2018 OPERATING CARE & MAINTENANCE ANNUAL REPORT

Denison Mines Inc.

Submitted to the

Canadian Nuclear Safety Commission

March 27, 2019

Denison Mines

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March 27, 2019

Dana Pandolfi, Project Officer
Wastes and Decommissioning Division
Canadian Nuclear Safety Commission
280 Slater Street
PO Box 1046, Station B
Ottawa, Ontario
K1P 5S9

Dear Dana Pandolfi:

RE: Denison Mines Inc. 2018 Operating Care and Maintenance Annual Report

Denison Mines Inc. is pleased to submit one copy of the Denison Mines Inc. Operating Care and Maintenance Annual Report for 2018. This document has been completed in accordance with: UMDL-Minemill-Denison.01/indf; and UMDL-Minemill-Stanrock.02/indf; and CofA No. 4-0067-74-766; CofA No. 4-0019-72-006; and CofA No. 4-034-76-006.

Yours truly,

Denison Mines Inc.

Janet Lowe

General Manager

Enclosure

Distribution

Elliot Lake Joint Review Group 2018

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Additional Distribution 2018

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1 ORGANIZATIONAL INFORMATION

Licensee
DENISON MINES INC.
1100-40 University Avenue
Toronto, Ontario
M5G 1T1

1.1 Board of Directors

Table 1.1 contains the list of names and titles of the Directors of Denison Mines Inc. as of December 31, 2018. All persons listed below may be contacted via the aforementioned licensee address.

Table 1.1 Denison Mines Inc. Directors as of December 31, 2018

Name	Office
David Cates	Director, President and Chief Executive Officer
Gabriel (Mac) McDonald	Director, Chief Financial Officer

1.2 List of Officers

Table 1.2 contains the list of names and titles of the Officers of Denison Mines Inc. as of December 31, 2018. All persons listed below may be contacted via the aforementioned licensee address.

Table 1.2 Denison Mines Inc. Officers as of December 31, 2018

Name	Office
David Cates	Director, President and Chief Executive Officer
Gabriel (Mac) McDonald	Director and Chief Financial Officer
Amanda Willett	Canadian Counsel and Corporate Secretary
Mary Jo Smith	Director, Internal Audit

2 FINANCIAL GUARANTEES

Federal and Provincial regulations which apply to the decommissioning programs of Denison Mines Inc. (Denison) in Elliot Lake require mine operators to provide adequate and secure

resources to meet current and future responsibilities with respect to mine closure and long-term care and maintenance.

All expenditures are funded through a reclamation trust fund where Denison is required to maintain a balance in the trust equivalent to six years of the estimated current annual costs. Sufficient funds are currently in the reclamation trust to meet all monitoring costs through 2024.

3 LICENCE AND MONITORING PROGRAM MODIFICATIONS

Denison Mines Inc. closed sites in Elliot Lake currently operate and are monitored within the scope of work outlined in UMDL-Minemill-Denison.01/indf and UMDL-Minemill-Stanrock.02/indf, as well as Certificate of Approval (C of A) No. 4-0067-74-766, C of A No. 4-0019-72-006, and C of A No. 4-034-76-006. There were no changes to any of these documents in 2018.

There were approved changes and/or modifications to the Source Area Monitoring Program (SAMP) and the Tailings Operational Monitoring Program (TOMP) in 2015, which are presented in the *Cycle 4 Study Design for the Serpent River Water Management Program (SRWMP), SAMP and TOMP* (Minnow Environmental Inc., 2016). A summary of approved changes is provided in Appendix I.

4 METHODOLOGY

4.1 Health and Safety

4.1.1 Health and Safety Injury Statistics

Health and safety in the workplace continues to be an important part of Denison Mines Inc. and practices to support this continue to be implemented so as to ensure safety is maintained in the workplace. In 2018, monthly safety meetings and daily line-ups were conducted to provide Denison staff with adequate training and education in matters relating to health and safety. This practice continues to be an integral part of Denison Mines Inc.'s safety program. Furthermore, any Denison staff member requiring additional training/education were provided to them on an as-required basis (specialty training for job-specific tasks).

4.1.2 Gamma Dosimetry

Denison has continued to voluntarily participate in the gamma dosimetry program. The program applies to all employees whose job responsibilities require them to work in and around the licensed sites, which include the tailings management areas (TMAs). These workers are classified as Nuclear Energy Workers (NEWs). The program does not apply to visitors visiting the sites or employees who do not actively work at the licensed sites, however, sometimes sub-contractors may be issued visitor badges should the work involve specific earthworks projects over an extended period of time.

The type of gamma dosimetry badges used are Optically Stimulated Luminescence (OSL) dosimeters, which have a wearing period of three months. Badges are issued in the first calendar month of the year and each quarter going forward. Each worker is issued a pre-labelled badge with its own unique dosimeter number that is designated for each worker. At the end of the wearing period, the dosimeters are sent to the Radiation Protection Bureau (RPB) Health Canada for processing. The RPB will issue a Radiation Exposure Report, for which it is Denison's

designate who is thereafter responsible for reviewing the information, reporting any anomalies to workers, and maintaining the company records.

4.1.3 Radon Progeny Monitoring

Radon progeny monitoring at all Denison Effluent Treatment Plants (ETPs) is conducted on a quarterly basis, as part of the quarterly health and safety inspections. Radon results are reported in Working Level (WL) units.

Radon level is measured by calculating alpha radiation from radon decay products. The sample is first collected on membrane filters with an air-sampling pump by walking through the entire ETP over a 5-minute period, simulating a normal work routine. The ETP should be ventilated as per routine work practice before the walkthrough. Alpha radiation is measured with an alpha counter between forty to ninety minutes after the sample has been collected. WL is then calculated based on the counts, count duration, sampling duration, sampling flow rate, decay factor, filter self-absorption value, background count, and efficiency factor.

The reportable action limit for radon exposure at all ETPs is 0.1 WL. To ensure radon levels stay below the reportable action limit, an internal investigation limit of 0.05 WL has been established to trigger a response whereby mitigating measures are implemented in order to ensure worker exposure to radon gas is reduced and controlled. Mitigating measures include but are not limited to the purchase of a radon fan and/or posting signage to employ longer ventilation time before ETP work begins.

The gamma and radon data are then used to calculate individual annual dose estimates for Care and Maintenance workers classified as NEWs. A worker dose estimate report is submitted annually to the Canadian Nuclear Safety Commission (CNSC) under separate cover.

4.2 Water Quality Monitoring Program

4.2.1 Program Requirements

Water quality monitoring requirements and criteria as per the aforementioned licences are fulfilled through the approved SAMP, TOMP, and SRWMP. Furthermore, approved recommendations for modifications to the SAMP and TOMP that were implemented in 2015 are presented in the *Cycle 4 Study Design* for the SRWMP, SAMP and TOMP (Minnow Environmental Inc., 2016). A summary of the approved changes is provided for reference at the end of this report in Appendix I. It is important to keep in mind when reviewing the water quality data in this report that the Denison monitoring locations make up part of the Serpent River Watershed (SRW), which is a shared watershed with Rio Algom Limited (RAL) sites and their monitoring locations. Therefore, to obtain an overall understanding of the data in this report, this report should be read in conjunction with the *Serpent River Watershed Monitoring Program 2018 Annual Water Quality Report* (RAL & Denison, 2019).

The 2018 SAMP and TOMP followed program requirements specific to the following: sampling locations, frequencies, parameters, and analytical protocols. These requirements have been recommended and approved in the *Cycle 4 Study Design for the SRWMP, SAMP and TOMP* (Minnow Environmental Inc., 2016). Appendix II provides maps of the sampling stations included in the water quality program. Tables in Appendix II provide a brief description of each location, the sampling frequency, and parameters monitored as well as Certificate of Approval regulatory requirements as identified in the aforementioned Certificates of Approval in Section 3.

4.2.2 Data Quality Objectives

Targeted Method Detection Limits (MDLs) and Data Quality Objectives (DQOs) for SAMP and TOMP requirements are provided in Table 4.2.2 which were derived from the Cycle 4 Study Design for the SRWMP, SAMP and TOMP (Minnow Environmental Inc., 2016). Laboratory data quality assessment is provided in Section 3.1 of the *Serpent River Watershed Monitoring Program 2018 Annual Water Quality Report* (RAL & Denison, 2019).

4.2.3 Changes in Analytical Methods

There were no changes in analytical methodology in 2018.

4.2.4 Data Screening and Assessment Conventions

Data validation is important and is conducted on SAMP and TOMP water quality data throughout the year. The data validation assessment-screening process within the electronic database flags all data points entered or imported that have values outside a rolling minimum 12 value mean $\pm$ 3 standard deviations. Prior to being accepted in the database, all flagged data is reviewed and validated through a quality assurance process.

As part of the TOMP, field quality assurance and quality control sampling was extended to the groundwater monitoring program in 2006. Data quality assessment involves monthly screening of field duplicate and field blank sample data against SAMP and TOMP DQOs found in Table 4.2.2. Detailed surface water and groundwater quality assurance and quality control (QA/QC) results are included in Appendix III of this report.

Laboratory analyses are contracted to Canadian Association of Laboratory Accreditation (CALA) certified laboratories. Laboratory QA/QC reports are provided under separate cover in the *Serpent River Watershed Monitoring Program 2018 Annual Water Quality Report* (RAL & Denison, 2019).

Flagged data and short-term response plans are then reported monthly to the CNSC, the Ministry of the Environment, Conservation and Parks (MECP) and Environment Canada (EC) in the monthly water quality report. Monthly data validation of flagged data for 2018 can be found in Appendix III.

Annual water quality reporting is designed to be concise and focused on the presentation of data in a standardized format with limited interpretation. Detailed statistical evaluation of water quality trends is included in the *Serpent River Watershed Cycle 4 (2010 to 2014) State of the Environment Report (SOE)* (Minnow Environmental Inc., 2016). Data validation, as documented in Data Validation Procedures, ensures prompt response to upset conditions or unusual results. Appendix IV includes all 2018 water quality monitoring results with surface water results compared to Table 4.2.2 Assessment Criteria (AC) for the receiving environment. Five years of groundwater quality data are also included in Appendix IV. It should be noted that elevation measurements for Denison sites were changed from feet to meters in 2015.

Surface water stations within the TMAs, as well as effluent, seepages, and downstream surface water stations are compared to SRWMP benchmarks for receiving water quality (i.e. the AC in Table 4.2.2). It is understood that mine sources (i.e. SAMP and TOMP stations) are not expected to achieve the benchmarks that are set for the receiving environment, but these comparisons are made to identify potential variables or sources of concern relative to the downstream receiving environment. Therefore, for this reason, water quality data in this report was compared to benchmarks established for the SRWMP. These benchmarks are based on water quality criteria for the protection of aquatic life or the upper range of background concentrations (except for pH for which the lower background range was relevant). The most recent federal or Ontario guideline was used to determine these benchmarks (or BCMOE water quality guidelines were applied if none existed in aforementioned jurisdictions).

Table 4.2.2 Assessment Criteria and Data Quality Objectives

		Assessement Criteria[1]	Data Quality Objectives [2]							
Parameter	**Units**	**Receiving Environment Criteria**	**Targeted Detection Limit**	**Minimum Detectable Difference**	**Field Blank Criteria**	**Laboratory Blank Criteria**	**Field Precision**	**Laboratory Precision**	**Laboratory Spikes**	**Laboratory Accuracy (CRM)**
Field Parameters										
Conductivity	µmho/cm	-	0.1	0.05	-	-	20%	-	-	-
Flow	L/s	-	method	method	-	-	-	-	-	-
pH	pH units		0.1	0.01 or 0.02	-	-	20%	-	-	-
Lake		6.5								
Wetland/stream		5.2								
Laboratory Parameters										
Acidity	mg/L	-	1.0	-	2	2	20%	10%	-	20%
Barium	mg/L	1.0	0.005	-	0.01	0.01	20%	10%	20%	20%
Cobalt	mg/L	0.0025	0.0005	-	0.001	0.001	20%	10%	20%	20%
Iron	mg/L			-	0.04	0.04	20%	10%	20%	20%
Lake		0.49	0.02							
Wetland/stream		1.69	0.02							
Manganese [3]	mg/L	0.8	0.002	-	0.004	0.004	20%	10%	20%	20%
Radium	Bq/L	1.0	0.005	-	0.01	0.01	20%	20%	20%	-
Sulphate [3]	mg/L	128-429	0.1	-	0.2	0.2	20%	10%	20%	20%
TSS	mg/L	-	1	-	2	-	20%	10%	-	20%
Uranium	mg/L	0.0150	0.0005	-	0.001	0.001	20%	10%	20%	20%

Notes:
1. Table 4.5 Cycle 4 Study Design for the SRWMP, SAMP and TOMP (Minnow Environmental Inc., 2016)
2. Table 5.2 Cycle 4 Study Design for the SRWMP, SAMP and TOMP (Minnow Environmental Inc., 2016)
3. Sulphate and manganese criteria taken from Table B.1, Appendix B, Cycle 4 Study Design for the SRWMP, SAMP and TOMP (Minnow Environmental Inc., 2016). Parameters are hardness dependent.

5 RESULTS AND DISCUSSION

5.1 Health and Safety

5.1.1 Health and Safety Injury Statistics

In 2018, health and safety related training and education continued to be an integral part of monthly safety meetings and daily line-ups for care and maintenance workers working at the Denison Elliot Lake sites. All care and maintenance workers continue to hold the following certifications and/or have completed the following training: Workplace Hazardous Materials Information System (WHMIS), Cardiopulmonary Resuscitation (CPR) and First Aid certification, as well as the Annual Radiation Safety training. Furthermore, many workers have completed additional training and certifications ensuring their qualification for specialty/specific tasks and jobs related to care and maintenance at the Elliot Lake sites. Denison ensures that all training/certifications are kept up to date and are re-certified and trained when required. In terms of workplace injuries, one incident required medical aid in 2017, which was the result of a foreign body to the right eye. Although the incident did require medical aid, there were no lost time accidents reported between 2016 and 2018 at the Elliot Lake sites (Table 5.1.1). In addition, Denison Environmental Services (DES), a division of Denison Mines Inc., celebrated a milestone late in 2018 by reaching 500,000 hours without a lost time injury. DES is the company who is responsible for the care and maintenance of the Denison Mine sites in Elliot Lake. This enormous feat took eight years to achieve, and was an accumulation of hours worked by all employees of DES, including full-time and part-time employees working not only in Elliot Lake, but elsewhere in Ontario, as well as Quebec and the Yukon. This great health and safety accomplishment is an example of the strong commitment to health and safety by workers of DES, including those working at the Denison sites in Elliot Lake.

Table 5.1.1 Health & Safety Injury Statistics

Category	*2018*		*2017*		*2016*	
	Number	*Frequency*	*Number*	*Frequency*	*Number*	*Frequency*
Medical Aid	0	0.0	1	4.1	0	0.0
Lost Time	0	0.0	0	0.0	0	0.0
Total	**0**	**0.0**	**1**	**4.1**	**0**	**0.0**
Person-Hours Worked	**45,385**		**48,270**		**50, 417**	

* Frequency is calculated as: Number / Person-hours Worked * 200,000

5.1.2 Gamma Dosimetry

Dose reports for gamma dosimetry will be provided to the Canadian Nuclear Safety Commission (CNSC) under separate cover.

5.1.3 Radon Progeny Monitoring

There were no radon progeny action level exceedances in 2018. Quarterly values for individual ETPs are provided in the following subsections.

5.1.3.1 Denison TMA-1 ETP

Quarterly radon progeny monitoring was completed at the Denison TMA-1 ETP in accordance with licence requirements. Radon progeny monitoring results for 2018 confirmed WLs remained well below the action level criteria of 0.10 WL (Table 5.1.3.1).

Table 5.1.3.1 Denison TMA-1 ETP Radon Progeny Monitoring Results 2018

Quarter	Radon (WL)
1	0.0014
2	0.0056
3	0.0013
4	0.0002

5.1.3.2 Denison Lower Williams Lake ETP

Quarterly radon progeny monitoring was conducted at the Lower Williams Lake (LWL) ETP in accordance with licence requirements. Radon progeny monitoring results for the year 2018 confirmed WLs remained well below the action level criteria of 0.10 WL (Table 5.1.3.2).

Table 5.1.3.2 Denison LWL ETP Radon Progeny Monitoring Results 2018

Quarter	Radon (WL)
1	0.0003
2	0.0226
3	0.0105
4	0.0048

5.1.3.3 Stanrock ETP

Quarterly radon progeny monitoring was also conducted at the Stanrock ETP in accordance with licence requirements. Radon progeny monitoring results for the year 2018 confirmed WLs remained well below the action level criteria of 0.10 WL (Table 5.1.3.3).

Table 5.1.3.3 Stanrock ETP Radon Progeny Monitoring Results 2018

Quarter	Radon (WL)
1	0.0138
2	0.0305
3	0.0157
4	0.0164

5.2 Water Quality Monitoring Program

The objective of the annual data review is to identify anomalous data and provide evaluation and short-term annual averages at select locations. Step changes and anomalies are identified by reviewing and compiling the last five years of annual average data for all SAMP and TOMP locations. Unusual individual results are routinely investigated in accordance with the *Water Quality Assessment and Response Plan,* which is included in Appendix A of the most recent SOE Report (Minnow Environmental Inc., 2017).

5.2.1 Surface Water Quality

Appendix III contains detailed QA/QC results against DQOs while Appendix IV contains surface water station-specific annual data reported as monthly averages including annual statistics and comparison to AC, as per *The Cycle 4 Study Design for the SRWMP, SAMP and TOMP* (Minnow, 2016). Surface water quality data is reported monthly to the following regulatory bodies: CNSC, MECP, and EC.

All field blank DQOs were met for all parameters in all samples in 2018.

Although all field blank DQOs were met, there were several field precision results which did not meet DQOs in 2018.

The TSS field precision objective of 20% was exceeded in 4 out of the 12 samples all at 67%. The exceedances occurred at concentrations between 1 and 2 mg/L and are indicative of the lack of precision at low TSS concentrations, and do not influence performance monitoring data integrity. The overall annual percent difference for TSS field precision was slightly above the DQO at 22%.

The radium field precision DQO of 20% was also slightly exceeded in one quarter (3 out of 12 samples) of the samples collected in 2018. The DQO exceedances in the 3 samples ranged between 24% and 31%. The exceedances were not a result of improper sampling protocol, but rather are consistent with the variability observed in radium concentrations. All results were within values typically observed at this location and therefore do not affect the interpretation of radium water quality results. Despite these exceedances, the annual average percent difference was only 11%.

The iron field precision DQO of 20% was exceeded in 1 of the 12 samples at 29%.. Iron concentrations between the primary and duplicate samples for this exceedance were relatively

low, and are values typically observed at this location. The annual average percent difference was well below the 20% DQO at 7%.

Manganese field precision also exceeded its 20% DQO in 2 of 12 samples at 41% and 58%, in July and August respectively. Values are typical for this time of the year and are within the typical range of values normally observed at this location. Therefore, interpretation of the water quality results are not compromised. The annual average percent difference was well below the DQO at 12%.

A summary of 2018 surface water field blank and field precision data is presented in Table 5.2.1.

Table 5.2.1 2018 Surface Water Field Blank and Field Precision Data Summary

	pH pH units	TSS (mg/L)	Hardness (mg/L)	SO4 (mg/L)	Ra(T) Bq/L)	U (mg/L)	Ba (mg/L)	Co (mg/L)	Fe (mg/L)	Mn (mg/L)
Field Blank Statistics										
Count	12	12	12	12	12	12	12	12	12	12
Average	6.0	1	<0.5	<0.1	<0.007	<0.0005	<0.005	<0.0005	<0.02	<0.002
Max	7.0	1	<0.5	<0.1	<0.007	<0.0005	<0.005	<0.0005	<0.02	<0.002
Min	5.2	1	<0.5	<0.1	<0.007	<0.0005	<0.005	<0.0005	<0.02	<0.002
Field Blank Exceedances										
Criteria [1]		2	1.0	0.2	0.01	0.001	0.01	0.001	0.04	0.004
# Exceedances		0	0	0	0	0	0	0	0	0
Field Duplicate Statistics										
Count	12	12	12	12	12	12	12	12	12	12
Average	0%	22%	5%	5%	11%	3%	4%	3%	7%	12%
Max	0%	67%	19%	8%	31%	11%	12%	18%	29%	58%
Min	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Field Precision Exceedances										
Criteria [1]	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
# Exceedances	0	**4**	0	0	**3**	0	0	0	**1**	**2**

[1]SAMP and TOMP field blank and field precision criteria taken from Table 5.2 of the Cycle 4 Study Design for SRWMP, SAMP, TOMP (Minnow Environmental Inc., 2016)
Bold indicates an exceedance in the field blank or field precision criteria

5.2.1.1 Denison TMA-1

Site-specific water quality monitoring at the Denison TMA-1 facility was completed in accordance with SAMP and TOMP design documents. All water quality data from all the sites from the monitoring programs are compared to SRWMP benchmarks (i.e. AC) to identify potential variables or sources of concern relative to the downstream receiving environment as well as to monitor performance. However, it is understood that mine sources are not expected to meet these benchmarks/AC. The monthly average detailed water quality results are provided in Appendix IV.

It is important to make the following distinction about assessment of performance between the different monitoring programs. The purpose of the TOMP (i.e. influent water stations from the TMAs) is to use the data from the program to make decisions about treatment and operations on the sites and within the treatment plants. The data is not intended to meet any criteria or guideline as it is water coming from the TMA that has not yet been treated. Therefore, the comparison to AC is only done in an attempt to try and show improving water quality in the TMAs, if any (i.e. D-1, D-22 and DS-2). There is more importance in the comparison of SAMP data to SRWMP AC at the final discharge stations (i.e. D-2, D-3 and DS-4) as these stations discharge directly into the receiving environment (i.e. the Serpent River Watershed).

Basin performance of TMA-1 is monitored at the ETP influent at station D-1. A review of the dataset from the last five years indicates consistent pH, acidity and cobalt levels, where pH has remained near neutral over time and acidity and cobalt remained near or below their respective MDL (Table 4.2.2). Uranium and hardness concentrations had been decreasing prior to 2016, but have appeared to be gradually increasing over time since 2017. Barium, iron and manganese concentrations show variability over time, but remain relatively low – below the SRWMP benchmark/AC. Radium concentrations remain relatively stable and slightly elevated above AC.

Table 5.2.1.1a Annual Average Concentrations ETP Influent (D-1)

PARAMETER UNITS	ACID mg/L	Hardness mg/L	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**309[C]**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2014	<1	163.8	7.4	118.5	1.204	0.068	<0.0005	0.06	0.049	0.0172
2015	<1	159.3	7.6	103.0	1.331	0.095	<0.0005	0.08	0.024	0.0157
2016	<1	117.2	7.5	83.0	1.622	0.047	0.0006	0.10	0.037	0.0118
2017	<1	120.6	7.5	78.0	1.764	0.071	<0.0005	0.05	0.013	0.0157
2018	<1	126.3	7.5	71.0	1.375	0.066	<0.0005	0.12	0.020	0.0166
Annual Summary Statistics[J]										
Average	<1	137.4	7.5	90.7	1.459	0.069	0.0006	0.08	0.029	0.0154
Maximum	<1	163.8	7.6	118.5	1.764	0.095	0.0006	0.12	0.049	0.0172
Minimum	<1	117.2	7.4	71.0	1.204	0.047	<0.0005	0.05	0.013	0.0118

[A]Criteria are benchmarks based on the most recent federal, Ontario, and BCMOE water quality guidelines for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the 5-year annual average of hardness at this station.

[D]PWQO for Radium (Minnow Environmental Inc., 2016)

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006)

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013)

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013)

[J]Statistics based on five year annual average, maximum and minimum.

The final point of control at TMA-1 facility is monitored at the Stollery Settling Pond Outlet, known as station D-2. Review of annual average concentrations for SAMP and TOMP parameters for the last five years indicate consistent TSS concentrations and near neutral pH values, both meeting their respective discharge criteria limits outlined in the licence. Iron concentrations appear to be increasing slightly over time, but continue to remain below the AC. Barium concentrations have been variable over the five-year period, with the highest concentration in the last five years being this year in 2018. This can be linked to the increased barium chloride treatment required to control the increasing radium concentrations observed at this station earlier this year (Table 5.3.1.2.1). Annual average sulphate and hardness concentrations in 2018 were the lowest they have been in the past five years. Hardness is measured for the purpose of assessing sulphate concentrations as sulphate is hardness dependent. This means that the AC for sulphate, which is derived from British Columbia Ministry of the Environment (BCMOE) guidelines, increases as water hardness increases (Minnow Environmental Inc., 2016). In this case at D-2, hardness is above the upper bound meaning it is difficult to derive an accurate AC for this station. Therefore, the assessment of hardness and sulphate were simply done relatively. Cobalt concentrations have remained low and stable over time, slightly above target detection limits. Radium and manganese concentrations are variable over time, but remains below SRWMP AC. Furthermore, radium concentrations remain well below the monthly mean discharge criteria of 0.37 Bq/L. Uranium concentrations have remained stable with a slight decrease over time since 2015, but concentrations are elevated compared to its corresponding influent station D-1. Uranium has also consistently been above AC.

Table 5.2.1.1b Final Discharge at Stollery Settling Pond Outlet (D-2)

PARAMETER UNITS	Hardness mg/L	pH pH units	SO4 mg/L	TSS mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**5.2/6.5[B]**	**-[C]**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2014	259.0	7.1	215.0	1	0.175	0.206	0.0008	0.18	0.209	0.0367
2015	296.8	7.2	241.7	1	0.113	0.140	0.0006	0.18	0.212	0.0416
2016	287.8	7.1	227.5	1	0.153	0.206	0.0006	0.22	0.134	0.0396
2017	305.8	7.3	230.8	1	0.123	0.205	0.0006	0.27	0.157	0.0390
2018	246.5	7.2	189.8	1	0.161	0.266	0.0006	0.27	0.157	0.0304
Annual Summary Statistics[J]										
Average	279.2	7.2	221.0	1	0.145	0.205	0.0006	0.22	0.174	0.0375
Maximum	305.8	7.3	241.7	1	0.175	0.266	0.0008	0.27	0.212	0.0416
Minimum	246.5	7.1	189.8	1	0.113	0.140	0.0006	0.18	0.134	0.0304

[A]Criteria are benchmarks based on the most recent federal, Ontario, and BCMOE water quality guidelines for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and since the 5-year annual average for hardness exceeds the highest hardness tested (i.e. the upper bound), a site-specific assessment would be required to accurately determine the AC for sulphate at this location.

[D]PWQO for Radium (Minnow Environmental Inc., 2016)

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006)

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013)

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013)

[J]Statistics based on five year annual average, maximum and minimum.

Toxicity is monitored for Denison TMA-1 at the final discharge station D-2 (Stollery Settling Pond Outlet) in order to estimate the potential effects the effluent has on biological components. Toxicity sampling was completed semi-annually in 2018 as per SAMP requirements and included the following tests: acute *Daphnia magna* and Rainbow Trout and sub lethal *Ceriodaphnia dubia.* In 2018, results confirmed 0% acute mortality/lethality for both *Daphnia magna* and rainbow trout at station D-2 in both sampling events (Appendix IV). Furthermore, a >100% IC_{25} result for *Ceriodaphnia dubia* was achieved during both sampling events in 2018, signifying a non-toxic effluent for the test organism (Appendix IV).

5.2.1.1.1 Discharge Compliance – Denison TMA-1 Final Discharge

In 2018, TMA-1 effluent quality at the final point of control, D-2, was in compliance with the discharge criteria that is established in the licence (Table 5.2.1.1.1).

Table 5.2.1.1.1 2018 TMA-1 Compliance with Discharge Limits at Final Point of Control (D-2)

Month	Samples Required	Number of Times Discharge Limits Were Exceeded					
		pH pH units		TSS mg/L		Ra(T) Bq/L	
		Grab Sample Limit[1]: Upper 9.5 Lower 5.5	Monthly Arithmetic Mean[1]: Upper 9.5 Lower 6.5	Grab Sample Limit[1]: Upper 50 Lower N/A	Monthly Arithmetic Mean[1]: Upper 25 Lower N/A	Grab Sample Limit[1]: Upper 1.11 Lower N/A	Monthly Arithmetic Mean[1]: Upper 0.37 Lower N/A
Jan.	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
Feb.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Mar.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Apr.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
May	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
June	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
July	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Aug.	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
Sept.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Oct.	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
Nov.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Dec.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
YTD	52	0 of 52	0 of 12	0 of 52	0 of 12	0 of 52	0 of 12

[1]Limits established in the Licence UMDL-MINEMILL-DENISON.01/indf issued December 15, 2004.

5.2.1.2 Denison Lower Williams Lake

Site-specific water quality monitoring at the Denison LWL ETP was completed in accordance with SAMP and TOMP requirements. Detailed monthly average results are provided in Appendix IV.

LWL Influent station (D-22) is used to monitor seepage from Dam 1. Review of annual average concentrations for TOMP parameters at this station indicates variability for all parameters over the last five years. Water quality at D-22 shows slightly below neutral pH values (Table 5.2.1.2a). Sulphate concentrations have varied over time, but have remained relatively low compared to other influent stations. Radium, uranium, barium, and cobalt concentrations have varied over time, but all consistently remained below receiving environment AC. Iron concentrations in 2018 increased from 2017, but are consistent with previous years. Manganese concentrations were elevated in 2018 (similar to 2015-2016), likely due to the minimal precipitation and dry conditions experienced during the summer in July causing a seasonal spike (Appendix IV). The lower annual average concentrations for most parameters in 2017 was unusual and were likely attributed to the greater than average rainfall that occurred throughout the year as evidenced by the volume of water treated in 2017: 505,000,000 L compared to 204,000,000 L in 2018 (Table 5.3.2.2.1). In 2018, all water quality data at D-22 appear to be consistent with years prior to 2017.

Table 5.2.1.2a Denison Lower Williams Lake ETP Influent (D-22)

PARAMETER UNITS	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**5.2/6.5[B]**	**-**	**1.0[C]**	**1.0[D]**	**0.0025[E]**	**0.49/1.69[F]**	**0.8[G]**	**0.015[H]**
2014	6.7	80.3	0.479	0.035	0.0010	3.90	0.635	0.0017
2015	6.7	118.8	0.449	0.047	0.0011	4.31	1.194	0.0030
2016	6.7	109.0	0.604	0.043	0.0009	5.43	1.603	0.0019
2017	6.7	72.0	0.171	0.023	<0.0005	1.39	0.186	0.0008
2018	6.7	93.0	0.485	0.041	0.0014	5.24	1.315	0.0019
Annual Summary Statistics[I]								
Average	6.7	94.6	0.438	0.038	0.0011	4.05	0.987	0.0019
Maximum	6.7	118.8	0.604	0.047	0.0014	5.43	1.603	0.0030
Minimum	6.7	72.0	0.171	0.023	0.0009	1.39	0.186	0.0008

[A]Criteria are benchmarks based on the most recent federal, Ontario, and BCMOE water quality guidelines for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]PWQO for Radium (Minnow Environmental Inc., 2016)

[D]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006)

[E]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013)

[F]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[G]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[H]Canadian Council of Ministers of the Environment limit (CCME, 2013)

[I]Statistics based on five year annual average, maximum and minimum.

The final discharge from LWL is monitored near the Denison Access Road at Station D-3. Review of annual average concentrations for SAMP and TOMP parameters from the last five years (Table 5.2.1.2b) demonstrate slight variability in concentrations of all parameters over time. Despite variability, concentrations have been low and all parameters have consistently been below the AC set for the SRWMP, as well as meet compliance limits set out in the licence for the associated parameters (TSS, pH, and Ra) (Table 5.2.1.2.1). As previously mentioned, sulphate AC is hardness-dependent, and based on the 5-year annual average hardness concentration, all yearly average sulphate concentrations are well below the calculated AC of 309 mg/L (Table 5.2.1.2b). As well, Cobalt and TSS concentrations have remained at or below method detection limits over the last 5 years. There are no other discernible trends in the data set.

Table 5.2.1.2b Lower Williams Final Discharge at Denison Access Road (D-3)

PARAMETER UNITS	Hardness mg/L	pH pH units	SO4 mg/L	TSS mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**5.2/6.5[B]**	**309[C]**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2014	101.6	7.1	66.8	1	0.127	0.320	0.0005	0.20	0.049	0.0039
2015	118.6	7.1	79.1	1	0.124	0.254	0.0006	0.24	0.063	0.0041
2016	122.2	7.0	82.7	1	0.101	0.211	<0.0005	0.06	0.006	0.0031
2017	113.8	7.1	68.2	1	0.120	0.228	<0.0005	0.12	0.015	0.0048
2018	109.7	7.2	65.6	1	0.126	0.282	<0.0005	0.12	0.016	0.0048
Annual Summary Statistics[J]										
Average	113.2	7.1	72.5	1	0.120	0.259	0.0006	0.15	0.030	0.0041
Maximum	122.2	7.2	82.7	1	0.127	0.320	0.0006	0.24	0.063	0.0048
Minimum	101.6	7.0	65.6	1	0.101	0.211	<0.0005	0.06	0.006	0.0031

[A]Criteria are benchmarks based on the most recent federal, Ontario, and BCMOE water quality guidelines for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the 5-year annual average of hardness at this station.

[D]PWQO for Radium (Minnow Environmental Inc., 2016)

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006)

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013)

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013)

[J]Statistics based on five year annual average, maximum and minimum.

5.2.1.2.1 Discharge Compliance – Lower Williams Final Discharge

In 2018, LWL effluent quality at the final point of control, D-3, was in compliance with the discharge criteria that is established in the decommissioning licence (Table 5.2.1.2.1).

Table 5.2.1.2.1 2018 Lower Williams Compliance with Discharge Limits at Final Point of Control (D-3)

Month	Samples Required	Number of Times Discharge Limits Were Exceeded					
		pH pH units		TSS mg/L		Ra(T) Bq/L	
		Grab Sample Limit[1]: Upper 9.5 Lower 5.5	Monthly Arithmetic Mean[1]: Upper 9.5 Lower 6.5	Grab Sample Limit[1]: Upper 50 Lower N/A	Monthly Arithmetic Mean[1]: Upper 25 Lower N/A	Grab Sample Limit[1]: Upper 1.11 Lower N/A	Monthly Arithmetic Mean[1]: Upper 0.37 Lower N/A
Jan.	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
Feb.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Mar.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Apr.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
May	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
June	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
July	Zero Flow At Final Discharge - No Sample Required						
Aug.	Zero Flow At Final Discharge - No Sample Required						
Sept.	Zero Flow At Final Discharge - No Sample Required						
Oct.	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
Nov.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Dec.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
YTD	39	0 of 39	0 of 9	0 of 39	0 of 9	0 of 39	0 of 9

[1]Limits established in the Licence UMDL-MINEMILL-DENISON.01/indf issued December 15, 2004.

5.2.1.3 Stanrock

Discharge, runoff, and seepage from the Stanrock TMA reports to a small holding pond where the ETP Influent station (DS-2) is monitored. A review of the annual averages over the last five years indicate relatively depressed pH values combined with elevated acidity and iron concentrations compared to other influent monitoring stations at the Denison sites in Elliot Lake, which is characteristic of the Stanrock TMA. Sulphate concentrations at DS-2 are also high in comparison to other monitoring stations in the program. Annual average radium concentrations at DS-2 appear to be relatively stable and consistently remain below the AC of 1.0 Bq/L, however, 2018 annual average radium concentrations were the highest of the last five years. Barium levels have been relatively lower in the last two years as compared with previous data, and continue to remain below AC of 1.0 mg/L. Furthermore, cobalt and uranium concentrations are relatively stable, but remain above receiving environment AC of 0.0025 mg/L and 0.015 mg/L respectively (Table 5.2.1.3a). Manganese concentrations were elevated in 2018 compared to previous years' annual average concentrations. This is likely due to the dry summer months coupled with low precipitation causing an increase in manganese concentrations in April and July (Appendix IV). This increase did not negatively impact water quality downstream at the final discharge station DS-4.

Table 5.2.1.3a Stanrock Influent (DS-2)

PARAMETER UNITS	ACID mg/L	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**5.2/6.5[B]**	**-**	**1.0[C]**	**1.0[D]**	**0.0025[E]**	**0.49/1.69[F]**	**0.8[G]**	**0.015[H]**
2014	156	3.0	422.5	0.188	0.028	0.0589	30.35	1.426	0.0188
2015	231	2.9	632.5	0.152	0.029	0.0763	46.65	1.939	0.0220
2016	235	2.9	580.0	0.182	0.030	0.0786	45.40	1.724	0.0321
2017	194	2.8	502.5	0.182	0.018	0.0682	28.80	1.349	0.0270
2018	231	2.9	595.0	0.231	0.019	0.0787	47.10	2.117	0.0188
Annual Summary Statistics[I]									
Average	209	2.9	546.5	0.187	0.025	0.0721	39.66	1.711	0.0237
Maximum	235	3.0	632.5	0.231	0.030	0.0787	47.10	2.117	0.0321
Minimum	156	2.8	422.5	0.152	0.018	0.0589	28.80	1.349	0.0188

[A]Criteria are benchmarks based on the most recent federal, Ontario, and BCMOE water quality guidelines for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]PWQO for Radium (Minnow Environmental Inc., 2016)

[D]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006)

[E]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013)

[F]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[G]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[H]Canadian Council of Ministers of the Environment limit (CCME, 2013)

[I]Statistics based on five year annual average, maximum and minimum.

Water quality at the Stanrock Final Point of Control is monitored at Orient Lake Outlet (DS-4). A review of water quality data at DS-4 for the last five years shows generally stable pH values and TSS levels, comparable to other final discharge stations, and consistently meet the discharge limits set out in the licence (Table 5.2.1.3.1). Annual average sulphate and hardness concentrations are relatively high for a final discharge point, but are consistent with Denison final discharge values (Tables 5.2.1.1b and 5.2.1.3b). Similar to final discharge station D-2, the average hardness concentration exceeds the upper bound that is set by BCMOE for the purpose of assessing sulphate, making it difficult to accurately determine a sulphate AC. This is the reason the assessment at this station for sulphate is done relatively. All metal concentrations consistently meet receiving water AC, with cobalt approaching detections levels (Table 5.2.1.3b). Uranium and radium concentrations are gradually increasing over time at DS-4, but concentrations are relatively low and radium continues to remain well below the monthly mean discharge criteria of 0.37 Bq/L. All other parameters appear to be relatively stable over time with no real outliers observed in the five-year annual average dataset.

Table 5.2.1.3b Orient Lake Outlet Stanrock Final Point of Control (DS-4)

PARAMETER UNITS	Hardness mg/L	pH pH units	SO4 mg/L	TSS mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**5.2/6.5[B]**	**- [C]**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2014	316.1	7.1	292.5	1	0.054	0.045	0.0007	0.15	0.049	0.0016
2015	292.5	7.1	258.3	1	0.062	0.050	0.0006	0.13	0.067	0.0021
2016	300.0	7.1	262.5	1	0.073	0.047	0.0006	0.10	0.044	0.0043
2017	331.8	7.2	277.5	1	0.072	0.045	0.0006	0.17	0.044	0.0042
2018	303.8	7.1	248.3	1	0.081	0.065	0.0006	0.15	0.052	0.0042
Annual Summary Statistics[J]										
Average	308.8	7.1	267.8	1	0.068	0.050	0.0006	0.14	0.051	0.0033
Maximum	331.8	7.2	292.5	1	0.081	0.065	0.0007	0.17	0.067	0.0043
Minimum	292.5	7.1	248.3	1	0.054	0.045	0.0006	0.10	0.044	0.0016

[A]Criteria are benchmarks based on the most recent federal, Ontario, and BCMOE water quality guidelines for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and since the 5 year annual average for hardness exceeds the highest hardness tested (i.e. the upper bound), a site-specific assessment would be required to accurately determine the AC for sulphate at this location.

[D]PWQO for Radium (Minnow Environmental Inc., 2016)

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006)

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013)

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013)

[J]Statistics based on five year annual average, maximum and minimum.

Toxicity is monitored for the Stanrock site at the final discharge (DS-4) as per SAMP Performance Monitoring requirements. In 2018, toxicity testing was done in the spring and fall, and included the same tests that were completed at the Denison TMA-1 final effluent (D-2). Results of the 2018 toxicity tests at DS-4 confirmed 0% acute mortality/lethality for both *Daphnia magna* and Rainbow Trout for both sampling events (Appendix IV). Furthermore, a >100% IC_{25} result for *Ceriodaphnia dubia* was confirmed in both the spring and fall sampling events at DS-4 (Appendix IV). Overall, results are indicative of a non-toxic environment for aquatic life.

5.2.1.3.1 Discharge Compliance – Stanrock Final Discharge

In 2018, Stanrock TMA effluent quality at the final point of control, as monitored at station DS-4, was in compliance with the discharge criteria that is established in the decommissioning licence (Table 5.2.1.3.1).

Table 5.2.1.3.1 2018 Stanrock TMA Compliance with Discharge Limits at Final Point of Control (DS-4)

Month	Samples Required	Number of Times Discharge Limits Were Exceeded					
		pH pH units		TSS mg/L		Ra(T) Bq/L	
		Grab Sample Limit[1]: Upper 9.5 Lower 5.5	Monthly Arithmetic Mean[1]: Upper 9.5 Lower 6.5	Grab Sample Limit[1]: Upper 50 Lower N/A	Monthly Arithmetic Mean[1]: Upper 25 Lower N/A	Grab Sample Limit[1]: Upper 1.11 Lower N/A	Monthly Arithmetic Mean[1]: Upper 0.37 Lower N/A
Jan.	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
Feb.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Mar.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Apr.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
May	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
June	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
July	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Aug.	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
Sept.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Oct.	5	0 of 5	0 of 1	0 of 5	0 of 1	0 of 5	0 of 1
Nov.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
Dec.	4	0 of 4	0 of 1	0 of 4	0 of 1	0 of 4	0 of 1
YTD	52	0 of 52	0 of 12	0 of 52	0 of 12	0 of 52	0 of 12

[1]Limits established in the Licence UMDL-Minemill-Stanrock.02/indf issued September, 2010.

5.2.2 Groundwater Quality

Field quality assurance and quality control sampling was extended to the groundwater monitoring program in 2006. Detailed groundwater QA/QC results against DQOs have been included in Appendix III and groundwater station-specific five-year annual data has been included in Appendix IV. The 2018 groundwater field blank and field precision data summary is presented in Table 5.2.2.

Due to higher than normal exceedances in field blank results in 2017, the field blank sampling methodology was revised to allow for more accurate/confident results. Rather than use the same tubing for each sample and rinsing/cleaning it between each sample, a new dedicated piece of tubing was cut and used for each sample, eliminating the chance of contamination with unclean rinse water or unclean tubing. This new method yielded far better QA/QC results overall for groundwater in 2018 as only one parameter in one sample exceeded the DQO, and it was only a slight exceedance. This was a significant improvement from the previous year's program.

The acidity field blank DQO of 2 mg/L was exceeded in one of the three samples taken in 2018. The result yielded was 4 mg/L. The slightly elevated result indicates slight contamination, but it is not significant enough to impact the interpretation of the groundwater results. Acidity concentrations from which the sample was taken are >1000.0 mg/L. Therefore, the result does not impact interpretation of the groundwater quality results.

The field precision DQOs were met for all parameters in all samples in 2018. The annual percent differences for all parameters were at or below 11% at all locations.

Table 5.2.2 2018 Groundwater Field Blank and Field Precision Data Summary

		pH	SO_4	Acidity	Fe
		pH units	mg/L	mg/L	mg/L
Field Blank Statistics					
	Count	3	3	3	3
	Average	6.4	0.1	2.3	<0.02
	Min	6.2	0.1	1	<0.02
	Max	6.5	0.1	4	<0.02
Field Blank Exceedances					
	Criteria[1]	-	0.2	2	0.04
	# Exceedances	0	0	**1**	0
Field Precision Statistics					
	Count	3	3	3	3
	Average	0%	1%	6%	6%
	Min	0%	0%	0%	3%
	Max	0%	2%	10%	11%
Field Precision Exceedances					
	Criteria[1]	20%	20%	20%	20%
	# Exceedances	0	0	0	0

[1]Field criteria taken from Table 5.2 of the Cycle 4 Study Design for SRWMP, SAMP and TOMP (Minnow Environmental Inc., 2016)
Bold indicates an exceedance of the criteria

5.2.2.1 Denison TMA-1 Groundwater Results

Review of the data at the east end of the TMA, downstream of Dam 17 on the North Abutment at monitoring stations BH91 D1A and BH91 D1B for the last five years indicates elevated iron and sulphate concentrations in the deeper well station BH91 D1A (total depth = 218.00 ft) (Appendix IV). These concentrations are lower near the surface overall at BH91 D1B (total depth = 149.20 ft). (Appendix IV). Acidity concentrations at both monitoring stations are low compared to other stations in the program and are near or below the MDL. pH is near neutral at both stations, but is gradually decreasing over time near surface at BH91 D1B. No sample was able to be collected near surface at station BH91 D1B in 2018 due to lack of recharge.

Groundwater quality downstream of Dam 17 in the North Valley (BH91 D3A and BH91 D3B) can be characterized by slightly depressed, but stable, pH values with relatively high acidity, iron, and sulphate concentrations. Concentrations of all parameters at these stations appeared to be decreasing slightly each year, but 2018 saw a slight increase in the majority of these concentrations when compared to the previous four years of data (Appendix IV).

Downstream of Dam 10 (BH91 DG4B) groundwater is characterized by near neutral pH, gradually increasing sulphate concentrations, and acidity below detection limits (Appendix IV). In 2018, sulphate concentrations decreased slightly from the previous five years. Iron concentrations have significantly increased in the last four years, but are consistent with values prior to 2013.

5.2.2.2 Denison Lower Williams Lake

A review of the last five years of groundwater monitoring results downstream of Dam 1 on the North Ridge (BH91 D9A) indicate relatively stable and near neutral pH levels. Both iron and acidity concentrations have been moderately elevated, but gradually decreasing over the same time period (Appendix IV). Sulphate concentrations appear to be stable and elevated at this station over the last five years.

5.2.2.3 Stanrock

Groundwater quality is measured at Stanrock downstream of the following dams: Dam A (BH91 SG1A), Dam B (BH98-16A), Dam C (BH98-15A), and Dam D (BH91-SG3). Dam A groundwater is characterized by depressed pH with elevated sulphate, acidity, and iron concentrations (Appendix IV). Although concentrations are elevated compared to other monitoring wells, overall, concentrations of most of these parameters have been decreasing over time in groundwater downstream of Dam A (Figure 5.2.2.3 1).

Dam B groundwater quality is similar to Dam A, with depressed pH and elevated sulphate, acidity and iron concentrations (Appendix IV). All parameters appear to fluctuate from year to year, increasing and decreasing from year to year since 2014 (Figure 5.2.2.3 2).

Groundwater quality monitored downstream of Dam C at BH98 15A indicates slightly depressed pH with elevated concentrations of sulphate, acidity and iron (Appendix IV). Although concentrations are high at this monitoring station, a review of the last five years of

data demonstrate that concentrations appear to be gradually decreasing over time (Figure 5.2.2.3 3).

Figure 5.2.2.3. 1 Sulphate, acidity, and iron concentrations at Station BH91 SG1A downstream of Dam A, 2014-2018

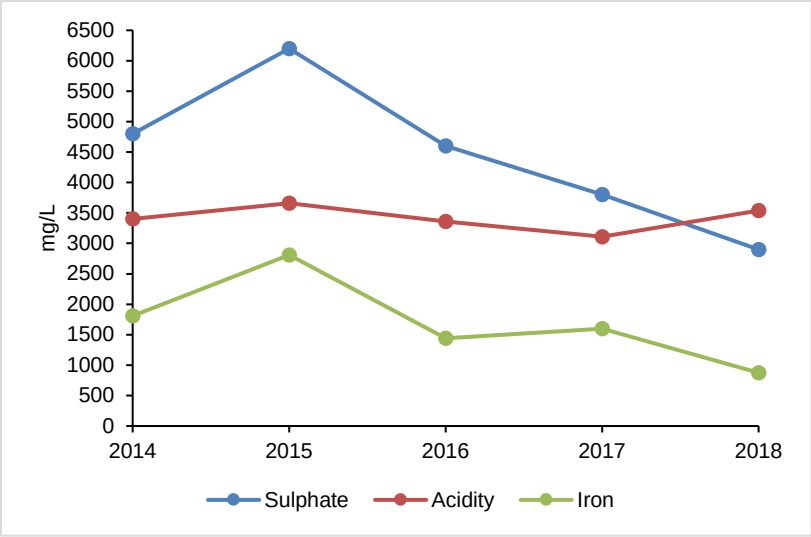


Figure 5.2.2.3. 2 Sulphate, acidity, and iron concentrations at Station BH98-16A downstream of Dam B, 2014-2018

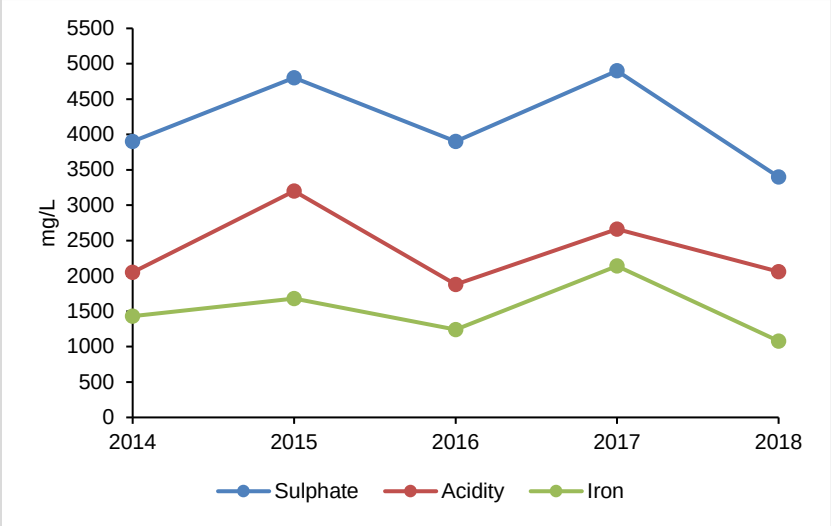
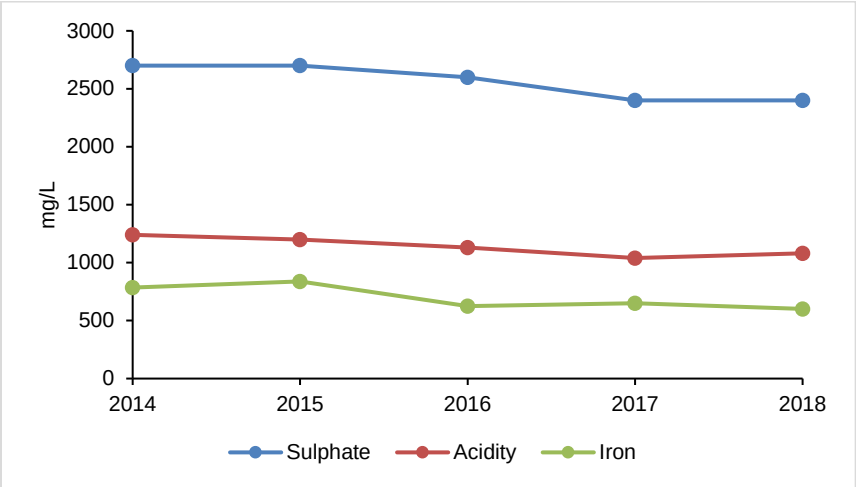


Figure 5.2.2.3. 3 Sulphate, acidity, and iron concentrations at Station BH98-15A downstream of Dam C, 2014-2018



5.2.3 Porewater Quality

Porewater quality at the Stanrock site is monitored upstream of Dam A at the following stations: ST3 P3 (total depth = 5.94 m), ST3 P5 (total depth = 2.64 m), ST3 P6 (total depth = 11.58 m), and ST3 P8 (total depth = 20.91m), and upstream of Dam D at BH91 SG2A (total depth = 33.31 m), BH91 SG2D (total depth = 4.39 m). Overall, visual review of the porewater quality data at these stations demonstrates low pH values combined with elevated acidity, sulphate, and iron concentrations. Concentrations of acidity, iron, and sulphate are significantly higher at deeper well locations (i.e. ST3 P6 and ST3 P8), but appear to decrease in more shallow wells (ST3 P3 and ST3 P5). This is apparent when comparing station ST3 P5 and ST3 P8, where concentrations of all parameters are more than half the concentration at the shallower well (Appendix IV). When reviewing temporal trends at each station, concentrations of each parameter do vary over time at station ST3 P3 and ST3 P5, but are gradually increasing at ST3 P6 (Figures 5.2.3 1,2,3,4). pH values appear to remain relatively stable at all stations, showing little variability over time (Figure 5.2.3 4). Furthermore, acidity at station ST3 P8 is gradually decreasing over time (Figure 5.2.3 1).

Monitoring wells located downstream of Dam D have not collected data over the last five years due to no recharge of the wells, with the exception of BH91 SG2A. Porewater quality results obtained at this station are variable over the last five years, with slightly depressed pH, and elevated concentrations of iron, acidity, and sulphate, very similar to all other monitoring stations at Stanrock (Figure 5.2.3 5). Samples were able to be collected at BH91 SG3B last year in 2017, however it is difficult to characterize groundwater quality at this station with only one set of data points. The data demonstrated very depressed pH value, with elevated concentrations of acidity, sulphate, and iron, with no real discernible trends in the dataset.

Figure 5.2.3. 1 Acidity Concentrations at ST3 P3 (5.94 m), ST3 P5 (2.64 m), ST3 P6 (11.58 m), and ST3 P8 (20.91 m), 2014-2018

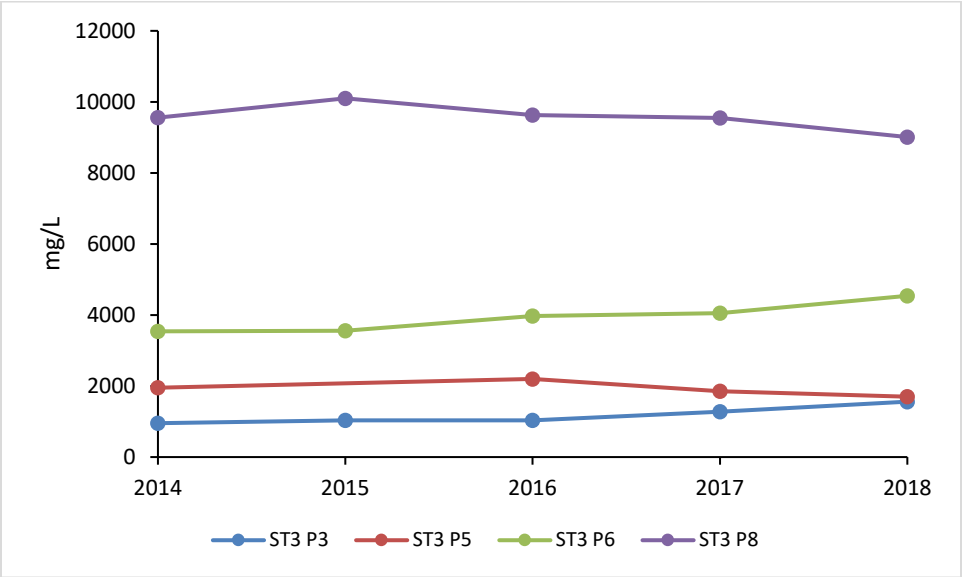


Figure 5.2.3. 2 Iron Concentrations at ST3 P3 (5.94 m), ST3 P5 (2.64 m), ST3 P6 (11.58 m), and ST3 P8 (20.91 m), 2014-2018

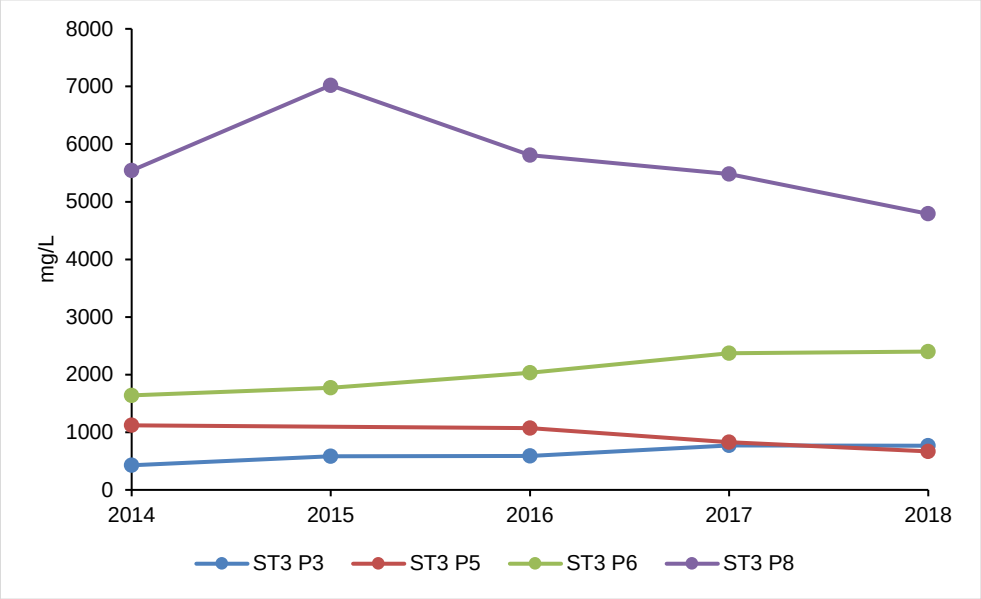


Figure 5.2.3. 3 Sulphate Concentrations at ST3 P3 (5.94 m), ST3 P5 (2.64 m), ST3 P6 (11.58 m), and ST3 P8 (20.91 m), 2014-2018

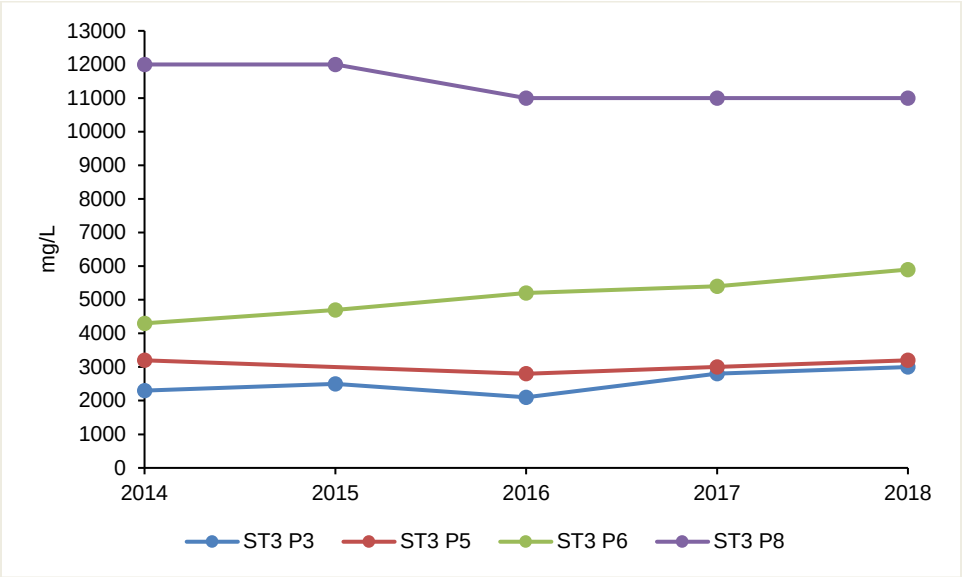


Figure 5.2.3. 4 pH at ST3 P3 (5.94 m), ST3 P5 (2.64 m), ST3 P6 (11.58 m), and ST3 P8 (20.91 m), 2014-2018

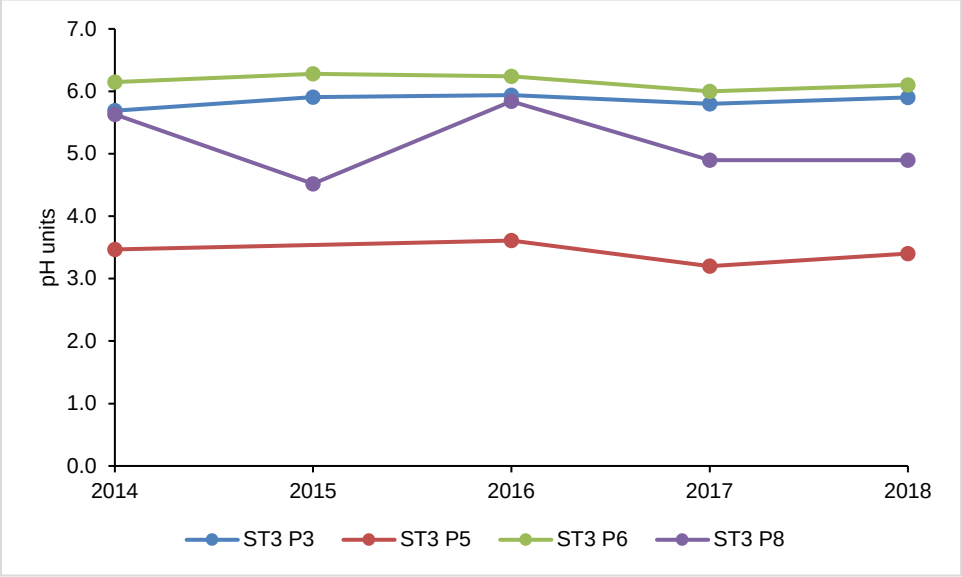
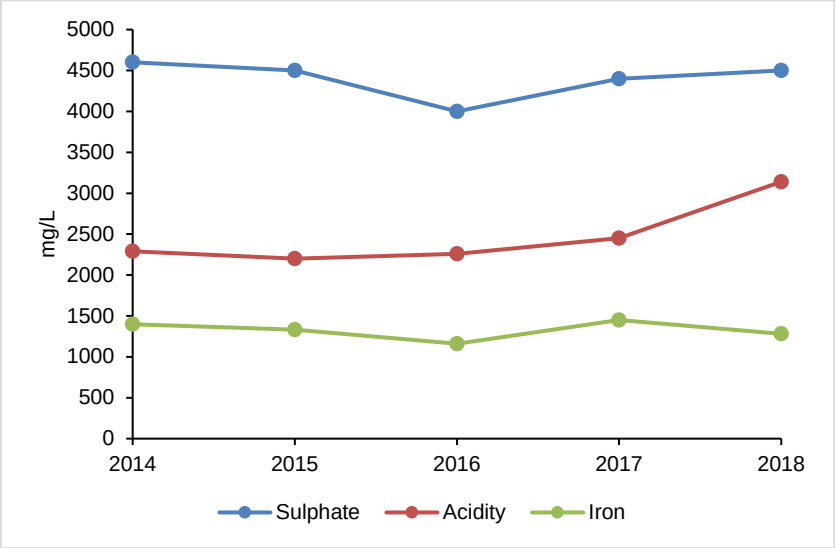


Figure 5.2.3 5 Sulphate, acidity and iron concentrations at Station BH91 SG2A upstream of Dam D, 2014-2018



5.3 Site Specific Maintenance and Operations Program

Site-specific program reports are provided in the following sections in accordance with the SAMP and TOMP Annual Reporting Requirements. Each section provides the following information:

- Summary of tailings management area (TMA) maintenance
- Summary of effluent treatment plant (ETP) operations

5.3.1 Denison TMA-1

5.3.1.1 TMA Maintenance

Routine inspections and preventative maintenance was performed as required. Any equipment that was able to be repaired either on-site or sent out was done so, and anything that was damaged/worn beyond repair was replaced with a new unit. All maintenance was completed to ensure continued efficiency and safe operations on site. Furthermore, proper calibration of monitoring equipment was conducted on a regular basis.

5.3.1.2 ETP Operations

The ETP located at the TMA-1 spillway (D-1) operated for 163 days in 2018. The ETP treated approximately 1,295,000,000 L of water, with a monthly average daily plant flow of 92 L/s. Due to elevated radium levels in the final discharge (D-2) and a decrease in influent pH at the beginning of 2018, sodium hydroxide was used for treatment in addition to the barium chloride. The total amount of sodium hydroxide consumed was 1551 kg by the end of the year, and the amount of barium chloride that was consumed was 3931 kg. An estimated 1,228,000,000 L was discharged from the final point of control at the Stollery Lake Settling Pond Outlet (D-2). Although the plant only operated for 163 days, discharge at D-2 did occur for 365 days in 2018 (Table 5.3.1.2.1). Monthly average daily discharge flow was 39 L/s.

5.3.1.2.1 Operating Summary

In 2018, the TMA-1 ETP operated continuously until June 12, at which point the plant was shut down for the remainder of the year due to low water levels. Similar to previous years, the use of siphons for TMA drawdown was effective to ensure the pond level remained below spillway elevation as well as to maintain a controlled release of water from TMA-1. This controlled release of water from TMA-1 ensures that radium settling in the Stollery Lake Settling Pond is maximized. However, 2018 saw elevated radium levels at the beginning of the year, prompting doubling the dosing rate of barium chloride paired with the reintroduction of sodium hydroxide to increase pH through the Spring freshet. Typically at this time of year, the influent pH decreases while radium increases at the final discharge. In an effort to control elevated radium levels, it was believed reintroduction of the sodium hydroxide would increase the pH enough to assist in the precipitation process. However, further investigation determined that using sodium hydroxide had little effect on radium levels and the reagent was discontinued in May 2018.

Sodium hydroxide treatment was done using the available sodium hydroxide tank at the ETP. The addition of sodium hydroxide as a treatment reagent began on February 23, 2018 and continued until May 18, 2018. Although this year saw elevated radium concentrations, there were no issues of non-compliance at D-2. Radium concentrations at the final point of control (D-2) met all licensed discharge criteria (1.11 Bq/L for a grab sample and 0.37 Bq/L for a monthly mean). Annual average concentration of radium at D-2 was 0.161 Bq/L.

No major operational issues occurred during 2018. A few minor operational issues that took place were taken care of in a timely manner. As in previous years, the siphons become blocked due to build-up of algae or other debris preventing optimal flows. However, with the installation of the new, larger-holed siphon screens in 2017, the siphon only had to be blown out with the compressor once in 2018, proving the effectiveness of the replacement screens. The larger holes in the siphon screens have ensured optimum flow rates, even in the event that small amounts of debris become built up in the line. It also makes it easier to start up and prevent loss of siphon when the ETP starts up again.

Other operating, care and maintenance highlights in 2018 are as follows:

- A rain gauge was installed at the TMA-1 ETP to allow for better precipitation monitoring during the summer;
- D-19 seepage monitoring station, which is located at the toe of Dam 10 and was buried when the filter berm was constructed, was cleared as per Golder's request;
- Concrete repairs were completed at the D-25 flow structure as per Golder's request;
- A secondary spill containment pad was installed at the chemical reagent offloading area at the ETP as per a request made during an MECP inspection in 2017.

Table 5.3.1.2.1 2018 TMA-1 Effluent Treatment Plant Flow Rates, Operating Days, and Discharge Days

ITEM	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	Y.T.D. 2018	Y.T.D. 2017
PLANT OPERATIONS														
Operating Days	31	28	31	30	31	12	0	0	0	0	0	0	163	217
Maximum Daily Plant Flow (L/s D-1)	110	113	110	98	177	38	0	0	0	0	0	0	177	134
Minimum Daily Plant Flow (L/s @ D-1)	99	105	43	43	38	38	0	0	0	0	0	0	0	0
Monthly Average Daily Plant Flow (L/s @ D-1)	107	110	56	65	145	38	0	0	0	0	0	0	92	89
Total Volume Treated (ML)	285	265	150	168	388	39	0	0	0	0	0	0	1295	1675
Barium Chloride Consumption														
total kg/month	847	782	663	220	1217	202	0	0	0	0	0	0	3931	5027
monthly average mg/litre	2.97	2.95	4.42	1.31	3.14	5.14	0.00	0.00	0.00	0.00	0.00	0.00	3.04	3.00
Sodium Hydroxide Consumption														
total kg/month	0	107	311	473	661	0	0	0	0	0	0	0	1551	783
monthly average mg/litre	0.00	0.40	2.07	2.82	1.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.47
EFFLUENT														
Discharge Days	31	28	31	30	31	30	31	31	30	31	30	31	365	365
Maximum Daily Discharge Flow (L/s D-2)	87	87	60	87	115	29	16	12	9	27	23	19	115	240
Minimum Daily Discharge Flow (L/s D-2)	66	39	39	39	97	16	9	8	9	19	17	14	8	9
Monthly Average Daily Discharge Flow (L/s D-2)	79	72	44	56	104	22	14	10	9	25	19	17	39	61
Total Volume Discharged (ML)	211	173	119	146	279	58	36	25	23	66	48	44	1228	1933

5.3.2 Denison Lower Williams Lake

5.3.2.1 TMA Maintenance

Routine inspection, calibrations, and preventative maintenance were performed at the LWL site as required.

5.3.2.2 Summary of ETP Operations

Treatment plant operations is monitored at station D-22. In 2018, the Lower Williams Lake ETP operated to control radium levels, operating for a total of 358 days. An estimated 204,000,000 L of water was treated, and the same amount was discharged from the final point of control, D-3. Due to low flows in the summer, discharge at the final point of control only occurred for 273 days in 2018. Barium chloride consumption for the year at the LW ETP was 566 kg at the end of the year (Table 5.3.2.2.1).

5.3.2.2.1 Operating Summary

Treatment conditions at LWL are for the sole purpose of controlling radium levels in the influent. Neutralization treatment has not been required at this site since 2002. Unlike 2017, water quantity was too low during the summer months, and so no discharge occurred between July and September, inclusively. However, flow to the ETP continued year-round, and the treatment plant continued to run all year.

Aside from routine maintenance of the ETP, there were no process or design changes to the LWL ETP in 2018.

Table 5.3.2.2.1 2018 Lower Williams ETP Flow Rates, Operating Days, and Discharge Days

ITEM	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	Y.T.D. 2018	Y.T.D. 2017
PLANT OPERATIONS														
Operating Days	31	28	31	30	31	30	31	24	30	31	30	31	358	365
Maximum Daily Plant Flow (L/s @ D-22)	10	12	1	55	46	7	<1	<1	<1	39	14	6	55	149
Minimum Daily Plant Flow (L/s @ D-22)	1	2	1	2	3	1	<1	<1	<1	3	7	3	1	1
Monthly Average Daily Plant Flow (L/s @ D-22)	5	6	1	15	16	3	<1	<1	<1	17	11	4	7	16
Total Volume Treated (ML)	12	15	3	40	43	8	<1	<1	<1	47	28	10	204	505
Barium Chloride Consumption														
total kg/month	54	48	52	47	50	46	50	35	39	52	49	45	566	647
monthly average mg/litre	4.37	3.28	19.41	1.18	1.16	5.94	0.00	0.00	0.00	1.11	1.75	4.51	3	1
Sodium Hydroxide Consumption														
total kg/month	0	0	0	0	0	0	0	0	0	0	0	0	0	0
monthly average mg/litre	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EFFLUENT														
Discharge Days	31	28	31	30	31	30	0	0	0	31	30	31	273	365
Maximum Discharge Flow (L/s @ D-3)	10	12	1	55	46	7	0	0	0	39	14	6	55	149
Minimum Discharge Flow (L/s @ D-3)	1	2	< 1	< 2	3	< 1	0	0	0	3	7	3	0	1
Monthly Average Discharge Flow (L/s @ D-3)	5	6	1	15	16	3	0	0	0	17	11	4	9	16
Total Volume Discharged (ML)	12	15	3	40	43	8	0	0	0	47	28	10	204	505

5.3.3 Stanrock TMA

5.3.3.1 TMA Maintenance

In 2018, routine inspection and preventative maintenance were performed as required. Proper calibration of monitoring equipment was conducted on a regular basis.

5.3.3.2 Summary of ETP Operations

The Stanrock ETP operated periodically throughout the year for the purpose of pH and radium level control. The ETP, which is monitored at station DS-3, operated a total of 126 days, with a monthly average daily plant flow of 126 L/s. Throughout 2018, an estimated 1,370,000,000 L of water was treated with barium chloride and lime. Barium chloride and lime consumption at the Stanrock ETP in 2018 was 479 kg and 108.14 dry tonnes respectively. Furthermore, 777,000,000 L was discharged from the final point of control, DS-4, over a total of 365 discharge days (Table 5.3.3.2.1). Monthly average daily discharge flow at DS-4 was 25 L/s for 2018.

5.3.3.2.1 Operating Summary

The Stanrock ETP operated as required throughout the year to maintain discharge compliance and control of the Holding Pond water levels. The majority of the operating days were during spring and fall as runoff and rainfall conditions respectively are most often present during these times of the year (Table 5.3.3.2.1).

Spring freshet resulted in water flows bypassing the plant via the Dam L spillway in both April and May. To compensate, additional treatment was initiated, meaning that the ETP operation was switched from automatic to manual and adjusted to ensure treatment of all water leaving the site. pH downstream of the ETP was monitored more frequently to ensure discharge compliance. There were no issues of non-compliance due to the bypassing of the water.

The siphon from Beaver Lake to the Dam G holding pond operated periodically throughout the year, but was shut down for several months between March and October. This year, approximately 65,413,440 L of water was siphoned from Beaver Lake to Dam G Holding Pond, and thereafter pumped to the Stanrock ETP. The reason this is done is to ensure better pH control of Moose Lake and the final discharge water quality.

The Dam M Pond pumps operated periodically throughout the year to ensure the Dam M Seepage Collection Pond level remained well below spillway elevation. An estimated 142,357,507 L of water was discharged from Dam M Pond to the Dam G Seepage Collection Pond. On April 25, the memory card for Dam M failed in the PLC, meaning that data for the month was lost including all flow data prior to the failure. So the only flow measurements for the month of April were from April 25 onward.

The Dam G pumps operated as required throughout the year to ensure the Dam G Seepage Collection Pond level remained well below spillway elevation. In 2018, an estimated 134,776,362 L of water was pumped from the Dam G Collection Pond to the ETP to be treated.

A new lime pump was purchased and installed in late May, but following installation there were technical issues, which resulted in the pump being removed and returned to the manufacturer for modifications. The pump was fixed and re-installed in June. However, issues

continued with the pump, and the manufacturer was contacted to resolve the issues with the packing. The original pump was refurbished and put back into service until the issues were resolved with the new one. Also, a new pump was purchased and installed at Dam M pump house, with the old one being serviced and kept available for a spare should it be required.

Table 5.3.3.2.1 2018 Stanrock ETP Flow Rates, Operating Days, and Discharge Days

ITEM	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	Y.T.D. 2018	Y.T.D. 2017
PLANT OPERATIONS														
Operating Days	16	8	5	15	18	7	6	0	0	24	17	10	126	201
Maximum Daily Plant Flow (L/s @ DS-2)	150	145	141	194	198	150	90	0	0	138	147	138	198	230
Minimum Daily Plant Flow (L/s @ DS-2)	110	109	90	95	105	91	47	0	0	66	75	97	0	78
Monthly Average Daily Plant Flow (L/s @ DS-2)	136	133	119	149	160	125	63	0	0	104	116	118	126	142
Total Volume Treated (ML)	188	92	51	193	248	75	33	0	0	216	170	102	1370	2458
Barium Chloride Consumption														
total kg/month	42	19	10	36	110	24	6	0	0	151	74	8	479	1257
monthly average mg/litre	0.22	0.21	0.19	0.19	0.44	0.31	0.18	0.00	0.00	0.70	0.43	0.08	0.35	0.51
Lime Consumption														
total dry tonnes/month	9.92	4.56	3.06	17.34	15.10	6.48	1.81	0.00	0.00	26.11	15.85	7.91	108.14	205.16
monthly average g/litre	0.05	0.05	0.06	0.09	0.06	0.09	0.06	0.00	0.00	0.12	0.09	0.08	0.08	0.08
NEUTRALIZATION														
Lime Consumption														
Beaver Lake total dry tonnes/month	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Site total including ETP Operations	9.92	4.56	3.06	17.34	15.10	6.48	1.81	0.00	0.00	26.11	15.85	7.91	108.14	205.16
EFFLUENT														
Discharge Days	31	28	31	30	31	30	31	31	30	31	30	31	365	365
Maximum Daily Discharge Flow (L/s @ DS-4)	47	17	6	105	211	21	6	6	13	105	91	35	211	400
Minimum Daily Discharge Flow (L/s @ DS-4)	9	6	3	9	9	6	3	1	3	6	17	13	1	1
Monthly Average Daily Discharge Flow (L/s @ DS-4)	21	10	5	41	81	10	4	3	7	51	42	22	25	61
Total Volume Discharged (ML)	55	23	12	105	216	25	10	9	18	138	109	58	777	1933

6 REFERENCES

Minnow Environmental Inc., 2016. The Cycle 4 Study Design for the SRWMP, SAMP and TOMP. Prepared for Rio Algom Limited and Denison Mines Inc. February 2016.

Minnow Environmental Inc., 2017. Serpent River Watershed Cycle 4 (2010 to 2014) State of the Environment Report. Prepared for Rio Algom Limited and Denison Mines Inc. November 2017.

Denison Mines Inc. and Rio Algom Limited. Serpent River Watershed Monitoring Program 2018 Annual Water Quality Report. (Rio Algom Limited and Denison Mines Inc.) March 2019.

APPENDIX I
Summary of Cycle 4 Changes

Table 5.1: Cycle 4 TOMP substances and frequency of data collected (2015 to 2019)

Denison Mines

			Parameters and Frequencies[a]												
TMA	TOMP Stations	Station Type/Purpose	Elevation	Flow	pH	Conductivity	Sulphate	Total Radium-226	Lime or NaOH Consumption	Barium Chloride Consumption	TSS	Acidity	Iron	SAMP Metals[b]	Change
Denison	D-1[g]	Basin performance (primary), ETP operations	W	D	M		Q	M	M	M		Q		Q	Flow W to D; pH D to M
	D-22[g]	ETP operations			W		Q	M		M		Q		Q	
	D-3[g]	Effluent		W[c]	W		M	W			W			M[c]	Flow D to W
	D-2[g]	Effluent		W[c]	W		M	W			W			M[c]	Flow D to W
	D-25	Basin performance (secondary)			S		S	S				S	S		
	BH91-D1A,B, BH91-D3A,B, BH91-DG4B, BH91-D9A	Groundwater			A		A					A	A		
Stanrock	DS-2[g]	Basin performance (primary), ETP operations		D	M		Q	M	M	M		Q		Q	pH D to M
	DS-3[g]	ETP operations			D										
	DS-4[g]	Effluent		W[c]	W		M	W			W			M[c]	
	DS-1[g]	Additional pH control, radium monitoring		W	W			Q							
	DS-6[g]	Additional pH control		W	W										
	DS-5	Seepages and surface water internal to TMA		Q	Q	Q									
	PN-ST3-P3,5,6,8; BH91-SG2A,D	Porewater			A		A					A	A		
	BH91-SG1A, BH98-16A, BH98-15A, BH91-SG3A,B	Groundwater			A		A					A	A		

[a] D - Work days, W - Weekly, M - Monthly, S - Semi-annually, A - Annually, Q-Quarterly.

[b] SAMP metals are barium, cobalt, iron, manganese and uranium.

[c] Monitoring requirement of SAMP.

[e] Spanish-American.

[f] During the snow-free period (April - November).

[g] Sampled when treatment plant is operating.

Table 5.2: Cycle 4 SAMP stations, parameters and frequencies (2015 to 2019)

TMA	Location	Type	Description	Frequency[a]						Change
				Flow	pH	Sulphate	Radium-226	SAMP metals[b]	Toxicity[c]	
Denison	D-2[d,e]	Primary	Stollery Lake Outlet	W	W	M	M	M	S	flow D to W
	D-3[d,e]	Primary	TMA-2 Effluent at Denison Mine access road	W	W	M	M	M		flow D to W
	D-9	Seepage	Seepage at Dam 17	Q	Q	Q	Q	Q		none
	D-16	Seepage	Seepage at Dam 9	Q	Q	Q	Q	Q		none
Stanrock	DS-4	Primary	Orient Lake Outlet (Final Point of Control)	W	W	M	M	M	S	none
	DS-16	Drainage	Quirke Lake Delta	Q	Q	Q	Q	Q		none
Reference	SR-16	Reference	Fox Creek at Highway 108		Q	Q	Q	Q		
	SR-17	Reference	Unnamed Creek from Lake Three at Highway 108		Q	Q	Q	Q		

[a] D =daily, W = weekly, M = monthly, Q = quarterly, S = semi-annual (twice per year).

[b] SAMP metals - barium, cobalt, iron, manganese, uranium.

[c] Toxicity includes: acute (*Daphnia magna* and rainbow trout) and sub lethal (*Ceriodaphnia dubia*) testing following Environment Canada (2000 and 2007 a, b) methods.

[d] This station is also TOMP effluent station and requirements have been harmonized to serve both programs.

[e] Sampled when treatment plant is operating.

[f] P-14 will revert to P-36 upon ETP shut down.

[g] Flow is based on influent flow to the ETP at P-13.

March 9, 2016
via e-mail

Karina Lange
Project Officer for Wastes and Decommissioning Division
Canadian Nuclear Safety Commission
280 Slater Street
P.O. Box 1046, Station B
Ottawa, ON, K1P 5S9

Dear Ms. Lange:

Re: Serpent River Watershed Cycle 4 State of the Environment Report

Denison Mines Inc. (DMI) and Rio Algom Limited (RAL) are pleased to submit the Serpent River Cycle 4 State of the Environment (SOE) Report (2010 to 2014). The report presents and integrates the monitoring data obtained through the Elliot Lake closed mines monitoring programs, namely the Serpent River Watershed Monitoring Program (SRWMP), the Source Area Monitoring Program (SAMP) and the TMA Operational Monitoring Program (TOMP). The report covers the period of January 1, 2010 to December 31, 2014 although historical data has been considered for trend analysis.

This report represents the completion of the fourth cycle of the SRWMP. A complete list of all study design and interpretive reports prepared since the start of Cycle 1 is provided in Table 1. This table also summarizes the time frame covered for each cycle and the key changes to each of the monitoring programs over time.

We are also distributing this Cycle 4 State of the Environment Report to the members of the Joint Regulatory Review Group (JRG; distribution attached). We look forward to your review of the report and the opportunity to address and any questions or comments you may have.

Yours very truly,

Denison Mines Inc.

Ian Ludgate,
Manager

Rio Algom Limited

Debbie Berthelot,
Reclamation Manager

cc: Distribution List

Table 1: Summary of the Elliot Lake monitoring programs; documents produced and changes to the programs during each cycle.

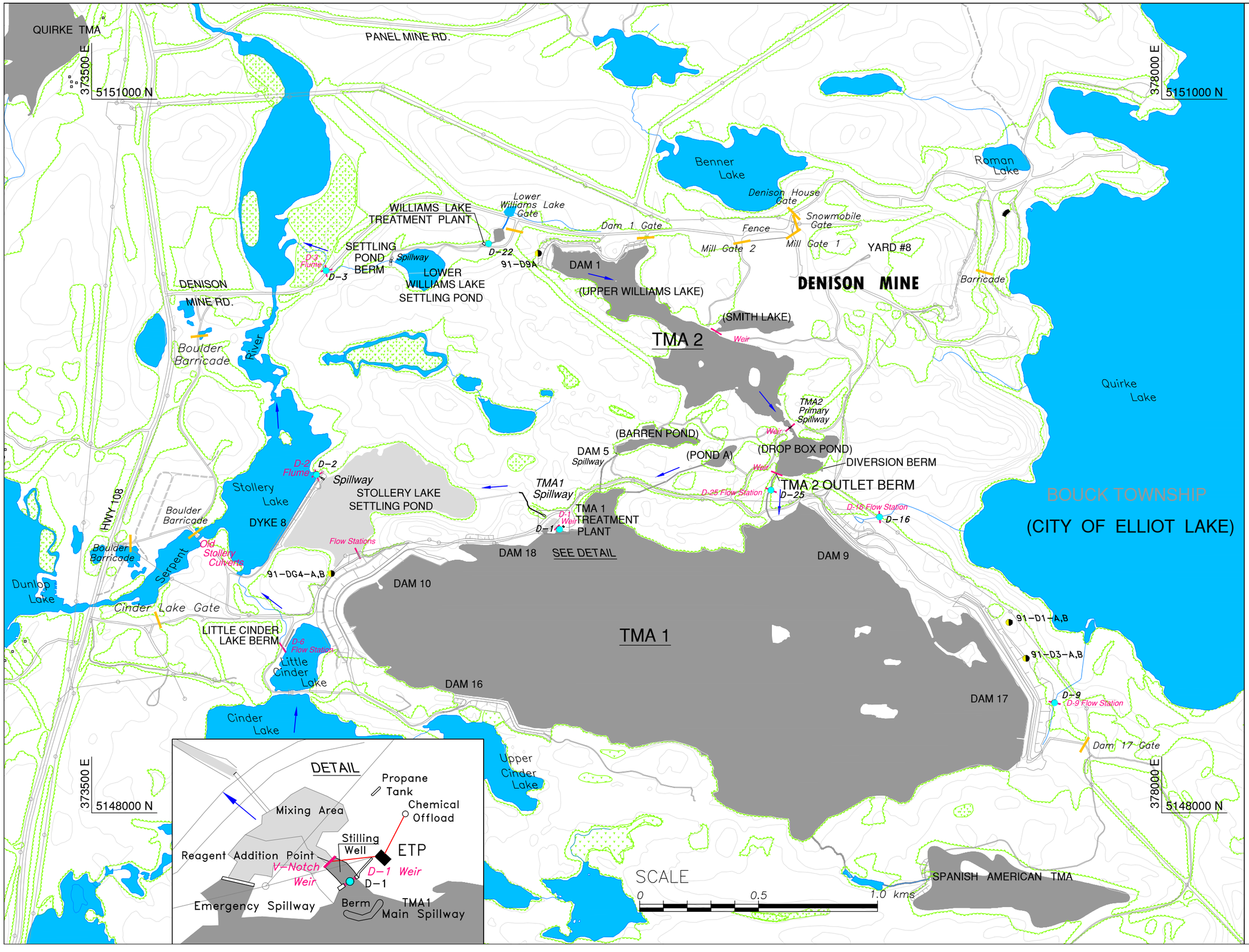
Cycle	Report Title	Year	Period Covered	Description Of Changes To The Monitoring Programs Within Each Cycle
Cycle 1	Serpent River Watershed Monitoring Program Framework Document.	1999	historical monitoring data	SRWMP, IBMP, SAMP and TOMP were developed based on program objectives and existing monitoring 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 - 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 -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, Ra-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); - 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 Interpreative 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- 2009	**IBMP** eliminated based on objectives of program being achieved. **SAMP and TOMP:** - removal of silver, selenium based on performance and removal of conductivity based on redundancy with sulphate; - 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; - 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 - 2014	Minor changes to SAMP and TOMP. **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; - 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		

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

APPENDIX II
Site Maps, Sampling Requirements

Denison Mines Inc.
Denison
SAMPLE LOCATION MAP

Rev. 2016-00
March 2016



Legend

- water covered tailings.
- settling ponds.
- surface water sample location.
- groundwater sample location.
- flow direction.
- roads or trails.
- power line.
- flow station or weir.
- pipeline.
- gate.
- wetlands.

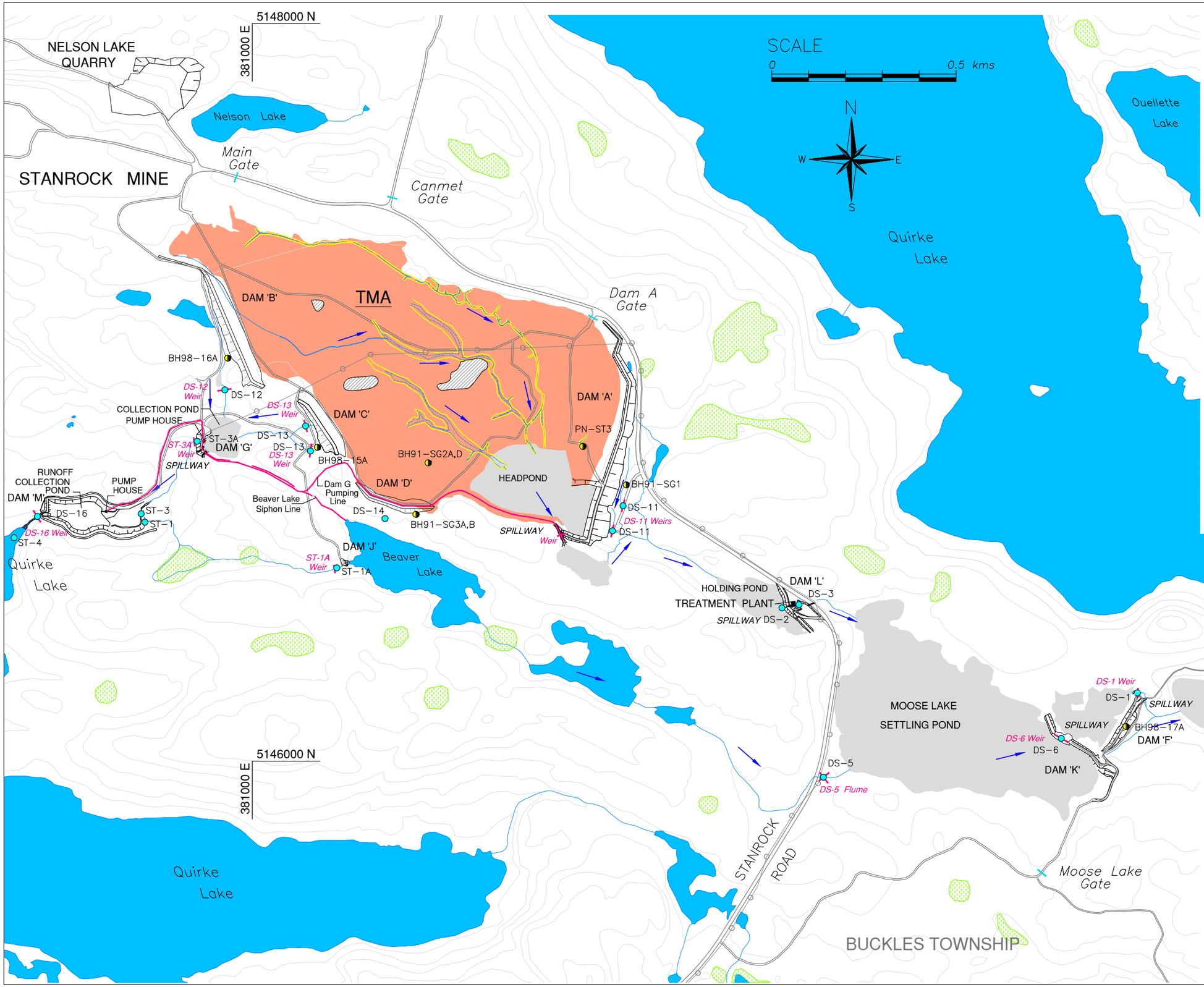
Notes

- OBM © Queens Printer for Ontario, 2008.
- Mine structures and property limits were derived from Denison Mines records.
- Mapping export parameters = NAD83 WGS_1984_UTM Zone_17N (Central Meridian = 81°W).
- Contour Interval = 10 metres.
- File 9.3.2 (Sample Location Map).

Issued on: _____

Issued by: _____

Denison Responsible Authority



Denison Mines

Denison Mines Inc.
Stanrock Site
SAMPLE LOCATION MAP

Rev. 2016-00
March 2016

Legend

- vegetated tailings.
- collection or settling ponds.
- surface water sample location.
- groundwater sample location.
- flow direction.
- roads or trails.
- power line.
- siphon line.
- pipeline.
- wetlands.
- exposed bedrock

Notes

- OBM©Queens Printer for Ontario, 2007.
- Mine structures and property limits were derived from Denison Mines records.
- Mapping export parameters = NAD83 WGS_1984_UTM Zone_17N (Central Meridian = 81°W).

Issued on: _____

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Denison Responsible Authority

Denison TOMP/SAMP
Surface Water Performance Monitoring 2018

Denison Mines

Sampling Station	Location / Description	Coordinates	Purpose	Elevation	Flow	pH	Conductivity	Sulphate	^{226}Radium (Total)	Lime or NaOH Consumption	Barium Chloride Consumption	TSS	Acidity	Hardness	SAMP METALS					Toxicity		
															Iron	Barium	Cobalt	Manganese	Uranium	Acute *Rainbow Trout*	Acute *Daphnia magna*	Chronic *Ceriodaphnia dubia*
D-1	TMA-1 Overflow	N 5149191 E 375468	TOMP	52	261	12		4	12	12	12		4		4	4	4	4	4			
D-2	TMA-1 Stollery Lake Overflow	N 5149421 E 374446	TOMP		52[a]	52		12[a]	52			52			12[a]	12[a]	12[a]	12[a]	12[a]			
D-3	TMA-2 Effluent	N 5150280 E 374485	TOMP		52[a]	52		12[a]	52			52			12[a]	12[a]	12[a]	12[a]	12[a]			
D-22	TMA-2 ETP Influent	N 5150391 E 375169	TOMP			52		4	12		12		4		4	4	4	4	4			
D-25	TMA-2 Overflow into TMA-1	N 5149357 E 376357	TOMP			2		2	2				2		2							
DS-1	Stanrock Moose Lake Outlet to Orient Lake	N 5146185 E 383401	TOMP		52	52			4													
DS-2	Stanrock ETP Influent	N 5146416 E 382437	TOMP		261	12		4	12	12[c]	12[c]		4		4	4	4	4	4			
DS-3	Stanrock ETP Effluent	N 5146424 E 382483	TOMP			261																
DS-4	Stanrock Final Discharge @ Orient Lake Outlet	N 5146327 E 383888	TOMP		52[a]	52		12	52			52			12[a]	12[a]	12[a]	12[a]	12[a]			
DS-5	Orient Creek Discharge into Moose Lake	N 5145956 E 382549	TOMP		4	4	4															
DS-6	Moose Lake Narrows upstream of Dam K	N 5146062 E 383194	TOMP		52	52																
Denison TOMP Sites Sample Subtotal					786	655	4	50	198	24	36	156	14		50	48	48	48	48			
D-2	TMA-1 Stollery Lake Overflow	N 5149421 E 374446	SAMP		52	52		12	12					12	12	12	12	12	12	2	2	2
D-3	TMA-2 Effluent	N 5150280 E 374485	SAMP		52	52		12	12					12	12	12	12	12	12			
D-9	Denison TMA-1; Dam 9 Seepage	N 5148462 E 377550	SAMP		4	4		4	4					4	4	4	4	4	4			
D-16	Denison TMA-1; Dam 17 Seepage	N 5149244 E 376814	SAMP		4	4		4	4					4	4	4	4	4	4			
DS-4	Stanrock Final Discharge @ Orient Lake Outlet	N 5146327 E 383888	SAMP		52	52		12	12					12	12	12	12	12	12	2	2	2
DS-16	Stanrock TMA; Dam M Seepage; Quirke Lake Delta	N 5146663 E 380417	SAMP		4	4		4	4					4	4	4	4	4	4			
SR-16	Reference - Fox Creek at Highway 108		SAMP			4		4	4					4	4	4	4	4	4			
SR-17	Reference - Unnamed Creek from Lake Three at Highway 108		SAMP			4		4	4					4	4	4	4	4	4			
Denison SAMP Sites Sample Subtotal					168	176		56	56					56	56	56	56	56	56	4	4	4
Denison Total Samples					954	831		106	254	24	36	156	14	48	106	104	104	104	104	4	4	4
FB	Field Blank							12	12			12		4	12	12	12	12	12			
BS	Blind Sample							12	12			12		4	12	12	12	12	12			

[a]Monitoring requirement of SAMP (Minnow Environmental Inc., 2016)

[b]This station is also a TOMP effluent station and requirements have been harmonized to serve both programs (Minnow Environmental Inc., 2016)

[c]Values captured under DS-3

Stanrock C of A
Performance Monitoring 2018

Sampling Station	Location / Description	Coordinates	Purpose	Flow	pH	Conductivity	Sulphate	^{226}Radium (Total)	Acidity	Alkalinity	Hardness	DOC	SAMP METALS				
													Iron	Barium	Cobalt	Manganese	Uranium
DS-11	Seepage of Dam A	N 5146624 E 381977 N 5146692 E 382006	MOE	4	4	4											
DS-12	Seepage of Dam B	N 5147007 E 380926	MOE	4	4	4											
DS-13	Seepage of Dam C	N 5146909 E 381145 N 5146841 E 381158	MOE	4	4	4											
DS-14	Seepage of Dam D	N 5146658 E 381360	MOE	4	4	4											
DS-18[A]	Halfmoon Lake Outlet	N 5145050 E 383761	MOE	4	4		4	4					4	4	4	4	4
ST-1	Downstream of Dam G	N 5146648 E 380709	MOE		4	4											
ST-1A	Dam J at toe of dam	N 5146524 E 381229	MOE	4	4	4											
ST-3	Downstream of Dam G	N 5146671 E 380699	MOE		4	4											
ST-3A	Dam G at toe of dam	N 5146867 E 380850	MOE	4	4	4											
ST-4	Within Quirke Lake Delta	N 5146606 E 380354	MOE		4	4	4	4	4	4	4	4	4	4	4	4	4

[A]Station is part of the SRWMP and the data is provided and discussed in detail in the SRWMP Annual Water Quality Report

Denison Groundwater
Performance Monitoring 2018

Denison Mines

Sampling Station	Location / Description	Coordinates	Type	Purpose	Elevation	Sulphate	pH	Acidity	Iron
BH91-D1	Dam 17 North Abutment	N 5148801 E 377359	Groundwater (2 wells)	TOMP	2	2	2	2	2
BH91-D3	Dam 17 North Valley, Toe	N 5148649 E 377430	Groundwater (2 wells)	TOMP	2	2	2	2	2
BH91-D9	Dam 1 North Ridge, Toe	N 5150352 E 375379	Groundwater (1 well)	TOMP	1	1	1	1	1
BH91-DG4	Below Dam 10	N 5149006 E 374508	Groundwater (1 well)	TOMP	1	1	1	1	1
BH91-SG2	Upstream of Dam D	N 5146809 E 381477	Porewater (2 wells)	TOMP	2	2	2	2	2
PN-ST3	Upstream of Dam A	N 5146853 E 381897	Porewater (4 wells)	TOMP	4	4	4	4	4
BH91-SG1	Downstream of Dam A	N 5146749 E 382014	Groundwater (1 well)	TOMP	1	1	1	1	1
BH91-SG3	Downstream of Dam D	N 5146669 E 381444	Groundwater (2 wells)	TOMP	2	2	2	2	2
BH98-15	Downstream of Dam C	N 5146851 E 381177	Groundwater (1 well)	TOMP	1	1	1	1	1
BH98-16	Downstream of Dam B	N 5147093 E 380933	Groundwater (1 well)	TOMP	1	1	1	1	1

APPENDIX III
Flagged Data & QA/QC Results

Denison Mines Inc.

SAMP/TOMP Flagged Data
2018

Location	Analyte	Date	Low	Hi	Result		Comment
D-2	Ra	2018-01-30	0	0.343	0.357	Bq/L	Result is above the high flag limit but still consistent with previous values in the last five years.
DS-1	Ra	2018-01-09	0	0.052	0.053	Bq/L	Result is only slightly above the high flag limit. Will continue to monitor at the current quarterly frequency.
D-2	Ra	2018-02-20	0	0.389	0.405	Bq/L	Results are above the high flag limits but consistent with seasonal spikes observed in the past five years. Operational adustments in flow and BaCl2 addition rates reduced concentrations to 0.199 Bq/L within two weeks.
	Ra	2018-02-27	0	0.389	0.390	Bq/L	
D-2	Ra	2018-03-06	0	0.419	0.422	Bq/L	Result is slightly above the high flag limit but consistent with previous values in the last five years. Operational adjustments made in response, however, decreased concentrations to 0.289 Bq/L by the following week. The monthly mean remained well below the discharge compliance limit of 0.37 Bq/L at 0.274 Bq/L.
D-3	U	2018-03-13	0	0.00777	0.0087	mg/L	Result is slightly above the high flag limit but consistent with previous values in the last five years.

Denison Mines Inc.

SAMP/TOMP Flagged Data
2018

Location	Analyte	Date	Low	Hi	Result		Comment
D-3	U	2018-04-10	0	0.00999	0.0118	mg/L	Result is slightly above the high flag limit but still consistent with previous values over the last five years.
DS-2	Fe	2018-04-12	3.94	73.4419	81.9	mg/L	Result is slightly above the high flag limit but still consistent with previous values over the last five years.
DS-3	pH	2018-04-27	10.3	11.2511	9.6		Result is below the low flag limit but consistent with operational adjustments made in response to a sudden increase in flow during ice cover conditions to ensure pH control in the final discharge.
D-16	FLOW	2018-05-08	0	1.5	3.2	L/s	Result is slightly above the high flag limit, but consistent with seasonal values during Spring freshet.

Denison Mines Inc.

SAMP/TOMP Flagged Data
2018

Location	Analyte	Date	Low	Hi	Result		Comment
D-2	Ba	2018-05-01	0	0.730	0.742	mg/L	Result is a historic high, but consistent with the increased barium chloride addition rates that were required, temporarily, to treat elevated radium concentrations.
	hard	2018-05-08	139.0	414.9	123.0	mg/L	Result is a historic low, but consistent with a gradually decreasing trend. Will continue to monitor at the current monthly frequency.
D-9	pH	2018-05-08	6.7	7.2	7.4		Result is a historic high, confirmed by repeat measurement, but is only slightly above the high flag limit. Will continue to monitor at the current quarterly frequency.
DS-1	pH	2018-05-09	6.6	8.1	8.8		Result is above the high flag limit, but consistent with seasonal values during periods of heavy rain and snowmelt. Operational adjustments made upstream decreased pH to 7.9 the following day.

Denison Mines Inc.

SAMP/TOMP Flagged Data
2018

Location	Analyte	Date	Low	Hi	Result		Comment
DS-4	Co	2018-05-08	0.0003	0.00081	0.0012	mg/L	Result is slightly above the high flag limit, but still consistent with previous values in the last five years.
	Fe	2018-05-08	0	0.44	0.59	mg/L	Result is a 13-year high confirmed by repeat analysis, but consistent with slightly elevated TSS (3 mg/L). Heavy rain and high flow likely caused flushing of the upstream settling pond (DS-1) where iron is historically elevated. Iron decreases to more typical values by the following month with concentrations at 0.11 mg/L.
	hard	2018-05-08	216.5	477.5	117.0	mg/L	Results are historic lows, both confirmed by repeat analysis, but consistent with seasonal lows observed each Spring when flow is high and causes dilution.
	SO4	2018-05-08	219.9	338.4	110.0	mg/L	
	TSS	2018-05-08	0	2	3	mg/L	Result is a five year high, but consistent with high flow and seasonal values within the last five. TSS falls to <1 mg/L by the end of the month.

Denison Mines Inc.

SAMP/TOMP Flagged Data
2018

Location	Analyte	Date	Low	Hi	Result		Comment
DS-6	FLOW	2018-05-04	0	280.9	292.0	L/s	Result is slightly above the high flag limit, but consistent with seasonal values during Spring freshet.
	pH	2018-05-09	6.4	8.8	9.0		Result is slightly above the high flag limit, but consistent with seasonal values during Spring freshet.
	pH	2018-05-10	6.4	8.8	8.9		Result is slightly above the high flag limit, but consistent with seasonal values during Spring freshet.
	pH	2018-05-15	6.4	8.8	8.9		Result is slightly above the high flag limit, but consistent with seasonal values during Spring freshet.
D-22	Ra	2018-07-10	0	0.699	0.965	Bq/L	Result is above the high flag limit, but still consistent with seasonal spikes observed during hot, dry conditions and low water levels.

Denison Mines Inc.

SAMP/TOMP Flagged Data
2018

Location	Analyte	Date	Low	Hi	Result		Comment
DS-2	Ra	2018-07-10	0.070	0.300	0.73	Bq/L	Result is above the high flag limit, confirmed by repeat analysis, but still consistent with historic values. Will continue to monitor at the current monthly frequency.
DS-4	Mn	2018-07-10	0.011	0.087	0.088	mg/L	Result is slightly above the high flag limit, but still consistent with previous values in the last three years.
D-22	Ra	2018-08-14	0	1.053	1.449	Bq/L	Result is above the high flag limit, but still consistent with previous values in the last two years during hot, dry conditions and low water levels.
D-22	Ra	2018-09-11	0	1.633	1.700	Bq/L	Result is slightly above the high flag limit, but consistent with previous values in the last year and low flow.

Denison Mines Inc.

SAMP/TOMP Flagged Data
2018

Location	Analyte	Date	Low	Hi	Result		Comment
D-25	Fe	2018-10-09	0.13	0.14	0.10	mg/L	Result is slightly below the low flag limit, but still consistent with previous values in the last six years.
DS-4	U	2018-10-09	0	0.00971	0.0146	mg/L	Result is slightly above the high flag, but still consistent with previous values in the last two years.
BSDST	Co	2018-11-13	0.0003	0.00074	0.0008	mg/L	Results are slightly above the high flag limit, but still consistent with previous values in the last five years.
	U	2018-11-13	0.0046	0.04706	0.0489	mg/L	
D-2	Co	2018-11-13	0.0004	0.00064	0.0008	mg/L	Result is slightly above the high flag limit, but still consistent with previous values in the last five years.

SAMP and TOMP DATA QUALITY REPORTING
Field Blank 2018
Revision 2016-01

Registry: RC8.5.4-02

	Date	pH	TSS mg/L	Hardness mg/L	Uranium mg/L	Sulphate mg/L	Radium Bq/L	Barium mg/L	Cobalt mg/L	Iron mg/L	Manganese mg/L
Blank Criteria											
	SAMP [1]	-	-	1.0	0.001	0.2	0.01	0.01	0.001	0.04	0.004
	TOMP [1]	-	2	-	0.001	0.2	0.01	0.01	0.001	0.04	0.004
FBDST	2018.01	7.0	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.02	6.5	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.03	5.2	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.04	6.5	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.05	5.6	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.06	5.9	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.07	5.9	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.08	5.2	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.09	6.0	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.10	5.9	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.11	6.3	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
FBDST	2018.12	5.8	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
Count		12	12	12	12	12	12	12	12	12	12
# Exceedances		0	0	0	0	0	0	0	0	0	0
Average		6.0	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
Max		7.0	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002
Min		5.2	1	< 0.5	< 0.0005	< 0.1	< 0.007	< 0.005	< 0.0005	< 0.02	< 0.002

[1] SAMP and TOMP field Precision criteria taken from Table 5.2 of the Cycle 4 Study Design for SRWMP, SAMP and TOMP (Minnow, 2016)

Bold Indicates an exceedance of the Blank Criteria

SAMP and TOMP DATA QUALITY REPORTING
Field Precision 2018
Revision 2016-01

Denison Mines

Location	Date	pH	TSS	Hardness	Sulphate	Radium (total)	Uranium	Barium	Cobalt	Iron	Manganese
			mg/L	mg/L	mg/L	Bq/L	mg/L	mg/L	mg/L	mg/L	mg/L
D-2	2018.01	7.1	1	213.0	160.0	0.230	0.0241	0.451	0.0005	0.45	0.123
BSDST		7.1	1	223.0	150.0	0.216	0.0236	0.452	0.0006	0.47	0.126
variance		0%	0%	5%	6%	6%	2%	0%	18%	4%	2%
D-2	2018.02	7.2	1	272.0	140.0	0.338	0.0195	0.533	0.0005	0.57	0.144
BSDST		7.2	2	266.0	150.0	0.313	0.0184	0.535	0.0005	0.56	0.150
variance		0%	**67%**	2%	7%	8%	6%	0%	0%	2%	4%
D-2	2018.03	7.3	2	223.0	140.0	0.289	0.0196	0.454	0.0005	0.59	0.125
BSDST		7.3	1	227.0	150.0	0.288	0.0196	0.450	0.0005	0.63	0.128
variance		0%	**67%**	2%	7%	0%	0%	1%	0%	7%	2%
D-2	2018.04	7.2	2	249.0	150.0	0.126	0.0234	0.343	0.0005	0.46	0.186
BSDST		7.2	1	245.0	160.0	0.135	0.0235	0.348	0.0005	0.44	0.183
variance		0%	**67%**	2%	6%	7%	0%	1%	0%	4%	2%
D-2	2018.05	7.0	1	123.0	98.0	0.203	0.0134	0.450	< 0.0005	0.33	0.161
BSDST		7.0	1	149.0	99.0	0.204	0.0150	0.493	0.0005	0.36	0.183
variance		0%	0%	19%	1%	0%	11%	9%	0%	9%	13%
D-2	2018.06	7.3	1	203.0	170.0	0.113	0.0198	0.293	< 0.0005	0.14	0.153
BSDST		7.3	< 1	198.0	160.0	0.119	0.0206	0.286	< 0.0005	0.13	0.151
variance		0%	0%	2%	6%	5%	4%	2%	0%	7%	1%
D-2	2018.07	7.0	< 1	237.0	190.0	0.073	0.0283	0.228	< 0.0005	0.13	0.097
BSDST		7.0	1	241.0	190.0	0.100	0.0299	0.211	< 0.0005	0.12	0.147
variance		0%	0%	2%	0%	**31%**	5%	8%	0%	8%	**41%**
D-2	2018.08	7.3	1	270.0	240.0	0.038	0.0360	0.107	< 0.0005	0.08	0.116
BSDST		7.3	1	256.0	230.0	0.046	0.0347	0.100	< 0.0005	0.06	0.064
variance		0%	0%	5%	4%	19%	4%	7%	0%	**29%**	**58%**
D-2	2018.09	7.0	1	280.0	230.0	0.047	0.0357	0.079	< 0.0005	0.08	0.073
BSDST		7.0	1	288.0	230.0	0.037	0.0350	0.076	< 0.0005	0.08	0.066

SAMP and TOMP DATA QUALITY REPORTING
Field Precision 2018
Revision 2016-01

Location	Date	pH	TSS	Hardness	Sulphate	Radium (total)	Uranium	Barium	Cobalt	Iron	Manganese
			mg/L	mg/L	mg/L	Bq/L	mg/L	mg/L	mg/L	mg/L	mg/L
variance		0%	0%	3%	0%	**24%**	2%	4%	0%	0%	10%
D-2	2018.10	7.0	1	266.0	240.0	0.132	0.0467	0.107	0.0007	0.12	0.234
BSDST		7.0	1	284.0	250.0	0.133	0.0456	0.110	0.0006	0.11	0.232
variance		0%	0%	7%	4%	1%	2%	3%	15%	9%	1%
D-2	2018.11	7.3	2	303.0	250.0	0.108	0.0475	0.100	0.0008	0.17	0.238
BSDST		7.3	1	304.0	270.0	0.108	0.0489	0.089	0.0008	0.16	0.234
variance		0%	**67%**	0%	8%	0%	3%	12%	0%	6%	2%
D-2	2018.12	7.4	< 1	319.0	270.0	0.038	0.0507	0.046	0.0007	0.11	0.228
BSDST		7.4	< 1	340.0	250.0	0.049	0.0507	0.047	0.0007	0.11	0.238
variance		0%	0%	6%	8%	**25%**	0%	2%	0%	0%	4%
Count		12	12	12	12	12	12	12	12	12	12
Average		0%	22%	5%	5%	11%	3%	4%	3%	7%	12%
Max		0%	67%	19%	8%	31%	11%	12%	18%	29%	58%
Min		0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Criteria[1]		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
# Exceedances		0	**4**	0	0	**3**	0	0	0	**1**	**2**

Bold Indicates an exceedance of the field precision criteria

SAMP and TOMP DATA QUALITY REPORTING
Groundwater Field Blank
Revision 2010.01

Report Form: RF8.5.4-01

Date			Acidity	Sulphate	pHF	Iron
			mg/L as CaCO3	mg/L		mg/L
Blank Criteria		TOMP [1]	2	0.2		0.04
2018.08	FBD-GW2		**4.0**	0.1	6.5	< 0.02
2018.09	FBD-GW3		2.0	< 0.1	6.2	< 0.02
2018.09	FBD-GW4		< 1.0	< 0.1	6.5	< 0.02
Count			3	3	3	3
# Exceedances			1	0	0	0
Average			2.3	0.1	6.4	< 0.02
Max			4	0.1	6.5	< 0.02
Min			1	0.1	6.2	< 0.02

[1] Field blank criteria from Table 4.1 TMA Operational Monitoring Program (TOMP) Design (Minnow, 2002b)

Bold Indicates an exceedance of the Blank Criteria

Issued on: August 30, 2010
Expires on: August 30, 2011

SAMP and TOMP DATA QUALITY REPORTING
Groundwater Field Precision
Revision 2010.01

Registry: RF8.5.4-02

Location	Date	pHF	Sulphate	Acidity	Iron
			mg/L	mg/L	mg/L
98-15A	2018.08	6.2	2400.0	1080.0	601.00
BSD-GW2		6.2	2400.0	1190.0	576.00
variance		0%	0%	10%	4%
BH91 DG4B	2018.09	6.6	560.0	< 1.0	13.90
BSD-GW3		6.6	560.0	< 1.0	12.50
variance		0%	0%	0%	11%
BH91-SG2A	2018.09	6.4	4500.0	3140.0	1280.00
BSD-GW4		6.4	4400.0	2910.0	1320.00
variance		0%	2%	8%	3%
Count		3	3	3	3
Average		0%	1%	6%	6%
Min		0%	2%	10%	11%
Max		0%	0%	0%	3%
Criteria1		20%	20%	20%	20%
# Exceedances		0	0	0	0

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Expires on: August 31, 2010

APPENDIX IV
Water Quality Results

BSDST

Parameter Units	Flow L/s	Hardness mg/L	pH pH units	SO4 mg/L	TSS mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**-[C]**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-01	87	223	7.1	150	1	0.216	0.452	0.0006	0.47	0.126	0.0236
2018-02	87	266	7.2	150	2	0.313	0.535	0.0005	0.56	0.15	0.0184
2018-03	39	227	7.3	150	1	0.288	0.45	0.0005	0.63	0.128	0.0196
2018-04	39	245	7.2	160	1	0.135	0.348	0.0005	0.44	0.183	0.0235
2018-05	115	149	7	99	1	0.204	0.493	0.0005	0.36	0.183	0.015
2018-06	17	198	7.3	160	<1	0.119	0.286	<0.0005	0.13	0.151	0.0206
2018-07	14	241	7	190	1	0.1	0.211	<0.0005	0.12	0.147	0.0299
2018-08	9	256	7.3	230	1	0.046	0.1	<0.0005	0.06	0.064	0.0347
2018-09	9	288	7	230	1	0.037	0.076	<0.0005	0.08	0.066	0.035
2018-10	19	284	7	250	1	0.133	0.11	0.0006	0.11	0.232	0.0456
2018-11	17	304	7.3	270	1	0.108	0.089	0.0008	0.16	0.234	0.0489
2018-12	19	340	7.4	250	<1	0.049	0.047	0.0007	0.11	0.238	0.0507
Count	12	12	12	12	12	12	12	12	12	12	12
High	115	340	7.4	270	2	0.313	0.535	0.0008	0.63	0.238	0.0507
Low	9	149	7	99	<1	0.037	0.047	<0.0005	0.06	0.064	0.015
Mean	39.25	251.8	7.2	190.8	1	0.146	0.266	0.0006	0.27	0.159	0.0305
High Limit			8.5	128	10	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	11	0	0	0	0	2	0	11
Frequency	0%	0%	0%	92%	0%	0%	0%	0%	17%	0%	92%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and since the annual average for hardness for 2018 exceeds the highest hardness tested (i.e. upper bound), a site-specific assessment would be required to accurately determine the AC for sulphate at this location.

[D]PWQO for Radium (Minnow Environmental Inc., 2016)

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006)

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013)

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013)

D-1: Denison TMA-1 Overflow (Influent and ETP Operations)

Parameter Units	ACID mg/L	BaCl2(T) kg/month	ELEV m	FLOW L/s	NaOH(T) kg/month	Odays day	Hardness mg/L	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5.2/6.5[B]**	**309[C]**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-01	<1	847.2	387.07	106.55	0	31	124	7.2	78	1.257	0.063	<0.0005	0.07	0.016	0.0118
2018-02		781.9	386.99	109.64	106.6	28		7.4		2.111					
2018-03		662.7	386.93	55.94	310.6	31		7		1.061					
2018-04	<1	220	386.92	64.74	473	30	131	7.2	64	1.21	0.068	<0.0005	0.16	0.024	0.0215
2018-05		1217.2	387	144.68	661	31		7.7		1.116					
2018-06		202.48	386.88	15.2	0	12		8.5		1.434					
2018-07		0	386.76	0	0	0									
2018-08		0	386.69	0	0	0									
2018-09		0	386.64	0	0	0	112								
2018-10		0	386.68	0	0	0									
2018-11		0	386.9	0	0	0									
2018-12		0	386.93	0	0	0	138								
Count	2	12	52	362	12	12	4	12	2	7	2	2	2	2	2
High	<1	1217.2	387.09	177	661	31	138	8.5	78	2.111	0.068	<0.0005	0.16	0.024	0.0215
Low	<1	0	386.17	0	0	0	112	7	64	1.061	0.063	<0.0005	0.07	0.016	0.0118
Mean	<1	327.62	386.87	40.87	129.27	14	126.3	7.5	71	1.375	0.066	<0.0005	0.12	0.02	0.0166
High Limit							0	8.5	128	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	0	0	0	0	0	0	7	0	0	0	0	1
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	50%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average of hardness at this station for 20

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013)

D-16: Denison TMA-1 Dam 17 Seepage

Parameter Units	FLOW L/s	Hardness mg/L	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**429[C]**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-01	0.75	263	6.1	220	0.019	0.028	0.0015	1.5	1.48	<0.0005
2018-05	3.2	131	6.8	120	0.011	0.022	0.0006	0.35	0.51	<0.0005
2018-07	0.33	307	6.1	260	0.054	0.042	0.0041	12.5	5.95	<0.0005
2018-10	2	159	6.5	160	0.012	0.021	0.0005	0.75	0.601	<0.0005
Count	4	4	4	4	4	4	4	4	4	4
High	3.2	307	6.8	260	0.054	0.042	0.0041	12.5	5.95	<0.0005
Low	0.33	131	6.1	120	0.011	0.021	0.0005	0.35	0.51	<0.0005
Mean	1.57	215	6.4	190	0.024	0.028	0.0017	3.77	2.135	<0.0005
High Limit			8.5	128	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	2	3	0	0	1	3	2	0
Frequency	0%	0%	50%	75%	0%	0%	25%	75%	50%	0%
10x Lim Ex	0	0	0	0	0	0	0	1	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average of hardness at this station for 2018

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013

D-2: Denison TMA-1 Stollery Lake Settling Pond Outlet (Final Discharge)

Parameter Units	FLOW L/s	hard mg/L	pH pH units	SO4 mg/L	TSS mg/L	TOXCD IC25	TOXDM %	TOXRT %	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**429[C]**	-	-	-	-	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-01	78.6	213	7.1	160	1				0.277	0.451	0.0005	0.45	0.123	0.0241
2018-02	71.5	272	7.2	140	1				0.369	0.533	0.0005	0.57	0.144	0.0195
2018-03	44.25	223	7.3	140	2				0.274	0.454	0.0005	0.59	0.125	0.0196
2018-04	56.25	249	7.2	150	1				0.141	0.343	0.0005	0.46	0.186	0.0234
2018-05	104.2	123	7.3	98	2				0.276	0.45	<0.0005	0.33	0.161	0.0134
2018-06	22.25	203	7.4	170	1	100	0	0	0.15	0.293	<0.0005	0.14	0.153	0.0198
2018-07	13.6	237	7.2	190	1				0.074	0.228	<0.0005	0.13	0.097	0.0283
2018-08	9.5	270	7.3	240	1				0.04	0.107	<0.0005	0.08	0.116	0.036
2018-09	9	280	7.1	230	1				0.042	0.079	<0.0005	0.08	0.073	0.0357
2018-10	24.6	266	7.2	240	1				0.132	0.107	0.0007	0.12	0.234	0.0467
2018-11	18.5	303	7.3	250	1				0.079	0.1	0.0008	0.17	0.238	0.0475
2018-12	16.5	319	7.2	270	1	100	0	0	0.045	0.046	0.0007	0.11	0.228	0.0507
Count	52	12	52	12	52	2	2	2	52	12	12	12	12	12
High	115	319	7.6	270	2	100	0	0	0.422	0.533	0.0008	0.59	0.238	0.0507
Low	8	123	6.9	98	<1	100	0	0	0.029	0.046	<0.0005	0.08	0.073	0.0134
Mean	40.31	246.5	7.2	189.8	1	100	0	0	0.161	0.266	0.0006	0.27	0.157	0.0304
High Limit			8.5	128	10				1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	11	0	0	0	0	0	0	0	2	0	11
Frequency	0%	0%	0%	92%	0%	0%	0%	0%	0%	0%	0%	17%	0%	92%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average of hardness at this station for 2018

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013

D-22: Denison TMA-2 ETP (Influent and ETP Operations)

Parameter Units	ACID mg/L	BaCl2T kg/month	ODays day	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	-	**5.2/6.5[B]**	**-**	**1.0[C]**	**1.0[D]**	**0.0025[E]**	**0.49/1.69[F]**	**0.8[G]**	**0.015[H]**
2018-01	<1	53.8	31	6.6	150	0.338	0.042	0.0018	3.19	0.9	0.0008
2018-02		47.6	28	6.5		0.303					
2018-03		52	31	6.5		0.35					
2018-04	<1	46.7	30	6.5	120	0.257	0.036	0.0018	2.21	1.11	0.0014
2018-05		49.9	31	6.7		0.023					
2018-06		46.2	30	7		0.248					
2018-07	<1	49.6	31	6.6	36	0.965	0.067	0.0014	15.3	3.18	0.0048
2018-08		35.2	24	6.7		1.449					
2018-09		39.47	30	6.6		1.7					
2018-10	<1	51.5	31	6.7	66	0.083	0.019	<0.0005	0.24	0.071	<0.0005
2018-11		48.7	30	6.7		0.028					
2018-12		45.3	31	6.8		0.071					
Count	4	12	12	52	4	12	4	4	4	4	4
High	<1	53.8	31	7.1	150	1.7	0.067	0.0018	15.3	3.18	0.0048
Low	<1	35.2	24	6.5	36	0.023	0.019	<0.0005	0.24	0.071	<0.0005
Mean	<1	47.16	30	6.7	93	0.485	0.041	0.0014	5.24	1.315	0.0019
High Limit				8.5	128	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	0	1	2	0	0	3	3	0
Frequency	0%	0%	0%	0%	25%	17%	0%	0%	75%	75%	0%
10x Lim Ex	0	0	0	0	0	0	0	0	1	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]PWQO for Radium (Minnow Environmental Inc., 2016

[D]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[E]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[F]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[G]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[H]Canadian Council of Ministers of the Environment limit (CCME, 201

D-25: Denison TMA-2 Overflow into TMA-1

Parameter Units	ACID mg/L	pH pH units	SO4 mg/L	Ra Bq/L	Fe mg/L
Assessment Criteria[A]	**-**	**5.2/6.5[B]**	**-**	**1.0[C]**	**0.49/1.69[D]**
2018-04	<1	7.7	110	0.446	0.13
2018-10	<1	7.2	120	0.259	0.1
Count	2	2	2	2	2
High	<1	7.7	120	0.446	0.13
Low	<1	7.2	110	0.259	0.1
Mean	<1	7.5	115	0.353	0.12
High Limit		8.5	128	1	0.49
Lim Ex	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]PWQO for Radium (Minnow Environmental Inc., 2016

[D]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 201

D-3: Denison TMA-2 Effluent (Final Discharge)

Parameter Units	FLOW L/s	hard mg/L	pH pH units	SO4 mg/L	TSS mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**309[C]**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-01	4.6	84.3	7.2	52	1	0.137	0.37	<0.0005	0.23	0.03	0.003
2018-02	6	141	7.1	62	1	0.125	0.3	<0.0005	0.16	0.029	0.0046
2018-03	<1.00	142	7.2	75	<1	0.125	0.307	<0.0005	0.07	0.009	0.0087
2018-04	15.25	166	7.2	86	1	0.127	0.331	<0.0005	0.07	0.02	0.0118
2018-05	16	49.3	7.1	29	1	0.12	0.206	<0.0005	0.18	0.02	0.0012
2018-06	3	115	7.2	81	1	0.18	0.317	<0.0005	0.06	0.014	0.0028
2018-07	0										
2018-08	0										
2018-09	0										
2018-10	17.4	113	7.1	84	1	0.122	0.253	<0.0005	0.06	0.004	0.0056
2018-11	10.75	83.5	7.1	59	1	0.095	0.224	<0.0005	0.14	0.009	0.0028
2018-12	3.75	93.6	7.3	62	1	0.103	0.231	<0.0005	0.09	0.006	0.0025
Count	52	9	52	9	39	39	9	9	9	9	9
High	55	166	7.4	86	2	0.201	0.37	<0.0005	0.23	0.03	0.0118
Low	0	49.3	6.9	29	<1	0.083	0.206	<0.0005	0.06	0.004	0.0012
Mean	6.71	109.7	7.2	65.6	1	0.126	0.282	<0.0005	0.12	0.016	0.0048
High Limit			8.5	128	10	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average of hardness at this station for 2018

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 201

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 201

D-9: Denison TMA-1 Dam 9 Seepage

Parameter Units	FLOW L/s	hard mg/L	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**- [C]**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-01	<1.00	684	7.1	540	0.009	0.018	0.0033	1.74	1.82	0.0183
2018-05	4.5	440	7.4	300	<0.007	0.015	0.0018	0.8	0.949	0.01
2018-07	1.26	892	6.7	840	0.009	0.02	0.0047	1.17	2.75	0.0174
2018-10	2.8	506	6.9	470	0.007	0.017	0.0024	0.94	1.25	0.0109
Count	4	4	4	4	4	4	4	4	4	4
High	4.5	892	7.4	840	0.009	0.02	0.0047	1.74	2.75	0.0183
Low	<1.00	440	6.7	300	<0.007	0.015	0.0018	0.8	0.949	0.01
Mean	2.39	630.5	7	537.5	0.008	0.018	0.003	1.16	1.692	0.0141
High Limit			8.5	128	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	4	0	0	2	4	4	2
Frequency	0%	0%	0%	100%	0%	0%	50%	100%	100%	50%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and since the annual average for hardness for 2018 exceeds the highest hardness tested (i.e. upper bound), a site-specific assessment would be required to accurately determine the AC for sulphate at this location.

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 201

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 201

DS-1: Stanrock Moose Lake Settling Pond Outlet to Orient Lake Polishing Pond

Parameter Units	FLOW L/s	pH pH units	Ra Bq/L
Assessment Criteria[A]	-	**5.2/6.5[B]**	**1.0[C]**
2018-01	11.6	7.1	0.053
2018-02	5.25	7.1	
2018-03	2.5	7.1	
2018-04	53.25	7.2	0.032
2018-05	82.6	7.5	
2018-06	6.25	7.8	
2018-07	5.6	7.6	0.008
2018-08	6.5	7.5	
2018-09	8.5	7.3	
2018-10	61.2	7.3	0.015
2018-11	40.75	7.2	
2018-12	25.75	7.3	
Count	52	52	4
High	212	8	0.053
Low	0	6.8	0.008
Mean	26.92	7.3	0.027
High Limit		8.5	1
Lim Ex	0	0	0
Frequency	0%	0%	0%
10x Lim Ex	0	0	0
Frequency	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]PWQO for Radium (Minnow Environmental Inc., 2016

DS-16: Stanrock TMA, Seepage from Dam M at Quirke Lake Delta

Parameter Units	FLOW L/s	hard mg/L	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**128[C]**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-03	0									
2018-05	0.8	25.9	6.6	18	<0.007	0.01	<0.0005	0.09	0.019	<0.0005
2018-09	0									
2018-10	0.7	29.9	6.5	24	<0.007	0.01	<0.0005	0.06	0.019	<0.0005
Count	4	2	5	2	2	2	2	2	2	2
High	0.8	29.9	6.6	24	<0.007	0.01	<0.0005	0.09	0.019	<0.0005
Low	0	25.9	6.5	18	<0.007	0.01	<0.0005	0.06	0.019	<0.0005
Mean	0.38	27.9	6.5	21	<0.007	0.01	<0.0005	0.07	0.019	<0.0005
High Limit			8.5	128	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average of hardness at this station for 2018

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 201

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 201

DS-2: Stanrock ETP Influent

Parameter Units	ACID mg/L	FLOW L/s	pH pH units	SO4 mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**-**	**1.0[C]**	**1.0[D]**	**0.0025[E]**	**0.49/1.69[F]**	**0.8[G]**	**0.015[H]**
2018-01	184	74.23	3	500	0.195	0.014	0.07	44.5	1.39	0.0192
2018-02		48.95	2.9		0.165					
2018-03		28.38	2.8		0.137					
2018-04	261	92.1	2.8	650	0.13	0.014	0.0923	81.9	2.74	0.0186
2018-05		97.26	3.4		0.153					
2018-06		29.1	2.7		0.207					
2018-07	289	12.26	2.7	680	0.73	0.029	0.0803	32.6	2.4	0.0171
2018-08		0								
2018-09		0								
2018-10	190	80.74	2.8	550	0.208	0.02	0.0723	29.4	1.94	0.0202
2018-11		65.63	2.8		0.192					
2018-12		38.16	3		0.19					
Count	4	320	12	4	10	4	4	4	4	4
High	289	198	3.4	680	0.73	0.029	0.0923	81.9	2.74	0.0202
Low	184	0	2.7	500	0.13	0.014	0.07	29.4	1.39	0.0171
Mean	231	44.49	2.9	595	0.231	0.019	0.0787	47.1	2.117	0.0188
High Limit			8.5	128	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	10	4	0	0	4	4	4	4
Frequency	0%	0%	100%	100%	0%	0%	100%	100%	100%	100%
10x Lim Ex	0	0	0	0	0	0	4	4	0	0
Frequency	0%	0%	0%	0%	0%	0%	100%	100%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]PWQO for Radium (Minnow Environmental Inc., 2016

[D]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[E]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[F]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 201

[G]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[H]Canadian Council of Ministers of the Environment limit (CCME, 201

DS-3: Stanrock pH Probe Control (ETP Operations)

Parameter Units	BaCl2T kg/month	CaOT tonnes/month	NaOH(T) kg/month	Odays days	pH pH units
Assessment Criteria[A]	**-**	**-**	**-**	**-**	**5.2/6.5[B]**
2018-01	42.2	9.9	0	16	10.9
2018-02	19	4.6	0	8	10.9
2018-03	9.7	3.1	0	5	10.8
2018-04	36	11.6	0	15	10.7
2018-05	109.8	15.1	0	18	10.7
2018-06	23.68	6.48	0	7	10.8
2018-07	6	1.8	0	6	10.7
2018-08	0	0	0	0	
2018-09	0	0	0	0	
2018-10	151.3	26.1	0	24	10.8
2018-11	73.9	15.9	0	17	10.9
2018-12	7.9	11.8	0	10	10.9
Count	12	12	12	12	294
High	151.3	26.1	0	24	11.3
Low	0	0	0	0	9.6
Mean	39.96	8.87	0	11	10.8
High Limit					8.5
Lim Ex	0	0	0	0	114
Frequency	0%	0%	0%	0%	100%
10x Lim Ex	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

DS-4: Stanrock Orient Lake Polishing Pond Outlet (Final Discharge)

Parameter Units	FLOW L/s	hard mg/L	pH pH units	SO4 mg/L	TSS mg/L	TOXCD IC25	TOXDM %	TOXRT %	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**	**- [C]**	**-**	**-**	**-**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-01	20.6	278	7.1	250	1				0.047	0.097	0.0006	0.22	0.047	0.0014
2018-02	9.5	423	7.1	280	<1				0.045	0.111	0.0005	0.14	0.057	0.0021
2018-03	4.5	375	7.2	290	1				0.059	0.092	<0.0005	0.09	0.05	0.0028
2018-04	40.5	372	7.1	280	1				0.062	0.074	<0.0005	0.09	0.065	0.003
2018-05	80.6	117	6.9	110	2				0.059	0.073	0.0012	0.59	0.065	0.0006
2018-06	9.75	270	7.3	220	1	100	0	0	0.096	0.06	<0.0005	0.11	0.035	0.0027
2018-07	3	292	7	230	1				0.108	0.051	<0.0005	0.04	0.088	0.0019
2018-08	3.25	317	7.1	270	1				0.122	0.049	<0.0005	0.06	0.065	0.005
2018-09	7	312	7.1	260	1				0.138	0.039	<0.0005	0.07	0.057	0.0073
2018-10	51.4	272	7.3	250	1				0.109	0.036	<0.0005	0.13	0.037	0.0122
2018-11	42	293	7.2	270	1				0.075	0.04	<0.0005	0.14	0.024	0.0066
2018-12	21.5	324	7.3	270	1	100	0	0	0.059	0.053	<0.0005	0.15	0.03	0.005
Count	52	12	52	12	52	2	2	2	52	12	12	12	12	12
High	211	423	7.5	290	3	100	0	0	0.157	0.111	0.0012	0.59	0.088	0.0122
Low	0	117	6.8	110	<1	100	0	0	0.03	0.036	<0.0005	0.04	0.024	0.0006
Mean	25.58	303.8	7.1	248.3	1	100	0	0	0.081	0.065	0.0006	0.15	0.052	0.0042
High Limit			8.5	128	10				1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	11	0	0	0	0	0	0	0	1	0	0
Frequency	0%	0%	0%	92%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and since the annual average for hardness for 2018 exceeds the highest hardness tested (i.e. upper bound), a site-specific assessment would be required to accurately determine the AC for sulphate at this location.

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 201

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 201

DS-5: Stanrock Orient Creek Discharge into Moose Lake

Parameter Units	CONDF µmho/cm	FLOW L/s	pH pH units
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**
2018-01	191.4	2	3.6
2018-05	129.2	10.42	3.6
2018-07		0	
2018-10	188.3	10.42	3.6
Count	4	4	4
High	191.4	10.42	3.6
Low	129.2	0	3.6
Mean	169.6	5.71	3.6
High Limit	69.5		8.5
Lim Ex	3	0	3
Frequency	100%	0%	100%
10x Lim Ex	0	0	0
Frequency	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

DS-6: Stanrock Moose Lake Settling Pond Narrows, Upstream of DS-1

Parameter Units	FLOW L/s	pH pH units
Assessment Criteria[A]	**-**	**5.2/6.5[B]**
2018-01	8.8	7.3
2018-02	4.5	7.5
2018-03	3	7.4
2018-04	51	7.2
2018-05	70.2	7.7
2018-06	0	
2018-07	0	
2018-08	0	
2018-09	0	
2018-10	49.2	7.4
2018-11	41	7.4
2018-12	27.5	7.3
Count	52	52
High	176	8.9
Low	0	6.7
Mean	22.1	7.4
High Limit		8.5
Lim Ex	0	1
Frequency	0%	3%
10x Lim Ex	0	0
Frequency	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)
[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

FBDST

Parameter Units	pH pH units	Hard mg/L	SO4 mg/L	TSS mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**5.2/6.5[B]**	**-**	**128[C]**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-01	7	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-02	6.5	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-03	5.2	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-04	6.5	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-05	5.6	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-06	5.9	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-07	5.9	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-08	5.2	<0.5	<0.1	1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-09	6	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-10	5.9	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-11	6.3	<0.5	<0.1	1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
2018-12	5.8	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
Count	12	12	12	12	12	12	12	12	12	12
High	7	<0.5	<0.1	1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
Low	5.2	<0.5	<0.1	<1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
Mean	6	<0.5	<0.1	1	<0.007	<0.005	<0.0005	<0.02	<0.002	<0.0005
High Limit	8.5		128	10	1	1	0.0025	0.49	0.8	0.015
Lim Ex	9	0	0	0	0	0	0	0	0	0
Frequency	75%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)
[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)
[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average of hardness at this station for 2018
[D]PWQO for Radium (Minnow Environmental Inc., 2016
[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006
[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201
[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 201
[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Static D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)
[I]Canadian Council of Ministers of the Environment limit (CCME, 201

SR-16: Fox Creek at Highway 108 (Reference Station)

Parameter Units	Hardness mg/L	pH pH units	SO4 mg/L	TSS mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**5.2/6.5[B]**	**128[C]**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-02	9	5.5	0.9	3	<0.007	0.008	<0.0005	1.08	0.034	<0.0005
2018-05	6.4	5.6	0.7	4	<0.007	0.006	<0.0005	0.35	0.031	<0.0005
2018-08	12.4	5.4	0.2	9	<0.007	0.01	<0.0005	0.66	0.067	<0.0005
2018-11	8.2	5.2	3.1	<1	<0.007	0.007	<0.0005	0.57	0.039	<0.0005
Count	4	4	4	4	4	4	4	4	4	4
High	12.4	5.6	3.1	9	<0.007	0.01	<0.0005	1.08	0.067	<0.0005
Low	6.4	5.2	0.2	<1	<0.007	0.006	<0.0005	0.35	0.031	<0.0005
Mean	9	5.4	1.2	4	<0.007	0.008	<0.0005	0.66	0.043	<0.0005
High Limit		5.2	128	10	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	0	0	0	0	3	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	75%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average of hardness at this station for 2018

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 201

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Static D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 201

SR-17: Unnamed Creek from Lake Three at Highway 108 (Reference Station)

Parameter Units	Hardness mg/L	pH pH units	SO4 mg/L	TSS mg/L	Ra Bq/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**5.2/6.5[B]**	**128[C]**	**-**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-02	17.7	5.7	2.8	2	<0.007	0.03	0.0014	0.94	0.096	<0.0005
2018-05	11.1	5.4	2.6	3	<0.007	0.026	0.0013	0.98	0.079	<0.0005
2018-08	16.7	5.6	0.5	9	<0.007	0.032	0.0015	1.91	0.102	<0.0005
2018-11	11.3	5.4	3.6	<1	0.009	0.02	0.0008	0.47	0.048	<0.0005
Count	4	4	4	4	4	4	4	4	4	4
High	17.7	5.7	3.6	9	0.009	0.032	0.0015	1.91	0.102	<0.0005
Low	11.1	5.4	0.5	<1	<0.007	0.02	0.0008	0.47	0.048	<0.0005
Mean	14.2	5.5	2.4	4	0.007	0.027	0.0013	1.08	0.081	<0.0005
High Limit		5.2	128	10	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	0	0	0	0	0	3	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	75%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average of hardness at this station for 2018

[D]PWQO for Radium (Minnow Environmental Inc., 2016

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 201

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Static D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 201

[I]Canadian Council of Ministers of the Environment limit (CCME, 201

DS-11: Stanrock Seepage of Dam A

Parameter	CONDF	FLOW	pH
Units	µmho/cm	L/s	pH units
Assessment Criteria[A]	-	-	5.2/6.5[B]
2018-01	315.8	0.35	5.8
2018-05	392	0.9	6.4
2018-07	386	0.23	4
2018-10	355.8	0.88	6.4
Count	4	4	4
High	392	0.9	6.4
Low	315.8	0.23	4
Mean	362.4	0.59	5.7
High Limit	69.5		8.5
Lim Ex	4	0	4
Frequency	100%	0%	100%
10x Lim Ex	0	0	0
Frequency	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

DS-12: Stanrock Seepage from Dam B

Parameter	CONDF	FLOW	pH
Units	µmho/cm	L/s	pH units
Assessment Criteria[A]	-	-	5.2/6.5[B]
2018-01	405.4	0.05	4.7
2018-05	369.9	1.5	3.4
2018-07		0	
2018-10	480	0.8	4.3
Count	4	4	4
High	480	1.5	4.7
Low	369.9	0	3.4
Mean	418.4	0.59	4.1
High Limit	69.5		8.5
Lim Ex	3	0	3
Frequency	100%	0%	100%
10x Lim Ex	0	0	0
Frequency	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

DS-13: Stanrock Seepage from Dam C

Parameter	CONDF	FLOW	pH
Units	µmho/cm	L/s	pH units
Assessment Criteria[A]	-	-	5.2/6.5[B]
2018-01	610	0	6.4
2018-05	525	0.15	7
2018-07	571	0.13	6.3
2018-10	351.7	0.16	6.7
Count	4	4	4
High	610	0.16	7
Low	351.7	0	6.3
Mean	514.4	0.11	6.6
High Limit	69.5		8.5
Lim Ex	4	0	2
Frequency	100%	0%	50%
10x Lim Ex	0	0	0
Frequency	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

DS-14: Stanrock Seepage from Dam D

Parameter Units	CONDF µmho/cm	FLOW L/s	pH pH units
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**
2018-01		0	
2018-05		0	
2018-07		0	
2018-10		0	
Count	4	4	4
High		0	
Low		0	
Mean		0	
High Limit	69.5		8.5
Lim Ex	0	0	0
Frequency	0%	0%	0%
10x Lim Ex	0	0	0
Frequency	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

ST-1: Stanrock Downstream of Dam G

Parameter Units	CONDF µmho/cm	pH pH units
Assessment Criteria[A]	**-**	**5.2/6.5[B]**
2018-01	67.9	5.8
2018-05	80.6	4.4
2018-07		
2018-10	105.1	4
Count	4	4
High	105.1	5.8
Low	67.9	4
Mean	84.5	4.8
High Limit	69.5	8.5
Lim Ex	2	3
Frequency	67%	100%
10x Lim Ex	0	0
Frequency	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

ST-1A: Stanrock Seepage from Dam J at Toe of Dam

Parameter Units	CONDF µmho/cm	FLOW L/s	pH pH units
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**
2018-01			
2018-05		0	
2018-07		0	
2018-10	117.6	0.19	4
Count	4	4	4
High	117.6	0.19	4
Low	117.6	0	4
Mean	117.6	0.06	4
High Limit	69.5		8.5
Lim Ex	1	0	1
Frequency	100%	0%	100%
10x Lim Ex	0	0	0
Frequency	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

ST-3: Stanrock Downstream of Dam G

Parameter Units	CONDF µmho/cm	pH pH units
Assessment Criteria[A]	**-**	**5.2/6.5[B]**
2018-01	461.7	3.3
2018-05	368.7	3.4
2018-07	517	3.3
2018-10	872	3.4
Count	4	4
High	872	3.4
Low	368.7	3.3
Mean	554.9	3.4
High Limit	69.5	8.5
Lim Ex	4	4
Frequency	100%	100%
10x Lim Ex	1	0
Frequency	25%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

ST-3A: Stanrock Dam G at Toe of Dam

Parameter Units	CONDF µmho/cm	FLOW L/s	pH pH units
Assessment Criteria[A]	**-**	**-**	**5.2/6.5[B]**
2018-01	771	0.11	5.5
2018-05	913	0.17	4
2018-07	1870	0.24	3.6
2018-10	1098	0.13	3.7
Count	4	4	4
High	1870	0.24	5.5
Low	771	0.11	3.6
Mean	1163	0.16	4.2
High Limit	69.5		8.5
Lim Ex	4	0	4
Frequency	100%	0%	100%
10x Lim Ex	4	0	0
Frequency	100%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guideline for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

ST-4: Stanrock within Quirke Lake Delta

Parameter Units	ACID mg/L	ALK mg/L	CONDF µmho/cm	hard mg/L	pH mg/L	SO4 mg/L	Ra Bg/L	Ba mg/L	Co mg/L	Fe mg/L	Mn mg/L	U mg/L
Assessment Criteria[A]	**-**	**-**	**-**	**-**	**5.2/6.5[B]**	**128[C]**	**1.0[D]**	**1.0[E]**	**0.0025[F]**	**0.49/1.69[G]**	**0.8[H]**	**0.015[I]**
2018-02	<1	7	77.1	40.7	7	28	0.017	0.041	<0.0005	0.12	0.017	0.0014
2018-05	<1	5	60.5	23.8	6.5	17	0.018	0.021	<0.0005	0.07	0.016	0.0008
2018-08	<1	7	101.1	37.1	7.2	29	0.018	0.037	<0.0005	<0.02	0.004	0.0012
2018-11	<1	7	67.2	40.3	6.7	29	0.024	0.041	<0.0005	<0.02	0.003	0.0011
Count	4	4	4	4	4	4	4	4	4	4	4	4
High	<1	7	101.1	40.7	7.2	29	0.024	0.041	<0.0005	0.12	0.017	0.0014
Low	<1	5	60.5	23.8	6.5	17	0.017	0.021	<0.0005	<0.02	0.003	0.0008
Mean	<1	6.5	76.5	35.5	6.8	25.8	0.019	0.035	<0.0005	0.06	0.01	0.0011
High Limit			69.5		8.5	128	1	1	0.0025	0.49	0.8	0.015
Lim Ex	0	0	2	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10x Lim Ex	0	0	0	0	0	0	0	0	0	0	0	0
Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[A]Criteria are benchmarks based on the most recent federal, Ontario, or BCMOE guidelines for the protection of aquatic life or the upper limit of background concentrations (between 2003-2013), whichever is higher (Minnow Environmental Inc., 2016)

[B]The lower limit of pH is used as the benchmark to identify potential mine-related reductions in pH in the receiving environment. pH 5.2 is the receiving environment criteria used for wetland/stream locations; pH 6.5 is criteria used for lake locations (Minnow Environmental Inc., 2016)

[C]Ambient Water Quality Guidelines (BCMOE, 2013). The guideline is hardness dependent and the value calculated for this station is based on the annual average hardness at this station in 2018.

[D]PWQO for Radium (Minnow Environmental Inc., 2016)

[E]Guideline taken from the Water Quality Working Guidelines (BCMOE, 2006)

[F]Guideline taken from Environment Canada's Federal Water Quality Guidelines (Environment Canada, 2013)

[G]0.49 mg/L based on upper limit of background concentrations for lakes; 1.69 mg/L is upper limit of background concentration for wetlands (Minnow Environmental Inc., 2016)

[H]Guideline taken from the Water Quality Working Guidelines, and is hardness dependent. The value calculated for the SRWMP is based on the average hardness at Station D-6, which is the only mine-exposed station where manganese is monitored (Minnow Environmental Inc., 2016)

[I]Canadian Council of Ministers of the Environment limit (CCME, 2013)

Denison Mines Inc. Elliot Lake Division
2018 Stanrock Tailings Management Area
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BH91 SG1A 5.49 m

Parameter Units	Elevation m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	387.89	4.5	4800.0	3400	1810
2015	387.98	4.0	6200.0	3660	2810
2016	387.90	4.2	4600.0	3360	1440
2017	387.98	4.0	3800.0	3110	1600
2018	387.68	4.1	2900.0	3540	875

BH91 SG2A 33.31 m

Parameter Units	Elevation m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	400.41	6.5	4600.0	2290	1400
2015	400.78	6.5	4500.0	2200	1330
2016	400.48	6.0	4000.0	2260	1160
2017	401.22	6.3	4400.0	2450	1450
2018	400.96	6.4	4500.0	3140	1280

BH91 SG2D 4.39 m

Parameter Units	Elevation m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	404.32	No sample collected (no recharge)			
2015	404.37	No sample collected (no recharge)			
2016	404.52	No sample collected (no recharge)			
2017	404.39	No sample collected (no recharge)			
2018	404.29	No sample collected (no recharge)			

Denison Mines Inc. Elliot Lake Division
2018 Stanrock Tailings Management Area
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BH91 SG3A 8.78 m

Parameter	Elevation	Field pH	Sulphate	Acidity	Iron
Units	m	pH units	mg/L	mg/L	mg/L
2014	399.77	No sample collected (no recharge)			
2015	399.52	No sample collected (no recharge)			
2016	399.29	No sample collected (no recharge)			
2017	399.69	No sample collected (no recharge)			
2018	399.39	No sample collected (no recharge)			

BH91 SG3B 5.85 m

Parameter	Elevation	Field pH	Sulphate	Acidity	Iron
Units	m	pH units	mg/L	mg/L	mg/L
2014	399.45	No sample collected (no recharge)			
2015	399.26	No sample collected (no recharge)			
2016	398.81	No sample collected (no recharge)			
2017	399.22	3.9	1700.0	901	295.00
2018	399.01	No sample collected (no recharge)			

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BH98 15A 7.86 m

Parameter	Elevation	Field pH	Sulphate	Acidity	Iron
Units	m	pH units	mg/L	mg/L	mg/L
2014	392.24	5.9	2700.0	1240	786
2015	392.24	6.4	2700.0	1200	838
2016	392.24	6.0	2600.0	1130	626
2017	392.21	5.4	2400.0	1040	651
2018	392.24	6.2	2400.0	1080	601

BH98 16A 5.49 m

Parameter	Elevation	Field pH	Sulphate	Acidity	Iron
Units	m	pH units	mg/L	mg/L	mg/L
2014	396.28	5.9	3900.0	2050	1430
2015	395.96	6.1	4800.0	3200	1680
2016	396.15	5.7	3900.0	1880	1240
2017	396.35	5.6	4900.0	2660	2140
2018	396.43	5.7	3400.0	2060	1080

Denison Mines Inc. Elliot Lake Division
2018 Stanrock Tailings Management Area
Groundwater Performance Monitoring Results

PN ST3 P3 5.94 m

Parameter Units	Elevation m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	404.20	5.7	2300.0	954	427
2015	404.37	5.9	2500.0	1030	586
2016	404.17	5.9	2100.0	1030	589
2017	404.61	5.8	2800.0	1280	771
2018	404.25	5.9	3000.0	1560	767

PN ST3 P5 2.64 m

Parameter Units	Elevation m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	404.25	3.5	3200.0	1950	1120
2015	404.34	No sample collected (no recharge)			
2016	404.18	3.6	2800.0	2200	1070
2017	404.08	3.2	3000.0	1850	827
2018	403.85	3.4	3200.0	1700	668

PN ST3 P6 11.58 m

Parameter Units	Elevation m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	404.02	6.2	4300.0	3540	1640
2015	404.29	6.3	4700.0	3560	1770
2016	404.06	6.2	5200.0	3970	2030
2017	404.54	6.0	5400.0	4050	2370
2018	404.37	6.1	5900.0	4540	2400

PN ST3 P8 20.91 m

Parameter Units	Elevation m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	402.00	5.6	12000.0	9560	5540
2015	402.36	4.5	12000.0	10100	7020
2016	401.89	5.8	11000.0	9630	5810
2017	402.68	4.9	11000.0	9550	5480
2018	402.38	4.9	11000.0	9010	4790

Denison Mines Inc. Elliot Lake Division
2018 Denison Tailings Management Area
Groundwater Performance Monitoring Results

Station: BH91 D1A 218.00 ft

Parameter Units	Elevation[A] m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	9060.10	7.2	870.0	<1	38.8
2015	359.73	7.1	980.0	<1	33.3
2016	360.60	6.8	790.0	<1	32
2017	363.16	7.3	830.0	<1	33.6
2018	359.89	6.9	770.0	<1	22.2

[A]elevation changed from feet to meters in 2015

Station: BH91 D1B 149.20 ft

Parameter Units	Elevation[A] m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	9061.52	8.1	570.0	<1	<0.02
2015	360.16	7.7	690.0	2	0.1
2016	360.75	7.6	570.0	<1	0.02
2017	363.67	7.3	620.0	<1	1.73
2018	360.34	No sample collected (no recharge)			

[A]elevation changed from feet to meters in 2015

Station: BH91 D3A 159.00 ft

Parameter Units	Elevation[A] m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	9054.71	7.1	1800.0	266	258
2015	361.22	6.7	1800.0	278	277
2016	361.07	6.5	1800.0	223	190
2017	363.62	6.6	1600.0	176	190
2018	361.17	6.6	1700.0	209	205

[A]elevation changed from feet to meters in 2015

Station: BH91 D3B 69.00 ft

Parameter Units	Elevation[A] m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	9090.89	6.8	1800.0	405	279
2015	370.30	6.3	1500.0	277	214
2016	370.37	6.3	1300.0	245	125
2017	370.99	6.4	1400.0	215	171
2018	370.20	6.6	1500.0	204	185

[A]elevation changed from feet to meters in 2015

Denison Mines Inc. Elliot Lake Division
2018 Denison Tailings Management Area
Groundwater Performance Monitoring Results

Station: BH91 D9A 72.20 ft

Parameter Units	Elevation[A] m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	9177.41	7.4	1700.0	262	221
2015	395.62	6.3	1700.0	256	204
2016	395.64	6.3	1800.0	224	189
2017	396.25	6.6	1600.0	238	223
2018	396.04	6.6	1600.0	220	202

[A]elevation changed from feet to meters in 2015

Station: BH91 DG4B 35.80 ft

Parameter Units	Elevation[A] m	Field pH pH units	Sulphate mg/L	Acidity mg/L	Iron mg/L
2014	9054.58	6.6	580.0	<1	2.27
2015	358.02	6.3	710.0	<1	10.5
2016	358.49	6.2	700.0	<1	10.4
2017	358.40	6.2	730.0	<1	21.90
2018	358.28	6.6	560.0	<1	14

[A]elevation changed from feet to meters in 2015