Serpent River Watershed Monitoring Program
2020 Annual Water Quality Report

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Canadian Nuclear Safety Commission
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1 INTRODUCTION

As part of the closure and decommissioning process, Rio Algom Limited (RAL) and Denison Mines Inc. (DMI) developed a focused and integrated performance monitoring network for legacy sites within the Serpent River Watershed (SRW). The comprehensive monitoring and management strategy clearly defined and delineated the purpose for all monitoring activities through three integrated programs; the Tailings Management Area (TMA) Operational Monitoring Program (TOMP), the Source Area Monitoring Program (SAMP), and the Serpent River Watershed Monitoring Program (SRWMP) (Minnow Environmental Inc. (Minnow), 2019). An integrated assessment of the results from all of these programs is prepared every five years in a *State of the Environment Report* (SOE) in compliance with license requirements and in accordance with the Canadian Standards Association (CSA) N288.4-10 (2010). The Cycle 5 SOE covering data collection and monitoring for the period of January 1, 2015 – December 31, 2019 will be submitted to the Canadian Nuclear Safety Commission (CNSC) as well as other members of the Elliot Lake Joint Regulatory Review Group (JRG) on March 31, 2021.

The SRWMP was initiated in 1999 as a joint initiative of RAL and DMI with the objectives of evaluating the effectiveness of mine decommissioning plans and assessing long-term environmental water quality trends in the watershed (Beak International Incorporated (Beak, 1999). Evolution of the program, key outcomes, program modification decisions, and associated references are summarized in Appendix I. In 2020, the SRWMP was completed in accordance with the 2020 program modifications and recommendations described in the *Cycle 5 Study Design for the SRWMP, SAMP and TOMP (*Cycle 5 Study Design*,* (Minnow, 2019).

The SRWMP Annual Water Quality Report for 2020 provides water quality data from shared RAL and DMI watershed monitoring locations from January 1, 2020 through December 31, 2020. This report should be read in conjunction with the Annual Operating Care and Maintenance (OCM) reports, prepared independently by each company, that incorporate upstream SAMP and TOMP data, and discuss operational activities of each company (RAL, 2021; DMI, 2021). The objective of the SRWMP annual data review is to identify anomalous data and provide visual evaluation of short-term data trends at key locations. Step changes and anomalies are identified in this report by reviewing and compiling the last five years of annual average data for all SRWMP monitoring locations, and visually reviewing the information for any noticeable changes. Significant changes and unusual results are investigated in accordance with the *Water Quality Assessment and Response Plan*, which is found in Appendix A of the *Cycle 5 SOE Report* (Minnow, 2021).

The 2020 SRWMP Annual Water Quality Report also provides a summary of the data quality management program for the period January 1, 2020 through December 31, 2020.

As part of the 2015 Cycle 4 SOE review, CNSC instructed RAL and DMI to include annual reporting of a representative radiation dose to the public associated with their closed uranium mine sites in the Serpent River Watershed. Details are discussed in Section 4.4 of this report.

2 METHODOLOGY

2.1 2020 Program Requirements

The 2020 SRWMP followed program requirements (sampling locations, frequencies, parameters, and analytical protocols) as recommended and approved in the *Cycle 5 Study Design* (Minnow, 2019). Table 2.1 provides a brief description of each monitoring location, the sampling frequency

and parameters monitored, as well as non-regulatory parameters. Figure 2.1 provides a map of the stations included in the SRWMP.

Table 2.1 2020 SRWMP Water Quality Monitoring Requirements

Sampling StationB1:Q19 B43B1:Q26B1:	Location / Description	Sample Type	Purpose	Flow (L/s)	Field pH	Sulphate (mg/L)	Radium-226 (Bq/L total)	Urnaium (mg/L)	Barium (mg/L)	Iron (mg/L)	Manganese (mg/L)	Hardness[3] (mg/L)	DOC[4] (mg/L)
SR-16[2]	Fox Creek at Highway 108	Wetland/stream reference	SAMP		4	4	4	4	4	4	4	4	4
SR-17[2]	Unnamed Creek Drain Lake 3 @ Hwy 108	Wetland/stream reference	SAMP		4	4	4	4	4	4	4	4	4
SR-18	Outlet of Jim Christ Lake	Lake reference	SRWMP		2	2	2	2	2	2	2	2	2
SR-19	Inlet to Elliot Lake	Lake reference	SRWMP		4	4	4	4	4	4	4	2	2
SR-08	Nordic Lk Outlet	far field	SRWMP/MECP[5]		4	4	4	4	4			4	4
SR-15	May Lake Outlet	far field	SRWMP	2	2	2	2	2	2	2		2	2
M-01[1]	Sherriff Ck @ Hwy 108	near field	SRWMP		4	4	4	4	4	4		4	4
Q-09	Serpent River Below Q Effluent	near field	SRWMP	4	4	4	4	4	4			4	4
Q-20	Evans Lk Outlet to Dunlop Lk	near field	SRWMP	1	1	1	1	1	1			1	1
SC-01	Westner Lk Outlet	near field	SRWMP/MECP		1	1	1	1	1	1		1	1
SR-06	McCabe Lk Outlet	near field	SRWMP	2	2	2	2	2	2			2	2
FBR5	Field Blank Rio	QA/QC	SRWMP		2	2	2	2	2	2		2	2
BSR5	Blind Sample Rio	QA/QC	SRWMP		2	2	2	2	2	2		2	2
Rio Algom total excluding field blanks & blind samples				**9**	**32**	**32**	**32**	**32**	**32**	**21**	**14**	**30**	**30**
D-4	Dunlop Lk Outlet	Lake reference	SRWMP		2	2	2	2	2	2	2	2	2
D-5	Serpent R. between Q and D	near field	SRWMP	4	4	4	4	4	4			4	4
D-6[1]	Cinder Lk Outlet	near field	SRWMP	4	4	4	4	4	4	4	4	4	4
DS-18	Halfmoon Lk Outlet	near field	SRWMP/MECP	4	4	4	4	4	4	4		4	4
SR-01	Quirke Lk Outlet	far field	SRWMP		1	1	1	1	1			1	1
FBD2	Field Blank Denison	QA/QC	SRWMP		2	2	2	2	2	2	2	2	2
BSD2	Blind Sample Denison	QA/QC	SRWMP		2	2	2	2	2	2	2	2	2
Denison total excluding field blanks & blind samples				**12**	**15**	**15**	**15**	**15**	**15**	**10**	**6**	**15**	**15**
Total QA/QC samples				0	8	8	8	8	8	8	4	8	8
TOTAL SAMPLES				**21**	**47**	**47**	**47**	**47**	**47**	**31**	**20**	**45**	**45**
QA/QC Fraction of Total				0%	17%	17%	17%	17%	17%	26%	20%	18%	18%

Notes:

1. Field QA-QC designated stations.
2. SR-16 and SR-17 are part of SAMP program Cycle 4 but are historically SRWMP locations.
3. Hardness is an ancillary parameter used to assess manganese and sulphate as both parameters are hardness dependant (Ambient Water Quality Guidelines (BC ENV 2019)
4. Due to the new Federal Water Quality Guideline (FWQG) for iron, DOC was added as a monitoring parameter at all SRWMP water quality monitoring stations.
5 Ontario Ministry of Environment Conservation and Parks (MECP) required sampling as per Nordic Environmental Compliance Approval..

Figure 2.1

Serpent River Watershed Monitoring Program

Water Sample Collection Locations
February 2018

SR18 Christman Lake
Semiwite Lake
Ten Mile Lake
639
Dunlop Lake
Evans Lake
QUIRKE TMA
Q20
D5
Q09
PANEL TMA
Rochester Lake
Quirke Lake
SR01
D4
D6
DENISON TMA 1,2
Cinder Lake
SPANISH AMERICAN TMA
108
STANROCK TMA
Halfmoon Lake
Bear Lake
Arm of the Bear Lake
DS18
SR-17
SR06
May Lake
Whiskey Lake
STANLEIGH TMA
McCabe Lake
SR-15
Gullbeak Lake
SR19
MILLIKEN TMA
M01
Sheriff Lake
Canyon Lake
Hough Lake
Elliot Lake
Horne Lake
SC01
Westner Lake
LACNOR TMA
NORDIC TMA
Pecors Lake
Serpent River
Quimby Lake
Nordic Lake
Esten Lake
SR08
Depot Lake
Trout Lake
Marshland Lake
Grandeur Lake
McCarthy Lake
CITY OF ELLIOT LAKE
TOWNSHIP OF THE NORTH SHORE
Tweedle Lake
Shedden Lake
Camp Lake
TOWN OF SPANISH
SR-16
PRONTO TMA
17
Grassy Lake
North Channel (Lake Huron)
Serpent River First Nation

0 1 2 5 km.
SCALE

N
W E
S

- Tailings Management Areas (TMA).
- Exposure Lakes (included in SRWMP).
- Reference Lakes (included in SRWMP).
- Water Sample Location (Exposure).
- Water Sample Location (Reference).
- Direction of flow.
- Exterior limit of the Serpent River Watershed.

\2005\205-018\srwmp\2018\srwmp2018-1

Denison Mines

Rio Algom

2.2 2020 Program Conformance

All Cycle 5 approved sampling, field measurement, and analytical requirements were met during the 2020 reporting period, with the exception of four flow measurements. Although all samples were collected, flow could not be measured at D-6 and DS-18 in February due to thick ice build-up across the channels. Flow could not be measured at stations D-5 and Q-09 in August as the ministry flow station located at Q-09 was shut down due to COVID-19 restrictions at the time, rendering the calculation for flow at both stations impossible.

Hardness continues to be monitored as an ancillary parameter at all SRWMP stations. According to the Approved Water Quality Guidelines for Aquatic Life, Wildlife & Agriculture from the British Columbia Ministry of Environment & Climate Change Strategy (BC ENV), formerly BCMOE Ambient Water Quality Guidelines, manganese and sulphate are hardness dependent (BC ENV, 2019). Dissolved Organic Carbon (DOC) was added to the monitoring program at the recommendation of the Ontario Ministry of Environment, Conservation and Parks (MECP). The DOC data is provided in Appendix V for 2020, however, it has not been used for iron assessment in this report, as the upper level of background concentrations of iron is higher than federal guidelines. Changes to the program are discussed in further detail in Section 4.2.

2.3 Field Measurements

Field measurement requirements and protocols for the 2020 SRWMP are presented in detail in the *Cycle 5 Study Design* (Table 6.2, Minnow, 2019). Field Staff have been thoroughly trained and have reviewed procedures associated with the proper calibration and use of field equipment for the measurement of field parameters. The models and accuracy for equipment used in measuring SRWMP field parameters are provided in Table 2.3.

Table 2.3 SRWMP Field Equipment Models and Accuracy

Parameter	Meter	Accuracy	Unit
pH	YSI Pro 10	+/- 0.02	pH units
flow	Global Flow Probe	0.1	feet per second

2.4 Data Quality Objectives

Field and laboratory data quality objectives (DQOs) for the 2020 SRWMP are presented in detail in the *Cycle 5 Study Design* (Minnow, 2019). Table 2.4.a. provides a summary of field DQOs and Table 2.4.b. provides a summary of laboratory methods, detection limits and DQOs. Data quality assessment results are covered in Section 3 of this report.

Table 2.4.a. 2020 SRWMP Field Data Quality Objectives

Parameter	Units	Assessment Criteria [1]		Data Quality Objectives[2]			
		PWQO BCMOE	Background	Detection Limit	Minimum [3] Detectable Difference	Field Blank Criteria	Field Precision
Field Parameters[3]							
Flow	L/s	-	-	method	method	-	30%
pH				0.1	0.01 or 0.02	-	10%
Lake Stations		6.5	-				
Wetland/Streams		-	5.3				
Laboratory Parameters							
Barium	mg/L	1.0	-	0.005	-	0.01	20%
Iron	mg/L	-	-		-		
Lake Stations		-	0.76	0.02	-	0.04	20%
Wetland/Streams		-	2.49	0.02	-	0.04	20%
Manganese [4]	mg/L	0.841	-	0.002	-	0.004	20%
Radium (total)	Bq/L	0.469[5]	-	0.005	-	0.01	20%
Sulphate [4]	mg/L	128-429[4]	-	0.1	-	0.2	20%
Uranium	mg/L	0.015	-	0.0005	-	0.001	20%
Hardness	mg/L	-	-	0.5	-	1.0	20%

Notes:

1. Table S.1, Apprendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)
2. Table 6.2 Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)
3. Minimum detectable difference as identified in instrument manual
4. Table S.2, Apprendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

5 The dose-base site-specific benchmark for radium is selected, as per CNSC request and is detailed in Section 5.2.5.2, of the Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

Table 2.4.b. 2020 SRWMP Laboratory Methods and Data Quality Objectives

Parameter	Units	Assessment Criteria [1]		Laboratory Data Quality Objectives[2]					
		PWQO BCMOE	Background	Method	Detection Limit	Laboratory Blank	Precision	Spikes	Accuracy (CRM)
Barium	mg/L	1.0	-	ICP-MS	0.005	0.01	10%	20%	20%
Iron	mg/L	-		ICP-OES					
Lake Stations			0.76		0.02	0.04	10%	20%	20%
Wetland/Streams			2.49		0.02	0.04	10%	20%	20%
Manganese [3]	mg/L	0.841	-	ICP-MS	0.002	0.004	10%	20%	20%
Radium (total)	Bq/L	0.469[4]	-	Alpha Spectroscopy	0.005	0.01	20%	20%	-
Sulphate [3]	mg/L	128-429	-	Ion Chromatography	0.1	0.2	10%	20%	20%
Uranium	mg/L	0.015	-	ICP-MS	0.0005	0.001	10%	20%	20%
Hardness	mg/L	-	-	ICP-OES	0.5	0.1	10%	-	-

Notes:

1. Table S.1, Apprendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)
2. Table 6.2 Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)
3. Table S.2, Apprendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)
4. The dose-base site-specific benchmark for radium is selected, as per CNSC request and is detailed in Section 5.2.5.2, of the Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

2.5 Changes in Analytical Methods

There were no changes in analytical methodology in 2020.

2.6 Reporting of Method Detection Limits

Program method detection limits (MDLs) are presented in Tables 2.4.a. and 2.4.b. The target MDL for radium-226 (0.005 Becquerel's per litre (Bq/L)) was not met on all samples analysed in 2020 due to decreased sample throughput of the analytical laboratory. There was no change in method during this period; however, the laboratory was only able to claim a MDL of 0.007 Bq/L.

2.7 Data Screening and Assessment Conventions

Data validation was conducted on SRWMP water quality data throughout the year. The assessment screening process flags all data points outside a rolling minimum 12 value mean $\pm$ 3 standard deviations.

Flagged data and short-term response plans for the SRWMP are reported quarterly to the regulatory agencies as part of the water quality report. Data validation of "flagged data" for the year 2020 can be found in Appendix II.

Annual water quality reporting is designed to be concise and focused on the presentation of data in a standardized format with limited interpretation, as per Section 14.2 of the Implementation Document (Beak, 1999c). Data validation ensures prompt response to upset conditions or unusual results, as documented in *Data Validation Procedures* in conjunction with *Water Quality Assessment and Response Plan*, which is included in Appendix B of the *Cycle 5 SOE* (Minnow, 2021). Assessment criteria as outlined in Table 2.4.a. and 2.4.b. of this report, are standardized to benchmarks selected, rationalized and presented in Appendix S, Tables S.1 and S.2 of the *Cycle 5 SOE (*Minnow, 2021*).*

Approved program modifications implemented in January of 2020 focused water quality monitoring on lakes located immediately downstream of the decommissioned TMAs. An in-depth and detailed statistical evaluation of water quality trends is included in the SOE every five years (Minnow 2009, 2011, 2017, 2021).

A SRWMP location summary of annual average concentrations is reviewed and compared to assessment criteria in this report in Table 3.2. In addition, the most recent five-year annual concentrations of mine indicator parameters at key downstream locations are reviewed in this report in Figures 3.1.a to 3.1.c.

3 RESULTS

3.1 Data Quality Results and Assessment

Detailed laboratory quality assurance and quality control (QA/QC) results are provided in Appendix III, and detailed field QA/QC results are provided in Appendix IV. Field quality control results are summarized in Table 3.1. Data quality assessments for each type of data quality objective are provided in the following sections.

3.1.1 Laboratory Quality Assurance and Quality Control

In 2020, all analytical requirements for the SRWMP were contracted to laboratories with Canadian Association for Laboratory Accreditation Inc. (CALA) accreditations. It should be noted that in June 2019, the laboratory accreditation from Perdue Central Analytical Facility (PCAF), formerly the Elliot Lake Research Field Station (ELRFS), was withdrawn by CALA due to previous management not filing the "Management Review" document. However, PCAF continued to maintain and pass regular proficiency testing (PT) for radium (Ra226) analysis, conduct analysis following the same Ra226 alpha spectrometer SOP method and incorporate all of the same quality control samples. Since identical procedures to those under the accreditation were still followed, PCAF continued to meet the requirements for regulatory reporting. Accreditation was formally restored on March 19, 2020 under ISO/IEC:17025-2017 for Ra226 in water and wastewater (Appendix III).

Detailed laboratory QA/QC results are provided in Appendix III. The 10% objective for QA/QC was met by both labs. SGS performed 6441 analyses with 8003 QC checks, which represents 124% QC for sample analysis (Appendix III). PCAF analyzed 62 batches totaling 987 radium samples with each batch incorporating blank, certified reference material (CRM), duplicate, and spiked samples providing greater than 20% quality control checks. All quality control samples were within control limits (mean +/- 3SD) (Appendix III).

3.1.2 Quality Assurance and Quality Control Resolution of Key Issues

There were no major issues with laboratory analysis requiring resolution in 2020. However, the radium target MDL of 0.005 Bq/L was not achieved by PCAF, but the MDL still remained below the laboratory Data Quality Objective (DQO) of 0.01 Bq/L at <0.007 Bq/L (Appendix III).

3.1.3 Analytical Blank Performance

Laboratory quality control results confirm that blank data quality objectives were met for all parameters in all samples (Appendix III).

3.1.4 Analytical Duplicate Performance

Laboratory quality control results confirm that duplicate data quality objectives of 20% for radium and 10% for all other remaining parameters were achieved in all samples (Appendix III).

3.1.5 Analytical Laboratory Spike Performance

Laboratory quality control results confirm that the spike data quality objective of 20% was achieved for all parameters in all samples (Appendix III).

3.1.6 Analytical Certified Reference Material Performance

Laboratory quality control results confirm that the CRM data quality objective of 20% accuracy was achieved for all parameters in all samples in 2020 (Appendix III). It should be noted that beginning in May, 2020, PCAF switched from the Eckert & Ziegler CRM (0.050Bq/L) to a NIST SRM or Standard Reference Material (#4965a - 0.0617Bq/L) in order to comply with ISO/IEC 17025:2017 assessment findings that an independently sourced reference material be used from the spike and instrument calibration standards. The new NIST 4965A SRM was tested 33 times to generate statistical data for control chart formation and had a 0.0566Bq/L or 91.69% average recovery with a standard deviation of +/-0.0045Bq/L.

3.1.7 Field Blank Performance

Field Blank quality control results confirm that SRWMP field blank data quality objectives were achieved in 2020 (Appendix IV).

3.1.8 Field Precision Performance

Field precision quality control results confirm that SRWMP field precision data quality objectives were achieved in 2020 (Appendix IV).

Table 3.1 2020 SRWMP Field Quality Control Results Summary

QA/QC	pH	SO4 (mg/L)	Ra(T) (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)	Fe (mg/L)	Mn (mg/L)	Hardness (mg/L)
MDL[1]	-	0.1	0.005	0.0005	0.005	0.0005	0.02	0.002	0.5
Field Blank Statistics									
Count	-	4	4	4	4	4	4	4	4
Average	-	<0.1	<0.007	<0.0005	<0.005	<0.0005	<0.02	<0.002	<0.5
Max	-	<0.1	<0.007	<0.0005	<0.005	<0.0005	<0.02	<0.002	<0.5
Min	-	<0.1	<0.007	<0.0005	<0.005	<0.0005	<0.02	<0.002	<0.5
Field Blank Exceedances									
Criteria[1]	-	0.2	0.01	0.001	0.01	0.001	0.04	0.004	1.0
Exceedance	0	0	0	0	0	0	0	0	0
Field Precision Statistics									
Count	4	4	4	4	4	4	4	2	2
Average	0.0%	3.3%	4.2%	2.9%	5.0%	0.0%	4.4%	1.2%	1.1%
Max	0.0%	8.7%	11.8%	6.7%	8.0%	0.0%	7.4%	2.3%	1.7%
Min	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
Field Precision Exceedances									
Criteria[1]	20%	20%	20%	20%	20%	20%	20%	20%	20%
Exceedance	0	0	0	0	0	0	0	0	0

Notes:

[1] Data Quality Objectives taken from Table 6.2 af the Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

Bold indicates an exceedance in the Data Quality Objectives (DQO's)

3.2 2020 Annual Average Location Results Summary

Annual average concentrations of SRWMP parameters for 2020 in comparison to the draft Cycle 5 SOE (Minnow, 2021) receiving environment assessment criteria are provided in Table 3.2. Annual detailed results and five-year summaries of annual average concentrations in comparison to assessment criteria are provided in Appendix V.

Water quality throughout the Serpent River Watershed continues to meet and remain well below the assessment criteria established for the protection of aquatic life. Annual average concentrations for all parameters in 2020 were better than assessment criteria at all locations (Appendix V).

The annual average iron concentration at M-01 (Sherriff Creek outlet @ HWY 108) appears elevated compared to other SRWMP locations at 1.56 mg/L. However, it did not exceed the assessment criteria established for wetland stations (2.49 mg/L, Table 2.4. a) This can be attributed to a seasonal spike (5.09 mg/L) that occurred in August when persistent upstream beaver activity was observed during a period of warmer, drier conditions and lower water levels. Iron concentrations are generally influenced by the particulate matter within the sample during periods of very low flow. The remaining concentrations throughout the year were considerably lower (ranging from 0.22 mg/L to 0.51 mg/L) and more typical of expected values when flow is generally higher (Appendix V).

Annual average barium concentrations at SR-06 (McCabe Lake Outlet) and further downstream at SR-15 (May Lake Outlet) decreased again in 2020 with averages at 0.148 mg/L and 0.103 mg/L, respectively. The three years prior to 2019 had indicated increasing trends at both locations (Appendix V), likely due to the increased barium chloride addition rates required for radium removal upstream from the Stanleigh final discharge (CL-06). The 2019 and 2020 decrease in barium concentrations is likely associated with an approved modification in the treatment process for radium removal upstream at the Stanleigh Effluent Treatment Plant (ETP). Due to the elevated radium and barium concentrations at CL-06, a pilot program was initiated in 2018 to modify the conventional treatment using barium chloride to pre-formed barite for radium removal. The modified treatment method thus far, indicates an improvement in radium removal and a reduction of residual barium in the CL-06 effluent and subsequently downstream at SR-06 and SR-15. Details of the pilot program and CL-06 barium data can be found in the 2018, 2019 and 2020 Rio Algom Annual OCM Reports (RAL, 2019, 2020, 2021). Although barium concentrations still appear elevated compared to other SRWMP stations, they are below the assessment criteria (1.0 mg/L) and well below levels considered to be toxic to the aquatic environment (>8.0 mg/L; WHO 2001).

The annual average sulphate concentration at SR-08 (Nordic Lake Outlet) also appears elevated (140.0 mg/l) compared to other SRWMP stations. However, as initially noted in section 2.2, according to the most recent approved guidelines for aquatic life from BC ENV, manganese and sulphate are hardness dependent. Toxicity studies for both parameters demonstrated amelioration of toxicity with increasing water hardness and were used to develop new water quality guidelines in the province of British Columbia for these substances. Therefore, based on this information, a specific assessment criterion for sulphate has been established for each station in the SRWMP. In this case, the mean hardness concentration at SR-08 was determined to be 177.0 mg/L (Minnow, 2021) and thus, the resulting criteria for sulphate at this location is 309 mg/L. In 2020, all results at SR-08 fell within BC ENV guidelines for the protection of aquatic life (BC ENV, 2020). A review of the data also indicates that sulphate annual concentrations have continued to decrease over the past five years (Figure

3.1.a.). Sulphate assessment criteria for individual stations is included in Appendix V of this report along with the detailed data, as well as in Table S-1, Appendix S, of the *Cycle 5 SOE* (Minnow, 2021).

3.3 Five-Year Annual Average Trends at Key Locations 2016-2020

Figures 3.1.a to 3.1.c show five-year trends of annual average concentrations for the mine-related parameters sulphate, radium, and uranium at the following key locations:

- SR-01, Quirke Lake Outlet;
- SR-06, McCabe Lake Outlet;
- SR-08, Nordic Lake Outlet;
- DS-18, Halfmoon Lake Outlet.

Based on a review of five years of data, annual sulphate concentrations at all key lake outlets are well below the assessment criterion of between 128-309 mg/L as established for each station. Furthermore, annual concentrations have been gradually decreasing at all locations over the past five years (Figure 3.1.a), with the exception of DS-18 (Halfmoon Lake Outlet). There was a slight increase observed in 2020; however, all results remained well below the assessment criterion of between 128-309 mg/L, ranging between 26 mg/L – 67 mg/L (Appendix V).

With the exception of DS-18, annual average radium concentrations at three key locations are significantly lower than the assessment criterion of 0.469 Bq/L (Figure 3.1.b). At station DS-18, annual average radium concentrations appear elevated compared to other annual radium concentrations in the last five years (Appendix V). This may be indicative of flushing through the historic tailings spill upstream in the Halfmoon wetland area. However, all results in the last five years remained well below the assessment criterion of 0.469 Bq/L (ranging from 0.073 Bq/L to 0.203 Bq/L) and well below the Health Canada (2009) drinking water quality standard of 0.5 Bq/L and appear to have decreased since 2017.

Annual radium concentrations at SR-06 appeared to be gradually increasing over the previous three years, but decreased significantly in 2019 and 2020 (Appendix V). Again, this is likely associated with an approved modification in the treatment process for radium removal upstream at the Stanleigh ETP (RAL, 2019, 2020, 2021). Based on review of the five-year annual average data, all radium concentrations have consistently remained below the assessment criterion of 0.469 Bq/L and well below Health Canada (2009) drinking water quality standard of 0.5 Bq/L (Figure 3.1.b).

Annual average uranium concentrations at all four key lake locations appear to be relatively stable and were more than an order of magnitude below the assessment criteria of 0.0150 mg/L (Figure 3.1.c).

Table 3.2 2020 SRWMP Location Annual Average Results Summary

Parameters			pH	SO4 [5] (mg/L)	DOC (mg/L)	Ra(T) (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L)	Hardness mg/L as $CaCO_3$
Assessment Criteria [1]	Wetland and lake benchmarks		**6.5**	**128-309**		**0.469**	**0.0150**	**1.000**		**0.841**	-
	Wetland/Stream benchmark [2]		**5.3**						**2.49**		
	Lake benchmark [3]								**0.76**		
MDL [4]				0.1		0.005	0.0005	0.005	0.02	0.005	0.5
Location		# of samples collected									
Reference	**Type**										
D-4	Lake	2	6.8	3.0	2.9	<0.007	<0.0005	0.013	0.04	0.014	8.9
SR-18	Lake	2	6.9	3.5	5.4	<0.007	<0.0005	0.045	0.07	0.017	9.6
SR-19	Lake	4	7.0	2.6	4.8	<0.007	<0.0005	0.022	0.38	0.060	15.9
SR-16	Wetland/Stream	4	6.2	0.8	12.6	<0.007	<0.0005	0.008	1.12	0.061	7.9
SR-17	Wetland/Stream	4	6.2	1.8	8.6	<0.007	<0.0005	0.020	1.63	0.074	10.7
Near Field											
D-5		4	7.0	10.6	3.1	0.044	0.0013	0.068	0.08	0.028	20.3
D-6		4	6.9	21.0	4.2	<0.007	<0.0005	0.014	0.37	0.146	31.2
DS-18		4	7.0	53.0	2.5	0.105	0.001	0.021	0.35	na	70.1
M-01		4	6.8	7.2	4.9	0.029	0.0024	0.018	1.56	na	35.4
Q-09		4	6.9	34.0	3.8	0.066	0.0019	0.074	na	na	45.6
Q-20		1	6.8	17.0	2.3	<0.007	<0.0005	0.019	na	na	35.7
SC-01		1	7.0	16.0	4.6	0.012	<0.0005	0.009	0.13	na	25.3
SR-06		2	7.2	26.0	3.2	0.053	0.0005	0.148	na	na	36.9
Far Field											
SR-15		2	7.2	27.0	3.3	0.044	<0.0005	0.103	na	na	40.6
SR-01		1	6.8	24.0	3.4	0.029	0.0012	0.042	na	na	34.3
SR-08		4	6.8	140.0	4.0	0.029	0.0008	0.019	na	na	173.8

Notes:

[1] Table S.1, Apprendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP draft (Minnow, 2020)

[2] Benchmark applies to wetland/stream stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 5.2 Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Apprendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP draft (Minnow, 2020) Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value
na = not applicable. Parameters are not monitored

Figure 3.1.a. Annual Average Sulphate Concentrations at SR-01, SR-06, SR-08, and DS-18, 2016-2020

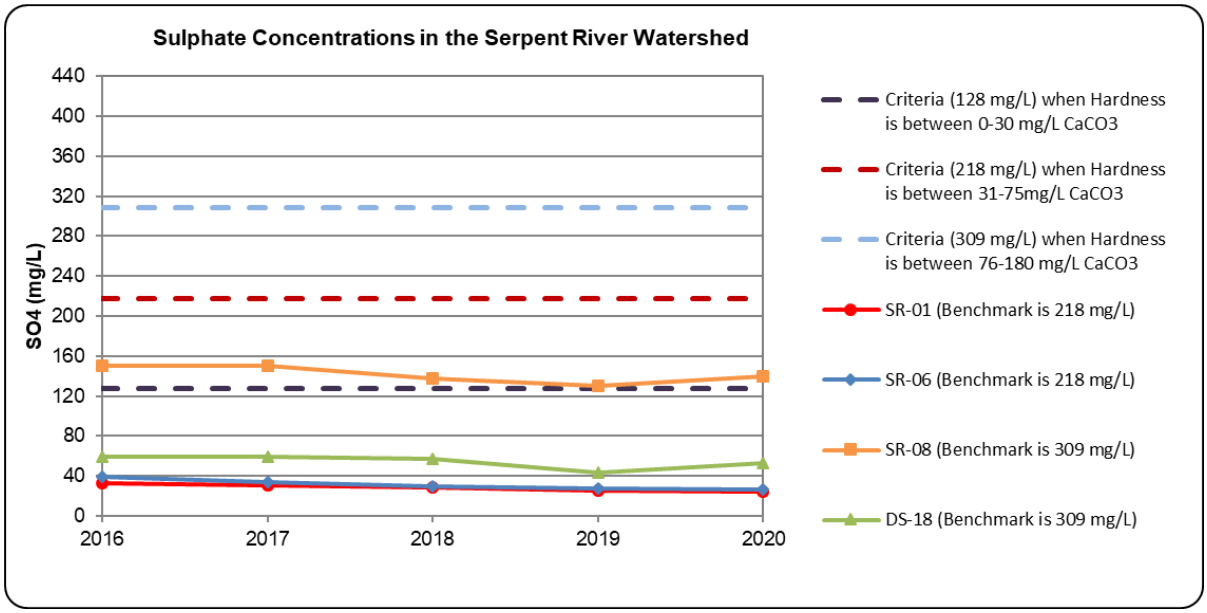


Figure 3.1.b. Annual Average Radium Concentrations at SR-01, SR-06, SR-08, and DS-18, 2016-2020

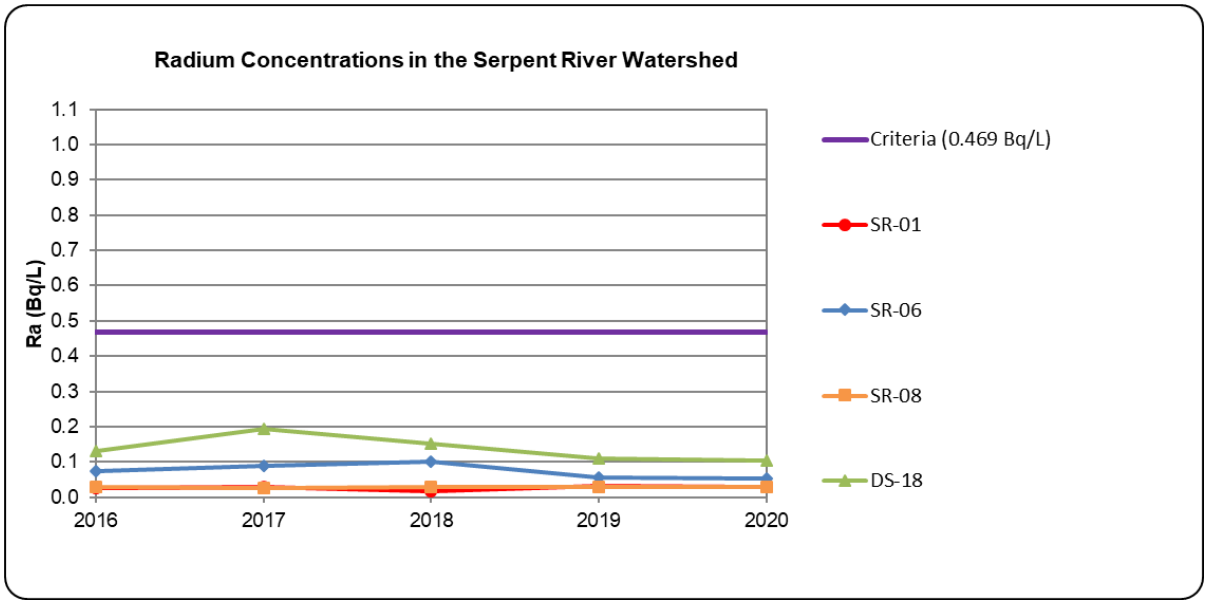
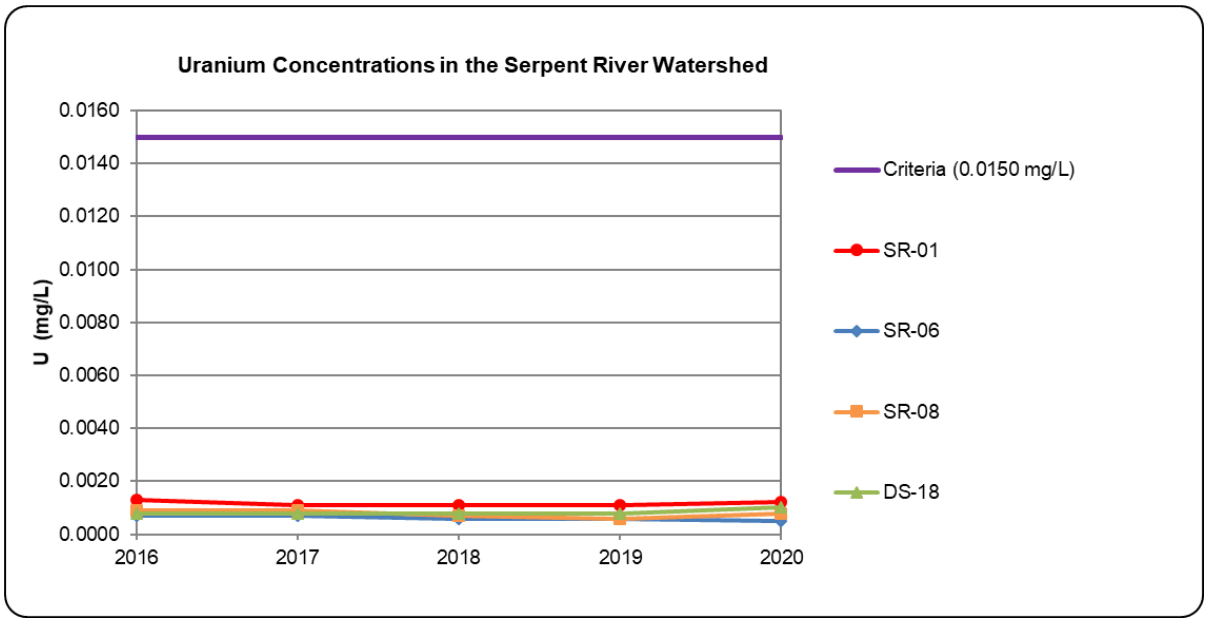


Figure 3.1.c. Annual Average Uranium Concentrations at SR-01, SR-06, SR-08, and DS-18, 2016-2020



4 DISCUSSION

4.1 Response Monitoring

Beginning in 2016, monitoring at the outlet of May Lake (SR-15) was voluntarily re-established in response to gradually increasing barium and radium concentrations upstream at the outlet of McCabe Lake (SR-06); it was previously removed in the SRWMP Cycle 3 Study Design (Minnow 2009). Although concentrations have decreased substantially in the last two years, particularly at SR-06, the station SR-15 was re-established in the monitoring program as per the Cycle 5 study design (beginning 2020) to aid in the assessment of any long-term impacts to the receiving environment.

4.2 SRWMP Performance Monitoring Program Changes

There were no changes to methodology in 2020. However, in response to the Cycle 4 SOE Report, the CNSC requested a review of the radium-226 benchmark used in the SRWMP for evaluating water quality in the receiving environment. In previous cycles, the Provincial Water Quality Objective (PWQO) value of 1 Bq/L (OMOE 1994) was used as the benchmark for evaluating radium-226 concentrations in the Serpent River Watershed (SRW). Based on this review, a site-specific water quality objective for radium-226 for the protection of aquatic life was derived. The new approved site specific water quality benchmark of 0.469 Bq/L for radium-266 will be used for water quality screening within future SRW assessments, rather than the historically used PWQO value of 1.0 Bq/L. Details of the review can be found in the *Cycle 5 Study Design for the SRWMP, SAMP, and TOMP* (Minnow, 2019).

As previously mentioned in section 2.2, after review of the Cycle 5 Study Design (Minnow, 2019), the MECP recommended adding DOC to the SRWMP monitoring program. This was in anticipation of a new federal environmental water quality guideline for iron currently posted for public review, which includes DOC and pH as toxicity modifiers. In addition, hardness continues to be monitored as an ancillary parameter to all SRWMP stations as it assists in the interpretation of water quality concentrations for manganese and sulphate, as discussed in the approved *Cycle 4 Study Design for the SRWMP, SAMP and TOMP* (BC ENV, 2019 and Minnow, 2016).

4.3 Changes to Location Classification and Frequency

Other than the re-establishment of the SRWMP station SR-15, there were no other changes to location classification or frequencies in 2020.

4.4 Interim Assessment in Support of Representative Public Radiation Dose Estimation

The CNSC requested that RAL and DMI provide annual reporting of the radiation dose to the public associated with the closed uranium mine sites in the Serpent River Watershed. Historically, estimates of the public dose had been based on the use of very conservative values to demonstrate that public dose in the vicinity of Elliot Lake did not exceed the upper dose limit. Measurements of radon and gamma collected during mine operations resulted in dose estimates less than 5% of the annual public dose limit of 1 mSv/a.

However, to determine an updated and more realistic representative annual public dose estimation for a person residing in Elliot Lake, a design monitoring program to support public dose estimation was prepared in early 2016. Details of the design program were provided in the document entitled *Preliminary Design Monitoring Program to Support Public Dose Estimation* (Ecometrix Incorporated (Ecometrix), 2016, 2017), which was included as an appendix in the *SRWMP Annual Water Quality Report 2016* (RAL, DMI, 2017)

All components of the design monitoring program were completed in 2019 and it was concluded that the new updated public dose limit is 0.01 mSv/a, two orders of magnitude lower than the regulatory public dose limit of 1 mSv/a. Details of the design monitoring program and the subsequent results are included in Appendix U of the *Cycle 5 SOE* (Minnow, 2021).

The public dose estimation will next be reviewed, and if required, updated as part of the Cycle 6 SOE.

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APPENDIX I
Performance Monitoring Changes 1999 - 2019
Evolution of Programs

Summary of Changes to the Elliot Lake Monitoring Programs (IBMP, TOMP, SAMP, and SRWMP) and Associated Documents[b]

Cycle	Report Title	Year	Period Covered	Descriptions of Changes to the Monitoring Programs within Each Cycle
Cycle 1	Serpent River Watershed Monitoring Program Framework Document	1999	historical monitoring data	**IBMP, TOMP, SAMP, and SRWMP** were developed based on program objectives and existing monitoring data collected over the period of operations and decommissioning.
	In-Basin Monitoring Program Report	1999		
	Serpent River Watershed and In-Basin Monitoring Program – Implementation Document	1999		
	Serpent River Watershed Monitoring Program -1999 Study	2001	1999 to 2000	
	In-Basin Monitoring Program for the Uranium Tailings Areas - 1999 Study	2001		
Cycle 2	Overview of Elliot Lake Monitoring Programs and Source Area Monitoring Program Design	2002	2000 to 2004	**Changes only SRWMP** most associated with optimization after first cycle of program was complete: • monitoring substances reduced to mine indicator parameters (barium, cobalt, DOC, iron, manganese, radium-226, selenium, silver, sulphate and uranium); • addition of two lake reference stations (Summers and Semiwite lakes) and 3 stream reference areas (SR-16, SR-17 and SR-18); • removal of shallow lakes for sediment and benthic sampling (Westner, Grassy, Halfmoom, Upper Cinder and Horne lakes); • removal of some stream sediment and benthic stations (D-15, SC-03 and SR-07); • removal of Depot Lake and Serpent Harbour; addition of May Lake; • the transfer of some SRWMP stations to SAMP or TOMP (N-12, ECA-131, P-11, MPE and Q-23); and • fish health assessment eliminated based on performance, fish community assessment added for McCabe Lake and fish tissue monitoring reduced in scope based on performance.
	TMA Operational Monitoring Program Design (TOMP)	2002		
	Cycle 2 Study Design – Serpent River Watershed and In- Basin Monitoring Programs	2004		
	Serpent River Watershed Monitoring Program: Cycle 2 Interpretive Report	2005		
	Serpent River In-Basin Monitoring Program: Cycle 2 Interpretive Report - 2004 Study	2005		
	Serpent River Watershed State of the Environment	2009		

Cycle 3	Monitoring Framework For Closed Uranium Mines Near Elliot Lake	2009	2005 to 2009	**IBMP** eliminated based on objectives of program being achieved. **TOMP and SAMP:** • removal of silver, selenium based on performance and removal of conductivity based on redundancy with sulphate; and • DOC, hardness and flow added at selected stations. **SRWMP:** • removal of selenium and sliver based on performance; • removal of station SR-12, ELO, SR-09, SR-15, SR-02, SR-03, SR-11, P-01, QL-01 and SR-16 and SR-17 based on performance; • monthly monitoring frequency reduced to quarterly; • sediment and benthic monitoring removed from Whiskey, Evans and Cinder lakes based on redundancy; • depositional streams (Q-20, D-6, SR-06, M-01 and SR-08) based on very high natural variability masking results; and • fishing in McCabe Lake and fish tissue monitoring eliminated based on performance.
	In Basin Monitoring Program, Cycle 3 Study Design	2009		
	Serpent River Watershed Monitoring Program: Cycle 3 Study Design	2009		
	Source Area Monitoring Program Revised Study Design	2009		
	Tailing Management Area Monitoring Program (TOMP) Revised Study Design	2009		
	Serpent River Watershed State of the Environment Report	2011		
Cycle 4	Cycle 4 Study Design For the SRWMP, SAMP and TOMP	2014[a]	2010 to 2014	Minor changes to **TOMP** and **SAMP**. **SRWMP**: • elimination of reference stations SR-05, P-222 and SR-14; • removal of cobalt as substance for monitoring, addition of DOC; • far-field lakes removed from the program (Hough, Pecors, and McCarthy); • removal of Rochester Lake as a sediment and benthic reference area; and • reduction in benthic and sediment sampling to 1/10 years based on measured deposition rates.
	Serpent River Watershed Cycle 4 State of the Environment	2016		

Cycle 5	Cycle 5 Study Design For the SRWMP, SAMP and TOMP	2019	2015 to 2019	**TOMP, SAMP, and SRWMP**: • improved approach to trend analysis of surface water quality using the non-parametric seasonal Kendall test. **SRWMP**: • improved approach to calculate benchmark upper limit of background water quality values have previously been calculated based on the upper 95th percentile of values collect across all five years (rather than annual means); • use of a Serpent River Watershed site-specific dose-based radium-226 benchmark for assessment of water quality; • addition of a lake-specific dose-based radium-226 benchmark for assessment of sediment quality; and • sediment and benthic monitoring removed from Elliot Lake based on improvements in water quality, negligible mine-related sediment toxicity, and gradual improvement in benthic invertebrate communities.

[a] Study Design was submitted to CNSC and JRG in 2014 but reissued with agency comments in 2016.

Notes: IBMP = In Basin Monitoring Program. TOMP = Tailings Management Area Monitoring Program. SAMP = Source Area Monitoring Program. SRWMP = Serpent River Watershed Monitoring Program.

[b] Table 1.2, Cycle 5 State of the Environment Report, Minnow, 2021

APPENDIX II
Flagged Data Results

Denison Mines

SRWMP Data Flags
February 2020
Revision 2015-01

Rio Algom

Report Form: RC8.7.3.01

Location	Analyte	Date	Low	Hi	Result		Comment
D-5	pHF	2020-02-04	6.4	7.2	7.4		Result is a six-year high, confirmed by repeat measurement, but only slightly above the high flag limit. Will continue to monitor at the current quarterly frequency.
D-6	pHF	2020-02-04	6.2	7.2	7.4		Result is an eleven-year high, confirmed by repeat measurement, but only slightly above the high flag limit. Will continue to monitor at the current quarterly frequency.
SR-16	Co	2020-05-26	0.0001	0.0011	0.0017	mg/L	Results are historic highs confirmed by repeat analysis, but only slightly above the high flag limits. Will continue to monitor at the current quarterly frequency.
	Mn	2020-05-26	0.0	0.099	0.135	mg/L	
	pHF	2020-05-26	5.0	6.3	6.4		Result is a historic high, confirmed by repeat measurement, but only slightly above the high flag limit. Will continue to monitor at the current quarterly frequency.
M-01	Ba	2020-08-20	0.006	0.024	0.029	mg/L	Results are above the high flags limits, all confirmed by repeat analysis, but consistent with very low flow and heavy upstream beaver activity. All concentrations returned to typical values by the next quarterly sample.
	Co	2020-08-20	0.0003	0.0008	0.0016	mg/L	
	DOC	2020-08-20	3.1	5.7	5.9	mg/L	
	Fe	2020-08-20	0.0	2.5	5.09	mg/L	
	Mn	2020-08-20	0.0	0.333	0.976	mg/L	
	Ra	2020-08-20	0.0	0.032	0.066	Bq/L	

Denison Mines

SRWMP Data Flags
February 2020
Revision 2015-01

Rio Algom

Report Form: RC8.7.3.01

Location	Analyte	Date	Low	Hi	Result		Comment
SR-16	DOC	2020-08-19	9.7	13.1	15.9	mg/L	Result is slightly above the high flag limit, but consistent with historical values. DOC monitoring was discontinued in 2013, but re-initiated in 2020.
SR-17	DOC	2020-08-19	7.3	9.4	9.7	mg/L	Result is slightly above the high flag limit, but consistent with historical values. DOC monitoring was discontinued in 2013, but re-initiated in 2020.
SR-19	DOC	2020-08-20	4.5	4.5	4.7	mg/L	Result is slightly above the high flag limit, but consistent with historical values. DOC monitoring was discontinued in 2013, but re-initiated in 2020.
SR-01	Fe	2020-10-19	0.02	0.02	0.03	mg/L	Result is a 13-year high, but only slightly above the high flag limit. Will continue to monitor at the current annual frequency.
SR-08	DOC	2020-11-04	3.3	4.2	4.8	mg/L	Result is slightly above the high flag limit, but consistent with historic values. DOC was discontinued in 2014, but re-established in 2020. Will continue to monitor at the current quarterly frequency.
D-6	DOC	2020-11-23	3.6	4.5	4.6	mg/L	Result is slightly above the high flag limit, but consistent with historic values. DOC was discontinued in 2014, but re-established in 2020. Will continue to monitor at the current quarterly frequency.

Report Form: RC8.7.3.01

Location	Analyte	Date	Low	Hi	Result		Comment
SR-19	DOC	2020-11-24	4.2	4.9	5.6	mg/L	Result is slightly above the high flag limit, but consistent with historic values. DOC was discontinued in 2014, but re-established in 2020. Will continue to monitor at the current semi annual frequency.

APPENDIX III
Laboratory QA/QC Results

REPORT CODE: *DEN-ANN20*

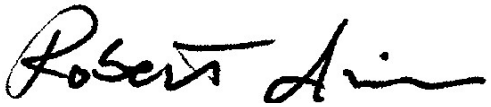
REPORT TITLE: *Annual 2020 Denison Data Quality Report*

REVISION: *1.0*

ISSUED BY:

Quality Coordinator,
SGS Environment, Health & Safety

AUTHORIZED BY:



Technical Manager,
SGS Environment, Health & Safety

DATE: *22 Jan. 2021*

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1. BACKGROUND

SGS Laboratory entered into an agreement with Denison Environmental Services for the analytical lab to provide analysis according to RFT #05-016. Please find below a summary of the laboratory quality management system, key actions taken by the laboratory, as well as a summary of numbers of samples analyzed.

2. QUALITY MANAGEMENT SYSTEM

SGS Environment, Health & Safety is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation (CALA), for specific tests listed in the scope of accreditation. ISO/IEC 17025 addresses both quality management and the technical aspects of operating a testing laboratory.

The quality management system at SGS Environment, Health & Safety consists of a documented quality system, which is directed by the Quality Coordinator who is independent of the production area. All appropriate documentation (quality manual, methods, written instructions, standard operating procedures, and data approval criteria) is in place and includes both general and method specific quality control requirements.

The quality control procedures include duplicate samples, spiked blanks, spiked replicates, reagent/instrument blanks, preparation control samples, certified reference material analysis, and instrument control samples, as appropriate for the individual methods. Matrix matching of reference materials to samples is always attempted. Frequency of insertion of control samples is method specific and follows legislated guidelines. A summary of the quality control recoveries is presented in the tables following.

3. QUALITY CONTROL PARAMETERS

All QC parameters are taken directly from SGS LIMS. Denison Environmental Services samples are processed as part of our “worksheet” batch system. A compilation of all QC data appropriate to the parameters tested has been compiled below.

4. NOTABLE OCCURANCES/ACTIONS

- SGS Environment, Health & Safety Lakefield laboratory performed 6441 analyses with 8003 QC checks, which represents 124% QC for sample analysis. **Corrective Action**: N/A
- All blank data results were within the data quality objectives. **Corrective Action**: N/A
- All CRM/spike blank data results were within the data quality objectives. **Corrective Action**: N/A
- No duplicate value exceeded the data quality objectives. **Corrective Action:** N/A
- No spike duplicates fell outside of the data quality objectives. **Corrective Action**: N/A

5. QC DATA SUMMARY

5.1. Blank Data

Parameter	Unit	Required Limit	Number of Blanks	Mean Blank Result
Acidity	mg/L as CaCO3	1	123	2
Silver	mg/L	0.00005	45	<0.00005
Alkalinity	mg/L as CaCO3	1	23	1
Arsenic	mg/L	0.0005	1	<0.0005
Barium	mg/L	0.005	275	<0.005
Cobalt	mg/L	0.0005	180	<0.0005
Copper	mg/L	0.0005	45	<0.0005
DOC	mg/L	0.5	30	<0.5
Iron	mg/L	0.02	232	<0.02
Manganese	mg/L	0.002	187	<0.002
Nickel	mg/L	0.0001	45	<0.0001
Lead	mg/L	0.00001	46	<0.00001
Selenium	mg/L	0.00004	45	<0.00004
Sulphate	mg/L	0.2	236	<0.2
Total Dissolved Solids	mg/L	30	1	<30
Total Suspended Solids	mg/L	1	401	<1
Uranium	mg/L	0.0005	179	<0.0005
Zinc	mg/L	0.002	45	<0.002

5.2. Reference Material/Spiked Blank Data

Parameter	Unit	Number of RM or SB	% Recovery
Acidity	mg/L as CaCO3	123	99.7
Silver	mg/L	45	100.9
Alkalinity	mg/L as CaCO3	23	101.3
Arsenic	mg/L	1	104.0
Barium	mg/L	275	100.4
Cobalt	mg/L	180	99.9
Copper	mg/L	45	100.9
DOC	mg/L	30	100.7

Iron	mg/L	232	101.0
Manganese	mg/L	187	100.4
Nickel	mg/L	45	100.7
Lead	mg/L	46	99.5
Selenium	mg/L	45	100.7
Sulphate	mg/L	235	95.6
Total Dissolved Solids	Mg/L	1	103.0
Total Suspended Solids	mg/L	401	97.1
Uranium	mg/L	179	98.2
Zinc	mg/L	45	100.5

5.3. Duplicate Data

Parameter	Unit	RPD* Limit	Number of Duplicates	RPD*
Acidity	mg/L as CaCO3	20	121	7.9
Silver	mg/L	20	45	1.9
Alkalinity	mg/L as CaCO3	20	23	1.3
Arsenic	mg/L	20	1	0.0
Barium	mg/L	20	275	3.2
Cobalt	mg/L	20	180	3.7
Copper	mg/L	20	45	4.0
DOC	mg/L	20	30	1.5
Iron	mg/L	20	232	4.7
Manganese	mg/L	20	187	3.4
Nickel	mg/L	20	45	3.5
Lead	mg/L	20	46	5.6
Selenium	mg/L	20	45	8.7
Sulphate	mg/L	20	235	2.2
Total Dissolved Solids	mg/L	20	1	2.0
Total Suspended Solids	mg/L	20	401	2.4
Uranium	mg/L	20	179	4.1
Zinc	mg/L	20	45	2.6

*RPD – Relative Percent Difference

5.4. Spike Duplicate Data

Parameter	Unit	Number of Spike Dups	Mean % Recovery
Silver	mg/L	45	94.1
Arsenic	mg/L	1	100.0
Barium	mg/L	275	101.9
Cobalt	mg/L	180	100.0
Copper	mg/L	45	100.2
DOC	mg/L	30	97.8
Iron	mg/L	232	107.7
Manganese	mg/L	187	101.1
Nickel	mg/L	45	98.8
Lead	mg/L	46	98.7
Selenium	mg/L	45	101.8
Sulphate	mg/L	235	94.8
Uranium	mg/L	179	98.7
Zinc	mg/L	45	105.6

5.5. QC Frequency

Total Number of Blanks:	2139
Total Number of Reference Materials/Spiked Blanks:	2138
Total Number of Duplicate Samples:	2136
Total Number of Spiked Duplicate Samples:	1590
Sum of QC Insertion:	**8003**
Total Analysis:	**6441**

Central Analytical Facility
PCAF AT LAURENTIAN UNIVERSITY
Centre d'analyse
CAP À L'UNIVERSITÉ LAURENTIENNE

LaurentianUniversity
UniversitéLaurentienne

^{226}Ra DATA QUALITY REPORT

2020 Annual

Prepared by:

Troy Maki

Troy Maki - Chemical Technologist

Reviewed by:

Alan Lock

Dr. Alan Lock – PCAF Laboratory Manager

Perdue Central Analytical Facility of Laurentian University
Date: January 27, 2021

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Contents

1 Background

The Perdue Central Analytical Facility (PCAF), previously Elliot Lake Research Field Station (ELRFS), entered into an agreement with Denison Environmental Services (DES) for the analytical laboratory to provide ^{226}Ra analysis according to the ELFRS Offer of Services document submitted to DES on December 3, 2010. Please find below the summaries of the monthly Quality Control (QC) results for blanks, duplicates, certified reference material (CRM) & standard reference material (SRM), and spiked sample analysis.

The Analytical Services Laboratory of the Elliot Lake Research Field Station (ELRFS) was established in 1992. In July 2019, ELRFS analytical services was incorporated as part of the new Perdue Central Analytical Facility (PCAF) at Laurentian University to support improved operations through new purposed space and additional, dedicated technical and management staff. The initial (1992) work of the laboratory was to support research into the effects of low-level radioactivity on the environment resulting from regional uranium mining activities.

From this base, the laboratory has provided analytical services in support of local decommissioning and environmental monitoring programs, and in support of academic research. While the laboratory specializes in **radionuclide** analysis, it also provides a wide range of inorganic and organic services for environmental samples, including solid wastes, effluents, receiving waters, ground waters, soils, sediments, geological materials, plant tissues and animal and fish tissues. The PCAF analytical team will also complete specialty analyses outside of the scope of accreditation, following good laboratory practice procedures, using similar QA/QC protocols.

2 Quality Management System

ELRFS maintained ISO/IEC 17025:2005 accreditation by the Canadian Association of Laboratory Accreditation (CALA) for specific environmental tests listed in the Scope of Accreditation since 2001. Shortly before the transition of ELRFS to PCAF, during July 2019, the laboratory accreditation was withdrawn by CALA due to previous management not submitting the Management Review document as required under the standard. Accreditation is the formal recognition of the competence of a laboratory to achieve and demonstrate the highest levels of scientific and management excellence through the combined principles of Competence, Consistency, Credibility and Communication. PCAF took this very seriously and spent several months and great effort to re-obtain accreditation quickly which was granted by CALA on March 19th, 2020 for ISO/IEC 17025:2017. Throughout this process, PCAF has been committed to operating using Good Laboratory Practice (GLP) and incorporating the same quality control data, impartiality, document control, and client confidentiality that has been used under the ISO/IEC 17025:2017 standard.

The quality management system at PCAF consists of a documented quality system stating the quality policy, quality system and quality practices designed to demonstrate quality control operations are being carried out, to ensure accountability of data, to assure traceability of reported data, and to show that reasonable precautions are being taken against the possibility of falsification of data. Within this manual, Quality Assurance Procedures and Standard Operation Procedures define the laboratory operational

duties that guide the analytical QC data. This includes a minimum target of 20% of the samples analysed being distributed as blanks, duplicate analysis, CRMs or SRMs, and spiked samples. The sample and QC results are logged into excel spread sheets with monthly and annual QC reports generated from the data sets.

Beginning in May, 2020, PCAF switched from the Eckert & Ziegler CRM (0.050Bq/L) to a NIST SRM or Standard Reference Material (#4965a - 0.0617Bq/L) in order to comply with ISO/IEC 17025:2017 assessment findings that an independently sourced reference material be used from the spike and instrument calibration standards. The new NIST 4965A SRM was tested 33 times to generate statistical data for control chart formation and had a 0.0566Bq/L or 91.69% average recovery with a standard deviation of +/-0.0045Bq/L.

3 Quality Control Parameters

All QC parameters are taken directly from the Excel spread sheets. DES samples are processed as part of the worksheet batch system. A compilation of all QC data appropriate to the parameters tested has been compiled below.

The QC summary reports are presented as control charts with the mean +/- 1 standard deviation illustrated as the SD Level, the mean +/- 2 standard deviations illustrated as the Warning Level and the mean +/- 3 standard deviations illustrated as the Control Level.

Control Level - If the Control Level is exceeded, the analysis of standards and samples must be repeated and if the repeat analysis exceeds the Control Level again, corrective action is required.
Warning Level – If 2 or more consecutive points exceed the Warning Level, another standard must be analyzed and if this analysis exceeds the Warning Level again, corrective action is required.
SD Level – If 4 consecutive results exceed the SD Level, analyse the next sample and if the SD Level is exceeded again, corrective action is required.

4 Notable Occurrences /Actions

Through the year of 2020, PCAF analyzed 62 batches totaling 987 samples for ^{226}Ra. Each batch incorporated blank, CRM or SRM, duplicate, and spiked samples providing greater than 20% quality control samples. All quality control samples are within control limits (mean +/- 3SD).

Nine quality control samples exceeded the warning (mean +/- 2SD) levels. This included one QC CRM (Figure 3a) sample, two QC Duplicate (Figure 2) samples and six QC Spike (Figure 4a) samples. All samples exceeding the warning level were not consecutive, with the next consecutive QC sample falling within the warning level (mean +/- 2SD) limit, thus no corrective actions were required. No QC samples exceeded objectives.

5 QC Data Summary

Table 1. Summary of QC results for January - December 2020.

Quality Element	Unit	Objective	Total Number of QC Samples	Expected Value	Mean	Number Outside Warning Limit	Number Outside Control Limit	Number Exceeding Objective
Blank	Bq/L	0.01	62	0	0.00065	0	0	0
Duplicate % error	%	20	62	0	6.77	2	0	0
CRM – Eckert & Ziegler	Bq/L	20	22	0.050	0.047	1	0	0
SRM - NIST	Bq/L	20	40	0.0617	0.057	0	0	0
Spike	Bq/L	20	62	0.250	0.239	6	0	0

1 Blanks

The blank sample is composed of ultra pure water and is treated in an identical manner, including all of the added reagents, as normal samples. The criterion of the blank sample is 0.01 Bq/L which is equal to 6 counts per 100 min (0.06 cpm). The 2020 mean blank value is 1.01 counts per 100min (0.00065 Bq/L). PCAF uses counts to monitor the blank quality control data.

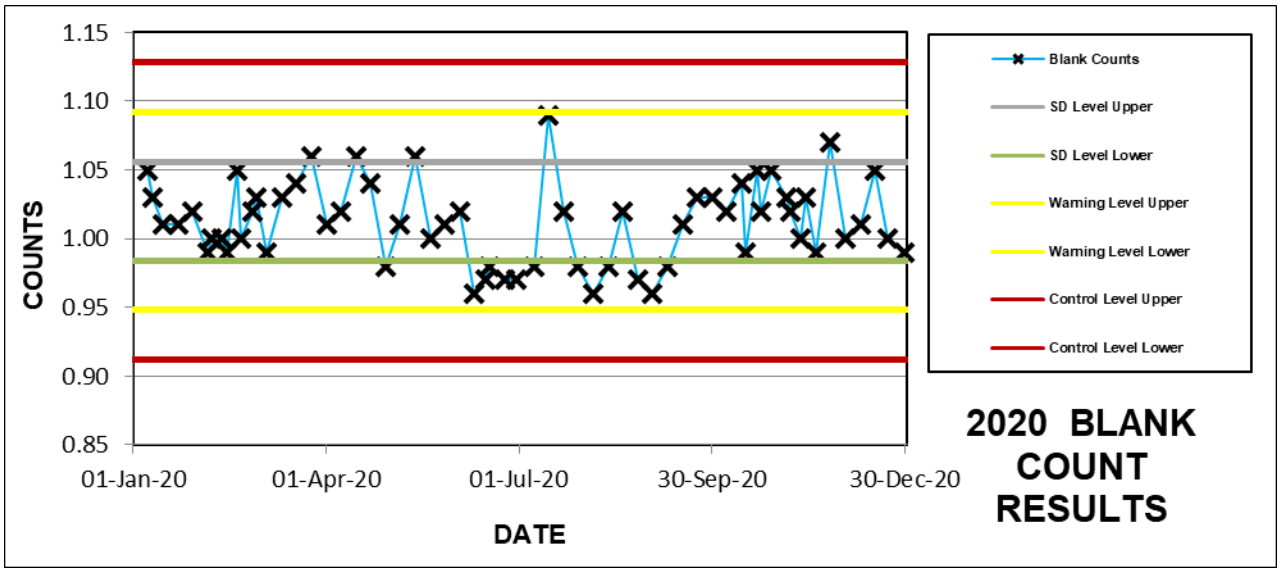

Figure 1a: Blank quality control results for the 2020 year.

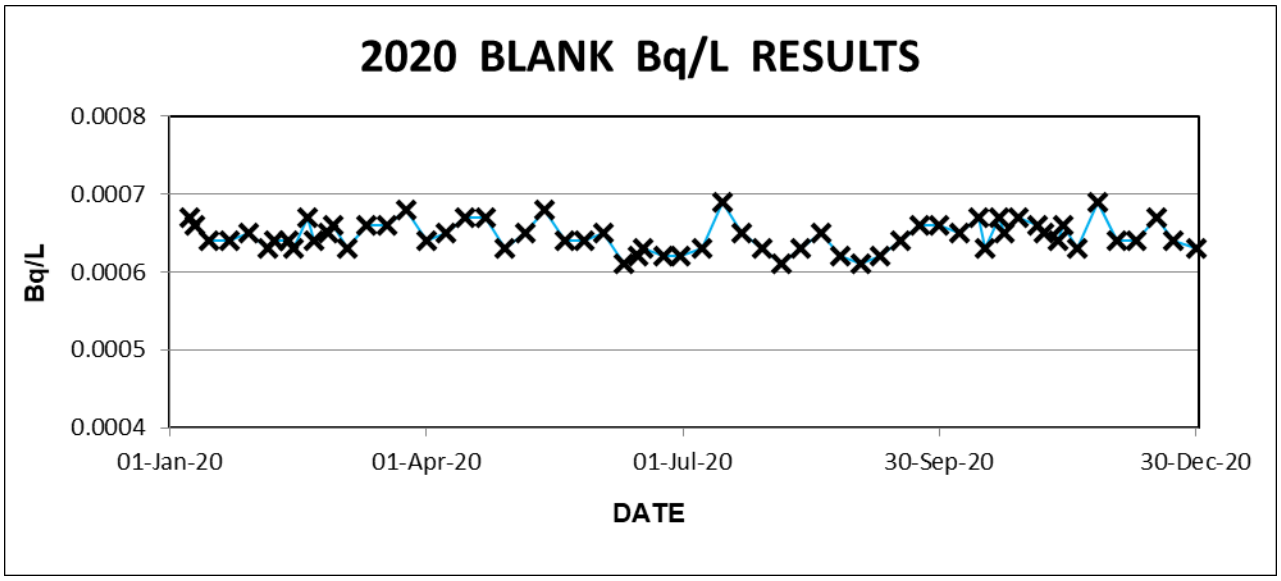

Figure 1b: Blank quality control concentrations for the 2020 year. Note maximum concentrations are 10 times lower than the 0.01 Bq/L criteria.

2 Duplicates

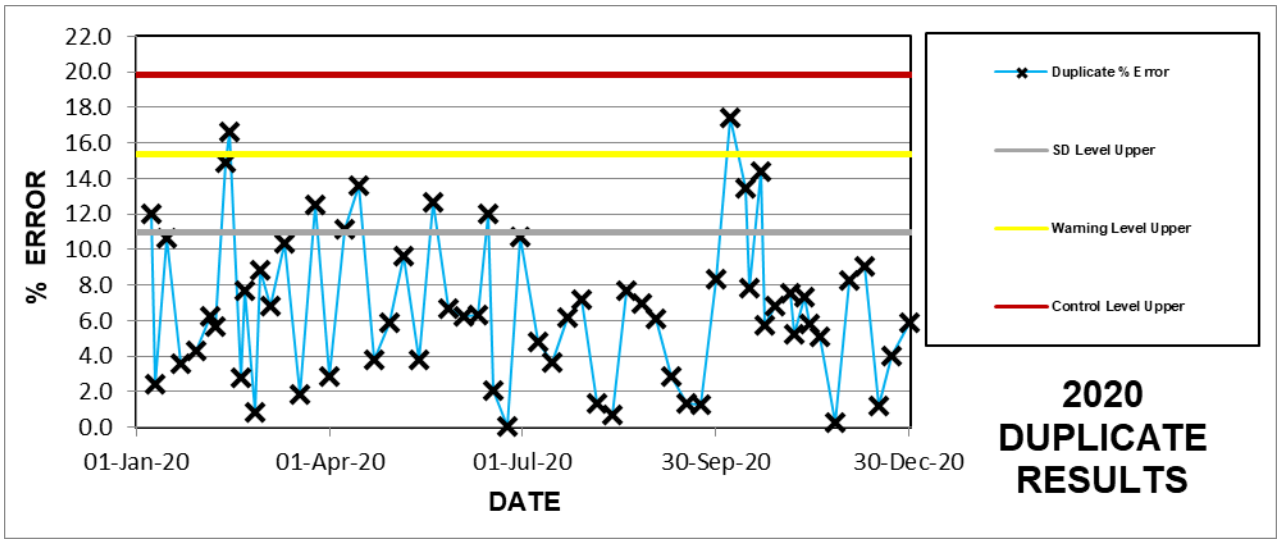

Figure 2: Duplicate quality control results for the 2020 year.

3 CRM

The CRM material used from January 1st to April 30th 2020 is from Eckert & Ziegler (0.050Bq/L). The SRM used from May 1st to December 30th is from NIST (4965a – 0.0617Bq/L).

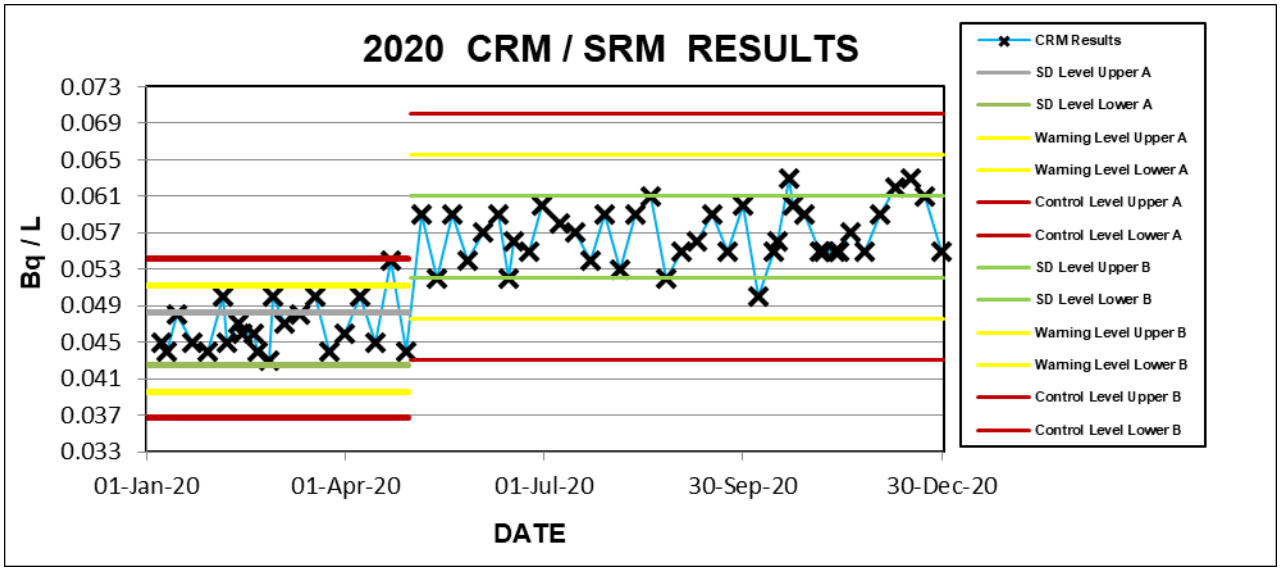

Figure 3a: CRM & SRM quality control results for the 2020 year.

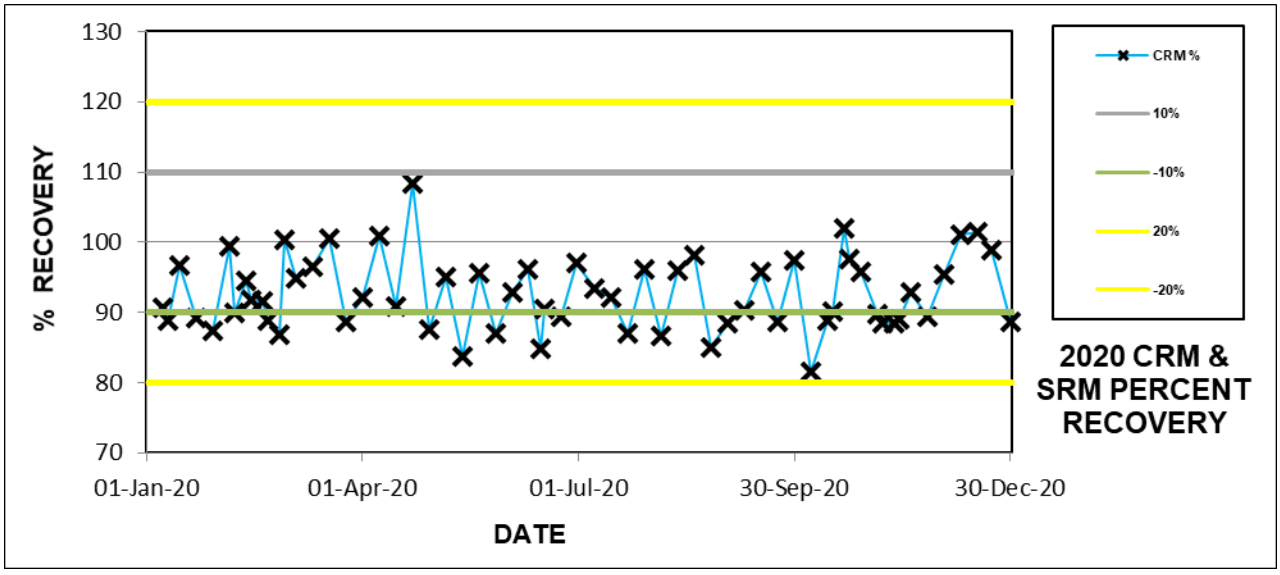

Figure 3b: CRM percent recovery quality control results for the 2020 year.

4 Spikes

The spike standard used is from Eckert & Ziegler (0.250Bq/L) .

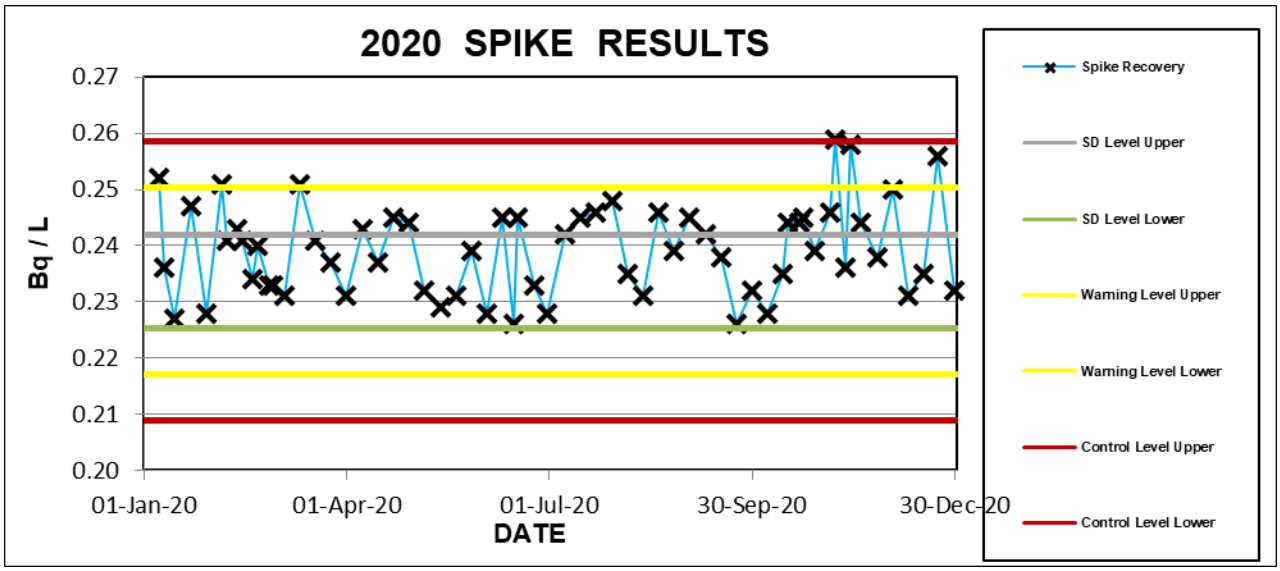

Figure 4a: Spike recovery quality control results for the 2020 year.

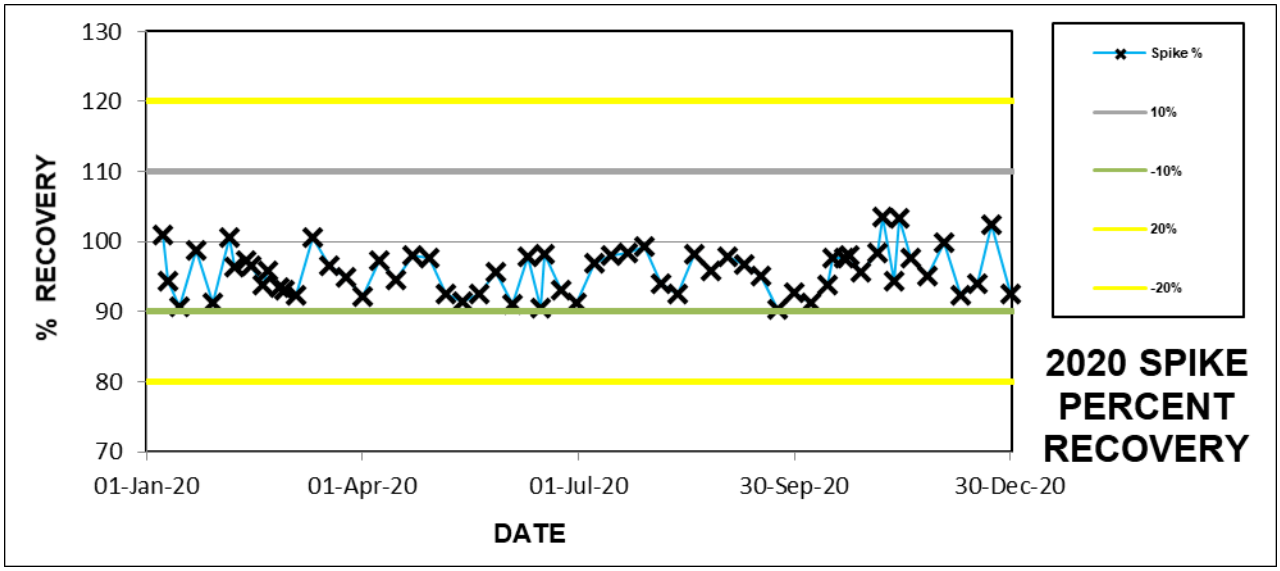

Figure 4b: Percent spike recovery quality control results for the 2020 year.

QC Frequency

Through the 2020 year, PCAF analyzed 62 batches totaling 987 samples for ^{226}Ra. Each batch incorporated blank, CRM or SRM, duplicate, and spiked samples providing greater than 20% quality control samples.

APPENDIX IV
Field QA/QC Results

Denison Mines

SRWMP DATA QUALITY REPORTING
2020 Field Precision
Revision: 2016-01

Rio Algom

Registry: RC8.5.4.01a

Month	Sample	pH	Sulphate	Radium (T)	Uranium	Barium	Iron	Manganese	Hardness
			mg/L	Bq/L	mg/L	mg/L	mg/L	mg/L	mg/L
2020-05	BSR5	6.8	9.3	0.018	0.0021	0.0160	0.23		33.3
	M-01	6.8	9.2	0.016	0.0020	0.0150	0.22		31.4
	variance	0.0%	1.1%	11.8%	4.9%	6.5%	4.4%		5.9%
2020-05	BSD2	6.6	29.0	< 0.007	< 0.0005	0.0180	0.52	0.260	42.5
	D-6	6.6	30.0	< 0.007	< 0.0005	0.0170	0.52	0.254	41.8
	variance	0.0%	3.4%	0.0%	0.0%	5.7%	0.0%	2.3%	1.7%
2020-11	BSR5	6.9	8.5	0.021	0.0031	0.0140	0.39		29.6
	M-01	6.9	8.5	0.020	0.0029	0.0140	0.42		29.8
	variance	0.0%	0.0%	4.9%	6.7%	0.0%	7.4%		0.7%
2020-11	BSD2	6.9	11.0	< 0.007	< 0.0005	0.0120	0.17	0.064	20.4
	D-6	6.9	12.0	< 0.007	< 0.0005	0.0130	0.18	0.064	20.3
	variance	0.0%	8.7%	0.0%	0.0%	8.0%	5.7%	0.0%	0.5%
Count		4	4	4	4	4	4	2	4
Average		0.0%	3.3%	4.2%	2.9%	5.0%	4.4%	1.2%	2.2%
Max		0.0%	8.7%	11.8%	6.7%	8.0%	7.4%	2.3%	5.9%
Min		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
SRWMP1 Target		20%	20%	20%	20%	20%	20%	20%	20%
# Exceedances		0	0	0	0	0	0	0	0

[1] Field Precision criteria as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

Bold indicates an exceedance in the field precision criteria

Denison Mines

SRWMP DATA QUALITY REPORTING
2020 Field Blank
Revision: 2016-01

Rio Algom

Report Form: RC8.5.4.01b

Date		pH	Sulphate	Radium (total)	Uranium	Barium	Iron	Manganese
			mg/L	Bq/L	mg/L	mg/L	mg/L	mg/L
SRWMP [1]		1	0.2	0.01	0.001	0.01	0.04	0.004
2020.05	FBR5	5.9	< 0.1	< 0.007	< 0.0005	< 0.0050	< 0.02	
2020.05	FBD2	6.0	< 0.1	< 0.007	< 0.0005	< 0.0050	< 0.02	< 0.002
2020.11	FBR5	5.9	< 0.1	< 0.007	< 0.0005	< 0.0050	< 0.02	
2020.11	FBD2	5.9	< 0.1	< 0.007	< 0.0005	< 0.0050	< 0.02	< 0.002
Count		4	4	4	4	4	4	2
# Exceedances		4	0	0	0	0	0	0
Average		5.9	< 0.10	< 0.007	< 0.0005	< 0.0050	< 0.02	< 0.0020
Max		6	< 0.10	< 0.007	< 0.0005	< 0.0050	< 0.02	< 0.0020
Min		5.9	< 0.10	< 0.007	< 0.0005	< 0.0050	< 0.02	< 0.0020

[1] [1] Field blank criteria taken from Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019))

Bold indicates an exceedance in the Field Blank criteria

APPENDIX V
Location Results

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

BSD2

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	Fe mg/L	Mn mg/L
2020-05	4.0	42.5	6.6	29.0	<0.007	0.018	0.52	0.260
2020-11	4.6	20.4	6.9	11.0	<0.007	0.012	0.17	0.064
Count	2	2	2	2	2	2	2	2
High	4.6	42.5	6.9	29.0	<0.007	0.018	0.52	0.260
Low	4.0	20.4	6.6	11.0	<0.007	0.012	0.17	0.064
Mean	4.3	31.4	6.8	20.0	<0.007	0.015	0.35	0.162
High Limit			8.5	218.0	0.469	1.000	0.76	0.841
Low Limit			6.5					
Lim Ex	0	0	0	0	0	0	1	0
Frequency	0%	0%	0%	0%	0%	0%	50%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

Month	U mg/L
2020-05	<0.0005
2020-11	<0.0005
Count	2
High	<0.0005
Low	<0.0005
Mean	<0.0005
High Limit	0.0150
Low Limit	
Lim Ex	0
Frequency	0%
10x Lim Ex	0
Frequency	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

BSR5

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	Fe mg/L	U mg/L
2020-05	4.1	33.3	6.8	9.3	0.018	0.016	0.23	0.0021
2020-11	5.1	29.6	6.9	8.5	0.021	0.014	0.39	0.0031
Count	2	2	2	2	2	2	2	2
High	5.1	33.3	6.9	9.3	0.021	0.016	0.39	0.0031
Low	4.1	29.6	6.8	8.5	0.018	0.014	0.23	0.0021
Mean	4.6	31.4	6.8	8.9	0.020	0.015	0.31	0.0026
High Limit			8.5	218.0	0.469	1.000	2.49	0.0150
Low Limit			5.3					
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

D-4 Dunlop Lake Outlet

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	Fe mg/L	Mn mg/L
2020-05	2.7	8.9	6.8	3.1	<0.007	0.013	0.04	0.013
2020-11	3.1	8.8	6.9	2.9	<0.007	0.012	0.04	0.014
Count	2	2	2	2	2	2	2	2
High	3.1	8.9	6.9	3.1	<0.007	0.013	0.04	0.014
Low	2.7	8.8	6.8	2.9	<0.007	0.012	0.04	0.013
Mean	2.9	8.9	6.8	3.0	<0.007	0.013	0.04	0.014
High Limit			8.5	128.0	0.469	1.000	0.76	0.841
Low Limit			6.5					
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

Month	U mg/L
2020-05	<0.0005
2020-11	<0.0005
Count	2
High	<0.0005
Low	<0.0005
Mean	<0.0005
High Limit	0.0150
Low Limit	
Lim Ex	0
Frequency	0%
10x Lim Ex	0
Frequency	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

D-5 Serpent R. between Denison and Quirke TMAs

Month	DOC	FLOW	hard	pHF	SO4	Ra	Ba	U
	mg/L	L/s	mg/L		mg/L	Bq/L	mg/L	mg/L
2020-02	2.9	2415.00	21.5	7.4	13.0	0.019	0.072	0.0016
2020-05	3.1	1290.00	27.1	6.8	15.0	0.057	0.078	0.0016
2020-08	3.2		17.6	6.9	7.1	0.087	0.089	0.0010
2020-11	3.1	6440.00	14.8	6.8	7.2	0.013	0.033	0.0009
Count	4	4	4	4	4	4	4	4
High	3.2	6440.00	27.1	7.4	15.0	0.087	0.089	0.0016
Low	2.9	1290.00	14.8	6.8	7.1	0.013	0.033	0.0009
Mean	3.1	3381.67	20.3	7.0	10.6	0.044	0.068	0.0013
High Limit				8.5	128.0	0.469	1.000	0.0150
Low Limit				6.5				
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

D-6 Cinder Lake Outlet

Month	DOC	FLOW	hard	pHF	SO4	Ra	Ba	Fe
	mg/L	L/s	mg/L		mg/L	Bq/L	mg/L	mg/L
2020-02	4.2		17.2	7.4	12.0	<0.007	0.013	0.18
2020-05	4.0	5.00	41.8	6.6	30.0	<0.007	0.017	0.52
2020-08	3.9	5.00	45.5	6.6	30.0	<0.007	0.015	0.59
2020-11	4.6	50.00	20.3	6.9	12.0	<0.007	0.013	0.17
Count	4	4	4	4	4	4	4	4
High	4.6	50.00	45.5	7.4	30.0	<0.007	0.017	0.59
Low	3.9	5.00	17.2	6.6	12.0	<0.007	0.013	0.17
Mean	4.2	20.00	31.2	6.9	21.0	<0.007	0.014	0.37
High Limit				8.5	218.0	0.469	1.000	0.76
Low Limit				6.5				
Lim Ex	0	0	0	0	0	0	0	2
Frequency	0%	0%	0%	0%	0%	0%	0%	50%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

Month	Mn	U
	mg/L	mg/L
2020-02	0.072	<0.0005
2020-05	0.254	<0.0005
2020-08	0.193	<0.0005
2020-11	0.064	<0.0005
Count	4	4
High	0.254	<0.0005
Low	0.064	<0.0005
Mean	0.146	<0.0005
High Limit	0.841	0.0150
Low Limit		
Lim Ex	0	0
Frequency	0%	0%
10x Lim Ex	0	0
Frequency	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

DS-18 Halfmoon Lake Outlet

Month	DOC mg/L	FLOW L/s	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	Fe mg/L
2020-02	2.4		76.5	7.2	67.0	0.095	0.021	0.51
2020-05	2.1	370.60	70.6	6.9	58.0	0.106	0.025	0.26
2020-08	2.8	322.00	47.0	7.1	26.0	0.073	0.014	0.51
2020-10	2.9	346.60	86.2	7.0	61.0	0.146	0.024	0.13
Count	4	4	4	4	4	4	4	4
High	2.9	370.60	86.2	7.2	67.0	0.146	0.025	0.51
Low	2.1	322.00	47.0	6.9	26.0	0.073	0.014	0.13
Mean	2.5	346.40	70.1	7.0	53.0	0.105	0.021	0.35
High Limit				8.5	309.0	0.469	1.000	2.49
Low Limit				5.3				
Lim Ex	0	0	0	0	0	0	0	2
Frequency	0%	0%	0%	0%	0%	0%	0%	50%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

Month	U mg/L
2020-02	0.0007
2020-05	0.0008
2020-08	0.0012
2020-10	0.0012
Count	4
High	0.0012
Low	0.0007
Mean	0.0010
High Limit	0.0150
Low Limit	
Lim Ex	0
Frequency	0%
10x Lim Ex	0
Frequency	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

FBD2

Month	DOC	hard	pHF	SO4	Ra	Ba	Fe	Mn
	mg/L	mg/L		mg/L	Bq/L	mg/L	mg/L	mg/L
2020-05	<0.5	<0.5	6.0	<0.1	<0.007	<0.005	<0.02	<0.002
2020-11	<0.5	<0.5	5.9	<0.1	<0.007	<0.005	<0.02	<0.002
Count	2	2	2	2	2	2	2	2
High	<0.5	<0.5	6.0	<0.1	<0.007	<0.005	<0.02	<0.002
Low	<0.5	<0.5	5.9	<0.1	<0.007	<0.005	<0.02	<0.002
Mean	<0.5	<0.5	6.0	<0.1	<0.007	<0.005	<0.02	<0.002

Month	U
	mg/L
2020-05	<0.0005
2020-11	<0.0005
Count	2
High	<0.0005
Low	<0.0005
Mean	<0.0005

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

FBR5

Month	DOC	hard	pHF	SO4	Ra	Ba	Fe	U
	mg/L	mg/L		mg/L	Bq/L	mg/L	mg/L	mg/L
2020-05	<0.5	<0.5	5.9	<0.1	<0.007	<0.005	<0.02	<0.0005
2020-11	<0.5	<0.5	5.9	<0.1	<0.007	<0.005	<0.02	<0.0005
Count	2	2	2	2	2	2	2	2
High	<0.5	<0.5	5.9	<0.1	<0.007	<0.005	<0.02	<0.0005
Low	<0.5	<0.5	5.9	<0.1	<0.007	<0.005	<0.02	<0.0005
Mean	<0.5	<0.5	5.9	<0.1	<0.007	<0.005	<0.02	<0.0005

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

M-01 Sherriff Creek @ Hwy 108

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	Fe mg/L	U mg/L
2020-02	4.7	34.7	6.8	9.5	0.012	0.015	0.51	0.0025
2020-05	4.1	31.4	6.8	9.2	0.016	0.015	0.22	0.0020
2020-08	5.9	45.7	6.6	1.6	0.066	0.029	5.09	0.0021
2020-11	5.0	29.8	6.9	8.5	0.020	0.014	0.42	0.0029
Count	4	4	4	4	4	4	4	4
High	5.9	45.7	6.9	9.5	0.066	0.029	5.09	0.0029
Low	4.1	29.8	6.6	1.6	0.012	0.014	0.22	0.0020
Mean	4.9	35.4	6.8	7.2	0.029	0.018	1.56	0.0024
High Limit			8.5	218.0	0.469	1.000	2.49	0.0150
Low Limit			5.3					
Lim Ex	0	0	0	0	0	0	2	0
Frequency	0%	0%	0%	0%	0%	0%	50%	0%
10x Lim Ex	0	0	0	0	0	0	1	0
Frequency	0%	0%	0%	0%	0%	0%	25%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

Q-09 Serpent R. below Quirke TMA Effluent

Month	DOC	FLOW	hard	pHF	SO4	Ra	Ba	U
	mg/L	L/s	mg/L		mg/L	Bq/L	mg/L	mg/L
2020-02	3.2	2550.00	54.2	7.2	47.0	0.033	0.067	0.0020
2020-05	3.7	1380.00	43.0	6.7	31.0	0.069	0.066	0.0020
2020-08	4.4		46.9	6.7	31.0	0.134	0.120	0.0020
2020-11	4.1	6640.00	38.5	6.9	27.0	0.027	0.042	0.0015
Count	4	4	4	4	4	4	4	4
High	4.4	6640.00	54.2	7.2	47.0	0.134	0.120	0.0020
Low	3.2	1380.00	38.5	6.7	27.0	0.027	0.042	0.0015
Mean	3.9	3523.33	45.6	6.9	34.0	0.066	0.074	0.0019
High Limit				8.5	128.0	0.469	1.000	0.0150
Low Limit				6.5				
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

Q-20 Evans Lake Outlet to Dunlop Lake

Month	DOC mg/L	FLOW L/s	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	U mg/L
2020-11	2.3	10.00	35.7	6.8	17.0	<0.007	0.019	<0.0005
Count	1	1	1	1	1	1	1	1
High	2.3	10.00	35.7	6.8	17.0	<0.007	0.019	<0.0005
Low	2.3	10.00	35.7	6.8	17.0	<0.007	0.019	<0.0005
Mean	2.3	10.00	35.7	6.8	17.0	<0.007	0.019	<0.0005
High Limit				8.5	128.0	0.469	1.000	0.0150
Low Limit				6.5				
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SC-01 Westner Lake Outlet

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	Fe mg/L	U mg/L
2020-11	4.6	25.3	7.0	16.0	0.012	0.009	0.13	<0.0005
Count	1	1	1	1	1	1	1	1
High	4.6	25.3	7.0	16.0	0.012	0.009	0.13	<0.0005
Low	4.6	25.3	7.0	16.0	0.012	0.009	0.13	<0.0005
Mean	4.6	25.3	7.0	16.0	0.012	0.009	0.13	<0.0005
High Limit			8.5	128.0	0.469	1.000	2.49	0.0150
Low Limit			5.3					
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SR-01 Quirke Lake Outlet

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	U mg/L
2020-10	3.4	34.3	6.8	24.0	0.029	0.042	0.0012
Count	1	1	1	1	1	1	1
High	3.4	34.3	6.8	24.0	0.029	0.042	0.0012
Low	3.4	34.3	6.8	24.0	0.029	0.042	0.0012
Mean	3.4	34.3	6.8	24.0	0.029	0.042	0.0012
High Limit			8.5	218.0	0.469	1.000	0.0150
Low Limit			6.5				
Lim Ex	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SR-06 McCabe Lake Outlet

Month	DOC	FLOW	hard	pHF	SO4	Ra	Ba	U
	mg/L	L/s	mg/L		mg/L	Bq/L	mg/L	mg/L
2020-06	3.1	569.00	35.3	7.4	27.0	0.055	0.130	0.0005
2020-10	3.2	651.40	38.5	7.0	25.0	0.052	0.166	0.0006
Count	2	2	2	2	2	2	2	2
High	3.2	651.40	38.5	7.4	27.0	0.055	0.166	0.0006
Low	3.1	569.00	35.3	7.0	25.0	0.052	0.130	0.0005
Mean	3.2	610.20	36.9	7.2	26.0	0.053	0.148	0.0005
High Limit				8.5	218.0	0.469	1.000	0.0150
Low Limit				6.5				
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SR-08 Nordic Lake Outlet

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	U mg/L
2020-02	3.9	193.0	6.7	150.0	0.022	0.020	0.0008
2020-05	3.6	136.0	6.8	120.0	0.029	0.018	0.0007
2020-08	3.7	189.0	6.9	140.0	0.031	0.020	0.0008
2020-11	4.8	177.0	6.9	150.0	0.036	0.019	0.0008
Count	4	4	4	4	4	4	4
High	4.8	193.0	6.9	150.0	0.036	0.020	0.0008
Low	3.6	136.0	6.7	120.0	0.022	0.018	0.0007
Mean	4.0	173.8	6.8	140.0	0.029	0.019	0.0008
High Limit			8.5	309.0	0.469	1.000	0.0150
Low Limit			6.5				
Lim Ex	0	0	0	3	0	0	0
Frequency	0%	0%	0%	75%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SR-15 May Lake

Month	DOC	hard	pHF	SO4	Ra	Ba	Fe	U
	mg/L	mg/L		mg/L	Bq/L	mg/L	mg/L	mg/L
2020-06	3.1	40.7	7.3	28.0	0.047	0.101	0.03	<0.0005
2020-10	3.5	40.5	7.0	26.0	0.042	0.104	<0.02	<0.0005
Count	2	2	2	2	2	2	2	2
High	3.5	40.7	7.3	28.0	0.047	0.104	0.03	<0.0005
Low	3.1	40.5	7.0	26.0	0.042	0.101	<0.02	<0.0005
Mean	3.3	40.6	7.2	27.0	0.044	0.103	0.03	<0.0005
High Limit			8.5	218.0	0.469	1.000	0.76	0.0150
Low limit			6.5					
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SR-16 Fox Creek @ Hwy 108

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra mg/L	Ba Bq/L	Fe mg/L	Mn mg/L
2020-02	11.8	8.8	5.9	0.8	<0.007	0.008	1.17	0.036
2020-05	11.0	7.0	6.4	0.8	<0.007	0.008	1.63	0.135
2020-08	15.9	10.0	6.0	0.5	<0.007	0.009	1.33	0.060
2020-11	11.6	6.0	6.4	1.2	<0.007	<0.005	0.36	0.014
Count	4	4	4	4	4	4	4	4
High	15.9	10.0	6.4	1.2	<0.007	0.009	1.63	0.135
Low	11.0	6.0	5.9	0.5	<0.007	<0.005	0.36	0.014
Mean	12.6	7.9	6.2	0.8	<0.007	0.008	1.12	0.061
High Limit			8.5	128.0	0.469	1.000	2.49	0.841
Low Limit			5.3					
Lim Ex	0	0	0	0	0	0	3	0
Frequency	0%	0%	0%	0%	0%	0%	75%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

Month	U mg/L
2020-02	<0.0005
2020-05	<0.0005
2020-08	<0.0005
2020-11	<0.0005
Count	4
High	<0.0005
Low	<0.0005
Mean	<0.0005
High Limit	0.0150
Low Limit	
Lim Ex	0
Frequency	0%
10x Lim Ex	0
Frequency	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SR-17 Unnamed Creek Drain Lake 3 @ Hwy 108

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra mg/L	Ba Bq/L	Fe mg/L	Mn mg/L
2020-02	8.1	10.7	5.8	2.1	<0.007	0.021	0.77	0.062
2020-05	8.6	9.7	6.4	2.1	<0.007	0.022	1.68	0.079
2020-08	9.7	16.5	6.2	0.6	<0.008	0.027	3.72	0.133
2020-11	8.1	6.0	6.5	2.5	<0.007	0.010	0.35	0.021
Count	4	4	4	4	4	4	4	4
High	9.7	16.5	6.5	2.5	<0.008	0.027	3.72	0.133
Low	8.1	6.0	5.8	0.6	<0.007	0.010	0.35	0.021
Mean	8.6	10.7	6.2	1.8	<0.007	0.020	1.63	0.074
High Limit			8.5	128.0	0.469	1.000	2.49	0.841
Low Limit			5.3					
Lim Ex	0	0	0	0	0	0	3	0
Frequency	0%	0%	0%	0%	0%	0%	75%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

Month	U mg/L
2020-02	<0.0005
2020-05	<0.0005
2020-08	<0.0005
2020-11	<0.0005
Count	4
High	<0.0005
Low	<0.0005
Mean	<0.0005
High Limit	0.0150
Low Limit	
Lim Ex	0
Frequency	0%
10x Lim Ex	0
Frequency	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SR-18 Jim Christ Lake Outlet

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	Fe mg/L	Mn mg/L
2020-05	5.1	9.6	6.9	3.4	<0.007	0.047	0.06	0.013
2020-11	5.8	9.7	6.9	3.6	<0.007	0.044	0.09	0.021
Count	2	2	2	2	2	2	2	2
High	5.8	9.7	6.9	3.6	<0.007	0.047	0.09	0.021
Low	5.1	9.6	6.9	3.4	<0.007	0.044	0.06	0.013
Mean	5.4	9.6	6.9	3.5	<0.007	0.045	0.07	0.017
High Limit			8.5	128.0	0.469	1.000	0.76	0.841
Low Limit			6.5					
Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

Month	U mg/L
2020-05	<0.0005
2020-11	<0.0005
Count	2
High	<0.0005
Low	<0.0005
Mean	<0.0005
High Limit	0.0150
Low Limit	
Lim Ex	0
Frequency	0%
10x Lim Ex	0
Frequency	0%

SRWMP ANNUAL WATER QUALITY REPORT 2020
Performance Monitoring Detailed Results 2020

SR-19 Inlet to Elliot Lake

Month	DOC mg/L	hard mg/L	pHF	SO4 mg/L	Ra Bq/L	Ba mg/L	Fe mg/L	Mn mg/L
2020-02	4.5	15.3	7.0	2.7	<0.007	0.020	0.29	0.025
2020-05	4.5	13.6	6.9	2.7	<0.007	0.019	0.13	0.022
2020-08	4.7	20.1	6.9	2.6	<0.007	0.029	0.89	0.169
2020-11	5.6	14.6	7.0	2.4	<0.007	0.018	0.22	0.026
Count	4	4	4	4	4	4	4	4
High	5.6	20.1	7.0	2.7	<0.007	0.029	0.89	0.169
Low	4.5	13.6	6.9	2.4	<0.007	0.018	0.13	0.022
Mean	4.8	15.9	7.0	2.6	<0.007	0.022	0.38	0.060
High Limit			8.5	128.0	0.469	1.000	0.76	0.841
Low Limit			6.5					
Lim Ex	0	0	0	0	0	0	1	0
Frequency	0%	0%	0%	0%	0%	0%	25%	0%
10x Lim Ex	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%

Month	U mg/L
2020-02	<0.0005
2020-05	<0.0005
2020-08	<0.0005
2020-11	<0.0005
Count	4
High	<0.0005
Low	<0.0005
Mean	<0.0005
High Limit	0.0150
Low Limit	
Lim Ex	0
Frequency	0%
10x Lim Ex	0
Frequency	0%

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station D-4

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	128.0		0.469	0.0150	1.000		0.841	-
	Wetland benchmark [2]	5.3						2.49		
	Lake benchmark [3]							0.76		
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.002	0.05
2016		6.8	3.8		< 0.008	< 0.0005	0.013	0.04	0.016	10.8
2017		6.8	3.5		< 0.007	< 0.0005	0.013	0.04	0.021	9.6
2018		6.7	3.4		< 0.007	< 0.0005	0.012	0.04	0.014	9.3
2019		7.0	3.3		< 0.007	< 0.0005	0.014	0.04	0.018	8.9
2020		6.8	3.0	2.9	< 0.007	< 0.0005	0.013	0.04	0.014	8.9

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SR-18

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	128.0		0.469	0.0150	1.000		0.841	-
	Wetland benchmark [2]	5.3						2.49		
	Lake benchmark [3]							0.76		
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.002	0.50
2016		7.0	4.5		< 0.008	< 0.0005	0.048	0.05	0.015	11.5
2017		6.8	4.0		< 0.007	< 0.0005	0.043	0.07	0.025	10.4
2018		6.8	4.5		< 0.007	< 0.0005	0.045	0.04	0.011	9.9
2019		6.9	3.6		< 0.007	< 0.0005	0.051	0.06	0.017	10.1
2020		6.9	3.5	5.4	< 0.007	< 0.0005	0.045	0.07	0.017	9.6

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SR-19

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)		Ra (Bq/L)		U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	128.0			0.469		0.0150	1.000		0.841	-
	Wetland benchmark [2]	5.3								2.49		
	Lake benchmark [3]									0.76		
MDL [4]		0.1	0.1			0.005		0.0005	0.005	0.02	0.002	0.50
2016		6.8	4.0		<	0.008	<	0.0005	0.026	0.35	0.054	16.0
2017		7.0	3.0			0.008	<	0.0005	0.019	0.36	0.031	14.4
2018		6.7	3.2			0.009	<	0.0005	0.025	0.35	0.060	17.9
2019		6.8	2.9		<	0.007	<	0.0005	0.023	0.30	0.039	14.7
2020		7.0	2.6	4.8	<	0.007	<	0.0005	0.022	0.38	0.060	15.9

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SR-16

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	128.0		0.469	0.0150	1.000		0.841	-
	Wetland benchmark [2]	5.3						2.49		
	Lake benchmark [3]							0.76		
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.002	0.5
2016		5.8	1.3		< 0.008	< 0.0005	0.007	0.67	0.032	8.0
2017		5.7	1.1		< 0.007	< 0.0005	0.007	0.94	0.038	7.4
2018		5.4	1.2		< 0.007	< 0.0005	0.008	0.66	0.043	9.0
2019		5.8	1.1		< 0.007	< 0.0005	0.007	0.80	0.034	7.7
2020		6.2	0.8	12.6	< 0.007	< 0.0005	0.008	1.12	0.061	7.9

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland/stream stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SR-17

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	128.0		0.469	0.0150	1.000		0.841	-
	Wetland benchmark [2]	5.3						2.49		
	Lake benchmark [3]							0.76		
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.002	0.5
2016		5.8	2.5		0.009	< 0.0005	0.022	1.32	0.064	12.8
2017		5.8	2.8		0.007	< 0.0005	0.022	0.73	0.048	11.8
2018		5.5	2.4		0.007	< 0.0005	0.027	1.08	0.081	14.2
2019		6.0	2.5		< 0.007	< 0.0005	0.021	0.59	0.039	9.7
2020		6.2	1.8	8.6	< 0.007	< 0.0005	0.020	1.63	0.074	10.7

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland/stream stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station D-5

YEAR		FLOW (L/s)	pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks		6.5	128.0		0.469	0.0150	1.000		0.841	
	Wetland benchmark [2]		5.3						2.49		
	Lake benchmark [3]								0.76		
MDL [4]			0.1	0.1		0.005	0.0005	0.005	0.02	0.002	0.5
2016		1884.0	6.8	14.1		0.069	0.0015	0.047	0.08	0.047	26.6
2017		4843.0	6.8	11.3		0.040	0.0013	0.045	0.07	0.026	20.5
2018		2065.0	6.7	13.8		0.073	0.0015	0.106	0.07	0.039	26.6
2019		3498.0	6.9	10.3		0.041	0.0010	0.051	0.05	0.024	19.4
2020		3381.7	7.0	10.6	3.1	0.044	0.0013	0.068	0.08	0.028	20.3

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021).
Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station D-6

YEAR		FLOW (L/s)	pHF	SO4 [5] (mg/L)	DOC (mg/L)		Ra (Bq/L)		U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks		6.5	218.0			0.469		0.0150	1.000		0.841	-
	Wetland benchmark [2]		5.3								2.49		
	Lake benchmark [3]										0.76		
MDL [4]			0.1	0.1			0.005		0.0005	0.005	0.02	0.002	0.5
2016		95.3	6.6	88.8			0.011	<	0.0005	0.022	0.54	0.458	100.9
2017		151.9	6.7	18.8		<	0.007	<	0.0005	0.013	0.19	0.102	28.7
2018		129.3	6.6	34.8			0.015	<	0.0005	0.017	0.82	0.481	49.0
2019		164.7	6.8	22.9			0.009	<	0.0005	0.018	0.82	0.370	35.9
2020		20.0	6.9	21.0	4.2	<	0.007	<	0.0005	0.014	0.37	0.146	31.2

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland/stream stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station BSD2

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L	Fe (mg/L)	Mn [5] (mg/L)	Hardness (mg/)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	218.0		0.469	0.0150	1.000		0.841	-
	Wetland benchmark [2]	5.3						2.49		
	Lake benchmark [3]							0.76		
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.002	0.5
2016		6.6	54.0		0.010	< 0.0005	0.017	0.28	0.160	64.6
2017		6.7	18.0		< 0.007	< 0.0005	0.013	0.17	0.099	27.2
2018		6.5	15.0		0.007	< 0.0005	0.012	0.17	0.088	22.8
2019		6.9	12.4		< 0.007	< 0.0005	0.013	0.17	0.074	20.1
2020		6.8	20.0	4.3	< 0.007	< 0.0005	0.015	0.35	0.162	31.4

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station FBD2

YEAR		pHF	SO4 [5] (mg/L	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Mn [5] (mg/L)	Hardness mg/L
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	218.0		0.469	0.0150	1.000		0.841	-
	Wetland benchmark [2]	5.3						2.49		
	Lake benchmark [3]							0.76		
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.002	0.5
2016		5.7	< 0.1		< 0.008	< 0.0005	< 0.005	< 0.02	< 0.002	< 0.5
2017		5.2	< 0.1		< 0.007	< 0.0005	< 0.005	< 0.02	< 0.002	< 0.5
2018		5.6	< 0.1		< 0.007	< 0.0005	< 0.005	< 0.02	< 0.002	< 0.5
2019		5.8	< 0.1		< 0.007	< 0.0005	< 0.005	< 0.02	< 0.002	< 0.5
2020		6.0	< 0.1	**<** 0.5	< 0.007	< 0.0005	< 0.005	< 0.02	< 0.002	< 0.5

Notes:

[1]Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station DS-18

YEAR		FLOW (L/s)	pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks		6.5	309.0		0.459	0.0150	1.000		-
	Wetland benchmark [2]		5.3						2.49	
	Lake benchmark [3]								0.76	
MDL [4]			0.1	0.1		0.005	0.0005	0.005	0.02	0.5
2016		118.5	7.0	58.8		0.131	0.0006	0.018	0.34	80.6
2017		338.7	6.8	59.8		0.193	0.0008	0.017	0.60	83.5
2018		240.9	7.1	56.8		0.152	0.0008	0.021	0.28	80.2
2019		248.0	7.1	43.2		0.110	0.0008	0.019	0.26	78.0
2020		356.4	7.1	53.0	2.5	0.105	0.0010	0.021	0.35	70.1

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station M-01

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	218.0		0.469	0.0150	1.000		-
	Wetland benchmark [2]	5.2						2.69	
	Lake benchmark [3]							0.76	
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.5
2016		6.7	11.4		0.021	0.0026	0.017	0.43	44.4
2017		6.8	10.0		0.016	0.0034	0.015	0.58	36.3
2018		6.7	8.9		0.015	0.0020	0.015	0.78	30.0
2019		6.7	8.4		0.017	0.0027	0.016	0.78	31.2
2020		6.8	7.2	4.9	0.029	0.0024	0.018	1.56	35.4

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station BSR5

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	218.0		0.469	0.0050	1.000		-
	Wetland benchmark [2]	5.3						2.49	
	Lake benchmark [3]							0.76	
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.5
2016		6.7	13.0		0.026	0.0021	0.018	0.41	38.8
2017		6.8	9.1		0.014	0.0031	0.014	0.32	34.5
2018		6.8	10.1		0.018	0.0024	0.015	0.43	33.1
2019		7.0	8.9		0.016	0.0023	0.014	0.32	31
2020		6.8	8.9	4.6	0.020	0.0026	0.015	0.31	31.4

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).
Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station FBR5

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	218.0		0.469	0.0150	1.000		-
	Wetland benchmark [2]	5.3						2.49	
	Lake benchmark [3]							0.76	
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.5
2016		5.3	< 0.1		< 0.008	< 0.0005	< 0.005	< 0.02	< 0.5
2017		5.3	< 0.1		< 0.007	< 0.0005	< 0.005	< 0.02	< 0.5
2018		5.8	< 0.1		< 0.007	< 0.0005	< 0.005	< 0.02	< 0.5
2019		6.0	< 0.1		< 0.007	< 0.0005	< 0.005	< 0.02	< 0.5
2020		5.9	< 0.1	**< 0.5**	< 0.007	< 0.0005	< 0.005	< 0.02	< 0.5

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station Q-09

YEAR		FLOW (L/s)	pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks		6.5	218.0		0.469	0.0150	1.000	-
	Wetland benchmark [2]		5.3						
	Lake benchmark [3]								
MDL [4]			0.1	0.1		0.005	0.0005	0.005	0.5
2016		1956.25	6.6	82.3		0.077	0.0027	0.097	92.8
2017		2531.30	6.7	44.8		0.052	0.0015	0.055	55.6
2018		2160.00	6.7	50.5		0.100	0.0022	0.119	66.6
2019		3620.00	6.9	47.3		0.051	0.0015	0.064	43.5
2020		3523.33	6.9	34.0	3.8	0.066	0.0019	0.074	45.6

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station Q-20

YEAR		FLOW (L/s)	pHF	SO4 [5] (mg/L)	DOC (mg/L)		Ra (Bq/L)		U (mg/L)	Ba (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks		6.5	218.0			0.469		0.0150	1.000	
	Wetland benchmark [2]		5.3								
	Lake benchmark [3]										
MDL [4]			0.1	0.1			0.005		0.0005	0.005	
2016		2.0	6.8	22.0		<	0.008	<	0.0005	0.020	40.0
2017		45.0	6.9	19.0		<	0.007	<	0.0005	0.018	37.1
2018		10.0	6.6	19.0		<	0.007	<	0.0005	0.019	38.2
2019		4.0	7.3	19.0			0.008	<	0.0005	0.020	39.4
2020		10.0	6.8	17.0	2.3	<	0.007	<	0.0005	0.019	35.7

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SC-01

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)		Ra (Bq/L)		U (mg/L)	Ba (mg/L)	Fe (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	128.0			0.469		0.0150	1.000		
	Wetland benchmark [2]	5.3								2.49	
	Lake benchmark [3]									0.76	
MDL [4]		0.1	0.1			0.005		0.0005	0.005	0.02	0.5
2016		6.9	20.0		<	0.008	<	0.0005	0.010	0.06	31.0
2017		6.9	16.0		<	0.007	<	0.0005	0.009	0.07	26.1
2018		6.6	18.0			0.009	<	0.0005	0.011	0.14	31.5
2019		7.3	16.0		<	0.007	<	0.0005	0.011	0.10	29.1
2020		7.0	16.0	4.6		0.012	<	0.0005	0.009	0.13	25.3

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SR-06

YEAR		FLOW (L/s)	pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks		6.5	218.0		0.469	0.0150	1.000	
	Wetland benchmark [2]		5.3						
	Lake benchmark [3]								
MDL [4]			0.1	0.1		0.005	0.0005	0.005	0.5
2016		494.5	6.9	39.3		0.074	0.0007	0.512	53.2
2017		842.1	7.0	35.5		0.089	0.0007	0.606	52.6
2018		515.8	7.0	30.2		0.100	0.0006	0.682	44.7
2019		803.5	7.2	28.0		0.057	0.0006	0.312	36.7
2020		610.2	7.2	26.0	3.2	0.053	0.0005	0.148	36.9

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SR-15

YEAR		pHF	SO4[5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Fe (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	218.0		0.469	0.0050	1.000		
	Wetland benchmark [2]	5.3						2.49	
	Lake benchmark [3]							0.76	
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.02	0.5
2016		7.0	36.5		0.049	< 0.0005	0.139	< 0.02	51.8
2017		6.9	32.0		0.069	< 0.0005	0.149	<0.02	52.3
2018		7.1	30.3		0.058	< 0.0005	0.213	0.02	44.5
2019		7.2	27.0		0.049	< 0.0005	0.146	0.02	39.0
2020		7.2	27.0	3.3	0.044	< 0.0005	0.103	0.03	40.6

Notes:

[1]Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SR-01

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	218.0		0.469	0.0150	1.000	-
	Wetland benchmark [2]	5.3						
	Lake benchmark [3]							
MDL [4]		0.1	0.1		0.005	0.0005	0.005	0.5
2016		6.8	33.0		0.026	0.0013	0.036	40.0
2017		6.9	31.0		0.028	0.0011	0.035	38.3
2018		6.7	29.0		0.017	0.0011	0.034	35.4
2019		7.0	25.0		0.031	0.0011	0.039	36.6
2020		6.8	24.0	3.4	0.029	0.0012	0.042	34.3

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value

Rio Algom Limited and Denison Mines Inc.
2020 Serpent River Watershed Water Quality Monitoring Results
Five Year Annual Average Station SR-08

YEAR		pHF	SO4 [5] (mg/L)	DOC (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Hardness (mg/L)
Assessment Criteria [1]	Wetland and lake benchmarks	6.5	309		0.469	0.0150	1.000	-
	Wetland benchmark [2]	5.3						
	Lake benchmark [3]							
MDL [4]		0.1			0.005	0.0005	0.005	0.5
2016		6.8	150.0		0.029	0.0009	0.017	178.5
2017		7.1	150.0		0.026	0.0009	0.017	186.3
2018		6.8	137.5		0.028	0.0007	0.019	184.0
2019		6.8	130.0		0.030	0.0006	0.018	164.0
2020		6.8	140.0	4.0	0.029	0.0008	0.019	173.8

Notes:

[1] Assessment criteria as per Table S.1, Appendix S, Cycle 5 State of the Environment Report for the SRWMP, SAMP and TOMP (Minnow, 2021)

[2] Benchmark applies to wetland stations: M-01, DS-18, SC-01.

[3] Benchmark applies to lake stations: D-5, D-6, Q-09, Q-20, SR-01, SR-06, SR-08.

[4] Method Detection Limits as per Table 6.2, Cycle 5 Study Design for the SRWMP, SAMP and TOMP (Minnow, 2019)

[5] Sulphate and manganese criteria taken from Table S.2, Appendix S, Cycle 5 State of the Envirnment Report for the SRWMP, SAMP and TOMP (Minnow, 2021). Parameters are hardness dependent.

Variation in number of significant figures reflect MDL's at the time of reporting. In 2006, laboratory reported MDL's were standardized to achieve consistency and meet program requirements, as per Cycle 2 Interpretive Report (Minnow 2005).

Bold indicates exceedance of evaluation criteria value