mg/L	2.00		102	80-120			
Chromium, total	0.0200	0.00050 mg/L	0.0200		100	80-120			
Cobalt, total	0.0204	0.00010 mg/L	0.0200		102	80-120			
Copper, total	0.0216	0.00020 mg/L	0.0200		108	80-120			
Iron, total	1.96	0.010 mg/L	2.00		98	80-120			
Lead, total	0.0206	0.00010 mg/L	0.0200		103	80-120			
Lithium, total	0.0209	0.00010 mg/L	0.0200		104	80-120			
Magnesium, total	2.32	0.010 mg/L	2.00		116	80-120			
Manganese, total	0.0192	0.00020 mg/L	0.0200		96	80-120			
Molybdenum, total	0.0184	0.00010 mg/L	0.0200		92	80-120			
Nickel, total	0.0200	0.00020 mg/L	0.0200		100	80-120			
Phosphorus, total	2.13	0.050 mg/L	2.00		107	80-120			
Potassium, total	2.26	0.10 mg/L	2.00		113	80-120			
Selenium, total	0.0226	0.00050 mg/L	0.0200		113	80-120			
Silicon, total	1.9	1.0 mg/L	2.00		97	80-120			
Silver, total	0.0202	0.000050 mg/L	0.0200		101	80-120			
Sodium, total	2.34	0.10 mg/L	2.40		98	80-120			
Strontium, total	0.0183	0.0010 mg/L	0.0200		92	80-120			
Sulfur, total	5.5	3.0 mg/L	5.00		110	80-120			
Tellurium, total	0.0192	0.00020 mg/L	0.0200		96	80-120			
Thallium, total	0.0207	0.000020 mg/L	0.0200		103	80-120			
Thorium, total	0.0198	0.00010 mg/L	0.0200		99	80-120			
Tin, total	0.0195	0.00020 mg/L	0.0200		97	80-120			
Titanium, total	0.0203	0.0050 mg/L	0.0200		102	80-120			
Uranium, total	0.0203	0.000020 mg/L	0.0200		101	80-120			
Vanadium, total	0.0196	0.0010 mg/L	0.0200		98	80-120			
Zinc, total	0.0207	0.0040 mg/L	0.0200		104	80-120			
Zirconium, total	0.0204	0.00010 mg/L	0.0200		102	80-120			
Reference (B7H1108-SRM1)					Prepared: 2017-08-15, Analyzed: 2017-08-17				
Aluminum, total	0.313	0.0050 mg/L	0.303		103	82-114			
Antimony, total	0.0472	0.00010 mg/L	0.0511		92	88-115			
Arsenic, total	0.110	0.00050 mg/L	0.118		94	88-111			
Barium, total	0.704	0.0050 mg/L	0.823		86	83-108			
Beryllium, total	0.0464	0.00010 mg/L	0.0496		94	80-119			
Boron, total	3.12	0.0050 mg/L	3.45		90	80-118			
Cadmium, total	0.0463	0.000010 mg/L	0.0495		94	90-110			
Calcium, total	10.5	0.20 mg/L	11.6		91	85-113			
Chromium, total	0.249	0.00050 mg/L	0.250		100	88-111			
Cobalt, total	0.0387	0.00010 mg/L	0.0377		103	93-114			
Copper, total	0.511	0.00020 mg/L	0.486		105	95-117			
Iron, total	0.489	0.010 mg/L	0.488		100	90-116			
Lead, total	0.189	0.00010 mg/L	0.204		93	91-110			

APPENDIX 1: QUALITY CONTROL DATA

REPORTED TO PROJECT Passmore Laboratory Ltd
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WORK ORDER REPORTED 7081129
2017-08-18

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Total Metals, Batch B7H1108, Continued									
Reference (B7H1108-SRM1), Continued					Prepared: 2017-08-15, Analyzed: 2017-08-17				
Lithium, total	0.369	0.00010 mg/L	0.403		92	79-118			
Magnesium, total	4.21	0.010 mg/L	3.79		111	88-116			
Manganese, total	0.102	0.00020 mg/L	0.109		94	88-108			
Molybdenum, total	0.185	0.00010 mg/L	0.198		94	88-110			
Nickel, total	0.250	0.00020 mg/L	0.249		100	91-112			
Phosphorus, total	0.220	0.050 mg/L	0.227		97	72-118			
Potassium, total	7.92	0.10 mg/L	7.21		110	87-116			
Selenium, total	0.132	0.00050 mg/L	0.121		109	92-122			
Sodium, total	8.53	0.10 mg/L	7.54		113	86-118			
Strontium, total	0.341	0.0010 mg/L	0.375		91	86-110			
Thallium, total	0.0761	0.000020 mg/L	0.0805		95	94-113			
Uranium, total	0.0280	0.000020 mg/L	0.0306		91	88-112			
Vanadium, total	0.376	0.0010 mg/L	0.386		97	87-109			
Zinc, total	2.40	0.0040 mg/L	2.49		96	90-113			

CERTIFICATE OF ANALYSIS

REPORTED TO Passmore Laboratory Ltd
4240 Passmore Upper Road
Winlaw, BC V0G 2J0

ATTENTION Jennifer Yeow

PO NUMBER

PROJECT Springer Creek

PROJECT INFO

WORK ORDER 7110236

RECEIVED / TEMP 2017-11-01 08:30 / 7°C

REPORTED 2017-11-15 15:07

COC NUMBER No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

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If you have any questions or concerns, please contact me at kmckeown@caro.ca

Authorized By:

Kristin McKeown
Account Manager



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TEST RESULTS

REPORTED TO PROJECT Passmore Laboratory Ltd
Springer Creek

CARO WO# REPORTED 7110236
2017-11-15 15:07

Analyte	Result	RL	Units	Analyzed	Qualifier
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Springer Creek Bridge (7110236-01) | Matrix: Water | Sampled: 2017-10-24 11:00

Calculated Parameters

Hardness, Total (as CaCO ₃)	41.4	0.500	mg/L	N/A	
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Total Metals

Aluminum, total	0.0085	0.0050	mg/L	2017-11-06	
Antimony, total	< 0.00020	0.00020	mg/L	2017-11-06	
Arsenic, total	< 0.00050	0.00050	mg/L	2017-11-06	
Barium, total	0.0145	0.0050	mg/L	2017-11-06	
Beryllium, total	< 0.00010	0.00010	mg/L	2017-11-06	
Bismuth, total	< 0.00010	0.00010	mg/L	2017-11-06	
Boron, total	0.0098	0.0050	mg/L	2017-11-06	
Cadmium, total	0.000073	0.000010	mg/L	2017-11-06	
Calcium, total	13.4	0.20	mg/L	2017-11-06	
Chromium, total	< 0.00050	0.00050	mg/L	2017-11-06	
Cobalt, total	< 0.00010	0.00010	mg/L	2017-11-06	
Copper, total	< 0.00040	0.00040	mg/L	2017-11-06	
Iron, total	< 0.010	0.010	mg/L	2017-11-06	
Lead, total	< 0.00020	0.00020	mg/L	2017-11-06	
Lithium, total	0.00091	0.00010	mg/L	2017-11-06	
Magnesium, total	1.89	0.010	mg/L	2017-11-06	
Manganese, total	0.00079	0.00020	mg/L	2017-11-06	
Molybdenum, total	0.00129	0.00010	mg/L	2017-11-06	
Nickel, total	< 0.00040	0.00040	mg/L	2017-11-06	
Phosphorus, total	< 0.050	0.050	mg/L	2017-11-06	
Potassium, total	0.60	0.10	mg/L	2017-11-06	
Selenium, total	< 0.00050	0.00050	mg/L	2017-11-06	
Silicon, total	3.2	1.0	mg/L	2017-11-06	
Silver, total	< 0.000050	0.000050	mg/L	2017-11-06	
Sodium, total	1.55	0.10	mg/L	2017-11-06	
Strontium, total	0.141	0.0010	mg/L	2017-11-06	
Sulfur, total	< 3.0	3.0	mg/L	2017-11-06	
Tellurium, total	< 0.00050	0.00050	mg/L	2017-11-06	
Thallium, total	< 0.000020	0.000020	mg/L	2017-11-06	
Thorium, total	< 0.00010	0.00010	mg/L	2017-11-06	
Tin, total	< 0.00020	0.00020	mg/L	2017-11-06	
Titanium, total	< 0.0050	0.0050	mg/L	2017-11-06	
Tungsten, total	< 0.0010	0.0010	mg/L	2017-11-06	
Uranium, total	0.000545	0.000020	mg/L	2017-11-06	
Vanadium, total	< 0.0010	0.0010	mg/L	2017-11-06	
Zinc, total	0.0137	0.0040	mg/L	2017-11-06	
Zirconium, total	< 0.00010	0.00010	mg/L	2017-11-06	

Springer Creek Sediment (7110236-02) | Matrix: Soil | Sampled: 2017-10-24 11:00

TEST RESULTS

REPORTED TO PROJECT Passmore Laboratory Ltd
Springer Creek

CARO WO# REPORTED 7110236
2017-11-15 15:07

Analyte	Result	RL	Units	Analyzed	Qualifier
Springer Creek Sediment (7110236-02) Matrix: Soil Sampled: 2017-10-24 11:00, Continued					
Strong Acid Leachable Metals					
Aluminum	4540	40	mg/kg dry	2017-11-14	
Antimony	0.13	0.10	mg/kg dry	2017-11-14	
Arsenic	2.19	0.30	mg/kg dry	2017-11-14	
Barium	38.6	1.0	mg/kg dry	2017-11-14	
Beryllium	0.26	0.10	mg/kg dry	2017-11-14	
Bismuth	0.17	0.10	mg/kg dry	2017-11-14	
Boron	< 2.0	2.0	mg/kg dry	2017-11-14	
Cadmium	0.591	0.040	mg/kg dry	2017-11-14	
Calcium	1910	100	mg/kg dry	2017-11-14	
Chromium	7.0	1.0	mg/kg dry	2017-11-14	
Cobalt	3.81	0.10	mg/kg dry	2017-11-14	
Copper	5.08	0.40	mg/kg dry	2017-11-14	
Iron	11600	20	mg/kg dry	2017-11-14	
Lead	10.9	0.20	mg/kg dry	2017-11-14	
Lithium	15.2	0.10	mg/kg dry	2017-11-14	
Magnesium	2730	10	mg/kg dry	2017-11-14	
Manganese	215	0.40	mg/kg dry	2017-11-14	
Mercury	< 0.040	0.040	mg/kg dry	2017-11-14	
Molybdenum	0.46	0.10	mg/kg dry	2017-11-14	
Nickel	4.39	0.60	mg/kg dry	2017-11-14	
Phosphorus	526	10	mg/kg dry	2017-11-14	
Potassium	465	40	mg/kg dry	2017-11-14	
Selenium	0.21	0.20	mg/kg dry	2017-11-14	
Silver	0.21	0.10	mg/kg dry	2017-11-14	
Sodium	57	50	mg/kg dry	2017-11-14	
Strontium	12.2	0.20	mg/kg dry	2017-11-14	
Sulfur	< 1000	1000	mg/kg dry	2017-11-14	
Tellurium	< 0.10	0.10	mg/kg dry	2017-11-14	
Thallium	< 0.10	0.10	mg/kg dry	2017-11-14	
Thorium	6.29	0.50	mg/kg dry	2017-11-14	
Tin	< 0.20	0.20	mg/kg dry	2017-11-14	
Titanium	231	1.0	mg/kg dry	2017-11-14	
Tungsten	0.32	0.20	mg/kg dry	2017-11-14	
Uranium	1.13	0.050	mg/kg dry	2017-11-14	
Vanadium	19.7	1.0	mg/kg dry	2017-11-14	
Zinc	117	2.0	mg/kg dry	2017-11-14	
Zirconium	< 2.0	2.0	mg/kg dry	2017-11-14	

APPENDIX 1: SUPPORTING INFORMATION

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Analysis Description	Method Ref.	Technique	Location
Hardness in Water	SM 2340 B* (2011)	Calculation: 2.497 [total Ca] + 4.118 [total Mg] (Est)	N/A
SALM in Soil	BCMOE SALM V.2 / EPA 6020B	HNO ₃ +HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO ₃ +HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
mg/kg dry	Milligrams per kilogram (dry weight basis)
mg/L	Milligrams per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

APPENDIX 2: QUALITY CONTROL RESULTS

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Springer Creek

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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk):** A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup):** An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS):** A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS):** A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM):** A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Strong Acid Leachable Metals, Batch B7K1015

Blank (B7K1015-BLK1)			Prepared: 2017-11-14, Analyzed: 2017-11-14						
Aluminum	< 40	40 mg/kg dry							
Antimony	< 0.10	0.10 mg/kg dry							
Arsenic	< 0.30	0.30 mg/kg dry							
Barium	< 1.0	1.0 mg/kg dry							
Beryllium	< 0.10	0.10 mg/kg dry							
Bismuth	< 0.10	0.10 mg/kg dry							
Boron	< 2.0	2.0 mg/kg dry							
Cadmium	< 0.040	0.040 mg/kg dry							
Calcium	< 100	100 mg/kg dry							
Chromium	< 1.0	1.0 mg/kg dry							
Cobalt	< 0.10	0.10 mg/kg dry							
Copper	< 0.40	0.40 mg/kg dry							
Iron	< 20	20 mg/kg dry							
Lead	< 0.20	0.20 mg/kg dry							
Lithium	< 0.10	0.10 mg/kg dry							
Magnesium	< 10	10 mg/kg dry							
Manganese	< 0.40	0.40 mg/kg dry							
Mercury	< 0.040	0.040 mg/kg dry							
Molybdenum	< 0.10	0.10 mg/kg dry							
Nickel	< 0.60	0.60 mg/kg dry							
Phosphorus	< 10	10 mg/kg dry							
Potassium	< 40	40 mg/kg dry							
Selenium	< 0.20	0.20 mg/kg dry							
Silver	< 0.10	0.10 mg/kg dry							
Sodium	< 50	50 mg/kg dry							
Strontium	< 0.20	0.20 mg/kg dry							
Sulfur	< 1000	1000 mg/kg dry							
Tellurium	< 0.10	0.10 mg/kg dry							
Thallium	< 0.10	0.10 mg/kg dry							
Thorium	< 0.50	0.50 mg/kg dry							
Tin	< 0.20	0.20 mg/kg dry							
Titanium	< 1.0	1.0 mg/kg dry							
Tungsten	< 0.20	0.20 mg/kg dry							
Uranium	< 0.050	0.050 mg/kg dry							
Vanadium	< 1.0	1.0 mg/kg dry							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Passmore Laboratory Ltd
Springer Creek

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Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B7K1015, Continued									
Blank (B7K1015-BLK1), Continued					Prepared: 2017-11-14, Analyzed: 2017-11-14				
Zinc	< 2.0	2.0 mg/kg dry							
Zirconium	< 2.0	2.0 mg/kg dry							
Blank (B7K1015-BLK2)					Prepared: 2017-11-14, Analyzed: 2017-11-14				
Aluminum	< 40	40 mg/kg dry							
Antimony	< 0.10	0.10 mg/kg dry							
Arsenic	< 0.30	0.30 mg/kg dry							
Barium	< 1.0	1.0 mg/kg dry							
Beryllium	< 0.10	0.10 mg/kg dry							
Bismuth	< 0.10	0.10 mg/kg dry							
Boron	< 2.0	2.0 mg/kg dry							
Cadmium	< 0.040	0.040 mg/kg dry							
Calcium	< 100	100 mg/kg dry							
Chromium	< 1.0	1.0 mg/kg dry							
Cobalt	< 0.10	0.10 mg/kg dry							
Copper	< 0.40	0.40 mg/kg dry							
Iron	< 20	20 mg/kg dry							
Lead	< 0.20	0.20 mg/kg dry							
Lithium	< 0.10	0.10 mg/kg dry							
Magnesium	< 10	10 mg/kg dry							
Manganese	< 0.40	0.40 mg/kg dry							
Mercury	< 0.040	0.040 mg/kg dry							
Molybdenum	< 0.10	0.10 mg/kg dry							
Nickel	< 0.60	0.60 mg/kg dry							
Phosphorus	< 10	10 mg/kg dry							
Potassium	< 40	40 mg/kg dry							
Selenium	< 0.20	0.20 mg/kg dry							
Silver	< 0.10	0.10 mg/kg dry							
Sodium	< 50	50 mg/kg dry							
Strontium	< 0.20	0.20 mg/kg dry							
Sulfur	< 1000	1000 mg/kg dry							
Tellurium	< 0.10	0.10 mg/kg dry							
Thallium	< 0.10	0.10 mg/kg dry							
Thorium	< 0.50	0.50 mg/kg dry							
Tin	< 0.20	0.20 mg/kg dry							
Titanium	< 1.0	1.0 mg/kg dry							
Tungsten	< 0.20	0.20 mg/kg dry							
Uranium	< 0.050	0.050 mg/kg dry							
Vanadium	< 1.0	1.0 mg/kg dry							
Zinc	< 2.0	2.0 mg/kg dry							
Zirconium	< 2.0	2.0 mg/kg dry							
Blank (B7K1015-BLK3)					Prepared: 2017-11-14, Analyzed: 2017-11-15				
Aluminum	< 40	40 mg/kg dry							
Antimony	< 0.10	0.10 mg/kg dry							
Arsenic	< 0.30	0.30 mg/kg dry							
Barium	< 1.0	1.0 mg/kg dry							
Beryllium	< 0.10	0.10 mg/kg dry							
Bismuth	< 0.10	0.10 mg/kg dry							
Boron	< 2.0	2.0 mg/kg dry							
Cadmium	< 0.040	0.040 mg/kg dry							
Calcium	< 100	100 mg/kg dry							
Chromium	< 1.0	1.0 mg/kg dry							
Cobalt	< 0.10	0.10 mg/kg dry							
Copper	< 0.40	0.40 mg/kg dry							
Iron	< 20	20 mg/kg dry							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Passmore Laboratory Ltd
Springer Creek

CARO WO# 7110236
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Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Strong Acid Leachable Metals, Batch B7K1015, Continued

Blank (B7K1015-BLK3), Continued

Prepared: 2017-11-14, Analyzed: 2017-11-15

Lead	< 0.20	0.20 mg/kg dry							
Lithium	< 0.10	0.10 mg/kg dry							
Magnesium	< 10	10 mg/kg dry							
Manganese	< 0.40	0.40 mg/kg dry							
Mercury	< 0.040	0.040 mg/kg dry							
Molybdenum	< 0.10	0.10 mg/kg dry							
Nickel	< 0.60	0.60 mg/kg dry							
Phosphorus	< 10	10 mg/kg dry							
Potassium	< 40	40 mg/kg dry							
Selenium	< 0.20	0.20 mg/kg dry							
Silver	< 0.10	0.10 mg/kg dry							
Sodium	< 50	50 mg/kg dry							
Strontium	< 0.20	0.20 mg/kg dry							
Sulfur	< 1000	1000 mg/kg dry							
Tellurium	< 0.10	0.10 mg/kg dry							
Thallium	< 0.10	0.10 mg/kg dry							
Thorium	< 0.50	0.50 mg/kg dry							
Tin	< 0.20	0.20 mg/kg dry							
Titanium	< 1.0	1.0 mg/kg dry							
Tungsten	< 0.20	0.20 mg/kg dry							
Uranium	< 0.050	0.050 mg/kg dry							
Vanadium	< 1.0	1.0 mg/kg dry							
Zinc	< 2.0	2.0 mg/kg dry							
Zirconium	< 2.0	2.0 mg/kg dry							

LCS (B7K1015-BS1)

Prepared: 2017-11-14, Analyzed: 2017-11-14

Antimony	1.84	0.10 mg/kg dry	2.00		92	80-120			
Arsenic	1.78	0.30 mg/kg dry	2.00		89	80-120			
Barium	1.8	1.0 mg/kg dry	2.00		90	80-120			
Beryllium	1.98	0.10 mg/kg dry	2.00		99	80-120			
Bismuth	1.91	0.10 mg/kg dry	2.00		95	80-120			
Boron	< 2.0	2.0 mg/kg dry	2.00		97	80-120			
Cadmium	1.81	0.040 mg/kg dry	2.00		91	80-120			
Calcium	186	100 mg/kg dry	200		93	80-120			
Chromium	1.9	1.0 mg/kg dry	2.00		94	80-120			
Cobalt	1.87	0.10 mg/kg dry	2.00		94	80-120			
Copper	2.01	0.40 mg/kg dry	2.00		101	80-120			
Iron	191	20 mg/kg dry	200		96	80-120			
Lead	1.94	0.20 mg/kg dry	2.00		97	80-120			
Lithium	2.04	0.10 mg/kg dry	2.00		102	80-120			
Magnesium	205	10 mg/kg dry	200		103	80-120			
Manganese	1.80	0.40 mg/kg dry	2.00		90	80-120			
Mercury	0.082	0.040 mg/kg dry	0.100		82	80-120			
Molybdenum	1.80	0.10 mg/kg dry	2.00		90	80-120			
Nickel	1.86	0.60 mg/kg dry	2.00		93	80-120			
Phosphorus	182	10 mg/kg dry	200		91	80-120			
Potassium	175	40 mg/kg dry	200		88	80-120			
Selenium	1.88	0.20 mg/kg dry	2.00		94	80-120			
Silver	1.82	0.10 mg/kg dry	2.00		91	80-120			
Sodium	208	50 mg/kg dry	240		87	80-120			
Strontium	1.80	0.20 mg/kg dry	2.00		90	80-120			
Sulfur	< 1000	1000 mg/kg dry	500		111	80-120			
Tellurium	1.80	0.10 mg/kg dry	2.00		90	80-120			
Thallium	1.88	0.10 mg/kg dry	2.00		94	80-120			
Thorium	1.71	0.50 mg/kg dry	2.00		85	80-120			
Tin	1.82	0.20 mg/kg dry	2.00		91	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Passmore Laboratory Ltd
Springer Creek

CARO WO# 7110236
REPORTED 2017-11-15 15:07

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Strong Acid Leachable Metals, Batch B7K1015, Continued

LCS (B7K1015-BS1), Continued

Prepared: 2017-11-14, Analyzed: 2017-11-14

Titanium	1.9	1.0 mg/kg dry	2.00		96	80-120			
Tungsten	1.73	0.20 mg/kg dry	2.00		87	80-120			
Uranium	1.95	0.050 mg/kg dry	2.00		97	80-120			
Vanadium	1.8	1.0 mg/kg dry	2.00		88	80-120			
Zinc	2.0	2.0 mg/kg dry	2.00		102	80-120			
Zirconium	< 2.0	2.0 mg/kg dry	2.00		84	80-120			

LCS (B7K1015-BS2)

Prepared: 2017-11-14, Analyzed: 2017-11-14

Antimony	1.81	0.10 mg/kg dry	2.00		90	80-120			
Arsenic	1.80	0.30 mg/kg dry	2.00		90	80-120			
Barium	1.8	1.0 mg/kg dry	2.00		88	80-120			
Beryllium	1.91	0.10 mg/kg dry	2.00		96	80-120			
Bismuth	1.89	0.10 mg/kg dry	2.00		94	80-120			
Boron	< 2.0	2.0 mg/kg dry	2.00		97	80-120			
Cadmium	1.79	0.040 mg/kg dry	2.00		89	80-120			
Calcium	185	100 mg/kg dry	200		93	80-120			
Chromium	1.9	1.0 mg/kg dry	2.00		93	80-120			
Cobalt	1.86	0.10 mg/kg dry	2.00		93	80-120			
Copper	1.97	0.40 mg/kg dry	2.00		98	80-120			
Iron	188	20 mg/kg dry	200		94	80-120			
Lead	1.93	0.20 mg/kg dry	2.00		97	80-120			
Lithium	1.99	0.10 mg/kg dry	2.00		100	80-120			
Magnesium	203	10 mg/kg dry	200		101	80-120			
Manganese	1.82	0.40 mg/kg dry	2.00		91	80-120			
Mercury	0.085	0.040 mg/kg dry	0.100		85	80-120			
Molybdenum	1.78	0.10 mg/kg dry	2.00		89	80-120			
Nickel	1.85	0.60 mg/kg dry	2.00		93	80-120			
Phosphorus	186	10 mg/kg dry	200		93	80-120			
Potassium	175	40 mg/kg dry	200		88	80-120			
Selenium	1.87	0.20 mg/kg dry	2.00		93	80-120			
Silver	1.80	0.10 mg/kg dry	2.00		90	80-120			
Sodium	206	50 mg/kg dry	240		86	80-120			
Strontium	1.78	0.20 mg/kg dry	2.00		89	80-120			
Sulfur	< 1000	1000 mg/kg dry	500		104	80-120			
Tellurium	1.78	0.10 mg/kg dry	2.00		89	80-120			
Thallium	1.88	0.10 mg/kg dry	2.00		94	80-120			
Thorium	1.70	0.50 mg/kg dry	2.00		85	80-120			
Tin	1.81	0.20 mg/kg dry	2.00		91	80-120			
Titanium	2.0	1.0 mg/kg dry	2.00		99	80-120			
Tungsten	1.77	0.20 mg/kg dry	2.00		89	80-120			
Uranium	1.94	0.050 mg/kg dry	2.00		97	80-120			
Vanadium	1.8	1.0 mg/kg dry	2.00		89	80-120			
Zinc	2.0	2.0 mg/kg dry	2.00		102	80-120			
Zirconium	< 2.0	2.0 mg/kg dry	2.00		85	80-120			

LCS (B7K1015-BS3)

Prepared: 2017-11-14, Analyzed: 2017-11-15

Antimony	1.90	0.10 mg/kg dry	2.00		95	80-120			
Arsenic	1.76	0.30 mg/kg dry	2.00		88	80-120			
Barium	1.8	1.0 mg/kg dry	2.00		88	80-120			
Beryllium	1.94	0.10 mg/kg dry	2.00		97	80-120			
Bismuth	1.91	0.10 mg/kg dry	2.00		95	80-120			
Boron	2.0	2.0 mg/kg dry	2.00		98	80-120			
Cadmium	1.80	0.040 mg/kg dry	2.00		90	80-120			
Calcium	186	100 mg/kg dry	200		93	80-120			
Chromium	2.0	1.0 mg/kg dry	2.00		99	80-120			
Cobalt	1.87	0.10 mg/kg dry	2.00		94	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Passmore Laboratory Ltd
Springer Creek

CARO WO# 7110236
REPORTED 2017-11-15 15:07

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Strong Acid Leachable Metals, Batch B7K1015, Continued

LCS (B7K1015-BS3), Continued

Prepared: 2017-11-14, Analyzed: 2017-11-15

Copper	1.97	0.40 mg/kg dry	2.00		99	80-120			
Iron	192	20 mg/kg dry	200		96	80-120			
Lead	1.97	0.20 mg/kg dry	2.00		98	80-120			
Lithium	2.03	0.10 mg/kg dry	2.00		102	80-120			
Magnesium	201	10 mg/kg dry	200		101	80-120			
Manganese	2.32	0.40 mg/kg dry	2.00		116	80-120			
Mercury	0.082	0.040 mg/kg dry	0.100		82	80-120			
Molybdenum	1.80	0.10 mg/kg dry	2.00		90	80-120			
Nickel	1.93	0.60 mg/kg dry	2.00		96	80-120			
Phosphorus	180	10 mg/kg dry	200		90	80-120			
Potassium	166	40 mg/kg dry	200		83	80-120			
Selenium	1.88	0.20 mg/kg dry	2.00		94	80-120			
Silver	1.83	0.10 mg/kg dry	2.00		92	80-120			
Sodium	205	50 mg/kg dry	240		86	80-120			
Strontium	1.77	0.20 mg/kg dry	2.00		89	80-120			
Sulfur	< 1000	1000 mg/kg dry	500		87	80-120			
Tellurium	1.85	0.10 mg/kg dry	2.00		93	80-120			
Thallium	1.88	0.10 mg/kg dry	2.00		94	80-120			
Thorium	1.74	0.50 mg/kg dry	2.00		87	80-120			
Tin	1.86	0.20 mg/kg dry	2.00		93	80-120			
Titanium	2.0	1.0 mg/kg dry	2.00		100	80-120			
Tungsten	1.71	0.20 mg/kg dry	2.00		85	80-120			
Uranium	1.96	0.050 mg/kg dry	2.00		98	80-120			
Vanadium	1.8	1.0 mg/kg dry	2.00		89	80-120			
Zinc	2.1	2.0 mg/kg dry	2.00		104	80-120			
Zirconium	< 2.0	2.0 mg/kg dry	2.00		85	80-120			

Duplicate (B7K1015-DUP1)

Source: 7110236-02

Prepared: 2017-11-14, Analyzed: 2017-11-14

Aluminum	4880	40 mg/kg dry	4540		7	21			
Antimony	0.13	0.10 mg/kg dry	0.13			30			
Arsenic	4.96	0.30 mg/kg dry	2.19		77	30			RPD
Barium	33.3	1.0 mg/kg dry	38.6		15	35			
Beryllium	0.28	0.10 mg/kg dry	0.26			28			
Bismuth	< 0.10	0.10 mg/kg dry	0.17			30			
Boron	< 2.0	2.0 mg/kg dry	< 2.0			30			
Cadmium	0.823	0.040 mg/kg dry	0.591		33	30			RPD
Calcium	2360	100 mg/kg dry	1910		21	29			
Chromium	6.1	1.0 mg/kg dry	7.0		13	30			
Cobalt	3.54	0.10 mg/kg dry	3.81		7	30			
Copper	5.35	0.40 mg/kg dry	5.08		5	30			
Iron	14200	20 mg/kg dry	11600		21	21			
Lead	12.7	0.20 mg/kg dry	10.9		15	40			
Lithium	16.8	0.10 mg/kg dry	15.2		10	22			
Magnesium	2910	10 mg/kg dry	2730		7	20			
Manganese	234	0.40 mg/kg dry	215		8	27			
Mercury	< 0.040	0.040 mg/kg dry	< 0.040			40			
Molybdenum	0.55	0.10 mg/kg dry	0.46		19	40			
Nickel	3.32	0.60 mg/kg dry	4.39		28	30			
Phosphorus	720	10 mg/kg dry	526		31	25			RPD
Potassium	471	40 mg/kg dry	465		1	24			
Selenium	0.33	0.20 mg/kg dry	0.21			27			
Silver	0.23	0.10 mg/kg dry	0.21			40			
Sodium	66	50 mg/kg dry	57			27			
Strontium	12.8	0.20 mg/kg dry	12.2		5	30			
Sulfur	< 1000	1000 mg/kg dry	< 1000			28			
Tellurium	< 0.10	0.10 mg/kg dry	< 0.10			40			

APPENDIX 2: QUALITY CONTROL RESULTS

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2017-11-15 15:07

Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B7K1015, Continued									
Duplicate (B7K1015-DUP1), Continued		Source: 7110236-02		Prepared: 2017-11-14, Analyzed: 2017-11-14					
Thallium	< 0.10	0.10 mg/kg dry		< 0.10				30	
Thorium	2.40	0.50 mg/kg dry		6.29			89	30	
Tin	0.23	0.20 mg/kg dry		< 0.20				40	
Titanium	261	1.0 mg/kg dry		231			12	40	
Tungsten	< 0.20	0.20 mg/kg dry		0.32				40	
Uranium	1.22	0.050 mg/kg dry		1.13			7	30	
Vanadium	22.1	1.0 mg/kg dry		19.7			12	20	
Zinc	156	2.0 mg/kg dry		117			29	30	
Zirconium	< 2.0	2.0 mg/kg dry		< 2.0				40	
Reference (B7K1015-SRM1)		Prepared: 2017-11-14, Analyzed: 2017-11-14							
Aluminum	17300	40 mg/kg dry	17500		99	70-130			
Antimony	6.23	0.10 mg/kg dry	6.46		96	70-130			
Arsenic	15.2	0.30 mg/kg dry	15.1		101	70-130			
Barium	73.7	1.0 mg/kg dry	80.6		91	70-130			
Beryllium	0.51	0.10 mg/kg dry	0.522		97	70-130			
Bismuth	1.81	0.10 mg/kg dry	1.89		96	70-130			
Boron	2.7	2.0 mg/kg dry	3.00		88	70-130			
Cadmium	0.220	0.040 mg/kg dry	0.216		102	70-130			
Calcium	3040	100 mg/kg dry	3290		92	70-130			
Chromium	25.9	1.0 mg/kg dry	27.5		94	70-130			
Cobalt	11.8	0.10 mg/kg dry	12.4		95	70-130			
Copper	42.6	0.40 mg/kg dry	45.3		94	70-130			
Iron	30300	20 mg/kg dry	32600		93	70-130			
Lead	13.2	0.20 mg/kg dry	13.8		96	70-130			
Lithium	9.80	0.10 mg/kg dry	9.91		99	70-130			
Magnesium	5560	10 mg/kg dry	5770		96	70-130			
Manganese	1010	0.40 mg/kg dry	1090		93	70-130			
Mercury	0.084	0.040 mg/kg dry	0.103		81	70-130			
Molybdenum	0.65	0.10 mg/kg dry	0.731		89	70-130			
Nickel	16.3	0.60 mg/kg dry	17.4		94	70-130			
Phosphorus	753	10 mg/kg dry	756		100	70-130			
Potassium	470	40 mg/kg dry	631		74	70-130			
Sodium	336	50 mg/kg dry	388		87	70-130			
Strontium	10.5	0.20 mg/kg dry	11.5		91	70-130			
Thorium	3.38	0.50 mg/kg dry	3.61		94	70-130			
Tin	1.03	0.20 mg/kg dry	1.03		100	70-130			
Titanium	814	1.0 mg/kg dry	833		98	70-130			
Uranium	0.777	0.050 mg/kg dry	0.837		93	70-130			
Vanadium	50.5	1.0 mg/kg dry	54.9		92	70-130			
Zinc	62.0	2.0 mg/kg dry	66.8		93	70-130			
Reference (B7K1015-SRM2)		Prepared: 2017-11-14, Analyzed: 2017-11-14							
Aluminum	18400	40 mg/kg dry	17500		105	70-130			
Antimony	6.25	0.10 mg/kg dry	6.46		97	70-130			
Arsenic	15.8	0.30 mg/kg dry	15.1		105	70-130			
Barium	76.1	1.0 mg/kg dry	80.6		94	70-130			
Beryllium	0.51	0.10 mg/kg dry	0.522		99	70-130			
Bismuth	1.93	0.10 mg/kg dry	1.89		102	70-130			
Boron	3.0	2.0 mg/kg dry	3.00		102	70-130			
Cadmium	0.219	0.040 mg/kg dry	0.216		101	70-130			
Calcium	3180	100 mg/kg dry	3290		97	70-130			
Chromium	27.3	1.0 mg/kg dry	27.5		99	70-130			
Cobalt	12.3	0.10 mg/kg dry	12.4		99	70-130			
Copper	43.9	0.40 mg/kg dry	45.3		97	70-130			
Iron	31900	20 mg/kg dry	32600		98	70-130			

APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Strong Acid Leachable Metals, Batch B7K1015, Continued

Reference (B7K1015-SRM2), Continued				Prepared: 2017-11-14, Analyzed: 2017-11-14					
Lead	13.0	0.20 mg/kg dry	13.8		94	70-130			
Lithium	9.95	0.10 mg/kg dry	9.91		100	70-130			
Magnesium	5820	10 mg/kg dry	5770		101	70-130			
Manganese	1060	0.40 mg/kg dry	1090		97	70-130			
Mercury	0.086	0.040 mg/kg dry	0.103		84	70-130			
Molybdenum	0.69	0.10 mg/kg dry	0.731		94	70-130			
Nickel	17.2	0.60 mg/kg dry	17.4		99	70-130			
Phosphorus	809	10 mg/kg dry	756		107	70-130			
Potassium	511	40 mg/kg dry	631		81	70-130			
Sodium	369	50 mg/kg dry	388		95	70-130			
Strontium	11.1	0.20 mg/kg dry	11.5		96	70-130			
Thorium	3.66	0.50 mg/kg dry	3.61		101	70-130			
Tin	0.95	0.20 mg/kg dry	1.03		93	70-130			
Titanium	862	1.0 mg/kg dry	833		103	70-130			
Uranium	0.805	0.050 mg/kg dry	0.837		96	70-130			
Vanadium	53.2	1.0 mg/kg dry	54.9		97	70-130			
Zinc	64.0	2.0 mg/kg dry	66.8		96	70-130			

Reference (B7K1015-SRM3)				Prepared: 2017-11-14, Analyzed: 2017-11-15					
Aluminum	18600	40 mg/kg dry	17500		106	70-130			
Antimony	6.29	0.10 mg/kg dry	6.46		97	70-130			
Arsenic	15.9	0.30 mg/kg dry	15.1		105	70-130			
Barium	78.5	1.0 mg/kg dry	80.6		97	70-130			
Beryllium	0.54	0.10 mg/kg dry	0.522		103	70-130			
Bismuth	1.95	0.10 mg/kg dry	1.89		103	70-130			
Boron	2.9	2.0 mg/kg dry	3.00		95	70-130			
Cadmium	0.232	0.040 mg/kg dry	0.216		107	70-130			
Calcium	3340	100 mg/kg dry	3290		102	70-130			
Chromium	27.9	1.0 mg/kg dry	27.5		101	70-130			
Cobalt	12.5	0.10 mg/kg dry	12.4		101	70-130			
Copper	45.3	0.40 mg/kg dry	45.3		100	70-130			
Iron	32400	20 mg/kg dry	32600		99	70-130			
Lead	14.0	0.20 mg/kg dry	13.8		101	70-130			
Lithium	10.5	0.10 mg/kg dry	9.91		106	70-130			
Magnesium	6040	10 mg/kg dry	5770		105	70-130			
Manganese	1080	0.40 mg/kg dry	1090		99	70-130			
Mercury	0.102	0.040 mg/kg dry	0.103		99	70-130			
Molybdenum	0.67	0.10 mg/kg dry	0.731		91	70-130			
Nickel	17.6	0.60 mg/kg dry	17.4		101	70-130			
Phosphorus	816	10 mg/kg dry	756		108	70-130			
Potassium	504	40 mg/kg dry	631		80	70-130			
Sodium	381	50 mg/kg dry	388		98	70-130			
Strontium	12.0	0.20 mg/kg dry	11.5		104	70-130			
Thorium	3.65	0.50 mg/kg dry	3.61		101	70-130			
Tin	0.97	0.20 mg/kg dry	1.03		94	70-130			
Titanium	889	1.0 mg/kg dry	833		107	70-130			
Uranium	0.819	0.050 mg/kg dry	0.837		98	70-130			
Vanadium	53.9	1.0 mg/kg dry	54.9		98	70-130			
Zinc	65.8	2.0 mg/kg dry	66.8		98	70-130			

Total Metals, Batch B7K0408

Blank (B7K0408-BLK1)				Prepared: 2017-11-06, Analyzed: 2017-11-06					
Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00020	0.00020 mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
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Total Metals, Batch B7K0408, Continued

Blank (B7K0408-BLK1), Continued

Prepared: 2017-11-06, Analyzed: 2017-11-06

Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Beryllium, total	< 0.00010	0.00010 mg/L							
Bismuth, total	< 0.00010	0.00010 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00040	0.00040 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00020	0.00020 mg/L							
Lithium, total	< 0.00010	0.00010 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00040	0.00040 mg/L							
Phosphorus, total	< 0.050	0.050 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Silicon, total	< 1.0	1.0 mg/L							
Silver, total	< 0.000050	0.000050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Sulfur, total	< 3.0	3.0 mg/L							
Tellurium, total	< 0.00050	0.00050 mg/L							
Thallium, total	< 0.000020	0.000020 mg/L							
Thorium, total	< 0.00010	0.00010 mg/L							
Tin, total	< 0.00020	0.00020 mg/L							
Titanium, total	< 0.0050	0.0050 mg/L							
Tungsten, total	< 0.0010	0.0010 mg/L							
Uranium, total	< 0.000020	0.000020 mg/L							
Vanadium, total	< 0.0010	0.0010 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
Zirconium, total	< 0.00010	0.00010 mg/L							

LCS (B7K0408-BS1)

Prepared: 2017-11-06, Analyzed: 2017-11-06

Aluminum, total	0.0239	0.0050 mg/L	0.0200	119	80-120
Antimony, total	0.0199	0.00020 mg/L	0.0200	100	80-120
Arsenic, total	0.0207	0.00050 mg/L	0.0200	103	80-120
Barium, total	0.0214	0.0050 mg/L	0.0200	107	80-120
Beryllium, total	0.0174	0.00010 mg/L	0.0200	87	80-120
Bismuth, total	0.0202	0.00010 mg/L	0.0200	101	80-120
Boron, total	0.0212	0.0050 mg/L	0.0200	106	80-120
Cadmium, total	0.0199	0.000010 mg/L	0.0200	99	80-120
Calcium, total	2.07	0.20 mg/L	2.00	103	80-120
Chromium, total	0.0212	0.00050 mg/L	0.0200	106	80-120
Cobalt, total	0.0214	0.00010 mg/L	0.0200	107	80-120
Copper, total	0.0223	0.00040 mg/L	0.0200	112	80-120
Iron, total	2.06	0.010 mg/L	2.00	103	80-120
Lead, total	0.0209	0.00020 mg/L	0.0200	104	80-120
Lithium, total	0.0195	0.00010 mg/L	0.0200	98	80-120
Magnesium, total	2.12	0.010 mg/L	2.00	106	80-120
Manganese, total	0.0206	0.00020 mg/L	0.0200	103	80-120
Molybdenum, total	0.0189	0.00010 mg/L	0.0200	95	80-120
Nickel, total	0.0210	0.00040 mg/L	0.0200	105	80-120

APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	MRL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Total Metals, Batch B7K0408, Continued									
LCS (B7K0408-BS1), Continued					Prepared: 2017-11-06, Analyzed: 2017-11-06				
Phosphorus, total	1.98	0.050 mg/L	2.00		99	80-120			
Potassium, total	2.15	0.10 mg/L	2.00		108	80-120			
Selenium, total	0.0218	0.00050 mg/L	0.0200		109	80-120			
Silicon, total	2.1	1.0 mg/L	2.00		103	80-120			
Silver, total	0.0198	0.000050 mg/L	0.0200		99	80-120			
Sodium, total	2.38	0.10 mg/L	2.40		99	80-120			
Strontium, total	0.0197	0.0010 mg/L	0.0200		98	80-120			
Sulfur, total	5.4	3.0 mg/L	5.00		107	80-120			
Tellurium, total	0.0180	0.00050 mg/L	0.0200		90	80-120			
Thallium, total	0.0206	0.000020 mg/L	0.0200		103	80-120			
Thorium, total	0.0202	0.00010 mg/L	0.0200		101	80-120			
Tin, total	0.0198	0.00020 mg/L	0.0200		99	80-120			
Titanium, total	0.0209	0.0050 mg/L	0.0200		104	80-120			
Tungsten, total	0.0199	0.0010 mg/L	0.0200		100	80-120			
Uranium, total	0.0201	0.000020 mg/L	0.0200		100	80-120			
Vanadium, total	0.0213	0.0010 mg/L	0.0200		107	80-120			
Zinc, total	0.0232	0.0040 mg/L	0.0200		116	80-120			
Zirconium, total	0.0183	0.00010 mg/L	0.0200		91	80-120			
Reference (B7K0408-SRM1)					Prepared: 2017-11-06, Analyzed: 2017-11-06				
Aluminum, total	0.299	0.0050 mg/L	0.303		99	82-114			
Antimony, total	0.0511	0.00020 mg/L	0.0511		100	88-115			
Arsenic, total	0.121	0.00050 mg/L	0.118		103	88-111			
Barium, total	0.839	0.0050 mg/L	0.823		102	83-110			
Beryllium, total	0.0437	0.00010 mg/L	0.0496		88	80-119			
Boron, total	3.39	0.0050 mg/L	3.45		98	80-118			
Cadmium, total	0.0486	0.000010 mg/L	0.0495		98	90-110			
Calcium, total	11.8	0.20 mg/L	11.6		101	85-113			
Chromium, total	0.263	0.00050 mg/L	0.250		105	88-111			
Cobalt, total	0.0413	0.00010 mg/L	0.0377		110	90-114			
Copper, total	0.542	0.00040 mg/L	0.486		112	90-117			
Iron, total	0.521	0.010 mg/L	0.488		107	90-116			
Lead, total	0.211	0.00020 mg/L	0.204		103	90-110			
Lithium, total	0.398	0.00010 mg/L	0.403		99	79-118			
Magnesium, total	3.93	0.010 mg/L	3.79		104	88-116			
Manganese, total	0.110	0.00020 mg/L	0.109		100	88-108			
Molybdenum, total	0.196	0.00010 mg/L	0.198		99	88-110			
Nickel, total	0.260	0.00040 mg/L	0.249		105	90-112			
Phosphorus, total	0.206	0.050 mg/L	0.227		91	72-118			
Potassium, total	7.75	0.10 mg/L	7.21		107	87-116			
Selenium, total	0.127	0.00050 mg/L	0.121		105	90-122			
Sodium, total	8.37	0.10 mg/L	7.54		111	86-118			
Strontium, total	0.364	0.0010 mg/L	0.375		97	86-110			
Thallium, total	0.0847	0.000020 mg/L	0.0805		105	90-113			
Uranium, total	0.0298	0.000020 mg/L	0.0306		97	88-112			
Vanadium, total	0.402	0.0010 mg/L	0.386		104	87-110			
Zinc, total	2.63	0.0040 mg/L	2.49		106	90-113			

QC Qualifiers:

RPD Relative percent difference (RPD) of duplicate analysis are outside of control limits for unknown reason(s).