



**Serpent River Watershed Monitoring Program  
2010 Annual Water Quality Report**

***Submitted to the  
Canadian Nuclear Safety Commission  
March 25, 2011***



March 29, 2011

Ron Stenson, Project Officer  
Wastes and Impacts Division  
Canadian Nuclear Safety Commission  
280 Slater Street  
P.O. Box 1046, Station B  
Ottawa ON K1P 5S9

Dear Mr. Stenson:

**Re: Serpent River Watershed Monitoring Program – Year One of Cycle 3**

Denison Mines Inc. and Rio Algom Limited are pleased to submit one copy of the Serpent River Watershed Monitoring Program Year One of Cycle 3 Water Quality Report for 2010.

If you have any questions or comments, please do not hesitate to contact the undersigned.

Yours very truly,

Denison Mines Inc.

A handwritten signature in black ink, appearing to read "Ian Ludgate".

Ian Ludgate,  
Manager

Rio Algom Limited

A handwritten signature in black ink, appearing to read "Debbie Berthelot".

Debbie Berthelot,  
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cc: Distribution List

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## **1 INTRODUCTION**

The Serpent River Watershed Annual Water Quality Report 2010 provides a summary of the quality management program and water quality results for the Serpent River Watershed Monitoring Program (SRWMP) for the period January through December 2010.

The Serpent River Watershed Monitoring Program was initiated in 1999 as a joint initiative of Rio Algom Limited and Denison Mines Inc. with the objectives of evaluating the effectiveness of mine decommissioning plans and assessing long term trends in watershed environmental quality (Beak, 1999). Following 10 years of water quality monitoring and two cycles (1999, 2004) of environmental effects monitoring the performance of the tailings management areas and conditions in the watershed were assessed in the Serpent River Watershed State of the Environment Report (Minnow, 2009a). This assessment formed the basis for program modifications as documented in the Serpent River Watershed Monitoring Program, Cycle 3 Study Design (Minnow, 2009b) and the associated Monitoring Framework for Closed Uranium Mines, Near Elliot Lake (Minnow, 2009c) (Cycle 3 Design Report). The 2010 Serpent River Watershed water quality monitoring program was executed in accordance with these design documents.

## **2 METHODOLOGY**

### ***2.1 Stations Monitored and Frequency***

Current rationale and requirements for sampling locations, frequencies, parameters and protocols for the SRWMP are presented in detail in the Cycle 3 Study Design (Minnow, 2009b). Figure 2.1 provides a map of the stations included in the water quality program and Table 2.1 provides a brief description of each location as well as the frequency and parameters monitored.

### ***2.2 Samples Collected***

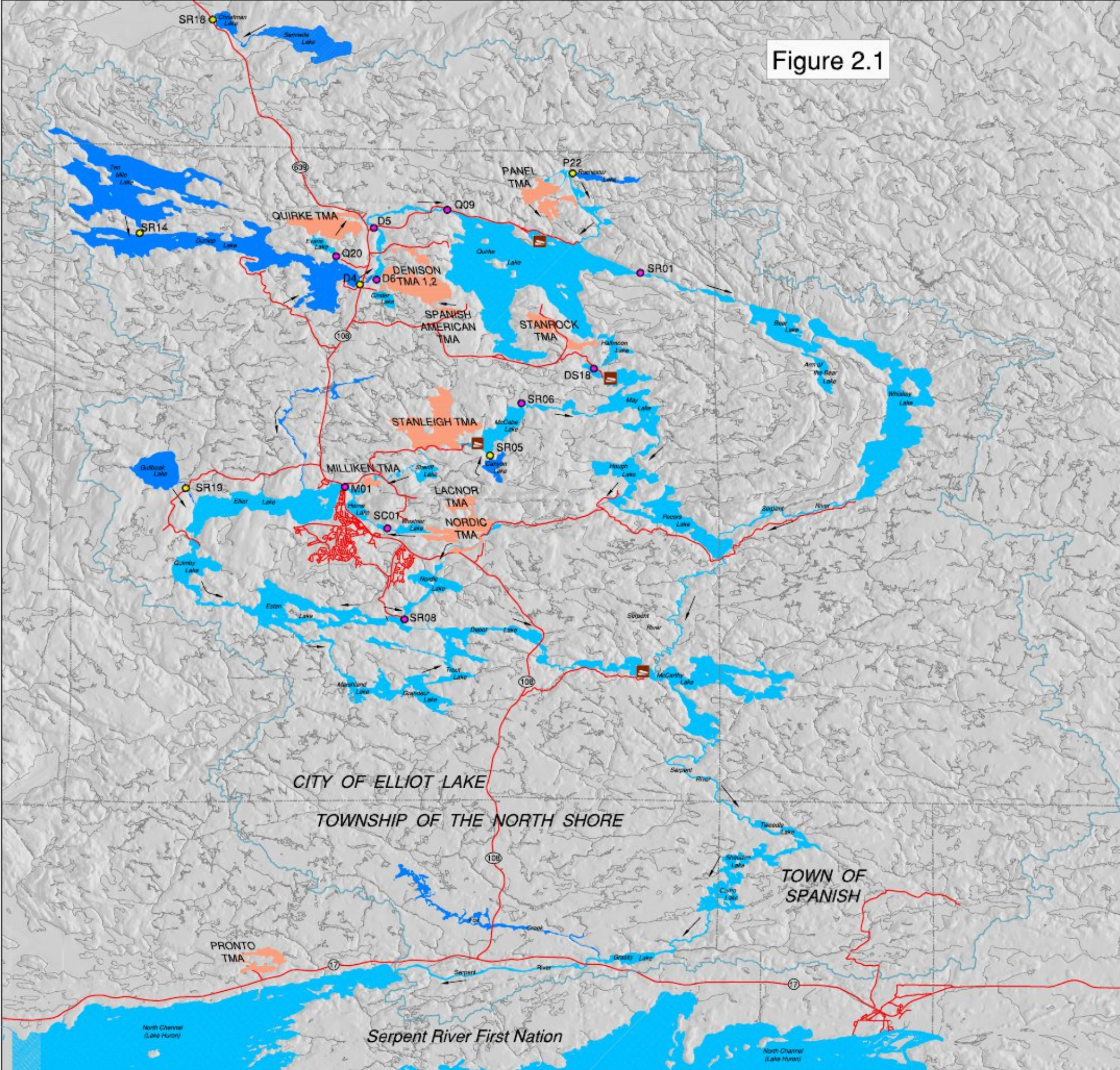
There were no deviations from program sampling and field measurement requirements during the 2010 reporting period.

**Table 2.1 2010 SRWMP Water Quality Monitoring Requirements**

Sampling Station	Location / Description	Sample Type	Flow	Field pH	Sulphate	Radium-226	Uranium	Barium	Cobalt	Iron	Manganese
			(L/s)		(mg/L)	(Bq/L total)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
P-22	Rochester Ck @ Rochester Lk Outlet	reference		2	2	2	2	2	2		
SR-05	Canyon Lk Outlet	reference	4	4	4	4	4	4	4		
SR-14	Ten Mile Creek at Inlet to Dunlop Lake	reference		1	1	1	1	1	1		
SR-18	Outlet of Jim Christ Lake	reference		2	2	2	2	2	2		
SR-19	Inlet to Elliot Lake	reference		4	4	4	4	4	4		
SR-08	Nordic Lk Outlet	far field		4	4	4	4	4	4		
M-01	Sherriff Ck @ Hwy 108	near field		4	4	4	4	4	4	4	
Q-09	Serpent River Below Q Effluent	near field	4	4	4	4	4	4	4		
Q-20	Evans Lk Outlet to Dunlop Lk	near field	1	1	1	1	1	1	1		
SC-01	Westner Lk Outlet	near field		1	1	1	1	1	1	1	
SR-06	McCabe Lk Outlet	near field	2	2	2	2	2	2	2		
FBR5	Field Blank Rio	QA/QC			2	2	2	2	2	2	2
BSR5	Blind Sample Rio	QA/QC		2	2	2	2	2	2	2	2
<b>Rio Algom total excluding field blanks &amp; blind samples</b>			<b>11</b>	<b>33</b>	<b>33</b>	<b>33</b>	<b>33</b>	<b>33</b>	<b>33</b>	<b>5</b>	<b>0</b>
D-4	Dunlop Lk Outlet	reference		2	2	2	2	2	2		
D-5	Serpent R. between Q and D	near field	4	4	4	4	4	4	4		
D-6	Cinder Lk Outlet	near field	4	4	4	4	4	4	4	4	4
DS-18	Halfmoon Lk Outlet	near field	4	4	4	4	4	4	4	4	
SR-01	Quirke Lk Outlet	far field		1	1	1	1	1	1		
FBD2	Field Blank Denison	QA/QC			2	2	2	2	2	2	2
BSD2	Blind Sample Denison	QA/QC		2	2	2	2	2	2	2	2
<b>Denison total excluding field blanks &amp; blind samples</b>			<b>12</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>8</b>	<b>4</b>
Total QA/QC samples			0	4	8	8	8	8	8	8	8
<b>TOTAL SAMPLES</b>			<b>23</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>13</b>	<b>4</b>
QA/QC Fraction of Total			0%	8%	17%	17%	17%	17%	17%	62%	200%
Denison Fraction of Total			52%	31%	31%	31%	31%	31%	31%	62%	100%

Category	Code	Description
Schedule	M, T, W, Th, F	Day of Week
	1-7; 8-14; 15-21; 22-28	Week of Month
	m1, m2, m3	Month of Quarter
	Mar; Se; Ap; Oc; May; No:	March and September: April and October: May and November
Purpose	MOE	Ministry of Environment; Certificate of Approval
	Internal	Internal sample
	SRWMP	Serpent River Watershed Monitoring Program

Figure 2.1



**Serpent River Watershed Monitoring Program**  
 Water Sample Collection Locations  
 March 2011



- 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.



### **2.3 Field Measurements**

Field measurement requirements and protocols for the 2010 SRWMP are presented in detail in the Cycle 3 Design Report. Field Staff have been thoroughly trained and have reviewed procedures associated with the proper calibration and use of field equipment for determination 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	Orion 265	+/- 0.01	pH units
	Orion 230A +	+/- 0.02	
	Accumet AP61	+/- 0.01	
Flow	Global Flow Probe	0.1	feet per second

### **2.4 Data Quality Objectives**

Field and laboratory data quality objectives (DQOs) for the 2010 SRWMP are presented in detail in the Cycle 3 Design Report. Table 2.4a provides a summary of field DQOs and Table 2.4b provides a summary of laboratory methods, detection limits and DQOs.

Data quality assessment is covered in Section 3 of this report.

### **2.5 Changes in Analytical Methods**

There were no changes in analytical methodology in 2010.

### **2.6 Reporting of Method Detection Limits**

Program method detection limits (MDL's) are presented in Tables 2.4.a and 2.4.b.

**Table 2.4.a 2010 SRWMP Field Data Quality Objectives**

Parameter	Units	Assessment Criteria <sup>1</sup>		Data Quality Objectives <sup>2</sup>			
		PWQO BCWQO	Background	Detection Limit	Minimum Detectable Difference	Field Blank Criteria	Field Precision
<b>Field Parameters<sup>3</sup></b>							
Flow	L/s	-	-	method	method	-	30%
pH		6.5-8.5	-	0.1	0.01 or 0.02	-	10%
<b>Laboratory Parameters</b>							
Barium	mg/L	-	0.0531	0.005	-	0.01	20%
Cobalt	mg/L	0.0009	-	0.0005	-	0.001	20%
Iron	mg/L	-	0.87	0.02	-	0.04	20%
Manganese	mg/L	0.8	-	0.002	-	0.004	20%
Radium (total)	Bq/L	1	-	0.005	-	0.01	20%
Sulphate	mg/L	100	-	0.1	-	0.2	20%
Uranium	mg/L	0.005	-	0.0005	-	0.001	20%

**Notes:**

1. Table 2.2 Serpent River Watershed Monitoring Program, Cycle 3 Study Design (Minnow, 2009b)
2. Table 2.10 Serpent River Watershed State of the Environment Report (Minnow, 2011 in progress)
3. Minimum detectable difference as identified in instrument manual

**Table 2.4.b 2010 SRWMP Laboratory Methods and Data Quality Objectives**

Parameter	Units	Assessment Criteria <sup>1</sup>		Method	Laboratory Data Quality Objectives <sup>2</sup>				
		PWQO BCWQG	Background		Detection Limit	Laboratory Blank	Precision	Spikes	Accuracy (CRM)
Barium	mg/L	-	0.0531	ICP-MS	0.005	0.01	10%	20%	20%
Cobalt	mg/L	0.0009	-	ICP-MS	0.0005	0.001	10%	20%	20%
Iron	mg/L	-	0.875	ICP-OES	0.02	0.04	10%	20%	20%
Manganese	mg/L	0.8	-	ICP-MS	0.002	0.004	10%	20%	20%
Radium (total)	Bq/L	1	-	Alpha Spectroscopy	0.005	0.01	20%	20%	-
Sulphate	mg/L	100	-	Ion Chromatography	0.1	0.2	10%	20%	20%
Uranium	mg/L	0.005	-	ICP-MS	0.0005	0.001	10%	20%	20%

**Notes:**

1. Table 2.2 Serpent River Watershed Monitoring Program, Cycle 3 Study Design (Minnow, 2009b)
2. Table 2.10 Serpent River Watershed State of the Environment Report (Minnow, 2011 in progress)

## **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 are reported monthly to the regulators as part of the SRWMP monthly water quality report. Monthly data validation of “flagged data” for the year 2010 can be found in Appendix I.

Annual water quality reporting is designed to be concise and focused on the presentation of data in a standardized format with limited interpretation. Data validation as documented in *Data Validation Procedures* in conjunction with *Water Quality Assessment and Response Plan* ensures prompt response to upset conditions or unusual results.

The objective of the 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 locations and visually reviewing the information for obvious changes. Step changes and unusual results are investigated in accordance with the Water Quality Assessment and Response Plan.

Program modifications implemented in January of 2010 focused water quality monitoring on lakes located immediately downstream of the decommissioned tailings management areas. Detailed statistical evaluation of water quality trends is included in Serpent River Watershed State of the Environment Reports (Minnow, 2009a and Minnow, 2011). The water quality trends provided in Figure 3.1.a through Figure 3.1.c provide a visual interpretation of most recent five year mine indicator parameter concentrations at key downstream locations.

## **3 RESULTS**

### **3.1 Data Quality Results and Assessment**

Detailed laboratory quality assurance and quality control (QA/QC) results are provided in Appendix II and detailed field QA/QC results are provided in Appendix III. 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 Field Blank Performance**

Field blank quality control results confirm that SRWMP blank criteria data quality objectives were achieved.

#### **3.1.2 Field Precision Performance**

Field precision quality control results confirm that SRWMP precision criteria data quality objectives were achieved.

**Table 3.1 SRWMP Field Quality Control Results Summary 2010**

QA/QC	pH	SO4	Ra(T)	U	Ba	Co	Fe	Mn
Assessment Criteria <sup>1</sup>	6.5-8.5	100	1	0.005	0.0531	0.0009	0.87	0.800
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005	0.02	0.002
		(mg/L)	(Bq/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Field Blank Statistics								
Count	-	4	4	4	4	4	4	2
Average	-	<0.10	<0.005	<0.0005	<0.005	<0.0005	<0.02	0.002
Max	-	<0.10	<0.005	<0.0005	<0.005	<0.0005	<0.02	0.002
Min	-	<0.10	<0.005	<0.0005	<0.005	<0.0005	<0.02	0.002
Field Blank Exceedances								
Criteria <sup>2</sup>	-	0.2	0.01	0.002	0.01	0.001	0.04	0.004
Exceedance	-	0	0	0	0	0	0	0
Field Precision Statistics								
Count	4	4	4	4	4	4	4	2
Average	0.0%	0.3%	8.5%	1.5%	1.2%	0.0%	3.1%	4.5%
Max	0.0%	1.4%	14.3%	3.3%	4.7%	0.0%	9.9%	5.4%
Min	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%
Field Precision Exceedances								
Criteria <sup>2</sup>	20%	20%	20%	20%	20%	20%	20%	20%
Exceedance	0	0	0	0	0	0	0	0

Notes:

<sup>1</sup> Assessment criteria as per Table 2.2 Serpent River Monitoring Program, Cycle 3 Study Design (Minnow , 2009b)

<sup>2</sup> Field blank and field precision criteria as per Table 2.10 Serpent River Watershed State of the Environment Report (Minnow , 2011 in progress)

### **3.1.3 Laboratory Quality Assurance and Quality Control**

In 2010, all analytical requirements for the SRWMP were contracted to a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited laboratory. Detailed laboratory QA/QC results are provided in Appendix II. The 10% objective for QA/QC was met; SGS performed 10505 analyses with 11748 QC checks which represents 112%.

### **3.1.4 Quality Assurance and Quality Control Resolution of Key Issues**

There were no major issues with laboratory analysis requiring resolution in 2010.

### **3.1.5 Analytical Blank Performance**

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

### **3.1.6 Analytical Duplicate Performance**

Laboratory quality control results confirm that duplicate data quality objectives of 20% for Radium and 10% for remaining parameters was achieved in all samples.

All analytical duplicate results were within the data quality objectives.

### **3.1.7 Analytical Laboratory Spike Performance**

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

### **3.1.8 Analytical Certified Reference Material Performance**

Laboratory quality control results confirm that the certified reference material (CRM) data quality objective accuracy of 20% was achieved for all parameters in all samples.

## **3.2 Location Summary**

Table 3.2 provides a summary of 2010 annual average concentrations of SRWMP parameters in comparison to Cycle 3 Design aquatic environment assessment criteria. Detailed results and five year summaries of average annual concentrations in comparison to assessment criteria are provided in Appendix IV.

Water quality throughout the Serpent River Watershed continues to be better than assessment criteria established to protect aquatic life. Average annual concentrations of pH, radium, uranium, cobalt, iron, and manganese, are better than assessment criteria at all locations.

The annual average barium (a constituent of barium chloride used in the treatment process for removal of radium) concentration exceeded background at three locations immediately downstream of treatment operations (Serpent River at Panel Mine Road, Q-09; McCabe Lake outlet downstream of Stanleigh, SR-06; and Serpent River downstream of Denison, D-5). This is consistent with past findings. The highest mean value of 0.176 mg/L observed at SR-06 is well below the level (5.8 mg/L) associated with chronic effects on zooplankton (*e.g.*, *Daphnia magna*; Biesinger and Christensen 1982) which appear to be among the most sensitive aquatic organisms to barium.

The British Columbia Water Quality Guideline (BCWQG) has been established as the SRWMP assessment criteria for sulphate (100 mg/L) (Minnow, 2009b). All locations were well below this guideline with the exception of SR-08, DS-18 and Q-09. Nordic Lake Outlet, SR-08, had the highest mean at 227.5 mg/L while the other two locations were just slightly above the limit with Halfmoon Lake Outlet, DS-18, at 117.3 mg/L and the Serpent River at

Panel Mine Road, Q-09, at 100.3 mg/L. A visual review of the data shows that sulphate has decreased since 1990 and appears to have stabilized over the past five years (Figure 3.1a). Furthermore, freshwater biota are unaffected by sulphate concentrations less than 500 mg/L at water hardness of at least 50 mg/L (Mount and Gulley 1992; Singleton 2000; Davies 2007).

Figures 3.1.a through 3.1.c show five-year trends for 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 visual review of 5 years of data, sulphate concentrations are below the assessment criterion of 100 mg/L at the outlets of Quirke (SR-01) and McCabe (SR-06) Lakes and are gradually declining (Figure 3.1.a). Statistically significant declining trends were identified at both these locations in the State of the Environment Report (Table 4.3, Minnow 2009a), confirming adequacy of visual data review for annual reporting purposes. The sulphate annual average concentration at Nordic Lake, SR-08, is above the assessment criteria but is consistent with previous years and appears to have stabilized. DS-18 is also slightly above the assessment criteria but this is likely due to the unusually dry spring and summer conditions observed in 2010; the annual average flow was the lowest it has been since 2000.

Radium values at all four locations are more than an order of magnitude below the assessment criteria. Based on a visual review of the data, radium appears to have reached relatively stable levels at Quirke Lake, SR-01, McCabe Lake, SR-06 and Nordic Lake, SR-08 (Figure 3.1.b). There was a slight increase in annual radium concentrations at Halfmoon Lake, DS-18 over the past year but this is likely due to one spiked value (0.250 Bq/L) observed in November 2010 during high flow conditions following a season of very low flow.

Uranium concentrations at the four locations appear to be relatively stable. Annual uranium concentrations were up slightly at DS-18 but again this was likely due to the dry spring and summer and low flows observed in 2010. All values remain well below the PWQO of 0.005 mg/L (Figure 3.1.c).

**Table 3.2 SRWMP Location Annual Average Results Summary 2010**

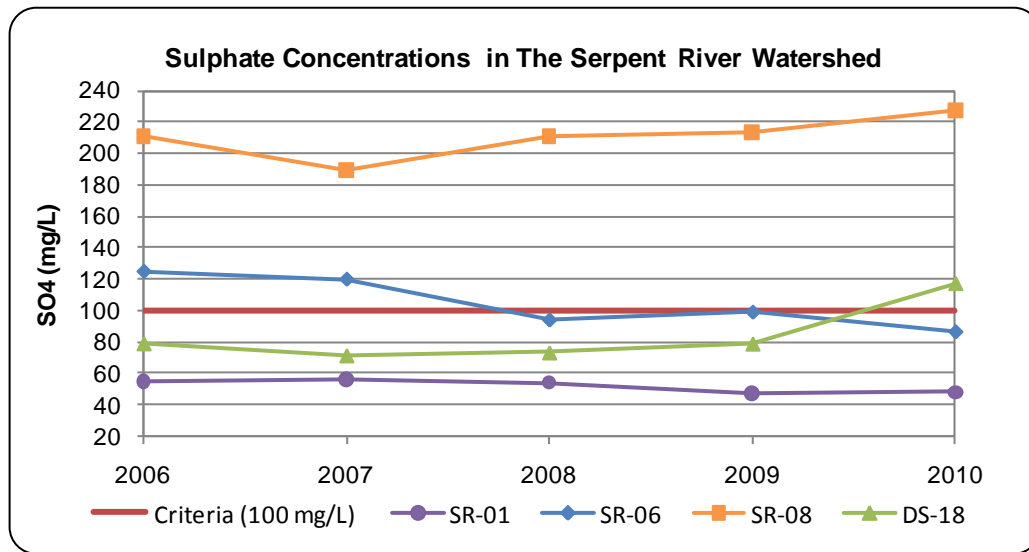
Location		pH	SO4 (mg/L)	Ra(T) (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)	Fe (mg/L)	Mn (mg/L)
<sup>1</sup> Assessment Criteria		<b>6.5-8.5</b>	<b>100</b>	<b>1</b>	<b>0.005</b>	<b>0.0531</b>	<b>0.0009</b>	<b>0.875</b>	<b>0.8</b>
MDL			0.1	0.005	0.0005	0.005	0.0005	0.02	0.002
<b>Reference</b>	# of samples collected								
D-4	2	7.0	4.3	<0.005	<0.0005	0.014	<0.0005		
P-22	2	6.7	3.6	<0.005	<0.0005	0.017	<0.0005		
SR-05	4	6.9	4.3	<0.005	<0.0005	0.006	<0.0005		
SR-14	1	7.1	5.4	<0.005	<0.0005	0.009	<0.0005		
SR-18	2	6.9	5.7	<0.005	<0.0005	0.052	<0.0005		
SR-19	4	6.8	4.5	<0.005	<0.0005	0.027	<0.0005		
<b>Near Field</b>									
D-5	4	7.0	24.5	0.083	0.0027	<b>0.076</b>	<0.0005		
D-6	4	6.6	61.8	0.007	0.0006	0.019	0.0007	0.38	0.294
DS-18	4	7.1	<b>117.3</b>	0.156	0.0021	0.017	<0.0005	0.20	
M-01	4	6.7	12.4	0.025	0.0044	0.021	0.0008	0.65	
Q-09	4	6.8	<b>100.3</b>	0.081	0.0046	<b>0.081</b>	0.0008		
Q-20	1	7.0	23.0	<0.005	<0.0005	0.021	<0.0005		
SC-01	1	7.0	24.0	<0.005	<0.0005	0.012	<0.0005	0.12	
SR-06	2	7.2	86.5	0.048	0.0013	<b>0.176</b>	<0.0005		
<b>Far Field</b>									
SR-01	1	6.9	48.0	0.018	0.0013	0.038	<0.0005		
SR-08	4	7.2	<b>227.5</b>	0.034	0.0015	0.021	<0.0005		

Notes:

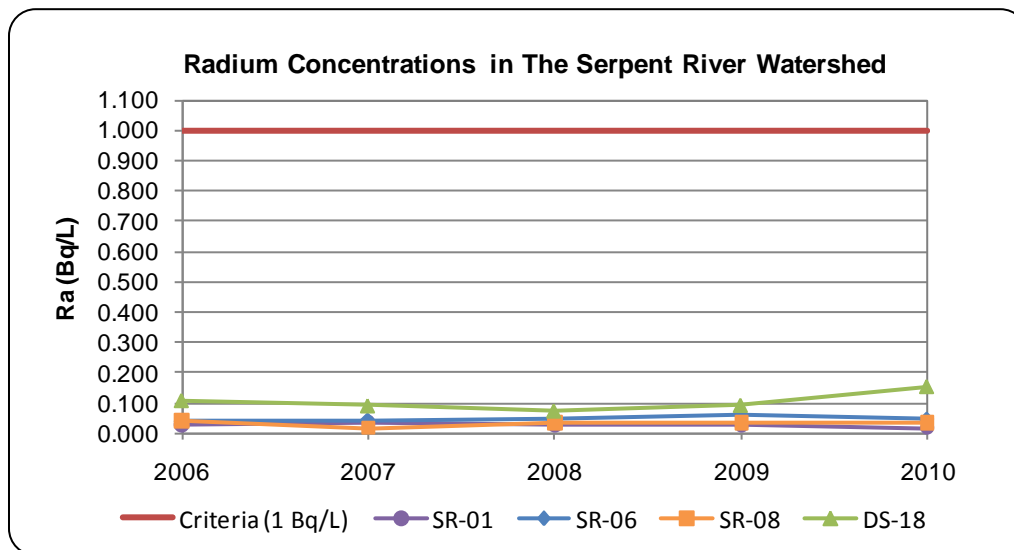
1. Assessment criteria as per Table 2.2 Serpent River Watershed Monitoring Program, Cycle 3 Study Design (Minnow , 2009b)

Bold indicates exceedance of assessment criteria

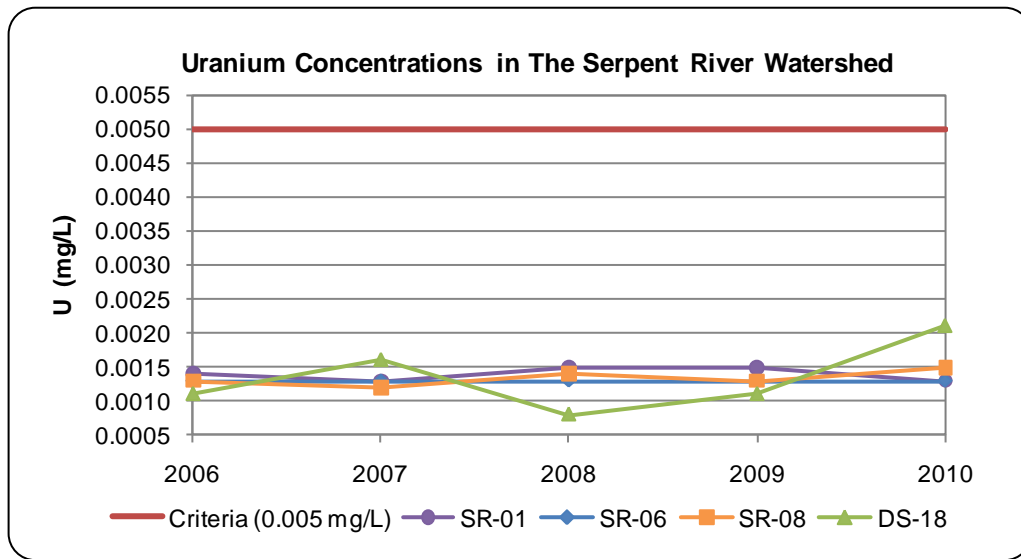
**Figure 3.1.a 2006-2010 Sulphate Concentrations at SR-01, SR-06, SR-08 and DS-18**



**Figure 3.1.b 2006-2010 Radium Concentrations at SR-01, SR-06, SR-08 and DS-18**



**Figure 3.1.c 2006-2010 Uranium Concentrations at SR-01, SR-06, SR-08 and DS-18**



## 4 RESPONSE MONITORING

There were no requirements for response monitoring programs related to the SRWMP in 2010.

## 5 RECOMMENDATIONS

### 5.1 Changes to Program Methodology

There were no changes to methodology in 2010.

### 5.2 Changes to Location Classification and Frequency

Modifications to the on-going water quality monitoring of the Serpent River Watershed as implemented in January 2010 following approval of the Cycle 3 Study Design are summarized in Table 5.1. There are no additional changes planned for the 2011 program.

**Table 5.1 Summary of Cycle 3 Water Quality Monitoring Program Modifications**

Stn	Location / Description	Cycle 2										Cycle 3							Rationale for Station-Specific Change	
		Flow	Temperature	Field pH	Dissolved Oxygen	Conductivity	Dissolved Organic Carbon	Sulfate	Metals <sup>a</sup>	<sup>226</sup> Radium	Uranium	Flow	Field pH	Sulfate	Metals <sup>b</sup>	Iron	Manganese	<sup>226</sup> Radium		Uranium
D4	Dunlop Lake Outlet		S	S	S	S	S	S	S	S	S	S	S	S			S	S	None	
P-22	Rochester Creek @ Rochester Lake Outlet		S	S	S	S	S	S	S	S	S	S	S	S			S	S	None	
SR-05	Canyon Lake Outlet	M	M	M	M	M	M	M	M	M	M	Q	Q	Q	Q		Q	Q	Monthly reduced to quarterly as per statistical evaluation in SRWMP Design	
SR-14	Ten Mile Creek at Inlet to Dunlop Lake		A	A	A	A	A	A	A	A	A		A	A	A		A	A	None	
SR-16	Fox Creek at Highway 108		S	S	S	S	S	S	S	S	S								Removal of non-lake reference stations	
SR-17	Unnamed Creek Draining Lake 3 at Highway 108		S	S	S	S	S	S	S	S	S								Removal of non-lake reference stations	
SR-18	Outlet of Jim Christ Lake		S	S	S	S	S	S	S	S	S		S	S	S		S	S	None	
SR-19	Inlet to Elliot Lake		M	M	M	M	M	M	M	M	M		Q	Q	Q		Q	Q	Monthly reduced to quarterly as per statistical evaluation in SRWMP Design	
D5	Serpent River between Q and D	M	M	M	M	M	M	M	M	M	M	Q	Q	Q	Q		Q	Q	Monthly reduced to quarterly as per statistical evaluation in SRWMP Design	
D6	Cinder Lake Outlet	M	M	M	M	M	M	M	M	M	M	Q	Q	Q	Q	Q	Q	Q	Monthly reduced to quarterly as per statistical evaluation in SRWMP Design Document; site-specific retention iron and manganese	
DS18	Halfmoon Lake Outlet	M	M	M	M	M	M	M	M	M	M	Q	Q	Q	Q	Q		Q	Q	Monthly reduced to quarterly as per statistical evaluation in SRWMP Design Document; site-specific retention iron
EL0	Elliot Lake Outlet		S	S	S	S	S	S	S	S	S								Removed - achieves acceptability criteria and has retained upstream monitoring	
M-01	Sheriff Creek @ Highway 108		M	M	M	M	M	M	M	M	M		Q	Q	Q	Q		Q	Q	Monthly reduced to quarterly as per statistical evaluation in SRWMP Design Document; site-specific retention iron
P-01	Rochester Creek @ Quirke Lake		M	M	M	M	M	M	M	M	M								Removed - achieves acceptability criteria and has retained upstream monitoring	
Q-09	Serpent River Below Q Effluent	M	M	M	M	M	M	M	M	M	M	Q	Q	Q	Q		Q	Q	Monthly reduced to quarterly as per statistical evaluation in SRWMP Design	
Q-20	Evans Lake Outlet to Dunlop Lake	A	A	A	A	A	A	A	A	A	A	A	A	A	A		A	A	None	
SC-01	Westner Lake Outlet		A	A	A	A	A	A	A	A	A		A	A	A	A	A	A	Site-specific retention of iron	
SR-01	Quirke Lake Outlet		A	A	A	A	A	A	A	A	A		A	A	A		A	A	None	
SR-02	Pecors Lake Inlet from Hough Lake		S	S	S	S	S	S	S	S	S								Removed - achieves acceptability criteria and has retained upstream monitoring	
SR-03	Pecors Lake Outlet		S	S	S	S	S	S	S	S	S								Removed - achieves acceptability criteria and has retained upstream monitoring	
SR-06	McCabe Lake Outlet	S	S	S	S	S	S	S	S	S	S	S	S	S		S	S	None		
SR-08	Nordic Lake Outlet		M	M	M	M	M	M	M	M	M		Q	Q	Q		Q	Q	Monthly reduced to quarterly as per statistical evaluation in SRWMP Design	
SR-09	Depot Lake Outlet		S	S	S	S	S	S	S	S	S								Removed - achieves acceptability criteria and has retained upstream monitoring	
SR-11	McCarthy Lake Outlet		S	S	S	S	S	S	S	S	S								Removed - achieves acceptability criteria and has retained upstream monitoring	
SR-12	Whiskey Lake Outlet		A	A	A	A	A	A	A	A	A								Removed - achieves acceptability criteria and has retained upstream monitoring	
SR-15	Outlet of May Lake		S	S	S	S	S	S	S	S	S								Removed - achieves acceptability criteria and has retained upstream monitoring	
QL-01 <sup>c</sup>	Main Basin of Quirke Lake																		None	

M= Monthly, S=Semi-Annual, A=Annual

<sup>a</sup> Metals: barium, cobalt, selenium, silver

<sup>b</sup> Metals: barium, cobalt

<sup>c</sup> Quirke Lake is sampled at depth from surface of 8 m and 21 m during five year field program

Common SRWMP Changes

Elimination of Dissolved Organic Carbon, iron, manganese, selenium and silver

Reduce frequency of temperature and dissolved oxygen to coincide with environmental effects monitoring

Replace monitoring of conductivity with sulphate

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APPENDIX I  
Flagged Data Results

Location	Analyte	Date	Low	Hi	Result	Comment
M-01	Ba	2010-02-17	0.009	0.025	0.028 mg/L	Result is a 10-year high confirmed by repeat analysis but is only slightly above the high flag limit, will continue to monitor at the current quarterly frequency.
D-5	SO4	2010-05-04	0	34.3	42.0 mg/L	Results are slightly above the high flag limits, consistent with previous values at this location.
	U	2010-05-04	0.0001	0.0030	0.0037 mg/L	
Q-09	Co	2010-05-04	0.0003	0.0008	0.0009 mg/L	Result is slightly above the high flag limit, consistent with previous values at this location.
D-6	U	2010-08-09	0.0005	0.0005	0.0009 mg/L	Result is a 10-year high but is only slightly above the MDL and is consistent with historical values and low flow, will continue to monitor at the current quarterly frequency.
DS-18	U	2010-08-17	0	0.0021	0.0044 mg/L	Result is a five-year high confirmed by repeat analysis but is still consistent with historic values and low flow, will continue to monitor at the current quarterly frequency.
M-01	Co	2010-08-16	0.0001	0.001	0.0013 mg/L	Results are slightly above the hi flag limits, consistent with previous values at this location.
	U	2010-08-16	0.0009	0.0063	0.0069 mg/L	

Issued by:

Debbie Berthelot, Rio Algom Responsible Authority

Issued on: 2010-04-20  
Last printed 25/03/2011

Location	Analyte	Date	Low	Hi	Result	Comment
SR-08	U	2010-08-16	0.0010	0.0017	0.0018 mg/L	Result is slightly above the hi flag limit, consistent with previous values at this location.
SR-19	Ba	2010-08-16	0.016	0.0312	0.035 mg/L	Results are slightly above the hi flag limits, consistent with previous values at this location.
	Fe	2010-08-16	0.01	0.60	0.64 mg/L	
	Mn	2010-08-16	0	0.136	0.185 mg/L	
DS-18	Ra	2010-11-09	0.056	0.214	0.250 Bq/L	Results are above the hi flag limits, consistent with previous values at this location and low flow.
	U	2010-11-09	0	0.0020	0.0027 mg/L	

APPENDIX II  
Laboratory QA/QC Results



**REPORT CODE:** DEN-ANN10

**REPORT TITLE:** Annual Quality Assessment Report

**REVISION:** 1.3

**ISSUED BY:**

A handwritten signature in blue ink, appearing to read 'Diane Wingett'.

Quality Coordinator, Canadian  
Operations - SGS Environmental  
Services

**AUTHORIZED BY:**

A handwritten signature in black ink, appearing to read 'Robert A. ...'.

Technical Manager,  
SGS Environmental Services

**DATE:** 15 March 2011

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## 1. BACKGROUND

SGS Environmental Services entered into an agreement with Denison Environmental Services for the analytical lab to provide analysis according to RFT #05-016. Below is a summary of the laboratory quality management system, key actions taken by the laboratory for samples analyzed during 2010, as well as a summary of the significant findings and the corrective actions implemented.

## 2. QUALITY MANAGEMENT SYSTEM

SGS Environmental Services 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 Environmental Services 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

The analysis of quality control samples is method specific and includes 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 and/or customer requirements. All QC analyses for Denison Environmental Services are tracked in unique files, specific to Denison Environmental Services. The samples are processed as part of our "worksheet" batch system and a compilation of all Denison Environmental Services QC data for the parameters tested during 2010 has been compiled below.

#### 4. MAJOR ACHIEVEMENTS IN QUALITY CONTROL

- SGS Environmental Services performed 5143 analyses with 7290 QC checks, which represents 142% QC for sample analysis. This level of QC is significantly higher than the lab standard, which is generally 20%.
- All blank data results were within the data quality objectives. **Corrective Action:** N/A
- All CRM 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 blanks 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 Detection Limit	Mean Blank Result	Number of Blanks	Number Outside +/- Limit
Acidity	mg/L as CaCO <sub>3</sub>	1	1.72639	79	0
Ba	mg/L	0.005	0.00241	163	0
Co	mg/L	0.0005	0.00024	163	0
DOC	mg/L	0.5	0.12431	308	0
Fe	mg/L	0.02	0.00956	203	0
Mn	mg/L	0.002	0.00095	168	0
SO <sub>4</sub>	mg/L	0.1	0.05016	190	0
Total Suspended Solids	mg/L	1	0.52426	278	0
U	mg/L	0.0005	0.00024	163	0

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**5.2. CRM Data**

Parameter	Unit	Certified Value	Lower Limit (at 20% Rel. Error)	Upper limit (at 20 % Rel. Error)	Number of CRM's	Mean Value	Precision (%RSD)	Accuracy (% Rel error)	Number QC CRM outside of DQO
Acidity	mg/L as CaCO3	50	40	60	79	50.20	1.70	-0.41	0
Ba	mg/L	0.1	0.08	0.12	171	0.102	2.56	-2.33	0
Co	mg/L	0.1	0.08	0.12	170	0.101	3.10	-1.14	0
DOC	mg/L	10	8	12	354	10.04	3.88	-0.43	0
Fe	mg/L	500	400	600	207	497.54	3.09	0.49	0
Mn	mg/L	0.1	0.08	0.12	168	0.103	2.68	-3.46	0
SO4	mg/L	5	4	6	174	5.08	3.00	-1.54	0
U	mg/L	0.1	0.08	0.12	170	0.103	2.79	-3.13	0

---

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**5.3. Duplicate Data**

Parameter	Unit	Expected Recovery (Rel %)	Lower Limit (Rel %)	Upper Limit (Rel %)	Number of Duplicates	Mean (% Rel Error)	Number Duplicate samples outside of DQO ( at 10x LOQ)
Acidity	% Rec.	100	90	110	43	8.853	0
Ba	% Rec.	100	90	110	115	8.950	0
Co	% Rec.	100	90	110	114	8.327	0
DOC	% Rec.	100	90	110	180	9.358	0
Fe	% Rec.	100	90	110	139	10.405	0
Mn	% Rec.	100	90	110	118	8.758	0
pH	% Rec.	100	90	110	0	---	0
SO4	% Rec.	100	90	110	148	0.502	0
Total Suspended Solids	% Rec.	100	90	110	246	9.525	0
U	% Rec.	100	90	110	145	0.336	0

**5.4. Spike Blank Data**

Parameter	Unit	Certified Value	Lower Limit (at 30% Rel. Error)	Upper limit (at 30 % Rel error)	Number of Spike Blank's	Mean % Recovery	Mean Precision (%)	Number Spike Blank outside of DQO
Acidity	mg/L as CaCO3	10	7	13	33	107.11	28.02	0
Ba	mg/L	0.004	0.0028	0.0052	160	64.19	0.00	0
Co	mg/L	0.002	0.0014	0.0026	159	100.61	0.00	0
DOC	mg/L	20	14	26	325	99.53	0.76	0
Fe	mg/L	0.1	0.07	0.13	195	104.92	0.01	0
Mn	mg/L	0.0032	0.00224	0.00416	156	100.64	0.00	0
SO4	mg/L	4	2.8	5.2	190	100.14	0.03	0
U	mg/L	0.0008	0.00056	0.00104	160	100.47	0.00	0

**5.5. Spike Duplicate Data**

Parameter	Unit	Certified Value	Lower Limit (at 30% Rel. Error)	Upper limit (at 30 % Rel error)	Number of Spiked Duplicates	Mean % Recovery	Precision (%RSD)	Number Spike Blank outside of DQO
Ba	µg/L	4	2.8	5.2	122	99.82	0.08	0
Co	µg/L	2	1.4	2.6	143	100.09	0.05	0
DOC	mg/L	100	70	130	316	96.34	5.75	0
Fe	mg/L	0.1	0.07	0.13	148	101.31	0.01	0
Mn	mg/L	3.2	2.24	4.16	56	101.71	0.10	0
SO4	mg/L	100	70	130	159	100.11	5.48	0
U	mg/L	0.8	0.56	1.04	117	98.23	0.05	0

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**5.6. QC Frequency**

Total Number of Blanks:	1800
Total Number of CRM:	1563
Total Number of Duplicates:	1325
Total Number of Spike Blank:	1450
Total Number of Spike Duplicates:	1122
<b>Sum of QC Insertion:</b>	<b>7290</b>
<b>Total Analysis:</b>	<b>5143</b>

**6. CONCLUSION & SIGNIFICANT FINDINGS**

SGS Environmental Services analyzed QC samples for this project beyond the lab standard of 20% QC insertion. Where the data quality objectives for the lab were exceeded, the additional QC samples analyzed within the run supported the data values and data was released on this basis.

SGS Environmental Services remains committed to delivering data that meets and/or exceeds the data quality objectives for Denison Environmental Services and staff will continue to work closely with Denison Environmental Services staff to ensure all objectives are achieved in 2010.

**7. CORRECTIVE ACTIONS & IMPLEMENTATION OF CORRECTIVE ACTIONS**

- Report CA10173-JAN10 was issued on Feb. 2/2010; however, included results for copper (not requested), but did not include results for hardness (requested). **Corrective Action:** the report was revised and re-issued on Feb. 19/10 with the hardness data included and copper data removed

**8. SUBCONTRACT LAB INFORMATION**

A full report has been provided by the subcontract lab and is included as Addendum A of this report.



## Addendum A



Becquerel Laboratories Inc.  
6790 Kitimat Rd., Unit 4  
Mississauga, Ontario  
Canada, L5N 5L9  
Phone: (905) 826-3080  
FAX: (905) 826-4151  
Date: 31-Jan-2011

### **Annual Quality Assessment Report for 2010**

#### Introduction

The number of samples analyzed was 681.

The following samples were used for quality control in 2010. A set of control samples was included with each set of 20 or fewer samples.

#### Reagent Blanks:

Reagent blanks were aliquots of deionized water that were processed in the same way as samples, using the same tracers, carriers and other reagents.

#### Duplicates:

Duplicate samples were replicate aliquots of a sample from each analysis run, and were processed in the same way as other samples.

#### Analyte Spikes:

A calibrated solution of Ra-226 was obtained from Isotope Products Laboratories and used to prepare these a solution containing 0.107 Bq/mL of Ra-226. A one-millilitre aliquot of this solution was added to a second aliquot of sample to test recoveries.

It should be noted that Barium-133 is added to every aliquot as a tracer, in order to measure the chemical yield of Ra-226 for each individual sample.

#### Check Standards:

Several check standards were using during 2010.

RA226.30, RA226.31, RA226.32, RA226.33, RA226.34 and RA226.35.

A calibrated solution of Ra-226 was obtained from Isotope Products Laboratories and used to prepare these check standards.

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Major Achievements in Quality Control

Tests showed that, even in apparently clear samples, fine particulates settled over time and carried Ra-226. This occurred even in the presence of nitric acid preservative. The analytical procedure was modified to include vigorous shaking of samples before subsampling.

QC Data Quality Summary

Analytical Parameter	Blank Result Bq/l	Number of Blanks	CRM accuracy %	Numbers of CRMs
DQO			+ - 20	
Ra-226	< 0.005	75	-4.2	75

Analytical Parameter	Spike accuracy %	Number of Spikes	Precision %	Number of Duplicates
DQO	+ - 20		+ -10	
Ra-226	-7.6	75	+0.6	75

**Notes:** CRM accuracy and Spike accuracy values are averages. The values above are percent differences from the expected values. If means are computed for absolute deviations, that for the CRM becomes 4.6% and that for the spike becomes 7.8%.

The precision value is the mean of the percent differences for duplicate results. If absolute differences are used, this mean becomes 5.7%. It should be noted that precision is expected to become worse as the detection limit is approached.

**Blank:** No positive blank result was obtained.

**CRM:** No CRM results differed from the expected value by more than 20 percent. The maximum deviation was -12 %.

**Spike:** No spike recovery deviated from 100% by more than 20%. The maximum deviation was -20 %.

**Duplicate:** Of the 75 duplicate sets run, 65 gave positive results. Of these, 11 duplicates differed by more than 10%. The maximum deviation was -19% for an original value of 0.37 Bq/l.

59 duplicates gave results greater than 10 times the detection limit: of these, 8 duplicates differed by more than 10 percent. The maximum deviation was -19%.



Conclusion and Significant Findings

Accuracy and recovery are satisfactory, as shown in the summary section.

Corrective Actions

Sample D-9, 15-Jul-2010 was reanalyzed as the original result was incorrectly reported.

Appendix Raw QC Data (Negative Values Signify Upper Limits)

Blank	Standard	Standard Value	Standard Result	Original	Duplicate	Spike % Recovery
-0.005	RA226.30	0.92	0.90	0.940	0.950	94
-0.005	RA226.30	0.92	0.90	0.022	0.025	95
-0.005	RA226.30	0.92	0.94	0.100	0.110	95
-0.005	RA226.30	0.92	0.94	0.200	0.210	99
-0.005	RA226.30	0.92	0.95	-0.005	-0.005	87
-0.005	RA226.30	0.92	0.93	0.058	0.055	92
-0.005	RA226.30	0.92	0.93	-0.005	-0.005	88
-0.005	RA226.30	0.92	0.89	0.032	0.034	91
-0.005	RA226.31	1.00	0.90	0.017	0.018	97
-0.005	RA226.31	1.00	0.92	0.110	0.100	94
-0.005	RA226.31	1.00	0.96	-0.005	0.006	89
-0.005	RA226.31	1.00	0.97	0.065	0.070	94
-0.005	RA226.31	1.00	0.99	0.180	0.160	83
-0.005	RA226.31	1.00	0.92	0.060	0.056	94
-0.005	RA226.31	1.00	0.91	0.180	0.170	90
-0.005	RA226.31	1.00	0.96	0.085	0.081	96
-0.005	RA226.31	1.00	0.92	0.170	0.170	91
-0.005	RA226.31	1.00	0.98	0.120	0.120	92
-0.005	RA226.31	1.00	0.93	0.120	0.130	92
-0.005	RA226.31	1.00	0.97	0.085	0.085	90
-0.005	RA226.31	1.00	0.94	0.083	0.089	94
-0.005	RA226.31	1.00	0.96	0.120	0.120	96
-0.005	RA226.31	1.00	0.96	0.066	0.070	97
-0.005	RA226.31	1.00	0.91	0.110	0.110	92
-0.005	RA226.31	1.00	0.92	0.450	0.430	101

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-0.005	RA226.31	1.00	0.99	1.100	1.100	91
-0.005	RA226.31	1.00	1.00	0.730	0.720	93
-0.005	RA226.31	1.00	0.97	0.220	0.180	90
-0.005	RA226.31	1.00	0.98	0.096	0.098	89
-0.005	RA226.31	1.00	0.92	0.058	0.057	93
-0.005	RA226.31	1.00	1.04	0.042	0.047	98
-0.005	RA226.31	1.00	0.99	0.072	0.065	93
-0.005	RA226.31	1.00	0.90	0.130	0.120	98
-0.005	RA226.31	1.00	1.02	0.370	0.440	90
-0.005	RA226.31	1.00	0.97	0.820	0.810	96
-0.005	RA226.31	1.00	0.98	-0.005	-0.005	89
-0.005	RA226.31	1.00	0.95	0.130	0.140	96
-0.005	RA226.31	1.00	0.95	0.200	0.200	91
-0.005	RA226.32	1.00	1.02	0.052	0.057	92
-0.005	RA226.32	1.00	0.92	0.065	0.067	95
-0.005	RA226.32	1.00	0.92	1.600	1.800	92
-0.005	RA226.32	1.00	0.93	0.075	0.069	89
-0.005	RA226.32	1.00	0.93	0.027	0.030	96
-0.005	RA226.32	1.00	0.96	0.120	0.120	92
-0.005	RA226.32	1.00	0.97	-0.005	-0.008	106
-0.005	RA226.32	1.00	0.94	0.120	0.120	87
-0.005	RA226.32	1.00	0.92	0.022	0.022	88
-0.005	RA226.32	1.00	0.98	0.110	0.100	97
-0.005	RA226.32	1.00	0.91	0.110	0.120	95
-0.005	RA226.33	1.00	0.96	1.600	1.400	92
-0.005	RA226.33	1.00	0.88	-0.005	-0.006	96
-0.005	RA226.33	1.00	0.95	0.160	0.160	90
-0.005	RA226.33	1.00	0.91	-0.005	-0.005	81
-0.005	RA226.33	1.00	0.96	0.048	0.045	99
-0.005	RA226.33	1.00	0.97	0.140	0.140	97
-0.005	RA226.33	1.00	0.94	-0.005	-0.005	82
-0.005	RA226.33	1.00	1.00	0.072	0.074	97
-0.005	RA226.33	1.00	0.94	0.066	0.069	93
-0.005	RA226.33	1.00	0.93	0.390	0.390	80
-0.005	RA226.34	1.00	0.94	0.200	0.200	91

**Confidential** – Intended only for the person or entity to which it is addressed and may contain confidential and/or privileged material.



-0.005	RA226.34	1.00	0.93	0.090	0.089	90
-0.005	RA226.34	1.00	0.96	0.130	0.150	91
-0.005	RA226.34	1.00	0.96	0.190	0.210	91
-0.005	RA226.34	1.00	0.91	0.710	0.620	97
-0.005	RA226.34	1.00	0.99	0.110	0.110	80
-0.005	RA226.34	1.00	0.99	0.088	0.092	99
-0.005	RA226.34	1.00	0.96	0.380	0.360	86
-0.005	RA226.34	1.00	1.00	0.500	0.520	84
-0.005	RA226.34	1.00	0.93	1.600	1.500	89
-0.005	RA226.35	1.00	1.00	0.280	0.270	91
-0.005	RA226.35	1.00	0.98	-0.005	-0.005	101
-0.005	RA226.35	1.00	1.02	0.190	0.190	92
-0.005	RA226.35	1.00	0.95	-0.005	-0.005	91
-0.005	RA226.35	1.00	0.97	0.126	0.113	89
-0.005	RA226.35	1.00	0.90	0.780	0.710	98
-0.005	RA226.35	1.00	0.96	0.110	0.120	92

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APPENDIX III  
Field QA/QC Results

Report Form: RF8.5.4-01

Date		pH	Sulphate	Radium (total)	Uranium	Barium	Cobalt	Iron	Manganese
		(blank)	mg/L	Bq/L	mg/L	mg/L	mg/L	mg/L	mg/L
SRWMP <sup>1</sup>		1	0.2	0.01	0.002	0.01	0.0010	0.04	0.004
2010.05	FBD2		< 0.1	< 0.005	< 0.0005	< 0.0050	< 0.0005	< 0.02	< 0.0020
2010.05	FBR5		< 0.1	< 0.005	< 0.0005	< 0.0050	< 0.0005	< 0.02	
2010.11	FBD2		< 0.1	< 0.005	< 0.0005	< 0.0050	< 0.0005	< 0.02	< 0.0020
2010.11	FBR5		< 0.1	< 0.005	< 0.0005	< 0.0050	< 0.0005	< 0.02	
Count			4	4	4	4	4	4	2
# Exceedances			0	0	0	0	0	0	0
Average			< 0.10	< 0.005	< 0.0005	< 0.0050	< 0.0005	< 0.02	< 0.0020
Max			< 0.10	< 0.005	< 0.0005	< 0.0050	< 0.0005	< 0.02	< 0.0020
Min			< 0.10	< 0.005	< 0.0005	< 0.0050	< 0.0005	< 0.02	< 0.0020

<sup>1</sup> Blank criteria as per Cycle 3 Study Design (Minnow, 2009)

**SRWMP DATA QUALITY REPORTING**  
**Field Precision**  
**Revision: 2010.01**

Registry: RF8.5.4-01

Page 1 of 1

Month	Sample	pH	Sulphate mg/L	Radium (T) Bq/L	Uranium mg/L	Barium mg/L	Cobalt mg/L	Iron mg/L	Managanese mg/L
2010-05	BSD2	6.6	74.0	0.010	< 0.0005	0.0210	0.0007	0.42	0.4400
	D-6	6.6	73.0	0.011	< 0.0005	0.0220	0.0007	0.43	0.4560
	variance	0.0%	1.4%	9.5%	0.0%	4.7%	0.0%	2.4%	3.6%
2010-05	BSR5	6.7	14.0	0.031	0.0036	0.0180	0.0006	0.48	
	M-01	6.7	14.0	0.028	0.0035	0.0180	0.0006	0.53	
	variance	0.0%	0.0%	10.2%	2.8%	0.0%	0.0%	9.9%	
2010-11	BSD2	6.7	21.0	< 0.005	< 0.0005	0.0130	< 0.0005	0.14	0.0760
	D-6	6.7	21.0	0.005	< 0.0005	0.0130	< 0.0005	0.14	0.0720
	variance	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%
2010-11	BSR5	7.1	12.0	0.013	0.0031	0.0150	< 0.0005	0.29	
	M-01	7.1	12.0	0.015	0.0030	0.0150	< 0.0005	0.29	
	variance	0.0%	0.0%	14.3%	3.3%	0.0%	0.0%	0.0%	
Count		4	4	4	4	4	4	4	2
Average		0.0%	0.3%	8.5%	1.5%	1.2%	0.0%	3.1%	4.5%
Max		0.0%	1.4%	14.3%	3.3%	4.7%	0.0%	9.9%	5.4%
Min		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%
SRWMP <sup>1</sup> Target		20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
# Exceedances		0	0	0	0	0	0	0	0

<sup>1</sup> Field Precision criteria as per Cycle 3 Study Design (Minnow, 2009)

APPENDIX IV  
Location Results

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station D-6**

<b>YEAR</b>	<b>FLOW (L/s)</b>	<b>pHF</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>	<b>Fe (mg/L)</b>	<b>Mn (mg/L)</b>
Assessment Criteria <sup>1</sup>		6.5-8.5	100.0	1.000	0.0050	0.053	0.0009	0.87	0.800
MDL		0.1	0.1	0.005	0.0005	0.005	0.0005	0.02	0.002
2006	47.26	6.8	54.3	0.006	< 0.0005	0.016	0.0006	0.21	0.263
2007	37.02	6.8	22.4	0.007	< 0.0005	0.015	< 0.0005	0.17	0.120
2008	67.73	6.7	33.5	0.005	< 0.0005	0.015	0.0005	0.29	0.152
2009	73.95	6.9	38.4	0.007	0.0005	0.017	0.0006	0.37	0.237
2010	30.40	6.6	61.8	0.007	0.0006	0.019	0.0007	0.38	0.294

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station DS-18**

YEAR	FLOW (L/s)	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)	Fe (mg/L)
Assessment Criteria <sup>1</sup>		6.5-8.5	100.0	1.000	0.0050	0.053	0.0009	0.87
MDL		0.1	0.1	0.005	0.0005	0.005	0.0005	0.02
2006	304.58	7.2	79.2	0.110	0.0011	0.013	0.0005	0.22
2007	198.75	7.1	71.6	0.093	0.0016	0.011	< 0.0005	0.26
2008	245.22	7.0	73.4	0.076	0.0008	0.012	< 0.0005	0.27
2009	228.02	6.9	79.0	0.094	0.0011	0.012	0.0005	0.59
2010	155.25	7.1	<b>117.3</b>	0.156	0.0021	0.017	< 0.0005	0.20

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station D-5**

YEAR	FLOW (L/s)	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)
Assessment Criteria <sup>1</sup>		6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL		0.1	0.1	0.005	0.0005	0.005	0.0005
2006	1717.58	7.1	21.6	0.099	0.0020	<b>0.107</b>	< 0.0005
2007	1463.17	7.0	25.8	0.100	0.0023	<b>0.095</b>	0.0005
2008	2488.92	6.9	19.9	0.065	0.0017	<b>0.066</b>	< 0.0005
2009	2905.92	7.1	20.9	0.074	0.0024	<b>0.078</b>	< 0.0005
2010	1121.50	7.0	24.5	0.083	0.0027	<b>0.076</b>	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station SR-18**

<b>YEAR</b>	<b>pHF</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>
Assessment Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2006	6.6	5.8	< 0.005	< 0.0005	0.048	< 0.0005
2007	7.0	5.9	0.006	< 0.0005	0.053	< 0.0005
2008	6.9	5.8	< 0.005	< 0.0005	0.051	< 0.0005
2009	6.7	4.7	< 0.005	< 0.0005	0.052	< 0.0005
2010	6.9	5.7	< 0.005	< 0.0005	0.052	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station D-4**

YEAR	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)
Assessment Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2006	7.0	5.5	< 0.005	< 0.0005	0.014	< 0.0005
2007	7.0	5.2	< 0.005	< 0.0005	0.013	< 0.0005
2008	7.0	5.3	< 0.005	< 0.0005	0.014	< 0.0005
2009	6.9	4.9	< 0.005	< 0.0005	0.015	< 0.0005
2010	7.0	4.3	< 0.005	< 0.0005	0.014	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station Q-09**

YEAR	FLOW (L/s)	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)
Assessment Criteria <sup>1</sup>		6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL		0.1	0.1	0.005	0.0005	0.005	0.0005
2006	1792.92	6.9	97.1	0.070	0.0048	<b>0.074</b>	0.0007
2007	1544.25	6.9	87.4	0.091	<b>0.0056</b>	<b>0.104</b>	0.0006
2008	2778.17	6.8	67.3	0.077	0.0034	<b>0.077</b>	0.0006
2009	3001.92	6.9	73.5	0.085	0.0040	<b>0.084</b>	0.0007
2010	1213.50	6.8	<b>100.3</b>	0.081	0.0046	<b>0.081</b>	0.0008

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.  
2010 Serpent River Watershed Water Quality Monitoring Results  
Five Year Annual Average Station SR-01**

<b>YEAR</b>	<b>pHF</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>
Assessment Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2006	7.3	55.0	0.028	0.0014	0.038	< 0.0005
2007	6.5	56.0	0.035	0.0013	0.040	< 0.0005
2008	6.8	54.0	0.028	0.0015	0.042	< 0.0005
2009	6.9	47.0	0.026	0.0015	0.039	< 0.0005
2010	6.9	48.0	0.018	0.0013	0.038	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station SR-05**

<b>YEAR</b>	<b>FLOW (L/s)</b>	<b>pHF</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>
Assessment Criteria <sup>1</sup>		6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL		0.1	0.1	0.005	0.0005	0.005	0.0005
2006	56.31	7.0	5.0	< 0.005	< 0.0005	0.006	< 0.0005
2007	27.01	6.8	5.0	< 0.005	< 0.0005	0.006	< 0.0005
2008	45.40	6.9	4.8	< 0.005	< 0.0005	0.006	< 0.0005
2009	49.63	6.9	4.5	< 0.005	< 0.0005	0.006	< 0.0005
2010	25.03	6.9	4.3	< 0.005	< 0.0005	0.006	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station M-01**

YEAR	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)	Fe (mg/L)
Assessment Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009	0.87
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005	0.02
2006	6.9	20.6	0.026	0.0037	0.018	0.0007	0.49
2007	6.9	16.1	0.035	<b>0.0058</b>	0.020	<b>0.0009</b>	<b>0.91</b>
2008	6.8	14.1	0.024	0.0047	0.018	0.0008	0.67
2009	6.7	13.1	0.018	0.0037	0.017	0.0006	0.67
2010	6.7	12.4	0.025	0.0044	0.021	0.0008	0.65

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station P-22**

YEAR	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)
Assessment Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2006	6.5	5.7	< 0.005	< 0.0005	0.020	< 0.0005
2007	6.6	5.0	< 0.005	< 0.0005	0.018	< 0.0005
2008	6.6	4.6	< 0.005	< 0.0005	0.021	< 0.0005
2009	6.0	3.9	< 0.005	< 0.0005	0.019	< 0.0005
2010	6.7	3.6	< 0.005	< 0.0005	0.017	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station SR-19**

<b>YEAR</b>	<b>pHF</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>
Assessment						
Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2006	6.8	4.7	< 0.005	< 0.0005	0.025	0.0006
2007	6.8	4.8	0.005	< 0.0005	0.026	< 0.0005
2008	6.8	4.6	< 0.005	< 0.0005	0.024	0.0006
2009	6.9	4.4	< 0.005	< 0.0005	0.022	< 0.0005
2010	6.8	4.5	< 0.005	< 0.0005	0.027	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.  
2010 Serpent River Watershed Water Quality Monitoring Results  
Five Year Annual Average Station SR-08**

YEAR	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)
Assessment Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2006	7.1	<b>211.1</b>	0.041	0.0013	0.024	< 0.0005
2007	7.0	<b>189.2</b>	0.035	0.0012	0.020	0.0005
2008	7.0	<b>210.8</b>	0.033	0.0014	0.019	0.0005
2009	6.9	<b>213.3</b>	0.035	0.0013	0.020	0.0005
2010	7.2	<b>227.5</b>	0.034	0.0015	0.021	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station SR-14**

YEAR	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)
Assessment Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2006	6.8	5.0	< 0.005	< 0.0005	0.008	< 0.0005
2007	7.0	5.0	< 0.005	< 0.0005	0.008	< 0.0005
2008	6.6	4.9	< 0.005	< 0.0005	0.014	< 0.0005
2009	6.8	4.7	< 0.005	< 0.0005	0.008	< 0.0005
2010	7.1	5.4	< 0.005	< 0.0005	0.009	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station Q-20**

<b>YEAR</b>	<b>FLOW (L/s)</b>	<b>pHF</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>
Assessment Criteria <sup>1</sup>		6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL		0.1	0.1	0.005	0.0005	0.005	0.0005
2006	5.00	6.9	21.0	< 0.005	< 0.0005	0.019	< 0.0005
2007	5.00	6.8	22.0	< 0.005	< 0.0005	0.019	< 0.0005
2008	7.10	7.0	22.0	< 0.005	< 0.0005	0.018	< 0.0005
2009	10.00	6.7	22.0	< 0.005	< 0.0005	0.019	< 0.0005
2010	4.50	7.0	23.0	< 0.005	< 0.0005	0.021	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station SC-01**

YEAR	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)	Fe (mg/L)
Assessment Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009	0.87
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005	0.02
2006	7.1	35.0	0.015	< 0.0005	0.011	< 0.0005	0.38
2007	7.2	32.0	0.013	< 0.0005	0.011	<b>0.0010</b>	0.18
2008	7.3	33.0	0.012	< 0.0005	0.012	< 0.0005	0.21
2009	6.7	25.0	0.006	< 0.0005	0.010	< 0.0005	0.12
2010	7.0	24.0	< 0.005	< 0.0005	0.012	< 0.0005	0.12

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station SR-06**

YEAR	FLOW (L/s)	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)
Assessment Criteria <sup>1</sup>		6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL		0.1	0.1	0.005	0.0005	0.005	0.0005
2006	962.18	7.0	<b>125.0</b>	0.041	0.0013	<b>0.067</b>	< 0.0005
2007	295.10	6.4	<b>120.0</b>	0.045	0.0013	<b>0.075</b>	< 0.0005
2008	704.50	7.1	94.0	0.046	0.0013	<b>0.128</b>	< 0.0005
2009	549.90	7.1	99.0	0.064	0.0013	<b>0.179</b>	< 0.0005
2010	479.00	7.2	86.5	0.048	0.0013	<b>0.176</b>	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station BSD2**

YEAR	pHF	SO4 (mg/L)	Ra (Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)
Assessment						
Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2010	6.7	47.5	0.008	< 0.0005	0.017	0.0006

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.**  
**2010 Serpent River Watershed Water Quality Monitoring Results**  
**Five Year Annual Average Station BSR5**

<b>YEAR</b>	<b>pHF</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>
Assessment						
Criteria <sup>1</sup>	6.5-8.5	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.1	0.005	0.0005	0.005	0.0005
2010	6.9	13.0	0.022	0.0034	0.017	0.0006

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.  
 2010 Serpent River Watershed Water Quality Monitoring Results  
 Five Year Annual Average Station FBD2**

<b>YEAR</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>
Assessment					
Criteria <sup>1</sup>	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.005	0.0005	0.005	0.0005
2010	< 0.1	< 0.005	< 0.0005	< 0.005	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value

**Rio Algom Limited and Denison Mines Inc.  
 2010 Serpent River Watershed Water Quality Monitoring Results  
 Five Year Annual Average Station FBR5**

<b>YEAR</b>	<b>SO4 (mg/L)</b>	<b>Ra (Bq/L)</b>	<b>U (mg/L)</b>	<b>Ba (mg/L)</b>	<b>Co (mg/L)</b>
Assessment					
Criteria <sup>1</sup>	100.0	1.000	0.0050	0.053	0.0009
MDL	0.1	0.005	0.0005	0.005	0.0005
2010	< 0.1	< 0.005	< 0.0005	< 0.005	< 0.0005

Notes:

<sup>1</sup> Assessment criteria as per the Cycle 3 Design Study (Minnow, 2009) or BCWQG (SO4 and Mn) or PWQO (pH) based on the State of the Environment Report (Minnow, 2009)

Bold indicates exceedance of evaluation criteria value



**SRWMP Annual Report**  
**Performance Monitoring Results**

**BSR5**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L	Fe mg/L
2010.05	6.7	14.0	0.031	0.0036	0.018	0.0006	0.48
2010.11	7.1	12.0	0.013	0.0031	0.015	<0.0005	0.29
Count	2	2	2	2	2	2	2
High	7.1	14.0	0.031	0.0036	0.018	0.0006	0.48
Low	6.7	12.0	0.013	0.0031	0.015	<0.0005	0.29
Mean	6.9	13.0	0.022	0.0033	0.017	0.0005	0.39
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009	0.87
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%

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**Performance Monitoring Results**

**D-4**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.05	6.9	4.0	<0.005	<0.0005	0.014	<0.0005
2010.11	7.0	4.6	<0.005	<0.0005	0.014	<0.0005
Count	2	2	2	2	2	2
High	7.0	4.6	<0.005	<0.0005	0.014	<0.0005
Low	6.9	4.0	<0.005	<0.0005	0.014	<0.0005
Mean	7.0	4.3	<0.005	<0.0005	0.014	<0.0005
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit	6.5					
Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%

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**D-5**

Month	FLOW L/s	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.02	1473.00	7.1	12.0	0.017	0.0011	0.026	<0.0005
2010.05	841.00	7.1	42.0	0.065	0.0037	0.058	<0.0005
2010.08	283.00	6.7	29.0	0.220	0.0045	0.170	<0.0005
2010.11	1889.00	7.2	15.0	0.028	0.0016	0.050	<0.0005
Count	4	4	4	4	4	4	4
High	1889.00	7.2	42.0	0.220	0.0045	0.170	<0.0005
Low	283.00	6.7	12.0	0.017	0.0011	0.026	<0.0005
Mean	1121.50	7.0	24.5	0.083	0.0027	0.076	<0.0005
High Limit		8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit		6.5					
Lim Ex	0	0	0	0	0	2	0
Frequency	0%	0%	0%	0%	0%	50%	0%
10x Lim Ex	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%

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**D-6**

Month	FLOW L/s	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L	Fe mg/L
2010.02	30.00	6.5	23.0	<0.005	<0.0005	0.016	<0.0005	0.18
2010.05	17.11	6.6	73.0	0.011	<0.0005	0.022	0.0007	0.43
2010.08	10.00	6.5	130.0	0.007	0.0009	0.026	0.0012	0.75
2010.11	64.48	6.7	21.0	0.005	<0.0005	0.013	<0.0005	0.14
Count	4	4	4	4	4	4	4	4
High	64.48	6.7	130.0	0.011	0.0009	0.026	0.0012	0.75
Low	10.00	6.5	21.0	<0.005	<0.0005	0.013	<0.0005	0.14
Mean	30.40	6.6	61.8	0.007	0.0006	0.019	0.0007	0.38
High Limit		8.5	100.0	1.000	0.0050	0.053	0.0009	0.87
Low Limit		6.5						
Lim Ex	0	0	1	0	0	0	1	0
Frequency	0%	0%	25%	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	Mn mg/L
2010.02	0.110
2010.05	0.456
2010.08	0.536
2010.11	0.072
Count	4
High	0.536
Low	0.072
Mean	0.294
High Limit	0.800
Low Limit	
Lim Ex	0
Frequency	0%
10x Lim Ex	0
Frequency	0%



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**FBD2**

Month	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L
2010.05	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02	<0.002
2010.11	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02	<0.002
Count	2	2	2	2	2	2	2
High	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02	<0.002
Low	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02	<0.002
Mean	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02	<0.002
High Limit	100.0	1.000	0.0050	0.053	0.0009	0.87	0.800
Low Limit							
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%

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**FBR5**

Month	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L	Fe mg/L
2010.05	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02
2010.11	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02
Count	2	2	2	2	2	2
High	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02
Low	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02
Mean	<0.1	<0.005	<0.0005	<0.005	<0.0005	<0.02
High Limit	100.0	1.000	0.0050	0.053	0.0009	0.87
Low Limit						
Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%

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**M-01**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L	Fe mg/L
2010.02	6.2	18.0	0.022	0.0040	0.028	0.0009	0.68
2010.05	6.7	14.0	0.028	0.0035	0.018	0.0006	0.53
2010.08	6.7	5.7	0.036	0.0069	0.024	0.0013	1.10
2010.11	7.1	12.0	0.015	0.0030	0.015	<0.0005	0.29
Count	4	4	4	4	4	4	4
High	7.1	18.0	0.036	0.0069	0.028	0.0013	1.10
Low	6.2	5.7	0.015	0.0030	0.015	<0.0005	0.29
Mean	6.7	12.4	0.025	0.0043	0.021	0.0008	0.65
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009	0.87
Low Limit	6.5						
Lim Ex	1	0	0	1	0	1	1
Frequency	25%	0%	0%	25%	0%	25%	25%
10x Lim Ex	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%

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**P-22**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.05	6.8	3.7	<0.005	<0.0005	0.016	<0.0005
2010.11	6.6	3.5	<0.005	<0.0005	0.017	<0.0005
Count	2	2	2	2	2	2
High	6.8	3.7	<0.005	<0.0005	0.017	<0.0005
Low	6.6	3.5	<0.005	<0.0005	0.016	<0.0005
Mean	6.7	3.6	<0.005	<0.0005	0.017	<0.0005
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit	6.5					
Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%

**SRWMP Annual Report**  
**Performance Monitoring Results**

**Q-09**

Month	FLOW L/s	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.02	1560.00	6.7	65.0	0.027	0.0031	0.032	0.0007
2010.05	916.00	6.9	110.0	0.150	0.0058	0.094	0.0009
2010.08	388.00	6.7	170.0	0.100	0.0061	0.144	0.0009
2010.11	1990.00	6.8	56.0	0.045	0.0032	0.052	<0.0005
Count	4	4	4	4	4	4	4
High	1990.00	6.9	170.0	0.150	0.0061	0.144	0.0009
Low	388.00	6.7	56.0	0.027	0.0031	0.032	<0.0005
Mean	1213.50	6.8	100.3	0.081	0.0046	0.080	0.0008
High Limit		8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit		6.5					
Lim Ex	0	0	2	0	2	2	0
Frequency	0%	0%	50%	0%	50%	50%	0%
10x Lim Ex	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%

**SRWMP Annual Report**  
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**Q-20**

Month	FLOW L/s	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.11	4.50	7.0	23.0	<0.005	<0.0005	0.021	<0.0005
Count	1	1	1	1	1	1	1
High	4.50	7.0	23.0	<0.005	<0.0005	0.021	<0.0005
Low	4.50	7.0	23.0	<0.005	<0.0005	0.021	<0.0005
Mean	4.50	7.0	23.0	<0.005	<0.0005	0.021	<0.0005
High Limit		8.5	100.0	1.000	0.0050	0.053	0.0009
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 Report**  
**Performance Monitoring Results**

**SC-01**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L	Fe mg/L
2010.11	7.0	24.0	<0.005	<0.0005	0.012	<0.0005	0.12
Count	1	1	1	1	1	1	1
High	7.0	24.0	<0.005	<0.0005	0.012	<0.0005	0.12
Low	7.0	24.0	<0.005	<0.0005	0.012	<0.0005	0.12
Mean	7.0	24.0	<0.005	<0.0005	0.012	<0.0005	0.12
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009	0.87
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 Report**  
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**SR-01**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.11	6.9	48.0	0.018	0.0013	0.038	<0.0005
Count	1	1	1	1	1	1
High	6.9	48.0	0.018	0.0013	0.038	<0.0005
Low	6.9	48.0	0.018	0.0013	0.038	<0.0005
Mean	6.9	48.0	0.018	0.0013	0.038	<0.0005
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit	6.5					
Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%

**SRWMP Annual Report**  
**Performance Monitoring Results**

**SR-05**

Month	FLOW L/s	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.02	27.00	7.0	4.7	<0.005	<0.0005	0.006	<0.0005
2010.05	19.70	6.9	4.2	<0.005	<0.0005	0.006	<0.0005
2010.08	2.00	6.6	4.2	<0.005	<0.0005	0.007	<0.0005
2010.11	51.40	7.1	4.0	<0.005	<0.0005	0.006	<0.0005
Count	4	4	4	4	4	4	4
High	51.40	7.1	4.7	<0.005	<0.0005	0.007	<0.0005
Low	2.00	6.6	4.0	<0.005	<0.0005	0.006	<0.0005
Mean	25.02	6.9	4.3	<0.005	<0.0005	0.006	<0.0005
High Limit		8.5	100.0	1.000	0.0050	0.053	0.0009
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%

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**Performance Monitoring Results**

**SR-06**

Month	FLOW L/s	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.05	98.00	6.9	84.0	0.054	0.0013	0.168	<0.0005
2010.11	860.00	7.4	89.0	0.041	0.0013	0.184	<0.0005
Count	2	2	2	2	2	2	2
High	860.00	7.4	89.0	0.054	0.0013	0.184	<0.0005
Low	98.00	6.9	84.0	0.041	0.0013	0.168	<0.0005
Mean	479.00	7.2	86.5	0.048	0.0013	0.176	<0.0005
High Limit		8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit		6.5					
Lim Ex	0	0	0	0	0	2	0
Frequency	0%	0%	0%	0%	0%	100%	0%
10x Lim Ex	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%

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**SR-08**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.02	6.9	250.0	0.036	0.0013	0.022	<0.0005
2010.05	7.4	210.0	0.034	0.0015	0.021	<0.0005
2010.08	7.2	230.0	0.029	0.0018	0.020	<0.0005
2010.11	7.4	220.0	0.037	0.0015	0.022	<0.0005
Count	4	4	4	4	4	4
High	7.4	250.0	0.037	0.0018	0.022	<0.0005
Low	6.9	210.0	0.029	0.0013	0.020	<0.0005
Mean	7.2	227.5	0.034	0.0015	0.021	<0.0005
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit	6.5					
Lim Ex	0	4	0	0	0	0
Frequency	0%	100%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%

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**SR-14**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.11	7.1	5.4	<0.005	<0.0005	0.009	<0.0005
Count	1	1	1	1	1	1
High	7.1	5.4	<0.005	<0.0005	0.009	<0.0005
Low	7.1	5.4	<0.005	<0.0005	0.009	<0.0005
Mean	7.1	5.4	<0.005	<0.0005	0.009	<0.0005
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit	6.5					
Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%

**SRWMP Annual Report**  
**Performance Monitoring Results**

**SR-18**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.05	6.8	5.7	<0.005	<0.0005	0.049	<0.0005
2010.11	6.9	5.6	<0.005	<0.0005	0.055	<0.0005
Count	2	2	2	2	2	2
High	6.9	5.7	<0.005	<0.0005	0.055	<0.0005
Low	6.8	5.6	<0.005	<0.0005	0.049	<0.0005
Mean	6.8	5.7	<0.005	<0.0005	0.052	<0.0005
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit	6.5					
Lim Ex	0	0	0	0	1	0
Frequency	0%	0%	0%	0%	50%	0%
10x Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%

**SRWMP Annual Report**  
**Performance Monitoring Results**

**SR-19**

Month	pHF	SO4 mg/L	Ra Bq/L	U mg/L	Ba mg/L	Co mg/L
2010.02	6.7	5.3	<0.005	<0.0005	0.025	<0.0005
2010.05	6.9	4.3	<0.005	<0.0005	0.025	<0.0005
2010.08	6.5	4.3	<0.005	<0.0005	0.035	<0.0005
2010.11	7.1	4.2	<0.005	<0.0005	0.022	<0.0005
Count	4	4	4	4	4	4
High	7.1	5.3	<0.005	<0.0005	0.035	<0.0005
Low	6.5	4.2	<0.005	<0.0005	0.022	<0.0005
Mean	6.8	4.5	<0.005	<0.0005	0.027	<0.0005
High Limit	8.5	100.0	1.000	0.0050	0.053	0.0009
Low Limit	6.5					
Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%