Cycle 6 Study Design
For the TOMP, SAMP, and SRWMP

Prepared for:
Rio Algom Limited
Elliot Lake, Ontario
and
Denison Mines Inc.
Elliot Lake, Ontario

Prepared by:
Minnow Environmental Inc.
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Cycle 6 Study Design for the TOMP, SAMP, and SRWMP

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ACRONYMS AND ABBREVIATIONS

AECB – Atomic Energy Control Board
BC ENV / BC MOE – British Columbia Ministry of the Environment
CNSC – Canadian Nuclear Safety Commission
CRM – Certified Reference Material
CSA – Canadian Standards Association
DMI – Denison Mines Inc.
DQA – Data Quality Assessment
DQO – Data Quality Objective
ECA-ISW – Environmental Compliance Approval for Industrial Sewage Works
ECCC – Environment and Climate Change Canada
EIS – Environment Impact Statement
ERP – Environmental Response Plan
ETP – Effluent Treatment Plant
GIS – Geographic Information System
ICRP – International Commission on Radiological Protection
JRG – Joint Review Group
K-M – Kaplan – Meier
LRL – Laboratory Reporting Limit
MECP – Ontario Ministry of Environment, Conservation and Parks
QC – Quality Control
QMP – Quality Management Plan
RAL – Rio Algom Limited
SAMP – Source Area Monitoring Program
SOE – State of the Environment Report
SOP – Standard Operation Procedures
SRW – Serpent River Watershed
SRWMP – Serpent River Watershed Monitoring Program
TMA – Tailings Management Area
TOMP – Tailings Management Area Operational Monitoring Program
TSS – Total Suspended Solids
UNSCEAR – United Nations Scientific Committee on the Effects of Atomic Radiation
WSC – Water Survey of Canada
XSB – *Ex-situ* Barite

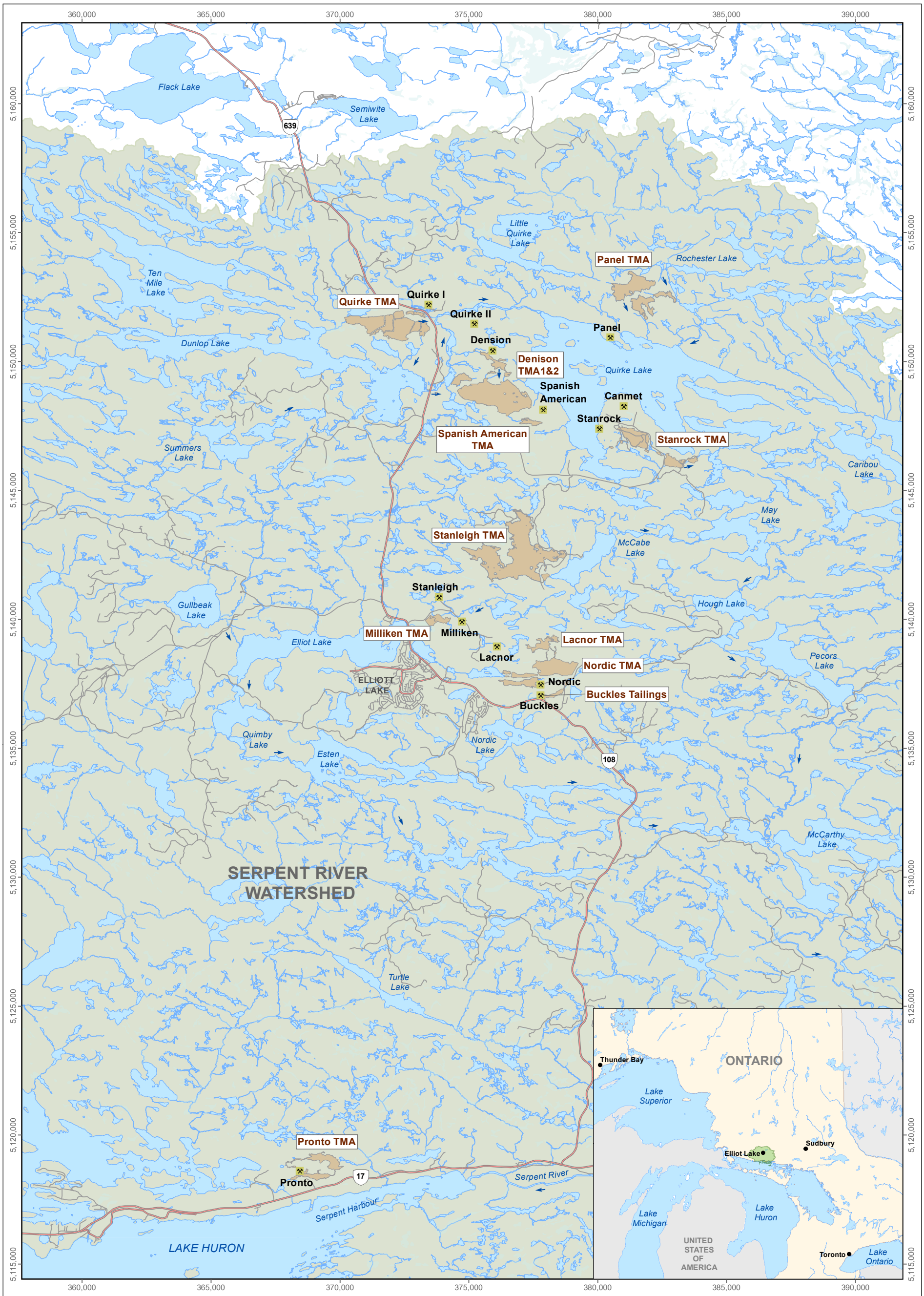
1 INTRODUCTION

1.1 Background

Uranium mining was undertaken in the Elliot Lake area of northeastern Ontario for approximately forty years. The mines generally operated from the late 1950s to the mid-1960s and again from the early 1970s until the early 1990s, when most of the mines ceased operations (Table 1.1). In total, there are eleven decommissioned mining operations located in the Serpent River Watershed (SRW; Quirke I and Quirke II, Panel, Denison, Spanish-American, Can-met, Stanrock, Stanleigh, Milliken, Lacnor, Nordic, Buckles), and one other (Pronto) is located near the north shore of Lake Huron (Figure 1.1). Associated with the mine sites are eleven decommissioned tailings management areas (TMAs) of which seven are flooded (Denison TMA-1, Denison TMA-2, Panel, Quirke, Spanish-American, Milliken, and Stanleigh) and four are vegetated (Lacnor, Nordic, Pronto, and Stanrock). Fine tailings and treatment solids were also historically deposited in Buckles Creek adjacent to the Nordic TMA and in Sheriff Creek adjacent to the Milliken mine. These areas are included within the licensed areas for the mines.

Final decommissioning and closure of the Quirke, Panel, Denison, Stanrock, and Spanish-American properties was undertaken between 1992 and 1996. The Stanleigh Mine and the historical properties (i.e., mine sites that operated in the 1950s and 1960s only; Table 1.1) were decommissioned from 1997 to 2000; in the case of the Stanleigh TMA, decommissioning was not completed until 2002 (i.e., when flooding was completed). Since closure, the TMAs have been in long-term care and maintenance that includes effluent treatment, source and watershed monitoring, and TMA care and maintenance. All of the TMAs discharge to the SRW, except the Pronto facility which discharges to the north shore of Lake Huron. The long-term care and maintenance of these sites is the responsibility of Rio Algom Limited (RAL) and Denison Mines Inc. (DMI).

As part of the closure and decommissioning process, RAL and DMI developed a focused and integrated performance monitoring framework. The comprehensive monitoring and management strategy clearly defined and delineated the purpose for all monitoring activities through three integrated programs: the TMA operational monitoring program (TOMP; Minnow 2002a), the source area monitoring program (SAMP; Minnow 2002b) and the Serpent River watershed monitoring program (SRWMP; Beak 1999a,b). These three programs allow for the effective management of the TMAs and the downstream receivers (Table 1.2). An integrated assessment of the results from these programs has previously been prepared every five years in a State of the Environment Report (SOE). Following long-term improvements in the receiving environment



LEGEND

- Mine Site
- Tailings Management Area (TMA)
- Serpent River Watershed

Serpent River Watershed and Location of Former Mines and Tailings Management Areas

0 2.5 5 10
km

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W E
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Map Projection: UTM Zone 17 NAD 1983
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Figure 1.1

Document Path: C:\Users\mlapalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure 1.1 Serpent River Watershed and Location of Former Mines.mxd

Table 1.1: Operating History, Size, and Cover Type of Elliot Lake Mines

Site[a]	Operating Period	Decommissioned	TMA Tailings			Treatment
			Quanitity[b] (million tonnes, Mt)	Area[c] (ha)	Cover (type)	
Denison	May 1957 - Apr 1992	1992 - 1998	63	280	Flooded	seasonal barium
Spanish-American	May 1958 - Feb 1959	1992 - 1996	0.45	12.3	Flooded	passive
Quirke	Sept 1956 - Feb 1961 Aug 1968 - Aug 1990	1992 - 1996	46	184	Flooded	continuous lime and barium chloride
Panel	Feb 1958 - Jun 1961 1979 - Aug 1990	1992 - 1996	16	131	Flooded	seasonal lime and barium chloride
Stanrock	Mar 1958 - Apr 1992	1992 - 1998	5.7	52.0	Vegetated	intermittent lime and barium
Stanleigh	Mar 1958 - Jun 1960 Jun 1983 - Jun 1996	1997 - 2000	20.5	370	Flooded	seasonal lime, barium chloride, and pre-formed barite
Milliken	Apr 1958 - Jun 1964	1997 - 2000	0.08[d]	23.1	Flooded	passive
Lacnor	Sept 1957 - Jul 1960	1997 - 2000	2.7	31.4	Vegetated	treatment at Nordic; includes Lacnor Pond
Nordic / Buckles[e]	Jan 1957 - Jul 1968	1997 - 2000	12	114	Vegetated	continuous lime
Pronto	Aug 1958 - 1970	1997 - 2000	4.4[f]	44.7	Vegetated	seasonal lime

Notes: Adapted from Table 5.2.2 in CNSC (2002). TMA = tailings management area.

[a] Denison Mines Inc. owns the Denison and Stanrock properties and Rio Algom Limited owns the Quirke, Panel, Spanish-American, Lacnor, Nordic, Milliken, Stanleigh, and Pronto properties.

[b] Includes treatment solids and waste rock co-deposited with tailings.

[c] Updated based on 2011 satellite image analysis.

[d] Majority of Milliken tailings (5.7 Mt) were deposited at Stanleigh TMA; the volume given is for tailings deposited in Milliken TMA only.

[e] Includes 0.04 Mt of contaminated sediment consisting of fine tailings and $Ba(Ra)SO_4$, in 10.3 ha of Buckles Creek.

[f] Includes 2.1Mt of uranium tailings and 2.3Mt of copper tailings.

Table 1.2: Current Monitoring Stations included in the SRWMP, SAMP, and TOMP

Site	Serpent River Watershed Monitoring Program (SRWMP)[a]	Source Area Monitoring Program (SAMP)	Tailings Management Area (TMA) Operational Monitoring Program (TOMP)[b]			
			Effluent Control Point	Operational Data		
				Surface	Groundwater[c]	Porewater[c]
Panel	SR-01	P-02, P-03, P-05, P-11, P-14, P-36	P-14	ECA-349, P-13, P-15, P-21, P-36	P-31, P-16 A, P-20	-
Quirke	Q-09, Q-20	ECA-398, Q-22, Q-23, Q-27, Q-28	Q-28	Q-03, Q-04P, Q-05, Cell 16S, Q-29, Cell 14, Cell 15, Cell 17	QPW1-1,4,8; 95QW-3A,C,D; 95QW-4; 95QW-5A,D	90DK-14-5 C; DK15-2 (A-D); DK15-4 (A-D); DK16-2 (A-D); DK17-2 (A-D)
Lacnor/Nordic	SC-01, SR-08	N-12	N-19	L-03, ECA-131, ECA-132, N-17, N-18, N-20, N-22, NWPH	M-12-1,3,6,9; M-13-1,3,6,9; M-14-1,3,6,9; 95N-4A,B; 95N-7A,B; 95N-11; 95N-12A,B; 95N-13A,C,E; 95N-14A,B,C; 95N-16A,C,E; 95N-17A,B,C	UW7(2,4,6); UW9(1-3)
Milliken	M-01	MPE	-	-	-	-
Stanleigh	SR-06, SR-15	CL-06	CL-06	CL-04, CL-05	SGW-3, SGW-5	-
Spanish-American	-	-	-	ECA-128	-	-
Pronto	-	LL-01, PR-01	PR-04	PR-02, PR-03	-	-
Denison	D-5, D-6	D-2, D-3, D-9, D-16	D-2, D-3	D-1, D-22, D-25	BH91-D9A; BH91-DG4B; BH91-D1A,B; BH91-D3A,B	-
Stanrock	DS-18, SR-15	DS-4, DS-16	DS-4	DS-1, DS-2, DS-3, DS-5, DS-6	BH91-SG1A; BH91-SG3A,B; BH98-16A; BH98-15A	BH91-SG2A,D; PN-ST3-P3,5,6,8
Reference	D-4, SR-16, SR-17, SR-18, SR-19	SR-16, SR-17	-	-	-	-
TOTAL STATIONS	**16[a]**	**24**	**8[b]**	**34**	**56**	**29**

Notes: "-" indicates no stations.

[a] SRWMP stations are not intended to be associated with a single source (TMA). Many stations integrate conditions from several TMAs.

[b] Includes some stations that are also identifed as SAMP stations (i.e., stations that serve multiple purposes).

[c] Number of groundwater and porewater stations represents the number of separate wells monitored (i.e ., A-C), some being monitored at multiple depths.

reported in the last cycle (Minnow 2022a) and in previous cycles (Minnow 2011, 2017), Minnow proposes to shift the SOE report to a 10-year cycle.

A central tenet of the monitoring framework for the Elliot Lake mines is that the monitoring programs (i.e., TOMP, SAMP, and SRWMP) should evolve in response to observed changes in watershed and TMA conditions (Beak 1999a,b; Minnow 2002a,b). The design for each of these programs is reviewed on a five-year cycle through the SOE, such that these programs may be modified over time in response to previous findings. Accordingly, changes were made to the Cycle 2 (Minnow 2004), Cycle 3 (Minnow 2009a,b,c,d), and Cycle 4 (Minnow 2016) programs. Recommendations from Cycle 5 (Minnow 2022a), and other modifications are proposed herein to ensure these monitoring programs remain relevant and effective (Appendix A). This study design document provides an overview of each of the monitoring programs (SRWMP, SAMP, and TOMP) together with recommended changes for future monitoring and reporting. As this study design recommends the transition to a 10-year reporting cycle, it is proposed that monitoring programs described herein will be implemented over the next 5 years and a Cycle 7 Study design will be submitted for approval in 2029 for the combined Cycle 6/7 SOE Report.

1.2 Objectives

The objective of this study design is to describe each of the TOMP, SAMP, and SRWMP, to identify any proposed monitoring program changes relative to the last study design, and to present a justification for the transition to a 10-year monitoring cycle for water quality. Proposed changes are described in detail together with a supporting rationale for each change.

2 TRANSITION TO TEN YEAR REPORTING CYCLE

2.1 Background

Since final decommissioning and closure, the 11 TMAs have been in long-term care and maintenance which has required subsequent TMA site improvements; these have been documented over time in the SOE Reports (Minnow 2022a). At the completion of the Cycle 5 SOE Report, the SOE Report series represent an approximate 20-year post-closure water quality monitoring period.

The approximate 20-year SOE dataset provides visibility into long-term water quality trends within the Serpent River Watershed. As of the completion of the Cycle 5 SOE Report, TMA basin surface water quality (TOMP) mostly showed improvements, with mine-associated parameter concentrations decreased (since closure) to near Environmental Impact Statement (EIS) predicted levels. In general, concentrations of radium-226, sulphate, and uranium are decreasing, with pH levels becoming circumneutral within the TMAs, and treated effluent discharge quality achieving discharge criteria (Minnow 2022a).

Concentrations of mine-associated parameters at the primary mine discharge locations (SAMP stations), which contributed the majority of chemical loadings to the receiving environment in Cycle 5, typically either improved or remained relatively unchanged over time. During the Cycle 5 SOE reporting period (2015 to 2019), the improvements in TMA basin surface water quality and at the Effluent Treatment Plant (ETP) discharge points were reflected in the downstream receiving environment where concentrations of barium, pH, radium-226, and uranium in grab samples of surface water were less than (or greater than for pH) the SRWMP Cycle 5 Benchmarks except for a small proportion of samples from stations D-6 and Q-09 (Minnow 2022a).

Water quality trends from the Cycle 5 SOE Report indicated that Serpent River watershed water quality has generally improved or remained stable since 2003 (Table 2.1), with the exception for concentrations of barium, iron, and radium-226 at select stations in the May Lake Sub-watershed, which is the receiver for Stanleigh and Stanrock TMAs (Minnow 2022a). However, these temporal trends have largely been associated with decreasing sulphate in the upstream source areas (i.e., Stanleigh and Stanrock) and have been addressed by minor adjustments to treatment; concentrations are all well below the SRWMP benchmarks, and do not appear to show increasing trends (see Sections 2.2.5.3 and 2.2.6.3). Overall, the SRWMP has indicated generally improving water quality at all monitoring locations over the past 20 years.

Table 2.1: **Seasonal Kendall Trend Analysis for Water Quality Parameters at TOMP, SAMP, and SRWMP Stations from 2003 to 2019, Cycle 5 State of the Environment**

Water Quality Monitoring Program	Tailings Management Area (TMA)	Station	Station Description	Seasonal Kendall Trend Analysis								
				Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	pH	Radium-226 (Bq/L)	Sulphate (mg/L)	Uranium (mg/L)
Tailings Management Area Operational Monitoring Program (TOMP)	Stanrock	DS-2	Basin Performance (Primary), ETP Operations	NS	4.20	-5.60	NS	NS	-0.200	1.70	-5.10	-6.90
	Stanleigh	CL-04	Basin Performance (Primary)	nt	NS	-15.0	-5.60	-18.0	NS	-2.40	-16.0	-8.80
	Denison	D-1	Basin Performance (Primary), ETP Operations	nt	11.0	nt	NS	NS	-0.200	8.30	-12.0	-5.10
	Quirke	Q-05	Basin Performance (Primary), ETP Influent	-22.0	-3.10	-13.0	NS	-7.20	1.80	-4.10	-2.60	-11.0
	Panel	P-13	Basin Performance (Primary), ETP Operations	nt	2.10	nt	NS	NS	0.400	-1.80	-7.20	2.80
	Pronto	PR-02	Basin Performance (Primary), ETP Influent	-7.90	NS	-3.50	NS	NS	0.800	NS	-3.30	-7.30
		PR-04	Final Treated Effluent	na	-5.4	NS	NS	-3.1	-0.700	NS	-5.20	-6.20
	Nordic/Lacnor	L-03	Basin Performance (Primary)	-7.10	NS	-3.80	-6.70	-4.50	NS	NS	-10.0	-6.80
		N-17	Basin Performance (Primary); ETP operations	NS	NS	-2.60	NS	-3.70	0.700	NS	NS	-2.00
	Spanish American	ECA-128	Basin Performance (Primary)	nt	NS	nt	NS	NS	NS	NS	-10	-6.5
Source Area Monitoring Program (SAMP)	Stanrock	DS-4[a]	Principal/Effluent	na	4.00	-7.50	NS	-1.70	-0.100	NS	-3.30	NS
	Stanleigh	CL-06[a]	Principal/Effluent	na	12.0	nt	-3.10	-14.0	-0.300	4.30	-12.0	-7.10
	Denison	D-2[a]	Principal	na	9.00	-11.0	2.50	-7.40	-0.100	NS	-8.20	-6.40
		D-3[a]	Principal	na	2.80	nt	6.70	4.10	-0.200	NS	-2.30	-7.70
	Quirke	Q-28[a]	Principal	na	1.70	-14.0	1.40	-8.20	-0.300	-1.90	-2.80	-5.80
	Panel	P-14[a]	Principal	na	10.0	nt	-13.0	-2.60	NS	NS	-7.10	NS
	Pronto	PR-01	Principal	na	-2.10	-2.50	NS	NS	NS	2.50	NS	-2.80
	Nordic	N-12	Principal	na	-2.30	-6.00	NS	NS	0.400	-2.80	-3.10	-2.90
	Milliken	MPE	Principal	na	-1.10	-5.60	NS	-2.10	NS	-3.20	-5.70	NS
Serpent River Watershed Monitoring Program (SRWMP)	Reference	D-4[b]	Dunlop Lake Outlet	na	NS	na	NS	NS	NS	nt	-3.30	nt
	Reference	SR-19[b]	Inlet to Elliot Lake	na	NS	na	NS	NS	NS	nt	-3.10	nt
	Reference	SR-18[b]	Outlet of Jim Christ Lake	na	NS	na	NS	NS	NS	nt	-4.50	nt
	Reference	SR-16[b]	Fox Creek at Hwy 108	na	NS	na	NS	NS	NS	nt	-6.40	nt
	Reference	SR-17[b]	Unnamed Creek Drain Lake 3 at Hwy 108	na	NS	na	NS	NS	1.10	nt	-5.50	nt
	Stanrock	DS-18	Halfmoon Lake Outlet	na	3.30	na	6.00	NS	-0.300	NS	-1.90	-3.60
	Stanleigh	SR-06	McCabe Outlet	na	15.0	na	na	na	NS	6.00	-13.0	-6.70
		SR-15[c]	May Lake Outlet	na	27.0	na	NS	na	NS	NS	-7.00	-3.90
	Denison	D-6	Cinder Lake Outlet	na	-1.30	na	NS	NS	NS	nt	-3.00	nt
		D-5	Serpent River between Denison and Quirke TMAs	na	NS	na	na	na	-0.300	-3.90	-4.70	-2.90
	Quirke	Q-09	Serpent River below Quirke TMA Effluent	na	NS	na	na	na	NS	-2.40	-3.20	-5.00
		Q-20	Evan Lake Outlet to Dunlop Lake	na	NS	na	NS	na	NS	nt	-2.00	nt
	Panel	SR-01	Quirke Lake	na	NS	na	na	na	NS	NS	-5.60	NS
	Nordic/Lacnor	SC-01	Westner Lake Outlet	na	NS	na	-8.20	NS	NS	-5.80	-5.10	nt
		SR-08	Nordic Lake Outlet	na	-2.00	na	na	na	NS	-5.40	-2.80	-5.30

Significant decreasing temporal trend (Seasonal Kendall test for monotonic trend at α = 0.05). Value reported is the Sen's slope reported as a percentage of the median concentration or value.

Significant increasing temporal trend (Seasonal Kendall test for monotonic trend at α = 0.05). Value reported is the Sen's slope reported as a percentage of the median concentration or value.

Notes: "nt" indicates there was not enough data to calculate a trend; "NS" indicates the trend was not significant; "na" indicates parameter not assessed for this station, as per the study design. Further description of calculations can be found in the Cycle 5 State of the Environment Report (Minnow 2022). ETP = effluent treatment plant. Hwy = highway.

[a] This station is also included in the TOMP monitoring program under the same station ID.

[b] This station is a "Reference" station and is, therefore, not directly associated with a TMA (i.e., is not downstream of a TMA).

[c] May Lake outlet station SR-15 was removed from SRWMP in 2009 but reinstated in 2014 following increasing radium-226 at the Stanleigh TMA and McCabe Lake, therefore no data are available from 2010 to 2014.

Based on environmental performance in the Serpent River watershed, the Canadian Nuclear Safety Commission (CNSC) and Ontario Ministry of Environment, Conservation, and Parks (MECP) met with RAL and DMI in January 2024 to discuss the potential transition to a 10-year reporting cycle. There was agreement that the SRWMP had successfully demonstrated improvement since decommissioning, and that future changes are expected to occur slower as source concentrations have lowered since decommissioning. In addition, environmental monitoring will continue regardless of the SOE reporting frequency and monthly and annual reports allow identification of potential negative changes in water quality. It was also noted that transition to a 10-year cycle will allow the TOMP, SAMP, and SRWMP surface water reporting to align with the SRWMP benthic and sediment data collection which is already on a 10-year reporting cycle. As an outcome of the meeting, RAL and DMI committed to preparing a Cycle 6 SOE Study Design which documents the rationale for transitioning to a 10-year reporting cycle.

2.2 Detailed Summary of Trends from Cycle 5 SOE and Discussion of Continued Monitoring Results

2.2.1 Approach

Serpent River watershed water quality has generally improved over the past 20 years (Table 2.1). However, as of the Cycle 5 SOE Report, despite significantly decreasing trends over the 20-year period, water quality at some stations may have experienced increases to various parameters over the 5-year Cycle 5 SOE reporting period. To decrease uncertainty around the potential for analytes to be increasing in the receiving environment, the five source area terms with the highest number of increasing trends (or the strongest increasing trend, when only one trend was identified as increasing) in a monitored parameter in the Cycle 5 SOE were identified to be reevaluated in the Cycle 6 Study Design. Accordingly, water quality data for select TMAs (Denison, Quirke, Panel, Stanleigh, and Stanrock) were updated with current data (2020 to 2023) as part of this study design. These TMAs were selected on the basis of significant increasing trend(s) in concentration for the Cycle 5 reporting period (2003 to 2019; Table 2.1) [1]. Stations that were evaluated in this update included the primary performance TOMP stations (effluent treatment plant influent), principal effluent SAMP station (which comprise the majority of mass loadings into the Serpent River watershed), and downstream receivers and reference stations (SRWMP stations). At TOMP, SAMP, and SRWMP stations, geochemical parameters for which trend analysis was completed in Cycle 5 have been reviewed

[1] The Pronto SAMP station PR-01 showed an increasing trend in radium-226, the ETP influent (PR-02) and treated effluent (station PR-04) showed stable concentrations over time (Table 2.1), and was not in the top five TMAs with increasing trends, based on the number of parameters with an increasing trend, or if only one, then the strongest trend (using Sen's slope; Table 2.1).

for potential changes in trend (see Tables 2.2, 2.3, and 2.4, respectively, for a list of all parameters and frequency of monitoring at stations from the associated monitoring programs). Water quality data from 2020 to 2023 for the select TMAs is provided as Appendix Tables C.1 to C.25.

2.2.2 Denison TMA – Quirke Lake Watershed

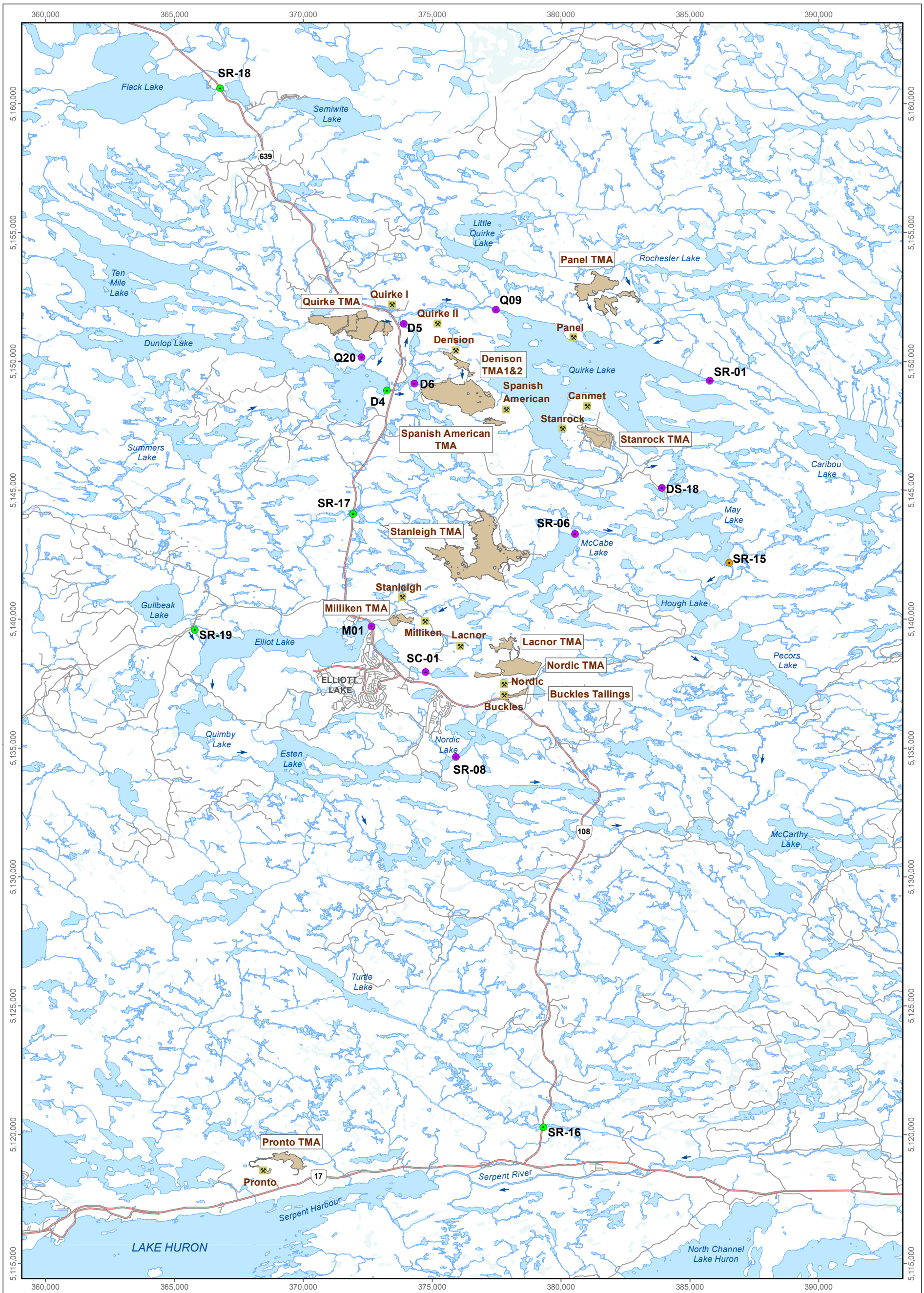
2.2.2.1 Denison TMA Basin Surface Water Quality

The Denison facility consists of a decommissioned mine and mill, two TMAs, and two ETPs; TMA 1 is the larger of the two TMAs and receives effluent/decant from TMA 2 through the TMA 2 spillway. Surface water from TMA 1 then enters the ETP on the northwest end of TMA 1, at TOMP monitoring station D-1 (Appendix Figure B.1). Treated water from the ETP flows along a channel into Stollery Settling Pond, and is monitored at the outflow of Stollery Settling Pond at the principal discharge station D-2, from here water flows into the Serpent River. At TMA 2, seepage is treated at the Williams Lake Treatment Plant that drains to the Lower Williams Lake Settling Pond prior to discharge to the Serpent River where water is monitored at station D-3. Water quality in the receiver is monitored at SRWMP stations downstream of these discharge points (station D-5; Figure 2.1; Appendix Figure B.1).

The TMA basin surface water quality, monitored at station D-1, showed significantly increasing trends in radium-226 and barium, and significantly decreasing trends in pH, sulphate, and uranium from 2003 to 2019 (Table 2.1; Minnow 2022a). Despite a significantly decreasing trend in TMA pH, conditions remained slightly basic (Appendix Figure C.6). Over the 2020 to 2023 monitoring period, sulphate, uranium, iron, and manganese remained stable or continued to decrease at station D-1 (Appendix Figures C.4, C.5, C.8, C.9); the pH of the TMA basin surface water remained stable and slightly basic (Appendix Figure C.6), and radium-226 showed stable concentrations (Appendix Figures C.7). Barium concentrations showed a mild increasing trend, with a median barium concentration at station D-1 from 2020 to 2023 of 0.0787 mg/L (Appendix Figure C.2, Appendix Table C.1) and slightly lower median barium concentrations of 0.0640 mg/L during Cycle 5 (Minnow 2022a). Although Denison TMA basin surface water showed a slight increasing trend in barium, radium-226 concentrations have stabilized in the Denison TMA; continued annual monitoring at Denison TMA-1 will identify if continued trends in increasing barium become an issue of concern.

2.2.2.2 Denison TMA Treatment Performance

Analysis conducted for the Cycle 5 SOE showed significant increases in barium, and iron and significant decreases in pH, sulphate, and uranium from 2003 to 2019 at SAMP stations D-2 and D-3; no significant trend was observed for radium-226 at these stations over this interval (Table 2.1). Cobalt showed a significantly decreasing trend at station D-2, while manganese



LEGEND

Water Quality Monitoring Location

- Mine-exposed
- Mine-exposed (not included in Cycle 6 / Cycle 7)
- Reference
- Mine Site
- Tailings Management Area (TMA)

Water Quality Monitoring Locations, SRWMP, Cycle 6/Cycle 7

0 2.5 5 10
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Map Projection: UTM Zone 17 NAD 1983
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Figure 2.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure 2.1 Water Quality Monitoring Locations, SRWMP Cycle 6 and 7.mxd

Table 2.2: Cycle 6/Cycle 7 TOMP Stations, Parameters, and Frequencies

TMA	TOMP Stations (Tailings Management Area [TMA] Operational Monitoring Program)	Station Type/Purpose	Parameters and Frequencies[a]												
			Elevation[b]	Flow	pH	Conductivity	Sulphate	Radium-226	Lime or NaOH Consumption	Barium Chloride Consumption	Sodium Sulphate Consumption	Total Suspended Solids	Acidity	Iron	SAMP Metals[c]
Denison	D-1[d]	Basin performance (primary), ETP operations	W	D	M	-	Q	M	M	M	-	-	Q	-	Q
	D-22[d]	ETP operations	-	-	W	-	Q	M	-	M	-	-	Q	-	Q
	D-3[f]	Effluent	-	W[e]	W	-	M	W	-	-	-	W	-	-	M[e]
	D-2[f]	Effluent	-	W[e]	W	-	M	W	-	-	-	W	-	-	M[e]
	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	-
Spanish-American	ECA-128	Basin performance (primary)	M	Q	Q	-	Q	Q	-	-	-	-	Q	-	Q
Quirke	Q-05[d]	Basin performance (primary), ETP operations	W	D	M	-	Q	M	M	M	-	-	Q	-	Q
	Q-03[d]	ETP operations	-	-	W	-	-	-	-	-	-	-	-	-	-
	Q-04P[d]	ETP operations	-	-	D	-	-	-	-	-	-	-	-	-	-
	Q-28[d]	Effluent	-	W[e]	W	-	M	W	-	-	-	W	-	-	M[e]
	Q-29	Perimeter monitoring	W	W[b]	-	-			-	-	-	-	-	-	-
	Cell 14, 15, 16S, 17	Basin performance (secondary)	M[d]	-	S	-	S	S	-	-	-	-	S	S	-
	90DK-14-5C; DK15-2(A-D); DK15-4(A-D); DK16-2(A-D); DK17-2(A-D)	Pore water	-	-	A	-	A	-	-	-	-	-	A	A	-
	QPW1-1,4,8; 95QW-3A,C,D; 95QW-4, 95QW-5A,D	Groundwater	-	-	A	-	A	-	-	-	-	-	A	A	-
Panel	P-13[d]	Basin performance (primary), ETP operations	W	D	M	-	Q	M	M	M	-	-	Q	-	Q
	ECA-349[d]	ETP operations	-	-	D	-	-	-	-	-	-	-	-	-	-
	P-14[d,g], P-36[d,g]	Effluent	-	W	W		M	W	-	-	-	W	-	-	M[e]
	P-15	Perimeter	-	-	-	M	-	-	-	-	-	-	-	-	-
	P-21	Basin performance (secondary)	M	-	S	-	S	S	-	-	-	-	S	S	-
	P-16A, P-20, P-31	Groundwater	-	-	A	-	A	-	-	-	-	-	A	A	-
Stanrock	DS-2[d]	Basin performance (primary), ETP operations	-	D	M	-	Q	M	M	M	-	-	Q	-	Q
	DS-3[d]	ETP operations	-	-	D	-	-	-	-	-	-	-	-	-	-
	DS-4[f]	Effluent	-	W[e]	W	-	M	W	-	-	-	W	-	-	M[e]
	DS-1[d]	Additional pH control, radium monitoring	-	W	W	-	-	Q	-	-	-	-	-	-	-
	DS-6[d]	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	Pore water	-	-	A	-	A	-	-	-	-	-	A	A	-
	BH91-SG1A, BH98-16A, BH98-15A, BH91-SG3A,B	Groundwater	-	-	A	-	A	-	-	-	-	-	A	A	-
Stanleigh	CL-04[d]	Basin performance (primary), ETP operations	W	D	M	-	Q	M	M	M	M	-	Q	-	Q
	CL-05[d]	ETP Operations	-	-	D	-	-	-	-	-	-	-	-	-	-
	CL-06[d]	Effluent	-	W[e]	W	-	M	W	-	-	-	W	-	-	M[e]
	SGW-3, SGW-5	Groundwater	-		A	-	A		-	-	-	-	A	A	-
Lacnor/Nordic	L-03	Basin performance (primary)	M	Q	Q	-	Q	Q	-	-	-	-	Q	-	Q
	N-17	Basin performance (primary), ETP operations	-	D	M	-	Q	M	M	-	-	-	Q	-	Q
	N-18	ETP operations	-	-	D	-	-	-	-	-	-	-	-	-	-
	N-19	Effluent	-	W	W	-	M	W	-	-	-	W	-	-	M
	N-22	Basin performance (secondary)	-	M[d]	S	-	S	S	-	-	-	-	S	-	S
	ECA-132	Basin performance (secondary)	M	M[b]	M[b]	-	S	S	-	-	-	-	S	-	S
	NWPH	Basin performance (secondary)	-	M[b]	S	-	S	S	-	-	-	-	S	-	S
	ECA-131, N-20	Basin performance (secondary)	-		Q	-	Q	Q	-	-	-	-	Q	-	Q
	CPW	Basin performance (secondary)	M	M[b]	M[b]	-	S	S	-	-	-	-	S	-	S
	UW7-2,4,6; UW9-1,2,3	Pore water	-		A	-	A	-	-	-	-	-	A	A	-
	M-12-1,3,6,9; M-13-1,3,6,9; M-14-1,3,6,9; 95N-4A,B; 95N-7A,B; 95N-11; 95N-12A,B; 95N-13A,C,E; 95N-14A,B,C; 95N-16A,C,E; 95N-17A,B,C	Groundwater	-	-	A	-	A	-	-	-	-	-	A	A	-
Pronto	PR-02[d]	Basin performance (primary), ETP operations	W	D	M	-	Q	M	M	M	-	-	Q	-	Q
	PR-03[d]	ETP operations	-	-	D	-	-	-	-	-	-	-	-	-	
	PR-04[d]	Effluent	-	W	W	-	M	W	-	-	-	W	-	-	M

Note: "-" indicates monitoring not required.

[a] D = work days, W = weekly, M = monthly, S = semi-annually, A = annually, Q = quarterly.

[b] When plant is operating during the snow-free period (April to November).

[c] Source Area Monitoring Program (SAMP) metals are barium, cobalt, iron, manganese, and uranium.

[d] Sampled when treatment plant is operating. Water level is collected when treatment plant is not operating at CL-04, P-13, PR-02, and Q-05.

[e] Monitoring requirement of SAMP.

[f] Sampled when flowing.

[g] P-14 will revert to P-36 if effluent treatment plant is shut down permanently or bypassing (see Appendix Table B.4).

Table 2.3: Cycle 6/Cycle 7 Source Area Monitoring Program (SAMP) Stations, Parameters, and Frequencies

Tailings Management Area (TMA)	Location	Type	Description	Parameters and Frequencies[a]						
				Flow	Hardness	pH	Sulphate	Radium-226	SAMP Metals[b]	Toxicity[c]
Denison	D-2[d,f]	Principal	Stollery Lake Outlet	W	M	W	M	M	M	S
	D-3[d,f]	Principal	TMA-2 Effluent at Denison Mine access road	W	M	W	M	M	M	-
	D-9	Seepage	Seepage at Dam 17	Q	Q	Q	Q	Q	Q	-
	D-16	Seepage	Seepage at Dam 9	Q	Q	Q	Q	Q	Q	-
Quirke	ECA-398	Seepage	Quirke II north of access road	Q	Q	Q	Q	Q	Q	-
	Q-22	Drainage	Quirke II Drainage south of access road	Q	Q	Q	Q	Q	Q	-
	Q-23	Drainage	Swamp Outlet west of Dam K1	Q	Q	Q	Q	Q	Q	-
	Q-27	Seepage	Dam J Toe Seepage	-	Q	Q	Q	Q	Q	-
	Q-28[d,e]	Principal	Final Treated Effluent	W	M	W	M	M	M	S
Panel	P-02	Seepage	Downstream of Dam B	Q	Q	Q	Q	Q	Q	
	P-03	Drainage	Beaver Pond C Outlet	Q	Q	Q	Q	Q	Q	-
	P-05	Drainage	Swamp Outlet north of Dam E	-	Q	Q	Q	Q	Q	-
	P-11	Drainage	Panel Creek Outlet at Quirke Lake	Q	Q	Q	Q	Q	Q	-
	P-14[d,e,g]	Principal	Final Treated Effluent	W	M	W	M	M	M	S
Stanrock	DS-4[f]	Principal	Orient Lake Outlet (Final Point of Control)	W	M	W	M	M	M	S
	DS-16	Drainage	Quirke Lake Delta	Q	Q	Q	Q	Q	Q	-
Stanleigh	CL-06[d,e]	Principal	Final Treated Effluent	W	M	W	M	M	M	S
Milliken	MPE	Principal	Milliken Park Effluent	-	M	M	M	M	M	S
Nordic	WL-4	Seepage	Seepage to Westner Lake from Coffer Pond	-	Q	M	Q	Q	Q	-
	N-12	Principal	Buckles Creek at Hwy. 108	M	M	M	M	M	M	S
Pronto	LL-01	Drainage	Pronto Creek at Inlet to Lake Lauzon	Q	Q	Q	Q	Q	Q	-
	PR-01	Principal	Pronto Discharge Channel at Highway 17	M	M	M	M	M	M	S
Reference	SR-16	Reference	Fox Creek at Highway 108	-	Q	Q	Q	Q	Q	-
	SR-17	Reference	Unnamed Creek from Lake Three at Highway 108	-	Q	Q	Q	Q	Q	-

Note: "-" indicates monitoring not required.

[a] D =daily, W = weekly, M = monthly, Q = quarterly, S = semi-annually (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 (2000a,b and 2007) methods.

[d] This station is also Tailings Management Area (TMA) Operational Monitoring Program (TOMP) effluent station and requirements have been harmonized to serve both programs.

[e] Sampled when effluent treatment plant (ETP) is operating.

[f] Sampled when flowing.

[g] Flow is based on influent flow to the ETP at TOMP station P-13. Monitoring at P-14 will revert to P-36 if effluent treatment plant is shut down permanently or bypassing (see Appendix Table B.4).

Table 2.4: Cycle 6/Cycle 7 Serpent River Watershed Monitoring Program (SRWMP) Water Quality Stations, Parameters, and Frequencies

Reference vs Mine-exposed	Station	Location / Description	Type	Frequency	Parameters
Reference	D-4	Dunlop Lake Outlet (Q-14)	lake	S	barium, pH, DOC, iron, manganese, radium-226, sulphate and uranium
	SR-19	Inlet to Elliot Lake		Q	
	SR-18	Outlet of Jim Christ Lake		S	
	SR-16	Fox Creek at Highway 108	wetland/ stream	Q	
	SR-17	Unnamed Creek Drain Lake 3 at Highway 108		Q	
Mine-exposed	D-6[a]	Cinder Lake Outlet	wetland	Q	barium, pH, DOC, iron, manganese, radium-226, sulphate and uranium
	DS-18	Halfmoon Lake Outlet	stream	Q	barium, pH, DOC, iron, radium-226, sulphate and uranium
	M-01	Sherriff Creek at Highway 108	stream	Q	
	SC-01	Westner Lake Outlet	stream	A	
	D-5	Serpent R between Denison & Quirke TMAs	lake	Q	barium, pH, radium-226, sulphate and uranium
	Q-09[a]	Serpent R Below Quirke TMA Effluent	lake	Q	
	Q-20	Evans Lake Outlet to Dunlop Lake	lake	A	
	SR-01	Quirke Lake Outlet	lake	A	
	SR-06	McCabe Lake Outlet	lake	S	
	SR-08[a]	Nordic Lake Outlet	lake	Q	
Total Number of Locations and Samples/Year			16	45	

Notes: Q = quarterly, S = semi-annually, A = annually. TMA = tailings management area. "DOC" = Dissolved organic carbon.

[a] Hardness monitored at D-6, Q-09, and SR-08, stations where sulphate concentrations are greater than 100 mg/L.

showed a significantly increasing trend at station D-2, and a significantly decreasing trend at D-3 (Table 2.1).

Annual tests of effluent from the Denison TMA were consistently non-lethal to *Daphnia magna* and rainbow trout from 2015 to 2019, with no mortality reported in semi-annual acute toxicity tests (Minnow 2022a). Similarly, reproduction of *Ceriodaphnia dubia* was not affected by exposure to 100% effluent over the 2015 to 2019 period (Minnow 2022a).

Over the 2020 to 2023 monitoring period, cobalt, manganese, pH, and radium-226 concentrations at discharge locations D-2 and D-3 have remained stable or decreased (Appendix Figures C.2, C.3, and to C.7). Barium concentrations increased at stations D-2 and D-3 from 2020 to 2023. Radium-226 concentrations showed one sampling event that exceeded the monthly mean discharge limit, but it was below the grab sample discharge limit and the average radium-226 for that month (July 2021; average of 0.35 Bq/L) was also below the monthly mean discharge limit (0.37 Bq/L; see Table 2.5 for discharge criteria). However, there was no observable increasing trend in radium-226 (Appendix Figure C.7 and Appendix Table C.3). The monthly mean exceedance is believed to be the result of a change in the instrumentation used to measure radium-226 and some changes in the sample preparation methodology. Prior to May 2021, radium-226 was measured using an alpha spectrometer at the Perdue Laboratory, Sudbury, ON. From May 2021 until October 2021, upon closure of the Perdue Laboratory, radium-226 was measured using an alpha counter at the TestMark Laboratory, Sudbury, ON. Discrepancies in repeatability of radium-226 analysis using the alpha counter were observed and were likely caused by radium-224 interference. Sample result concentrations were greatly reduced over a period of time after the decay of radium-224, which has a short half-life of 3.6 days[2]. The inclusion of radium-224 in the alpha count methodology accounts for the high initial results, the lower re-run results, and high relative percent difference. Radium-226 analysis was moved to SGS Laboratories, Lakefield, ON, using alpha spectrometry and since then radium-226 concentrations have been within discharge criteria (mean monthly and grab). Thus, radium-226 data collected from May 2021 to October 2021 should be interpreted with caution as the reported values are likely conflated.

At station D-2, iron, and sulphate showed minor increases in concentration in 2022 and 2023, while for station D-3, minor increases could be observed in sulphate only (Appendix Figures C.4 and C.8). In general, concentrations of iron, sulphate, and uranium remained within the range of values previously observed during Cycle 5 (Appendix Figures C.4, C.8, and C.9, respectively). Monthly mean discharge limits were not exceeded for pH at stations D-2 and D-3 and showed no

[2] The half-life of radium-226 is approximately 1,600 years.

Table 2.5: Monthly Mean and Grab Sample Effluent Discharge Criteria

Parameter	Grab Sample Discharge Criteria	Monthly Mean Discharge Criteria
Radium-226	1.11 Bq/L	0.37 Bq/L
pH	5.5 to 9.5	6.5 to 9.5
TSS	50 mg/L	25 mg/L

Note: "TSS" means Total Suspended Solids.

observable decreasing trend. With limited changes in the concentration of mine-associated parameters at the primary discharge locations (SAMP stations), water discharged to the receiving environment remained of similar quality to discharge observed during Cycle 5.

2.2.2.3 Denison TMA Receiver Water Quality

The receiving environment water quality downstream of the Denison TMA is monitored quarterly near the outlet of Cinder Lake (SRWMP station D-6; reflecting seepage from Dams 10 and 16) and in the Serpent River downstream from the Denison TMA-2 and upstream of the Quirke TMA (SRWMP station D-5; Figure 2.1). Analysis during Cycle 5 showed significant decreasing trends in pH, radium-226, sulphate, and uranium from 2003 to 2019 at D-5 and significant decreasing trends in barium and sulphate over this same interval at D-6 (Table 2.1). Water quality data at these locations generally met the SRWMP Benchmarks during Cycle 5 except for iron, manganese, and sulphate at station D-6, which exceeded the SRWMP benchmarks in less than 20% of quarterly samples collected from 2015 to 2019 (Minnow 2022a). However, these exceedances were partially a result of using “lake-type” SRWMP benchmarks for station D-6 despite its notable wetland characteristics, and from using average hardness values when screening data; correcting the benchmarks for these differences decreased the number of exceedances to less than 10% of measured samples (2 of 20 samples; Minnow 2022a). It was recommended to calculate sulphate benchmarks based on hardness for individual samples, and to screen D-6 against “wetland-type” benchmarks in the future (Minnow 2022a). For the purposes of this evaluation, SRWMP benchmarks that were derived in Cycle 5 (Minnow 2019) have been used with minor modifications. Following recommendations from the SRWMP Cycle 5 SOE, station D-6 was assessed relative to wetland benchmarks, and sulphate and manganese benchmarks were calculated based on hardness concentrations for a given water quality sample rather than using an average hardness concentration over the monitoring period (2020 to 2023).

Continued monitoring of SRWMP stations D-5 and D-6 (i.e., 2019 to 2023) showed good performance in the receiver, with most parameters remaining below Cycle 5 SRWMP Benchmarks. Iron showed minor increases concurrent with effluent discharge, but remained well below the Cycle 5 SRWMP Benchmarks (Appendix Figure C.4), while sulphate and uranium showed stable concentrations relative to the observed Cycle 5 concentrations (Appendix Figures C.8 and C.9). Radium-226 concentrations in the receiving environment remained well below the SRWMP Cycle 5 Benchmark (Appendix Figure C.7). When evaluated against SRWMP wetland-type benchmarks, pH levels at station D-6 did not exceed the benchmark. However, further downstream, SRWMP station D-5 exhibited pH levels below SRWMP benchmarks in four consecutive measurements in late 2022 and 2023

(Appendix Figure C.6). In the same period, the treated effluent from Denison TMA-1 (station D-3 which is directly upstream of station D-5), showed stable, circumneutral pH levels, as did SAMP station D-2 (treated effluent from Denison TMA-1; Appendix Figure C.7). However, a decrease in pH was observed at the upstream SRWMP reference station D-4 concurrent with the exceedances observed D-5 (Appendix Figure C.51), suggesting the decreased pH may be non-TMA related and the result of natural variability. Additionally, a beaver dam was observed immediately upstream of station D-5, which may contribute to slower flow, and increased marshland areas upstream. Increased occurrence of wetlands can result in seasonal declines in pH (e.g., McLaughlin and Webster 2010). The continued monitoring from 2019 to current indicated water quality in the receiving environment remained of acceptable quality and showed no observable increasing patterns.

2.2.3 Quirke TMA – Quirke Lake Watershed

2.2.3.1 Quirke TMA Basin Surface Water Quality

The Quirke TMA is a flooded TMA consisting of five terraced cells in a bedrock basin with lower water elevations in each cell from upstream (Cell 14) to downstream (Cell 18; Appendix Figure B.2). Basin surface water quality is monitored at the influent to the ETP, TOMP station Q-05 (Appendix Figure B.2). At station Q-05, basin water quality improved from 2003 to 2019 based on significantly decreasing trends in acidity, barium, cobalt, manganese, radium-226, sulphate, and uranium, and a significantly increasing trend in pH (Table 2.1; Minnow 2022a).

From 2020 to 2023, basin surface water quality monitoring at station Q-05 showed stable or decreasing concentrations of cobalt, iron, manganese, pH, sulphate, and uranium, but showed increasing radium-226 concentrations from 2021 to 2023 (Appendix Figures C.12 to C18). However, radium-226 concentrations remained within the range of values observed from 2010 to 2019. Total acidity in basin surface water increased in mid-2022 to 2023 relative to total acidity as $CaCO_3$, which was measured from 2020 to mid-2022 (Appendix Table C.9). These parameters are not necessarily comparable depending on the constituents in surface water that contribute to total acidity, and the observed trend may be associated with different calculations used to determine acidity. The total acidity values observed in 2022 and 2023 showed similar concentrations as those previously observed during Cycle 4 and Cycle 5, indicating basin surface water remained relatively stable over the past approximately 10 years (Appendix Figure C.10). Despite increases in radium-226 and acidity relative to Cycle 5, Quirke TMA Basin surface water shows overall stable conditions relative to long-term monitoring.

2.2.3.2 Quirke TMA Treatment Performance

Water quality of Quirke ETP treated effluent is monitored at SAMP station Q-28, which flows into the Serpent River (Appendix Figure B.2). Over the period 2003 to 2019, discharge from station Q-28 showed significantly increasing trends in barium and iron, and significantly decreasing trends in cobalt, manganese, pH, radium-226, sulphate, and uranium (Table 2.1; Minnow 2022a). Discharge from Q-28 did not exceed established criteria for pH and radium-226 for all months between 2015 and 2019 (Minnow 2022a; see Table 2.5 for discharge criteria).

Effluent from the Quirke TMA was non-lethal to *D. magna* in semi-annual acute toxicity tests and to rainbow trout, except for one rainbow trout test in June 2018, where 10% mortality was observed (Minnow 2022a). Reproduction of *C. dubia* was not affected by exposure to 100% effluent in all but one of the tests conducted over the 2015 to 2019 period (Minnow 2022a). The IC25 (effluent concentration causing 25% inhibition relative to control organisms) for this sample was 85.7%, whereas the concentration of effluent from the Quirke TMA in the Serpent River is much lower (i.e., <5%, Calder 2015). As such, effects to these invertebrates would not be expected in the receiving environment.

Continued monitoring at the ETP discharge station Q-28 from 2020 to 2023 showed that concentrations of barium, cobalt, iron, manganese, sulphate, and uranium remained stable, with a similar range in concentration to those observed during Cycle 5 (Appendix Figures C.11 to C.14, C.17, and C.18). Despite increased radium-226 concentrations in TMA basin surface water, radium-226 concentrations remained stable at the discharge point (Appendix Figure C.16), indicating continued effective performance in the treatment of TMA water prior to discharge to the receiver. Radium-226 and pH concentrations remained within the range of values observed during Cycle 5 and remained below Monthly Mean Discharge Limits (Table 2.5; Appendix Table C.7, Appendix Figures C.15 and C.16). Overall, water quality at the Quirke ETP discharge point (station Q-28) remained stable from 2020 to 2023.

2.2.3.3 Quirke TMA Receiver Water Quality

The receiving environment downstream from the Quirke TMA effluent discharge point is monitored quarterly at station Q-09, the inflow to Quirke Lake (Figure 2.1). Water quality showed significant decreases in sulphate, radium-226, and uranium concentrations at Q-09 from 2003 to 2019, indicating improving water quality conditions and water quality was below the SRWMP benchmarks (Minnow 2022a). Monitoring results from 2020 to 2023 showed continued decreasing or stable concentrations of barium and radium-226, all of which remained below the SRWMP Cycle 5 Benchmarks (Appendix Figures C.11 and C.16). In 2022 and 2023, sulphate showed a slight increase concurrent with increases in sulphate concentration observed

at the discharge location, but concentrations remained well below Cycle 5 Benchmarks (Appendix Figure C.17). Similar to other TMAs in the May and Quirke Lake watershed, pH in the receiving environment showed slightly acidic values that fell below SRWMP Cycle 5 Benchmarks in late 2022 and early 2023 at station Q-09 (Appendix Figure C.15). A possible source of low-pH water is from a toe seepage at Dam J (SAMP station Q-27) which enters Evans Lake, the outflow of which is sampled at SRWMP station Q-20. Water from Evans Lake flows into Dunlop Lake which flows into the Serpent River; Dunlop Lake outflow is monitored at station D-4 (Figure 2.1). Water quality monitored at Q-27 did not show decreased pH levels during this interval (Appendix Figure C.15). Water monitored at the outlet of Evans Lake did show a slight decrease in pH around this time frame (Appendix Figure C.15), but the downstream reference station D-4 also showed lower pH levels, further supporting that the low pH observed in the SRWMP was associated with natural variability rather than mine-influence (Appendix Figure C.51).

Additionally, BHP conducted a shoreline study of the north end of Evans Lake in 2023 to assess the effects of seepage through Dam J on adjacent water quality in Evans Lake. Results found that a combination of physical and chemical attenuation within subsurface soils between Dam J and the Evans Lake shoreline, and the assimilative capacity of Evans Lake, was sufficient for maintaining acceptable water quality in Evans Lake for the protection of fish and aquatic life (Minnow 2023). Water quality in the receivers of Quirke Lake TMA (i.e., SRWMP stations Q-09 and Q-20) showed overall acceptable water quality, with conditions remaining stable or improving relative to Cycle 5.

2.2.4 Panel TMA – Quirke Lake Watershed

2.2.4.1 Panel TMA Basin Surface Water Quality

The Panel TMA is composed of two bedrock-rimmed basins, including the Main Basin which, controlled by stoplogs, drains into the South Basin (Appendix Figure B.3). The Panel South Basin water quality is monitored at the ETP influent (station P-13). Analysis of trends in mine-associated parameters from 2003 to 2019 at station P-13 showed significant decreases in radium-226 and sulphate concentrations and significantly increasing trends in pH, barium, and uranium (Table 2.1). Although barium concentrations showed an increasing trend, concentrations remained low (less than 0.1 mg/L) through the entire monitoring period (Appendix Figure C.20; Appendix Table C.11).

From 2020 to 2023, Panel South Basin surface water quality monitoring (station P-13) showed continued decreasing or stable concentrations of barium, cobalt, iron, manganese, radium-226, and sulphate (Appendix Figures C.20 to C.27). Acidity in Panel TMA basin surface

water has remained stable, below detection, from 2006 to 2023 (Appendix Figure C.19). These results indicated continued improvements in Panel TMA basin surface water.

2.2.4.2 Panel TMA Treatment Performance

Effluent from the Panel ETP is discharged into settling ponds to allow the settling of treatment solids; the principal discharge point is monitored at the outflow of the settling ponds, station P-14 (Appendix Figure B.3). From 2003 to 2019, iron, manganese, and sulphate at station P-14 significantly decreased and barium significantly increased; no significant trend was observed in pH, radium-226 or uranium concentrations at this station (Table 2.1). Radium-226 and pH remained below (or above for pH) monthly mean discharge criteria in samples collected from 2015 to 2019, indicating good water quality and successful treatment of TMA water (Minnow 2022a; see Table 2.5 for discharge criteria).

Treated effluent from the Panel facility was non-lethal to rainbow trout in all semi-annual acute toxicity tests conducted over the 2015 to 2019 period, whereas one test (October 2019) resulted in minimal mortality (3.3%) to *D. magna* (Minnow 2022a). Similarly, reproduction of *C. dubia* was not affected by exposure to 100% effluent in all but one test (October 2019), when the IC25 equaled 68.9% (Minnow 2022a). Overall, Panel TMA discharge showed acceptable quality during Cycle 5.

For the 2020 to 2023 period, water quality monitoring at the principal discharge point (station P-14) showed continued improvements in surface water quality. Concentrations of cobalt, iron, and manganese continued to decrease, and pH remained stable and slightly basic (Appendix Figures C.21, to C.24). From 2017 to 2020 radium-226 concentrations remained stable, while barium concentrations increased (Appendix Figures C.20 and C.25), at which point, both barium and radium-226 concentrations decreased; this was associated with an improvement in treatment associated with improving the mixing of reagents in the mixing channel by installing a new agitator, and adjusting barium chloride dose. Neither radium-226, nor pH exceeded the SRWMP Cycle 5 Monthly Mean Discharge Benchmarks (Table 2.5; Appendix Table C.12, Appendix Figures C.33 and C.34). Overall water quality at the principal discharge point of Panel TMA continued to show improvements over the 2020 to 2023 period.

2.2.4.3 Panel TMA Receiver Water Quality

Treated water from the Panel ETP flows from station P-14 along Effluent Creek into Quirke Lake (Appendix Figure B.3). Quirke Lake also receives water from the principal discharge points and seepage from the Denison and Quirke TMAs, and surface water from the Stanrock TMA from drainage point DS-16 (Appendix Figure B.5). Quirke Lake water quality is measured downstream of all these locations at the outflow of Quirke Lake (SRWMP station SR-01; Figure 2.1).

During Cycle 5, analysis showed a significantly decreasing trend in sulphate concentrations from 2003 to 2019, but no other significant trends were observed and all mine-associated parameters remained less than SRWMP benchmarks (Table 2.1; Minnow 2022a).

For the 2020 to 2023 period, water quality at station SR-01 continued to show low, stable concentrations of barium, radium-226, and sulphate (Appendix Figures C.20, C.25, and C.26). Similar to observations at upstream SRWMP locations (Q-20, D-4, D-5, Q-09), pH in late 2022 fell below the lower limit of the Cycle 5 SRWMP Benchmark for pH (Appendix Figure C.24). Based on comparison to reference areas (stations D-4 and SR-19; Appendix Figure C.51), and the lack of a corresponding decrease at principal TMA discharge points, this decrease in pH was likely associated with regional environmental conditions. Overall, water quality in the receiving environment downstream of the Panel TMA remained of acceptable quality over the 2020 to 2023 period.

2.2.5 Stanleigh TMA – May Lake Sub-Watershed

2.2.5.1 Stanleigh TMA Basin Surface Water Quality

Surface water quality from the Stanleigh TMA basin is monitored at the primary ETP influent location (TOMP station CL-04; Appendix Figure B.4). From 2003 to 2019, concentrations of cobalt, iron, manganese, radium-226, sulphate, and uranium at station CL-04 significantly decreased (Table 2.1). In addition to the observed trends, pH remained circumneutral (Appendix Figure C.33). Overall, this indicated surface water quality in the Stanleigh TMA has improved significantly since decommissioning and continues to improve.

For the 2020 to 2023 period, Stanleigh ETP influent (station CL-04) water quality monitoring showed continued decreasing or stable levels of barium, cobalt, iron, manganese, pH, radium-226, sulphate, and uranium (Appendix Figures C.29 to C.31 and C.34 to C.36). The recent Stanleigh TMA surface water quality results indicated overall stable or decreasing levels of the mine-associated parameters showing continued improvement since Cycle 5.

2.2.5.2 Stanleigh Treatment Performance

Water from the Stanleigh ETP flows via the Stanleigh Settling Pond to the principal effluent location (SAMP station CL-06) where it discharges into McCabe Lake in the May Lake sub-watershed (Appendix Figure B.4). Significantly decreasing trends in iron, manganese, pH, sulphate, and uranium and significantly increasing trends in barium and radium-226 were observed from 2003 to 2019 at station CL-06 (Table 2.1). During Cycle 5, Stanleigh experienced

treatment challenges associated with refractory radium-226[3] in late 2017 and 2018, which resulted in elevated radium-226 concentrations. Barium concentrations at the effluent discharge point (station CL-06) reached a peak in 2017 associated with adjustments in barium dose for treatment of refractory radium-226 at the Stanleigh TMA using conventional barium chloride additions. After the introduction of the *ex-situ* barite (XSB) treatment method in 2018, barium and radium-226 concentrations decreased (Appendix Figure C.29 and C.34). Despite increasing radium-226 (before the treatment change), effluent quality remained below monthly mean discharge limits for all months from 2015 to 2019 except for December 2017 and January 2018 which just surpassed the limit of 0.37 Bq/L (Minnow 2022a; see Table 2.5 for discharge criteria); these exceedances were associated with the refractory radium-226 issue which has since been resolved. In contrast, the annual lime consumption rate decreased substantially over the 2015 to 2019 period reflecting the circumneutral pH within the TMA basin (i.e., pH in treatment plant influent [CL-04] generally achieves discharge criteria without treatment). Levels of pH remained within monthly mean discharge limits from 2015 to 2019 (Minnow 2022a).

Toxicity testing of ETP effluent from the Stanleigh facility was consistently non-lethal to rainbow trout and no effects were observed on the reproduction of *C. dubia* in tests using 100% effluent from 2014 to 2019 (Minnow 2022a). Two of 24 toxicity tests on *D. magna* exhibited minimal mortality (i.e., 20% in one test from May 2017 and 3.3% in one test from May 2018), whereas no mortality was reported in all other tests (Minnow 2022a). Treated water discharged to the receiving environment was, therefore, considered good quality.

For the 2020 to 2023 period, water quality at the Stanleigh effluent at the principal discharge location (CL-06) showed decreasing or stable concentrations of cobalt, iron, manganese, sulphate, and uranium from 2020 to 2023 (Appendix Figures C30 to C.32, C.35, and C.36). At station CL-06, pH decreased from slightly basic to slightly acidic from 2017 to 2019, and has remained slightly acidic since, reflecting the circumneutral pH within the TMA basin that generally achieves discharge criteria without treatment, and concentrations have remained above the lower limit of SOE Cycle 5 monthly mean discharge criteria (Appendix Figure C.33). Barium and radium-226 concentrations reached peak concentrations in 2017/2018 before decreasing in 2019. Concentrations of both radium-226 and barium remained low and stable from 2019 to 2023 (Appendix Figure C.29 and C.34). Radium-226 concentrations remained below the Cycle 5 monthly mean discharge limits from 2020 to 2023 (Table 2.5; Appendix Table C.15, Appendix Figure C.34). In general, the Stanleigh TMA treated effluent (station CL06)

[3] Refractory radium is defined as when the dissolved radium concentration is equal to the total radium concentration (i.e., there is no detectable particulate-radium) above a threshold of 0.2 Bq/L (Minnow 2022).

showed improved water quality, particularly compared to conditions observed from Cycle 5 during which refractory radium-226 complicated water treatment.

2.2.5.3 Stanleigh Receiver Water Quality

The SRWMP assesses water quality downstream of the Stanleigh TMA semi-annually at the outlet of McCabe Lake (SRWMP station SR-06); treated discharge from the Stanleigh TMA contributes the largest proportion of loadings to McCabe Lake. May Lake is situated downstream of McCabe Lake (SRWMP station SR-15), and receives water influenced by both the Stanleigh and Stanrock TMAs (Figure 2.1).

From 2003 to 2019, significantly decreasing trends were observed in sulphate and uranium, and significantly increasing trends observed in barium at both SR-06 and SR-15 (Table 2.1). Radium-226 concentrations at McCabe Lake were significantly increasing and reached a peak around late 2017 and early 2018 after which XSB was introduced as a treatment method at the Stanleigh ETP, and concentrations subsequently decreased (Appendix Figure C.34). Over the 2015 to 2019 period, annual mean concentrations of water quality analytes at SR-06 and SR-15 were consistently lower than SRWMP benchmarks indicating overall acceptable water quality conditions in the receiving environment (Minnow 2022a).

For the 2020 to 2023 period, water quality at SRWMP stations SR-06 and SR-15 showed stable or decreasing concentrations of barium, radium-226, sulphate, and uranium (Appendix Figures C.29 and C.34 to C.36). Of the mine-associated parameters monitored in the SRWMP, only pH exceeded SRWMP Cycle 5 benchmarks, with pH levels below the benchmark in 2023 at stations SR-06 (Appendix Figure C.33). Monitoring of the ETP influent (station CL-04) showed that pH was within the general range of pH previously observed from 2009 to 2019 on site, and pH at the principal discharge point (station CL-06) showed similar levels to those observed from 2019 to 2022; this suggested that mine effluent was not the cause of decreased pH at the outflow of McCabe Lake (station SR-06). As discussed above, the decreased pH observed at SRWMP sites was likely the result of natural environmental variability as reference stations also showed a decrease in pH during this period (Appendix Figure C.51). Overall, the water quality in the Stanleigh TMA receiver (McCabe Lake) continued to improve following adaptations of treatment methods to address issues with refractory radium-226.

2.2.6 Stanrock TMA – May Lake Sub-Watershed

2.2.6.1 Stanrock TMA Basin Surface Water Quality

Stanrock TMA is a vegetative covered TMA and, as such, there is no surface water contained within the TMA. Surface water runoff and seepage are collected in a holding pond and water

quality is assessed at the influent of the Stanrock ETP (TOMP station DS-2; Appendix Figure B.5). Water quality measured from 2003 to 2019 at DS-2 showed significantly decreasing cobalt, pH, sulphate, and uranium, and significantly increasing barium and radium-226 concentrations (Table 2.1).

For the period 2020 to 2023, water quality monitoring at TOMP station DS-2 showed continued decreasing or stable concentrations of acidity, cobalt, iron, manganese, pH, sulphate, and minor increases in barium and uranium concentrations (Appendix Figures C.37 to C.42, C.44, and C.45). Radium-226 concentrations appeared to generally exhibit similar concentrations to the Cycle 5 period, although there were some fluctuations to higher than typical concentrations from around 2019 onwards (Appendix Figure C.43). Overall, water quality at the Stanrock ETP influent showed stable or improving quality from 2020 to 2023, with mine-associated parameters generally remaining similar in concentrations to those observed during Cycle 5.

2.2.6.2 Stanrock Treatment Performance

Treated effluent from the Stanrock ETP enters the receiver, Orient Lake, at the principal discharge location associated with SAMP monitoring station DS-4 (Appendix Figure B.5). With the exception of barium, all mine-associated parameters showed significantly decreasing or non-significant trends from 2003 to 2019 at station DS-4 (Table 2.1). Although pH showed a significantly decreasing trend, pH remained circumneutral (Appendix Figure C.42).

Semi-annual toxicity testing of effluent from the Stanrock Facility (at station DS-4) was non-lethal to *D. magna* and rainbow trout over the 2015 to 2019 period, with no mortality reported in acute toxicity tests (Minnow 2022a). Similarly, reproduction of *C. dubia* was not affected by exposure to 100% effluent in all but one chronic toxicity test conducted in October 2017, when reproduction was affected at an effluent concentration of 55% (Minnow 2022a).

Water quality monitoring at station DS-4 from 2020 to 2023 showed decreasing or stable concentrations of cobalt, iron, and manganese, (Appendix Figures C.39 to C.42). Radium-226 showed a slight increase in 2021, but decreased afterward, concurrent with a similar pattern in barium concentration (i.e., an increase followed by a decrease in 2021), likely indicating successful treatment of TMA water using conventional barium chloride additions (Appendix Figures C.38 and C.43). Peak radium-226 concentrations were observed during the change in laboratories in 2021 and were influenced by the inclusion of radium-224 in the reported radium-226 concentrations (see section 2.2.2.2). Sulphate showed a minor increase in 2022 and 2023 but remained within the range of values observed in Cycle 5 (Appendix Figure C.44). Uranium concentrations showed an approximate two-times increase in concentration in 2022 and 2023 relative to 2020 and 2021, but concentrations remained low relative to those observed in ETP influent (station DS-2; Appendix Figure C.45). Neither pH nor radium-226 exceeded the

monthly mean discharge limits established in Cycle 5 (Table 2.5; Appendix Figures C.42 and C.43; Appendix Table C.19). Overall, water at the principal ETP discharge showed stable and/or low concentrations of mine-associated parameters.

2.2.6.3 Stanrock Receiver Water Quality

The SRWMP assesses water quality downstream of the Stanrock TMA quarterly at the outlet of Halfmoon Lake (SRWMP station DS-18) and semi-annually at the May Lake outlet SRWMP (SR-15), which receives water influenced by both the Stanleigh and Stanrock TMAs (Figure 2.1). From 2003 to 2019, water quality monitoring results showed significantly increasing trends in barium and iron and significantly decreasing trends in pH, sulphate, and uranium at DS-18 (Table 2.1; Minnow 2022a). Parameters were consistently below (or above for pH) the SRWMP benchmarks, and iron and pH did not show significant trends, either increasing or decreasing, at the downstream monitoring station at the May Lake outlet (station SR-15).

For the 2020 to 2023 period, water quality monitoring at station DS-18, the outlet of Halfmoon Lake, showed good quality, with all parameters remaining below (or above for pH) Cycle 5 Benchmarks (Appendix Figures C.38 to C.45). Although there was an increase in uranium and sulphate in Stanrock ETP discharge (station DS-4) in 2020 and 2023, corresponding increases were not observed in the receiving environment and concentrations remained well below the Cycle 5 Benchmarks (Appendix Figures C.44 and C.45). Increases in barium and radium-226 in 2021 at the ETP discharge were mirrored by increases in concentration at Halfmoon Lake outlet (station DS-18), but concentrations remained below Cycle 5 benchmarks and decreased concurrent with decreases in radium-226 concentrations in the ETP principal discharge (Appendix Figures C.38 and C.43). Overall, water in the receiving environment was stable or showed continued improvement from 2020 to 2023 for most mine-associated parameters.

2.3 Recommendations

Based on general long-term stable or improving water quality trends at the Elliot Lake TMAs and Serpent River Watershed, as evidenced in the Cycle 5 SOE Interpretive Report and updated water quality data presented herein, changes in water quality in the Serpent River watershed are occurring at a slower rate due to reduced SAMP parameter loadings from discharges to the environment. Thus, it is appropriate to transition the SOE water quality reporting to a 10-year cycle. A 10-year monitoring cycle will allow for coordination with the SOE benthic and sediment reporting cycle, and monthly / annual water quality reporting requirements will remain in place to identify areas where adaptive management is required to maintain environmental performance. The proposed modified schedule includes a Cycle 7 study design,

inclusive of benthos/sediment monitoring and reporting requirements in 2029, and a combined Cycle 6/7 SOE Report in 2030 (Table 2.6).

Table 2.6: Serpent River Watershed Monitoring Program Projected Project Reporting Schedule

Estimated Delivery Year	Project Deliverable
2024	Cycle 6 Study Design
2029	Cycle 7 Study Design - Sediment, Benthic Invertebrate, and Water Quality Monitoring
2030	Combined Cycle 6/7 State of the Environment Report
2039	Cycle 8 Study Design - Sediment, Benthic Invertebrate, and Water Quality Monitoring
2040	Cycle 8 State of the Environment Report

3 INCORPORATION OF AGENCY COMMENTS

The initial Cycle 5 SOE Report was submitted to the Joint Review Group (JRG) in March 2021. The CNSC completed the review of the Cycle 5 SOE interpretive report on March 30, 2022. An updated Cycle 5 SOE Report, was submitted in April 2022 (Appendix A) to address CNSC comments. Recommendations for future study designs were included with the Cycle 5 SOE report as well as comments from the JRG. Based on the transition to a 10-year reporting cycle, this Cycle 6 Study Design addresses comments pertaining to the water quality monitoring program, whereas comments pertaining to other aspects (e.g., benthic invertebrates, sediments, and public dose) will be addressed through the Cycle 7 Study Design.

Recommended changes to the study design were provided following the Cycle 5 SOE. During the preceding cycle, the following recommendations were made:

1. Continue to monitor radium-226 at SAMP station PR-01, and if it continues to increase, conduct an investigation;
2. Change the station-type designation for SRWMP station D-6 from a lake-type to a wetland-type (which alters the SRWMP water quality benchmarks against which water quality data at D-6 would be screened);
3. Calculate the hardness-based SRWMP water quality benchmarks using real-time hardness data as opposed to the current method of estimating water quality guidelines based on an annual average hardness value for a given station;
4. Review the public dose estimation to determine if it needs to be updated; and
5. Include a statement of uncertainties for the monitoring data results and any dose estimates derived from them, according to CSA standard N288.5-11.

Actions taken in response to recommended changes to the study design in the Cycle 5 SOE:

1. At the Pronto TMA, primary discharge SAMP station PR-01 showed a slight increase in radium-226 concentration since 2003 (Minnow 2022a). Radium-226 concentrations from 2020 to 2023 remained below the monthly mean discharge criterion (0.37 Bq/L) and below the SRWMP benchmark of 0.469 Bq/L. If concentrations continue to rise to a level which could cause concern (i.e., above the SRWMP benchmark), an investigation into the cause should be conducted.
2. Based on habitat characterization, SRWMP station D-6, located at the outlet of Cinder Lake, should be considered a “wetland” type station rather than a “lake” type station with respect to SRWMP benchmarks (Minnow 2022a). Compared to most other

lake outlets monitored for water quality in the SRWMP, Cinder Lake has relatively small surface area (36.6 ha) and is relatively shallow (10 m average depth), with a narrow, shallow stream channel the hosts abundant emergent vegetation (See Appendix Photo Set D.1). Cinder Lake is similar in size to Westner Lake whose outlet station SC-01 is compared to the "wetland" SRWMP benchmarks. Based on the above justifications, SRWMP station D-6 will be assessed based on comparison to wetland benchmarks in this Study Design and in the future combined Cycle 6/7 SOE Report.

3. For SRWMP water quality benchmarks, hardness-based benchmarks will be calculated for each individual sample using the hardness of that sample rather than using the average hardness for that station over the study period. If hardness is unavailable for a given sample, guidelines will be conservatively estimated using the lowest 25th percentile hardness value for the year in which the sample falls.
4. The public dose estimation will be reviewed, and if required, updated as part of the combined Cycle 6/7 SOE report.
5. In 2020, a formal gap analysis was conducted between the existing monitoring network (TOMP, SAMP, and SRWMP) and its evolution and the CSA Standards N288.4-10 (Minnow 2020a). Based on the gap analysis, reporting needs to include a statement of uncertainties inherent in the monitoring results and any dose estimate derived from them to meet the requirement of the N288.5-11 (Clause 11.2.2). Currently, annual reporting includes a statement on whether data quality objectives are met; however, uncertainties can arise from other sources. In the future, a statement of uncertainties shall be included as part of the SOE reporting, beginning with the combined Cycle 6/7 SOE Report.

The following list outlines the CNSC's additional comments and requirements and indicates either how they will be addressed within the Cycle 6 and 7 SOE study designs, or how they will be addressed in the interpretive reports:

- Conduct a literature review with respect to the relative sensitivity and tolerance of benthic invertebrate species to help inform the discussion of temporal trends.

  Details regarding benthic invertebrate species reporting will be addressed as part of the Cycle 7 SOE Study Design; however, a literature review of the sensitivity and tolerance of benthic invertebrate species will be performed, and sensitivity and tolerance content will be integrated where applicable in the combined Cycle 6/7 SOE report.

- Provide a graph showing trend over time in realistic public dose starting with data from 2017;

There is a need to update the public dose estimate based on changes in possible community demographics, changes in waste management operations, or trends observed in the watershed monitoring program. Based on this approach, there has been one update from the original public dose estimate, and graphing public dose estimate temporally would reflect the two estimates (the original and the updated); the lack of additional data points show that there has been no change (and thus no trend) in dose estimate since the last update. As part of the combined Cycle 6/7 SOE there will be a review of the public dose estimate, and an update, if required. If an update is required, a temporal trend graphic can then be provided.

- Evaluation of surface water quality trends should include clarification whether the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves (in the respective Environmental Impact Statements [EIS]) for the Quirke, Panel, Denison, Stanrock, and Stanleigh facilities.

  The Cycle 6/7 SOE report will include a provision for an evaluation of surface water quality trends that include clarification whether the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves from the appropriate EIS (for Quirke, Panel, Denison, Stanrock, and Stanleigh facilities). This will be incorporated into the Cycle 7 SOE Study Design.

- CNSC recommends future iterations of the SOE include a discussion of climate change driven effects and associated impacts they may have in relation to environmental and human health risk from the Elliot Lake Sites.

  The Cycle 6/7 SOE report will include a discussion of climate change driven effects on the Elliot Lake facilities and associated potential impacts in relation to environmental and human health risk.

Following draft submission of the Cycle 6/7 SOE Study Design, feedback was provided by CNSC on November 7, 2024. Comments from the CNSC are provided and addressed below:

- It was noted in the review of the previous Cycle 5 SOE Report (Minnow 2022a) that there were increasing radium-226 concentrations in the TMA-1 ETP (station D-1) influent from 2008 to 2019, which exceeded concentrations predicted in the 1995 EIS. From 2020 to 2023 concentrations of radium-226 have remained consistent with stable concentrations. While concentrations have continued to remain below discharge limits outlined in the licence at SAMP station D-2, DMI had committed to engaging consultants to refine the understanding of radium-226 in the TMA and downstream and working with RAL on developing mechanisms to control radium-226 concentration at RAL sites beginning in

2021. Relevant findings of the investigation were to be reported in the next SOE report or appropriate forum [Minnow Environmental Inc. December 2021]. RAL and DMI Responses to Regulator Comments on the Serpent River Watershed Cycle 5 (2015 to 2019) State of the Environment Report]. As the combined Cycle 6/Cycle 7 SOE report is proposed to be submitted in 2030, an update on this work should be included in the current Cycle 6 study design or another appropriate forum within the next year, as to complete the commitment to provide an update within a reasonable timeframe.

The licensees are expected to provide an update on the understanding of radium-226 concentrations in the Denison TMA and mechanisms to control radium-226 concentrations at RAL sites with the Cycle 6 study design, or within another appropriate forum within the next year.

Denison Mines will provide a report under separate cover that details the results of studies aimed at improving the understanding of radium-226 dynamics at Denison TMA-1 and downstream by the end of 2025.

- Among the 11 sites, some sites (i.e., Lacnor, Nordic, Buckles, Stanrock, Stanleigh, Panel, Quirke, Denison) have groundwater and pore water monitoring locations, while others (i.e., Pronto, Miliken, Spanish-American) do not have groundwater and pore water monitoring locations. It is not clear why.

  The licensees are expected to clarify why some sites have groundwater and pore water monitoring stations, while others do not.

  The Pronto facility has a groundwater monitoring program as required by MECP ECA No. A-500-4136725216 (Appendix E). As this groundwater monitoring and reporting is covered by a separate regulatory instrument, the results are not planned for inclusion in the SRWMP Cycle 6/7 Report. Effects of groundwater on the receiving environment are captured by the SRWMP Monitoring and Reporting.

  In 2022, Minnow conducted a full review of groundwater monitoring programs at RAL's Elliot Lake Sites. A groundwater monitoring program for the Milliken TMA was not recommended as the expected prevailing groundwater flow pathways are shallow in nature and discharge to the surface in the near-field area (Minnow 2022b). Additionally, there is potential for natural attenuation of metals and radionuclides within the peat layer, which is expected to be the predominate hydrostratigraphic unit within the Milliken TMA that conveys groundwater flow. The current water quality monitoring at MPE and M-01 (Figure 2.1; Table 2.4; Figure B.7) capture the important locations downstream of the TMA

and allows for assessment of potential water quality effects that TMA seepage may have on the surface water environment (Minnow 2022b).

A groundwater monitoring program for the Spanish-American TMA is not recommended as the TMA is situated in a bedrock-rimmed basin that is bound on all sides by low-permeability bedrock ridges (Minnow 2022c). Because there are no obvious directional flow pathways outward from the TMA, and seepage exiting the west end of the facility would likely reflect the chemistry monitored at ECA-128 (Table 2.2; Figure B.6), no groundwater monitoring locations at the Spanish-American TMA site are recommended at this time (Minnow 2022c).

- It seems that the Upper Cinder Lake might receive seepage from the Denison TMA1, while Little Cinder Lake might receive seepage from Dam 10. It is not clear why the surface water in the Upper Cinder Lake (close to Denison TMA1) and the Little Cinder Lake (close to Dam 10) are not sampled.

  The licensees are expected to clarify why surface water at the above-mentioned locations are not monitored.

  The quality of water in Upper Cinder Lake, potentially influenced by Dam 16, was monitored monthly at the Upper Cinder Lake outflow (Station D-15) until 2004 (Minnow 2004). Station D-15, upstream of the SRWMP station D-6, was removed from the SRWMP in the Cycle 2 Study Design (Minnow 2004) as approved by the JRG. There was no evidence of mine-related impacts in Upper Cinder Lake in Cycle 1 (Minnow and Beak 2001). Upper Cinder Lake discharges into Cinder Lake and then into Little Cinder Lake; therefore, any mine impacts to Upper Cinder Lake, Cinder Lake, and Little Cinder Lake would be adequately captured by station D-6. The SRWMP location D-6 is located after the outlet of Little Cinder Lake near the inlet to Stollery Lake (Figure 2.1).

  Substantial amounts of seepage discharge occur at Dam 10, which is consistent with the design of the structure (Minnow 2022a). Seepage migrates from the tailings basin through the permeable soils beneath the Dam 10 foundation and is collected in the southern and northern toe drain systems. The southern toe drain also collects seepage from Little Cinder Lake which acts as a positive hydraulic head barrier preventing westward migration of tailings water. Tailings seepage does not influence Little Cinder Lake as seepage from both the lake and Dam 10 reports to the toes drains. The seepage from both the southern and northern drains discharges into the Stollery Lake Settling Pond.

- It seems that seepage water from Quirke TMA might flow towards the Dam L (Figure B.2). Additionally, it seems that water from a drainage channel flows towards Dam H. It is not

clear why surface water at Dam L and Dam H are not sampled. The licensees are expected to clarify why surface water at the above-mentioned locations are not monitored.

Gravelpit Lake (North of Dam L), is at higher elevation and at a higher hydrological head. The prevailing seepage flow direction is toward the Quirke TMA rather than toward Dam L and Gravelpit Lake (Minnow 2022d).

Dam H was constructed to reduce the amount of freshwater reporting to the Quirke TMA by impounding water in Lake C and redirecting runoff away from the Quirke TMA. Lake C is situated on a bedrock outcrop at an elevation approximately 11 m higher than the TMA. A short channel was constructed to convey water impounded at Lake C to Dunlop Lake. Because Dam H and Lake C are located at higher elevations than the TMA, the flow path and hydraulic gradient of these waterbodies are expected to prevent TMA seepage and/or groundwater from affecting water quality within the tributary stream and Lake C. Freshwater seepage from Dam H currently flows along the historical channel into the Quirke Facility TMA, where it is managed/treated as TMA water (Minnow 2022a Appendix L; 2022d). Therefore, water quality monitoring at the tributary stream and Lake C outlet are not warranted as each represent non-contact waters. A flow direction arrow has been added to Figure B.2 to clarify the flow direction along this channel.

- It seems that Dam R3, Dam R5, Dam A and the small water body close to the northernmost TMA might receive seepage from the TMA (Figure B.4). It is not clear why surface water in these locations are not sampled.

  The licensees are expected to clarify why surface water at the above-mentioned locations are not monitored.

  Dam R3 and Dam R5 are freshwater diversion dams designed to limit water from entering the Stanleigh TMA and the hydrological gradient at these dams flows towards the Stanleigh TMA (Minnow 2022e). Additional flow arrows have been added to Figure B.4 to improve clarity. As water from the small water bodies outside Dams R3 and R5 are non-contact waters, surface water quality monitoring is not warranted.

  Potential seepage from the Stanleigh TMA through Dam A into the receiving environment is monitored at groundwater well SGW-3 (Figure B.4). This creek ultimately flows into Sherrif Creek, which flows west as a contributing catchment area into the Milliken TMA. Surface water is monitored at the outlet of the Milliken TMA at station MPE. The established groundwater and downstream surface water monitoring stations are sufficient for capturing the environmental effects of potential seepage from the Stanleigh TMA at Dam A.

- In Figures B.5 and B.6, the limits of land under CNSC licence are not shown as in other figures. In Figure B.8, flow directions are not shown at N-20 and N-17 (the drainage channel to the east of N-17). The flow directions at these locations are needed to facilitate the understanding of the surface water sampling locations.

  The licensees are expected to show the limits of land under CNSC licences on Figures B.5 and B.6, and flow directions at N-20 and N-17 on Figure B.8

  Figures B.5 and B.6 have been updated to include the limits of the land under CNSC licence.

  Figure B.8 has been updated to include flow directions near N-20 and N-17. Station N-20 is situated along Buckles Creek which drains southwesterly towards Nordic Lake. Station N-17 represents basin influent into the ETP, which in turn, discharges west (at Station N-18) to the Nordic Settling Pond.

- CNSC staff understand that for the SRWMP, it is proposed to remove station SR-15 because radium-226 concentrations at this station are within SRWMP benchmarks and that the SRWMP has stations closer to the Stanleigh and Stanrock facilities. It is also noted that this station was re-introduced into the SRWMP in 2016 during the period of refractory radium at the Stanleigh facility and that this issue was resolved in 2018. CNSC staff reviewed the justification and agreed with removing SR-15 from the SRWMP

  We acknowledge the review and response from CNSC and have removed Station SR-15 from the Cycle 6/7 Study Design. The text in Sections 6.2.2 and 10 has been updated to reflect CNSC's confirmation of removing Station SR-15.

- In Figure B.9, there are two surface water monitoring stations associated with the potential impacted releases from Pronto TMA/Dam E and Dam F at PR-01 and LL-01. However, there is no seepage monitoring near Dam F and the near field surface water monitoring station prior to LL-01.

  The licensees are expected to justify and clarify why there were no seepage monitoring at Dam F and elaborate on the potential impact to the immediate and near field receiving surface water environment.

  The SRWMP and SAMP was designed with Lake Lauzon as the receiver (Minnow 2009e), and not the drainage downstream of Dam F. Accordingly, Station LL-01 is a SAMP monitoring station to measure water quality draining into the receiver Lake Lauzon.

  Dam F was constructed to divert flow away from Lake Lauzon. Seepage quality is currently monitored by groundwater well PRBH1-R as a part of the groundwater

monitoring program required by the MECP ECA A-500-4136725216 (Appended). As this groundwater monitoring is covered by a separate regulatory instrument, the results are not planned for inclusion in the SRWMP Cycle 6/7 Report.

4 TOMP

4.1 Overview

The TMA Operational Monitoring Program (TOMP) was developed to track the performance of the TMAs and generate data used to make decisions about the management and discharge compliance of the TMAs (Minnow 2002a). Specific objectives are addressed through the four sub-programs of the TOMP:

- Basin Performance Monitoring,
- Monitoring to Support Effluent Treatment Plant (ETP) Operations,
- Effluent Monitoring and Control, and
- Perimeter Monitoring.

The TOMP program includes:

- Water elevation and flow monitoring to assess water management,
- Water quality within the TMA basins,
- Groundwater and pore water quality, and
- Treatment performance.

4.2 Sample and Data Collection

TMA elevations, effluent treatment reagent use, and water quality are documented as part of the TOMP. Collection of surface water, seepage, groundwater, and pore water TOMP samples is the responsibility RAL and DMI, for their specific properties within the TOMP. Care and Maintenance includes following standard operating procedures (SOPs) that address all aspects of sample collection and management for the TOMP from sample collection to laboratory submissions, data entry, validation, and response. SOPs are provided in detail in the Cycle 5 SOE report (Minnow 2022a). There are no proposed changes to TOMP sample and data collection SOPs.

4.3 Monitoring Stations

The TOMP includes all TMA stations located upstream of SAMP locations (Table 2.2). Each monitoring station serves one or more of the sub-programs listed (Section 4.1) and the monitoring parameters and frequency for each station have been established accordingly. Maps and tables describing the location and function of each station monitored as part of the

TOMP are provided in Appendix B (Appendix Figures B.1 to B.9 and Appendix Tables B.1 to B.9). There are no proposed changes to the TOMP stations.

4.4 Monitoring Frequency

Monitoring is conducted at TOMP stations at varying frequencies depending on the station type and purpose. Water samples and measurements are collected daily (workdays), weekly, monthly, quarterly, semi-annually, or annually. There are no proposed changes to TOMP station monitoring frequency (Table 2.2).

4.5 Monitoring Parameters

Monitoring parameters within the TOMP vary depending on the station type and purpose, and include:

- elevation,
- flow,
- pH,
- conductivity,
- sulphate,
- total radium-226,
- lime or NaOH consumption,
- barium chloride consumption,
- sodium sulphate consumption,
- total suspended solids (TSS),
- acidity,
- iron only, or,
- SAMP metals (barium, cobalt, iron, manganese, and uranium).

There are no changes proposed to the parameters to be monitored at TOMP stations (Table 2.2).

4.6 Data Analysis

TMA elevations will be assessed relative to operating levels specified in site-specific Operating Care and Maintenance Plans (RAL sites) and Tailings Management Area Operating Manuals (DMI sites). Effluent treatment reagent use will be evaluated relative to treated effluent volume to assess changes in reagent consumption over time. Water quality data will be compared to the

50-year post-decommissioning Environmental Impact Statement (EIS) predictions to understand whether TMA surface water is on the increasing or decreasing limb of the predicted breakthrough curves (i.e., 2040; Rio Algom 1995, Denison 1995). Analyses of temporal changes in water quality will be performed on data from all TOMP surface water, seepage, pore water, and groundwater stations.

Prior to Cycle 5, trends were separately analyzed for each season using Spearman rank correlation (r_S) between variable concentrations and years (McLeod et al. 1991). This identified any statistically significant temporal trends within seasons. For locations and variables for which multiple seasons were assessed for significant correlations (trends), van Belle tests were applied to test for differences among seasonal trends and test the common (combined) trend over all seasons. For Cycle 5, trends in water quality data were assessed using the non-parametric seasonal Kendall test described by Hirsch et al. (1982), which is similar, but accommodates non-detection values below the laboratory reporting limit (LRL). For the combined Cycle 6/7 SOE report, the seasonal Kendall test will be used to assess temporal trends. Data analysis will be conducted using R software (R Core Team 2023). The seasonal Kendall test assesses temporal trends separately for each season (or month in this case) and combines the results for each season into an overall test for trend. The test is non-parametric and assesses whether there is a monotonic increasing or monotonic decreasing trend over time. The test will be conducted by calculating the test statistic i which is equal to the sum of the number of increases and decreases from a time period t to all time periods after t for each observation in season i. The overall test statistic S is computed as the sum of i for all seasons. The significance of the observed S is determined by comparing it to a critical value of S (at the significance level α = 0.05) determined from the exact sampling distribution of S (calculated by determining all possible permutations and combinations of S based on the increases and decreases from the number of pairwise comparisons made; Hirsch et al. 1982). If more than 45 pairwise comparisons are made (equivalent to the number of pairwise comparisons for n = 10 in a single season), then the normal approximation will be used to calculate a p-value and to assess significance (Hirch et al. 1982). The standard normal deviate Z is calculated as:

$$Z = \begin{cases} \frac{S-1}{\sqrt{\sigma_S}} if\ S > 0 \\ 0 \quad if\ S = 0 \\ \frac{S+1}{\sqrt{\sigma_S}} if\ S < 0 \end{cases}$$

where $\sigma_S = \sum_{i=1}^{k} \frac{n_i(n_i-1)(2n_i+5) - \sum_{T_i} t_i(t_i-1)(2t_i+5)}{18}$ and n_i is the number of samples in month i, t_i is the number of tied values for each tied value T_i, and k is the number of seasons

(Hirsch et al. 1982). An estimate of the trend slope over time will be estimated by computing the median of all slopes between data pairs within the same month (Helsel and Hirsch 2002). The slope will be reported as a percentage change of the median value per year. The intercept of a line through the time series will be estimated as the median intercept of all lines through each point with the estimated slope (Pohlert 2016). The trend analysis will only be conducted with a minimum number of 5 pairwise comparisons, the minimum number required for all consecutive increases or decrease to be significant at $\alpha = 0.05$.

5 SAMP

5.1 Overview

The Source Area Monitoring Program (SAMP) was designed to monitor the nature and quantity of contaminants being discharged from the TMAs to the SRW receiving environment, or, in the case of Pronto, to the receiving environment in Lake Huron and Lake Lauzon (Minnow 2002b).

5.2 Sample Collection

Collection of surface water SAMP samples is the responsibility of RAL and DMI. Care and maintenance includes following SOPs that address all aspects of sample collection and management for the SAMP from sample collection to laboratory submissions, data entry, validation, and response. SOPs are provided in detail in the Cycle 5 SOE report (Minnow 2022a). There are no proposed changes to SAMP sample collection SOPs.

5.3 Monitoring Stations

There are currently 24 monitoring stations within the SAMP. The SAMP includes water monitoring at effluent (principal), seepage, and site drainage locations for mine related substances (Table 2.3). Source area monitoring program monitoring locations are described for each TMA, in Appendix B (Appendix Figures B.1 to B.9 and Appendix Tables B.10 to B.17). There are no proposed changes to the SAMP stations.

5.4 Monitoring Frequency

The frequency of monitoring at SAMP locations is dependent upon the type of station and the parameter being monitored (Table 2.3) such that sampling is conducted on a daily (workdays), weekly, monthly, quarterly, or semi-annual basis. There are no changes proposed to the monitoring frequency for SAMP stations.

5.5 Monitoring Parameters

Monitoring parameters at SAMP stations includes:

- flow,
- pH,
- sulphate,
- radium-226,
- SAMP metals (barium, cobalt, iron, manganese, and uranium),

- toxicity[4], and
- hardness[5].

These parameters are monitored at all stations, except toxicity testing, which is only conducted at final discharge (principal) stations. There are no changes proposed to the SAMP monitoring parameters.

5.6 Data Analysis

Water quality at SAMP stations will be evaluated by comparison to discharge criteria (Table 2.5), through the assessment of temporal concentration trends, and through comparison of annual loadings from various stations. Water quality data for SAMP stations will be screened against effluent grab criteria and monthly average discharge criteria.

Temporal trends in SAMP water quality data will be assessed using the non-parametric seasonal Kendall test described by Hirsch et al. (1982), as outlined in Section 4.6. Annual loadings (2020 to 2029) of monitored substances will be calculated for TMA direct (controlled) discharge locations and TMA seepage locations. Loadings from TMA discharge locations will be calculated from monitoring results (flow and concentration) for each year (2020 to 2029). Weekly flow and concentration data measured during discharge periods at the main TMA discharge locations (2020 to 2029) will be used to calculate weekly loads (kilograms per week [kg/wk] or Becquerels per week [Bq/wk]). Weekly loads will be summed to estimate annual loads for each variable. In some instances, loads will be computed by averaging concentrations for dates immediately before and after a date when flow data but no concentration data were available. Flows for seepage locations will be based on mean flows from site monitoring data if available or design flows reported in the EIS documents (Rio Algom 1995, Denison 1995). These flow rates will be multiplied by mean annual concentrations (2020 to 2029) for the same station to approximately estimate annual loads for each variable.

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

[5] Hardness is an ancillary parameter that is monitored to assist with the interpretation of measured water concentrations as Hardness has been found to modify aquatic toxicity for some substances. Hardness is used in the determination of guideline values for both sulphate and manganese and thus should be retained in the program for as long as these substances are monitored.

6 SRWMP

6.1 Overview

The SRWMP was designed to assess the recovery of the receiving environment following the implementation of the decommissioning plans. The SRWMP was designed to evolve over time in response to conditions within the watershed such that as conditions improved, the scope of the program would retract based on acceptability criteria that were established at the onset of the program. Currently the program includes the assessment of water, sediment, and benthic invertebrates in downstream receiver and reference lakes within the watershed.

6.2 Water Quality

6.2.1 Sample Collection

Care and Maintenance of the sites is the responsibility of RAL and DMI, and this includes routine collection of SRWMP water samples. Standard operating procedures have been developed that address all aspects of sample collection and management for the SRWMP from sample collection to laboratory submissions, data entry, validation, and response. SOPs are provided in detail in the Cycle 5 SOE report (Minnow 2022a). There are no proposed changes to SRWMP water quality sample collection SOPs.

6.2.2 Monitoring Stations

There are currently 16 water quality monitoring stations in the SRWMP. These stations represent reference (5) and mine-exposed (11) locations. The mine-exposed stations are generally located immediately downstream of the decommissioned mines (i.e., near-field locations; Figures 2.1).

Based on recommendations from the Cyle 5 SOE report, it is proposed that the classification of SRWMP station D-6 be changed from a “lake”-type to a “wetland”-type station as the characteristics of the station correspond more closely to those typical of wetlands (see Section 3 for details). The proposed change to the station type of D-6 would impact the benchmarks against which water quality parameters are screened, but would not influence the sampling frequency or parameters assessed.

Station SR-15 at the outlet of May Lake is situated downstream of both the Stanleigh and Stanrock facilities, with SRWMP stations SR-06 and DS-18 located nearer to each facility, respectively. Station SR-15 was removed from the monitoring program at the end of 2009 (Minnow 2011). As a result of increasing radium-226 concentrations in discharge from the Stanleigh TMA (station CL-06) during the refractory radium period (see section 2.2.5),

station SR-15 was re-introduced as a SRWMP station in 2016. Since the refractory radium issue was resolved in 2018, radium-226 concentrations in the Stanleigh facility primary effluent (station CL-06) have been within monthly mean discharge limits (Appendix Figure C.34). Throughout the refractory radium period, radium-226 concentrations within the receiver, McCabe Lake (station SR-06), were well within SRWMP benchmarks, and radium-226 concentrations further downstream at May Lake (station SR-15) are also will within SRWMP benchmarks from the period from 2016 period to 2023 (Appendix Figure C.34). Radium-226 concentrations at station SR-15 are indicative of acceptable water quality, and the SRWMP includes stations nearer to both the Stanleigh and Stanrock facilities. Therefore, station SR-15 will be re-removed from the SRWMP.

6.2.3 Monitoring Frequency

Water samples are collected in the SRW on a quarterly, semi-annual, or annual basis, based on the hydrology of each station (Table 2.4). Frequency of monitoring was established based on the hydraulic residence times of the lakes upstream of the SRWMP stations being assessed, such that monitoring is conducted at a frequency commensurate with the ability of the system to demonstrate change (Beak 1999a)[6]. There are no changes proposed to the frequency of monitoring at SRWMP water quality monitoring stations.

6.2.4 Monitoring Parameters

Water samples are analyzed for mine-related parameters: barium, pH, radium-226, sulphate, and uranium. Iron and manganese are analyzed in samples collected from reference stations as well as mine-exposed station D-6, and iron is analyzed at mine-exposed stations DS-18, M-01, and SC-01 (Table 2.4). Dissolved organic carbon is monitored as a modifying parameter at stations where iron is analyzed (i.e., at reference stations, and stations D-6, DS-18, M-01, and SC-01; Table 2.4). Hardness is also monitored as an ancillary parameter to assist with the interpretation of measured water concentrations, as it is used in the determination of guideline values for both sulphate and manganese (stations D-6, Q-09, and SR-08). No changes are proposed for SRWMP water quality parameters.

[6] The ability of water quality within a lake to demonstrate change is a function of the hydraulic residence time (i.e., the flushing rate of the lake). Therefore, the monitoring frequency was established to reflect the hydraulic residence time of each lake and was set at approximately half the retention time for all lake outlets. This resulted in lake outlets being sampled either biannually or annually. Stations located in the Serpent River or tributary streams where water quality could be expected to more rapidly respond to a change in source loading are sampled quarterly.

6.2.5 Data Analysis

6.2.5.1 Overview

Serpent River Watershed Monitoring Program water quality will be evaluated by comparison to predictions, by assessment of trends, by assessment of annual loadings, and by comparison to benchmarks (Sections 6.2.5.2 and 6.2.5.3). Serpent River Watershed Monitoring Program data will be compared to 1999 and 2099 predicted values (CNSC 2002), and 2012 predicted values for station SR-06 (CNSC 1997). Temporal trends in SRWMP water quality data will be assessed using the non-parametric seasonal Kendall test described by Hirsch et al. (1982; Section 4.6). Annual loadings (2020 to 2029) of monitored substances will be calculated for SRW stations. Loadings will be estimated by pro-rating data from a Water Survey of Canada (WSC) flow gauging station (02CD006 Serpent River upstream of Quirke Lake) based on watershed areas. Watershed areas will be determined from previously published reports, historical WSC data, or calculated using geographic information system (GIS) based tools (OMNRF 2019) for each location. Mean annual flow will be determined for each year (2020 to 2029) at each location and pro-rated flow estimates will be multiplied by mean annual concentrations to approximately estimate annual loads at SRWMP stations.

6.2.5.2 Water Quality Benchmarks

SRWMP water quality data will be compared to benchmarks established for the SRWMP. The benchmarks used for comparison will be either a selected water quality guideline, or the upper limit of background concentration, whichever is higher. The selected water quality guideline will be the most recent of the federal guideline or the Ontario Provincial Water Quality Objectives at the time of Cycle 6/Cycle 7 SOE Report. In instances where neither jurisdiction (federal or Ontario) has developed a guideline (i.e., sulphate) the British Columbia Ministry of the Environment (BC ENV) water quality guideline is applied. The most recent federal or Ontario guideline is selected so that decisions are made based on current toxicity literature rather than on dated research. During Cycle 5 and for this Cycle, BC ENV water quality guidelines for manganese and sulphate, which rely on hardness, were applied (BC ENV 2001, 2013). In Cycle 5, benchmarks were calculated based on the average hardness at a given station over the study period (2015 to 2019). BC ENV guidance for manganese and sulphate recommend calculation of acute and long-term guidelines using a monthly average hardness value based on at least five evenly spaced samples over a 30-day period (BC ENV 2001, 2013). The water quality monitoring frequency of SRWMP ranges from quarterly to annually. For the estimation of guidelines in the Cycle 6/7 SOE Report, individual grab samples will be assumed to represent monthly average concentrations. Acute and long-term manganese guidelines for a given grab sample will be calculated based on the hardness concentration of the same grab sample.

The long-term sulphate guideline will be similarly calculated for individual grab samples based on the hardness value of the sample; no short-term guideline is available based on BC ENV guidance (BC ENV 2013). If hardness values for a given sample are unavailable, the lowest 25th percentile hardness value for the year in which the missing data falls will be used in the calculation of sulphate or manganese guidelines. The benchmark for radium-226 will be based on the site-specific dose-based water quality objective developed by EcoMetrix (2019).

If the reference background concentration (upper limit of background, or lower limit for pH) is greater than the selected water quality guideline, background is used as the benchmark. In order to compare the mine-exposed stations to reference stations with similar habitat characteristics, background concentrations are separately pooled for two habitat types: stations located at lake outlets and stations located downstream of shallow basins with wetland habitats. These habitat types typically have differing water quality, particularly for parameters that can be influenced by the dissolved oxygen and the organic content of surface waters (e.g., iron and manganese). Water quality for mine-exposed stations with wetland characteristics stations (D-6, M-01, DS-18, and SC-01) are compared to pooled data for the reference stations SR-16 and SR-17. Water quality for the remaining mine-exposed stations D-5, Q-09, Q-20, SR-01, SR-06 and SR-08 are compared to a background value calculated from lake discharge reference stations D-4, SR-18, and SR-19. Prior to Cycle 5, benchmark background water quality values were calculated as the upper limit of background based on the 95th percentile of the annual means of SRWMP reference stations. In Cycle 5 and moving forward for the combined Cycle 6/7 SOE report, the upper limit of background will be estimated as upper 95th percentile of values collected across all ten years (i.e., 2020 to 2029). If data are censored at the laboratory reporting limit (LRL), percentiles will be calculated using the Kaplan-Meier (K-M) method using the survfit() function in the survival package (Therneau 2017) in R (R Core Team 2023) and following the methods described in (Helsel 2012). The method involves transforming the left censored (i.e., < value) dataset to a right censored (i.e., > value) dataset, and then using the K-M estimator. The method uses the distribution of values below a detection limit to represent a non-detected value. For example, the maximum value in a data set with values <2, 3, 4, <5, 6, 7, and <10, would be 7 (instead of <10) and the median would be 4 (instead of <5). When a greater proportion of the data is below the LRL than the percentile being estimated, the K-M method in R does not provide an estimate for that percentile. Instead, a 'maximum' percentile is calculated by replacing values with their detection limit and calculating the percentiles using the quantile function in R (type 7). If the estimated quantile is between values in the dataset, the higher value will be reported as the percentile as '<' the value. The upper limit of background will be calculated using data from 2020 to 2029 for the Cycle 6/7 SOE interpretive report.

In summary, the SRWMP benchmarks are based on the higher of:

- the selected water quality guideline (i.e., most recent federal or Ontario guideline, or if not available, a guideline from another Canadian jurisdiction); or
- the upper limit of background concentration where stations SR-16 and SR-17 (wetland/stream reference) are used to calculate a background value for comparison to stations D-6, M-01, DS-18 and SC-01, and lake reference stations (D-4, SR-18 and SR-19) are used to calculate a background value for comparison to stations D-5, Q-09, Q-20, SR01, SR06 and SR-08.

6.3 Sediment and Benthic Invertebrate Monitoring

Sediment and benthic invertebrate assessments occur on a 10-year cycle, with the previous assessment presented in the Cycle 5 SOE. A detailed description of proposed sample collection and monitoring parameters, sampling areas, frequency, and data analysis will be provided in the Cycle 7 SOE study design, for inclusion in the Cycle 6/7 SOE report.

6.4 Dose and Risk

Risk assessments were previously conducted in the SRW as part of the Environmental Assessments conducted in support of mine decommissioning (Rio Algom 1995, Denison 1995, AECB 1997, CNSC 2002) and the 1999 SRWMP (Minnow and Beak 2001). A comprehensive study of dose and risk was conducted in 2009 as part of the Cycle 3 SOE interpretive report and was updated in 2011 (EcoMetrix 2011, Minnow 2012). In the Cycle 5 SOE report, radium-226 concentrations were screened against the site-specific water quality objective of 0.469 Bq/L, as this is the lowest concentration of radium-226 in water that would equal a dose benchmark (Minnow 2022a). Concentrations above the benchmark would have been considered indicators of potential human or ecological concern that would trigger further investigative action. All water quality data were well below the benchmark and updating the 2009 Dose and Risk Assessment was not warranted (Minnow 2022a). To meet the general intent of Canadian Standards Association (CSA) Standard N288.6-12[7], a review of the 2014 to 2023 SRWMP water quality data from the receiving water of key near-field lakes (Quirke, McCabe, Nordic, and May Lakes) was conducted to assess the need to update the 2009 Dose and Risk Assessment. All water quality data were well below the site-specific benchmark (Tables 6.1, 6.2). Therefore, no new risk is anticipated and updating the 2009 Dose and Risk

[7] The CSA standard is for operating sites, whereas the Elliot Lake sites are closed/decommissioning sites in the process of demonstrating recovery. Nevertheless, the CSA standard will be used as a general guideline for dose and risk assessment as part of the Cycle 6 and 7 SOE study designs.

Table 6.1: Comparison of Measures of Position for Radium-226 to Benchmark Guideline, 2014 to 2023

Status	Station	Statistic	2004 Ra-226	2005 Ra-226	2006 Ra-226	2007 Ra-226	2008 Ra-226	2009 Ra-226	2010 Ra-226	2011 Ra-226	2012 Ra-226	2013 Ra-226	2014 Ra-226	2015 Ra-226	2016 Ra-226	2017 Ra-226	2018 Ra-226	2019 Ra-226	2020 Ra-226	2021 Ra-226	2022 Ra-226	2023 Ra-226
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		GL	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469
Mine-Exposed	D-4	n	2	2	2	2	1	2	2	2	2	2	2	2	2	2	1	2	2	2	3	3
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.0100	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00500	<0.005	<0.005
		75th Percentile	0.0100	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00500	<0.005	<0.005
		Median	0.00950	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00500	<0.005	<0.005
		25th Percentile	0.00900	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00500	<0.005	<0.005
		Minimum	0.00900	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00500	<0.005	<0.005
	SR-18	n	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.00500	0.00800	<0.00500	0.00600	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00700	<0.005	<0.005
		75th Percentile	0.00500	0.00800	<0.00500	0.00600	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00700	<0.005	<0.005
		Median	0.00500	0.00650	<0.00500	0.00550	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00600	<0.005	<0.005
		25th Percentile	0.00500	<0.00800	<0.00500	<0.00600	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00700	<0.005	<0.005
		Minimum	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.005	<0.005	<0.005
	SR-19	n	12	12	12	12	12	12	4	4	4	4	4	4	4	4	3	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.0170	0.00700	<0.00700	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	0.0100	0.0100	<0.007	<0.007	0.0110	<0.005	<0.005
		75th Percentile	0.00950	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	0.00850	0.0100	<0.007	<0.007	0.00800	<0.005	<0.005
		Median	0.00600	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00700	<0.005	<0.005
		25th Percentile	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00500	<0.005	<0.005
		Minimum	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.005	<0.005	<0.005
	SR-16	n	2	2	2	2	2	2	4	4	4	4	4	4	4	4	3	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.00700	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.0100	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.007	0.00700	<0.005
		75th Percentile	0.00700	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.00750	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.005	0.00600	<0.005
		Median	0.00600	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.005	0.00500	<0.005
		25th Percentile	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.005	<0.005	<0.005
		Minimum	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.005	<0.005	<0.005
	SR-17	n	2	2	2	2	2	2	4	4	5	4	4	4	4	4	3	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	<0.00500	0.00500	<0.00500	0.00700	<0.00500	<0.00500	0.00500	<0.00500	0.00700	<0.00500	<0.00500	<0.00800	0.0100	0.00800	<0.00700	<0.007	<0.007	0.00800	<0.005	0.00600
		75th Percentile	<0.00500	0.00500	<0.00500	0.00700	<0.00500	<0.00500	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	0.00900	0.00750	<0.00700	<0.007	<0.007	0.00800	<0.005	0.00550
		Median	<0.00500	0.00500	<0.00500	0.00600	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00650	<0.005	0.00500
		25th Percentile	<0.00500	<0.00500	<0.00500	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	<0.007	<0.007	0.00700	<0.005	0.00500
		Minimum	<0.00500	<0.00500	<0.00500	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.005	<0.005	<0.005
	D-5	n	13	12	12	12	12	12	4	4	4	4	4	4	4	4	3	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.260	0.280	0.330	0.260	0.150	0.220	0.220	0.125	0.184	0.0800	0.129	0.141	0.139	0.0940	0.209	0.108	0.0870	0.0820	0.121	0.137
		75th Percentile	0.190	0.195	0.150	0.200	0.100	0.120	0.143	0.0875	0.130	0.0525	0.0860	0.0890	0.116	0.0650	0.209	0.0645	0.0720	0.0810	0.108	0.114
		Median	0.0740	0.0770	0.0355	0.0595	0.0545	0.0445	0.0465	0.0375	0.0605	0.0245	0.0315	0.0310	0.0600	0.0275	0.0400	0.0190	0.0380	0.0550	0.0605	0.0620
		25th Percentile	0.0280	0.0290	0.0175	0.0195	0.0210	0.0300	0.0225	0.0200	0.0415	0.0220	0.0200	0.0250	0.0225	0.0145	0.0320	0.0165	0.0160	0.0235	0.0165	0.0185
		Minimum	0.0210	0.0200	0.00900	0.0130	0.00900	0.0220	0.0170	0.0150	0.0370	0.0200	0.0200	0.0250	0.0170	0.0100	0.0320	0.0160	0.0130	0.0170	0.00800	<0.005
	D-6	n	12	12	12	9	12	12	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.0210	0.0150	0.0130	0.0130	0.00700	0.0130	0.0110	0.0250	0.0150	0.00800	0.00900	0.0110	0.0150	<0.00700	0.0390	0.0140	<0.007	0.0100	<0.005	<0.005
		75th Percentile	0.0105	0.0115	0.00650	0.00700	0.00500	0.00800	0.00900	0.0150	0.0130	0.00700	0.00700	0.00800	0.0140	<0.00700	0.0310	0.0105	<0.007	0.00950	<0.005	<0.005
		Median	0.00850	0.00950	0.00500	0.00700	<0.00500	<0.00500	0.00600	<0.00500	0.0100	0.00550	<0.00500	<0.00800	0.0105	<0.00700	0.0150	0.00700	<0.007	0.00850	<0.005	<0.005
		25th Percentile	0.00500	0.00550	<0.00500	<0.00500	<0.00500	<0.00500	0.00500	<0.00500	0.00700	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	0.00700	<0.007	0.00750	<0.005	<0.005
		Minimum	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00800	<0.00700	<0.00700	<0.007	<0.007	<0.007	<0.005	<0.005
	DS-18	n	12	12	12	12	12	12	4	4	4	4	6	4	4	4	4	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.270	0.130	0.160	0.190	0.110	0.140	0.250	0.134	0.103	0.146	0.246	0.202	0.165	0.203	0.183	0.132	0.146	0.221	0.133	0.142
		75th Percentile	0.145	0.115	0.125	0.0965	0.0975	0.115	0.210	0.134	0.100	0.120	0.237	0.164	0.154	0.198	0.178	0.123	0.126	0.177	0.120	0.122
		Median	0.0890	0.0985	0.110	0.0805	0.0735	0.0930	0.145	0.110	0.0940	0.0900	0.134	0.120	0.126	0.190	0.160	0.108	0.100	0.126	0.0940	0.0830
		25th Percentile	0.0730	0.0815	0.0975	0.0750	0.0580	0.0710	0.102	0.0750	0.0685	0.0850	0.0780	0.106	0.108	0.187	0.126	0.0980	0.0840	0.0885	0.0790	0.0560
		Minimum	0.0610	0.0680	0.0660	0.0620	0.0490	0.0550	0.0830	0.0650	0.0470	0.0850	0.0560	0.0980	0.107	0.186	0.103	0.0940	0.0730	0.0580	0.0780	0.0480

Indicates radium concentrations surpassed guidelines.

Notes: "GL" = Guideline; "n" = number of samples.

Table 6.1: Comparison of Measures of Position for Radium-226 to Benchmark Guideline, 2014 to 2023

Status	Station	Statistic	2004 Ra-226	2005 Ra-226	2006 Ra-226	2007 Ra-226	2008 Ra-226	2009 Ra-226	2010 Ra-226	2011 Ra-226	2012 Ra-226	2013 Ra-226	2014 Ra-226	2015 Ra-226	2016 Ra-226	2017 Ra-226	2018 Ra-226	2019 Ra-226	2020 Ra-226	2021 Ra-226	2022 Ra-226	2023 Ra-226
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		GL	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469
Reference	M-01	n	9	7	9	12	12	12	4	4	4	4	4	4	4	4	3	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.0450	0.0410	0.0320	0.0540	0.0380	0.0260	0.0360	0.0250	0.0260	0.0260	0.0180	0.0170	0.0330	0.0260	0.0190	0.0230	0.0660	0.0470	0.0260	0.0190
		75th Percentile	0.0360	0.0380	0.0270	0.0465	0.0285	0.0220	0.0320	0.0195	0.0255	0.0255	0.0160	0.0160	0.0260	0.0210	0.0190	0.0200	0.0430	0.0345	0.0225	0.0190
		Median	0.0320	0.0230	0.0270	0.0350	0.0225	0.0175	0.0250	0.0135	0.0240	0.0245	0.0130	0.0140	0.0190	0.0140	0.0170	0.0165	0.0180	0.0215	0.0180	0.0170
		25th Percentile	0.0270	0.0190	0.0230	0.0285	0.0190	0.0160	0.0185	0.0120	0.0195	0.0190	0.0115	0.0105	0.0155	0.0110	<0.0170	0.0135	0.0140	0.0205	0.0155	0.0100
		Minimum	0.0160	0.0160	0.0190	0.0220	0.0100	<0.00500	0.0150	0.0110	0.0160	0.0140	0.0110	<0.00800	0.0120	0.0100	<0.00700	0.0110	0.0120	0.0200	0.0140	<0.005
	Q-09	n	13	12	12	12	12	12	4	5	4	4	4	4	4	4	3	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.180	0.200	0.200	0.210	0.160	0.200	0.150	0.142	0.266	0.0910	0.184	0.174	0.162	0.100	0.283	0.114	0.134	0.108	0.126	0.173
		75th Percentile	0.170	0.170	0.104	0.170	0.115	0.150	0.125	0.0800	0.170	0.0585	0.108	0.105	0.118	0.0795	0.283	0.0720	0.102	0.0985	0.112	0.136
		Median	0.100	0.0955	0.0500	0.0545	0.0635	0.0490	0.0725	0.0450	0.0685	0.0255	0.0310	0.0360	0.0600	0.0430	0.0570	0.0300	0.0510	0.0740	0.0635	0.0685
		25th Percentile	0.0360	0.0350	0.0255	0.0275	0.0305	0.0365	0.0360	0.0390	0.0420	0.0230	0.0270	0.0320	0.0365	0.0245	0.0410	0.0295	0.0300	0.0475	0.0225	0.0310
		Minimum	0.0150	0.0180	0.0190	0.0160	0.0230	0.0280	0.0270	0.0270	0.0220	0.0210	0.0250	0.0280	0.0260	0.0220	0.0410	0.0290	0.0270	0.0360	0.0160	0.0250
	Q-20	n	2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	2	3
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0
		Maximum	0.00600	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	0.00700	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	-	0.00800	<0.007	<0.005	<0.005	<0.005
		75th Percentile	0.00600	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	0.00700	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	-	0.00800	<0.007	<0.005	<0.005	<0.005
		Median	0.00550	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	0.00700	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	-	0.00800	<0.007	<0.005	<0.005	<0.005
		25th Percentile	<0.00600	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	0.00700	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	-	0.00800	<0.007	<0.005	<0.005	<0.005
		Minimum	<0.00500	0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.00600	0.00700	<0.00500	<0.00500	<0.00800	<0.00800	<0.00700	-	0.00800	<0.007	<0.005	<0.005	<0.005
	SC-01	n	4	0	5	3	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
		n>GL	0	-	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0
		Maximum	0.230	-	0.0300	0.0130	0.0120	0.00600	<0.00500	0.0270	0.0100	<0.00500	0.00600	<0.00800	<0.00800	<0.00700	-	<0.007	0.0120	0.0150	0.0140	0.0260
		75th Percentile	0.230	-	0.0260	0.0130	0.0120	0.00600	<0.00500	0.0270	0.0100	<0.00500	0.00600	<0.00800	<0.00800	<0.00700	-	<0.007	0.0120	0.0150	0.0140	0.0260
		Median	0.225	-	0.0150	0.0110	0.0120	0.00600	<0.00500	0.0270	0.0100	<0.00500	0.00600	<0.00800	<0.00800	<0.00700	-	<0.007	0.0120	0.0150	0.0140	0.0260
		25th Percentile	0.149	-	0.0130	0.00800	0.0120	0.00600	<0.00500	0.0270	0.0100	<0.00500	0.00600	<0.00800	<0.00800	<0.00700	-	<0.007	0.0120	0.0150	0.0140	0.0260
		Minimum	0.0780	-	<0.0100	0.00800	0.0120	0.00600	<0.00500	0.0270	0.0100	<0.00500	0.00600	<0.00800	<0.00800	<0.00700	-	<0.007	0.0120	0.0150	0.0140	0.0260
	SR-01	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.0500	0.0370	0.0280	0.0350	0.0280	0.0260	0.0180	0.0240	0.0190	0.0250	0.0170	0.0190	0.0260	0.0280	0.0170	0.0310	0.0290	0.0270	<0.005	0.0220
		75th Percentile	0.0500	0.0370	0.0280	0.0350	0.0280	0.0260	0.0180	0.0240	0.0190	0.0250	0.0170	0.0190	0.0260	0.0280	0.0170	0.0310	0.0290	0.0270	<0.005	0.0220
		Median	0.0500	0.0370	0.0280	0.0350	0.0280	0.0260	0.0180	0.0240	0.0190	0.0250	0.0170	0.0190	0.0260	0.0280	0.0170	0.0310	0.0290	0.0270	<0.005	0.0220
		25th Percentile	0.0500	0.0370	0.0280	0.0350	0.0280	0.0260	0.0180	0.0240	0.0190	0.0250	0.0170	0.0190	0.0260	0.0280	0.0170	0.0310	0.0290	0.0270	<0.005	0.0220
		Minimum	0.0500	0.0370	0.0280	0.0350	0.0280	0.0260	0.0180	0.0240	0.0190	0.0250	0.0170	0.0190	0.0260	0.0280	0.0170	0.0310	0.0290	0.0270	<0.005	0.0220
	SR-06	n	2	2	2	2	2	2	2	2	2	2	2	2	3	4	13	2	2	2	2	2
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.0670	0.0400	0.0460	0.0460	0.0540	0.0720	0.0540	0.0500	0.0460	0.0620	0.0590	0.0690	0.0890	0.0990	0.121	0.0620	0.0550	0.0520	0.0410	0.0460
		75th Percentile	0.0670	0.0400	0.0460	0.0460	0.0540	0.0720	0.0540	0.0500	0.0460	0.0620	0.0590	0.0690	0.0890	0.0990	0.113	0.0620	0.0550	0.0520	0.0410	0.0460
		Median	0.0515	0.0325	0.0405	0.0445	0.0460	0.0640	0.0475	0.0415	0.0440	0.0515	0.0570	0.0635	0.0860	0.0955	0.102	0.0570	0.0535	0.0460	0.0405	0.0440
		25th Percentile	0.0360	0.0250	0.0350	0.0430	0.0380	0.0560	0.0410	0.0330	0.0420	0.0410	0.0550	0.0580	0.0480	0.0790	0.0900	0.0520	0.0520	0.0400	0.0400	0.0420
		Minimum	0.0360	0.0250	0.0350	0.0430	0.0380	0.0560	0.0410	0.0330	0.0420	0.0410	0.0550	0.0580	0.0480	0.0660	0.0720	0.0520	0.0520	0.0400	0.0400	0.0420
	SR-08	n	12	12	12	12	12	12	4	4	4	4	4	4	4	4	3	4	4	4	4	4
		n>GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Maximum	0.0760	0.100	0.0540	0.0450	0.0450	0.0450	0.0370	0.0430	0.0360	0.0310	0.0290	0.0340	0.0390	0.0390	0.0360	0.0360	0.0360	0.0440	0.0300	0.0350
		75th Percentile	0.0700	0.0650	0.0430	0.0385	0.0390	0.0405	0.0365	0.0390	0.0330	0.0275	0.0290	0.0320	0.0350	0.0310	0.0360	0.0330	0.0335	0.0355	0.0280	0.0315
		Median	0.0570	0.0595	0.0400	0.0355	0.0310	0.0365	0.0350	0.0305	0.0300	0.0235	0.0275	0.0290	0.0290	0.0225	0.0310	0.0300	0.0300	0.0255	0.0250	0.0250
		25th Percentile	0.0515	0.0510	0.0380	0.0335	0.0275	0.0305	0.0315	0.0250	0.0280	0.0215	0.0235	0.0245	0.0230	0.0210	0.0280	0.0275	0.0255	0.0235	0.0215	0.0210
		Minimum	0.0420	0.0480	0.0340	0.0240	0.0250	0.0210	0.0290	0.0240	0.0260	0.0200	0.0210	0.0210	0.0190	0.0200	0.0280	0.0250	0.0220	0.0230	0.0190	0.0200
	SR-15	n	2	2	2	2	2	2	0	0	0	0	0	0	2	2	3	2	2	2	2	2
		n>GL	0	0	0	0	0	0	-	-	-	-	-	-	0	0	0	0	0	0	0	0
		Maximum	0.0530	0.0470	0.0430	0.0430	0.0450	0.0620	-	-	-	-	-	-	0.0640	0.0820	0.0700	0.0520	0.0470	0.0540	0.0630	0.0240
		75th Percentile	0.0530	0.0470	0.0430	0.0430	0.0450	0.0620	-	-	-	-	-	-	0.0640	0.0820	0.0700	0.0520	0.0470	0.0540	0.0630	0.0240
		Median	0.0495	0.0460	0.0390	0.0325	0.0420	0.0475	-	-	-	-	-	-	0.0485	0.0690	0.0540	0.0485	0.0445	0.0470	0.0525	0.0235
		25th Percentile	0.0460	0.0450	0.0350	0.0220	0.0390	0.0330	-	-	-	-	-	-	0.0330	0.0560	0.0500	0.0450	0.0420	0.0400	0.0420	0.0230
		Minimum	0.0460	0.0450	0.0350	0.0220	0.0390	0.0330	-	-	-	-	-	-	0.0330	0.0560	0.0500	0.0450	0.0420	0.0400	0.0420	0.0230

Indicates radium concentrations surpassed guidelines.

Notes: "GL" = Guideline; "n" = number of samples.

Table 6.2: SRWMP Station Radium-226 Concentrations, 2019 to 2023

Station Type	Station	Sample Date	Radium-226 Bq/L
Reference	D-4	15-May-19	<0.007
Reference	D-4	15-Nov-19	<0.007
Reference	D-4	25-May-20	<0.007
Reference	D-4	23-Nov-20	<0.007
Reference	D-4	20-May-21	0.00500
Reference	D-4	11-Nov-21	<0.005
Reference	D-4	5-May-22	<0.005
Reference	D-4	23-Aug-22	<0.005
Reference	D-4	23-Nov-22	<0.005
Reference	D-4	11-May-23	<0.005
Reference	D-4	14-Aug-23	<0.005
Reference	D-4	15-Nov-23	<0.005
Reference	SR-16	15-Mar-19	<0.007
Reference	SR-16	15-May-19	<0.007
Reference	SR-16	15-Aug-19	<0.007
Reference	SR-16	15-Nov-19	<0.007
Reference	SR-16	21-Feb-20	<0.007
Reference	SR-16	26-May-20	<0.007
Reference	SR-16	19-Aug-20	<0.007
Reference	SR-16	24-Nov-20	<0.007
Reference	SR-16	24-Feb-21	<0.007
Reference	SR-16	18-May-21	<0.005
Reference	SR-16	19-Aug-21	<0.005
Reference	SR-16	18-Nov-21	<0.005
Reference	SR-16	17-Feb-22	<0.005
Reference	SR-16	27-May-22	<0.005
Reference	SR-16	9-Aug-22	<0.005
Reference	SR-16	3-Nov-22	0.00700
Reference	SR-16	22-Feb-23	<0.005
Reference	SR-16	10-May-23	<0.005
Reference	SR-16	16-Aug-23	<0.005
Reference	SR-16	30-Oct-23	<0.005
Reference	SR-17	15-Feb-19	<0.007
Reference	SR-17	15-May-19	<0.007
Reference	SR-17	15-Aug-19	<0.007
Reference	SR-17	15-Nov-19	<0.007
Reference	SR-17	6-Feb-20	<0.007
Reference	SR-17	26-May-20	<0.007
Reference	SR-17	19-Aug-20	<0.007
Reference	SR-17	24-Nov-20	<0.007
Reference	SR-17	24-Feb-21	<0.007
Reference	SR-17	18-May-21	0.00800
Reference	SR-17	19-Aug-21	0.00800
Reference	SR-17	18-Nov-21	<0.005
Reference	SR-17	15-Feb-22	<0.005
Reference	SR-17	26-May-22	<0.005
Reference	SR-17	9-Aug-22	<0.005
Reference	SR-17	28-Nov-22	<0.005
Reference	SR-17	22-Feb-23	<0.005
Reference	SR-17	10-May-23	0.00500
Reference	SR-17	17-Aug-23	0.00600
Reference	SR-17	31-Oct-23	<0.005
Reference	SR-18	15-May-19	<0.007
Reference	SR-18	15-Nov-19	<0.007
Reference	SR-18	13-May-20	<0.007
Reference	SR-18	19-Nov-20	<0.007
Reference	SR-18	20-May-21	0.00700
Reference	SR-18	18-Nov-21	<0.005
Reference	SR-18	26-May-22	<0.005
Reference	SR-18	23-Nov-22	<0.005
Reference	SR-18	10-May-23	<0.005
Reference	SR-18	31-Oct-23	<0.005

Indicates radium concentrations surpassed guidelines.

Table 6.2: SRWMP Station Radium-226 Concentrations, 2019 to 2023

Station Type	Station	Sample Date	Radium-226 Bq/L
Reference	SR-19	15-Feb-19	<0.007
Reference	SR-19	15-May-19	<0.007
Reference	SR-19	15-Aug-19	<0.007
Reference	SR-19	15-Nov-19	<0.007
Reference	SR-19	6-Feb-20	<0.007
Reference	SR-19	13-May-20	<0.007
Reference	SR-19	20-Aug-20	<0.007
Reference	SR-19	24-Nov-20	<0.007
Reference	SR-19	22-Feb-21	<0.007
Reference	SR-19	12-May-21	0.0110
Reference	SR-19	16-Aug-21	<0.005
Reference	SR-19	15-Nov-21	<0.005
Reference	SR-19	17-Feb-22	<0.005
Reference	SR-19	26-May-22	<0.005
Reference	SR-19	9-Aug-22	<0.005
Reference	SR-19	17-Nov-22	<0.005
Reference	SR-19	8-Feb-23	<0.005
Reference	SR-19	10-May-23	<0.005
Reference	SR-19	15-Aug-23	<0.005
Reference	SR-19	30-Oct-23	<0.005
Mine-exposed	D-5	15-Feb-19	0.0170
Mine-exposed	D-5	15-May-19	0.0160
Mine-exposed	D-5	15-Aug-19	0.108
Mine-exposed	D-5	15-Nov-19	0.0210
Mine-exposed	D-5	4-Feb-20	0.0190
Mine-exposed	D-5	25-May-20	0.0570
Mine-exposed	D-5	19-Aug-20	0.0870
Mine-exposed	D-5	23-Nov-20	0.0130
Mine-exposed	D-5	22-Feb-21	0.0170
Mine-exposed	D-5	20-May-21	0.0300
Mine-exposed	D-5	11-Aug-21	0.0820
Mine-exposed	D-5	11-Nov-21	0.0800
Mine-exposed	D-5	3-Feb-22	0.00800
Mine-exposed	D-5	5-May-22	0.0250
Mine-exposed	D-5	23-Aug-22	0.0960
Mine-exposed	D-5	23-Nov-22	0.121
Mine-exposed	D-5	24-Feb-23	0.0320
Mine-exposed	D-5	11-May-23	<0.005
Mine-exposed	D-5	14-Aug-23	0.0920
Mine-exposed	D-5	15-Nov-23	0.137
Mine-exposed	D-6	15-Feb-19	<0.007
Mine-exposed	D-6	15-May-19	<0.007
Mine-exposed	D-6	15-Aug-19	0.0140
Mine-exposed	D-6	15-Nov-19	<0.007
Mine-exposed	D-6	4-Feb-20	<0.007
Mine-exposed	D-6	25-May-20	<0.007
Mine-exposed	D-6	19-Aug-20	<0.007
Mine-exposed	D-6	23-Nov-20	<0.007
Mine-exposed	D-6	22-Feb-21	<0.007
Mine-exposed	D-6	20-May-21	0.00900
Mine-exposed	D-6	11-Aug-21	0.0100
Mine-exposed	D-6	11-Nov-21	0.00800
Mine-exposed	D-6	3-Feb-22	<0.005
Mine-exposed	D-6	5-May-22	<0.005
Mine-exposed	D-6	23-Aug-22	<0.005
Mine-exposed	D-6	25-Nov-22	<0.005
Mine-exposed	D-6	23-Feb-23	<0.005
Mine-exposed	D-6	18-May-23	<0.005
Mine-exposed	D-6	17-Aug-23	<0.005
Mine-exposed	D-6	15-Nov-23	<0.005

Indicates radium concentrations surpassed guidelines.

Table 6.2: SRWMP Station Radium-226 Concentrations, 2019 to 2023

Station Type	Station	Sample Date	Radium-226 Bq/L
Mine-exposed	DS-18	15-Feb-19	0.132
Mine-exposed	DS-18	15-May-19	0.102
Mine-exposed	DS-18	15-Aug-19	0.0940
Mine-exposed	DS-18	15-Nov-19	0.114
Mine-exposed	DS-18	4-Feb-20	0.0950
Mine-exposed	DS-18	26-May-20	0.106
Mine-exposed	DS-18	11-Aug-20	0.0730
Mine-exposed	DS-18	19-Oct-20	0.146
Mine-exposed	DS-18	23-Feb-21	0.0580
Mine-exposed	DS-18	13-May-21	0.221
Mine-exposed	DS-18	17-Aug-21	0.119
Mine-exposed	DS-18	13-Oct-21	0.133
Mine-exposed	DS-18	15-Feb-22	0.108
Mine-exposed	DS-18	25-May-22	0.133
Mine-exposed	DS-18	23-Aug-22	0.0780
Mine-exposed	DS-18	29-Nov-22	0.0800
Mine-exposed	DS-18	14-Feb-23	0.142
Mine-exposed	DS-18	25-May-23	0.102
Mine-exposed	DS-18	23-Aug-23	0.0480
Mine-exposed	DS-18	7-Nov-23	0.0640
Mine-exposed	M-01	15-Feb-19	0.0110
Mine-exposed	M-01	15-May-19	0.0170
Mine-exposed	M-01	15-Aug-19	0.0230
Mine-exposed	M-01	15-Nov-19	0.0160
Mine-exposed	M-01	6-Feb-20	0.0120
Mine-exposed	M-01	13-May-20	0.0160
Mine-exposed	M-01	20-Aug-20	0.0660
Mine-exposed	M-01	4-Nov-20	0.0200
Mine-exposed	M-01	22-Feb-21	0.0200
Mine-exposed	M-01	12-May-21	0.0210
Mine-exposed	M-01	16-Aug-21	0.0470
Mine-exposed	M-01	10-Nov-21	0.0220
Mine-exposed	M-01	17-Feb-22	0.0140
Mine-exposed	M-01	26-May-22	0.0170
Mine-exposed	M-01	9-Aug-22	0.0260
Mine-exposed	M-01	17-Nov-22	0.0190
Mine-exposed	M-01	16-Feb-23	0.0190
Mine-exposed	M-01	18-May-23	0.0190
Mine-exposed	M-01	15-Aug-23	<0.005
Mine-exposed	M-01	1-Nov-23	0.0150
Mine-exposed	Q-09	15-Feb-19	0.0300
Mine-exposed	Q-09	15-May-19	0.0290
Mine-exposed	Q-09	15-Aug-19	0.114
Mine-exposed	Q-09	15-Nov-19	0.0300
Mine-exposed	Q-09	4-Feb-20	0.0330
Mine-exposed	Q-09	25-May-20	0.0690
Mine-exposed	Q-09	19-Aug-20	0.134
Mine-exposed	Q-09	23-Nov-20	0.0270
Mine-exposed	Q-09	22-Feb-21	0.0360
Mine-exposed	Q-09	20-May-21	0.0590
Mine-exposed	Q-09	11-Aug-21	0.108
Mine-exposed	Q-09	11-Nov-21	0.0890
Mine-exposed	Q-09	3-Feb-22	0.0290
Mine-exposed	Q-09	5-May-22	0.0160
Mine-exposed	Q-09	23-Aug-22	0.126
Mine-exposed	Q-09	24-Nov-22	0.0980
Mine-exposed	Q-09	22-Feb-23	0.0370
Mine-exposed	Q-09	11-May-23	0.0250
Mine-exposed	Q-09	14-Aug-23	0.173
Mine-exposed	Q-09	1-Nov-23	0.100
Mine-exposed	Q-20	15-Nov-19	0.00800
Mine-exposed	Q-20	19-Nov-20	<0.007
Mine-exposed	Q-20	18-Nov-21	<0.005
Mine-exposed	Q-20	23-Aug-22	<0.005
Mine-exposed	Q-20	7-Nov-22	<0.005
Mine-exposed	Q-20	10-May-23	<0.005
Mine-exposed	Q-20	17-Aug-23	<0.005
Mine-exposed	Q-20	31-Oct-23	<0.005

Indicates radium concentrations surpassed guidelines.

Table 6.2: SRWMP Station Radium-226 Concentrations, 2019 to 2023

Station Type	Station	Sample Date	Radium-226 Bq/L
Mine-exposed	SC-01	15-Nov-19	<0.007
Mine-exposed	SC-01	18-Nov-20	0.0120
Mine-exposed	SC-01	18-Nov-21	0.0150
Mine-exposed	SC-01	25-Nov-22	0.0140
Mine-exposed	SC-01	30-Oct-23	0.0260
Mine-exposed	SR-01	15-Oct-19	0.0310
Mine-exposed	SR-01	19-Oct-20	0.0290
Mine-exposed	SR-01	30-Sep-21	0.0270
Mine-exposed	SR-01	29-Sep-22	<0.005
Mine-exposed	SR-01	28-Sep-23	0.0220
Mine-exposed	SR-06	15-May-19	0.0620
Mine-exposed	SR-06	15-Oct-19	0.0520
Mine-exposed	SR-06	25-Jun-20	0.0550
Mine-exposed	SR-06	19-Oct-20	0.0520
Mine-exposed	SR-06	13-May-21	0.0400
Mine-exposed	SR-06	13-Oct-21	0.0520
Mine-exposed	SR-06	25-May-22	0.0400
Mine-exposed	SR-06	29-Sep-22	0.0410
Mine-exposed	SR-06	25-May-23	0.0420
Mine-exposed	SR-06	2-Nov-23	0.0460
Mine-exposed	SR-08	15-Feb-19	0.0360
Mine-exposed	SR-08	15-May-19	0.0300
Mine-exposed	SR-08	15-Aug-19	0.0250
Mine-exposed	SR-08	15-Nov-19	0.0300
Mine-exposed	SR-08	6-Feb-20	0.0220
Mine-exposed	SR-08	13-May-20	0.0290
Mine-exposed	SR-08	20-Aug-20	0.0310
Mine-exposed	SR-08	4-Nov-20	0.0360
Mine-exposed	SR-08	23-Feb-21	0.0240
Mine-exposed	SR-08	18-May-21	0.0230
Mine-exposed	SR-08	11-Aug-21	0.0270
Mine-exposed	SR-08	15-Nov-21	0.0440
Mine-exposed	SR-08	17-Feb-22	0.0260
Mine-exposed	SR-08	27-May-22	0.0240
Mine-exposed	SR-08	9-Aug-22	0.0190
Mine-exposed	SR-08	3-Nov-22	0.0300
Mine-exposed	SR-08	8-Feb-23	0.0350
Mine-exposed	SR-08	10-May-23	0.0220
Mine-exposed	SR-08	15-Aug-23	0.0280
Mine-exposed	SR-08	30-Oct-23	0.0200
Mine-exposed	SR-15	15-May-19	0.0520
Mine-exposed	SR-15	15-Oct-19	0.0450
Mine-exposed	SR-15	25-Jun-20	0.0470
Mine-exposed	SR-15	19-Oct-20	0.0420
Mine-exposed	SR-15	13-May-21	0.0400
Mine-exposed	SR-15	13-Oct-21	0.0540
Mine-exposed	SR-15	25-May-22	0.0420
Mine-exposed	SR-15	23-Sep-22	0.0630
Mine-exposed	SR-15	25-May-23	0.0240
Mine-exposed	SR-15	14-Nov-23	0.0230

Indicates radium concentrations surpassed guidelines.

Assessment is not warranted at this time. Additional data will be screened and reviewed as part of the Cycle 7 SOE study design, or more frequently if major facility changes are proposed that would represent a potential increase in risk.

The CNSC has asked RAL and DMI to undertake annual reporting of radiation dose to the public associated with their closed uranium mine sites in the SRW. The annual dose reporting will be based on periodic updates undertaken as part of the SOE reports with the intention for annual SRWMP Reports to include realistic doses for a representative person residing in the town of Elliot Lake. The “representative person” (ICRP 2007) is equivalent to and replaces the “average member of the critical group” (ICRP 1986) as the basis for determining compliance with public dose limits and guidelines. Any Public Dose Estimation updates that have occurred or are recommended will be discussed in detail in the Cycle 7 SOE study design.

7 QUALITY MANAGEMENT PLAN

7.1 Overview

Total quality management is a key operational objective of all the environmental monitoring programs at the Elliot Lake closed uranium mines. Consistent with this, a Quality Management Plan (QMP) was embraced in the original design for the SRWMP (Beak 1999b) and similar QMPs were presented in the original designs for SAMP and TOMP (Minnow 2002a,b). The QMP was updated in a Framework Document prepared to support the three monitoring programs (Minnow 2009f). While there are no changes proposed to the QMP, a description of the program is provided below.

A number of formal procedures have been implemented and are maintained to assure the quality of data generated by the monitoring programs. Such procedures include definition of organization and reporting channels, adherence to SOPs, requirements for training, adherence to data quality and quantity objectives, requirements for the collection of quality control data, and procedures for Data Quality Assessment (DQA) as well as the management of data and documents.

7.2 General Responsibilities, Controls and Reporting Channels

Each licensee is responsible for monitoring their own source areas, so the responsibility for reporting and responding to the results is separately retained by each mining company. The companies participate jointly in the SRWMP where they share responsibility for reporting and responding to results. Both companies have agreed to implement consistent standards and procedures for field measurements, sample collection and handling, data validation and management, data quality management, response monitoring, and training.

Consistency is an important component of a QMP. To minimize field and laboratory error and to maintain consistency in data collected, RAL and DMI have agreed to implement standardized sampling and analytical methods. Consistent SOPs are maintained with any modifications undertaken through a formal revision of standards. Such modifications to SOPs are reported in the Annual Reports of each company. Each established SOP has an operating procedure number as part of routine monitoring (Table 7.1). Any short-term changes to the specified methods must be documented in the field or laboratory notes and recorded in the data management database. Detailed notes are made in the field so that any discrepancy may be traced. All samples, related field observations, and field data are logged into the data management system with relevant sample information recorded on the chain of custody form.

Table 7.1: List of Standard Operating Procedures Associated with Routine Monitoring

Procedure Name	Operating Procedure Number
Surface Water Grab Sampling Procedure	PR8.6.1-01
Depth Sampling Procedure	PR8.6.1-02
Toxicity Sampling Procedure	PR8.6.1-03
Groundwater Sampling & Sample Preparation Procedure	PR8.6.2-01
Field pH Determination Procedure	PR8.6.3-01
Conductivity Determination Procedure	PR8.6.3-03
Current Meter Flow Monitoring Procedure	PR8.6.4-01
Flow Determination Procedure	PR8.6.4-02
Field Quality Control Procedure	PR8.5.3-01
Data Entry Procedure	PR8.7.3-01
Data Validation Procedure	PR8.7.3-02
Limit Maintenance Procedure	PR8.7.2-02
Water Quality Data Quality Assessment	PR8.5.4-01
Water Quality Assessment and Response Plan	PR8.8.0-01
Database Archiving and Back-up Procedure	PR8.7.2-03

7.3 Training, Health and Safety Requirements

All staff and consultants involved in the Elliot Lake monitoring programs must be appropriately qualified and trained for their respective responsibilities in the programs (e.g., sample collection and handling, analyses, data entry, reporting, etc.). Experience and skill requirements for care and maintenance personnel are documented in position profiles. Each SOP identifies training requirements with completion of training tracked in the Training Database.

Everyone involved in field components of the monitoring programs are required to comply with the Health and Safety Policies and Procedures of RAL and DMI.

7.4 Data Quality Objectives

Data Quality Objectives (DQO) are statements of desired sensitivity, precision, and accuracy that will permit a defined level of confidence in data from the monitoring programs. Data quality objectives are established for the Elliot Lake monitoring programs to serve as criteria for data acceptability (Table 7.2). These objectives consider the intended use of the data and the technical feasibility of collecting data of such quality. They also consider the need to ensure compatibility of data among the TOMP, SAMP, and SRWMP.

Assurance of adequate data quality is only possible when uses of specific data and DQO have been defined (Table 7.2). Data quality objectives may pertain to factors such as sensitivity, precision, accuracy, comparability, compatibility, representativeness, and completeness. These DQO include negligible contaminant levels in all blanks and rinses, acceptable variability between field duplicates and laboratory replicate samples, efficient recovery of matrix spikes, minimal bias in analytical estimates for certified reference materials, and sub-sampling checks and organism recovery checks for benthic invertebrate community samples.

7.5 Quality Control

Quality control (QC) samples are taken in the field and in the laboratory. General guidelines for the type of quality control samples required to track and minimize the effects of bias and imprecision in the sampling effort are outlined below. Collectively, these types of QC samples should be applied to approximately 10% of all samples collected. Types of QC samples that will be used in the SRWMP, SAMP, and TOMP include:

Field (Bottle) Blanks: A field blank is a sample of distilled/de-ionized water that is placed by field personnel into a bottle identical to those used for all samples at a randomly selected sampling location. The field blank allows assessment of the potential contamination of the sample by the bottle itself, preservatives, dust, and sample handling.

Table 7.2: Data Quality Objectives for the TOMP, SAMP, and SRWMP

Measurements	Units	Laboratory Reporting Limit	Blank Criterion	Analytical Precision (Duplicates)	Analytical Accuracy		Field Precision (Duplicates)
					Spike	CRM[b]	
Field Measurements							
pH	pH units	0.1	-	0.1[a]	-	-	10%
conductivity	mS/cm	0.01	-	0.05[a]	-	-	10%
dissolved oxygen	mg/L	0.01	-	0.05[a]	-	-	20%
temperature	°C	-[a]	-	0.1[a]	-	-	20%
flow	L/s	-[a]	-	0.1[a]	-	-	30%
Laboratory Water Chemistry							
acidity	mg/L	1.0	2.0	10%	-	-	20%
barium	mg/L	0.005	0.01	10%	20%	20%	20%
cobalt	mg/L	0.0005	0.001	10%	20%	20%	20%
hardness	mg/L	0.5	1.0	10%	-	-	20%
iron	mg/L	0.02	0.04	10%	20%	20%	20%
manganese	mg/L	0.002	0.004	10%	20%	20%	20%
radium-226	Bq/L	0.005	0.01	10%	20%	-	20%
sulphate	mg/L	0.1	0.2	10%	20%	20%	20%
total suspended solids	mg/L	1.0	2.0	10%	-	-	20%
uranium	mg/L	0.0005	0.001	10%	20%	20%	20%
Laboratory Sediment Chemistry							
barium	mg/kg	0.5	-	20%	30%	30%	40%
cobalt	mg/kg	0.2	-	20%	30%	30%	40%
iron	mg/kg	20	-	20%	30%	30%	40%
manganese	mg/kg	0.5	-	20%	30%	30%	40%
nickel	mg/kg	0.5	-	20%	30%	30%	40%
radium-226	Bq/kg	5	-	20%	30%	30%	40%
uranium	mg/kg	0.1	-	20%	30%	30%	40%
grain size	%	0.1	-	20%	30%	30%	40%
Total Organic Carbon	%	0.05	-	20%	30%	30%	40%
Benthos							
organism recovery		-	-	90%	-	-	-
sub-sampling precision		-	-	20%	-	-	-
sub-sampling accuracy		-	-	20%	-	-	-

Notes: "-" indicates TOMP = (Tailings Management Area [TMA] Operational Monitoring Program). SAMP = Source Area Monitoring Program. SRWMP = Serpent River Watershed Monitoring Program.

[a] Laboratory Reporting Limit varies with method.

[b] CRM (Certified Reference Material).

Field Duplicates: A field duplicate is a randomly selected sample that is taken by field personnel at the same time and location as a regular field sample (i.e., side by side). The samples are prepared and analyzed in an identical manner. The data from field duplicate samples reflect the natural spatial and/or temporal variability, as well as the variability associated with sample collection, handling, and analysis.

Laboratory Blanks: A laboratory blank is a randomly selected laboratory analysis vial that is filled with distilled water and/or appropriate laboratory reagent(s) by laboratory personnel and then analyzed as a regular sample. The laboratory blank is similar to the field (bottle) blank and allows an assessment of the potential contribution of the analysis vial, laboratory reagents, or laboratory cross-contamination to analyte concentrations.

Laboratory Duplicates: A laboratory duplicate is a sample that has been submitted for analysis and is randomly divided by laboratory personnel into two (or more) sub samples that are analyzed independently. The laboratory duplicate sample results reflect the variability introduced during laboratory sample handling and analysis.

Certified Reference Samples: A certified reference sample is certified reference material (CRM) prepared and analyzed by laboratory personnel in a manner identical to the field-collected samples. The certified reference material allows an assessment of the analytical accuracy and allows for instrument calibration.

Sub-Sampling Checks: Sub-sampling checks are performed on benthic invertebrate community samples when excessive sample volume and/or organism density results in only a small amount of the original sample being analyzed. By comparing the numbers of periphyton cells or benthic invertebrates recovered between at least two sub-samples, this measure provides an evaluation of how effective the sub-sampling method was in evenly dividing the original sample. Therefore, sub-sampling error provides a measure of analytical accuracy and precision. The processing of entire samples in representative sample fractions also allows an evaluation of sub-sampling accuracy.

Organism Recovery Checks: Organism recovery checks for benthic invertebrate community samples involve the re-processing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved during the original processing to reduce any bias. This check allows the determination of accuracy through assessment of recovery efficiency.

The number of field QC samples should correspond to a minimum of 10% of the total number of samples taken in the sampling period the QC samples are intended to represent. The same rule

applies to the laboratory QC samples. Quality control samples are integral to a quality assurance program, and recommendations for their use should be strictly followed.

7.6 Data Quality Assessment

In order to assess whether the overall quality of the monitoring programs is assured, formal DQA procedures must be utilized. The overall objective of a quality assurance program is to control measurement errors to acceptable levels and to ensure, therefore, that the data are useful and of known quality. For water monitoring DQA will be undertaken monthly on an informal basis and annually on a more formal basis. The informal monthly assessment will be geared to pinpointing and correcting errors, while the annual assessment will involve formal quality assurance reporting. Formal reporting will be based on a direct comparison of QC sample results with the specified objectives (Table 7.2). The analytical facility provides a monthly and annual summary report of blank sample analyses, and the precision and accuracy achieved on sets of analyses. The annual data quality assessment reviews these laboratory reports and incorporates all field blank and field duplicate measurements to identify any significant findings relative to the DQO. Formal quality assurance reporting will also include an assessment of the implications, if any, of any results that did not achieve the DQO, as well as any recommendations for improvement. Formal quality assurance reports must be issued by each contracted laboratory, reviewed and signed by the Environmental Coordinator (or equivalent position), filed as part of the long-term quality assurance record of the monitoring program and included with the Annual Reports (Section 9). This will provide data users with a consistent record of data quality and can be used to determine the cause of any inconsistencies.

Based on a recommendation from the Cycle 5 SOE report, the Cycle 6/7 SOE report Data Quality Assessment will include a statement of uncertainties identified through annual data quality assessments and during preparation of the SOE report.

7.7 Data Management

All water quality monitoring and physical measurement data are maintained in a secure environmental monitoring database with functions that include:

- Scheduling of field activities, samples and parameters;
- Data entry and review;
- Data validation including comparison to control limits;
- Audit of data entry and review activities;
- Report generation; and

- Data archiving.

Data validation procedures (Figure 7.1) ensure that all data are reviewed and validated in a timely manner. The data validation process ensures that only data that are considered reliable are entered into the database. The process will flag any data falling outside of the primary assessment limits (mean ± 3 standard deviations) and trigger investigation of the possible cause. Potential causes may include:

- Sampling error;
- Laboratory analysis or reporting error;
- Data quality issue;
- Temporary system upset (e.g., extreme flow event); and/or
- System change (e.g., flow by-pass).

Flagged water quality will be verified against other findings in a weight of evidence approach. More specifically, the data will be evaluated in the context of other parameters measured in the same sample, data for upstream and downstream stations, and field conditions, based on considerations such as those listed below:

- Is the outlier isolated to one chemical parameter? If other parameters show extreme values too, then it is not likely an analysis error;
- Is there an extreme value upstream or downstream for the same parameter? Involvement of another station may indicate a change in the system rather than an analysis or sampling error;
- Are there similar outliers at unrelated stations? If the only outliers are at related stations, original outliers are corroborated; if not, a sampling or analysis error is likely;
- Do the data correspond to the expected geochemical evolution of upstream sources? If yes, the data points likely represent a real change;
- Is there evidence of a previous trend that was not detected until the data exceeded the assessment limits? If the outlier is a continuation of this trend, the data point can assumed to be valid; and
- Is there a trend at the source? If there is a corresponding change at source, the outlier is likely the downstream manifestation of this change and indicates a system change.

If the cause is known and/or repeated testing confirms a change in condition (step change or gradual trend), the data are accepted into the database and the monitoring program continues.

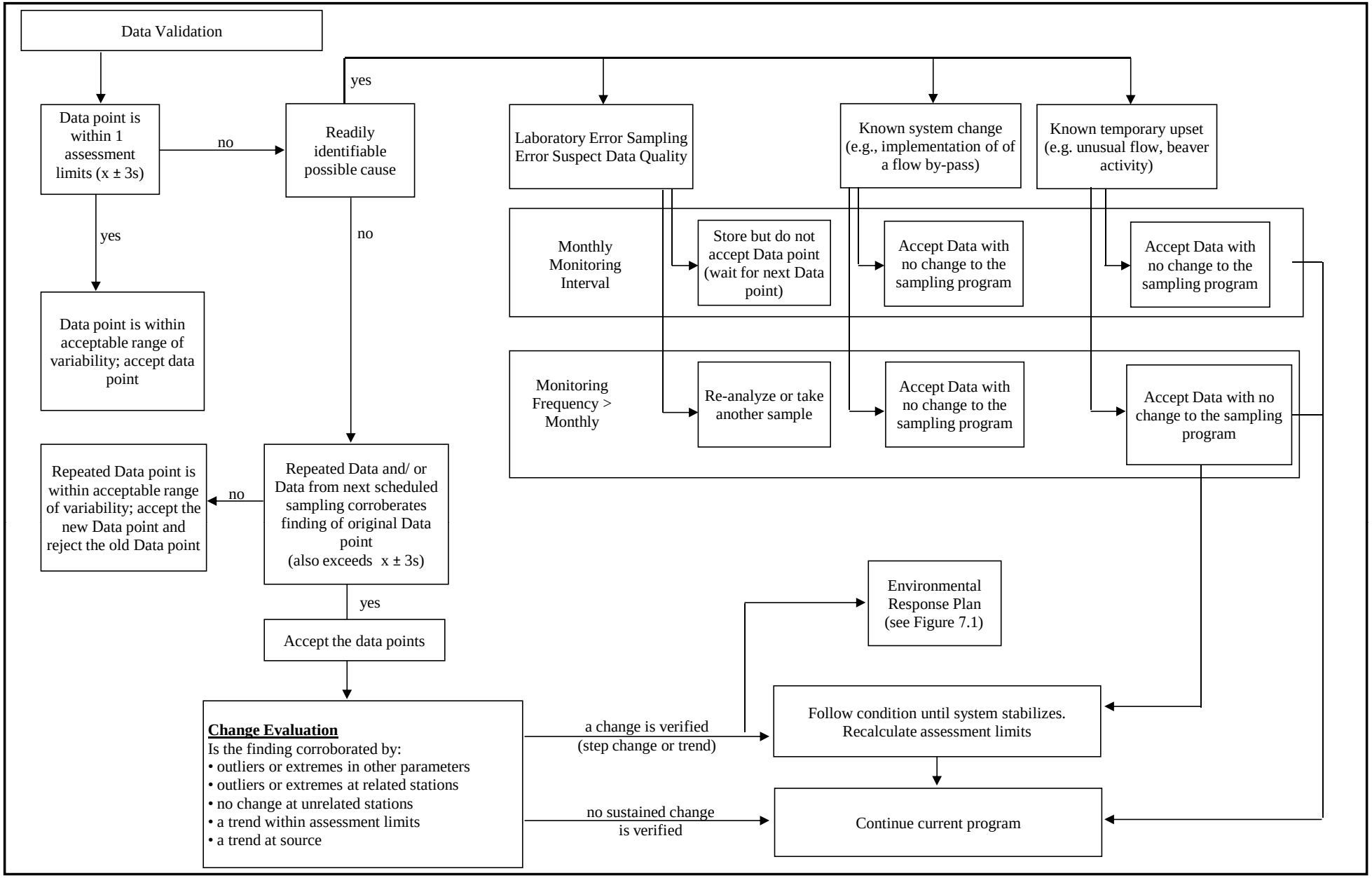

Figure 7.1: Decision Path for Data Validation for SRWMP, SAMP, and TOMP, Cycle 6/7 (2020 to 2030)

If a negative change in condition is confirmed an Environmental Response Plan will be initiated (Section 8).

7.8 Document and Data Control

The management of data, monitoring program reports and the monitoring program database is the responsibility of the licensees. The environmental monitoring database will be the permanent record of all water quality data. The Environmental Coordinator (or equivalent position) for each of the licensees is responsible for assuring complete and accurate identification and scheduling of all required program samples and data parameters as well as for ensuring required back-up and off-site storage of information.

Monitoring program reports are required to include all related program data and must be provided in an electronic format that can be included in the permanent electronic reference archive.

8 ENVIRONMENTAL RESPONSE PLAN

An Environmental Response Plan (ERP) was prepared as part of the original design for the SRWMP (Beak 1999b) and updated in a Framework Document prepared to support the three monitoring programs (Minnow 2009f). While there are no changes proposed to the ERP, a description of the program is provided below.

As identified in Section 7 (quality management plan Figure 7.1), water quality data (TOMP, SAMP or SRWMP) that are confirmed to be outside of the "normal" range of data for a given location will trigger an investigation to determine the possible cause. In cases where the data indicate a change has occurred (i.e., a step change or gradual trend toward a new condition) an Environmental Response Plan will be triggered.

The purpose of the response plan is to evaluate the available data and, to the extent possible, implement a response to protect the downstream environment and the public. Ultimate responsibility for the implementation of the response plan lies with the licensees.

If a trend or change is confirmed and is found to be acceptable (e.g., indicative of improving environmental quality), the findings will simply be reported in the next Annual Report and the monitoring program will continue. Also, potential changes to the program study design (likely a reduction in scope) should be evaluated at the next scheduled study design review (Section 9). If a confirmed change is unacceptable (i.e., worsening conditions), the cause should be further investigated (Figure 8.1). If a cause can be identified and is mining related, the ecological, human health, and socio-economic significance should be assessed. A negligible impact would be cause to maintain the current monitoring program.

If the evaluation indicates an unacceptable, mine-related change with significant ecological, human health, or socio-economic impact, appropriate responses must be implemented to minimize the effects. Such protection will entail source management and/or mitigation of ecological and/or human health effects. For example, source management may involve improvements to effluent treatment or cessation of discharge. Mitigation of environmental effects may be achieved through source management or may involve alternative strategies, such as a water diversion to limit biological exposures. Mitigation of human health is expected only should a catastrophic failure occur and would be achieved through public advisories. Specifically, if the concentrations of mine-related chemical constituents under review exceed human-health guidelines (e.g., public dose limit), advisories will alert the public to such conditions and recommend appropriate actions/precautions to be taken. Communication of confirmed system changes is critical and it is the responsibility of the licensees to notify the CNSC of such occurrences in accordance with licence and regulatory reporting guidelines.

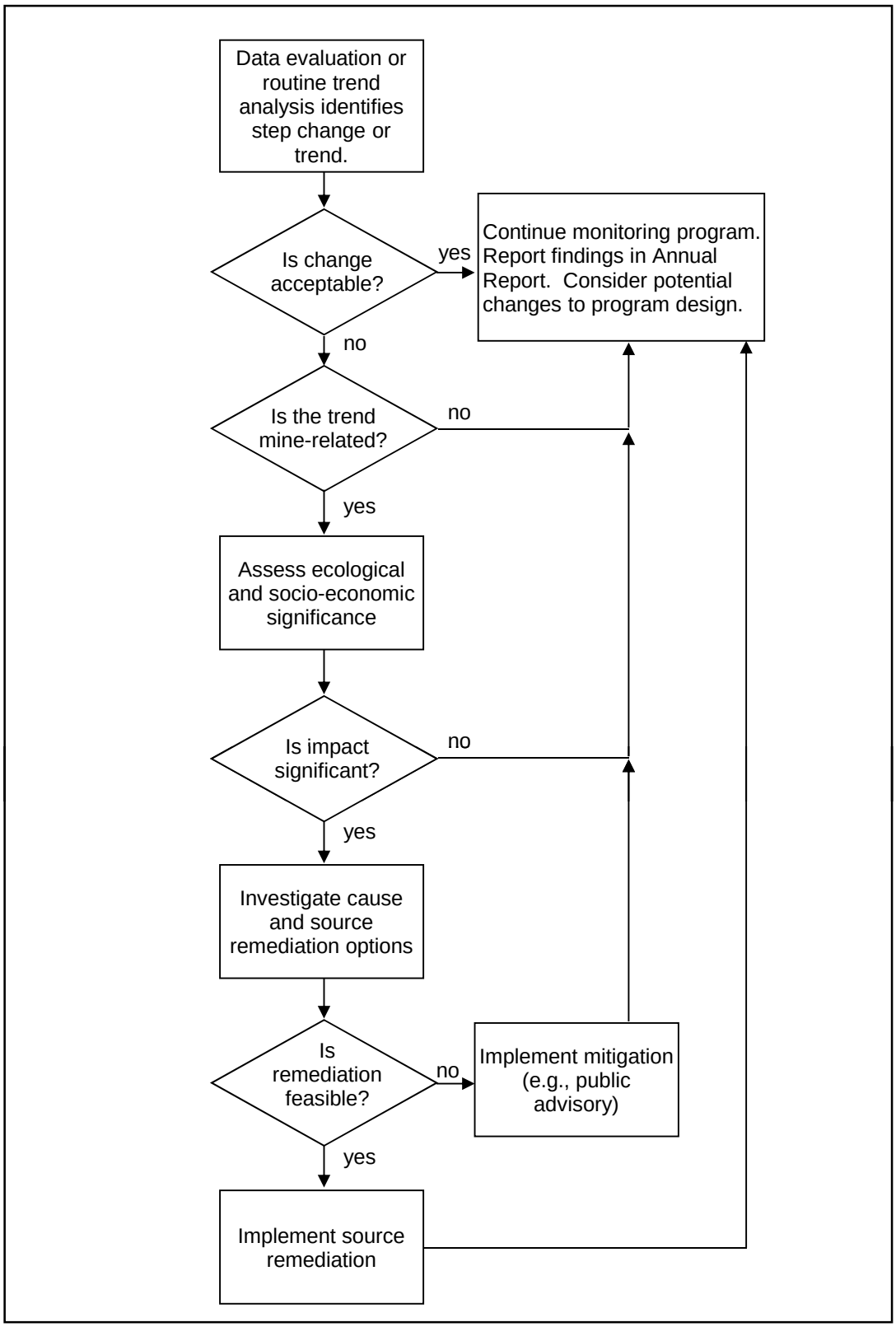

Figure 8.1: Environmental Response Plan Process, Cycle 6/Cycle 7

9 REPORTING AND SCHEDULE

Water quality data from the TOMP, SAMP, and SRWMP are reported in monthly (RAL only) and annual reports as well as in a 10-year SOE Report which presents and integrates the findings of the TOMP, SAMP, and SRWMP.

Monthly reports are submitted by RAL to the CNSC, the MECP, and Environment and Climate Change Canada (ECCC) within 90 days of the end of each calendar month. Denison does not have a monthly reporting requirement. General procedures for monthly water quality reporting, including scope, format, distribution, and archiving, are described in the operating policies and procedures maintained by each licensee (RAL). Each report includes all water quality monitoring data collected from the SRWMP, SAMP, and TOMP for the reporting period. The objective of the monthly report is to provide a standardized document that:

- demonstrates compliance with applicable program requirements and legislation,
- identifies monitoring program triggers and response plan implementation, where required,
- documents completion of water quality monitoring requirements, and
- provides a concise record of conditions for managerial review and action.

Each licensee prepares an Annual Operating Care and Maintenance Report, which summarizes the results of all water quality data associated with the SAMP and TOMP at TMAs for which the licensee is responsible, as well as TMA and ETP improvements/modifications. Each licensee submits its annual reports to the regulatory agencies and local communities within a timeframe specified in the TMA licences based on general procedures described in the Operating, Care and Maintenance Plans of each licensee. The report presents the water quality monitoring results obtained over the previous year and includes the following information:

- organizational structure,
- licence, procedure, and plan modification,
- health and safety statistics,
- monitoring program methods,
- data quality assessment, and
- results of site-specific (TMA) programs (SAMP and TOMP).

An Annual SRWMP Report is also prepared jointly by RAL and DMI, which summarizes all water quality data associated with the receiving environment. The monthly and annual water quality reports are intended to be concise and contain limited interpretation of results.

As the SRWMP spatially retracts in response to improved conditions within the watershed, and the focus of monitoring programs shifts towards source areas, the integration between the SRWMP, SAMP, and TOMP becomes more important. Therefore, every ten years an SOE Report is prepared that presents the findings of each program (TOMP, SAMP, and SRWMP) and provides an integrated assessment of conditions within and downstream of the TMAs. The report focuses on general TMA performance relative to criteria and predictions, loadings to the receiving environment and conditions with the SRW, including:

- identification of any changes in source areas or activities that may have influenced the results of the programs or should be considered in subsequent monitoring and evaluation;
- presentation of methods used in each program;
- review of quality assurance/quality control procedures and data quality assessment;
- trends in water quality over time;
- presentation of the monitoring results;
- an integration of the results to identify and evaluate chemical, physical, and biological relationships within and among programs;
- assessment of the conditions in the watershed relative to predicted changes; and
- recommendations for changes to subsequent monitoring cycles.

To date, four SOE interpretive reports have been prepared (Minnow 2009e, 2011, 2017, 2022a). As this study design marks the transition from a 5-year to 10-year reporting period, it is proposed that the data analysis and presentation of results in the combined Cycle 6/7 SOE interpretive report will be consistent with the last SOE interpretive report (Minnow 2022a), with additional efforts to connect plots and data analysis to the corresponding raw data (Section 2). Water quality samples for TOMP, SAMP, and SRWMP will continue to be collected by RAL and DMI as scheduled (Sections 4.4, 5.4, and 6.2.3). The Cycle 7 SOE study design will be submitted to the regulatory agencies in 2029, addressing comments received on the Cycle 5 SOE related to reporting, monitoring programs related to sediment / benthic data collection, and dose and risk. The Cycle 6/7 SOE interpretive report will be submitted to the regulatory agencies on or before December 31, 2030.

10 SUMMARY OF CHANGES

There are no changes proposed for the TOMP or SAMP. For the SRWMP, the following changes are proposed:

- Previously, SRWMP station D-6 was considered a "lake" type station with respect to SRWMP benchmarks. Compared to most other lake outlets monitored for water quality in the SRWMP, Cinder Lake is relatively small surface area (36.6 ha) and is relatively shallow (10 m average depth), with a narrow, shallow stream channel the hosts abundant emergent vegetation (See Appendix Photo Set D.1.) Cinder Lake is similar in size to Westner Lake whose outlet station SC-01 is compared to the "wetland" SRWMP benchmark. Based on the above justifications, SRWMP station D-6 was assessed based on comparison to wetland benchmarks in this study design and will be compared to wetland benchmarks in the combined Cycle 6/7 SOE report.
- Station SR-15 at the outlet of May Lake is situated downstream of both the Stanleigh and Stanrock facilities, with SRWMP stations SR-06 and DS-18 located nearer to each facility, respectively. Station SR-15 was removed from the monitoring program at the end of 2009, and re-introduced in 2016 during the period of refractory radium at the Stanleigh facility. Throughout the refractory radium period, radium-226 concentrations within the receiver, McCabe Lake (station SR-06), were well within SRWMP benchmarks, and radium-226 concentrations further downstream at May Lake (station SR-15) are also will within SRWMP benchmarks from the period from 2016 period to 2023 (Appendix Figure C.34). The refractory radium issue was resolved in 2018, radium-226 concentrations at station SR-15 being were indicative of acceptable water quality, and the SRWMP has stations nearer to both the Stanleigh and Stanrock facilities. Therefore, SR-15 has, again, been removed from the SRWMP.
- For SRWMP water quality benchmarks, hardness-based benchmarks will be calculated for each individual sample using the hardness of that sample rather than using the average hardness for that station over the study period. If hardness values are unavailable for a given sample, the lower 25th percentile of hardness value will be used to calculate a conservative estimate of the true hardness-based guideline.
- Based on general long-term stable or improving water quality trends at the Elliot Lake TMAs and Serpent River Watershed, changes in water quality in the Serpent River watershed are occurring at a slower rate due to reduced SAMP parameter loadings from discharges to the environment. Thus, it is appropriate to transition the SOE water quality reporting to a 10-year cycle. A 10-year monitoring cycle will allow for coordination with

the SOE benthic and sediment reporting cycle, and monthly / annual water quality reporting requirements will remain in place to identify areas where adaptive management is required to maintain environmental performance. The proposed modified schedule includes a Cycle 7 study design, inclusive of benthos/sediment monitoring and reporting requirements in 2029, and a combined Cycle 6/7 SOE Report in 2030.

11 REFERENCES

AECB (Atomic Energy Control Board). 1997. Comprehensive Study Report Decommissioning of the Stanleigh Waste Management Area Mine and Mill. May.

BC ENV (British Columbia Ministry of the Environment and Climate Change Strategy). 2001. Ambient Water Quality Guidelines for Manganese Overview Report. Water Protection & Sustainability Branch Environmental Sustainability and Strategic Policy Division.

BC ENV. 2013. Ambient Water Quality Guidelines for Sulphate Technical Appendix. Water Protection & Sustainability Branch Environmental Sustainability and Strategic Policy Division.

Beak (Beak International Incorporated).1999a. Serpent River Watershed Monitoring Program Framework Document. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario, February. Project 2001.

Beak. 1999b. Serpent River Watershed and In-Basin Monitoring Program – Implementation Document. Prepared for Rio Algom Limited and Denison Mines Limited, Elliot Lake, Ontario. February. Project 2001.

Calder (Calder Engineering Limited). 2015. Serpent River Mixing Zone Assessment – Elliot Lake, Ontario. Draft Report Prepared for BHP Billiton Canada Inc. Saskatoon, SK. April 2015.

CNSC (Canadian Nuclear Safety Commission). 1997. Comprehensive Study Report: Decommissioning of the Stanleigh Waste Management Area, Mine and Mill. Prepared for the Atomic Energy Control Board. May.

CNSC. 2002. Environmental Assessment Screening Report: Possession and Management of Waste Nuclear Substances Situated at Spanish-American, Milliken, Lacnor, Nordic/Buckles, and Pronto Historical Properties in the Elliot Lake Area, Ontario.

Denison (Denison Mines Ltd.) 1995. EIS Decommissioning of the Denison and Stanrock TMAs. February.

EcoMetrix (EcoMetrix Incorporated). 2011. Special Investigations 2009. Implications for Radiological Dose and Risk Calculations. Prepared for Denison Mines Inc. and Rio Algom Ltd., Elliot lake, Ontario. February.

EcoMetrix. 2019. Memo: Site-specific Criteria for Ra-226. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. January.

Environment Canada. 2000. Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia magna. EPS1/RM/14. Second Edition, December 2000.

Environment Canada. 2007a. Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout. EPS1/RM/13. Second Edition, Updated May 2007.

Environment Canada. 2007b. Biological Test Method: Test of Reproduction and Survival Using the Cladoceran Ceriodaphnia dubia. Second Edition. EPS1/RM/21. February.

Environment Canada. 2012. Metal Mining Environmental Effects Monitoring (EEM) Technical

Helsel, D.R. 2012. Statistics for censored environmental data using Minitab and R, 2nd edition. John Wiley and Sons, New York. 344 p.

Helsel, D.R. and R.M. Hirsch. 2002. Statistical Methods in Water Resources Techniques of Water Resources Investigations, Book 4, chapter A3. U.S. Geological Survey. 522 pages.

Hirsch, R.M., J.R. Slack and R.A. Smith. 1982. Techniques of trend analysis for monthly water quality data. Water Resources Research 18: 107-121.

ICRP (International Commission on Radiological Protection). 1986. Radiation Protection Principles for the Disposal of Solid Radioactive Waste. ICRP Publication 46.

ICRP. 2007. The 2007 Recommendations of the International Commission on Radiological Protection. Publication 103.

McLaughlin, J.W., K.L. Webster. 2010. Alkalinity and acidity cycling and fluxes in an intermediate fen peatland in northern Ontario. Biogeochemistry 99: 143-155.

McLeod, A.I., Hippel, K.W., and B.A. Bodo. 1991. Trend analysis methodology for water quality time series. Environmetrics 2, 169e200. doi:10.1002/env.3770020205

Minnow (Minnow Environmental Inc.). and Beak International Inc. (Beak). 2001. Serpent River Watershed Monitoring Program – 1999 Study. Prepared for Rio Algom Ltd. and Denison Mine Inc. April. Project 2001.

Minnow. 2002a. TMA Operational Monitoring Program Design (TOMP). Prepared for Rio Algom Limited and Denison Mines Inc. Elliot Lake, Ontario. August. Project 2024.

Minnow. 2002b. Overview of Elliot Lake Monitoring Programs and Source Area Monitoring Program Design. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. August. Project 2002.

Minnow. 2004. Cycle 2 Study Design – Serpent River Watershed and In-Basin Monitoring Programs. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. June. Project 2018.

Minnow. 2009a. Monitoring Framework for Closed Uranium Mines near Elliot Lake. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. May. Project 2200.

Minnow. 2009b. Tailings Management Area Operational Monitoring Program, Revised Study Design. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. May. Project 2200.

Minnow. 2009c. Source Area Monitoring Program, Revised Study Design. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. May. Project 2200.

Minnow. 2009d. Serpent River Watershed Monitoring Program, Cycle 3 Study Design. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. May. Project 2200.

Minnow. 2009e. Serpent River Watershed State of the Environment Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. February. Project 2145.

Minnow. 2009f. Monitoring Framework for Closed Uranium Mines near Elliot Lake. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. May. Project 2200.

Minnow. 2011. Serpent River Watershed State of the Environment. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. July. Project 2295.

Minnow. 2012. Quirke Lake Radionuclides in Fish and Macrophytes. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. March. Project 2417.

Minnow. 2016. Cycle 4 Study Design for the SRWMP, SAMP and TOMP. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. January. Project 2506.

Minnow. 2017. Serpent River Watershed Cycle 4 (2010 to 2014) State of the Environment Report. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. November. Project 2555.

Minnow. 2019. Cycle 5 Study Design for the SRWMP, SAMP, and TOMP. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. April. Project 187202.0055.

Minnow. 2022a. Serpent River Watershed Cycle 5 (2015 to 2019) State of the Environment Report. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. March. Project 197202.0041.

Minnow. 2022b. Technical Memo: Technical Review and Groundwater Monitoring Requirements, Milliken TMA. Prepared for Rio Algom Limited. June. Project 217202.0089.

Minnow. 2022c. Technical Memo: Technical Review and Groundwater Monitoring Requirements, Spanish-American TMA. Prepared for Rio Algom Limited. June. Project 217202.0089.

Minnow. 2022d. Quirke Groundwater Monitoring Program. Prepared for Rio Algom Limited. June. Project 217202.0089.

Minnow. 2022e. Stanleigh Groundwater Monitoring Program Revision 1. Prepared for Rio Algom Limited. February. Project 217202.0089.

Minnow. 2023. Technical Memo: Evans Lake Shoreline Study, Quicke Facility, Rev. 1. August. Project 237202.0057.

Minnow (Minnow Environmental Inc.) and Beak (Beak International Incorporated). 2001. Serpent River Watershed Monitoring Program - 1999 Study. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. April. Project 2001.

OMNRF (Ontario Ministry of Natural Resources and Forestry). 2019. Ontario Flow Assessment Tools III, Powered by Land Information Ontario. http://www.gisapplication.lrc.gov.on.ca/OFAT/Index.html?site=OFAT&viewer=OFAT&locale=en-US. Accessed June, 2015.

Pohlert, T. 2016. Trend: Non-parametric Trend Tests and Change-point Detection. R package version 0.2.0. https://CRAN.R-project.org/package=trend

R Core Team. 2023. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Rio Algom. 1995. EIS Decommissioning of the Quirke and Panel WMAs. February.

Therneau, T.M. 2017. Survival analysis. Package “survival” for R. April 4, 2017. URL https://cran.r-project.org/web/packages/survival/survival.pdf

APPENDIX A

From: Pandolfi, Dana
To: Heffner, Holly
Cc: Lambert, Tony; Stenson, Ron
Subject: CNSC staff"s review comments of SOE report
Date: Tuesday, October 12, 2021 11:20:05 AM

Good day Holly,

Please find below CNSC staff's review comments of the SOE report. A couple of the comments/recommendations provided by the CNSC's specialists will be discussed outside of the SOE review report. Feel free to contact me if you have any questions.

Regards,
Dana

Dana Pandolfi
Project Officer, Regulatory Operations Branch
Canadian Nuclear Safety Commission/ Government of Canada
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Agente de Projet, Réglementation des opérations
Commission canadienne de sûreté nucléaire/Gouvernement du Canada
dana.pandolfi@cnsc-ccsn.gc.ca /Tél:613-297-4340

Comment 1 – Section 2.2.2 Sample/Data Collection - Description of metals analysis for sediment samples is inaccurate

The laboratory preparation for metals analysis of sediment samples is described as follows: "Sediments collected for metal content were digested in a mixture of hydrochloric acid, nitric acid, and reverse osmosis de-ionized water then analyzed by inductively coupled plasma mass spectrometry (ICP-MS)". The description above is inaccurate since the preparation of sediment samples in a laboratory can be summarized in the following steps: sediment samples are dried, a portion of dried sample is weighed and digested in a mixture of hydrochloric acid and nitric acid, an aliquot of the digested sample is diluted with milliQ water to a known volume, and the diluted sample is analyzed by inductively coupled plasma mass spectrometry (ICP-MS) [1].

Expectations to Address Comment –The metals analysis laboratory preparation for sediment samples should be clarified and/or referenced.

Comment 2 – Section 3.6 – Ba and Ra-226 in the May Lake Sub-watershed

Water quality monitoring in the May Lake Sub-watershed has indicated that Ba and Ra-226 have generally increased during the 2015-2019 period. It is stated this is believed to be due to refractory radium and the subsequent barium treatment, it is noted that Ra-226 has decreased since the

commencement of the XSB treatment.

Expectations to address comment – None, CNSC staff will continue monitoring Ra-226 trends in the May Lake sub-watershed in subsequent monitoring reports to ensure Ra-226 continues to decrease.

Comment 3 – Figure 4.7 – Ra-226 trends
While Ra-226 concentrations seemed to approach the 0.2 Bq/L prediction in 1996, it appears to be steadily increasing in the influent of station D-1, during 2008 to 2019. Therefore, it is not clear if conditions at this TMA may be such as to trigger refractory radium in the effluent, similar to what occurred at the Stanleigh TMA in 2017?

Expectations to Address Comment –Rio Algom and Denison Mines should address the following questions regarding the increasing trend in Ra-226 in station D-1 influent:

- Are there predictions available for this increasing trend? If so, is it expected to stabilize or decrease in the future?

Comment 4 – Section 8.1 – Correlation between Grain Size and Total Organic Carbon
In Section 8.1, it states that "the TOC from a mean of 7.6 to 9.1% in mine-exposed lakes compared to 8.2 to 11% in reference lakes, and tended to be lower in samples containing higher proportions of sand". In Section 10.3, there is also inference that higher concentrations are likely due to increased TOC and proportion of clay particles. The above statements (regarding correlation between grain size, TOC and contaminant concentrations) are not supported with published references.

Expectations to Address Comment – Rio Algom and Denison Mines should include published references to support observed correlation between grain size, TOC and contaminant concentrations.

Comment 5 - Section 8.2.2 and 8.2.4 - Benthic Invertebrate Species Tolerance
Statistical trend analyses noted significant trends in community structure (8.2.4) and species composition (8.2.2) over time, along with discussion of which species were increasing or decreasing. It would be beneficial to strengthen these analyses by adding some discussion around benthic invertebrate species tolerance to contamination to help explain why some species are more abundant in recent years, and/or sensitive species less abundant, since this could serve as an indicator of potential effect and/or improving site conditions.
Expectations to Address Comment – Rio Algom and Denison Mines should consider evaluating the relative sensitivity and tolerance of benthic invertebrate species in their discussion of temporal trends.

Comment 6 – Section 9.1 – Trend Analysis
Section 9.1 provides a detailed description of the historical dose estimates, but it is not straightforward to easily compare the doses from the previous reports (e.g. cycle 3 SOE in 2009 and updates in 2011) to the current estimates and do a trend analysis to support the text.

Expectations to Address Comment – Rio Algom and Denison Mines are expected to consider (in future reports) including graphical trend analysis for the historical dose estimates for straightforward data comparison and analysis.

Comment 7 – Section 9.2 – Current Public Dose Estimates and Assumptions
Section 9.2 states that the dose to the representative person was calculated using the following assumptions:

- 110.76 hours per year spent walking near the Tailings Management Areas (TMAs);
- Consumption of 1.5 L of treated Elliot Lake drinking water per day, 365 days per year; and
- Consumption of 1.59 kg/year of sport fish (on a fresh weight basis).

However, the rationale provided in the report is not sufficient to justify how these assumptions are conservative for the representative group (adults).

Expectations to Address Comment – Rio Algom and Denison Mines are expected to justify how the assumptions are conservative for the calculation of public dose for the representative group (adults).

Comment 8 – Section 10 Summary (page 256) states that "Surface water quality was generally at or near EIS-predicted levels for Cycle 5 data (2015 to 2019)". Surface water monitoring results are presented for the Stanrock, Stanleigh, Denison, Spanish American, Quirke, Panel, Lacnor/Nordic, and Pronto TMAs in the TOMP. But only one EIS is referenced in the Cycle 5 SOE report as follows:

Rio Algom Limited 1995. Environmental Impact Statement (EIS) for the Decommissioning of the Quirke and Panel Waste Management Areas. Prepared by SENES Consultants Limited. February.

Additionally, when a comparison of the monitoring data with EIS predictions (like in Figure 4.16 on page 123) was made, the prediction shown in the figure is a single value. It is not clear if the single value is extracted from the predicted breakthrough curves in the EIS, or if the EIS only provided a single value prediction. If predicted breakthrough curves exist in the EIS, comments should be provided with regard to the location of the single prediction value in the breakthrough curves (i.e., in the increasing or decreasing limb) in evaluating the trend of surface water quality over time, and if peak concentrations have appeared or to be shown up in the future. This clarification is essential to determine if the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves and to evaluate the trend of surface water quality over time.

Expectations to Address Comment – CNSC staff expects that the EIS for all the sites will be provided in the **References** section of the Cycle 5 SOE report. In addition, in evaluating the trend of surface water quality over time, comments should be provided to clarify if the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves.

Comment 9 – Table B.9 – Sampling dates cannot be identified

Table B.9 includes several water sampling dates that cannot be identified (i.e. hashtags appear rather than dates).

Expectations to Address Comment – CNSC staff expect that all sampling dates in tables are present.

Comment 10 – pH Determination Procedure PR8.6.3.01 – pH is temperature dependent

In the pH Determination Procedure, there is no mention of recording the sample temperature in the field or in the effluent treatment plant (ETP). It was noted that only Table S.17 and Table S.18 include temperature measurements along with pH data for samples taken at different depths. It is unclear whether the pH meter used in the field and in the ETP has a probe that measures temperature and whether the probe is equipped with an automatic temperature compensation. This is important since the hydrogen ion activity in a water sample is affected by temperature so pH is temperature dependent. To reduce potential measurement errors and improve accuracy, the US EPA recommends performing instrument calibration and sample measurements at the same temperature and that temperature should be recorded during measurements [2].

Expectations to Address Comment - Rio Algom and Denison Mines are expected to provide more information regarding the pH Determination Procedure used in the field and in the ETP and to consider using a pH probe that measures temperature, is equipped with an automatic temperature compensation, and ensure sample temperatures are recorded along with pH measurements.

Comment 11 – Appendix U – Questionnaire Survey

The questionnaire survey to characterize resident exposure pathways and habits was performed in 2016 (Appendix A of Appendix U) and the same survey results (e.g., group size and its characteristics, etc.) are used in the SOE updates for the period from 2015 – 2019. The use of the same data is not supported by data analysis to demonstrate how representative the data are in 2019.

Expectations to Address Comment – Rio Algom and Denison Mines are expected to demonstrate how 2016 survey results are still representative in 2019.

Confidential Technical Memo

Date: December 17, 2021

To: Tony Lambert and Holly Heffner (Rio Algom Ltd. [RAL]), Sarah Benson and Diane Martens (Denison Mines Inc. [DMI])

From: Jess Tester and Cynthia Russel, Minnow Environmental Inc.

Cc: Cheryl Wiramanaden, Minnow Environmental Inc.

RE: RAL and DMI Responses to Regulator Comments on the Serpent River Watershed Cycle 5 (2015 to 2019) State of the Environment Report

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The Serpent River Watershed (SRW) Cycle 5 (2015 to 2019) State of the Environment (SOE) Report was submitted to the Joint Review Group (JRG) in March 2021. Comments on the study report were received from the Canadian Nuclear Safety Commission (CNSC) on October 12, 2021 (Attachment A). Licensee responses to comments are provided below.

CNSC Comment 1 – Section 2.2.2 Sample/Data Collection - Description of metals analysis for sediment samples is inaccurate

The laboratory preparation for metals analysis of sediment samples is described as follows: "Sediments collected for metal content were digested in a mixture of hydrochloric acid, nitric acid, and reverse osmosis de-ionized water then analyzed by inductively coupled plasma mass spectrometry (ICP-MS)". The description above is inaccurate since the preparation of sediment samples in a laboratory can be summarized in the following steps: sediment samples are dried, a portion of dried sample is weighed and digested in a mixture of hydrochloric acid and nitric acid, an aliquot of the digested sample is diluted with milliQ water to a known volume, and the diluted sample is analyzed by inductively coupled plasma mass spectrometry (ICP-MS) [1].

Expectations to Address Comment –The metals analysis laboratory preparation for sediment samples should be clarified and/or referenced.

Licensee Response to Comment 1

An amendment will be included to change the paragraph to:

Sediment samples collected for metals, radium-226, TOC, and particle size analyses were submitted to Bureau Veritas Laboratories in Mississauga, ON. Sediments collected for metal content were dried, then a portion of each dried sample was weighed and digested in a mixture of hydrochloric acid and nitric acid. An aliquot of each digested sample was then diluted with reverse osmosis de-ionized water to a known volume, and then the diluted sample was analyzed by inductively coupled plasma mass spectrometry (ICP-MS). Sediment samples for radium-226 analysis were dried, then each sample was digested in a mixture of nitric, hydrochloric, and hydrofluoric acids, and then each sample was analyzed for radium-226 activity using alpha spectroscopy. Particle size was analyzed using sieve and hydrometer methods while TOC was analyzed using a LECO Carbon Analyzer.

CNSC Comment 2 – Section 3.6 – Ba and Ra-226 in the May Lake Sub-watershed

Water quality monitoring in the May Lake Sub-watershed has indicated that Ba and Ra-226 have generally increased during the 2015-2019 period. It is stated this is believed to be due to refractory radium and the subsequent barium treatment, it is noted that Ra-226 has decreased since the commencement of the XSB treatment.

Expectations to address comment – None, CNSC staff will continue monitoring Ra-226 trends in the May Lake sub-watershed in subsequent monitoring reports to ensure Ra-226 continues to decrease.

Licensee Response to Comment 2

Comment acknowledged. The licensees will continue to monitor water quality at the outlet of May Lake (station SR-15).

CNSC Comment 3 – Figure 4.7 – Ra-226 trends

While Ra-226 concentrations seemed to approach the 0.2 Bq/L prediction in 1996, it appears to be steadily increasing in the influent of station D-1, during 2008 to 2019. Therefore, it is not clear if conditions at this TMA may be such as to trigger refractory radium in the effluent, similar to what occurred at the Stanleigh TMA in 2017?

Expectations to Address Comment –Rio Algom and Denison Mines should address the following questions regarding the increasing trend in Ra-226 in station D-1 influent: Are there predictions available for this increasing trend? If so, is it expected to stabilize or decrease in the future?

Licensee Response to Comment 3

To clarify, DMI is the owner and operator of TMA-1 where station D-1, influent to the effluent treatment plant, is located. The 1995 Environmental Impact Statement (EIS) Decommissioning of the Denison and Stanrock Tailings Management Areas (TMA; DML 1995) provided predictions for post-decommissioning TMA pond water and tailings pore water quality, specifically radium-226 and sulphate, at Denison TMA-1. Radium-226 and sulphate levels were predicted to decrease post-decommissioning, with radium-226 increasing again, plateauing, and then decreasing in the long term.

Radium-226 levels in tailings pore water are initially dependent upon sulphate levels. As sulphate levels decline, gypsum and other metal sulphate precipitates begin to dissolve. As metal sulphates dissolve due to decreasing sulphate concentrations in the water, radium-226 is released to pore water, and radium-226 concentrations in the pond water increase. Radium-226 was expected to reach peak concentrations of approximately 0.6 Bq/L in pond water about 400 years post-decommissioning (DML 1995; see Figure 6.2.1 and Table 6.2.6 below).

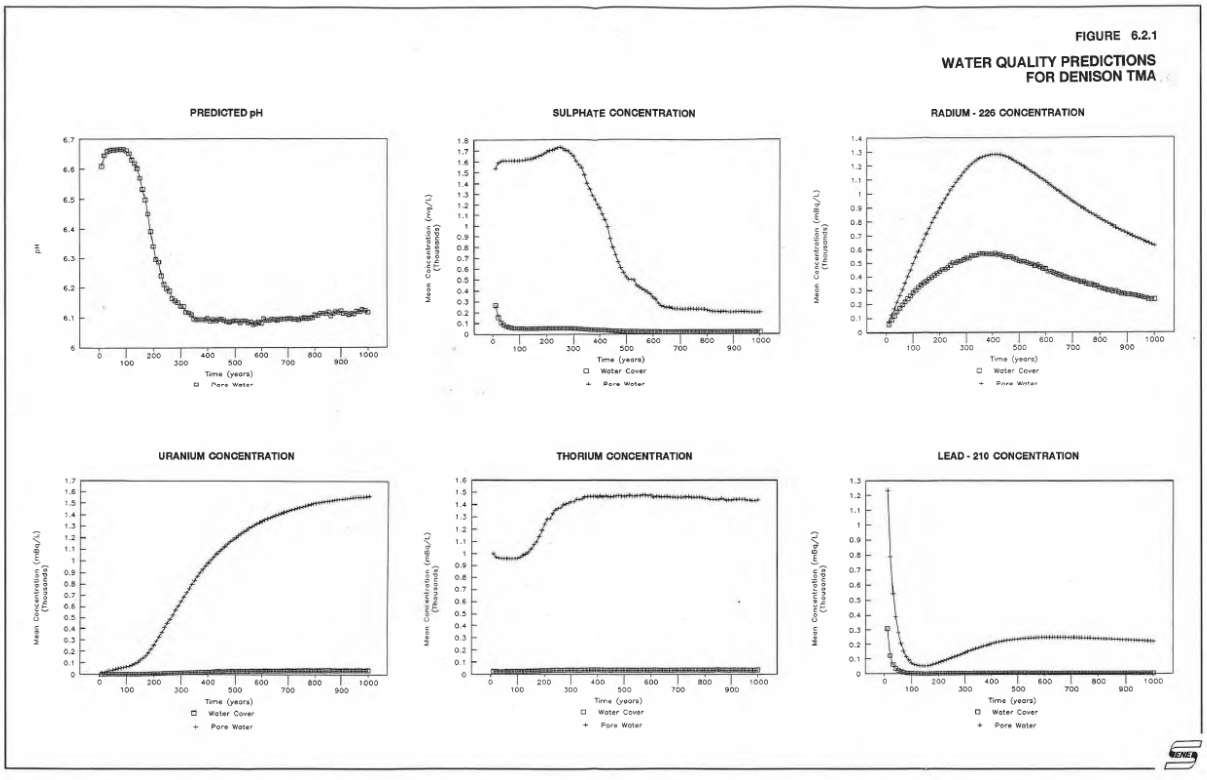

Figure 6.2.1: Water Quality Predictions for Denison TMA, from the 1995 EIS (DML 1995)

Table 6.2.6: Denison TMA Pore and Pond Water Quality, from the 1995 EIS (DML 1995)

Table 6.2.6

DENISON TMA PORE AND POND WATER QUALITY

		Pore Water				Pond Water			
		50[1]	100[1]	500[1]	1,000[1]	50[1]	100[1]	500[1]	1,000[1]
pH	Units	6.7	6.7	6.1	6.1	>7	7	7	7
SO_4	mg/L	1,600	1,600	525	200	75	50	25	18
Ra-226	Bq/L	0.3	0.5	1.2	0.6	0.2	0.3	0.5	0.2
Uranium	Bq/L	0.038	0.063	1.20	1.56	0.001	0.002	0.028	0.036
Thorium	Bq/L	0.96	0.96	1.47	1.44	0.022	0.023	0.034	0.034
Pb-210	Bq/L	0.39	0.073	0.24	0.22	0.036	0.003	0.006	0.005

(1) Years after closure.

The current radium-226 concentration in the TMA-1 ETP influent (station D-1) is greater than the predicted concentrations for this time period as well as the peak concentration time period. Although TMA-1 pond water radium-226 concentrations are higher than predicted in the 1995 EIS, the ETP continues to have good removal efficiency and treated effluent discharge (station D-2). Radium-226 concentrations at station D-2 have remained below the grab sample and monthly mean discharge limits outlined in the license, and have remained within the EIS pond water concentrations that were used in the environmental assessment (Denison 2021).

DMI has engaged with consultants to refine the understanding of radium-226 in the TMA and downstream. DMI is also working collaboratively with RAL to determine whether some of the mechanisms controlling radium-226 concentrations at RAL sites also exist at TMA-1. Preliminary investigations began in 2021. Any relevant findings of the investigation will be presented to the CNSC in the next SOE report or in another appropriate forum.

CNSC Comment 4 – Section 8.1 – Correlation between Grain Size and Total Organic Carbon

In Section 8.1, it states that “the TOC from a mean of 7.6 to 9.1% in mine-exposed lakes compared to 8.2 to 11% in reference lakes, and tended to be lower in samples containing higher proportions of sand”. In Section 10.3, there is also inference that higher concentrations are likely due to increased TOC and proportion of clay particles. The above statements (regarding correlation between grain size, TOC and contaminant concentrations) are not supported with published references.

Expectations to Address Comment – Rio Algom and Denison Mines should include published references to support observed correlation between grain size, TOC and contaminant concentrations.

Licensee Response to Comment 4

The sentences in Section 10.3 will be updated in an amendment as:

> *In Quirke Lake, sediment concentrations of iron, manganese, and nickel were significantly higher in 2019 compared to 1999 (manganese, nickel) and 2004 (iron). These higher concentrations were likely due to increased TOC concentrations and proportion of clay particles, which have been shown to accumulate metals in sediment, including iron, manganese, and nickel (Baird and Cann 2012; Horowitz 1985).*

which will provide citation for these published references:

Baird, C. and M. C. Cann. 2012. Environmental Chemistry. 5th Edition, W. H. Freeman and Company, New York.

Horowitz, A. J. 1985. A primer on trace metal sediment chemistry. United States Geological Survey Water-Supply Paper 2277. Alexandria, VA. pp67.

CNSC Comment 5 – Section 8.2.2 and 8.2.4 - Benthic Invertebrate Species Tolerance

Statistical trend analyses noted significant trends in community structure (8.2.4) and species composition (8.2.2) over time, along with discussion of which species were increasing or decreasing. It would be beneficial to strengthen these analyses by adding some discussion around benthic invertebrate species tolerance to contamination to help explain why some species are more abundant in recent years, and/or sensitive species less abundant, since this could serve as an indicator of potential effect and/or improving site conditions.

Expectations to Address Comment – Rio Algom and Denison Mines should consider evaluating the relative sensitivity and tolerance of benthic invertebrate species in their discussion of temporal trends.

Licensee Response to Comment 5

In future reports, the licensees will consider evaluating the relative sensitivity and tolerance of benthic invertebrate species within the report discussion of temporal trends. These types of data can be challenging to integrate, as data are typically limited, types of data can vary (e.g., tolerance data available for copper but not iron), the data are often not consistent between species

(e.g., iron for one taxon but not for another taxon), and the pool of taxa with available data does not always overlap with the taxa that exist in a given environment. Additionally, the benthic invertebrate community structure in a lake can be driven by other habitat factors, such as oxygen content, grain size, and organic inputs. These data limitations make it challenging for this type of species-specific evaluation to be consistently applied; however, a literature review will be performed for future reports and sensitivity and tolerance context will be integrated where applicable.

CNSC Comment 6 – Section 9.1 – Trend Analysis

Section 9.1 provides a detailed description of the historical dose estimates, but it is not straightforward to easily compare the doses from the previous reports (e.g., cycle 3 SOE in 2009 and updates in 2011) to the current estimates and do a trend analysis to support the text.

Expectations to Address Comment – Rio Algom and Denison Mines are expected to consider (in future reports) including graphical trend analysis for the historical dose estimates for straightforward data comparison and analysis.

Licensee Response to Comment 6

The historical dose estimates described in Section 9.1 are all derived from the 2009 data collections, with a 2011 supplementary collection of forage fish and macrophyte data in Quirke Lake. The latter were resampled in 2011 because the 2009 collection point in Quirke Lake was found to be tailings impacted and was not representative of the lake. The dose estimates were reported in Ecometrix (2011), with 2009 data for Quirke Lake, and in Minnow (2012) with the 2011 data for Quirke Lake. Since 2009, there have been no significant changes in the operation of the Elliot Lake site facilities. As part of the Cycle 5 Study Design for the SRWMP, SAMP, and TOMP (Minnow 2019), a review of the 2009 to 2018 SRWMP water quality data from the receiving water of key near-field lakes (Quirke, McCabe, Nordic, and May lakes) was conducted to assess the need to update the 2009 Dose and Risk Assessment. No risk was anticipated and updating the existing Dose and Risk Assessment for aquatic biota and riparian wildlife was not warranted (Minnow 2019). Therefore, there are no temporal data to present for doses to aquatic biota and riparian wildlife.

The dose ranges for aquatic biota, riparian wildlife, and a human receptor mentioned in Section 9.1 represent the variability among the lakes of the Serpent River Watershed at the time of these comprehensive studies. They do not represent trends over time. The Ecometrix (2011) report also included some comparisons back to EIS dose predictions, where possible; however,

assumptions have varied, both among EIS reports and as compared to the 2009/2011 study, so the comparisons cannot be interpreted as reflecting a temporal trend in lake condition.

The historical generic human doses described in Section 9.1 were for a hypothetical generic human resident on each lake in the Serpent River Watershed, with assumed consumption of water, fish, and game. While generic human doses allow for comparison among lakes, the assumptions are conservative and do not reflect actual usage of each lake.

Based on a comment by the CNSC on the SRW Cycle 4 (2010 to 2014) SOE Report, RAL and DMI committed to updating the human dose estimates. As such, RAL and DMI designed a monitoring program to support realistic public dose reporting (Ecometrix 2016), completed the monitoring, and provided an interim public dose estimation (Ecometrix 2018). This interim report recommended an update of sport fish data; so, the new sport fish data were collected, and an updated public dose estimation was provided in 2020 (Ecometrix 2020). The latter was presented in Section 9.2 (and was provided in Appendix U of the SRW Cycle 5 SOE Report).

The recent public dose estimation (Ecometrix 2020) was focused on the critical group residing in the City of Elliot Lake. The estimate was supported by a site-specific survey of fish and game consumption, and of local trail use relevant to external exposure, and by monitoring of gamma fields and radon near the trails, and of radionuclides at the drinking water intake. This realistic dose estimation is not comparable to the hypothetical generic human dose values that were presented in previous SOE reports.

Doses presented in a trend analysis should be comparable to allow for data interpretation. Accordingly, in future SOE reports, a graph showing trend over time in realistic public dose can be presented, starting in 2017 when the first such dose was calculated.

CNSC Comment 7 – Section 9.2 – Current Public Dose Estimates and Assumptions

Section 9.2 states that the dose to the representative person was calculated using the following assumptions:

- 110.76 hours per year spent walking near the Tailings Management Areas (TMAs);
- Consumption of 1.5 L of treated Elliot Lake drinking water per day, 365 days per year; and
- Consumption of 1.59 kg/year of sport fish (on a fresh weight basis).

However, the rationale provided in the report is not sufficient to justify how these assumptions are conservative for the representative group (adults).

Expectations to Address Comment – Rio Algom and Denison Mines are expected to justify how the assumptions are conservative for the calculation of public dose for the representative group (adults).

Licensee Response to Comment 7

This method was applied to determine the dose for a representative person residing in Elliot Lake, not to determine the upper bound of public dose. This method was consistent with methods outlined in the SRW Cycle 4 (2010 to 2014) SOE Report (Minnow 2017) as well as the Cycle 5 Study Design for the SRWMP, SAMP, and TOMP (Minnow 2019).

Section 6.4 of the SRW Cycle 4 (2010 to 2014) SOE Report (Minnow 2017) stated:

> *The CNSC has requested annual reporting of public dose. Whereas all previous public dose estimations in SOE reports have focused on demonstrating upper bounds of public dose, using rather conservative assumptions for hypothetical human residents on downstream lakes, the intention moving forward is for annual SRWMP Reports to include realistic doses for a representative person residing in the town of Elliot Lake.*

Section 5.4.2 of the Cycle 5 Study Design for the SRWMP, SAMP, and TOMP (Minnow 2019) stated:

> *Whereas all previous public dose estimations in SOE reports (Section 5.4.1) have focused on demonstrating upper bounds of public dose, using rather conservative assumptions for hypothetical human residents on downstream lakes, the intention moving forward is for annual SRWMP Reports to include realistic doses for a representative person residing in the town of Elliot Lake. The "representative person" (ICRP 2007) is equivalent to and replaces the "average member of the critical group" (ICRP 1986) as the basis for determining compliance with public dose limits and guidelines.*
>
> *An interim public dose estimation for a representative member of the Elliot Lake public was calculated for the Cycle 5 SOE study design (Ecometrix 2018). Detailed methods are provided in Appendix E.*

The JRG approved the SRW Cycle 4 (2010 to 2014) SOE Report (Minnow 2017) and the Cycle 5 Study Design for the SRWMP, SAMP, and TOMP (Minnow 2019), including this approach to calculating the public dose estimation based on a "representative person". Please refer to the response to Comment 11 for additional information on data collection.

CNSC Comment 8 – Section 10 Summary

Section 10 Summary (page 256) states that "Surface water quality was generally at or near EIS-predicted levels for Cycle 5 data (2015 to 2019)". Surface water monitoring results are presented for the Stanrock, Stanleigh, Denison, Spanish American, Quirke, Panel, Lacnor/Nordic, and Pronto TMAs in the TOMP. But only one EIS is referenced in the Cycle 5 SOE report as follows:

> *Rio Algom Limited 1995. Environmental Impact Statement (EIS) for the Decommissioning of the Quirke and Panel Waste Management Areas. Prepared by SENES Consultants Limited. February.*

Additionally, when a comparison of the monitoring data with EIS predictions (like in Figure 4.16 on page 123) was made, the prediction shown in the figure is a single value. It is not clear if the single value is extracted from the predicted breakthrough curves in the EIS, or if the EIS only provided a single value prediction. If predicted breakthrough curves exist in the EIS, comments should be provided with regard to the location of the single prediction value in the breakthrough curves (i.e., in the increasing or decreasing limb) in evaluating the trend of surface water quality over time, and if peak concentrations have appeared or to be shown up in the future. This clarification is essential to determine if the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves and to evaluate the trend of surface water quality over time.

Expectations to Address Comment – CNSC staff expects that the EIS for all the sites will be provided in the References section of the Cycle 5 SOE report. In addition, in evaluating the trend of surface water quality over time, comments should be provided to clarify if the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves.

Licensee Response to Comment 8

EIS predictions were available for Quirke (RAL 1995a), Panel (RAL 1995a), Denison (DML 1995), Stanrock (DML 1995) and Stanleigh (RAL 1995b) TMAs. In addition to the RAL 1995a reference, DML 1995 was referenced in the report, as follows:

> *DML (Denison Mines Ltd). 1995. EIS Decommissioning of the Denison and Stanrock TMAs. Prepared by SENES Consultants Limited. February.*

The reference for Stanleigh TMA was not provided, but it is:

RAL (Rio Algom Limited). 1995b. Stanleigh Mine Decommissioning Plan. Prepared by SENES Consultants Limited. February.

The predicted concentrations in the SOE are the predicted maximum concentrations within 50 years post closure (i.e., between closure and the year 2040). Break through curves over the period of zero years post closure to 100 years post closure are presented in the EIS documents. In future reports, evaluation of surface water quality trends will include clarification whether the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves.

CNSC Comment 9 – Table B.9 – Sampling dates cannot be identified

Table B.9 includes several water sampling dates that cannot be identified (i.e., hashtags appear rather than dates).

Expectations to Address Comment – CNSC staff expect that all sampling dates in tables are present.

Licensee Response to Comment 9

Table B.9 has been edited to resolve the issue and is presented on the following page.

CNSC Comment 10 – pH Determination Procedure PR8.6.3.01 – pH is temperature dependent

In the pH Determination Procedure, there is no mention of recording the sample temperature in the field or in the effluent treatment plant (ETP). It was noted that only Table S.17 and Table S.18 include temperature measurements along with pH data for samples taken at different depths. It is unclear whether the pH meter used in the field and in the ETP has a probe that measures temperature and whether the probe is equipped with an automatic temperature compensation. This is important since the hydrogen ion activity in a water sample is affected by temperature so pH is temperature dependent. To reduce potential measurement errors and improve accuracy, the US EPA recommends performing instrument calibration and sample measurements at the same temperature and that temperature should be recorded during measurements [2].

Expectations to Address Comment - Rio Algom and Denison Mines are expected to provide more information regarding the pH Determination Procedure used in the field and in the ETP and to consider using a pH probe that measures temperature, is equipped with an automatic temperature compensation, and ensure sample temperatures are recorded along with pH measurements

Table B.9: Field blanks for TOMP (Station N-19) Water Samples, 2015 to 2019

Parameter	Units	Field Blank Criterion	N-19																		
			7-Jan-15	4-Feb-15	4-Mar-15	1-Apr-15	6-May-15	3-Jun-15	8-Jul-15	5-Aug-15	2-Sep-15	7-Oct-15	25-Nov-15	16-Dec-15	6-Jan-16	3-Feb-16	2-Mar-16	6-Apr-16	4-May-16	1-Jun-16	6-Jul-16	3-Aug-16
Barium	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cobalt	mg/L	0.001	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Iron	mg/L	0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Manganese	mg/L	0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
pH	-	-	5.4	5.60	5.6	6.10	5.95	5.49	5.8	5.8	5.6	5.9	5.5	5.4	5.74	5.41	5.97	5.7	5.76	6.81	5.9	8.17
Radium-226	Bq/L	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Sulphate	mg/L	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TSS	mg/L	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	mg/L	0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Parameter	Units	Field Blank Criterion	N-19																		
			7-Sep-16	5-Oct-16	2-Nov-16	7-Dec-16	4-Jan-17	8-Feb-17	1-Mar-17	5-Apr-17	3-May-17	7-Jun-17	5-Jul-17	2-Aug-17	6-Sep-17	4-Oct-17	1-Nov-17	6-Dec-17	3-Jan-18	7-Feb-18	7-Mar-18	4-Apr-18
Barium	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cobalt	mg/L	0.001	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Iron	mg/L	0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Manganese	mg/L	0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
pH	-	-	7.04	5.05	8.2	6.0	5.7	5.5	5.7	5.6	5.8	6.7	5.7	5.8	5.9	5.8	5.9	6.2	5.8	5.3	6.2	5.6
Radium-226	Bq/L	0.01	<0.008	<0.008	<0.008	<0.008	<0.007	<0.007	<0.007	<0.007	0.009	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Sulphate	mg/L	0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TSS	mg/L	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	mg/L	0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Parameter	Units	Field Blank Criterion	N-19																		
			2-May-18	6-Jun-18	5-Jul-18	1-Aug-18	5-Sep-18	3-Oct-18	7-Nov-18	5-Dec-18	2-Jan-19	6-Feb-19	13-Mar-19	3-Apr-19	8-May-19	5-Jun-19	3-Jul-19	7-Aug-19	4-Sep-19	2-Oct-19	6-Nov-19	4-Dec-19
Barium	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cobalt	mg/L	0.001	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Iron	mg/L	0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.033	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Manganese	mg/L	0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
pH	-	-	5.4	5.9	5.7	6.1	5.7	5.7	6.3	5.3	5.4	6.5	6.5	6.5	6.6	6.7	5.9	5.9	5.9	7.0	6.6	7.1
Radium-226	Bq/L	0.01	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Sulphate	mg/L	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
TSS	mg/L	2	<1	<1	1	<1	<2	<1	<1	<1	<1	<1	1	<1	<1	1	1	1	1	1	<1	<1
Uranium	mg/L	0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Field blank criterion not met.
Actual MDL does not meet target MDL.

Note: TSS = Total Suspended Solids.

Licensee Response to Comment 10

Field pH is measured using a YSI 1001 pH Sensor integrated within a handheld YSI unit, which also includes an integrated temperature sensor. Temperature compensation for pH is automatically adjusted by the YSI water quality meter (YSI 2015).

CNSC Comment 11 – Appendix U – Questionnaire Survey

The questionnaire survey to characterize resident exposure pathways and habits was performed in 2016 (Appendix A of Appendix U) and the same survey results (e.g., group size and its characteristics, etc.) are used in the SOE updates for the period from 2015 – 2019. The use of the same data is not supported by data analysis to demonstrate how representative the data are in 2019.

Expectations to Address Comment – Rio Algom and Denison Mines are expected to demonstrate how 2016 survey results are still representative in 2019.

Licensee Response to Comment 11

This approach to data collection was identified in Section 6.4 of the SRW Cycle 4 (2010 to 2014) SOE Report (Minnow 2017), which stated:

> *An interim public dose determination for a representative member of the Elliot Lake public based on readily available data and seasonal site-specific radon and gamma surveys will be developed in early 2016, and data collection will be initiated shortly thereafter. Public dose estimates to be included in the 2016 to 2020 annual SRWMP Reports will be based on updated public dose estimates generated through the 2016 interim program.*

The Cycle 5 Study Design for the SRWMP, SAMP, and TOMP (Minnow 2019) provided the Interim Public Dose Estimation Report in Appendix E and summarized the interim report in Section 5.4.2. Section 5.4.3 of the study design outlined how the public dose from the interim report would be updated using sport fish data to be collected 2019.

The JRG approved the SRW Cycle 4 (2010 to 2014) SOE Report (Minnow 2017) and the Cycle 5 Study Design for the SRWMP, SAMP, and TOMP (Minnow 2019), including this approach to the questionnaire survey, interim public dose estimation report, and updated public dose estimation report.

References

Denison (Denison Mines Inc). 2021. 2020 Operating Care and Maintenance Annual Report Denison Mines Inc. March 30, 2021.

DML (Denison Mines Ltd). 1995. EIS Decommissioning of the Denison and Stanrock TMAs. February

Ecometrix (EcoMetrix Incorporated). 2011. Special Investigations 2009 – Implications for Radiological Dose and Risk Calculations. Prepared for Denison Mines Inc. and Rio Algom Limited. February.

Ecometrix. 2016. Preliminary Design for a Monitoring Program to Support Public Dose Estimation. Prepared for Rio Algom Limited and Denison Mines Inc. September.

Ecometrix. 2018. Interim Public Dose Estimation for the Closed Mines of the Serpent River Watershed. Prepared for Rio Algom Limited and Denison Mines Inc. February.

Ecometrix. 2020. Public Dose Estimation for the Closed Mines of the Serpent River Watershed. Prepared for Rio Algom Limited and Denison Mines Inc. October.

Minnow (Minnow Environmental Inc.). 2012. Quirke Lake Radionuclides in Fish and Macrophytes. Report prepared for Rio Algom Limited and Denison Mines Inc. March.

Minnow. 2017. Serpent River Watershed Cycle 4 (2010 to 2014) State of the Environment Report. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. November. Project 2555.

Minnow. 2019. Cycle 5 Study Design for the SRWMP, SAMP, and TOMP. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. April. Project 187202.0055.

Minnow. 2021. Serpent River Watershed Cycle 5 (2015 to 2019) State of the Environment Report. Prepared for Rio Algom Limited and Denison Mines Inc., Elliot Lake, Ontario. March. Project 197202.0041.

RAL (Rio Algom Limited). 1995a. Environmental Impact Statement (EIS) for the Decommissioning of the Quirke and Panel Waste Management Areas. Prepared by SENES Consultants Limited. February.

RAL (Rio Algom Limited). 1995b. Stanleigh Mine Decommissioning Plan. Prepared by SENES Consultants Limited. February.

YSI. 2015. The pH Handbook. YSI: Yellow Springs, OH 45387.

ATTACHMENT A
CORRESPONDENCE

From: Pandolfi, Dana
To: Heffner, Holly
Cc: Lambert, Tony; Stenson, Ron
Subject: CNSC staff"s review comments of SOE report
Date: Tuesday, October 12, 2021 11:20:05 AM

Good day Holly,

Please find below CNSC staff's review comments of the SOE report. A couple of the comments/recommendations provided by the CNSC's specialists will be discussed outside of the SOE review report. Feel free to contact me if you have any questions.

Regards,
Dana

Dana Pandolfi
Project Officer, Regulatory Operations Branch
Canadian Nuclear Safety Commission/ Government of Canada
dana.pandolfi@cnsc-ccsn.gc.ca /Tel: 613-297-4340

Agente de Projet, Réglementation des opérations
Commission canadienne de sûreté nucléaire/Gouvernement du Canada
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Comment 1 – Section 2.2.2 Sample/Data Collection - Description of metals analysis for sediment samples is inaccurate

The laboratory preparation for metals analysis of sediment samples is described as follows: "Sediments collected for metal content were digested in a mixture of hydrochloric acid, nitric acid, and reverse osmosis de-ionized water then analyzed by inductively coupled plasma mass spectrometry (ICP-MS)". The description above is inaccurate since the preparation of sediment samples in a laboratory can be summarized in the following steps: sediment samples are dried, a portion of dried sample is weighed and digested in a mixture of hydrochloric acid and nitric acid, an aliquot of the digested sample is diluted with milliQ water to a known volume, and the diluted sample is analyzed by inductively coupled plasma mass spectrometry (ICP-MS) [1].

Expectations to Address Comment –The metals analysis laboratory preparation for sediment samples should be clarified and/or referenced.

Comment 2 – Section 3.6 – Ba and Ra-226 in the May Lake Sub-watershed

Water quality monitoring in the May Lake Sub-watershed has indicated that Ba and Ra-226 have generally increased during the 2015-2019 period. It is stated this is believed to be due to refractory radium and the subsequent barium treatment, it is noted that Ra-226 has decreased since the

commencement of the XSB treatment.

Expectations to address comment – None, CNSC staff will continue monitoring Ra-226 trends in the May Lake sub-watershed in subsequent monitoring reports to ensure Ra-226 continues to decrease.

Comment 3 – Figure 4.7 – Ra-226 trends
While Ra-226 concentrations seemed to approach the 0.2 Bq/L prediction in 1996, it appears to be steadily increasing in the influent of station D-1, during 2008 to 2019. Therefore, it is not clear if conditions at this TMA may be such as to trigger refractory radium in the effluent, similar to what occurred at the Stanleigh TMA in 2017?

Expectations to Address Comment –Rio Algom and Denison Mines should address the following questions regarding the increasing trend in Ra-226 in station D-1 influent:

- Are there predictions available for this increasing trend? If so, is it expected to stabilize or decrease in the future?

Comment 4 – Section 8.1 – Correlation between Grain Size and Total Organic Carbon
In Section 8.1, it states that "the TOC from a mean of 7.6 to 9.1% in mine-exposed lakes compared to 8.2 to 11% in reference lakes, and tended to be lower in samples containing higher proportions of sand". In Section 10.3, there is also inference that higher concentrations are likely due to increased TOC and proportion of clay particles. The above statements (regarding correlation between grain size, TOC and contaminant concentrations) are not supported with published references.

Expectations to Address Comment – Rio Algom and Denison Mines should include published references to support observed correlation between grain size, TOC and contaminant concentrations.

Comment 5 - Section 8.2.2 and 8.2.4 - Benthic Invertebrate Species Tolerance
Statistical trend analyses noted significant trends in community structure (8.2.4) and species composition (8.2.2) over time, along with discussion of which species were increasing or decreasing. It would be beneficial to strengthen these analyses by adding some discussion around benthic invertebrate species tolerance to contamination to help explain why some species are more abundant in recent years, and/or sensitive species less abundant, since this could serve as an indicator of potential effect and/or improving site conditions.
Expectations to Address Comment – Rio Algom and Denison Mines should consider evaluating the relative sensitivity and tolerance of benthic invertebrate species in their discussion of temporal trends.

Comment 6 – Section 9.1 – Trend Analysis
Section 9.1 provides a detailed description of the historical dose estimates, but it is not straightforward to easily compare the doses from the previous reports (e.g. cycle 3 SOE in 2009 and updates in 2011) to the current estimates and do a trend analysis to support the text.

Expectations to Address Comment – Rio Algom and Denison Mines are expected to consider (in future reports) including graphical trend analysis for the historical dose estimates for straightforward data comparison and analysis.

Comment 7 – Section 9.2 – Current Public Dose Estimates and Assumptions
Section 9.2 states that the dose to the representative person was calculated using the following assumptions:

- 110.76 hours per year spent walking near the Tailings Management Areas (TMAs);
- Consumption of 1.5 L of treated Elliot Lake drinking water per day, 365 days per year; and
- Consumption of 1.59 kg/year of sport fish (on a fresh weight basis).

However, the rationale provided in the report is not sufficient to justify how these assumptions are conservative for the representative group (adults).

Expectations to Address Comment – Rio Algom and Denison Mines are expected to justify how the assumptions are conservative for the calculation of public dose for the representative group (adults).

Comment 8 – Section 10 Summary (page 256) states that "Surface water quality was generally at or near EIS-predicted levels for Cycle 5 data (2015 to 2019)". Surface water monitoring results are presented for the Stanrock, Stanleigh, Denison, Spanish American, Quirke, Panel, Lacnor/Nordic, and Pronto TMAs in the TOMP. But only one EIS is referenced in the Cycle 5 SOE report as follows:

Rio Algom Limited 1995. Environmental Impact Statement (EIS) for the Decommissioning of the Quirke and Panel Waste Management Areas. Prepared by SENES Consultants Limited. February.

Additionally, when a comparison of the monitoring data with EIS predictions (like in Figure 4.16 on page 123) was made, the prediction shown in the figure is a single value. It is not clear if the single value is extracted from the predicted breakthrough curves in the EIS, or if the EIS only provided a single value prediction. If predicted breakthrough curves exist in the EIS, comments should be provided with regard to the location of the single prediction value in the breakthrough curves (i.e., in the increasing or decreasing limb) in evaluating the trend of surface water quality over time, and if peak concentrations have appeared or to be shown up in the future. This clarification is essential to determine if the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves and to evaluate the trend of surface water quality over time.

Expectations to Address Comment – CNSC staff expects that the EIS for all the sites will be provided in the **References** section of the Cycle 5 SOE report. In addition, in evaluating the trend of surface water quality over time, comments should be provided to clarify if the current monitoring data is on the increasing or decreasing limb of the predicted breakthrough curves.

Comment 9 – Table B.9 – Sampling dates cannot be identified

Table B.9 includes several water sampling dates that cannot be identified (i.e. hashtags appear rather than dates).

Expectations to Address Comment – CNSC staff expect that all sampling dates in tables are present.

Comment 10 – pH Determination Procedure PR8.6.3.01 – pH is temperature dependent

In the pH Determination Procedure, there is no mention of recording the sample temperature in the field or in the effluent treatment plant (ETP). It was noted that only Table S.17 and Table S.18 include temperature measurements along with pH data for samples taken at different depths. It is unclear whether the pH meter used in the field and in the ETP has a probe that measures temperature and whether the probe is equipped with an automatic temperature compensation. This is important since the hydrogen ion activity in a water sample is affected by temperature so pH is temperature dependent. To reduce potential measurement errors and improve accuracy, the US EPA recommends performing instrument calibration and sample measurements at the same temperature and that temperature should be recorded during measurements [2].

Expectations to Address Comment - Rio Algom and Denison Mines are expected to provide more information regarding the pH Determination Procedure used in the field and in the ETP and to consider using a pH probe that measures temperature, is equipped with an automatic temperature compensation, and ensure sample temperatures are recorded along with pH measurements.

Comment 11 – Appendix U – Questionnaire Survey

The questionnaire survey to characterize resident exposure pathways and habits was performed in 2016 (Appendix A of Appendix U) and the same survey results (e.g., group size and its characteristics, etc.) are used in the SOE updates for the period from 2015 – 2019. The use of the same data is not supported by data analysis to demonstrate how representative the data are in 2019.

Expectations to Address Comment – Rio Algom and Denison Mines are expected to demonstrate how 2016 survey results are still representative in 2019.

15 March 2022
Dana Pandolfi
Project Officer, Uranium Mines and Mills Division
Canadian Nuclear Safety Commission
280 Slated Street
PO Box 1046, Station B
Ottawa, Ontario K1P 5S9

Dear Dana

RAL and DMI Responses to Regulator Comments on the Serpent River Watershed Cycle 5 (2015 to 2019) State of the Environment Report – Round 2

The Serpent River Watershed (SRW) Cycle 5 (2015 to 2019) State of the Environment (SOE) Report was submitted to the Joint Review Group (JRG) in March 2021. Comments on the study report were received from the Canadian Nuclear Safety Commission (CNSC) on October 12, 2021, with response provided to CNSC January 3, 2022. Additional comments were received from CNSC March 1 and 2, 2022.

The below provides the information required to respond to the additional comments received from the CNCS in March 2022.

CNSC Response to Licensee Response to Comment 8

Response is partially acceptable. The response indicates that EIS predictions were available for Quirke (RAL 1995a), Panel (RAL 1995a), Denison (DML 1995), Stanrock (DML 1995), and Stanleigh (RAL 1995b). However, there is no mention of the EIS prediction for Spanish American, Lacnor/Nordic, and Pronto TMAs. CNSC staff except the EIS predictions for these sites to be included as well.

Licensee Response to CNSC Follow-up regarding Comment 8

During the 1960's, the historic properties (Spanish American, Milliken, Lacnor, Nordic/Buckles and Pronto) were regulated by a single license issued by the Atomic Energy Control Board (AECB), predecessor of the Canadian Nuclear Safety Commission (CNSC). Following closure the license lapsed and in 1994, a report by the Auditor General identified the need to bring the historic properties under AECB control. In 1995, Rio Algom Limited applied to the AECB for a prescribed substance license (PSL) to continue to possess and mange the radionuclides in the tailings and treatment precipitates of the historic TMAs. When RAL applied for a radioactive waste facility operating license in 2002, CNSC determined that before it could make a licensing decision, a "screening" environmental assessment would be required for this historic sites. The screening report provided qualitative predictions with respect to acid generating potential from the historic properties, however quantitative predictions for the individual sites were not produced.

However, cumulative effects from historic mining activities were originally assessed in the 1995 Quirke and Panel EIS, Denison and Stanrock EIS (February 1995) and in the Stanleigh Comprehensive Study Report (May 1997). The EIS assessments indicated that there was no significant predicted cumulative impacts associated with the management of the historic mine wastes (SENES 2002). As such the continued comparison to EIS predictions will occur for the Quirke, Panel, Denison, Stanrock and Stanleigh facilities.

References:

DML (Denison Mines Ltd). 1995. EIS Decommissioning of the Denison and Stanrock TMAs. Prepared by SENES Consultants Limited. February.

Rio Algom Limited 1995a. Environmental Impact Statement (EIS) for the Decommissioning of the Quirke and Panel Waste Management Areas. Prepared by SENES Consultants Limited. February.

RAL (Rio Algom Limited). 1995b. Stanleigh Mine Decommissioning Plan. Prepared by SENES Consultants Limited. February.

SENES Consultants Limited 1997. Comprehensive Study Report Decommissioning of the Stanleigh Waste Management Area, Mine and Mill. Prepared by SENES Consultants Limited. May.

SENES Consultants Limited 2002. Environmental Assessment Screening Report Possession and Management of Waste Nuclear Substances Situated at Spanish American, Milliken, Lacnor, Nordic/Buckles, and Pronto Historical Properties in the Elliot Lake Area, Ontario. Prepared by SENES Consultants Limited. March.

CNSC Comment 12

With increasing understanding of climate change and its effects, the potential impact climate change may have on environmental risks at a site is a consideration. CNSC staff recognize that there is currently no explicit expectation on climate change in CSA N288.6, however, the standard does recognize the need to address stressors for reasons of public perception (e.g., Clause 7.2.5.4.3 for contaminants of potential concern) and recommends to identify “scientific advances that require a change to ERA approaches or parameters” prior to each update (Clause 11.1). As such, CNSC staff recommend that Rio Algom and Denison Mines include a discussion on anticipated climate change impacts in future assessments, and for those identified, the subsequent potential changes to the environmental risk profile. Table T.20 and figure T.9 suggests that increased water temperature may have a relationship with some benthic invertebrate criteria; increased water temperatures may in turn be a potential effect of climate change.

Expectations to Address Comment – CNSC staff recommend that in future iterations of the SOE a discussion of climate change driven effects and the associated impacts they may have in relation to environmental and human health risk from the Elliot Lake sites is included.

Licensee Response to CNSC Comment 12

Future iterations of the SOE will include a discussion of climate change driven effects and potential associated impacts they may have in relation to environmental and human health risk from the Elliot Lake sites.

Closing

Should you have any additional questions or comments please contact Sarah Benson at sbenson@denisonmines.com and Holly Heffner at holly.heffner@bhp.com.

Kind Regards,

Holly Heffner

Holly Heffner
Principal Licensing and Permitting
Rio Algom Limited

SBenson

Sarah Benson
Environmental and Regulatory Manager
Denison Mines Inc.

20220315_RAL-DMI-CNSC_Response to CNSC 2nd review comments_final

Final Audit Report 2022-03-15

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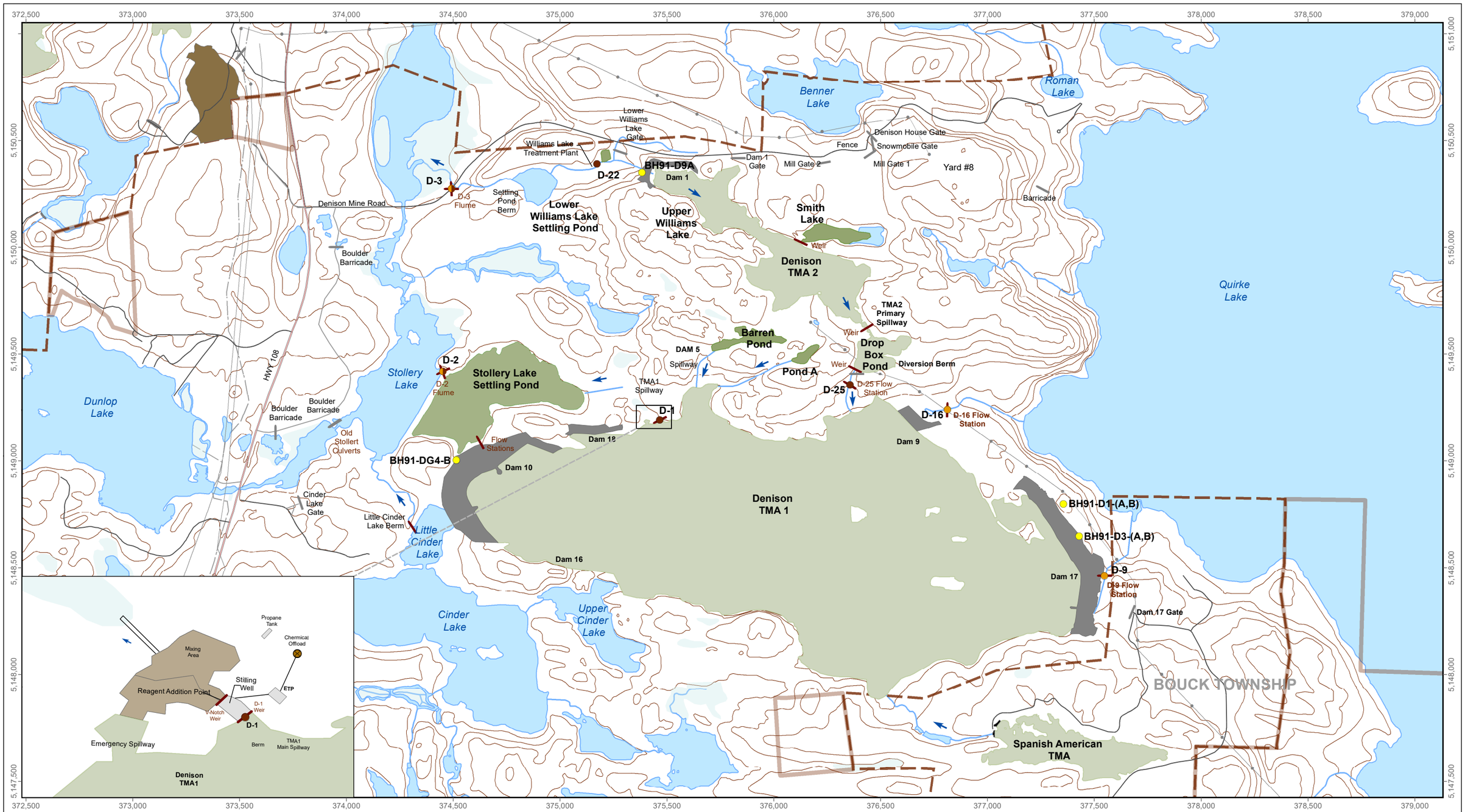
APPENDIX B



LEGEND

Monitoring Station
- SAMP Surface Water
- TOMP Surface Water
- TOMP Groundwater
- SAMP and TOMP Surface Water

- Berm
- Dam
- Till Pit

- Water Covered Tailings
- Settling Pond
- Vegetated Tailings
- Limits of CNSC Licence
- Limits of Unlicenced Property

- Hydro Line
- Contour (10 m)

0 280 560 1,120
Meters

N W E S

Denison Site SAMP and TOMP Monitoring Stations

Date: May 2024
Project 247202.0033

minnow environmental inc.

Figure B.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure B.1 Denison Site SAMP and TOMP Monitoring Stations.mxd

LEGEND

Monitoring Station

- SAMP Surface Water
- TOMP Surface Water
- TOMP Groundwater
- TOMP Pore Water
- SAMP and TOMP Surface Water
- Dyke
- Spillway
- Berm
- Dam
- Quarry
- Till Pit
- Water Covered Tailings
- Settling Pond
- Limits of CNSC Licence
- Limits of Unlicenced Property
- Hydro Line
- Contour (10 m)

0 287.5 575 1,150

Meters

N W E S

Quirke Site SAMP and TOMP Monitoring Stations

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Project 247202.0033

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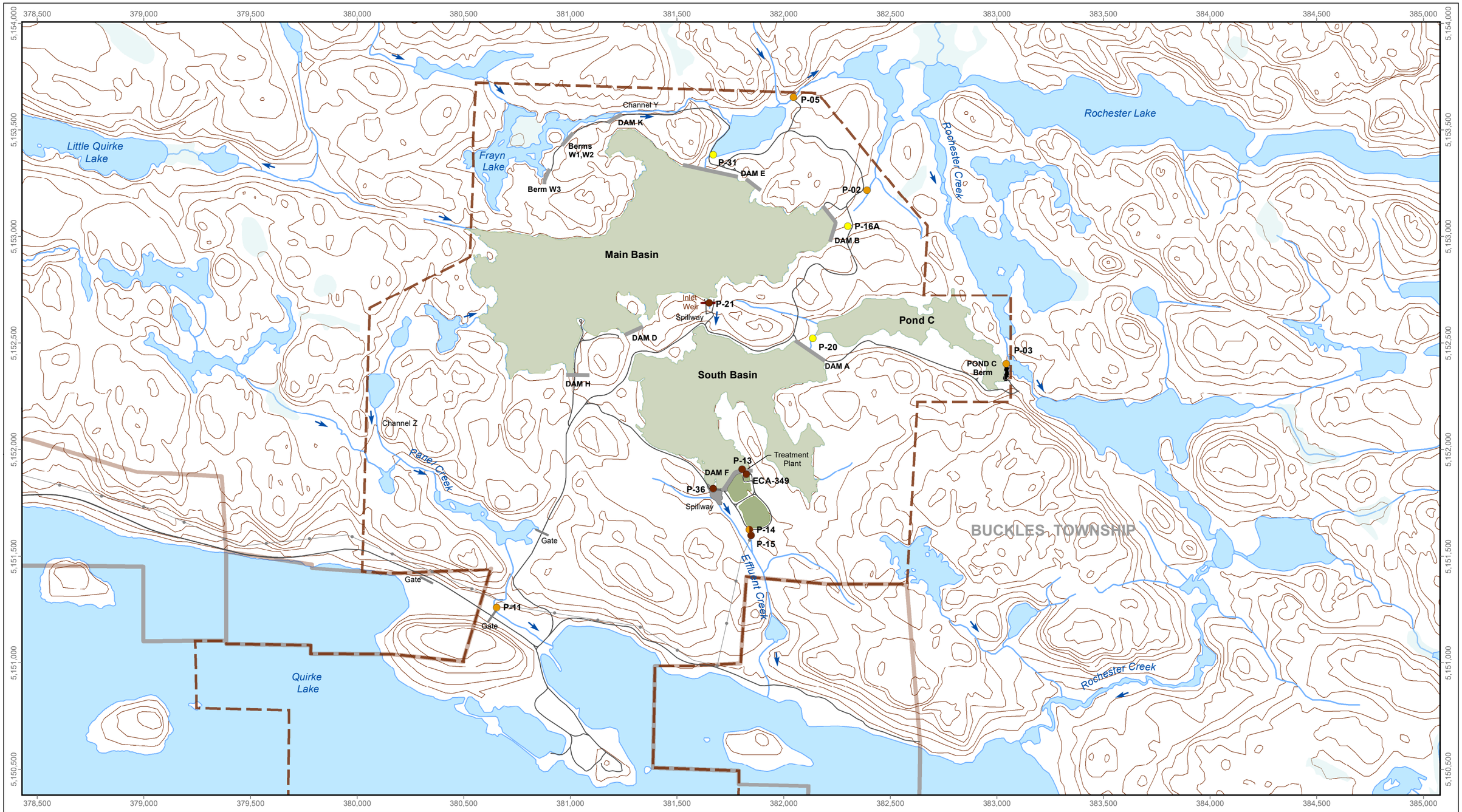
Figure B.2

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure B.2 Quirke Site SAMP and TOMP Monitoring Stations.mxd



LEGEND

Monitoring Station
- SAMP Surface Water
- TOMP Surface Water
- TOMP Groundwater
- SAMP and TOMP Surface Water

- Berm
- Dam
- Settling Pond
- Water Covered Tailings

- Limits of CNSC Licence
- Limits of Unlicenced Property
- Hydro Line
- Contour (10 m)

0 280 560 1,120
Meters

N W E S

Panel Site SAMP and TOMP Monitoring Stations

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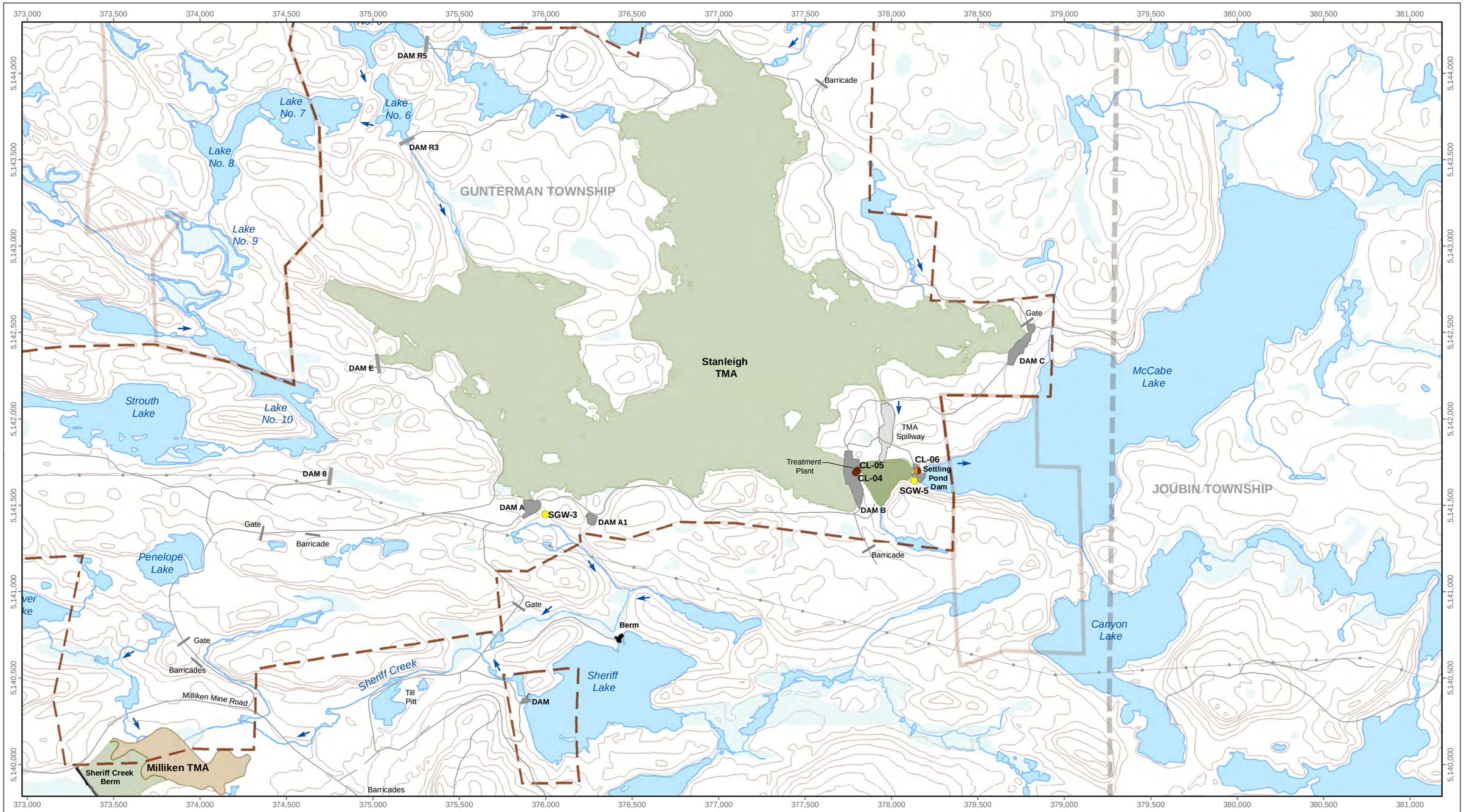
Figure B.3

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure B.3 Panel Site SAMP and TOMP Monitoring Stations.mxd



LEGEND

Monitoring Station
- SAMP Surface Water
- TOMP Surface Water
- TOMP Groundwater
- SAMP and TOMP Surface Water

- Spillway
- Berm
- Dam
- Tailings Management Area (Water Cover)
- Settling Pond
- Vegetated Tailings
- Limits of CNSC Licence
- Limits of Unlicenced Property
- Ontario_township
- Hydro Line
- Contour (10 m)

0 350 700 1,400
Meters

N
W E
S

Projection: North American Datum 1983 UTM Zone 17

Stanleigh Site SAMP and TOMP Monitoring Stations

Date: November 2024
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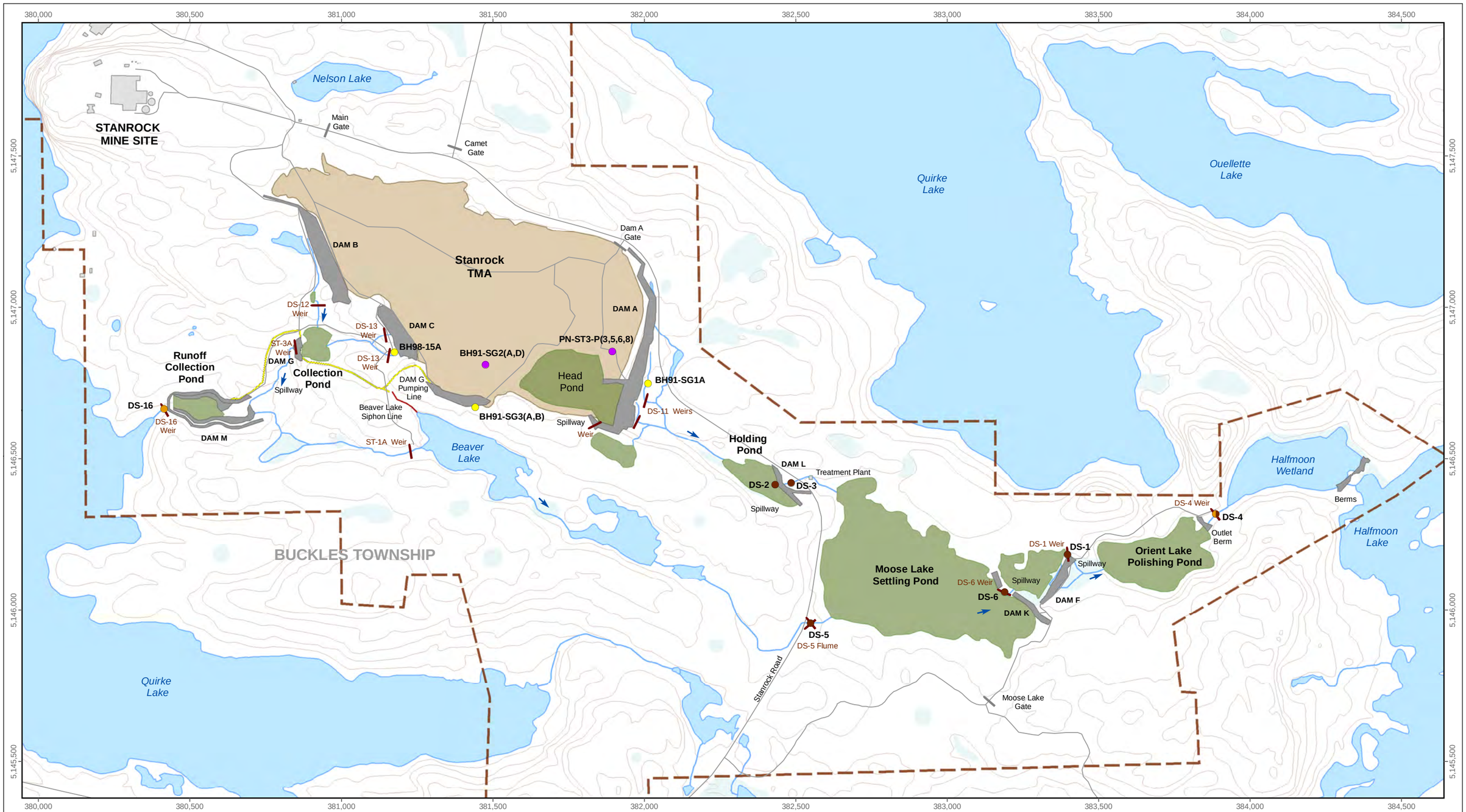
Figure B.4

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure B.4 Stanleigh Site SAMP and TOMP Monitoring Stations.mxd



LEGEND

Monitoring Station

- SAMP Surface Water
- TOMP Surface Water
- TOMP Groundwater
- TOMP Pore Water
- SAMP and TOMP Surface Water
- Dam
- Collection and Settling Pond
- Vegetated Tailings
- Limits of CNSC Licence
- Gate
- Flow Station or Weir
- Drainage Channel
- Pipeline
- Siphon Line
- Hydro Line
- Contour (10 m)

0 200 400 800
Meters

N W E S

Stanrock Site SAMPS and TOMP Monitoring Stations

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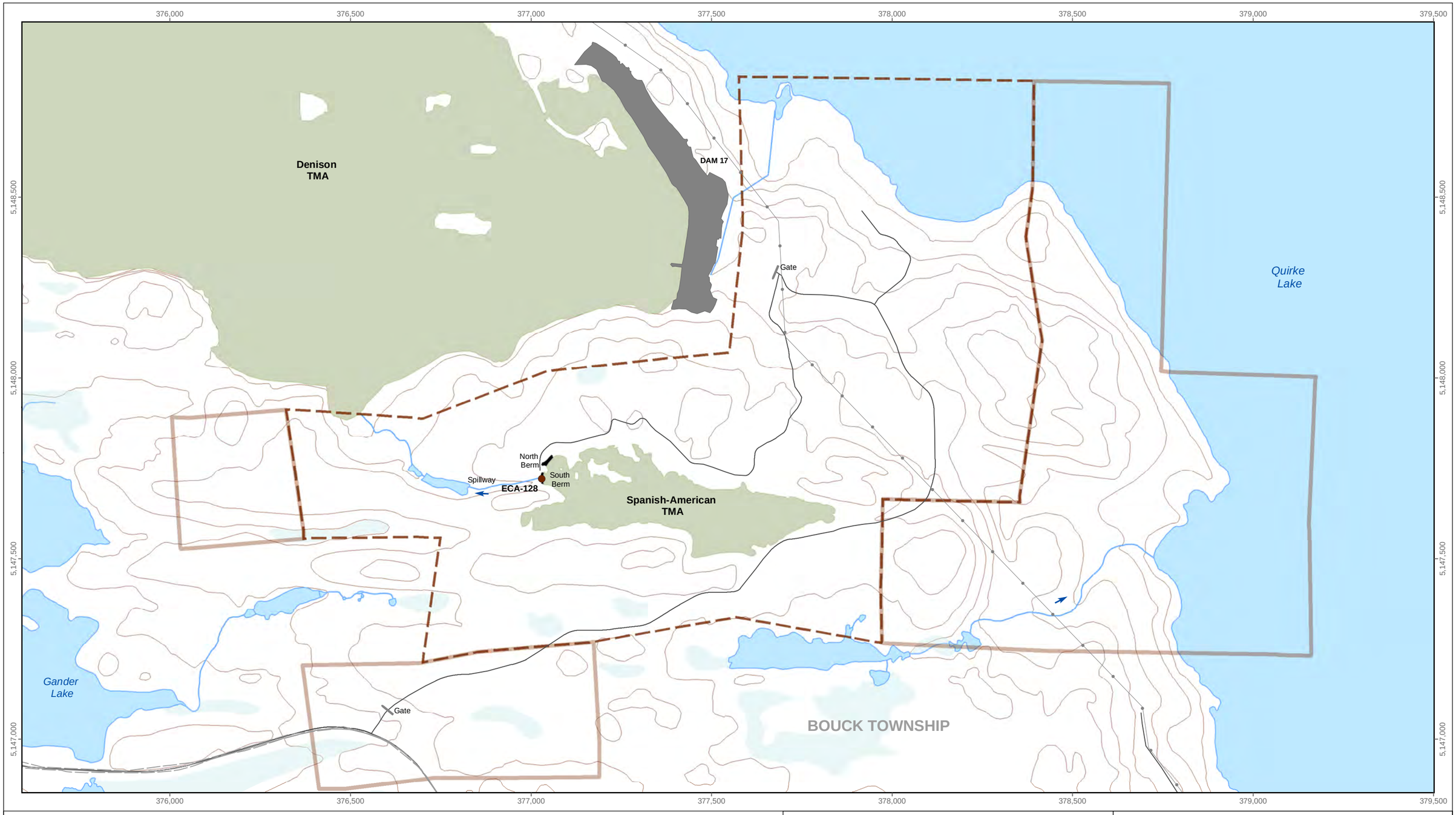
Figure B.5

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure B.5 Stanrock Site SAMP and TOMP Monitoring Stations.mxd



LEGEND

- TOMP Surface Water
- Berm
- Dam
- Water Covered Tailings
- Limits of CNSC Licence
- Limits of Unlicenced Property
- Berm
- Dam
- Gate
- Hydro Line
- Contour (10 m)

0 150 300 600
Meters

N
W E
S

Spanish American TMA TOMP Monitoring Station

Date: November 2024
Project 247202.0033

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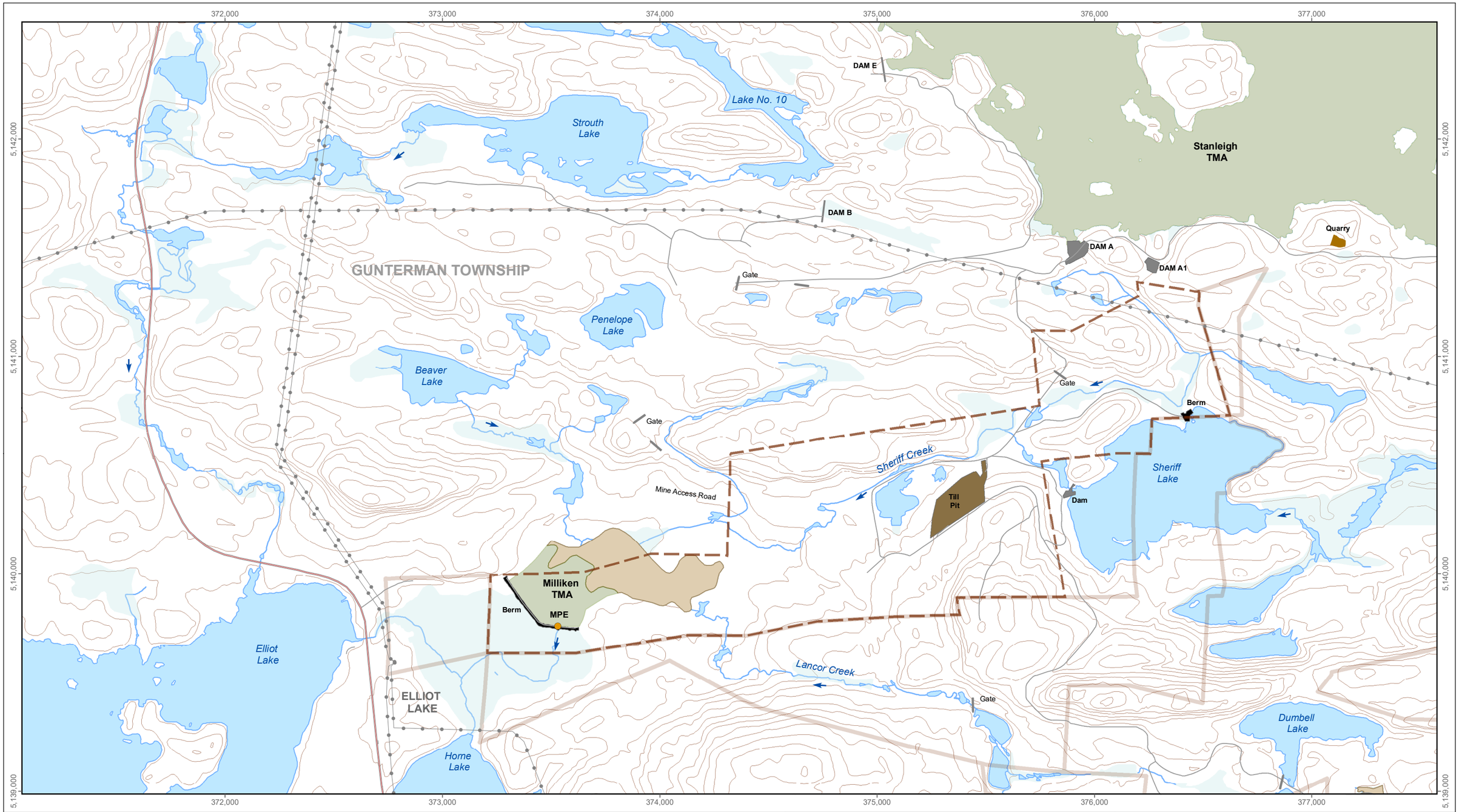
Figure B.6

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - D - GIS\Report\24-33 Figure B.6 Spanish American TMA TOMP Monitoring Stations.mxd



LEGEND

Monitoring Station
- SAMP Surface Water

- Berm
- Dam
- Quarry
- Till Pit

- Tailings Management Area (Water Covered)
- Tailings Management Area (Vegetated)
- Limits of Millken CNSC Licence
- Limits of Unlicenced Property

- Dam
- Gate
- Hydro Line
- Contour (10 m)

0 0.25 0.5 1 km

N W E S

Miliken Site SAMP Monitoring Station

Date: May 2024
Project 247202.0033

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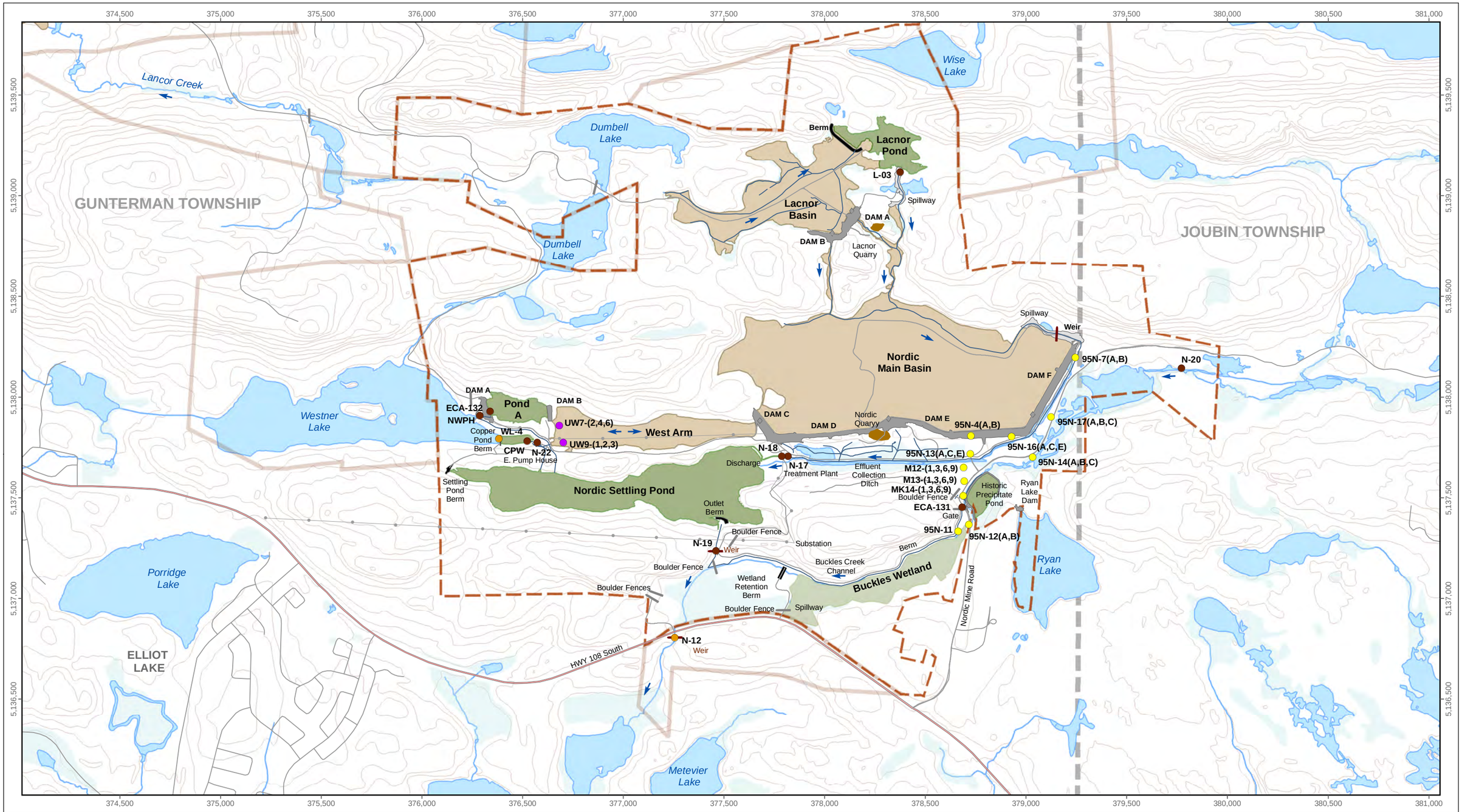
Figure B.7

Document Path: C:\Users\mlapalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure B.7 Milliken Site SAMP and TOMP Monitoring Stations.mxd



LEGEND

Monitoring Station
- SAMP Surface Water
- TOMP Surface Water
- TOMP Groundwater
- TOMP Pore Water

- Spillway
- Berm
- Dam
- Quarry

- Water Covered Tailings
- Settling Pond
- Vegetated Tailings

- Limits of CNSC Licence
- Limits of Unlicenced Property
- Ontario_township

- Drainage Channel
- Hydro Line
- Contour (10 m)

0 300 600 1,200
Meters

N
W E
S

Lacnor, Nordic and Buckles Sites SAMP and TOMP Monitoring Stations

Date: November 2024
Project 247202.0033

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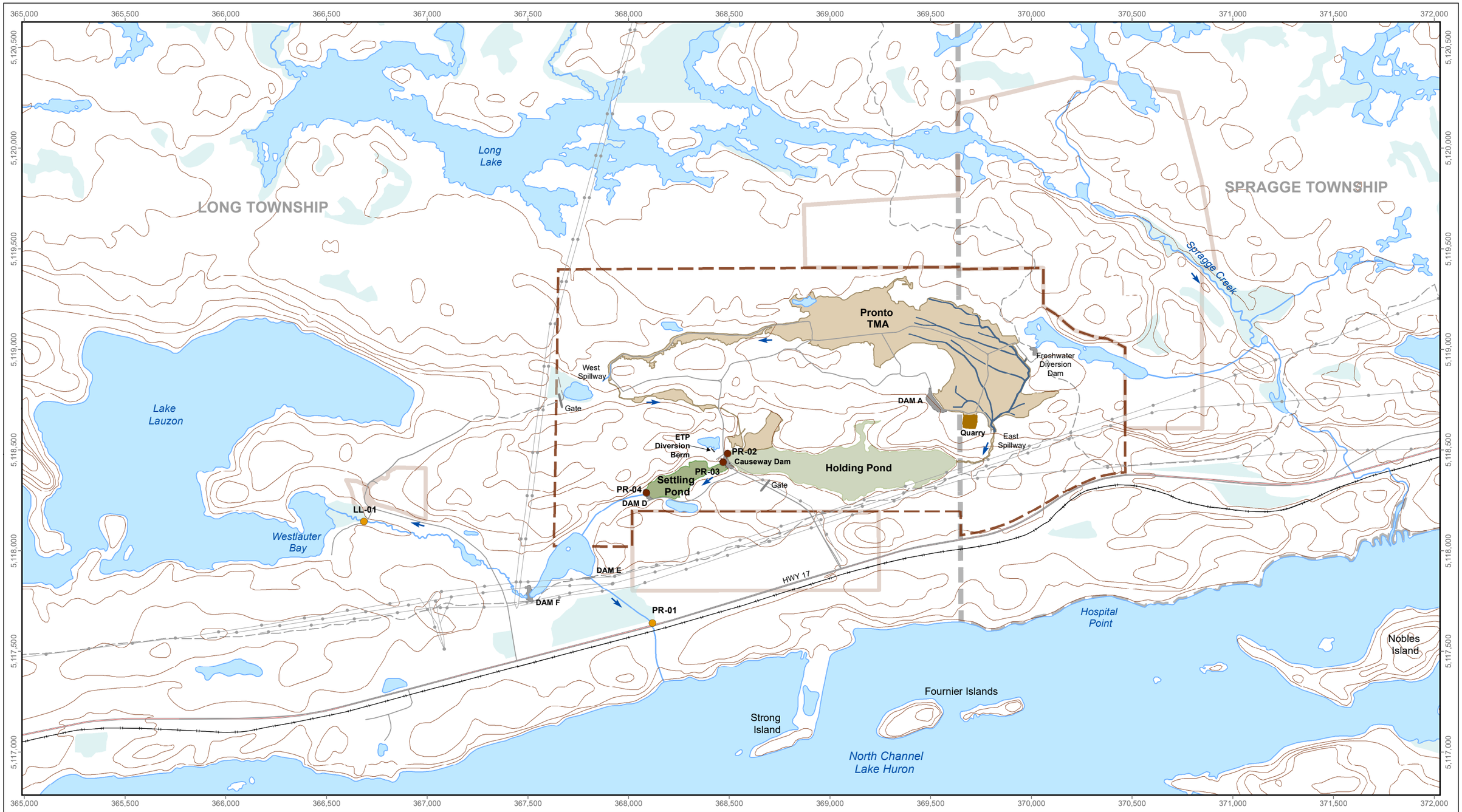
Figure B.8

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure B.8 Lacnor, Nordic, Buckles Site SAMP and TOMP Monitoring Stations.mxd



LEGEND

Monitoring Station
- SAMP Surface Water
- TOMP Surface Water

- Berm
- Dam
- Berm
- Dam
- Quarry

- Vegetated Tailings
- Settling Pond
- Water Covered Tailings
- Limits of CNSC Licence

- Limits of Unlicenced Property
- Ditch
- Drainage Channel
- Ontario_township

- Ontario_Railway
- Hydro Line
- Contour (10 m)

0 0.25 0.5 1
Kilometers

N W E S

Pronto Site SAMP and TOMP Monitoring Stations

Date: May 2024
Project 247202.003

minnow environmental inc.

Figure B.9

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\BHP - 247202.0033 - Cycle 6 SOE Study Design\D - GIS\Report\24-33 Figure B.9 Pronto Site SAMP and TOMP Monitoring Stations.mxd

Table B.1: TOMP Monitoring Program Stations for Denison TMA

Station ID	Location	Station Type	Description
D-1	TMA-1 (Long Lake) Outlet	Surface water	Reflects water quality of the overflow from TMA-1 toward Stollery Lake.
D-2	Stollery Lake Outlet	Surface water	Reflects water quality of the final point of control for TMA-1.
D-3	TMA-2 Seepage at Denison Mine access road	Surface water	Reflects seepage from TMA-2.
D-22	Influent to ETP at TMA-2 (formerly Williams Lake)	Surface water	Reflects the quality of seepage from TMA-2 and contribution from historical tailings deposits located between Dam 1 and the ETP.
D-25	Spillway Between TMA-1 and TMA-2	Surface water	Reflects water quality in TMA-2.
BH91-D1(A,B)	Dam 17, North Abutment Groundwater	Groundwater	Reflects seepage to Quirke Lake.
BH91-D3(A,B)	Dam 17 North Valley, Toe Groundwater	Groundwater	Reflects seepage to Cinder Lake.
BH91-DG4B	Below Dam 10 Groundwater	Groundwater	Reflects seepage from Dam 10.
BH91-D9A	North Ridge Dam 1, Toe Groundwater	Groundwater	Reflects seepage from Dam 1.

Table B.2: TOMP Monitoring Program Stations for Quirke TMA

Station ID	Location	Station Type	Description
Q-03	Dam E Overflow	Surface water	Detects acidity levels from Main Dam seepage. Lime addition is adjusted accordingly at the ETP.
Q-04P	pH probe at ETP	Surface water	Operational monitoring of pH is conducted at this location for the purpose of calibrating the in-line continuous pH probe used in the lime addition control loop at the ETP.
Q-05	Treatment Plant Influent	Surface water	Reflects Cell 18 and ETP influent water quality and is used for operational control.
Q-28	Final Treated Effluent	Surface water	Reflects final treated effluent quality released to Serpent River.
Q-29	Gravel Pit Lake Feed to Quirke Tailings	Surface water	Represents background watershed conditions. Water flows down gradient from Gravel Pit Lake to Quirke TMA through this location. Flow is controlled to optimize water levels in Quirke TMA versus Gravel Pit Lake.
Cell 14	Cell 14 at Spillway	Surface water	Reflects water quality of Cell 14 and thus assists in assessing relative performance of Quirke TMA cells.
Cell 15	Cell 15 at Spillway	Surface water	Reflects water quality of Cell 15 and thus assists in assessing relative performance of Quirke TMA cells.
Cell 16S	Cell 16S at Spillway	Surface water	Reflects water quality of Cell 16S and thus assists in assessing relative performance of Quirke TMA cells.
Cell 17	Cell 17 at Spillway	Surface water	Reflects water quality of Cell 17 and thus assists in assessing relative performance of Quirke TMA cells.
90DK-14-5C	Cell 15 Porewater at West End Below Dyke 14	Pore water	Reflects basin performance and tracks changes in basin conditions over time.
DK15-2(A-D)	Dyke 15 Pore water	Pore water	Reflects basin performance and tracks changes in basin conditions over time.
DK15-4(A-D)	Dyke 15 Pore water	Pore water	Reflects basin performance and tracks changes in basin conditions over time.
DK16-2(A-D)	Dyke 16 Pore water	Pore water	Reflects basin performance and tracks changes in basin conditions over time.
DK17-2(A-D)	Dyke 17 Pore water	Pore water	Reflects basin performance and tracks changes in basin conditions over time.
QPW-1(1,4,8)	Overburden Downstream of Dam K1 Upstream of Dyke 23	Groundwater	Reflects seepage at Dam K1.
95QW-3(A,C,D)	Overburden Downstream of Main Dam	Groundwater	Monitoring at this station has been conducted to determine the residual activity in the overburden left after the main dam and slurry wall were constructed.
95QW-4	Overburden Downstream of Dam G2 at East End TMA	Groundwater	Monitoring at this station reflects seepage at Dam G2. The groundwater quality has remained constant over the past 5 years, with low levels of metals and radionuclides, elevated levels of sulfate and neutral pH. Monitoring of pH, conductivity and iron should continue for an interim period to determine if conditions are continuing to improve.
95QW-5(A,D)	Overburden Downstream of Dam K1	Groundwater	Monitoring at this station reflects seepage at Dam K1. This location displays no evidence of tailings porewater at any level, with the exception of level A, which is marginally acidic with elevated levels of iron. Monitoring pH, conductivity, acidity and iron should continue for an interim period to confirm conditions are continuing to improve, however, one half of the monitoring levels should be eliminated because they are not providing additional useful information.

Table B.3: TOMP Monitoring Program Stations for Panel TMA

Station ID	Location	Station Type	Description
ECA-349	pH probe at ETP	Surface water	Operational monitoring of pH is conducted at this location for calibrating the in-line continuous pH probe used in the lime addition control loop at the ETP.
P-13	ETP Influent	Surface water	Reflects South Basin and treatment plant influent water quality and is used for operational control.
P-14	Final Treated Effluent	Surface water	Reflects water quality of final treated effluent (also a SAMP station).
P-15	ETP Settling Pond Underflow Drainage	Surface water	Monitored to verify the integrity of the settling pond liners.
P-21	Main Basin Outflow	Surface water	Reflects Main Basin water quality.
P-36	Panel Overflow Spillway	Surface water	Reflects water quality of Panel Overflow Spillway and is monitored during by-pass conditions to determine watershed loadings. Will ultimately be the point of final discharge (i.e., post-ETP decommissioning).
P-16A	Dam B Seepage	Groundwater	Reflects seepage at Dam B.
P-20	Dam A Overburden	Groundwater	Reflects seepage at Dam A to Pond C.
P-31	Groundwater Below Dam E	Groundwater	Monitoring at this station reflects overburden seepage from Dam E.

Table B.4: TOMP Monitoring Program Stations for Stanrock TMA

Station ID	Location	Station Type	Description
DS-1	Moose Lake Settling Pond Outlet	Surface water	Data from this station are used to make operational adjustments at ETP.
DS-2	Treatment Plant Feed	Surface water	Reflects Holding Pond and treatment plant influent water quality for computing reagent addition requirements.
DS-3	Treatment Plant Discharge	Surface water	Reflects water quality of Treatment Plant Effluent and thus provides direct feedback to ETP operations.
DS-4	Orient Lake Polishing Pond Outlet (Final Point of Control)	Surface water	This station reflects the combined quality of effluent and seepages that discharge from Stanrock TMA to Halfmoon Lake.
DS-5	Orient Creek	Surface water	Reflects water quality of flow from Beaver Lake and runoff between Beaver Lake and Moose Lake. This flow ultimately reports to Halfmoon Lake via DS-4.
DS-6	Overflow at Dam K	Surface water	Reflects water quality at Moose Lake. Lime is occasionally added here to augment pH control at upstream ETP.
BH91-SG1A	Groundwater Downstream of Dam A	Groundwater	Reflects groundwater conditions downstream of Dam A.
BH98-16A	Groundwater Downstream of Dam B	Groundwater	Reflects groundwater conditions downstream of Dam B.
BH98-15A	Groundwater Downstream of Dam C	Groundwater	Reflects groundwater conditions downstream of Dam C.
BH91-SG3A,B	Groundwater Downstream of Dam D	Groundwater	Reflects groundwater conditions downstream of Dam D.
PN-ST3P 3,5,6,8	Pore water Upgradient of Dam A	Pore water	Reflects basin performance and tracks changes in basin conditions over time.
BH91-SG2 A,D	Pore water Upgradient of Headpool	Pore water	Reflects basin performance and tracks changes in basin conditions over time.

Table B.5: TOMP Monitoring Program Stations for Stanleigh TMA

Station ID	Location	Station Type	Description
CL-04	Treatment Plant Influent	Surface water	This station is used to evaluate water quality in the tailings basin.
CL-05	pH Probe at ETP	Surface water	Used to calibrate the in-line continuous pH probe used in the lime addition control loop at the ETP.
CL-06	Final Effluent	Surface water	Reflects quality of final treated effluent. Discharge resumed in May 2002 following basin decommissioning. Also a SAMP station.
SGW-3	Downstream Dam A Groundwater	Groundwater	Reflects seepage at Dam A.
SGW-5	Downstream Dam B Groundwater	Groundwater	Reflects seepage at Dam B.

Table B.6: TOMP Monitoring Program Stations for Lacnor and Nordic TMAs

Station ID	Location	Station Type	Description
ECA-131	Buckles Creek at Mine Road	Surface water	Monitors Nordic groundwater seepage plume and historic barium/radium precipitate contributions to Buckles Creek.
ECA-132	Nordic Pond A	Surface water	Reflects water quality of Nordic Pond A upstream of Westner seepage collection pumping stations.
L-03	Lacnor Tailings Discharge	Surface water	Reflects water quality of Lacnor Pond.
N-17	Treatment Plant Influent	Surface water	Reflects water quality of treatment plant influent and is used for operational control.
N-18	pH probe at ETP	Surface water	Operational monitoring of pH is conducted at this location for the purpose of calibrating the in-line continuous pH probe used in the lime addition control loop at the ETP.
N-19	Final Treated Effluent	Surface water	Reflects water quality of Nordic Settling Pond and final treated effluent.
N-20	Buckles Creek Upstream of N-13	Surface water	Provides background for the mitigation monitoring of the Nordic Plume effects on Buckles Creek.
N-22	West Arm Pump Discharge	Surface water	Monitoring is conducted here to determine improvements in seepage from the West Arm.
NWPH	Northwest Pumphouse	Surface water	Reflects seepage at Dam A.
CPW	Coffer Dam Pond	Surface water	Reflects water quality in Coffer Dam Pond and is used to determine requirement for lime addition.
UW7(2,4,6)	West End of Nordic West Arm Pore water	Pore water	Reflects basin performance and tracks changes in basin conditions over time.
UW9(1-3)	West End of Nordic West Arm Pore water	Pore water	Reflects basin performance and tracks changes in basin conditions over time.
M-12(1,3,6,9)	Groundwater 50’ Downstream ECD	Groundwater	Reflects the effectiveness of plume remediation measures respecting the seepage plume from the Main Tailings Basin.
M-13(1,3,6,9)	Nordic Plume Groundwater	Groundwater	Reflects the effectiveness of plume remediation measures respecting the seepage plume from the Main Tailings Basin.
M-14(1,3,6,9)	Toe of Dam F – Plum Downstream of M-13	Groundwater	Reflects the effectiveness of plume remediation measures respecting the seepage plume from the Main Tailings Basin.
95N-4(A,B)	Toe of Dam F West – Head of Plume Groundwater	Groundwater	Monitors the groundwater seepage at the source and Nordic settling pond.
95N-7(A,B)	Toe of Dam F East – Upstream ECD Groundwater	Groundwater	Monitors groundwater at the base of Dam F and the source plume water quality.
95N-11	Nordic Plume Groundwater South of Pecors Road	Groundwater	Reflects the effectiveness of plume remediation measures respecting the seepage plume from the Main Tailings Basin.
95N-12(A,B)	Nordic Plume Groundwater at Pecors Road	Groundwater	Reflects the effectiveness of plume remediation measures respecting the seepage plume from the Main Tailings Basin.
95N-3(A,C,E)	Nordic Plume North of Collection Ditch Groundwater	Groundwater	Monitors seepage quality upstream of the collection ditch.
95N-14(A-C)	South Pecors Rd., Downstream of ECD Groundwater	Groundwater	Reflects the effectiveness of plume remediation measures respecting the seepage plume from the Main Tailings Basin.
95N-6(A,C,E)	Toe of Dam F - Upstream of ECD Groundwater	Groundwater	Monitors groundwater at the upstream side of the effluent collection ditch, midway along Dam F, measuring the source plume water quality.
95N-17(A-C)	North of Pecors Rd., Downstream of ECD Groundwater	Groundwater	Reflects the effectiveness of plume remediation measures respecting the seepage plume from the Main Tailings Basin.

Table B.7: TOMP Monitoring Program Stations for Pronto TMA

Station ID	Location	Station Type	Description
PR-02	Treatment Plant Influent	Surface water	Reflects Holding Pond and treatment plant influent water quality.
PR-03	pH probe at ETP	Surface water	Operational monitoring of pH is conducted at this location for the purpose of calibrating the in-line continuous pH probe used in the lime addition control loop at the ETP.
PR-04	Final Treated Effluent	Surface water	Reflects water quality of final treated effluent.

Table B.8: TOMP Monitoring Program Stations for Denison TMA

Station ID	Location	Rationale
D-2	Stollery Settling Pond Discharge (Final Point of Control)	This station reflects water quality of the final point of control for TMA-1.
D-3	TMA-2 Seepage at Denison Mine access road	Although this station was formerly the effluent control point for TMA-2, it ceased being a main discharge when the spillway between TMA-1 and TMA-2 was created during site decommissioning. It now reflects only seepage from TMA-2. Barium is added when there is flow at D-22.
D-9	Seepage at Dam 17	Reflects seepage at Dam 17 to Quirke Lake.
D-16	Seepage at Dam 9	Reflects seepage from Dam 9 to Quirke Lake.

Table B.9: TOMP Monitoring Program Stations for Spanish-American TMA

Station ID	Location	Station Type	Description
ECA-128	Discharge for TMA.	Surface water	Reflects water quality draining to Denison TMA 1.

Table B.10: SAMP Monitoring Program Stations for Quirke TMA

Station ID	Location	Rationale
ECA-398	Drainage Ditch near Quirke II	This station was eliminated from the SRWMP but should be included in the SAMP because it reflects the influence of historical Quirke II Minesite activities.
Q-22	Quirke II Drainage Creek at Panel/Quirke II Mine Road	This station was eliminated from the SRWMP but should be included in the SAMP because it reflects the influence of historical Quirke II Minesite activities.
Q-23	Drainage to Dunlop Lake West of Dam K1	This station monitors the discharge from the swamp downstream of Quirke Dam K to Dunlop Lake and incorporates inputs from upstream station Q-25. The receiving environment, Quirke Lake, is monitored at Q-34.
Q-27	Seepage downstream of Dam J	Reflects seepage from Dam J to Evans Lake.
Q-28	Final Treated Effluent	Reflects final treated effluent quality released to Serpent River.

Table B.11: SAMP Monitoring Program Stations for Panel TMA

Station ID	Location	Rationale
P-02	Downstream of Dam B	Reflects seepage from Dam B to Rochester Creek.
P-03	Beaver Pond C Outlet	Reflects Pond C water quality contributions to Rochester Creek.
P-05	Swamp Outlet north of WMA	Reflects seepage from Dam E to Rochester Creek.
P-11	Panel Creek at Quirke Lake	This station monitors the discharge from Panel Creek to Quirke Lake and incorporates inputs from upstream stations ECA-270 and P-09. It is more appropriately classified as a source area station. The receiving environment, Quirke Lake, is monitored at P-26.
P-14[a]	Final Treated Effluent	Reflects water quality of final treated effluent.
P-36[a]	Panel Overflow Spillway	Reflects water quality of Panel Overflow Spillway and is monitored during by-pass conditions to determine watershed loadings. Will ultimately be the point of final discharge (i.e., post-ETP decommissioning).

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

Table B.12: SAMP Monitoring Program Stations for Stanrock TMA

Station ID	Location	Rationale
DS-4	Orient Lake Outlet (Final Point of Control)	This station reflects the combined quality of effluent and seepages that discharge from Stanrock TMA to Halfmoon Lake.
DS-16	Quirke Lake Delta	Historically also referred to as ST-2. Reflects combined seepages from Dam G and Dam J to Quirke Lake.

Table B.13: SAMP Monitoring Program Stations for Stanleigh TMA

Station ID	Location	Rationale
CL-06	Final Effluent	Effluent discharge resumed in May 2002. Monthly monitoring has been initiated to characterize effluent quality and verify that the suite of parameters recommended for other SAMP stations is appropriate at CL-06 (Section 3.0).

Table B.14: SAMP Monitoring Program Stations for Milliken TMA

Station ID	Location	Rationale
MPE	Milliken Park Effluent	Reflects water quality from Milliken TMA and captures all upstream sources and conditions (S-02, S-03, S-08, CL-07, M-02, M-04 and L-02). The receiving environment, Elliot Lake, is monitored at M-01.

Table B.15: SAMP Monitoring Program Stations for Nordic TMA

Station ID	Location	Rationale
N-12	Buckles Creek at Hwy. 108	Reflects combined water quality contributions of Buckles Creek Tailings Management Area (TMA) and Nordic Final Treated Effluent. Will be retained as the long-term monitoring location for Nordic TMA.
WL-4	Seepage downstream of Coffer Pond in Westner Lake	Reflects seepage from Coffer Pond Berm to Westner Lake

Table B.16: SAMP Monitoring Program Stations for Pronto TMA

Station ID	Location	Rationale
LL-01	Pronto Creek at Inlet to Lake Lauzon	This station monitors the outflow of Pronto Creek to Lake Lauzon and reflects contributions from upstream sources.
PR-01	Effluent Creek at Highway 17	Reflects combined water quality contributions associated with Final Treated Effluent and downstream beaver pond.

Table B.17: SAMP Monitoring Program Reference Stations

Station ID	Location	Rationale
SR-16	Fox Creek at Highway 108	Provides background water quality for habitats found at several TMAs.
SR-17	Unnamed Creek from Lake Three at Highway 108	Provides background water quality for habitats found at several TMAs.

APPENDIX C

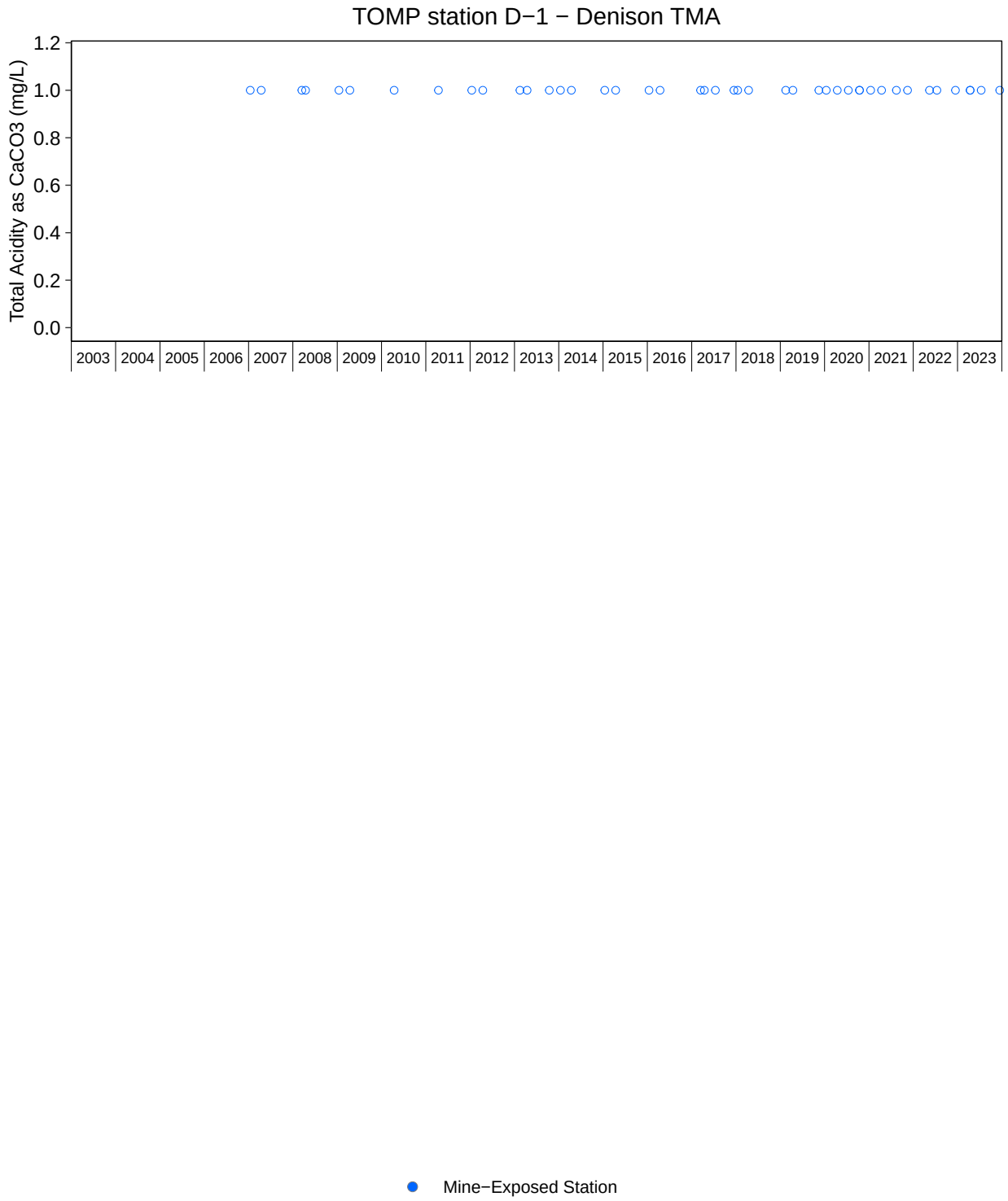


Figure C.1: Concentration of Total Acidity as CaCO3 at TOMP Water Quality Monitoring Stations at Denison TMA, 2007 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

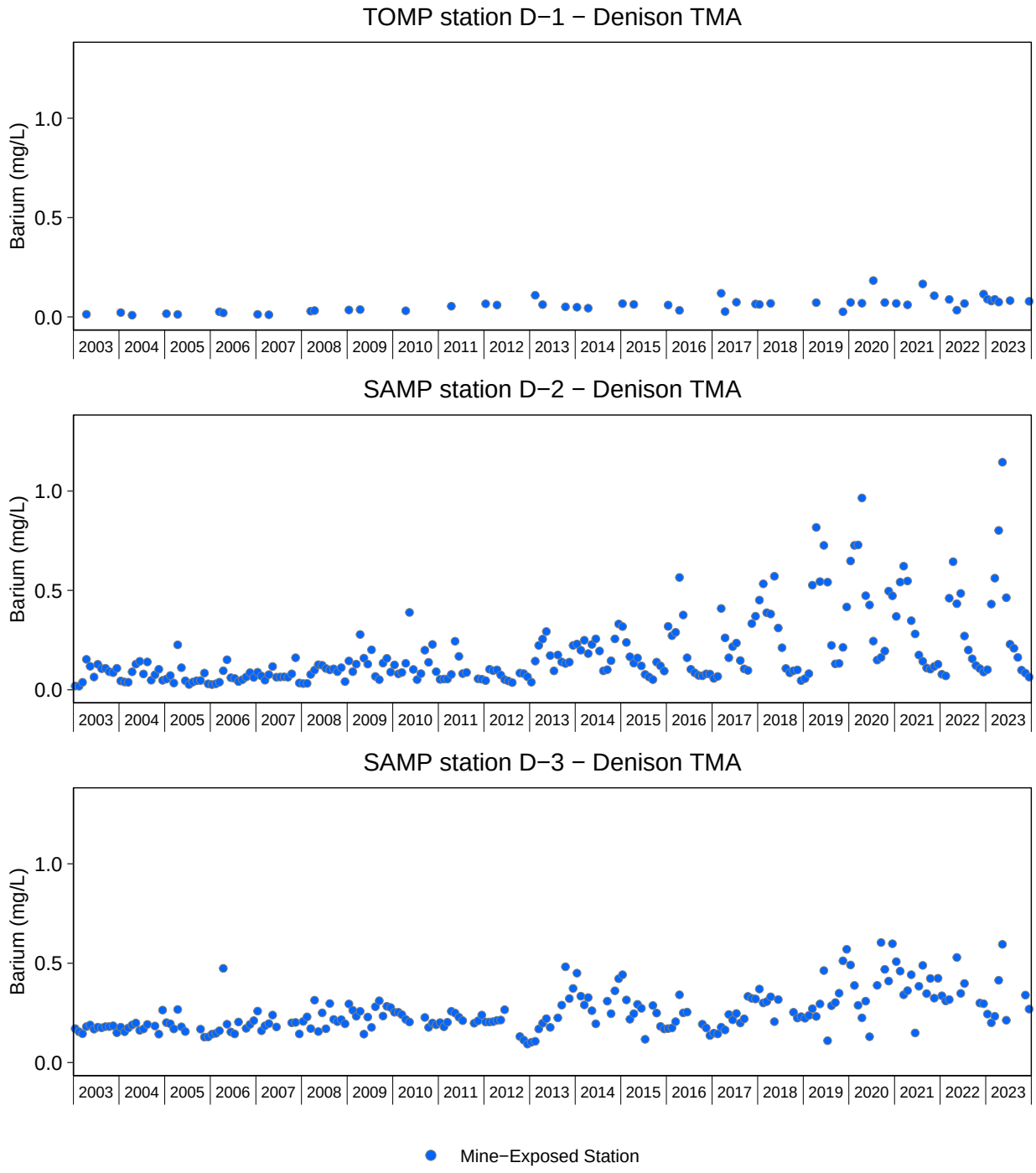


Figure C.2: Concentrations of Barium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

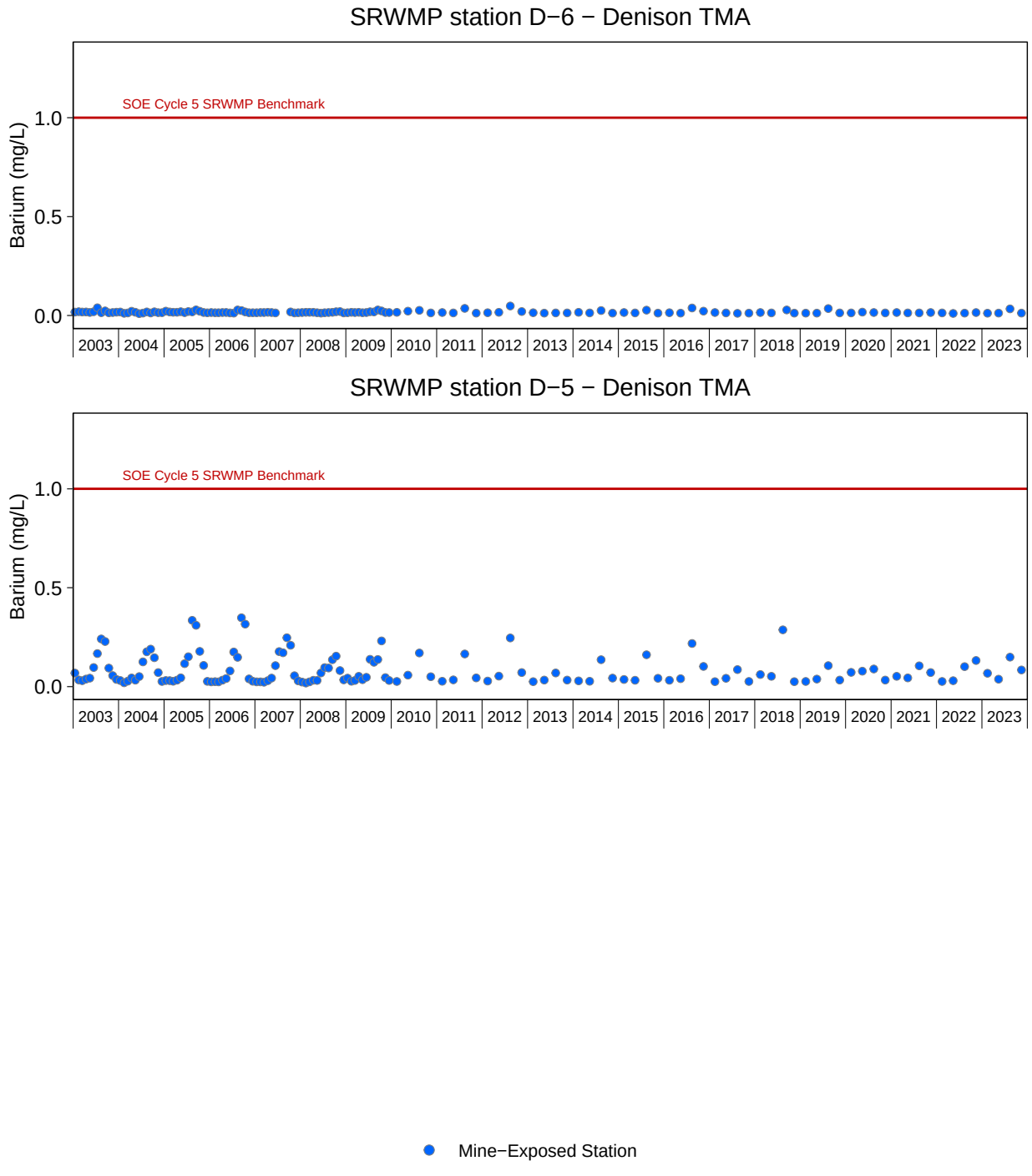


Figure C.2: Concentrations of Barium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

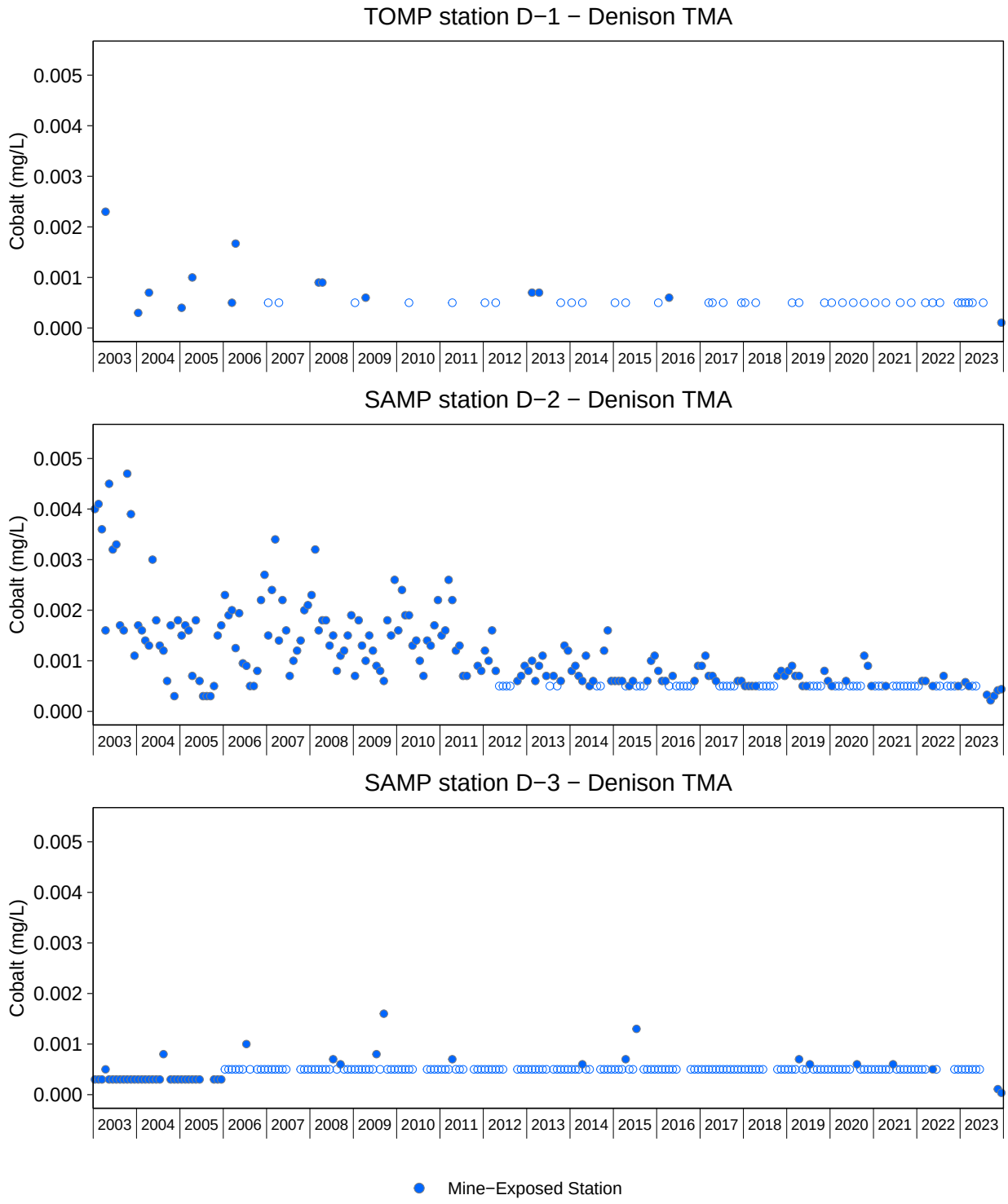


Figure C.3: Concentrations of Cobalt for SAMP and TOMP Water Quality Monitoring Stations at Denison TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

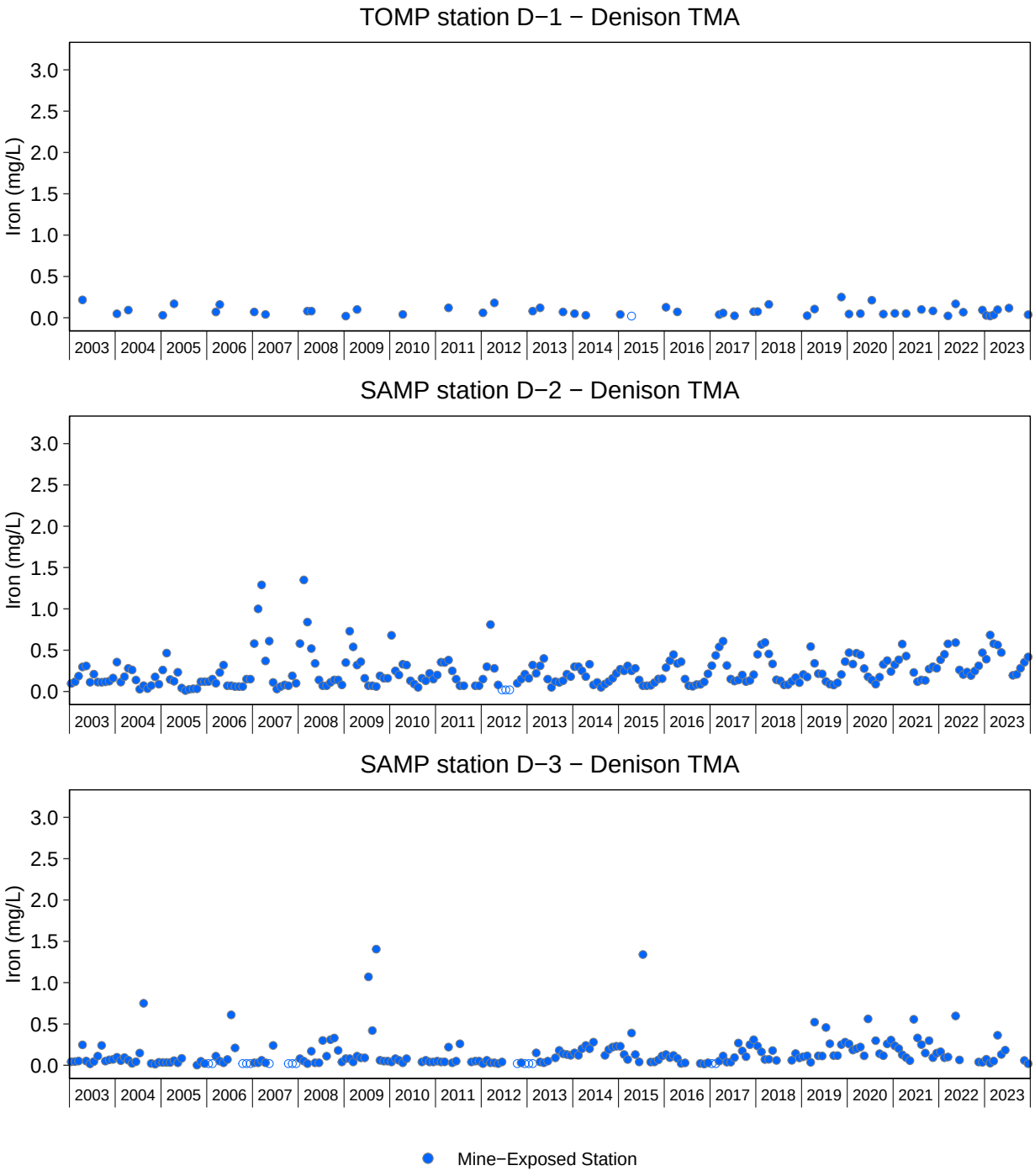


Figure C.4: Concentrations of Iron for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

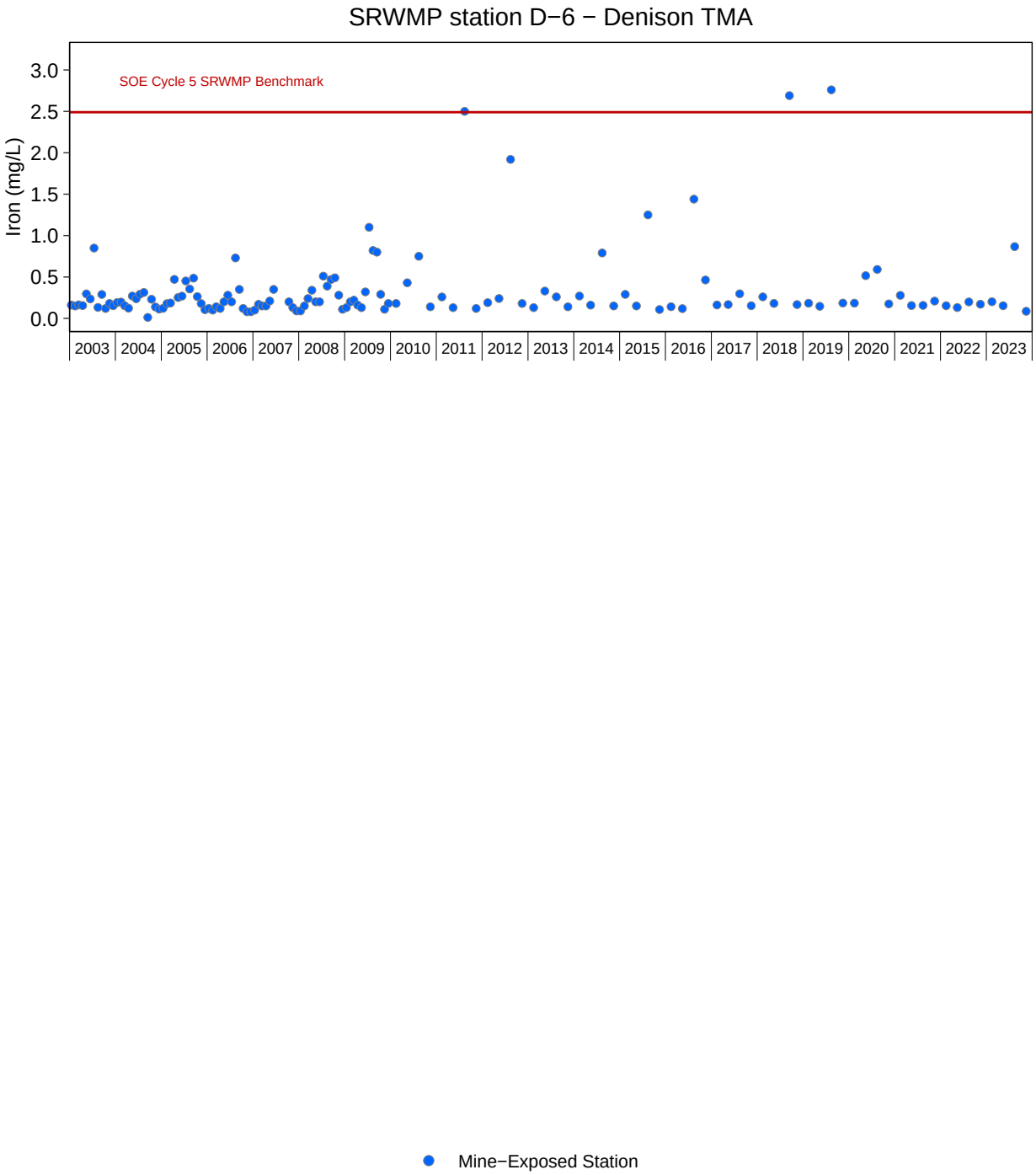


Figure C.4: Concentrations of Iron for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

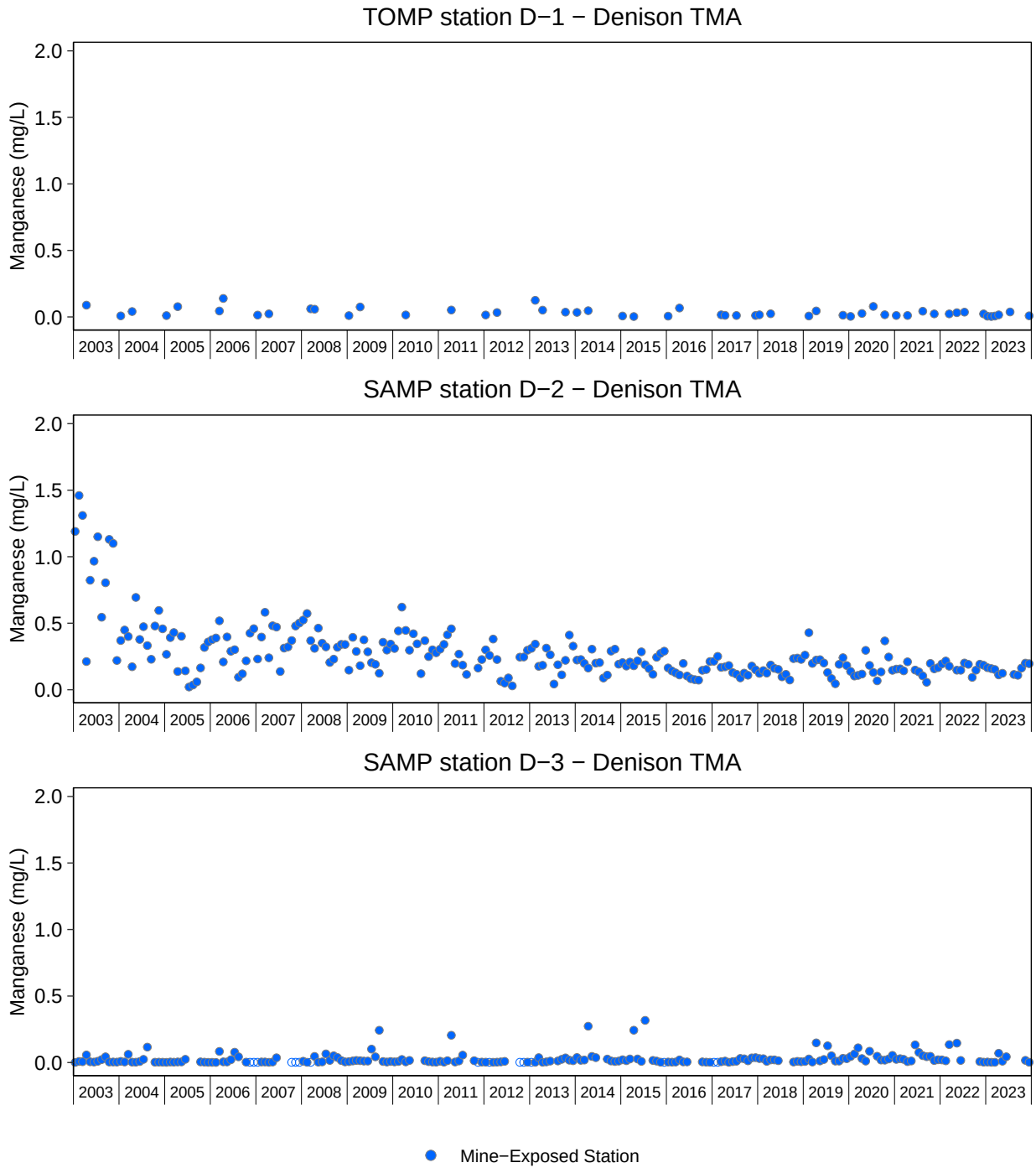


Figure C.5: Concentrations of Manganese for SAMP and TOMP Water Quality Monitoring Stations at Denison TMA-1 and TMA-2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

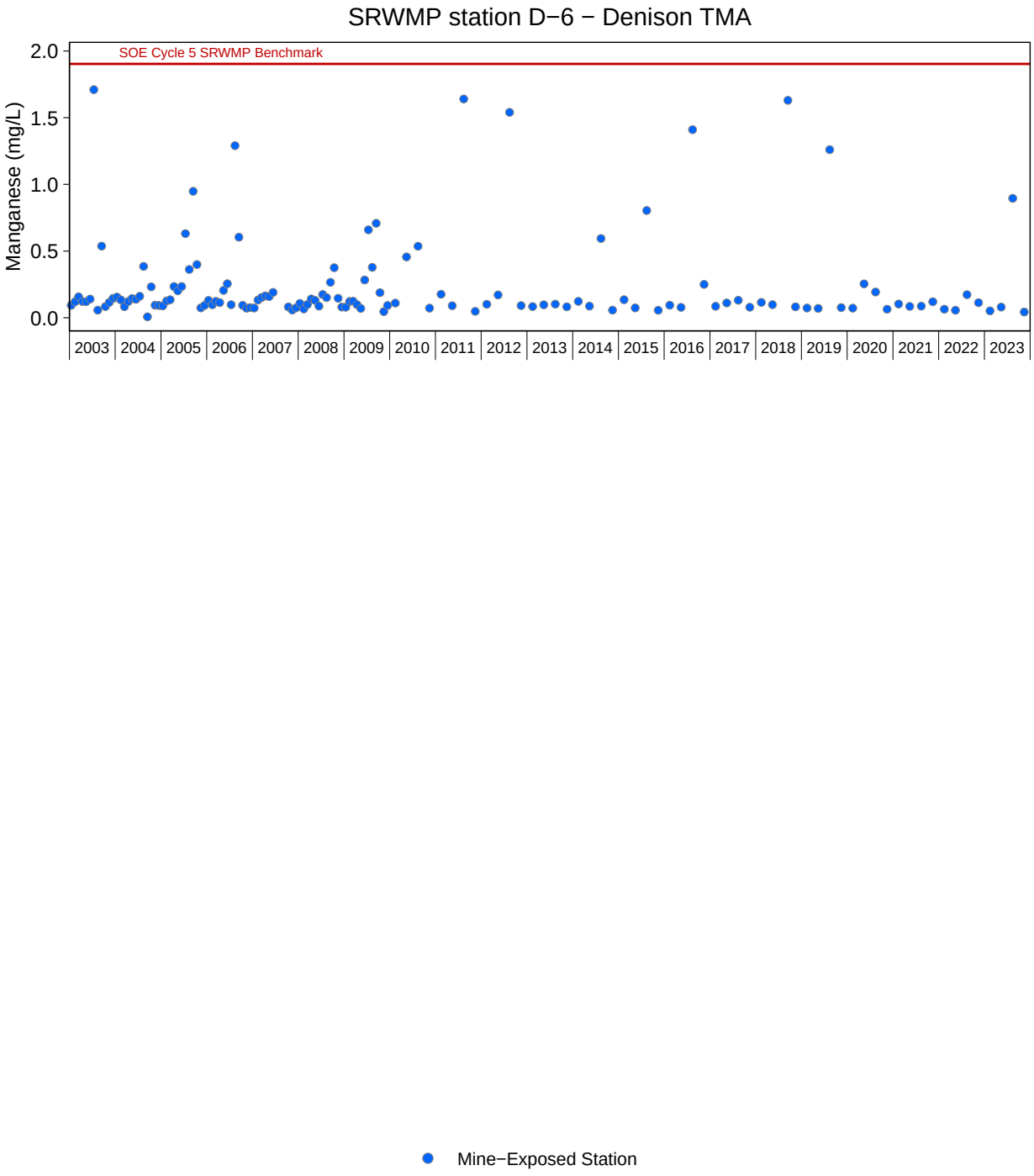


Figure C.5: Concentrations of Manganese for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA-1 and TMA-2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

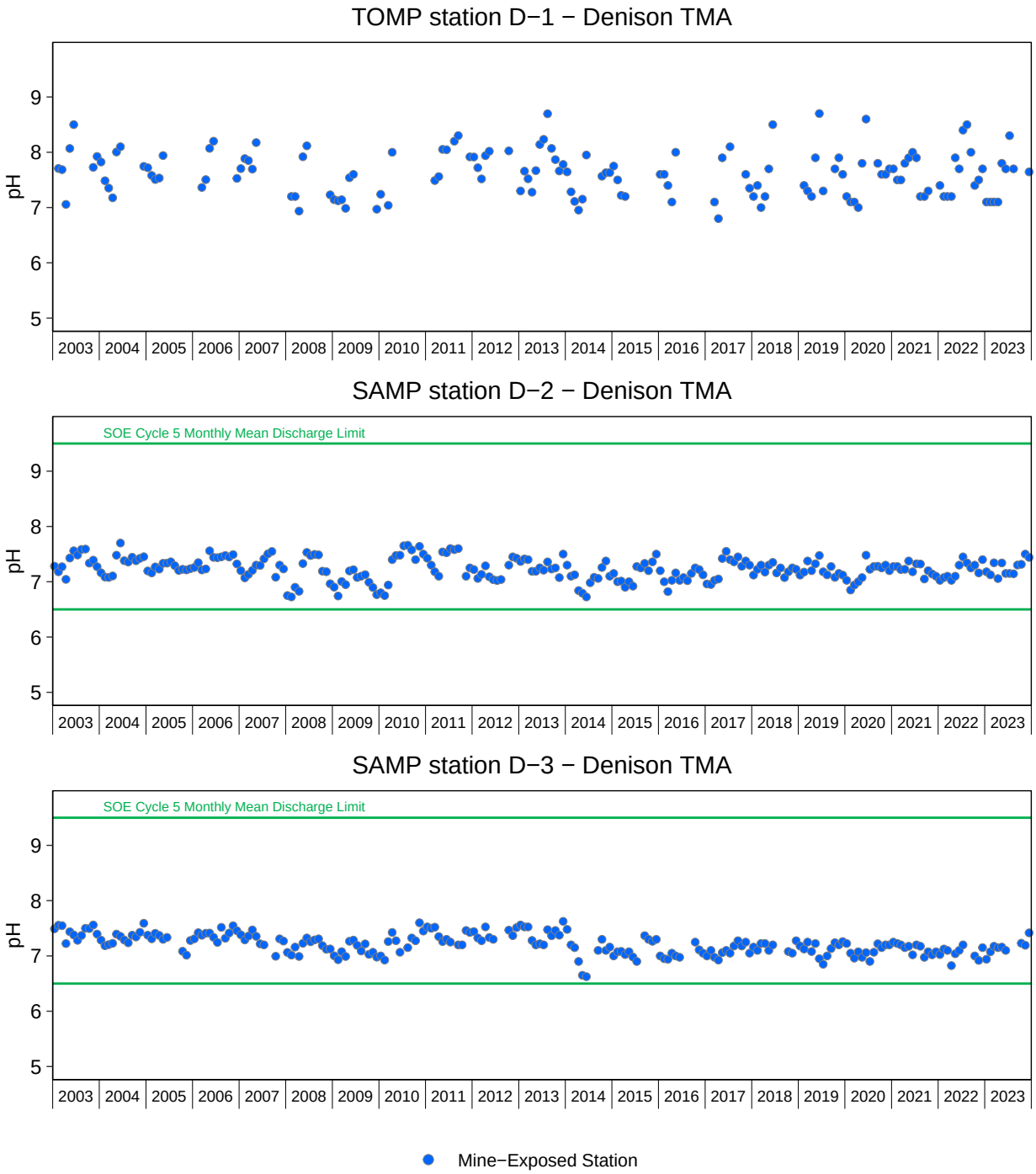


Figure C.6: Levels of pH for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

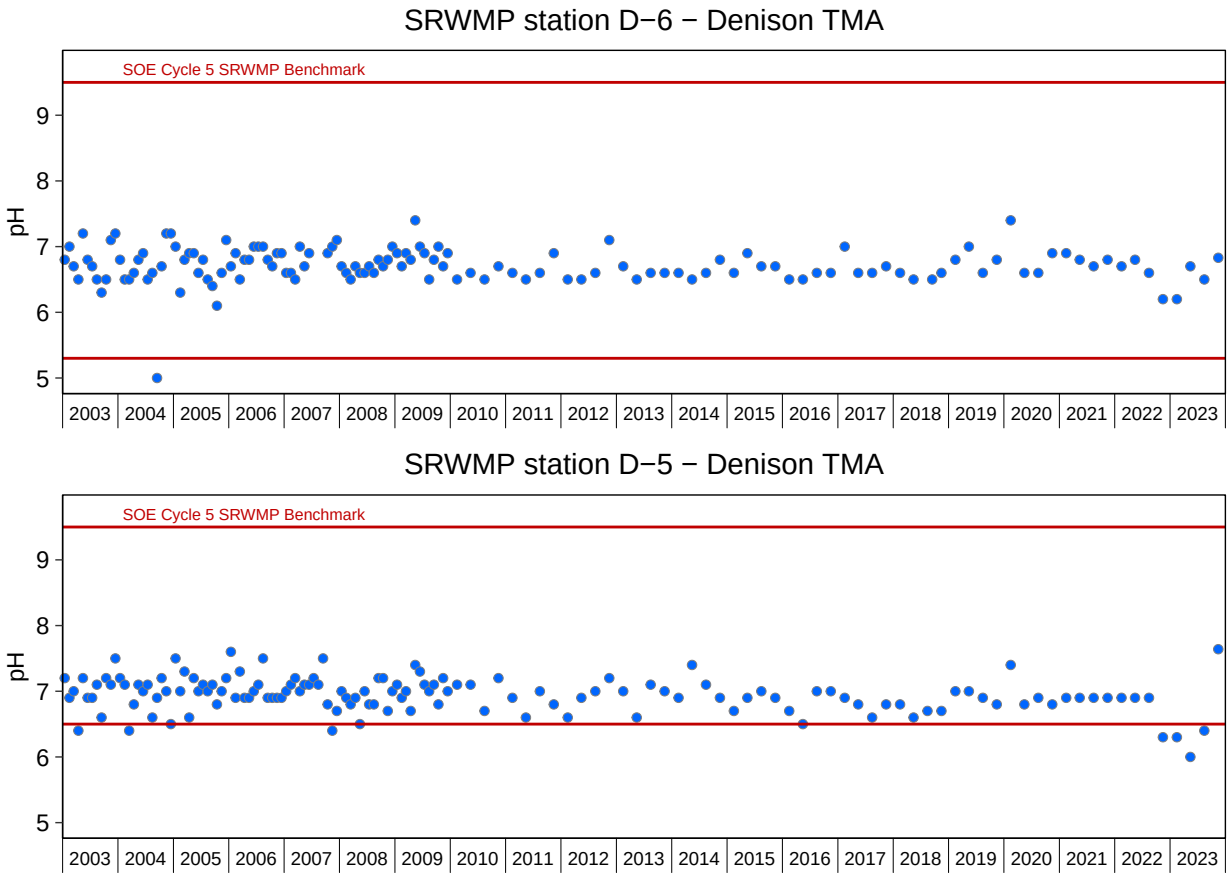


Figure C.6: Levels of pH for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

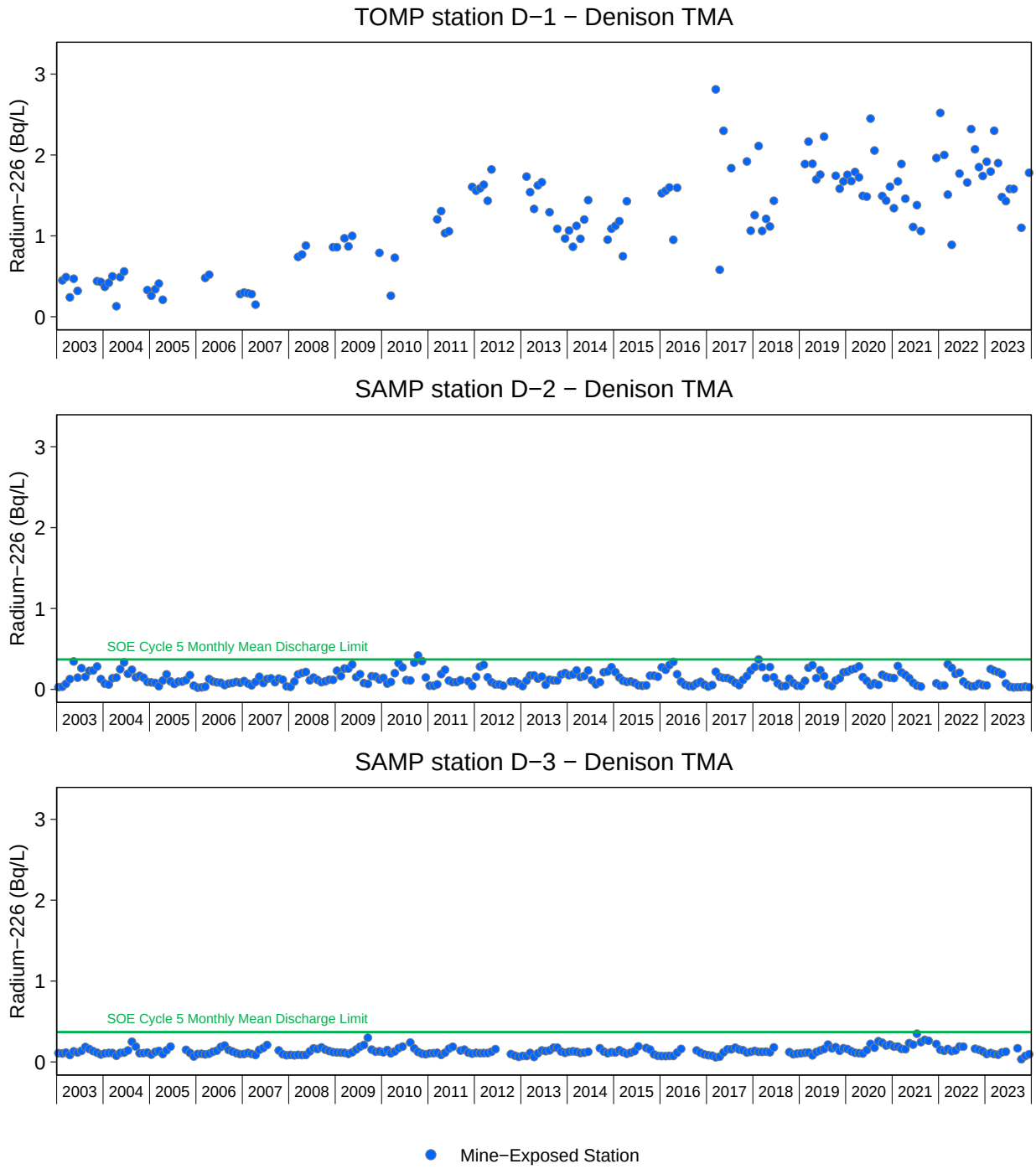


Figure C.7: Concentrations of Radium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

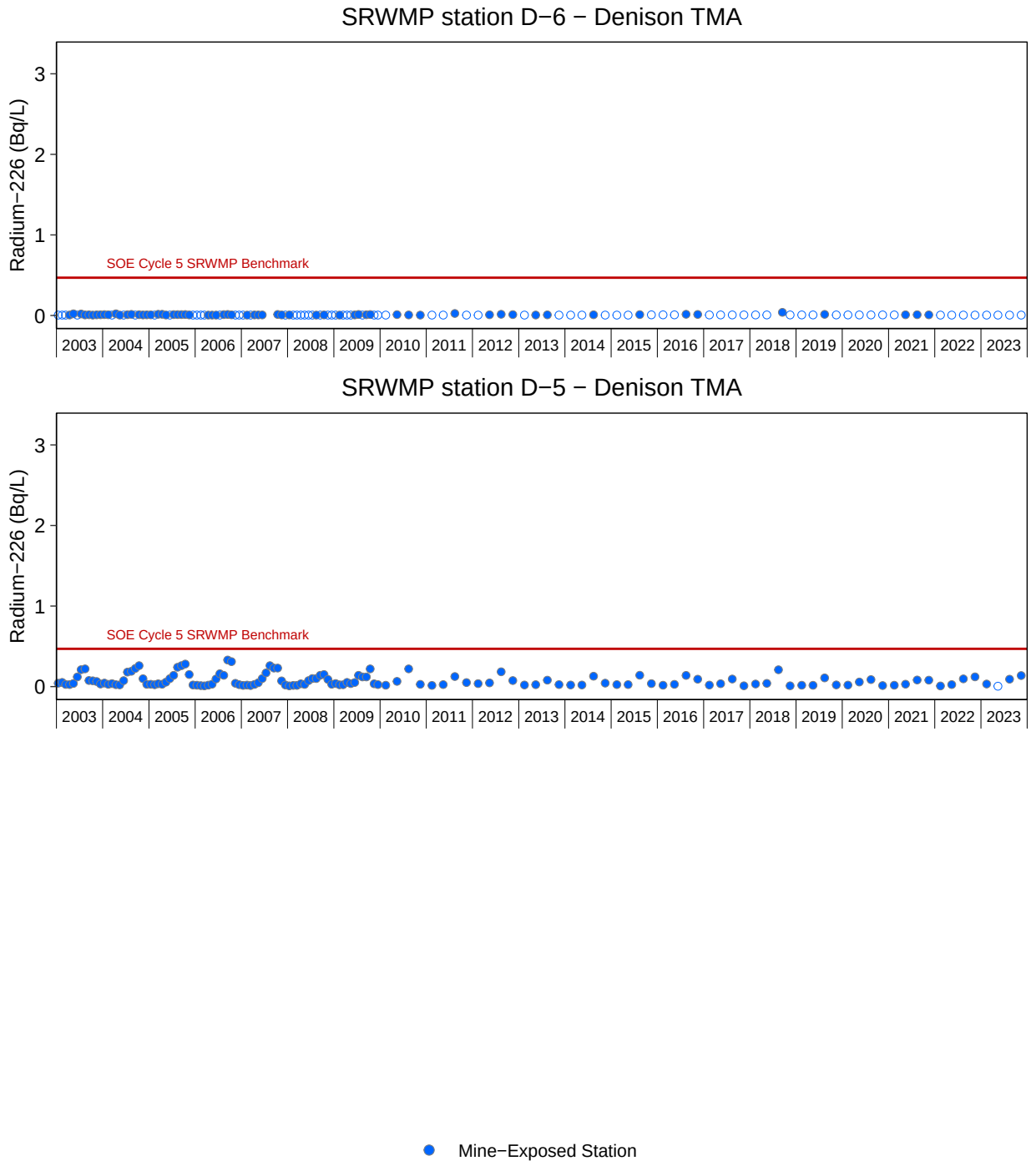


Figure C.7: Concentrations of Radium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

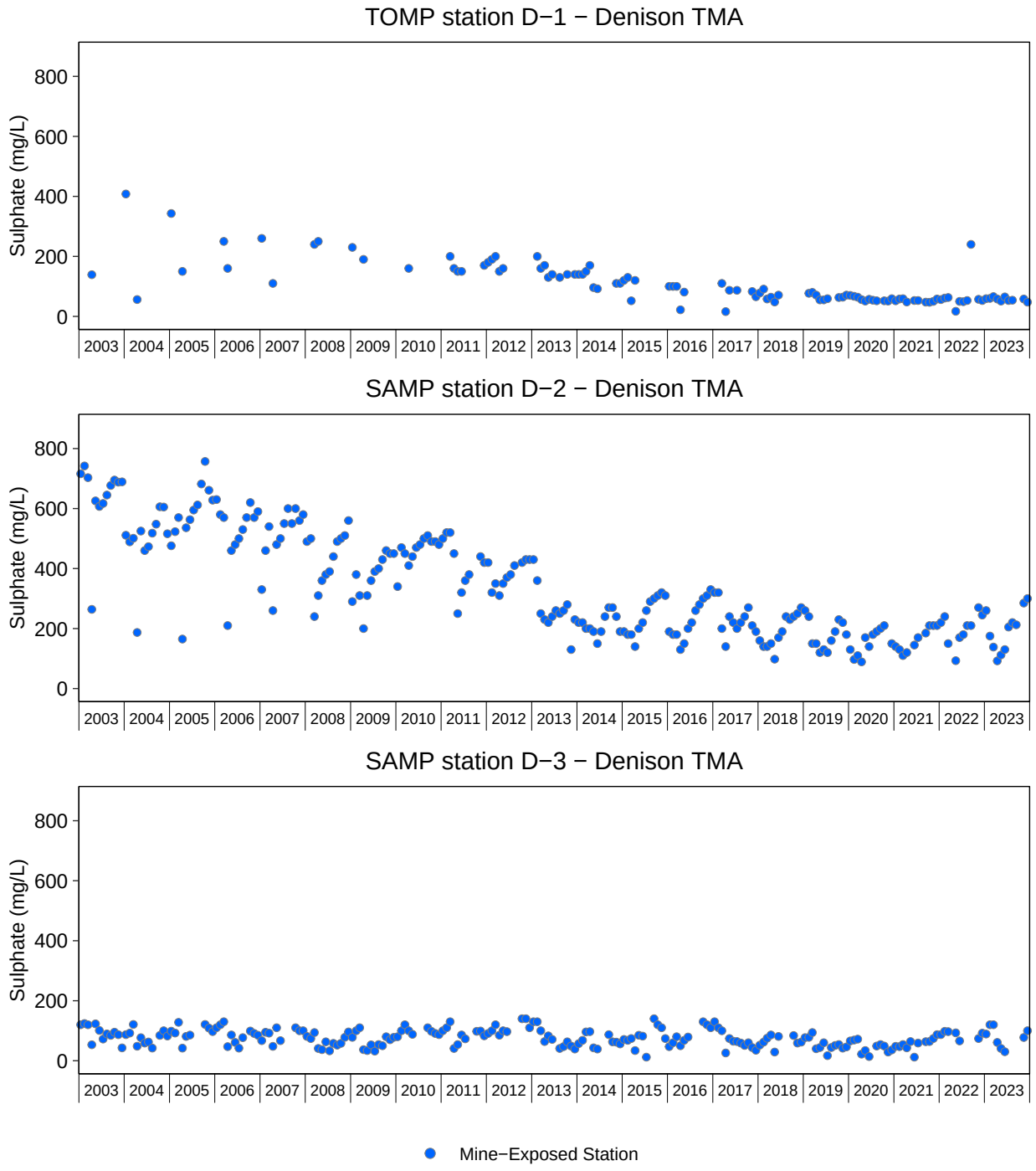


Figure C.8: Concentrations of Sulphate for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.
Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

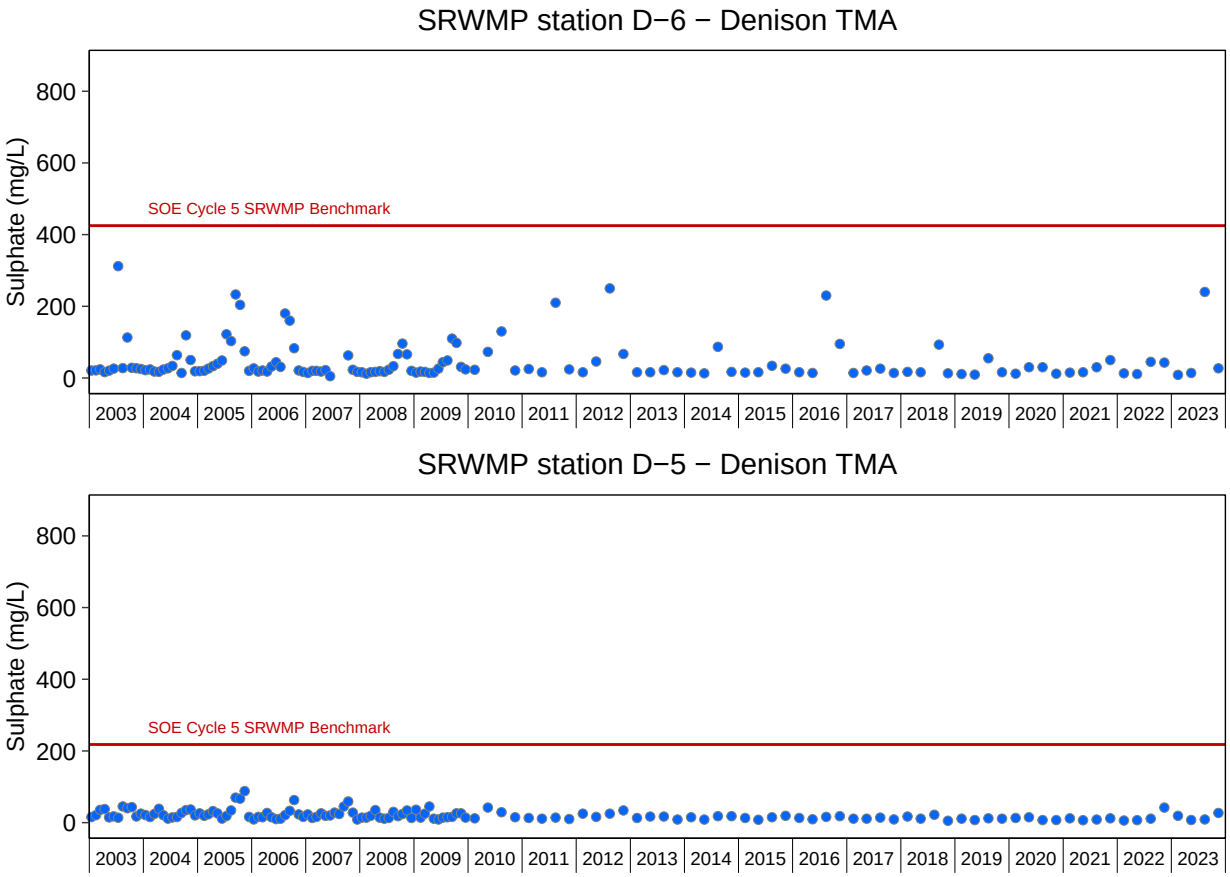


Figure C.8: Concentrations of Sulphate for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

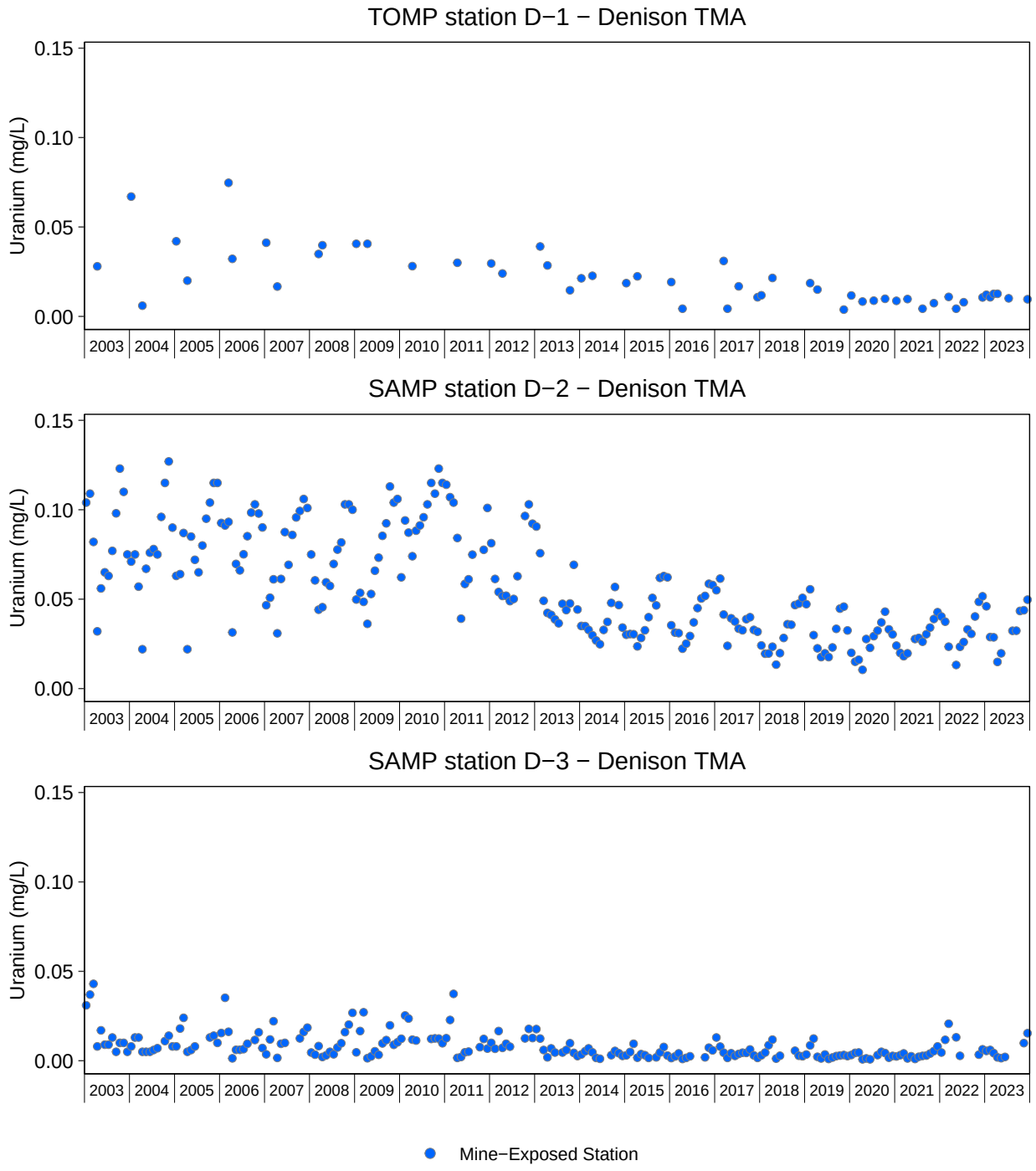


Figure C.9: Concentrations of Uranium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

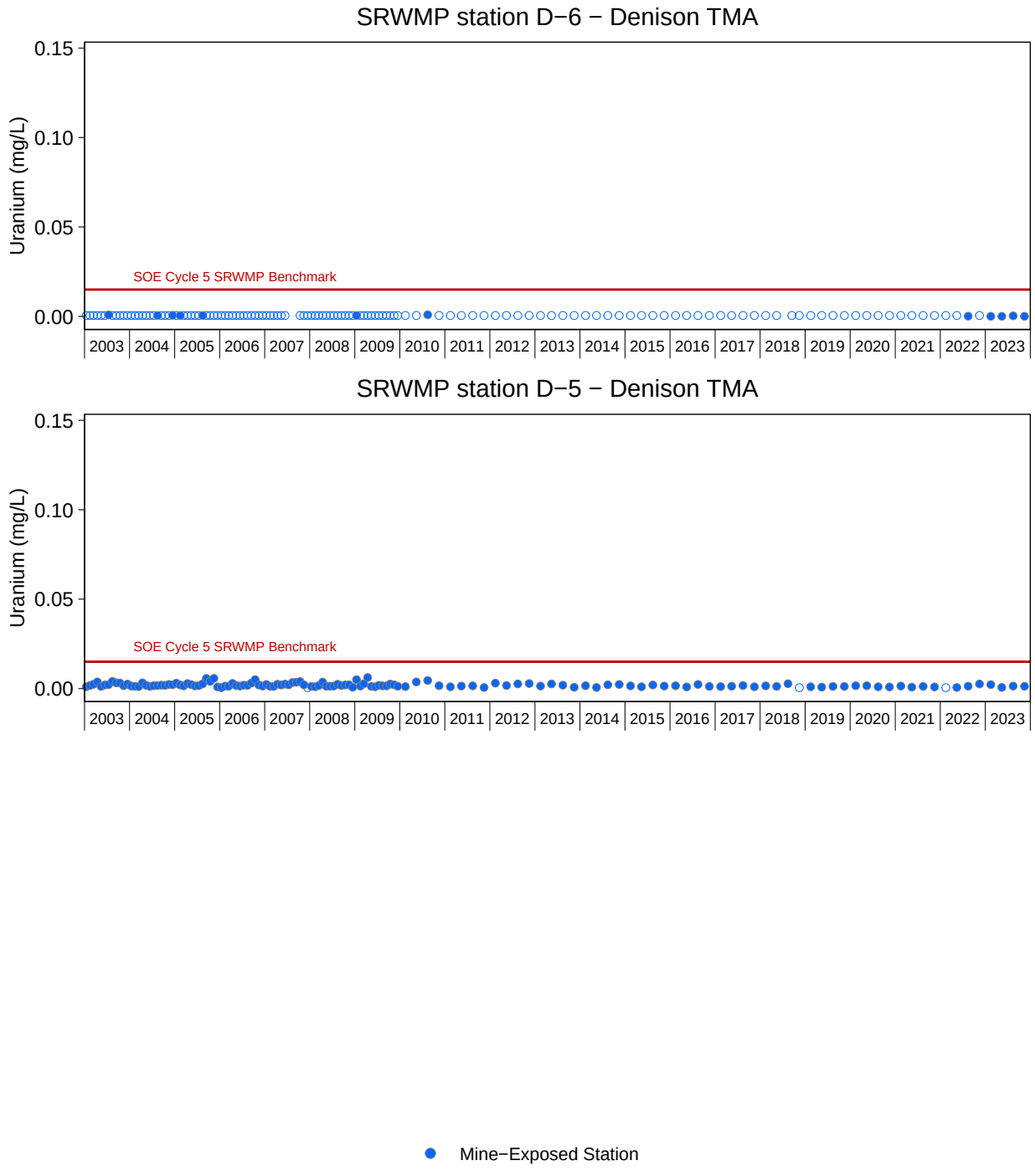


Figure C.9: Concentrations of Uranium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Denison TMA−1 and TMA−2, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

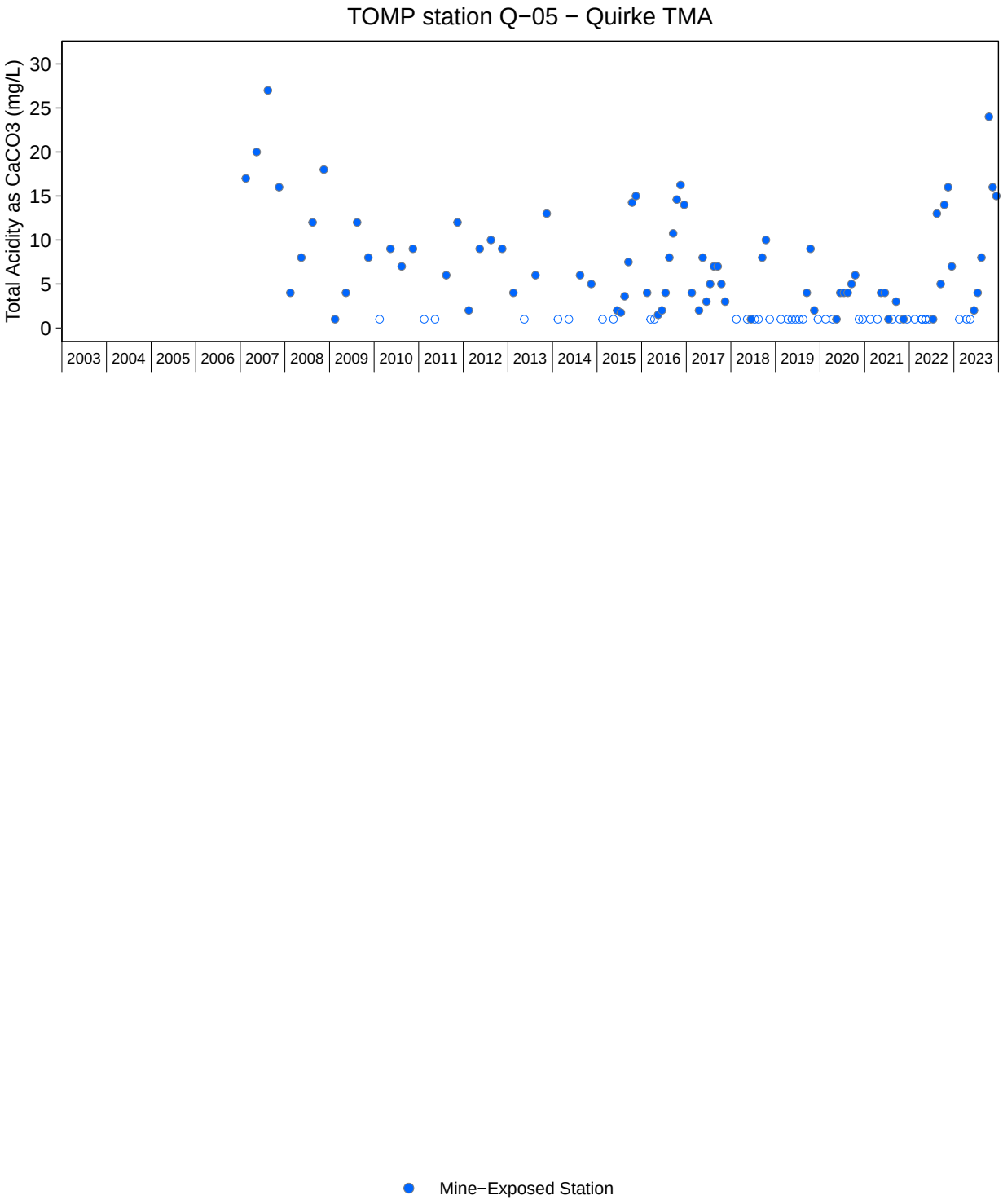


Figure C.10: Concentration of Total Acidity as CaCO3 at TOMP Water Quality Monitoring Station Q-05, Quirke TMA, 2007 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

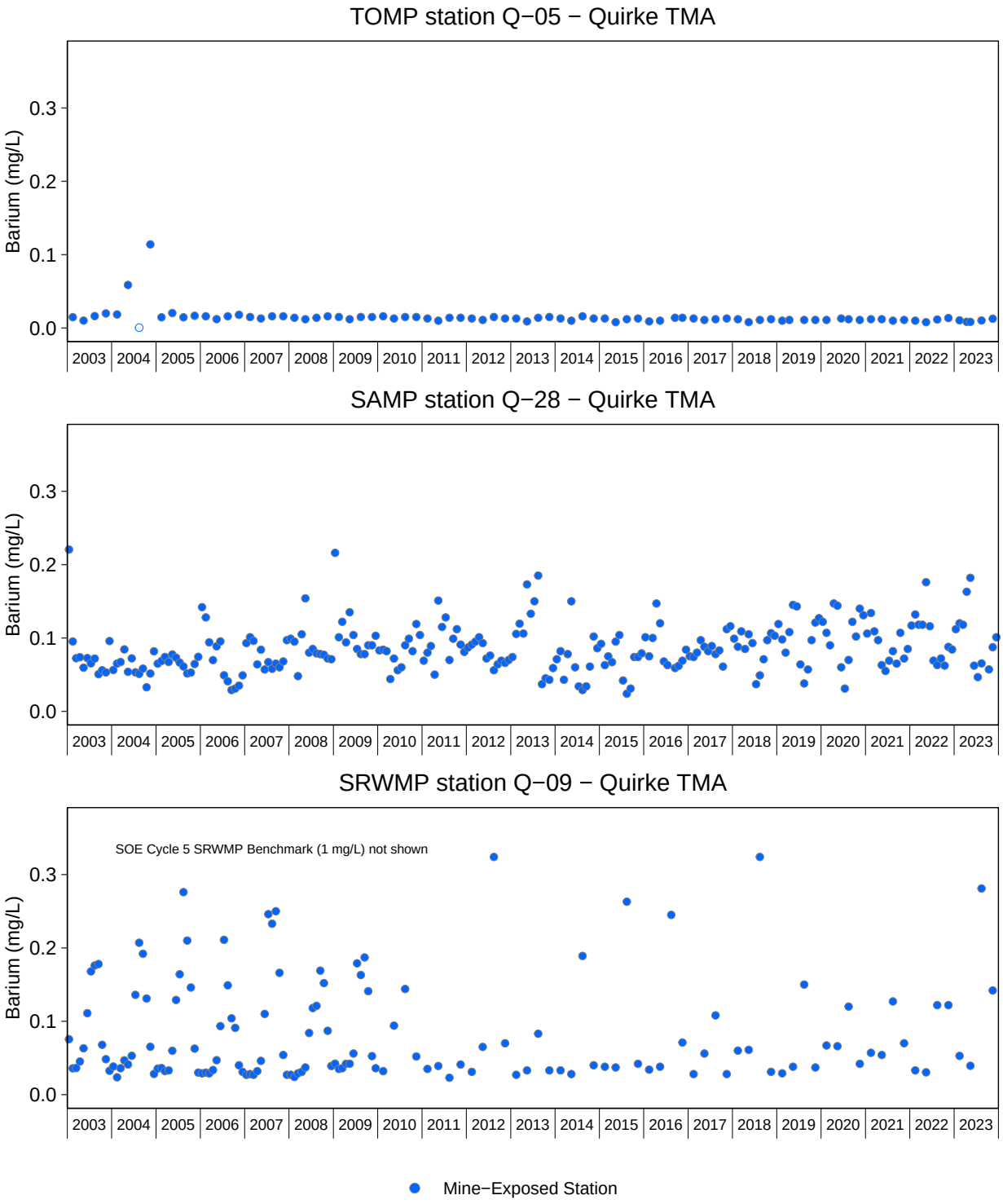


Figure C.11: Concentrations of Barium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

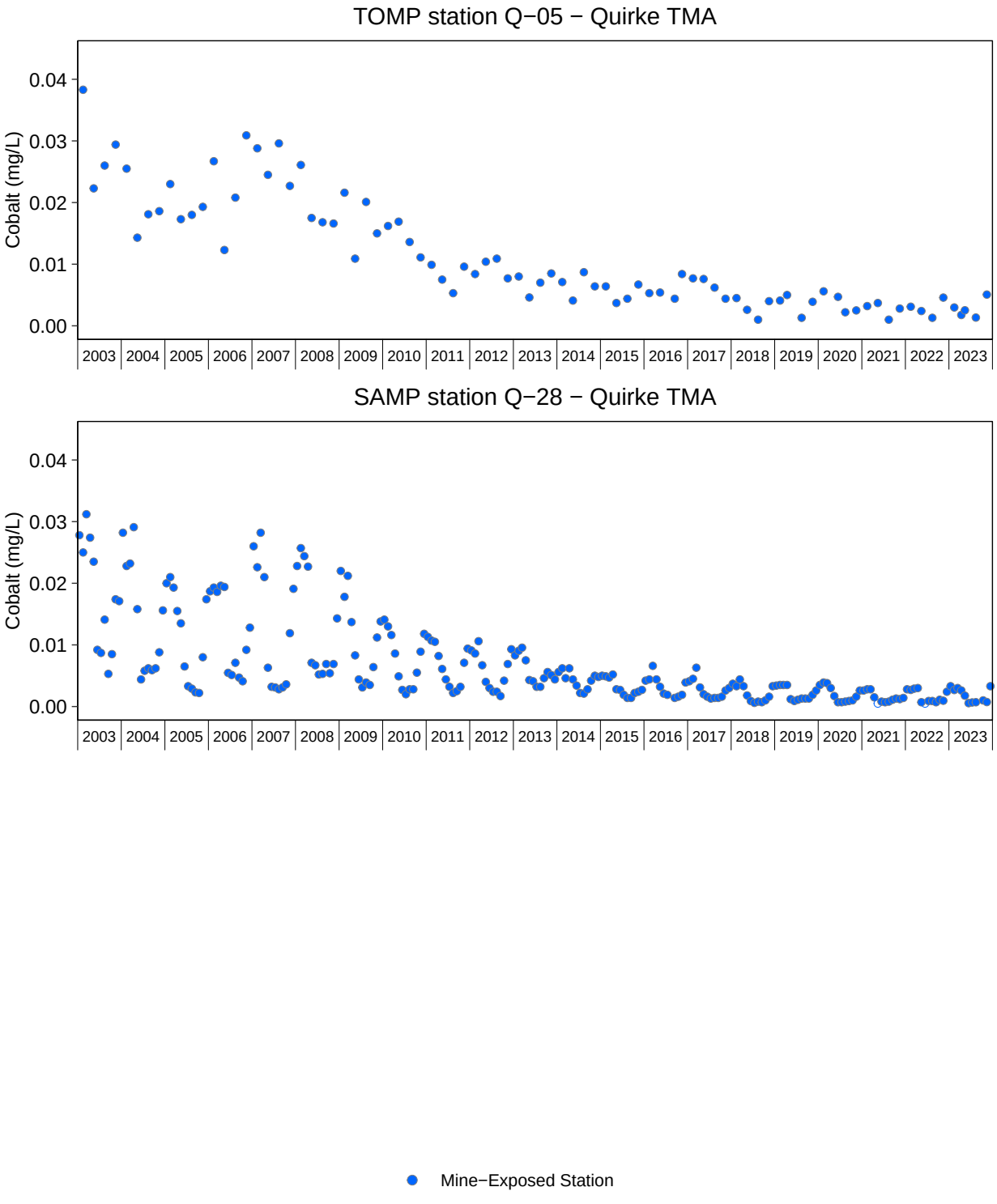


Figure C.12: Concentrations of Cobalt for SAMP and TOMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

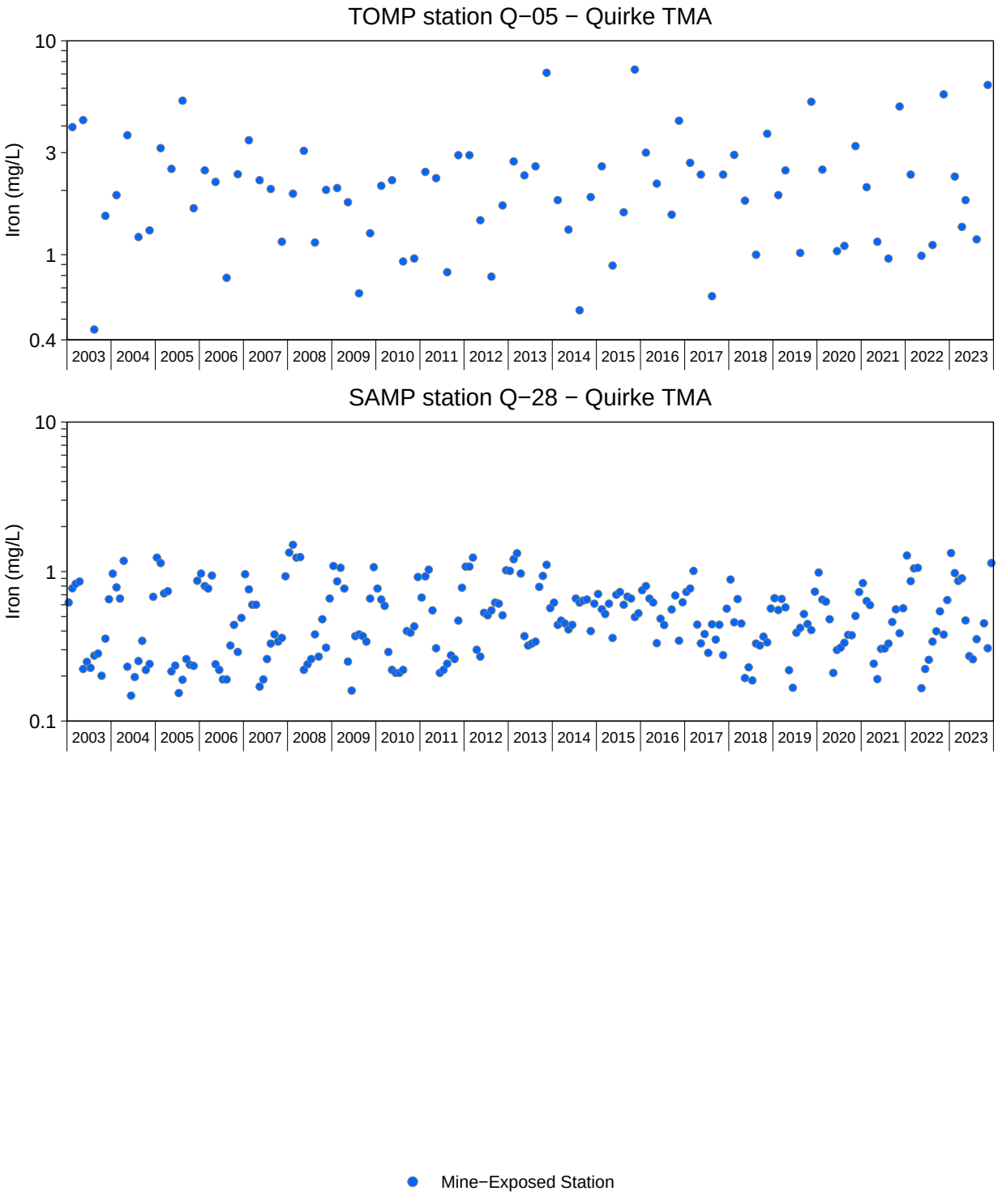


Figure C.13: Concentrations of Iron for SAMP and TOMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

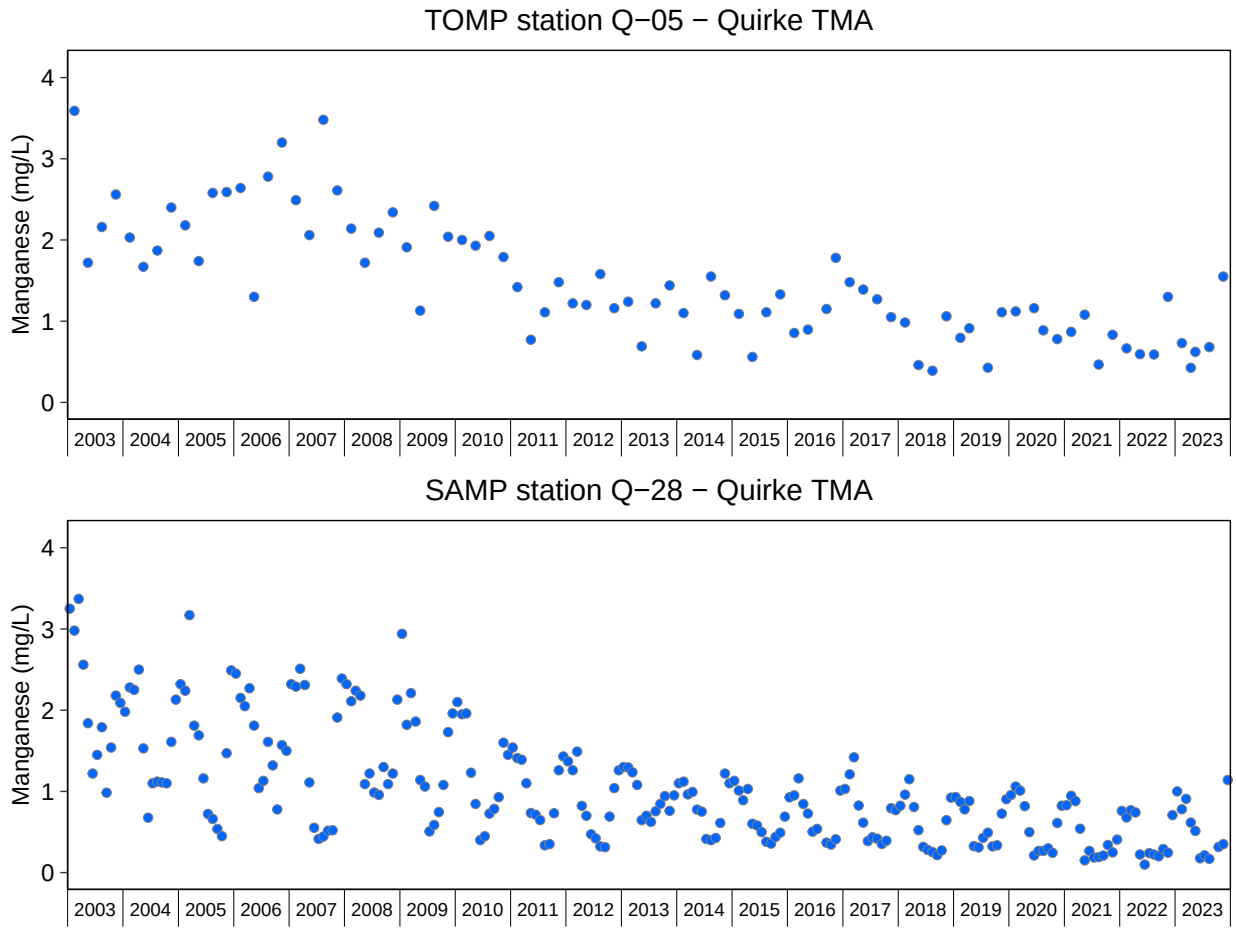


Figure C.14: Concentrations of Manganese for SAMP and TOMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

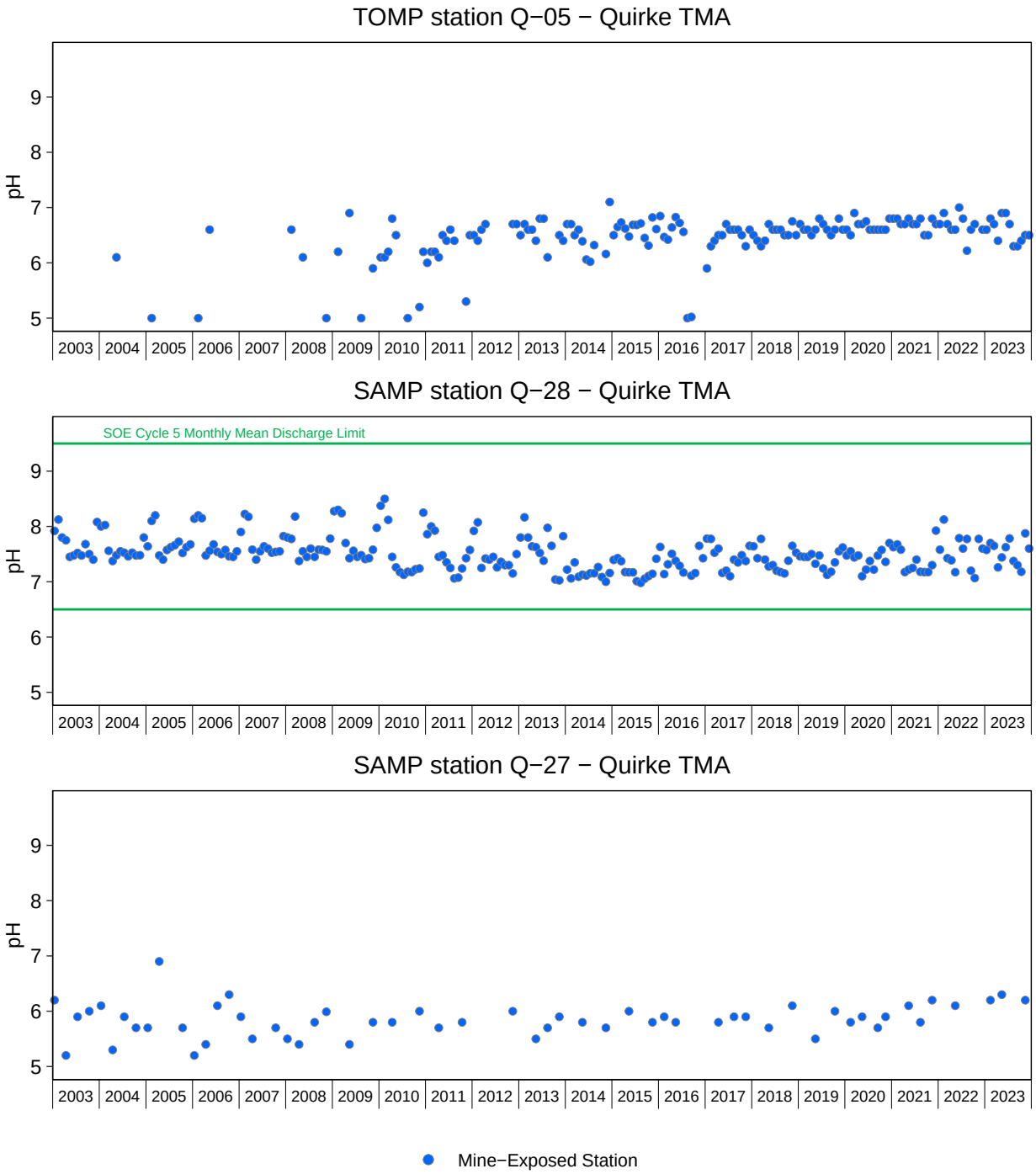


Figure C.15: Concentrations of pH for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

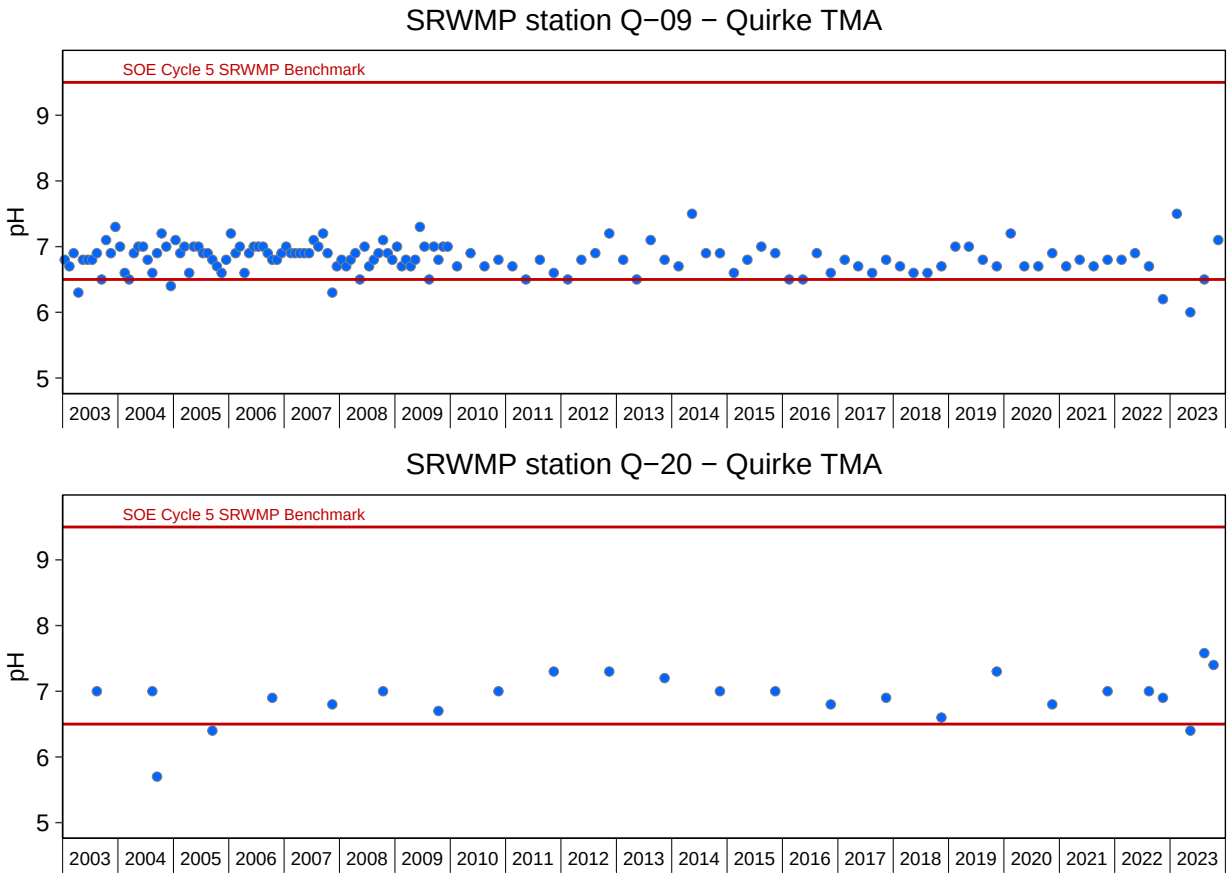


Figure C.15: Concentrations of pH for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

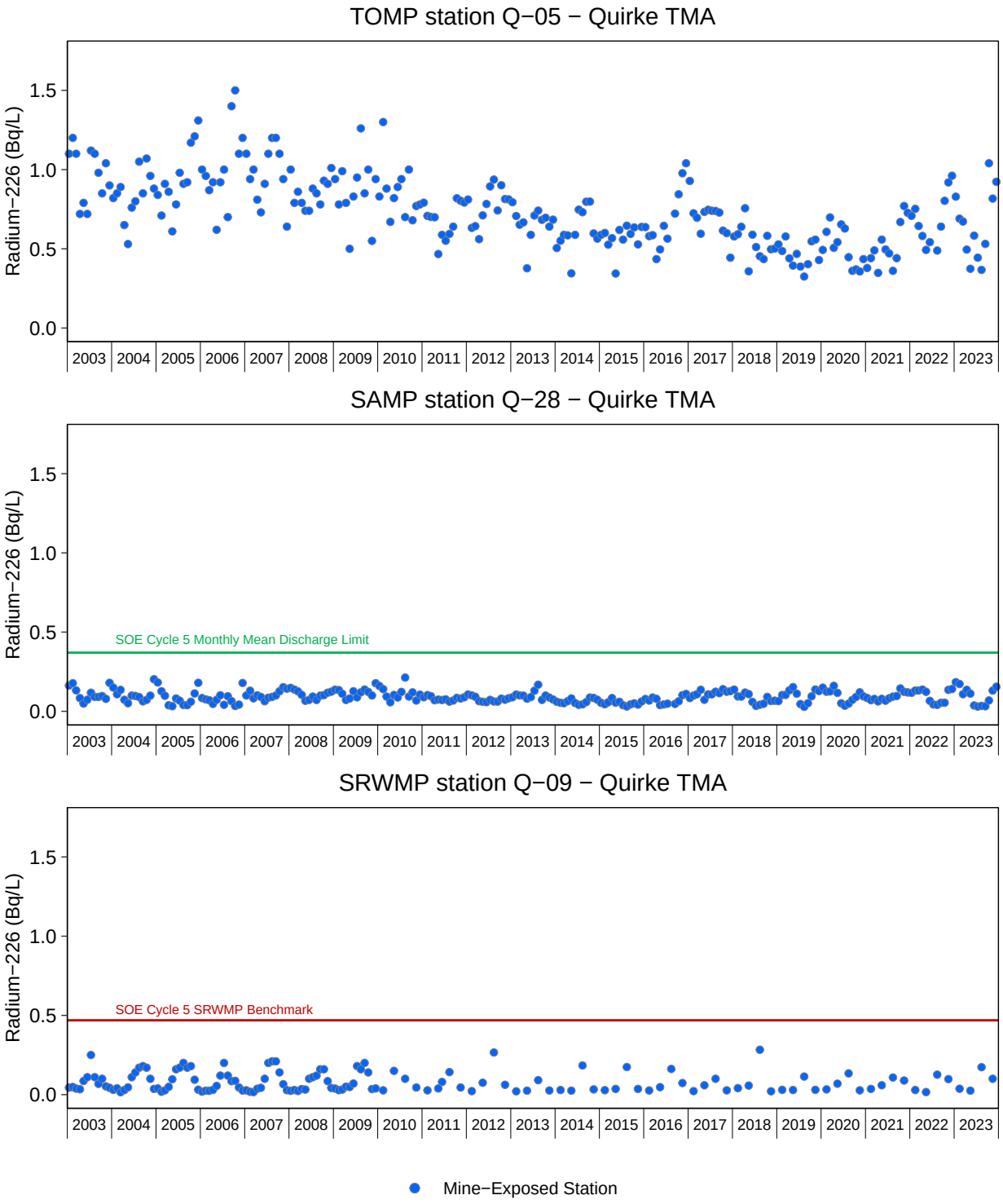


Figure C.16: Concentrations of Radium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

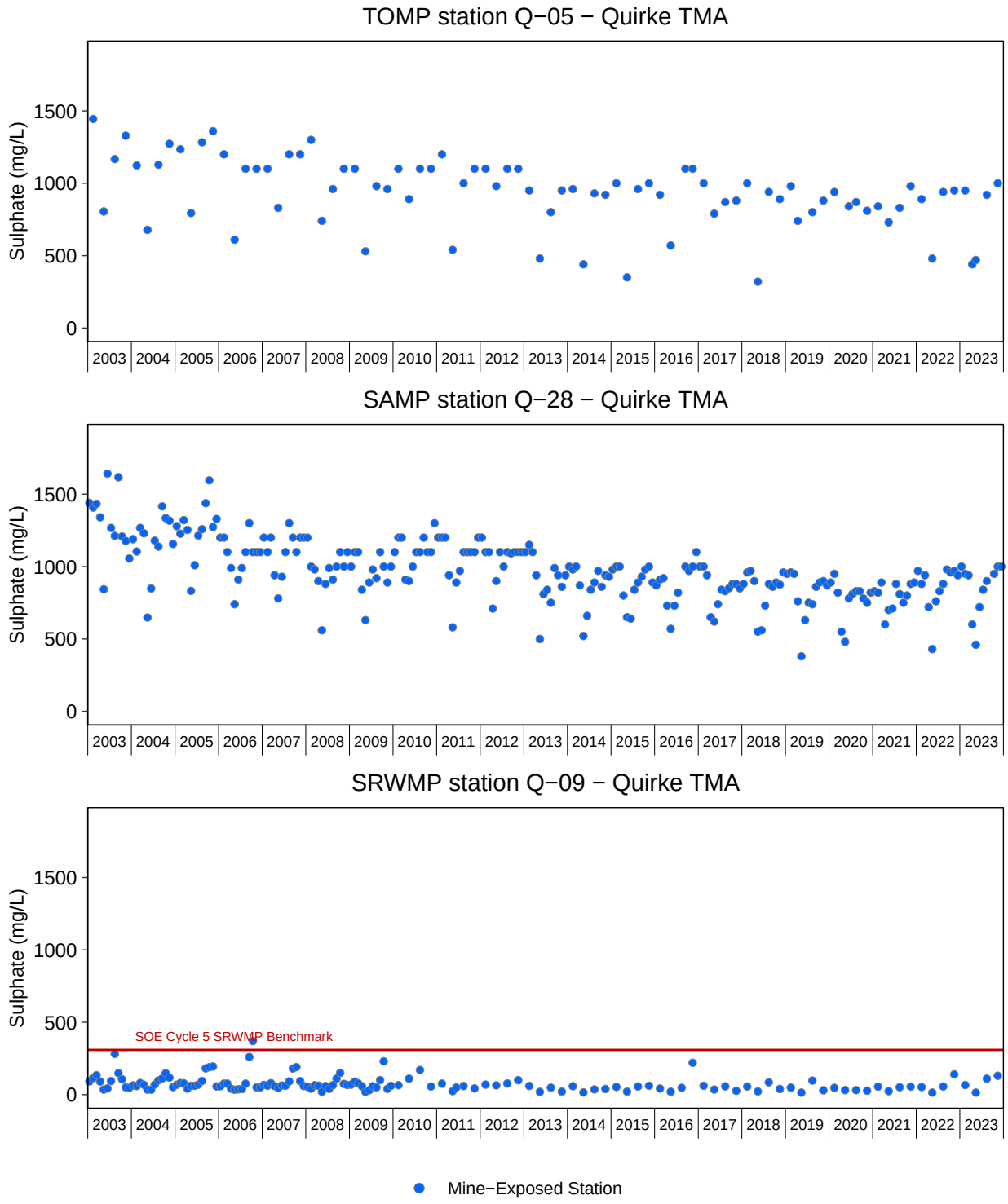


Figure C.17: Concentrations of Sulphate for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

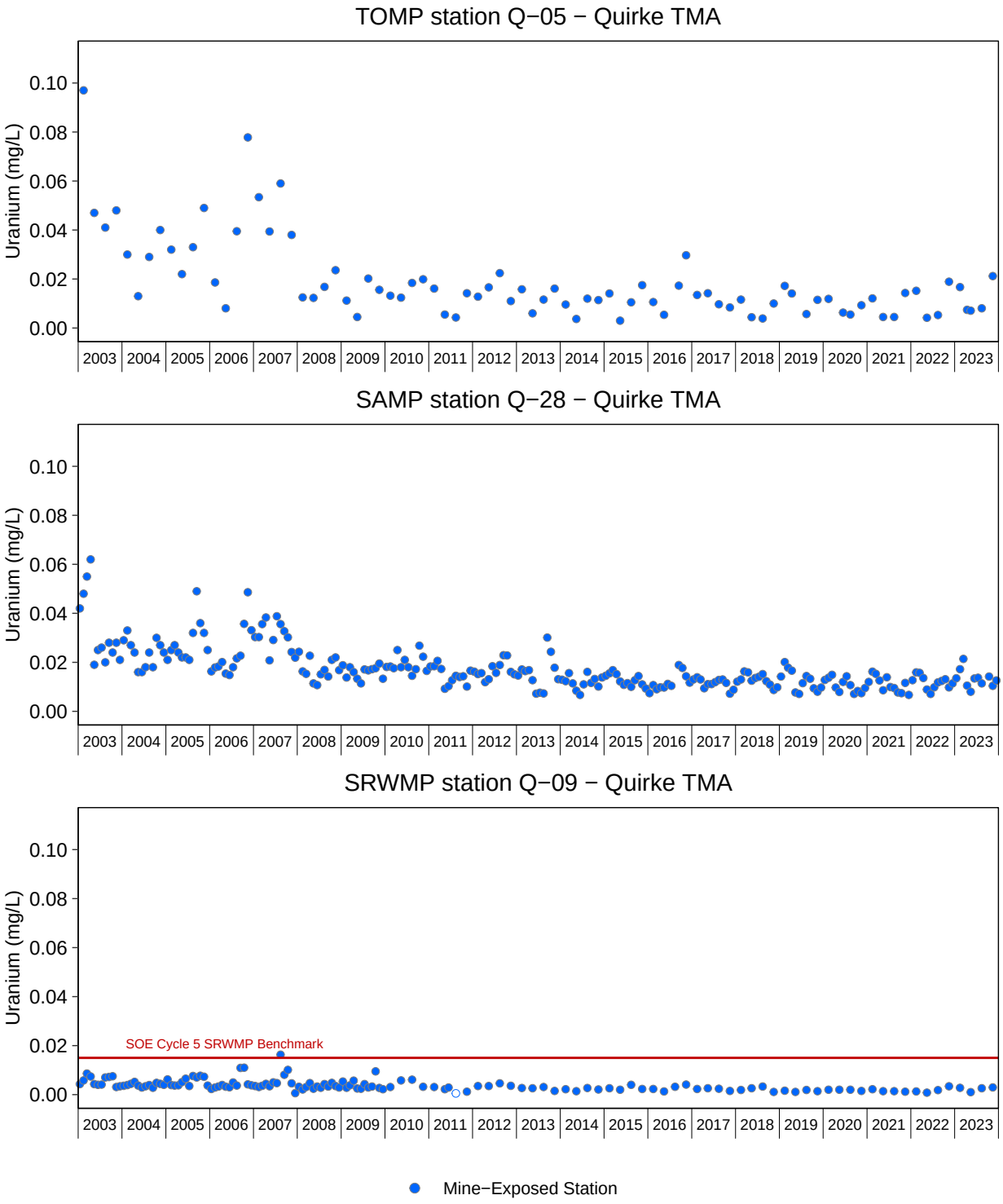


Figure C.18: Concentrations of Uranium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Quirke TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

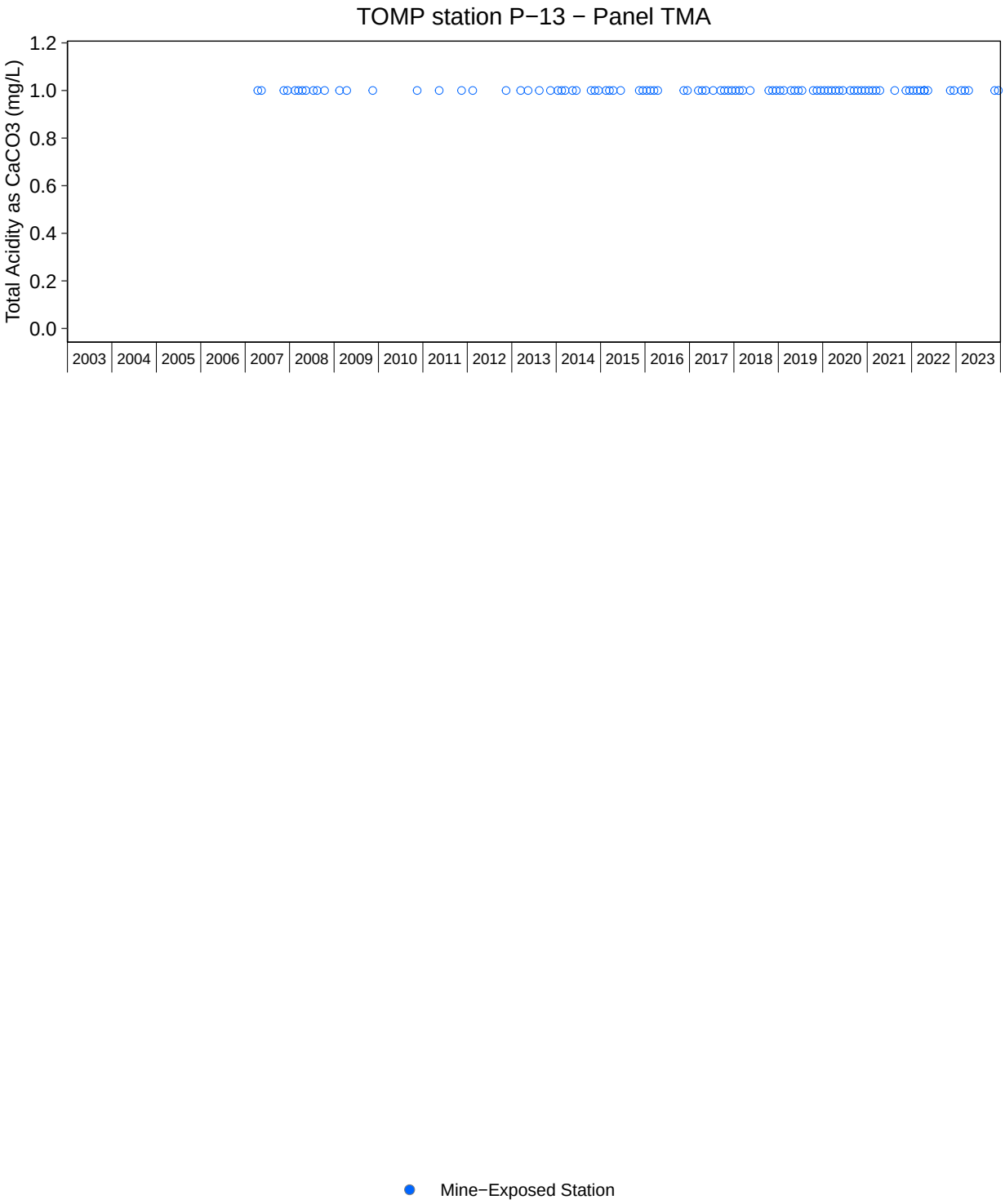


Figure C.19: Concentration of Total Acidity as CaCO3 at TOMP Water Quality Monitoring Station P-13, Panel TMA, 2007 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

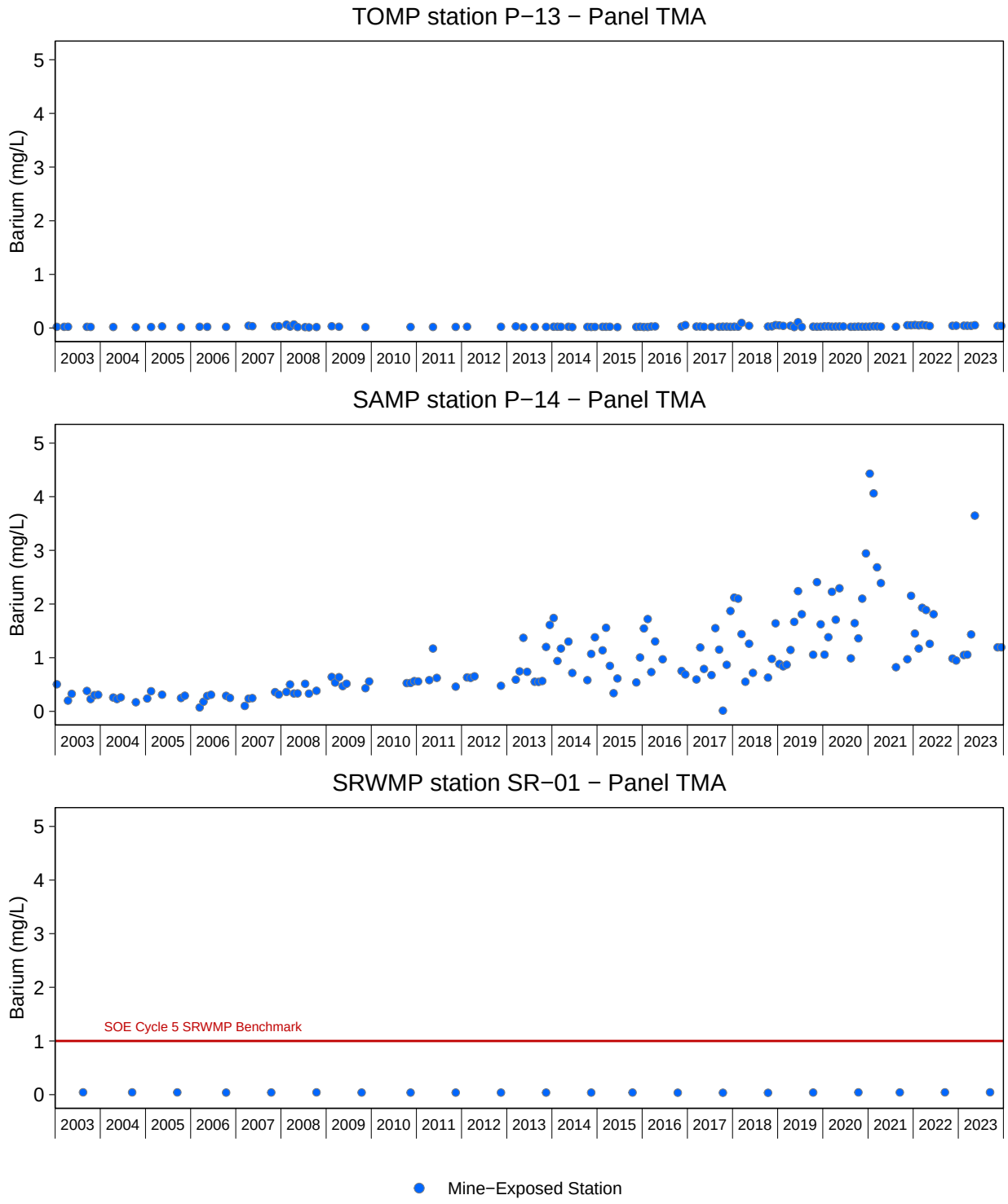


Figure C.20: Concentrations of Barium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Panel TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

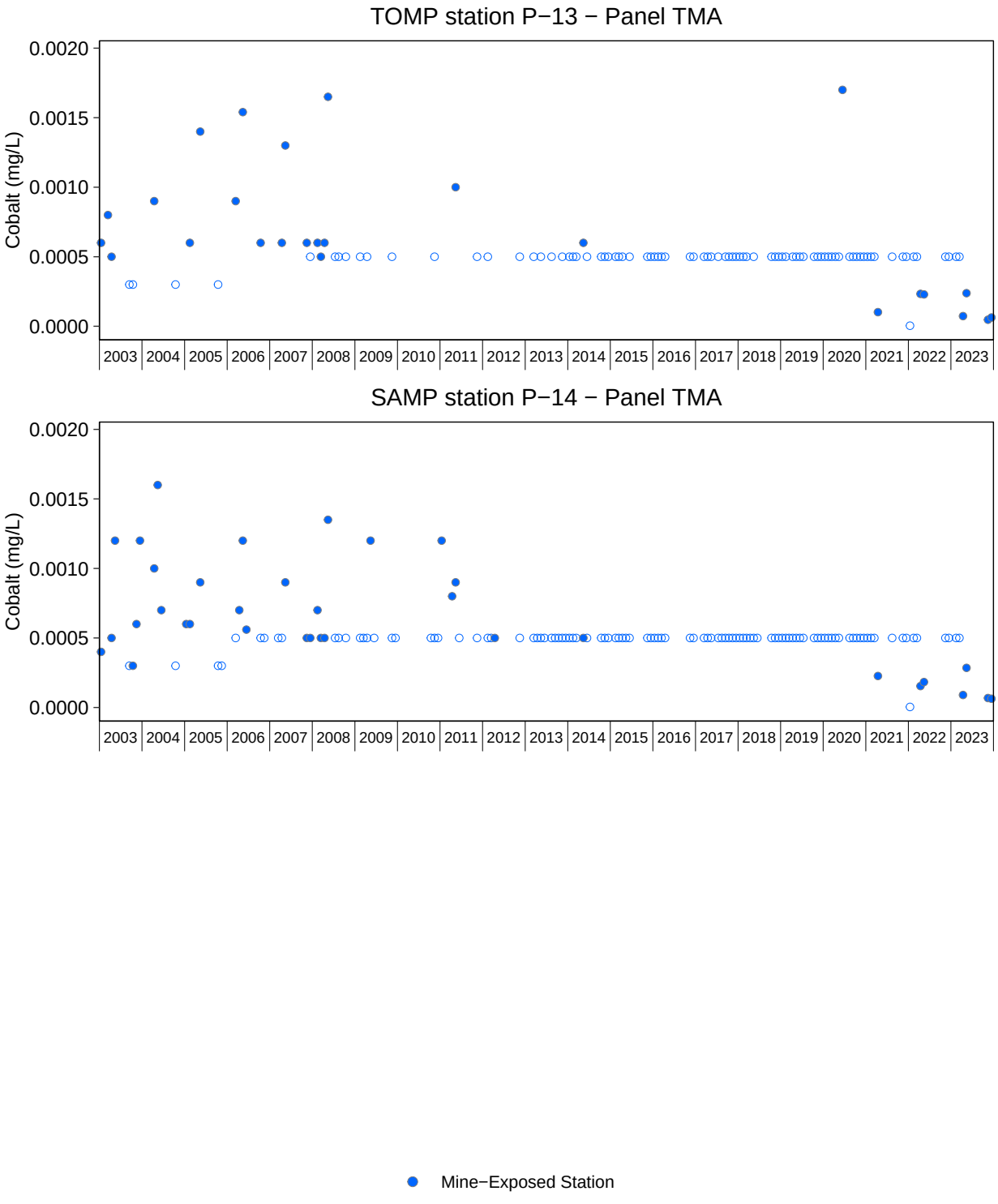


Figure C.21: Concentrations of Cobalt for SAMP and TOMP Water Quality Monitoring Stations at Panel TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

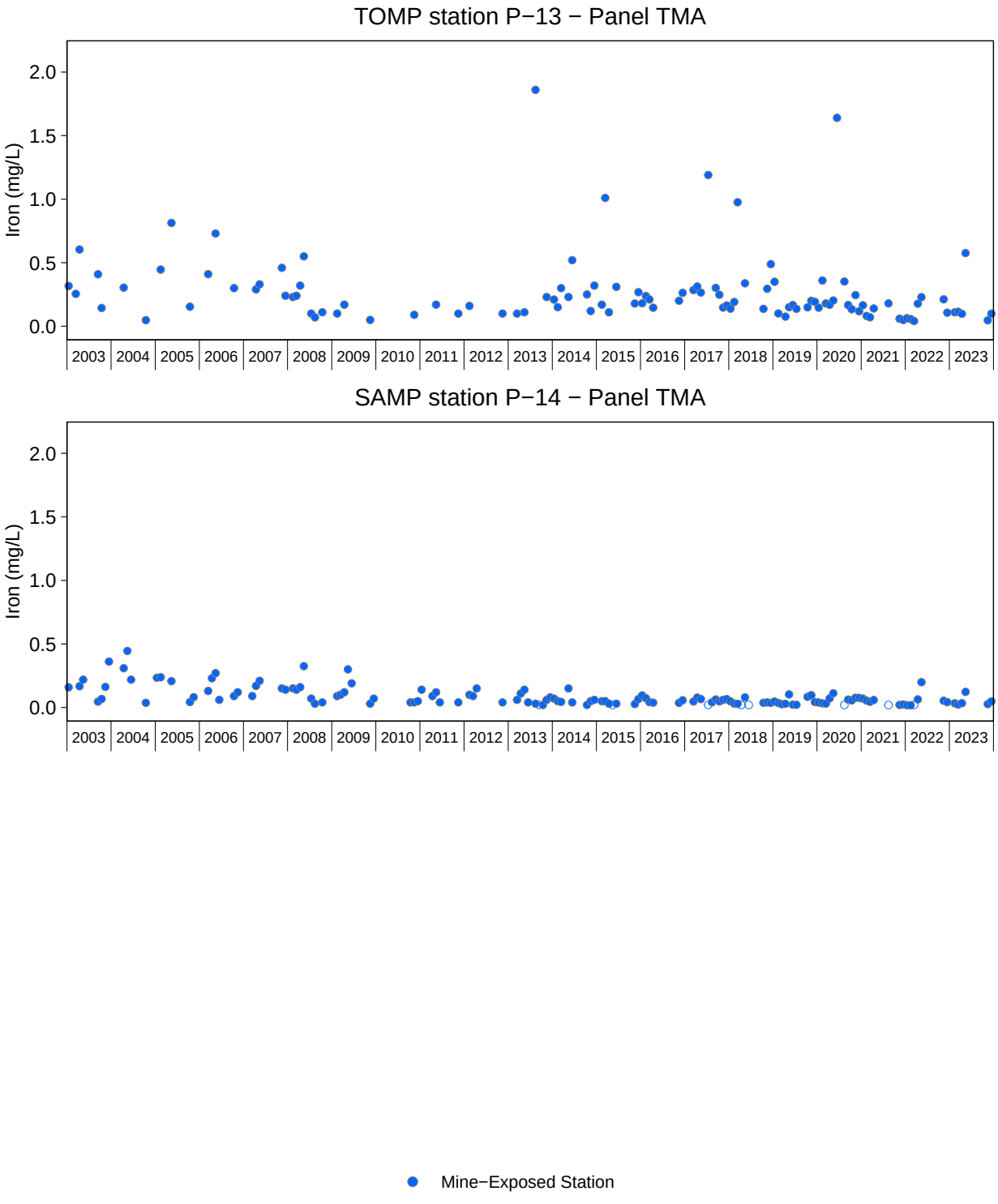


Figure C.22: Concentrations of Iron for SAMP and TOMP Water Quality Monitoring Stations at Panel TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

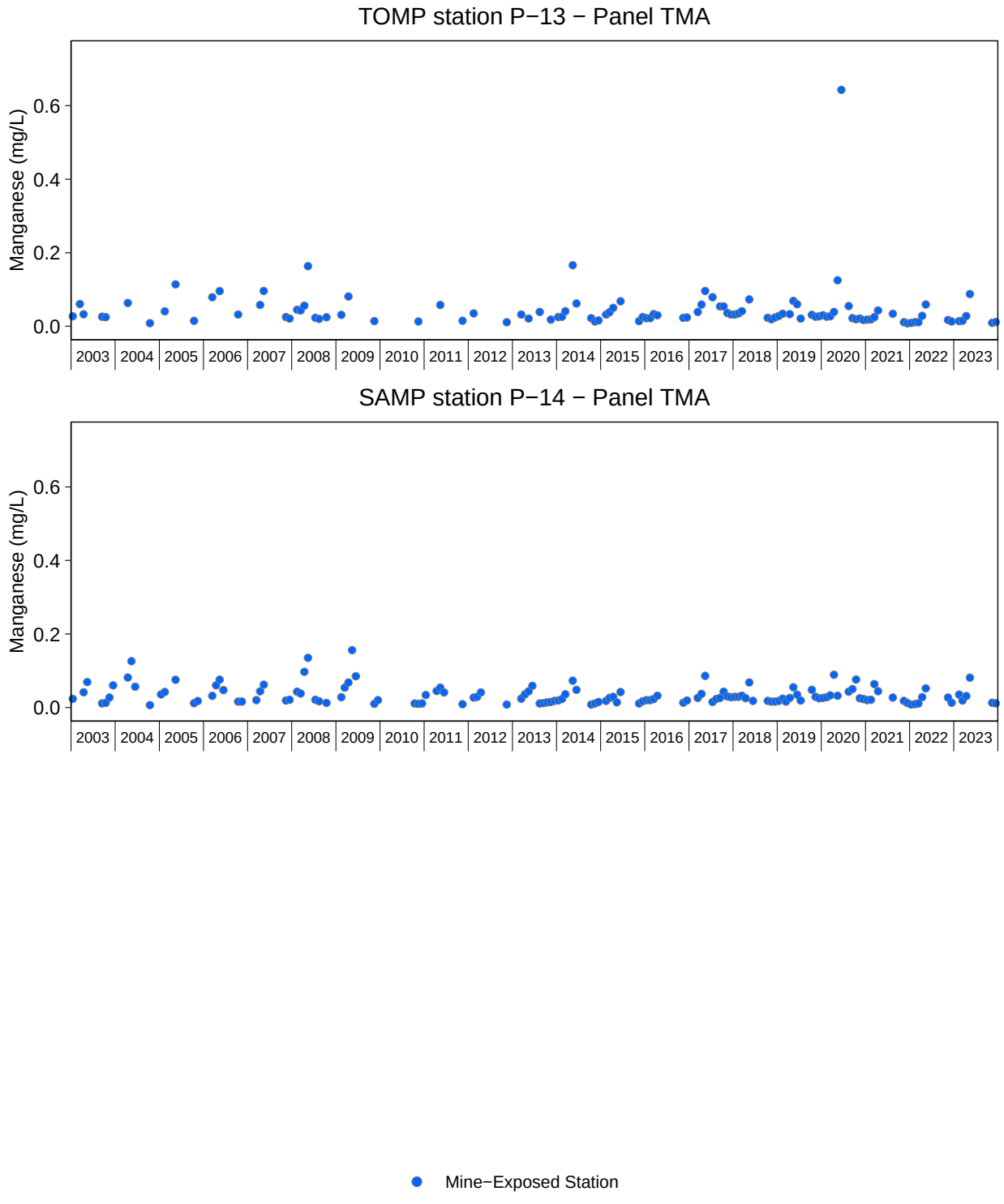


Figure C.23: Concentrations of Manganese for SAMP and TOMP Water Quality Monitoring Stations at Panel TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

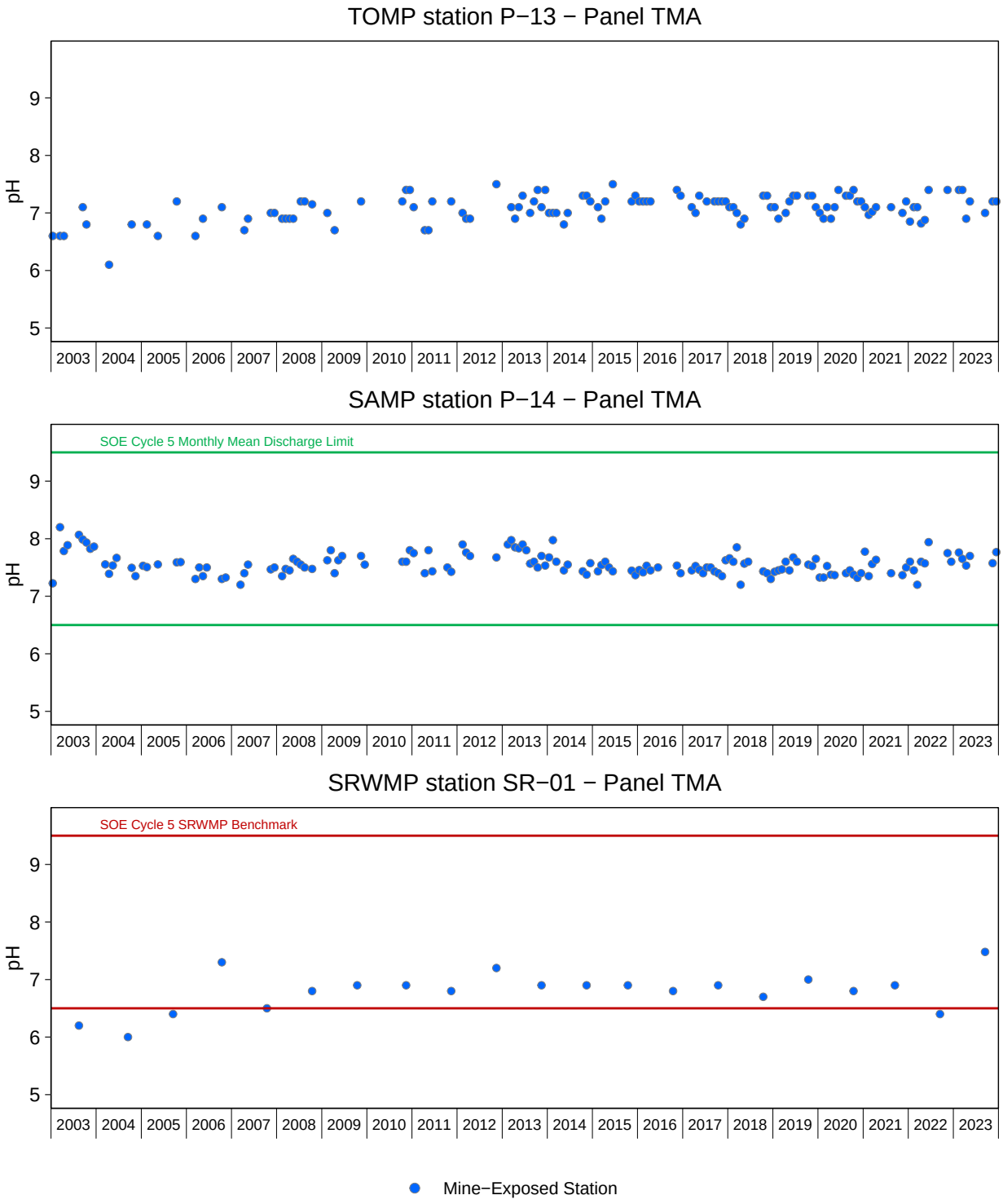


Figure C.24: Concentrations of pH for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Panel TMA, 2003 to 2023

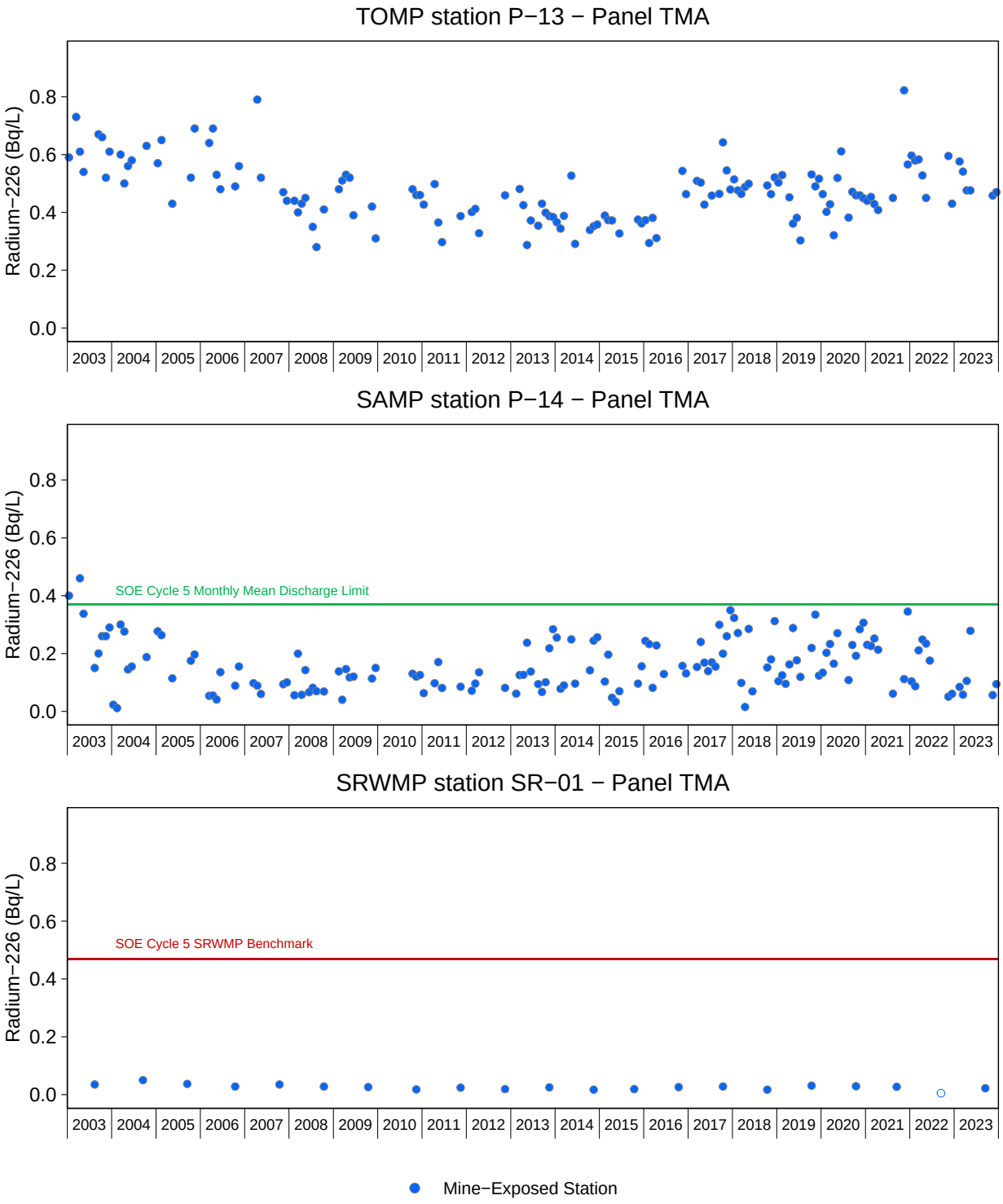


Figure C.25: Concentrations of Radium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Panel TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

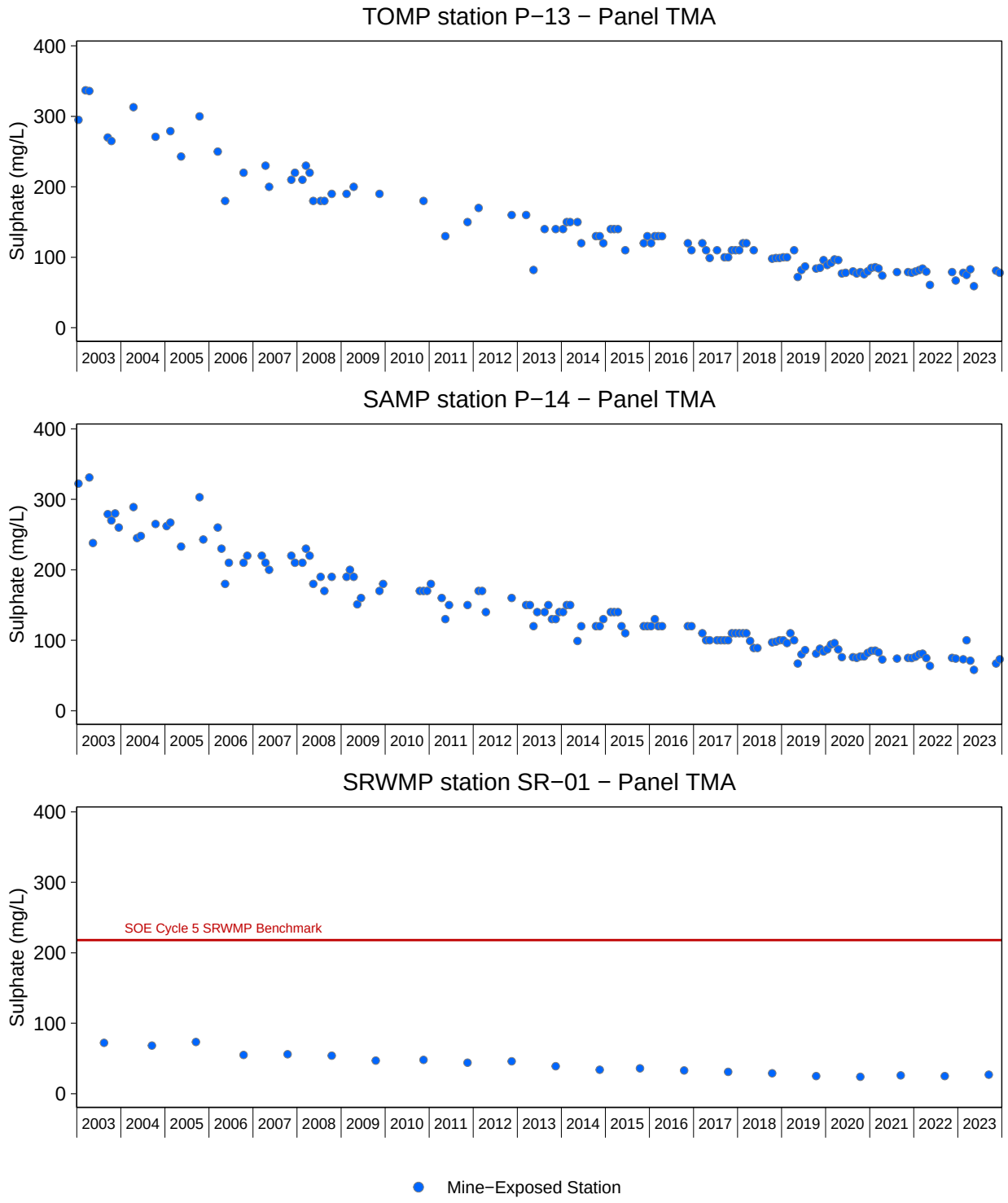


Figure C.26: Concentrations of Sulphate for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Panel TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

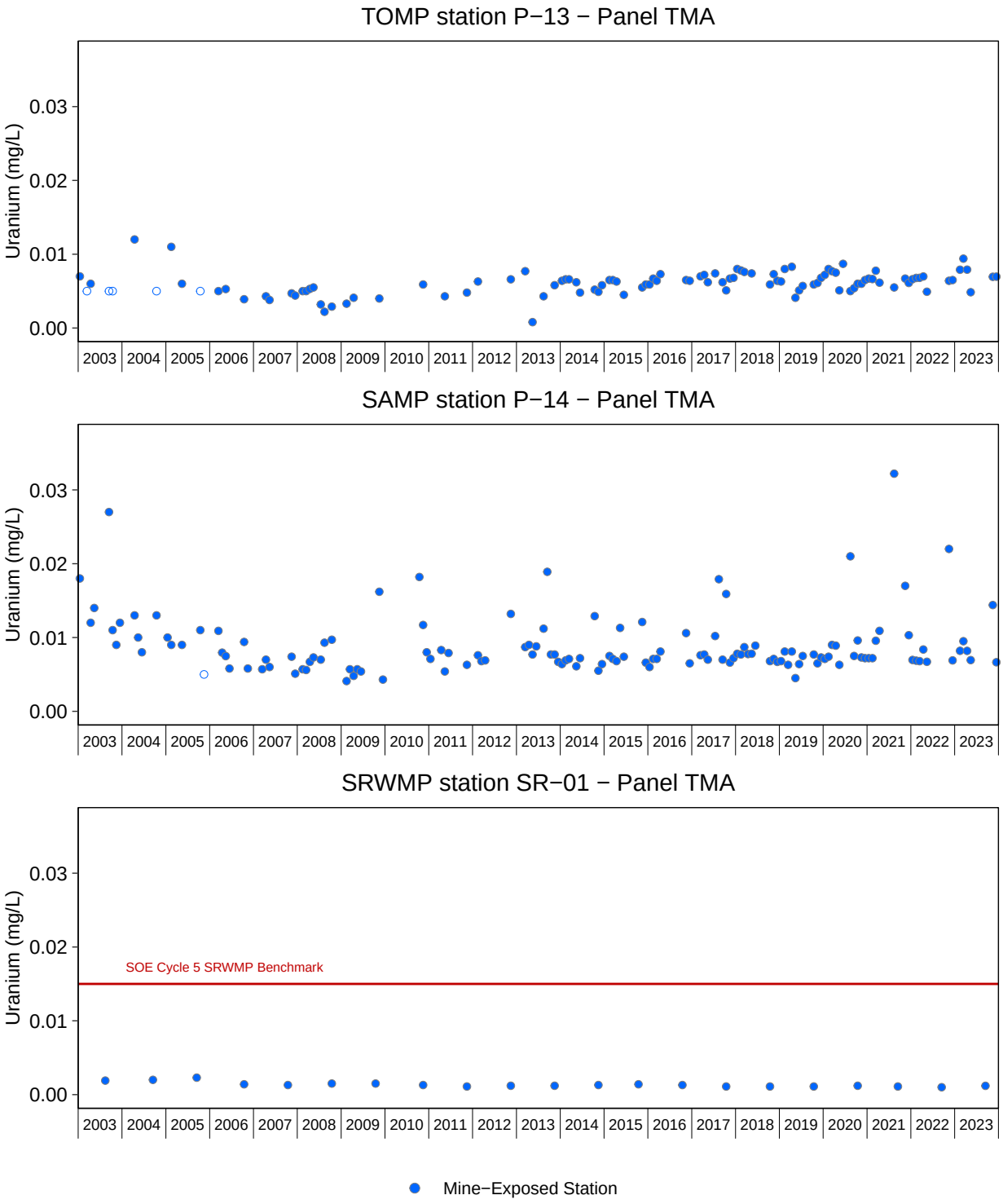


Figure C.27: Concentrations of Uranium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Panel TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

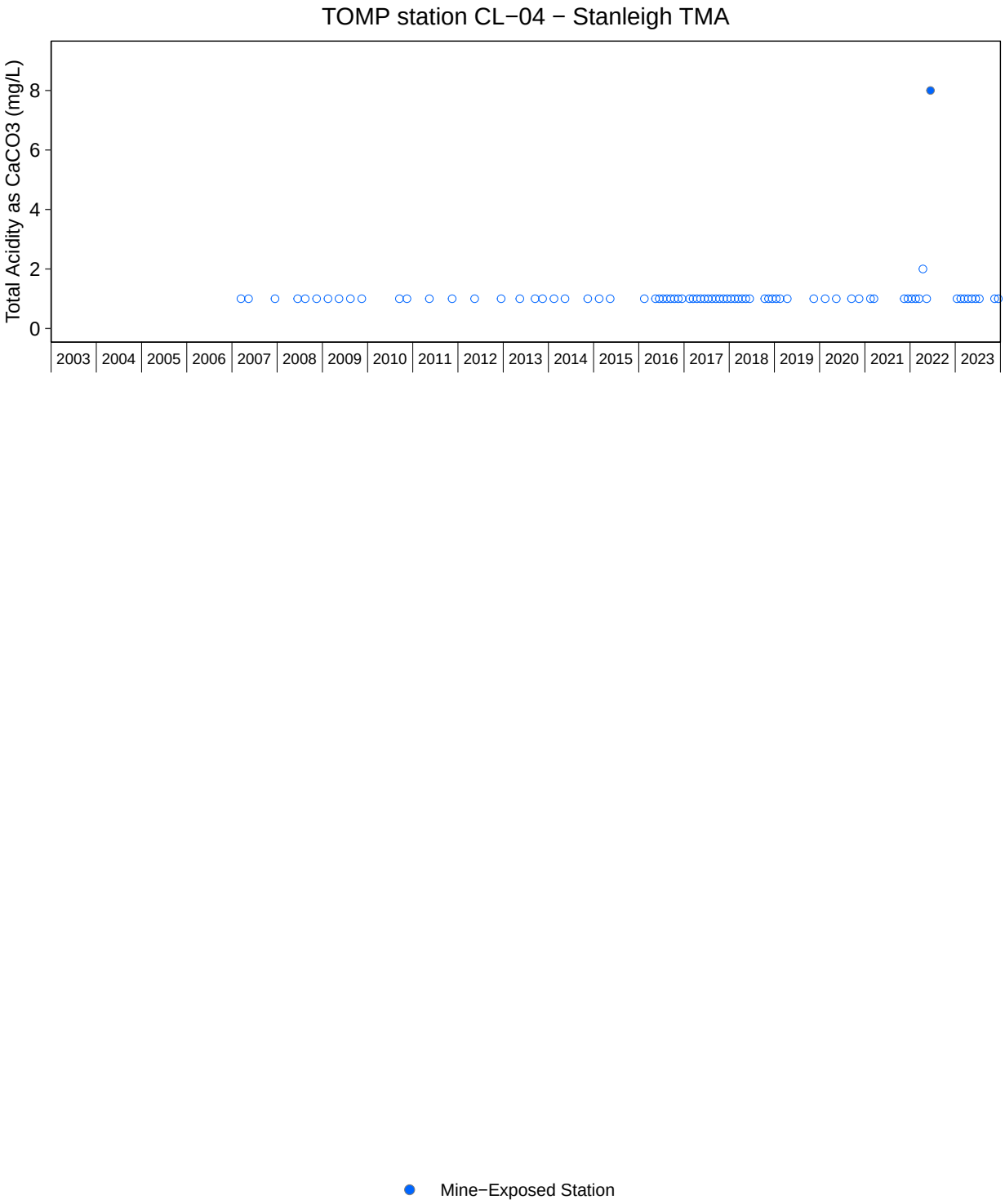


Figure C.28: Concentration of Total Acidity as CaCO3 at TOMP Water Quality Monitoring Station CL-04, Stanleigh TMA, 2007 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

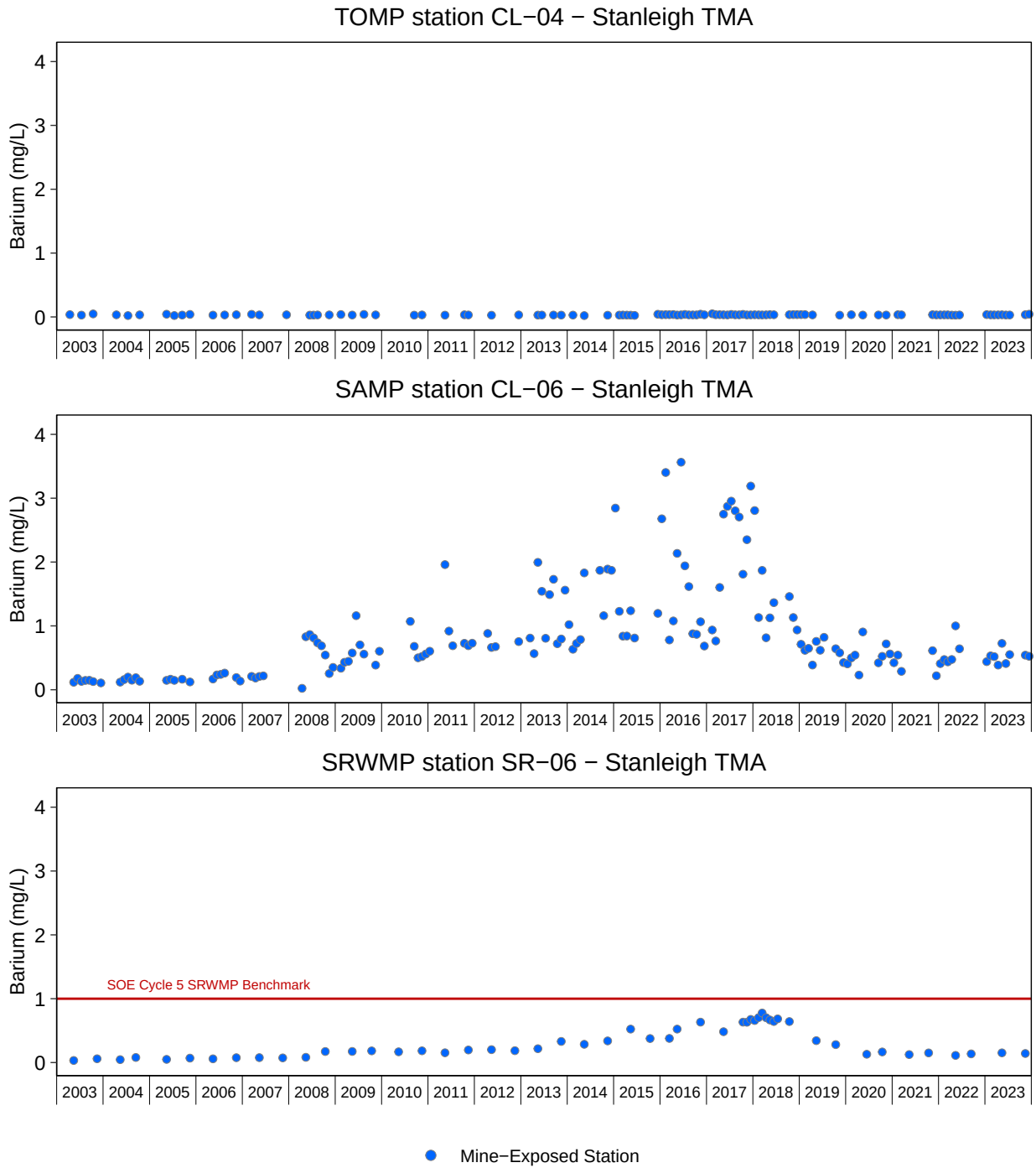


Figure C.29: Concentrations of Barium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

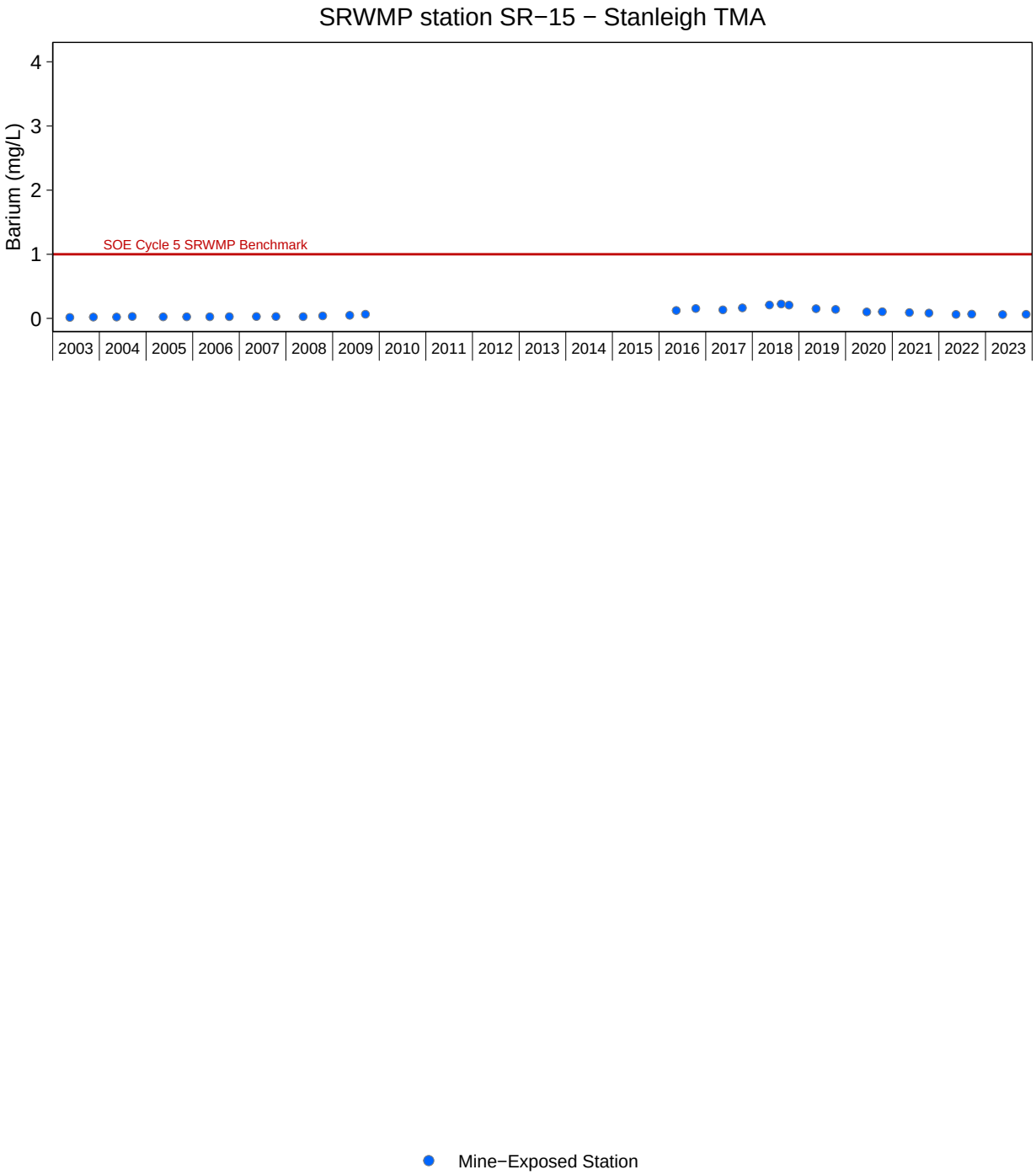


Figure C.29: Concentrations of Barium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

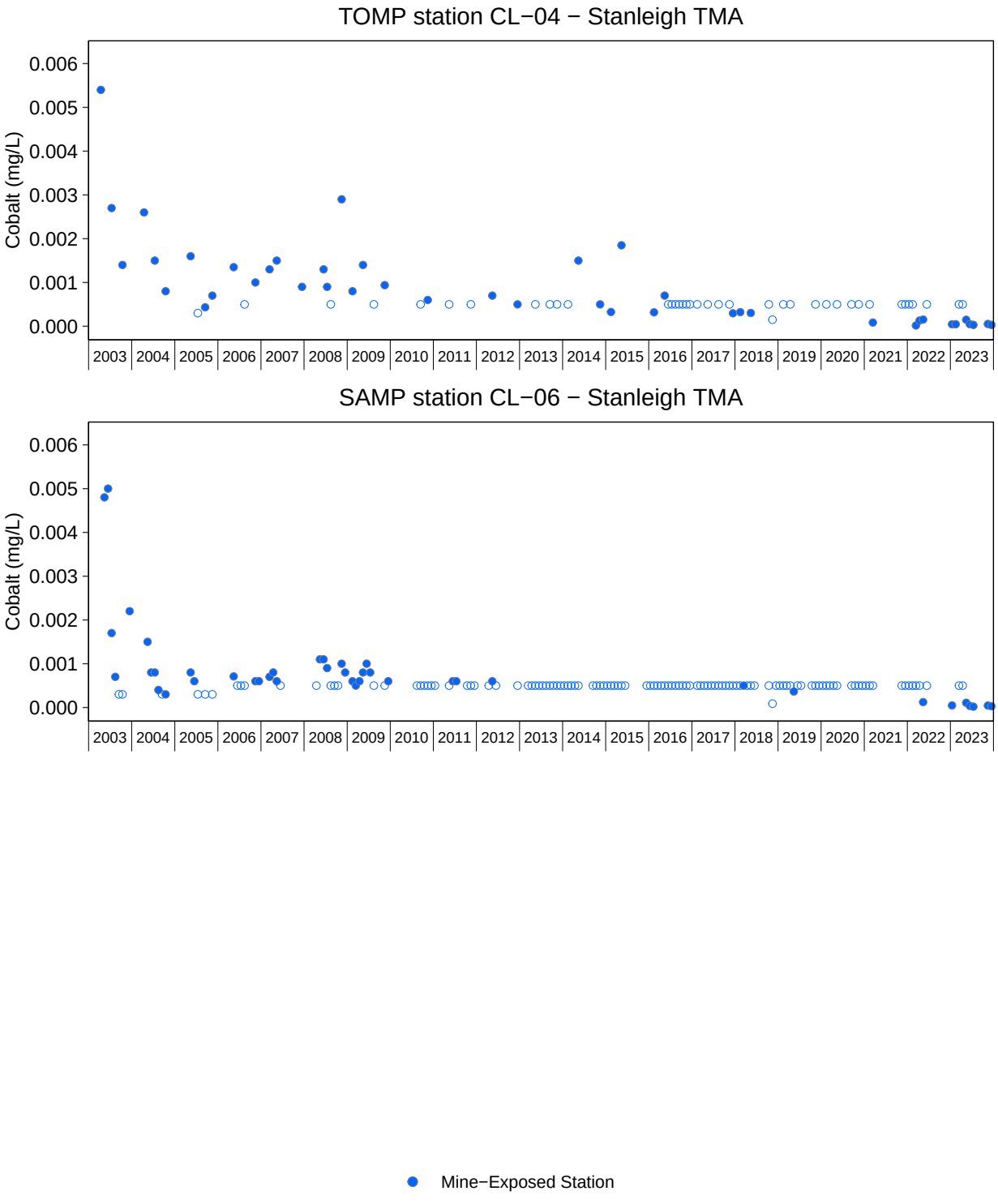


Figure C.30: Concentrations of Cobalt for SAMP and TOMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

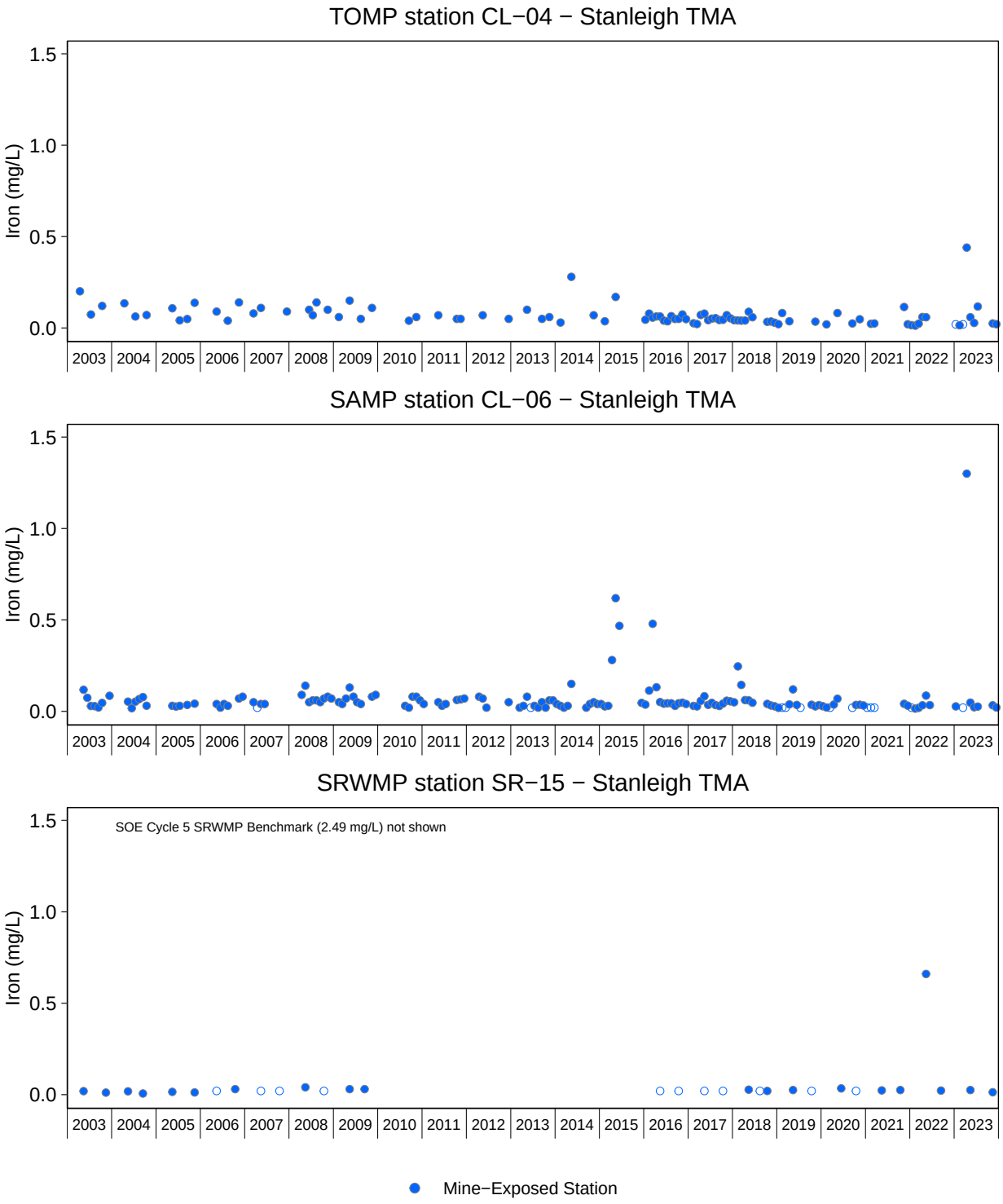


Figure C.31: Concentrations of Iron for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

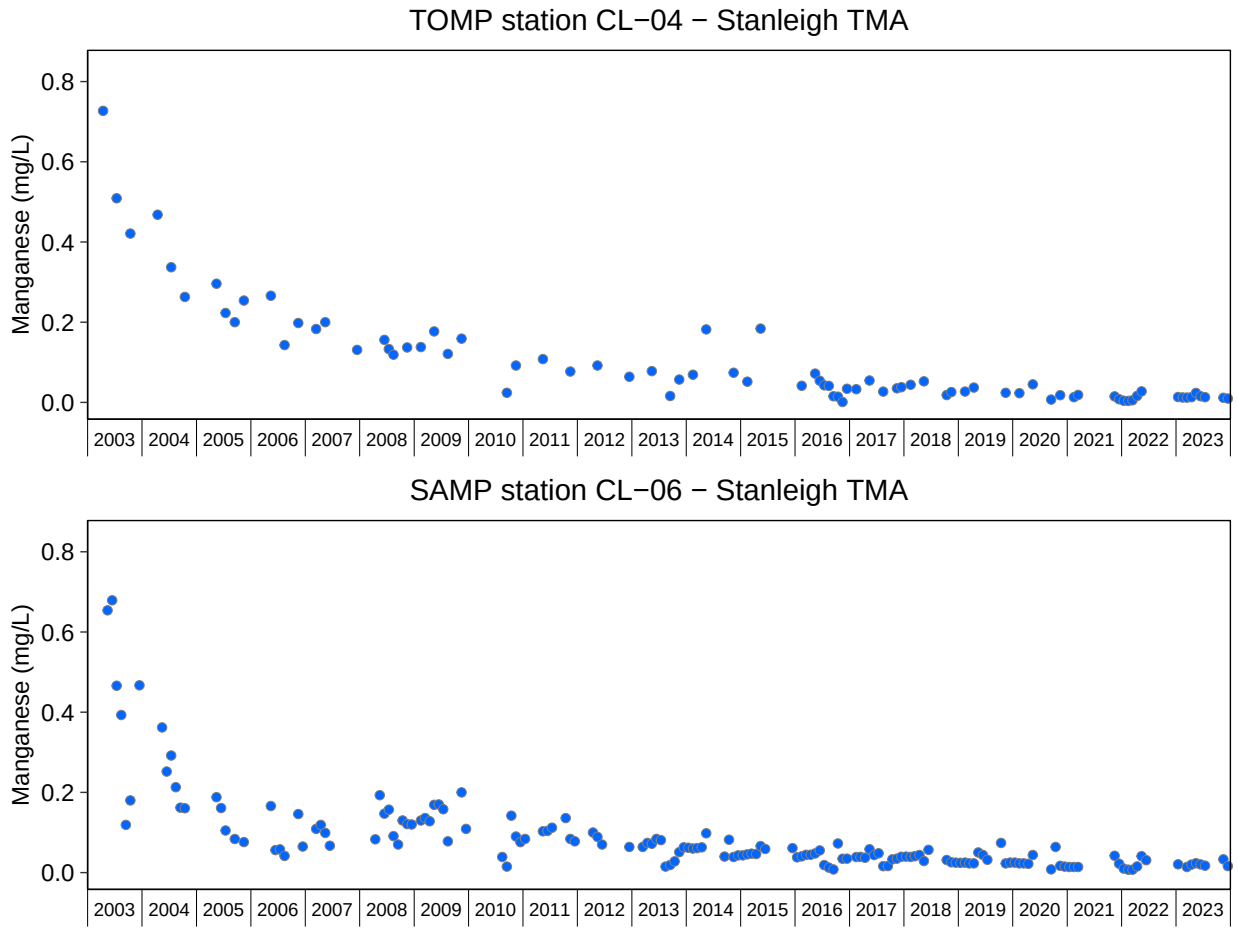


Figure C.32: Concentrations of Manganese for SAMP and TOMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

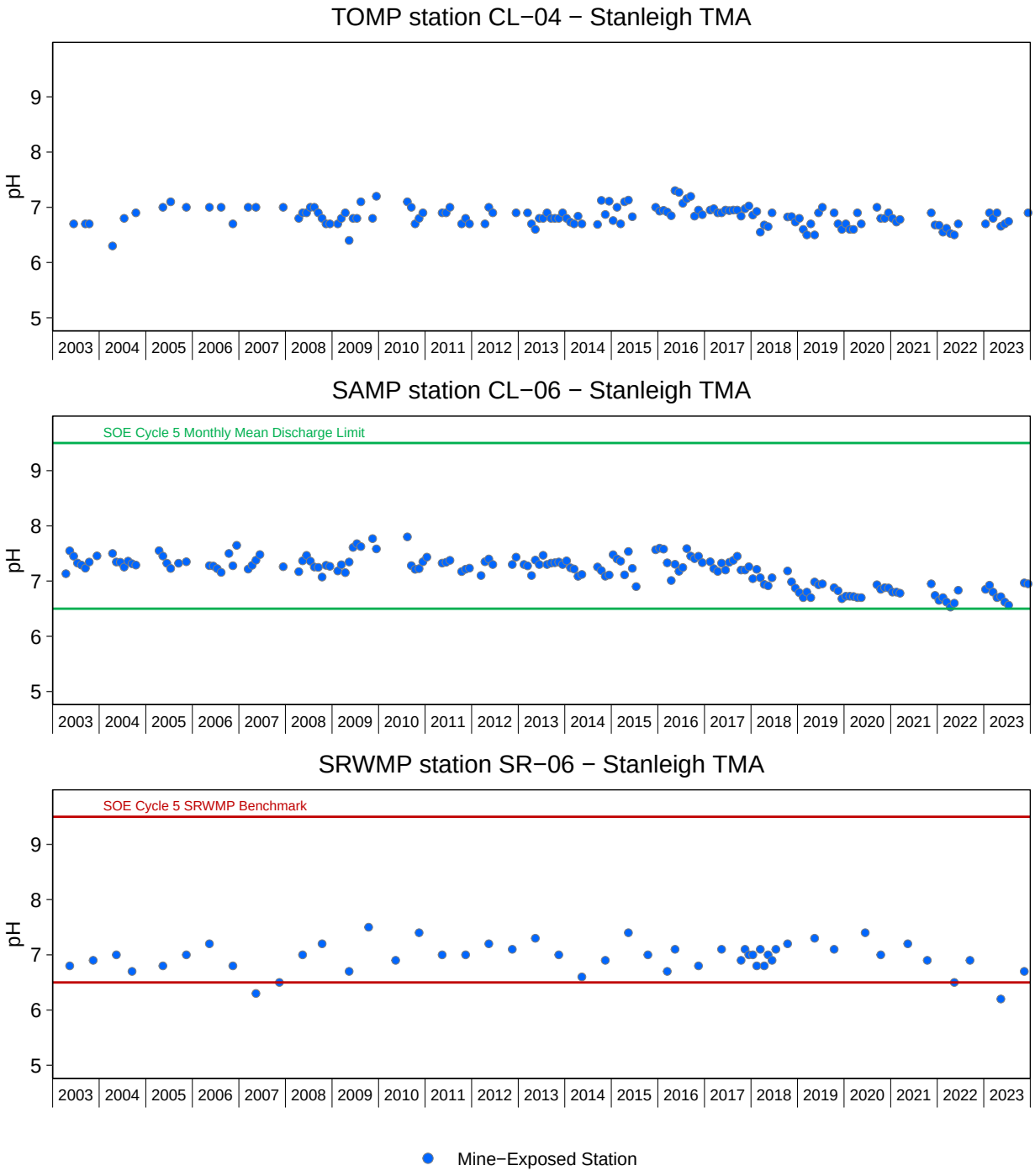


Figure C.33: Concentrations of pH for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

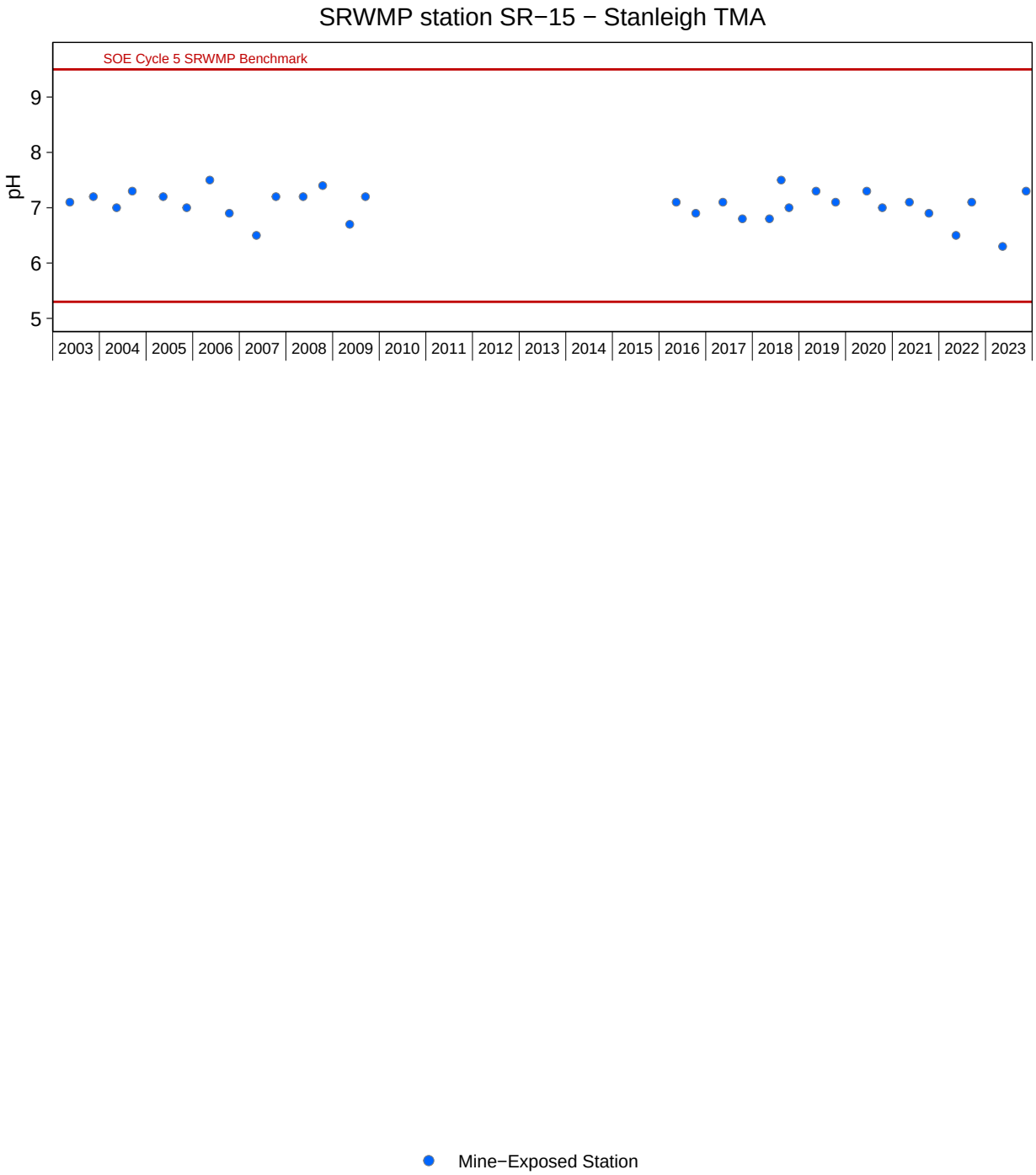


Figure C.33: Concentrations of pH for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

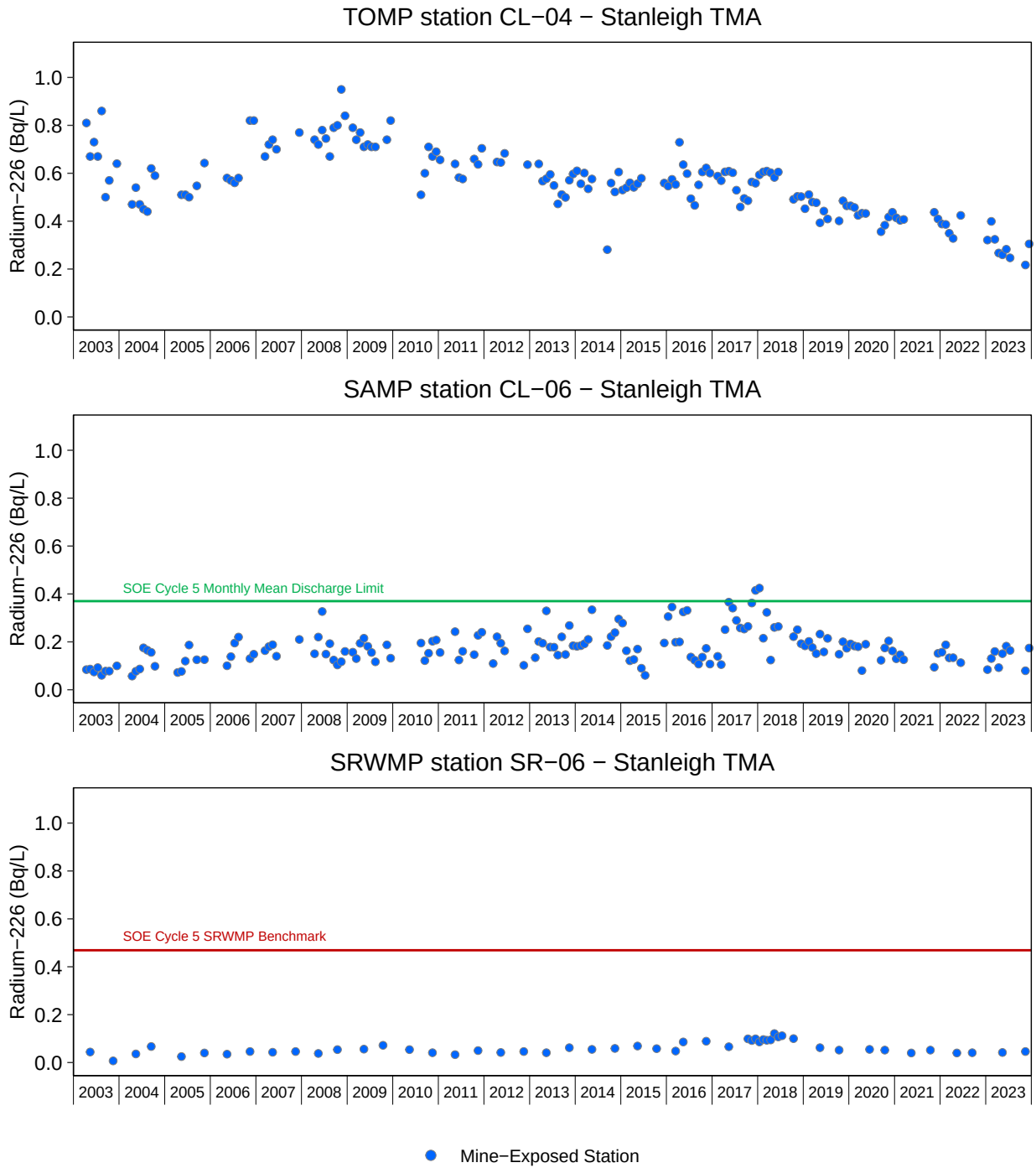


Figure C.34: Concentrations of Radium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

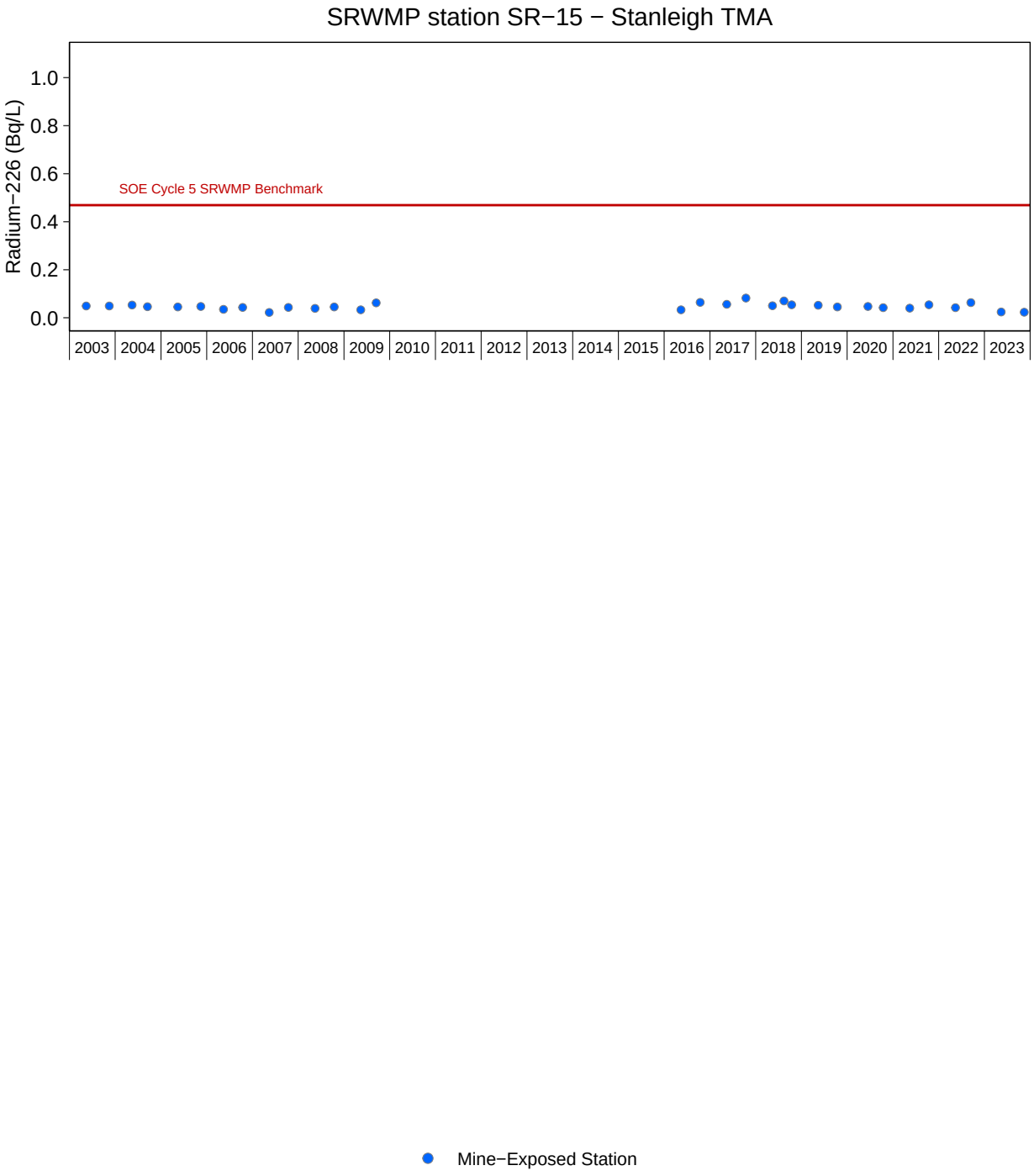


Figure C.34: Concentrations of Radium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

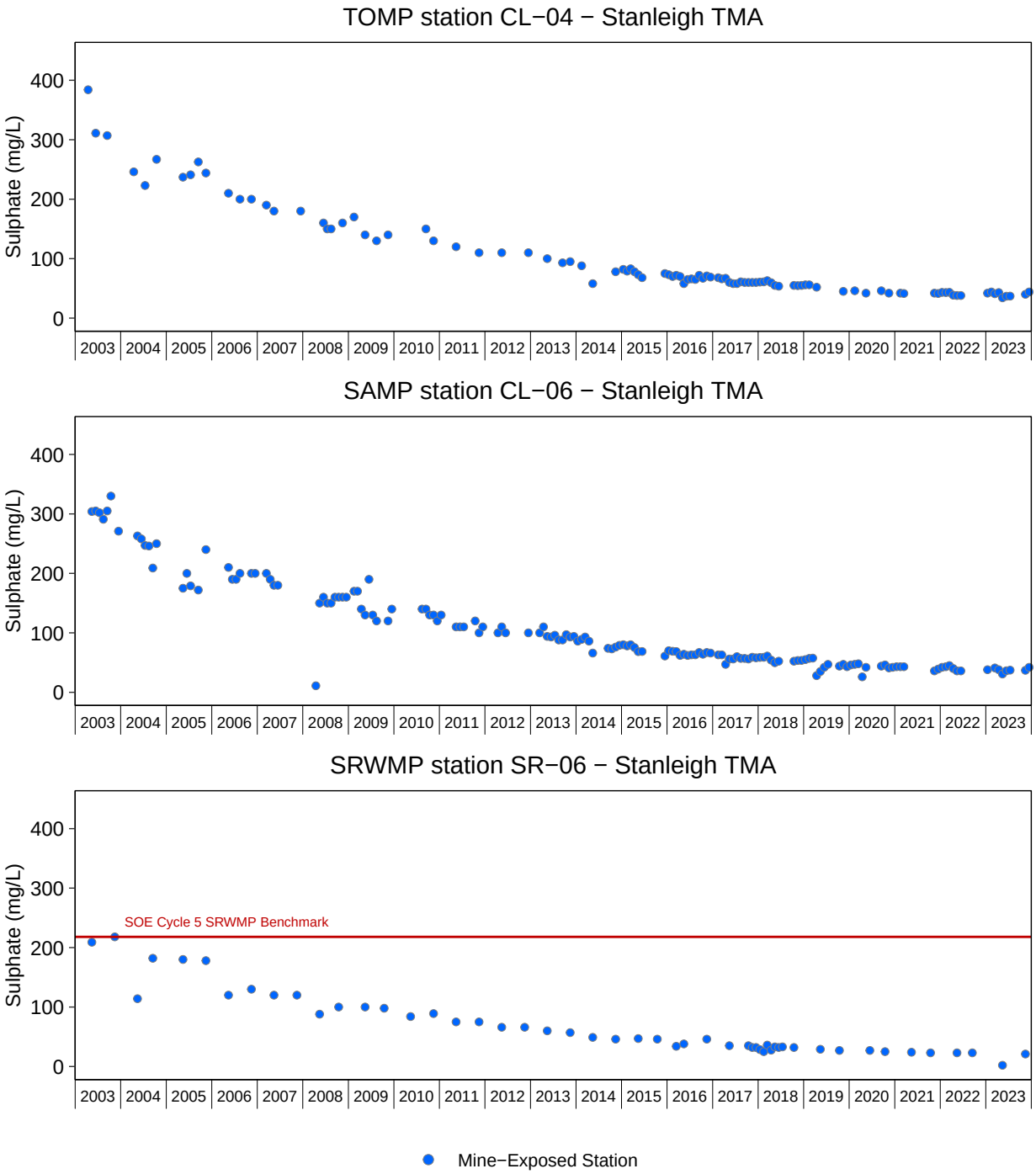


Figure C.35: Concentrations of Sulphate for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

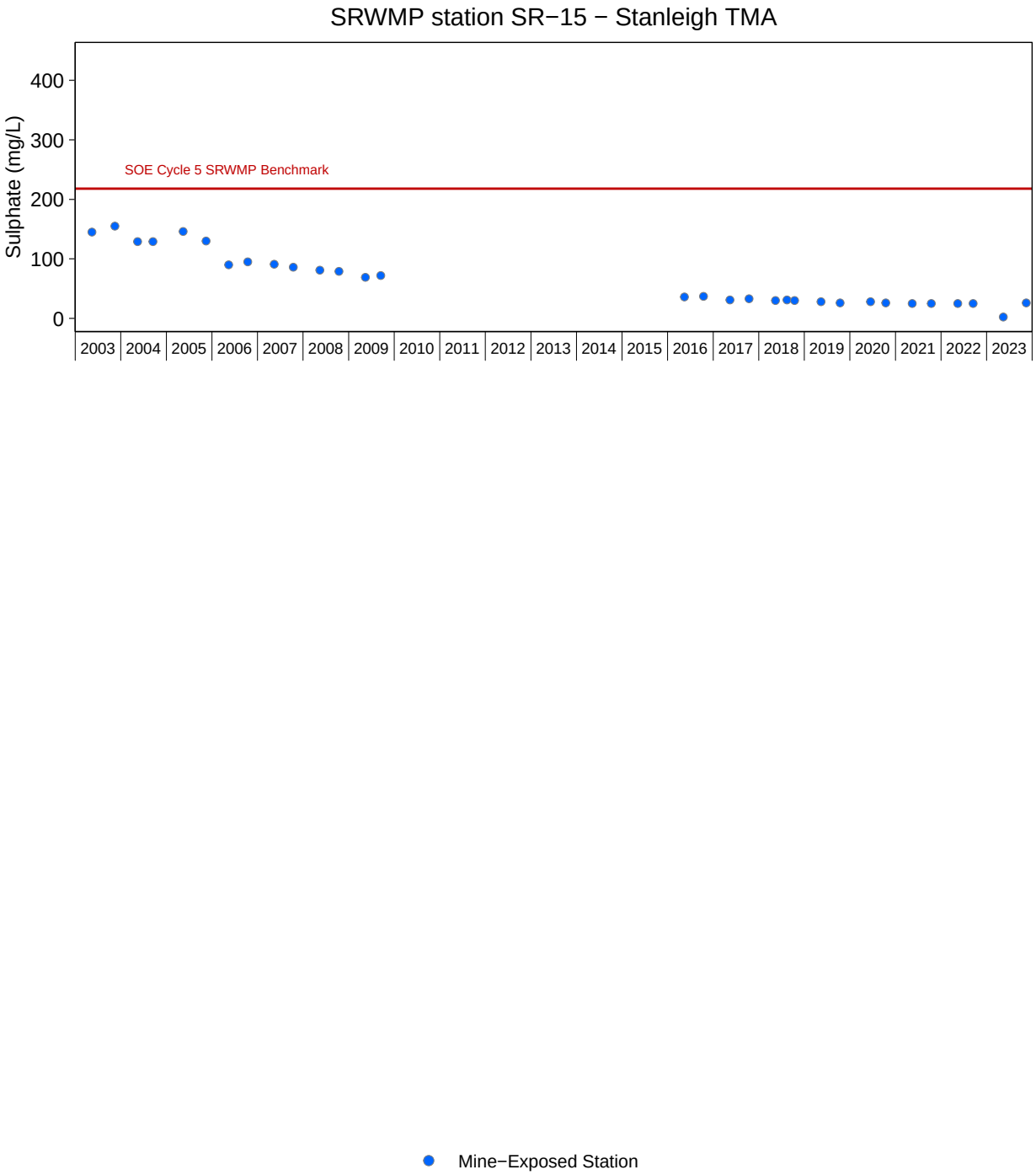


Figure C.35: Concentrations of Sulphate for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.
Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

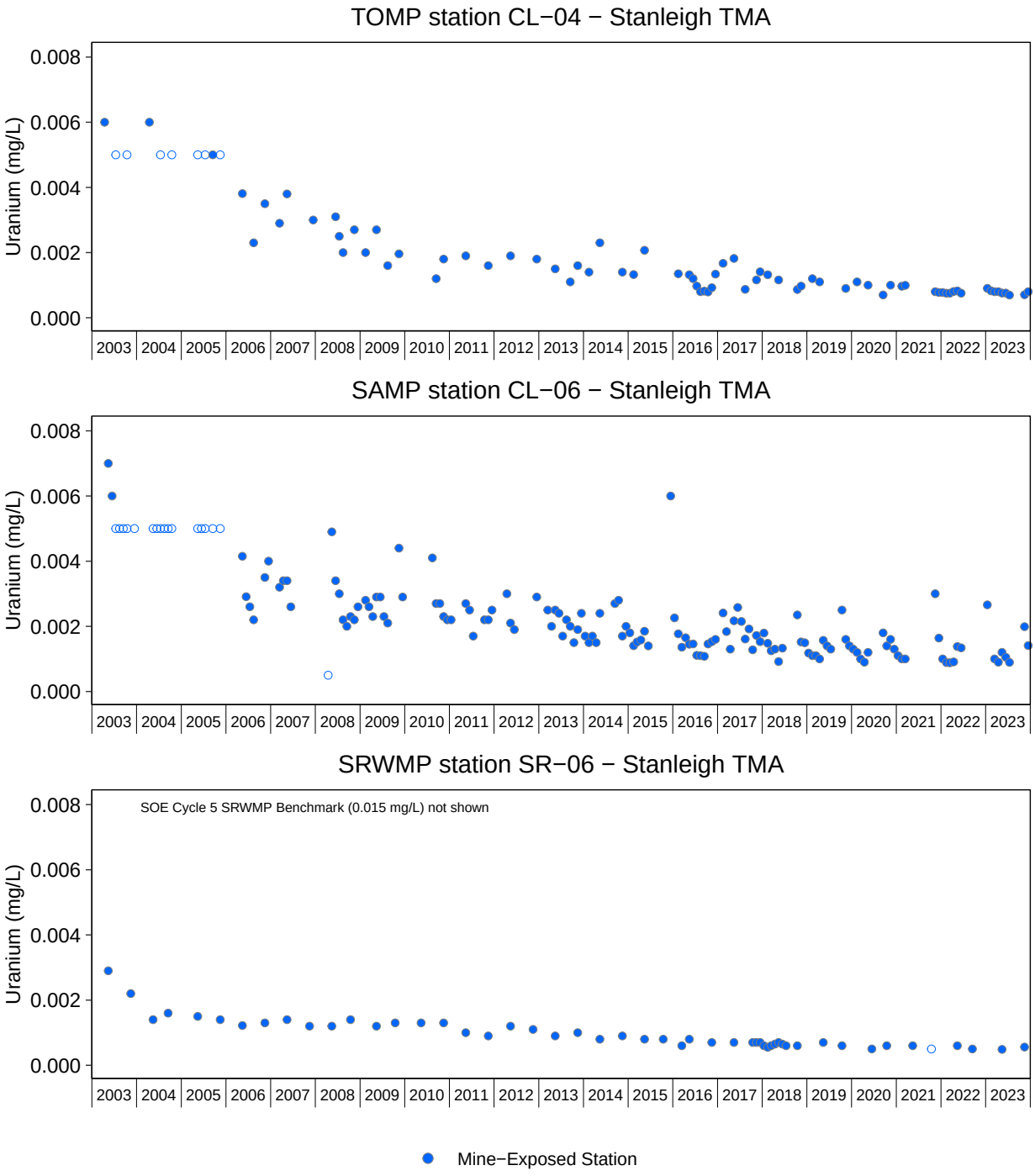


Figure C.36: Concentrations of Uranium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

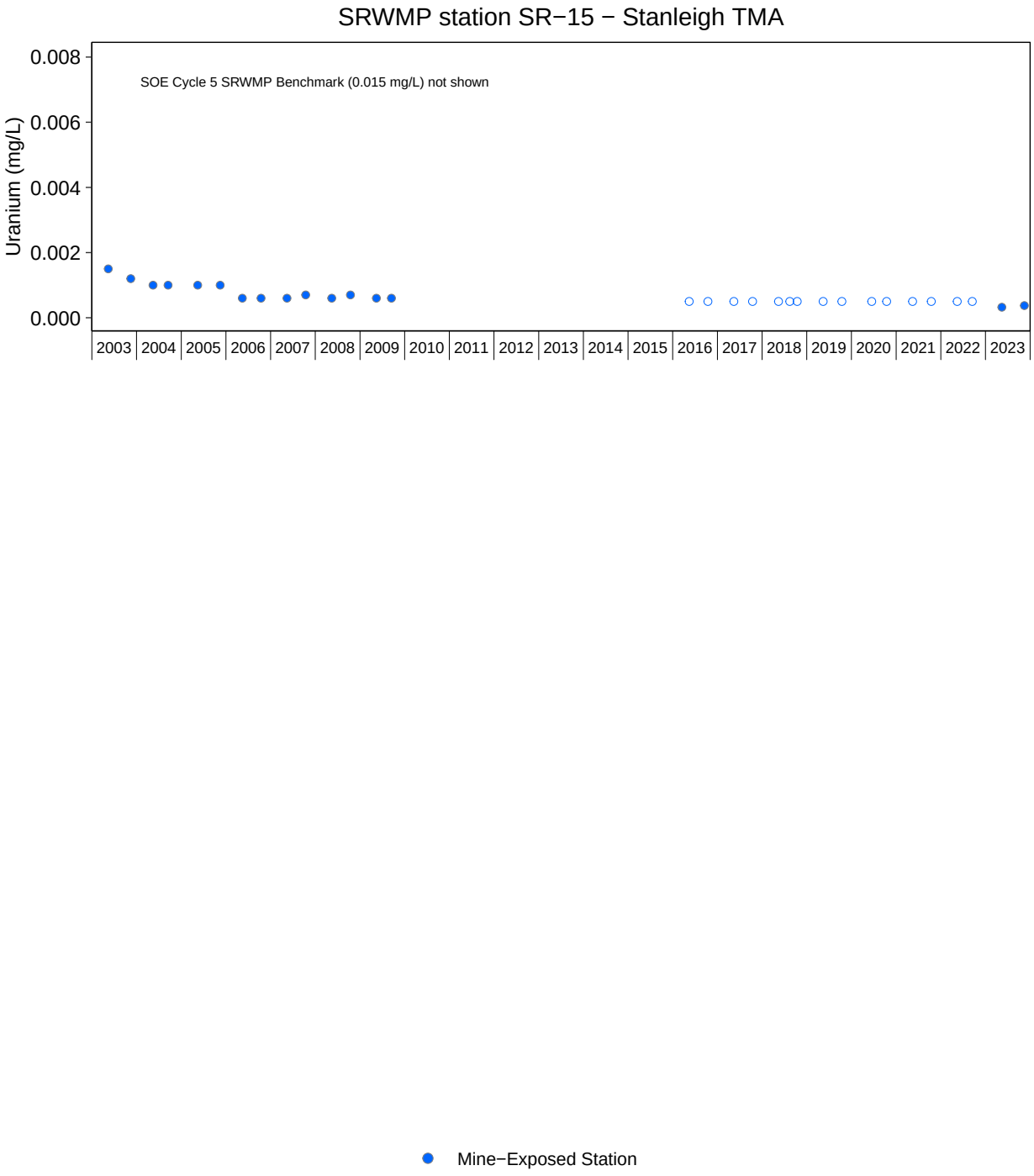


Figure C.36: Concentrations of Uranium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanleigh TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

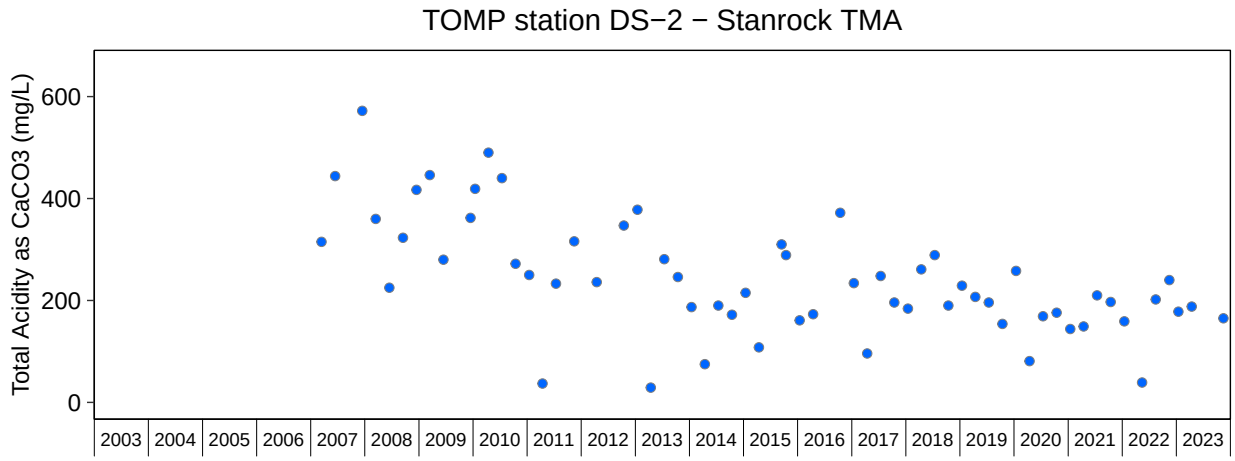


Figure C.37: Concentration of Total Acidity as CaCO3 at TOMP Water Quality Monitoring Station DS-2, Stanrock TMA, 2007 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

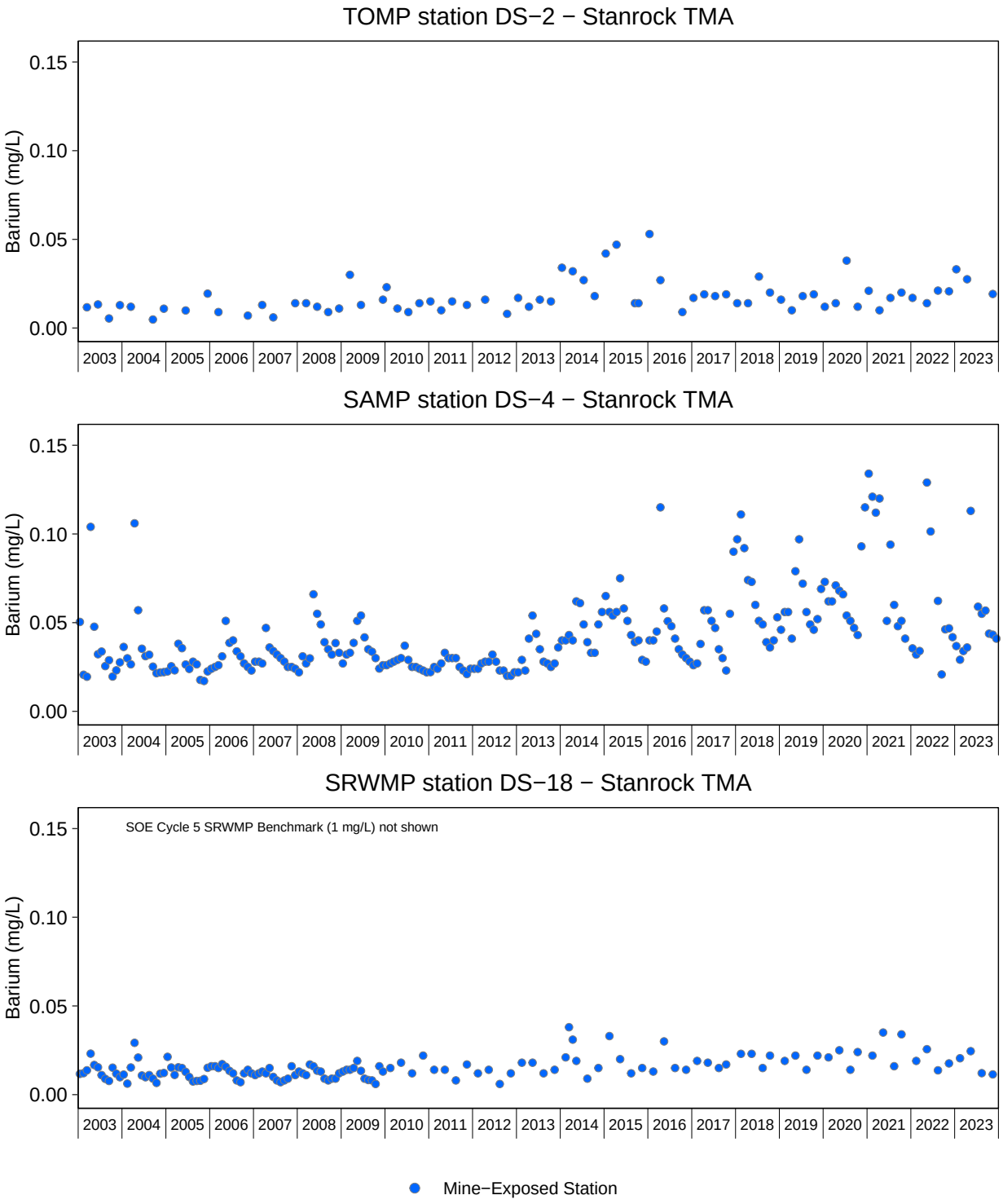


Figure C.38: Concentrations of Barium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanrock TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

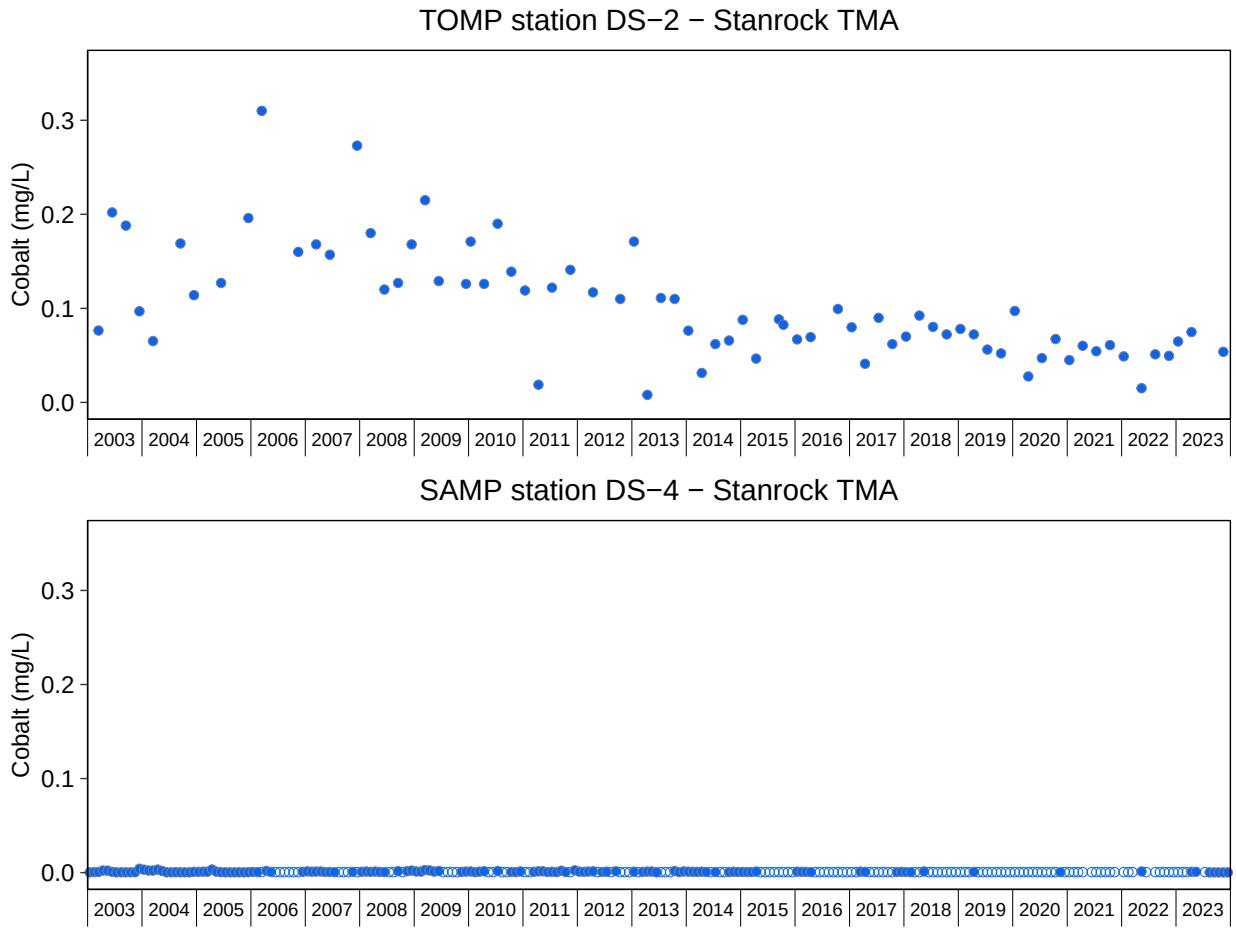


Figure C.39: Concentrations of Cobalt for SAMP and TOMP Water Quality Monitoring Stations at Stanrock TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

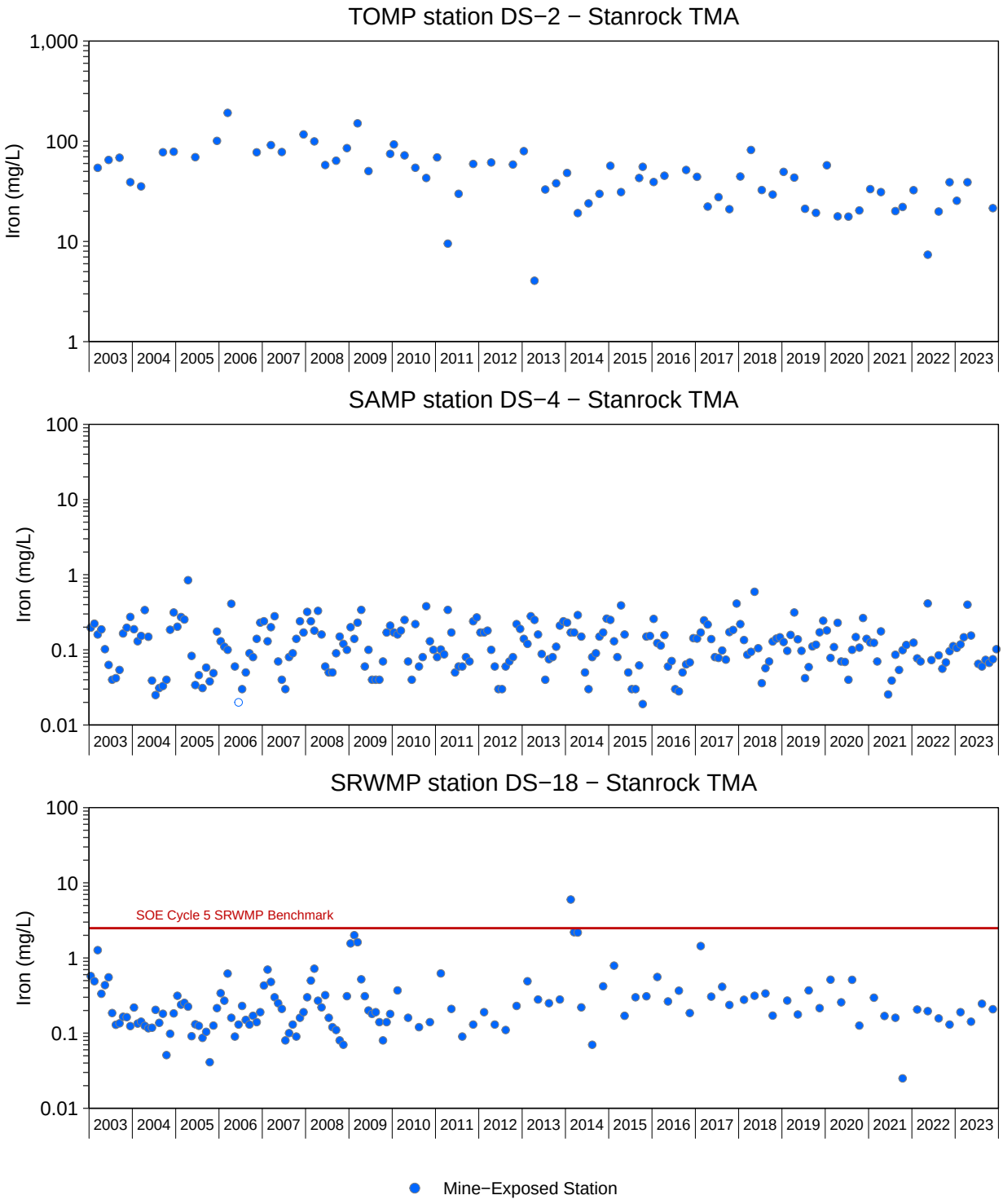


Figure C.40: Concentrations of Iron for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanrock TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

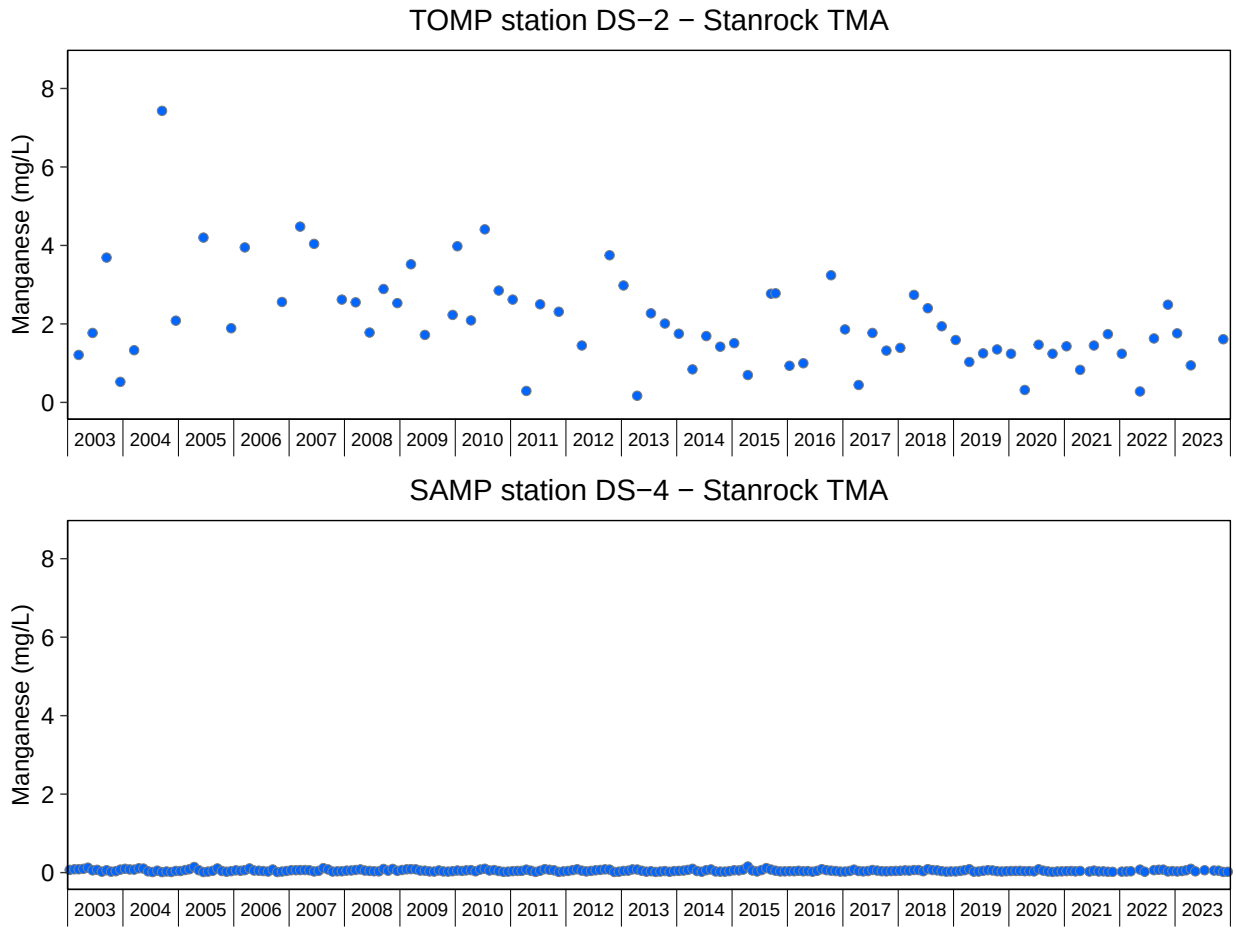


Figure C.41: Concentrations of Manganese for SAMP and TOMP Water Quality Monitoring Stations at Stanrock TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

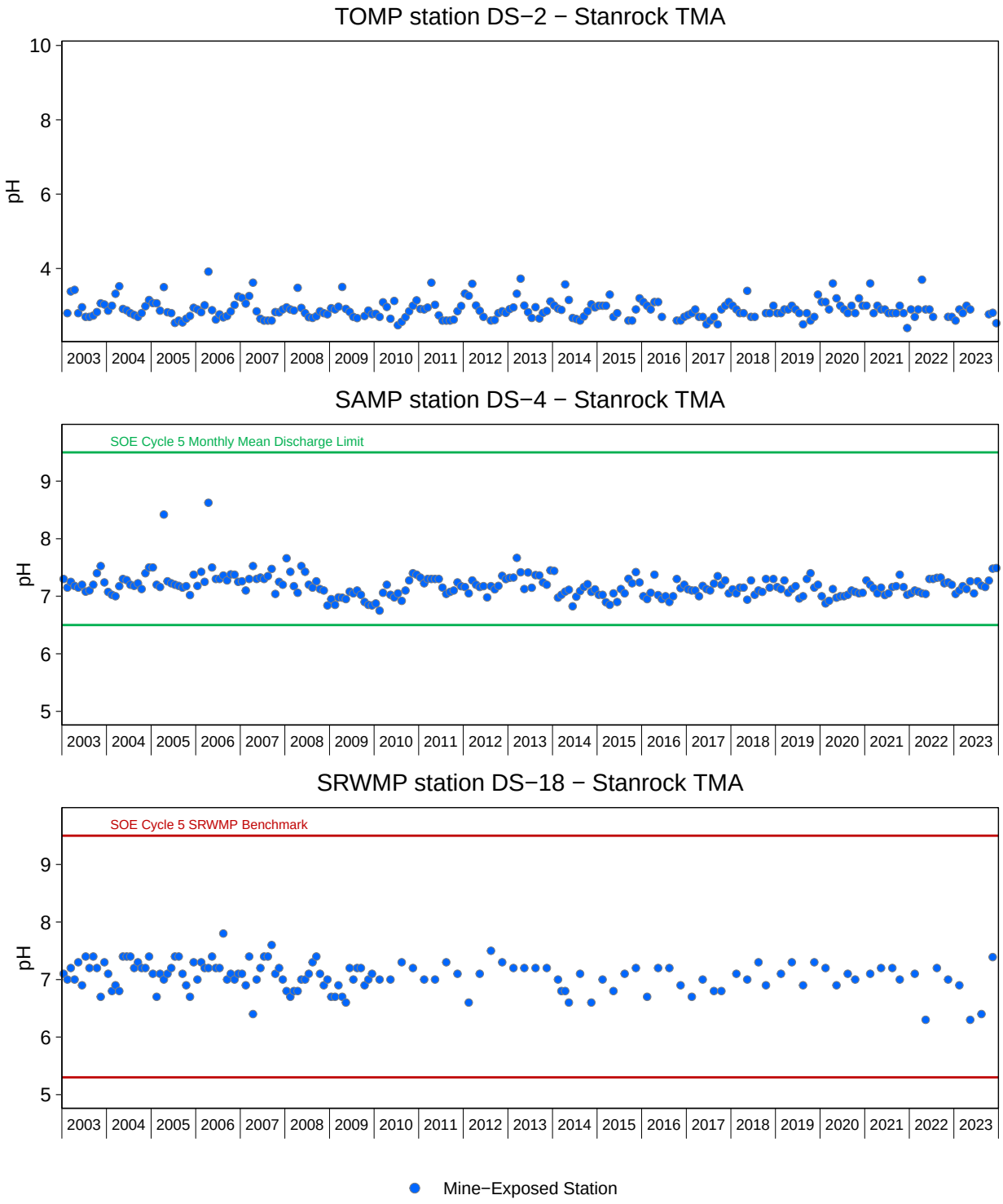


Figure C.42: Concentrations of pH for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanrock TMA, 2003 to 2023

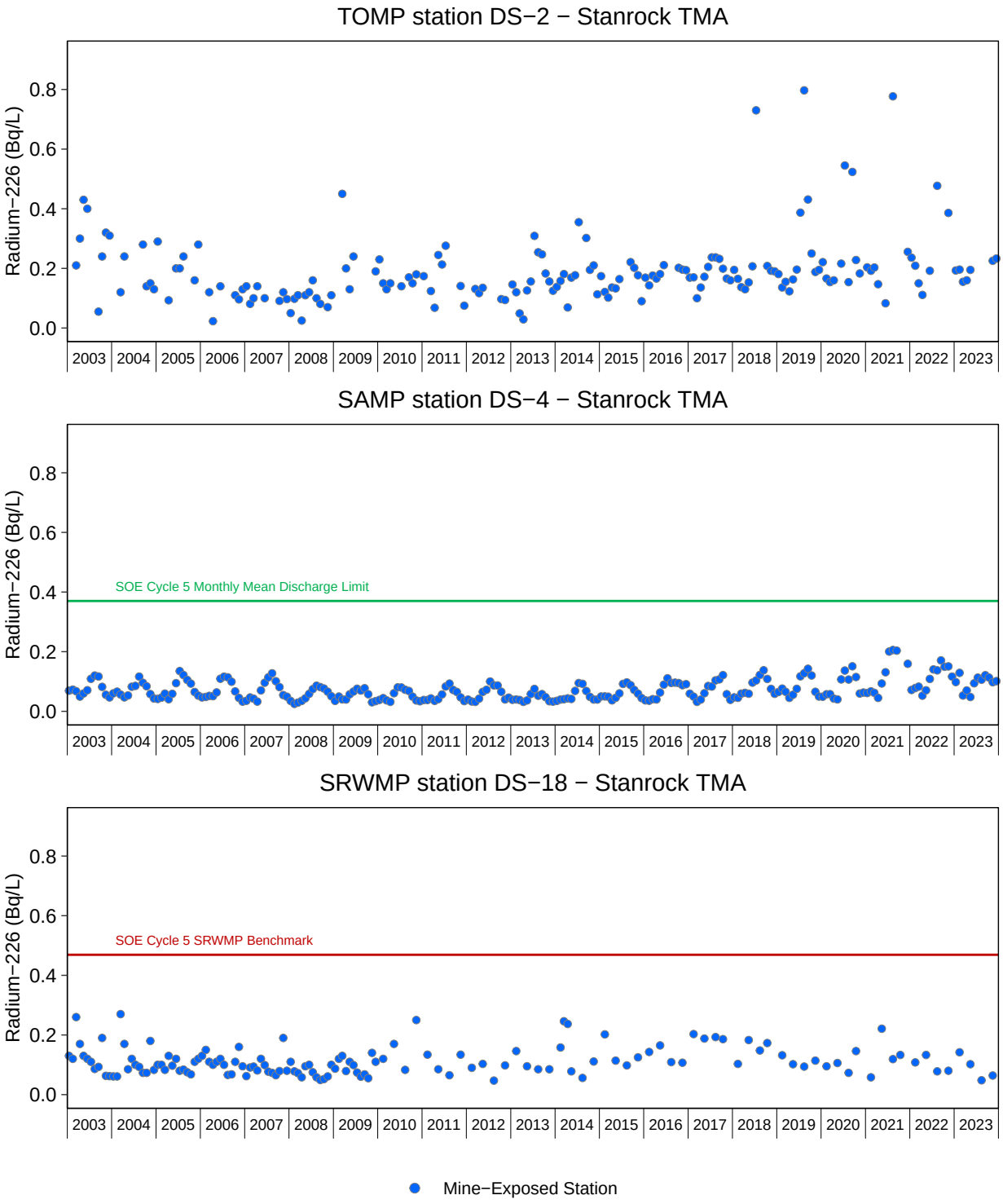


Figure C.43: Concentrations of Radium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanrock TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

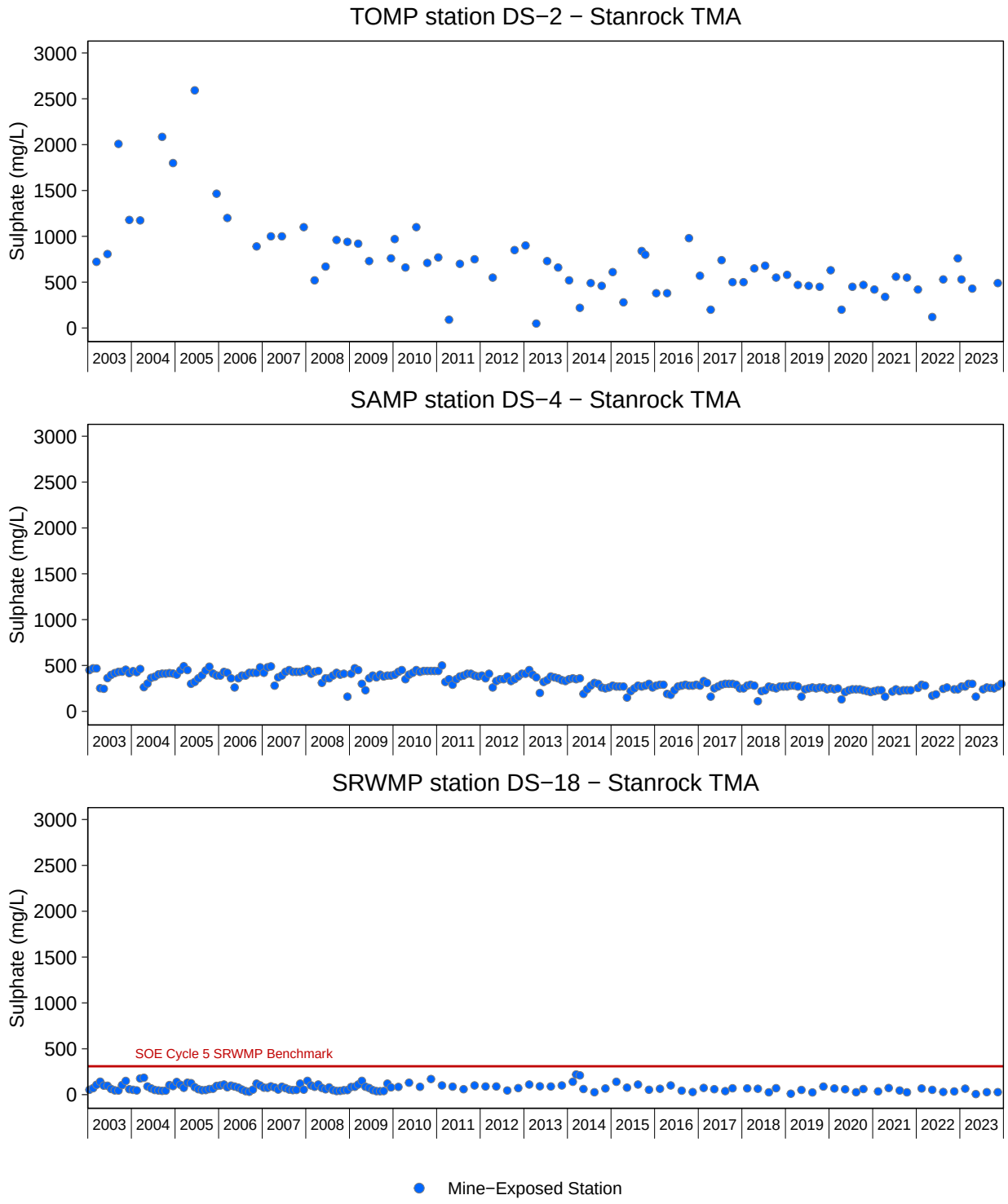


Figure C.44: Concentrations of Sulphate for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanrock TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

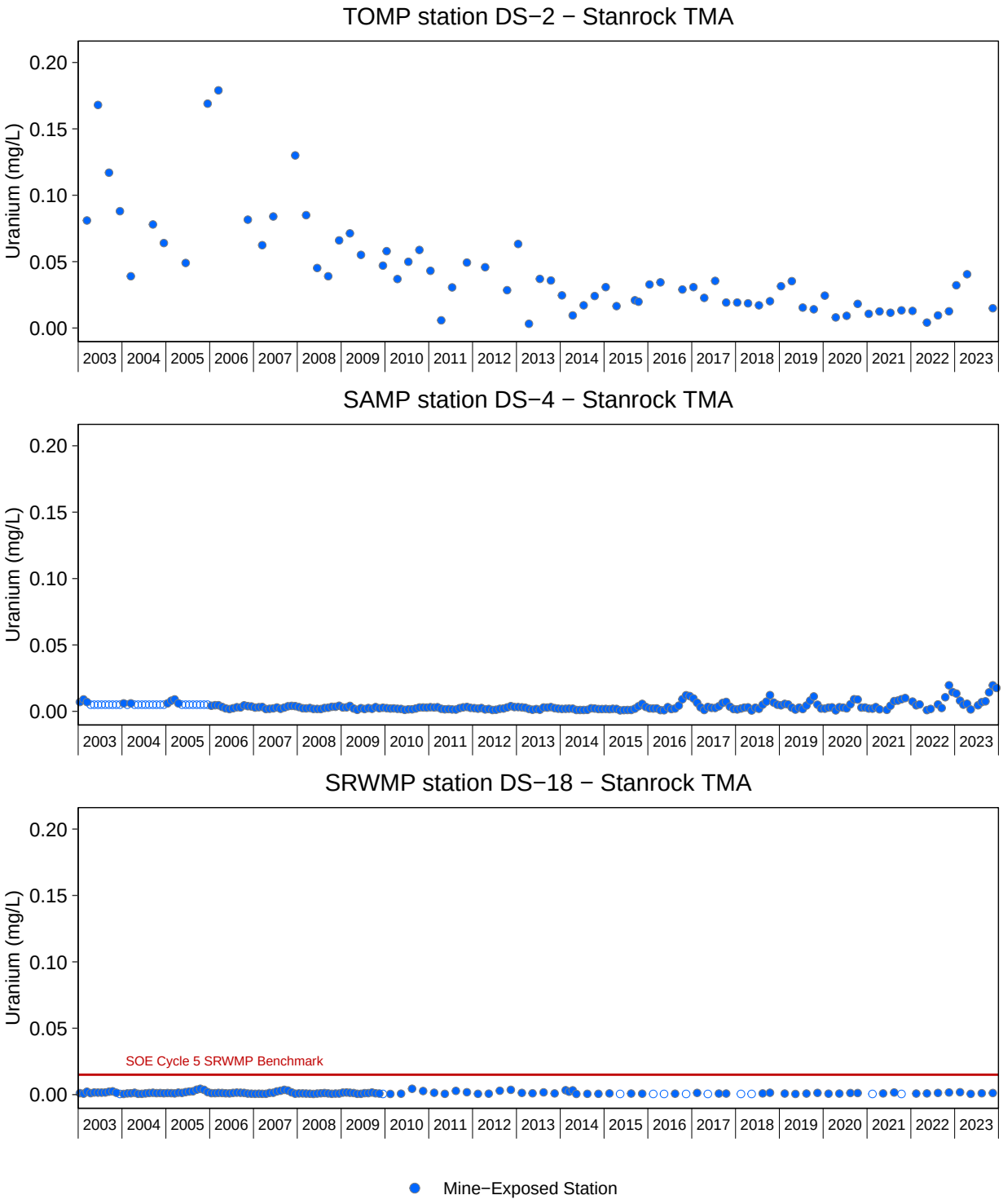


Figure C.45: Concentrations of Uranium for SAMP, TOMP, and SRWMP Water Quality Monitoring Stations at Stanrock TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

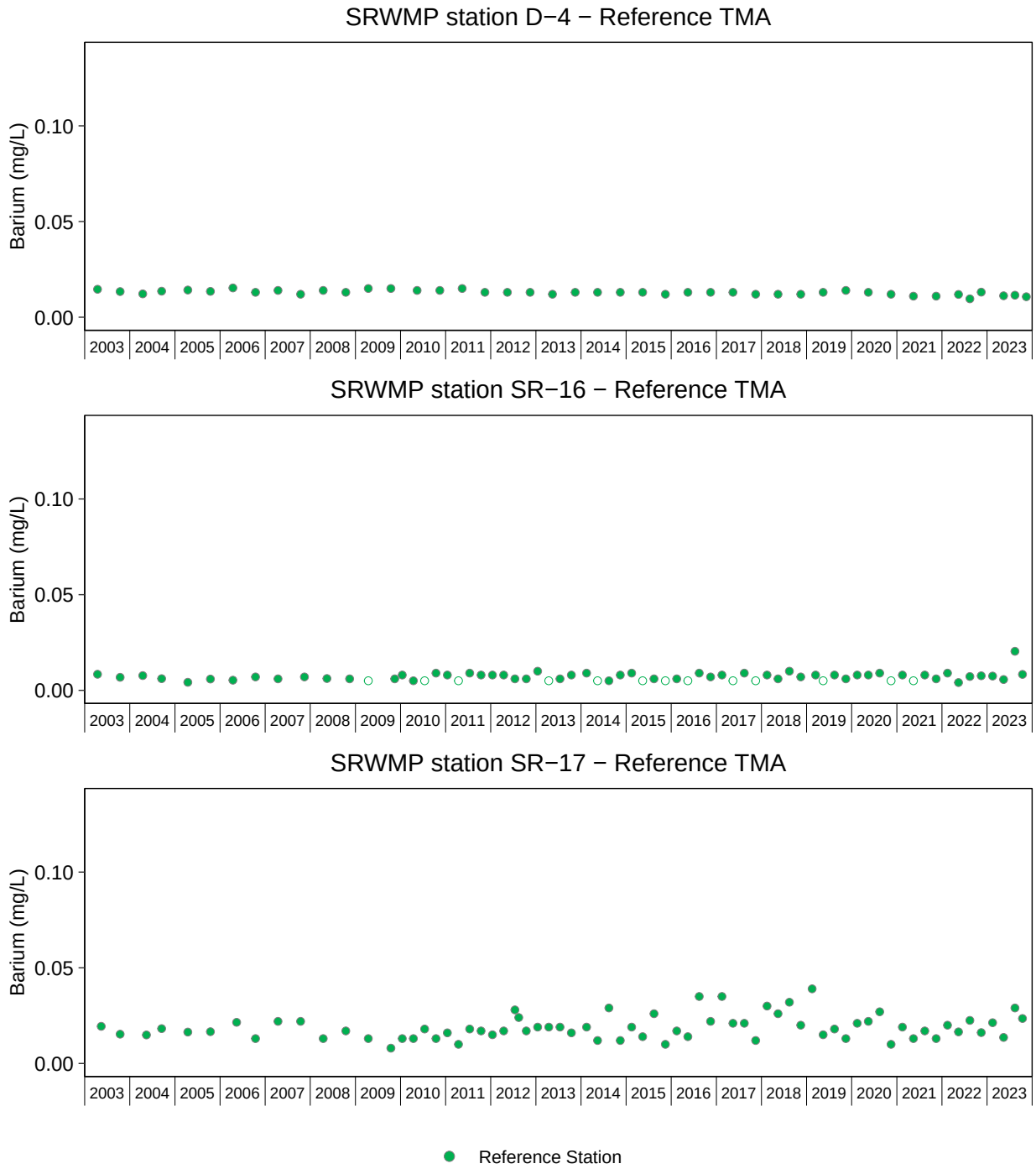


Figure C.47: Concentrations of Barium for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

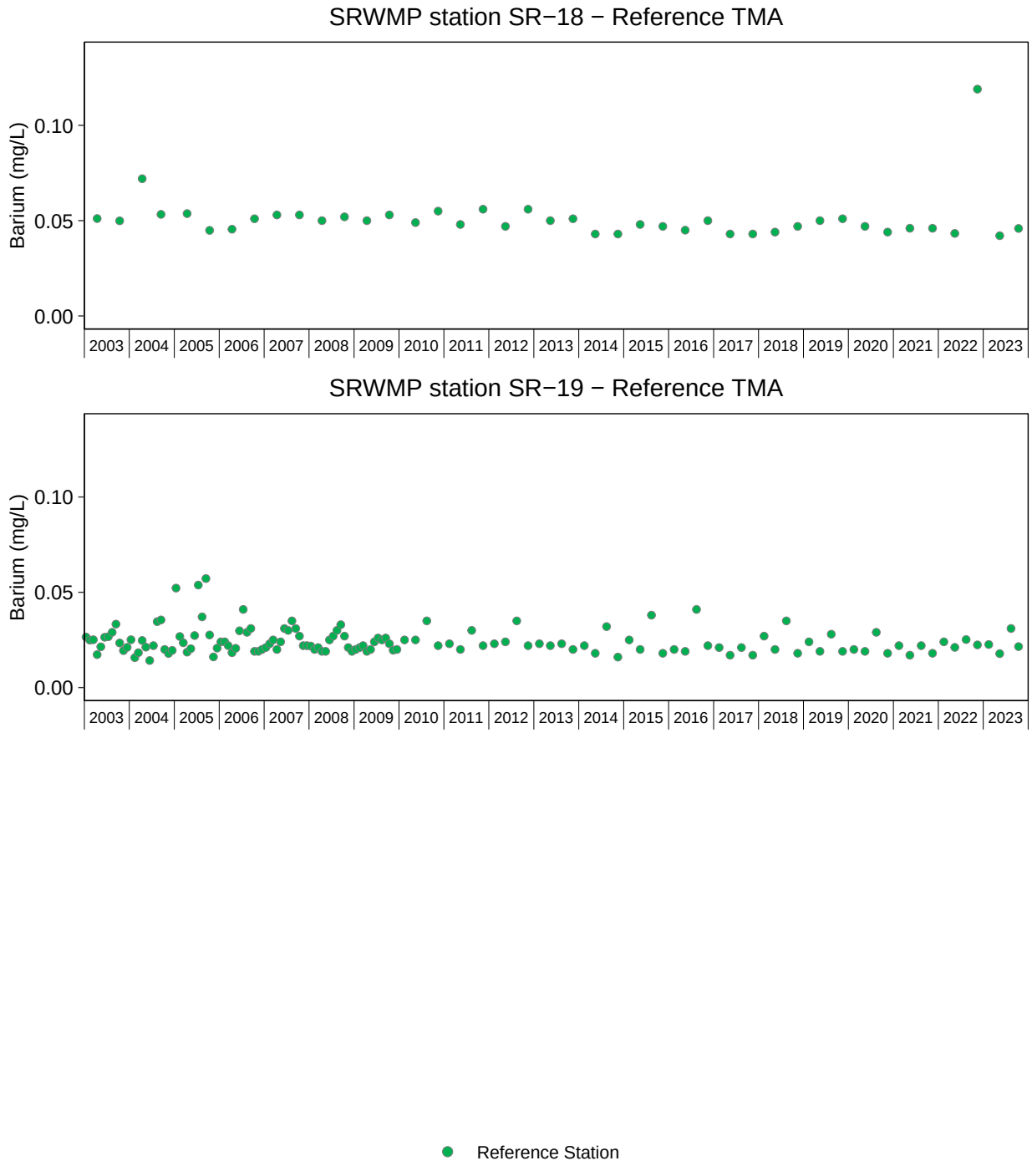


Figure C.47: Concentrations of Barium for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

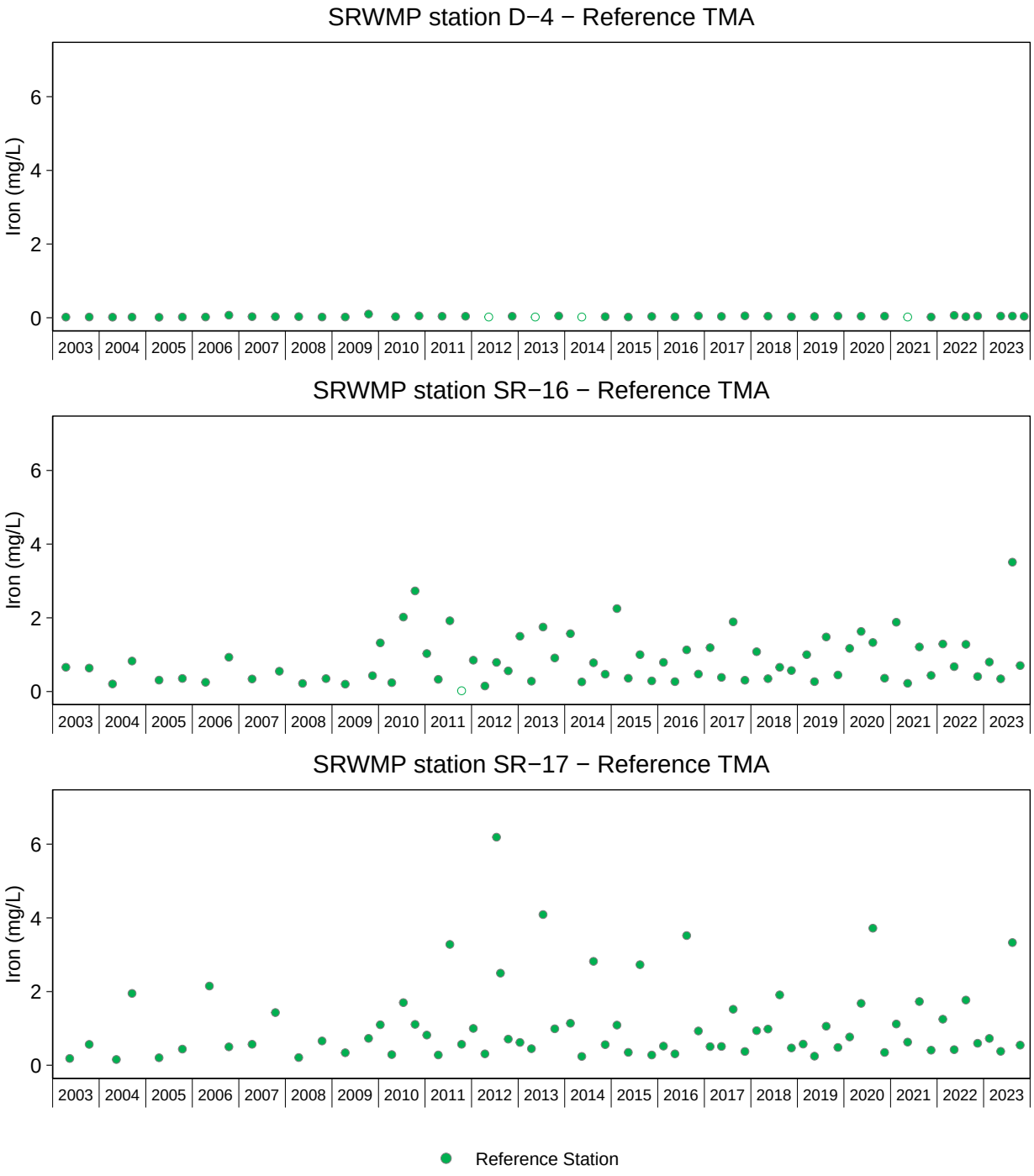


Figure C.49: Concentrations of Iron for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

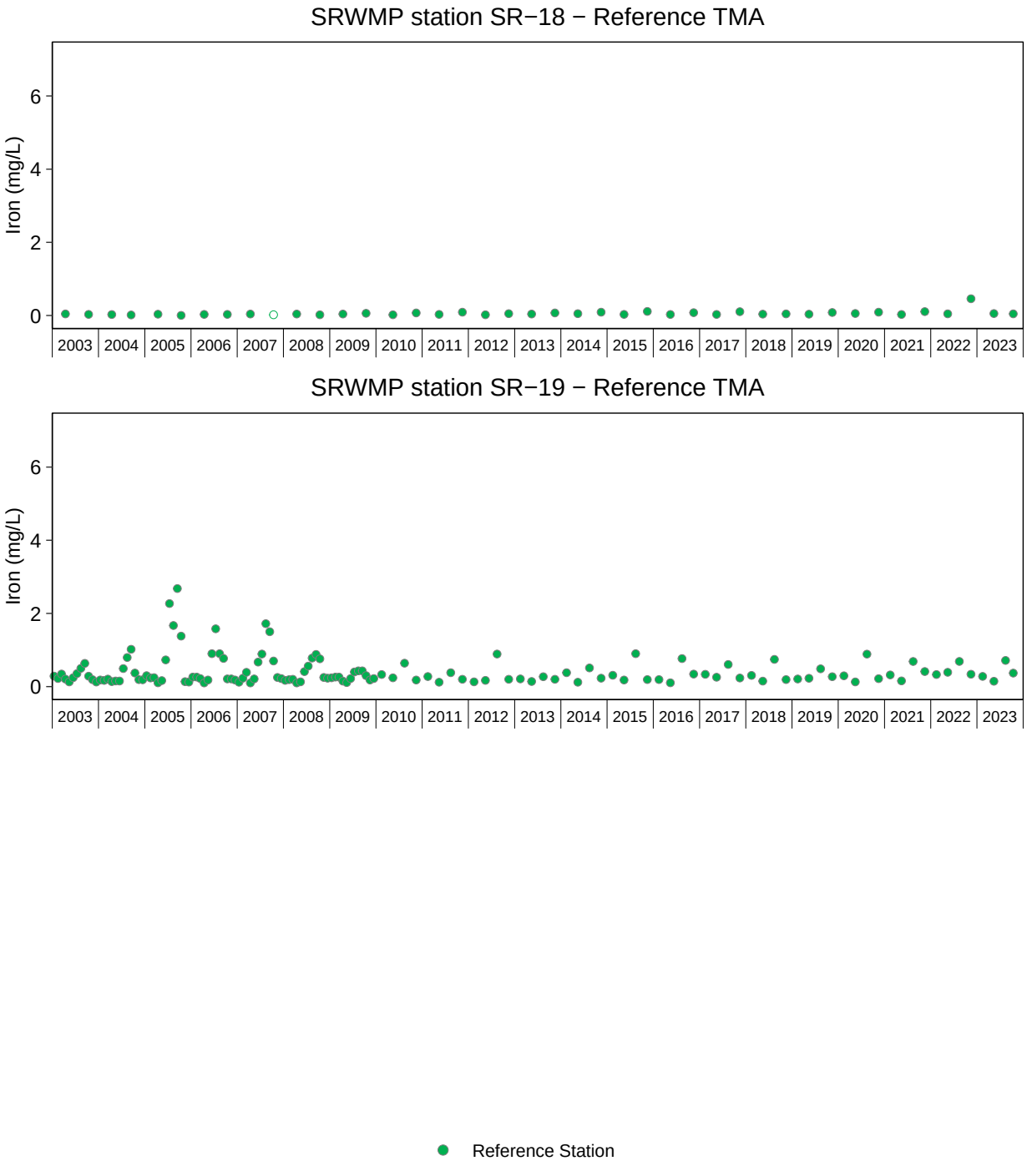


Figure C.49: Concentrations of Iron for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

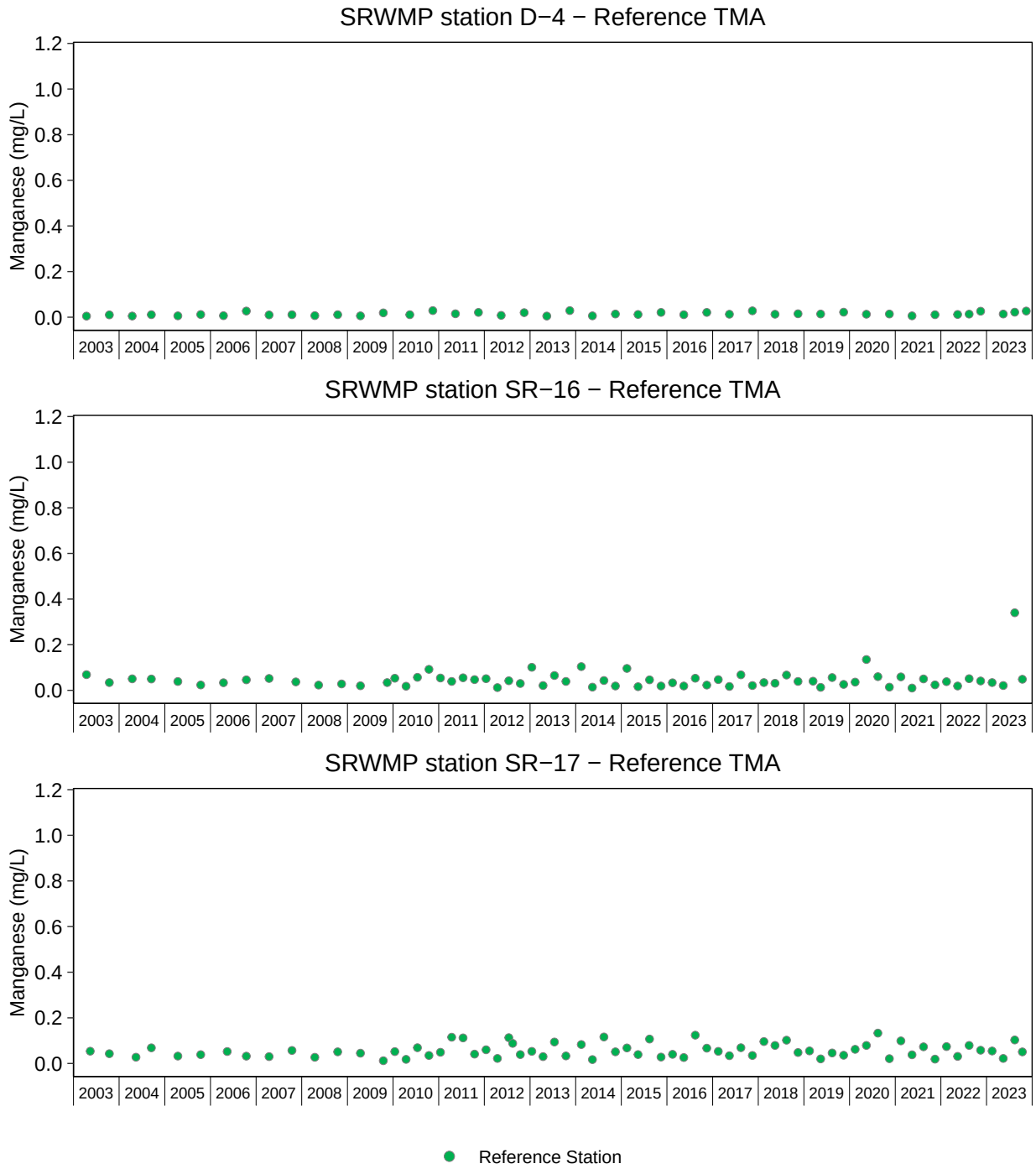


Figure C.50: Concentrations of Manganese for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

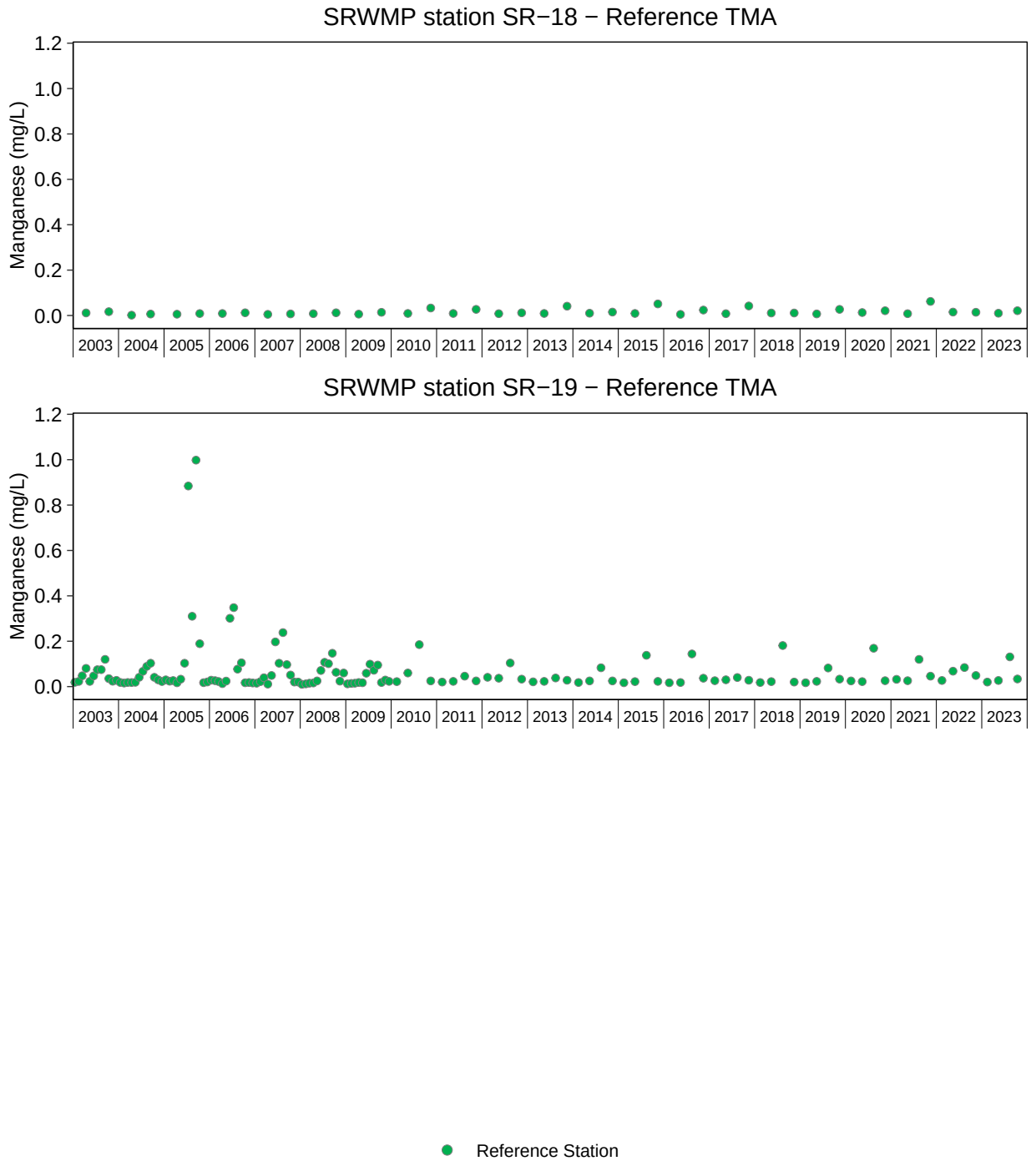


Figure C.50: Concentrations of Manganese for SAMP and TOMP Water Quality Monitoring Stations at Reference TMA, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

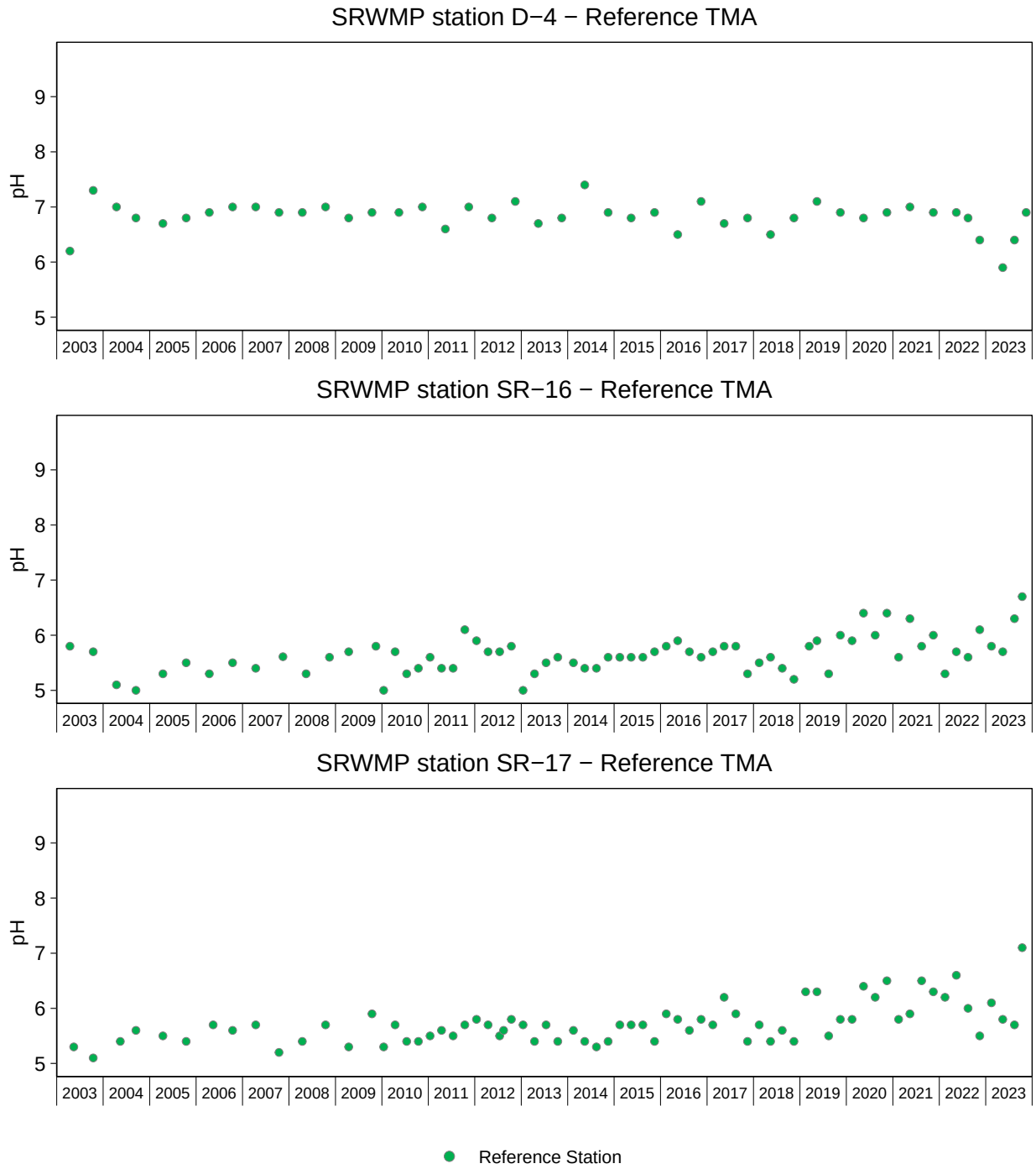


Figure C.51: Levels of pH for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

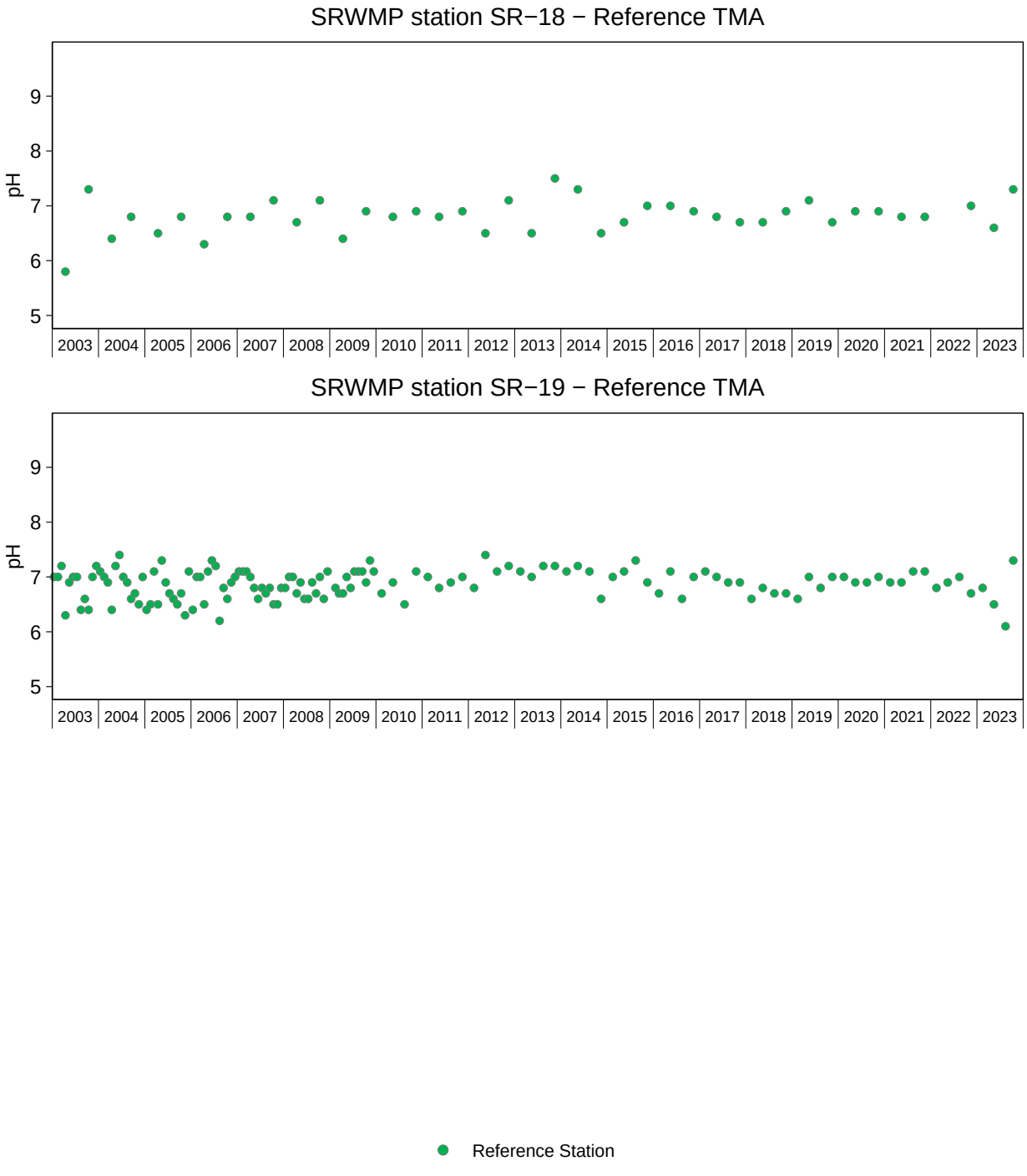


Figure C.51: Levels of pH for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

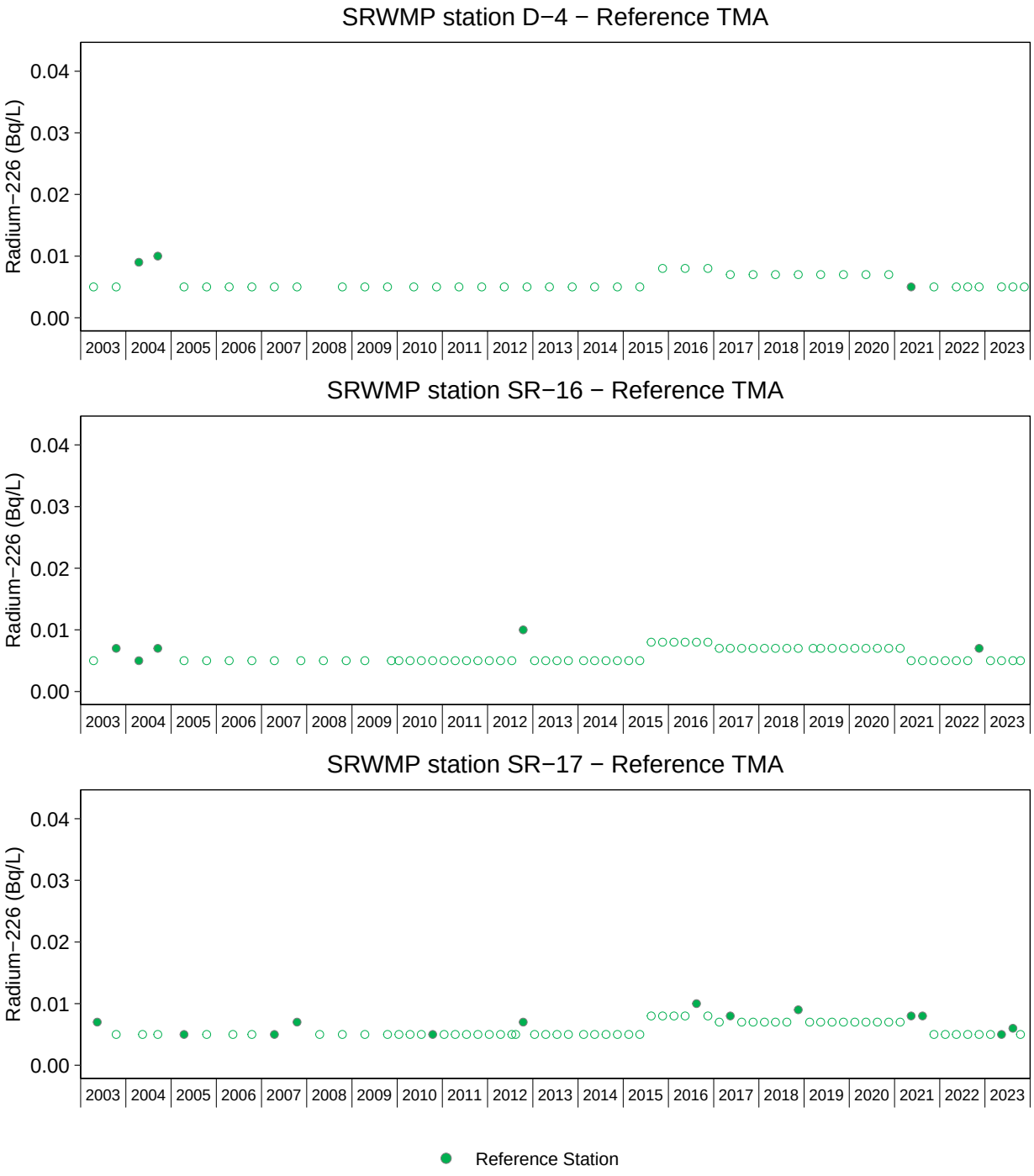


Figure C.52: Concentrations of Radium for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

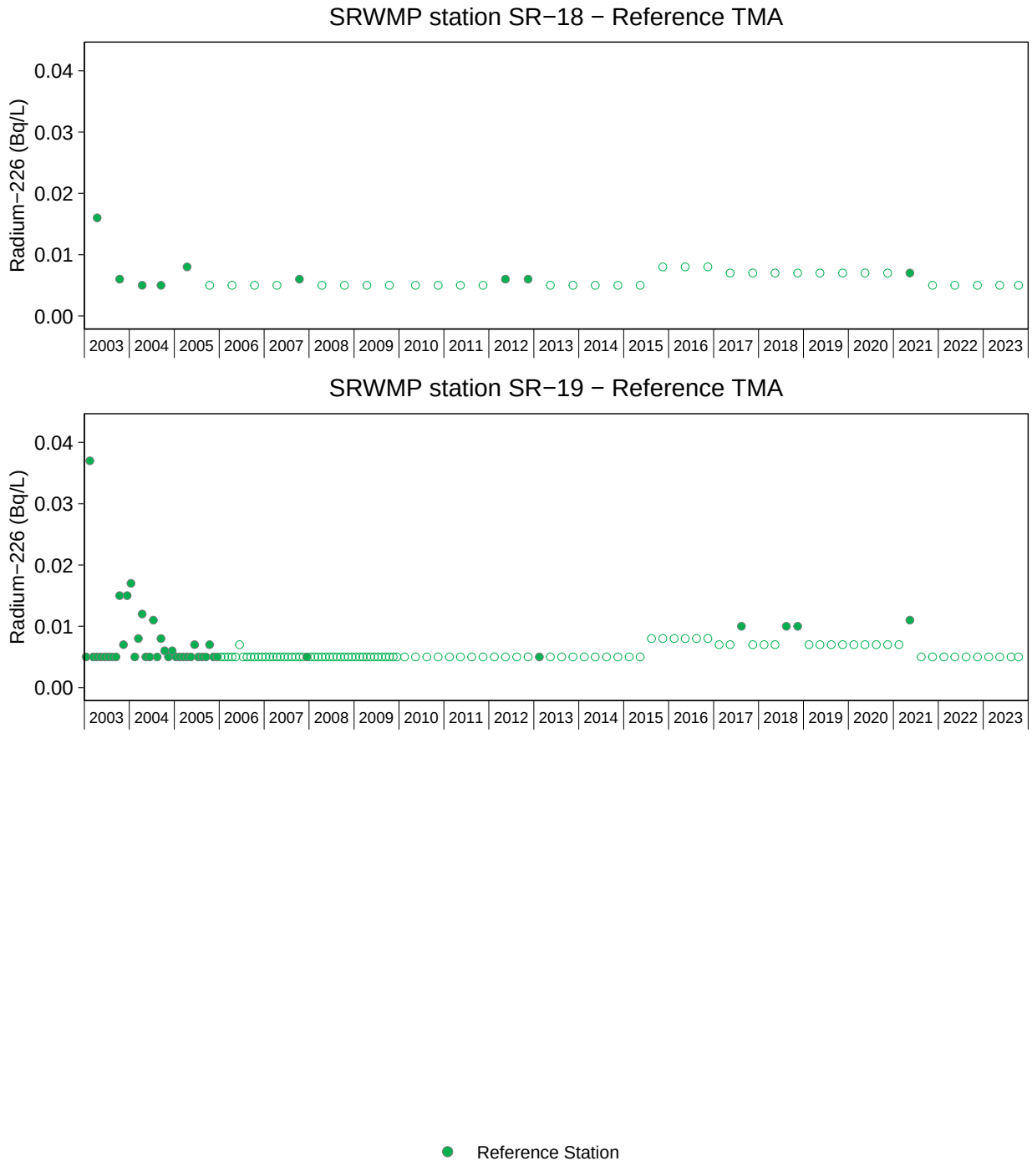


Figure C.52: Concentrations of Radium for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

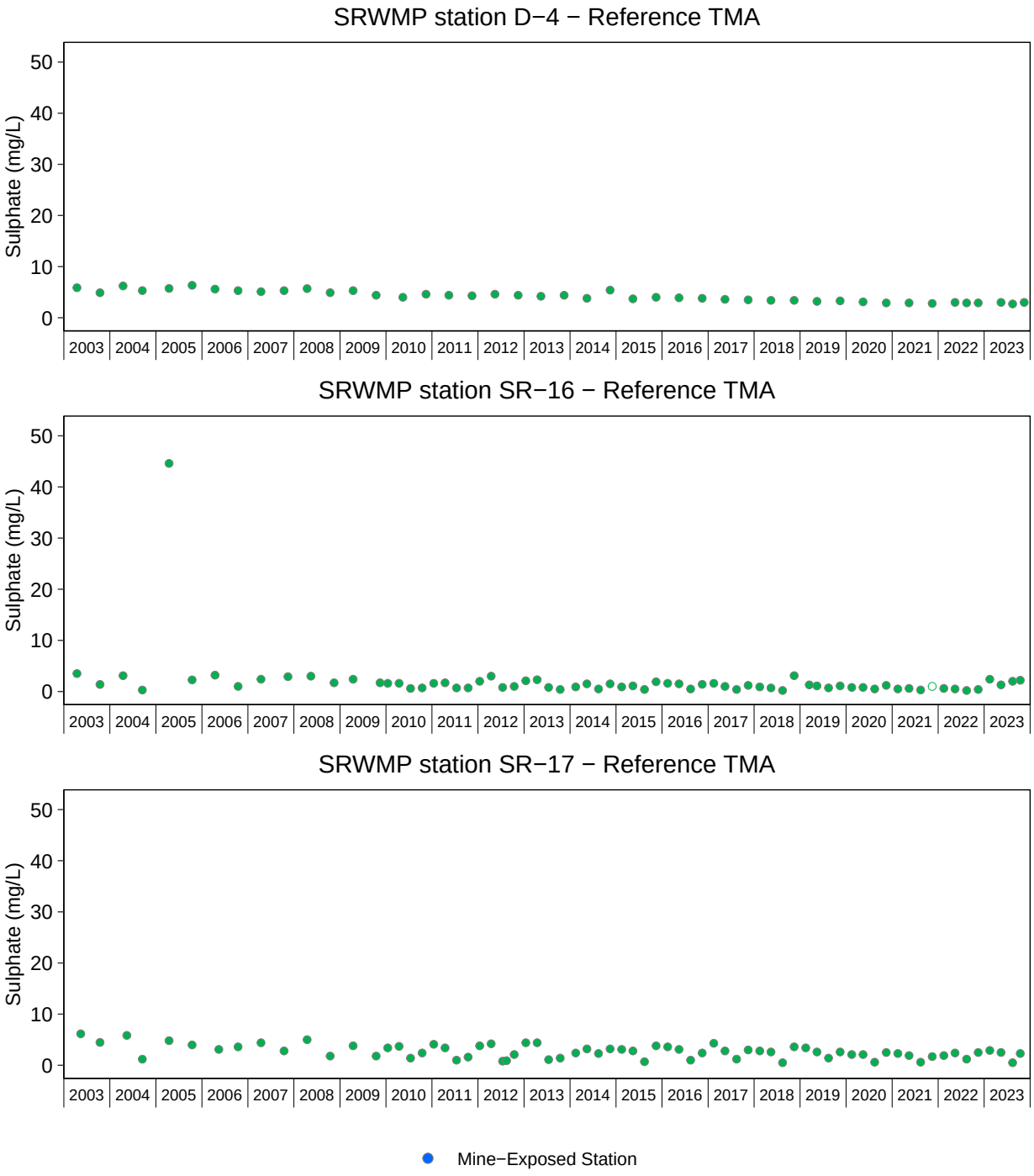


Figure C.53: Concentrations of Sulphate for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.
Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

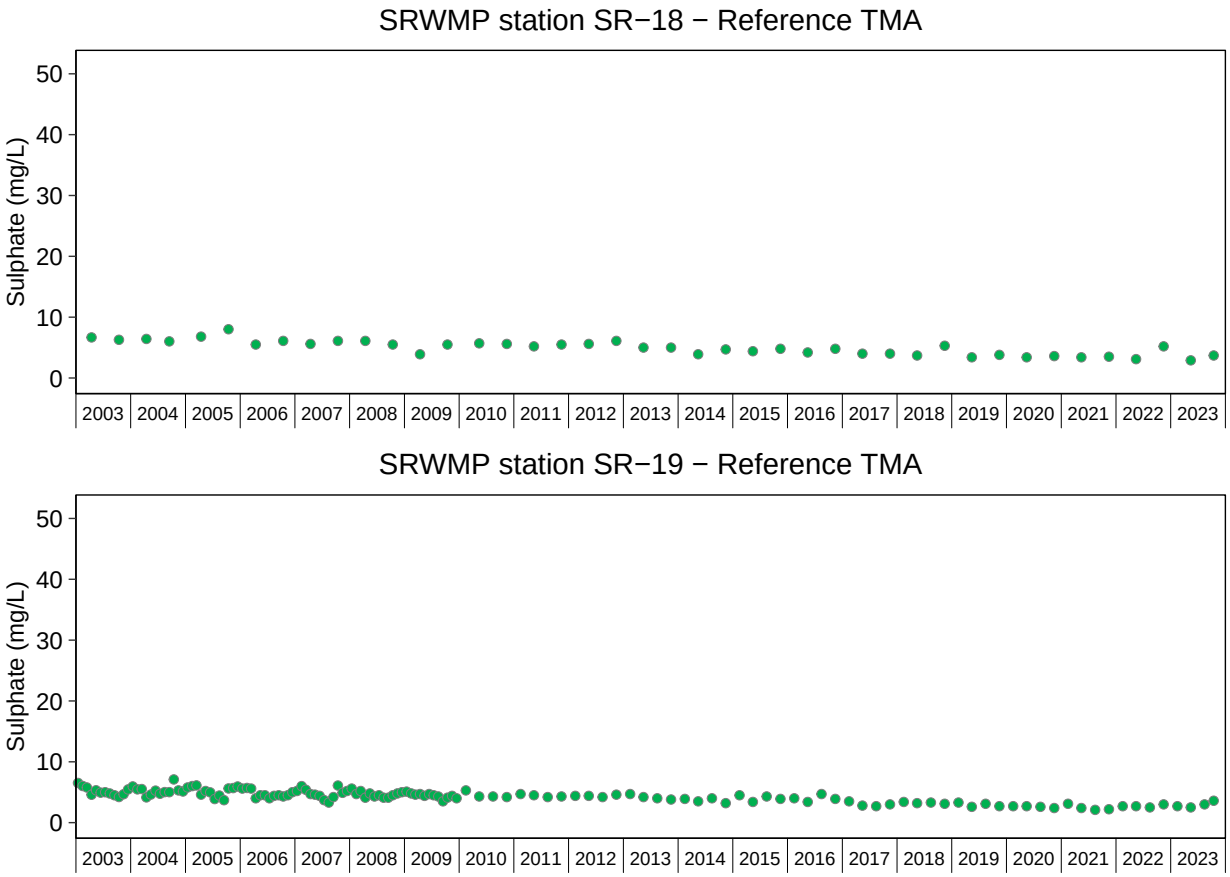


Figure C.53: Concentrations of Sulphate for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.
Sulphate Benchmark was calculated for each sample collected from 2020 to 2023 based on water hardness; the maximum value for the sulphate benchmark is shown above.

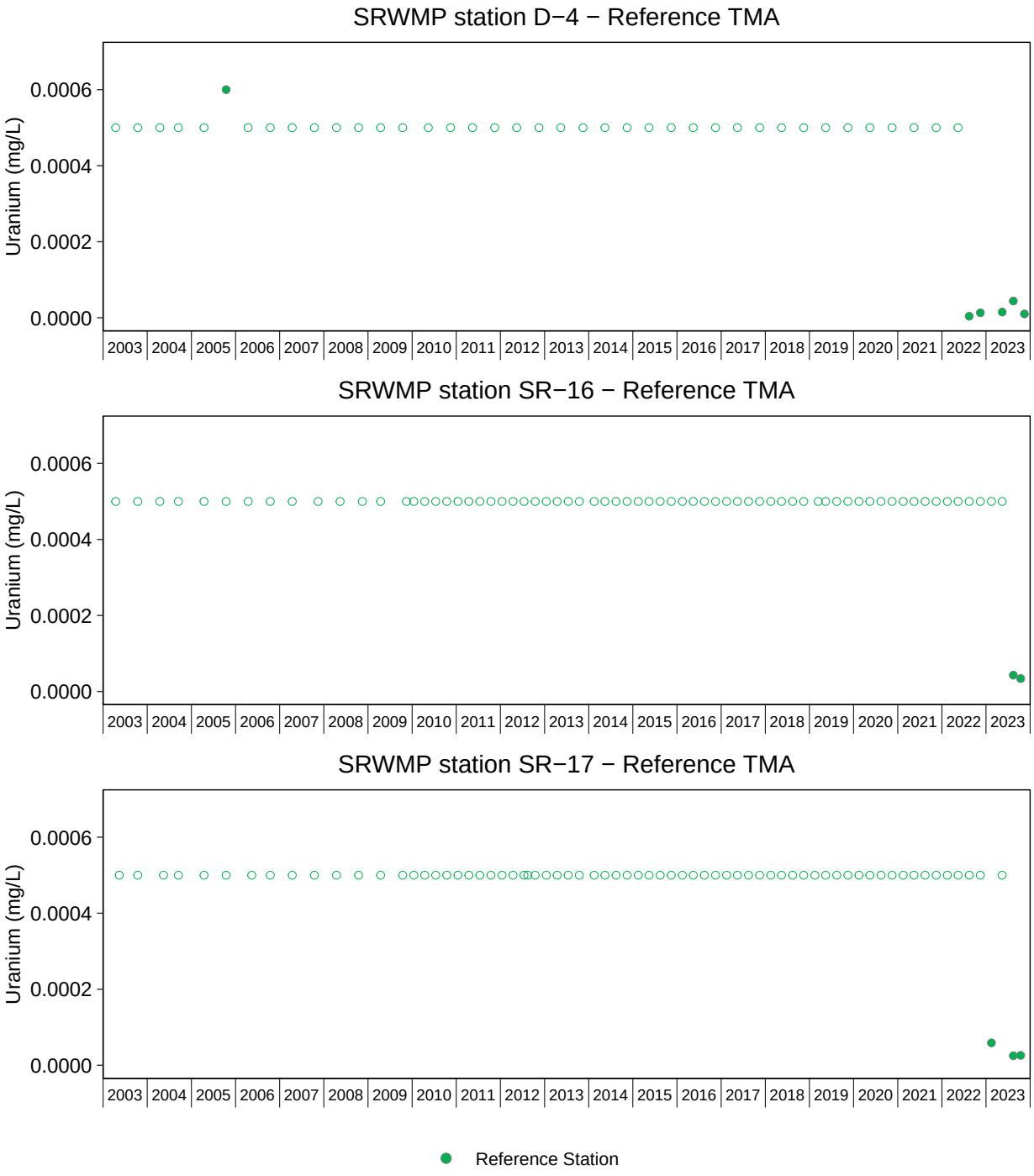


Figure C.54: Concentrations of Uranium for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

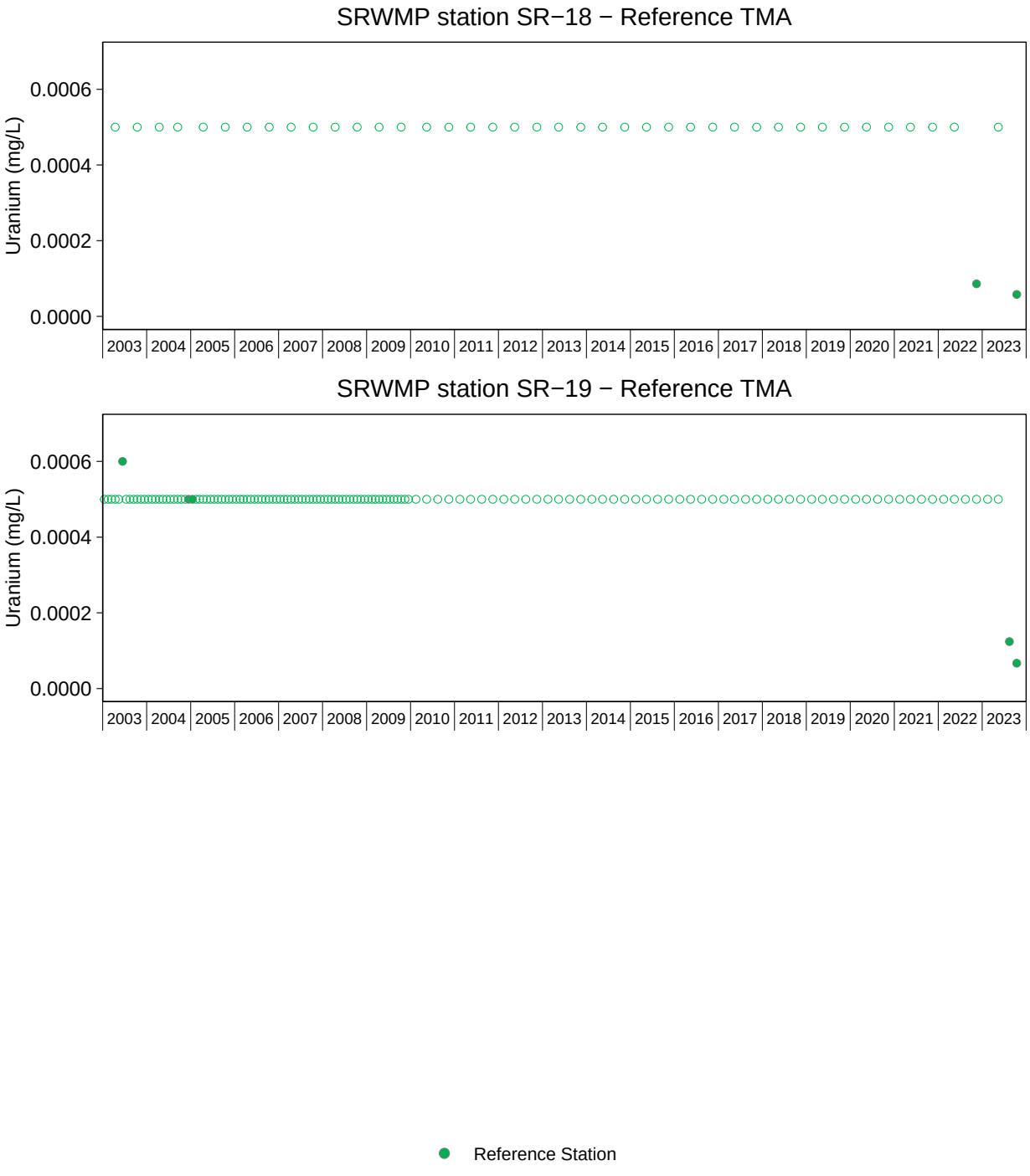


Figure C.54: Concentrations of Uranium for Reference SRWMP Water Quality Monitoring Stations, 2003 to 2023

Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

Table C.1: Water Quality at TOMP Station D-1 (Primary Basin Performance - ETP Operations), Denison TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Acidity (mg/L as CaCO3)	Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
14-Jan-20	7.20	-	-	-	-	-	-	-	-	-
15-Jan-20	-	-	1.76	-	-	-	-	-	-	-
20-Jan-20	-	70.0	-	<1	-	-	-	-	-	-
21-Jan-20	-	-	-	-	-	0.0730	<0.0005	0.0450	0.00400	0.0117
11-Feb-20	7.10	-	-	-	-	-	-	-	-	-
19-Feb-20	-	-	1.68	-	-	-	-	-	-	-
20-Feb-20	-	67.0	-	-	-	-	-	-	-	-
10-Mar-20	7.10	-	-	-	-	-	-	-	-	-
11-Mar-20	-	-	1.79	-	-	-	-	-	-	-
19-Mar-20	-	64.0	-	-	-	-	-	-	-	-
14-Apr-20	7.00	-	-	-	-	-	-	-	-	-
15-Apr-20	-	-	1.72	-	-	-	-	-	-	-
17-Apr-20	-	-	-	-	-	0.0690	<0.0005	0.0500	0.0260	0.00830
21-Apr-20	-	-	-	<1	-	-	-	-	-	-
24-Apr-20	-	56.0	-	-	-	-	-	-	-	-
12-May-20	7.80	-	-	-	-	-	-	-	-	-
21-May-20	-	51.0	-	-	-	-	-	-	-	-
27-May-20	-	-	1.50	-	-	-	-	-	-	-
9-Jun-20	8.60	-	-	-	-	-	-	-	-	-
15-Jun-20	-	-	1.48	-	-	-	-	-	-	-
18-Jun-20	-	57.0	-	-	-	-	-	-	-	-
15-Jul-20	-	-	2.45	-	-	-	-	-	-	-
20-Jul-20	-	-	-	<1	-	-	-	-	-	-
21-Jul-20	-	-	-	-	-	0.183	<0.0005	0.212	0.0790	0.00880
22-Jul-20	-	54.0	-	-	-	-	-	-	-	-
12-Aug-20	-	-	2.06	-	-	-	-	-	-	-
20-Aug-20	-	52.0	-	-	-	-	-	-	-	-
29-Sep-20	7.80	-	-	-	-	-	-	-	-	-
13-Oct-20	7.60	53.0	-	-	<1	0.0700	<0.0005	0.0450	0.0190	0.0101
14-Oct-20	-	-	1.49	-	-	-	-	-	-	-
16-Oct-20	-	-	-	<1	-	-	-	-	-	-
26-Oct-20	-	-	-	-	-	0.0750	<0.0005	0.0440	0.0140	0.00960
30-Oct-20	-	51.0	-	-	-	-	-	-	-	-
10-Nov-20	7.60	-	-	-	-	-	-	-	-	-
13-Nov-20	-	-	1.44	-	-	-	-	-	-	-
25-Nov-20	-	51.0	-	-	-	-	-	-	-	-
8-Dec-20	7.70	-	-	-	-	-	-	-	-	-
9-Dec-20	-	-	1.58	-	-	-	-	-	-	-
14-Dec-20	-	59.0	-	-	-	-	-	-	-	-
18-Dec-20	-	-	1.63	-	-	-	-	-	-	-
12-Jan-21	7.70	-	-	-	-	-	-	-	-	-
13-Jan-21	-	-	1.34	-	-	-	-	-	-	-
19-Jan-21	-	-	-	-	-	0.0680	<0.0005	0.0530	0.0110	0.00870
20-Jan-21	-	-	-	<1	-	-	-	-	-	-
21-Jan-21	-	52.0	-	-	-	-	-	-	-	-
2-Feb-21	7.50	-	-	-	-	-	-	-	-	-
3-Feb-21	-	-	1.67	-	-	-	-	-	-	-
18-Feb-21	-	58.0	-	-	-	-	-	-	-	-
9-Mar-21	7.50	-	-	-	-	-	-	-	-	-
12-Mar-21	-	-	1.89	-	-	-	-	-	-	-
29-Mar-21	-	59.0	-	-	-	-	-	-	-	-
13-Apr-21	7.80	-	-	-	-	-	-	-	-	-
14-Apr-21	-	-	1.46	-	-	-	-	-	-	-
16-Apr-21	-	-	-	<1	-	-	-	-	-	-
20-Apr-21	-	-	-	-	-	0.0610	<0.0005	0.0500	0.0110	0.00970
21-Apr-21	-	48.0	-	-	-	-	-	-	-	-
25-May-21	7.90	-	-	-	-	-	-	-	-	-
1-Jun-21	-	53.0	-	-	-	-	-	-	-	-
8-Jun-21	8.00	-	1.19	-	-	-	-	-	-	-
17-Jun-21	-	53.0	-	-	-	-	-	-	-	-
29-Jun-21	-	-	1.03	-	-	-	-	-	-	-
13-Jul-21	7.90	-	-	-	-	-	-	-	-	-
21-Jul-21	-	53.0	-	-	-	-	-	-	-	-
22-Jul-21	-	-	1.38	-	-	-	-	-	-	-
10-Aug-21	7.20	-	-	-	-	-	-	-	-	-
18-Aug-21	-	-	-	-	-	0.166	<0.0005	0.100	0.0430	0.00430
20-Aug-21	-	-	-	<1	-	-	-	-	-	-
27-Aug-21	-	-	1.06	-	-	-	-	-	-	-
3-Sep-21	-	48.0	-	-	-	-	-	-	-	-
14-Sep-21	7.20	-	-	-	-	-	-	-	-	-
21-Sep-21	-	47.0	-	-	-	-	-	-	-	-
12-Oct-21	7.30	-	-	-	-	-	-	-	-	-
18-Oct-21	-	47.0	-	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected, or SD was incalculable because there was no variability in the data.

Table C.1: Water Quality at TOMP Station D-1 (Primary Basin Performance - ETP Operations), Denison TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Acidity (mg/L as CaCO3)	Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
19-Nov-21	-	-	-	<1	-	-	-	-	-	-
23-Nov-21	-	-	-	-	-	0.107	<0.0005	0.0830	0.0230	0.00740
25-Nov-21	-	50.0	-	-	-	-	-	-	-	-
21-Dec-21	-	58.0	-	-	-	-	-	-	-	-
22-Dec-21	-	-	2.04	-	-	-	-	-	-	-
29-Dec-21	-	-	1.73	-	-	-	-	-	-	-
11-Jan-22	7.40	-	-	-	-	-	-	-	-	-
18-Jan-22	-	56.0	2.52	-	-	-	-	-	-	-
8-Feb-22	7.20	-	-	-	-	-	-	-	-	-
11-Feb-22	-	-	2.00	-	-	-	-	-	-	-
15-Feb-22	-	61.0	-	-	-	-	-	-	-	-
8-Mar-22	7.20	-	-	-	-	-	-	-	-	-
15-Mar-22	-	63.0	-	-	-	-	-	-	-	-
16-Mar-22	-	-	1.51	-	-	0.0880	<0.0005	0.0230	0.0230	0.0109
12-Apr-22	7.20	-	-	-	-	-	-	-	-	-
18-Apr-22	-	-	0.889	-	-	-	-	-	-	-
4-May-22	-	17.0	-	-	<1	0.0340	<0.0005	0.168	0.0320	0.00430
17-May-22	7.90	-	-	-	-	-	-	-	-	-
2-Jun-22	-	-	1.84	-	-	-	-	-	-	-
14-Jun-22	7.70	-	-	-	-	-	-	-	-	-
20-Jun-22	-	-	1.70	-	-	-	-	-	-	-
30-Jun-22	-	48.0	-	-	-	-	-	-	-	-
12-Jul-22	8.40	-	-	-	-	-	-	-	-	-
14-Jul-22	-	-	-	<1	-	-	-	-	-	-
18-Jul-22	-	-	-	-	-	0.0675	<0.0005	0.0670	0.0360	0.00790
19-Jul-22	-	49.0	-	-	-	-	-	-	-	-
9-Aug-22	8.50	-	-	-	-	-	-	-	-	-
12-Aug-22	-	-	1.64	-	-	-	-	-	-	-
19-Aug-22	-	-	1.68	-	-	-	-	-	-	-
22-Aug-22	-	53.0	-	-	-	-	-	-	-	-
13-Sep-22	8.00	-	-	-	-	-	-	-	-	-
22-Sep-22	-	-	2.32	-	-	-	-	-	-	-
27-Sep-22	-	240	-	-	-	-	-	-	-	-
11-Oct-22	7.40	-	-	-	-	-	-	-	-	-
18-Oct-22	-	-	2.07	-	-	-	-	-	-	-
8-Nov-22	7.50	-	-	-	-	-	-	-	-	-
16-Nov-22	-	57.0	1.85	-	-	-	-	-	-	-
7-Dec-22	-	49.0	-	-	-	-	-	-	-	-
13-Dec-22	7.70	-	-	-	-	-	-	-	-	-
16-Dec-22	-	-	1.74	-	-	-	-	-	-	-
19-Dec-22	-	-	-	<1	-	0.115	<0.0005	0.0930	0.0230	0.0106
30-Dec-22	-	57.0	-	-	-	-	-	-	-	-
10-Jan-23	7.20	-	-	-	-	-	-	-	-	-
17-Jan-23	-	59.0	-	-	-	-	-	-	-	-
19-Jan-23	-	-	1.59	-	-	-	-	-	-	-
23-Jan-23	7.10	-	-	-	-	-	-	-	-	-
26-Jan-23	-	-	2.08	-	-	-	-	-	-	-
27-Jan-23	-	-	2.08	-	-	0.0893	<0.0005	0.0280	0.00547	0.0121
31-Jan-23	7.00	-	-	-	-	-	-	-	-	-
2-Feb-23	-	58.0	-	-	-	-	-	-	-	-
7-Feb-23	7.00	-	-	-	-	-	-	-	-	-
13-Feb-23	-	-	2.03	-	-	-	-	-	-	-
14-Feb-23	7.10	-	-	-	-	-	-	-	-	-
19-Feb-23	-	-	-	-	-	0.0799	<0.0005	0.0210	0.00340	0.0107
21-Feb-23	7.20	62.0	-	-	-	-	-	-	-	-
28-Feb-23	-	-	1.56	-	-	-	-	-	-	-
1-Mar-23	-	59.0	-	-	-	0.0846	<0.0005	0.0220	0.00400	0.0117
21-Mar-23	7.10	-	-	-	-	-	-	-	-	-
24-Mar-23	-	-	2.30	-	-	-	-	-	-	-
29-Mar-23	-	78.0	-	-	-	-	-	-	-	-
5-Apr-23	-	56.0	2.18	-	<1	0.0750	<0.0005	0.0860	0.00873	0.0114
11-Apr-23	7.10	-	-	-	-	-	-	-	-	-
14-Apr-23	-	-	1.62	-	-	-	-	-	-	-
18-Apr-23	-	-	-	-	-	0.0744	<0.0005	0.109	0.0226	0.0139
21-Apr-23	-	-	-	<1	-	-	-	-	-	-
25-Apr-23	-	60.0	-	-	-	-	-	-	-	-
9-May-23	7.80	-	-	-	-	-	-	-	-	-
16-May-23	-	51.0	1.48	-	-	-	-	-	-	-
13-Jun-23	7.70	-	-	-	-	-	-	-	-	-
16-Jun-23	-	-	1.43	-	-	-	-	-	-	-
28-Jun-23	-	65.0	-	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected, or SD was incalculable because there was no variability in the data.

Table C.1: Water Quality at TOMP Station D-1 (Primary Basin Performance - ETP Operations), Denison TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Acidity (mg/L as CaCO3)	Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
11-Jul-23	8.30	-	-	-	-	-	-	-	-	-
17-Jul-23	-	-	1.58	-	-	-	-	-	-	-
18-Jul-23	-	53.0	-	-	-	-	-	-	-	-
19-Jul-23	-	-	-	<1	-	0.0821	<0.0005	0.117	0.0374	0.0101
8-Aug-23	7.70	-	-	-	-	-	-	-	-	-
11-Aug-23	-	-	1.58	-	-	-	-	-	-	-
17-Aug-23	-	54.0	-	-	-	-	-	-	-	-
31-Oct-23	-	-	1.10	-	-	-	-	-	-	-
9-Nov-23	-	58.0	-	-	-	-	-	-	-	-
5-Dec-23	7.80	67.0	1.62	-	-	-	-	-	-	-
19-Dec-23	7.49	28.0	-	-	<1	0.0787	0.000106	0.0370	0.00845	0.00959
22-Dec-23	-	-	1.94	-	-	-	-	-	-	-
n	46	51	51	12	4	21	21	21	21	21
Minimum	7.00	17.0	0.889	<1	<1	0.0340	0.000106	0.0210	0.00340	0.00430
Maximum	8.60	240	2.53	<1	<1	0.183	0.000106	0.212	0.0790	0.0139
Mean	7.55	58.5	1.71	<1	<1	0.0873	0.000106	0.0715	0.0211	0.00978
Median	7.50	56.0	1.67	<1	<1	0.0787	0.000106	0.0500	0.0190	0.0101
SD	0.415	27.5	0.369	-	-	0.0334	-	0.0493	0.0178	0.00248
10th Percentile	7.10	48.0	1.34	<1	<1	0.0675	0.000106	0.0230	0.00400	0.00740
95th Percentile	8.40	70.0	2.45	<1	<1	0.166	0.000106	0.168	0.0430	0.0135

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected, or SD was incalculable because there was no variability in the data.

Table C.2: Water Quality at SAMP Station D-2 (Stollery Lake Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
9-Jan-20	7.00	-	-	-	-	-	-	-
10-Jan-20	-	-	0.220	-	-	-	-	-
14-Jan-20	7.10	-	-	-	-	-	-	-
15-Jan-20	-	-	0.209	0.689	-	-	-	-
20-Jan-20	-	130	-	-	-	-	-	-
21-Jan-20	7.10	-	-	0.704	0.000500	0.470	0.138	0.0200
22-Jan-20	-	-	0.217	-	-	-	-	-
27-Jan-20	-	-	-	0.551	-	-	-	-
28-Jan-20	6.90	-	-	-	-	-	-	-
29-Jan-20	-	-	0.230	-	-	-	-	-
3-Feb-20	-	-	-	0.751	-	-	-	-
4-Feb-20	7.00	-	-	-	-	-	-	-
10-Feb-20	-	-	-	0.711	-	-	-	-
11-Feb-20	7.00	-	-	-	-	-	-	-
12-Feb-20	-	-	0.272	-	-	-	-	-
18-Feb-20	6.70	-	-	-	-	-	-	-
19-Feb-20	-	-	0.209	0.740	<0.0005	0.332	-	0.0150
20-Feb-20	-	97.0	-	-	-	-	-	-
24-Feb-20	-	-	-	0.704	-	-	0.103	-
25-Feb-20	6.70	-	-	-	-	-	-	-
26-Feb-20	-	-	0.254	-	-	-	-	-
3-Mar-20	6.90	-	-	0.774	-	-	-	-
4-Mar-20	-	-	0.204	-	-	-	-	-
9-Mar-20	-	-	-	0.678	-	-	-	-
10-Mar-20	7.00	-	-	-	-	-	-	-
11-Mar-20	-	-	0.253	-	-	-	-	-
16-Mar-20	-	-	-	0.686	<0.0005	0.464	0.108	0.0161
17-Mar-20	7.00	-	-	-	-	-	-	-
18-Mar-20	-	-	0.279	-	-	-	-	-
19-Mar-20	-	110	-	-	-	-	-	-
24-Mar-20	7.10	-	-	-	-	-	-	-
25-Mar-20	-	-	0.290	-	-	-	-	-
30-Mar-20	-	-	-	0.777	-	-	-	-
31-Mar-20	6.70	-	-	-	-	-	-	-
1-Apr-20	-	-	0.292	-	-	-	-	-
6-Apr-20	-	-	-	0.809	-	-	-	-
7-Apr-20	7.00	-	-	-	-	-	-	-
8-Apr-20	-	-	0.324	-	-	-	-	-
14-Apr-20	6.80	-	-	-	-	-	-	-
15-Apr-20	-	-	0.250	1.05	-	-	-	-
16-Apr-20	-	-	-	1.04	-	-	-	-
17-Apr-20	-	-	-	1.13	<0.0005	0.444	0.118	0.0105
21-Apr-20	7.00	-	-	-	-	-	-	-
22-Apr-20	-	-	0.286	-	-	-	-	-
24-Apr-20	-	89.0	-	0.965	-	-	-	-
28-Apr-20	7.20	-	-	-	-	-	-	-
29-Apr-20	-	-	0.205	-	-	-	-	-
30-Apr-20	-	-	-	0.797	-	-	-	-
5-May-20	6.90	-	-	-	-	-	-	-
6-May-20	-	-	0.152	-	-	-	-	-
8-May-20	-	-	-	0.528	-	-	-	-
12-May-20	7.30	-	-	-	-	-	-	-
13-May-20	-	-	0.155	-	-	-	-	-
19-May-20	7.10	-	-	0.419	0.000600	0.278	0.296	0.0277
21-May-20	-	170	-	-	-	-	-	-
25-May-20	-	-	-	0.473	-	-	-	-
26-May-20	7.00	-	-	-	-	-	-	-
27-May-20	-	-	0.147	-	-	-	-	-
2-Jun-20	7.50	-	-	0.542	-	-	-	-
5-Jun-20	-	-	-	0.505	-	-	-	-
9-Jun-20	7.70	-	-	-	-	-	-	-
12-Jun-20	-	-	-	0.496	<0.0005	0.178	0.183	0.0228
16-Jun-20	7.50	-	-	-	-	-	-	-
17-Jun-20	-	-	0.0970	-	-	-	-	-
18-Jun-20	-	140	-	-	-	-	-	-
19-Jun-20	-	-	-	0.322	-	-	-	-
23-Jun-20	7.30	-	0.157	-	-	-	-	-
24-Jun-20	-	-	0.0790	-	-	-	-	-
29-Jun-20	7.40	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.2: Water Quality at SAMP Station D-2 (Stollery Lake Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
30-Jun-20	-	-	0.0910	0.268	-	-	-	-
6-Jul-20	-	-	-	0.262	-	-	-	-
7-Jul-20	7.30	-	-	-	-	-	-	-
8-Jul-20	-	-	0.0530	-	-	-	-	-
14-Jul-20	7.40	-	-	0.266	-	-	-	-
15-Jul-20	-	-	0.0720	-	-	-	-	-
21-Jul-20	7.20	-	-	0.264	<0.0005	0.140	0.130	0.0293
22-Jul-20	-	180	0.0450	-	-	-	-	-
28-Jul-20	7.00	-	-	0.187	-	-	-	-
29-Jul-20	-	-	0.0420	-	-	-	-	-
4-Aug-20	7.00	-	-	-	-	-	-	-
5-Aug-20	-	-	0.0340	0.181	-	-	-	-
11-Aug-20	7.40	-	-	-	-	-	-	-
12-Aug-20	-	-	0.171	-	-	-	-	-
18-Aug-20	7.30	-	-	0.142	<0.0005	0.0890	0.0670	0.0324
19-Aug-20	-	-	0.0400	-	-	-	-	-
20-Aug-20	-	190	-	-	-	-	-	-
24-Aug-20	-	-	-	0.125	-	-	-	-
25-Aug-20	7.40	-	-	-	-	-	-	-
26-Aug-20	-	-	0.0320	-	-	-	-	-
1-Sep-20	7.40	-	-	-	-	-	-	-
2-Sep-20	-	-	0.0420	-	-	-	-	-
8-Sep-20	7.20	-	-	0.181	-	-	-	-
9-Sep-20	-	-	0.102	-	-	-	-	-
11-Sep-20	-	-	-	0.148	<0.0005	0.174	0.134	0.0370
15-Sep-20	7.30	-	-	-	-	-	-	-
16-Sep-20	-	200	0.0250	-	-	-	-	-
18-Sep-20	-	-	-	0.121	-	-	-	-
21-Sep-20	-	-	-	0.190	-	-	-	-
22-Sep-20	7.20	-	-	-	-	-	-	-
29-Sep-20	7.30	-	-	-	-	-	-	-
6-Oct-20	7.10	-	-	-	-	-	-	-
7-Oct-20	-	-	0.186	-	-	-	-	-
13-Oct-20	7.30	-	-	0.154	-	-	-	-
14-Oct-20	-	-	0.199	-	-	-	-	-
20-Oct-20	7.30	-	-	0.184	-	-	-	-
22-Oct-20	-	-	0.135	0.161	-	-	-	-
23-Oct-20	-	-	0.215	-	-	-	-	-
26-Oct-20	-	-	-	0.269	0.00110	0.328	0.367	0.0430
27-Oct-20	7.30	-	-	-	-	-	-	-
28-Oct-20	-	-	0.252	0.206	-	-	-	-
30-Oct-20	-	210	-	-	-	-	-	-
3-Nov-20	7.40	-	-	0.608	-	-	-	-
4-Nov-20	-	-	0.175	-	-	-	-	-
9-Nov-20	-	-	-	0.506	-	-	-	-
10-Nov-20	7.20	-	-	-	-	-	-	-
11-Nov-20	-	-	0.166	-	-	-	-	-
17-Nov-20	7.20	-	-	0.435	-	-	-	-
18-Nov-20	-	-	0.105	-	-	-	-	-
24-Nov-20	7.40	-	-	0.504	0.000900	0.374	0.246	0.0331
25-Nov-20	-	-	0.176	-	-	-	-	-
30-Nov-20	-	-	-	0.429	-	-	-	-
1-Dec-20	7.40	-	-	-	-	-	-	-
2-Dec-20	-	-	0.142	-	-	-	-	-
7-Dec-20	-	-	-	0.564	-	-	-	-
8-Dec-20	7.20	-	-	-	-	-	-	-
9-Dec-20	-	170	0.194	-	-	-	-	-
14-Dec-20	-	130	-	0.543	0.000500	0.242	0.146	0.0303
15-Dec-20	6.90	-	-	-	-	-	-	-
21-Dec-20	7.40	-	-	-	-	-	-	-
22-Dec-20	-	-	0.114	0.422	-	-	-	-
29-Dec-20	7.10	-	0.128	-	-	-	-	-
30-Dec-20	-	-	-	0.362	-	-	-	-
4-Jan-21	7.00	-	-	-	-	-	-	-
5-Jan-21	-	-	0.128	0.333	-	-	-	-
8-Jan-21	-	-	-	0.382	-	-	-	-
12-Jan-21	7.40	-	-	-	-	-	-	-
13-Jan-21	-	-	0.117	-	-	-	-	-
19-Jan-21	7.40	-	-	0.380	<0.0005	0.325	0.155	0.0240

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.2: Water Quality at SAMP Station D-2 (Stollery Lake Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
20-Jan-21	-	-	0.122	-	-	-	-	-
21-Jan-21	-	140	-	-	-	-	-	-
26-Jan-21	7.30	-	-	0.381	-	-	-	-
27-Jan-21	-	-	0.210	-	-	-	-	-
2-Feb-21	7.40	-	-	-	-	-	-	-
3-Feb-21	-	-	0.281	-	-	-	-	-
9-Feb-21	7.20	-	-	0.514	<0.0005	0.384	0.157	0.0199
10-Feb-21	-	-	0.317	-	-	-	-	-
12-Feb-21	-	-	-	0.617	-	-	-	-
16-Feb-21	7.10	-	-	0.456	-	-	-	-
18-Feb-21	-	130	0.283	-	-	-	-	-
22-Feb-21	-	-	-	0.580	-	-	-	-
23-Feb-21	7.40	-	-	-	-	-	-	-
24-Feb-21	-	-	0.275	-	-	-	-	-
1-Mar-21	-	-	-	0.753	-	-	-	-
2-Mar-21	7.30	-	-	-	-	-	-	-
3-Mar-21	-	-	0.190	-	-	-	-	-
8-Mar-21	-	-	-	0.575	-	-	-	-
9-Mar-21	7.40	-	-	-	-	-	-	-
10-Mar-21	-	-	0.200	-	-	-	-	-
16-Mar-21	7.30	-	-	-	-	-	-	-
17-Mar-21	-	-	0.194	-	-	-	-	-
23-Mar-21	7.10	-	-	-	-	-	-	-
24-Mar-21	-	-	0.224	-	-	-	-	-
29-Mar-21	-	110	-	0.586	<0.0005	0.574	0.142	0.0181
30-Mar-21	7.00	-	-	0.599	-	-	-	-
31-Mar-21	-	-	0.239	-	-	-	-	-
6-Apr-21	7.00	-	-	-	-	-	-	-
7-Apr-21	-	-	0.219	-	-	-	-	-
8-Apr-21	-	-	-	0.677	-	-	-	-
12-Apr-21	-	-	-	0.640	-	-	-	-
13-Apr-21	7.40	-	-	-	-	-	-	-
14-Apr-21	-	-	0.154	-	-	-	-	-
20-Apr-21	7.40	-	-	0.455	0.000500	0.429	0.210	0.0197
21-Apr-21	-	120	0.159	-	-	-	-	-
27-Apr-21	7.10	-	-	-	-	-	-	-
29-Apr-21	-	-	-	0.417	-	-	-	-
4-May-21	7.50	-	-	0.389	-	-	-	-
10-May-21	-	-	-	0.329	-	-	-	-
11-May-21	7.40	-	-	-	-	-	-	-
13-May-21	-	-	0.138	-	-	-	-	-
17-May-21	-	-	0.107	-	-	-	-	-
18-May-21	7.50	-	-	-	-	-	-	-
20-May-21	-	-	-	0.349	-	-	-	-
21-May-21	-	-	0.183	-	-	-	-	-
25-May-21	7.10	-	-	-	-	-	-	-
27-May-21	-	-	-	0.323	-	-	-	-
28-May-21	-	-	0.125	-	-	-	-	-
1-Jun-21	6.80	140	-	-	-	-	-	-
3-Jun-21	-	-	0.0970	-	-	-	-	-
4-Jun-21	-	-	-	0.279	<0.0005	0.276	0.130	0.0278
8-Jun-21	7.30	-	-	-	-	-	-	-
10-Jun-21	-	-	0.100	-	-	-	-	-
11-Jun-21	-	-	-	0.276	-	-	-	-
15-Jun-21	7.10	-	-	-	-	-	-	-
17-Jun-21	-	150	-	0.292	<0.0005	0.185	0.166	0.0276
22-Jun-21	7.30	-	0.0530	-	-	-	-	-
23-Jun-21	-	-	-	0.349	-	-	-	-
28-Jun-21	-	-	0.101	-	-	-	-	-
29-Jun-21	7.40	-	-	0.208	-	-	-	-
30-Jun-21	-	-	0.0590	-	-	-	-	-
5-Jul-21	-	-	0.0500	-	-	-	-	-
6-Jul-21	7.40	-	-	-	-	-	-	-
9-Jul-21	-	-	0.0430	0.201	-	-	-	-
13-Jul-21	7.30	-	-	-	-	-	-	-
14-Jul-21	-	-	-	0.175	-	-	-	-
20-Jul-21	7.30	-	0.0380	0.188	<0.0005	0.119	0.134	0.0283
21-Jul-21	-	170	-	-	-	-	-	-
27-Jul-21	7.30	-	0.0570	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.2: Water Quality at SAMP Station D-2 (Stollery Lake Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
28-Jul-21	-	-	-	0.134	-	-	-	-
3-Aug-21	7.40	-	-	-	-	-	-	-
6-Aug-21	-	-	0.0320	0.148	-	-	-	-
10-Aug-21	7.30	-	-	-	-	-	-	-
12-Aug-21	-	-	0.0420	-	-	-	-	-
17-Aug-21	7.20	-	-	-	-	-	-	-
18-Aug-21	-	-	0.0410	0.151	<0.0005	0.140	0.104	0.0262
24-Aug-21	7.30	-	-	0.131	-	-	-	-
30-Aug-21	-	-	0.0240	-	-	-	-	-
31-Aug-21	7.40	-	-	-	-	-	-	-
1-Sep-21	-	-	-	0.112	-	-	-	-
3-Sep-21	-	180	-	-	-	-	-	-
7-Sep-21	7.10	-	-	0.111	-	-	-	-
14-Sep-21	7.10	-	-	0.124	-	-	-	-
17-Sep-21	-	-	-	0.0920	<0.0005	0.134	0.0560	0.0304
21-Sep-21	7.00	190	-	-	-	-	-	-
28-Sep-21	7.00	-	-	-	-	-	-	-
5-Oct-21	7.30	-	-	0.115	-	-	-	-
7-Oct-21	-	-	-	0.0880	-	-	-	-
12-Oct-21	7.20	-	-	0.110	-	-	-	-
18-Oct-21	-	210	-	-	-	-	-	-
19-Oct-21	7.20	-	-	-	-	-	-	-
20-Oct-21	-	-	-	0.101	<0.0005	0.272	0.198	0.0341
26-Oct-21	7.10	-	-	-	-	-	-	-
1-Nov-21	7.00	-	-	0.108	-	-	-	-
9-Nov-21	7.40	-	-	-	-	-	-	-
16-Nov-21	7.00	-	-	-	-	-	-	-
23-Nov-21	7.10	-	-	0.117	<0.0005	0.300	0.157	0.0389
25-Nov-21	-	210	-	-	-	-	-	-
29-Nov-21	-	-	-	0.114	-	-	-	-
30-Nov-21	7.20	-	-	-	-	-	-	-
7-Dec-21	7.00	-	-	-	-	-	-	-
14-Dec-21	7.00	-	-	-	-	-	-	-
21-Dec-21	7.00	210	0.0230	-	<0.0005	0.281	0.166	0.0427
22-Dec-21	-	-	0.0350	0.149	-	-	-	-
24-Dec-21	-	-	0.0790	-	-	-	-	-
28-Dec-21	-	-	0.133	0.145	-	-	-	-
29-Dec-21	7.40	-	0.147	0.185	-	-	-	-
4-Jan-22	7.00	-	-	-	-	-	-	-
5-Jan-22	-	-	0.0100	0.0720	-	-	-	-
11-Jan-22	7.10	-	-	0.113	-	-	-	-
14-Jan-22	-	-	-	0.0650	-	-	-	-
18-Jan-22	7.00	220	0.0580	-	<0.0005	0.384	0.194	0.0403
24-Jan-22	-	-	-	0.0700	-	-	-	-
25-Jan-22	7.00	-	0.0630	-	-	-	-	-
31-Jan-22	-	-	0.0500	-	-	-	-	-
1-Feb-22	7.00	-	-	-	-	-	-	-
4-Feb-22	-	-	0.0330	-	-	-	-	-
8-Feb-22	7.20	-	-	0.0700	-	-	-	-
11-Feb-22	-	-	0.0550	-	-	-	-	-
15-Feb-22	7.10	240	-	-	-	-	-	-
16-Feb-22	-	-	-	0.0700	0.000600	0.450	0.216	0.0374
22-Feb-22	7.00	-	0.0510	-	-	-	-	-
25-Feb-22	-	-	-	0.0690	-	-	-	-
28-Feb-22	-	-	0.0590	-	-	-	-	-
1-Mar-22	7.10	-	-	-	-	-	-	-
2-Mar-22	-	-	-	0.132	-	-	-	-
7-Mar-22	-	-	0.250	-	-	-	-	-
8-Mar-22	7.00	-	-	-	-	-	-	-
9-Mar-22	-	-	0.0480	0.0710	-	-	-	-
15-Mar-22	7.20	150	-	-	-	-	-	-
16-Mar-22	-	-	0.367	0.626	0.000600	0.577	0.177	0.0234
18-Mar-22	-	-	-	0.701	-	-	-	-
21-Mar-22	-	-	0.577	-	-	-	-	-
23-Mar-22	7.10	-	-	-	-	-	-	-
28-Mar-22	-	-	-	0.704	-	-	-	-
29-Mar-22	7.10	-	-	-	-	-	-	-
1-Apr-22	-	-	0.199	-	-	-	-	-
4-Apr-22	-	-	-	0.573	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.2: Water Quality at SAMP Station D-2 (Stollery Lake Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
5-Apr-22	-	-	0.437	-	-	-	-	-
6-Apr-22	7.00	-	-	-	-	-	-	-
12-Apr-22	7.20	-	0.213	-	-	-	-	-
13-Apr-22	-	-	-	0.557	-	-	-	-
18-Apr-22	-	-	0.213	-	-	-	-	-
19-Apr-22	6.90	-	-	-	-	-	-	-
25-Apr-22	-	-	0.263	-	-	-	-	-
26-Apr-22	7.00	-	-	-	-	-	-	-
27-Apr-22	-	-	-	0.803	-	-	-	-
3-May-22	6.90	-	-	-	-	-	-	-
4-May-22	-	93.0	0.150	0.517	0.000500	0.592	0.147	0.0132
6-May-22	-	-	0.0590	-	-	-	-	-
10-May-22	6.90	-	-	-	-	-	-	-
13-May-22	-	-	0.240	-	-	-	-	-
16-May-22	-	-	-	0.211	-	-	-	-
17-May-22	7.40	-	-	-	-	-	-	-
24-May-22	7.00	-	0.200	0.490	-	-	-	-
27-May-22	-	-	0.305	-	-	-	-	-
30-May-22	7.30	-	-	-	-	-	-	-
1-Jun-22	-	-	-	0.563	-	-	-	-
6-Jun-22	-	-	0.386	0.597	-	-	-	-
7-Jun-22	7.40	-	-	-	-	-	-	-
10-Jun-22	-	-	0.189	0.464	-	-	-	-
14-Jun-22	7.30	-	-	-	-	-	-	-
17-Jun-22	-	-	0.120	-	-	-	-	-
21-Jun-22	7.20	-	-	0.398	<0.0005	0.145	0.0980	0.0224
24-Jun-22	-	-	0.128	-	-	-	-	-
28-Jun-22	7.30	-	-	-	-	-	-	-
29-Jun-22	-	-	-	0.283	-	-	-	-
30-Jun-22	-	170	-	0.604	<0.0005	0.377	0.195	0.0243
5-Jul-22	7.30	-	-	-	-	-	-	-
8-Jul-22	-	-	0.105	0.269	-	-	-	-
12-Jul-22	7.70	-	-	-	-	-	-	-
18-Jul-22	-	-	0.0880	0.240	<0.0005	0.205	0.201	0.0260
19-Jul-22	7.50	180	-	-	-	-	-	-
26-Jul-22	7.30	-	-	-	-	-	-	-
2-Aug-22	7.40	-	-	-	-	-	-	-
3-Aug-22	-	-	0.106	-	-	-	-	-
4-Aug-22	-	-	-	0.220	-	-	-	-
5-Aug-22	-	-	0.0510	-	-	-	-	-
9-Aug-22	7.70	-	-	-	-	-	-	-
12-Aug-22	-	-	0.0420	-	-	-	-	-
15-Aug-22	-	-	0.0690	-	-	-	-	-
16-Aug-22	7.10	-	-	-	-	-	-	-
17-Aug-22	-	-	-	0.228	0.000700	0.235	0.191	0.0331
19-Aug-22	-	-	-	0.228	-	-	-	-
22-Aug-22	-	210	-	-	-	-	-	-
23-Aug-22	7.20	-	0.0430	0.162	-	-	-	-
26-Aug-22	-	-	0.0300	-	-	-	-	-
30-Aug-22	7.30	-	-	0.147	-	-	-	-
2-Sep-22	-	-	0.0310	-	-	-	-	-
6-Sep-22	7.40	-	-	0.173	-	-	-	-
9-Sep-22	-	-	0.0510	-	-	-	-	-
13-Sep-22	7.30	-	-	0.151	-	-	-	-
19-Sep-22	-	-	0.0260	0.144	<0.0005	0.193	0.0930	0.0306
20-Sep-22	7.00	-	-	-	-	-	-	-
23-Sep-22	-	-	-	0.124	-	-	-	-
26-Sep-22	-	-	0.0380	-	-	-	-	-
27-Sep-22	7.30	210	-	-	-	-	-	-
30-Sep-22	-	-	-	0.187	-	-	-	-
4-Oct-22	7.40	-	-	-	-	-	-	-
7-Oct-22	-	-	0.0420	-	-	-	-	-
11-Oct-22	7.30	-	-	-	-	-	-	-
14-Oct-22	-	-	0.0400	-	-	-	-	-
17-Oct-22	-	-	0.0570	-	-	-	-	-
18-Oct-22	7.20	-	-	0.131	<0.0005	0.248	0.147	0.0403
21-Oct-22	-	-	0.0200	-	-	-	-	-
25-Oct-22	7.30	-	-	-	-	-	-	-
28-Oct-22	-	-	0.0430	0.113	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.2: Water Quality at SAMP Station D-2 (Stollery Lake Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
1-Nov-22	7.20	-	-	0.114	-	-	-	-
2-Nov-22	-	270	-	-	-	-	-	-
3-Nov-22	-	-	-	0.114	-	-	-	-
4-Nov-22	-	-	0.0530	-	-	-	-	-
8-Nov-22	7.30	-	-	0.0929	-	-	-	-
11-Nov-22	-	-	0.0660	-	-	-	-	-
14-Nov-22	-	-	-	0.105	<0.0005	0.311	0.192	0.0485
15-Nov-22	7.20	-	-	-	-	-	-	-
22-Nov-22	7.00	-	-	-	-	-	-	-
25-Nov-22	-	-	0.0920	-	-	-	-	-
29-Nov-22	7.10	-	-	-	-	-	-	-
2-Dec-22	-	-	-	0.0865	-	-	-	-
6-Dec-22	7.70	-	-	-	-	-	-	-
7-Dec-22	-	240	-	-	-	-	-	-
8-Dec-22	-	-	0.0660	-	-	-	-	-
9-Dec-22	-	-	0.0590	0.0893	-	-	-	-
13-Dec-22	7.60	-	-	-	-	-	-	-
14-Dec-22	-	-	-	0.0954	-	-	-	-
16-Dec-22	-	-	0.0460	-	-	-	-	-
19-Dec-22	-	-	-	0.0780	0.000500	0.469	0.184	0.0516
20-Dec-22	7.10	-	-	-	-	-	-	-
21-Dec-22	-	-	0.0630	0.0969	-	-	-	-
28-Dec-22	7.20	-	0.0320	-	-	-	-	-
30-Dec-22	-	250	-	-	-	-	-	-
3-Jan-23	7.20	-	-	-	-	-	-	-
6-Jan-23	-	-	0.0600	0.165	-	-	-	-
10-Jan-23	7.20	-	-	-	-	-	-	-
12-Jan-23	-	-	0.0420	-	-	-	-	-
16-Jan-23	-	-	-	0.0632	<0.0005	0.391	0.166	0.0460
17-Jan-23	7.30	260	-	-	-	-	-	-
20-Jan-23	-	-	-	0.0557	-	-	-	-
23-Jan-23	7.10	-	-	-	-	-	-	-
26-Jan-23	-	-	0.0370	-	-	-	-	-
27-Jan-23	-	-	-	0.120	-	-	-	-
30-Jan-23	-	-	0.0570	-	-	-	-	-
31-Jan-23	7.10	-	-	-	-	-	-	-
7-Feb-23	7.00	-	-	-	-	-	-	-
13-Feb-23	-	-	0.208	-	-	-	-	-
14-Feb-23	7.10	-	-	-	-	-	-	-
19-Feb-23	-	-	-	0.373	0.000608	0.698	0.174	0.0319
21-Feb-23	7.20	200	0.288	-	-	-	-	-
22-Feb-23	-	-	-	0.489	0.000547	0.669	0.144	0.0257
27-Feb-23	-	150	-	-	-	-	-	-
28-Feb-23	7.20	-	0.256	-	-	-	-	-
1-Mar-23	-	210	0.0220	0.0592	<0.0005	0.532	0.155	0.0331
3-Mar-23	-	-	0.373	-	-	-	-	-
7-Mar-23	7.20	-	-	0.716	-	-	-	-
13-Mar-23	-	-	0.337	-	-	-	-	-
14-Mar-23	7.60	-	-	-	-	-	-	-
16-Mar-23	7.70	-	-	-	-	-	-	-
17-Mar-23	-	-	0.265	-	-	-	-	-
20-Mar-23	-	-	-	0.806	-	-	-	-
21-Mar-23	7.20	-	0.230	-	-	-	-	-
22-Mar-23	-	-	-	0.881	-	-	-	-
23-Mar-23	7.20	120	-	-	-	-	-	-
24-Mar-23	-	110	0.307	-	-	-	-	-
27-Mar-23	-	-	-	0.745	-	-	-	-
28-Mar-23	7.30	-	-	0.0768	-	-	-	-
29-Mar-23	-	120	-	-	-	-	-	-
30-Mar-23	7.20	120	-	0.814	-	-	-	-
31-Mar-23	-	-	0.179	-	-	-	-	-
3-Apr-23	-	-	0.241	-	-	-	-	-
4-Apr-23	7.30	-	0.215	-	-	-	-	-
6-Apr-23	6.60	-	-	-	-	-	-	-
11-Apr-23	7.10	100	0.187	0.781	<0.0005	0.594	0.120	-
12-Apr-23	-	-	0.201	-	-	-	-	-
13-Apr-23	7.20	-	-	-	-	-	-	-
14-Apr-23	-	99.0	0.288	-	-	-	-	-
17-Apr-23	-	-	-	0.782	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.2: Water Quality at SAMP Station D-2 (Stollery Lake Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
18-Apr-23	7.10	-	-	0.850	<0.0005	0.532	0.103	0.0149
19-Apr-23	-	120	0.191	-	-	-	-	-
20-Apr-23	7.10	-	-	-	-	-	-	-
21-Apr-23	-	-	0.172	-	-	-	-	-
25-Apr-23	7.00	97.0	-	-	-	-	-	-
26-Apr-23	-	74.0	-	-	-	-	-	-
28-Apr-23	-	-	-	0.815	-	-	-	-
30-Apr-23	-	64.0	-	-	-	-	-	-
1-May-23	-	96.0	0.282	0.821	-	-	-	-
2-May-23	7.10	-	-	2.12	-	-	-	-
3-May-23	-	54.0	0.316	1.41	-	-	-	0.0190
9-May-23	7.30	-	0.125	-	-	-	-	-
10-May-23	-	120	-	1.03	-	-	-	-
15-May-23	-	-	-	0.882	<0.0005	0.472	0.124	0.0204
16-May-23	7.60	150	0.113	-	-	-	-	-
23-May-23	7.50	-	-	-	-	-	-	-
29-May-23	-	-	0.105	-	-	-	-	-
30-May-23	7.20	-	-	0.607	-	-	-	-
31-May-23	-	140	-	-	-	-	-	-
6-Jun-23	7.00	-	0.0750	-	-	-	-	-
7-Jun-23	-	-	-	0.398	-	-	-	-
12-Jun-23	-	130	0.116	0.654	-	-	-	-
13-Jun-23	7.30	-	-	-	-	-	-	-
15-Jun-23	-	-	0.0470	-	-	-	-	-
16-Jun-23	-	-	0.0530	-	-	-	-	-
20-Jun-23	7.20	-	-	0.396	-	-	-	-
27-Jun-23	7.10	-	-	-	-	-	-	-
4-Jul-23	7.10	-	-	-	-	-	-	-
11-Jul-23	7.20	-	-	-	-	-	-	-
12-Jul-23	-	200	-	-	-	-	-	-
13-Jul-23	-	-	-	0.271	-	-	-	-
17-Jul-23	-	-	0.0290	-	-	-	-	-
18-Jul-23	7.20	200	-	-	-	-	-	-
19-Jul-23	-	-	-	0.213	-	-	-	-
24-Jul-23	7.10	200	0.0360	-	-	-	-	-
28-Jul-23	-	220	0.0330	-	-	-	-	-
31-Jul-23	-	-	-	0.203	-	-	-	-
1-Aug-23	7.20	-	-	-	-	-	-	-
2-Aug-23	-	-	-	0.227	0.000259	0.166	0.115	0.0300
4-Aug-23	-	-	0.0300	-	-	-	-	-
8-Aug-23	7.00	-	-	-	-	-	-	-
11-Aug-23	-	220	0.0150	-	-	-	-	-
14-Aug-23	-	-	-	0.183	-	-	-	-
15-Aug-23	7.10	-	-	0.215	0.000394	0.225	-	0.0346
17-Aug-23	-	220	-	-	-	-	-	-
22-Aug-23	7.10	-	-	-	-	-	-	-
24-Aug-23	-	-	0.0260	-	-	-	-	-
28-Aug-23	7.32	-	0.0240	-	-	-	-	-
5-Sep-23	7.33	160	0.0370	0.271	-	0.0300	0.0290	0.0258
7-Sep-23	-	-	-	-	-	-	0.176	-
11-Sep-23	-	160	-	-	-	-	-	-
12-Sep-23	7.20	-	-	-	<0.0005	-	-	-
15-Sep-23	-	-	0.0200	-	-	-	-	-
19-Sep-23	7.41	-	-	-	-	-	-	-
21-Sep-23	-	240	0.0150	0.133	-	-	-	-
22-Sep-23	-	-	0.0210	-	-	-	-	-
25-Sep-23	-	240	0.0180	0.152	-	-	-	-
26-Sep-23	7.17	-	-	0.119	0.000216	0.384	0.121	0.0389
27-Sep-23	-	-	-	0.102	-	-	-	-
28-Sep-23	7.40	-	-	-	-	-	-	-
29-Sep-23	-	-	0.0260	-	-	-	-	-
5-Oct-23	7.22	-	-	-	-	-	-	-
11-Oct-23	-	-	0.0230	-	-	-	-	-
13-Oct-23	-	-	0.0310	-	-	-	-	-
16-Oct-23	-	-	-	0.107	-	-	-	-
17-Oct-23	7.29	-	-	0.111	0.000307	0.282	0.163	0.0434
23-Oct-23	-	-	0.0270	-	-	-	-	-
24-Oct-23	7.47	-	-	-	-	-	-	-
25-Oct-23	-	-	-	0.0827	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.2: Water Quality at SAMP Station D-2 (Stollery Lake Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
31-Oct-23	7.28	-	-	-	-	-	-	-
1-Nov-23	-	-	0.0190	-	-	-	-	-
6-Nov-23	-	-	-	0.0859	-	-	-	-
8-Nov-23	7.08	-	-	-	-	-	-	-
13-Nov-23	-	-	-	0.0852	-	-	-	-
14-Nov-23	7.63	-	-	-	-	-	-	-
20-Nov-23	-	-	0.0460	0.0826	0.000415	0.354	0.200	0.0438
21-Nov-23	7.58	-	-	-	-	-	-	-
23-Nov-23	-	300	-	0.0901	-	-	-	-
24-Nov-23	-	270	0.0380	-	-	-	-	-
29-Nov-23	7.71	-	-	0.0745	-	-	-	-
4-Dec-23	-	-	0.0330	-	-	-	-	-
5-Dec-23	7.58	-	0.0260	-	-	-	-	-
6-Dec-23	-	-	-	0.0688	-	-	-	-
12-Dec-23	7.53	-	-	-	-	-	-	-
14-Dec-23	-	300	-	0.0671	0.000438	0.418	0.196	0.0497
15-Dec-23	-	-	0.0270	-	-	-	-	-
18-Dec-23	-	-	-	0.0599	-	-	-	-
19-Dec-23	7.25	-	-	-	-	-	-	-
22-Dec-23	-	-	0.0200	-	-	-	-	-
27-Dec-23	7.40	-	-	-	-	-	-	-
29-Dec-23	-	-	-	0.0589	-	-	-	-
n	214	74	210	213	51	51	51	51
Minimum	6.60	54.0	0.0100	0.0557	0.000216	0.0300	0.0290	0.0105
Maximum	7.71	300	0.577	2.12	0.00110	0.698	0.367	0.0516
Mean	7.21	172	0.127	0.365	0.000415	0.343	0.156	0.0299
Median	7.20	170	0.102	0.266	0.000415	0.328	0.155	0.0293
SD	0.201	57.3	0.101	0.300	0.000239	0.163	0.0560	0.0100
10th Percentile	7.00	97.0	0.0270	0.0852	0.000216	0.140	0.103	0.0181
95th Percentile	7.58	270	0.307	0.838	0.000700	0.625	0.246	0.0485

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.3: Water Quality at SAMP Station D-3 (TMA-2 Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
7-Jan-20	7.40	-	-	-	-	-	-	-
8-Jan-20	-	-	0.182	-	-	-	-	-
14-Jan-20	7.20	-	-	-	-	-	-	-
15-Jan-20	-	-	0.161	-	-	-	-	-
20-Jan-20	-	66.0	-	-	-	-	-	-
21-Jan-20	7.30	-	-	0.491	<0.0005	0.258	0.0450	0.00320
22-Jan-20	-	-	0.159	-	-	-	-	-
28-Jan-20	7.00	-	-	-	-	-	-	-
29-Jan-20	-	-	0.137	-	-	-	-	-
4-Feb-20	7.30	-	-	-	-	-	-	-
7-Feb-20	-	-	0.134	-	-	-	-	-
11-Feb-20	6.90	-	-	-	-	-	-	-
18-Feb-20	7.10	-	-	-	-	-	-	-
19-Feb-20	-	-	0.136	0.388	<0.0005	0.184	-	0.00440
20-Feb-20	-	69.0	-	-	-	-	-	-
21-Feb-20	-	-	0.128	-	-	-	-	-
24-Feb-20	-	-	-	-	-	-	0.0650	-
25-Feb-20	6.90	-	-	-	-	-	-	-
26-Feb-20	-	-	0.130	-	-	-	-	-
3-Mar-20	6.70	-	-	-	-	-	-	-
4-Mar-20	-	-	0.115	-	-	-	-	-
10-Mar-20	7.10	-	-	-	-	-	-	-
11-Mar-20	-	-	0.128	-	-	-	-	-
16-Mar-20	-	-	-	0.288	<0.0005	0.201	0.111	0.00460
17-Mar-20	7.10	-	-	-	-	-	-	-
18-Mar-20	-	-	0.112	-	-	-	-	-
19-Mar-20	-	72.0	-	-	-	-	-	-
24-Mar-20	7.00	-	-	-	-	-	-	-
25-Mar-20	-	-	0.0990	-	-	-	-	-
31-Mar-20	6.90	-	-	-	-	-	-	-
1-Apr-20	-	-	0.117	-	-	-	-	-
7-Apr-20	7.10	-	-	-	-	-	-	-
8-Apr-20	-	-	0.0750	-	-	-	-	-
14-Apr-20	7.00	-	-	-	-	-	-	-
15-Apr-20	-	-	0.0960	-	-	-	-	-
17-Apr-20	-	-	-	0.225	<0.0005	0.221	0.0300	0.000800
21-Apr-20	7.20	-	-	-	-	-	-	-
22-Apr-20	-	-	0.122	-	-	-	-	-
24-Apr-20	-	22.0	-	-	-	-	-	-
28-Apr-20	7.00	-	-	-	-	-	-	-
29-Apr-20	-	-	0.135	-	-	-	-	-
5-May-20	6.90	-	-	-	-	-	-	-
6-May-20	-	-	0.0780	-	-	-	-	-
12-May-20	7.30	-	-	-	-	-	-	-
19-May-20	6.90	-	-	0.309	<0.0005	0.115	0.0110	0.00130
21-May-20	-	34.0	-	-	-	-	-	-
26-May-20	6.80	-	-	-	-	-	-	-
27-May-20	-	-	0.130	-	-	-	-	-
2-Jun-20	7.30	-	-	-	-	-	-	-
9-Jun-20	6.90	-	-	-	-	-	-	-
12-Jun-20	-	-	-	0.130	<0.0005	0.561	0.0850	0.000800
15-Jun-20	-	-	0.117	-	-	-	-	-
16-Jun-20	7.00	-	-	-	-	-	-	-
17-Jun-20	-	-	0.126	-	-	-	-	-
18-Jun-20	-	14.0	-	-	-	-	-	-
23-Jun-20	6.90	-	-	-	-	-	-	-
24-Jun-20	-	-	0.204	-	-	-	-	-
29-Jun-20	7.20	-	-	-	-	-	-	-
30-Jun-20	-	-	0.174	-	-	-	-	-
21-Jul-20	6.90	-	-	-	-	-	-	-
22-Jul-20	-	-	0.192	-	-	-	-	-
28-Jul-20	6.90	-	-	-	-	-	-	-
29-Jul-20	-	-	0.255	-	-	-	-	-
5-Aug-20	-	-	-	0.368	0.000700	0.504	0.0850	0.00220
6-Aug-20	-	43.0	-	-	-	-	-	-
11-Aug-20	6.90	-	-	-	-	-	-	-
12-Aug-20	-	-	0.226	-	-	-	-	-
18-Aug-20	7.10	-	-	0.409	<0.0005	0.0920	0.0100	0.00410
19-Aug-20	-	-	0.107	-	-	-	-	-
20-Aug-20	-	55.0	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.3: Water Quality at SAMP Station D-3 (TMA-2 Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
25-Aug-20	7.20	-	-	-	-	-	-	-
26-Aug-20	-	-	0.196	-	-	-	-	-
1-Sep-20	7.30	-	-	-	-	-	-	-
2-Sep-20	-	-	0.204	-	-	-	-	-
8-Sep-20	7.30	-	-	-	-	-	-	-
9-Sep-20	-	-	0.229	-	-	-	-	-
11-Sep-20	-	-	-	0.604	<0.0005	0.140	0.0190	0.00500
15-Sep-20	7.20	-	-	-	-	-	-	-
16-Sep-20	-	54.0	0.285	-	-	-	-	-
22-Sep-20	7.10	-	-	-	-	-	-	-
29-Sep-20	7.20	-	-	-	-	-	-	-
6-Oct-20	7.00	-	-	-	-	-	-	-
7-Oct-20	-	-	0.228	-	-	-	-	-
13-Oct-20	7.20	-	-	-	-	-	-	-
16-Oct-20	-	-	0.270	-	-	-	-	-
20-Oct-20	7.20	-	-	-	-	-	-	-
22-Oct-20	-	-	0.229	-	-	-	-	-
23-Oct-20	-	-	0.257	-	-	-	-	-
26-Oct-20	-	-	-	0.469	<0.0005	0.116	0.0180	0.00430
27-Oct-20	7.20	-	-	-	-	-	-	-
28-Oct-20	-	-	0.155	-	-	-	-	-
30-Oct-20	-	49.0	-	-	-	-	-	-
3-Nov-20	7.20	-	-	-	-	-	-	-
6-Nov-20	-	-	0.179	-	-	-	-	-
10-Nov-20	7.00	-	-	-	-	-	-	-
13-Nov-20	-	-	0.237	-	-	-	-	-
17-Nov-20	7.30	-	-	0.410	<0.0005	0.259	0.0270	0.00170
18-Nov-20	-	-	0.194	-	-	-	-	-
24-Nov-20	7.30	-	-	-	-	-	-	-
25-Nov-20	-	29.0	-	-	-	-	-	-
1-Dec-20	7.20	-	-	-	-	-	-	-
2-Dec-20	-	-	0.196	-	-	-	-	-
8-Dec-20	7.20	-	-	-	-	-	-	-
9-Dec-20	-	-	0.242	-	-	-	-	-
14-Dec-20	-	36.0	-	0.598	<0.0005	0.305	0.0540	0.00270
15-Dec-20	7.10	-	-	-	-	-	-	-
21-Dec-20	7.20	-	-	-	-	-	-	-
22-Dec-20	-	-	0.208	-	-	-	-	-
29-Dec-20	7.30	-	0.214	-	-	-	-	-
4-Jan-21	7.10	-	-	-	-	-	-	-
5-Jan-21	-	-	0.192	-	-	-	-	-
12-Jan-21	7.30	-	-	-	-	-	-	-
13-Jan-21	-	-	0.191	-	-	-	-	-
19-Jan-21	7.30	-	-	0.508	<0.0005	0.235	0.0240	0.00240
20-Jan-21	-	-	0.175	-	-	-	-	-
21-Jan-21	-	48.0	-	-	-	-	-	-
26-Jan-21	7.30	-	-	-	-	-	-	-
27-Jan-21	-	-	0.200	-	-	-	-	-
2-Feb-21	7.30	-	-	-	-	-	-	-
3-Feb-21	-	-	0.186	-	-	-	-	-
9-Feb-21	7.10	-	-	0.460	<0.0005	0.202	0.0290	0.00310
10-Feb-21	-	-	0.196	-	-	-	-	-
16-Feb-21	7.20	-	-	-	-	-	-	-
18-Feb-21	-	47.0	0.181	-	-	-	-	-
23-Feb-21	7.30	-	-	-	-	-	-	-
24-Feb-21	-	-	0.200	-	-	-	-	-
2-Mar-21	7.30	-	-	-	-	-	-	-
3-Mar-21	-	-	0.180	-	-	-	-	-
9-Mar-21	7.30	-	-	-	-	-	-	-
12-Mar-21	-	-	0.174	-	-	-	-	-
16-Mar-21	7.30	-	-	-	-	-	-	-
17-Mar-21	-	-	0.167	-	-	-	-	-
23-Mar-21	7.10	-	-	-	-	-	-	-
24-Mar-21	-	-	0.170	-	-	-	-	-
29-Mar-21	-	54.0	-	0.341	<0.0005	0.127	0.0240	0.00410
30-Mar-21	7.00	-	-	-	-	-	-	-
31-Mar-21	-	-	0.119	-	-	-	-	-
6-Apr-21	7.00	-	-	-	-	-	-	-
7-Apr-21	-	-	0.154	-	-	-	-	-
13-Apr-21	7.20	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.3: Water Quality at SAMP Station D-3 (TMA-2 Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
20-Apr-21	7.20	-	-	0.362	<0.0005	0.0930	0.00700	0.00130
21-Apr-21	-	43.0	0.146	-	-	-	-	-
23-Apr-21	-	-	0.173	-	-	-	-	-
27-Apr-21	7.20	-	-	-	-	-	-	-
4-May-21	7.20	-	-	-	-	-	-	-
11-May-21	7.20	-	-	-	-	-	-	-
13-May-21	-	-	0.223	-	-	-	-	-
17-May-21	-	-	0.187	-	-	-	-	-
18-May-21	7.20	-	-	-	-	-	-	-
19-May-21	-	64.0	-	-	-	-	-	-
20-May-21	-	-	-	0.442	<0.0005	0.0560	0.0120	0.00250
25-May-21	7.10	-	-	-	-	-	-	-
26-May-21	-	-	0.290	-	-	-	-	-
1-Jun-21	6.90	-	-	-	-	-	-	-
2-Jun-21	-	-	0.233	-	-	-	-	-
8-Jun-21	6.80	-	0.255	-	-	-	-	-
15-Jun-21	7.00	-	-	-	-	-	-	-
17-Jun-21	-	12.0	-	0.149	0.000600	0.556	0.133	0.00100
22-Jun-21	7.20	-	0.174	-	-	-	-	-
28-Jun-21	-	-	0.153	-	-	-	-	-
29-Jun-21	7.20	-	0.257	-	-	-	-	-
5-Jul-21	-	-	0.271	-	-	-	-	-
6-Jul-21	7.20	-	-	-	-	-	-	-
7-Jul-21	-	-	0.270	-	-	-	-	-
20-Jul-21	7.20	-	0.529	-	-	-	-	-
27-Jul-21	7.20	-	-	-	-	-	-	-
28-Jul-21	-	59.0	-	0.384	<0.0005	0.331	0.0760	0.00220
29-Jul-21	-	-	0.327	-	-	-	-	-
3-Aug-21	7.20	-	-	-	-	-	-	-
5-Aug-21	-	-	0.256	-	-	-	-	-
10-Aug-21	7.20	-	-	-	-	-	-	-
17-Aug-21	7.10	-	-	-	-	-	-	-
18-Aug-21	-	-	0.237	0.489	<0.0005	0.250	0.0520	0.00270
27-Aug-21	-	-	0.243	-	-	-	-	-
31-Aug-21	7.20	-	-	-	-	-	-	-
3-Sep-21	-	64.0	-	-	-	-	-	-
7-Sep-21	7.00	-	-	-	-	-	-	-
14-Sep-21	7.00	-	0.260	-	-	-	-	-
17-Sep-21	-	-	-	0.347	<0.0005	0.148	0.0440	0.00290
21-Sep-21	7.00	63.0	-	-	-	-	-	-
28-Sep-21	6.90	-	-	-	-	-	-	-
30-Sep-21	-	-	0.288	-	-	-	-	-
5-Oct-21	7.10	-	-	-	-	-	-	-
12-Oct-21	7.00	-	-	-	-	-	-	-
13-Oct-21	-	-	0.262	-	-	-	-	-
15-Oct-21	-	-	0.216	-	-	-	-	-
18-Oct-21	-	64.0	-	-	-	-	-	-
19-Oct-21	7.10	-	-	-	-	-	-	-
20-Oct-21	-	-	-	0.423	<0.0005	0.298	0.0470	0.00400
26-Oct-21	7.10	-	-	-	-	-	-	-
1-Nov-21	7.00	-	-	-	-	-	-	-
9-Nov-21	7.10	-	-	-	-	-	-	-
15-Nov-21	-	74.0	-	-	-	-	-	-
16-Nov-21	7.00	-	-	-	-	-	-	-
17-Nov-21	-	-	-	-	<0.0005	0.0920	0.0150	0.00540
23-Nov-21	7.00	-	-	0.324	-	-	-	-
30-Nov-21	7.00	-	-	-	-	-	-	-
7-Dec-21	7.00	-	-	-	-	-	-	-
13-Dec-21	-	-	0.235	-	-	-	-	-
14-Dec-21	7.00	-	-	-	-	-	-	-
21-Dec-21	7.00	87.0	-	-	<0.0005	0.147	0.0210	0.00800
22-Dec-21	-	-	0.197	0.424	-	-	-	-
24-Dec-21	-	-	0.172	-	-	-	-	-
28-Dec-21	-	-	0.290	-	-	-	-	-
29-Dec-21	7.30	-	0.285	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.3: Water Quality at SAMP Station D-3 (TMA-2 Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
4-Jan-22	7.00	-	-	-	-	-	-	-
5-Jan-22	-	-	0.112	-	-	-	-	-
11-Jan-22	7.10	-	-	-	-	-	-	-
14-Jan-22	-	-	-	0.336	-	-	-	-
18-Jan-22	7.00	87.0	0.183	-	<0.0005	0.164	0.0200	0.00460
25-Jan-22	7.00	-	0.165	-	-	-	-	-
31-Jan-22	-	-	0.148	-	-	-	-	-
1-Feb-22	7.10	-	-	-	-	-	-	-
4-Feb-22	-	-	0.137	-	-	-	-	-
8-Feb-22	7.20	-	-	-	-	-	-	-
11-Feb-22	-	-	0.128	-	-	-	-	-
15-Feb-22	7.10	98.0	-	-	-	-	-	-
16-Feb-22	-	-	-	0.310	<0.0005	0.0910	0.0130	0.0117
22-Feb-22	7.10	-	0.172	-	-	-	-	-
28-Feb-22	-	-	0.113	-	-	-	-	-
1-Mar-22	7.10	-	-	-	-	-	-	-
7-Mar-22	-	-	0.0500	-	-	-	-	-
8-Mar-22	7.20	-	-	-	-	-	-	-
9-Mar-22	-	-	0.156	-	-	-	-	-
15-Mar-22	7.20	97.0	-	-	-	-	-	-
16-Mar-22	-	-	0.162	0.317	<0.0005	0.100	0.135	0.0207
21-Mar-22	-	-	0.172	-	-	-	-	-
22-Mar-22	7.00	-	-	-	-	-	-	-
29-Mar-22	7.00	-	0.264	-	-	-	-	-
1-Apr-22	-	-	0.126	-	-	-	-	-
6-Apr-22	6.90	-	-	-	-	-	-	-
12-Apr-22	6.90	-	0.114	-	-	-	-	-
18-Apr-22	-	-	0.0680	-	-	-	-	-
19-Apr-22	6.80	-	-	-	-	-	-	-
25-Apr-22	-	-	0.228	-	-	-	-	-
26-Apr-22	6.70	-	-	-	-	-	-	-
3-May-22	6.90	-	-	-	-	-	-	-
4-May-22	-	93.0	0.111	0.529	0.000500	0.597	0.146	0.0131
6-May-22	-	-	0.140	-	-	-	-	-
10-May-22	6.90	-	-	-	-	-	-	-
13-May-22	-	-	0.136	-	-	-	-	-
17-May-22	7.10	-	-	-	-	-	-	-
24-May-22	7.10	-	-	-	-	-	-	-
30-May-22	7.20	-	0.186	-	-	-	-	-
2-Jun-22	-	-	0.169	-	-	-	-	-
6-Jun-22	-	-	0.281	-	-	-	-	-
7-Jun-22	7.30	-	-	-	-	-	-	-
10-Jun-22	-	-	0.157	-	-	-	-	-
14-Jun-22	7.00	-	-	-	-	-	-	-
20-Jun-22	-	-	0.180	-	-	-	-	-
21-Jun-22	7.30	-	-	0.348	<0.0005	0.0730	0.0240	0.00250
24-Jun-22	-	-	0.167	-	-	-	-	-
28-Jun-22	6.80	-	-	-	-	-	-	-
30-Jun-22	-	64.0	-	-	<0.0005	0.0560	0.00800	0.00300
5-Jul-22	7.20	-	-	-	-	-	-	-
8-Jul-22	-	-	0.163	0.398	-	-	-	-
18-Oct-22	6.90	-	-	-	-	-	-	-
21-Oct-22	-	-	0.154	-	-	-	-	-
25-Oct-22	7.10	-	-	-	-	-	-	-
28-Oct-22	-	-	0.173	-	-	-	-	-
1-Nov-22	7.00	-	-	0.306	<0.0005	0.0460	0.0110	0.00280
3-Nov-22	-	74.0	-	-	-	-	-	-
4-Nov-22	-	-	0.190	-	-	-	-	-
7-Nov-22	-	-	-	-	-	-	-	-
8-Nov-22	6.90	-	-	-	-	-	-	-
14-Nov-22	-	-	-	0.293	<0.0005	0.0330	0.00400	0.00400
15-Nov-22	6.80	-	-	-	-	-	-	-
16-Nov-22	-	-	0.164	-	-	-	-	-
22-Nov-22	6.90	-	-	-	-	-	-	-
25-Nov-22	-	-	0.0990	-	-	-	-	-
29-Nov-22	7.00	-	-	-	-	-	-	-
6-Dec-22	7.40	-	0.131	-	-	-	-	-
7-Dec-22	-	89.0	-	-	-	-	-	-
9-Dec-22	-	-	0.111	-	-	-	-	-
13-Dec-22	7.20	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.3: Water Quality at SAMP Station D-3 (TMA-2 Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
16-Dec-22	-	-	0.178	-	-	-	-	-
19-Dec-22	-	-	-	0.296	<0.0005	0.0360	0.00300	0.00638
20-Dec-22	6.90	-	-	-	-	-	-	-
21-Dec-22	-	-	0.122	-	-	-	-	-
28-Dec-22	7.10	-	0.117	-	-	-	-	-
30-Dec-22	-	95.0	-	-	-	-	-	-
3-Jan-23	7.20	-	-	-	-	-	-	-
6-Jan-23	-	-	0.117	-	-	-	-	-
10-Jan-23	6.70	-	-	-	-	-	-	-
12-Jan-23	-	-	0.0970	-	-	-	-	-
16-Jan-23	-	-	-	0.244	<0.0005	0.0730	0.00400	0.00550
17-Jan-23	7.20	89.0	-	-	-	-	-	-
19-Jan-23	-	-	0.0460	-	-	-	-	-
23-Jan-23	6.80	-	-	-	-	-	-	-
26-Jan-23	-	-	0.111	-	-	-	-	-
30-Jan-23	-	-	0.120	-	-	-	-	-
31-Jan-23	6.80	-	-	-	-	-	-	-
7-Feb-23	7.00	-	-	-	-	-	-	-
13-Feb-23	-	-	0.111	-	-	-	-	-
14-Feb-23	7.00	-	-	-	-	-	-	-
16-Feb-23	-	-	0.104	-	-	-	-	-
21-Feb-23	7.10	-	0.118	-	-	-	-	-
22-Feb-23	-	-	-	0.200	<0.0005	0.0260	0.00192	0.00603
27-Feb-23	-	120	-	-	-	-	-	-
28-Feb-23	7.20	-	-	-	-	-	-	-
2-Mar-23	-	-	0.106	-	-	-	-	-
3-Mar-23	-	-	0.0800	-	-	-	-	-
7-Mar-23	7.00	-	-	-	-	-	-	-
13-Mar-23	-	-	0.0810	-	-	-	-	-
14-Mar-23	7.40	-	-	-	-	-	-	-
17-Mar-23	-	-	0.122	-	-	-	-	-
21-Mar-23	7.10	-	-	-	-	-	-	-
22-Mar-23	-	-	-	0.233	<0.0005	0.0510	0.00200	0.00430
23-Mar-23	-	120	-	-	-	-	-	-
24-Mar-23	-	-	0.122	-	-	-	-	-
28-Mar-23	7.20	-	-	-	-	-	-	-
31-Mar-23	-	-	0.0730	-	-	-	-	-
4-Apr-23	7.20	-	-	-	-	-	-	-
11-Apr-23	7.10	-	0.0510	-	-	-	-	-
14-Apr-23	-	-	0.0970	-	-	-	-	-
18-Apr-23	7.20	-	-	0.414	<0.0005	0.363	0.0697	0.00189
21-Apr-23	-	-	0.122	-	-	-	-	-
25-Apr-23	7.10	61.0	-	-	-	-	-	-
1-May-23	-	-	0.0890	-	-	-	-	-
2-May-23	7.20	-	-	-	-	-	-	-
9-May-23	7.10	-	0.128	-	-	-	-	-
15-May-23	-	-	-	0.595	<0.0005	0.131	0.0101	0.00145
16-May-23	7.30	41.0	0.136	-	-	-	-	-
23-May-23	7.30	-	-	-	-	-	-	-
29-May-23	-	-	0.123	-	-	-	-	-
30-May-23	6.90	-	-	-	-	-	-	-
6-Jun-23	7.00	-	0.182	-	-	-	-	-
9-Jun-23	-	-	0.114	-	-	-	-	-
12-Jun-23	-	-	0.109	-	-	-	-	-
13-Jun-23	7.20	-	-	-	-	-	-	-
16-Jun-23	-	-	0.104	-	-	-	-	-
20-Jun-23	7.30	-	-	0.213	<0.0005	0.183	0.0436	0.00212
27-Jun-23	6.90	-	-	-	-	-	-	-
28-Jun-23	-	30.0	-	-	-	-	-	-
5-Jul-23	-	-	-	-	-	-	-	-
5-Sep-23	-	-	0.194	-	-	-	-	-
24-Oct-23	7.23	-	-	-	-	-	-	-
31-Oct-23	7.23	-	0.0340	-	-	-	-	-
6-Nov-23	-	-	-	0.330	0.000159	0.0400	0.0278	0.00333
8-Nov-23	7.04	-	-	-	-	-	-	-
9-Nov-23	-	58.0	-	-	-	-	-	-
14-Nov-23	6.96	-	-	-	-	-	-	-
15-Nov-23	-	-	0.0980	-	-	-	-	-
20-Nov-23	-	-	0.0340	0.349	0.0000580	0.0760	0.00522	0.0164
21-Nov-23	7.29	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.3: Water Quality at SAMP Station D-3 (TMA-2 Primary Discharge Point), Denison TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
23-Nov-23	-	97.0	-	-	-	-	-	-
24-Nov-23	-	-	0.0900	-	-	-	-	-
28-Nov-23	7.48	-	-	-	-	-	-	-
4-Dec-23	-	-	0.106	-	-	-	-	-
5-Dec-23	7.55	-	-	-	-	-	-	-
8-Dec-23	-	-	0.0970	-	-	-	-	-
12-Dec-23	7.72	-	-	-	-	-	-	-
14-Dec-23	-	100	-	0.269	0.0000350	0.0190	0.00217	0.0154
15-Dec-23	-	-	0.0800	-	-	-	-	-
19-Dec-23	7.00	-	-	-	-	-	-	-
22-Dec-23	-	-	0.0980	-	-	-	-	-
27-Dec-23	7.40	-	-	-	-	-	-	-
n	173	42	168	42	42	42	42	42
Minimum	6.70	12.0	0.0340	0.130	0.0000350	0.0190	0.00192	0.000800
Maximum	7.72	120	0.529	0.604	0.000700	0.597	0.146	0.0207
Mean	7.10	64.4	0.169	0.365	0.000121	0.182	0.0375	0.00476
Median	7.10	64.0	0.164	0.348	0.0000580	0.136	0.0240	0.00326
SD	0.168	26.5	0.0688	0.114	0.000253	0.151	0.0386	0.00441
10th Percentile	6.90	30.0	0.0970	0.225	0.0000350	0.0400	0.00400	0.00130
95th Percentile	7.30	100	0.285	0.595	0.000500	0.556	0.133	0.0154

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.4: Water Quality at mine-Exposed SRWMP Station D-6, Cinder Lake Outlet, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
Cycle 5 Benchmark	-	5.3	128 to 429	0.469	1.0	2.49	0.680 to 1.90	0.015
4-Feb-20	17.2	7.40	12.0	<0.007	0.0130	0.184	0.0720	<0.0005
25-May-20	41.8	6.60	30.0	<0.007	0.0170	0.516	0.254	<0.0005
19-Aug-20	45.5	6.60	30.0	<0.007	0.0150	0.591	0.193	<0.0005
23-Nov-20	20.3	6.90	12.0	<0.007	0.0130	0.175	0.0640	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	17.2	6.60	12.0	<0.007	0.0130	0.175	0.0640	<0.0005
Maximum	45.5	7.40	30.0	<0.007	0.0170	0.591	0.254	<0.0005
Mean	31.2	6.88	21.0	<0.007	0.0145	0.366	0.146	<0.0005
SD	14.5	0.377	10.4	-	0.00191	0.218	0.0932	-
22-Feb-21	24.9	6.90	15.0	<0.007	0.0150	0.278	0.103	<0.0005
20-May-21	25.3	6.80	16.0	0.00900	0.0130	0.155	0.0850	<0.0005
11-Aug-21	40.1	6.70	30.0	0.0100	0.0130	0.157	0.0870	<0.0005
11-Nov-21	58.4	6.80	50.0	0.00800	0.0150	0.209	0.120	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	24.9	6.70	15.0	<0.007	0.0130	0.155	0.0850	<0.0005
Maximum	58.4	6.90	50.0	0.0100	0.0150	0.278	0.120	<0.0005
Mean	37.2	6.80	27.8	0.00850	0.0140	0.200	0.0988	<0.0005
SD	15.8	0.0816	16.3	0.00102	0.00115	0.0578	0.0163	-
3-Feb-22	22.3	6.70	13.0	<0.005	0.0130	0.153	0.0640	<0.0005
5-May-22	18.7	6.80	11.0	<0.005	0.0105	0.131	0.0560	<0.0005
23-Aug-22	54.0	6.60	45.0	<0.005	0.0120	0.199	0.173	0.000123
25-Nov-22	58.0	6.20	43.0	<0.005	0.0148	0.171	0.113	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	18.7	6.20	11.0	<0.005	0.0105	0.131	0.0560	0.000123
Maximum	58.0	6.80	45.0	<0.005	0.0148	0.199	0.173	0.000123
Mean	38.2	6.58	28.0	<0.005	0.0126	0.164	0.102	0.000123
SD	20.6	0.263	18.5	-	0.00180	0.0288	0.0539	-
23-Feb-23	17.1	6.20	8.70	<0.005	0.0116	0.201	0.0515	0.0000510
18-May-23	23.0	6.70	14.0	<0.005	0.0121	0.153	0.0800	0.0000470
17-Aug-23	295	6.50	240	<0.005	0.0335	0.867	0.895	0.000310
15-Nov-23	32.4	6.83	27.0	<0.005	0.0121	0.0860	0.0429	0.0000460
n	4	4	4	4	4	4	4	4
Minimum	17.1	6.20	8.70	<0.005	0.0116	0.0860	0.0429	0.0000460
Maximum	295	6.83	240	<0.005	0.0335	0.867	0.895	0.000310
Mean	91.9	6.56	72.4	<0.005	0.0173	0.327	0.267	0.000114
SD	136	0.274	112	-	0.0108	0.363	0.419	0.000131
Summary Statistics for 2020 to 2023								
n	16	16	16	16	16	16	16	16
Minimum	17.1	6.20	8.70	<0.005	0.0105	0.0860	0.0429	0.0000460
Maximum	295	7.40	240	0.0100	0.0335	0.867	0.895	0.000310
Mean	49.6	6.70	37.3	0.00575	0.0146	0.264	0.153	0.000115
Median	28.8	6.70	21.5	0.00700	0.0130	0.180	0.0860	0.0000510
SD	67.0	0.281	55.7	0.000645	0.00530	0.211	0.206	0.000203
10th Percentile	17.2	6.20	11.0	0.00500	0.0116	0.131	0.0515	0.0000460
95th Percentile	295	7.40	240	0.0100	0.0335	0.867	0.895	0.000310

Indicates value exceeded Benchmarks.

Note: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

[a] Sulphate Benchmark was calculated based on the hardness of a given sample based on the BC ENV 2013 guidance.

Table C.5: Water Quality at mine-Exposed SRWMP Station D-5, Serpent River between Denison and Quirke TMAs, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Uranium (mg/L)
Cycle 5 Benchmark	-	6.55	128 to 218	0.469	1.0	0.015
4-Feb-20	21.5	7.40	13.0	0.0190	0.0720	0.00160
25-May-20	27.1	6.80	15.0	0.0570	0.0780	0.00160
19-Aug-20	17.6	6.90	7.10	0.0870	0.0890	0.00100
23-Nov-20	14.8	6.80	7.20	0.0130	0.0330	0.000900
n	4	4	4	4	4	4
Minimum	14.8	6.80	7.10	0.0130	0.0330	0.000900
Maximum	27.1	7.40	15.0	0.0870	0.0890	0.00160
Mean	20.2	6.98	10.6	0.0440	0.0680	0.00128
SD	5.33	0.287	4.04	0.0347	0.0244	0.000377
22-Feb-21	22.3	6.90	12.0	0.0170	0.0520	0.00140
20-May-21	15.1	6.90	6.70	0.0300	0.0440	0.000800
11-Aug-21	25.2	6.90	8.60	0.0820	0.105	0.00120
11-Nov-21	20.9	6.90	12.0	0.0800	0.0710	0.000900
n	4	4	4	4	4	4
Minimum	15.1	6.90	6.70	0.0170	0.0440	0.000800
Maximum	25.2	6.90	12.0	0.0820	0.105	0.00140
Mean	20.9	6.90	9.82	0.0522	0.0680	0.00108
SD	4.25	0	2.63	0.0336	0.0271	0.000275
3-Feb-22	15.3	6.90	5.90	0.00800	0.0260	<0.0005
5-May-22	15.9	6.90	6.90	0.0250	0.0298	0.000600
23-Aug-22	23.0	6.90	11.0	0.0960	0.101	0.00134
23-Nov-22	63.8	6.30	42.0	0.121	0.132	0.00256
n	4	4	4	4	4	4
Minimum	15.3	6.30	5.90	0.00800	0.0260	<0.0005
Maximum	63.8	6.90	42.0	0.121	0.132	0.00256
Mean	29.5	6.75	16.4	0.0625	0.0722	0.00125
SD	23.1	0.300	17.2	0.0545	0.0527	0.000983
24-Feb-23	32.1	6.30	19.0	0.0320	0.0674	0.00220
11-May-23	14.8	6.00	7.30	<0.005	0.0375	0.000635
14-Aug-23	23.7	6.40	8.90	0.0920	0.149	0.00137
15-Nov-23	33.6	7.64	27.0	0.137	0.0841	0.00128
n	4	4	4	4	4	4
Minimum	14.8	6.00	7.30	<0.005	0.0375	0.000635
Maximum	33.6	7.64	27.0	0.137	0.149	0.00220
Mean	26.0	6.58	15.6	0.0665	0.0845	0.00137
SD	8.67	0.724	9.22	0.0541	0.0471	0.000642
Summary Statistics for 2020 to 2023						
n	16	16	16	16	16	16
Minimum	14.8	6.00	5.90	<0.005	0.0260	<0.0005
Maximum	63.8	7.64	42.0	0.137	0.149	0.00256
Mean	24.2	6.80	13.1	0.0563	0.0732	0.00124
Median	21.9	6.90	9.95	0.0445	0.0715	0.00124
SD	12.1	0.404	9.48	0.0429	0.0363	0.000558
10th Percentile	14.8	6.30	6.70	0.00800	0.0298	0.000600
95th Percentile	63.8	7.64	42.0	0.137	0.149	0.00256

Indicates value exceeded Benchmarks.

Note: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

[a] Sulphate Benchmark was calculated based on the hardness of a given sample based on the BC ENV 2013 guidance.

Table C.6: Water Quality at TOMP Station Q-05 (Primary Basin Performance - ETP Operations), Quirke TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Acidity (mg/L as CaCO3)	Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
13-Jan-20	6.60	-	0.493	-	-	-	-	-	-	-
18-Feb-20	6.50	940	0.607	<1	-	0.0110	0.00560	2.50	1.12	0.0119
9-Mar-20	6.90	-	0.698	-	-	-	-	-	-	-
13-Apr-20	6.70	-	0.506	<1	-	-	-	-	-	-
11-May-20	6.70	-	0.542	1.00	-	-	-	-	-	-
8-Jun-20	6.70	-	-	1.00	-	-	-	-	-	-
15-Jun-20	6.80	840	0.654	7.00	-	0.0130	0.00470	1.04	1.16	0.00630
13-Jul-20	6.60	-	0.628	4.00	-	-	-	-	-	-
10-Aug-20	6.60	870	0.447	4.00	-	0.0120	0.00220	1.10	0.887	0.00550
14-Sep-20	6.60	-	0.361	5.00	-	-	-	-	-	-
14-Oct-20	6.60	-	0.370	6.00	-	-	-	-	-	-
9-Nov-20	6.60	810	0.357	<1	-	0.0110	0.00250	3.22	0.780	0.00930
14-Dec-20	6.80	-	0.435	<1	-	-	-	-	-	-
11-Jan-21	6.80	-	0.379	-	-	-	-	-	-	-
9-Feb-21	6.80	840	0.441	<1	-	0.0120	0.00320	2.07	0.869	0.0121
8-Mar-21	6.70	-	0.490	-	-	-	-	-	-	-
12-Apr-21	6.70	-	0.348	<1	-	-	-	-	-	-
31-May-21	6.80	730	0.558	4.00	-	0.0120	0.00370	1.15	1.08	0.00450
14-Jun-21	6.70	-	0.496	4.00	-	-	-	-	-	-
12-Jul-21	6.70	-	0.471	1.00	-	-	-	-	-	-
9-Aug-21	6.80	830	0.361	<1	-	0.0100	0.00100	0.960	0.466	0.00450
13-Sep-21	6.50	-	0.441	3.00	-	-	-	-	-	-
12-Oct-21	6.50	-	0.669	<1	-	-	-	-	-	-
15-Nov-21	6.80	980	0.770	1.00	-	0.0110	0.00280	4.93	0.833	0.0143
13-Dec-21	6.70	-	0.727	<1	-	-	-	-	-	-
10-Jan-22	6.70	-	0.708	-	-	-	-	-	-	-
14-Feb-22	6.90	890	0.752	<1	-	0.0100	0.00310	2.37	0.665	0.0152
14-Mar-22	6.70	-	0.644	-	-	-	-	-	-	-
11-Apr-22	6.60	-	0.581	<1	<1	-	-	-	-	-
9-May-22	6.60	480	0.493	<1	<1	0.00798	0.00240	0.989	0.594	0.00420
13-Jun-22	7.00	-	0.542	-	<1	-	-	-	-	-
11-Jul-22	6.80	-	-	-	1.00	-	-	-	-	-
8-Aug-22	-	940	0.489	-	13.0	0.0116	0.00130	1.11	0.590	0.00530
12-Sep-22	6.60	-	0.640	-	5.00	-	-	-	-	-
11-Oct-22	6.70	-	0.803	-	-	-	-	-	-	-
17-Oct-22	-	-	-	-	14.0	-	-	-	-	-
7-Nov-22	-	950	0.919	-	16.0	0.0136	0.00458	5.62	1.30	0.0189
12-Dec-22	6.60	-	0.961	-	7.00	-	-	-	-	-
9-Jan-23	6.60	-	0.829	-	-	-	-	-	-	-
13-Feb-23	6.80	950	0.690	-	<1	0.0105	0.00298	2.32	0.730	0.0167
13-Mar-23	6.70	-	0.672	-	-	-	-	-	-	-
24-Apr-23	6.40	440	0.495	-	<1	0.00849	0.00176	1.35	0.426	0.00743
8-May-23	6.90	470	0.374	-	<1	0.00836	0.00252	1.80	0.622	0.00708
12-Jun-23	6.90	-	0.583	-	2.00	-	-	-	-	-
10-Jul-23	6.70	-	0.444	-	4.00	-	-	-	-	-
14-Aug-23	6.30	920	0.367	-	8.00	0.0103	0.00134	1.18	0.681	0.00805
11-Sep-23	6.30	-	0.531	-	-	-	-	-	-	-
10-Oct-23	6.40	-	1.04	-	24.0	-	-	-	-	-
13-Nov-23	6.50	1,000	0.817	-	16.0	0.0127	0.00507	6.22	1.55	0.0212
11-Dec-23	6.50	-	0.923	-	15.0	-	-	-	-	-
n	47	17	47	24	18	17	17	17	17	17
Minimum	6.30	440	0.348	<1	<1	0.00798	0.00100	0.960	0.426	0.00420
Maximum	7.00	1,000	1.04	7.00	24.0	0.0136	0.00560	6.22	1.55	0.0212
Mean	6.67	816	0.586	2.21	7.28	0.0109	0.00299	2.35	0.844	0.0101
Median	6.70	870	0.542	1.00	4.50	0.0110	0.00280	1.80	0.780	0.00805
SD	0.155	182	0.178	1.93	7.34	0.00162	0.00136	1.69	0.307	0.00543
10th Percentile	6.50	470	0.367	1.00	1.00	0.00836	0.00130	0.989	0.466	0.00450
95th Percentile	6.90	1,000	0.923	6.00	24.0	0.0136	0.00560	6.22	1.55	0.0212

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected, or SD was incalculable because there was no variability in the data.

Table C.7: Water Quality at SAMP Station Q-28 (Principal Discharge Point), Quirke TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
6-Jan-20	7.70	-	0.137	-	-	-	-	-
13-Jan-20	7.60	890	0.182	0.122	0.00350	0.985	0.956	0.0128
20-Jan-20	7.40	-	0.156	-	-	-	-	-
27-Jan-20	7.20	-	0.122	-	-	-	-	-
3-Feb-20	7.20	-	0.133	-	-	-	-	-
10-Feb-20	7.50	-	0.0810	-	-	-	-	-
18-Feb-20	7.90	950	0.123	0.107	0.00390	0.649	1.06	0.0137
24-Feb-20	7.60	-	0.158	-	-	-	-	-
2-Mar-20	7.60	-	0.126	-	-	-	-	-
9-Mar-20	7.80	820	0.109	0.0900	0.00380	0.629	1.01	0.0149
16-Mar-20	7.40	-	0.166	-	-	-	-	-
23-Mar-20	7.10	-	0.116	-	-	-	-	-
30-Mar-20	7.30	-	0.110	-	-	-	-	-
6-Apr-20	7.10	-	0.177	-	-	-	-	-
13-Apr-20	7.40	550	0.167	0.147	0.00300	0.480	0.819	0.00970
20-Apr-20	8.00	-	0.153	-	-	-	-	-
27-Apr-20	7.40	-	0.146	-	-	-	-	-
4-May-20	7.20	-	0.141	-	-	-	-	-
11-May-20	7.10	480	0.140	0.144	0.00170	0.210	0.498	0.00790
19-May-20	7.10	-	0.103	-	-	-	-	-
25-May-20	7.00	-	0.0820	-	-	-	-	-
1-Jun-20	7.10	-	0.0620	-	-	-	-	-
8-Jun-20	7.10	-	0.0680	-	-	-	-	-
15-Jun-20	7.20	780	0.0400	0.0600	0.000700	0.299	0.211	0.0120
22-Jun-20	7.50	-	0.0360	-	-	-	-	-
29-Jun-20	7.20	-	0.0470	-	-	-	-	-
6-Jul-20	7.30	-	0.0310	-	-	-	-	-
13-Jul-20	7.50	810	0.0250	0.0310	0.000700	0.310	0.267	0.0143
20-Jul-20	7.40	-	0.0370	-	-	-	-	-
27-Jul-20	7.30	-	0.0480	-	-	-	-	-
4-Aug-20	7.40	-	0.0330	-	-	-	-	-
10-Aug-20	7.00	830	0.0380	0.0700	0.000800	0.334	0.268	0.0107
18-Aug-20	7.10	-	0.0350	-	-	-	-	-
24-Aug-20	7.40	-	0.0580	-	-	-	-	-
31-Aug-20	7.20	-	0.0780	-	-	-	-	-
8-Sep-20	7.30	-	0.0750	-	-	-	-	-
14-Sep-20	7.50	830	0.0670	0.122	0.000900	0.377	0.299	0.00710
21-Sep-20	7.50	-	0.0700	-	-	-	-	-
28-Sep-20	7.60	-	0.0770	-	-	-	-	-
5-Oct-20	7.60	-	0.0690	-	-	-	-	-
14-Oct-20	7.60	780	0.0630	0.102	0.00100	0.375	0.244	0.00830
19-Oct-20	7.60	-	0.0870	-	-	-	-	-
26-Oct-20	7.50	-	0.142	-	-	-	-	-
2-Nov-20	7.00	-	0.135	-	-	-	-	-
9-Nov-20	7.60	750	0.133	0.140	0.00160	0.505	0.611	0.00740
16-Nov-20	7.10	-	0.0870	-	-	-	-	-
23-Nov-20	7.50	-	0.133	-	-	-	-	-
30-Nov-20	7.60	-	0.112	-	-	-	-	-
7-Dec-20	7.70	820	0.0960	0.131	0.00260	0.730	0.824	0.00950
14-Dec-20	7.70	-	0.0830	-	-	-	-	-
21-Dec-20	7.70	-	0.100	-	-	-	-	-
29-Dec-20	7.70	-	0.0990	-	-	-	-	-
4-Jan-21	7.50	-	0.0940	-	-	-	-	-
11-Jan-21	7.70	830	0.0930	0.106	0.00260	0.837	0.830	0.0120
18-Jan-21	7.50	-	0.0800	-	-	-	-	-
25-Jan-21	7.80	-	0.0690	-	-	-	-	-
1-Feb-21	7.80	-	0.0710	-	-	-	-	-
9-Feb-21	7.80	820	0.0650	0.134	0.00280	0.635	0.946	0.0162
16-Feb-21	7.40	-	0.0700	-	-	-	-	-
22-Feb-21	7.70	-	0.0750	-	-	-	-	-
1-Mar-21	7.70	-	0.0800	-	-	-	-	-
8-Mar-21	7.70	890	0.0880	0.109	0.00280	0.597	0.880	0.0153
15-Mar-21	7.70	-	0.0660	-	-	-	-	-
22-Mar-21	7.40	-	0.0830	-	-	-	-	-
29-Mar-21	7.40	-	0.0750	-	-	-	-	-
5-Apr-21	7.10	-	0.0500	-	-	-	-	-
12-Apr-21	7.20	600	0.0510	0.0970	0.00150	0.242	0.540	0.0126
19-Apr-21	7.20	-	0.0670	-	-	-	-	-
26-Apr-21	7.20	-	0.0820	-	-	-	-	-
3-May-21	7.20	-	0.110	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.7: Water Quality at SAMP Station Q-28 (Principal Discharge Point), Quirke TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
10-May-21	7.20	-	0.0800	-	-	-	-	-
17-May-21	7.10	-	0.0980	-	-	-	-	-
25-May-21	7.30	-	0.0640	-	-	-	-	-
31-May-21	7.30	700	0.0410	0.0630	<0.0005	0.191	0.151	0.00860
7-Jun-21	7.30	-	0.0750	-	-	-	-	-
14-Jun-21	7.40	710	0.0600	0.0550	0.000800	0.304	0.267	0.0139
21-Jun-21	7.10	-	0.0660	-	-	-	-	-
28-Jun-21	7.20	-	0.0670	-	-	-	-	-
5-Jul-21	7.70	-	0.103	-	-	-	-	-
12-Jul-21	7.30	880	0.0680	0.0690	0.000700	0.306	0.186	0.00990
19-Jul-21	7.20	-	0.0710	-	-	-	-	-
26-Jul-21	7.40	-	0.0880	-	-	-	-	-
3-Aug-21	7.10	-	0.0820	-	-	-	-	-
9-Aug-21	7.20	810	0.0790	0.0820	0.000800	0.330	0.191	0.00950
16-Aug-21	7.20	-	0.0820	-	-	-	-	-
23-Aug-21	7.40	-	0.0980	-	-	-	-	-
30-Aug-21	7.00	-	0.123	-	-	-	-	-
7-Sep-21	7.10	-	0.102	-	-	-	-	-
13-Sep-21	7.10	750	0.0640	0.0650	0.00110	0.460	0.210	0.00770
20-Sep-21	7.20	-	0.0910	-	-	-	-	-
27-Sep-21	7.30	-	0.129	-	-	-	-	-
4-Oct-21	7.10	-	0.146	-	-	-	-	-
12-Oct-21	7.00	800	0.135	0.107	0.00130	0.559	0.340	0.00740
18-Oct-21	7.20	-	0.190	-	-	-	-	-
25-Oct-21	7.40	-	0.106	-	-	-	-	-
1-Nov-21	7.30	-	0.171	-	-	-	-	-
8-Nov-21	7.20	-	0.152	-	-	-	-	-
15-Nov-21	7.10	880	0.0940	0.0720	0.00120	0.387	0.249	0.0116
22-Nov-21	7.00	-	0.0820	-	-	-	-	-
29-Nov-21	7.90	-	0.117	-	-	-	-	-
6-Dec-21	8.40	-	0.0620	-	-	-	-	-
13-Dec-21	8.30	890	0.106	0.0850	0.00140	0.568	0.407	0.00670
20-Dec-21	7.60	-	0.144	-	-	-	-	-
29-Dec-21	7.40	-	0.165	-	-	-	-	-
4-Jan-22	7.30	-	0.0700	-	-	-	-	-
10-Jan-22	7.30	970	0.161	0.117	0.00280	1.28	0.759	0.0127
17-Jan-22	7.50	-	0.122	-	-	-	-	-
24-Jan-22	7.80	-	0.110	-	-	-	-	-
31-Jan-22	8.00	-	0.121	-	-	-	-	-
7-Feb-22	8.20	-	0.173	-	-	-	-	-
14-Feb-22	8.20	880	0.172	0.132	0.00270	0.863	0.679	0.0159
22-Feb-22	7.90	-	0.128	-	-	-	-	-
28-Feb-22	8.20	-	0.0510	-	-	-	-	-
7-Mar-22	7.80	-	0.169	-	-	-	-	-
14-Mar-22	7.30	940	0.111	0.118	0.00290	1.05	0.768	0.0157
21-Mar-22	7.20	-	0.140	-	-	-	-	-
29-Mar-22	7.40	-	0.118	-	-	-	-	-
4-Apr-22	8.00	-	0.125	-	-	-	-	-
11-Apr-22	7.20	720	0.157	0.118	0.00300	1.06	0.741	0.0136
18-Apr-22	7.10	-	0.126	-	-	-	-	-
25-Apr-22	7.20	-	0.151	-	-	-	-	-
2-May-22	7.40	-	0.171	-	-	-	-	-
9-May-22	7.10	430	0.155	0.176	0.000700	0.166	0.223	0.00890
16-May-22	7.10	-	0.122	-	-	-	-	-
18-May-22	7.30	-	0.0850	-	-	-	-	-
24-May-22	7.00	-	0.0700	-	-	-	-	-
30-May-22	7.20	-	0.0880	-	-	-	-	-
6-Jun-22	-	-	0.0700	-	-	-	-	-
10-Jun-22	8.20	-	-	-	-	-	-	-
13-Jun-22	7.90	760	0.0660	0.116	<0.0005	0.223	0.0990	0.00710
20-Jun-22	7.80	-	0.0620	-	-	-	-	-
21-Jun-22	7.60	-	-	-	-	-	-	-
23-Jun-22	7.60	-	-	-	-	-	-	-
24-Jun-22	7.80	-	-	-	-	-	-	-
4-Jul-22	-	-	0.0310	-	-	-	-	-
6-Jul-22	7.60	-	-	-	-	-	-	-
7-Jul-22	7.80	-	-	-	-	-	-	-
8-Jul-22	7.50	-	-	-	-	-	-	-
11-Jul-22	7.40	830	0.0390	0.0691	0.000900	0.257	0.240	0.00980
18-Jul-22	7.60	-	0.0450	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.7: Water Quality at SAMP Station Q-28 (Principal Discharge Point), Quirke TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
25-Jul-22	7.70	-	0.0500	-	-	-	-	-
26-Jul-22	-	-	0.0500	-	-	-	-	-
2-Aug-22	7.80	-	0.0360	-	-	-	-	-
8-Aug-22	8.00	880	0.0400	0.0631	0.000900	0.340	0.223	0.0118
15-Aug-22	7.90	-	0.0460	-	-	-	-	-
22-Aug-22	7.50	-	0.0370	-	-	-	-	-
29-Aug-22	-	-	0.0450	-	-	-	-	-
6-Sep-22	7.20	-	0.0460	-	-	-	-	-
12-Sep-22	7.30	980	0.0460	0.0721	0.000700	0.399	0.201	0.0124
19-Sep-22	7.30	-	0.0550	-	-	-	-	-
26-Sep-22	7.00	-	0.0680	-	-	-	-	-
3-Oct-22	7.00	-	0.0460	-	-	-	-	-
4-Oct-22	7.00	-	-	-	-	-	-	-
11-Oct-22	7.00	960	0.0590	0.0623	0.00110	0.542	0.291	0.0131
17-Oct-22	6.90	-	<0.005	-	-	-	-	-
24-Oct-22	7.00	-	-	-	-	-	-	-
31-Oct-22	7.50	-	0.107	-	-	-	-	-
7-Nov-22	7.30	970	0.129	0.0878	0.000944	0.379	0.245	0.00977
14-Nov-22	7.90	-	0.156	-	-	-	-	-
21-Nov-22	7.90	-	0.141	-	-	-	-	-
28-Nov-22	8.00	-	0.115	-	-	-	-	-
7-Dec-22	-	-	0.0690	-	-	-	-	-
12-Dec-22	7.20	940	0.166	0.0843	0.00240	0.645	0.708	0.0114
19-Dec-22	-	-	0.159	-	-	-	-	-
28-Dec-22	8.00	-	0.169	-	-	-	-	-
3-Jan-23	7.30	-	0.231	-	-	-	-	-
9-Jan-23	7.40	1,000	0.223	0.112	0.00330	1.33	1.00	0.0135
16-Jan-23	7.90	-	0.134	-	-	-	-	-
23-Jan-23	7.70	-	0.148	-	-	-	-	-
3-Feb-23	7.70	-	0.114	-	-	-	-	-
6-Feb-23	8.00	-	0.211	-	-	-	-	-
13-Feb-23	7.90	950	0.202	0.120	0.00268	0.977	0.780	0.0172
21-Feb-23	7.60	-	0.141	-	-	-	-	-
27-Feb-23	7.30	-	0.194	-	-	-	-	-
6-Mar-23	7.50	-	0.122	-	-	-	-	-
13-Mar-23	7.40	940	0.116	0.118	0.00300	0.866	0.908	0.0214
20-Mar-23	7.70	-	0.124	-	-	-	-	-
27-Mar-23	8.00	-	0.0710	-	-	-	-	-
3-Apr-23	7.70	-	0.0840	-	-	-	-	-
10-Apr-23	7.10	-	0.135	-	-	-	-	-
17-Apr-23	7.10	-	0.162	-	-	-	-	-
24-Apr-23	7.30	600	0.161	0.163	0.00261	0.901	0.616	0.0105
1-May-23	7.50	-	0.142	-	-	-	-	-
8-May-23	7.40	460	0.143	0.182	0.00176	0.471	0.513	0.00799
15-May-23	7.30	-	0.109	-	-	-	-	-
23-May-23	7.40	-	0.0910	-	-	-	-	-
29-May-23	7.60	-	0.0730	-	-	-	-	-
5-Jun-23	7.50	-	0.0580	-	-	-	-	-
12-Jun-23	7.30	720	0.0300	0.0623	0.000553	0.272	0.176	0.0134
19-Jun-23	7.90	-	0.0290	-	-	-	-	-
26-Jun-23	7.80	-	0.0310	-	-	-	-	-
4-Jul-23	7.60	-	0.0290	-	-	-	-	-
10-Jul-23	7.80	840	0.0200	0.0466	0.000662	0.259	0.213	0.0137
19-Jul-23	7.70	-	0.0320	-	-	-	-	-
24-Jul-23	7.80	-	0.0340	-	-	-	-	-
31-Jul-23	7.90	-	0.0350	-	-	-	-	-
8-Aug-23	7.60	-	0.0280	-	-	-	-	-
14-Aug-23	7.00	900	0.0360	0.0653	0.000700	0.353	0.169	0.0114
21-Aug-23	7.40	-	0.0430	-	-	-	-	-
28-Aug-23	7.50	-	0.0300	-	-	-	-	-
5-Sep-23	7.00	-	0.0340	-	-	-	-	-
11-Sep-23	7.40	-	0.0320	-	-	-	-	-
18-Sep-23	7.40	-	0.0130	-	-	-	-	-
25-Sep-23	7.40	-	0.0490	-	-	-	-	-
2-Oct-23	7.30	-	0.0480	-	-	-	-	-
10-Oct-23	7.20	950	0.0370	0.0571	0.00100	0.451	0.315	0.0142
16-Oct-23	7.20	-	0.0360	-	-	-	-	-
23-Oct-23	7.20	-	0.0400	-	-	-	-	-
30-Oct-23	7.00	-	0.182	-	-	-	-	-
6-Nov-23	7.70	-	0.0920	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.7: Water Quality at SAMP Station Q-28 (Principal Discharge Point), Quirke TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
13-Nov-23	7.70	1,000	0.147	0.0874	0.000729	0.307	0.350	0.0104
20-Nov-23	7.80	-	0.122	-	-	-	-	-
27-Nov-23	8.30	-	0.163	-	-	-	-	-
4-Dec-23	7.90	-	0.199	-	-	-	-	-
11-Dec-23	7.20	1,000	0.115	0.101	0.00330	1.14	1.14	0.0126
18-Dec-23	7.30	-	0.154	-	-	-	-	-
27-Dec-23	8.00	-	0.217	-	-	-	-	-
n	211	47	209	47	48	47	47	47
Minimum	6.90	430	<0.005	0.0310	<0.0005	0.166	0.0990	0.00670
Maximum	8.40	1,000	0.231	0.182	0.00390	1.33	1.14	0.0214
Mean	7.46	819	0.0970	0.0987	0.00176	0.550	0.503	0.0117
Median	7.40	830	0.0880	0.101	0.00135	0.460	0.350	0.0118
SD	0.319	144	0.0486	0.0346	0.00107	0.307	0.310	0.00313
10th Percentile	7.10	600	0.0360	0.0600	0.000700	0.242	0.186	0.00740
95th Percentile	8.00	1,000	0.177	0.163	0.00350	1.14	1.01	0.0162

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.8: Water Quality (pH) at Dam J Toe Seepage Point, Station Q-27, 2020 to 2023

Date	pH
10-Feb-20	5.80
20-May-20	5.90
8-Sep-20	5.70
9-Nov-20	5.90
n	4
Minimum	5.70
Maximum	5.90
Mean	5.82
SD	0.0957
11-May-21	6.10
10-Aug-21	5.80
8-Nov-21	6.20
n	3
Minimum	5.80
Maximum	6.20
Mean	6.03
SD	0.208
12-May-22	6.10
n	1
Minimum	6.10
Maximum	6.10
Mean	6.10
SD	-
23-Feb-23	6.20
15-May-23	6.30
13-Nov-23	6.20
n	3
Minimum	6.20
Maximum	6.30
Mean	6.23
SD	0.0577
Summary Statistics for 2020 to 2023	
n	11
Minimum	5.70
Maximum	6.30
Mean	6.02
Median	6.10
SD	0.204
10th Percentile	5.80
95th Percentile	6.30

Note: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data.
"SD" represents Standard Deviations.

Table C.9: Water Quality at mine-Exposed SRWMP Station Q-09, Serpent River below Quirke TMA Effluent, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Uranium (mg/L)
Cycle 5 Benchmark	-	6.55	128 to 309	0.469	1.0	0.015
4-Feb-20	54.2	7.20	47.0	0.0330	0.0670	0.00200
25-May-20	43.0	6.70	31.0	0.0690	0.0660	0.00200
19-Aug-20	46.9	6.70	31.0	0.134	0.120	0.00200
23-Nov-20	38.5	6.90	27.0	0.0270	0.0420	0.00150
n	4	4	4	4	4	4
Minimum	38.5	6.70	27.0	0.0270	0.0420	0.00150
Maximum	54.2	7.20	47.0	0.134	0.120	0.00200
Mean	45.6	6.88	34.0	0.0658	0.0738	0.00188
SD	6.65	0.236	8.87	0.0491	0.0329	0.000250
22-Feb-21	66.0	6.70	55.0	0.0360	0.0570	0.00220
20-May-21	34.7	6.80	24.0	0.0590	0.0540	0.00140
11-Aug-21	64.3	6.70	51.0	0.108	0.127	0.00140
11-Nov-21	57.9	6.80	55.0	0.0890	0.0700	0.00120
n	4	4	4	4	4	4
Minimum	34.7	6.70	24.0	0.0360	0.0540	0.00120
Maximum	66.0	6.80	55.0	0.108	0.127	0.00220
Mean	55.7	6.75	46.2	0.0730	0.0770	0.00155
SD	14.4	0.0577	15.0	0.0319	0.0340	0.000443
3-Feb-22	63.9	6.80	52.0	0.0290	0.0330	0.00130
5-May-22	23.6	6.90	14.0	0.0160	0.0304	0.000800
23-Aug-22	68.1	6.70	56.0	0.126	0.122	0.00184
24-Nov-22	169	6.20	140	0.0980	0.122	0.00340
n	4	4	4	4	4	4
Minimum	23.6	6.20	14.0	0.0160	0.0304	0.000800
Maximum	169	6.90	140	0.126	0.122	0.00340
Mean	81.2	6.65	65.5	0.0672	0.0768	0.00184
SD	61.9	0.311	53.2	0.0532	0.0521	0.00113
22-Feb-23	81.3	7.50	66.0	0.0370	0.0528	0.00277
11-May-23	21.2	6.00	14.0	0.0250	0.0393	0.00101
14-Aug-23	128	6.50	110	0.173	0.281	0.00260
1-Nov-23	152	7.10	130	0.100	0.142	0.00294
n	4	4	4	4	4	4
Minimum	21.2	6.00	14.0	0.0250	0.0393	0.00101
Maximum	152	7.50	130	0.173	0.281	0.00294
Mean	95.6	6.78	80.0	0.0838	0.129	0.00233
SD	57.6	0.660	51.5	0.0680	0.111	0.000891
Summary Statistics for 2020 to 2023						
n	16	16	16	16	16	16
Minimum	21.2	6.00	14.0	0.0160	0.0304	0.000800
Maximum	169	7.50	140	0.173	0.281	0.00340
Mean	69.5	6.76	56.4	0.0724	0.0891	0.00190
Median	60.9	6.75	51.5	0.0640	0.0665	0.00192
SD	43.6	0.354	38.6	0.0472	0.0635	0.000740
10th Percentile	23.6	6.20	14.0	0.0250	0.0330	0.00101
95th Percentile	169	7.50	140	0.173	0.281	0.00340

Indicates value exceeded Benchmarks.

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations.

Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

[a] Sulphate Benchmark was calculated based on the hardness of a given sample based on the BC ENV 2013 guidance.

Table C.10: Water Quality (pH) at mine-Exposed SRWMP Station Q-20, Outlet of Evans Lake, 2020 to 2023

Date	pH
19-Nov-20	6.80
n	1
Minimum	6.80
Maximum	6.80
Mean	6.80
SD	-
18-Nov-21	7.00
n	1
Minimum	7.00
Maximum	7.00
Mean	7.00
SD	-
23-Aug-22	7.00
7-Nov-22	6.90
n	2
Minimum	6.90
Maximum	7.00
Mean	6.95
SD	0.0707
10-May-23	6.40
17-Aug-23	7.58
31-Oct-23	7.40
n	3
Minimum	6.40
Maximum	7.58
Mean	7.13
SD	0.636
Summary Statistics for 2020 to 2023	
n	7
Minimum	6.40
Maximum	7.58
Mean	7.01
Median	7.00
SD	0.388
10th Percentile	6.40
95th Percentile	7.58

Note: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data.
"SD" represents Standard Deviations.

Table C.11: Water Quality at TOMP Station P-13 (Basin Performance - ETP Operations), Panel TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (mg/L)	Acidity (mg/L as CaCO3)	Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
13-Jan-20	7.00	89.0	0.463	<1	-	0.0310	<0.0005	0.146	0.0300	0.00720
10-Feb-20	6.90	92.0	0.402	<1	-	0.0310	<0.0005	0.360	0.0260	0.00800
11-Mar-20	7.10	97.0	0.428	<1	-	0.0260	<0.0005	0.180	0.0270	0.00770
13-Apr-20	6.90	96.0	0.321	<1	-	0.0280	<0.0005	0.169	0.0390	0.00750
19-May-20	7.10	77.0	0.519	<1	-	0.0290	<0.0005	0.203	0.125	0.00510
26-Jun-20	7.40	78.0	0.611	<1	-	0.0290	0.00170	1.64	0.643	0.00870
20-Aug-20	7.30	80.0	0.382	<1	-	0.0230	<0.0005	0.352	0.0550	0.00500
14-Sep-20	7.30	77.0	0.471	<1	-	0.0240	<0.0005	0.167	0.0220	0.00540
13-Oct-20	7.40	79.0	0.459	<1	-	0.0270	<0.0005	0.134	0.0190	0.00600
9-Nov-20	7.20	76.0	0.459	<1	-	0.0250	<0.0005	0.245	0.0210	0.00600
14-Dec-20	7.20	80.0	0.449	<1	-	0.0250	<0.0005	0.118	0.0170	0.00650
12-Jan-21	7.10	85.0	0.440	<1	-	0.0270	<0.0005	0.165	0.0180	0.00670
9-Feb-21	7.10	85.0	0.464	<1	-	0.0380	<0.0005	0.0980	0.0210	0.00650
16-Feb-21	6.70	87.0	0.480	-	-	0.0290	<0.0005	0.0690	0.0180	0.00610
22-Feb-21	7.10	86.0	0.416	-	-	0.0280	<0.0005	0.0770	0.0170	0.00730
1-Mar-21	6.90	84.0	0.421	-	-	0.0310	<0.0005	0.0640	0.0200	0.00760
8-Mar-21	7.00	85.0	0.425	<1	-	0.0276	<0.0005	0.0810	0.0207	0.00668
15-Mar-21	6.90	86.0	0.450	-	-	0.0310	<0.0005	0.0670	0.0250	0.00770
22-Mar-21	6.90	81.0	0.422	-	-	0.0344	<0.0005	0.0810	0.0332	0.00936
29-Mar-21	7.40	85.0	0.425	-	-	0.0283	<0.0005	0.0600	0.0245	0.00748
5-Apr-21	6.90	82.0	0.435	-	-	0.0298	<0.000056	0.0810	0.0225	0.00683
12-Apr-21	7.30	70.0	0.388	<1	-	0.0236	<0.0005	0.120	0.0446	0.00593
19-Apr-21	7.10	70.0	0.402	-	-	0.0242	0.000147	0.219	0.0619	0.00568
26-Apr-21	7.10	-	-	-	-	-	-	-	-	-
9-Aug-21	7.10	79.0	0.450	<1	-	0.0250	<0.0005	0.180	0.0340	0.00550
30-Nov-21	7.00	79.0	0.822	<1	-	0.0520	<0.0005	0.0590	0.0110	0.00670
13-Dec-21	7.30	75.0	0.543	<1	-	0.0518	<0.0005	0.0670	0.00880	0.00635
20-Dec-21	7.10	81.0	0.600	-	-	0.0516	<0.0005	0.0390	0.00768	0.00628
29-Dec-21	7.20	78.0	0.554	-	-	0.0501	<0.0005	0.0420	0.00720	0.00570
4-Jan-22	7.10	76.0	0.645	-	-	0.0668	<0.0005	0.129	0.00947	0.00610
17-Jan-22	6.60	80.0	0.554	<1	-	0.0555	<0.0005	0.0560	0.00915	0.00700
24-Jan-22	6.60	81.0	0.548	-	-	0.0533	<0.0005	0.0420	0.00900	0.00660
31-Jan-22	7.10	81.0	0.639	-	-	0.0548	<0.000004	0.0450	0.00907	0.00668
7-Feb-22	7.20	81.0	0.516	-	-	0.0484	<0.0005	0.0420	0.00942	0.00686
14-Feb-22	7.30	82.0	0.638	<1	-	0.0470	<0.0005	0.0390	0.00900	0.00717
22-Feb-22	6.90	82.0	0.612	-	-	0.0522	<0.0005	0.0800	0.00969	0.00730
28-Feb-22	7.00	82.0	0.551	-	-	0.0490	<0.0005	0.0600	0.0140	0.00630
7-Mar-22	7.10	84.0	0.583	<1	-	0.0580	<0.0005	0.0410	0.0110	0.00680
4-Apr-22	6.70	87.0	0.598	-	-	0.0590	<0.0005	0.196	0.0220	0.00820
11-Apr-22	7.10	89.0	0.534	<1	<1	0.0510	<0.0005	0.154	0.0260	0.00710
18-Apr-22	6.70	73.0	0.507	-	-	0.0439	0.000233	0.241	0.0365	0.00677
25-Apr-22	6.60	65.0	0.475	-	-	0.0437	<0.0005	0.132	0.0300	0.00580
2-May-22	6.90	54.0	0.400	-	-	0.0455	0.000289	0.171	0.0512	0.00385
9-May-22	6.90	62.0	0.456	-	<1	0.0372	0.000169	0.176	0.0707	0.00482
16-May-22	6.90	65.0	0.494	-	-	0.0369	<0.0005	0.174	0.0600	0.00540
24-May-22	6.90	69.0	-	-	-	0.0346	<0.0005	0.395	0.0550	0.00560
20-Jun-22	7.60	-	-	-	-	-	-	-	-	-
21-Nov-22	7.40	79.0	0.595	-	<1	0.0417	<0.0005	0.212	0.0170	0.00640
12-Dec-22	-	67.0	0.430	-	<1	0.0439	<0.0005	0.107	0.0130	0.00650
13-Feb-23	7.40	78.0	0.576	-	<1	0.0438	<0.0005	0.110	0.0140	0.00790
13-Mar-23	7.40	75.0	0.541	-	<1	0.0427	<0.0005	0.114	0.0150	0.00940
17-Apr-23	6.90	83.0	0.476	-	<1	0.0404	0.0000730	0.0980	0.0278	0.00791
8-May-23	7.20	59.0	0.476	-	-	0.0528	0.000238	0.576	0.0876	0.00485
25-Sep-23	7.00	-	-	-	-	-	-	-	-	-
13-Nov-23	7.20	81.0	0.458	-	<1	0.0401	0.0000470	0.0470	0.00929	0.00694
4-Dec-23	7.20	78.0	0.470	-	<1	0.0403	0.0000630	0.0990	0.0115	0.00696
n	55	53	52	22	9	53	54	53	54	53
Minimum	6.60	54.0	0.321	<1	<1	0.0230	<0.000004	0.0390	0.00720	0.00385
Maximum	7.60	97.0	0.822	<1	<1	0.0668	0.00170	1.64	0.643	0.00940
Mean	7.07	79.1	0.498	<1	<1	0.0389	0.000158	0.166	0.0386	0.00665
Median	7.10	80.0	0.473	<1	<1	0.0380	0.000147	0.114	0.0210	0.00668
SD	0.227	8.42	0.0888	-	-	0.0116	0.000309	0.230	0.0867	0.00110
10th Percentile	6.70	67.0	0.402	<1	<1	0.0250	0.000169	0.0420	0.00907	0.00540
95th Percentile	7.40	92.0	0.639	<1	<1	0.0580	0.000289	0.395	0.0876	0.00870

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected, or SD was incalculable because there was no variability in the data.

Table C.12: Water Quality at SAMP Station P-14 (Final Effluent Discharge), Panel TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
6-Jan-20	7.30	-	0.116	0.808	-	-	-	-
13-Jan-20	7.40	87.0	0.124	0.909	<0.0005	0.0390	0.0260	0.00710
20-Jan-20	7.30	-	0.174	1.24	-	-	-	-
27-Jan-20	7.30	-	0.120	1.27	-	-	-	-
3-Feb-20	7.20	-	0.139	1.40	-	-	-	-
11-Feb-20	7.30	94.0	0.146	0.856	<0.0005	0.0330	0.0280	0.00740
18-Feb-20	7.40	-	0.206	1.38	-	-	-	-
24-Feb-20	7.40	-	0.319	1.89	-	-	-	-
11-Mar-20	7.60	96.0	0.299	2.13	<0.0005	0.0310	0.0330	0.00900
16-Mar-20	7.70	-	0.275	2.45	-	-	-	-
23-Mar-20	7.40	-	0.262	2.61	-	-	-	-
30-Mar-20	7.40	-	0.0950	1.72	-	-	-	-
6-Apr-20	7.40	-	0.102	1.37	-	-	-	-
13-Apr-20	7.30	87.0	0.145	1.59	<0.0005	0.0720	0.0890	0.00890
20-Apr-20	7.40	-	0.217	1.89	-	-	-	-
27-Apr-20	7.40	-	0.195	1.98	-	-	-	-
4-May-20	7.30	-	0.219	2.18	-	-	-	-
11-May-20	7.30	-	0.294	2.30	-	-	-	-
19-May-20	7.50	76.0	0.298	2.40	<0.0005	0.112	0.0320	0.00630
20-Aug-20	7.30	76.0	0.0410	0.393	<0.0005	<0.02	0.0430	0.0210
24-Aug-20	7.60	-	0.122	1.12	-	-	-	-
31-Aug-20	7.30	-	0.161	1.45	-	-	-	-
8-Sep-20	7.30	-	0.190	1.56	-	-	-	-
14-Sep-20	7.60	75.0	0.229	1.64	<0.0005	0.0620	0.0500	0.00750
21-Sep-20	7.40	-	0.269	1.73	-	-	-	-
5-Oct-20	7.40	-	0.205	1.54	-	-	-	-
13-Oct-20	7.50	77.0	0.200	1.53	<0.0005	0.0560	0.0760	0.00960
19-Oct-20	7.40	-	0.169	1.26	-	-	-	-
26-Oct-20	7.20	-	0.194	1.11	-	-	-	-
2-Nov-20	7.20	-	0.213	1.25	-	-	-	-
9-Nov-20	7.40	77.0	0.322	2.02	<0.0005	0.0770	0.0250	0.00730
16-Nov-20	7.30	-	0.274	1.70	-	-	-	-
23-Nov-20	7.40	-	0.285	2.49	-	-	-	-
30-Nov-20	7.30	-	0.325	3.04	-	-	-	-
7-Dec-20	7.30	-	0.304	2.61	-	-	-	-
14-Dec-20	7.30	82.0	0.350	2.50	<0.0005	0.0760	0.0230	0.00720
29-Dec-20	7.60	-	0.265	3.72	-	-	-	-
4-Jan-21	8.40	-	0.250	4.49	-	-	-	-
12-Jan-21	7.90	85.0	0.240	4.32	<0.0005	0.0700	0.0200	0.00720
18-Jan-21	7.50	-	0.226	4.39	-	-	-	-
25-Jan-21	7.30	-	0.204	4.52	-	-	-	-
1-Feb-21	7.30	-	0.240	4.34	-	-	-	-
9-Feb-21	7.40	84.0	0.213	4.61	<0.0005	0.0530	0.0220	0.00720
16-Feb-21	7.30	86.0	0.251	3.84	<0.0005	0.0630	0.0210	0.00640
22-Feb-21	7.40	86.0	0.200	3.46	<0.0005	0.0470	0.0200	0.00800
1-Mar-21	7.30	82.0	0.271	3.35	<0.0005	0.0420	0.0220	0.00830
8-Mar-21	7.40	85.0	0.249	2.74	<0.0005	0.0450	0.0196	0.00802
15-Mar-21	7.50	84.0	0.224	2.50	<0.0005	0.0500	0.166	0.0119
22-Mar-21	7.60	84.0	0.259	2.43	<0.0005	0.0410	0.0663	0.00930
29-Mar-21	8.00	79.0	0.256	2.40	<0.0005	0.0470	0.0443	0.0103
5-Apr-21	7.40	79.0	0.239	2.25	<0.000145	0.0570	0.0354	0.00983
12-Apr-21	8.00	79.0	0.212	2.47	<0.0005	0.0550	0.0455	0.0110
19-Apr-21	7.50	60.0	0.188	2.45	0.000308	0.0650	0.0520	0.0119
9-Aug-21	7.40	74.0	0.0610	0.822	<0.0005	<0.02	0.0270	0.0322
15-Nov-21	7.70	-	0.180	1.28	-	-	-	-
30-Nov-21	7.20	75.0	0.0430	0.662	<0.0005	0.0200	0.0180	0.0170
13-Dec-21	7.30	73.0	0.169	1.03	<0.0005	0.0220	0.0165	0.0146
20-Dec-21	7.70	73.0	0.378	2.29	<0.0005	0.0230	0.0111	0.00904
29-Dec-21	7.50	78.0	0.488	3.14	<0.0005	0.0260	0.00831	0.00730

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.12: Water Quality at SAMP Station P-14 (Final Effluent Discharge), Panel TMA 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
4-Jan-22	7.50	73.0	0.107	1.97	<0.0005	0.0190	0.00708	0.00700
17-Jan-22	7.50	78.0	0.0860	1.43	<0.0005	0.0170	0.00784	0.00773
24-Jan-22	8.00	78.0	0.114	1.49	<0.0005	<0.02	0.00800	0.00660
31-Jan-22	7.40	77.0	0.108	1.18	<0.000004	0.0180	0.00841	0.00673
7-Feb-22	7.40	78.0	0.0720	1.09	<0.0005	0.0150	0.00817	0.00678
14-Feb-22	7.50	80.0	-	1.08	<0.0005	<0.02	0.00900	0.00752
22-Feb-22	7.50	78.0	0.0940	1.12	<0.0005	0.0170	0.00919	0.00721
28-Feb-22	7.40	82.0	0.0940	1.28	<0.0005	0.0200	0.0100	0.00640
7-Mar-22	7.20	81.0	0.211	1.93	<0.0005	<0.02	0.0110	0.00680
4-Apr-22	7.90	81.0	0.128	1.26	<0.0005	0.0240	0.0150	0.0103
11-Apr-22	7.40	79.0	0.272	2.17	<0.0005	0.0300	0.0180	0.00790
18-Apr-22	7.60	73.0	0.280	1.52	0.000154	0.0930	0.0398	0.00844
25-Apr-22	7.50	64.0	0.325	2.46	<0.0005	0.126	0.0450	0.00710
2-May-22	7.60	62.0	0.229	2.16	0.000186	0.119	0.0412	0.00604
9-May-22	7.70	60.0	0.247	1.06	0.000180	0.0910	0.0567	0.00621
16-May-22	7.50	66.0	0.230	0.624	<0.0005	0.0780	0.0620	0.00680
24-May-22	7.40	68.0	0.231	1.19	<0.0005	0.508	0.0480	0.00780
6-Jun-22	7.40	-	-	-	-	-	-	-
9-Jun-22	-	-	0.156	-	-	-	-	-
13-Jun-22	8.20	-	0.195	1.81	-	-	-	-
20-Jun-22	8.00	-	-	-	-	-	-	-
17-Nov-22	-	-	0.0150	0.527	-	-	-	-
21-Nov-22	7.60	75.0	0.0440	1.25	<0.0005	0.0530	0.0270	0.0220
28-Nov-22	7.90	-	0.0930	1.03	-	-	-	-
5-Dec-22	7.40	-	-	0.971	-	-	-	-
12-Dec-22	7.70	74.0	0.0560	0.923	<0.0005	0.0420	0.0130	0.00690
19-Dec-22	7.70	-	0.0650	-	-	-	-	-
3-Feb-23	7.60	-	0.0130	0.876	-	-	-	-
6-Feb-23	7.70	-	0.104	1.21	-	-	-	-
13-Feb-23	7.80	73.0	0.0420	1.16	<0.0005	0.0330	0.0350	0.00820
21-Feb-23	7.80	-	0.203	0.889	-	-	-	-
27-Feb-23	7.90	-	0.0600	1.11	-	-	-	-
6-Mar-23	7.50	-	0.0600	1.57	-	-	-	-
13-Mar-23	7.80	100	0.0550	0.542	<0.0005	0.0230	0.0190	0.00950
10-Apr-23	7.90	-	0.0720	1.09	-	-	-	-
17-Apr-23	7.30	71.0	0.115	1.10	0.0000900	0.0340	0.0311	0.00819
24-Apr-23	7.40	-	0.128	2.11	-	-	-	-
1-May-23	7.40	-	0.206	2.54	-	-	-	-
8-May-23	8.20	58.0	0.261	4.13	0.000285	0.123	0.0811	0.00694
15-May-23	7.60	-	0.330	3.79	-	-	-	-
23-May-23	7.60	-	0.317	4.13	-	-	-	-
6-Nov-23	7.50	-	0.0680	1.11	-	-	-	-
13-Nov-23	7.60	67.0	0.0480	1.31	0.0000680	0.0270	0.0129	0.0144
20-Nov-23	7.60	-	0.0480	1.04	-	-	-	-
27-Nov-23	7.60	-	0.0600	1.31	-	-	-	-
4-Dec-23	7.80	73.0	0.105	1.28	0.0000630	0.0480	0.0113	0.00665
11-Dec-23	7.70	-	0.117	1.20	-	-	-	-
18-Dec-23	7.80	-	0.0600	1.10	-	-	-	-
n	106	52	104	104	53	53	53	52
Minimum	7.20	58.0	0.0130	0.393	<0.000004	0.0150	0.00708	0.00604
Maximum	8.40	100	0.488	4.61	0.000308	0.508	0.166	0.0322
Mean	7.52	77.3	0.184	1.89	0.000139	0.0558	0.0318	0.00936
Median	7.50	78.0	0.198	1.54	0.000122	0.0420	0.0230	0.00776
SD	0.238	8.57	0.0947	1.03	0.000216	0.0700	0.0276	0.00468
10th Percentile	7.30	66.0	0.0600	0.909	0.000180	0.0170	0.00841	0.00660
95th Percentile	8.00	94.0	0.325	4.32	0.000308	0.123	0.0811	0.0210

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.13: Water Quality at mine-Exposed SRWMP Station SR-01, Quirke Lake, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Uranium (mg/L)
Cycle 5 Benchmark	-	6.55	128 to 218	0.469	1.0	0.015
19-Oct-20	34.3	6.80	24.0	0.0290	0.0420	0.00120
30-Sep-21	28.9	6.90	26.0	0.0270	0.0410	0.00110
29-Sep-22	37.8	6.40	25.0	<0.005	0.0422	0.00100
28-Sep-23	35.6	7.48	27.0	0.0220	0.0434	0.00119
Summary Statistics for 2020 to 2023						
n	4	4	4	4	4	4
Minimum	28.9	6.40	24.0	<0.005	0.0410	0.00100
Maximum	37.8	7.48	27.0	0.0290	0.0434	0.00120
Mean	34.2	6.90	25.5	0.0208	0.0422	0.00112
Median	35.0	6.85	25.5	0.0245	0.0421	0.00114
SD	3.79	0.446	1.29	0.00377	0.000985	0.0000932
10th Percentile	28.9	6.40	24.0	0.0220	0.0410	0.00100
95th Percentile	37.8	7.48	27.0	0.0290	0.0434	0.00120

Indicates value exceeded Benchmarks.

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

[a] Sulphate Benchmark was calculated based on the hardness of a given sample based on the BC ENV 2013 guidance.

Table C.14: Water Quality at TOMP Station CL-04 (Basin Performance - Primary, ETP Operations), Stanleigh TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Acidity (mg/L as CaCO3)	Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
6-Jan-20	6.70	-	0.464	-	-	-	-	-	-	-
3-Feb-20	6.60	46.0	0.457	<1	-	0.0350	<0.0005	0.0200	0.0230	0.00110
2-Mar-20	6.60	-	0.424	-	-	-	-	-	-	-
6-Apr-20	6.90	-	0.433	-	-	-	-	-	-	-
25-May-20	6.70	42.0	0.432	<1	-	0.0300	<0.0005	0.0820	0.0450	0.00100
28-Sep-20	7.00	46.0	0.356	<1	-	0.0310	<0.0005	0.0250	0.00700	0.000700
5-Oct-20	6.80	-	0.383	-	-	-	-	-	-	-
2-Nov-20	6.80	42.0	0.417	<1	-	0.0300	<0.0005	0.0480	0.0180	0.00100
7-Dec-20	6.90	-	0.437	-	-	-	-	-	-	-
11-Jan-21	6.80	-	0.414	-	-	-	-	-	-	-
1-Feb-21	6.80	43.0	0.402	<1	-	0.0310	<0.0005	0.0290	0.0120	0.000900
17-Feb-21	6.70	39.0	0.411	-	-	0.0340	<0.0005	<0.02	0.0130	0.000900
23-Feb-21	6.70	44.0	0.397	-	-	0.0400	<0.0005	0.0200	0.0140	0.00110
2-Mar-21	6.70	43.0	0.432	<1	-	0.0340	<0.0005	<0.02	0.0130	0.00100
9-Mar-21	6.80	43.0	0.406	-	-	0.0340	<0.0005	<0.02	0.0130	0.00102
16-Mar-21	6.80	42.0	0.401	-	-	0.0317	0.0000840	0.0220	0.0153	0.000950
23-Mar-21	6.70	40.0	0.403	-	-	0.0310	<0.0005	0.0250	0.0220	0.000900
30-Mar-21	6.90	39.0	0.393	-	-	0.0350	<0.0005	0.0380	0.0300	0.00110
22-Nov-21	6.90	42.0	0.437	<1	-	0.0350	<0.0005	0.115	0.0150	0.000800
1-Dec-21	6.70	42.0	0.498	-	-	0.0301	<0.0005	0.0250	0.00994	0.000741
7-Dec-21	6.60	41.0	0.369	<1	-	0.0310	<0.0005	0.0240	0.00900	0.000700
14-Dec-21	6.70	42.0	0.447	-	-	0.0330	<0.0005	0.0170	0.00759	0.000897
21-Dec-21	6.70	40.0	0.378	-	-	0.0320	<0.0005	<0.02	0.00700	0.000800
29-Dec-21	6.70	42.0	0.354	-	-	0.0327	<0.0005	0.0190	0.00582	0.000741
5-Jan-22	6.60	42.0	0.366	<1	-	0.0340	<0.0005	<0.02	0.00500	0.000700
11-Jan-22	6.70	41.0	0.374	-	-	0.0300	<0.0005	<0.02	0.00400	0.000700
18-Jan-22	6.70	47.0	0.447	-	-	0.0328	<0.0005	0.0180	0.00415	0.000889
25-Jan-22	6.70	43.0	0.365	-	-	0.0314	<0.0005	0.0130	0.00374	0.000807
1-Feb-22	6.60	42.0	0.415	<1	-	0.0340	<0.0005	<0.02	0.00400	0.000800
8-Feb-22	6.50	42.0	0.363	-	-	0.0281	<0.0005	0.0140	0.00397	0.000652
15-Feb-22	6.60	44.0	0.377	-	-	0.0360	<0.0005	0.0120	0.00397	0.000757
23-Feb-22	6.50	44.0	0.390	-	-	0.0320	<0.0005	<0.02	0.00300	0.000800
1-Mar-22	6.60	41.0	0.367	<1	-	0.0319	<0.0005	0.0190	0.00385	0.000758
8-Mar-22	6.50	44.0	0.363	-	-	0.0311	<0.0005	0.0140	0.00372	0.000803
22-Mar-22	6.60	43.0	0.367	-	-	0.0347	0.0000100	0.0190	0.00572	0.000727
29-Mar-22	6.70	46.0	0.338	-	-	0.0342	0.0000260	0.0210	0.00752	0.000826
5-Apr-22	6.60	44.0	0.322	<2	-	0.0306	<0.0005	0.0160	0.00689	0.000725
12-Apr-22	6.50	43.0	0.320	-	-	0.0299	0.0000240	0.0220	0.00691	0.000931
19-Apr-22	6.60	39.0	0.364	-	-	0.0297	0.000161	0.0520	0.0176	0.000739
26-Apr-22	6.40	31.0	0.305	-	-	0.0264	0.000207	0.129	0.0284	0.000788
3-May-22	6.50	38.0	-	<1	-	0.0275	0.000153	0.0590	0.0275	0.000824
14-Jun-22	6.70	38.0	0.424	-	8.00	0.0308	<0.0005	-	-	0.000754
24-Jan-23	6.70	42.0	0.321	-	<1	0.0366	0.0000450	<0.02	0.0134	0.000902
7-Feb-23	6.90	44.0	0.399	-	<1	0.0326	0.0000460	0.0150	0.0123	0.000825
7-Mar-23	6.80	41.0	0.324	-	<1	0.0321	<0.0005	<0.02	0.0120	0.000800
4-Apr-23	6.90	43.0	0.267	-	<1	0.0324	<0.0005	0.440	0.0130	0.000800
2-May-23	6.70	23.0	0.148	-	<1	0.0207	0.000191	0.0880	0.0187	0.000634
18-May-23	6.40	35.0	0.303	-	-	0.0460	0.000171	0.0570	0.0275	0.000774
19-May-23	6.70	-	-	-	-	-	-	-	-	-
23-May-23	6.50	33.0	0.287	-	-	0.0346	0.000121	0.0530	0.0254	0.000821
24-May-23	6.80	-	-	-	-	-	-	-	-	-
25-May-23	6.80	34.0	0.256	-	-	0.0344	0.000138	0.0550	0.0243	0.000776
29-May-23	6.30	40.0	0.293	-	-	0.0328	0.000122	0.0430	0.0223	0.000787
30-May-23	6.90	-	-	-	-	-	-	-	-	-
31-May-23	6.80	-	-	-	-	-	-	-	-	-
1-Jun-23	6.80	-	0.317	-	-	-	-	-	-	-
2-Jun-23	6.80	-	-	-	-	-	-	-	-	-
5-Jun-23	-	40.0	0.324	-	<1	0.0286	0.0000850	0.0340	0.0211	0.000816
6-Jun-23	6.60	-	-	-	-	-	-	-	-	-
7-Jun-23	6.70	-	-	-	-	-	-	-	-	-
8-Jun-23	6.70	-	-	-	-	-	-	-	-	-
19-Jun-23	6.60	32.0	0.253	-	<2	0.0330	0.0000290	0.0240	0.0132	0.000730
20-Jun-23	6.60	-	-	-	-	-	-	-	-	-
21-Jun-23	6.60	-	-	-	-	-	-	-	-	-
22-Jun-23	6.70	36.0	0.326	-	-	0.0300	0.0000420	0.0390	0.0138	0.000729
23-Jun-23	6.70	-	-	-	-	-	-	-	-	-
26-Jun-23	-	39.0	0.250	-	-	0.0326	0.0000270	0.0180	0.0145	0.000790
28-Jun-23	6.80	-	-	-	-	-	-	-	-	-
29-Jun-23	6.80	37.0	0.226	-	-	0.0279	0.0000580	0.0240	0.0143	0.000723
30-Jun-23	6.80	-	-	-	-	-	-	-	-	-
4-Jul-23	6.80	37.0	0.219	-	<1	0.0323	0.0000260	0.0260	0.0142	0.000711
6-Jul-23	6.60	38.0	0.235	-	-	0.0290	0.0000250	0.0500	0.0124	0.000724
7-Jul-23	6.80	-	-	-	-	-	-	-	-	-
10-Jul-23	6.70	37.0	0.295	-	-	0.0304	0.0000260	0.0320	0.0136	0.000741
11-Jul-23	6.70	-	-	-	-	-	-	-	-	-
13-Jul-23	6.80	37.0	0.226	-	-	0.0287	0.0000270	0.0240	0.0130	0.000651
14-Jul-23	6.90	-	-	-	-	-	-	-	-	-
17-Jul-23	-	37.0	0.198	-	-	0.0318	0.0000480	0.353	0.0131	0.000688
19-Jul-23	6.70	-	-	-	-	-	-	-	-	-
20-Jul-23	6.70	36.0	0.307	-	-	0.0312	0.0000360	0.220	0.0116	0.000656
21-Nov-23	-	40.0	0.217	-	<1	0.0350	0.0000520	0.0250	0.0115	0.000706
5-Dec-23	6.90	44.0	0.305	-	<1	0.0433	0.0000310	0.0210	0.00963	0.000798
n	81	59	67	13	11	59	64	58	59	59
Minimum	6.30	23.0	0.148	<1	<1	0.0207	0.0000100	0.0120	0.00300	0.000634
Maximum	7.00	47.0	0.498	<2	8.00	0.0460	0.000207	0.440	0.0450	0.00110
Mean	6.70	40.3	0.349	<1	1.64	0.0322	0.0000725	0.0476	0.0131	0.000807
SD	0.132	4.19	0.0742	-	-	0.00370	0.0000902	0.0754	0.00831	0.000115
Median	6.70	42.0	0.364	<1	1.00	0.0320	0.0000455	0.0240	0.0130	0.000790
10th Percentile	6.50	35.0	0.235	<1	1.00	0.0286	0.0000240	0.0140	0.00397	0.000688
95th Percentile	6.90	46.0	0.447	<1	8.00	0.0400	0.000191	0.220	0.0284	0.00110

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected, or SD was incalculable because there was no variability in the data.

Table C15: Water Quality at SAMP Station CL-06 (Final Effluent Discharge), Stanleigh TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
6-Jan-20	6.70	46.0	0.155	0.191	<0.0005	0.0280	0.0250	0.00130
13-Jan-20	6.80	-	0.182	0.285	-	-	-	-
20-Jan-20	6.70	-	0.217	0.518	-	-	-	-
27-Jan-20	6.70	-	0.211	0.627	-	-	-	-
3-Feb-20	6.70	47.0	0.165	0.442	<0.0005	0.0210	0.0230	0.00120
10-Feb-20	6.70	-	0.207	0.558	-	-	-	-
18-Feb-20	6.80	-	0.175	0.495	-	-	-	-
24-Feb-20	6.70	-	0.184	0.501	-	-	-	-
2-Mar-20	6.70	48.0	0.177	0.524	<0.0005	<0.02	0.0230	0.00100
9-Mar-20	6.70	-	0.168	0.454	-	-	-	-
16-Mar-20	6.80	-	0.221	0.664	-	-	-	-
23-Mar-20	6.80	-	0.216	0.784	-	-	-	-
30-Mar-20	6.60	-	0.116	0.284	-	-	-	-
6-Apr-20	6.70	26.0	0.0780	0.141	<0.0005	0.0370	0.0220	0.000900
13-Apr-20	6.70	-	0.0640	0.164	-	-	-	-
20-Apr-20	6.70	-	0.0890	0.212	-	-	-	-
27-Apr-20	6.70	-	0.0890	0.401	-	-	-	-
4-May-20	6.60	-	0.209	1.05	-	-	-	-
11-May-20	6.60	-	0.224	0.993	-	-	-	-
19-May-20	6.80	-	0.227	0.903	-	-	-	-
25-May-20	6.80	42.0	0.100	0.676	<0.0005	0.0690	0.0440	0.00120
18-Sep-20	7.00	-	0.0770	0.338	-	-	-	-
21-Sep-20	6.90	-	0.125	0.469	-	-	-	-
28-Sep-20	6.90	44.0	0.167	0.458	<0.0005	<0.02	0.00800	0.00180
5-Oct-20	6.90	46.0	0.160	0.511	<0.0005	0.0350	0.0640	0.00140
13-Oct-20	6.80	-	0.175	0.581	-	-	-	-
19-Oct-20	6.80	-	0.187	0.389	-	-	-	-
26-Oct-20	6.90	-	0.176	0.612	-	-	-	-
2-Nov-20	6.80	41.0	0.207	0.561	<0.0005	0.0360	0.0170	0.00160
9-Nov-20	7.00	-	0.177	0.587	-	-	-	-
16-Nov-20	6.90	-	0.220	0.682	-	-	-	-
23-Nov-20	6.90	-	0.201	0.860	-	-	-	-
30-Nov-20	6.80	-	0.214	0.902	-	-	-	-
7-Dec-20	6.80	42.0	0.196	0.667	<0.0005	0.0320	0.0150	0.00130
14-Dec-20	6.90	-	0.175	0.630	-	-	-	-
21-Dec-20	6.80	-	0.149	0.664	-	-	-	-
29-Dec-20	7.00	-	0.128	0.282	-	-	-	-
4-Jan-21	6.70	-	0.154	0.546	-	-	-	-
11-Jan-21	6.80	43.0	0.138	0.349	<0.0005	<0.02	0.0140	0.00110
18-Jan-21	6.80	-	0.123	0.0670	-	-	-	-
25-Jan-21	6.90	-	0.103	0.730	-	-	-	-
1-Feb-21	6.80	43.0	0.149	0.331	<0.0005	<0.02	0.0140	0.00100
9-Feb-21	6.70	-	0.164	0.808	-	-	-	-
17-Feb-21	6.90	-	0.129	0.489	-	-	-	-
27-Feb-21	6.80	-	0.143	-	-	-	-	-
2-Mar-21	6.70	43.0	0.176	0.414	<0.0005	<0.02	0.0140	0.00100
9-Mar-21	6.90	-	0.126	0.292	-	-	-	-
16-Mar-21	6.90	-	0.102	0.169	-	-	-	-
23-Mar-21	6.70	-	0.0930	0.130	-	-	-	-
30-Mar-21	6.70	-	0.130	0.435	-	-	-	-
18-Nov-21	7.00	-	0.0750	0.522	-	-	-	-
22-Nov-21	6.90	36.0	0.113	0.703	<0.0005	0.0410	0.0420	0.00300
1-Dec-21	6.80	-	0.198	0.323	-	-	-	-
7-Dec-21	6.80	39.0	0.175	0.195	<0.0005	0.0310	0.0222	0.00164
14-Dec-21	6.70	-	0.113	0.0567	-	-	-	-
21-Dec-21	6.70	-	0.102	0.245	-	-	-	-
29-Dec-21	6.70	-	0.171	0.275	-	-	-	-
5-Jan-22	6.60	42.0	0.130	0.332	<0.0005	<0.02	0.0100	0.00100
11-Jan-22	6.70	-	0.176	0.578	-	-	-	-
18-Jan-22	6.70	-	0.147	0.393	-	-	-	-
25-Jan-22	6.60	-	0.174	0.334	-	-	-	-
1-Feb-22	6.70	43.0	0.148	0.254	<0.0005	0.0150	0.00728	0.000888
8-Feb-22	6.70	-	0.242	0.434	-	-	-	-
15-Feb-22	6.60	-	0.147	0.588	-	-	-	-
23-Feb-22	6.80	-	0.213	0.616	-	-	-	-
1-Mar-22	6.60	45.0	0.142	0.462	<0.0005	0.0190	0.00721	0.000882
8-Mar-22	6.60	-	0.156	0.507	-	-	-	-
15-Mar-22	6.60	-	0.166	0.590	-	-	-	-
22-Mar-22	6.70	-	0.121	0.385	-	-	-	-
29-Mar-22	6.60	-	0.113	0.220	-	-	-	-
5-Apr-22	6.60	40.0	0.362	0.358	<0.0005	0.0330	0.0154	0.000908
12-Apr-22	6.50	-	0.0810	0.240	-	-	-	-
19-Apr-22	6.50	-	0.0690	0.179	-	-	-	-
26-Apr-22	6.50	-	0.134	1.06	-	-	-	-
3-May-22	6.60	36.0	-	1.00	0.000123	0.0860	0.0410	0.00138
10-Jun-22	6.90	-	0.0790	0.301	-	-	-	-
14-Jun-22	6.80	36.0	0.147	0.982	<0.0005	0.0340	0.0310	0.00134

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C15: Water Quality at SAMP Station CL-06 (Final Effluent Discharge), Stanleigh TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
24-Jan-23	6.80	38.0	0.0670	0.314	0.0000470	0.0270	0.0207	0.00266
31-Jan-23	6.90	-	0.101	0.566	-	-	-	-
7-Feb-23	6.90	-	-	-	-	-	-	-
14-Feb-23	6.90	-	0.151	0.630	-	-	-	-
21-Feb-23	6.90	-	0.102	0.386	-	-	-	-
28-Feb-23	7.00	-	0.138	0.576	-	-	-	-
7-Mar-23	6.90	41.0	0.153	0.397	<0.0005	<0.02	0.0140	0.00100
14-Mar-23	6.70	-	0.216	0.673	-	-	-	-
21-Mar-23	6.80	-	0.148	0.619	-	-	-	-
28-Mar-23	6.80	-	0.122	0.386	-	-	-	-
4-Apr-23	6.70	38.0	0.0980	0.258	<0.0005	1.30	0.0200	0.000900
11-Apr-23	6.60	-	0.130	0.470	-	-	-	-
18-Apr-23	6.80	-	0.0470	0.287	-	-	-	-
25-Apr-23	6.70	-	0.0940	0.530	-	-	-	-
2-May-23	6.70	33.0	0.0100	1.26	0.000118	0.0520	0.0189	0.00131
9-May-23	6.60	-	0.226	0.823	-	-	-	-
16-May-23	6.70	-	0.208	0.848	0.000115	0.0560	0.0248	0.00125
18-May-23	6.60	33.0	0.179	0.515	0.000153	0.0500	0.0273	0.00123
19-May-23	6.70	-	-	-	-	-	-	-
23-May-23	6.60	34.0	0.169	0.368	0.000106	0.0490	0.0282	0.00119
24-May-23	6.90	-	-	-	-	-	-	-
25-May-23	6.90	35.0	0.166	0.411	0.0000800	0.0390	0.0226	0.00105
29-May-23	6.70	39.0	0.205	0.264	0.0000780	0.0330	0.0232	0.00108
30-May-23	6.80	-	-	-	-	-	-	-
31-May-23	6.70	-	-	-	-	-	-	-
1-Jun-23	6.70	-	0.188	-	-	-	-	-
5-Jun-23	6.70	39.0	0.218	0.554	0.0000820	0.0340	0.0225	0.00114
7-Jun-23	6.70	-	-	-	-	-	-	-
8-Jun-23	6.60	-	-	-	-	-	-	-
16-Jun-23	6.60	-	-	-	-	-	-	-
19-Jun-23	6.60	32.0	0.201	0.334	0.0000190	0.0270	0.0233	0.00106
20-Jun-23	6.50	-	-	-	-	-	-	-
21-Jun-23	6.50	-	-	-	-	-	-	-
22-Jun-23	6.60	34.0	0.144	0.183	0.0000290	0.0150	0.0165	0.00100
23-Jun-23	6.60	-	-	-	-	-	-	-
26-Jun-23	6.50	39.0	0.190	0.617	0.0000350	0.0190	0.0212	0.00106
28-Jun-23	6.70	-	-	-	-	-	-	-
29-Jun-23	6.60	37.0	0.151	0.364	0.0000180	0.0160	0.0189	0.000997
30-Jun-23	6.70	-	-	-	-	-	-	-
4-Jul-23	6.60	37.0	0.220	0.471	0.0000300	0.0230	0.0254	0.00101
6-Jul-23	6.50	40.0	0.164	0.448	0.0000130	0.0170	0.0156	0.000927
7-Jul-23	6.60	-	-	-	-	-	-	-
10-Jul-23	6.70	38.0	0.149	0.470	0.00000800	0.0160	0.0146	0.000936
11-Jul-23	6.50	-	-	-	-	-	-	-
13-Jul-23	6.60	37.0	0.140	0.604	0.0000150	0.0170	0.0137	0.000794
14-Jul-23	6.70	-	-	-	-	-	-	-
17-Jul-23	6.50	38.0	0.161	0.592	0.0000190	0.0390	0.0168	0.000836
18-Jul-23	6.50	-	-	-	-	-	-	-
19-Jul-23	6.50	-	-	-	-	-	-	-
20-Jul-23	6.50	33.0	0.136	0.454	0.0000190	0.0440	0.0162	0.000814
14-Nov-23	6.90	-	0.0590	0.507	-	-	-	-
21-Nov-23	7.00	37.0	0.0880	0.564	0.0000440	0.0330	0.0331	0.00199
28-Nov-23	7.00	-	0.0910	0.554	-	-	-	-
5-Dec-23	6.90	42.0	0.150	0.593	0.0000290	0.0210	0.0163	0.00141
12-Dec-23	7.00	-	0.174	0.474	-	-	-	-
19-Dec-23	7.00	-	0.185	0.608	-	-	-	-
27-Dec-23	6.90	-	0.187	0.420	-	-	-	-
n	135	42	123	117	44	44	44	44
Minimum	6.50	<0.2	<0.005	0.0567	0.00000800	0.0150	0.00721	0.000794
Maximum	7.00	48.0	0.362	1.32	0.000153	1.30	0.0640	0.00300
Mean	6.74	38.1	0.152	0.502	0.0000572	0.0600	0.0216	0.00122
SD	0.138	4.99	0.0510	0.238	0.0000611	0.192	0.0106	0.000442
Median	6.70	39.0	0.155	0.474	0.0000350	0.0295	0.0196	0.00107
10th Percentile	6.60	33.0	0.0880	0.220	0.0000150	0.0160	0.0137	0.000888
95th Percentile	7.00	46.0	0.220	0.993	0.000123	0.0690	0.0420	0.00199

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.16: Water Quality at Mine-Exposed SRWMP Station SR-06, McCabe Outlet, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Uranium (mg/L)
Cycle 5 Benchmark	-	6.55	218	0.469	1.0	0.015
25-Jun-20	35.3	7.40	27.0	0.0550	0.130	0.000500
19-Oct-20	38.5	7.00	25.0	0.0520	0.166	0.000600
n	2	2	2	2	2	2
Minimum	35.3	7.00	25.0	0.0520	0.130	0.000500
Maximum	38.5	7.40	27.0	0.0550	0.166	0.000600
Mean	36.9	7.20	26.0	0.0535	0.148	0.000550
SD	2.26	0.283	1.41	0.00212	0.0255	0.0000707
13-May-21	35.7	7.20	24.0	0.0400	0.125	0.000600
13-Oct-21	36.5	6.90	23.0	0.0520	0.151	<0.0005
n	2	2	2	2	2	2
Minimum	35.7	6.90	23.0	0.0400	0.125	<0.0005
Maximum	36.5	7.20	24.0	0.0520	0.151	0.000600
Mean	36.1	7.05	23.5	0.0460	0.138	0.000550
SD	0.566	0.212	0.707	0.00849	0.0184	-
25-May-22	33.6	6.50	23.0	0.0400	0.112	0.000600
29-Sep-22	36.3	6.90	23.0	0.0410	0.136	0.000500
n	2	2	2	2	2	2
Minimum	33.6	6.50	23.0	0.0400	0.112	0.000500
Maximum	36.3	6.90	23.0	0.0410	0.136	0.000600
Mean	35.0	6.70	23.0	0.0405	0.124	0.000550
SD	1.91	0.283	0	0.000707	0.0170	0.0000707
25-May-23	33.9	6.20	2.10	0.0420	0.152	0.000487
2-Nov-23	37.1	6.70	21.0	0.0460	0.142	0.000559
n	2	2	2	2	2	2
Minimum	33.9	6.20	2.10	0.0420	0.142	0.000487
Maximum	37.1	6.70	21.0	0.0460	0.152	0.000559
Mean	35.5	6.45	11.6	0.0440	0.147	0.000523
SD	2.26	0.354	13.4	0.00283	0.00707	0.0000509
Summary Statistics for 2020 to 2023						
n	8	8	8	8	8	8
Minimum	33.6	6.20	2.10	0.0400	0.112	0.000487
Maximum	38.5	7.40	27.0	0.0550	0.166	0.000600
Mean	35.9	6.85	21.0	0.0460	0.139	0.000542
Median	36.0	6.90	23.0	0.0440	0.139	0.000530
SD	1.62	0.382	7.84	0.00616	0.0172	0.0000539
10th Percentile	33.6	6.20	2.10	0.0400	0.112	0.000487
95th Percentile	38.5	7.40	27.0	0.0550	0.166	0.000600

Indicates value exceeded Benchmarks

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

[a] Sulphate Benchmark was calculated based on the hardness of a given sample based on the BC ENV 2013 guidance.

Table C.17: Water Quality at mine-Exposed SRWMP Stations SR-15, May Lake Outlet, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Uranium (mg/L)
Cycle 5 Benchmark	-	5.3	218	0.469	1.0	0.015
25-Jun-20	40.7	7.30	28.0	0.0470	0.101	<0.0005
19-Oct-20	40.5	7.00	26.0	0.0420	0.104	<0.0005
n	2	2	2	2	2	2
Minimum	40.5	7.00	26.0	0.0420	0.101	<0.0005
Maximum	40.7	7.30	28.0	0.0470	0.104	<0.0005
Mean	40.6	7.15	27.0	0.0445	0.102	<0.0005
SD	0.141	0.212	1.41	0.00354	0.00212	-
13-May-21	40.9	7.10	25.0	0.0400	0.0910	<0.0005
13-Oct-21	43.5	6.90	25.0	0.0540	0.0830	<0.0005
n	2	2	2	2	2	2
Minimum	40.9	6.90	25.0	0.0400	0.0830	<0.0005
Maximum	43.5	7.10	25.0	0.0540	0.0910	<0.0005
Mean	42.2	7.00	25.0	0.0470	0.0870	<0.0005
SD	1.84	0.141	0	0.00990	0.00566	-
25-May-22	36.9	6.50	25.0	0.0420	0.0623	<0.0005
23-Sep-22	41.3	7.10	25.0	0.0630	0.0667	<0.0005
n	2	2	2	2	2	2
Minimum	36.9	6.50	25.0	0.0420	0.0623	<0.0005
Maximum	41.3	7.10	25.0	0.0630	0.0667	<0.0005
Mean	39.1	6.80	25.0	0.0525	0.0645	<0.0005
SD	3.11	0.424	0	0.0148	0.00311	-
25-May-23	38.1	6.30	2.30	0.0240	0.0602	0.000323
14-Nov-23	35.9	7.30	26.0	0.0230	0.0636	0.000373
n	2	2	2	2	2	2
Minimum	35.9	6.30	2.30	0.0230	0.0602	0.000323
Maximum	38.1	7.30	26.0	0.0240	0.0636	0.000373
Mean	37.0	6.80	14.2	0.0235	0.0619	0.000348
SD	1.56	0.707	16.8	0.000707	0.00240	0.0000354
Summary Statistics for 2020 to 2023						
n	8	8	8	8	8	8
Minimum	35.9	6.30	2.30	0.0230	0.0602	0.000323
Maximum	43.5	7.30	28.0	0.0630	0.104	0.000373
Mean	39.7	6.94	22.8	0.0419	0.0790	0.000348
Median	40.6	7.05	25.0	0.0420	0.0748	0.000348
SD	2.53	0.362	8.34	0.0136	0.0181	0.0000707
10th Percentile	35.9	6.30	2.30	0.0230	0.0602	0.000323
95th Percentile	43.5	7.30	28.0	0.0630	0.104	0.000373

Indicates value exceeded Benchmarks

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

[a] Sulphate Benchmark was calculated based on the hardness of a given sample based on the BC ENV 2013 guidance.

Table C.18: Water Quality at TOMP Stations DS-2 (Primary Basin Performance - ETP Operations), Stanrock TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Acidity (mg/L as CaCO3)	Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
14-Jan-20	3.10	-	-	-	-	-	-	-	-	-
20-Jan-20	-	630	-	258	-	-	-	-	-	-
21-Jan-20	-	-	-	-	-	0.0120	0.0972	57.6	1.24	0.0244
22-Jan-20	-	-	0.221	-	-	-	-	-	-	-
11-Feb-20	3.10	-	-	-	-	-	-	-	-	-
19-Feb-20	-	-	0.166	-	-	-	-	-	-	-
17-Mar-20	2.90	-	-	-	-	-	-	-	-	-
18-Mar-20	-	-	0.154	-	-	-	-	-	-	-
14-Apr-20	3.60	-	-	-	-	-	-	-	-	-
17-Apr-20	-	-	-	-	-	0.0140	0.0276	17.8	0.317	0.00800
21-Apr-20	-	-	-	81.0	-	-	-	-	-	-
22-Apr-20	-	-	0.160	-	-	-	-	-	-	-
24-Apr-20	-	200	-	-	-	-	-	-	-	-
12-May-20	3.20	-	-	-	-	-	-	-	-	-
9-Jun-20	3.00	-	-	-	-	-	-	-	-	-
17-Jun-20	-	-	0.216	-	-	-	-	-	-	-
21-Jul-20	2.90	-	-	-	-	-	-	-	-	-
22-Jul-20	-	-	0.545	-	-	-	-	-	-	-
27-Jul-20	-	450	-	169	-	-	-	-	-	-
28-Jul-20	-	-	-	-	-	0.0380	0.0471	17.7	1.47	0.00920
12-Aug-20	-	-	0.154	-	-	-	-	-	-	-
28-Aug-20	2.80	-	-	-	-	-	-	-	-	-
2-Sep-20	-	-	0.756	-	-	-	-	-	-	-
8-Sep-20	3.00	-	-	-	-	-	-	-	-	-
9-Sep-20	-	-	0.291	-	-	-	-	-	-	-
14-Oct-20	2.80	-	-	-	-	-	-	-	-	-
16-Oct-20	-	-	0.228	-	-	-	-	-	-	-
20-Oct-20	-	-	-	176	-	-	-	-	-	-
22-Oct-20	-	-	-	-	-	0.0120	0.0674	20.4	1.24	0.0182
26-Oct-20	-	470	-	-	-	-	-	-	-	-
10-Nov-20	3.20	-	-	-	-	-	-	-	-	-
13-Nov-20	-	-	0.183	-	-	-	-	-	-	-
8-Dec-20	3.00	-	-	-	-	-	-	-	-	-
5-Jan-21	-	-	0.203	-	-	-	-	-	-	-
13-Jan-21	3.00	-	-	-	-	-	-	-	-	-
15-Jan-21	-	-	0.204	-	-	-	-	-	-	-
21-Jan-21	-	420	-	144	-	0.0210	0.0450	33.3	1.43	0.0107
3-Feb-21	3.60	-	-	-	-	-	-	-	-	-
5-Feb-21	-	-	0.192	-	-	-	-	-	-	-
10-Mar-21	2.80	-	-	-	-	-	-	-	-	-
12-Mar-21	-	-	0.203	-	-	-	-	-	-	-
13-Apr-21	3.00	-	-	-	-	-	-	-	-	-
16-Apr-21	-	-	-	149	-	-	-	-	-	-
20-Apr-21	-	-	-	-	-	0.0100	0.0602	31.1	0.829	0.0125
21-Apr-21	-	340	0.147	-	-	-	-	-	-	-
27-May-21	2.90	-	-	-	-	-	-	-	-	-
10-Jun-21	-	-	0.0830	-	-	-	-	-	-	-
22-Jun-21	2.90	-	-	-	-	-	-	-	-	-
16-Jul-21	2.80	-	-	-	-	-	-	-	-	-
23-Jul-21	-	-	-	210	-	-	-	-	-	-
27-Jul-21	-	-	-	-	-	0.0170	0.0544	-	1.45	0.0115
28-Jul-21	-	560	-	-	-	-	-	-	-	-
5-Aug-21	-	-	-	-	-	-	-	20.1	-	-
10-Aug-21	2.80	-	-	-	-	-	-	-	-	-
27-Aug-21	-	-	0.777	-	-	-	-	-	-	-
7-Sep-21	2.80	-	-	-	-	-	-	-	-	-
5-Oct-21	3.00	-	-	-	-	-	-	-	-	-
8-Oct-21	-	-	-	197	-	-	-	-	-	-
12-Oct-21	-	550	-	-	-	-	-	-	-	-
14-Oct-21	-	-	-	-	-	0.0200	0.0609	22.1	1.74	0.0133
26-Nov-21	2.80	-	-	-	-	-	-	-	-	-
14-Dec-21	2.40	-	-	-	-	-	-	-	-	-
20-Dec-21	-	-	0.311	-	-	-	-	-	-	-
21-Dec-21	-	-	0.200	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected, or SD was incalculable because there was no variability in the data.

Table C.18: Water Quality at TOMP Stations DS-2 (Primary Basin Performance - ETP Operations), Stanrock TMA, 2020 to 2023

Date	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Acidity (mg/L as CaCO3)	Acidity (mg/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
13-Jan-22	2.90	-	-	-	-	-	-	-	-	-
18-Jan-22	-	420	-	-	-	0.0170	0.0489	32.5	1.24	0.0129
19-Jan-22	-	-	-	159	-	-	-	-	-	-
24-Jan-22	-	-	0.236	-	-	-	-	-	-	-
1-Feb-22	2.70	-	-	-	-	-	-	-	-	-
4-Feb-22	-	-	0.209	-	-	-	-	-	-	-
10-Mar-22	2.90	-	-	-	-	-	-	-	-	-
15-Mar-22	-	-	0.150	-	-	-	-	-	-	-
12-Apr-22	3.70	-	-	-	-	-	-	-	-	-
18-Apr-22	-	-	0.111	-	-	-	-	-	-	-
4-May-22	-	120	-	-	39.0	0.0140	0.0151	7.38	0.279	0.00410
17-May-22	2.90	-	-	-	-	-	-	-	-	-
2-Jun-22	-	-	0.211	-	-	-	-	-	-	-
14-Jun-22	2.90	-	-	-	-	-	-	-	-	-
20-Jun-22	-	-	0.173	-	-	-	-	-	-	-
12-Jul-22	2.70	-	-	-	-	-	-	-	-	-
19-Aug-22	-	-	0.477	-	-	-	-	-	-	-
30-Aug-22	-	530	-	-	202	0.0211	0.0511	19.9	1.63	0.00950
8-Nov-22	2.70	-	-	-	-	-	-	-	-	-
11-Nov-22	-	-	0.386	240	-	-	-	-	-	-
14-Nov-22	-	-	-	-	-	0.0207	0.0495	39.0	2.49	0.0126
2-Dec-22	-	760	-	-	-	-	-	-	-	-
16-Dec-22	2.70	-	-	-	-	-	-	-	-	-
6-Jan-23	-	-	0.226	-	-	-	-	-	-	-
10-Jan-23	2.60	-	-	-	-	-	-	-	-	-
13-Jan-23	-	-	-	178	-	-	-	-	-	-
16-Jan-23	-	-	-	-	-	0.0331	0.0648	25.5	1.76	0.0322
17-Jan-23	-	530	-	-	-	-	-	-	-	-
19-Jan-23	-	-	0.160	-	-	-	-	-	-	-
14-Feb-23	2.90	-	-	-	-	-	-	-	-	-
21-Feb-23	-	-	0.196	-	-	-	-	-	-	-
23-Mar-23	2.80	-	-	-	-	-	-	-	-	-
30-Mar-23	-	-	0.155	-	-	-	-	-	-	-
11-Apr-23	3.00	-	-	-	-	-	-	-	-	-
14-Apr-23	-	-	-	188	-	-	-	-	-	-
17-Apr-23	-	-	0.160	-	-	-	-	-	-	-
18-Apr-23	-	-	-	-	-	0.0275	0.0748	39.0	0.944	0.0405
25-Apr-23	-	430	-	-	-	-	-	-	-	-
9-May-23	2.90	-	-	-	-	-	-	-	-	-
16-May-23	-	-	0.195	-	-	-	-	-	-	-
31-Oct-23	2.77	-	-	-	-	-	-	-	-	-
3-Nov-23	-	-	0.389	-	-	-	-	-	-	-
8-Nov-23	2.81	-	-	-	-	-	-	-	-	-
14-Nov-23	-	-	-	165	-	-	-	-	-	-
15-Nov-23	-	-	0.0620	-	-	-	-	-	-	-
20-Nov-23	-	-	-	-	-	0.0192	0.0538	21.5	1.61	0.0149
23-Nov-23	-	490	-	-	-	-	-	-	-	-
6-Dec-23	2.53	-	-	-	-	-	-	-	-	-
11-Dec-23	-	-	0.233	-	-	-	-	-	-	-
n	41	15	37	13	2	15	15	15	15	15
Minimum	2.40	120	0.0620	81.0	39.0	0.0100	0.0151	7.38	0.279	0.00410
Maximum	3.70	760	0.777	258	202	0.0380	0.0972	57.6	2.49	0.0405
Mean	2.92	460	0.247	178	120	0.0198	0.0545	27.0	1.31	0.0156
Median	2.90	470	0.203	176	120	0.0192	0.0538	22.1	1.43	0.0126
SD	0.258	158	0.159	44.5	115	0.00789	0.0190	12.1	0.564	0.00971
10th Percentile	2.70	200	0.147	144	39.0	0.0120	0.0276	17.7	0.317	0.00800
95th Percentile	3.60	760	0.756	258	202	0.0380	0.0972	57.6	2.49	0.0405

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected, or SD was incalculable because there was no variability in the data.

Table C.19: Water Quality at SAMP Station DS-4 (Final Effluent Discharge), Stanrock TMA 2020 to 2023

Date	pH	Sulphate (mg/)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
7-Jan-20	7.10	-	-	-	-	-	-	-
8-Jan-20	-	-	0.0470	-	-	-	-	-
14-Jan-20	6.80	-	-	-	-	-	-	-
20-Jan-20	-	250	-	-	-	-	-	-
21-Jan-20	7.10	-	-	0.0730	<0.0005	0.181	0.0400	0.00200
22-Jan-20	-	-	0.0430	-	-	-	-	-
28-Jan-20	7.00	-	-	-	-	-	-	-
29-Jan-20	-	-	0.0550	-	-	-	-	-
4-Feb-20	7.00	-	-	-	-	-	-	-
7-Feb-20	-	-	0.0560	-	-	-	-	-
11-Feb-20	6.80	-	-	-	-	-	-	-
18-Feb-20	6.80	-	-	-	-	-	-	-
19-Feb-20	-	-	0.0580	0.0620	<0.0005	0.0780	-	0.00280
20-Feb-20	-	240	-	-	-	-	-	-
21-Feb-20	-	-	0.0520	-	-	-	-	-
24-Feb-20	-	-	-	-	-	-	0.0420	-
25-Feb-20	6.90	-	-	-	-	-	-	-
26-Feb-20	-	-	0.0630	-	-	-	-	-
3-Mar-20	6.70	-	-	-	-	-	-	-
4-Mar-20	-	-	0.0580	-	-	-	-	-
10-Mar-20	7.10	-	-	-	-	-	-	-
11-Mar-20	-	-	0.0690	-	-	-	-	-
16-Mar-20	-	-	-	0.0620	<0.0005	0.109	0.0450	0.00300
17-Mar-20	7.10	-	-	-	-	-	-	-
19-Mar-20	-	250	-	-	-	-	-	-
24-Mar-20	6.90	-	-	-	-	-	-	-
25-Mar-20	-	-	0.0560	-	-	-	-	-
31-Mar-20	6.80	-	-	-	-	-	-	-
1-Apr-20	-	-	0.0500	-	-	-	-	-
7-Apr-20	7.40	-	-	-	-	-	-	-
8-Apr-20	-	-	0.0510	-	-	-	-	-
14-Apr-20	6.90	-	-	-	-	-	-	-
17-Apr-20	-	-	-	0.0710	<0.0005	0.229	0.0350	0.000700
21-Apr-20	7.20	-	-	-	-	-	-	-
22-Apr-20	-	-	0.0450	-	-	-	-	-
24-Apr-20	-	130	-	-	-	-	-	-
28-Apr-20	7.00	-	-	-	-	-	-	-
29-Apr-20	-	-	0.0280	-	-	-	-	-
5-May-20	6.80	-	-	-	-	-	-	-
6-May-20	-	-	0.0400	-	-	-	-	-
12-May-20	7.40	-	-	-	-	-	-	-
19-May-20	6.80	-	-	0.0680	<0.0005	0.0700	0.0390	0.00310
21-May-20	-	210	-	-	-	-	-	-
26-May-20	6.90	-	-	-	-	-	-	-
2-Jun-20	7.20	-	-	-	-	-	-	-
9-Jun-20	7.00	-	-	-	-	-	-	-
12-Jun-20	-	-	-	0.0660	<0.0005	0.0690	0.0310	0.00280
15-Jun-20	-	-	0.104	-	-	-	-	-
16-Jun-20	7.00	-	-	-	-	-	-	-
17-Jun-20	-	-	0.0950	-	-	-	-	-
18-Jun-20	-	230	-	-	-	-	-	-
23-Jun-20	6.90	-	-	-	-	-	-	-
24-Jun-20	-	-	0.113	-	-	-	-	-
29-Jun-20	6.90	-	-	-	-	-	-	-
30-Jun-20	-	-	0.113	-	-	-	-	-
7-Jul-20	7.00	-	-	-	-	-	-	-
8-Jul-20	-	-	0.133	-	-	-	-	-
14-Jul-20	6.90	-	-	-	-	-	-	-
15-Jul-20	-	-	0.130	-	-	-	-	-
20-Jul-20	-	240	-	-	-	-	-	-
21-Jul-20	7.20	-	-	0.0540	<0.0005	0.0400	0.0850	0.00220
22-Jul-20	-	-	0.144	-	-	-	-	-
28-Jul-20	6.90	-	-	-	-	-	-	-
29-Jul-20	-	-	0.140	-	-	-	-	-
4-Aug-20	7.00	-	-	-	-	-	-	-
5-Aug-20	-	-	0.128	-	-	-	-	-
11-Aug-20	7.00	-	-	-	-	-	-	-
18-Aug-20	7.00	-	-	0.0510	<0.0005	0.100	0.0500	0.00530
19-Aug-20	-	-	0.0510	-	-	-	-	-
20-Aug-20	-	240	-	-	-	-	-	-
25-Aug-20	7.10	-	-	-	-	-	-	-
26-Aug-20	-	-	0.136	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.19: Water Quality at SAMP Station DS-4 (Final Effluent Discharge), Stanrock TMA 2020 to 2023

Date	pH	Sulphate (mg/)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
1-Sep-20	6.90	-	-	-	-	-	-	-
2-Sep-20	-	-	0.131	-	-	-	-	-
8-Sep-20	7.20	-	-	-	-	-	-	-
9-Sep-20	-	-	0.151	-	-	-	-	-
11-Sep-20	-	-	-	0.0470	<0.0005	0.148	0.0300	0.00910
15-Sep-20	7.20	-	-	-	-	-	-	-
16-Sep-20	-	240	-	-	-	-	-	-
22-Sep-20	7.10	-	-	-	-	-	-	-
29-Sep-20	7.10	-	-	-	-	-	-	-
6-Oct-20	7.10	-	-	-	-	-	-	-
7-Oct-20	-	-	0.116	-	-	-	-	-
13-Oct-20	7.10	-	-	-	-	-	-	-
16-Oct-20	-	-	0.118	-	-	-	-	-
20-Oct-20	7.20	-	-	-	-	-	-	-
22-Oct-20	-	-	0.134	-	-	-	-	-
23-Oct-20	-	-	0.107	-	-	-	-	-
26-Oct-20	-	-	-	0.0430	<0.0005	0.107	0.0190	0.00890
27-Oct-20	6.90	-	-	-	-	-	-	-
28-Oct-20	-	-	0.0680	-	-	-	-	-
30-Oct-20	-	230	-	-	-	-	-	-
3-Nov-20	7.10	-	-	-	-	-	-	-
6-Nov-20	-	-	0.0610	-	-	-	-	-
10-Nov-20	6.90	-	-	-	-	-	-	-
13-Nov-20	-	-	0.0570	-	-	-	-	-
17-Nov-20	7.10	-	-	-	-	-	-	-
18-Nov-20	-	-	0.0610	-	-	-	-	-
24-Nov-20	7.10	220	-	0.0930	0.000500	0.265	0.0290	0.00280
1-Dec-20	7.10	-	-	-	-	-	-	-
2-Dec-20	-	-	0.0600	-	-	-	-	-
8-Dec-20	7.20	-	-	-	-	-	-	-
11-Dec-20	-	210	-	-	-	-	-	-
14-Dec-20	-	-	-	0.115	<0.0005	0.140	0.0320	0.00290
15-Dec-20	6.90	-	-	-	-	-	-	-
21-Dec-20	7.10	-	-	-	-	-	-	-
22-Dec-20	-	-	0.0560	-	-	-	-	-
29-Dec-20	7.00	-	0.0650	-	-	-	-	-
4-Jan-21	7.10	-	-	-	-	-	-	-
5-Jan-21	-	-	0.0720	-	-	-	-	-
12-Jan-21	7.40	-	-	-	-	-	-	-
13-Jan-21	-	-	0.0540	-	-	-	-	-
19-Jan-21	7.30	-	-	0.134	<0.0005	0.125	0.0370	0.00210
20-Jan-21	-	220	0.0640	-	-	-	-	-
26-Jan-21	7.30	-	-	-	-	-	-	-
27-Jan-21	-	-	0.0510	-	-	-	-	-
2-Feb-21	7.40	-	-	-	-	-	-	-
3-Feb-21	-	-	0.0630	-	-	-	-	-
9-Feb-21	7.00	230	-	0.121	<0.0005	0.124	0.0410	0.00200
10-Feb-21	-	-	0.0720	-	-	-	-	-
16-Feb-21	7.20	-	-	-	-	-	-	-
18-Feb-21	-	-	0.0660	-	-	-	-	-
23-Feb-21	7.20	-	-	-	-	-	-	-
2-Mar-21	7.20	-	-	-	-	-	-	-
3-Mar-21	-	-	0.0560	-	-	-	-	-
9-Mar-21	7.40	-	-	-	-	-	-	-
12-Mar-21	-	-	0.0590	-	-	-	-	-
16-Mar-21	7.10	-	-	-	-	-	-	-
17-Mar-21	-	-	0.0710	-	-	-	-	-
23-Mar-21	7.00	-	-	-	-	-	-	-
24-Mar-21	-	-	0.0700	-	-	-	-	-
29-Mar-21	-	230	-	0.112	<0.0005	0.0700	0.0320	0.00320
30-Mar-21	7.00	-	-	-	-	-	-	-
31-Mar-21	-	-	0.0440	-	-	-	-	-
6-Apr-21	7.00	-	-	-	-	-	-	-
7-Apr-21	-	-	0.0400	-	-	-	-	-
13-Apr-21	7.10	-	-	-	-	-	-	-
20-Apr-21	7.00	-	-	0.120	<0.0005	0.176	0.0420	0.00150
21-Apr-21	-	160	0.0430	-	-	-	-	-
23-Apr-21	-	-	0.0520	-	-	-	-	-
27-Apr-21	7.10	-	-	-	-	-	-	-
4-May-21	7.20	-	-	-	-	-	-	-
11-May-21	7.20	-	-	-	-	-	-	-
14-May-21	-	-	0.0800	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.19: Water Quality at SAMP Station DS-4 (Final Effluent Discharge), Stanrock TMA 2020 to 2023

Date	pH	Sulphate (mg/)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
17-May-21	-	-	0.0950	-	-	-	-	-
18-May-21	7.00	-	-	-	-	-	-	-
25-May-21	7.20	-	-	-	-	-	-	-
26-May-21	-	-	0.105	-	-	-	-	-
1-Jun-21	7.00	220	-	-	-	-	-	-
2-Jun-21	-	-	0.0900	-	-	-	-	-
4-Jun-21	-	-	-	<0.005	<0.0005	<0.02	<0.002	<0.0005
8-Jun-21	6.90	-	0.164	-	-	-	-	-
15-Jun-21	6.90	-	-	-	-	-	-	-
16-Jun-21	-	210	-	-	-	-	-	-
17-Jun-21	-	-	-	0.0970	<0.0005	0.0310	0.0540	0.00170
22-Jun-21	7.10	-	0.0930	-	-	-	-	-
28-Jun-21	-	-	0.151	-	-	-	-	-
29-Jun-21	7.20	-	0.157	-	-	-	-	-
5-Jul-21	-	-	0.170	-	-	-	-	-
6-Jul-21	7.00	-	-	-	-	-	-	-
7-Jul-21	-	-	0.178	-	-	-	-	-
13-Jul-21	6.90	-	-	-	-	-	-	-
20-Jul-21	7.00	-	0.244	0.0940	<0.0005	0.0390	0.0510	0.00420
21-Jul-21	-	240	-	-	-	-	-	-
22-Jul-21	-	-	0.211	-	-	-	-	-
27-Jul-21	7.30	-	-	-	-	-	-	-
29-Jul-21	-	-	0.199	-	-	-	-	-
3-Aug-21	7.20	-	-	-	-	-	-	-
5-Aug-21	-	-	0.254	-	-	-	-	-
10-Aug-21	7.00	-	-	-	-	-	-	-
16-Aug-21	-	-	-	0.0600	<0.0005	0.0860	0.0300	0.00770
17-Aug-21	7.30	220	-	-	-	-	-	-
18-Aug-21	-	-	0.224	-	-	-	-	-
24-Aug-21	7.00	-	-	-	-	-	-	-
27-Aug-21	-	-	0.139	-	-	-	-	-
31-Aug-21	7.30	-	-	-	-	-	-	-
7-Sep-21	7.10	-	-	-	-	-	-	-
13-Sep-21	-	-	0.206	-	-	-	-	-
14-Sep-21	7.10	-	-	-	-	-	-	-
17-Sep-21	-	-	-	0.0480	<0.0005	0.0540	0.0320	0.00810
21-Sep-21	7.20	230	-	-	-	-	-	-
22-Sep-21	-	-	0.201	-	-	-	-	-
28-Sep-21	7.30	-	-	-	-	-	-	-
5-Oct-21	7.30	-	-	-	-	-	-	-
12-Oct-21	7.50	-	-	-	-	-	-	-
18-Oct-21	-	230	-	-	-	-	-	-
19-Oct-21	7.50	-	-	0.0510	<0.0005	0.0990	0.0220	0.00910
26-Oct-21	7.20	-	-	-	-	-	-	-
1-Nov-21	7.10	-	-	-	-	-	-	-
9-Nov-21	7.30	-	-	-	-	-	-	-
16-Nov-21	7.10	-	-	-	-	-	-	-
23-Nov-21	7.20	-	-	0.0410	<0.0005	0.116	0.0200	0.0100
25-Nov-21	-	230	-	-	-	-	-	-
30-Nov-21	7.10	-	-	-	-	-	-	-
7-Dec-21	7.00	-	-	-	-	-	-	-
14-Dec-21	7.00	-	-	-	-	-	-	-
20-Dec-21	-	-	0.130	-	-	-	-	-
21-Dec-21	7.00	-	0.111	-	-	-	-	-
22-Dec-21	-	-	0.233	-	-	-	-	-
24-Dec-21	-	-	0.0620	-	-	-	-	-
28-Dec-21	-	-	0.196	-	-	-	-	-
29-Dec-21	7.10	-	-	-	-	-	-	-
4-Jan-22	7.00	-	-	-	-	-	-	-
5-Jan-22	-	-	0.0680	-	-	-	-	-
11-Jan-22	7.20	-	0.0720	-	-	-	-	-
14-Jan-22	-	-	-	0.0320	<0.0005	0.130	0.0330	0.00470
17-Jan-22	-	260	0.0700	-	-	-	-	-
18-Jan-22	7.00	-	-	-	-	-	-	-
19-Jan-22	-	250	-	0.0390	<0.0005	0.119	0.0160	0.0100
25-Jan-22	7.00	-	0.0740	-	-	-	-	-
31-Jan-22	-	-	0.0740	-	-	-	-	-
1-Feb-22	7.00	-	-	-	-	-	-	-
4-Feb-22	-	-	0.0840	-	-	-	-	-
8-Feb-22	7.30	-	-	-	-	-	-	-
11-Feb-22	-	-	0.0830	-	-	-	-	-
14-Feb-22	-	-	-	0.0320	<0.0005	0.0770	0.0290	0.00450

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.19: Water Quality at SAMP Station DS-4 (Final Effluent Discharge), Stanrock TMA 2020 to 2023

Date	pH	Sulphate (mg/)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
15-Feb-22	7.10	290	-	-	-	-	-	-
22-Feb-22	7.00	-	-	-	-	-	-	-
23-Feb-22	-	-	0.0870	-	-	-	-	-
28-Feb-22	-	-	0.0580	-	-	-	-	-
1-Mar-22	7.10	-	-	-	-	-	-	-
7-Mar-22	-	-	0.0710	-	-	-	-	-
8-Mar-22	7.20	-	-	-	-	-	-	-
14-Mar-22	-	280	-	-	-	-	-	-
15-Mar-22	7.20	-	0.0990	-	-	-	-	-
16-Mar-22	-	-	-	0.0340	<0.0005	0.0700	0.0340	0.00520
21-Mar-22	-	-	0.0630	-	-	-	-	-
22-Mar-22	6.90	-	-	-	-	-	-	-
29-Mar-22	7.00	-	0.0980	-	-	-	-	-
1-Apr-22	-	-	0.0550	-	-	-	-	-
6-Apr-22	7.00	-	-	-	-	-	-	-
12-Apr-22	6.90	-	0.0540	-	-	-	-	-
13-Apr-22	-	-	-	-	-	-	-	-
18-Apr-22	-	-	0.0360	-	-	-	-	-
19-Apr-22	7.10	-	-	-	-	-	-	-
25-Apr-22	-	-	0.0650	-	-	-	-	-
26-Apr-22	7.20	-	-	-	-	-	-	-
3-May-22	7.20	-	-	-	-	-	-	-
4-May-22	-	170	0.0400	0.129	0.00120	0.414	0.0770	0.000900
9-May-22	-	-	0.0400	-	-	-	-	-
10-May-22	6.90	-	-	-	-	-	-	-
13-May-22	-	-	0.0990	-	-	-	-	-
17-May-22	6.90	-	-	-	-	-	-	-
24-May-22	7.10	-	-	-	-	-	-	-
30-May-22	7.10	-	0.103	-	-	-	-	-
2-Jun-22	-	-	0.0840	-	-	-	-	-
7-Jun-22	7.30	-	-	-	-	-	-	-
10-Jun-22	-	-	0.0860	-	-	-	-	-
14-Jun-22	7.00	-	-	-	-	-	-	-
20-Jun-22	-	-	0.118	-	-	-	-	-
21-Jun-22	7.50	-	-	0.0798	<0.0005	0.0600	0.0240	0.00240
24-Jun-22	-	-	0.0900	-	-	-	-	-
28-Jun-22	7.40	-	-	-	-	-	-	-
29-Jun-22	-	150	-	0.123	<0.0005	0.0860	0.0210	0.00120
30-Jun-22	-	220	-	-	-	-	-	-
5-Jul-22	7.00	-	-	-	-	-	-	-
11-Jul-22	-	-	0.176	-	-	-	-	-
12-Jul-22	7.10	-	-	-	-	-	-	-
18-Jul-22	-	-	0.105	-	-	-	-	-
19-Jul-22	7.50	-	-	-	-	-	-	-
26-Jul-22	7.60	-	-	-	-	-	-	-
2-Aug-22	7.30	-	-	-	-	-	-	-
8-Aug-22	-	-	0.138	-	-	-	-	-
9-Aug-22	7.60	-	-	-	-	-	-	-
12-Aug-22	-	-	0.144	-	-	-	-	-
16-Aug-22	7.10	-	-	-	-	-	-	-
17-Aug-22	-	-	-	0.0599	<0.0005	0.0960	0.0440	0.00750
19-Aug-22	-	-	0.137	-	-	-	-	-
22-Aug-22	-	260	-	-	-	-	-	-
23-Aug-22	7.40	-	<0.005	-	-	-	-	-
26-Aug-22	-	-	0.153	-	-	-	-	-
30-Aug-22	7.20	230	-	0.0646	<0.0005	0.0730	0.0810	0.00290
2-Sep-22	-	-	0.185	-	-	-	-	-
6-Sep-22	7.30	-	-	-	-	-	-	-
9-Sep-22	-	-	0.153	-	-	-	-	-
13-Sep-22	7.40	-	-	-	-	-	-	-
19-Sep-22	-	-	-	0.0208	<0.0005	0.0560	0.0730	0.00250
20-Sep-22	7.40	-	-	-	-	-	-	-
22-Sep-22	-	-	0.175	-	-	-	-	-
26-Sep-22	-	-	0.197	-	-	-	-	-
27-Sep-22	7.20	260	-	-	-	-	-	-
30-Sep-22	-	-	0.144	-	-	-	-	-
4-Oct-22	7.30	-	-	-	-	-	-	-
11-Oct-22	7.20	-	-	-	-	-	-	-
18-Oct-22	7.20	-	0.147	0.0462	<0.0005	0.0680	0.0760	0.0106
19-Oct-22	-	-	0.146	-	-	-	-	-
24-Oct-22	-	-	0.166	-	-	-	-	-
25-Oct-22	7.20	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.19: Water Quality at SAMP Station DS-4 (Final Effluent Discharge), Stanrock TMA 2020 to 2023

Date	pH	Sulphate (mg/)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
28-Oct-22	-	-	0.139	-	-	-	-	-
1-Nov-22	7.20	-	-	-	-	-	-	-
2-Nov-22	-	240	-	-	-	-	-	-
4-Nov-22	-	-	0.147	-	-	-	-	-
8-Nov-22	7.30	-	-	-	-	-	-	-
11-Nov-22	-	-	0.139	-	-	-	-	-
14-Nov-22	-	-	-	0.0468	<0.0005	0.0960	0.0300	0.0196
15-Nov-22	7.30	-	-	-	-	-	-	-
18-Nov-22	-	-	0.134	-	-	-	-	-
23-Nov-22	7.30	-	-	-	-	-	-	-
29-Nov-22	7.10	-	0.183	-	-	-	-	-
2-Dec-22	-	260	-	-	-	-	-	-
6-Dec-22	7.50	-	0.138	-	-	-	-	-
9-Dec-22	-	-	0.112	-	-	-	-	-
13-Dec-22	7.30	-	-	-	-	-	-	-
16-Dec-22	-	-	0.110	-	-	-	-	-
19-Dec-22	7.00	-	-	0.0418	<0.0005	0.112	0.0380	0.0145
22-Dec-22	-	-	0.106	-	-	-	-	-
28-Dec-22	7.00	-	-	-	-	-	-	-
30-Dec-22	-	220	-	-	-	-	-	-
3-Jan-23	7.10	-	-	-	-	-	-	-
4-Jan-23	-	-	0.109	-	-	-	-	-
10-Jan-23	7.00	-	-	-	-	-	-	-
11-Jan-23	-	-	0.0890	-	-	-	-	-
16-Jan-23	-	-	-	0.0368	<0.0005	0.106	0.0290	0.0134
17-Jan-23	7.20	270	-	-	-	-	-	-
19-Jan-23	-	-	0.0930	-	-	-	-	-
23-Jan-23	7.10	-	-	-	-	-	-	-
24-Jan-23	-	-	0.125	-	-	-	-	-
27-Jan-23	-	-	0.0740	-	-	-	-	-
31-Jan-23	6.80	-	-	-	-	-	-	-
7-Feb-23	7.00	-	-	-	-	-	-	-
14-Feb-23	7.00	-	-	-	-	-	-	-
16-Feb-23	-	-	0.144	-	-	-	-	-
21-Feb-23	7.10	-	0.114	-	-	-	-	-
22-Feb-23	-	-	-	0.0291	<0.0005	0.118	0.0390	0.00800
27-Feb-23	-	270	-	-	-	-	-	-
28-Feb-23	7.30	-	-	-	-	-	-	-
1-Mar-23	-	-	0.0530	-	-	-	-	-
2-Mar-23	-	-	0.0620	-	-	-	-	-
7-Mar-23	7.10	-	-	-	-	-	-	-
13-Mar-23	7.00	-	-	-	-	-	-	-
17-Mar-23	-	-	0.0660	-	-	-	-	-
20-Mar-23	-	-	0.0440	-	-	-	-	-
21-Mar-23	7.10	-	-	-	-	-	-	-
24-Mar-23	-	-	0.0560	-	-	-	-	-
27-Mar-23	-	300	-	-	-	-	-	-
28-Mar-23	7.50	-	-	-	-	-	-	-
29-Mar-23	-	-	-	0.0340	<0.0005	0.147	0.0580	0.00500
31-Mar-23	-	-	0.0490	-	-	-	-	-
4-Apr-23	7.20	-	-	-	-	-	-	-
11-Apr-23	7.10	-	0.0730	-	-	-	-	-
17-Apr-23	-	-	0.0600	-	-	-	-	-
18-Apr-23	7.10	-	-	0.0360	0.000900	0.399	0.0970	0.00570
21-Apr-23	-	-	0.0600	-	-	-	-	-
25-Apr-23	7.10	300	-	-	-	-	-	-
28-Apr-23	-	-	0.0870	-	-	-	-	-
2-May-23	7.30	-	-	-	-	-	-	-
9-May-23	7.50	-	-	-	-	-	-	-
15-May-23	-	-	0.0440	0.113	0.000900	0.155	0.0323	0.00140
16-May-23	7.30	160	0.0520	-	-	-	-	-
23-May-23	7.20	-	-	-	-	-	-	-
30-May-23	7.00	-	-	-	-	-	-	-
6-Jun-23	6.90	-	0.103	-	-	-	-	-
9-Jun-23	-	-	0.112	-	-	-	-	-
12-Jun-23	-	-	0.0750	-	-	-	-	-
13-Jun-23	7.20	-	-	-	-	-	-	-
15-Jun-23	-	-	0.0670	-	-	-	-	-
16-Jun-23	-	-	0.0910	-	-	-	-	-
20-Jun-23	6.80	-	-	-	-	-	-	-
23-Jun-23	-	-	0.0990	-	-	-	-	-
27-Jun-23	7.30	-	-	-	-	-	-	-

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.19: Water Quality at SAMP Station DS-4 (Final Effluent Discharge), Stanrock TMA 2020 to 2023

Date	pH	Sulphate (mg/)	Radium-226 (Bq/L)	Barium (mg/L)	Cobalt (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
30-Jun-23	-	-	0.111	-	-	-	-	-
4-Jul-23	7.20	-	-	-	-	-	-	-
11-Jul-23	7.30	-	0.102	-	-	-	-	-
17-Jul-23	-	-	0.136	-	-	-	-	-
18-Jul-23	7.20	240	-	-	-	-	-	-
19-Jul-23	-	-	-	0.0590	<0.0005	0.0650	0.0598	0.00454
21-Jul-23	-	-	0.110	-	-	-	-	-
24-Jul-23	7.30	-	-	-	-	-	-	-
28-Jul-23	-	-	0.104	-	-	-	-	-
31-Jul-23	7.30	-	-	-	-	-	-	-
4-Aug-23	-	-	0.109	-	-	-	-	-
8-Aug-23	7.40	-	-	-	-	-	-	-
11-Aug-23	-	-	0.121	-	-	-	-	-
15-Aug-23	7.00	-	-	0.0550	0.000231	0.0600	-	0.00690
17-Aug-23	-	260	-	-	-	-	-	-
22-Aug-23	7.10	-	0.0830	-	-	-	-	-
28-Aug-23	7.24	-	0.111	-	-	-	-	-
5-Sep-23	7.24	240	-	0.0628	<0.0005	0.0690	0.0377	0.00446
7-Sep-23	-	-	-	-	-	-	0.0568	-
12-Sep-23	7.10	-	-	-	-	-	-	-
15-Sep-23	-	-	0.121	-	-	-	-	-
19-Sep-23	7.20	-	-	0.0508	0.000225	0.0780	0.0627	0.0106
21-Sep-23	-	270	-	-	-	-	-	-
22-Sep-23	-	-	0.106	-	-	-	-	-
25-Sep-23	-	-	0.121	-	-	-	-	-
26-Sep-23	7.10	-	-	-	-	-	-	-
29-Sep-23	-	-	0.119	-	-	-	-	-
5-Oct-23	7.05	-	-	-	-	-	-	-
10-Oct-23	7.41	-	-	-	-	-	-	-
11-Oct-23	-	-	0.138	-	-	-	-	-
13-Oct-23	-	-	0.123	-	-	-	-	-
17-Oct-23	7.29	-	-	0.0438	0.000189	0.0670	0.0499	0.0143
23-Oct-23	-	250	0.105	-	-	-	-	-
24-Oct-23	7.45	-	-	-	-	-	-	-
31-Oct-23	7.16	-	0.0870	-	-	-	-	-
7-Nov-23	7.53	-	-	-	-	-	-	-
10-Nov-23	-	-	0.110	-	-	-	-	-
14-Nov-23	7.52	-	-	0.0432	0.000212	0.0750	0.0178	0.0196
20-Nov-23	-	-	0.102	-	-	-	-	-
21-Nov-23	7.09	-	-	-	-	-	-	-
23-Nov-23	-	270	0.0770	-	-	-	-	-
24-Nov-23	-	-	0.101	-	-	-	-	-
29-Nov-23	7.78	-	-	-	-	-	-	-
4-Dec-23	-	-	0.119	-	-	-	-	-
5-Dec-23	7.59	-	-	-	-	-	-	-
8-Dec-23	-	-	0.0980	-	-	-	-	-
12-Dec-23	7.65	-	-	-	-	-	-	-
14-Dec-23	-	300	-	0.0410	0.000174	0.102	0.0218	0.0176
18-Dec-23	-	-	0.0900	-	-	-	-	-
19-Dec-23	7.32	-	-	-	-	-	-	-
22-Dec-23	-	-	0.0980	-	-	-	-	-
27-Dec-23	7.40	-	-	-	-	-	-	-
n	208	48	206	48	48	48	48	48
Minimum	6.70	130	<0.005	<0.005	0.000174	<0.02	<0.002	<0.0005
Maximum	7.78	300	0.254	0.134	0.00120	0.414	0.0970	0.0196
Mean	7.14	236	0.105	0.0634	0.000262	0.112	0.0412	0.00612
Median	7.10	240	0.100	0.0545	0.000212	0.0960	0.0374	0.00452
SD	0.189	36.9	0.0486	0.0310	0.000220	0.0779	0.0193	0.00496
10th Percentile	6.90	170	0.0510	0.0320	0.000174	0.0540	0.0200	0.00140
95th Percentile	7.50	300	0.199	0.123	0.000900	0.265	0.0810	0.0176

Note: "SD" = standard deviation. "n" = number of samples. "-" = no data collected.

Table C.20: Water Quality at Mine-Exposed SRWMP Station DS-18, Halfmoon Lake Outlet, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Iron (mg/L)	Uranium (mg/L)
Cycle 5 Benchmark	-	5.3	218 to 309	0.469	1.0	2.49	0.015
4-Feb-20	76.5	7.20	67.0	0.0950	0.0210	0.514	0.000700
26-May-20	70.6	6.90	58.0	0.106	0.0250	0.257	0.000800
11-Aug-20	47.0	7.10	26.0	0.0730	0.0140	0.512	0.00120
19-Oct-20	86.2	7.00	61.0	0.146	0.0240	0.126	0.00120
n	4	4	4	4	4	4	4
Minimum	47.0	6.90	26.0	0.0730	0.0140	0.126	0.000700
Maximum	86.2	7.20	67.0	0.146	0.0250	0.514	0.00120
Mean	70.1	7.05	53.0	0.105	0.0210	0.352	0.000975
SD	16.7	0.129	18.4	0.0306	0.00497	0.193	0.000263
23-Feb-21	59.6	7.10	35.0	0.0580	0.0220	0.296	<0.0005
13-May-21	87.5	7.20	72.0	0.221	0.0350	0.169	0.000900
17-Aug-21	44.1	7.20	45.0	0.119	0.0160	0.160	0.00160
13-Oct-21	42.4	7.00	25.0	0.133	0.0340	0.0250	<0.0005
n	4	4	4	4	4	4	4
Minimum	42.4	7.00	25.0	0.0580	0.0160	0.0250	<0.0005
Maximum	87.5	7.20	72.0	0.221	0.0350	0.296	0.00160
Mean	58.4	7.12	44.2	0.133	0.0268	0.162	0.000875
SD	20.9	0.0957	20.2	0.0672	0.00929	0.111	0.000429
15-Feb-22	79.3	7.10	67.0	0.108	0.0190	0.206	0.000800
25-May-22	61.8	6.30	52.0	0.133	0.0256	0.196	0.000900
23-Aug-22	51.5	7.20	29.0	0.0780	0.0137	0.157	0.00127
29-Nov-22	61.1	7.00	35.0	0.0800	0.0176	0.130	0.00160
n	4	4	4	4	4	4	4
Minimum	51.5	6.30	29.0	0.0780	0.0137	0.130	0.000800
Maximum	79.3	7.20	67.0	0.133	0.0256	0.206	0.00160
Mean	63.4	6.90	45.8	0.0998	0.0190	0.172	0.00114
SD	11.6	0.408	17.2	0.0261	0.00495	0.0352	0.000366
14-Feb-23	91.2	6.90	65.0	0.142	0.0205	0.190	0.00180
25-May-23	75.4	6.30	5.80	0.102	0.0245	0.142	0.000578
23-Aug-23	47.7	6.40	27.0	0.0480	0.0121	0.246	0.00102
7-Nov-23	48.1	7.39	27.0	0.0640	0.0114	0.208	0.00121
n	4	4	4	4	4	4	4
Minimum	47.7	6.30	5.80	0.0480	0.0114	0.142	0.000578
Maximum	91.2	7.39	65.0	0.142	0.0245	0.246	0.00180
Mean	65.6	6.75	31.2	0.0890	0.0171	0.196	0.00115
SD	21.4	0.502	24.7	0.0420	0.00642	0.0432	0.000507
Summary Statistics for 2020 to 2023							
n	16	16	16	16	16	16	16
Minimum	42.4	6.30	5.80	0.0480	0.0114	0.0250	<0.0005
Maximum	91.2	7.39	72.0	0.221	0.0350	0.514	0.00180
Mean	64.4	6.96	43.5	0.107	0.0210	0.221	0.00104
Median	61.5	7.05	40.0	0.104	0.0208	0.193	0.000960
SD	16.7	0.334	19.9	0.0431	0.00702	0.130	0.000389
10th Percentile	44.1	6.30	25.0	0.0580	0.0121	0.126	0.000578
95th Percentile	91.2	7.39	72.0	0.221	0.0350	0.514	0.00180

Indicates value exceeded Benchmarks.

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

[a] Sulphate Benchmark was calculated based on the hardness of a given sample based on the BC ENV 2013 guidance.

Table C.21: Water Quality at Reference SRWMP Station D-4, Dunlop Lake Outlet, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)	Radium-226 (Bq/L)	Barium (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
25-May-20	8.90	6.80	3.10	<0.007	0.0130	0.0410	0.0130	<0.0005
23-Nov-20	8.80	6.90	2.90	<0.007	0.0120	0.0430	0.0140	<0.0005
n	2	2	2	2	2	2	2	2
Minimum	8.80	6.80	2.90	<0.007	0.0120	0.0410	0.0130	<0.0005
Maximum	8.90	6.90	3.10	<0.007	0.0130	0.0430	0.0140	<0.0005
Mean	8.85	6.85	3.00	<0.007	0.0125	0.0420	0.0135	<0.0005
SD	0.0707	0.0707	0.141	-	0.000707	0.00141	0.000707	-
20-May-21	8.70	7.00	2.90	0.00500	0.0110	<0.02	0.00600	<0.0005
11-Nov-21	9.20	6.90	2.80	<0.005	0.0110	0.0210	0.0110	<0.0005
n	2	2	2	2	2	2	2	2
Minimum	8.70	6.90	2.80	0.00500	0.0110	<0.02	0.00600	<0.0005
Maximum	9.20	7.00	2.90	0.00500	0.0110	0.0210	0.0110	<0.0005
Mean	8.95	6.95	2.85	0.00500	0.0110	0.0205	0.00850	<0.0005
SD	0.354	0.0707	0.0707	-	0	-	0.00354	-
5-May-22	9.70	6.90	3.00	<0.005	0.0119	0.0650	0.0120	<0.0005
23-Aug-22	9.23	6.80	2.90	<0.005	0.00960	0.0300	0.0135	0.00000400
23-Nov-22	10.0	6.40	2.90	<0.005	0.0131	0.0480	0.0263	0.0000130
n	3	3	3	3	3	3	3	3
Minimum	9.23	6.40	2.90	<0.005	0.00960	0.0300	0.0120	0.00000400
Maximum	10.0	6.90	3.00	<0.005	0.0131	0.0650	0.0263	0.0000130
Mean	9.64	6.70	2.93	<0.005	0.0115	0.0477	0.0173	0.00000850
SD	0.388	0.265	0.0577	-	0.00178	0.0175	0.00786	0.00000779
11-May-23	9.10	5.90	3.00	<0.005	0.0112	0.0460	0.0139	0.0000150
14-Aug-23	9.59	6.40	2.70	<0.005	0.0115	0.0450	0.0220	0.0000440
15-Nov-23	8.20	6.90	3.00	<0.005	0.0107	0.0380	0.0270	0.0000100
n	3	3	3	3	3	3	3	3
Minimum	8.20	5.90	2.70	<0.005	0.0107	0.0380	0.0139	0.0000100
Maximum	9.59	6.90	3.00	<0.005	0.0115	0.0460	0.0270	0.0000440
Mean	8.96	6.40	2.90	<0.005	0.0111	0.0430	0.0210	0.0000230
SD	0.705	0.500	0.173	-	0.000404	0.00436	0.00661	0.0000184
Summary Statistics for 2020 to 2023								
n	10	10	10	10	10	10	10	10
Minimum	8.20	5.90	2.70	0.00500	0.00960	<0.02	0.00600	0.00000400
Maximum	10.0	7.00	3.10	0.00500	0.0131	0.0650	0.0270	0.0000440
Mean	9.14	6.69	2.92	0.00500	0.0115	0.0397	0.0159	0.0000172
Median	9.15	6.85	2.90	0.00500	0.0114	0.0420	0.0137	0.0000130
SD	0.529	0.348	0.114	-	0.00106	0.0134	0.00689	0.0000220
10th Percentile	8.45	6.15	2.75	0.00500	0.0102	0.0205	0.00850	0.00000400
95th Percentile	10.0	7.00	3.10	0.00500	0.0131	0.0650	0.0270	0.0000440

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

Table C.22: Water Quality at Reference SRWMP Station SR-19, Inlet to Elliot Lake, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
6-Feb-20	15.3	7.00	2.70	<0.007	0.0200	0.295	0.0250	<0.0005
13-May-20	13.6	6.90	2.70	<0.007	0.0190	0.128	0.0220	<0.0005
20-Aug-20	20.1	6.90	2.60	<0.007	0.0290	0.888	0.169	<0.0005
24-Nov-20	14.6	7.00	2.40	<0.007	0.0180	0.217	0.0260	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	13.6	6.90	2.40	<0.007	0.0180	0.128	0.0220	<0.0005
Maximum	20.1	7.00	2.70	<0.007	0.0290	0.888	0.169	<0.0005
Mean	15.9	6.95	2.60	<0.007	0.0215	0.382	0.0605	<0.0005
SD	2.89	0.0577	0.141	-	0.00507	0.344	0.0724	-
22-Feb-21	16.9	6.90	3.10	<0.007	0.0220	0.319	0.0320	<0.0005
12-May-21	12.2	6.90	2.40	0.0110	0.0170	0.156	0.0260	<0.0005
16-Aug-21	13.8	7.10	2.10	<0.005	0.0220	0.687	0.120	<0.0005
15-Nov-21	15.1	7.10	2.20	<0.005	0.0180	0.412	0.0460	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	12.2	6.90	2.10	<0.005	0.0170	0.156	0.0260	<0.0005
Maximum	16.9	7.10	3.10	0.0110	0.0220	0.687	0.120	<0.0005
Mean	14.5	7.00	2.45	0.00650	0.0198	0.394	0.0560	<0.0005
SD	1.99	0.115	0.451	-	0.00263	0.222	0.0435	-
17-Feb-22	18.5	6.80	2.70	<0.005	0.0240	0.330	0.0270	<0.0005
26-May-22	15.3	6.90	2.70	<0.005	0.0211	0.391	0.0680	<0.0005
9-Aug-22	17.0	7.00	2.50	<0.005	0.0252	0.688	0.0840	<0.0005
17-Nov-22	15.5	6.70	3.00	<0.005	0.0224	0.338	0.0490	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	15.3	6.70	2.50	<0.005	0.0211	0.330	0.0270	<0.0005
Maximum	18.5	7.00	3.00	<0.005	0.0252	0.688	0.0840	<0.0005
Mean	16.6	6.85	2.72	<0.005	0.0232	0.437	0.0570	<0.0005
SD	1.49	0.129	0.206	-	0.00180	0.170	0.0246	-
8-Feb-23	16.3	6.80	2.70	<0.005	0.0226	0.279	0.0200	<0.0005
10-May-23	13.7	6.50	2.50	<0.005	0.0178	0.146	0.0270	<0.0005
15-Aug-23	23.2	6.10	3.00	<0.005	0.0310	0.715	0.131	0.000124
30-Oct-23	15.0	7.30	3.60	<0.005	0.0215	0.369	0.0336	0.0000670
n	4	4	4	4	4	4	4	4
Minimum	13.7	6.10	2.50	<0.005	0.0178	0.146	0.0200	0.0000670
Maximum	23.2	7.30	3.60	<0.005	0.0310	0.715	0.131	0.000124
Mean	17.0	6.68	2.95	<0.005	0.0232	0.377	0.0529	0.0000955
SD	4.24	0.506	0.480	-	0.00558	0.243	0.0524	0.0000570
Summary Statistics for 2020 to 2023								
n	16	16	16	16	16	16	16	16
Minimum	12.2	6.10	2.10	<0.005	0.0170	0.128	0.0200	0.0000670
Maximum	23.2	7.30	3.60	0.0110	0.0310	0.888	0.169	0.000124
Mean	16.0	6.87	2.68	0.00538	0.0219	0.397	0.0566	0.0000955
Median	15.3	6.90	2.70	0.00500	0.0217	0.334	0.0328	0.0000955
SD	2.73	0.273	0.367	-	0.00394	0.227	0.0459	0.000114
10th Percentile	13.6	6.50	2.20	0.00500	0.0178	0.146	0.0220	0.0000670
95th Percentile	23.2	7.30	3.60	0.0110	0.0310	0.888	0.169	0.000124

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

Table C.23: Water Quality at Reference SRWMP Station SR-18, Outlet of Jim Christ Lake, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
13-May-20	9.60	6.90	3.40	<0.007	0.0470	0.0550	0.0130	<0.0005
19-Nov-20	9.70	6.90	3.60	<0.007	0.0440	0.0900	0.0210	<0.0005
n	2	2	2	2	2	2	2	2
Minimum	9.60	6.90	3.40	<0.007	0.0440	0.0550	0.0130	<0.0005
Maximum	9.70	6.90	3.60	<0.007	0.0470	0.0900	0.0210	<0.0005
Mean	9.65	6.90	3.50	<0.007	0.0455	0.0725	0.0170	<0.0005
SD	0.0707	0	0.141	-	0.00212	0.0247	0.00566	-
20-May-21	9.60	6.80	3.40	0.00700	0.0460	0.0280	0.00800	<0.0005
18-Nov-21	10.0	6.80	3.50	<0.005	0.0460	0.106	0.0620	<0.0005
n	2	2	2	2	2	2	2	2
Minimum	9.60	6.80	3.40	<0.005	0.0460	0.0280	0.00800	<0.0005
Maximum	10.0	6.80	3.50	0.00700	0.0460	0.106	0.0620	<0.0005
Mean	9.80	6.80	3.45	0.00600	0.0460	0.0670	0.0350	<0.0005
SD	0.283	0	0.0707	-	0	0.0552	0.0382	-
26-May-22	9.60	-	3.10	<0.005	0.0433	0.0450	0.0150	<0.0005
23-Nov-22	11.8	7.00	5.20	<0.005	0.119	0.458	0.0142	0.0000860
n	2	1	2	2	2	2	2	2
Minimum	9.60	7.00	3.10	<0.005	0.0433	0.0450	0.0142	0.0000860
Maximum	11.8	7.00	5.20	<0.005	0.119	0.458	0.0150	0.0000860
Mean	10.7	7.00	4.15	<0.005	0.0812	0.252	0.0146	0.0000860
SD	1.56	-	1.48	-	0.0535	0.292	0.000566	-
10-May-23	9.26	6.60	2.90	<0.005	0.0421	0.0530	0.0100	<0.0005
31-Oct-23	12.0	7.30	3.70	<0.005	0.0459	0.0450	0.0211	0.0000580
n	2	2	2	2	2	2	2	2
Minimum	9.26	6.60	2.90	<0.005	0.0421	0.0450	0.0100	0.0000580
Maximum	12.0	7.30	3.70	<0.005	0.0459	0.0530	0.0211	0.0000580
Mean	10.6	6.95	3.30	<0.005	0.0440	0.0490	0.0156	0.0000580
SD	1.94	0.495	0.566	-	0.00269	0.00566	0.00785	-
Summary Statistics for 2020 to 2023								
n	8	7	8	8	8	8	8	8
Minimum	9.26	6.60	2.90	<0.005	0.0421	0.0280	0.00800	0.0000580
Maximum	12.0	7.30	5.20	0.00700	0.119	0.458	0.0620	0.0000860
Mean	10.2	6.90	3.60	0.00525	0.0542	0.110	0.0205	0.0000720
Median	9.65	6.90	3.45	0.00500	0.0460	0.0540	0.0146	0.0000720
SD	1.07	0.216	0.697	-	0.0263	0.143	0.0174	0.0000396
10th Percentile	9.26	6.60	2.90	0.00500	0.0421	0.0280	0.00800	0.0000580
95th Percentile	12.0	7.30	5.20	0.00700	0.119	0.458	0.0620	0.0000860

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

Table C.24: Water Quality at Reference SRWMP Station SR-16, Fox Creek at Highway 108, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
21-Feb-20	8.80	5.90	0.800	<0.007	0.00800	1.17	0.0360	<0.0005
26-May-20	7.00	6.40	0.800	<0.007	0.00800	1.63	0.135	<0.0005
19-Aug-20	10.0	6.00	0.500	<0.007	0.00900	1.33	0.0600	<0.0005
24-Nov-20	5.95	6.40	1.20	<0.007	<0.005	0.361	0.0140	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	5.95	5.90	0.500	<0.007	<0.005	0.361	0.0140	<0.0005
Maximum	10.0	6.40	1.20	<0.007	0.00900	1.63	0.135	<0.0005
Mean	7.94	6.18	0.825	<0.007	0.00750	1.12	0.0612	<0.0005
SD	1.81	0.263	0.287	-	0.000530	0.542	0.0526	-
24-Feb-21	10.8	5.60	0.500	<0.007	0.00800	1.88	0.0590	<0.0005
18-May-21	5.00	6.30	0.600	<0.005	<0.005	0.223	0.0100	<0.0005
19-Aug-21	7.60	5.80	0.300	<0.005	0.00800	1.21	0.0500	<0.0005
18-Nov-21	6.40	6.00	<1	<0.005	0.00600	0.437	0.0240	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	5.00	5.60	0.300	<0.005	<0.005	0.223	0.0100	<0.0005
Maximum	10.8	6.30	0.600	<0.007	0.00800	1.88	0.0590	<0.0005
Mean	7.45	5.92	0.467	<0.005	0.00675	0.938	0.0357	<0.0005
SD	2.47	0.299	0.176	-	0.00122	0.758	0.0227	-
17-Feb-22	9.89	5.30	0.600	<0.005	0.00900	1.29	0.0380	<0.0005
27-May-22	5.30	5.70	0.500	<0.005	0.00407	0.675	0.0190	<0.0005
9-Aug-22	9.20	5.60	0.200	<0.005	0.00722	1.28	0.0510	<0.0005
3-Nov-22	8.90	6.10	0.400	0.00700	0.00760	0.407	0.0410	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	5.30	5.30	0.200	<0.005	0.00407	0.407	0.0190	<0.0005
Maximum	9.89	6.10	0.600	0.00700	0.00900	1.29	0.0510	<0.0005
Mean	8.32	5.68	0.425	0.00550	0.00697	0.913	0.0372	<0.0005
SD	2.06	0.330	0.171	-	0.00208	0.443	0.0134	-
22-Feb-23	9.10	5.80	2.40	<0.005	0.00745	0.800	0.0340	<0.0005
10-May-23	6.03	5.70	1.30	<0.005	0.00565	0.345	0.0210	<0.0005
16-Aug-23	16.4	6.30	2.00	<0.005	0.0204	3.51	0.340	0.0000430
30-Oct-23	10.2	6.70	2.20	<0.005	0.00833	0.704	0.0485	0.0000340
n	4	4	4	4	4	4	4	4
Minimum	6.03	5.70	1.30	<0.005	0.00565	0.345	0.0210	0.0000340
Maximum	16.4	6.70	2.40	<0.005	0.0204	3.51	0.340	0.0000430
Mean	10.4	6.12	1.98	<0.005	0.0105	1.34	0.111	0.0000385
SD	4.35	0.465	0.479	-	0.00672	1.46	0.153	0.00000900
Summary Statistics for 2020 to 2023								
n	16	16	16	16	16	16	16	16
Minimum	5.00	5.30	0.200	<0.005	0.00407	0.223	0.0100	0.0000340
Maximum	16.4	6.70	2.40	0.00700	0.0204	3.51	0.340	0.0000430
Mean	8.54	5.98	0.926	0.00512	0.00780	1.08	0.0613	0.0000385
Median	8.85	5.95	0.600	0.00500	0.00780	0.985	0.0395	0.0000385
SD	2.81	0.371	0.703	-	0.00378	0.819	0.0798	0.0000180
10th Percentile	5.30	5.60	0.300	0.00500	0.00407	0.345	0.0140	0.0000340
95th Percentile	16.4	6.70	2.40	0.00700	0.0204	3.51	0.340	0.0000430

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

Table C.25: Water Quality at Reference SRWMP Station SR-17, Unnamed Creek Drain Lake 3 at Hwy 108, 2020 to 2023

Date	Hardness (mg/L)	pH	Sulphate (mg/L)[a]	Radium-226 (Bq/L)	Barium (mg/L)	Iron (mg/L)	Manganese (mg/L)	Uranium (mg/L)
6-Feb-20	10.7	5.80	2.10	<0.007	0.0210	0.768	0.0620	<0.0005
26-May-20	9.70	6.40	2.10	<0.007	0.0220	1.68	0.0790	<0.0005
19-Aug-20	16.5	6.20	0.600	<0.007	0.0270	3.72	0.133	<0.0005
24-Nov-20	6.04	6.50	2.50	<0.007	0.0100	0.348	0.0210	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	6.04	5.80	0.600	<0.007	0.0100	0.348	0.0210	<0.0005
Maximum	16.5	6.50	2.50	<0.007	0.0270	3.72	0.133	<0.0005
Mean	10.7	6.22	1.82	<0.007	0.0200	1.63	0.0738	<0.0005
SD	4.33	0.310	0.838	-	0.00716	1.50	0.0464	-
24-Feb-21	12.5	5.80	2.30	<0.007	0.0190	1.12	0.0990	<0.0005
18-May-21	6.40	5.90	1.90	0.00800	0.0130	0.629	0.0380	<0.0005
19-Aug-21	9.60	6.50	0.600	0.00800	0.0170	1.73	0.0730	<0.0005
18-Nov-21	7.50	6.30	1.70	<0.005	0.0130	0.410	0.0190	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	6.40	5.80	0.600	<0.005	0.0130	0.410	0.0190	<0.0005
Maximum	12.5	6.50	2.30	0.00800	0.0190	1.73	0.0990	<0.0005
Mean	9.00	6.12	1.62	0.00650	0.0155	0.972	0.0572	<0.0005
SD	2.68	0.330	0.727	0	0.00300	0.586	0.0357	-
15-Feb-22	10.6	6.20	1.90	<0.005	0.0200	1.25	0.0740	<0.0005
26-May-22	9.80	6.60	2.40	<0.005	0.0165	0.424	0.0310	<0.0005
9-Aug-22	12.3	6.00	1.20	<0.005	0.0225	1.77	0.0790	<0.0005
28-Nov-22	11.3	5.50	2.50	<0.005	0.0161	0.597	0.0580	<0.0005
n	4	4	4	4	4	4	4	4
Minimum	9.80	5.50	1.20	<0.005	0.0161	0.424	0.0310	<0.0005
Maximum	12.3	6.60	2.50	<0.005	0.0225	1.77	0.0790	<0.0005
Mean	11.0	6.08	2.00	<0.005	0.0188	1.01	0.0605	<0.0005
SD	1.06	0.457	0.594	-	0.00303	0.619	0.0216	-
22-Feb-23	12.8	6.10	2.90	<0.005	0.0213	0.728	0.0546	0.0000590
10-May-23	6.62	5.80	2.50	0.00500	0.0136	0.378	0.0220	<0.0005
17-Aug-23	16.7	5.70	0.500	0.00600	0.0290	3.33	0.103	0.0000250
31-Oct-23	15.8	7.10	2.30	<0.005	0.0235	0.547	0.0507	0.0000260
n	4	4	4	4	4	4	4	4
Minimum	6.62	5.70	0.500	<0.005	0.0136	0.378	0.0220	0.0000250
Maximum	16.7	7.10	2.90	0.00600	0.0290	3.33	0.103	0.0000590
Mean	13.0	6.18	2.05	0.00525	0.0218	1.25	0.0576	0.0000367
SD	4.56	0.640	1.06	0.000612	0.00638	1.40	0.0336	0.0000223
Summary Statistics for 2020 to 2023								
n	16	16	16	16	16	16	16	16
Minimum	6.04	5.50	0.500	<0.005	0.0100	0.348	0.0190	0.0000250
Maximum	16.7	7.10	2.90	0.00800	0.0290	3.72	0.133	0.0000590
Mean	10.9	6.15	1.88	0.00547	0.0190	1.21	0.0623	0.0000367
Median	10.6	6.15	2.10	0.00600	0.0195	0.748	0.0600	0.0000260
SD	3.42	0.410	0.757	0.00118	0.00527	1.03	0.0325	0.0000447
10th Percentile	6.40	5.70	0.600	0.00500	0.0130	0.378	0.0210	0.0000250
95th Percentile	16.7	7.10	2.90	0.00800	0.0290	3.72	0.133	0.0000590

Notes: "-" indicates no benchmark available or SD was incalculable because there was no variability in the data. "SD" represents Standard Deviations. Benchmarks are based on the Serpent River Watershed Monitoring Program Cycle 5 State of the Environment Report (Minnow 2022).

APPENDIX D

Cider Stream beaver dams, upstream of station D-6.

Cider Stream, upstream of station D-6.

Cider Stream, upstream of station D-6.

Cider Stream, station D-6 is sampled downstream of the culverts. The confluence of the Cinder Stream and Serpent River is behind the trees.

Photo Set D.1: Wetland Habitat at SRWMP Station D-6, SRWMP Cycle 5 SOE, 2019

APPENDIX E

ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER A-500-4136725216
Version: 1.0
Issue Date: June 29, 2023

Pursuant to section 20.3 of the Environmental Protection Act, Revised Statutes of Ontario (R.S.O.) 1990, c. E. 19 and subject to all other applicable Acts or regulations this Environmental Compliance Approval is issued to:

Rio Algom Limited/Rio Algom Limitee

1 CHARLES WALK
ELLIOT LAKE ONTARIO
P5A 2A5

For the following site:

Former Pronto Mine Tailings Management Area
County/District: ALGOMA, Unorganized Area: South East Algoma

Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s) 4-0023-97-006, issued on April 25, 1997.

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

Modification of existing sewage works for the collection, treatment and disposal of sewage/runoff from the uranium and copper mine tailings containment areas of the closed Pronto mine site, located at Long Township, District of Algoma, Ontario, to Lake Huron via a creek up to a maximum peak instantaneous flow rate of 200 L/s and consisting of an effluent treatment plant (ETP) based on neutralization of effluent by lime addition, followed by barium chloride addition for removal of radium as per the following works:

Proposed Works

- one (1) pumpstation consisting of a single story building equipped with:
  - two (2) parallel 38 m long 600 mm HDPE intakes;
  - one (1) Concrete wet well;
  - two (2) vertical turbine pumps with a maximum flow rate of 242 L/s, designed to allow for a flow rate of 50-200 L/s (200 L/s is the existing permitted maximum ETP flow rate);
  - all other piping, valves, instruments and appurtenances essential for the proper operation of the aforementioned sewage works and
- one (1) 360 metre, 400 millimetre diameter HDPE forcemain line equipped with dual containment piping consisting of 500 millimeter diameter HDPE DR-21 containment pipe with built in leak detection technology along the downstream section of the forcemain.

Existing Works

- Effluent treatment plant with a maximum treatment rate of 200 L/s using lime and/or barium chloride addition equipped with:

- two (2) interconnected concrete rapid mix tanks, each with approximate volumetric capacity of 86.0 cubic metres, complete with agitators for mixing of wastewater with lime slurry and barium chloride;
- two (2) lime slurry storage tanks, each with approximate volumetric capacity of 23.0 cubic metres and equipped with agitators;
- one (1) lime dilution pump, approximately rated at 2.0 L/s at 6.0 metres of total dynamic head;
- two (2) variable speed lime slurry metering pumps, each approximately rated at 0.3 Litres/second for addition of lime slurry to the mix tanks;
- one (1) barium chloride storage tank with approximate volumetric capacity of 5.3 cubic metres and equipped with agitator;
- all other piping, valves, instruments and appurtenances essential for the proper operation of the aforementioned sewage works.

- One (1) holding pond with a 726,000 cubic metre capacity
- One (1) settling pond with a 55,000 cubic metre capacity and discharge control structure.

Existing Works to be decommissioned

- Removal of one (1) existing gravity fed decant structure and line through the causeway dam, after commissioning, training, acceptance of the new pumpstation. Reconstruction of the causeway dam to the original design elevation,

including all other controls, electrical equipment, instrumentation, piping, valves and appurtenances essential for the proper operation of the aforementioned sewage works;

all in accordance with the submitted supporting documents listed in Schedule 1.

DEFINITIONS

For the purpose of this environmental compliance approval, the following definitions apply:

1. "Approval" means this entire Environmental Compliance Approval and any Schedules attached to it;
2. "Daily Maximum Concentration" means the concentration of a contaminant in the effluent discharged over any single day, as measured by a composite or grab sample, whichever is required;
3. "Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;
4. "District Manager" means the District Manager of the appropriate local district office of the Ministry, where the Works is geographically located;
5. "EPA" means the *Environmental Protection Act,* R.S.O. 1990, c.E.19;
6. "Equivalent Equipment" means a substituted equipment or like-for-like equipment that meets the required quality and performance standards of the approved named equipment;
7. "Final Effluent" means effluent that is discharged to the environment through the approved effluent disposal facilities, that are required to meet the compliance limits stipulated in the Approval for the Effluent Treatment Plant at the Final Effluent sampling point(s);
8. "Influent" means flows to the Effluent Treatment Plant from the Pronto Tailings Management Area at the holding pond;
9. "Licensed Engineering Practitioner" means a person who holds a licence, limited licence or temporary licence under the

Professional Engineers Act, R.S.O. 1990, c. P.28;

10. "Ministry" means the ministry of the Minister and includes all, employees or other persons acting on its behalf;
11. "Monthly Average Effluent Concentration" is the mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured during a calendar month,
12. “Owner” means Rio Algom Limited, including any successors and assignees, and has the same meaning set out in section 25 of the EPA, section 1 of the OWRA, as applicable
13. "OWRA" means the *Ontario Water Resources Act,* R.S.O. 1990, c. O.40;
14. "Peak Instantaneous Flow Rate" means the instantaneous maximum flow rate as measured by a metering device for which the sewage treatment process unit or equipment is designed to handle;
15. "Previous Works" means those portions of the sewage Works previously approved under an Approval;
16. "Single Sample Result" means the test result of a parameter in the effluent discharged on any day, as measured by a probe, analyzer or in a composite or grab sample, as required;
17. “Works” means the approved sewage works

TERMS AND CONDITIONS

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

1. **GENERAL CONDITIONS**
    1. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.
    2. Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the application for approval of the Works.
    3. Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.
    4. Where there is a conflict between the documents listed in Schedule 1 and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.
    5. The conditions of this Approval are severable. If any condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.
    6. The issuance of, and compliance with the conditions of, this Approval does not:
        1. relieve any person of any obligation to comply with any provision of any applicable statute, regulation or other legal requirement, including, but not limited to, the obligation to obtain approval from the local conservation authority/MNRF necessary to construct or operate the sewage works; or
        2. limit in any way the authority of the Ministry to require certain steps be taken to require the Owner to furnish any further information related to compliance with this Approval.]
2. **EXPIRY OF APPROVAL**
    1. This Approval will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Approval.

2. In the event that completion and commissioning of any portion of the Works is anticipated to be delayed beyond the specified expiry period, the Owner shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the Works are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. **CHANGE OF OWNER**

1. The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

    a. change of address of Owner;

    b. change of Owner, including address of new owner;

    c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c. B.17 shall be included in the notification; or

    d. change of name of the corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification.

2. In the event of any change in ownership of the Works, the Owner shall notify in writing the succeeding owner of the existence of this Approval, and a copy of such notice shall be forwarded to the District Manager and the Director.

3. The Owner shall ensure that all communications made pursuant to this condition refer to the number of this Approval.

4. **OPERATION AND MAINTENANCE**

1. If applicable, any proposed storm sewers or other stormwater conveyance in this Approval can be constructed but not operated until the proposed stormwater management facilities in this Approval or any other Approval that are designed to service the storm sewers or other stormwater conveyance are in operation.

2. The Owner shall make all necessary investigations, take all necessary steps and obtain all necessary approvals so as to ensure that the physical structure, siting and operations of the Works do not constitute a safety or health hazard to the general public.

3. The Owner shall inspect and ensure that the design minimum liquid retention volume is maintained in the Works at all times, except when maintenance is required.]

4. The Owner shall undertake an inspection of the condition of the Works, at least once a year, and undertake any necessary cleaning and maintenance to ensure that sediment, debris and excessive decaying vegetation are removed from the Works to prevent the excessive build-up of sediment, oil/grit, debris and/or decaying vegetation, to avoid reduction of the capacity and/or permeability of the Works, as applicable. The Owner shall also regularly inspect and clean out the inlet to and outlet from the Works to ensure that these are not obstructed.

5. The Owner shall construct, operate and maintain the Works with the objective that the effluent from the Works is essentially free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen, foam or discoloration on the receiving waters.

6. The Owner shall maintain a logbook to record the results of these inspections and any cleaning and maintenance operations undertaken, and shall keep the logbook at the Owner's administrative office for inspection by the Ministry. The logbook shall include the following:

    a. the name of the Works; and

    b. the date and results of each inspection, maintenance and cleaning, including an estimate of the quantity of any materials removed and method of clean-out of the Works.

7. The Owner shall prepare an operations manual prior to the commencement of operation of the Works that includes, but is not necessarily limited to, the following information:
    a. operating and maintenance procedures for routine operation of the Works;
    b. inspection programs, including frequency of inspection, for the Works and the methods or tests employed to detect when maintenance is necessary;
    c. repair and maintenance programs, including the frequency of repair and maintenance for the Works;
    d. contingency plans and procedures for dealing with potential spills and any other abnormal situations and for notifying the District Manager; and
    e. procedures for receiving, responding and recording public complaints, including recording any follow-up actions taken.
8. The Owner shall maintain the operations manual current and retain a copy at the Owner's administrative office for the operational life of the Works. Upon request, the Owner shall make the manual available to Ministry staff.

5. **CHANGES IN PROCESSES OR PROCESS MATERIALS**

1. The Owner shall give written notice to the District Manager of any plans to change the processes or process materials in the Owner's enterprise serviced by the Works where the change may not significantly alter the quantity or quality of the influent to the Works, while complying with the approved effluent quantity and quality from the Works, and no such change(s) shall be made unless with the written concurrence or approval of the District Manager

6. **EFFLUENT LIMITS**

1. The Owner shall design, construct and operate the Works such that the concentrations of the materials listed as effluent parameters in the effluent limits table in Schedule 2 are not exceeded in the effluent from the Works
2. For the purposes of determining compliance with and enforcing subsection (1):
    1. Non-compliance with respect to a Concentration Limit is deemed to have occurred when any single (composite, grab) sample analyzed for a parameter named in Column 1 of the Effluent Limits Table listed in Schedule 2 is greater than the corresponding maximum concentration or outside of the range set out in Column 2 of the Effluent Limits Table listed in Schedule 2
    2. Non-compliance with respect to an Average Concentration Limit is deemed to have occurred when the arithmetic mean concentration of all samples taken in a month analyzed for a parameter named in Column 1 of the Effluent Limits Table listed in Schedule 2 is greater than the corresponding average concentration or outside of the range set out in Column 3 of the Effluent Limits Table listed in Schedule 2;
3. The Owner shall operate and maintain the Works such that the effluent from the Works is non-acutely lethal to Rainbow Trout and Daphnia magna by ensuring that each Rainbow Trout acute lethality test and each Daphnia magna acute lethality test performed on any grab sample of effluent shall result in mortality of no more than 50% of the test organism in 100 percent effluent.

7. **EFFLUENT AND RECEIVER MONITORING AND RECORDING**

1. The Owner shall, upon commencement of operation of the sewage works, carry out a monitoring program and all samples and measurements taken for the purposes of this Approval are to be taken at a time and in a location characteristic of the quality and quantity of the effluent stream over the time period being monitored.
2. Samples shall be collected and analyzed at the sampling point(s), at the sampling frequencies and using the sample type specified for each parameter listed in the effluent monitoring table included in Schedule 2
3. The methods and protocols for sampling, analysis, toxicity testing, and recording shall conform, in order of precedence, to the methods and protocols specified in the following:
    2. The Ministry's publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater

Version 2.0" (January 2016), PIBS 2724e02, as amended;

3. The publication "Standard Methods for the Examination of Water and Wastewater" (21st edition) as amended from time to time by more recently published editions;

4. The Environment Canada publications "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" (EPS 1/RM/13 Second Edition - December 2000) and "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia magna" (EPS 1/RM/14 Second Edition - December 2000), as amended from time to time by more recently published editions; and

5. In respect of any parameters not mentioned in (a) – (c) – the written approval of the District Manager, which approval shall be obtained prior to sampling.

4. The measurement frequencies specified in the effluent monitoring table in Schedule 2 in respect of any parameter are minimum requirements which may, after twelve (12) months of monitoring in accordance with this Condition, be modified by the Director in writing from time to time.

5. A continuous flow measuring device(s), which must be operable under winter conditions, shall be installed and maintained to measure the flowrate of the effluent from the sewage works, with an accuracy to within plus or minus 15 per cent of the actual flowrate for the entire design range of the flow measuring device and the Owner shall measure, record and calculate the flowrate for each effluent stream on each day of sampling.

6. The Owner shall retain for a minimum of five (5) years from the date of their creation, all

7. records and information related to or resulting from the monitoring activities required by this Approval.

8. **GROUNDWATER MONITORING AND RECORDING**

1. The Owner shall, within 6 months of issuance of this Approval, design a groundwater monitoring and sampling program to characterize the groundwater quality in the area that is acceptable to the District Manager that assess potential groundwater impacts and compliance with Provincial regulations (i.e. Ministry Guideline B-7, Aquatic Protection Values, etc.). The groundwater monitoring program must include at minimum the following:
    1. monitoring well network including upgradient and downgradient wells of the Tailings Management Area (TMA) located within the sand and gravel deposits and shallow bedrock (i.e. nested wells).

    2. The proposed analytical parameters and sampling frequency. The analytical parameters must be comprehensive and shall include general chemistry and metals.

    3. The groundwater monitoring and sampling program must be designed by a licensed professional geoscientist/engineer.

9. **REPORTING**

1. One week prior to the start up of the operation of the Works, the Owner shall notify the District Manager (in writing) of the pending start up date

2. The Owner shall report to the District Manager or designate, any exceedance of any parameter specified in Condition 6 orally, as soon as reasonably possible, and in writing within seven (7) days of the exceedance

3. In addition to the obligations under Part X of the EPA, the Owner shall, within ten (10) working days of the occurrence of any reportable spill as defined in Ontario Regulation 675/98, bypass or loss of any product, by-product, intermediate product, oil, solvent, waste material or any other polluting substance into the environment, submit a full written report of the occurrence to the District Manager describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation.

4. The Owner shall prepare performance reports on an annual basis and submit to the District Manager by March 31 of the calendar year following the period being reported upon. The first such report shall cover the first annual period following the commencement of operation of the Works and subsequent reports shall be submitted to cover successive annual periods following thereafter. The reports shall contain, but shall not be limited to, the

following information:

1. A summary and interpretation of all monitoring data and a comparison to the effluent limits outlined in Condition 6, including an overview of the success and adequacy of the sewage Works;
2. A description of any operating problems encountered and corrective actions taken;
3. A summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the sewage works;
4. A summary of any effluent quality assurance or control measures undertaken in the reporting period;
5. A summary of the calibration and maintenance carried out on all effluent monitoring equipment;
6. Any other information the District Manager requires from time to time.
7. Annual receiving water report that shall include the following minimum information
    1. Tabulation and interpretation of current and historical receiver surface water monitoring data (including electronic file of historic and current data in EXCEL format) with comparison to Provincial Water Quality Objectives (PWQO), national water quality guidelines (CCME, FEQG) and for Sulphate the BCMOE guideline
    2. Graphs illustrating current and historical trends with time of water quality parameters
    3. Description and evaluation of any and all aquatic environmental effects associated with the mining operations
    4. A site plan or plans or the entire site illustrating significant features such as lakes, streams, ponds, seeps, ditches, collection and treatment facilities and roadways, as well as all of the sampling locations; and
    5. Universal Transverse Mercator (UTM) coordinates for sampling sites, North American Datum (NAD83).

5. The Owner shall submit an annual groundwater monitoring report prepared by a licensed independent Professional Geoscientist or Professional Engineer qualified in the field of hydrogeology, in both digital and hardcopy formats, to the District Manager on March 31st of each calendar year. This report can be merged with the annual report required pursuant to subsection (3) at the discretion of the District Manager. The annual groundwater monitoring report shall include the following minimum information
    1. A site plan or plans of the entire site illustrating significant site features such as lakes, rivers, seeps, ponds, ditches, collection and treatment facilities, and roadways, as well as all of the sampling locations.
    2. A cross section of the subsurface soils, stratigraphy, displaying the groundwater elevations
    3. A groundwater contour map showing the groundwater elevations for each well and the groundwater flow directions
    4. Tables summarizing all historical and current water level data and analytical results for all parameters for each groundwater monitoring well.
    5. A copy of borehole logs for all groundwater monitoring wells (may be provided electronically).
    6. A copy of the original laboratory analytical results (may be provided electronically).

10. **REVOCATION**
    1. Upon issuance of the environmental compliance approval, I hereby revoke Approval Nos. 4-103-71-006 issued 1971, 4-062-79878 issued 1987 and 4-0023-97-006 issued 1997.

REASONS

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review

2. Condition 2 is included to ensure that the Ministry records are kept accurate and current with respect to approved works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

3. Condition 3 regarding construction of Proposed Works is included to ensure that the Works are constructed in a timely manner so that standards applicable at the time of Approval of the Works are still applicable at the time of construction to ensure the ongoing protection of the environment, and that prior to the commencement of construction of the portion of the Works that are approved in principle only, the Director will have the opportunity to review detailed design drawings, specifications and an engineer's report containing detailed design calculations for that portion of the Works, to determine capability to comply with the Ministry's requirements stipulated in the terms and conditions of the Approval, and also ensure that the Works are constructed in accordance with the Approval and that record drawings of the Works "as constructed" are updated and maintained for future references.

4. Condition 4 is included to emphasize that the Owner has an ongoing duty to mitigate any adverse impacts resulting from non-compliance with the Approval. This Condition is included to ensure that the sewage works will be operated, maintained, funded, staffed and equipped in a manner enabling compliance with the terms and conditions of this Approval, such that the environment is protected and deterioration, loss, injury or damage to any person or property is prevented. Condition 4 is also included to ensure that a comprehensive operations manual governing all significant areas of operation, maintenance and repair is prepared, implemented and kept up-to-date by the Owner and made available to the Ministry. Such a manual is an integral part of the operation of the Works. Its compilation and use should assist the owner in staff training, in proper plant operation and in identifying and planning for contingencies during possible abnormal conditions. The manual will also act as a benchmark for Ministry staff when reviewing the Owner's operation of the Works.

5. Condition 5 is included to ensure that the works is operated in accordance with the information submitted by the Owner relating to the process and materials which are served by the Works, and to ensure that any contemplated changes in them which could potentially affect the characteristics of effluent from the Works will be properly reviewed and approved.

6. Condition 6 is imposed to ensure that the effluent discharged from the Works to Lake Huron meets the Ministry's effluent quality requirements thus minimizing environmental impact on the receiver.

7. Condition 7 is included to require the Owner to demonstrate on a continual basis that the quality and quantity of the effluent from the approved works is consistent with the effluent limits specified in the Approval and that the approved works do not cause any impairment to the receiving watercourse.

8. Condition 8 is included to require the Owner to establish a groundwater monitoring and recording program to characterize the groundwater quality in the area and to assess potential groundwater impacts and compliance with Provincial regulations.

9. Condition 9 is included to provide a performance record for future references and to ensure that the Ministry is made aware of problems as they arise, so that the Ministry can work with the Owner in resolving the problems in a timely manner.

10. Condition 10 is included to revoke the old sewage approvals for this site.

APPEAL PROVISIONS

In accordance with Section 139 of the *Environmental Protection Act*, you may by written notice served upon me and the Ontario Land Tribunal within 15 days after receipt of this notice, require a hearing by the Tribunal. Section 142 of the *Environmental Protection Act* provides that the notice requiring the hearing ("the Notice") shall state:

I. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;

II. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

Pursuant to subsection 139(3) of the *Environmental Protection Act*, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.
The Notice should also include:

I. The name of the appellant;

II. The address of the appellant;

III. The environmental compliance approval number;

IV. The date of the environmental compliance approval;

V. The name of the Director, and;

VI. The municipality or municipalities within which the project is to be engaged in.

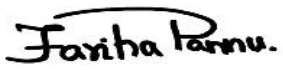
And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

Registrar* Ontario Land Tribunal 655 Bay Street, Suite 1500 Toronto, Ontario M5G 1E5 OLT.Registrar@ontario.ca	and	The Director appointed for the purposes of Part II.1 of the *Environmental Protection Act* Ministry of the Environment, Conservation and Parks 135 St. Clair Avenue West, 1st Floor Toronto, Ontario M4V 1P5

*** Further information on the Ontario Land Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349 or 1 (866) 448-2248, or www.olt.gov.on.ca**
The above noted activity is approved under s.20.3 of Part II.1 of the *Environmental Protection Act*.

Dated at Toronto this 29th day of June, 2023



Fariha Pannu

Director

appointed for the purposes of Part II.1 of the Environmental Protection Act

c: Don Carr, Minnow Environmental

The following schedules are a part of this environmental compliance approval:

SCHEDULE 1

1. Application for an Environmental Compliance Approval dated September 2, 2021 and signed by Anthony Lambert Rio Algom Limited/Rio Algom Limitee submitted by Don Carr, Minnow Environmental.
2. Application for Approval of Industrial Sewage Works dated February 26, 1997, submitted by Mr. R.A. Payne, Manager Environment and Decommissioning, Rio Algom Limited, Elliot Lake Division, Elliot Lake Ontario.
3. Certificates of Approvals No. 4-062-79-878 and No. 4-0023-97-006, issued on April 10th 1987 and April 25th 1997 respectively
4. Environmental Compliance Approval Application for Industrial Sewage Works submitted and signed electronically by Anthony Lambert, Director of Rio Algom Limited, received September 7, 2021.
5. Report “Pronto Facility Supporting Document for Environmental Compliance Approval Amendment Application, dated June 2021, including calculations, and engineering drawings, prepared by Minnow Environmental Inc.

SCHEDULE 2

Surface Water Monitoring

Station	UTM (NAD83)	Location Description	Parameter	Frequency
LL-01		Pronto Creek inflow to Lauzon Lake	Flow, hardness, pH, SO4, Ra226, Ba, Co, Fe, Mn, U, DOC	Quarterly
PR-01		Diversion Channel from Beaver Pond to Lake Huron, at Hwy 17.	Flow, hardness, pH, SO4, Ra226, Ba, Co, Fe, Mn, U, DOC	Monthly
			Acute Toxicity (Rainbow Trout, Daphnia magna) Sublethal Toxicity (Ceriodaphnia dubia)	Semi-Annual
PR-02		Treatment Plant Influent	Flow	Daily[ab]
			Water level elevation	Weekly[a]
			pH, Ra226 Lime consumption BaCl2 consumption	Monthly[a]
			SO4, acidity, Ba, Co, Fe, Mn, U	Quarterly[a]
PR-03		Treatment Plant Effluent	pH	Daily[ab]
PR-04		Dam D overflow Final Treated Effluent Compliance Point	Flow, pH, Ra226, TSS, Fe	Weekly[ac]
			SO4, Ba, Co, Mn, U, DOC, hardness	Monthly[ac]
			Acute Toxicity (Rainbow Trout, Daphnia magna)	Semi-Annual

A – Sampled when treatment plant is operating

B – Daily monitoring conducted on weekdays only

C – Monthly sample collected same time as Weekly sample

Final Effluent Limits

Effluent Parameter	Effluent Limits (PR-04 Compliance Point)
pH	6.0-9.5 Daily Maximum 6.0-9.0 Monthly Average
Radium-226 (total)	1.11 Bq/L Daily Maximum 0.37 Bq/L Monthly Average
Fe	2 mg/L Daily Maximum 1 mg/L Monthly Average
TSS	30 mg/L Daily Maximum 15 mg/L Monthly Average