Appendix 10

Geochemistry Reports

Appendix 10a

Geochemical Characterization Key Assumptions Report (SRK, August 2016)

Grassy Mountain Project

Geochemical Characterization Report

Prepared for

Millennium EMS Solutions Ltd.

Prepared by

SRK Consulting (Canada) Inc.
1CM029.008
August 2016

Grassy Mountain Project

Geochemical Characterization Report

August 2016

Prepared for

Millennium EMS Solutions Ltd.
Suite 325 – 1925 18 Avenue NE
Calgary, AB T2E 7T8
Canada

Tel: +1 403 592 6180
Web: www.mems.ca

Prepared by

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2
Canada

Tel: +1 604 681 4196
Web: www.srk.com

Project No: 1CM029.008

File Name: GeochemChar_Report_1CM029-008_20160811_SJD_LNB

Copyright © SRK Consulting (Canada) Inc., 2016

srk consulting

Executive Summary

SRK Consulting (Canada) Inc. (SRK) undertook geochemical characterization of mine wastes for the Grassy Mountain Coal Project (the Project). This work supports the development of geochemical design criteria for water and waste management at the Project, and the derivation of geochemical inputs into water quality predictions.

Core representing future waste rock, legacy (existing) waste rock and waste products from trial processing of coal from the Project were characterized to evaluate metal leaching and acid rock drainage (ML/ARD) potential using acid-base accounting, mineralogy, trace element analysis and laboratory kinetic tests. This work indicated that ARD potential is restricted to certain stratigraphic horizons (the Cadomin Conglomerate, the top of the Mutz Formation to its contact with the Cadomin Conglomerate and the Moose Mountain Formation). The Adanac Formation has mixed ARD potential and the Hillside Formation has negligible ARD potential. Characterization of the Fernie Formation was ongoing at the time of report preparation but based on visual observation is expected to show low ARD potential. These findings were used define potentially ARD generating (PAG) management units (PAGMUs).

Coal processing rejects are non-PAG on balance due to the natural blending resulting from combing seams for processing. Seam 1 Reject is PAG but will not be produced on its own.

Humidity cell tests showed that potentially ARD generating (PAG) units are expected to generate acidic leachate in time frames of 1 to 8 years due to differences in composition and reactivity.

SRK has recommended that ARD potential be mitigated by subaqueous disposal of PAG rock in backfilled pits, and where this cannot be achieved due to sequencing and waste quantities, mitigation by blending with non-PAG waste rock. The blending approach would involve ensuring that the overall rock mixture has three times more neutralizing minerals than acid generating minerals, and placement so that PAG and non-PAG rock become naturally co-mingled with the objective that the mixture behaves as non-PAG.

Geochemical analysis also determined that management of selenium leaching needs to be incorporated into the project. Selenium content of the rock and leaching rates measured in humidity cells are consistent with similar coal-bearing strata in nearby British Columbia. Since selenium originates from oxidation of iron sulphide, source selenium leaching can be managed by subaqueous disposal. In addition, selenium can be attenuated in low oxygen conditions which develop in backfill conditions provided that sufficient reaction time exists for conversions to occur to less mobile forms.

Contact water source terms for all facilities were developed. Uncertainty in the terms is reflected in two cases referred to as the Base Case and Upper Case. The former represents the most likely outcome and the latter a boundary condition. Source concentrations were estimated using results from geochemical testing, experience from nearby coal-mining in the Elk Valley, site monitoring data and scientific judgement. The source terms are inputs into the water quality model for the project.

Table of Contents

1 Introduction 1
1.1 Scope of Work 1
1.2 Background 1
1.3 Geological Setting 1
1.4 Historical Workings 3
1.5 Mine Plan 3
1.6 Report Objective 3
1.7 Acknowledgements 3
1.8 Report Structure 4
2 Geochemical Characterization Program Design 4
2.1 Introduction 4
2.2 Regulatory Context 4
2.3 Conceptual Geochemical Models 4
2.4 Characterization Program Design 5
3 Methods 6
3.1 Sample Acquisition 6
3.1.1 Future Waste Rock 6
3.1.2 Legacy Wastes 8
3.1.3 Coal Handling and Processing Plant Residues 8
3.2 Analysis 9
3.2.1 Solid Sample Preparation 9
3.2.2 Static Geochemical Tests 9
3.2.3 Humidity Cells 10
3.2.4 Particle Size Analysis 11
3.2.5 Mineralogical Analyses 11
3.2.6 Seep Analysis 11
3.2.7 Quality Control 11
4 Results 13
4.1 Future Waste Rock 13
4.1.1 Sulphur Occurrence 13
4.1.2 Neutralization Potential Occurrence 16
4.1.3 Trace Element Occurrence 19
4.1.4 Acid Rock Drainage Potential 19
4.1.5 Metal Leaching Potential 21
4.1.6 Humidity Cells 23

4.2 Legacy Wastes 25
4.2.1 Sulphur Occurrence 25
4.2.2 Neutralization Potential Occurrence 25
4.2.3 Acid Rock Drainage Potential 27
4.2.4 Metal Leaching Potential 29
4.3 Coal Handling and Processing Plant Residues 30
4.3.1 Sulphur Occurrence 30
4.3.2 Neutralization Potential Occurrence 30
4.3.3 Acid Rock Drainage Potential 30
4.3.4 Metal Leaching Potential 30
4.3.5 Humidity Cells 30
5 Management of ARD Potential 31
5.1 Introduction 31
5.2 Definition of ARD Potential 31
5.3 Identification of PAG Units 31
5.4 Management of PAG Units 31
5.4.1 Selection of Management Approaches 31
5.4.2 Subaqueous Disposal 33
5.4.3 Waste Rock Blending 34
6 Management of Selenium Leaching Potential 39
6.1 Current Understanding 39
6.2 General Mitigation Approaches 39
6.3 Selection of Preferred Approach and Assessment 39
7 Derivation of Contact Water Source Terms 41
7.1 Introduction 41
7.2 Evaluating Uncertainty 41
7.3 Waste Rock 41
7.3.1 Backfill 44
7.3.2 Co-Disposed Waste Rock and CHPP Rejects 44
7.3.3 Pit Walls 45
8 Conclusions 47
9 References 49

List of Figures

Figure 1: Stratigraphic Column for the Grassy Mountain Project 2

Figure 2: Geochemistry Sample Sites 7

Figure 3: Near Source Water Sampling Locations 12

Figure 4: Box-and-Whisker Plot of Sulphide Sulphur by Rock Unit 13

Figure 5: Box-and-Whisker Plot of Sulphide Sulphur in the Cadomin Formation by Lithotype 15

Figure 6: Core from Hole RGSC0006 (depth 133.8 to 136.8 m). Pen within Picture is 140 mm in Length 15

Figure 7: Comparison of Modified Neutralization Potential (NP) and Total Inorganic Carbon (TIC) in Drill Core Samples 17

Figure 8: Comparison of Modified Neutralization Potential (NP) and Calcium and Magnesium-Bearing Carbonate ($IC_{Ca,Mg}$) in Drill Core Samples Analyzed for Mineralogy. 18

Figure 9: Box-and-Whisker Plot of Modified NP by Rock Unit 18

Figure 10: Acid Rock Drainage Classifications for Drill Core Samples 21

Figure 11: Box-and-Whisker Plot of Cadmium Concentrations by Rock Unit 22

Figure 12: Box-and-Whisker Plot of Selenium Concentrations by Rock Unit 22

Figure 13: pH of Waste Rock Humidity Cell Test Leachates 23

Figure 14: Sulphate Concentrations in Waste Rock Humidity Cell Test Leachates 24

Figure 15: Cadmium Concentrations in Waste Rock Humidity Cell Test Leachates 24

Figure 16: Selenium Concentrations in Waste Rock Humidity Cell Test Leachates 25

Figure 17: Comparison of Modified Neutralization Potential (NP) and Total Inorganic Carbon (TIC) in Legacy Waste Bulk and -2 mm Fraction Samples 26

Figure 18: Legacy Waste at TP-09 Showing Prevalent Carbonaceous Fines 27

Figure 19: Acid Rock Drainage Classifications for the Legacy Waste Samples 28

Figure 20: Comparison of Paste and Rinse pH in the -2 mm Fraction of Legacy Waste Samples 28

Figure 21: Iron Staining at Legacy Waste Seep Sites (a) Seep-01, and (b) Seep-03 30

Figure 22: Oxidation Rate as a Function of Sulphide Content for Humidity Cells 34

Figure 23: Concept for Blending 37

Figure 24: Example of pH Control Shown by Data for Cobalt 43

List of Tables

Table 1: Drill Hole Listing 6
Table 2: Samples Selected for Humidity Cell Testing 10
Table 3: Summary of Static Geochemical Test Data 14
Table 4: PAG Management Units 20
Table 5: SRK Seep Sample Chemistry Summary 29
Table 6: Recommended Maximum Exposure Times Prior to Inundation by Pit Waters of PAG Rock by Formation 33
Table 7: Mass Balance NP/AP for Co-Mingled Non-PAG:PAG at 75:25. 35
Table 8: Mass Balance NP/AP for Co-Mingled Mutz Non-PAG:PAG at 75:25. 36
Table 9: Calculated Placement Requirements for Co-Mingling of PAGMU with non-PAG 38
Table 10: Release Rate for Selenium and Sulphate (mg/bank m^3/year) 42
Table 11: Solubility Controls (in mg/L) for pH Constrained Elements Using Two pH Ranges 44
Table 12: Wall Runoff Concentrations 46

List of Appendices

Appendix A – Summary of Analytical Data Quality Checks

Appendix B – Mineralogy Results

Appendix C – Downhole Plots

Appendix D – Correlation Matrices

Appendix E – Static Test Results for Future Wastes

Appendix F – Static Test Results for Legacy Wastes

Appendix G – Static Test Results for CHPP Residues

Appendix H – Waste Rock Humidity Cell Test Charts

Appendix I – CHPP Residue Humidity Cell Test Charts

List of Acronyms

AP	acid potential
ARD	acid rock drainage
BMA	bulk mineral analysis
CGM	conceptual geochemical models
CHPP	coal handling and processing plant
CRM	certified reference material
EC	electrical conductivity
ICP-MS	inductively coupled plasma mass spectrometry
MEMS	Millennium EMS Solutions Ltd.
ML	metal leaching
MMF	Mist Mountain Formation
non-PAG	non-potentially ARD generating
NP	Neutralization Potential
ORP	oxidation-reduction potential
PAG	potentially ARD generating
PAGMU	PAG management units
RPD	relative percent difference
TIC	total inorganic carbon
XRD	x-ray diffraction
XRF	x-ray fluorescence

1 Introduction

1.1 Scope of Work

SRK Consulting (Canada) Inc. (SRK) undertook geochemical characterization of mine wastes for the Grassy Mountain Coal Project (the Project). This work supports the development of geochemical design criteria for water and waste management at the Project, and the development of geochemical inputs into water quality predictions.

1.2 Background

The Project, owned by Benga Mining Limited (Benga) a wholly owned subsidiary of Riversdale Resources Limited (Riversdale), is located 150 km south of Calgary, Alberta and 7 km north of the town of Blairmore, Alberta. The proposed Project would involve an open pit coal mine, waste rock disposal areas, a Coal Handling and Processing Plant (CHPP), access and haul roads, and a product coal overland conveyor that will connect the CHPP area to a train load out facility (Benga 2016).

The Project will target high quality steel-making (metallurgical) coal to ship to overseas steel producing markets.

1.3 Geological Setting

The economic coal seams at Grassy Mountain occur within the Kootenay Formation. The Kootenay Formation conformably overlies interbedded sandstone, siltstone, and shale of the Upper Jurassic Fernie Formation. It is disconformably overlain by conglomerate and sandstone of the Lower Cretaceous Cadomin Formation of the Blairmore Group (Figure 1).

Stratigraphy at Grassy Mountain follows the nomenclature of Norris (1959 in Gibson 1985) whereby the Kootenay Group is described as the Kootenay Formation, and is divided into the Moose Mountain, Adanac, Hillcrest, and Mutz Members (Figure 1).

The economic coal seams from top to bottom of the stratigraphic column are Zones 1, 2, and 4 (Figure 1). The coal zones extend approximately 7 km along strike in a north north-east direction occupying a zone of interest approximately 2 km wide (Norwest 2012). The strata have been strongly folded and faulted resulting in sediments and coal zones repeated in parallel bands.

The stratigraphy at Grassy Mountain shows some similarities to the coal-hosting Mist Mountain Formation (MMF) in the nearby Elk Valley of British Columbia though nomenclature is different. In the Elk Valley, the lowest Moose Mountain Member is in the Morrisey Formation with the latter separating the MMF and Fernie Formation. In the Elk Valley, the Elk Formation occurs between the MMF and Cadomin Formation (which is equivalent to the Cadomin conglomerate of the overlying Gladstone Formation at Grassy Mountain), and the Elk, Mist Mountain and Morrisey Formations compose the Kootenay Group.

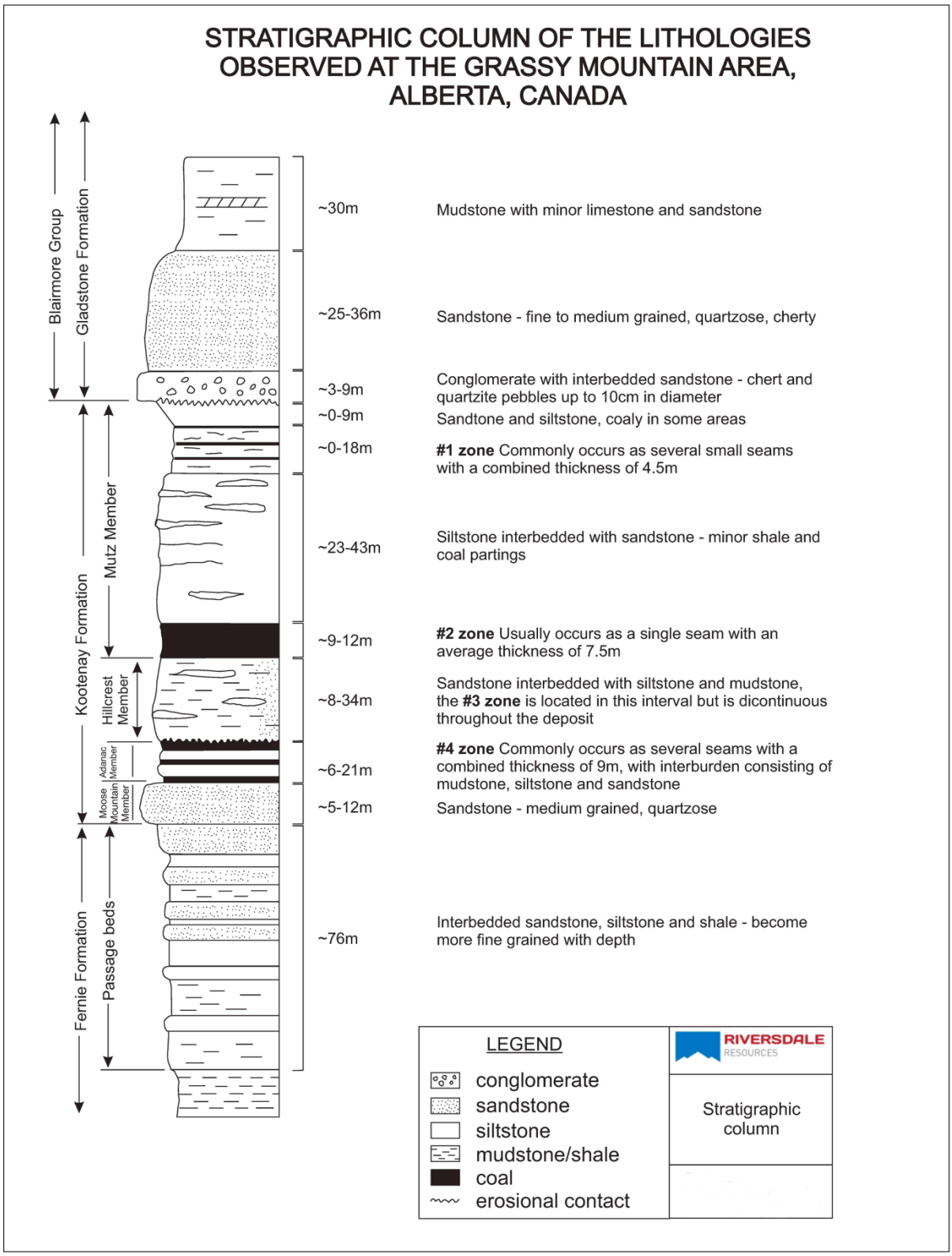


Figure 1: Stratigraphic Column for the Grassy Mountain Project

1.4 Historical Workings

Historical mines are scattered along strike in the form of several small open pits and underground mines. The underground mines were operated by West Canadian Collieries from 1909 to 1968 and mined seams 1, 2 and 4. The open pits were operated by West Canadian Collieries from 1956 to 1960, and by Consolidated Coal from 1974 to 1975 (Norwest 2012), and mined seams 1 and 2.

1.5 Mine Plan

The Project mine operating life is currently 24 years and will involve the following key components (Benga 2016):

- Mining coal by conventional open pit methods (blasting, truck and excavator operation).
- Rehandling and stabilization of legacy wastes within the mine footprint.
- Transport of coal to the CHPP and waste rock to dedicated disposal areas by haul truck.
- Ex-pit disposal of waste rock at two locations (north and south of the pit area) until in-pit locations for backfilling become available.
- Management of acid rock drainage (ARD) potential in certain stratigraphic horizons and plant refuse by blending potentially ARD generating (PAG) materials with non-PAG materials to create a waste rock mixture that performs as non-PAG.
- Backfilling of pits to create saturated zones for passive treatment of selenium.
- Crushing and processing of run-of-mine coal within the CHPP.
- Transport of coarse and fine coal processing wastes as a combined dewatered product by truck and co-disposal with waste rock at the mine.
- Transport of the final coal product via overland conveyors to the load out facility adjacent to the existing Canadian Pacific Railway located in Blairmore, Alberta.

1.6 Report Objective

This report describes the geochemical characterization program, results, interpretations and applications to development of waste management geochemical design criteria and contact water chemistry predictions.

1.7 Acknowledgements

This report was prepared by SRK with input from the following organizations:

- Millennium EMS Solutions Ltd. – project description and mine planning information.
- Riversdale Resources – sampling of future waste rock.
- Sedgman Canada Ltd. – selection of CHPP residues for geochemical testing.
- SGS Canada – geochemical and mineralogical testing of future waste rock, legacy wastes, and CHPP residues.

1.8 Report Structure

This report describes the design of the geochemical characterization program based on conceptual geochemical models (Section 2). Section 3 describes the implementation of the design followed by results (Section 4).

Based on the finding that ARD and selenium leaching needed to be considered for the Project, Sections 5 and 6 provided recommended management approaches. Section 7 then provides predictions of contact (or source) water chemistry for use as inputs in the water quality model (SRK 2016a). These predictions assume the management measures are implemented.

2 Geochemical Characterization Program Design

2.1 Introduction

The objectives of the geochemical characterization program are to:

- Provide geochemical design criteria for management of mine wastes to address the potential for metal leaching and acid rock drainage (ML/ARD); and
- Provide water chemistry predictions at the rock-water interface (source terms) that can be used to assess the effect of the project on water quality.

The underlying basis for the design of the program is the development of Conceptual Geochemical Models (CGMs) which capture the current understanding of geochemical performance of each Project component based on regional and site experience. CGMs frame the geochemical questions that need to be answered for each component and therefore focus the characterization program by selection of appropriate methodologies for sample collection, testing, and data interpretation. The following sections describe the CGMs.

2.2 Regulatory Context

There are no detailed specifications for geochemical characterization in Alberta. SRK has referred to guidance provided by the governments of Canada and British Columbia, as well as detailed experience from characterization of similar geological formations in the nearby Elk Valley.

2.3 Conceptual Geochemical Models

Experience in the Elk Valley indicates that the analogous MMF has low potential for acid rock drainage due to its relatively low iron sulphide content and elevated carbonate mineral content (as dolomite) (Kennedy et al. 2012). Selenium leaching is an ongoing management concern (Day et al. 2012) along with precipitation of calcite in streams downstream of waste rock dumps (MacGregor et al. 2012).

The following major components of the conceptual geochemical model were incorporated into the program design by using experience from the Elk Valley and observation of legacy features at the Project:

- Waste rock and pit walls composed of the coal-bearing units (i.e. the Adanac, Hillcrest and Mutz Members) weather under generally non-acidic conditions resulting in oxidation of pyrite releasing selenium, sulphate, and acidity. The acidity is completely neutralized by carbonate minerals by assuming that acid-generating materials are thoroughly mixed with acid-consuming materials.
- Iron sulphides are enriched in carbonaceous layers and appear to increase in abundance near the coal seams. CHPP residues are likely to contain more iron-sulphides and selenium because of their close association with the coal seams. Depending on the relationship between sulphide and carbonate mineral content, near seam wastes and CHPP residues may have higher ARD potential than waste rock.
- Selenium and sulphate release for oxidizing waste rock occurs at a rate proportional to the cumulative mass of waste rock.
- Once released by oxidation of pyrite, sulphate mass is conserved and is assumed not to be removed from waters until saturation with respect to gypsum is reached.
- Attenuation of selenium occurs where waters become sub-oxic, for example, in backfilled pits (SRK 2012, Bianchin et al. 2013) and process reject piles (Kennedy et al. 2015).

Other formations will be mined in order to access the MMF at the Project. General experience in other coal fields (e.g. SRK 2012) shows that surrounding formations may have variable ML/ARD potential due to differences in paleo-environmental depositional conditions. Marine incursions may result in an increase in the pyrite and carbonate content due to the higher sulphate and alkalinity of seawater. In this region, this applies to the Fernie Formation (which was deposited from the inland Fernie Sea) and marine-littoral transitional formations such as the Morrissey in the Elk Valley and Moose Mountain Member at the Grassy Project.

2.4 Characterization Program Design

The program design was based on programs in the Elk Valley and the northeastern BC coalfields that have resulted in an appropriate level of characterization of host rocks and process wastes. The components of the program include:

- Continuous stratigraphic sampling of host rocks to characterize ML/ARD potential using static and mineralogical test methods.
- Static geochemical characterization of legacy waste rock and sampling of site waters as an analog for future waste rock.
- Kinetic geochemical characterization of wastes to evaluate correlation of bulk characteristics (sulphur content, carbonate content, ARD potential, trace element content) with release rates.

The geochemical conditions in the underground working were not characterized as part of this program.

3 Methods

3.1 Sample Acquisition

3.1.1 Future Waste Rock

Future waste rock was sampled primarily by two programs. SRK selected four drill holes in coordination with Riversdale geologists to characterize the stratigraphic sequence that would be intersected by mining on a continuous downhole basis (Program A in Table 1). These holes were selected because they provided a cross-section of the major stratigraphic units. Riversdale geologists collected sample intervals in November 2014 with particular care taken to:

- Not sample intervals crossing formation contacts,
- Avoid crossing lithological contacts,
- Not sample the economic coal seams (these will be sent to the CHPP and will not contribute to future waste rock), and
- Collect samples 0.2 m above and below the seams to characterize rock that could be removed as seam cleanings, sent to the CHPP as coal dilution, and/or form the final pit footwalls.

The average interval length of the RGSC series was 2.7 m.

A second series of drill holes was sampled and characterized by MEMS in January 2014 (Program B in Table 1), and the information forwarded to SRK for inclusion in the geochemical characterization program. Sample selection and analysis differed for these holes in comparison to those under Program A; however, they were included in the assessment because they are located in the southern part of the mining lease which was not adequately covered by the Program A holes (Figure 2). The average interval length of the RGOH series was 7.5 m.

Table 1: Drill Hole Listing

Program	Hole ID	Location (UTM Zone 11)		Drill Date
		Easting (m)	Northing (m)	
A	RGSC0006	685577	5507161	30-Aug-14
	RGSC0008	686638	5507638	11-Sep-14
	RGSC0009	686742	5509160	16-Sep-14
	RGSC0010	686807	5510108	20-Sep-14
B	RGOH3001	685357	5504917	10-Jan-14
	RGOH3002	685581	5504340	12-Jan-14
	RGOH3003	686194	5506263	14-Jan-14

Source: \\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev00_BAF.xlsx]

The Fernie Formation was not intersected by the drilling program but will be locally mined in relatively small quantities to stabilize pit walls and provide access to the coal-bearing sequence below reverse faults. Samples of Fernie Formation were obtained from road cuts and were being tested at the time this report was prepared.

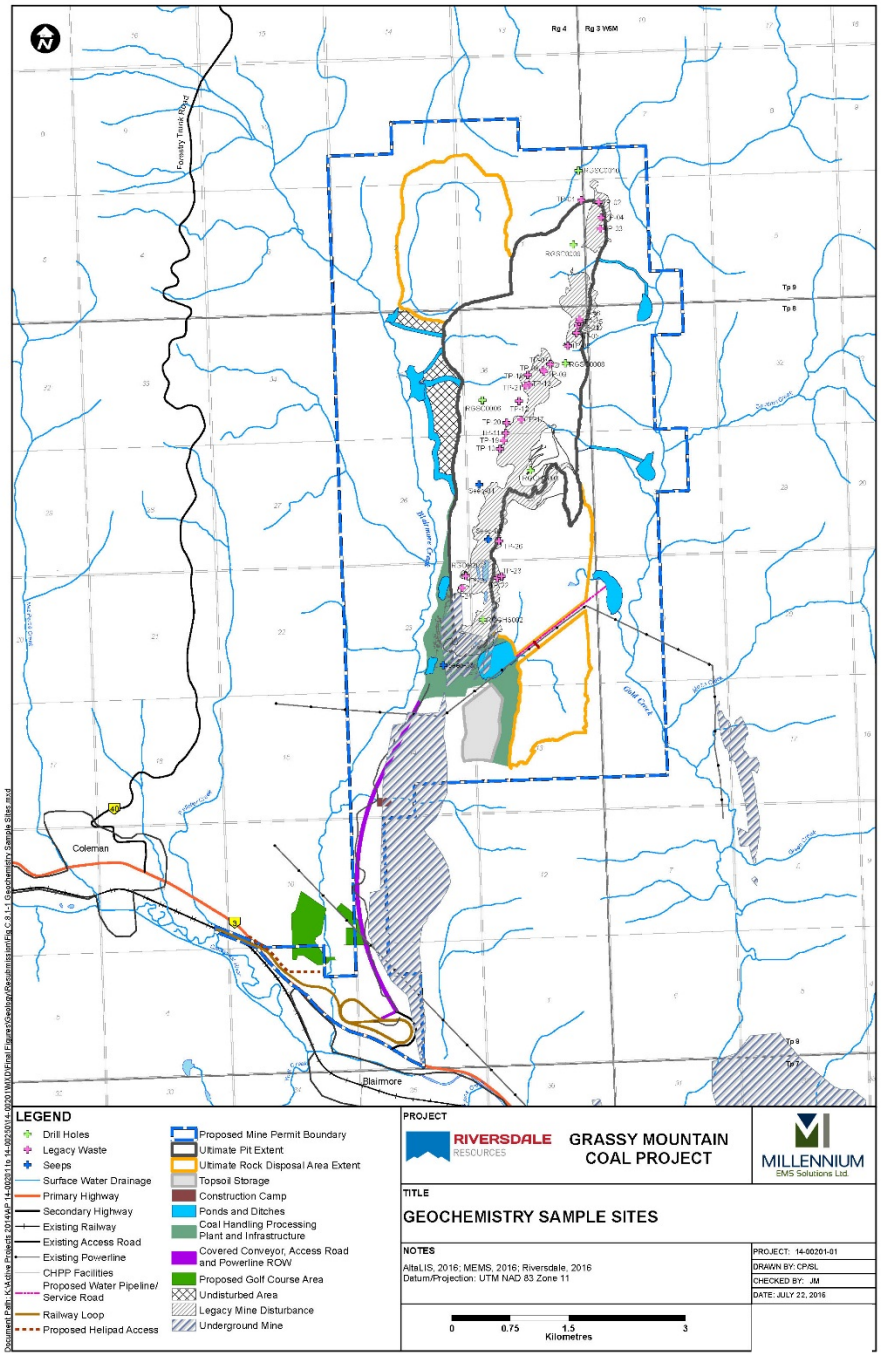


Figure 2: Geochemistry Sample Sites

3.1.2 Legacy Wastes

SRK geochemist, Bronwen Forsyth, and Riversdale geologist, Jackie Rowley, collected near-surface legacy waste samples from 26 locations from October 21 to 23, 2014 (Figure 2). Areas of legacy waste were selected as sample locations using aerial imagery with particular emphasis on capturing samples from across the proposed mine footprint.

A test pit program was initially proposed to capture legacy waste samples several metres below surface; however, this approach was revised after an inspection of the site showed the legacy waste was widely distributed across the lease, and was often as relatively shallow (1 to 2 m) dumps due to the historical end dumping over the existing sloping terrain.

Legacy waste samples were sampled manually by digging approximately 0.2 m into the spoil and collecting a bulk sample approximately 2 kg in weight. A second bulk sample was collected and sieved onsite to -2 mm. The following measurements and observations were recorded at each location:

- Rock type (for example, medium to fine-grained sandstone and carbonaceous fines),
- Colour and texture,
- Visible sulphide content (%), and
- Contact tests.

Contact tests on the -2 mm fraction were performed on the same day of collection. Rinse pH and electrical conductivity (EC) measurements were undertaken by shaking approximately 10 g sample with 10 mL of deionized water, and measuring the pH and EC of the supernatant. A fizz test was undertaken by adding a few drops of 10% hydrochloric acid to each sample, and recording the degree of bubbling visually observed to occur in response to carbonate dissolution.

During the site visit, SRK collected seep samples from three locations (Figure 2). The seeps were flowing, and were located close to the toe of legacy waste dumps. Onsite measurements of pH, EC, oxidation-reduction potential (ORP), and temperature were recorded at the time of sample collection.

3.1.3 Coal Handling and Processing Plant Residues

A combined CHPP residue sample (approximately 5 kg) was collected from pilot plant processing each of the three coal seams by ALS Coal in Newcastle, Australia under the direction of process engineers from Sedgman Canada Ltd in March 2015. Each sample was composed of the following residue composition (by weight, as-received moisture content) to represent the expected composition of final CHPP residues:

- 65% coarse reject,
- 17% fine reject, and
- 18% ultrafine reject.

3.2 Analysis

3.2.1 Solid Sample Preparation

All solid samples, excluding the RGOH hole series, were analyzed by SGS in Burnaby, British Columbia. The RGOH hole series were analyzed by ALS in Calgary, Alberta.

Samples analyzed by SGS were air-dried at room temperature to minimize the loss of volatile elements and formation of minerals not found in the field. Drill core and legacy waste samples were crushed to -6.4 mm (-1/4 inch). The CHPP residues were not crushed except as required for the analytical procedures.

3.2.2 Static Geochemical Tests

A total of 146 future waste rock (RGSC hole series), 39 legacy waste, and three CHPP residue samples were tested for:

- Paste pH,
- Total sulphur and total carbon by Leco,
- HCl-extractable sulphur,
- Total inorganic carbon by HCl leach and CO_2 conversion,
- Modified Neutralization Potential (NP) (Coastech Research 1991), and
- Element analysis by aqua regia digestion and inductively coupled plasma mass spectrometry (ICP-MS).

Results for future wastes, legacy wastes and CHPP wastes are provided in Appendix E, Appendix F and Appendix G, respectively.

Based on the assumption that aqua regia does not digest carbonaceous matter, sulphide sulphur was calculated as the difference between sulphur by aqua regia digestion and HCl-extractable sulphur to account for the presence of organic sulphur (Eq. 1).

$$[\text{Sulphide S, \%}] = [S_{HNO3+HCl\ soluble}, \%] - [S_{HCl\ soluble}, \%] \quad \textbf{(Eq. 1)}$$

Organic sulphur was calculated as the difference between total sulphur by Leco, and sulphide sulphur (Eq. 2) and sulphate sulphur (HCl-extractable).

$$[\text{Organic S, \%}] = [\text{Total } S_{Leco}, \%] - [\text{Sulphide } S_{calculated}, \%] - [S_{HCl\ soluble}, \%] \quad \textbf{(Eq. 2)}$$

Thirty samples from the RGOH drill hole series were analyzed for the parameters listed above; however, sulphur by aqua regia digestion was not measured, and a different NP method was used (Sobek et al. 1978). When comparing the two NP methods, the modified method will

commonly generate lower NP values than the standard Sobek method for the same test materials due to differences in the analytical procedures.

3.2.3 Humidity Cells

Fifteen waste rock and three CHPP residue samples (Table 2) were selected for humidity cell testing (Price 2009). Samples were selected from the inventory of samples tested for static characteristics (Section 3.2.2). Sample selection was based on:

- Complete stratigraphic coverage of the Kootenay and Cadomin units,
- Within formation coverage of major rock types,
- Characterization of range of sulphide contents as the main variable determining reactivity,
- Selection of PAG samples to observe the delay to acidification and the trace elements released by acidification, and
- Most intense coverage in the Cadomin Formation due to its volumetric significance and reactivity as indicated by static testing (see Section 4.1.4).

The Fernie Formation was not tested because fresh materials were not available. It is also a minor unit.

Table 2: Samples Selected for Humidity Cell Testing

Sample ID	Rock Type	Unit	Hole	Depth	
				From (m*)	To (m*)
SRK-WR-RGSC0008-043	Claystone	Adanac	RGSC0008	59.71	59.91
SRK-WR-RGSC0009-089	Claystone	Adanac	RGSC0009	140.15	143.03
SRK-WR-RGSC0009-052	Claystone	Cadomin	RGSC0009	36.32	38.52
SRK-WR-RGSC0009-059	Conglomerate	Cadomin	RGSC0009	57.15	62.21
SRK-WR-RGSC0010-103	Conglomerate	Cadomin	RGSC0010	39.66	43.18
SRK-WR-RGSC0009-054	Sandstone	Cadomin	RGSC0009	41.57	44.62
SRK-WR-RGSC0010-098	Sandstone	Cadomin	RGSC0010	22.0	28.1
SRK-WR-RGSC0010-097	Siltstone	Cadomin	RGSC0010	20.29	22.0
SRK-WR-RGSC0006-027	Claystone	Hillcrest	RGSC0006	111.03	116.1
SRK-WR-RGSC0010-129	Claystone	Hillcrest	RGSC0010	127.59	127.79
SRK-WR-RGSC0008-046	Sandstone	Moose	RGSC0008	67.22	72.22
SRK-WR-RGSC0008-047	Sandstone	Moose	RGSC0008	72.22	77.23
SRK-WR-RGSC0009-068	Sandstone	Mutz	RGSC0009	86.0	89.6
SRK-WR-RGSC0010-106A	Claystone	Mutz	RGSC0010	53.84	54.04
SRK-WR-RGSC0010-109	Claystone	Mutz	RGSC0010	58.97	62.97
Seam 1 Reject Blend	CHPP residue	n.a.	n.a.	n.a.	n.a.
Seam 2 Reject Blend	CHPP residue	n.a.	n.a.	n.a.	n.a.
Seam 4 Reject Blend	CHPP residue	n.a.	n.a.	n.a.	n.a.

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\3. HCT_Selection\[HCTSelections_1CM029008_SJD_REV00.xlsx]

Notes:

* m below ground surface.

n.a. – Not applicable.

The humidity cell tests involve a 1 kg (dry weight) sample of material being exposed to weekly aeration cycles, consisting of three days of dry air and three days of moist air, followed by a leaching cycle whereby the sample is flushed with deionised water on the seventh day. The tests have been run for 56 weeks and are continuing.

Until week 40, leachates were analyzed for pH, ORP, and EC on a weekly basis, with full chemical analysis undertaken each week during weeks 0 to 4, and then once every two weeks during weeks 5 to 40. Chemical analysis includes acidity/alkalinity, dissolved organic carbon, sulphate, chloride, fluoride, ammonia, nitrite, nitrate, and low level dissolved elements by ICP-MS.

After week 40, monitoring was reduced to pH and conductivity every three weeks.

3.2.4 Particle Size Analysis

Particle size by dry sieving was undertaken on samples selected for humidity cell testing (Table 2). The following sieve sizes were used: 9.5 mm (+3/8”), 6.3 mm (-3/8" + 1/4"), 4 mm (-1/4" + 5), 1.7 mm (5 + 10), 0.425 mm (-10 + 35), 0.15 mm (-48 + 100), and 0.053 mm (-200 + 270).

3.2.5 Mineralogical Analyses

Mineralogical characterization was undertaken on samples selected for humidity cell testing (Table 2) to identify and quantify bulk and trace (<1 wt.%) mineralogy, with particular emphasis on sulphide and carbonate mineral identification. The 15 waste rock and three CHPP residue samples were analyzed by X-ray diffraction (XRD) with mineral quantification by Rietveld refinement, and QEMSCAN® bulk mineral analysis (BMA).

An internal standard was added to the XRD samples to quantify amorphous and residual phases. Samples were analyzed for major elements by X-ray fluorescence (XRF) to assist in accurate mineral quantification.

3.2.6 Seep Analysis

Benga has assembled a dataset consisting of 122 water samples collected from locations that are in close proximity to legacy mine facilities. The samples were collected from 2012 to 2016 from ponds (59 samples), portal drainage (46 samples), seeps and springs (11 samples) and small streams (6 samples). Sampling locations are shown in Figure 4. Three of the seeps were sampled by SRK in October 2014.

The samples were analysed for a variety of parameters which included pH, conductivity, ORP, turbidity, alkalinity, hardness, total dissolved solids, total suspended solids, total organic carbon, sulphate, other major anions, nitrogen forms and low level dissolved elements by ICP-MS.

3.2.7 Quality Control

All analyses passed SGS’s quality control program. Additional checks were undertaken by SRK as summarized in Appendix A. All results were accepted as reported.

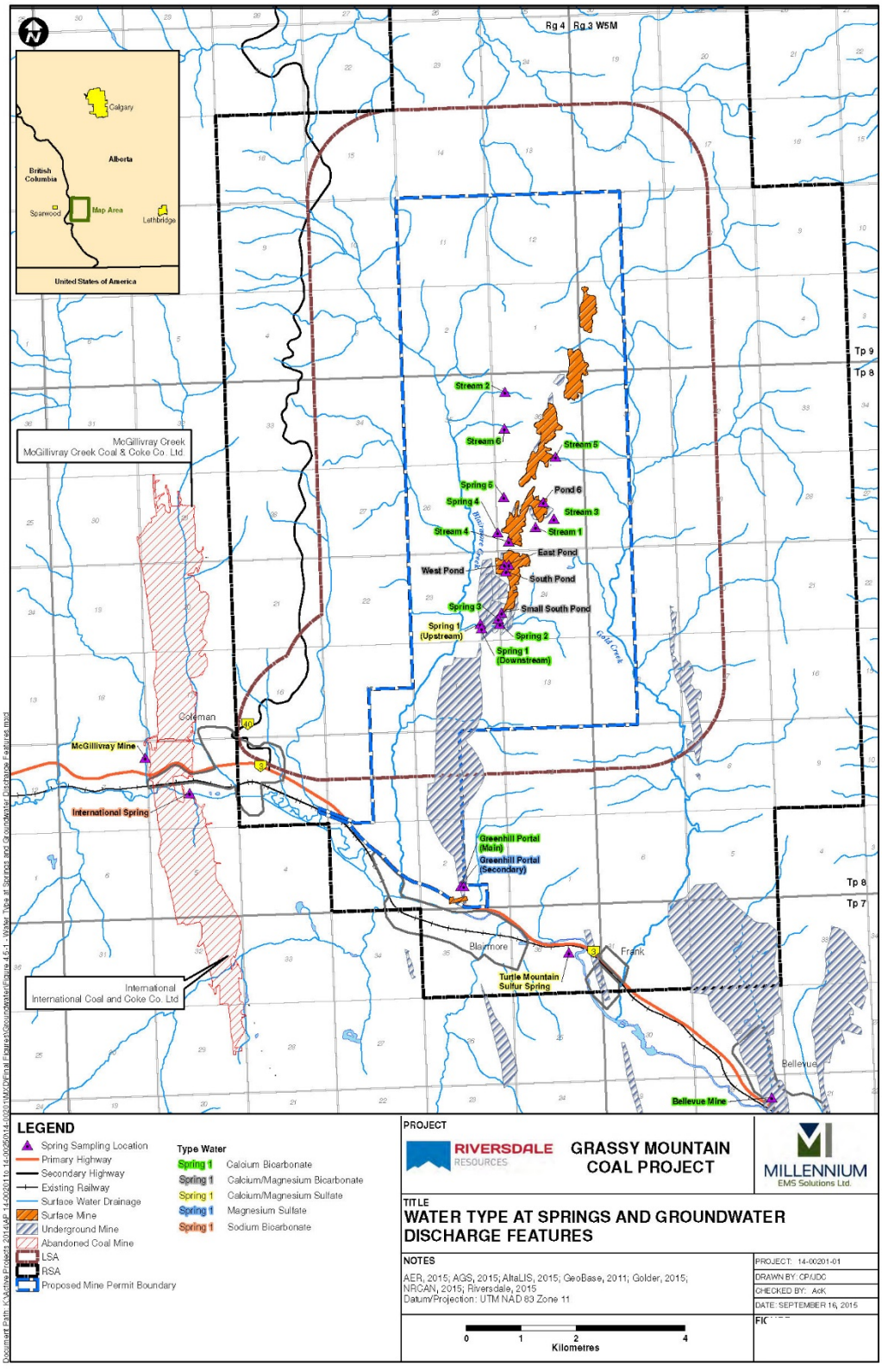


Figure 3: Near Source Water Sampling Locations

4 Results

4.1 Future Waste Rock

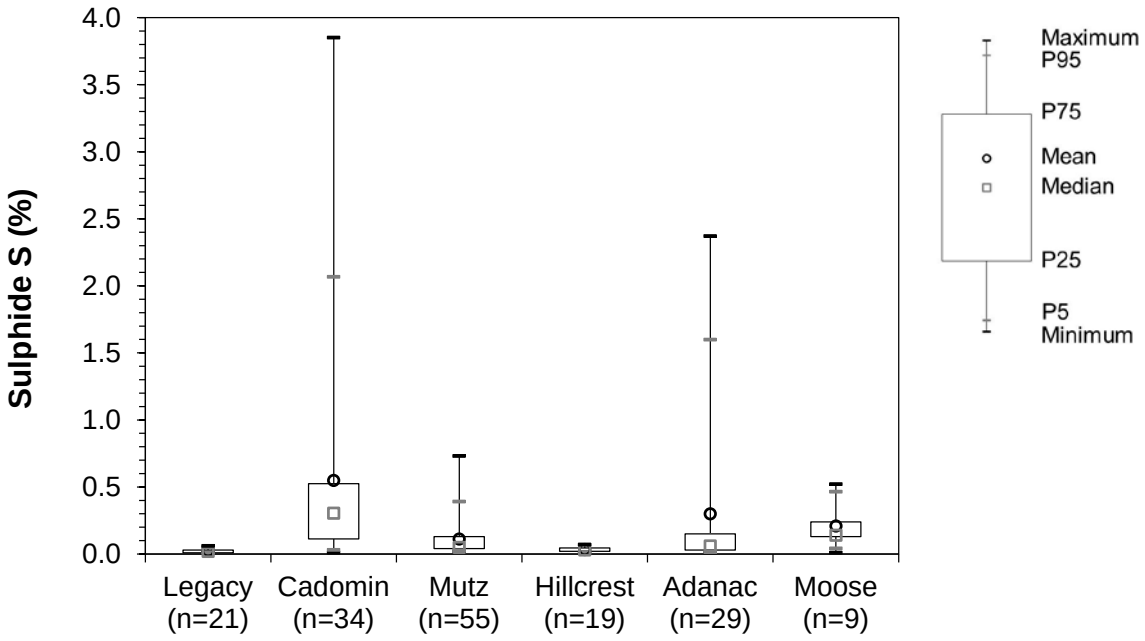
4.1.1 Sulphur Occurrence

Mineralogical analyses indicated that sulphur occurs mainly as pyrite (FeS_2) with traces (less than 0.1 wt.%) of sphalerite (ZnS) and chalcopyrite ($CuFeS_2$) (Appendix B).

Sulphide sulphur determined using Equation 1 ranged from less than 0.01 to 3.9%, with concentrations greater than 0.1% associated with the Cadomin, Mutz, Adanac, and Moose Mountain samples (Table 3, Figure 4). Sulphide concentrations greater than 1% were associated with carbonaceous mudstone and siltstone of the Cadomin and Adanac (Figure 4), and conglomerate of the Cadomin (Figure 5).

Examination of downhole plots shows sulphide tends to increase near coal seams 1 and 4 (Appendix C). Sulphide in drill core was typically observed in association with carbonaceous facies as blebs 1 to 5 mm in diameter (Figure 6).

Other forms of sulphur, including sulphate and organic sulphur, were present at typically low levels (less than 0.01 to 0.04% as S, and less than 0.01 to 0.17% as S, respectively). Only sulphide sulphur contributes to acid production.



P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Figure 4: Box-and-Whisker Plot of Sulphide Sulphur by Rock Unit

Table 3: Summary of Static Geochemical Test Data

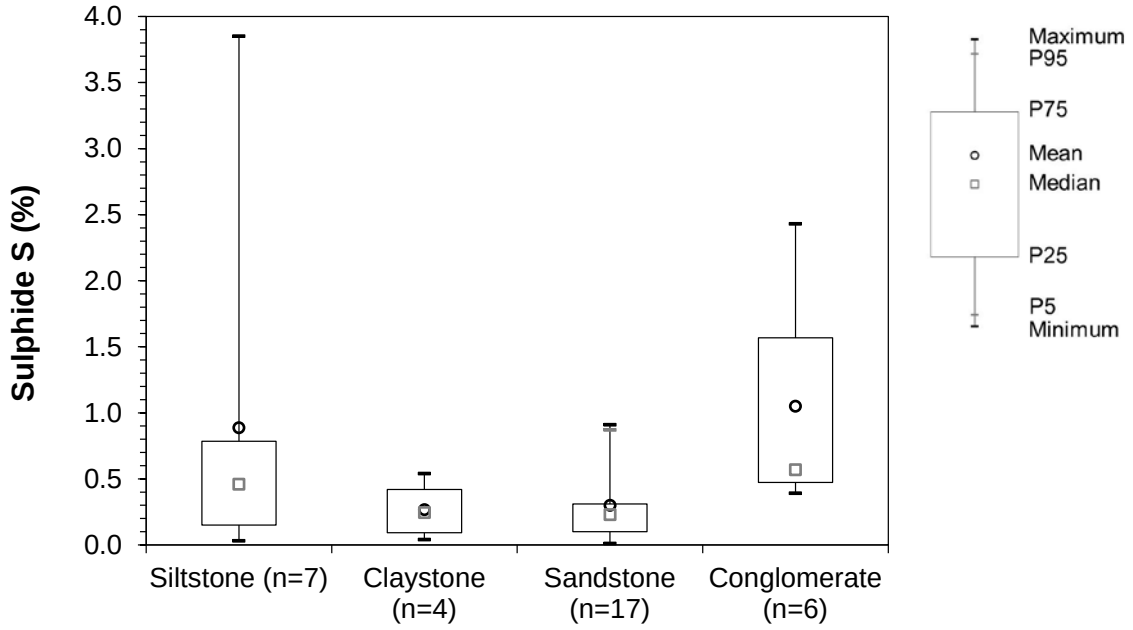
Group	Rock Unit or Other Subgroup	Summary Statistic	Total S %	Sulphide S[(a)] %	AP [Sulphide S] kg $CaCO_3$/t	Sobek NP[(b)] kg $CaCO_3$/t	Modified NP[(b)] kg $CaCO_3$/t	NP/AP Ratio	Cd mg/kg	Se mg/kg
Drill core	Cadomin Conglomerate	No. of samples	42	34	34	8	34	34	42	42
		P5	0.041	0.03	0.94	4.7	-0.46	0.0046	0.48	0.1
		Mean	0.54	0.55	17	14	17	0.99	0.95	0.6
		Median	0.3	0.31	9.5	13	10	1.4	0.82	0.5
		P95	2.0	2.1	65	28	57	14	1.7	1.3
	Mutz	No. of samples	65	55	55	10	55	55	65	65
		P5	0.06	0.027	0.84	11	0.08	0.052	0.87	0.7
		Mean	0.17	0.11	3.5	60	26	7.4	1.9	1.7
		Median	0.12	0.05	1.6	60	10	4	1.9	1.6
		P95	0.46	0.39	12	120	91	74	2.8	2.9
	Hillcrest	No. of samples	28	19	19	9	19	19	28	28
		P5	0.05	0.01	0.31	17	1.5	1.3	0.75	0.6
		Mean	0.09	0.034	1.1	64	19	18	1.2	0.9
		Median	0.085	0.03	0.94	57	8.1	8.1	1.2	0.9
		P95	0.14	0.07	2.2	150	47	79	1.8	1.6
	Adanac	No. of samples	32	29	29	3	29	29	32	32
		P5	0.05	0.014	0.44	17	-0.06	0.011	0.3	0.5
		Mean	0.4	0.3	9.4	25	13	1.4	1.1	1.2
		Median	0.17	0.06	1.9	26	3.4	2.2	1.2	1.1
		P95	1.7	1.6	50	33	54	42	1.8	2.1
	Moose	No. of samples	9	9	9	-	9	9	9	9
		Min.	0.05	0.01	0.31	-	0.4	0.074	<0.01	<0.1
		Mean	0.25	0.21	6.5	-	23	3.5	0.15	0.2
		Median	0.17	0.14	4.4	-	6.3	1.6	0.16	0.1
		Max.	0.54	0.46	15	-	86	28	0.25	0.5
Legacy waste	Bulk samples	No. of samples	21	21	21	-	21	21	21	21
		P5	0.03	0.01	0.31	-	-5.0	0.08	0.13	0.2
		Mean	0.09	0.023	0.71	-	23	34	1.4	0.9
		Median	0.1	0.02	0.63	-	21	28	1.5	0.8
		P95	0.17	0.05	1.6	-	58	93	2.7	1.5
CHPP residues	Seam 1 Reject Blend	Individual value	0.33	0.14	4.4	-	3.9	0.89	1.8	2.7
	Seam 2 Reject Blend	Individual value	0.09	0.02	0.63	-	22	36	0.36	0.3
	Seam 4 Reject Blend	Individual value	0.10	0.04	1.3	-	18	14	0.4	0.7

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Notes:

(a) Sulphide S determined using Equation 1. (b) Sobek NP was measured on RGOH series holes; Modified NP was measured on RGSC series holes.

Figures are reported to two significant values unless constrained by analytical detection limits (for example, Se).



P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Figure 5: Box-and-Whisker Plot of Sulphide Sulphur in the Cadomin Formation by Lithotype

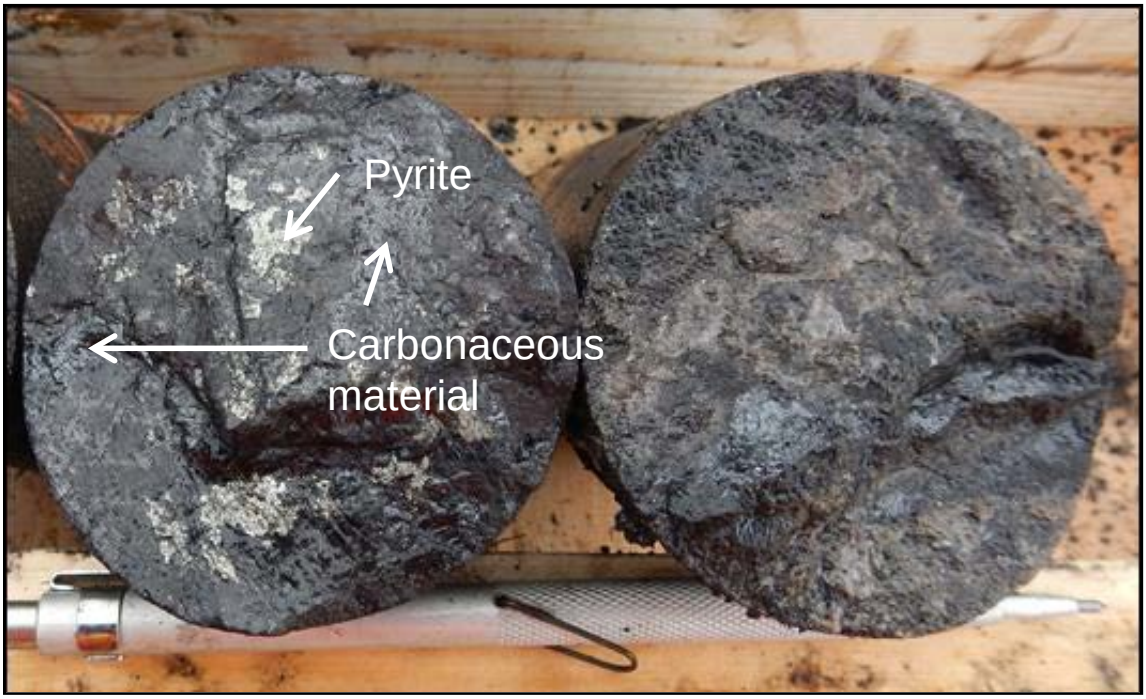


Figure 6: Core from Hole RGSC0006 (depth 133.8 to 136.8 m). Pen within Picture is 140 mm in Length

4.1.2 Neutralization Potential Occurrence

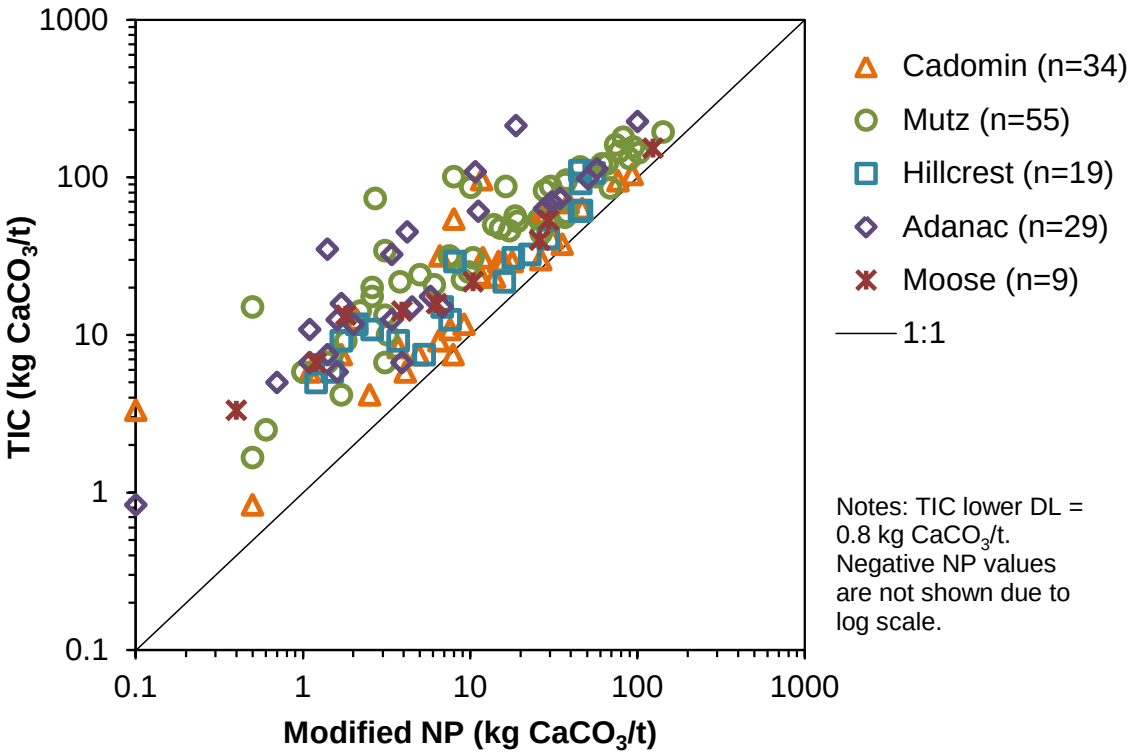
The drill core samples typically contained more TIC than Modified NP (Figure 7) consistent with the presence of iron-bearing carbonates such as siderite ($FeCO_3$) and ankerite ($CaFe(CO_3)_2$). Unlike calcium and magnesium-bearing carbonates such as calcite ($CaCO_3$) and pure dolomite ($CaMg(CO_3)_2$), iron and manganese-bearing carbonates do not contribute to acid neutralization.

Mineralogical analyses (Appendix B) indicated that iron-bearing carbonates account for an average 62% of TIC (range 16 to 100% for 15 samples) assuming end member mineral compositions. Modified NP values were similar to inorganic carbon concentrations when the fraction of inorganic carbon associated with iron carbonates was removed (Figure 8). Whilst the proportion of iron carbonates vary between samples, these results show that iron carbonates are present, and that Modified NP values appear to accurately account for their presence.

Modified NP values did not show notable differences between the rock units (Figure 9). Sobek NP values from the RGOH hole series were typically greater than Modified NP values from the RGSC hole series (Table 3). These differences are likely attributable to differences in the analytical procedures as TIC values were similar between the two series.

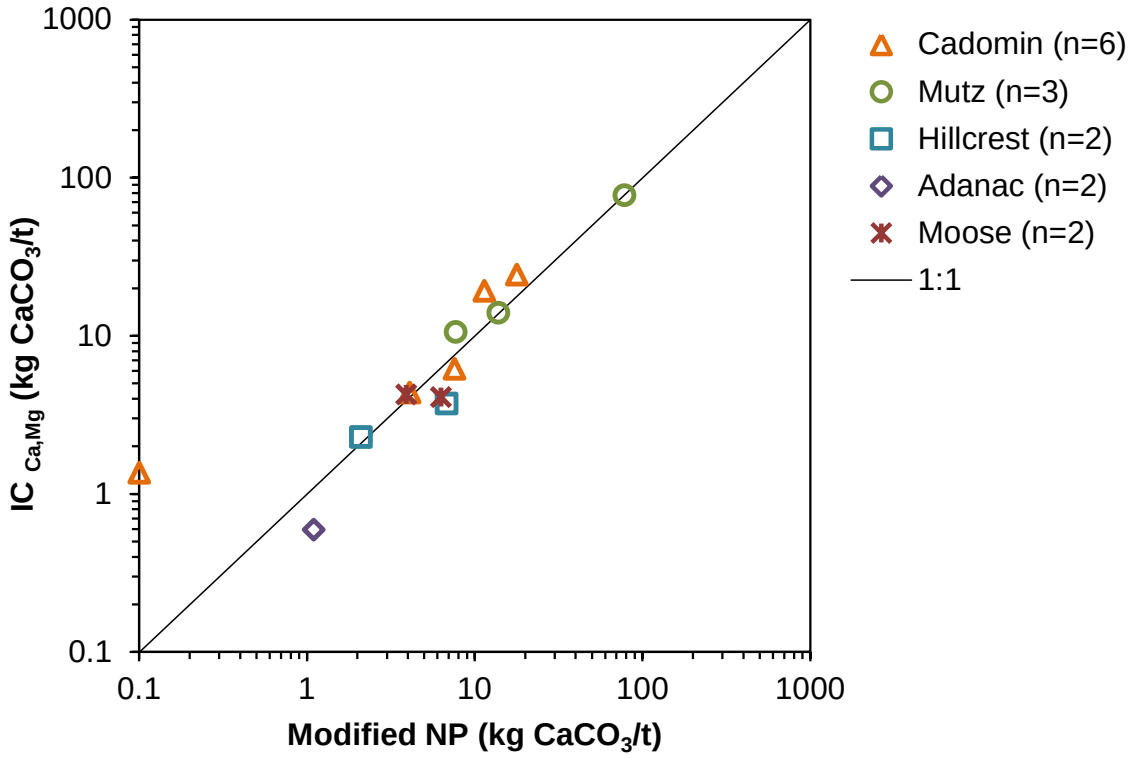
The Sobek method has a lower titration end point pH (pH 7.0) in comparison to the modified method (pH 8.3). This means that ferrous iron released by dissolving iron carbonates is incompletely oxidized using the Sobek method, potentially resulting in falsely high measurements of NP. Also, the Sobek method boils the sample resulting in an aggressive dissolution that partially dissolves some silicates, as well as the carbonates. Again, this potentially results in falsely high measurements of NP.

In summary, Modified NP is an appropriate measure of neutralization potential for future waste rock because it reflects Ca and Mg carbonate content.



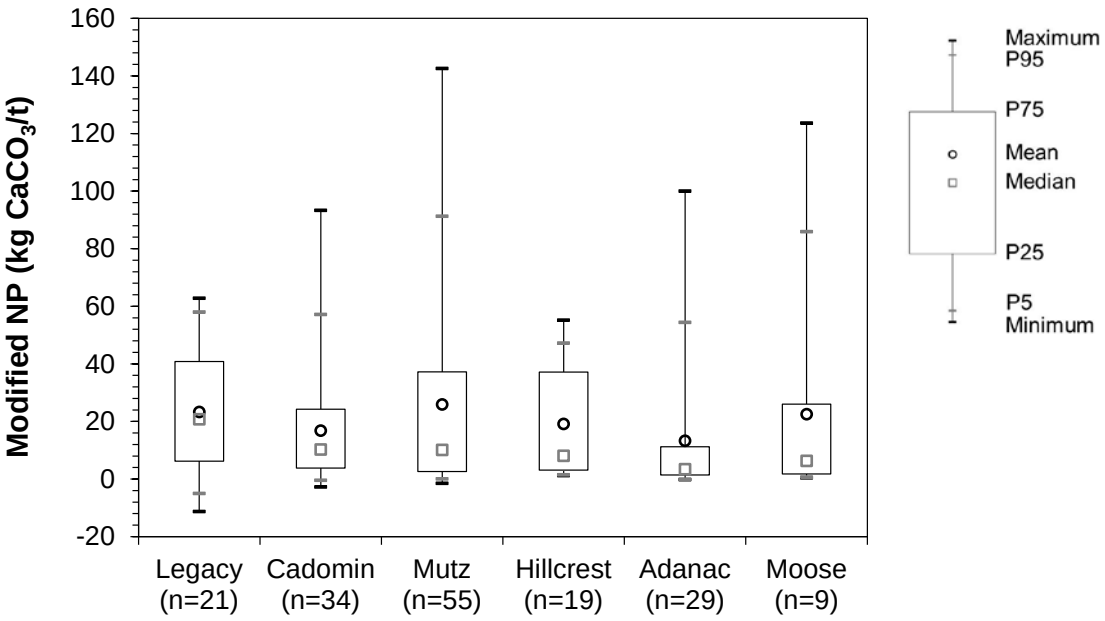
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Figure 7: Comparison of Modified Neutralization Potential (NP) and Total Inorganic Carbon (TIC) in Drill Core Samples



P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Figure 8: Comparison of Modified Neutralization Potential (NP) and Calcium and Magnesium-Bearing Carbonate ($IC_{Ca,Mg}$) in Drill Core Samples Analyzed for Mineralogy.



P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Figure 9: Box-and-Whisker Plot of Modified NP by Rock Unit

4.1.3 Trace Element Occurrence

A correlation matrix for trace elements was calculated to provide an initial evaluation of associations between elements and possible linkages to mineralogical hosts (Appendix D). Strong relationships were assessed from a correlation coefficient equal to or more than 0.7. When reviewed in combination with mineralogical analyses, the matrix indicated that:

- Hillcrest samples showed strongly positive relationships between sulphide sulphur and arsenic (r=0.76) and molybdenum (r=0.73).
- Moose Mountain samples showed a strongly positive relationship between sulphide sulphur and antimony (r=0.88), arsenic (r=0.97), cadmium (r=0.83), mercury (r=0.95), and selenium (r=0.85).
- The other rock units did not show any distinct correlations between sulphide sulphur and the trace elements; however, several trace elements that are commonly associated with iron sulphides were correlated with each other, including cadmium, selenium, lead, nickel, and zinc.

4.1.4 Acid Rock Drainage Potential

ARD potential was evaluated on the basis of the ratio of Modified NP and AP calculated from sulphide-sulphur expressed in common units of kg $CaCO_3$/t. A second ARD potential classification criterion was applied based on sulphide content such that all wastes that contain less than 0.1% sulphide sulphur were classified as non-PAG irrespective of their NPR. Any acidity produced by these low sulphide wastes is expected to be readily consumed through reaction with silicate minerals or alkalinity produced by silicate weathering.

The ARD potential classifications are:

- PAG: NP/AP<1 and sulphide S ≥0.1%.
- Uncertain: 2>NP/AP ≥1 and sulphide S ≥0.1%.
- Non-PAG: NP/AP≥2 or sulphide S <0.1%.

ARD classifications for the drill core intervals by rock unit are shown graphically in Figure 10. Non-PAG material was associated with the Hillcrest samples. Material classified as PAG or uncertain with respect to acid generation was associated with samples from the Cadomin (particularly the conglomerate), Mutz, Adanac, and Moose Mountain.

For the purpose of managing ARD potential, PAG management units have been described stratigraphically (Table 4). Currently, two contiguous PAG units have been defined:

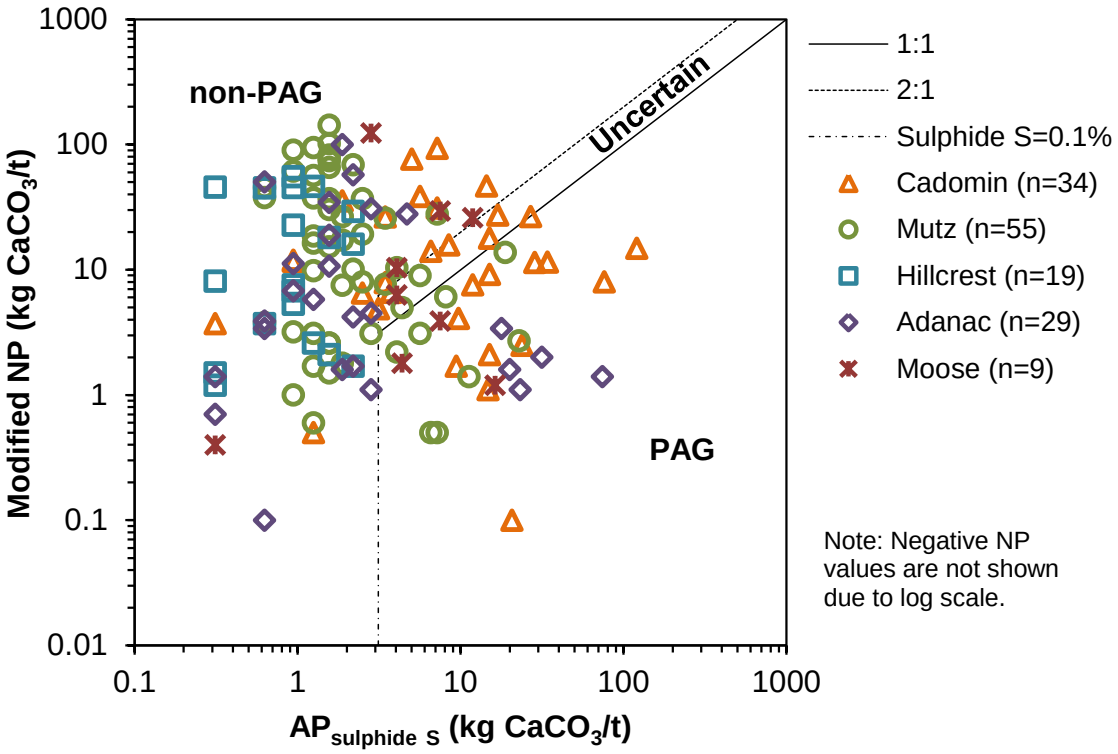
- In the Mutz and the Cadomin conglomerate at their contact.
- Moose Member.

The Adanac Member is not consistently PAG but for the purpose of management should be considered to be 50% PAG.

Table 4: PAG Management Units

Stratigraphic Unit	Location of PAG Management Unit and Extent indicated by Drilling	Drillhole Basis for Thickness Estimate	Comment
Cadomin conglomerate	24 m above contact with Mutz	RGSC0010	PAG in Cadomin is continuous with PAG in Mutz
Mutz	18 m below contact with Cadomin	RGSC0006, RGSC0009, RGSC0010	
Hillcrest	None		Hillcrest Formation contains PAG layers but these are expected to become mixed with non-PAG rock without active measures.
Adanac	Highly variable and will need to be defined operationally by testing.		For waste management purposes, assume 50% of Adanac is PAG.
Moose	Whole formation.		Currently unconstrained by existing drilling.
Fernie	None		Assumed lack of PAG is based on visual characteristics pending confirmation by testwork.
Reject	Seam 1		Process blending of rejects from Seams 1, 2 and 4 may eliminate need for management of Seam 1 reject separately as PAG.

Characterization of the Fernie Formation is ongoing. The samples currently being tested contained abundant carbonate as indicate by reaction with HCl and had no visible sulphide.



\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-

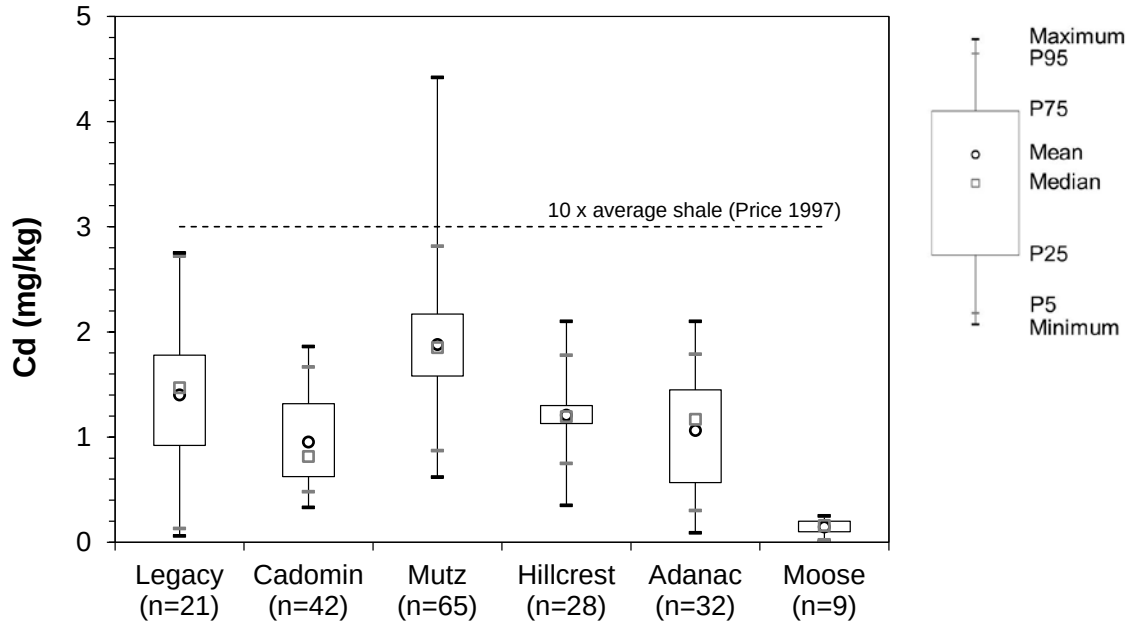
Figure 10: Acid Rock Drainage Classifications for Drill Core Samples

4.1.5 Metal Leaching Potential

Metal leaching potential was evaluated at a screening level by comparing trace element concentrations by aqua regia digestion with ten times the average crustal abundance for shale (Price 1997). The value in comparing trace element concentrations to average shale reference values is in identifying enriched elements that warrant further investigation, for example, through kinetic testing (Section 4.1.6). Shale was selected in preference to other rock types such as sandstone because of the prevalence of siltstone and mudstone lithotypes and carbonaceous material within rock at Grassy Mountain.

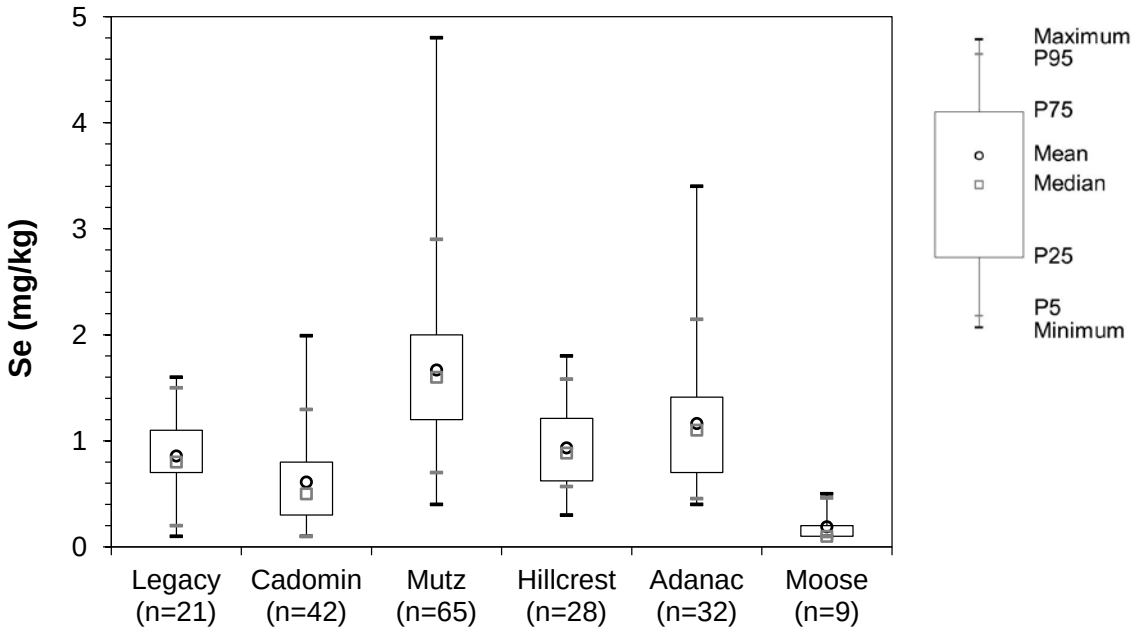
Aqua regia is a partial digest which targets most minerals expected to be reactive under exposure to surficial conditions (i.e. sulphides, oxides, sulphates, carbonates, and some silicates). Comparison of solid concentrations to average shale values does not consider element mobility or element release rates; these are determined by kinetic testing (Section 4.1.6).

Mild cadmium enrichment was identified in three Mutz samples (3.0 to 4.4 mg/kg, or 10 to 15 times average shale) (Figure 11). No other elements were enriched with respect to average shale. Selenium concentrations ranged from less than 0.1 to 4.8 mg/kg, or 0.2 to 8 times average shale. The highest concentrations of selenium were associated with claystone samples from the Mutz and Adanac (Figure 12).



\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Figure 11: Box-and-Whisker Plot of Cadmium Concentrations by Rock Unit



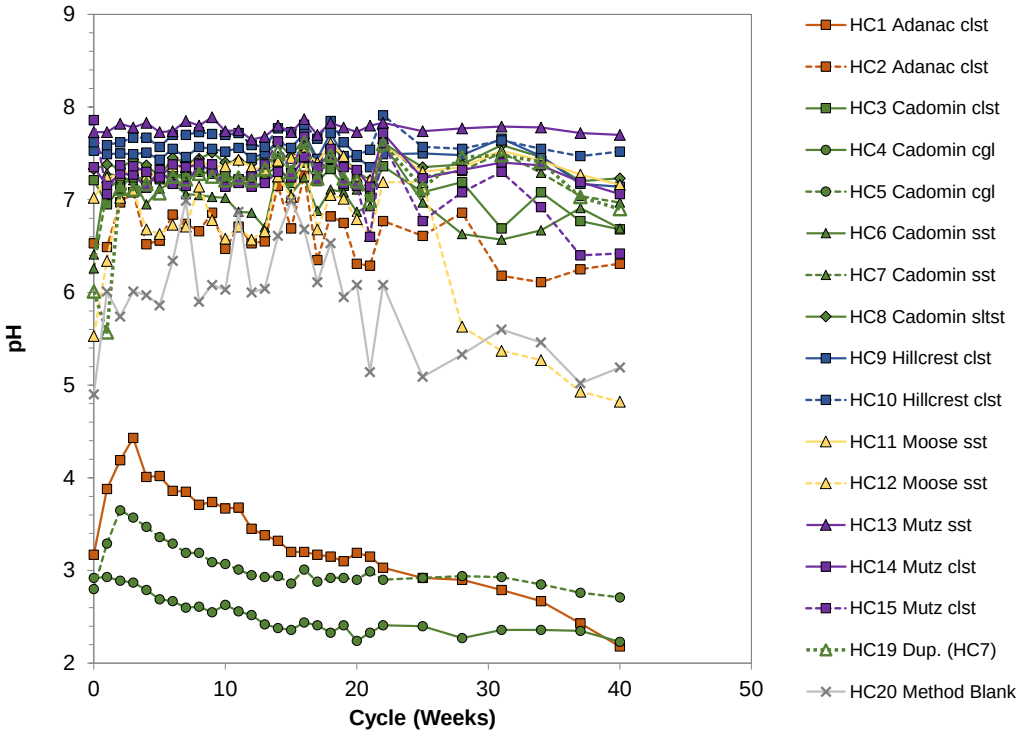
\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Figure 12: Box-and-Whisker Plot of Selenium Concentrations by Rock Unit

4.1.6 Humidity Cells

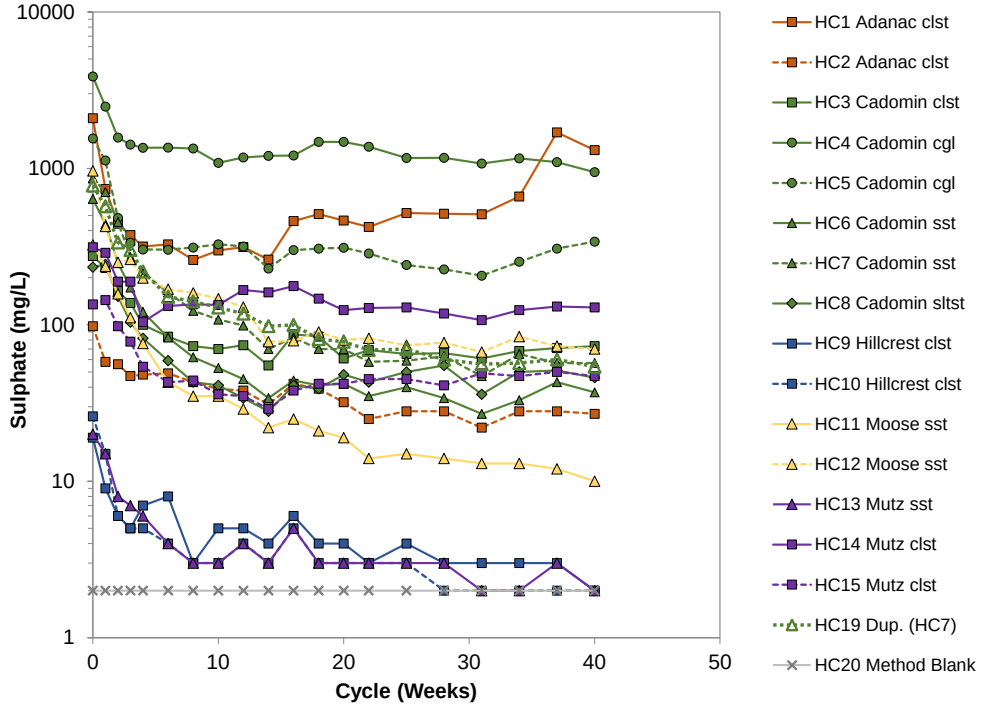
Eleven of the 15 waste rock humidity cells yielded near-neutral leachates (pH 6.3 to 7.9) after 40 cycles of testing. The remaining four cells, containing Cadomin conglomerate (two samples, HC 7 and HC 8), Adanac claystone (HC 1) and Moose sandstone (HC12), produced acidic leachate (pH less than 5). The former three tests had negligible initial NP and yielded pH below 5 from the first cycle whereas the Moose sandstone showed a delay of 25 weeks before showing a decline in pH (Figure 13). This sample contained NP of 4 kg $CaCO_3$/t. All four samples were classified as PAG using static geochemical classifications (Section 4.1.4).

The three most acidic humidity cells (HC 1, HC 7 and HC 8) produced the highest release rates for sulphate (Figure 14) and dissolved metals including aluminium, cadmium (Figure 15), cobalt, copper, iron, manganese, nickel, and zinc (Appendix H). Selenium release rates are not determined by pH, but appear to be correlated with selenium content. The highest selenium release rates are associated with claystone from the Hillcrest, Adanac, Mutz, and Cadomin (Figure 16).



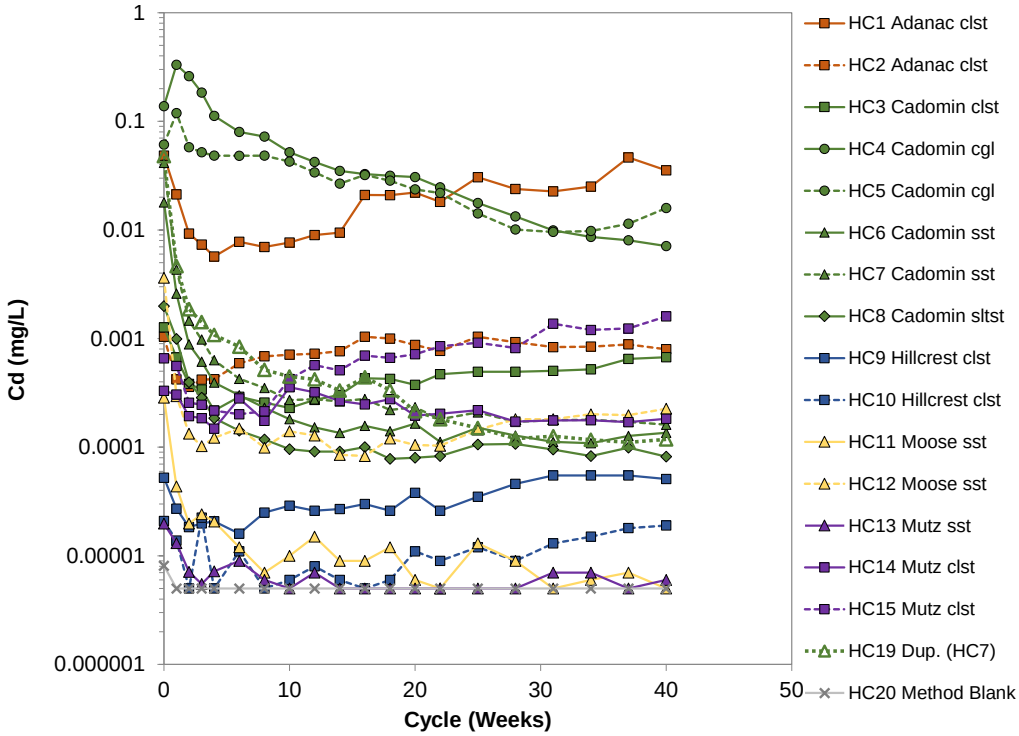
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx

Figure 13: pH of Waste Rock Humidity Cell Test Leachates



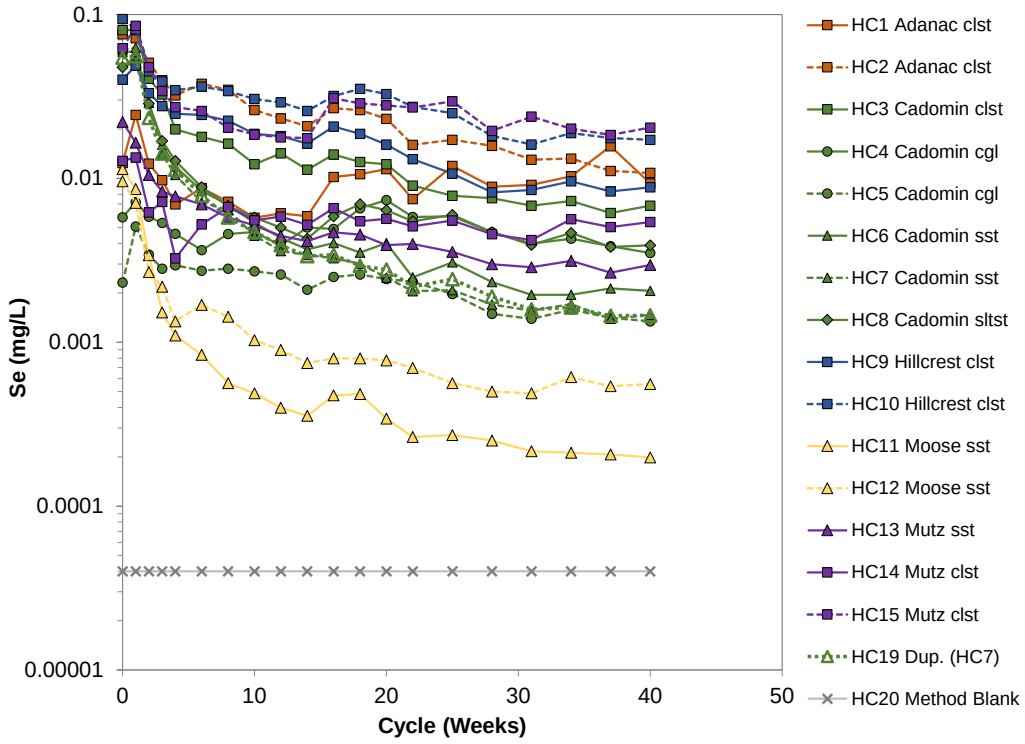
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx

Figure 14: Sulphate Concentrations in Waste Rock Humidity Cell Test Leachates



P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx

Figure 15: Cadmium Concentrations in Waste Rock Humidity Cell Test Leachates



P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx

Figure 16: Selenium Concentrations in Waste Rock Humidity Cell Test Leachates

4.2 Legacy Wastes

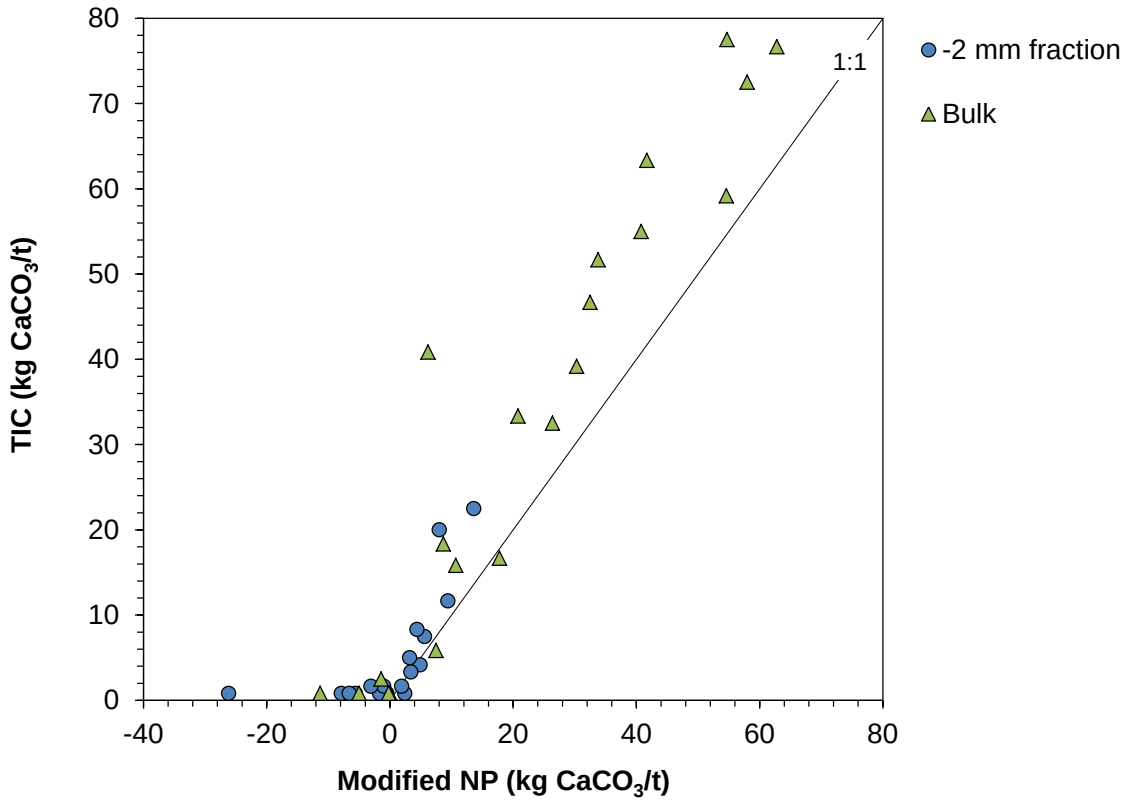
4.2.1 Sulphur Occurrence

In comparison to the drill core samples, sulphide sulphur in the legacy waste was low ranging from 0.01 to 0.06%. Sulphides were not visible in hand specimens of legacy waste, and showed little difference in measured abundance between the fines (-2 mm fraction) and bulk samples. Samples were not analyzed for mineralogy; however, the low concentrations of sulphide are likely pyrite on the basis of mineralogical results from the drill core samples (Appendix B).

Other forms of sulphur, including sulphate and organic sulphur, were present at typically low levels (less than 0.01 to 0.03% as sulphate-S, and less than 0.01 to 0.17% as organic-S).

4.2.2 Neutralization Potential Occurrence

The legacy waste samples typically contained more TIC than Modified NP (Figure 17) consistent with the presence of iron-bearing carbonates. TIC and Modified NP concentrations in the -2 mm fraction were typically less than the bulk. The fines largely consisted of carbonaceous material (organic carbon) that easily breaks down into smaller fragments (Figure 18). The fines are not a significant source of NP.



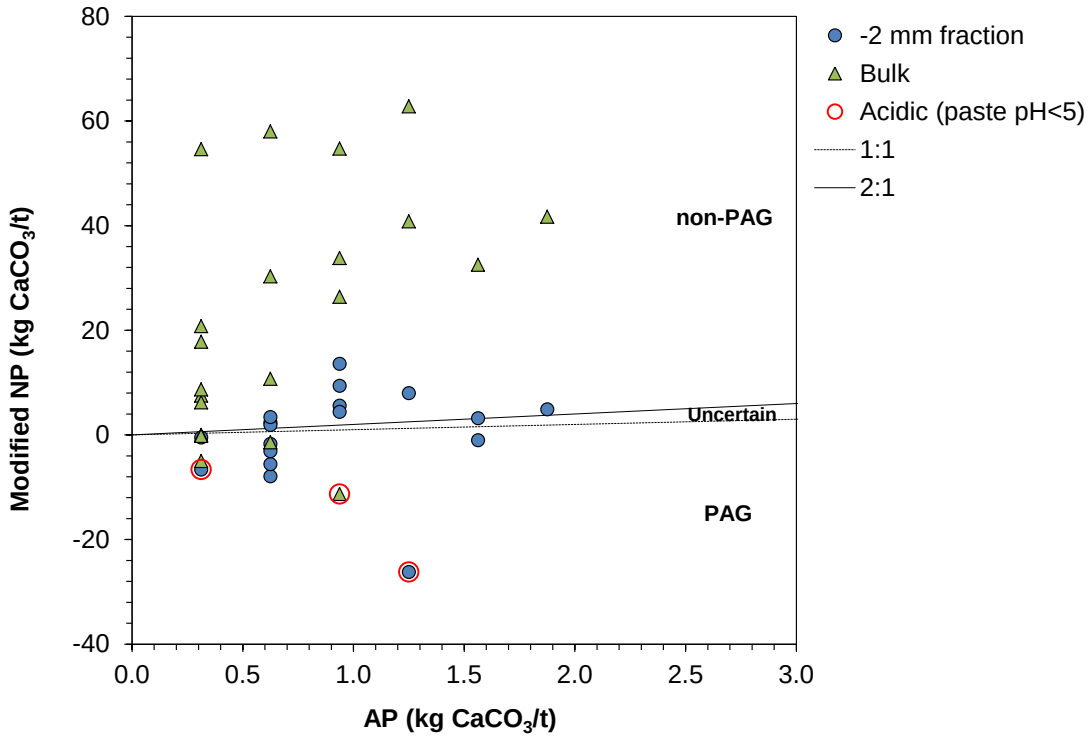
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\220_Legacy_Spoils\[LegacySpoils_1CM029-008_Rev01_BAF.xlsx]

Figure 17: Comparison of Modified Neutralization Potential (NP) and Total Inorganic Carbon (TIC) in Legacy Waste Bulk and -2 mm Fraction Samples

Figure 18: Legacy Waste at TP-09 Showing Prevalent Carbonaceous Fines

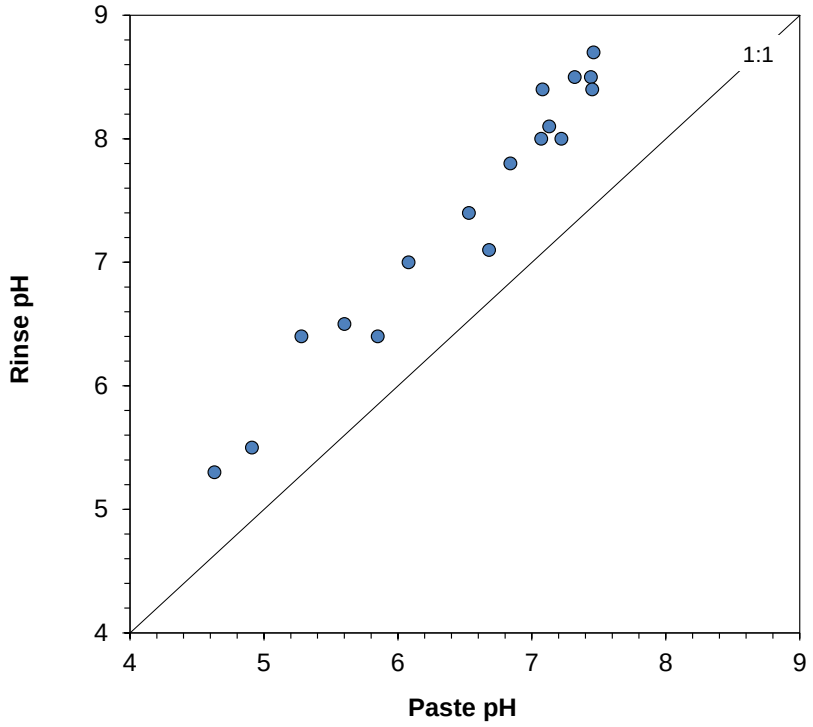
4.2.3 Acid Rock Drainage Potential

ARD classifications for the legacy waste samples are shown graphically in Figure 19 and Figure 20. All 21 bulk samples contained low sulphur (less than 0.1%) and were classified as non-PAG. One bulk and two -2 mm fraction samples were acidic with paste pH of 4.6 to 4.9. Rinse pH for the -2 mm fraction samples were typically greater than paste pH and were all above pH 5.0 (Figure 20), suggesting that the few sulphides that are present within the legacy wastes are not reactive unless fresh surfaces are exposed (for example, through sample pulverization to measure paste pH).



\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\220_Legacy_Spoils\[LegacySpoils_1CM029-008_Rev01_BAF.xlsx]

Figure 19: Acid Rock Drainage Classifications for the Legacy Waste Samples



\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\220_Legacy_Spoils\[LegacySpoils_1CM029-008_Rev01_BAF.xlsx]

Figure 20: Comparison of Paste and Rinse pH in the -2 mm Fraction of Legacy Waste Samples

4.2.4 Metal Leaching Potential

Metal leaching potential in the legacy wastes was evaluated by comparing trace element concentrations by aqua regia digestion with ten times the average crustal abundance for shale (Price 1997), and examining the range of dissolved element concentrations in seep samples collected from the site.

Element Enrichment

Mild cadmium enrichment was found in the -2 mm fraction from TP-02 (3.2 mg/kg, or 11 times average shale). Cadmium and selenium concentrations in the legacy waste were typically intermediate of the concentrations found in the Cadomin and Mutz drill core samples (Figure 11 and Figure 12, respectively).

Site Seep Chemistry

Three seeps sampled in SRK in October 2014 were near-neutral pH (Table 5). The highest sulphate and trace element concentrations were associated with Seep-03. Water at Seep-03 drained from a nearby legacy waste dump and underground workings. Iron staining was observed at two of the seep sites (Figure 21), suggesting the water had passed through an area of reduced (oxygen-depleted) conditions before daylighting at surface.

Table 5: SRK Seep Sample Chemistry Summary

Parameter	Unit	Seep-01	Seep-02	Seep-03
Field pH		7.5	7.8	6.9
Field ORP	mV	230	-	240
Total Alkalinity	mg $CaCO_3$/L	150	200	140
Ammonia	mg/L as N	0.37	0.052	0.25
Nitrate	mg/L as N	0.021	0.3	<0.01
Ca	mg/L	43	54	79
Mg	mg/L	24	34	50
SO_4	mg/L	53	71	310
As	mg/L	0.00062	0.000078	0.000074
B	mg/L	0.025	<0.02	0.13
Cd	mg/L	<0.000005	0.000076	0.0017
Co	mg/L	0.00037	0.000022	0.062
Fe	mg/L	0.0017	0.0012	0.003
Mn	mg/L	0.091	0.0003	1.9
Mo	mg/L	0.00099	0.0012	0.00014
Ni	mg/L	0.0024	0.0018	0.16
Se	mg/L	<0.00004	0.01	0.00024
Zn	mg/L	0.0018	0.0027	0.25

Source: \\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\230_Drainage_Monitoring\[Grassy_Mt_Seep_Chemistry_1CM029-008_Rev00_BAF.xlsx]

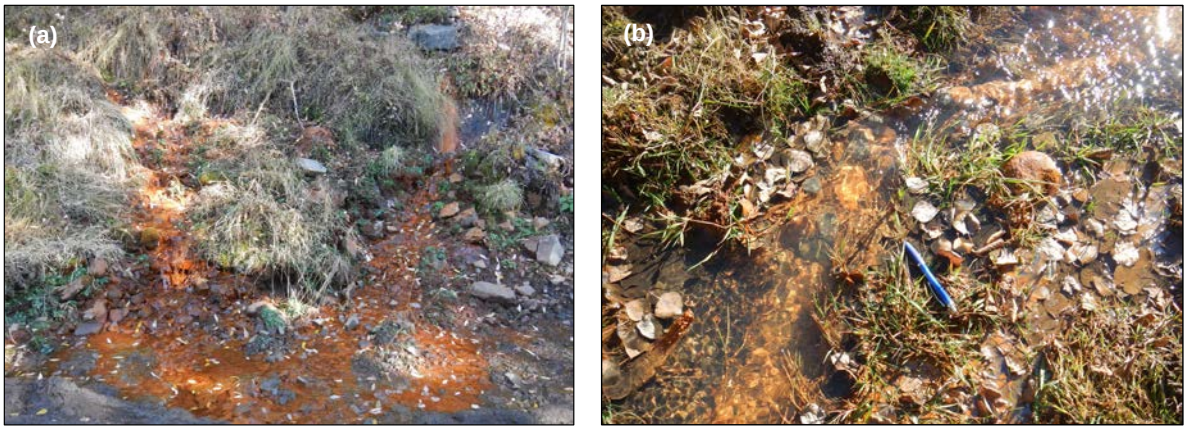


Figure 21: Iron Staining at Legacy Waste Seep Sites (a) Seep-01, and (b) Seep-03

4.3 Coal Handling and Processing Plant Residues

4.3.1 Sulphur Occurrence

The dominant form of sulphur in the CHPP residues was organic, ranging from 0.05 to 0.18%. Sulphate was not detected. Sulphide sulphur determined using Equation 1 ranged from 0.02 to 0.14% with the highest concentration contained within residue from coal seam 1 (Table 3). Mineralogical analyses indicated that sulphide occurs mainly as pyrite with traces (less than 0.1 wt.%) of sphalerite and chalcopyrite.

4.3.2 Neutralization Potential Occurrence

Mineralogical analyses (Appendix B) indicated that iron-bearing carbonates account for 60 to 80% of TIC in the CHPP residues assuming end member mineral compositions. Iron carbonates do not contribute to acid neutralization. Similar to future waste rock and legacy wastes, Modified NP was used as a measure of neutralization potential for the CHPP residues.

4.3.3 Acid Rock Drainage Potential

Using the definitions in Section 4.1.4, residue from coal seam 1 was classified as PAG, whereas residue from coal seams 2 and 4 were classified as non-PAG.

4.3.4 Metal Leaching Potential

No elements were identified as enriched within the CHPP residues relative to ten times average shale concentrations (Price 1997). Similar to sulphide, cadmium and selenium concentrations were greatest in residue from coal seam 1 (Table 3), and are likely to occur in association with iron sulphides such as pyrite.

4.3.5 Humidity Cells

The humidity cells remained near-neutral (pH 7.3 to 8.1) after 40 cycles. The more sulphur-rich Seam 1 reject yielded slightly lower pHs and distinctively higher sulphate. Element release rates generally declined and stabilized as the tests continued. Seam 1 reject yielded higher concentrations of cadmium, cobalt (initially), molybdenum, nickel, selenium, thallium and zinc. The results of the CHPP residue humidity cell tests are provided in Appendix I.

5 Management of ARD Potential

5.1 Introduction

The static and kinetic geochemical characterization of waste rock and CHPP residues identified that some waste components have potential to generate acid which has been confirmed for some materials in humidity cell tests. This section therefore provides guidance for identification and management of these materials.

5.2 Definition of ARD Potential

PAG units are defined by:

$$\frac{NP}{AP} \leq 2 \text{ ; and } S_{sulphide} \geq 0.1\%.$$

NP is neutralization potential determined by the modified method (Coastech 1991) and AP is acid potential determined from sulphide content ($S_{Sulphide}$).

Sulphide content is determined as total sulphur by ICP following aqua regia digestion.

5.3 Identification of PAG Units

Table 4 shows the current understanding of the locations of PAG Management Units (PAGMUs) determined from acid base accounting. A PAGMU is rock that can practically be managed with typical open pit coal mining equipment.

Thicknesses of PAG units shown in Table 4 for Cadomin and Adanac. Formations will need to be corrected for core-to-bedding angles of intercepts to obtain true thicknesses.

5.4 Management of PAG Units

5.4.1 Selection of Management Approaches

Options for management of PAG rock to address the potential for accelerated leaching associated with acidic conditions fall into the following technology groups:

- **Exclusion of oxygen for oxidation by underwater disposal**. Under these conditions, the availability of oxygen for reaction with sulphide minerals is limited to the concentration that can be dissolved in water (typically about 10 mgO_2/L) compared to atmospheric conditions (20% in air). Under subaqueous conditions, the availability of oxygen becomes rate limiting in that sulphide minerals will only react as fast as the rate of oxygen that can be dissolved in water. The very slow rates of oxidation under these conditions means that the acid generated is readily neutralized usually by reaction with acid consuming minerals or dissolved alkalinity. Underwater disposal can be achieved in artificial impoundments, natural water bodies and mine voids. Artificial impoundments are the least preferred because they involve perpetual management of a facility constructed to retain water. Backfilling is the

preferred approach because it provides perpetual containment and does not impact natural water bodies.

- **Blending acid-consuming waste rock to offset acid generation potential.** The intent of blending acid consuming rock with acid generating rock is to create a net acid consuming rock mass. Mixing may occur passively in the natural course of mining if PAG layers are relatively thin and low in abundance, and there is a large excess of acid consuming rock. Active management involving segregation at the mining face and re-combination to produce an effective mixture is needed as any of these factors moves towards the PAG rock having a greater potential influence. Implementation of blending requires a site specific approach and in some circumstances cannot be implemented.

- **Limitation of water for leaching of acidic weathering products**. Limitation of contact water under unsaturated conditions can be achieved with natural (e.g. soil) and artificial (e.g. geotextile) barriers. Soil covers may be engineered to achieve limited infiltration through enhanced runoff, or enhancement of storage and evaporative processes. Due to the unsaturated conditions, oxidation proceeds resulting in acidic conditions but the availability of water theoretically results in lower leached loads. Designs need to be site-specific to address local climate and soil characteristics. Depending on effectiveness, water treatment may still be needed.

- **Exclusion of oxygen by covers.** Likewise, limitation of oxygen availability under unsaturated conditions can be achieved with barriers designed to limit air entry by advection and diffusion. The goal is similar to submergence in that oxygen levels become rate limiting for the weathering minerals. The success of such barriers depends on numerous factors including the oxygen demand of the waste. Rock with low demand resulting from low sulphide content and/or low reactivity results in challenges to excluding oxygen to achieve the objective.

- **No source management.** This option would lead to water treatment by passive or active measures.

Underwater disposal, blending and exclusion of oxygen by covers may be viewed as prevention technologies because they are intended to prevent rapid oxidation and associated acid and metal leaching from occurring. In this group, underwater disposal is technologically most reliable and also addresses leaching of elements that do not require acidic conditions to be mobilized, which blending will not achieve. Covers to limit water contact do not limit oxidation processes but control the volume of contact water. As noted above, covers on PAG wastes may leave a residual need for water treatment.

For the Project, the primary source mitigation approaches will be blending and subaqueous disposal by backfilling pits in the sequence of mining. Blending is necessary because the capacity available for subaqueous disposal is lower than the PAG waste rock quantity and sequencing does not always result in mine voids being available when needed.

Specific implementation aspects are described below.

5.4.2 Subaqueous Disposal

Subaqueous disposal will involve placement of PAG rock underwater as part of backfilling. Inundation needs to occur before acidification to avoid the water column acidifying or possibly having unacceptable chemistry.

Table 6 provides maximum recommended exposure times estimated using humidity cell data. Since testing was performed on rock which had already weathered for five years, the allowable exposure periods are possibly greater than indicated.

Table 6: Recommended Maximum Exposure Times Prior to Inundation by Pit Waters of PAG Rock by Formation

Formation	Maximum Exposure Years
Cadomin	7
Mutz	2
Adanac	1
Moose	8
Seam 1 Reject	17

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\!080_Deliverables\2016-06_Waste_Management_Guidance\[BlendingCalc_1CM029008_SJD_REV01.xlsx]

These exposures times were calculated using the following formula that links delay to onset of acidic conditions to initial NP/AP $(NP/AP)_0$, the reactivity of sulphide under non-acidic conditions (k) and the relative utilization of NP by oxidizing sulphide $(NP/AP)_{crit}$:

$$t_{onset} = \frac{\left(NP^*/AP^*\right)_0}{k.\left(NP^*/AP^*\right)_{crit}}$$

The equation reflects that acidification occurs when NP is depleted, and that the rate of NP depletion is a function of the rate of acid generation. k is derived from humidity cell data and is expressed in units of $[T]^{-1}$ which is the slope of the regression line for the data shown in Figure 22. $(NP/AP)_{crit}$ is the same as the threshold for definition of PAG materials described in Section 5.2.

The equation tends to over-estimate reactivity because reaction rates decrease as sulphide content decreases due to depletion but it does consider that 100% of NP is not available which is a factor for rock with lower NP/AP. The time frames shown in Table 6 were adjusted to reflect low reaction rates under site conditions due to lower temperatures and were calculated using median $(NP/AP)_0$. It is clear from the kinetic testing that some components of the PAG waste rock could generate acid immediately upon exposure but in a mixed waste rock mass this would not result in widespread acidification.

Table 6 shows that some rock types require prioritization for earlier underwater disposal (Mutz and Adanac)

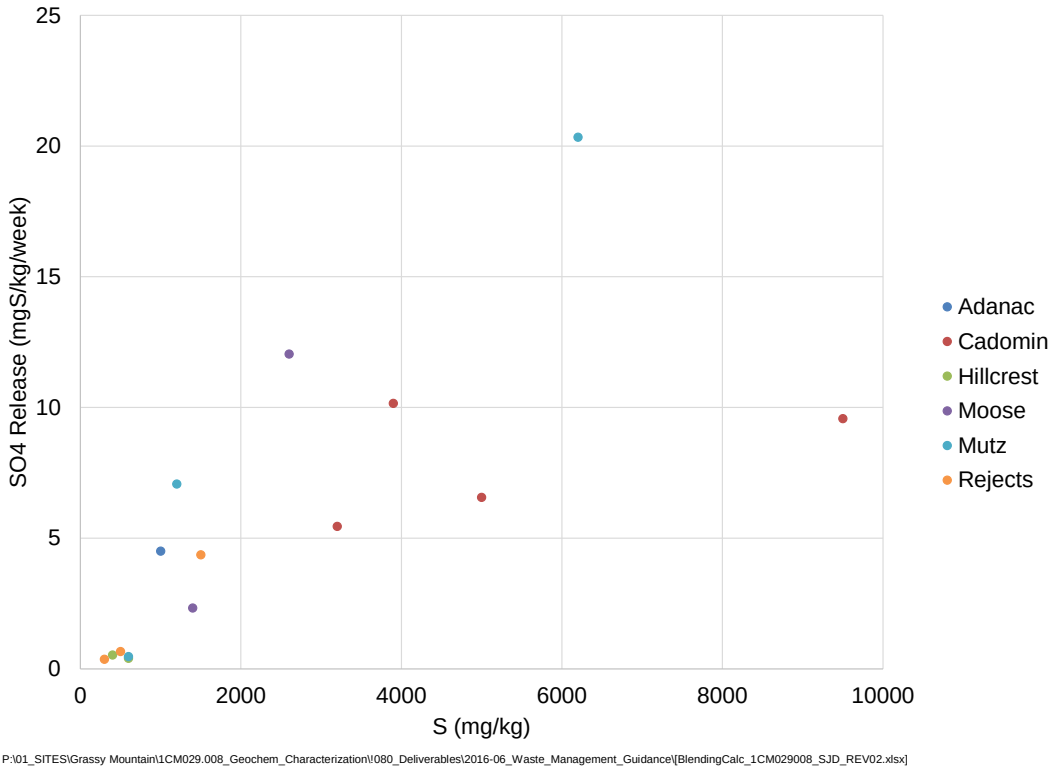


Figure 22: Oxidation Rate as a Function of Sulphide Content for Humidity Cells

5.4.3 Waste Rock Blending

Background

Blending will involve combining PAG and non-PAG rock components to result in a rock mixture that operationally performs as non-PAG. The objective is to minimize acidification at any scale so that not only is ARD prevented but accelerated leaching that accompanies localized acidification at small scales is also prevented. There are two components to implementation of blending to achieve the objective:

- Mass balance such that neutralization potential always exceeds acid potential by an appropriate margin; and
- Intimate co-mingling of PAG and non-PAG rock.

Input to design criteria for both aspects are provided below. The approach recommended has been approved and implemented at coal mines in northern BC (Perry Creek Mine, Trend Mine, Quintette Coal Operations).

Mass Balance Excess of Neutralization Potential over Acid Potential

The recommended definition of excess NP is:

$$\frac{NP}{AP} > 3$$

The use of a ratio of 3 rather than the ratio of 2 used to define PAGMUs (Section 5.2) provides a greater margin to reflect operational factors such as variability in the NP/AP of PAG materials and operational misclassification.

Mixing ratios of non-PAG and PAG based on the geochemical characteristics of the rock determined for the project were used to estimate the overall mass balance and the ratio needed to achieve sufficient excess NP over AP. The current estimate of the life of mine average non-PAG:PAG is 67:33 assuming that Cadomin conglomerate, 30% of Mutz, 50% of Adanac and all of Moose are PAG (Table 4). This proportion shows little annual variation from year to year.

An initial calculation of mass balance NP:AP was performed at the 67:33 ratio to show the effect of mixing different PAGMUs with any non-PAG waste rock which showed life of mine NP/AP<3 for several units. The calculation was then repeated using a ratio of 75:25. Table 7 shows the result of mixing at this ratio for any non-PAG waste rock. The average case is the average sulphide and NP for non-PAG and PAGMU. The worst case combines the lower confidence limit on NP with the upper confidence limit on AP to yield a lower limit NP/AP with a 5% probability. NP/AP in each case is obtained by combining the resulting sulphide and NP. The statistics are not calculated directly for NP/AP.

Table 7: Mass Balance NP/AP for Co-Mingled Non-PAG:PAG at 75:25.

Non-PAG/PAGMU	Case	Sulphide S %	NP kg $CaCO_3$/t	NP/AP
All with Cadomin	Average	0.27	23	2.7
	Worst	0.29	22	2.4
All with Mutz	Average	0.12	22	5.7
	Worst	0.13	21	5.3
All with Adanac	Average	0.27	21	2.4
	Worst	0.29	20	2.2
All with Moose	Average	0.10	21	6.7
	Worst	0.11	20	6.2

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\!080_Deliverables\2016-06_Waste_Management_Guidance\[BlendingCalc_1CM029008_SJD_REV01.xlsx]

The calculation indicates that the target NP/AP (>3) is not achievable for Cadomin and Adanac but is readily achievable for Mutz and Moose because the latter two PAGMUs have lower sulphide content. Table 8 shows the same calculation performed using the non-PAG rock from the lower Mutz Formation due to its higher overall NP compared to other units. The target NP/AP is achieved for Cadomin and should be achievable for Adanac.

Table 8: Mass Balance NP/AP for Co-Mingled Mutz Non-PAG:PAG at 75:25.

Non-PAG/PAGMU	Case	Sulphide S %	NP kg $CaCO_3$/t	NP/AP
Mutz with Cadomin	Average	0.26	29	3.5
	Worst	0.28	27	3.2
Mutz with Mutz	Average	0.11	28	8.1
	Worst	0.11	26	7.4
Mutz with Adanac	Average	0.26	27	3.3
	Worst	0.28	25	2.9
Mutz with Moose	Average	0.089	27	9.8
	Worst	0.092	26	8.9

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\!080_Deliverables\2016-06_Waste_Management_Guidance\[BlendingCalc_1CM029008_SJD_REV01.xlsx]

The calculations also indicate that for the Mutz and Moose PAGMUs, a lower mixing ratio of 50:50 would achieve NP/AP>3.

The following are concluded:

- Detailed short range planning will be needed to ensure that sufficient non-PAG rock is available to meet the mass balance needs for blending.
- The target mixing ratio for PAGMUs in the Mutz and Moose is 50:50 Non-PAG:PAG where any Non-PAG rock can be used.
- The target mixing ratio for PAGMUs in the Cadomin and Adanac Formations is 75:25 Non-PAG:PAG where Mutz needs to be the Non-PAG rock.

Contingencies for management of excess PAG rock should be evaluated because there is more PAG than can be handled by blending. This could include temporary stockpiling or prioritizing opportunities for subaqueous disposal. Stockpiling should ensure re-handling to final disposal locations before the exposure times shown in are not exceeded.

Intimate Co-Mingling

The required approach to co-mingling is end-dumping over high faces such that PAG rock is distributed as thin layers and becomes mixed with non-PAG rock in the course of placement, and localized sloughing of the face due to over-steepening. The minimum acceptable height of the dump face is determined by the required maximum thickness of the PAG layers on the face such that the PAG rock does not acidify.

The concept for blending is shown in Figure 23. The purpose is to place PAG and non-PAG wastes so that PAG wastes do not become acidic and leach iron and aluminum onto non-PAG materials resulting in “sterilization” of neutralization potential. Prevention of acidic conditions also results in slower oxidation rates in PAG materials and reduced leaching of associated heavy elements (including Zn and Cd).

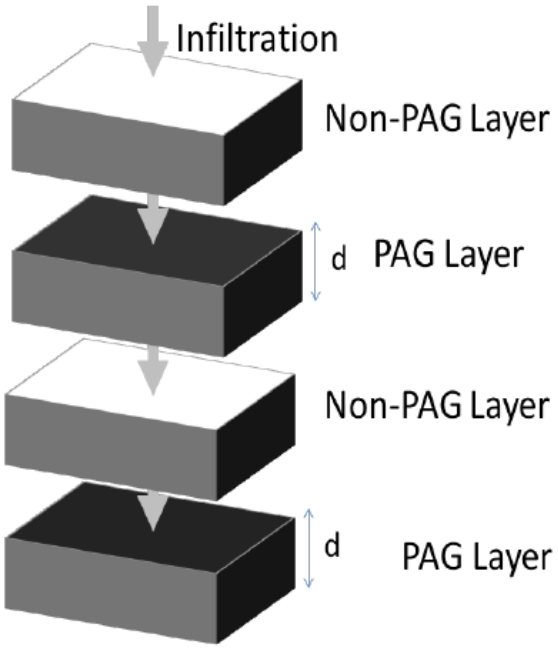


Figure 23: Concept for Blending

Prevention of net acidic conditions from developing in PAG layers is achieved when alkalinity leached from non-PAG layers provides sufficient alkalinity to offset acid production in the PAG layer after NP has been depleted from the PAG layer. Since alkalinity from non-PAG layers is delivered to PAG layers in dissolved form, a critical flow path length exists within the PAG layer such that dissolved alkalinity will eventually be completely consumed by acid generation in the PAG layer. The calculation determines the critical flow path length (d_{crit}) from:

$$d_{crit} = 0.48 \frac{B.I}{\rho.R}$$

In which B is alkalinity ($mgCaCO_3/L$) delivered by non-PAG layers, I is infiltration, ρ is density and R is the acid generation rate ($mgSO_4/kg/year$).

Table 9 shows the calculated face layer thicknesses for each PAGMU. The inputs to these calculations are:

- The average and 95% confidence limits on the sulphide content and NP of each PAGMU.
- The relationship between sulphide content and sulphide oxidation rate under non-acidic conditions indicated by humidity cells for waste rock.
- Lab to field scaling factor 0.03 for waste rock.
- Dissolved alkalinity delivered by non-PAG rock of 198 $mgCaCO_3/L$ which is the 50th percentile value for existing waste rock seepage at the site.
- Mean Annual Precipitation of 628 mm with 50% infiltrating.

- Loose rock density of 1,700 kg/m^3.
- End dump face angle of 38^o.
- Haul truck box volume of 130 m^3 and box width of 7.7 m.

The indicated lower and upper values were calculated by combined upper confidence limit on sulphide content and lower confidence limit on NP.

Aspects of the calculation that tend to increase the dump height (i.e. increasing the certainty that mixing will be significant) are the scaling factor (range probably 0.01 to 0.03) and the use of the median of alkalinity values. Alkalinity in waste rock drainage can exceed 300 mg$CaCO_3$/L under confined conditions. The calculation of thickness is linear with respect to both inputs. If the scaling factor decreases by a factor of 2, the dump height would be 50% that indicated. Likewise, doubling the alkalinity would have the same effect.

The calculation indicates that the end dumping height needs to be greater for the more reactive Cadomin and Adanac PAGMUs but a site wide minimum dumping height of 40 m would achieve the co-mingling objective for all PAGMUs (Table 9). In the early phases, free-dumping of PAG and non-PAG waste rock at the dump crest and pushing over the face is an option to achieve mixing on short faces at other projects before full height is achieved.

Table 9: Calculated Placement Requirements for Co-Mingling of PAGMU with non-PAG

PAGMU	Maximum Face Layer Thickness (m)		Minimum End-Dump Height (m)	
	Average	Lower	Average	Upper
Cadomin	0.3	0.3	34	37
Mutz	0.9	0.8	10	14
Adanac	0.3	0.3	40	43
Moose	1	1	10	10

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\!080_Deliverables\2016-06_Waste_Management_Guidance\[BlendingCalc_1CM029008_SJD_REV01.xlsx]

Placement Approach

The placement approach needs to address mass balance and co-mingling requirements simultaneously and at all times. For co-mingling, PAG waste rock must never be placed at a location without the non-PAG required to achieve mass balance being placed below and above it.

For Mutz and Moose PAGMUs, the sequence of loads placed at any location is 1:1 (PAG-NPAG-PAG-NPAG-PAG-NPAG etc).

For the more reactive, Cadomin and Adanac PAGMUs, the sequence is (1:3) (PAG-NPAG-NPAG-NPAG-PAG-NPAG-NPAG-NPAG-PAG-NPAG-NPAG-NPAG-PAG-NPAG-NPAG-NPAG etc.).

The final waste rock placed on any face should be the NPAG sequence so that PAG rock is not exposed to weathering on a final face.

6 Management of Selenium Leaching Potential

6.1 Current Understanding

The Project will extract coal from rock using comparable mining and processing methods to those employed in other Rocky Mountain coal fields in southeastern and northeastern British Columbia and Alberta. At many of these operations, selenium leaching needs to be managed to address selenium concentrations observed in nearby surface waters.

Based on the analogous geological setting and comparable selenium concentrations in the coal-bearing stratigraphy, similar leaching effects are expected for the Project. For example, selenium concentrations in the Mist Mountain Formation within the Elk Valley typically range from less than 1 mg/kg to about 5 mg/kg (Kennedy et al. 2012; SRK 2014). This is comparable to selenium concentrations observed at Grassy Mountain within coal seam 1 residue (2.7 mg/kg) and drill core from the Mutz Member (0.4 to 4.8 mg/kg) and Adanac Member (0.4 to 3.4 mg/kg) of the Kootenay Formation. Static test results combined with results from kinetic tests and seepage from legacy wastes provide supporting evidence that selenium leaching is a consideration for the Project.

6.2 General Mitigation Approaches

A number of passive and active measures paralleling those used for PAG rock management are potentially available to limit selenium leaching effects including:

- Subaqueous disposal in backfilled pits and artificial impoundments to limit availability of oxygen and consequent oxidation of pyrite, which is assumed to be the source of leachable selenium.
- Measures to decrease the contact of water with wastes including covers on wastes.
- Passive or semi-active treatment of contact waters in sub-oxic saturated zones of backfilled pits resulting in sequestration of selenium in adsorbed and precipitated forms due to reduction by oxidation of reactive dissolved organic carbon.
- Active management using water treatment plants.

These measures were identified in the Elk Valley Water Quality Plan (Teck Coal 2014) and continue to be implemented at coal mining operations elsewhere in western Canada.

6.3 Selection of Preferred Approach and Assessment

SRK completed scoping level water quality assessments and concluded that of the first three source prevention or control measures, the greatest reduction in selenium loadings would likely come from using sub-oxic saturated backfills zones to provide treatment. Experience from other sites (SRK 2012; Bianchin et al. 2013) has demonstrated that selenium concentrations can passively be decreased by one to two orders-of-magnitude often resulting in discharge concentrations below surface water quality guidelines.

Conceptual models for this approach to manage selenium leaching indicate that the residence time of water in saturated backfills is a critical variable because it determines the time available for microbiologically-mediated reactions to achieve the conditions under which selenium can be removed from solution. A primary requirement is removal of dissolved oxygen and other ions that may block reactions that convert selenium from mobile oxidized forms (selenate, SeO_4^{2-}) to less oxidized less mobile forms (selenite, SeO_3^{2-} and elemental selenium, Se^0). In order for these reactions to proceed, reactive reduced carbon needs to be present. The case studies indicate that carbonaceous materials present in the sedimentary rocks (including thin non-recoverable coal strata) probably act as the source of carbon.

Residence time is calculated from:

Total pore space in saturated backfill (m^3) / total inflow rate into the backfill (m^3/year).

There are currently no data to indicate when a residence time would be too short to result in effective selenium removal. Case studies compiled by SRK (2012) and Bianchin et al. (2013) indicate that the approach will be more effective the longer the residence time (up to several years). Bianchin et al. concluded from one case study that selenium attenuation may have occurred at residence times ranging from 0.3 to 3 years. The uncertainty reflected the range of groundwater flows in the backfill.

It can reasonably be concluded that the effectiveness of the measure probably decreases as the residence time decreases, all other factors being equal. Based on the preliminary scoping level assessments and conceptual models for the Project, SRK recommends:

- In-pit co-disposal of plant refuse (which contains carbon) to provide additional long term carbon sources in backfills.
- Residence times for pit design should be targeted to exceed 1 year to achieve passive selenium removal.
- An assumption that if residence times are less than 1 year, the need for intervention becomes increasingly likely to offset shorter residence times by providing for more aggressive oxygen removal which could be accomplished by adding other carbon sources.
- Assume 95% to 99% of influent selenium loading could be removed.
- Construction of all backfills to include in situ performance monitoring (i.e. groundwater wells) and the ability to inject reactive carbon forms directly into the backfill.
- Allowance for repeated additions of carbon to maintain sub-oxic conditions in backfills with low residence times.

The presence of nitrate in waters (from explosives residuals) is an important consideration for this approach to selenium management because nitrate denitrification to nitrogen gas may need to occur before conditions are sufficiently sub-oxic for selenate to be converted to less oxidized forms. This is an important consideration for the operational period and immediate post closure period when nitrate leaching is greatest.

Further discussion of the implementation of this approach is provided by SRK (2016a, 2016b).

7 Derivation of Contact Water Source Terms

7.1 Introduction

This section describes numerical implementation of the conceptual models (Section 2.3) using similar methods to those reported elsewhere for coal and metal mine projects to derive contact water source terms that are used in the water quality model (SRK 2016a). The methods are consistent with those used in the nearby Elk Valley. Methods by facility are described in the following sections.

These predictions are for leaching processes associated with rock weathering mechanisms (for example, oxidation of sulphide minerals and neutralization of acidity by reaction with carbonate minerals). The methods used to predict leaching of explosives residues are described in SRK (2016).

7.2 Evaluating Uncertainty

Consistent with other studies, uncertainty in geochemical source terms is reflected in two cases referred to as “Base Case” and “Upper Case”. The Base Case indicates the most likely outcome combining numerical inputs that reflect typical conditions and scientific judgment for some aspects. The Upper Case is analogous to a boundary condition in that it is considered highly unlikely that concentrations would be exceeded. This deterministic rather than stochastic approach is preferred for contact water source terms is preferred because, in contrast to hydrological inputs to models, the underlying mechanisms are less quantifiable and it is not possible to assign statistical distributions to the inputs and outputs of the calculations.

7.3 Waste Rock

The waste rock predictions assume that weathering will occur under non-acidic conditions due to the implementation of blending to mitigate ARD potential. Conversion of rock components in leachable forms is predicted according to the expected geochemical behaviour of ions falling into two groups:

- Ions with weak pH control under non-conditions – sulphate and selenium.
- Ions expected to have a strong pH controls – all other ions primarily but not exclusively leaching as cations.

For the first group of ions, leaching is described in terms of mass leached per mass of rock per time so that the load leached increases in direct proportion to the quantity of waste rock placed. The input rates were determined from humidity cell tests which were scaled to field conditions based on laboratory-to-field scaling factors determined for coal mine wastes in the Elk Valley (Table 10) (Kennedy et al. 2012). Humidity cell rates are medians for non-acidic conditions. The range of scaling factors was used to provide a range of rates for the two cases (see Section 7.2)

The resulting selenium and sulphate release rates for the low end of the range are about three to four times higher than those determined for the Elk Valley (SRK 2014).

Table 10: Release Rate for Selenium and Sulphate (mg/bank m^3/year)

		Waste Rock		Co-Disposed Waste Rock and CHPP Reject	
Case	**Unit**	**Base**	**Upper**	**Base**	**Upper**
Scaling Factors	Unitless	0.01	0.03	0.01	0.03
Se	mg/bank m^3/year	3.1	9.4	9.4	15
SO_4	mg/bank m^3/year	24000	73000	33000	77000

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\201604_SourceTerms\[Se_SourceTerm_April2016_1CM029008_SJD_REV01.xlsx]

For those ions expected to be strongly controlled by pH, the assumption is that concentrations will be controlled by the solubility of secondary minerals such as oxides and carbonates either through precipitation of these minerals or sorption processes. While neutral pH conditions are expected to dominate, the presence of PAG materials indicates that internal pH conditions may vary in response to build up of CO_2 in waste rock pores. Accumulation of CO_2 results in lower pHs even as buffering by carbonate minerals occurs.

The fixed concentration assumption means that the load leached is a function of volume of contact water not volume of waste placed. As a result, load increases as footprint area increases.

To develop the fixed concentrations, the following methodology was used:

- All site data reflecting direct water contact with waste rock materials was compiled (see Section 3.2.6). This included all HCT leachates and near source data such as seeps.
- The data were inspected for pH relationships. Based on the common observation of negative correlations with pH (i.e. higher concentrations at lower pHs), it was concluded that the data showed pH control on concentrations (for example, Figure 24).
- The dataset was used to determine 99th percentile concentrations for 0.2 pH envelopes around pHs of 8 and 7 which are the Base and Upper cases (Section 7.2). The lower pH is considered to be a boundary condition because it represents tens of percent CO_2 accumulating in pore spaces. The former is closer to atmospheric CO_2 partial pressure. Both are consistent with buffering by carbonate minerals.

Resulting concentrations for the two pH ranges are shown in Table 11. It is apparent that element occurring as cations (Al, Be, Cd, Co, Cu, Mn, Ni, Zn) typically have higher concentrations at lower pHs whereas those occurring as anions have higher concentrations at lower pHs or there is little difference (e.g. As, Sb, U).

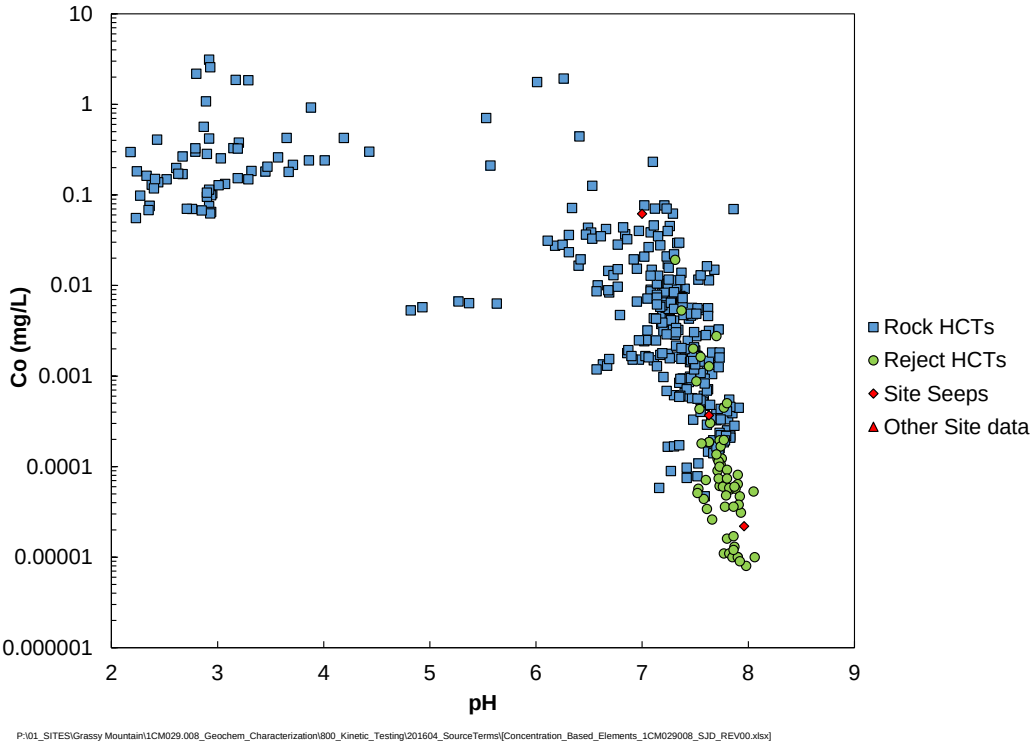


Figure 24: Example of pH Control Shown by Data for Cobalt

Table 11: Solubility Controls (in mg/L) for pH Constrained Elements Using Two pH Ranges

Case	Base	Upper
pH Ranges	7.8 to 8.2	6.8 to 7.2
Ag	0.0001	0.000092
Al	0.053	0.13
As	0.0012	0.00075
Ba	0.55	0.6
Be	0.00001	0.000089
Cd	0.00043	0.0029
Co	0.044	0.15
Cr	0.001	0.00025
Cu	0.0012	0.0021
F	1	0.83
Fe	0.0041	0.0033
Hg	0.00005	0.00005
Mn	0.0023	0.067
Mo	0.088	0.084
Ni	0.16	0.34
Pb	0.00025	0.00055
Sb	0.006	0.003
Tl	0.00015	0.00011
U	0.00084	0.0008
V	0.0037	0.0018
Zn	0.034	0.36

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\201604_SourceTerms\[Concentration_Based_Elements_1CM029008_SJD_REV00.xlsx]

7.3.1 Backfill

The unsaturated part of backfill is assumed to function the same as waste rock whereas the saturated part is assumed not to contribute load due to low oxygen conditions. The saturated zone is assumed to attenuate selenium as a proportion of the load contributed by the unsaturated waste rock.

7.3.2 Co-Disposed Waste Rock and CHPP Rejects

The overall approach used for co-disposed waste rock and CHPP rejects is similar to waste rock except that weathering rates indicated by humidity cells were combined with waste rock rates. The CHPP rate was obtained as a weighted average in proportion to the seam proportions (12% Seam 1, 52% Seam 2 and 36% Seam 4). The weighted rate for waste rock and CHPP rejects assumes 9% CHPP which is the life of mine average for those locations that receive CHPP. The rate used for CHPP was adjusted only to reflect temperature differences between site and laboratory conditions.

The derived rates are shown in Table 10. Although rejects represent 9% of the mass, they increase the rate for selenium by a factor 3 at the waste rock scaling factor of 0.01. This reflects the smaller particle size of CHPP rejects.

7.3.3 Pit Walls

The effects of pit walls were evaluated by assuming they perform as thin waste rock dumps. Two types of walls will be present: benched walls that form highwalls and unbenched walls which are the footwall of the lowest seam mined. The former are formed by blasting practices resulting in bench rubble due to over-blast and fractured walls. Weathering is expected to result in talus cones. The latter are formed by dozing to cleanly remove coal and result in little broken material.

For each type of wall, an acidic and non-acidic source term was defined. Raw concentrations were obtained from humidity cell release rates (R) from acidic and non-acidic cells using:

$$\frac{R \cdot k \cdot M}{Q}$$

k is the scaling factor used to scale laboratory rates to full scale to account for differences in temperature, particle size, water contact and oxygen availability. M is the reacting mass of rock which is based on assumed to be a 2 m thick waste rock-like blast zone on benched walls and 0.005 m on unbenched walls. Q is the volume of contact water which is simplified to 90% of annual precipitation. The resulting raw concentrations for non-acidic walls were constrained to the pH 8 concentrations indicated in Table 12. This pH was chosen because pit walls are expected to be in equilibrium with the atmosphere. Acidic concentrations were not constrained.

For benched walls the scaling factor was set to 0.01. For unbenched walls, the scaling factor is 0.3 to reflect temperature differences only as the rubble on unbenched walls tends to be sparse but relatively fine grained. The use of 0.005 m as the reacting thickness results in unbenched walls yielding lower loads.

Base and Upper Case concentrations (see Section 7.2) were derived by calculating concentrations using 50th and 95th percentile humidity cell rates.

Resulting wall runoff concentrations are shown in Table 12.

Table 12: Wall Runoff Concentrations

Parameter	Benched Wall Source Terms				Unbenched Wall Source Terms			
	Acid		Non-Acid		Acid		Non-Acid	
	Base	Upper	Base	Upper	Base	Upper	Base	Upper
Ag	0.00025	0.00036	0.000029	0.000031	0.000011	0.000016	1.3E-06	1.4E-06
Al	29	83	0.053	0.053	1.3	3.7	0.0047	0.018
As	0.034	0.65	0.00093	0.0012	0.0015	0.029	0.000042	0.0001
Ba	0.042	0.059	0.13	0.55	0.0019	0.0027	0.0056	0.041
Be	0.022	0.24	0.00001	0.00001	0.00097	0.011	2.6E-06	0.00001
Cd	0.086	0.14	0.00043	0.00043	0.0039	0.0064	0.000037	0.00024
Co	0.56	1.6	0.012	0.044	0.025	0.071	0.00056	0.006
Cr	0.22	0.62	0.00057	0.00073	0.0098	0.028	0.000026	0.000033
Cu	1.2	2.2	0.0012	0.0012	0.052	0.1	0.00012	0.00033
Fluoride	2	5.7	0.91	1	0.09	0.26	0.041	0.13
Fe	880	2100	0.0041	0.0041	40	93	0.0019	0.0041
Hg	0.000058	0.00026	0.00005	0.00005	2.6E-06	0.000012	2.5E-06	2.7E-06
Mg	22	120	28	71	1	5.5	1.3	3.2
Mn	8.2	74	0.0023	0.0023	0.37	3.3	0.0023	0.0023
Mo	0.0021	0.074	0.019	0.088	0.000095	0.0033	0.00086	0.0045
Ni	2.2	5	0.024	0.16	0.098	0.23	0.0011	0.019
Pb	0.016	0.034	0.00022	0.00025	0.00073	0.0015	9.8E-06	0.000029
Sb	0.00074	0.0053	0.0025	0.006	0.000033	0.00024	0.00011	0.00077
Se	0.027	0.053	0.029	0.13	0.0012	0.0024	0.0013	0.0061
Sulphate	4000	6200	220	580	180	280	10	26
Tl	0.00073	0.0019	0.000097	0.00015	0.000033	0.000088	4.4E-06	0.000013
U	0.038	0.044	0.00049	0.00084	0.0017	0.002	0.000022	0.000092
V	0.15	1.5	0.0019	0.0037	0.0068	0.068	0.000087	0.00032
Zn	3.7	15	0.025	0.034	0.17	0.68	0.0011	0.016

Source: P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\201604_SourceTerms\[Se_SourceTerm_April2016_1CM029008_SJD_REV01.xlsx]

8 Conclusions

Results of the geochemical characterization program for the Grassy Mountain Project indicate:

- ARD potential is associated with the Cadomin Formation (particularly the conglomerate), and the Mutz, Adanac, and Moose Mountain Members of the Kootenay Formation.
- Near-surface legacy spoil appears to have negligible ARD potential with all samples containing less than 0.1% sulphide sulphur.
- Some ARD potential appears associated with CHPP residues from seam 1 coal; whereas residues from seams 2 and 4 are non-PAG.
- Relative to global average values for sedimentary rocks cadmium is somewhat enriched.
- Selenium was not found to be enriched based on comparison with global average values but the concentrations observed indicated that selenium leaching is a consideration for the project based on experience at other coal projects in British Columbia and Alberta.

Based on these findings, it is recommended that ARD potential and selenium leaching potential are mitigated by:

- Subaqueous disposal of PAG rock by backfilling in pits below the final water table.
- Blending of PAG and non-PAG rock using disposal approaches to produce a mixture that functions as non-PAG.
- Development of sub-oxic conditions in backfills to attenuate selenium.

This report, “Grassy Mountain Project - Geochemical Characterization Progress Report", was prepared by SRK Consulting (Canada) Inc.

Original Signed By

Stephen Day, PGeol
Corporate Consultant (Geochemistry)

and reviewed by

Original Signed By

Lisa Barazzuol, PGeo
Senior Consultant (Geochemistry)

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Millennium EMS Solutions Ltd. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

9 References

Benga Mining Limited (Benga). 2016. Grassy Mountain Coal Project - Environmental Impact Assessment. Prepared by Benga Mining Limited operating as Riversdale Resources Ltd. Submitted to Alberta Energy Regulator and the Canadian Environmental Assessment Agency. August 12, 2016.

Bianchin, M., A. Martin, and J. Adams, 2013, In-Situ Immobilization of Selenium within the Saturated Zones of Backfilled Pits at Coal-Mine Operations: BC Mine Reclamation Symposium, September 2013.

Coastech Research. 1991. Acid Rock Drainage Prediction Manual. MEND Project 1.16.1b.

Day, S., Kennedy, C., and Pumphrey, J. 2012. Interpretation of Selenium Release from Coal Mine Waste Rock Dumps, Southeastern British Columbia, Canada. 9th International Conference on Acid Rock Drainage (ICARD). Ottawa, Canada, May 20 to 25.

Ferguson, K.D., and Leask, S.M. 1988. The Export of Nutrients from Surface Coal Mines. Environment Canada Regional Program Report 87-12, March.

Gibson, D.W. 1985. Stratigraphy, Sedimentology and Depositional Environments of the Coal-bearing Jurassic-Cretaceous Kootenay Group, Alberta and British Columbia. Geological Survey of Canada, Bulletin 357, Natural Resources Canada.

Kennedy, C., Day, S., MacGregor, D., and Pumphrey, J. 2012. Selenium Leaching from Coal Waste Rock in the Elk Valley, B.C. 9th International Conference on Acid Rock Drainage (ICARD). Ottawa, Canada, May 20 to 25.

Kennedy, C., Day, S., Mackie, D., and Pesonen, N. 2015. Biogeochemical selenium sequestration in unsaturated coal reject piles. 10th International Conference on Acid Rock Drainage (ICARD). Santiago, Chile, April 20 to 25.

MacGregor, D., Day, S., and Lopez, G. 2012. Investigations of Calcite Deposits in Streams Downstream of Coal Waste Rock Dumps, British Columbia and Alberta, Canada. 9th International Conference on Acid Rock Drainage (ICARD). Ottawa, Canada, May 20 to 25.

MEMS. 2015. Grassy Mountain Coal Project: Project Description. Prepared by Millennium EMS Solutions Ltd., Calgary on behalf of Riversdale Resources Limited, Blairmore for the Canadian Environmental Assessment Agency, Ottawa. March.

MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials MEND Report 1.20.1. CANMET Mining and Mineral Sciences Laboratories, Smithers, British Columbia.

Norris, D.K. 1994. Structural style of the Kootenay Group, with particular reference to the Mist Mountain Formation on Grassy Mountain, Alberta. Geological Survey of Canada, Bulletin 449, Natural Resources Canada.

Norwest. 2012. Technical Report Grassy Mountain Property. Prepared by Norwest Corporation, Calgary for the Devon Canada Corporation and Consol Energy Inc., January 26.

Price, W. 1997. Draft Standards and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia. Reclamation Section, British Columbia Ministry of Energy and Mines. April.

Price, W.A. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Materials. Report prepared for MEND Program. MEND Report 1.20.1. 579p.

Sobek, A.A., Schuller, W.A., Freeman, J.R., Smith,s R.M. 1978. Field and Laboratory Methods Applicable to Overburdens and Minesoils. Report EPA-600/2-78-054, U.S. National Technical Information Report PB-280 495.

SRK Consulting. 2011. Line Creek Operations Phase II Project Geochemistry Baseline Report. Annex B in Line Creek Operations Phase II Project. Available at https://a100.gov.bc.ca/appsdata/epic/documents/p352/d34076/1329343338414_3cc850cd38a7a33b01511f80a9bce25310ff08e476d5d94c9834600a438b410d.pdf (accessed September 1, 2015).

SRK Consulting. 2012. Metal Leaching and Acid Rock Drainage Management Plan Quintette Project. SRK Project Number 1CT017.008. Dated March, 2012.

SRK Consulting. 2014. Geochemical Source Term Inputs and Methods for the Elk Valley Water Quality Planning Model. Annex D.4 in the Elk Valley Water Quality Plan. Available at http://www2.gov.bc.ca/gov/DownloadAsset?assetId=625F5EC7F7FA4BEFA6DE9E78E85FC224&filename=d4_geochemical_source_term_inputs_methods.pdf (accessed May 22, 2015).

SRK Consulting. 2016a. Grassy Mountain Water and Load Balance Model. SRK Project Number 1CM029.008. Dated August 2016.

SRK Consulting. 2016b. Grassy Mountain Water Quality Management. SRK Project Number 1CM029.011. Dated August 2016.

Teck 2014. Elk valely Water Quality Plan. Available at http://www.teck.com/media/2015-Water-elk_valley_water_quality_plan_T3.2.3.2.pdf (accessed August 11, 2016).

Appendix A – Summary of Analytical Data Quality Checks

Table A1: Summary of analytical data quality checks

Quality Check	Criteria	Future Waste Rock	Legacy Wastes	CHPP Residues
Acid-Base Accounting				
Sulphur balance	Total sulphur ≥ sulphate sulphur	• All 146 samples passed.	• All 41 samples passed.	• All 3 samples passed.
Carbon balance	Total carbon ≥ inorganic carbon	• All 146 samples passed.	• All 41 samples passed.	• All 3 samples passed.
Modified NP consistent with fizz rating	NP does not exceed maximum NP indicated by acid strength and volume (determined by fizz rating), unless laboratory confirms that additional acid was added during the digestion to maintain pH 2 to 2.5 in accordance with the method.	• All 146 samples passed.	• All 41 samples passed.	• All 3 samples passed.
Modified NP consistent with carbonate content	NP correlated with carbonate and values near parity.	• Carbonate and NP was correlated but not near parity due to presence of Fe carbonates (discussed in text). Results accepted.	• Carbonate and NP was correlated but not near parity due to presence of Fe carbonates (discussed in text). Results accepted.	• Carbonate and NP was correlated but not near parity due to presence of Fe carbonates (discussed in text). Results accepted.
Laboratory duplicates	For paste pH, better than ±0.5 difference between duplicates. For all other parameters, relative percent difference better than 20% when values are more than ten times the limit of detection.	• 10% lab duplication included. • All parameters passed.	• 10% lab duplication included. • Variation exceeding 20% RPD in NP observed in 2 samples with NP less than 5 kg $CaCO_3$/t. Results accepted.	• 1 lab duplicate included (33% duplication). • All parameters passed.
Certified reference materials (CRMs)	Relative percent difference from certified value better than 10% or absolute difference within ten times the limit of detection.	• GS311-1 included for total S and total C. • PD-1 included for sulphate-S. • SY-4 and TIC-L1 included for TIC. • NBM-1 included for Modified NP. • All passed.	• GS311-1 included for total S and total C. • RTS-3A included for sulphate-S. • SY-4 included for TIC. • NBM-1 included for Modified NP. • All passed.	• GS311-1 included for total S and total C. • PD-1 included for sulphate-S. • SY-4 included for TIC. • NBM-1 included for Modified NP. • All passed.
Method blank	Blank concentrations are equal to or below analytical detection limits.	• Blanks included for total C, total S, sulphate-S, and TIC. • All passed.	• Blanks included for total C, total S, sulphate-S, and TIC. • All passed.	• Blanks included for total C, total S, sulphate-S, and TIC. • All passed.
Element Analysis by Aqua Regia Digestion				
Laboratory duplicates	Relative percent difference better than 20% when values are more than ten times the limit of detection.	• 6 lab duplicates were analyzed (4% duplication). • All parameters passed.	• 2 lab duplicates were analyzed (5% duplication). • All parameters passed.	• 1 lab duplicate included (33% duplication). • All parameters passed.
CRMs	Relative percent difference from certified value better than 20%.	• DS10 included. • 1 out of 5 DS10 replicates failed for Mo (RPD 27%); 2 out of 5 failed for Au (55%, 21%); 1 out of 5 failed for Th (24%); 1 out of 5 for La (30%); 1 out of 5 for Ti (26%); and 2 out of 5 for W (21%, 28%). • Results accepted as reported on basis that all elements passed tolerance checks by SGS; and Au, W, and Ti are poorly targeted by aqua regia digestion.	• DS10 included. • 1 out of 2 DS10 replicates failed for Au (53% RPD); and 1 out of 2 failed for Ti (23%). • Results accepted as reported on basis that all elements passed tolerance checks by SGS; and Au and Ti are poorly targeted by aqua regia digestion.	• DS10 included. • All parameters passed.
CRMs	CRM concentration is within the same order of magnitude as sample concentrations.	• Se sample concentrations ranged from <0.1 to 4.8 mg/kg, average 1.1 mg/kg. DS10 contains 2.1 mg/kg. Acceptable. • Cd sample concentrations ranged from <0.01 to 4.4 mg/kg, average 1.3 mg/kg. DS10 contains 3.0 mg/kg. Acceptable.	• Se sample concentrations ranged from <0.1 to 2.1 mg/kg, average 1.0 mg/kg. DS10 contains 2.1 mg/kg. Acceptable. • Cd sample concentrations ranged from 0.06 to 3.2 mg/kg, average 1.5 mg/kg. DS10 contains 3.0 mg/kg. Acceptable.	• Se sample concentrations ranged from 0.3 to 2.7 mg/kg, average 1.2 mg/kg. DS10 contains 2.1 mg/kg. Acceptable. • Cd sample concentrations ranged from 0.36 to 1.8 mg/kg, average 0.84 mg/kg. DS10 contains 3.0 mg/kg. Acceptable.
Method blank	Blank concentrations are equal to or below analytical detection limits.	• Cu (0.03 to 0.08 mg/kg), Pb (0.03 mg/kg), Ag (0.007 to 0.010 mg/kg), Hg (0.006 mg/kg), and Se (0.2 mg/kg) were detected in blanks. • Blank concentrations were accepted because not all blanks failed, and the concentrations (if present throughout the batch) will only potentially influence sample concentrations within 10 times the analytical detection limit.	• Pb (0.04 mg/kg), Ag (0.003 mg/kg), and Cd (0.02 mg/kg) were detected in blanks. • Blank concentrations were accepted because not all blanks failed, and the concentrations (if present throughout the batch) will only potentially influence sample concentrations within 10 times the analytical detection limit.	• Pb (0.02 mg/kg) detected in blank. • Accounts for less than 1% of minimum sample concentration (9.6 mg/kg). Acceptable.
X-ray Diffraction				
Sulphide sulphur and carbonate concentrations	Comparison of sulphide sulphur and carbonate concentrations calculated from modal mineralogy to analytically determined values typically better than 30% RPD.	• 15 samples were analyzed by XRD. • Sulphide S and TIC concentrations typically showed more than 30% RPD; however, results were accepted because sulphide S and TIC concentrations were typically close to or below XRD analytical detection limits.	• No legacy waste samples were analyzed by XRD.	• 3 samples were analyzed by XRD. • Sulphide S and TIC concentrations typically showed more than 30% RPD; however, results were accepted because sulphide S and TIC concentrations were typically close to or below XRD analytical detection limits.
QEMSCAN BMA				
Element analysis and	Comparison of element concentrations calculated from modal	• 15 samples were analyzed by QEMSCAN.	• No legacy waste samples were analyzed by QEMSCAN.	• 3 samples were analyzed by QEMSCAN.

Quality Check	Criteria	Future Waste Rock	Legacy Wastes	CHPP Residues
modal mineralogy comparison	mineralogy to analytically determined XRF values typically better than 30% RPD.	• Some variation was observed between the QEMSCAN and chemical assay results; however, overall the results were accepted on the basis of a satisfactory linear relationship (R^2=0.98). Refer to SGS QEMSCAN report for more detail.		• Some variation was observed between the QEMSCAN and chemical assay results; however, overall the results were accepted on the basis of a satisfactory linear relationship (R^2=0.98). Refer to SGS QEMSCAN report for more detail.
Humidity Cell Tests (in progress)				
Ion balance	Ion imbalance is not greater than ±10%.	• 15 future waste rock humidity cell tests. • 7 cycles were reached as of Aug 27, 2015. • All checks passed and/or were resolved with lab.	• No humidity cell tests.	• 3 CHPP residue humidity cell tests. • 7 cycles were reached as of Aug 27, 2015. • All checks passed and/or were resolved with lab.
Trend analysis	Within +/- Deviation Limits = 4*Std. Dev.(Xn-4…Xn-1, Xn+1….Xn+4)) + Average (Xn-4…Xn-1, Xn+1….Xn+4) Random spiking, unusual trends are flagged.	• All checks passed and/or were resolved with lab.	• No humidity cell tests.	• All checks passed and/or were resolved with lab.
Duplicate humidity cell test	Duplicates behave in the same way.	• HC19 contains duplicate sample SRK-WR-RGSC010-098. • Similar behaviour to cycle 7.	• No humidity cell tests.	• HC19 contains duplicate sample SRK-WR-RGSC010-098. • Similar behaviour to cycle 7.
Duplicate leachate analysis	For pH, difference between duplicates is better than ±0.5. For all other values, relative percent difference better than 20% when values are more than ten times the limit of detection.	• All checks passed and/or were resolved with lab.	• No humidity cell tests.	• All checks passed and/or were resolved with lab.
Blank humidity cell test	Minimum criteria is <2X DL. If outside criteria, subject to evaluation and lab is asked to comment. Also, trends over time are checked.	• HC20 is the method blank. • All checks passed and/or were resolved with lab.	• No humidity cell tests.	• HC20 is the method blank. • All checks passed and/or were resolved with lab.

Source: \\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\500_Reporting\201509_UpdateReport\030_Appendices\WorkingFiles\AppA_QASummary.docx

Appendix B – Mineralogy Results

QEMSCAN DATA

prepared for:

SRK Grassy Mountain

Project CAVM-14936-101
MI7008-JUN15
September 11, 2015

Prepared by:

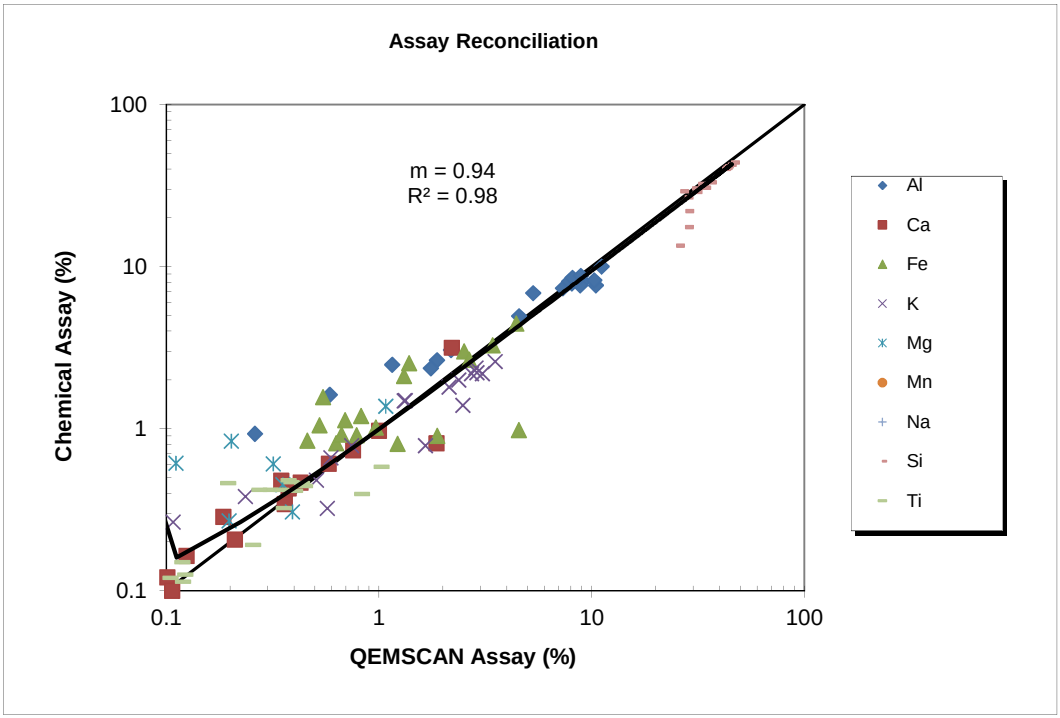
Kareen Fleury-Frenette/Sarah Prout
Mineralogist /Senior Mineralogist

SGS Canada
3260 Production Way Burnaby, BC V5A 4W4
Tel. (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

SRK Grassy Mountain
CAVM-14936-101
MI7008-JUN15

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Assay Reconciliation

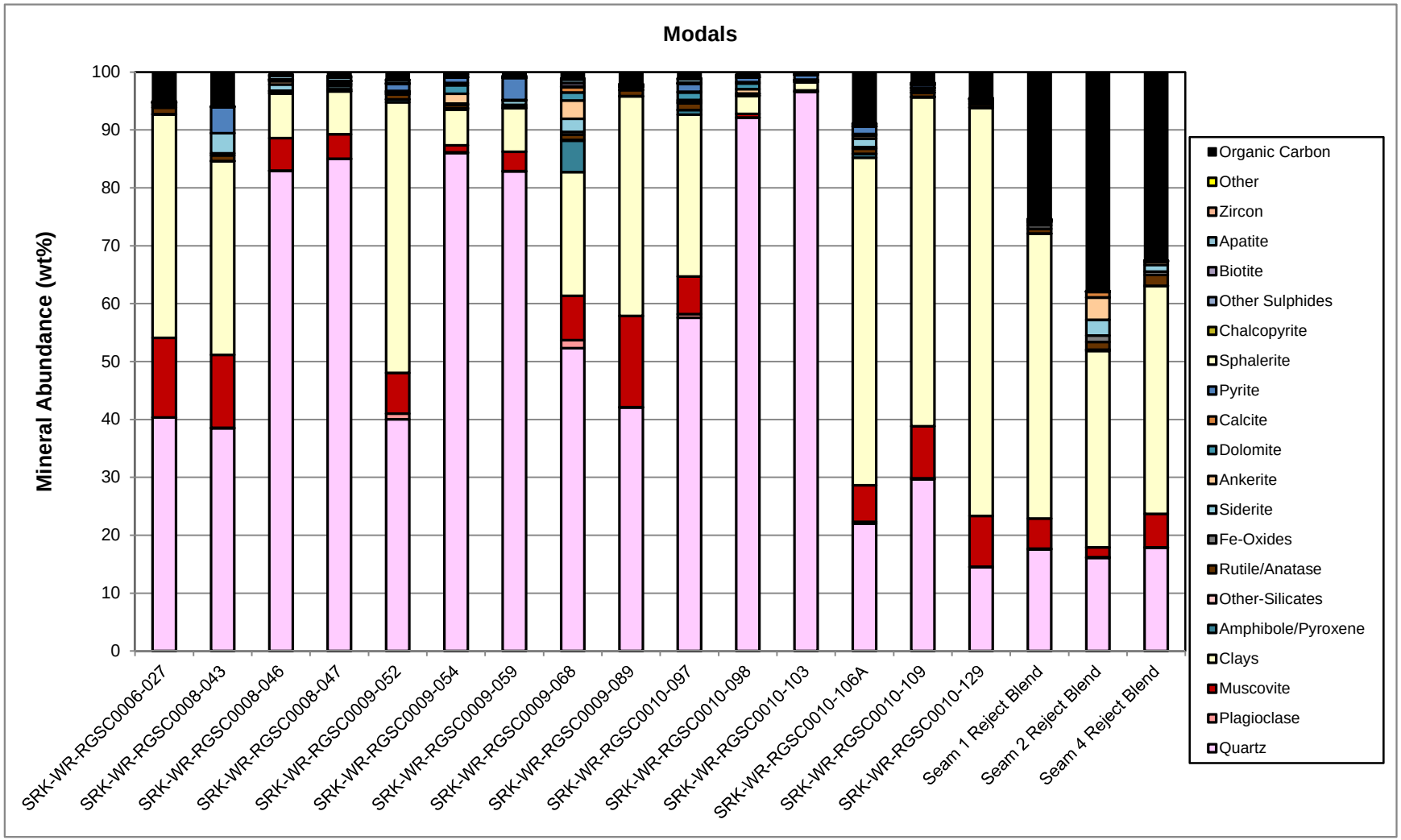


Sample	SRK-WR-RGSC0006-027	SRK-WR-RGSC0008-043	SRK-WR-RGSC0008-046	SRK-WR-RGSC0008-047	SRK-WR-RGSC0009-052	SRK-WR-RGSC0009-054	SRK-WR-RGSC0009-059	SRK-WR-RGSC0009-068
Element	**Unsized**	**Unsized**	**Unsized**	**Unsized**	**Unsized**	**Unsized**	**Unsized**	**Unsized**
Al (QEMSCAN)	8.06	7.33	2.18	1.87	7.82	1.15	1.76	4.56
Al (Chemical)	7.89	7.36	3.06	2.65	8.10	2.49	2.37	4.96
Ca (QEMSCAN)	0.10	0.03	0.43	0.36	0.38	1.00	0.08	2.20
Ca (Chemical)	0.12	0.17	0.46	0.34	0.43	0.97	0.06	3.17
Fe (QEMSCAN)	0.46	4.42	0.79	0.63	1.31	0.97	2.51	3.41
Fe (Chemical)	0.85	4.46	0.92	0.82	2.13	1.02	3.01	3.29
K (QEMSCAN)	2.72	2.37	0.74	0.59	2.13	0.23	0.51	1.32
K (Chemical)	2.19	2.00	0.79	0.66	1.81	0.38	0.48	1.49
Mg (QEMSCAN)	0.03	0.01	0.05	0.03	0.11	0.35	0.00	1.07
Mg (Chemical)	0.38	0.37	0.19	0.14	0.62	0.45	0.08	1.38
Mn (QEMSCAN)	0.01	0.00	0.02	0.01	0.00	0.05	0.00	0.08
Mn (Chemical)	0.00	0.05	0.00	0.00	0.02	0.01	0.01	0.05
Na (QEMSCAN)	0.00	0.01	0.00	0.00	0.05	0.01	0.00	0.07
Na (Chemical)	0.07	0.07	0.04	0.00	0.02	0.03	0.00	0.01
Si (QEMSCAN)	32.6	30.4	42.0	42.7	31.9	42.1	41.4	33.4
Si (Chemical)	30.8	29.0	40.9	41.7	32.5	40.7	40.1	30.7
Ti (QEMSCAN)	0.44	0.38	0.12	0.10	0.31	0.26	0.12	0.36
Ti (Chemical)	0.46	0.48	0.15	0.12	0.42	0.19	0.13	0.32

Sample	SRK-WR-RGSC0009-089	SRK-WR-RGSC0010-097	SRK-WR-RGSC0010-098	SRK-WR-RGSC0010-103	SRK-WR-RGSC0010-106A	SRK-WR-RGSC0010-109	SRK-WR-RGSC0010-129	Seam 1 Reject Blend
Element	**Unsized**	**Unsized**	**Unsized**	**Unsized**	**Unsized**	**Unsized**	**Unsized**	**Unsized**
Al (QEMSCAN)	8.13	5.31	0.59	0.26	9.08	8.83	11.1	10.5
Al (Chemical)	8.57	6.88	1.62	0.93	8.10	7.67	10.1	7.67
Ca (QEMSCAN)	0.02	0.76	0.58	0.11	0.35	0.19	0.07	0.12
Ca (Chemical)	0.21	0.74	0.61	0.10	0.48	0.29	0.21	0.16
Fe (QEMSCAN)	0.54	1.38	0.67	0.53	2.65	0.82	0.69	1.22
Fe (Chemical)	1.57	2.55	0.92	1.06	2.68	1.20	1.13	0.81
K (QEMSCAN)	2.85	1.33	0.11	0.04	2.89	3.06	3.52	2.48
K (Chemical)	2.38	1.49	0.27	0.20	2.22	2.19	2.60	1.39
Mg (QEMSCAN)	0.02	0.32	0.20	0.00	0.20	0.06	0.03	0.04
Mg (Chemical)	0.49	0.61	0.27	0.06	0.84	0.56	0.49	0.35
Mn (QEMSCAN)	0.00	0.01	0.02	0.00	0.01	0.01	0.01	0.01
Mn (Chemical)	0.02	0.04	0.00	0.00	0.02	0.00	0.00	0.00
Na (QEMSCAN)	0.00	0.03	0.00	0.00	0.02	0.01	0.01	0.01
Na (Chemical)	0.09	0.06	0.00	0.00	0.05	0.05	0.11	0.06
Si (QEMSCAN)	32.7	35.6	44.1	45.6	27.6	29.8	26.3	27.8
Si (Chemical)	31.7	33.1	42.6	44.0	26.8	30.5	29.3	22.0
Ti (QEMSCAN)	0.39	0.45	0.12	0.10	0.35	0.27	0.19	0.40
Ti (Chemical)	0.47	0.44	0.11	0.07	0.42	0.42	0.46	0.41

Sample	Seam 2 Reject Blend	Seam 4 Reject Blend
Element	**Unsized**	**Unsized**
Al (QEMSCAN)	8.89	10.3
Al (Chemical)	8.79	8.26
Ca (QEMSCAN)	1.86	0.21
Ca (Chemical)	0.81	0.21
Fe (QEMSCAN)	4.54	1.88
Fe (Chemical)	0.99	0.91
K (QEMSCAN)	0.57	1.65
K (Chemical)	0.32	0.79
Mg (QEMSCAN)	0.39	0.06
Mg (Chemical)	0.31	0.22
Mn (QEMSCAN)	0.16	0.02
Mn (Chemical)	0.00	0.00
Na (QEMSCAN)	0.01	0.00
Na (Chemical)	0.07	0.04
Si (QEMSCAN)	25.1	27.7
Si (Chemical)	13.5	17.6
Ti (QEMSCAN)	0.83	1.03
Ti (Chemical)	0.40	0.58

Modal Chart_Organic Carbon



QEMSCAN Data Normalised to the Organic Carbon Content

Survey		CAVM-14936-101 / MI7008-JUN15																	
Project		SRK Grassy Mountain																	
Sample		SRK-WR-RGSC0006-027	SRK-WR-RGSC0008-043	SRK-WR-RGSC0008-046	SRK-WR-RGSC0008-047	SRK-WR-RGSC0009-052	SRK-WR-RGSC0009-054	SRK-WR-RGSC0009-059	SRK-WR-RGSC0009-068	SRK-WR-RGSC0009-089	SRK-WR-RGSC0010-097	SRK-WR-RGSC0010-098	SRK-WR-RGSC0010-103	SRK-WR-RGSC0010-106A	SRK-WR-RGSC0010-109	SRK-WR-RGSC0010-129	Seam 1 Reject Blend	Seam 2 Reject Blend	Seam 4 Reject Blend
Fraction		Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized	Unsized
Mass Size Distribution (%)		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated ESD Particle Size		18	19	24	29	17	22	20	17	16	15	23	25	18	19	19	16	15	17
		Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
	Organic Carbon	***5.09***	***5.90***	***0.48***	***0.74***	***1.32***	***0.27***	***0.66***	***1.07***	***2.12***	***1.09***	***0.47***	***0.21***	***8.91***	***1.85***	***4.55***	***25.4***	***37.8***	***32.6***
Mineral Mass (%)	Quartz	40.3	38.5	82.9	85.0	40.0	86.0	82.9	52.3	42.1	57.6	92.1	96.6	22.0	29.7	14.5	17.5	16.1	17.9
	Plagioclase	0.03	0.09	0.07	0.05	0.96	0.11	0.04	1.38	0.01	0.60	0.03	0.01	0.30	0.19	0.10	0.14	0.12	0.04
	Muscovite	13.7	12.6	5.59	4.26	7.03	1.24	3.34	7.68	15.8	6.53	0.62	0.25	6.34	8.96	8.75	5.21	1.70	5.77
	Clays	38.6	33.4	7.70	7.36	46.7	6.13	7.50	21.3	37.9	27.9	3.11	1.41	56.5	56.8	70.5	49.2	33.9	39.3
	Amphibole/Pyroxene	0.03	0.04	0.12	0.08	0.51	0.26	0.01	5.44	0.02	0.80	0.07	0.01	0.67	0.09	0.07	0.04	0.23	0.06
	Other-Silicates	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.11	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Rutile/Anatase	1.13	0.99	0.29	0.26	0.86	0.58	0.30	0.91	1.04	1.15	0.28	0.22	0.89	0.73	0.52	0.81	1.36	1.89
	Fe-Oxides	0.06	0.36	0.08	0.06	0.08	0.05	0.29	0.48	0.06	0.12	0.00	0.00	0.27	0.03	0.15	0.61	1.09	0.56
	Siderite	0.38	3.47	1.08	0.56	0.24	0.15	0.75	2.27	0.46	0.25	0.08	0.12	1.45	0.37	0.43	0.46	2.74	1.17
	Ankerite	0.32	0.00	0.58	0.26	0.02	1.70	0.01	3.15	0.03	0.22	0.74	0.00	0.49	0.38	0.23	0.15	3.83	0.51
	Dolomite	0.00	0.00	0.00	0.00	0.21	1.48	0.01	1.39	0.00	1.28	0.96	0.02	0.24	0.04	0.00	0.03	0.03	0.02
	Calcite	0.01	0.01	0.15	0.14	0.05	0.38	0.04	0.91	0.01	0.14	0.23	0.05	0.09	0.04	0.01	0.05	0.94	0.06
	Pyrite	0.05	4.50	0.09	0.43	1.21	1.00	3.83	0.09	0.19	1.38	0.86	0.81	1.27	0.48	0.09	0.16	0.01	0.08
	Sphalerite	0.04	0.01	0.01	0.00	0.02	0.00	0.01	0.03	0.02	0.02	0.01	0.00	0.04	0.02	0.05	0.02	0.01	0.00
	Chalcopyrite	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
	Other Sulphides	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.00
	Biotite	0.08	0.04	0.04	0.03	0.15	0.02	0.01	0.59	0.09	0.15	0.01	0.00	0.33	0.16	0.05	0.06	0.01	0.03
	Apatite	0.06	0.02	0.60	0.61	0.49	0.39	0.15	0.57	0.03	0.63	0.31	0.20	0.11	0.16	0.03	0.06	0.01	0.02
	Zircon	0.01	0.04	0.18	0.18	0.03	0.17	0.05	0.15	0.06	0.05	0.07	0.08	0.01	0.01	0.00	0.01	0.02	0.00
	Other	0.03	0.05	0.01	0.01	0.04	0.04	0.14	0.12	0.01	0.06	0.04	0.02	0.03	0.03	0.01	0.01	0.04	0.02
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Quartz	10	11	23	27	9	20	20	12	10	10	22	25	6	10	6	7	6	7
	Plagioclase	6	14	5	5	7	5	5	5	5	5	5	7	5	5	5	5	5	6
	Muscovite	9	9	9	9	7	7	8	7	9	7	7	7	7	8	8	8	8	9
	Clays	11	10	8	9	12	8	9	8	10	9	8	8	15	15	17	15	16	15
	Amphibole/Pyroxene	6	5	6	5	6	6	5	6	5	6	5	5	6	6	6	7	5	5
	Other-Silicates	0	4	0	4	4	4	0	5	0	4	4	0	4	7	4	0	4	4
	Rutile/Anatase	6	7	0	7	6	7	6	6	6	6	7	7	6	6	5	6	6	6
	Fe-Oxides	6	9	7	6	7	7	10	6	6	6	4	9	7	5	8	38	20	12
	Siderite	14	26	14	13	10	7	10	11	11	8	7	9	11	12	12	12	16	15
	Ankerite	19	0	9	9	7	10	15	10	25	8	11	4	14	16	19	12	11	13
	Dolomite	0	0	4	0	13	13	10	12	0	14	14	22	16	32	0	15	6	9
	Calcite	5	9	7	7	6	6	8	6	4	6	6	6	7	6	6	12	8	6
	Pyrite	5	9	6	10	17	10	11	7	9	13	10	10	10	11	7	8	4	20
	Sphalerite	8	5	4	4	7	4	4	6	7	6	7	4	7	6	7	8	7	4
	Chalcopyrite	5	0	4	6	5	0	4	7	4	5	5	4	4	4	5	6	4	9
	Other Sulphides	6	0	0	4	0	4	4	6	6	7	7	4	4	0	4	6	57	0
	Biotite	5	5	4	5	4	4	4	5	5	5	4	4	5	5	4	4	5	5
	Apatite	6	6	11	15	8	10	7	10	5	9	10	9	6	8	7	6	4	7
	Zircon	9	14	15	17	8	20	6	12	17	6	8	8	6	4	4	10	9	4
	Other	8	6	5	6	7	7	7	5	4	6	7	5	4	6	5	6	6	7

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14936-101/MI4535-JUN15*
Sample Receipt:	*June 29, 2015*
Sample Analysis:	*July 1, 2015*
Reporting Date:	*July 15, 2015*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations:	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit:	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Quantitative XRD Results
4) XRD Pattern(s)

<Original signed by>

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

<Original signed by>

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Minerals Services Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada - Minerals Services - Lakefield: http://palcan.scc.ca/SpecsSearch/GLSearchForm.do.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

DISCLAIMER: This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	SRK-WR-RGSC0006-027 JUN4535-01 (wt %)	SRK-WR-RGSC0008-043 JUN4535-02 (wt %)	SRK-WR-RGSC0008-046 JUN4535-03 (wt %)	SRK-WR-RGSC0008-047 JUN4535-04 (wt %)	SRK-WR-RGSC0009-052 JUN4535-05 (wt %)	SRK-WR-RGSC0009-054 JUN4535-06 (wt %)	SRK-WR-RGSC0009-059 JUN4535-07 (wt %)	SRK-WR-RGSC0009-068 JUN4535-08 (wt %)
Quartz	35.6	28.7	58.5	63.6	35.3	69.0	65.9	39.6
Albite	1.1	1.4	0.9	0.4	0.7	0.6	-	-
Muscovite	12.8	10.2	4.8	5.0	10.8	2.5	3.5	7.8
Kaolinite	7.1	6.3	2.4	2.4	8.3	4.2	2.5	3.3
Rutile	0.8	0.6	-	0.1	0.6	0.1	-	0.2
Magnetite	-	0.7	-	-	-	-	-	-
Pyrite	-	2.4	0.1	0.2	0.7	0.4	2.4	-
Siderite	-	3.2	0.9	0.6	0.4	0.1	-	3.5
Ankerite	-	-	0.7	0.5	-	0.7	-	3.7
Dolomite	-	-	-	-	-	3.6	-	6.8
Anatase	-	-	-	-	-	-	-	-
Amorphous	42.6	46.5	31.7	27.3	43.3	18.8	25.6	35.1
TOTAL	100	100	100	100	100	100	100	100

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

**Please note that 10% corundum was added to each sample to calculate the amorphous content. Data has been normalized.*

Mineral/Compound	Formula
Quartz	SiO_2
Albite	$NaAlSi_3O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Rutile	TiO_2
Magnetite	Fe_3O_4
Pyrite	FeS_2
Siderite	$FeCO_3$
Ankerite	$CaFe(CO_3)_2$
Dolomite	$CaMg(CO_3)_2$
Anatase	TiO_2

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	SRK-WR-RGSC0009-089 JUN4535-09 (wt %)	SRK-WR-RGSC0010-097 JUN4535-10 (wt %)	SRK-WR-RGSC0010-098 JUN4535-11 (wt %)	SRK-WR-RGSC0010-103 JUN4535-12 (wt %)	SRK-WR-RGSC0010-106A JUN4535-13 (wt %)	SRK-WR-RGSC0010-109 JUN4535-14 (wt %)	SRK-WR-RGSC0010-129 JUN4535-15 (wt %)
Quartz	36.5	61.0	84.9	87.8	26.3	30.5	25.1
Albite	1.8	1.6	-	-	1.7	1.5	2.2
Muscovite	14.4	13.5	2.5	1.4	13.5	12.0	14.2
Kaolinite	6.2	12.8	2.8	1.3	5.4	5.5	7.2
Rutile	0.8	0.7	-	-	0.8	0.6	0.9
Magnetite	-	0.8	-	-	-	-	-
Pyrite	0.4	0.9	0.6	0.9	0.7	0.5	0.4
Siderite	1.6	1.6	-	-	2.9	0.8	0.8
Ankerite	-	-	0.4	-	-	-	-
Dolomite	0.3	2.5	2.4	1.0	0.7	0.2	-
Anatase	-	-	-	-	-	-	0.6
Amorphous	37.9	4.7	6.5	7.5	48.2	48.3	48.7
TOTAL	100	100	100	100	100	100	100

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

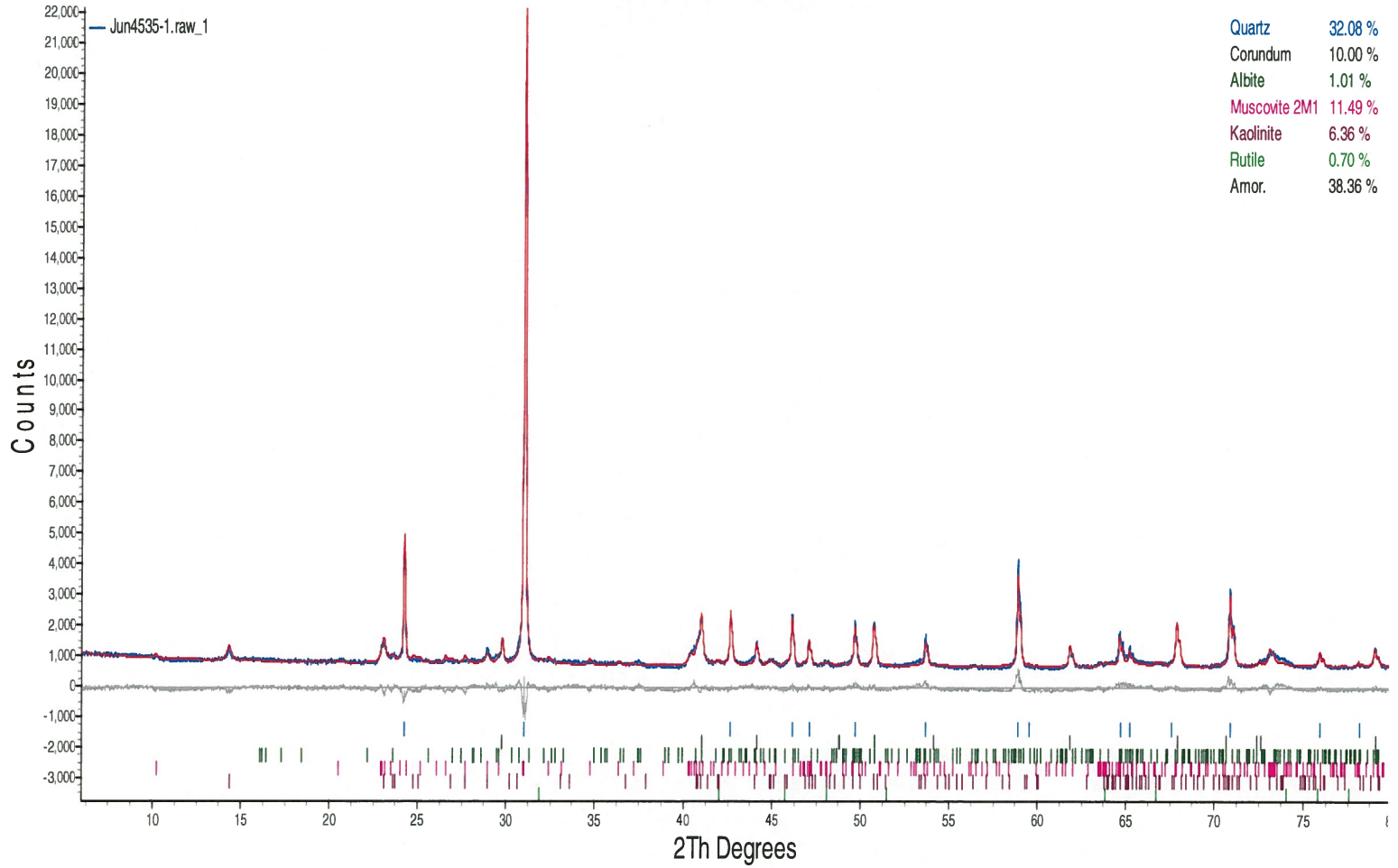
Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

**Please note that 10% corundum was added to each sample to calculate the amorphous content. Data has been normalized.*

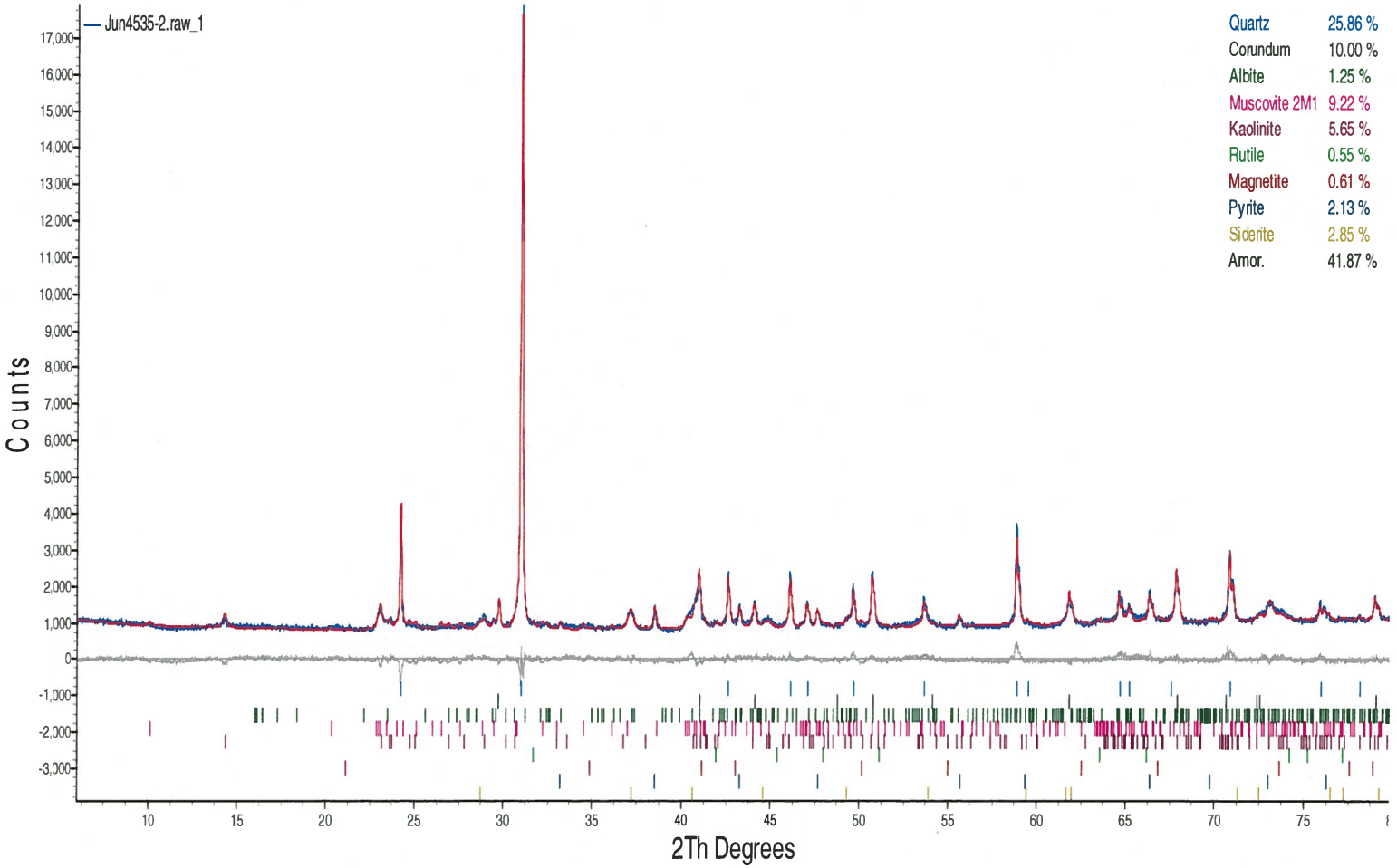
Mineral/Compound	Formula
Quartz	SiO_2
Albite	$NaAlSi_3O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Rutile	TiO_2
Magnetite	Fe_3O_4
Pyrite	FeS_2
Siderite	$FeCO_3$
Ankerite	$CaFe(CO_3)_2$
Dolomite	$CaMg(CO_3)_2$
Anatase	TiO_2

SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

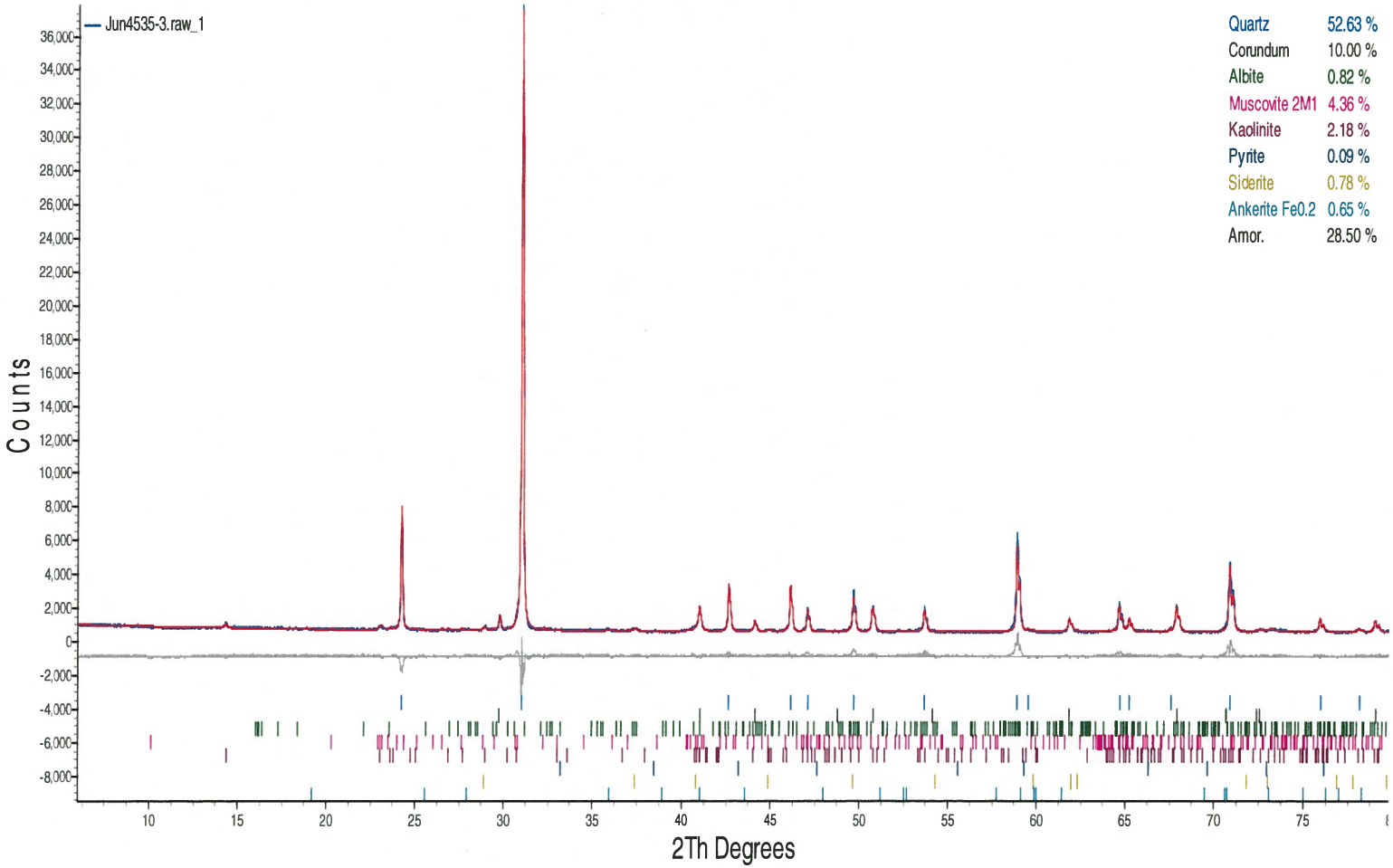
SRK-WR-RGSC0006-027



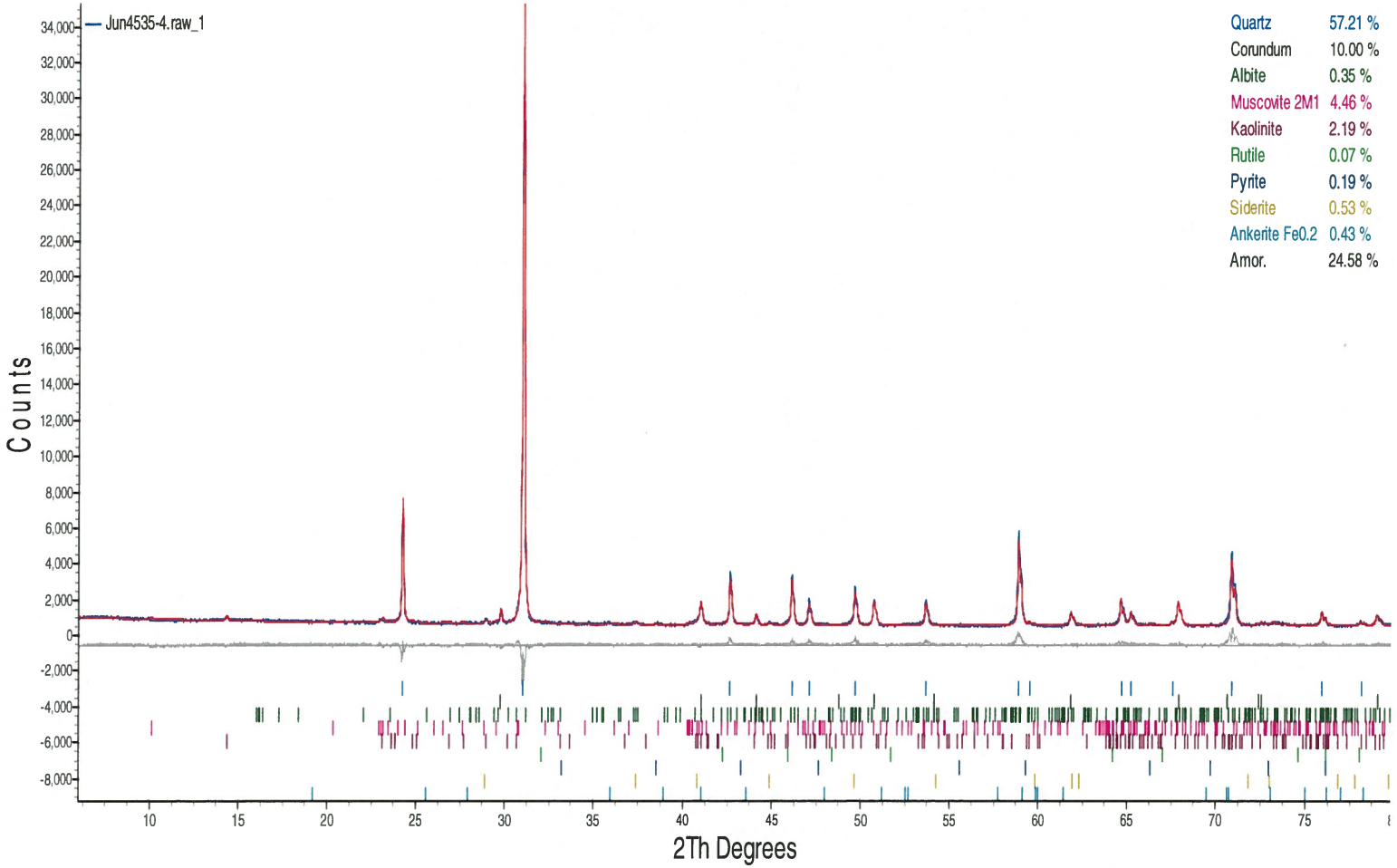
SRK-WR-RGSC0008-043



SRK-WR-RGSC0008-046

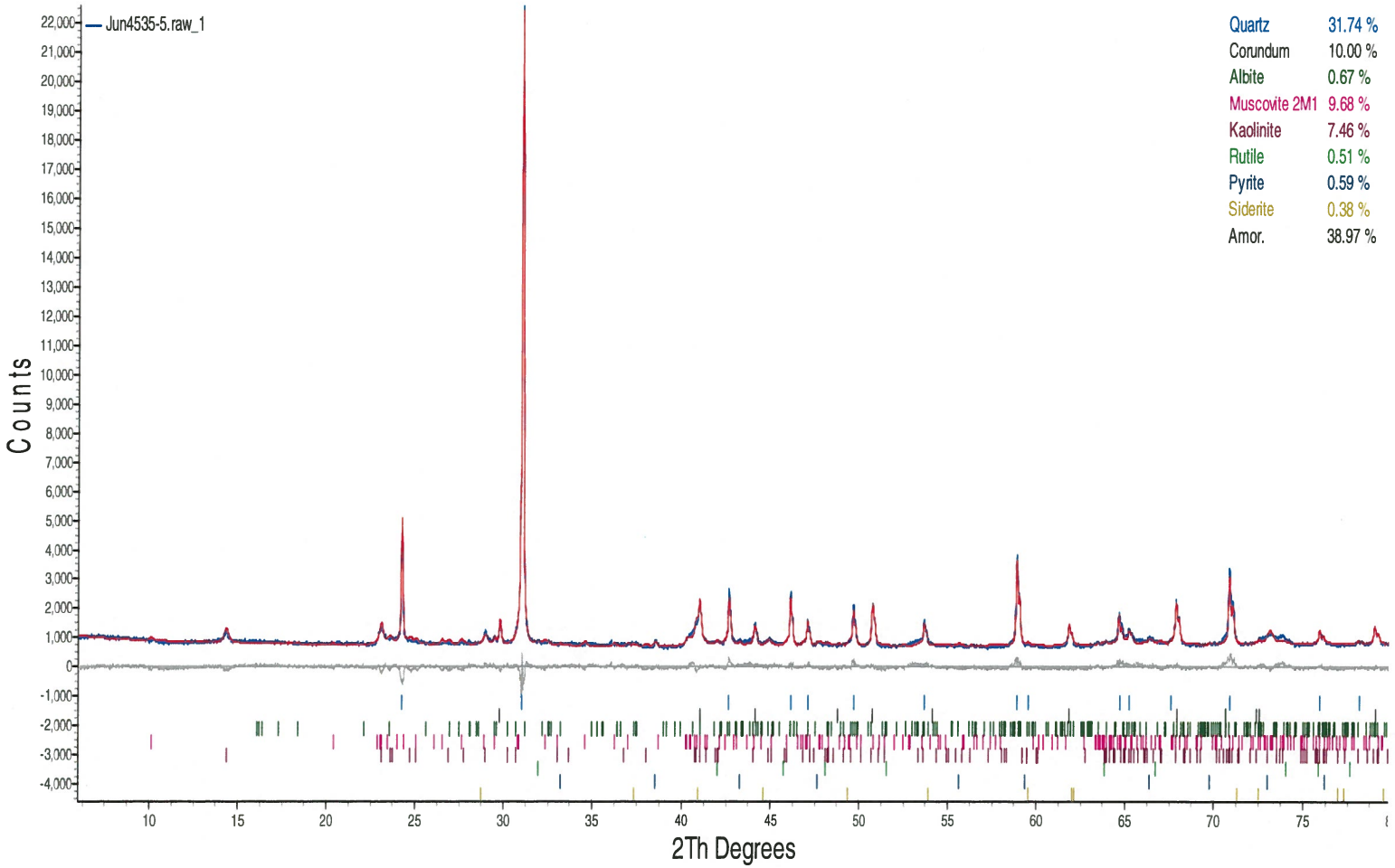


SRK-WR-RGSC0008-047

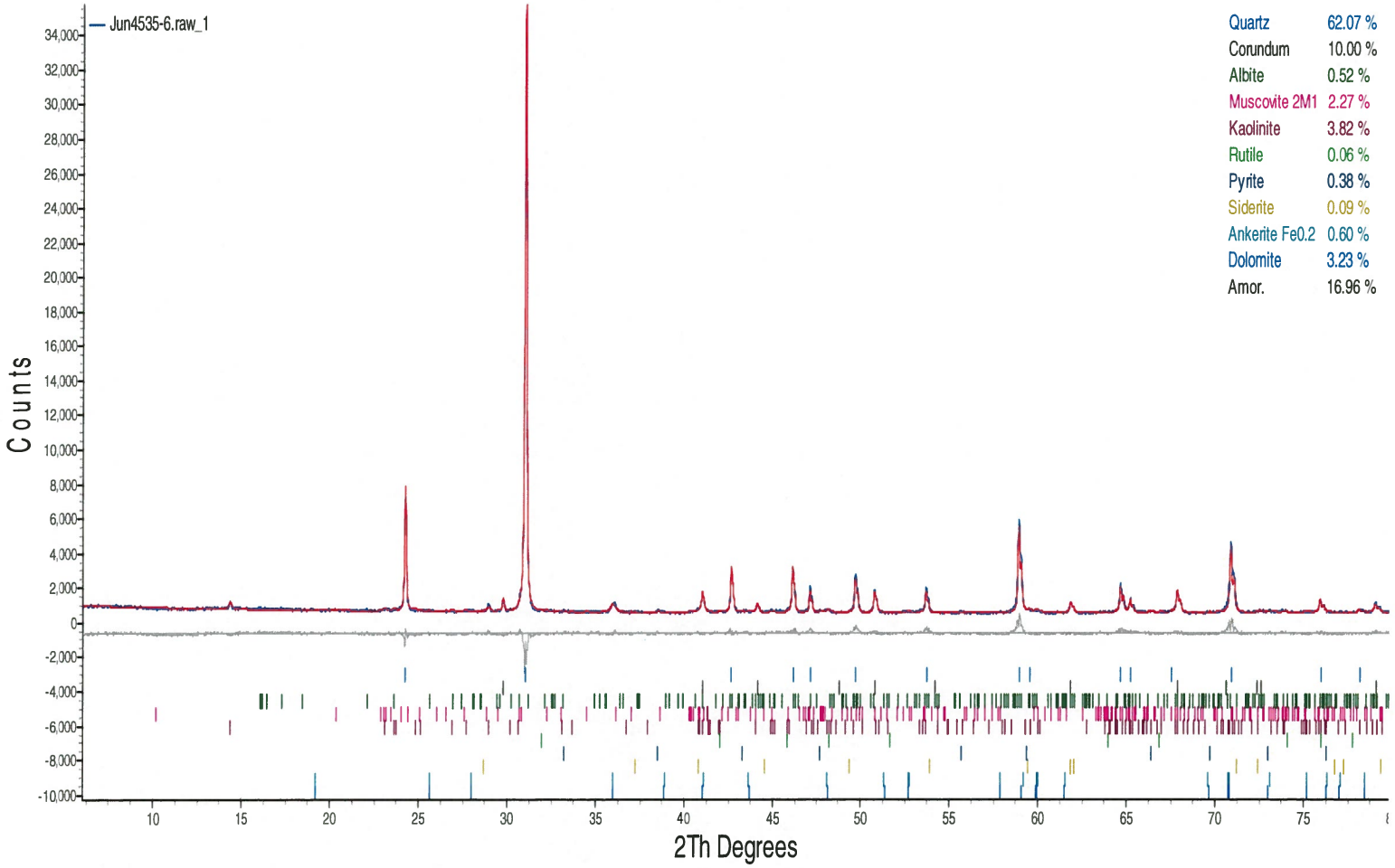


SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0009-052

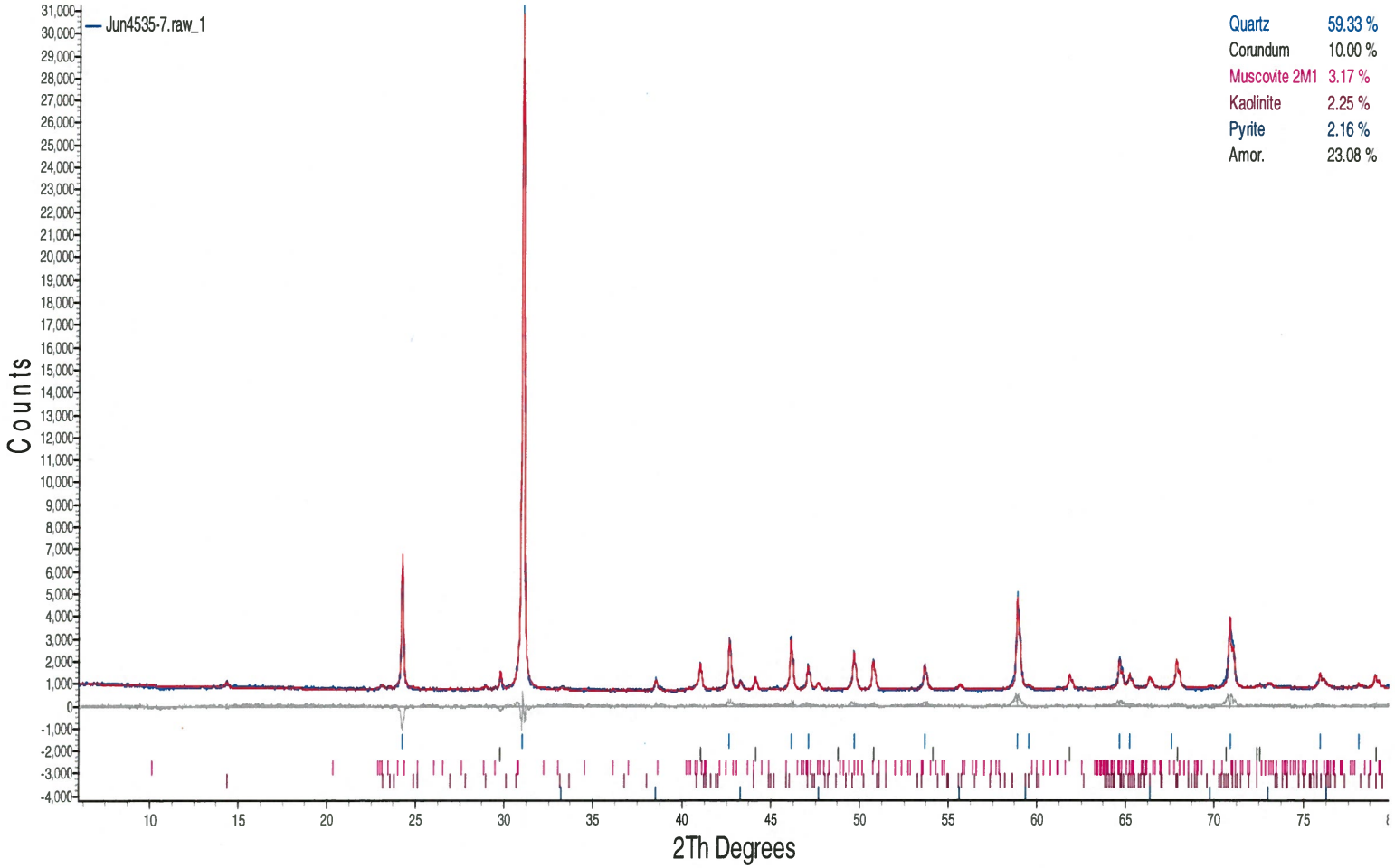


SRK-WR-RGSC0009-054



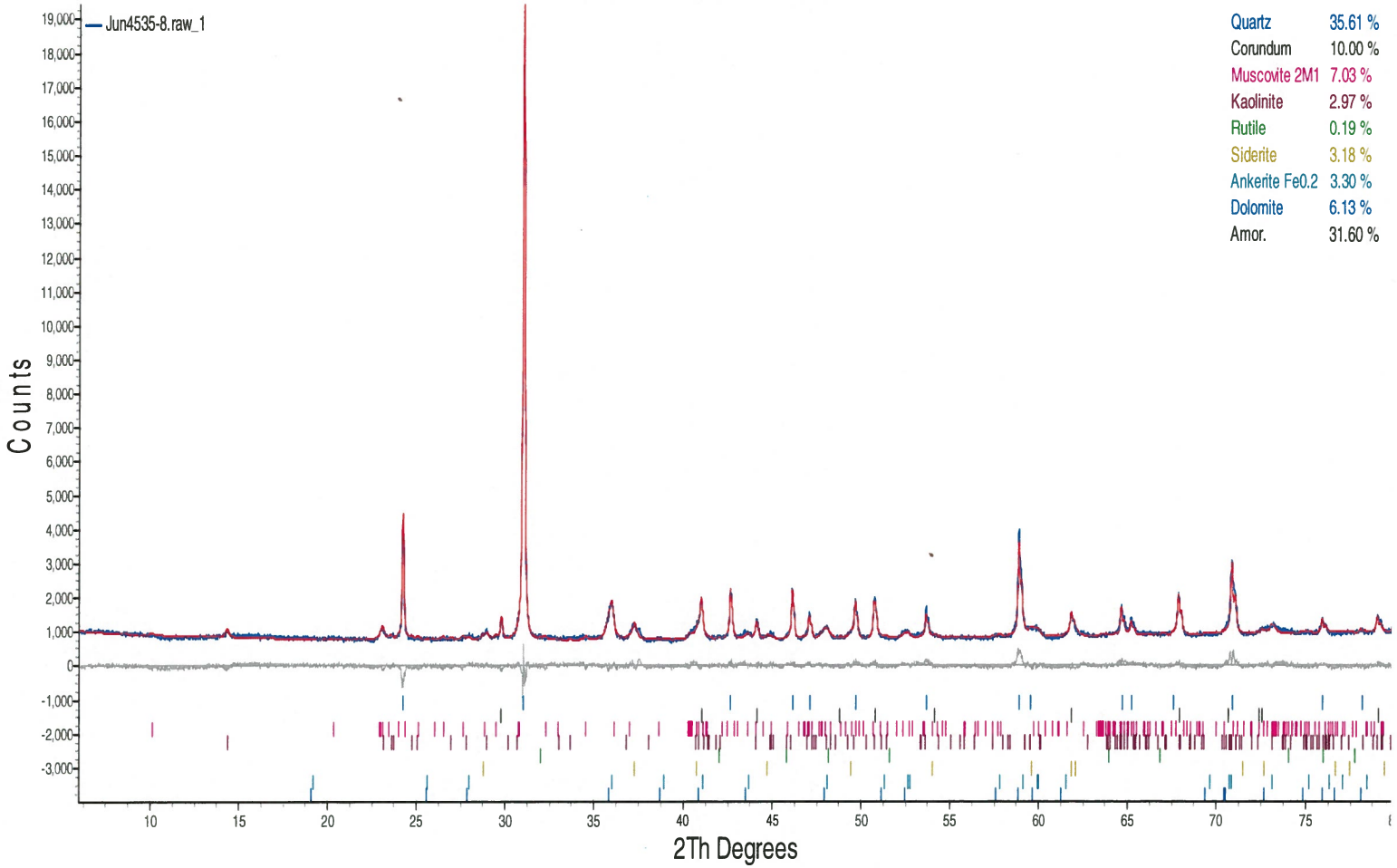
SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0009-059



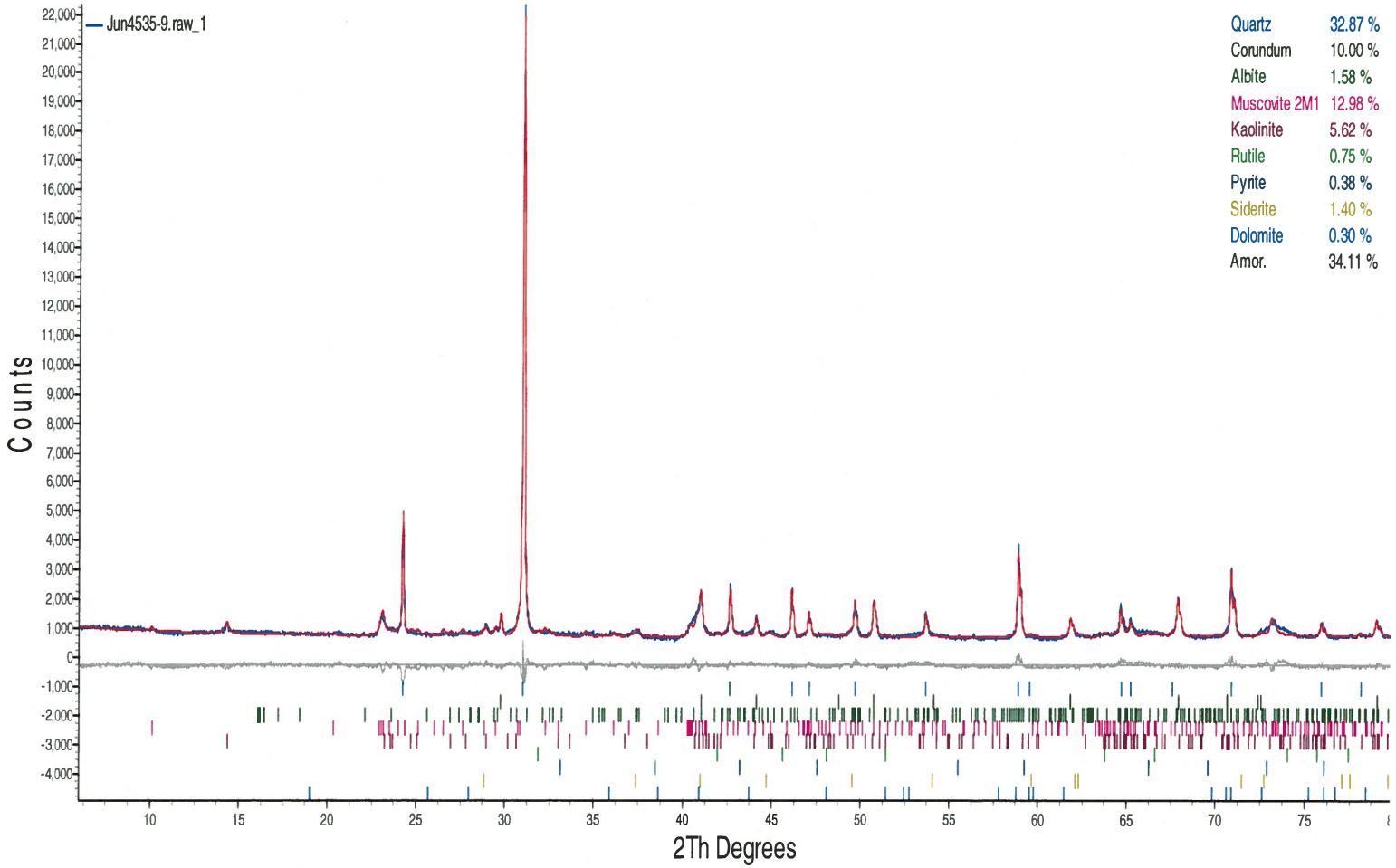
SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0009-068



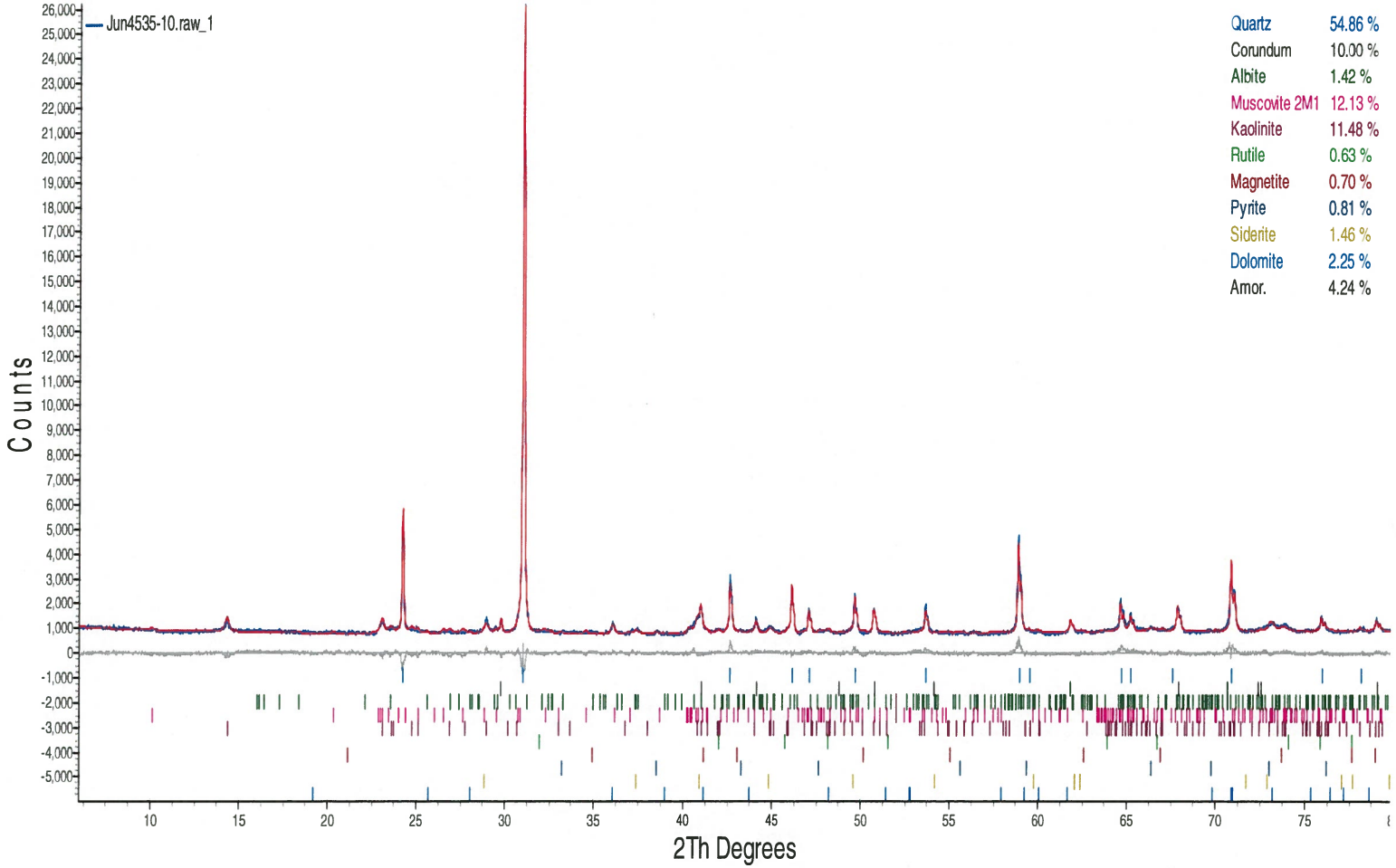
SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0009-089



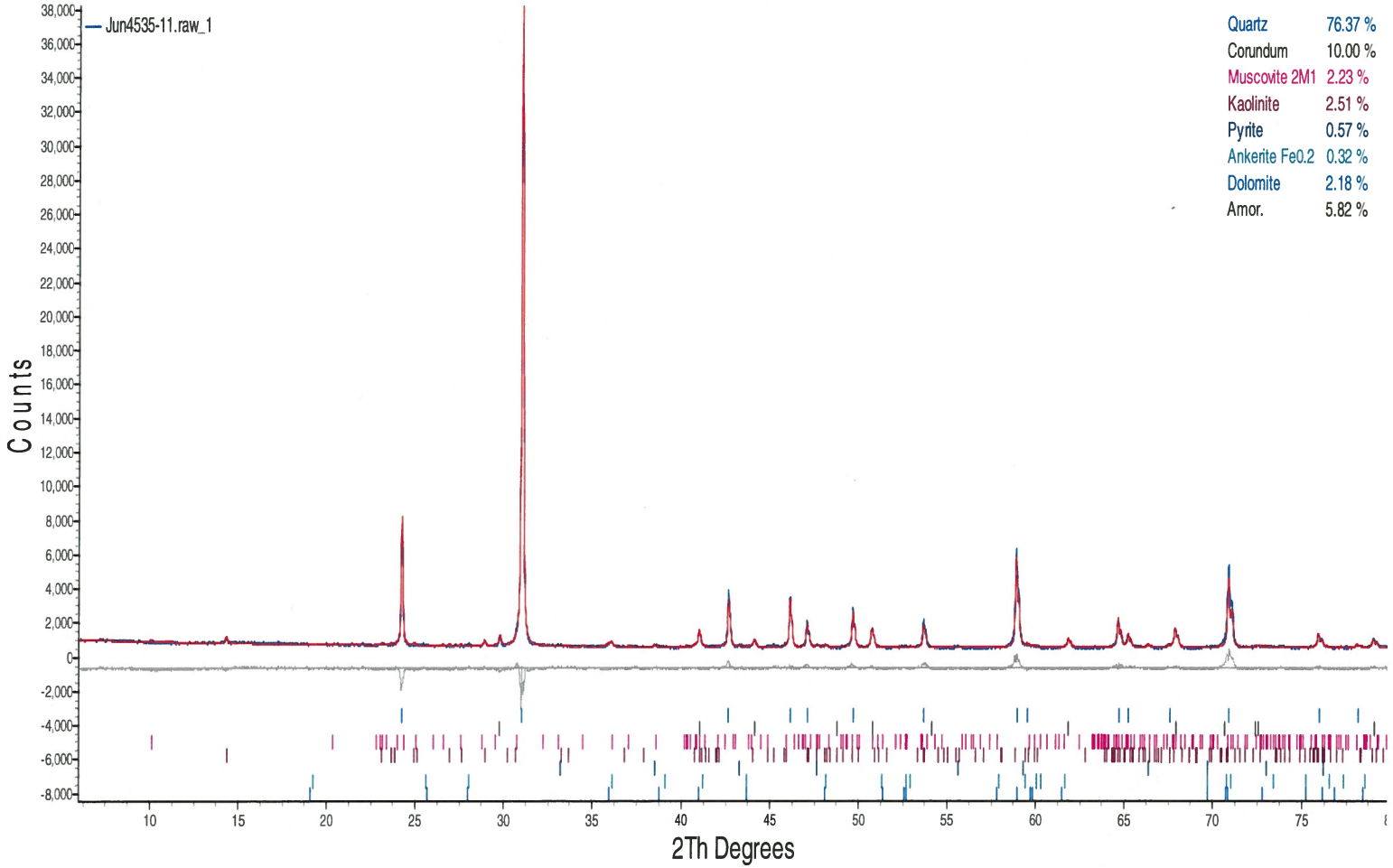
SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0010-097



SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

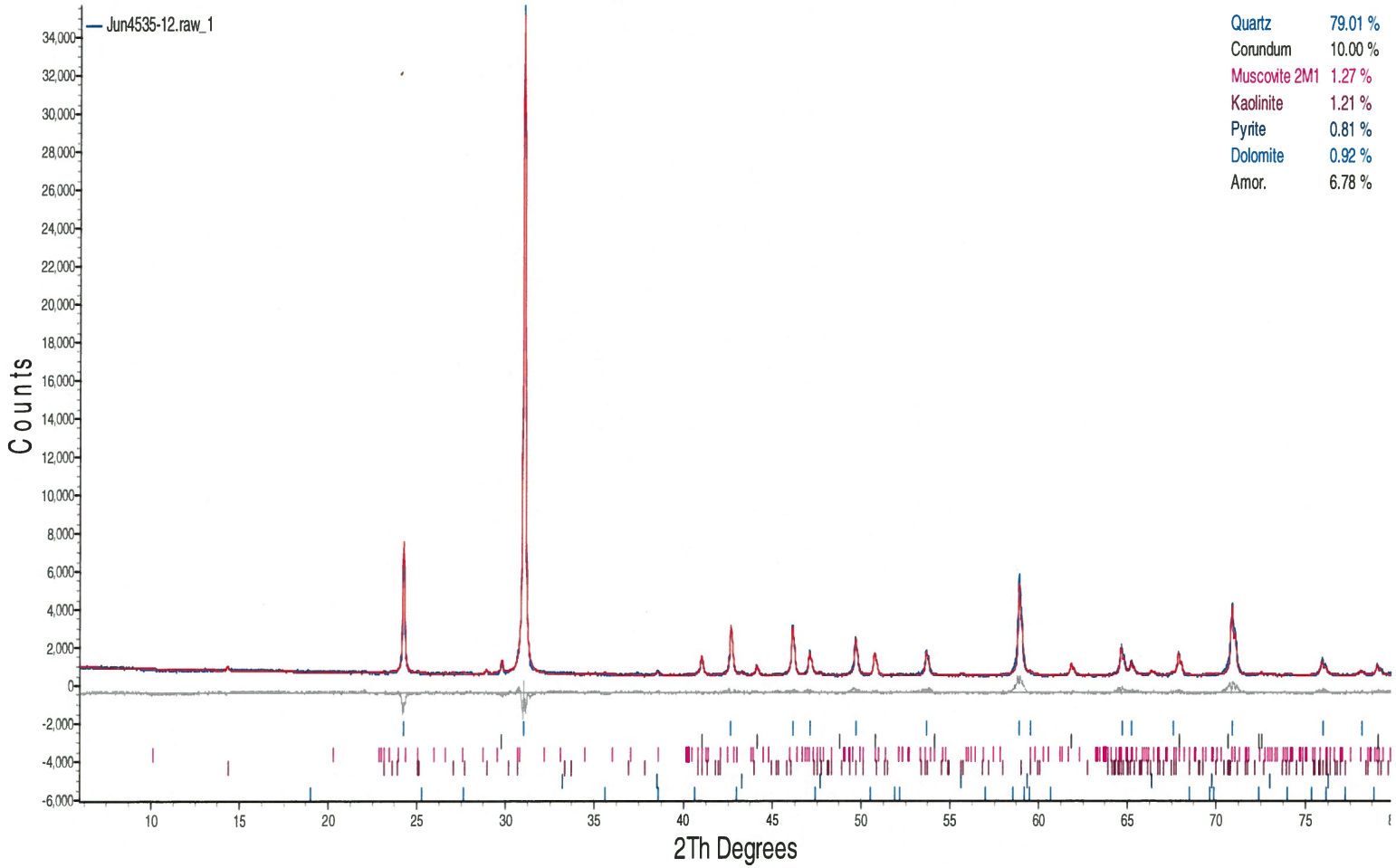
SRK-WR-RGSC0010-098



Quartz	76.37 %
Corundum	10.00 %
Muscovite 2M1	2.23 %
Kaolinite	2.51 %
Pyrite	0.57 %
Ankerite Fe0.2	0.32 %
Dolomite	2.18 %
Amor.	5.82 %

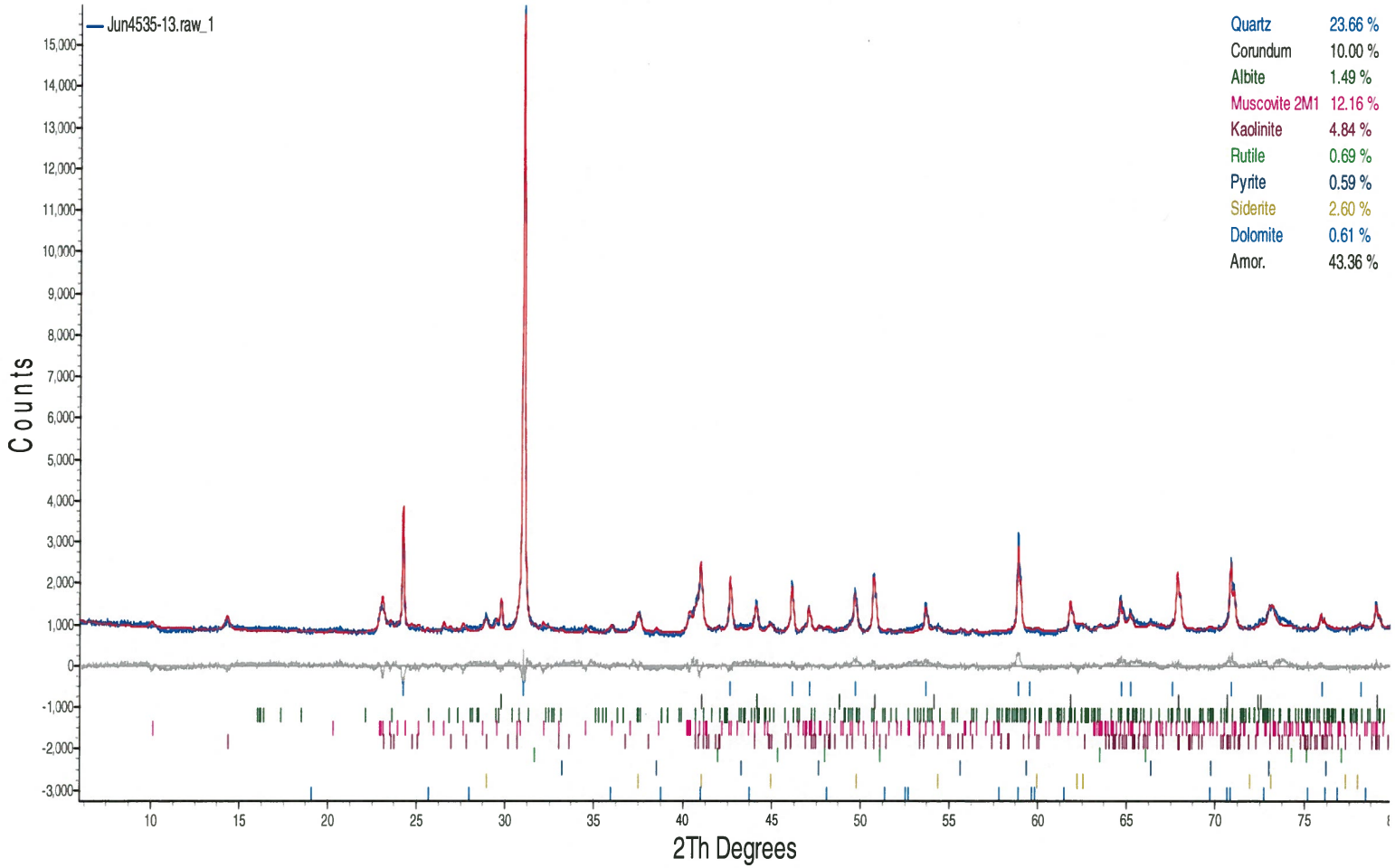
SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0010-103



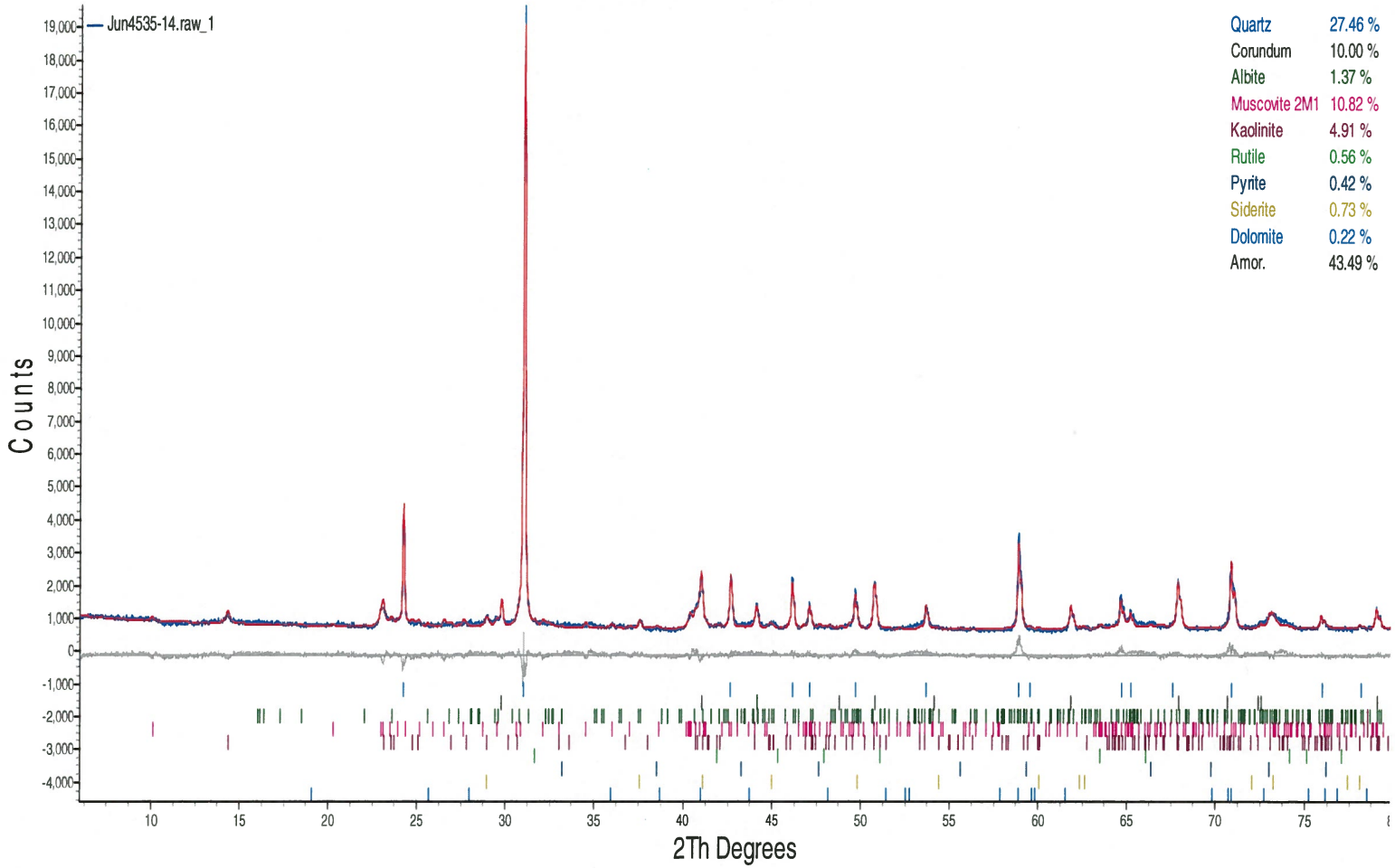
SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0010-106A



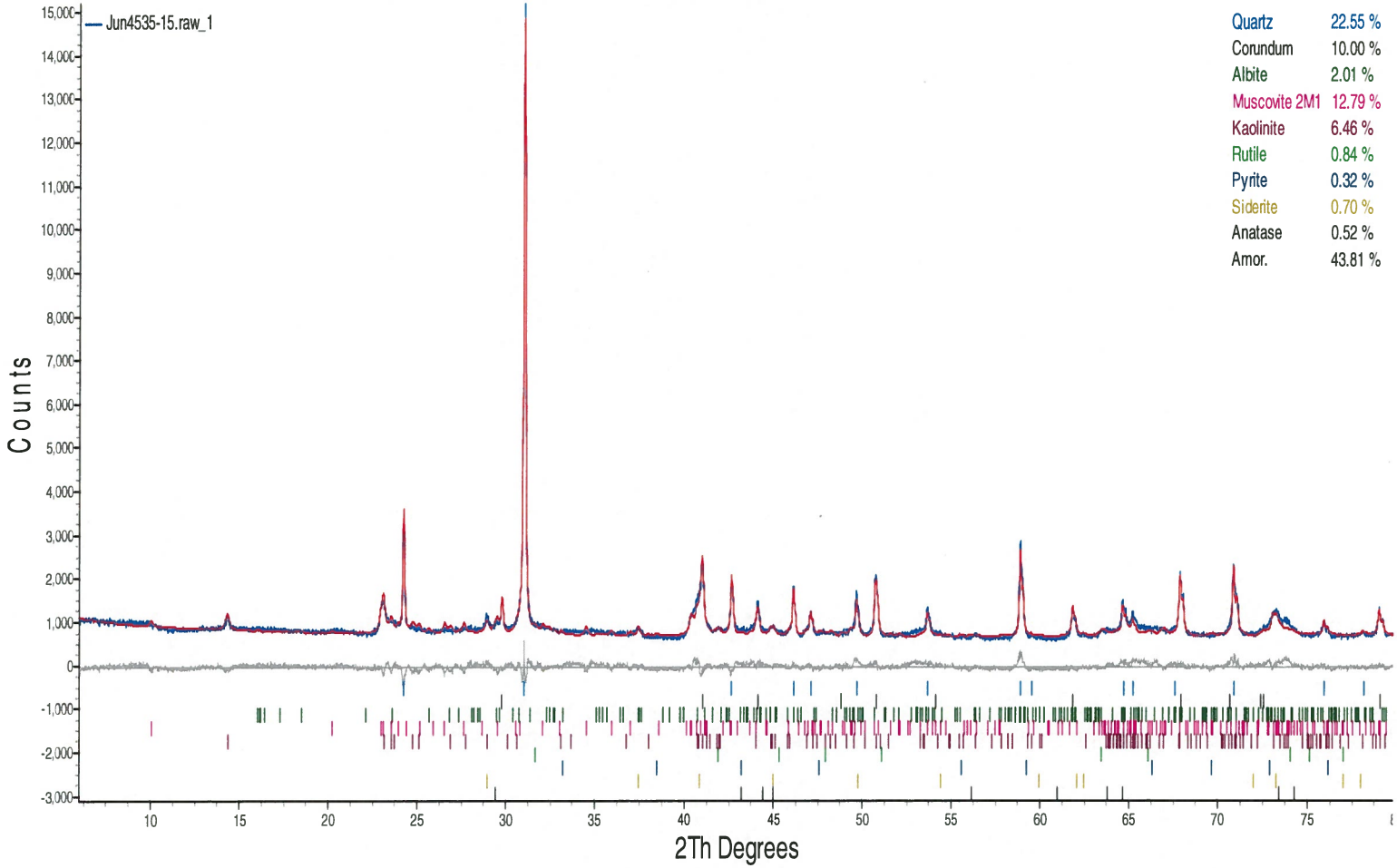
SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0010-109



SGS Canada Inc
14936-101/MI4535-JUN15
15-Jul-15

SRK-WR-RGSC0010-129



Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101B/MI4502-APR15*
Batch No.	*1447 Grassy Mountain*
Sample Receipt:	*April 2, 2015*
Sample Analysis:	*April 6, 2015*
Reporting Date:	*April 14, 2015*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations:	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit:	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Quantitative XRD Results
4) XRD Pattern(s)

<Original signed by>

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

<Original signed by>

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Minerals Services Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada - Minerals Services - Lakefield: http://palcan.scc.ca/SpecsSearch/GLSearchForm.do.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

DISCLAIMER: This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	Seam 1 APR4502-01 (wt %)	Seam 2 APR4502-02 (wt %)	Seam 4 APR4502-03 (wt %)
Quartz	21.0	8.5	14.1
Kaolinite	9.9	21.2	15.1
Muscovite	8.6	5.3	6.4
Dolomite	0.2	0.8	0.1
Anatase	1.1	2.4	1.8
Ankerite	-	0.2	-
Calcite	-	0.1	-
Amorphous	59.1	61.4	62.3
TOTAL	100	100	100

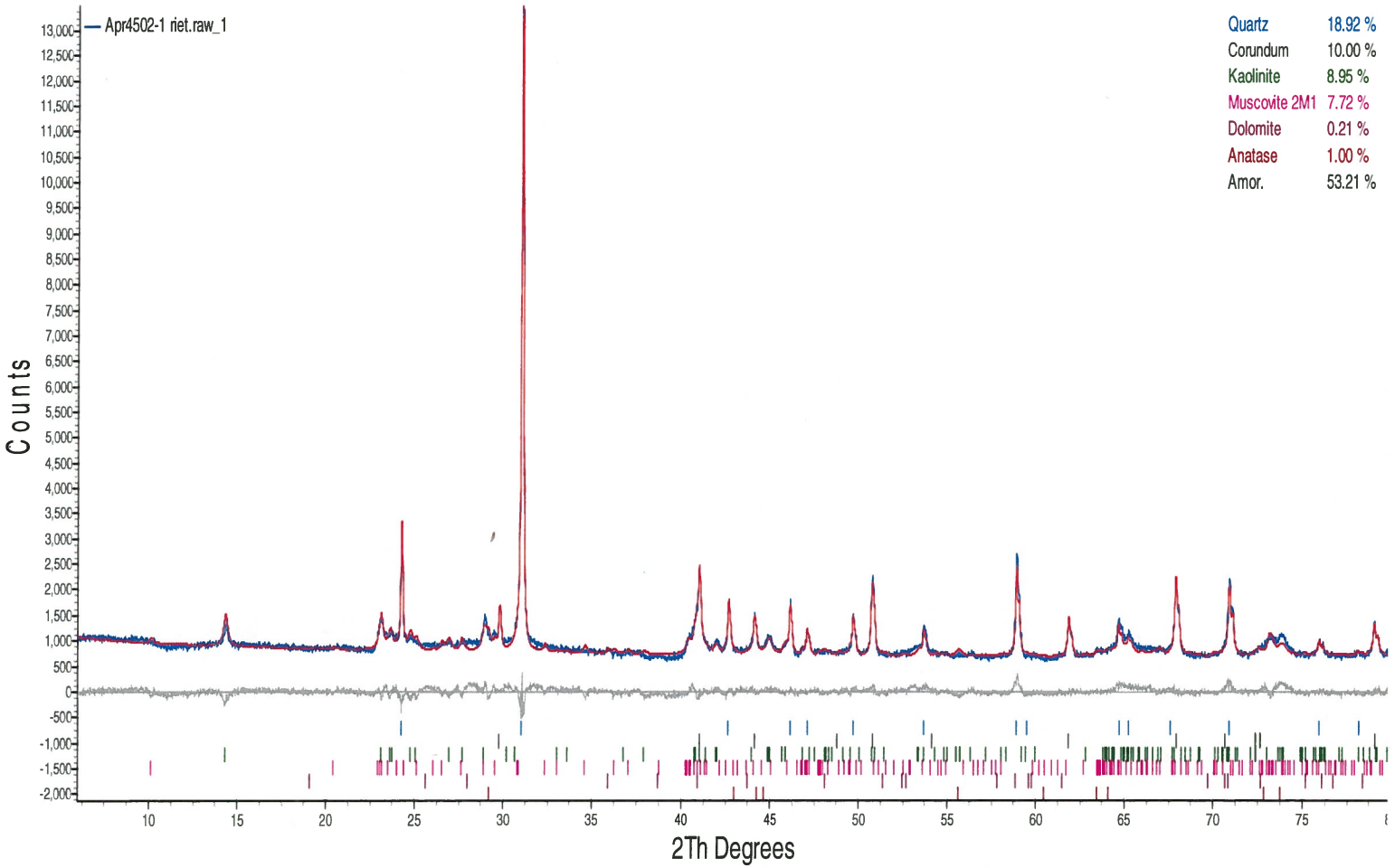
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

**Please note that 10% corundum was added to each sample to calculate the amorphous content. Data has been normalized.*

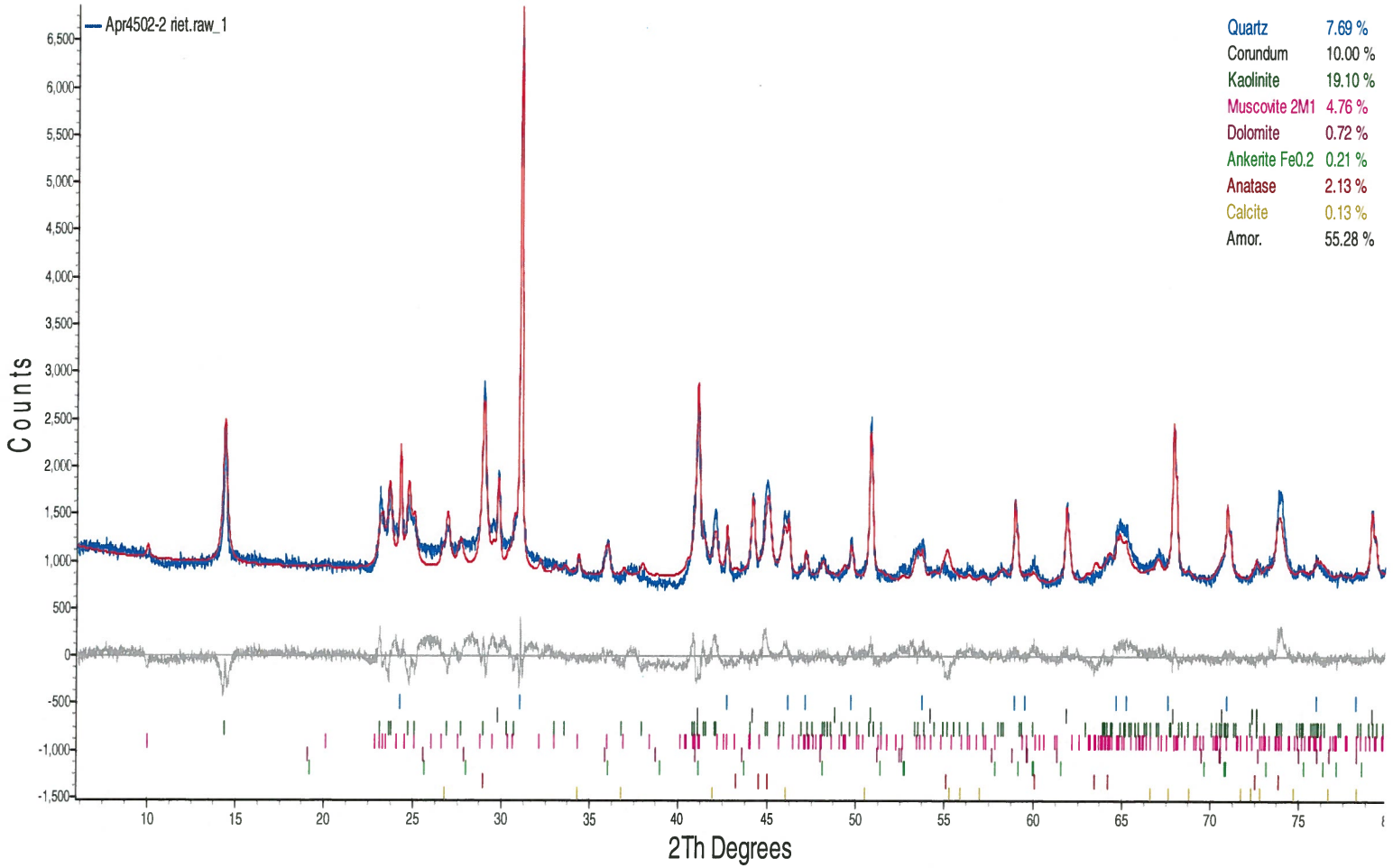
Mineral/Compound	Formula
Quartz	SiO_2
Kaolinite	$Al_2Si_2O_5(OH)_4$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Dolomite	$CaMg(CO_3)_2$
Anatase	TiO_2
Ankerite	$CaFe(CO_3)_2$
Calcite	$CaCO_3$

Seam 1


Apr4502-1 riet.raw_1
Counts
2Th Degrees
Quartz 18.92 %
Corundum 10.00 %
Kaolinite 8.95 %
Muscovite 2M1 7.72 %
Dolomite 0.21 %
Anatase 1.00 %
Amor. 53.21 %

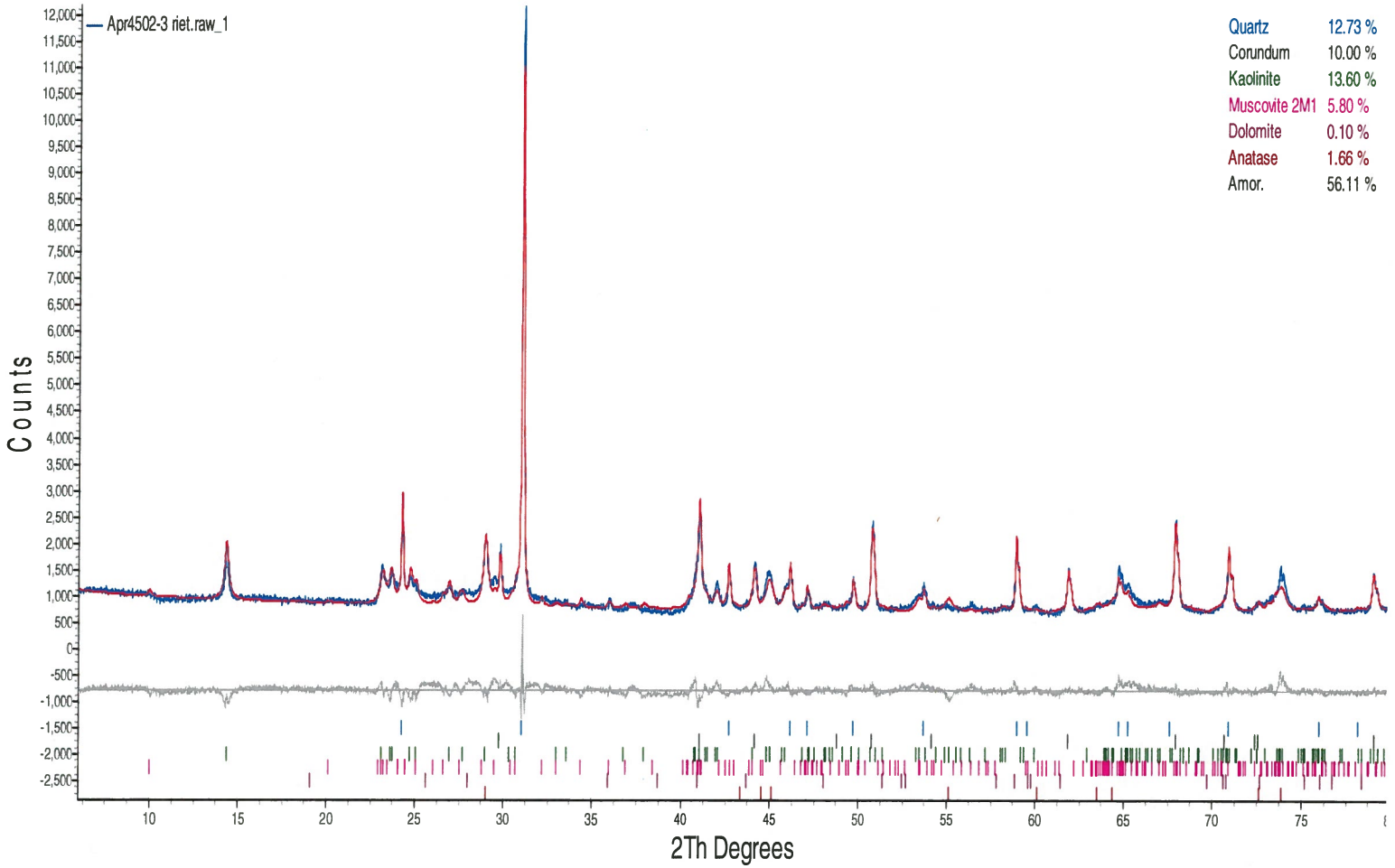
SGS Canada Inc
14094-101B/MI4502-APR15
14-Apr-15

Seam 2

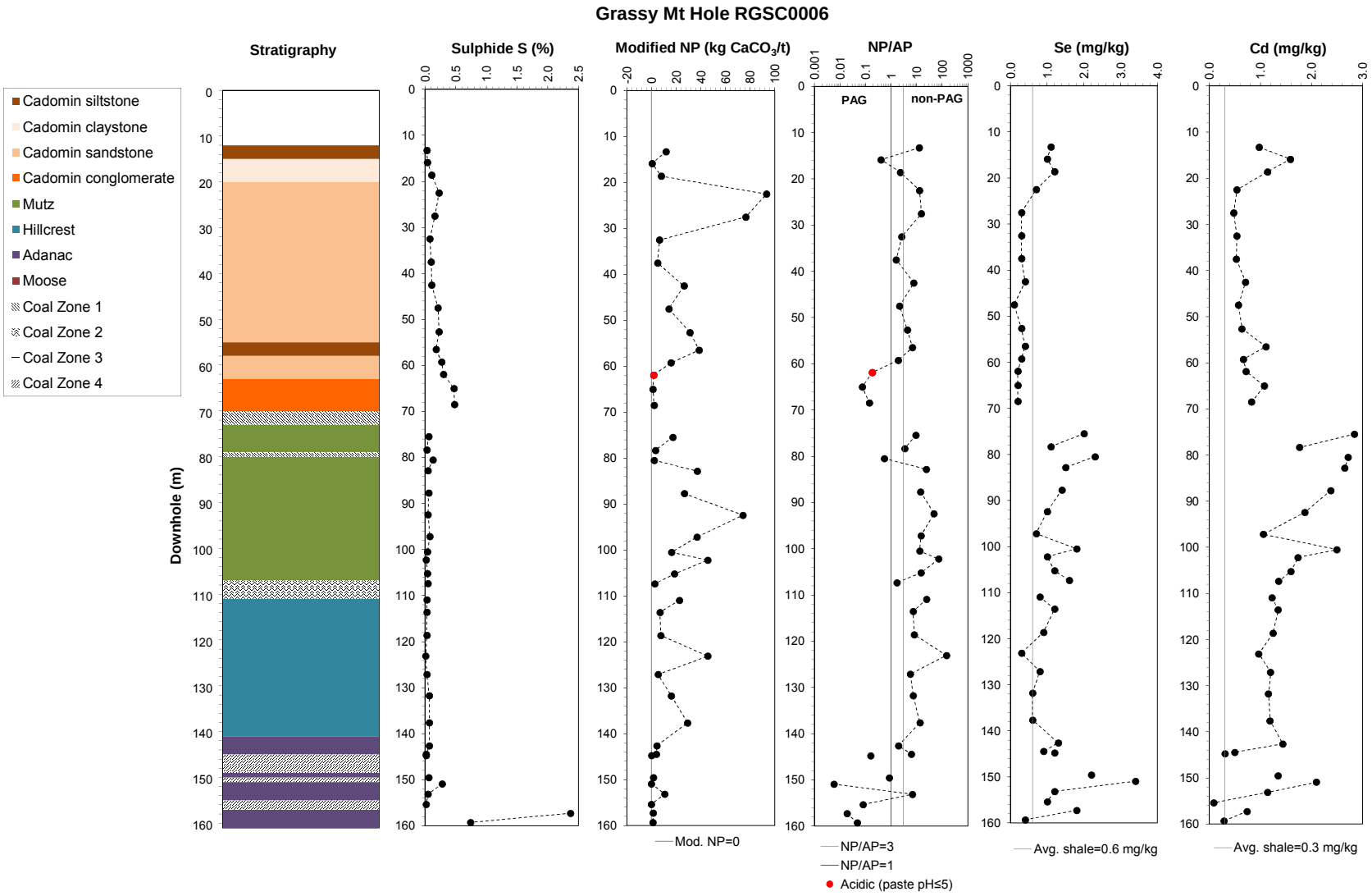


SGS Canada Inc
14094-101B/MI4502-APR15
14-Apr-15

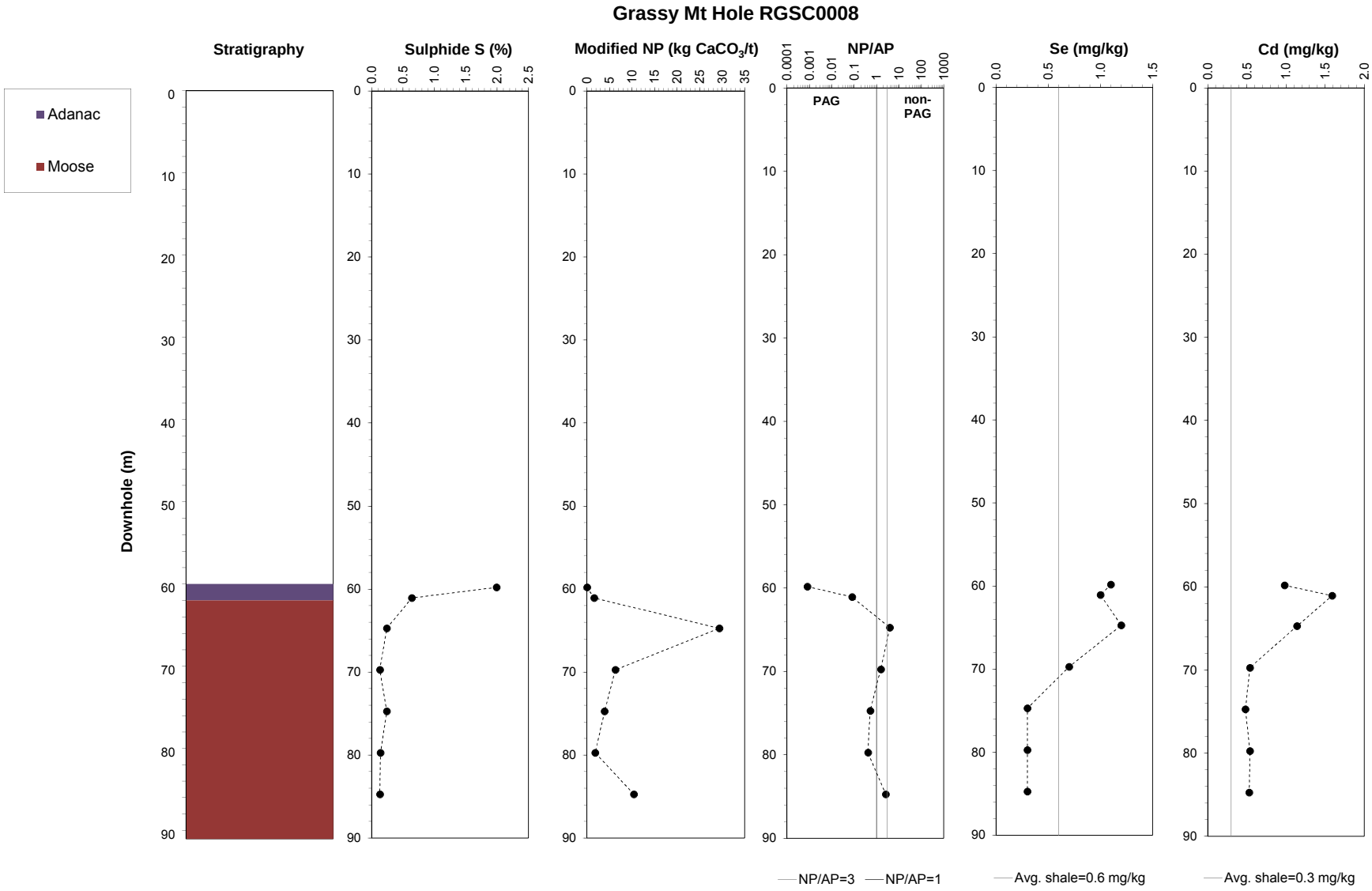
Seam 4



Appendix C – Downhole Plots

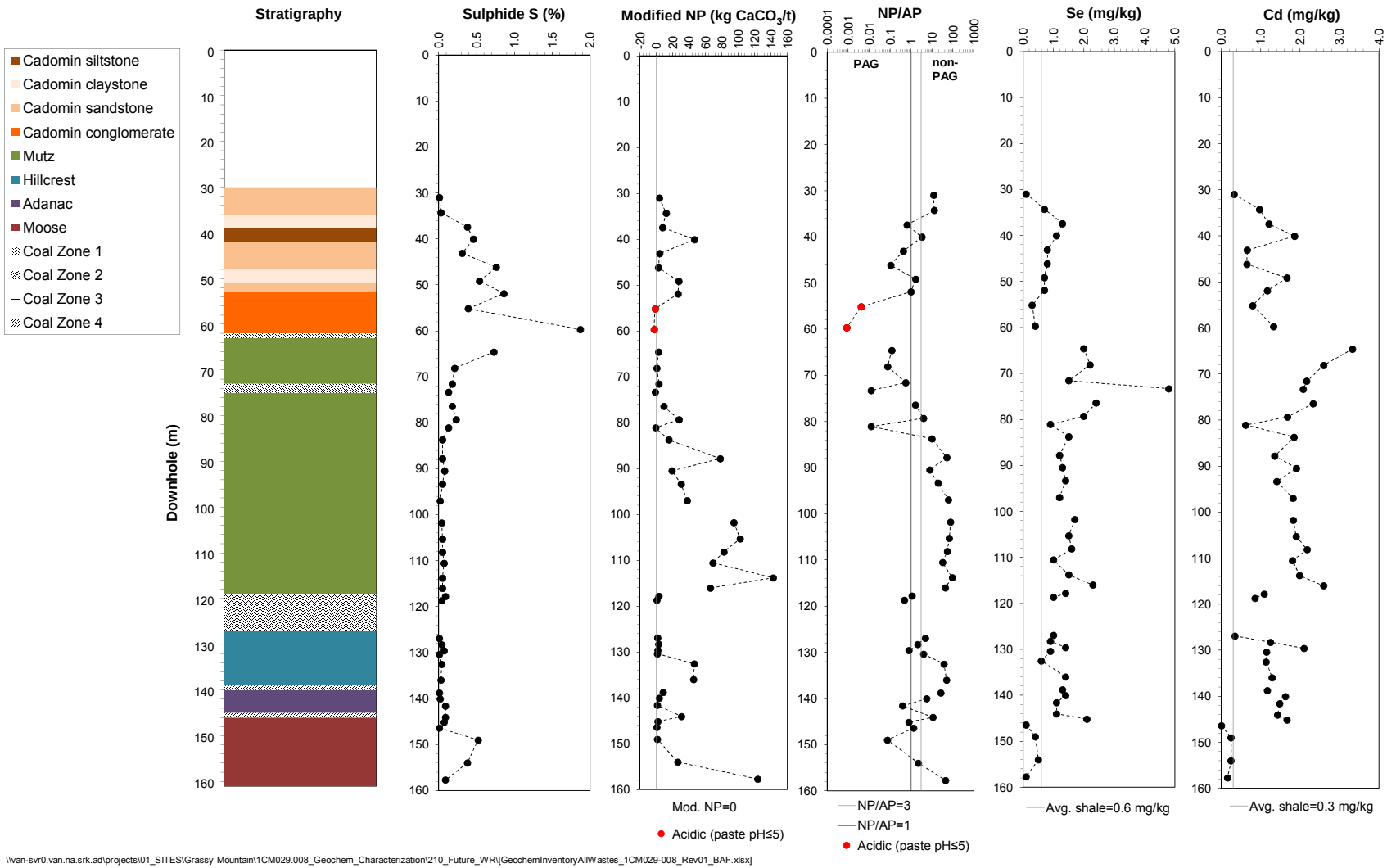


\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

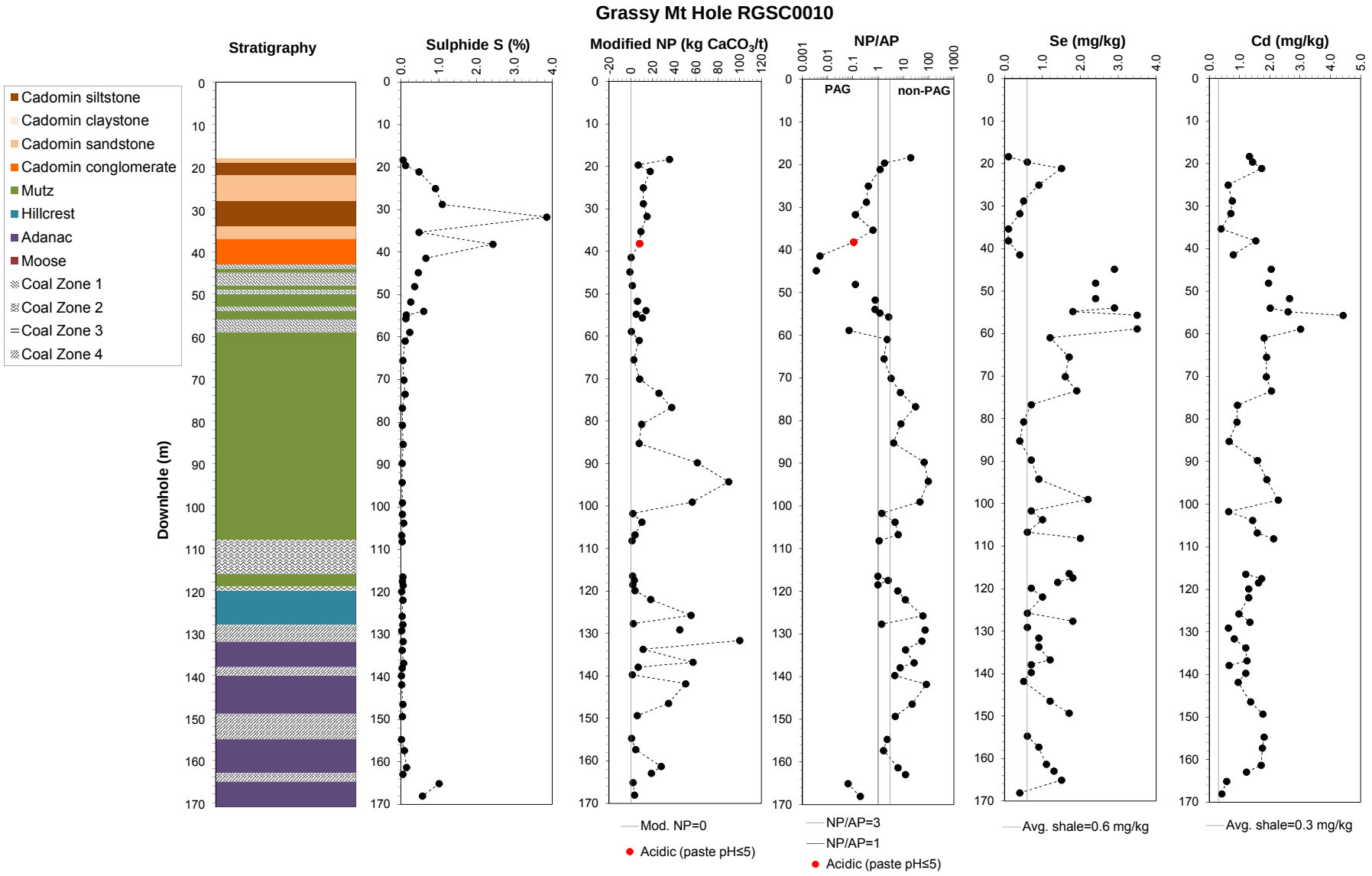


\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Grassy Mt Hole RGSC0009



\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]



\\van-svr0.van.na.srk.ad\projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\210_Future_WR\[GeochemInventoryAllWastes_1CM029-008_Rev01_BAF.xlsx]

Appendix D – Correlation Matrices

Appendix D1: Correlation matrix for the Cadomin Formation samples (n=34)

	TIC	*Total S*	*HCl-Extractable S*	*Sulphide S*	*Organic S*	*Al*	*Sb*	*As*	*Ba*	*Bi*	*Cd*	*Ca*	*Cr*	*Co*	*Cu*	*Ga*	*Fe*	*La*	*Pb*	*Mg*	*Mn*	*Hg*	*Mo*	*Ni*	*P*	*K*	*Sc*	*Se*	*Ag*	*Na*	*Sr*	*Te*	*Tl*	*Th*	*U*	*V*	*Zn*
TIC	1.00																																			
Total S	-0.03	1.00																																		
HCl-Extractable S	-0.11	0.91	1.00																																	
Sulphide S	-0.04	1.00	0.90	1.00																																
Organic S	0.09	0.41	0.46	0.36	1.00																															
Al	0.20	-0.08	-0.17	-0.06	-0.30	1.00																														
Sb	-0.38	0.15	0.21	0.12	0.42	-0.54	1.00																													
As	-0.36	-0.06	0.05	-0.08	0.25	-0.65	0.79	1.00																												
Ba	0.26	-0.11	-0.05	-0.11	-0.10	0.34	-0.20	-0.18	1.00																											
Bi	-0.01	-0.03	-0.11	-0.02	-0.16	0.79	-0.30	-0.33	0.39	1.00																										
Cd	0.13	0.12	0.11	0.11	0.31	0.45	0.00	-0.19	0.16	0.66	1.00																									
Ca	0.84	-0.17	-0.26	-0.17	-0.14	0.18	-0.48	-0.37	0.33	-0.02	0.03	1.00																								
Cr	0.09	-0.17	-0.18	-0.16	-0.12	-0.08	-0.07	0.12	0.29	0.04	-0.06	0.20	1.00																							
Co	0.05	-0.03	-0.09	-0.03	0.05	0.46	0.06	0.03	0.24	0.70	0.65	-0.03	-0.03	1.00																						
Cu	-0.06	-0.04	-0.08	-0.03	-0.13	0.62	-0.07	-0.28	0.30	0.76	0.50	-0.07	-0.04	0.64	1.00																					
Ga	0.13	-0.10	-0.19	-0.08	-0.26	0.97	-0.46	-0.55	0.38	0.88	0.52	0.12	-0.06	0.60	0.73	1.00																				
Fe	0.39	0.52	0.46	0.52	0.30	0.37	-0.03	-0.26	0.11	0.25	0.31	-0.07	-0.23	0.26	0.24	0.35	1.00																			
La	0.35	-0.29	-0.37	-0.28	-0.25	0.88	-0.46	-0.57	0.38	0.66	0.53	0.36	0.02	0.51	0.53	0.86	0.27	1.00																		
Pb	-0.30	-0.03	-0.07	-0.03	-0.01	0.37	0.14	0.18	0.20	0.79	0.56	-0.31	0.08	0.75	0.65	0.54	0.08	0.28	1.00																	
Mg	0.92	-0.07	-0.18	-0.07	0.01	0.25	-0.46	-0.38	0.38	0.14	0.19	0.94	0.19	0.15	0.07	0.23	0.15	0.40	-0.15	1.00																
Mn	0.44	0.25	0.17	0.24	0.29	0.45	0.02	-0.27	0.10	0.28	0.48	0.09	-0.19	0.37	0.25	0.44	0.79	0.49	0.07	0.24	1.00															
Hg	-0.19	0.10	0.19	0.09	0.25	0.29	0.24	0.22	0.29	0.55	0.37	-0.23	0.10	0.48	0.54	0.40	0.16	0.11	0.66	-0.07	0.07	1.00														
Mo	-0.09	-0.07	-0.02	-0.08	0.05	-0.24	0.30	0.40	0.18	-0.11	-0.06	-0.02	0.85	0.00	-0.08	-0.20	-0.18	-0.09	0.05	-0.06	-0.13	0.12	1.00													
Ni	0.04	-0.09	-0.13	-0.09	-0.04	0.69	-0.07	-0.14	0.39	0.86	0.68	0.01	0.16	0.86	0.77	0.80	0.28	0.67	0.77	0.17	0.39	0.63	0.11	1.00												
P	0.41	-0.30	-0.39	-0.29	-0.21	0.60	-0.36	-0.49	0.24	0.38	0.49	0.55	0.10	0.31	0.28	0.56	0.04	0.82	0.07	0.49	0.41	-0.06	-0.03	0.45	1.00											
K	0.26	-0.13	-0.18	-0.11	-0.25	0.97	-0.53	-0.61	0.35	0.81	0.51	0.20	-0.08	0.53	0.63	0.96	0.40	0.87	0.41	0.30	0.49	0.32	-0.25	0.73	0.58	1.00										
Sc	0.37	-0.01	-0.07	-0.01	-0.04	0.87	-0.37	-0.51	0.42	0.72	0.60	0.31	0.03	0.62	0.65	0.88	0.47	0.87	0.41	0.44	0.56	0.44	-0.10	0.80	0.68	0.89	1.00									
Se	0.13	-0.12	-0.15	-0.12	-0.06	0.47	-0.05	-0.13	0.46	0.64	0.49	0.09	0.16	0.61	0.68	0.55	0.19	0.46	0.56	0.25	0.12	0.56	0.08	0.77	0.33	0.52	0.60	1.00								
Ag	-0.12	-0.10	-0.06	-0.11	0.07	0.28	0.36	0.12	-0.05	0.34	0.54	-0.34	-0.10	0.45	0.41	0.32	0.30	0.30	0.45	-0.21	0.40	0.36	-0.06	0.52	0.18	0.34	0.39	0.40	1.00							
Na	0.35	-0.08	-0.07	-0.08	-0.05	0.80	-0.35	-0.53	0.28	0.56	0.48	0.16	-0.10	0.43	0.44	0.75	0.53	0.82	0.18	0.28	0.53	0.18	-0.15	0.60	0.51	0.82	0.81	0.50	0.45	1.00						
Sr	0.32	0.03	-0.03	0.03	0.00	0.46	-0.12	-0.35	0.34	0.30	0.43	0.43	0.02	0.32	0.45	0.46	0.14	0.53	0.09	0.42	0.37	0.15	0.05	0.50	0.65	0.45	0.58	0.51	0.15	0.36	1.00					
Te	0.00	0.01	0.14	-0.02	0.31	0.22	-0.06	-0.15	-0.08	0.20	0.18	-0.16	-0.14	0.11	0.09	0.19	0.16	0.13	0.06	-0.06	0.22	0.16	-0.09	0.17	-0.01	0.28	0.15	0.17	0.04	0.40	0.08	1.00				
Tl	-0.01	0.13	0.10	0.14	-0.09	0.48	0.12	0.02	-0.06	0.48	0.44	-0.11	0.08	0.48	0.45	0.51	0.35	0.41	0.50	-0.03	0.46	0.39	0.13	0.59	0.22	0.51	0.56	0.27	0.64	0.46	0.25	0.08	1.00			
Th	0.31	-0.17	-0.28	-0.15	-0.21	0.90	-0.49	-0.56	0.44	0.85	0.63	0.34	0.06	0.64	0.64	0.92	0.26	0.91	0.48	0.44	0.44	0.31	-0.12	0.81	0.73	0.91	0.89	0.64	0.28	0.75	0.56	0.24	0.42	1.00		
U	-0.09	-0.16	-0.21	-0.15	-0.18	0.51	-0.33	-0.38	0.09	0.21	-0.01	-0.07	-0.07	0.05	0.23	0.45	0.09	0.41	-0.07	-0.07	0.06	0.12	-0.09	0.27	0.22	0.41	0.36	0.20	0.08	0.42	0.27	0.08	0.06	0.38	1.00	
V	0.25	0.04	0.09	0.04	-0.06	0.75	-0.33	-0.50	0.19	0.41	0.33	0.09	-0.22	0.32	0.43	0.69	0.56	0.65	0.11	0.17	0.59	0.30	-0.26	0.49	0.45	0.76	0.81	0.28	0.42	0.74	0.39	0.14	0.52	0.57	0.43	1.00
Zn	0.18	-0.23	-0.30	-0.22	-0.18	0.82	-0.35	-0.39	0.43	0.90	0.66	0.19	0.07	0.79	0.74	0.89	0.21	0.83	0.68	0.32	0.32	0.46	-0.10	0.90	0.60	0.85	0.86	0.72	0.40	0.69	0.42	0.13	0.45	0.93	0.28	0.53

1

Note: Shaded cells indicate a correlation coefficient equal to or greater than ±0.7.

Appendix D2: Correlation matrix for the Mutz Member samples (n=55)

	TIC	Total S	HCl-Extractable S	Sulphide S	Organic S	Al	Sb	As	Ba	Bi	Cd	Ca	Cr	Co	Cu	Ga	Fe	La	Pb	Mg	Mn	Hg	Mo	Ni	P	K	Sc	Se	Ag	Na	Sr	Te	Tl	Th	U	V	Zn
TIC	1.00																																			
Total S	-0.31	1.00																																		
HCl-Extractable S	-0.02	0.78	1.00																																	
Sulphide S	-0.22	0.97	0.81	1.00																																
Organic S	-0.48	0.69	0.35	0.49	1.00																															
Al	0.07	0.24	0.27	0.28	0.01	1.00																														
Sb	-0.12	0.25	0.05	0.26	0.14	-0.25	1.00																													
As	0.17	-0.10	-0.12	-0.03	-0.27	-0.22	0.35	1.00																												
Ba	0.07	-0.17	-0.01	-0.18	-0.09	0.33	-0.25	-0.32	1.00																											
Bi	-0.47	0.34	0.09	0.26	0.46	0.30	0.09	-0.36	0.12	1.00																										
Cd	0.05	0.28	0.27	0.35	-0.07	0.42	0.39	-0.14	0.10	0.27	1.00																									
Ca	0.92	-0.38	-0.13	-0.29	-0.49	-0.06	-0.11	0.20	-0.03	-0.49	0.02	1.00																								
Cr	0.12	0.00	0.00	0.06	-0.17	-0.35	0.25	0.51	-0.36	-0.24	-0.07	0.16	1.00																							
Co	-0.07	0.18	0.20	0.28	-0.19	0.35	0.10	0.17	0.26	0.06	0.42	-0.17	0.00	1.00																						
Cu	-0.45	0.35	0.09	0.21	0.61	0.35	0.15	-0.41	0.23	0.83	0.33	-0.52	-0.35	0.08	1.00																					
Ga	0.08	0.27	0.26	0.32	0.00	0.95	-0.15	-0.12	0.19	0.26	0.39	-0.04	-0.29	0.38	0.31	1.00																				
Fe	0.80	-0.07	0.23	0.03	-0.36	0.26	-0.11	0.15	0.15	-0.37	0.09	0.53	0.05	0.15	-0.29	0.30	1.00																			
La	0.68	-0.40	-0.10	-0.32	-0.49	0.19	-0.05	0.11	-0.12	-0.39	0.15	0.64	0.10	-0.19	-0.27	0.27	0.57	1.00																		
Pb	-0.47	0.29	0.05	0.23	0.38	0.33	0.17	-0.28	0.25	0.77	0.50	-0.46	-0.23	0.25	0.71	0.30	-0.38	-0.37	1.00																	
Mg	0.96	-0.35	-0.10	-0.26	-0.51	0.03	-0.05	0.17	0.04	-0.47	0.11	0.97	0.13	-0.12	-0.46	0.05	0.62	0.70	-0.44	1.00																
Mn	0.78	0.00	0.35	0.10	-0.31	0.27	-0.11	0.19	0.03	-0.38	0.08	0.53	0.11	0.14	-0.31	0.29	0.95	0.58	-0.42	0.61	1.00															
Hg	-0.31	0.29	-0.05	0.26	0.29	0.04	0.36	0.25	0.00	0.47	0.34	-0.31	0.06	0.32	0.47	0.02	-0.25	-0.40	0.55	-0.28	-0.26	1.00														
Mo	-0.12	0.27	0.09	0.34	-0.06	-0.15	0.40	0.40	-0.35	-0.04	0.39	-0.09	0.64	0.34	-0.11	-0.10	-0.10	-0.17	0.15	-0.09	-0.07	0.42	1.00													
Ni	-0.02	0.31	0.22	0.42	-0.15	0.38	0.33	0.22	-0.05	0.01	0.71	-0.08	0.07	0.76	0.04	0.44	0.14	-0.03	0.29	-0.01	0.13	0.30	0.60	1.00												
P	0.70	-0.32	0.03	-0.17	-0.65	0.09	0.11	0.35	-0.09	-0.59	0.25	0.69	0.27	0.06	-0.53	0.18	0.58	0.83	-0.44	0.73	0.59	-0.34	0.07	0.21	1.00											
K	0.16	0.13	0.17	0.21	-0.16	0.89	-0.14	-0.16	0.44	0.14	0.49	0.02	-0.33	0.45	0.23	0.83	0.34	0.19	0.25	0.13	0.30	0.11	-0.05	0.49	0.14	1.00										
Sc	0.50	0.00	0.12	0.00	-0.01	0.48	-0.03	-0.16	0.41	0.05	0.30	0.31	-0.21	0.18	0.29	0.49	0.61	0.45	0.04	0.44	0.53	-0.04	-0.33	0.14	0.34	0.46	1.00									
Se	-0.25	0.47	0.18	0.47	0.30	0.31	0.29	-0.19	-0.05	0.72	0.65	-0.25	-0.09	0.20	0.59	0.27	-0.22	-0.24	0.70	-0.21	-0.22	0.61	0.38	0.43	-0.28	0.26	0.03	1.00								
Ag	-0.05	0.32	0.20	0.43	-0.12	0.37	0.40	0.08	-0.02	0.26	0.79	-0.08	-0.14	0.52	0.24	0.42	0.04	-0.03	0.41	0.00	0.01	0.39	0.38	0.75	0.15	0.45	0.17	0.66	1.00							
Na	0.22	-0.06	0.07	-0.01	-0.17	0.62	-0.16	-0.13	0.68	0.16	0.25	0.10	-0.29	0.29	0.15	0.47	0.30	0.01	0.17	0.21	0.27	0.10	-0.21	0.13	0.06	0.66	0.42	0.09	0.13	1.00						
Sr	0.60	-0.22	-0.04	-0.10	-0.48	0.31	-0.05	0.13	0.41	-0.26	0.25	0.62	0.04	0.23	-0.29	0.32	0.41	0.38	-0.05	0.66	0.37	-0.11	-0.07	0.19	0.59	0.36	0.46	-0.10	0.19	0.58	1.00					
Te	-0.23	0.39	0.32	0.38	0.25	0.12	0.10	-0.20	-0.17	0.53	0.25	-0.27	-0.03	-0.05	0.42	0.10	-0.10	-0.10	0.26	-0.24	-0.07	0.11	-0.01	0.00	-0.23	0.01	0.04	0.42	0.25	-0.17	-0.31	1.00				
Tl	0.42	-0.17	-0.06	-0.04	-0.49	0.00	0.43	0.54	-0.09	-0.34	0.37	0.40	0.34	0.17	-0.27	0.12	0.38	0.56	-0.19	0.46	0.35	0.10	0.40	0.37	0.68	0.19	0.20	-0.04	0.32	0.03	0.34	-0.13	1.00			
Th	0.34	-0.09	0.05	-0.04	-0.23	0.41	0.13	-0.09	0.00	0.15	0.41	0.23	0.00	-0.05	0.22	0.51	0.41	0.78	0.08	0.34	0.38	-0.10	-0.14	0.10	0.56	0.34	0.56	0.17	0.22	0.09	0.26	0.20	0.48	1.00		
U	0.35	0.11	0.28	0.20	-0.22	0.37	0.21	-0.04	0.02	0.09	0.65	0.32	0.07	0.13	0.11	0.43	0.35	0.62	0.14	0.40	0.34	-0.01	0.09	0.31	0.66	0.28	0.46	0.31	0.43	0.19	0.50	0.19	0.50	0.79	1.00	
V	0.47	0.28	0.38	0.39	-0.15	0.63	0.03	-0.02	0.15	-0.01	0.53	0.29	-0.12	0.25	0.07	0.67	0.66	0.45	0.05	0.41	0.62	-0.02	0.01	0.46	0.46	0.64	0.67	0.27	0.53	0.37	0.47	0.14	0.37	0.55	0.62	1.00
Zn	-0.17	0.31	0.21	0.38	-0.03	0.44	0.46	-0.04	0.09	0.22	0.78	-0.23	-0.08	0.60	0.31	0.50	0.00	-0.02	0.53	-0.14	-0.03	0.30	0.35	0.78	0.11	0.53	0.25	0.44	0.73	0.17	0.19	0.15	0.31	0.29	0.39	0.40

Note: Shaded cells indicate a correlation coefficient equal to or greater than ±0.7.

Appendix D3: Correlation matrix for the Hillcrest Member samples (n=19)

	TIC	*Total S*	*HCl-Extractable S*	*Sulphide S*	*Organic S*	*Al*	*Sb*	*As*	*Ba*	*Bi*	*Cd*	*Ca*	*Cr*	*Co*	*Cu*	*Ga*	*Fe*	*La*	*Pb*	*Mg*	*Mn*	*Hg*	*Mo*	*Ni*	*P*	*K*	*Sc*	*Se*	*Ag*	*Na*	*Sr*	*Te*	*Tl*	*Th*	*U*	*V*	*Zn*
TIC	1.00																																			
Total S	-0.38	1.00																																		
HCl-Extractable S	0.00	0.00	1.00																																	
Sulphide S	-0.14	0.56	0.00	1.00																																
Organic S	-0.35	0.76	0.00	-0.11	1.00																															
Al	0.41	-0.47	0.00	-0.30	-0.32	1.00																														
Sb	0.13	0.57	0.00	0.47	0.32	-0.16	1.00																													
As	-0.07	0.50	0.00	0.76	0.01	-0.47	0.40	1.00																												
Ba	0.02	-0.41	0.00	-0.42	-0.16	0.67	-0.18	-0.73	1.00																											
Bi	-0.14	0.06	0.00	-0.14	0.18	0.51	0.01	-0.57	0.67	1.00																										
Cd	-0.22	0.18	0.00	0.56	-0.23	-0.06	0.01	0.17	0.25	0.22	1.00																									
Ca	0.93	-0.35	0.00	-0.02	-0.41	0.23	0.15	0.11	-0.17	-0.33	-0.29	1.00																								
Cr	-0.09	0.39	0.00	0.64	-0.03	-0.56	0.23	0.83	-0.80	-0.58	0.06	0.10	1.00																							
Co	0.11	0.08	0.00	0.54	-0.33	0.24	0.12	0.13	0.26	0.10	0.73	0.09	-0.06	1.00																						
Cu	-0.19	0.03	0.00	-0.02	0.05	0.47	-0.12	-0.53	0.78	0.84	0.56	-0.36	-0.58	0.48	1.00																					
Ga	0.56	-0.50	0.00	-0.20	-0.44	0.92	-0.15	-0.32	0.47	0.21	-0.08	0.45	-0.42	0.37	0.28	1.00																				
Fe	0.31	0.02	0.00	-0.19	0.18	-0.13	0.33	-0.13	-0.10	-0.18	-0.41	0.40	-0.15	-0.18	-0.33	-0.04	1.00																			
La	0.56	-0.32	0.00	0.10	-0.47	0.05	0.00	0.31	-0.38	-0.67	-0.19	0.70	0.45	0.13	-0.54	0.36	0.20	1.00																		
Pb	-0.08	-0.04	0.00	0.00	-0.05	0.51	-0.07	-0.47	0.70	0.89	0.53	-0.25	-0.50	0.36	0.92	0.29	-0.35	-0.49	1.00																	
Mg	0.83	-0.26	0.00	-0.21	-0.15	0.17	0.22	-0.13	-0.07	-0.20	-0.40	0.86	-0.15	-0.05	-0.32	0.34	0.77	0.49	-0.26	1.00																
Mn	0.21	0.06	0.00	-0.18	0.22	-0.19	0.33	-0.12	-0.12	-0.18	-0.40	0.32	-0.13	-0.20	-0.32	-0.11	0.99	0.15	-0.36	0.70	1.00															
Hg	-0.23	0.39	0.00	0.64	-0.03	-0.30	0.28	0.46	-0.02	-0.10	0.64	-0.18	0.14	0.59	0.13	-0.26	-0.05	-0.23	0.01	-0.19	-0.03	1.00														
Mo	-0.11	0.46	0.00	0.73	-0.02	-0.48	0.40	0.82	-0.69	-0.46	0.12	0.08	0.95	0.08	-0.47	-0.38	-0.11	0.39	-0.41	-0.16	-0.09	0.26	1.00													
Ni	0.15	0.17	0.00	0.61	-0.27	0.07	0.20	0.34	-0.01	-0.17	0.62	0.20	0.14	0.91	0.21	0.29	-0.04	0.28	0.10	0.05	-0.06	0.55	0.21	1.00												
P	0.42	-0.11	0.00	0.25	-0.33	-0.06	0.13	0.48	-0.54	-0.65	-0.18	0.54	0.67	0.05	-0.62	0.20	0.14	0.91	-0.53	0.33	0.11	-0.22	0.62	0.24	1.00											
K	0.20	-0.44	0.00	-0.41	-0.21	0.95	-0.22	-0.59	0.75	0.64	-0.04	-0.02	-0.69	0.15	0.58	0.80	-0.21	-0.18	0.59	-0.01	-0.25	-0.33	-0.62	-0.07	-0.28	1.00										
Sc	0.74	-0.16	0.00	-0.08	-0.13	0.62	0.11	-0.34	0.39	0.43	0.11	0.59	-0.41	0.37	0.42	0.64	0.23	0.16	0.50	0.62	0.15	-0.14	-0.36	0.26	0.02	0.48	1.00									
Se	-0.30	0.13	0.00	0.14	0.05	0.40	0.18	-0.31	0.61	0.71	0.44	-0.48	-0.36	0.28	0.69	0.13	-0.22	-0.60	0.65	-0.39	-0.20	0.23	-0.19	0.10	-0.54	0.49	0.10	1.00								
Ag	-0.37	0.22	0.00	0.59	-0.19	-0.03	0.25	0.37	0.19	0.12	0.70	-0.39	0.27	0.45	0.32	-0.13	-0.58	-0.17	0.29	-0.61	-0.56	0.59	0.41	0.30	-0.09	-0.01	-0.25	0.50	1.00							
Na	0.31	-0.04	0.00	-0.17	0.09	0.47	0.38	-0.36	0.39	0.45	-0.28	0.27	-0.44	0.04	0.19	0.38	0.65	-0.09	0.24	0.55	0.62	-0.05	-0.26	-0.07	-0.12	0.40	0.53	0.28	-0.26	1.00						
Sr	0.71	-0.17	0.00	-0.07	-0.15	0.31	0.35	-0.06	0.10	-0.05	-0.33	0.79	-0.10	0.12	-0.14	0.42	0.66	0.42	-0.09	0.84	0.61	-0.06	0.00	0.15	0.31	0.09	0.61	-0.20	-0.35	0.74	1.00					
Te	0.43	0.03	0.00	0.01	0.03	0.42	0.28	-0.34	0.42	0.53	0.30	0.18	-0.29	0.33	0.54	0.32	-0.09	-0.17	0.55	0.16	-0.14	-0.02	-0.21	0.22	-0.16	0.39	0.62	0.52	0.12	0.23	0.18	1.00				
Tl	0.03	-0.34	0.00	0.28	-0.63	-0.10	-0.26	0.43	-0.33	-0.57	0.29	0.12	0.53	0.19	-0.38	0.09	-0.30	0.64	-0.29	-0.16	-0.32	0.07	0.44	0.28	0.66	-0.19	-0.28	-0.29	0.31	-0.52	-0.25	-0.30	1.00			
Th	0.59	-0.48	0.00	0.08	-0.63	0.29	-0.15	0.14	-0.14	-0.43	0.00	0.65	0.28	0.32	-0.24	0.57	-0.07	0.88	-0.16	0.35	-0.13	-0.27	0.21	0.41	0.80	0.08	0.32	-0.44	-0.11	-0.15	0.32	0.07	0.64	1.00		
U	0.48	0.01	0.00	0.53	-0.41	0.19	0.22	0.35	-0.23	-0.20	0.26	0.52	0.47	0.54	-0.09	0.39	0.02	0.69	-0.01	0.30	-0.03	0.03	0.51	0.60	0.76	-0.05	0.43	-0.14	0.12	0.07	0.38	0.26	0.47	0.77	1.00	
V	0.62	-0.20	0.00	-0.18	-0.10	0.80	0.20	-0.27	0.41	0.30	-0.21	0.47	-0.36	0.13	0.20	0.78	0.26	0.22	0.20	0.52	0.20	-0.28	-0.28	0.09	0.16	0.68	0.70	0.23	-0.19	0.61	0.58	0.44	-0.23	0.28	0.33	1.00
Zn	0.13	0.03	0.00	0.39	-0.28	0.34	0.13	-0.11	0.48	0.47	0.78	0.05	-0.25	0.77	0.75	0.32	-0.25	-0.14	0.74	-0.07	-0.27	0.32	-0.15	0.66	-0.22	0.31	0.55	0.50	0.42	0.04	0.04	0.57	-0.04	0.15	0.36	0.22

Note: Shaded cells indicate a correlation coefficient equal to or greater than ±0.7.

Appendix D4: Correlation matrix for the Adanac Member samples (n=29)

	TIC	*Total S*	*HCl-Extractable S*	*Sulphide S*	*Organic S*	*Al*	*Sb*	*As*	*Ba*	*Bi*	*Cd*	*Ca*	*Cr*	*Co*	*Cu*	*Ga*	*Fe*	*La*	*Pb*	*Mg*	*Mn*	*Hg*	*Mo*	*Ni*	*P*	*K*	*Sc*	*Se*	*Ag*	*Na*	*Sr*	*Te*	*Tl*	*Th*	*U*	*V*	*Zn*
TIC	1.00																																			
Total S	-0.15	1.00																																		
HCl-Extractable S	-0.06	0.55	1.00																																	
Sulphide S	-0.14	1.00	0.55	1.00																																
Organic S	-0.14	0.53	0.24	0.45	1.00																															
Al	0.05	-0.31	-0.04	-0.25	-0.63	1.00																														
Sb	0.29	-0.08	-0.17	-0.10	0.16	-0.11	1.00																													
As	0.00	0.77	0.23	0.79	0.20	-0.10	0.04	1.00																												
Ba	0.03	-0.65	-0.42	-0.67	-0.17	0.27	0.17	-0.56	1.00																											
Bi	-0.03	-0.39	-0.29	-0.42	0.10	0.03	0.24	-0.46	0.45	1.00																										
Cd	0.07	-0.39	-0.28	-0.36	-0.44	0.35	0.52	-0.21	0.45	0.36	1.00																									
Ca	0.82	-0.24	-0.13	-0.23	-0.17	0.08	0.45	0.03	0.02	-0.06	0.08	1.00																								
Cr	0.18	-0.01	0.06	0.03	-0.33	0.55	0.02	0.31	-0.01	-0.56	0.05	0.24	1.00																							
Co	0.17	0.40	0.12	0.44	-0.16	0.20	0.45	0.55	-0.22	-0.14	0.35	0.13	0.32	1.00																						
Cu	-0.23	-0.34	-0.29	-0.36	0.09	0.12	0.39	-0.34	0.62	0.74	0.62	-0.20	-0.25	0.06	1.00																					
Ga	0.39	-0.27	0.01	-0.23	-0.49	0.79	-0.07	0.00	0.14	-0.14	0.09	0.39	0.69	0.19	-0.13	1.00																				
Fe	0.88	0.16	0.13	0.18	-0.07	0.04	0.08	0.20	-0.12	-0.16	-0.02	0.51	0.24	0.31	-0.33	0.34	1.00																			
La	0.45	0.01	0.18	0.06	-0.53	0.39	0.03	0.24	-0.07	-0.38	0.15	0.39	0.55	0.46	-0.41	0.44	0.53	1.00																		
Pb	-0.04	-0.22	-0.29	-0.24	0.01	-0.04	0.43	-0.20	0.36	0.82	0.54	0.01	-0.54	0.16	0.67	-0.20	-0.17	-0.21	1.00																	
Mg	0.90	-0.25	-0.13	-0.25	-0.13	0.01	0.42	-0.04	0.06	-0.02	0.08	0.96	0.15	0.09	-0.17	0.38	0.61	0.30	0.03	1.00																
Mn	0.77	0.08	0.12	0.09	-0.07	0.06	-0.04	0.05	0.01	-0.06	0.02	0.29	0.14	0.23	-0.22	0.28	0.95	0.46	-0.15	0.43	1.00															
Hg	-0.11	0.96	0.46	0.96	0.45	-0.23	0.01	0.77	-0.57	-0.25	-0.23	-0.18	-0.07	0.44	-0.21	-0.27	0.17	0.01	-0.05	-0.20	0.07	1.00														
Mo	0.10	0.12	0.02	0.12	0.02	0.08	0.53	0.25	0.06	-0.18	0.36	0.09	0.46	0.65	0.25	0.06	0.16	0.21	-0.05	0.05	0.14	0.09	1.00													
Ni	-0.01	0.52	0.17	0.55	-0.03	0.14	0.39	0.61	-0.24	-0.22	0.27	-0.04	0.32	0.95	0.06	0.07	0.17	0.36	0.10	-0.09	0.10	0.54	0.70	1.00												
P	0.48	-0.24	-0.02	-0.19	-0.51	0.43	0.11	0.04	0.24	-0.06	0.26	0.45	0.47	0.35	-0.17	0.55	0.47	0.87	0.07	0.37	0.42	-0.20	0.13	0.21	1.00											
K	0.08	-0.16	0.00	-0.10	-0.56	0.80	0.07	-0.02	0.32	0.04	0.56	0.05	0.36	0.31	0.16	0.61	0.13	0.38	0.14	0.04	0.13	-0.03	0.00	0.22	0.42	1.00										
Sc	0.74	-0.26	-0.03	-0.25	-0.25	0.40	0.25	-0.10	0.32	0.31	0.26	0.63	0.17	0.14	0.08	0.49	0.64	0.55	0.28	0.64	0.57	-0.14	-0.05	-0.02	0.68	0.41	1.00									
Se	-0.10	0.18	-0.03	0.15	0.33	-0.20	0.43	0.15	0.32	0.30	0.46	-0.18	-0.11	0.44	0.67	-0.34	-0.01	-0.16	0.44	-0.16	0.06	0.23	0.65	0.52	-0.08	-0.08	-0.04	1.00								
Ag	-0.36	0.75	0.42	0.77	0.22	-0.02	0.11	0.63	-0.37	-0.34	0.03	-0.39	0.20	0.55	-0.05	-0.15	-0.06	0.13	-0.15	-0.42	-0.10	0.74	0.29	0.64	-0.10	0.22	-0.30	0.28	1.00							
Na	0.47	-0.30	-0.11	-0.27	-0.37	0.58	0.15	-0.08	0.15	0.23	0.31	0.39	0.39	0.04	0.04	0.62	0.41	0.35	0.09	0.37	0.35	-0.19	0.00	-0.12	0.47	0.48	0.62	-0.22	-0.18	1.00						
Sr	0.64	-0.38	-0.21	-0.37	-0.33	0.36	0.41	-0.10	0.14	0.15	0.28	0.80	0.30	0.01	-0.01	0.52	0.35	0.32	0.15	0.75	0.17	-0.26	-0.01	-0.16	0.45	0.29	0.65	-0.25	-0.34	0.79	1.00					
Te	-0.05	0.15	-0.12	0.14	0.12	-0.26	-0.26	0.08	-0.12	0.10	-0.07	-0.29	-0.33	-0.06	0.00	-0.33	0.11	-0.11	0.17	-0.21	0.21	0.17	-0.10	0.05	-0.13	-0.24	-0.03	0.15	-0.15	-0.40	-0.48	1.00				
Tl	-0.08	0.89	0.61	0.90	0.26	-0.12	-0.03	0.77	-0.61	-0.41	-0.20	-0.13	0.11	0.52	-0.39	-0.13	0.20	0.29	-0.17	-0.18	0.11	0.86	0.12	0.58	0.04	0.08	-0.08	0.10	0.74	-0.19	-0.28	0.10	1.00			
Th	0.35	-0.30	-0.08	-0.26	-0.48	0.44	0.05	-0.02	0.25	-0.02	0.17	0.40	0.43	0.26	-0.14	0.51	0.29	0.80	0.11	0.29	0.24	-0.28	0.03	0.16	0.93	0.34	0.64	-0.13	-0.18	0.33	0.37	-0.04	-0.01	1.00		
U	0.58	-0.47	-0.21	-0.45	-0.40	0.42	0.48	-0.24	0.47	0.26	0.44	0.62	0.30	0.34	0.25	0.55	0.38	0.51	0.31	0.61	0.31	-0.37	0.26	0.18	0.74	0.39	0.77	0.09	-0.29	0.46	0.61	-0.19	-0.28	0.71	1.00	
V	0.54	-0.36	-0.15	-0.37	-0.16	0.36	0.38	-0.20	0.21	0.34	0.23	0.59	0.25	0.11	0.27	0.60	0.31	0.12	0.18	0.62	0.22	-0.29	0.06	-0.04	0.36	0.22	0.59	-0.10	-0.30	0.55	0.68	-0.24	-0.31	0.33	0.74	1.00
Zn	0.10	-0.15	-0.02	-0.11	-0.43	0.39	0.49	0.07	0.11	-0.02	0.64	0.17	0.25	0.36	0.11	0.19	0.05	0.48	0.22	0.12	0.01	-0.03	0.18	0.31	0.40	0.59	0.32	0.03	0.30	0.31	0.35	-0.24	0.09	0.36	0.35	0.11

Note: Shaded cells indicate a correlation coefficient equal to or greater than ±0.7.

Appendix D5: Correlation matrix for the Moose Mountain samples (n=9)

	TIC	*Total S*	*HCl-Extractable S*	*Sulphide S*	*Organic S*	*Al*	*Sb*	*As*	*Ba*	*Bi*	*Cd*	*Ca*	*Cr*	*Co*	*Cu*	*Ga*	*Fe*	*La*	*Pb*	*Mg*	*Mn*	*Hg*	*Mo*	*Ni*	*P*	*K*	*Sc*	*Se*	*Ag*	*Na*	*Sr*	*Te*	*Tl*	*Th*	*U*	*V*	*Zn*
TIC	1.00																																			
Total S	-0.23	1.00																																		
HCl-Extractable S	-0.27	-0.07	1.00																																	
Sulphide S	-0.20	1.00	-0.07	1.00																																
Organic S	-0.33	0.88	-0.30	0.86	1.00																															
Al	0.35	0.03	-0.03	0.07	-0.21	1.00																														
Sb	-0.20	0.88	-0.24	0.88	0.82	0.02	1.00																													
As	-0.29	0.97	0.09	0.98	0.79	0.00	0.85	1.00																												
Ba	0.33	0.76	-0.42	0.77	0.66	0.36	0.63	0.64	1.00																											
Bi	-0.12	0.85	-0.15	0.86	0.74	0.21	0.65	0.79	0.86	1.00																										
Cd	0.20	0.83	-0.18	0.84	0.67	0.45	0.81	0.77	0.85	0.72	1.00																									
Ca	1.00	-0.22	-0.30	-0.19	-0.32	0.39	-0.18	-0.29	0.35	-0.11	0.22	1.00																								
Cr	0.22	-0.14	0.21	-0.11	-0.37	0.91	-0.08	-0.12	0.08	0.03	0.28	0.25	1.00																							
Co	-0.01	0.47	0.26	0.50	0.09	0.78	0.34	0.52	0.44	0.49	0.61	0.01	0.68	1.00																						
Cu	-0.05	0.68	-0.22	0.69	0.58	0.53	0.72	0.60	0.74	0.79	0.81	-0.01	0.46	0.58	1.00																					
Ga	0.41	-0.07	0.02	-0.03	-0.35	0.98	-0.03	-0.07	0.24	0.06	0.38	0.44	0.94	0.74	0.43	1.00																				
Fe	0.56	0.03	0.06	0.06	-0.22	0.75	-0.12	0.03	0.32	0.04	0.43	0.56	0.63	0.61	0.16	0.76	1.00																			
La	0.80	-0.21	-0.08	-0.17	-0.44	0.82	-0.20	-0.25	0.28	-0.09	0.30	0.82	0.71	0.47	0.17	0.86	0.83	1.00																		
Pb	0.06	0.39	0.53	0.41	0.10	0.56	0.36	0.46	0.24	0.27	0.64	0.06	0.67	0.70	0.52	0.58	0.56	0.40	1.00																	
Mg	0.99	-0.24	-0.23	-0.21	-0.36	0.37	-0.18	-0.30	0.31	-0.12	0.19	0.99	0.25	0.01	-0.02	0.44	0.49	0.80	0.08	1.00																
Mn	0.52	-0.50	0.07	-0.48	-0.56	0.60	-0.46	-0.51	-0.16	-0.42	0.00	0.53	0.69	0.16	-0.07	0.67	0.75	0.75	0.39	0.48	1.00															
Hg	-0.14	0.95	-0.21	0.94	0.91	-0.18	0.92	0.90	0.72	0.75	0.77	-0.14	-0.34	0.21	0.58	-0.26	-0.14	-0.30	0.23	-0.15	-0.59	1.00														
Mo	0.11	0.31	-0.20	0.34	0.13	0.63	0.61	0.31	0.34	0.22	0.62	0.16	0.63	0.57	0.70	0.67	0.27	0.42	0.55	0.18	0.19	0.27	1.00													
Ni	-0.08	0.49	0.35	0.53	0.11	0.73	0.37	0.56	0.40	0.50	0.60	-0.07	0.67	0.99	0.60	0.70	0.55	0.39	0.76	-0.06	0.13	0.23	0.57	1.00												
P	0.34	-0.32	0.10	-0.29	-0.50	0.74	-0.21	-0.29	-0.17	-0.41	0.12	0.36	0.76	0.49	0.01	0.82	0.75	0.76	0.49	0.33	0.80	-0.45	0.50	0.43	1.00											
K	0.44	0.11	-0.03	0.15	-0.18	0.98	0.05	0.09	0.46	0.28	0.50	0.47	0.83	0.82	0.50	0.95	0.79	0.85	0.54	0.45	0.52	-0.10	0.57	0.76	0.68	1.00										
Sc	0.48	-0.05	-0.01	-0.01	-0.30	0.85	-0.11	-0.04	0.23	-0.04	0.37	0.49	0.72	0.67	0.18	0.87	0.96	0.85	0.51	0.44	0.74	-0.23	0.42	0.60	0.87	0.86	1.00									
Se	-0.09	0.85	-0.33	0.85	0.79	0.16	0.72	0.76	0.89	0.98	0.72	-0.07	-0.06	0.39	0.80	0.01	-0.04	-0.12	0.14	-0.09	-0.49	0.79	0.27	0.39	-0.45	0.23	-0.10	1.00								
Ag	0.10	0.58	-0.12	0.59	0.43	0.69	0.58	0.53	0.60	0.47	0.87	0.13	0.58	0.72	0.74	0.64	0.64	0.45	0.73	0.07	0.34	0.43	0.70	0.70	0.51	0.67	0.66	0.44	1.00							
Na	0.34	-0.13	0.18	-0.08	-0.47	0.82	-0.23	-0.06	0.07	-0.08	0.19	0.34	0.74	0.74	0.08	0.86	0.86	0.76	0.48	0.31	0.64	-0.36	0.35	0.69	0.82	0.84	0.93	-0.17	0.48	1.00						
Sr	0.98	-0.23	-0.23	-0.19	-0.38	0.52	-0.19	-0.28	0.33	-0.13	0.25	0.98	0.39	0.15	0.02	0.58	0.67	0.90	0.17	0.97	0.62	-0.19	0.24	0.07	0.50	0.59	0.63	-0.11	0.23	0.50	1.00					
Te	-0.16	0.21	0.74	0.21	-0.01	0.35	-0.03	0.29	0.05	0.26	0.28	-0.18	0.52	0.52	0.28	0.33	0.44	0.15	0.79	-0.18	0.35	-0.02	0.03	0.61	0.22	0.32	0.31	0.06	0.40	0.37	-0.09	1.00				
Tl	-0.19	0.96	-0.23	0.95	0.93	-0.13	0.93	0.91	0.70	0.73	0.79	-0.18	-0.30	0.26	0.59	-0.22	-0.10	-0.29	0.25	-0.20	-0.56	0.99	0.32	0.27	-0.37	-0.05	-0.17	0.78	0.50	-0.30	-0.22	-0.02	1.00			
Th	0.49	-0.23	0.00	-0.18	-0.48	0.88	-0.18	-0.21	0.08	-0.19	0.24	0.52	0.81	0.63	0.14	0.93	0.84	0.90	0.47	0.49	0.76	-0.38	0.52	0.55	0.94	0.87	0.95	-0.23	0.55	0.92	0.66	0.21	-0.32	1.00		
U	0.48	-0.07	-0.06	-0.04	-0.26	0.88	0.05	-0.09	0.20	-0.09	0.45	0.51	0.84	0.60	0.36	0.92	0.80	0.86	0.61	0.48	0.76	-0.19	0.70	0.54	0.91	0.83	0.89	-0.11	0.73	0.76	0.64	0.25	-0.12	0.93	1.00	
V	0.38	-0.01	-0.02	0.02	-0.20	0.93	0.06	-0.03	0.26	0.05	0.48	0.41	0.92	0.66	0.49	0.95	0.79	0.81	0.67	0.38	0.76	-0.18	0.69	0.63	0.84	0.87	0.87	0.00	0.78	0.76	0.54	0.40	-0.12	0.89	0.97	1.00
Zn	0.22	0.61	-0.02	0.64	0.35	0.78	0.56	0.58	0.71	0.60	0.90	0.24	0.64	0.85	0.79	0.72	0.67	0.56	0.77	0.22	0.28	0.44	0.71	0.83	0.46	0.80	0.67	0.55	0.94	0.56	0.34	0.46	0.49	0.58	0.71	0.77

Note: Shaded cells indicate a correlation coefficient equal to or greater than ±0.7.

Appendix E – Static Test Results for Future Wastes

Sample ID	Sample Origin	Hole	From (field) m	To (field) m	Interval Length m	Unit	Composition	Acid Base Accounting													
								Paste pH Std. Units	Total C %	Organic C % Calc.	TIC % as C	TIC kg CaCO3/t Calc.	Total S %S	HCl-Extractable S %	Sulphide S % Calc.	Organic S % Calc.	AP kg CaCO3/t Calc.	Sobek NP kg CaCO3/t	Modified NP kg CaCO3/t	Fizz Test	(Mod. NP)/AP Ratio Calc.
SRK-WR-RGSC0006-001	SRK	RGSC0006	12.0	14.5	2.5	CADOMIN	SILTSTONE	7.20	2.05	0.89	1.16	96.7	0.05	<0.01	0.03	0.01	0.9	#N/A	11.7	Slight	12.48
SRK-WR-RGSC0006-002	SRK	RGSC0006	14.5	17.2	2.7	CADOMIN	CLAYSTONE	6.32	0.91	0.9	<0.01	<0.83	0.06	<0.01	0.04	0.01	1.3	#N/A	0.5	None	0.40
SRK-WR-RGSC0006-002A	SRK	RGSC0006	17.2	20.0	2.8	CADOMIN	CLAYSTONE	6.61	1.84	1.75	0.09	7.5	0.15	0.02	0.11	0.02	3.4	#N/A	7.9	None	2.30
SRK-WR-RGSC0006-003	SRK	RGSC0006	20.0	25.0	5.0	CADOMIN	SANDSTONE	7.81	1.54	0.29	1.25	104.2	0.29	0.02	0.23	0.04	7.2	#N/A	93.3	Slight	12.98
SRK-WR-RGSC0006-004	SRK	RGSC0006	25.0	30.0	5.0	CADOMIN	SANDSTONE	7.89	1.45	0.31	1.14	95.0	0.19	<0.01	0.16	0.02	5.0	#N/A	76.5	Moderate	15.30
SRK-WR-RGSC0006-005	SRK	RGSC0006	30.0	35.0	5.0	CADOMIN	SANDSTONE	7.08	0.28	0.17	0.11	9.2	0.1	<0.01	0.08	0.01	2.5	#N/A	6.5	None	2.60
SRK-WR-RGSC0006-006	SRK	RGSC0006	35.0	40.0	5.0	CADOMIN	SANDSTONE	6.70	0.45	0.36	0.09	7.5	0.13	<0.01	0.1	0.02	3.1	#N/A	4.9	None	1.57
SRK-WR-RGSC0006-007	SRK	RGSC0006	40.0	45.0	5.0	CADOMIN	SANDSTONE	7.53	0.88	0.52	0.36	30.0	0.14	<0.01	0.11	0.02	3.4	#N/A	26.4	Slight	7.68
SRK-WR-RGSC0006-008	SRK	RGSC0006	45.0	50.0	5.0	CADOMIN	SANDSTONE	7.24	0.57	0.29	0.28	23.3	0.26	0.02	0.21	0.03	6.6	#N/A	14.0	Slight	2.13
SRK-WR-RGSC0006-009	SRK	RGSC0006	50.0	55.3	5.3	CADOMIN	SANDSTONE	7.62	0.96	0.47	0.49	40.8	0.28	<0.01	0.23	0.04	7.2	#N/A	31.1	Slight	4.33
SRK-WR-RGSC0006-010	SRK	RGSC0006	55.3	57.7	2.4	CADOMIN	SILTSTONE	7.60	1.29	0.46	0.83	69.2	0.21	<0.01	0.18	0.02	5.6	#N/A	38.6	Slight	6.86
SRK-WR-RGSC0006-011	SRK	RGSC0006	57.7	60.8	3.1	CADOMIN	SANDSTONE	7.29	0.62	0.27	0.35	29.2	0.32	0.02	0.27	0.03	8.4	#N/A	15.8	Slight	1.87
SRK-WR-RGSC0006-012	SRK	RGSC0006	60.8	63.0	2.2	CADOMIN	SANDSTONE	5.02	0.39	0.3	0.09	7.5	0.35	0.02	0.3	0.03	9.4	#N/A	1.7	None	0.18
SRK-WR-RGSC0006-013	SRK	RGSC0006	63.0	67.0	4.0	CADOMIN	CONGLOMERATE	5.68	0.35	0.28	0.07	5.8	0.54	0.02	0.47	0.05	14.7	#N/A	1.1	Slight	0.07
SRK-WR-RGSC0006-014	SRK	RGSC0006	67.0	70.0	3.0	CADOMIN	CONGLOMERATE	5.44	0.32	0.17	0.15	12.5	0.56	0.02	0.48	0.06	15.0	#N/A	2.1	Slight	0.14
SRK-WR-RGSC0006-015	SRK	RGSC0006	73.0	77.9	4.9	MUTZ	CLAYSTONE	7.35	3.62	3.07	0.55	45.8	0.13	<0.01	0.06	0.06	1.9	#N/A	17.2	Slight	9.17
SRK-WR-RGSC0006-016	SRK	RGSC0006	77.9	78.8	0.8	MUTZ	CLAYSTONE	6.89	3.4	3.28	0.12	10.0	0.08	<0.01	0.03	0.04	0.9	#N/A	3.2	None	3.41
SRK-WR-RGSC0006-017	SRK	RGSC0006	80.4	80.6	0.2	MUTZ	CLAYSTONE	6.41	6.17	6	0.17	14.2	0.23	0.01	0.13	0.09	4.1	#N/A	2.2	None	0.54
SRK-WR-RGSC0006-018	SRK	RGSC0006	80.6	85.1	4.5	MUTZ	CLAYSTONE	7.29	3.7	2.59	1.11	92.5	0.1	<0.01	0.05	0.04	1.6	#N/A	37.0	Slight	23.68
SRK-WR-RGSC0006-019	SRK	RGSC0006	85.2	90.2	5.0	MUTZ	CLAYSTONE	7.27	3.33	2.8	0.53	44.2	0.11	<0.01	0.06	0.04	1.9	#N/A	26.6	Slight	14.19
SRK-WR-RGSC0006-020	SRK	RGSC0006	90.2	94.6	4.4	MUTZ	CLAYSTONE	7.73	3.12	1.19	1.93	160.8	0.09	<0.01	0.05	0.03	1.6	#N/A	74.2	Moderate	47.49
SRK-WR-RGSC0006-021	SRK	RGSC0006	94.6	99.7	5.1	MUTZ	SANDSTONE	7.64	1.38	0.71	0.67	55.8	0.12	<0.01	0.08	0.03	2.5	#N/A	36.9	Moderate	14.76
SRK-WR-RGSC0006-022	SRK	RGSC0006	99.7	101.3	1.5	MUTZ	CLAYSTONE	7.29	2.78	1.73	1.05	87.5	0.08	<0.01	0.04	0.03	1.3	#N/A	16.3	Slight	13.04
SRK-WR-RGSC0006-023	SRK	RGSC0006	101.3	103.2	1.9	MUTZ	SILTSTONE	7.63	2.55	1.15	1.4	116.7	0.06	<0.01	0.02	0.03	0.6	#N/A	45.5	Moderate	72.80
SRK-WR-RGSC0006-024	SRK	RGSC0006	103.2	107.3	4.1	MUTZ	SANDSTONE	7.36	1.99	1.31	0.68	56.7	0.08	<0.01	0.04	0.03	1.3	#N/A	18.6	Moderate	14.88
SRK-WR-RGSC0006-025	SRK	RGSC0006	107.3	107.5	0.2	MUTZ	CLAYSTONE	6.76	11.17	10.96	0.21	17.5	0.15	<0.01	0.05	0.09	1.6	#N/A	2.6	None	1.66
SRK-WR-RGSC0006-026	SRK	RGSC0006	110.8	111.0	0.2	HILLCREST	SANDSTONE	7.67	1.74	1.35	0.39	32.5	0.06	<0.01	0.03	0.02	0.9	#N/A	22.7	Slight	24.21
SRK-WR-RGSC0006-027	SRK	RGSC0006	111.0	116.1	5.1	HILLCREST	CLAYSTONE	7.21	5.27	5.09	0.18	15.0	0.1	<0.01	0.03	0.06	0.9	#N/A	6.8	Slight	7.25
SRK-WR-RGSC0006-028	SRK	RGSC0006	116.1	121.1	5.0	HILLCREST	SANDSTONE	7.33	1.84	1.69	0.15	12.5	0.07	<0.01	0.03	0.03	0.9	#N/A	7.6	Slight	8.11
SRK-WR-RGSC0006-029	SRK	RGSC0006	121.1	125.1	4.0	HILLCREST	SANDSTONE	7.85	1.56	0.46	1.1	91.7	0.04	<0.01	0.01	0.02	0.3	#N/A	45.7	Slight	146.24
SRK-WR-RGSC0006-030	SRK	RGSC0006	125.1	129.1	4.0	HILLCREST	SANDSTONE	7.11	0.51	0.42	0.09	7.5	0.06	<0.01	0.03	0.02	0.9	#N/A	5.3	None	5.65
SRK-WR-RGSC0006-031	SRK	RGSC0006	129.1	134.4	5.3	HILLCREST	SANDSTONE	7.28	3.08	2.82	0.26	21.7	0.13	<0.01	0.07	0.05	2.2	#N/A	16.0	Slight	7.31
SRK-WR-RGSC0006-032	SRK	RGSC0006	134.4	140.9	6.4	HILLCREST	SANDSTONE	7.59	4.37	3.88	0.49	40.8	0.14	<0.01	0.07	0.06	2.2	#N/A	29.3	Slight	13.39
SRK-WR-RGSC0006-033	SRK	RGSC0006	140.9	144.4	3.5	ADANAC	CLAYSTONE	7.14	2.26	1.72	0.54	45.0	0.11	<0.01	0.07	0.03	2.2	#N/A	4.2	None	1.92
SRK-WR-RGSC0006-034	SRK	RGSC0006	144.4	144.6	0.2	ADANAC	CLAYSTONE	7.12	29.02	28.94	0.08	6.7	0.21	<0.01	0.02	0.18	0.6	#N/A	3.9	None	6.24
SRK-WR-RGSC0006-035	SRK	RGSC0006	144.7	144.8	0.1	ADANAC	CLAYSTONE	6.84	31.51	31.5	<0.01	<0.83	0.19	<0.01	0.02	0.16	0.6	#N/A	0.1	None	0.16
SRK-WR-RGSC0006-036	SRK	RGSC0006	149.3	149.7	0.4	ADANAC	CLAYSTONE	7.03	6.26	6.11	0.15	12.5	0.13	<0.01	0.06	0.06	1.9	#N/A	1.6	None	0.85
SRK-WR-RGSC0006-038	SRK	RGSC0006	150.8	151.0	0.2	ADANAC	CLAYSTONE	6.72	8.87	8.84	0.03	2.5	0.45	<0.01	0.28	0.16	8.8	#N/A	-0.1	None	0.01
SRK-WR-RGSC0006-039	SRK	RGSC0006	151.0	155.3	4.3	ADANAC	CLAYSTONE	7.00	7.08	5.78	1.3	108.3	0.14	<0.01	0.05	0.08	1.6	#N/A	10.7	Slight	6.85
SRK-WR-RGSC0006-040	SRK	RGSC0006	155.3	155.5	0.2	ADANAC	CLAYSTONE	6.66	28.05	28.04	<0.01	<0.83	0.22	<0.01	0.02	0.19	0.6	#N/A	-0.2	None	0.08
SRK-WR-RGSC0006-041	SRK	RGSC0006	157.2	157.4	0.2	ADANAC	CLAYSTONE	6.38	11.49	11.07	0.42	35.0	2.55	0.01	2.37	0.17	74.1	#N/A	1.4	None	0.02
SRK-WR-RGSC0006-042	SRK	RGSC0006	157.4	161.2	3.8	ADANAC	SILTSTONE	6.82	2.73	2.65	0.08	6.7	0.84	0.01	0.74	0.09	23.1	#N/A	1.1	Slight	0.05
SRK-WR-RGSC0008-043	SRK	RGSC0008	59.7	59.9	0.2	ADANAC	CLAYSTONE	5.58	6.41	5.9	0.51	42.5	2.23	0.03	1.99	0.21	62.2	#N/A	0.0	None	0.00
SRK-WR-RGSC0008-044	SRK	RGSC0008	59.9	62.2	2.3	ADANAC	SILTSTONE	6.68	3.95	3.88	0.07	5.8	0.75	0.01	0.64	0.1	20.0	#N/A	1.6	None	0.08
SRK-WR-RGSC0008-045	SRK	RGSC0008	62.2	67.2	5.0	MOOSE	SANDSTONE	7.37	1.59	0.95	0.64	53.3	0.29	0.01	0.24	0.04	7.5	#N/A	29.4	Slight	3.92
SRK-WR-RGSC0008-046	SRK	RGSC0008	67.2	72.2	5.0	MOOSE	SANDSTONE	6.91	0.67	0.48	0.19	15.8	0.17	0.01	0.13	0.03	4.1	#N/A	6.3	Slight	1.55
SRK-WR-RGSC0008-047	SRK	RGSC0008	72.2	77.2	5.0	MOOSE	SANDSTONE	6.18	0.91	0.74	0.17	14.2	0.29	0.02	0.24	0.03	7.5	#N/A	3.9	Slight	0.52
SRK-WR-RGSC0008-048	SRK	RGSC0008	77.2	82.2	5.0	MOOSE	SANDSTONE	5.69	0.58	0.42	0.16	13.3	0.17	0.02	0.14	0.01	4.4	#N/A	1.8	Slight	0.41
SRK-WR-RGSC0008-049	SRK	RGSC0008	82.2	87.2	5.0	MOOSE	SANDSTONE	7.04	0.79	0.53	0.26	21.7	0.15	0.01	0.13	0.01	4.1	#N/A	10.4	Slight	2.56
SRK-WR-RGSC0009-050	SRK	RGSC0009	29.7	32.2	2.5	CADOMIN	SANDSTONE	7.05	0.15	0.05	0.1	8.3	<0.02	<0.01	<0.01	0	0.3	#N/A	3.7	None	11.84
SRK-WR-RGSC0009-051	SRK	RGSC0009	32.2	36.3	4.1	CADOMIN	SANDSTONE	7.18	0.68	0.31	0.37	30.8	0.04	<0.01	0.03	0	0.9	#N/A	11.9	Slight	12.69
SRK-WR-RGSC0009-052	SRK	RGSC0009	36.3	38.5	2.2	CADOMIN	CLAYSTONE	6.76	1.45	1.32	0.13	10.8	0.47	<0.01	0.38	0.08	11.9	#N/A	7.6	None	0.64
SRK-WR-RGSC0009-053	SRK	RGSC0009	38.5	41.6	3.1	CADOMIN	SILTSTONE	7.14	1.75	0.99	0.76	63.3	0.54	0.01	0.46	0.07	14.4	#N/A	46.7	Slight	3.25
SRK-WR-RGSC0009-054	SRK	RGSC0009	41.6	44.6	3.1	CADOMIN	SANDSTONE	6.57	0.34	0.27	0.07	5.8	0.34	0.01	0.31	0.02	9.7	#N/A	4.1	Slight	0.42
SRK-WR-RGSC0009-055	SRK	RGSC0009	44.6	47.7	3.1	CADOMIN	SANDSTONE	5.59	0.47	0.42	0.05	4.2	0.9	0.04	0.76	0.1	23.8	#N/A	2.5	Slight	0.11
SRK-WR-RGSC0009-056	SRK	RGSC0009	47.7	50.6	3.0	CADOMIN	CLAYSTONE	6.76	1.11	0.45	0.66	55.0	0.64	0.02	0.54	0.08	16.9	#N/A	27.3	Slight	1.62
SRK-WR-RGSC0009-057	SRK	RGSC0009	50.6	53.2	2.5	CADOMIN	SANDSTONE	6.68	1.98	1.27	0.71	59.2	1.04	0.05	0.86	0.13	26.9	#N/A	26.5	Slight	0.99
SRK-WR-RGSC0009-058	SRK	RGSC0009	53.2	57.2	4.0	CADOMIN	CONGLOMERATE	4.62	0.18	0.17	<0.01	<0.83	0.48	0.04	0.39	0.05	12.2	#N/A	-1.5	Slight	0.00
SRK-WR-RGSC0009-059	SRK	RGSC0009	57.2	62.2	5.1	CADOMIN	CONGLOMERATE	3.69	0.68	0.66	0.02	1.7	2.04	0.1	1.87	0.07	58.4	#N/A	-2.8	Slight	0.00
SRK-WR-RGSC0009-060	SRK	RGSC0009	62.9	66.3	3.5	MUTZ	CLAYSTONE	5.56	4.27	3.39	0.88	73.3	0.91	0.04	0.73	0.14	22.8	#N/A	2.7	None	0.12
SRK-WR-RGSC0009-061	SRK	RGSC0009	66.3	69.9	3.6	MUTZ	CLAYSTONE	5.54	5.14	4.96	0.18	15.0	0.3	0.01	0.21	0.08	6.6	#N/A	0.5	None	0.08
SRK-WR-RGSC0009-062	SRK	RGSC0009	69.9	73.2	3.3	MUTZ	CLAYSTONE	6.41	4.42	4.01	0.41	34.2	0.25	0.01	0.18	0.06	5.6	#N/A	3.1	None	0.55
SRK-WR-RGSC0009-063	SRK	RGSC0009	73.2	73.4	0.2	MUTZ	CLAYSTONE	6.21	16.4	16.39	<0.01	<0.83	0.26	<0.01	0.13	0.12	4.1	#N/A	-1.5	None	0.01
SRK-WR-RGSC0009-064	SRK	RGSC0009	74.9	77.9	3.0	MUTZ	CLAYSTONE	6.75	2.72	2.45	0.27	22.5	0.25	0.01	0.18	0.06	5.6	#N/A	9.0	None	1.60
SRK-WR-RGSC0009-065	SRK	RGSC0009	77.9	80.7	2.8	MUTZ	CLAYSTONE	6.97	2.7	1.71	0.99	82.5	0.31	0.01	0.23	0.07	7.2	#N/A	27.8	Slight	3.87
SRK-WR-RGSC0009-066	SRK	RGSC0009	80.7	81.5	0.7	MUTZ	CARB. MUDSTONE	6.39	20.63	20.62	0.01	0.8	0.32	<0.01	0.13	0.18	4.1	#N/A	-0.9	None	0.01
SRK-WR-RGSC0009-067	SRK	RGSC0009	81.5	86.0	4.6	MUTZ	CLAYSTONE	7.18	2.8	2.23	0.57	47.5	0.09	<0.01	0.05	0.03	1.6	#N/A	15.2	Slight	9.73
SRK-WR-RGSC0009-068	SRK	RGSC0009	86.0	89.6	3.6	MUTZ	SANDSTONE	7.69	2.82	1.07	1.75	145.8	0.09	<0.01	0.05	0.03	1.6	#N/A	78.0	Slight	49.92
SRK-WR-RGSC0009-069	SRK	RGSC0009	89.6	91.3	1.7	MUTZ	CLAYSTONE	7.24	2.95	2.32	0.63	52.5	0.14	<0.01	0.08	0.05	2.5	#N/A	19.2	Slight	7.68
SRK-WR-RGSC0009-070	SRK	RGSC0009	91.3	95.3	4.0	MUTZ	SILTSTONE	7.26	2.9	1.85	1.05	87.5	0.09	<0.01	0.05	0.03	1.6	#N/A	30.2	Slight	19.33
SRK-WR-RGSC0009-071	SRK	RGSC0009	95.3	98.6	3.3	MUTZ	SILTSTONE	7.51	1.87	1.16	0.71	59.2	0.06	<0.01	0.02	0.03	0.6	#N/A	37.7	Slight	60.32
SRK-WR-RGSC0009-072	SRK	RGSC0009	100.3	103.3	3.1	MUTZ	SANDSTONE	7.82	2.82	0.95	1.87	155.8	0.08	0.01	0.04	0.03	1.3	#N/A	94.6	Moderate	75.68
SRK-WR-RGSC0009-073	SRK	RGSC0009	103.3	107.3	4.0	MUTZ	SANDSTONE	7.87	2.7	0.98	1.72	143.3	0.08	<0.01	0.05	0.02	1.6	#N/A	102.2	Moderate	65.41
SRK-WR-RGSC0009-074	SRK	RGSC0009	107.3	109.0	1.7	MUTZ	CLAYSTONE	7.69	3.88	1.73	2.15	179.2	0.1	<0.01	0.05	0.04	1.6	#N/A	82.2	Moderate	52.61
SRK-WR-RGSC0009-075	SRK	RGSC0009	109.0	112.1	3.1	MUTZ	SANDSTONE	7.68	1.67	0.64	1.03	85.8	0.1	<0.01	0.07	0.02	2.2	#N/A	69.0	Moderate	31.54
SRK-WR-RGSC0009-076	SRK	RGSC0009	112.1	115.5	3.4	MUTZ	SANDSTONE	7.94	3.36	1.03	2.33	194.2	0.09	<0.01	0.05	0.03	1.6	#N/A	142.6	Moderate	91.26
SRK-WR-RGSC0009-077	SRK	RGSC0009	115.5	116.5	1.0	MUTZ	CLAYSTONE	7.72	2.94	1.48	1.46	121.7	0.08	<0.01	0.05	0.02	1.6	#N/A	65.7	Moderate	42.05
SRK-WR-RGSC0009-078	SRK	RGSC0009	117.0	118.6	1.6	MUTZ	SILTSTONE	6.98	5.72	5.64	0.08	6.7	0.15	<0.01	0.09	0.05	2.8	#N/A	3.1	None	1.10
SRK-WR-RGSC0009-079	SRK	RGSC0009	118.6	118.8	0.2	MUTZ	SILTSTONE	6.89	12.55	12.52	0.03	2.5	0.13	<0.01	0.04	0.08	1.3	#N/A	0.6	None	0.48
SRK-WR-RGSC0009-080	SRK	RGSC0009	126.8	127.0	0.2	HILLCREST	CLAYSTONE	7.05	7.77	7.7	0.07	5.8	0.09	<0.01	0.01	0.07	0.3	#N/A	1.5	None	4.80
SRK-WR-RGSC0009-081	SRK	RGSC0009	127.0	129.5	2.5	HILLCREST	CLAYSTONE	7.31	8.07	7.94	0.13	10.8	0.14	<0.01	0.04	0.09	1.3	#N/A	2.6	None	2.08
SRK-WR-RGSC0009-082	SRK	RGSC0009	129.5	129.7	0.2	HILLCREST	CLAYSTONE	7.00	1.86	1.75	0.11	9.2	0.1	<0.01	0.07	0.02	2.2	#N/A	1.7	None	0.78
SRK-WR-RGSC0009-083	SRK	RGSC0009	130.3	130.5	0.2	HILLCREST	CLAYSTONE	7.02	3.18	3.12	0.06	5.0	0.06	<0.01	0.01	0.04	0.3	#N/A	1.2	None	3.84
SRK-WR-RGSC0009-084	SRK	RGSC0009	130.5	134.6	4.1	HILLCREST	CLAYSTONE	7.42	2.56	1.82	0.74	61.7	0.06	<0.01	0.04	0.01	1.3	#N/A	46.3	Slight	37.04
SRK-WR-RGSC0009-085	SRK	RGSC0009	134.6	137.4	2.8	HILLCREST	FAULT BRECCIA	7.37	5.39	4.07	1.32	110.0	0.08	<0.01	0.03	0.04	0.9	#N/A	45.3	Slight	48.32
SRK-WR-RGSC0009-087	SRK	RGSC0009	138.6	138.9	0.3	HILLCREST	CLAYSTONE	6.97	6.88	6.53	0.35	29.2	0.08	<0.01	0.01	0.06	0.3	#N/A	8.1	Slight	25.92
SRK-WR-RGSC0009-088	SRK	RGSC0009	140.0	140.2	0.2	ADANAC	CLAYSTONE	6.76	2.9	2.51	0.39	32.5	0.06	<0.01	0.02	0.03	0.6	#N/A	3.4	None	5.44
SRK-WR-RGSC0009-089	SRK	RGSC0009	140.2	143.0	2.9	ADANAC	CLAYSTONE	6.62	2.25	2.12	0.13	10.8	0.14	<0.01	0.09	0.04	2.8	#N/A	1.1	None	0.39
SRK-WR-RGSC0009-090	SRK	RGSC0009	143.0	145.1	2.0	ADANAC	SILTSTONE	7.34	2.96	2.12	0.84	70.0	0.13	<0.01	0.09	0.03	2.8	#N/A	30.7	Slight	10.92
SRK-WR-RGSC0009-091	SRK	RGSC0009	145.1	145.3	0.2	ADANAC	SANDSTONE	7.85	7.9	7.71	0.19	15.8	0.15	<0.01	0.07	0.07	2.2	#N/A	1.7	None	0.78
SRK-WR-RGSC0009-092	SRK	RGSC0009	146.3	146.5	0.2	MOOSE	CLAYSTONE	6.08	4.9	4.86	0.04	3.3	0.05	<0.01	0.01	0.03	0.3	#N/A	0.4	None	1.28
SRK-WR-RGSC0009-093	SRK	RGSC0009	146.5	151.5	5.0	MOOSE	SANDSTONE	6.02	2.41	2.33	0.08	6.7	0.61	0.01	0.52	0.08	16.3	#N/A	1.2	None	0.07
SRK-WR-RGSC0009-094	SRK	RGSC0009	151.5	156.5	5.0	MOOSE	SANDSTONE	7.34	2.09	1.61	0.48	40.0	0.44	0.01	0.38	0.05	11.9	#N/A	2.6	Slight	2.19
SRK-WR-RGSC0009-094A	SRK	RGSC0009	156.5	158.9	2.4	MOOSE	SANDSTONE	7.97	2.22	0.38	1.84	153.3	0.11	<0.01	0.09	0.01	2.8	#N/A	123.6	Moderate	43.95

Sample ID	Sample Origin	Hole	From (field) m	To (field) m	Interval Length m	Unit	Composition	Acid Base Accounting													
								Paste pH Std. Units	Total C %	Organic C % Calc.	TIC % as C	TIC kg CaCO3/t Calc.	Total S %S	HCl-Extractable S %	Sulphide S % Calc.	Organic S % Calc.	AP kg CaCO3/t Calc.	Sobek NP kg CaCO3/t	Modified NP kg CaCO3/t	Fizz Test	(Mod. NP)/AP Ratio Calc.
SRK-WR-RGSC0010-095	SRK	RGSC0010	17.7	19.0	1.3	CADOMIN	SANDSTONE	7.50	0.7	0.25	0.45	37.5	0.07	<0.01	0.06	0	1.9	#N/A	35.5	Slight	18.93
SRK-WR-RGSC0010-096	SRK	RGSC0010	19.0	20.3	1.3	CADOMIN	SILTSTONE	6.79	1.28	0.9	0.38	31.7	0.15	<0.01	0.12	0.02	3.8	#N/A	6.6	None	1.76
SRK-WR-RGSC0010-097	SRK	RGSC0010	20.3	22.0	1.7	CADOMIN	SILTSTONE	6.92	1.44	1.09	0.35	29.2	0.52	0.02	0.48	0.02	15.0	#N/A	17.8	Slight	1.19
SRK-WR-RGSC0010-098	SRK	RGSC0010	22.0	28.1	6.1	CADOMIN	SANDSTONE	6.77	0.76	0.47	0.29	24.2	1	0.04	0.91	0.05	28.4	#N/A	11.4	Slight	0.40
SRK-WR-RGSC0010-099	SRK	RGSC0010	28.1	29.5	1.4	CADOMIN	SILTSTONE	6.62	0.79	0.51	0.28	23.3	1.17	0.04	1.09	0.04	34.1	#N/A	11.5	Slight	0.34
SRK-WR-RGSC0010-100	SRK	RGSC0010	29.5	34.0	4.5	CADOMIN	SILTSTONE	6.31	0.67	0.32	0.35	29.2	3.92	0.09	3.85	-0.02	120.3	#N/A	14.8	Slight	0.12
SRK-WR-RGSC0010-101	SRK	RGSC0010	34.0	36.7	2.7	CADOMIN	SANDSTONE	7.07	0.21	0.07	0.14	11.7	0.56	0.02	0.48	0.06	15.0	#N/A	9.2	Slight	0.61
SRK-WR-RGSC0010-102	SRK	RGSC0010	36.7	39.7	3.0	CADOMIN	CONGLOMERATE	4.72	0.93	0.28	0.65	54.2	2.76	0.08	2.43	0.25	75.9	#N/A	8.0	Slight	0.11
SRK-WR-RGSC0010-103	SRK	RGSC0010	39.7	43.2	3.5	CADOMIN	CONGLOMERATE	7.52	0.25	0.21	0.04	3.3	0.75	0.03	0.66	0.06	20.6	#N/A	0.1	Slight	0.00
SRK-WR-RGSC0010-104	SRK	RGSC0010	44.3	45.5	1.2	MUTZ	CLAYSTONE	6.19	4.74	4.72	0.02	1.7	0.6	0.02	0.46	0.12	14.4	#N/A	-0.9	None	0.00
SRK-WR-RGSC0010-105	SRK	RGSC0010	47.7	48.5	0.8	MUTZ	CLAYSTONE	6.69	4.99	4.91	0.08	6.7	0.49	<0.01	0.36	0.12	11.3	#N/A	1.4	None	0.12
SRK-WR-RGSC0010-106	SRK	RGSC0010	50.3	53.1	2.8	MUTZ	CLAYSTONE	7.02	3.4	3.15	0.25	20.8	0.34	<0.01	0.26	0.07	8.1	#N/A	6.1	None	0.75
SRK-WR-RGSC0010-106A	SRK	RGSC0010	53.8	54.0	0.2	MUTZ	CLAYSTONE	6.91	9.51	8.91	0.6	50.0	0.77	0.02	0.6	0.15	18.8	#N/A	13.8	None	0.74
SRK-WR-RGSC0010-106B	SRK	RGSC0010	54.0	55.6	1.5	MUTZ	CLAYSTONE	7.13	2.2	1.91	0.29	24.2	0.18	<0.01	0.14	0.03	4.4	#N/A	5.0	None	1.14
SRK-WR-RGSC0010-107	SRK	RGSC0010	55.6	55.8	0.2	MUTZ	CLAYSTONE	7.18	3.16	2.79	0.37	30.8	0.19	<0.01	0.13	0.05	4.1	#N/A	10.4	None	2.56
SRK-WR-RGSC0010-108	SRK	RGSC0010	58.8	59.0	0.2	MUTZ	CLAYSTONE	7.03	4.65	4.63	0.02	1.7	0.33	<0.01	0.23	0.09	7.2	#N/A	0.5	None	0.07
SRK-WR-RGSC0010-109	SRK	RGSC0010	59.0	63.0	4.0	MUTZ	CLAYSTONE	7.05	2.22	1.85	0.37	30.8	0.16	<0.01	0.11	0.04	3.4	#N/A	7.7	Slight	2.24
SRK-WR-RGSC0010-110	SRK	RGSC0010	63.0	68.1	5.1	MUTZ	CLAYSTONE	6.99	2.72	2.48	0.24	20.0	0.11	<0.01	0.05	0.05	1.6	#N/A	2.6	None	1.66
SRK-WR-RGSC0010-111	SRK	RGSC0010	68.1	72.1	4.0	MUTZ	SILTSTONE	7.11	3.35	2.14	1.21	100.8	0.13	<0.01	0.08	0.04	2.5	#N/A	8.0	Slight	3.20
SRK-WR-RGSC0010-112	SRK	RGSC0010	72.1	74.8	2.7	MUTZ	CLAYSTONE	7.34	2.3	1.65	0.65	54.2	0.14	<0.01	0.11	0.02	3.4	#N/A	25.8	Slight	7.51
SRK-WR-RGSC0010-113	SRK	RGSC0010	74.8	78.8	4.0	MUTZ	SANDSTONE	7.61	2	0.85	1.15	95.8	0.06	<0.01	0.04	0.01	1.3	#N/A	37.5	Slight	30.00
SRK-WR-RGSC0010-114	SRK	RGSC0010	78.8	82.8	4.0	MUTZ	SANDSTONE	7.22	1.05	0.75	0.3	25.0	0.07	<0.01	0.04	0.02	1.3	#N/A	9.8	Slight	7.84
SRK-WR-RGSC0010-115	SRK	RGSC0010	82.8	87.8	5.0	MUTZ	SANDSTONE	7.16	1.21	0.83	0.38	31.7	0.09	<0.01	0.06	0.02	1.9	#N/A	7.5	Slight	4.00
SRK-WR-RGSC0010-116	SRK	RGSC0010	87.8	91.8	4.0	MUTZ	SILTSTONE	7.73	2.39	0.93	1.46	121.7	0.06	<0.01	0.03	0.02	0.9	#N/A	61.2	Moderate	65.28
SRK-WR-RGSC0010-117	SRK	RGSC0010	91.8	96.8	5.0	MUTZ	SILTSTONE	7.85	2.57	0.99	1.58	131.7	0.06	<0.01	0.03	0.02	0.9	#N/A	89.8	Moderate	95.79
SRK-WR-RGSC0010-118	SRK	RGSC0010	96.8	101.3	4.6	MUTZ	CLAYSTONE	7.53	3.61	2.4	1.21	100.8	0.09	<0.01	0.04	0.04	1.3	#N/A	56.4	Moderate	45.12
SRK-WR-RGSC0010-119	SRK	RGSC0010	101.3	102.2	0.8	MUTZ	CARB. MUDSTONE	6.58	33.6	33.55	0.05	4.2	0.32	<0.01	0.04	0.27	1.3	#N/A	1.7	None	1.36
SRK-WR-RGSC0010-120	SRK	RGSC0010	102.2	105.4	3.3	MUTZ	CLAYSTONE	7.00	5.58	4.54	1.04	86.7	0.14	<0.01	0.07	0.06	2.2	#N/A	10.1	Slight	4.62
SRK-WR-RGSC0010-121	SRK	RGSC0010	105.4	108.1	2.6	MUTZ	CLAYSTONE	6.99	1.4	1.14	0.26	21.7	0.05	<0.01	0.02	0.02	0.6	#N/A	3.8	None	6.08
SRK-WR-RGSC0010-122	SRK	RGSC0010	108.1	108.3	0.2	MUTZ	CARB. MUDSTONE	6.74	7.38	7.31	0.07	5.8	0.12	<0.01	0.03	0.08	0.9	#N/A	1.0	None	1.07
SRK-WR-RGSC0010-123	SRK	RGSC0010	116.4	116.5	0.2	MUTZ	CLAYSTONE	6.92	9	8.91	0.09	7.5	0.13	<0.01	0.05	0.07	1.6	#N/A	1.5	None	0.96
SRK-WR-RGSC0010-124	SRK	RGSC0010	116.5	118.4	1.8	MUTZ	CLAYSTONE	6.89	11.62	11.46	0.16	13.3	0.15	<0.01	0.04	0.1	1.3	#N/A	3.1	None	2.48
SRK-WR-RGSC0010-125	SRK	RGSC0010	118.4	118.6	0.2	MUTZ	CLAYSTONE	6.90	6.78	6.67	0.11	9.2	0.12	<0.01	0.06	0.05	1.9	#N/A	1.8	None	0.96
SRK-WR-RGSC0010-126	SRK	RGSC0010	119.8	120.0	0.2	HILLCREST	CLAYSTONE	7.02	12.64	12.53	0.11	9.2	0.13	<0.01	0.02	0.1	0.6	#N/A	3.7	None	5.92
SRK-WR-RGSC0010-127	SRK	RGSC0010	120.0	123.9	3.9	HILLCREST	CLAYSTONE	7.32	5.89	5.52	0.37	30.8	0.12	<0.01	0.05	0.06	1.6	#N/A	18.1	Slight	11.58
SRK-WR-RGSC0010-128	SRK	RGSC0010	123.9	127.6	3.7	HILLCREST	SILTSTONE	7.56	3.47	2.19	1.28	106.7	0.06	<0.01	0.03	0.02	0.9	#N/A	55.2	Slight	58.88
SRK-WR-RGSC0010-129	SRK	RGSC0010	127.6	127.8	0.2	HILLCREST	CLAYSTONE	7.08	4.69	4.55	0.14	11.7	0.1	<0.01	0.05	0.04	1.6	#N/A	2.1	None	1.34
SRK-WR-RGSC0010-130	SRK	RGSC0010	129.0	129.3	0.3	HILLCREST	CARB. MUDSTONE	7.39	14.06	13.33	0.73	60.8	0.1	<0.01	0.02	0.07	0.6	#N/A	45.0	Moderate	72.00
SRK-WR-RGSC0010-131	SRK	RGSC0010	131.5	131.7	0.2	ADANAC	CLAYSTONE	7.61	22.66	19.95	2.71	225.8	0.24	<0.01	0.06	0.17	1.9	#N/A	100.0	Moderate	53.33
SRK-WR-RGSC0010-132	SRK	RGSC0010	131.7	135.7	4.0	ADANAC	CLAYSTONE	7.29	7.33	6.6	0.73	60.8	0.1	<0.01	0.03	0.06	0.9	#N/A	11.2	Slight	11.95
SRK-WR-RGSC0010-133	SRK	RGSC0010	135.7	137.8	2.1	ADANAC	SANDSTONE	7.75	4.62	3.26	1.36	113.3	0.12	<0.01	0.07	0.04	2.2	#N/A	57.1	Slight	26.10
SRK-WR-RGSC0010-134	SRK	RGSC0010	137.8	138.0	0.2	ADANAC	CLAYSTONE	7.04	11.32	11.14	0.18	15.0	0.14	<0.01	0.03	0.1	0.9	#N/A	6.8	None	7.25
SRK-WR-RGSC0010-135	SRK	RGSC0010	139.6	139.8	0.2	ADANAC	CLAYSTONE	7.09	3.09	3	0.09	7.5	0.04	<0.01	0.01	0.02	0.3	#N/A	1.4	None	4.48
SRK-WR-RGSC0010-136	SRK	RGSC0010	139.8	143.8	4.0	ADANAC	CLAYSTONE	7.67	2.99	1.81	1.18	98.3	0.05	<0.01	0.02	0.02	0.6	#N/A	50.4	Slight	80.64
SRK-WR-RGSC0010-137	SRK	RGSC0010	143.8	149.1	5.3	ADANAC	CLAYSTONE	7.61	4.75	3.87	0.88	73.3	0.11	<0.01	0.05	0.05	1.6	#N/A	34.5	Slight	22.08
SRK-WR-RGSC0010-138	SRK	RGSC0010	149.1	149.5	0.4	ADANAC	CLAYSTONE	7.14	20.6	20.39	0.21	17.5	0.24	<0.01	0.04	0.19	1.3	#N/A	5.8	None	4.64
SRK-WR-RGSC0010-139	SRK	RGSC0010	154.6	154.8	0.2	ADANAC	SILTSTONE	7.08	3.36	3.3	0.06	5.0	0.05	<0.01	0.01	0.03	0.3	#N/A	0.7	None	2.24
SRK-WR-RGSC0010-140	SRK	RGSC0010	154.8	159.8	5.0	ADANAC	SILTSTONE	7.19	1.6	1.42	0.18	15.0	0.12	<0.01	0.09	0.02	2.8	#N/A	4.5	None	1.60
SRK-WR-RGSC0010-141	SRK	RGSC0010	159.8	162.8	3.0	ADANAC	CLAYSTONE	7.74	2.83	2.07	0.76	63.3	0.19	<0.01	0.15	0.03	4.7	#N/A	27.9	Slight	5.95
SRK-WR-RGSC0010-142	SRK	RGSC0010	162.8	163.0	0.2	ADANAC	CARB. MUDSTONE	7.66	5.72	3.17	2.55	212.5	0.09	<0.01	0.05	0.03	1.6	#N/A	18.8	Slight	12.03
SRK-WR-RGSC0010-143	SRK	RGSC0010	165.0	165.2	0.2	ADANAC	CARB. MUDSTONE	6.61	5	4.86	0.14	11.7	1.18	0.01	1.01	0.16	31.6	#N/A	2.0	Slight	0.06
SRK-WR-RGSC0010-145	SRK	RGSC0010	165.2	170.9	5.7	ADANAC	SANDSTONE	6.89	1.83	1.68	0.15	12.5	0.61	0.02	0.57	0.02	17.8	#N/A	3.4	Slight	0.19
L1437868-1	MEMS	RGOH3003	4.0	14.0	10.0	CADOMIN	SILTSTONE	7.6	1.7	1.27	0.43	35.8	0.04	0.01	#N/A	#N/A	#N/A	32	#N/A	2	#N/A
L1437868-2	MEMS	RGOH3003	15.0	25.0	10.0	CADOMIN	CONGLOMERATE	7.7	0.6	0.39	0.21	17.5	0.05	0.02	#N/A	#N/A	#N/A	10	#N/A	1	#N/A
L1437868-3	MEMS	RGOH3003	26.0	30.0	4.0	CADOMIN	SILTSTONE+CONGLOMERATE	7.5	1	0.96	0.04	3.3	0.07	0.01	#N/A	#N/A	#N/A	6	#N/A	1	#N/A
L1437868-4	MEMS	RGOH3003	32.0	33.0	1.0	CADOMIN	SILTSTONE	7.1	11.4	11.4	0.01	0.8	0.26	0.03	#N/A	#N/A	#N/A	4	#N/A	1	#N/A
L1437868-5	MEMS	RGOH3003	34.0	40.0	6.0	MUTZ	SANDSTONE+SHALE	8.0	3.9	2.48	1.42	118.3	0.09	<0.01	#N/A	#N/A	#N/A	100	#N/A	3	#N/A
L1437868-6	MEMS	RGOH3003	41.0	50.0	9.0	MUTZ	SHALE	7.7	5.1	4.49	0.61	50.8	0.09	0.01	#N/A	#N/A	#N/A	37	#N/A	2	#N/A
L1437868-7	MEMS	RGOH3003	52.0	57.0	5.0	MUTZ	CARBONACEOUS MUDSTONE	7.3	8.1	8.12	0.01	0.8	0.14	0.01	#N/A	#N/A	#N/A	6	#N/A	1	#N/A
L1437868-8	MEMS	RGOH3003	81.0	84.0	3.0	HILLCREST	SHALE	7.9	1.4	0.96	0.44	36.7	0.05	0.02	#N/A	#N/A	#N/A	21	#N/A	2	#N/A
L1437868-9	MEMS	RGOH3003	102.0	109.0	7.0	HILLCREST	SHALE	7.5	5.9	5.61	0.29	24.2	0.14	0.02	#N/A	#N/A	#N/A	16	#N/A	2	#N/A
L1437868-10	MEMS	RGOH3003	116.0	127.0	11.0	HILLCREST	SHALE+SANDSTONE+SILTSTONE	8.0	5.1	4.32	0.78	65.0	0.09	0.01	#N/A	#N/A	#N/A	50	#N/A	2	#N/A
L1437868-11	MEMS	RGOH3003	136.0	137.0	1.0	HILLCREST	SHALE	8.0	19.3	17.6	1.7	141.7	0.17	0.04	#N/A	#N/A	#N/A	57	#N/A	2	#N/A
L1437868-12	MEMS	RGOH3003	143.0	144.0	1.0	ADANAC	SANDSTONE	7.9	2.4	1.87	0.53	44.2	0.44	0.07	#N/A	#N/A	#N/A	34	#N/A	2	#N/A
L1437868-13	MEMS	RGOH3001	1.0	12.0	11.0	CADOMIN	SHALE+SILTSTONE	7.5	27	26.7	0.3	25.0	0.19	0.03	#N/A	#N/A	#N/A	15	#N/A	1	#N/A
L1437868-14	MEMS	RGOH3001	14.0	20.0	6.0	CADOMIN	CONGLOMERATE	6.8	1.2	1.02	0.18	15.0	0.31	0.02	#N/A	#N/A	#N/A	9	#N/A	1	#N/A
L1437868-15	MEMS	RGOH3001	21.0	32.0	11.0	CADOMIN	CONGLOMERATE	6.6	1.1	0.7	0.4	33.3	0.5	0.02	#N/A	#N/A	#N/A	21	#N/A	2	#N/A
L1437868-16	MEMS	RGOH3001	33.0	49.0	16.0	MUTZ	SILTSTONE+SHALE	7.7	9.2	8.7	0.5	41.7	0.19	0.03	#N/A	#N/A	#N/A	27	#N/A	2	#N/A
L1437868-17	MEMS	RGOH3001	53.0	59.0	6.0	MUTZ	SHALE+CLAYSTONE	8.1	8.9	8.11	0.79	65.8	0.15	0.02	#N/A	#N/A	#N/A	59	#N/A	2	#N/A
L1437868-18	MEMS	RGOH3001	60.0	70.0	10.0	MUTZ	SHALE+SILSTONE	8.1	4.2	3.09	1.11	92.5	0.11	0.03	#N/A	#N/A	#N/A	87	#N/A	3	#N/A
L1437868-19	MEMS	RGOH3001	71.0	77.0	6.0	MUTZ	SHALE	8.1	4.5	3.45	1.05	87.5	0.12	0.07	#N/A	#N/A	#N/A	67	#N/A	2	#N/A
L1437868-20	MEMS	RGOH3001	88.0	97.0	9.0	HILLCREST	SHALE	8.6	4.1	3.01	1.09	90.8	0.07	0.04	#N/A	#N/A	#N/A	62	#N/A	2	#N/A
L1437868-21	MEMS	RGOH3001	98.0	105.0	7.0	HILLCREST	SHALE+SILTSTONE	8.7	2.4	1.47	0.93	77.5	0.08	0.04	#N/A	#N/A	#N/A	59	#N/A	2	#N/A
L1437868-22	MEMS	RGOH3001	106.0	113.0	7.0	HILLCREST	SILTSTONE+SANDSTONE	8.9	3.3	1.25	2.05	170.8	0.05	0.03	#N/A	#N/A	#N/A	136	#N/A	3	#N/A
L1437868-23	MEMS	RGOH3001	129.0	135.0	6.0	ADANAC	SANDSTONE	8.4	1.4	0.99	0.41	34.2	0.34	0.03	#N/A	#N/A	#N/A	26	#N/A	2	#N/A
L1437868-24	MEMS	RGOH3002	1.0	8.0	7.0	CADOMIN	SANDSTONE+SILTSTONE+SHALE	7.6	3.5	3.2	0.3	25.0	0.06	0.02	#N/A	#N/A	#N/A	18	#N/A	2	#N/A
L1437868-25	MEMS	RGOH3002	16.0	25.0	9.0	MUTZ	SANDSTONE+SILTSTONE+SHALE	8.1	3.5	1.59	1.91	159.2	0.11	0.09	#N/A	#N/A	#N/A	136	#N/A	3	#N/A
L1437868-26	MEMS	RGOH3002	25.0	33.0	8.0	MUTZ	SANDSTONE+SILTSTONE+SHALE	7.5	7.2	6.77	0.43	35.8	0.21	0.07	#N/A	#N/A	#N/A	16	#N/A	1	#N/A
L1437868-27	MEMS	RGOH3002	34.0	41.0	7.0	MUTZ	SHALE+CLAYSTONE	7.9	3.2	2.27	0.93	77.5	0.12	0.04	#N/A	#N/A	#N/A	60	#N/A	2	#N/A
L1437868-28	MEMS	RGOH3002	53.0	61.0	8.0	HILLCREST	SILTSTONE+SANDSTONE+SHALE	7.8	2.6	2.21	0.39	32.5	0.1	0.03	#N/A	#N/A	#N/A	19	#N/A	2	#N/A
L1437868-29	MEMS	RGOH3002	62.0	70.0	8.0	HILLCREST	SANDSTONE+SILTSTONE+SHALE	8.2	3.7	1.58	2.12	176.7	0.05	0.01	#N/A	#N/A	#N/A	153	#N/A	3	#N/A
L1437868-30	MEMS	RGOH3002	77.0	93.0	16.0	ADANAC	SILTSTONE+SANDSTONE	7.5	5.5	4.86	0.64	53.3	0.3	<0.01	#N/A	#N/A	#N/A	16	#N/A	1	#N/A

Sample ID		Element Analysis by Aqua Regia Digestion + ICP-MS																																							
	(Mod. NP)/AP Classification Calc.	Al mg/kg	Sb mg/kg	As mg/kg	Ba mg/kg	Bi mg/kg	B mg/kg	Cd mg/kg	Ca mg/kg	Cr mg/kg	Co mg/kg	Cu mg/kg	Ga mg/kg	Au mg/kg	Fe mg/kg	La mg/kg	Pb mg/kg	Mg mg/kg	Mn mg/kg	Hg mg/kg	Mo mg/kg	Ni mg/kg	P mg/kg	K mg/kg	Sc mg/kg	Se mg/kg	Ag mg/kg	Na mg/kg	Sr mg/kg	S mg/kg	Te mg/kg	Tl mg/kg	Th mg/kg	Ti mg/kg	W mg/kg	U mg/kg	V mg/kg	Zn mg/kg
SRK-WR-RGSC0006-001	Non-PAG	9100	0.4	4.1	200.8	0.14	<20	0.98	6400	16.8	7.5	22.77	2.5	0.0002	58700	6	10.45	5000	793	0.042	1.5	29.3	940	2400	4.4	1.1	0.419	120	15.9	400	0.07	0.11	3.3	10	<0.1	1	36	110.7
SRK-WR-RGSC0006-002	Non-PAG	7800	0.39	9.4	76.4	0.33	<20	1.59	1900	34.3	10.7	45.04	3	0.0006	9900	3.4	23.29	2100	39	0.103	1.97	42.4	570	2000	3.1	1	0.322	30	13.7	500	0.05	0.13	3.6	<10	<0.1	0.6	21	160.5
SRK-WR-RGSC0006-002A	non-PAG	7500	0.51	9.1	573	0.25	<20	1.14	3800	54.8	11.9	38.25	2.9	<0.0002	16400	5	18.81	3000	178	0.1	2.87	41.5	740	1900	4.4	1.2	0.334	50	17.6	1300	<0.02	0.08	4.1	10	<0.1	0.9	24	164.5
SRK-WR-RGSC0006-003	non-PAG	2200	0.43	8	491.9	0.04	<20	0.54	23500	114.9	6.3	7.55	0.8	0.0006	9900	2.7	7.02	10600	152	0.044	5.71	21.9	830	600	2.7	0.7	0.177	30	24.7	2500	0.02	0.08	1.9	<10	<0.1	0.4	20	62
SRK-WR-RGSC0006-004	non-PAG	4400	0.35	9	43.4	0.05	<20	0.48	21000	10.8	6.7	9.09	1.4	0.0018	11800	3.6	7.14	9800	164	0.043	1.6	17.4	950	1100	3.3	0.3	0.217	40	19.4	1700	<0.02	0.08	2.3	10	<0.1	0.6	25	63.1
SRK-WR-RGSC0006-005	Non-PAG	1500	0.61	12.6	34	0.04	<20	0.54	3000	206.1	6.2	7.71	0.6	<0.0002	6300	2.3	11.4	1000	73	0.045	9.88	23.6	680	400	1.8	0.3	0.311	20	10	900	0.02	0.12	1	<10	<0.1	0.5	17	46.9
SRK-WR-RGSC0006-006	Uncertain	1800	0.71	14.9	39	0.04	<20	0.53	2300	8.8	8.9	8.71	0.7	0.0005	9000	2.1	11.85	800	137	0.036	1.32	19.2	650	500	1.7	0.3	0.337	20	8.2	1100	0.04	0.11	1	<10	<0.1	0.4	19	52.2
SRK-WR-RGSC0006-007	non-PAG	3200	0.48	7.6	42.3	0.04	<20	0.71	8000	10.8	7.1	9.31	1.1	<0.0002	12400	2.8	9.89	3200	148	0.045	1.67	17.4	840	800	2.5	0.4	0.249	30	12.7	1200	0.03	0.08	1.5	10	<0.1	0.5	26	63.6
SRK-WR-RGSC0006-008	non-PAG	2200	0.48	9	43	0.04	<20	0.57	5200	10.2	7.6	9.52	0.9	<0.0002	11800	2.4	12.5	2100	169	0.044	1.78	17.9	680	600	2.3	0.1	0.313	30	10.7	2300	<0.02	0.11	1.1	10	<0.1	0.5	25	55.7
SRK-WR-RGSC0006-009	non-PAG	2300	0.4	5.9	40.4	0.03	<20	0.64	9700	7.9	6.1	7.3	0.9	<0.0002	9600	2.6	7.7	3900	143	0.031	0.85	12.8	840	700	2	0.3	0.217	20	13.2	2400	<0.02	0.07	1.3	10	<0.1	0.5	20	58.6
SRK-WR-RGSC0006-010	non-PAG	6700	0.27	4.6	99.6	0.09	<20	1.11	12200	12.1	9.5	20.84	2	<0.0002	17900	4.6	10.93	5700	298	0.03	1.19	21.9	780	2000	3.2	0.4	0.333	50	17.9	1900	<0.02	0.11	2.6	10	<0.1	0.6	27	102.8
SRK-WR-RGSC0006-011	Uncertain	1800	0.65	9.2	38.5	0.03	<20	0.67	5200	11	6.2	10.7	0.9	<0.0002	14200	1.9	8.8	2500	246	0.031	1.72	17.9	580	500	1.6	0.3	0.395	40	8	2900	<0.02	0.09	1	10	<0.1	0.5	24	55.6
SRK-WR-RGSC0006-012	PAG	1200	0.66	9.7	45.2	0.04	<20	0.72	1100	8.4	6.7	8.42	0.6	<0.0002	9900	1.4	11.03	400	146	0.029	1.37	14.6	430	400	1.2	0.2	0.355	30	5.7	3200	0.03	0.1	0.6	<10	<0.1	0.4	20	49.6
SRK-WR-RGSC0006-013	PAG	1900	1.01	13.9	70.9	0.08	<20	1.08	1400	9.4	8	13.26	0.8	0.0003	11500	2.2	13.58	400	142	0.046	3.43	19	550	500	1.4	0.2	0.376	30	10.2	4900	<0.02	0.11	0.9	10	<0.1	0.5	18	47.3
SRK-WR-RGSC0006-014	PAG	1200	0.95	12.5	67.1	0.05	<20	0.83	1100	9.1	6.6	11.9	0.7	0.0004	15600	1.6	9.89	600	347	0.053	2.99	17.1	400	300	1.2	0.2	0.354	30	10.6	5000	0.03	0.11	0.7	10	<0.1	0.4	16	32.8
SRK-WR-RGSC0006-015	Non-PAG	4900	1.29	3.3	312.1	0.23	<20	2.84	6900	9.8	9.7	39.65	1.4	<0.0002	14400	6.6	15.7	4400	160	0.159	2.43	43.8	1300	2300	4.8	2	0.423	70	27.3	700	0.03	0.13	5.4	10	<0.1	1.7	34	213.7
SRK-WR-RGSC0006-016	Non-PAG	4100	0.5	1.5	224.4	0.19	<20	1.77	1800	7	7.4	34.78	1	<0.0002	5300	4.3	12.73	1400	59	0.141	2.63	24.6	170	2000	2.1	1.1	0.37	50	12.5	400	0.06	0.07	2	<10	<0.1	0.8	18	155.5
SRK-WR-RGSC0006-017	PAG	5300	1.79	3.8	257.6	0.35	<20	2.72	2100	7.3	9.5	51.74	1.4	<0.0002	7300	4.2	19.97	2000	50	0.2	1.39	43.6	510	2600	4.2	2.3	0.436	80	16.7	1400	0.07	0.06	3.7	<10	<0.1	1.1	26	283.1
SRK-WR-RGSC0006-018	Non-PAG	4800	1.08	2.5	318.5	0.25	<20	2.65	10900	9.7	8.1	40.14	1.3	<0.0002	25400	7	15.3	7900	431	0.159	1.75	30.3	1050	2100	5.6	1.5	0.36	80	28.1	600	0.04	0.11	5.2	<10	<0.1	1.4	36	209.4
SRK-WR-RGSC0006-019	Non-PAG	5100	0.74	3.3	359.2	0.22	<20	2.38	8300	8.7	7.7	36.96	1.4	<0.0002	10000	6.2	14.11	4600	122	0.179	2.46	29.2	1080	2400	3.5	1.4	0.364	80	27.1	700	0.08	0.09	4.2	10	<0.1	1.5	27	189.7
SRK-WR-RGSC0006-020	Non-PAG	6500	0.26	4	436.5	0.14	<20	1.87	22800	13.9	8.9	30.25	1.8	0.0004	41500	7	11.38	10800	516	0.094	1.56	34.8	960	3000	5.6	1	0.339	80	37	600	0.04	0.09	4.4	<10	<0.1	1.3	49	141.3
SRK-WR-RGSC0006-021	Non-PAG	4400	0.53	9.9	200.9	0.04	<20	1.06	12700	11.5	7.9	14.59	1.3	<0.0002	12500	5.8	12.31	4200	155	0.149	1.37	33.7	1130	1600	2.9	0.7	0.323	30	27.7	900	<0.02	0.09	2.8	10	<0.1	1.1	26	137.7
SRK-WR-RGSC0006-022	Non-PAG	8000	0.26	2.2	445.3	0.19	<20	2.5	6700	16.8	11.8	39.73	2.1	<0.0002	37600	7.2	13.13	4500	528	0.137	2.2	50.2	1040	3400	6.9	1.8	0.4	70	24.9	500	0.05	0.08	5.2	<10	<0.1	1.4	57	181.6
SRK-WR-RGSC0006-023	Non-PAG	7000	0.19	1.7	391.3	0.11	<20	1.74	15400	15.2	8.1	30.38	1.9	<0.0002	36200	7.9	10.46	7000	511	0.103	1.32	27.4	1000	2900	5.3	1	0.328	70	29.5	300	0.05	0.06	4.3	10	<0.1	1.2	47	138.1
SRK-WR-RGSC0006-024	Non-PAG	4300	0.48	6.8	289.6	0.09	<20	1.6	6700	12.2	8.5	24.99	1.2	<0.0002	23300	6.6	9.48	3600	305	0.153	1.69	28.9	1100	1700	4.1	1.2	0.34	50	23	500	0.03	0.08	3.9	<10	<0.1	1.2	33	133.2
SRK-WR-RGSC0006-025	Non-PAG	6800	0.31	1.9	302.4	0.18	<20	1.36	1800	7.9	6.4	40	1.7	<0.0002	9000	3.8	12.13	1200	120	0.108	1.99	25	410	1900	4.3	1.6	0.363	50	12	600	0.05	<0.02	2.4	<10	<0.1	0.7	24	145.3
SRK-WR-RGSC0006-026	Non-PAG	3600	0.23	5.5	418.3	0.05	<20	1.23	7300	6.8	8.2	18.48	0.9	<0.0002	7100	1.7	7.94	2500	66	0.197	1.39	22.6	20	1700	2.2	0.8	0.286	50	32.4	400	<0.02	0.05	1.1	<10	<0.1	0.4	14	88.4
SRK-WR-RGSC0006-027	Non-PAG	4600	0.23	3.2	399.1	0.14	<20	1.35	2500	6.2	9.2	29.71	1.2	<0.0002	5000	2.7	13.27	1400	39	0.141	1.16	25.4	20	1900	3.2	1.2	0.266	50	16.9	400	0.04	0.05	1.2	<10	<0.1	0.5	13	116
SRK-WR-RGSC0006-028	Non-PAG	7300	0.18	3.1	451.1	0.17	<20	1.25	4300	10.8	10.9	33.73	2	<0.0002	5200	5.1	13.44	1300	42	0.103	1.4	29.6	610	3100	3.2	0.9	0.257	80	25.7	400	0.03	0.07	3.5	<10	<0.1	0.8	23	122.2
SRK-WR-RGSC0006-029	Non-PAG	6800	0.1	1.7	379.1	0.09	<20	0.97	15200	11.1	6.7	19.5	1.8	<0.0002	21800	7.1	10.31	6000	100	0.05	0.72	14.6	820	2600	4.9	0.3	0.196	70	40.5	200	<0.02	0.07	4	<10	<0.1	0.9	25	89.1
SRK-WR-RGSC0006-030	Non-PAG	4200	0.15	2.6	357.4	0.08	<20	1.2	4000	96.9	8.1	20.99	1.1	<0.0002	3100	5.4	11.52	800	20	0.065	4.44	26	970	1600	2.4	0.8	0.238	40	24.5	400	<0.02	0.08	4	<10	<0.1	1	13	99.4
SRK-WR-RGSC0006-031	Non-PAG	2500	0.31	13.5	153.2	0.03	<20	1.16	6400	181.5	6.3	11.18	0.7	<0.0002	4900	4.5	6.88	1600	40	0.144	8.16	22.2	950	900	2.5	0.6	0.272	30	26.7	800	<0.02	0.07	2.4	<10	<0.1	1	14	66.4
SRK-WR-RGSC0006-032	Non-PAG	2300	0.37	11.8	150.2	0.03	<20	1.19	10900	181.1	6.3	11.19	0.8	<0.0002	8100	5.6	7.98	2900	59	0.137	8.17	22.3	930	800	2.9	0.6	0.28	40	34.4	800	0.02	0.07	2.3	<10	<0.1	0.9	17	76
SRK-WR-RGSC0006-033	Non-PAG	8000	0.18	5.5	549.5	0.26	<20	1.44	3500	9.1	11.5	38.04	2.1	<0.0002	24100	4.2	17.63	2400	447	0.087	0.97	34.1	740	3400	5.9	1.3	0.279	120	31.8	800	0.08	0.09	4.5	<10	<0.1	1	27	157.3
SRK-WR-RGSC0006-034	Non-PAG	5000	0.23	0.3	585.3	0.22	<20	0.5	2000	6.2	2.1	29.55	1.3	<0.0002	2600	0.8	14.82	1200	13	0.065	0.71	4.8	50	2500	4	0.9	0.221	90	19.2	300	0.04	<0.02	1	<10	<0.1	0.6	13	63.6
SRK-WR-RGSC0006-035	Non-PAG	5100	0.12	0.2	554.2	0.32	<20	0.31	1000	5.3	2.5	38.37	1.3	<0.0002	1200	0.7	17.13	600	7	0.045	0.66	4.3	40	1800	3.5	1.2	0.191	70	17.8	300	0.05	<0.02	1.2	<10	<0.1	0.4	12	28.3
SRK-WR-RGSC0006-036	Non-PAG	7000	0.16	2.5	590.5	0.27	<20	1.35	1800	7.5	7.4	43.97	1.4	<0.0002	8800	0.8	15.33	1200	205	0.128	2.24	26.6	20	2400	3.7	2.2	0.246	150	33.3	700	0.05	0.02	0.7	<10	<0.1	0.6	19	56.8
SRK-WR-RGSC0006-038	PAG	6300	0.49	4	514.6	0.28	<20	2.1	1000	9.6	15.7	61.77	1.5	<0.0002	5200	1.1	18.69	800	29	0.175	4.39	57.4	<10	2300	3.3	3.4	0.312	100	23.6	2900	0.05	0.03	0.9	<10	<0.1	0.8	23	110.1
SRK-WR-RGSC0006-039	Non-PAG	6500	0.25	2.3	356.2	0.23	<20	1.14	4400	6.6	8.8	28.59	1.5	<0.0002	47600	2.3	14.27	2600	983	0.051	2.2	24.4	120	2200	4.2	1.2	0.174	190	35.3	600	0.08	<0.02	0.8	<10	<0.1	0.5	15	119
SRK-WR-RGSC0006-040	Non-PAG	3600	0.1	<0.1	227.1	0.32	<20	0.09	500	3.9	0.5	25.67	1	0.0004	700	0.5	17.32	200	9	<0.005	0.53	2.3	<10	500	3.5	1	0.09	80	17	300	0.13	<0.02	1.8	20	<0.1	0.4	16	8.2
SRK-WR-RGSC0006-041	PAG	4300	0.25	26.7	111.8	0.22	<20	0.74	1300	5	16.4	25.41	1	<0.0002	37500	1.9	18.42	800	363	1.191	1.52	57.5	50	2200	3.7	1.8	0.422	110	21.3	23800	0.11	0.24	0.5	<10	<0.1	0.4	12	76.6
SRK-WR-RGSC0006-042	PAG	6500	0.13	6.3	279.8	0.09	<20	0.29	1200	9.1	7.9	15.3	1.7	0.0005	14000	1.9	10.91	700	122	0.247	1.19	27	20	2200	2.3	0.4	0.288	90	21.8	7500	<0.02	0.07	1	<10	<0.1	0.4	15	111.3
SRK-WR-RGSC0008-043	PAG	5800	0.22	12.9	136.8	0.21	<20	0.59	1600	6.3	12.5	24.19	1.4	0.0007	39000	2.8	14.64	1100	562	0.841	1.45	41	60	2600	4.6	1.5	0.412	110	12.7	20200	0.04	0.29	0.9	<10	<0.1	0.4	15	112.6
SRK-WR-RGSC0008-044	PAG	6300	0.19	8.7	209.5	0.15	<20	0.56	1600	8.7	8.6	21.44	1.5	<0.0002	11100	2.6	12.45	700	94	0.247	1.28	28.8	30	2500	3	0.6	0.377	80	17.6	6500	0.05	0.09	1.4	<10	<0.1	0.4	16	135.4
SRK-WR-RGSC0008-045	non-PAG	3900	0.12	3.1	104	0.04	<20	0.18	11600	7.9	4.7	7.23	1	<0.0002	19200	4.1	7.35	2400	151	0.059	0.64	14.7	660	1300	3.6	0.2	0.256	60	41.7	2500	0.03	0.05	1.7	<10	<0.1	0.5	14	65
SRK-WR-RGSC0008-046	Uncertain	4600	0.14	1.8	48	<0.02	<20	0.13	4000	9.9	4.9	7.83	1.2	<0.0002	12800	4	6.28	1200	129	0.022	1.2	14.6	870	1400	2.9	<0.1	0.227	50	25.9	1400	<0.02	0.04	1.9	<10	<0.1	0.6	15	57.9
SRK-WR-RGSC0008-047	PAG	4100	0.17	3.7	43.1	0.03	<20	0.2	2700	12.2	5.4	9.34	1.2	<0.0002	14900	3.6	15.12	1100	149	0.065	1.29	19.3	790	1200	2.7	<0.1	0.272	50	22.5	2600	0.04	0.05	1.6	<10	0.1	0.6	17	74.2
SRK-WR-RGSC0008-048	PAG	2500	0.08	2.7	27.7	0.03	<20	0.04	1300	6.6	4.8	4.8	0.7	<0.0002	11500	2.5	6.05	1000	105	0.01	0.4	15.9	320	1000	1.9	<0.1	0.059	50	15.6	1600	0.03	<0.02	1.1	<10	<0.1	0.2	5	30.8
SRK-WR-RGSC0008-049	non-PAG	3900	0.15	2.5	35.1	<0.02	<20	0.1	5200	9.6	4.9	7.51	1.2	<0.0002	12800	3.4	6.09	1600	128	0.021	1.35	16.3	750	1200	2.8	<0.1	0.172	60	27.1	1400	<0.02	0.03	1.8	<10	<0.1	0.5	13	48.5
SRK-WR-RGSC0009-050	Non-PAG	10700	0.27	3	143.5	0.12	<20	0.33	2800	20.4	5	26.92	3	<0.0002	18900	5	9.25	1300	211	0.067	1.25	25.5	520	2300	4.4	0.1	0.352	80	12.6	<200	<0.02	0.13	2.4	20	<0.1	2.4	41	87.8
SRK-WR-RGSC0009-051	Non-PAG	8700	0.5	8.1	190.2	0.16	23	0.97	6400	15.7	12.7	30.29	2.9	<0.0002	27300	7.4	13.71	2700	351	0.035	4.15	37.5	980	2000	4.9	0.7	0.3	100	18.1	400	<0.02	0.13	3.6	20	<0.1	1.5	33	156.5
SRK-WR-RGSC0009-052	PAG	8300	0.73	7.9	126.2	0.21	<20	1.21	4100	47.5	12.3	36.98	2.9	<0.0002	13600	5.5	17.88	2900	188	0.1	3.69	42.7	1040	1800	4.7	1.3	0.355	80	18.1	3900	0.07	0.11	3.8	10	<0.1	0.9	25	166.1
SRK-WR-RGSC0009-053	non-PAG	5900	0.47	4.7	120	0.15	<20	1.86	13500	62	10.1	27.68	2	<0.0002	16000	6.1	12.99	7300	397	0.041	3.3	37	1300	1500	4.7	1.1	0.425	80	27.9	4700	0.03	0.14	4.2	10	<0.1	0.9	24	135.4
SRK-WR-RGSC0009-054	PAG	5200	0.45	6.4	60.8	0.05	<20	0.66	2800	15.8	6.6	15.21	1.5	<0.0002	10500	3.1	7.47	900	104	0.052	2.7	23.6	860	1000	2.3	0.8	0.279	40	25	3200	0.05	0.07	2.4	20	<0.1	3.1	24	63.4
SRK-WR-RGSC0009-055	PAG	1700	0.85	14.5	88.1	0.03	<20	0.65	1500	13.2	7.6	12.11	0.8	<0.0002	14700	1.3	12.86	600	139	0.056	2.93	25.8	340	400	1.6	0.8	0.337	40	23.1	8000	0.06	0.1	0.7	10	<0.1	0.7	20	37.1
SRK-WR-RGSC0009-056	Uncertain	6200	0.4	4.8	95.3	0.18	<20	1.67	7800	14.4	13.8	30.31	2.2	0.0011	24500	4.8	13.6	5600	422	0.037	1.32	39.6	810	1700	3.8	0.7	0.348	80	20	5600	0.08	0.09	3.7	10	<0.1	1	24	144.4
SRK-WR-RGSC0009-057	PAG	8100	0.59	7.7	126.8	0.14	<20	1.17	8500	14.9	8.6	21.86	2.3	0.0004	28000	4.8	10.94	4800	516	0.089	2.4	30.1	750	2300	4.5	0.7	0.341	100	18.3	9100	0.16	0.14	3.5	10	<0.1	0.9	32	106
SRK-WR-RGSC0009-058	PAG	2000	0.53	8.7	86.1	0.04	<20	0.8	400	12.7	4.6	11.4	0.9	<0.0002	11400	2	9.43	<100	107	0.025	3.64	12.6	430	600	1.4	0.3	0.266	40	16.4	4300	0.1	0.09	0.9	10	0.3	0.6	19	18
SRK-WR-RGSC0009-059	PAG	3400	0.59	7.9	105	0.07	<20	1.33	600	13.3	8.1	14.48	1	<0.0002	23900	1.9	10.05	300	177	0.079	2.79	24.3	580	900	3.1	0.4	0.352	60	13.9	19700	0.06	0.11	1	10	0.1	0.5	33	56.2
SRK-WR-RGSC0009-060	PAG	11300	0.53	2.3	323.8	0.23	<20	3.33	3600	19.7	13.4	41.02	2.8	<0.0002	43100	6.3	13.66	3000	991	0.103	2.31	53.2	1300	3600	5.4	2	0.398	110	29.4	7700	0.11	0.06	5	20	<0.1	2.1	61	234.5
SRK-WR-RGSC0009-061	PAG	11100	0.58	2.9	202.9	0.31	<20	2.6	1800	16.9	11.5	41.73	2.8	0.0002	11100	5	16.84	2000	178	0.162	2.59	55.6	640	3500	4.5	2.2	0.422	90	29.4	2200	0.03	0.05	3.8	10	<0.1	1.5	49	235.1
SRK-WR-RGSC0009-062	PAG	8500	0.54	2.4	230.2	0.25	<20	2.17	2900	12.5	12.8	41.37	2.3	0.0007	18900	5.9	15.42	2700	355	0.142	1.83	48.6	840	3000	4.9	1.5	0.389	90	38.9	1900	0.07	0.05	4.7	10	<0.1	1.4	38	237.2
SRK-WR-RGSC0009-063	PAG	8400	0.42	<0.1	117.8	1.03	<20	2.08	700	7.5	2.4	81.03	2.2	<0.0002	2100	6.2	34.92	500	17	0.231	1.15	8.6	30	1900	3.9	4.8	0.38	60	7.5	1400	0.16	<0.02	7	20	<0.1	1.8	34	89.5
SRK-WR-RGSC0009-064	Uncertain	10300	0.46	4.5	182.6	0.25	<20	2.33	4500	14.2	10.4	45.49	2.8	0.0006	11700	6	14.7	3200	122	0.263	2.92	43.9	870	4000	4.3	2.4	0.403	100	24.3	1900	<0.02	0.09	4.8	10	<0.1	1.5	38	216.4
SRK-WR-RGSC0009-065	non-PAG	4700	1.4	18.3	142	0.18	<20	1.68	9200	84.8	10.1	29.03	1.5	<0.0002	29500	5.6	13.53	5500	569	0.318	5.46	45.7	1080	1800	4.1	2	0.38	70	34.8	2400	0.04	0.16	3.9	10	<0.1	1.2	35	179.1
SRK-WR-RGSC0009-066	PAG	5600	0.35	3	158.1	0.16	<20	0.62	500	6.5	2.6	24.47	1.5	0.0004	3800	5.1	10.61	500	48	0.12	0.81	8.8	60	1700	2.8	0.9	0.169	60	7.5	1400	<0.02	<0.02	3	10	<0.1	0.7	15	67.2
SRK-WR-RGSC0009-067	Non-PAG	7900	0.4	3.2	345.3	0.21	<20	1.85	6200	11.7	10.9	39.14	2.1	<0.0002	17800	7.2	13.74	4300	297	0.15	1.74	42.5	870	3300	4.6	1.5	0.375	90	27.8	600	<0.02	0.06	4.5	10	<0.1	1.1	34	190.7
SRK-WR-RGSC0009-068	Non-PAG	9600	0.3	3.5	419.5	0.15	<20	1.36	22900	17.2	10.2	30.05	2.6	0.0004	32900	7.6	11.79	10100	604	0.149	1.58	33.3	1050	3900	5.2	1.2	0.3	110	48.2	600	<0.02	0.08	4.4	10	<0.1	1.1	47	150.1
SRK-WR-RGSC0009-069	Non-PAG	10000	0.57	7.8	396.2	0.25	<20	1.91	6700

Sample ID		Element Analysis by Aqua Regia Digestion + ICP-MS																																							
	(Mod. NP)/AP Classification Calc.	Al mg/kg	Sb mg/kg	As mg/kg	Ba mg/kg	Bi mg/kg	B mg/kg	Cd mg/kg	Ca mg/kg	Cr mg/kg	Co mg/kg	Cu mg/kg	Ga mg/kg	Au mg/kg	Fe mg/kg	La mg/kg	Pb mg/kg	Mg mg/kg	Mn mg/kg	Hg mg/kg	Mo mg/kg	Ni mg/kg	P mg/kg	K mg/kg	Sc mg/kg	Se mg/kg	Ag mg/kg	Na mg/kg	Sr mg/kg	S mg/kg	Te mg/kg	Tl mg/kg	Th mg/kg	Ti mg/kg	W mg/kg	U mg/kg	V mg/kg	Zn mg/kg
SRK-WR-RGSC0010-095	Non-PAG	8700	0.47	3.4	165.1	0.1	<20	1.32	13500	16	5.3	20.69	2.4	0.0015	9000	7.2	8.69	3900	442	0.018	2.04	22.1	1740	1700	3.7	0.1	0.316	60	31.2	700	<0.02	0.1	3.4	20	0.1	0.9	27	89.1
SRK-WR-RGSC0010-096	Uncertain	10200	0.62	7.5	133.7	0.21	<20	1.43	4800	19	13.9	34.81	3.5	0.0021	29100	6.6	15.5	2700	995	0.064	3.12	47.8	1310	2700	5.4	0.6	0.395	70	29.3	1300	0.08	0.16	4.7	20	<0.1	0.9	39	149
SRK-WR-RGSC0010-097	Uncertain	10300	0.5	5.5	229	0.22	<20	1.73	7500	20.3	10.8	37.56	3.2	0.0016	21500	6.3	15.06	3700	373	0.076	2	43	1300	2800	6	1.5	0.453	90	33.2	5000	<0.02	0.14	4.5	20	<0.1	0.9	40	172.7
SRK-WR-RGSC0010-098	PAG	1800	0.89	9.1	84.7	0.04	<20	0.62	3800	16.5	8.4	55.71	1	0.0012	22000	1.6	11.33	2300	270	0.067	3.1	24.7	500	500	2.6	0.9	0.349	20	24.7	9500	<0.02	0.11	0.7	10	<0.1	0.5	25	53
SRK-WR-RGSC0010-099	PAG	1800	0.91	12.7	65.1	0.04	<20	0.76	3900	14.2	9.2	12.53	0.9	0.0013	22300	1.6	13.83	2300	278	0.075	3.06	28.2	500	500	2.5	0.5	0.377	20	24.1	11300	<0.02	0.13	0.8	20	<0.1	0.5	24	48.8
SRK-WR-RGSC0010-100	PAG	8400	0.31	2.6	106.2	0.17	<20	0.71	6000	15.3	7.6	22.83	2.5	<0.0002	40500	3	11.8	3300	407	0.033	1.41	23.4	530	1700	3.3	0.4	0.236	50	17.4	39400	<0.02	0.13	2.8	20	<0.1	0.7	25	72.1
SRK-WR-RGSC0010-101	PAG	3800	0.37	2.4	92.9	0.06	<20	0.39	3700	11.7	4.5	10.9	1.1	0.0009	9700	2.5	7.87	1500	136	0.011	1.48	11.6	610	900	1.5	<0.1	0.195	30	16	5000	0.09	0.05	1.5	20	<0.1	0.5	20	43
SRK-WR-RGSC0010-102	PAG	2100	0.8	10.5	92.4	0.06	<20	1.53	2900	11.9	8.1	11.79	1	0.0024	49900	2.1	11.62	3500	806	0.07	2.85	21.5	600	500	3.4	0.1	0.318	30	16.1	25100	<0.02	0.1	1	10	<0.1	0.6	29	46.6
SRK-WR-RGSC0010-103	PAG	1700	0.77	12.3	104.2	0.05	<20	0.79	1000	12.1	7.6	11.96	0.7	<0.0002	14500	1.9	9.24	300	197	0.044	3.79	20.9	370	500	1.1	0.4	0.293	20	13.2	6900	<0.02	0.08	0.6	10	<0.1	0.5	18	32.9
SRK-WR-RGSC0010-104	PAG	7700	0.62	2.8	246.8	0.43	<20	2.04	800	8.9	13.6	39.12	2.4	0.0008	5500	1.3	24.58	800	81	0.143	3.74	60.9	30	3000	3.7	2.9	0.446	60	16.8	4800	0.04	0.05	1.9	<10	<0.1	0.8	31	251.7
SRK-WR-RGSC0010-105	PAG	8000	0.62	4	201.9	0.36	<20	1.95	1200	8.8	13.1	39.37	2.2	0.0006	6100	1.3	20.43	1200	70	0.181	3.01	56.4	30	3100	3.7	2.4	0.429	70	23.1	3700	0.1	0.04	1.2	<10	<0.1	0.7	32	244.1
SRK-WR-RGSC0010-106	PAG	7800	0.69	1.6	347.8	0.25	<20	2.65	3300	13.3	10.3	42.49	2.4	0.0008	11400	5.5	15.64	2600	106	0.124	2.76	46.4	930	3300	4	2.4	0.456	80	36.5	2700	<0.02	0.07	4.8	10	<0.1	1.6	39	210.1
SRK-WR-RGSC0010-106A	PAG	6900	0.89	0.9	458.3	0.33	<20	2.01	4800	12.5	7.1	45	1.9	0.0006	21400	3	18.83	4500	189	0.251	1.66	24	420	3000	5.6	2.9	0.458	80	45.8	6200	0.09	0.06	3.9	10	<0.1	1.5	60	174.1
SRK-WR-RGSC0010-106B	Uncertain	9700	0.53	4.4	346.5	0.28	<20	2.6	3300	15.4	10.4	39.85	2.6	0.001	11700	6.7	15.17	3300	85	0.091	1.74	47	1000	3400	5	1.8	0.412	90	38.6	1500	0.13	0.09	5.4	10	<0.1	1.6	42	223.1
SRK-WR-RGSC0010-107	non-PAG	10100	0.88	2	436.6	0.33	<20	4.42	5700	15.7	11.4	46.93	2.8	0.0008	11000	6.9	46.13	3800	72	0.216	3.88	68.8	1250	3800	5.1	3.5	0.521	100	62.7	1400	<0.02	0.09	5.6	10	<0.1	2.1	54	395.8
SRK-WR-RGSC0010-108	PAG	6500	0.38	4.3	301.5	0.31	<20	3.01	1000	6.1	13.2	46.73	1.2	0.0004	3300	1.2	25.87	800	23	0.353	4.62	60.7	<10	3200	2.2	3.5	0.44	90	13.7	2400	0.04	0.06	0.9	<10	<0.1	0.8	24	171.5
SRK-WR-RGSC0010-109	non-PAG	7000	0.84	7.1	346	0.19	<20	1.81	3900	13.1	11.6	30.09	2.1	0.0012	14400	4.8	13.63	3300	124	0.16	2.87	49.2	890	2900	3.8	1.2	0.377	90	39.3	1200	<0.02	0.07	3.6	10	<0.1	1.3	32	181.3
SRK-WR-RGSC0010-110	Non-PAG	7900	0.55	3.6	495.3	0.22	<20	1.89	2200	9.6	9.7	41.16	1.8	0.0009	10200	5.4	14.11	2300	75	0.113	1.63	36.6	610	3400	4.1	1.7	0.36	100	30.7	600	0.03	0.06	3.9	<10	<0.1	1.1	30	186.4
SRK-WR-RGSC0010-111	Non-PAG	8800	0.56	3.7	499.7	0.27	<20	1.88	4500	13.9	12.6	42.47	2.4	0.0014	46600	6.5	14.67	4400	671	0.142	2.49	37.5	820	3800	5.7	1.6	0.327	130	33.3	900	0.06	0.1	4.7	10	<0.1	1.4	43	188.8
SRK-WR-RGSC0010-112	non-PAG	8100	0.66	4.8	434.1	0.19	<20	2.05	9400	13.5	11.9	37.52	2.2	<0.0002	16400	7.4	12.77	4900	278	0.181	2.54	42.8	1090	3100	4.6	1.9	0.354	100	42.8	1200	<0.02	0.11	5	10	<0.1	1.7	38	195.5
SRK-WR-RGSC0010-113	Non-PAG	6500	0.37	4.5	258.3	0.09	<20	0.93	12900	16	8.4	21.55	1.8	<0.0002	34200	6.7	8.69	5800	565	0.074	1.17	26.9	1160	2300	4.4	0.7	0.269	80	41.3	500	0.03	0.06	3.8	20	<0.1	1.2	35	118.4
SRK-WR-RGSC0010-114	Non-PAG	6200	0.37	5.9	196	0.07	<20	0.91	4900	18.4	10.8	18.34	1.9	0.0005	13500	5.6	8.03	2100	206	0.103	1.37	31.8	1190	2100	3.4	0.5	0.32	60	32.2	500	<0.02	0.06	3.2	20	<0.1	1.2	31	129.6
SRK-WR-RGSC0010-115	Non-PAG	4000	0.48	8.2	159.6	0.04	<20	0.65	4000	14.5	8.7	14.09	1.4	0.0006	18200	4.4	7.59	2000	328	0.113	1.71	23.9	1010	1400	3	0.4	0.372	60	29.6	700	<0.02	0.05	2.3	20	<0.1	1	26	94.4
SRK-WR-RGSC0010-116	Non-PAG	7700	0.34	3.4	414.2	0.13	<20	1.59	18000	14.4	9.5	25.21	1.9	0.0007	30400	8	11.91	8900	515	0.068	1.43	31.2	1240	2800	4.5	0.7	0.31	110	49.4	400	<0.02	0.08	4.3	20	<0.1	1.5	37	142
SRK-WR-RGSC0010-117	Non-PAG	7300	0.48	4.2	378.8	0.09	<20	1.9	24700	13.3	7.1	21.57	1.7	<0.0002	19900	7.9	8.69	11200	328	0.097	1.42	25.2	1440	2600	4.8	0.9	0.32	100	55.8	400	<0.02	0.07	3.9	20	<0.1	1.6	37	135.2
SRK-WR-RGSC0010-118	Non-PAG	7600	0.46	3.4	433.7	0.17	<20	2.28	16100	12.3	9.1	31.16	1.9	<0.0002	21500	7.3	13.39	8700	415	0.182	1.95	33.6	1170	2800	4.9	2.2	0.388	100	42.5	500	<0.02	0.07	4.5	10	<0.1	1.6	33	158
SRK-WR-RGSC0010-119	Non-PAG	4900	0.55	0.4	338.1	0.31	<20	0.64	600	3.2	2.6	77.56	1.4	<0.0002	1900	4.9	19.66	700	16	0.147	0.5	4.2	20	1200	6.1	0.7	0.156	40	11.8	500	0.03	<0.02	3.5	<10	<0.1	1	17	93.4
SRK-WR-RGSC0010-120	Non-PAG	8900	0.35	2.4	547.6	0.32	<20	1.43	5000	9	11.5	39.78	2.3	0.0006	39600	5.4	18.85	4400	451	0.186	1.07	31.7	750	3400	6	1	0.281	130	37.2	800	<0.02	0.04	4.5	10	<0.1	1.2	30	188.1
SRK-WR-RGSC0010-121	Non-PAG	9400	0.18	1.3	555.3	0.3	<20	1.58	3500	9.1	7	37.77	2.6	0.0005	9500	6.6	18.98	2300	110	0.106	1	20.8	920	3700	4.4	0.6	0.267	110	38.2	300	<0.02	0.1	5.6	10	<0.1	1.3	28	175.2
SRK-WR-RGSC0010-122	Non-PAG	9100	0.45	4.9	669.7	0.45	<20	2.12	1900	4.7	18.8	56.21	2.3	<0.0002	3400	2.9	29.87	1200	26	0.247	1.05	34.5	420	3400	4.8	2	0.403	100	36.6	400	0.05	0.04	2.9	<10	<0.1	1.1	20	196
SRK-WR-RGSC0010-123	Non-PAG	7300	0.31	1.6	694.2	0.33	<20	1.2	1200	4.9	4.3	36.45	1.3	0.0008	4500	0.7	18.38	1200	20	0.105	1.16	10.2	<10	2700	2.9	1.7	0.288	170	37.8	600	<0.02	<0.02	0.6	<10	<0.1	0.7	25	80.2
SRK-WR-RGSC0010-124	Non-PAG	6400	0.41	2.6	575.3	0.37	<20	1.73	1600	5.6	11.6	44.42	1.4	<0.0002	6800	0.9	19.79	1600	32	0.24	1.55	33.1	<10	2500	5.4	1.8	0.287	150	44.9	500	<0.02	<0.02	1.1	<10	<0.1	0.9	30	108.2
SRK-WR-RGSC0010-125	Non-PAG	4800	0.23	1.4	493.7	0.41	<20	1.62	1600	12	13	44.87	1.2	<0.0002	4600	1.7	20.87	1300	15	0.2	1.14	25.7	10	1700	4.5	1.4	0.323	100	42.8	700	0.06	0.03	2.9	<10	<0.1	1.1	17	220.2
SRK-WR-RGSC0010-126	Non-PAG	3500	0.13	1.1	401.6	0.3	<20	1.3	1400	18	9.4	38.02	0.8	<0.0002	3900	1	15.68	1300	17	0.135	1.64	20.2	<10	1700	3.9	0.7	0.217	90	30.7	300	0.05	<0.02	0.8	<10	<0.1	0.6	13	98.6
SRK-WR-RGSC0010-127	Non-PAG	7600	0.27	6.9	408.7	0.29	<20	1.3	7400	8.4	12	34.75	1.8	0.0002	7400	2	17.25	2600	57	0.131	1.49	35.8	190	2900	4.8	1	0.231	150	47.4	600	<0.02	0.03	1.8	<10	<0.1	0.8	25	164.9
SRK-WR-RGSC0010-128	Non-PAG	8300	0.24	2.8	406.3	0.24	<20	0.98	18000	9.8	9.3	26.15	2.2	<0.0002	28100	5.1	15.59	6500	132	0.11	1.09	23.9	630	2800	5.7	0.6	0.196	200	71.9	400	0.06	0.05	4.1	<10	<0.1	1	25	109.4
SRK-WR-RGSC0010-129	Non-PAG	7900	0.41	1.8	542.9	0.49	<20	1.34	1900	5.5	10.7	41.72	1.5	0.0008	5100	1.2	20.4	1100	31	0.138	3.64	17	70	3200	4.1	1.8	0.344	270	50	600	0.06	0.03	0.7	<10	<0.1	0.8	24	140.3
SRK-WR-RGSC0010-130	Non-PAG	3400	0.38	2	325.5	0.12	<20	0.63	14400	6.8	4.5	14.55	1	<0.0002	269700	4.2	7.35	9900	6001	0.108	1.5	18.3	500	1300	4.3	0.6	0.118	300	88.8	300	<0.02	<0.02	1.2	10	<0.1	0.7	23	60.8
SRK-WR-RGSC0010-131	Non-PAG	4200	0.47	2.1	324.9	0.23	<20	0.82	26900	6.9	7.6	25.1	1.9	0.0007	59900	0.9	15.49	12500	673	0.077	1.45	13	140	1900	5.4	0.9	0.154	220	105.1	700	<0.02	<0.02	0.9	<10	<0.1	0.9	37	60.8
SRK-WR-RGSC0010-132	Non-PAG	6400	0.24	2.4	353.5	0.33	<20	1.2	3600	7.3	8.6	35.71	1.8	<0.0002	27600	1.2	19.19	2800	323	0.082	1.26	21.3	90	2600	4.6	0.9	0.236	280	54.4	400	0.04	<0.02	1.1	<10	<0.1	0.6	22	128.1
SRK-WR-RGSC0010-133	Non-PAG	7400	0.32	18.8	357.3	0.24	<20	1.24	19000	9.9	10.7	32.07	2	<0.0002	30200	3.5	16.53	6600	184	0.152	1.72	30.2	430	2600	6	1.2	0.202	260	88.6	800	0.04	0.06	2.6	<10	<0.1	0.8	27	158.1
SRK-WR-RGSC0010-134	Non-PAG	6700	0.27	0.8	334.7	0.4	<20	0.65	2800	5.8	10	44.51	1.7	0.0005	4300	0.7	17.38	1300	34	0.09	1.1	23.8	60	2000	4.1	0.7	0.241	240	51	400	<0.02	<0.02	1.1	10	<0.1	0.8	36	48.1
SRK-WR-RGSC0010-135	Non-PAG	8200	0.1	0.5	347.2	0.3	<20	1.2	1200	5.8	5.9	32.51	1.8	0.0006	4100	1	17.18	1000	26	0.078	0.8	11.9	<10	3300	3.6	0.7	0.226	300	60.4	<200	<0.02	0.04	0.7	<10	<0.1	0.5	17	89.2
SRK-WR-RGSC0010-136	Non-PAG	7400	0.25	2.1	313.8	0.2	<20	0.95	16100	9.1	8.7	25.19	1.7	0.0008	25500	4	13.46	5900	133	0.08	1.36	22.2	240	2500	5.8	0.5	0.193	230	81.3	300	<0.02	0.04	2.4	<10	<0.1	0.8	21	122.1
SRK-WR-RGSC0010-137	Non-PAG	8000	0.37	2.8	450.4	0.32	<20	1.36	12700	9	11	34.92	1.9	0.0006	19200	3.2	19.97	4400	119	0.137	1.52	31.2	510	3100	6.1	1.2	0.235	300	96	600	<0.02	0.04	3.3	<10	<0.1	0.9	24	166.5
SRK-WR-RGSC0010-138	Non-PAG	5300	0.47	0.3	490.2	0.39	<20	1.77	2400	5	3.3	50.87	1	<0.0002	5700	0.7	18.84	1400	63	0.237	1.18	7.7	10	2400	5	1.7	0.322	300	72.7	500	<0.02	<0.02	0.5	<10	<0.1	0.6	23	205.5
SRK-WR-RGSC0010-139	Non-PAG	7000	0.13	0.7	350.7	0.22	<20	1.81	900	8.8	3.3	33.8	1.6	<0.0002	5300	1.3	14.78	700	61	0.108	0.58	7.1	<10	3000	3	0.6	0.227	240	53.7	<200	0.07	0.03	0.6	<10	<0.1	0.4	21	118.6
SRK-WR-RGSC0010-140	Non-PAG	8200	0.33	6.2	441.8	0.27	<20	1.75	2700	8.1	11.2	34.2	2.1	0.0007	7800	2.6	18.45	1500	64	0.085	1.07	32.4	330	3500	4.8	0.9	0.269	330	67.1	1000	<0.02	0.07	2.1	<10	<0.1	0.7	22	165.6
SRK-WR-RGSC0010-141	non-PAG	7500	0.38	5.9	385.3	0.22	<20	1.71	12200	10.4	13.1	27.11	1.8	0.0012	21100	4.9	16.42	2700	185	0.096	2.5	35.7	760	2900	5	1.1	0.265	300	68.9	1600	<0.02	0.12	3.8	<10	<0.1	0.9	22	149.1
SRK-WR-RGSC0010-142	Non-PAG	7300	0.18	2	487.5	0.27	<20	1.23	9600	10.2	10.8	26.47	2.1	<0.0002	102100	5.5	14.59	5400	1699	0.046	1.85	25.9	770	3000	7.8	1.3	0.211	420	69.5	600	0.07	0.04	3.4	<10	<0.1	1	27	105.9
SRK-WR-RGSC0010-143	PAG	5000	0.27	20.5	223.9	0.13	<20	0.57	1300	12.1	11.8	23.51	1.5	0.0005	20000	1.8	11.39	700	205	0.347	2.56	36.9	20	1900	2.4	1.5	0.366	190	32.8	10200	<0.02	0.16	0.8	<10	<0.1	0.3	13	82.5
SRK-WR-RGSC0010-145	PAG	6300	0.11	7.3	218.4	0.08	<20	0.41	2400	11.5	7.3	14.64	1.9	<0.0002	15100	3.9	10.31	1000	113	0.15	1.9	23	400	2100	3.1	0.4	0.313	200	44.8	5900	<0.02	0.07	1.9	<10	<0.1	0.6	18	98.9
L1437868-1	#N/A	#N/A	0.79	2.32	220	#N/A	#N/A	1.54	#N/A	5.4	7.6	21.3	#N/A	#N/A	#N/A	#N/A	9	#N/A	#N/A	0.075	1.4	35.4	#N/A	#N/A	#N/A	0.7	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	17.4	164
L1437868-2	#N/A	#N/A	0.54	5.81	87.8	#N/A	#N/A	<0.5	#N/A	3.81	6.4	7.6	#N/A	#N/A	#N/A	#N/A	7	#N/A	#N/A	0.073	<1	20.7	#N/A	#N/A	#N/A	<0.5	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	12.7	71
L1437868-3	#N/A	#N/A	0.63	15.1	64.5	#N/A	#N/A	<0.5	#N/A	5.42	6.5	6.7	#N/A	#N/A	#N/A	#N/A	7.6	#N/A	#N/A	0.183	<1	24.5	#N/A	#N/A	#N/A	<0.5	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	12.1	66
L1437868-4	#N/A	#N/A	1.92	17.5	170	#N/A	#N/A	1.31	#N/A	3.79	3.9	26.8	#N/A	#N/A	#N/A	#N/A	16.2	#N/A	#N/A	0.444	2.3	19.7	#N/A	#N/A	#N/A	1.99	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	16.5	81
L1437868-5	#N/A	#N/A	1	4.09	321	#N/A	#N/A	1.56	#N/A	8.16	7.7	27.3	#N/A	#N/A	#N/A	#N/A	10.5	#N/A	#N/A	0.118	1.8	29.5	#N/A	#N/A	#N/A	1.26	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	31.2	138
L1437868-6	#N/A	#N/A	1.17	4.94	258	#N/A	#N/A	1.61	#N/A	8.62	8.8	30.1	#N/A	#N/A	#N/A	#N/A	11.6	#N/A	#N/A	0.167	1.8	31.9	#N/A	#N/A	#N/A	1.54	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	33.7	169
L1437868-7	#N/A	#N/A	1.46	4.65	342	#N/A	#N/A	1.83	#N/A	4.74	10.1	44.5	#N/A	#N/A	#N/A	#N/A	15.5	#N/A	#N/A	0.202	1.9	38.4	#N/A	#N/A	#N/A	2.14	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	25.9	173
L1437868-8	#N/A	#N/A	0.45	2.74	101	#N/A	#N/A	0.97	#N/A	2.28	4.1	18.1	#N/A	#N/A	#N/A	#N/A	10.6	#N/A	#N/A	0.063	<1	10.3	#N/A	#N/A	#N/A	0.55	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	9.7	112
L1437868-9	#N/A	#N/A	1.28	4.26	323	#N/A	#N/A	1.9	#N/A	6.08	9.2	39.1	#N/A	#N/A	#N/A	#N/A	12.7	#N/A	#N/A	0.203	1.7	27.6	#N/A	#N/A	#N/A	1.68	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	28.5	335
L1437868-10	#N/A	#N/A	0.77	3.65	353	#N/A	#N/A	1.19	#N/A	4.13	7.2	28.8	#N/A	#N/A	#N/A	#N/A	10.8	#N/A	#N/A	0.086	<1	19.6	#N/A	#N/A	#N/A	0.88	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	16.3	123
L1437868-11	#N/A	#N/A	0.52	2.41	386	#N/A	#N/A	1.05	#N/A	2.74	7.2	28	#N/A	#N/A	#N/A	#N/A	11.3	#N/A	#N/A	0.083	1.2	19.3	#N/A	#N/A	#N/A	1.25	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	12.3	107
L1437868-12	#N/A	#N/A	0.27	4.49	180	#N/A	#N/A	<0.5	#N/A	2.51	5.1	8.5	#N/A	#N/A	#N/A	#N/A	7.3	#N/A	#N/A	0.122	<1	16.8	#N/A	#N/A	#N/A	<0.5	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	7.9	70
L1437868-13	#N/A	#N/A	1.16	4.57	242	#N/A	#N/A	1.38	#N/A	6.58	6.9	32.8	#N/A	#N/A	#N/A	#N/A	11.5	#N/A	#N/A	0.163	2.1	30.2	#N/A	#N/A	#N/A	1.14	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	26.3	133
L1437868-14	#N/A	#N/A	1.52	17.5	26.8	#N/A	#N/A	0.94	#N/A	9.67	7.7	10.8	#N/A	#N/A	#N/A	#N/A	8.9	#N/A	#N/A	0.091	2.6	24.4	#N/A	#N/A	#N/A	0.62	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	31.1	64
L1437868-15	#N/A	#N/A	0.91	8.26	21.9	#N/A	#N/A	<0.5	#N/A	3.42	4.6	8.4	#N/A	#N/A	#N/A	#N/A	8.1	#N/A	#N/A	0.063	1.2	12.1	#N/A	#N/A	#N/A	<0.5	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	19	29
L1437868-16	#N/A	#N/A	0.96	1.92	699	#N/A	#N/A	1.09	#N/A	8.48	4.6	33.8	#N/A	#N/A	#N/A	#N/A	12.9	#N/A	#N/A	0.08	1.7	16.6	#N/A	#N/A	#N/A	1.65	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	32.7	100
L1437868-17	#N/A	#N/A	1.05	2.82	397	#N/A	#N/A	2.23	#N/A	7.96	7.8	32.7	#N/A	#N/A	#N/A	#N/A	13	#N/A	#N/A	0.181	2.6	33.2	#N/A	#N/A	#N/A	2.24	<1	#N/A	#N/A	#N/A	#N/A	<0.5	#N/A	#N/A	#N/A	<2	32.8	175
L1437868-18	#N/A	#N/A	0.97	3.4	376	#N/A	#N/A	1.78	#N/A	8.25	6.9	32.3	#N/A	#N/A	#N/A	#N/A	10.2	#N/A	#N/A	0.166	1.6

Appendix F – Static Test Results for Legacy Wastes

Reference	Location (UTM Zone 11)			Date Sampled	Field Observations					
	Easting m	Northing m	Elevation m		Fizz Test	Rinse pH	Rinse EC µS/cm	Rock Type	Site Description	Sample Description
TP-01	686847	5509734	1855	21-Oct-14	none	6.4	35	Coarse-grained sandstone	Waste rock recently pushed by drill pad construction; approx. 1.5 m depth on hillside.	No visible sulphides or carbonates; much lichen.
TP-02	687065	5509703	1802	21-Oct-14	none	6.4	6	Med to fine-grained sandstone + siltstone + carbonaceous fines	Undisturbed waste rock pile directly below mine cut, approx. 3 m in height.	Large fragments of fine to medium-grained sandstone (30-50 cm); smaller fragments of siltstone (<20 cm); carbonaceous fines. One patch of calcite on a fracture surface. No visible sulphides. Fe colouration within some medium-grained sandstone fragments, and along fracture surfaces of fine-grained sandstone and siltstone.
TP-03	687087	5509366	1792	21-Oct-14	none	7.8	16	Med to fine-grained sandstone + siltstone + carbonaceous fines	Waste rock pushed for road construction earlier this year.	Similar to TP-02. Occassional conglomerate fragment. No visible sulphides or carbonate.
TP-04	687100	5509508	1788	21-Oct-14	#N/A	#N/A	#N/A	Med to fine-grained sandstone + siltstone	Undisturbed waste rock, approx. 0.5 m in depth. Suspect not a dump as such, but debris from mine workings above.	Very few fines rock fines. Unable to collect a -2 mm sample that was not soil. Predominantly sandstone with minor interbedded siltstone. Fe colouration present within some sandstone fragments, and on fracture surfaces of finer-grained rocks. No visible sulphides or carbonate.
TP-05	686781	5508027	1890	21-Oct-14	none	7.0	21	Fine-grained sandstone + siltstone + carbonaceous fines	Waste rock pushed for road construction earlier this year.	Fine-grained sandstone, siltstone, and carbonaceous fines. Plant fossils. No visible sulphides or carbonate.
TP-06	686670	5507863	1892	21-Oct-14	none	7.4	16	Fine-grained sandstone + siltstone + carbonaceous fines	Waste rock pushed for road construction earlier this year.	Similar to TP-05. Fe colouration observed along fracture surfaces on some fragments.
TP-07	686445	5507622	2008	21-Oct-14	none	8.5	42	Fine-grained sandstone + siltstone + carbonaceous fines	Waste rock pushed for road construction earlier this year.	Similar to TP-05 and TP-06, except fragments typically smaller (<10 cm). Occassional calcite bleb observed on fracture surfaces. No visible sulphides.
TP-08	686355	5507550	2016	21-Oct-14	none	6.8	22	Carbonaceous fines	Material recently pushed for drill pad construction. Taken from NW side of pad.	Carbonaceous fines with occassional siltstone fragments. No visible sulphides or calcite.
TP-09	686364	5507528	2011	21-Oct-14	none	7.1	63	Carbonaceous fines	Material recently pushed for drill pad construction. Taken from SE side of pad.	Similar to TP-08, but more siltstone fragments. No visible sulphides or calcite.
TP-10	685801	5506539	1900	21-Oct-14	none	6.9	38	Med to coarse-grained sandstone	Waste rock pushed for road construction earlier this year.	Medium to coarse-grained sandstone with minor conglomerate containing rounded to sub-angular clasts of siltstone and quartz. Generally large fragments (30 to 50 cm). Some lichen. No visible sulphides or carbonate.
TP-11	685872	5506740	1933	21-Oct-14	none	8.4	23	Fine-grained sandstone + siltstone	Waste rock beside road constructed earlier this year.	Fine-grained sandstone to siltstone with minor conglomerate and coal. Fe colouration observed in sandstone, and along fracture surfaces (query clay?). Most fragments 2 to 20 cm in size.
TP-12	686046	5507152	2000	21-Oct-14	#N/A	#N/A	#N/A	Conglomerate	Cutting made into waste rock profile for road construction ealier this year. Waste rock approx. 1 m deep, likely tipped down mountainside from mine workings above.	Conglomerate with minor sandstone. Very few fines (no -2 mm sample collected). No visible sulphides or carbonates.
TP-13	686171	5507357	2026	21-Oct-14	none	6.6	10	Conglomerate + carbonaceous fines	Small dump on top of ridge, approx. 3 m in height.	Large conglomerate fragments (30 to 60 cm) in carbonaceous fines.
TP-14	686801	5508120	1888	22-Oct-14	none	8.1	27	Siltstone + carbonaceous fines	Material recently pushed for road construction.	Mostly fines (-2 mm) with some fragments of siltstone (20 to 40 cm). No visible sulphides or carbonates. Dug down 30 cm to obtain -2 mm sample. Some plant roots present.
TP-15	686816	5508168	1894	22-Oct-14	none	5.5	12	Siltstone + carbonaceous fines	Within mine workings along ridge, on eastern side.	Similar to TP-14, but contained more siltstone fragments than TP-14. No visible sulphides or carbonates. Dug down 30 cm to obtain -2 mm sample. Moist.
TP-16	686821	5508201	1880	22-Oct-14	none	6.3	6	Fine-grained sandstone	Within mine workings along ridge, on western side.	Few fines. Appears to be weathered fragments of the exposed ridge above. Samples still collected because weathered rock still representative of likely waste and its weathering. Suspect -2 mm sample contains soil, and not necessarily reflective of the rock in this area. Many fossils in this area.
TP-17	686069	5506910	2034	22-Oct-14	none	5.3	15	Siltstone + carbonaceous fines	Blasted this year for bulk sample.	Freshly blasted rock taken for comparison against weathered samples. Mostly siltstone and carbonaceous fines with minor sandstone fragments.
TP-18	686156	5507489	2029	22-Oct-14	none	6.5	13	Siltstone + carbonaceous fines	Material beside road constructed earlier this year.	Fine, most fragments less than 2 cm with only a few greater than 10 cm. Mostly carbonaceous material, with lesser siltstone.
TP-19	685846	5506643	1922	22-Oct-14	none	8.0	45	Coarse to medium-grained sandstone	Waste rock beside road constructed earlier this year, approx. 0.5 to 1.0 m in depth.	Large fragments of coarse to medium-grained sandstone (30-50 cm) with minor conglomerate and fine-grained sandstone-siltstone fragments. Siltstone represented strongly in the -2 mm fraction. No visible sulphides or carbonates.
TP-20	685880	5506874	1945	22-Oct-14	#N/A	#N/A	#N/A	Coarse-grained sandstone	Waste rock beside road constructed earlier this year, approx. 0.5 to 1.0 m in depth.	Much lichen, very few fines. Coarse-grained sandstone does not appear to breakdown readily over time. No -2 mm sample collected. No visible sulphides or carbonates.
TP-21	686127	5507349	2025	22-Oct-14	none	6.4	12	Siltstone + carbonaceous fines	Material recently pushed for road construction.	Similar in composition to TP-18, but contains more coarse (5-10 cm) fragments.
TP-22	685763	5504879	1566	22-Oct-14	none	8.7	81	Fine-grained sandstone + siltstone	Waste rock dump approx. 3 m in height.	Fe colouration and quartz blebs on fracture surfaces of fine-grained sandstone. Fines mostly weathered siltstone. No visible sulphides or carbonates.
TP-23	685822	5504900	1562	22-Oct-14	none	9.3	55	Carbonaceous fines	Waste rock dump approx. 5 m in height.	Mostly coal fines with some siltstone and sandstone fragments. Fewer coal fines observed along the southern end of the dump. Potential seep locations at base of dump, although not flowing at this time.
TP-24	685314	5504749	1532	23-Oct-14	slight	8.5	36	Sandstone + siltstone fragments in siltstone + carbonaceous fines	One of two waste dumps on side of hill (approx. 90 m wide and 15 m high, but height difficult to gauge given underlying topography). Sampled by digging with a shovel into the dump surface.	Mostly coal and siltstone fines, with siltstone and fine- to medium-grained sandstone fragments. Large boulders just below surface, and visible at base of hill. Several fragments show Fe-clay on fracture surfaces, similar to other sites. Fe-coloured layers also cross-bedded within the sandstone. No visible sulphides or carbonates.
TP-25	685360	5504908	1555	23-Oct-14	slight	8.4	56	Sandstone + siltstone fragments in siltstone + carbonaceous fines	Two of two waste dumps on side of hill (approx. 90 m wide and 15 m high, but height difficult to gauge given underlying topography). Sampled from pile recently excavated for the construction of a drill sump (note samples were not taken from the sump). Excavation approx. 2 m in depth.	Similar to TP-24, with the exception being that carbonate was visible as isolated blebs on the surface of some sandstone fragments, with one large fragment showing extensive carbonate; query fracture surface (picture taken). No visible sulphides.
TP-26	685785	5505350	1599	23-Oct-14	none	8.0	34	Sandstone + siltstone fragments in siltstone + carbonaceous fines	Material pushed for road construction earlier this year. Stockpile beside road, approx. 2.5 m in height.	Similar to TP-24. No visible sulphides or carbonates.

Tag No.	Fraction	Reference	Acid Base Accounting														Element Analysis by Aqua Regia Digestion + ICP-MS														
			Paste pH	Total C	Organic C	TIC	TIC	Total S	HCl-Extractable S	Sulphide S	Organic S	AP	Modified NP	Fizz Test	NP/AP	NP/AP	Al	Sb	As	Ba	Bi	B	Cd	Ca	Cr	Co	Cu	Ga	Au	Fe	La
			Std. Units	%	%	% as C	kg CaCO3/t	%	%	%	%	kg CaCO3/t	kg CaCO3/t		Ratio	Classification	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
02201	-2 mm	TP-01	5.85	1.95	1.95	<0.01	<0.83	0.04	0.02	0.01	0.01	0.3	-0.5	None	0.16	Non-PAG	13600	0.32	8.4	215.3	0.21	<20	0.72	1900	89.5	7.4	15.99	4.2	0.0022	19200	11.2
02203	-2 mm	TP-02	5.28	34.54	34.54	<0.01	<0.83	0.2	<0.01	0.02	0.17	0.6	-7.9	None	0.08	Non-PAG	3800	0.3	1.7	340.1	0.27	<20	3.23	3500	30.7	7.3	37.3	1.4	<0.0002	5000	7.3
02205	-2 mm	TP-03	6.84	14.53	14.52	0.01	0.83	0.16	<0.01	0.02	0.13	0.6	2.4	None	3.84	Non-PAG	4300	0.43	6.9	218.3	0.25	<20	1.82	3100	53.4	13.1	35.11	1.4	<0.0002	15400	5.8
02209	-2 mm	TP-05	6.08	26.4	26.39	0.01	0.83	0.16	<0.01	0.02	0.13	0.6	-5.6	None	0.08	Non-PAG	3900	0.54	4.7	548.8	0.24	<20	2.06	5600	21.5	10.6	36.93	1.5	<0.0002	11600	6.2
02211	-2 mm	TP-06	6.53	13.15	13.15	<0.01	<0.83	0.11	<0.01	0.02	0.08	0.6	-1.7	None	0.08	Non-PAG	5100	0.47	8.7	489.3	0.24	<20	2.47	4100	29.8	12.4	37.72	1.7	<0.0002	10300	7.7
02213	-2 mm	TP-07	7.44	11.33	11.24	0.09	7.50	0.14	<0.01	0.03	0.1	0.9	5.6	None	5.97	Non-PAG	4600	0.44	6.5	397.6	0.29	<20	1.71	4000	21.5	10.7	42.46	1.5	0.0003	10800	6.3
02217	-2 mm	TP-09	6.68	31.31	31.29	0.02	1.67	0.25	0.01	0.05	0.19	1.6	-1.0	None	0.03	Non-PAG	4100	0.68	9.3	529.3	0.24	<20	1.96	5800	20	13.6	48.37	1.6	0.0003	13700	7.2
02221	-2 mm	TP-11	7.45	10.43	10.29	0.14	11.67	0.12	<0.01	0.03	0.08	0.9	9.4	None	10.03	Non-PAG	5000	0.48	7.9	350	0.3	<20	1.55	4400	28.4	8.4	39.45	1.6	<0.0002	12200	6.3
02226	-2 mm	TP-14	7.13	10.58	10.56	0.02	1.67	0.11	<0.01	0.02	0.08	0.6	1.9	None	3.04	Non-PAG	5000	0.45	9	401.7	0.28	<20	2.14	4300	28.6	9.2	37.61	1.7	<0.0002	8800	7.9
02228	-2 mm	TP-15	4.91	11.4	11.39	0.01	0.83	0.11	<0.01	0.01	0.09	0.3	-6.6	None	0.16	Non-PAG	5000	0.2	2.7	196.3	0.3	<20	0.56	700	17	3.8	27.21	1.6	<0.0002	4000	2
02232	-2 mm	TP-17	4.63	30.83	30.82	0.01	0.83	0.31	0.07	0.04	0.2	1.3	-26.2	None	0.04	Non-PAG	6900	0.96	9.3	294.2	0.36	<20	0.88	5600	20.3	4.4	35.76	2.7	0.0003	11100	6.2
02234	-2 mm	TP-18	5.60	11.38	11.36	0.02	1.67	0.17	0.02	0.02	0.13	0.6	-3.1	None	0.08	Non-PAG	5400	0.58	7.3	234.8	0.3	<20	1.93	2900	24	8.2	44.42	1.8	0.0003	12700	6.5
02236	-2 mm	TP-19	7.22	7.52	7.25	0.27	22.50	0.1	0.01	0.03	0.06	0.9	13.6	Slight	14.51	Non-PAG	4600	0.5	4.7	325	0.24	<20	1.69	7200	33.4	11.2	41.03	1.5	0.001	13800	6.3
02241	-2 mm	TP-22	7.46	6.39	6.15	0.24	20.00	0.11	<0.01	0.04	0.06	1.3	8.0	Slight	6.40	Non-PAG	5400	0.54	13.4	351	0.31	<20	2.16	7600	25.8	13.4	47.87	1.7	<0.0002	17500	7.2
02243	-2 mm	TP-23	7.56	63.31	63.21	0.1	8.33	0.3	<0.01	0.03	0.26	0.9	4.4	None	4.69	Non-PAG	1700	0.23	1	241.1	0.14	<20	0.37	2900	5.5	3.1	23.64	0.7	<0.0002	3900	3.4
02247	-2 mm	TP-24	7.32	50.59	50.54	0.05	4.17	0.32	<0.01	0.06	0.25	1.9	4.9	None	2.61	Non-PAG	2500	0.7	1.9	204.2	0.2	21	1.2	2500	10.9	11.8	33.81	1	<0.0002	4800	4.1
02249	-2 mm	TP-25	7.08	36.04	35.98	0.06	5.00	0.24	<0.01	0.05	0.18	1.6	3.2	None	2.05	Non-PAG	2800	0.77	4.4	385.1	0.26	<20	1.57	6100	17.3	9.3	38.27	1.1	0.0002	9800	4.5
02251	-2 mm	TP-26	7.07	15.63	15.59	0.04	3.33	0.15	<0.01	0.02	0.12	0.6	3.4	None	5.44	Non-PAG	3800	0.48	5.2	215.2	0.27	<20	0.93	3500	21.6	9.9	27.75	1.1	0.0004	15800	4.6
02202	bulk	TP-01	5.98	0.2	0.2	<0.01	<0.83	0.03	0.02	0.01	0	0.3	0.0	None	0.16	Non-PAG	1600	0.34	7	61.7	0.06	<20	0.13	200	158.1	1.2	5.56	0.8	0.0013	6000	2.4
02204	bulk	TP-02	6.27	4.37	4.3	0.07	5.83	0.05	<0.01	0.01	0.03	0.3	7.5	None	24.00	Non-PAG	4600	0.3	5	253.8	0.13	<20	2.75	4900	120.5	6.2	19	1.4	<0.0002	13500	8.8
02206	bulk	TP-03	7.70	2.58	2.18	0.4	33.34	0.05	<0.01	0.01	0.03	0.3	20.8	Slight	66.56	Non-PAG	4400	0.24	6.3	146.1	0.1	<20	1.21	8600	136.9	7.7	16.51	1.3	0.0002	25300	7.8
02210	bulk	TP-05	7.48	3.28	2.57	0.71	59.17	0.05	<0.01	0.01	0.03	0.3	54.6	Slight	174.72	Non-PAG	5400	0.37	3.6	277.5	0.18	<20	1.52	17000	68.9	11.2	30.32	1.7	0.0003	21800	9.5
02212	bulk	TP-06	7.39	2.01	1.81	0.2	16.67	0.03	<0.01	0.01	0.01	0.3	17.8	Slight	56.96	Non-PAG	5400	0.31	5.5	276.4	0.16	<20	1.78	9000	84.6	11.9	26.94	1.6	0.0003	20400	10
02214	bulk	TP-07	7.79	4.07	3.51	0.56	46.67	0.11	<0.01	0.05	0.05	1.6	32.5	Slight	20.80	Non-PAG	4800	0.49	11.5	253.6	0.15	<20	1.8	11000	90.2	9.7	28.41	1.5	<0.0002	22200	8
02218	bulk	TP-09	7.14	16.14	15.75	0.39	32.50	0.15	<0.01	0.03	0.11	0.9	26.4	Slight	28.16	Non-PAG	4000	0.44	5	324	0.18	<20	1.26	12200	70.9	9.1	29.03	1.5	<0.0002	14900	7.2
02222	bulk	TP-11	7.76	11.26	10.64	0.62	51.67	0.1	<0.01	0.03	0.06	0.9	33.8	Slight	36.05	Non-PAG	4100	0.39	3.5	299.9	0.14	<20	1.48	11200	94.5	7.2	25.3	1.2	<0.0002	20200	7.5
02223	bulk	TP-12	6.05	0.12	0.11	0.01	0.83	0.04	0.03	0.01	0	0.3	-0.2	None	0.16	Non-PAG	1200	0.54	5.5	119.8	0.05	<20	0.06	100	302.8	1	4.59	0.6	0.0002	4500	1.6
02225	bulk	TP-13	5.75	7.86	7.83	0.03	2.50	0.1	0.01	0.02	0.07	0.6	-1.4	None	0.08	Non-PAG	3400	0.54	6.1	144.3	0.16	<20	0.82	1500	182.3	4.2	23.24	1.2	<0.0002	10300	4.3
02227	bulk	TP-14	7.48	7.79	7.6	0.19	15.83	0.1	<0.01	0.02	0.07	0.6	10.7	Slight	17.12	Non-PAG	5600	0.42	4.6	385	0.26	<20	2.72	5100	43.4	8.9	41.85	1.8	<0.0002	13800	9.4
02229	bulk	TP-15	4.96	12.9	12.89	0.01	0.83	0.1	<0.01	0.01	0.08	0.3	-5.0	None	0.16	Non-PAG	4800	0.27	4.7	169	0.29	<20	0.67	500	20	8.4	34.41	1.5	<0.0002	17800	2.3
02231	bulk	TP-16	6.50	1.89	1.4	0.49	40.84	0.02	<0.01	0.01	0	0.3	6.2	None	19.84	Non-PAG	4600	0.28	2.9	236.8	0.13	<20	1.47	2900	68.2	12.1	26.1	1.5	0.0003	47200	7.9
02233	bulk	TP-17	4.78	16.03	16.02	0.01	0.83	0.17	0.02	0.03	0.12	0.9	-11.3	None	0.05	Non-PAG	5100	0.38	3.5	193.7	0.27	<20	0.77	2300	43.3	4.1	23.77	1.9	<0.0002	8200	6.8
02235	bulk	TP-18	6.08	4.51	4.29	0.22	18.33	0.06	<0.01	0.01	0.04	0.3	8.7	None	27.84	Non-PAG	5500	0.42	6.5	182.1	0.24	<20	1.49	4800	47.4	9.4	34.93	1.7	0.0003	23900	7.1
02237	bulk	TP-19	7.83	2.31	1.38	0.93	77.51	0.06	<0.01	0.03	0.02	0.9	54.7	Slight	58.35	Non-PAG	4100	0.32	3.1	263.6	0.12	<20	2.04	15900	109	7	24.68	1.4	0.0006	20600	6.7
02242	bulk	TP-22	7.87	3.15	2.23	0.92	76.67	0.08	<0.01	0.04	0.03	1.3	62.8	Slight	50.24	Non-PAG	4400	0.52	6.4	330.3	0.13	<20	2.02	19300	104.4	9.5	28.25	1.5	0.0004	18600	7.3
02244	bulk	TP-23	7.88	38.18	37.52	0.66	55.00	0.22	<0.01	0.04	0.17	1.3	40.8	Slight	32.64	Non-PAG	2400	0.39	2.2	316.9	0.13	<20	0.92	13600	61.6	5.4	25.29	1.1	<0.0002	13400	6
02248	bulk	TP-24	7.69	14	13.53	0.47	39.17	0.14	<0.01	0.02	0.11	0.6	30.3	Slight	48.48	Non-PAG	3500	0.71	2	322.7	0.24	<20	1.4	9500	55.2	8	33.04	1	0.0003	15700	5.4
02250	bulk	TP-25	7.34	9	8.24	0.76	63.34	0.13	<0.01	0.06	0.06	1.9	41.7	Slight	22.24	Non-PAG	3000	0.69	10	333.3	0.18	<20	1.41	11400	81	7.9	23.98	1	0.0005	19600	4.3
02252	bulk	TP-26	7.59	7.96	7.09	0.87	72.50	0.1	<0.01	0.02	0.07	0.6	58.0	Slight	92.80	Non-PAG	3200	0.6	3.6	243.4	0.18	<20	1.7	15500	63.9	8.2	25	0.9	<0.0002	23200	5.5

Tag No.	Fraction	Reference	Pb	Mg	Mn	Hg	Mo	Ni	P	K	Sc	Se	Ag	Na	Sr	S	Te	Tl	Th	Ti	W	U	V	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
02201	-2 mm	TP-01	14.8	2100	653	0.053	4.37	21.1	840	1000	2.7	0.4	0.17	80	16.6	300	0.03	0.19	1.6	210	<0.1	0.9	31	76.9
02203	-2 mm	TP-02	17.42	500	113	0.103	1.79	27.2	440	900	3.3	0.5	0.263	30	34.5	300	0.06	0.03	3.3	10	<0.1	1.2	17	96.8
02205	-2 mm	TP-03	16.36	800	237	0.13	3.09	41.6	700	1500	4.6	0.9	0.278	50	19.8	300	0.07	0.06	3.5	<10	<0.1	1.3	36	150.2
02209	-2 mm	TP-05	16.55	1500	227	0.192	1.92	37.3	570	1300	4.5	1.1	0.289	40	29.8	300	0.08	0.03	4.1	10	<0.1	1.3	27	139
02211	-2 mm	TP-06	17.97	900	213	0.168	1.85	43.7	720	1700	4.2	0.8	0.269	50	29.7	300	0.04	0.06	5.2	10	<0.1	1.5	34	158.6
02213	-2 mm	TP-07	18.48	1700	188	0.206	2.15	41.6	590	2000	4.6	1.6	0.403	50	24.7	400	0.05	0.05	4.7	<10	<0.1	1.3	32	165.3
02217	-2 mm	TP-09	19.88	1500	307	0.225	2.41	43.2	470	1200	4.5	1.8	0.306	50	40.7	600	0.05	0.03	2.2	10	<0.1	1.3	38	146.6
02221	-2 mm	TP-11	18	1900	165	0.229	2.44	38.3	710	1800	4.7	1.5	0.381	50	27.5	400	0.09	0.06	4.9	<10	<0.1	1.5	33	168.5
02226	-2 mm	TP-14	17.6	900	119	0.174	2.1	36.3	920	1900	4.8	1.2	0.419	50	29.9	300	0.05	0.06	5.9	<10	<0.1	1.7	34	160.9
02228	-2 mm	TP-15	17.55	400	18	0.113	1.17	12	50	1700	4.1	0.4	0.181	50	11.9	200	0.07	0.04	1.8	<10	<0.1	0.8	22	67.2
02232	-2 mm	TP-17	26.35	400	26	0.18	3.31	17	270	1000	4.6	2.1	0.28	20	36.3	1100	0.13	0.03	2.7	40	<0.1	1.7	40	33.3
02234	-2 mm	TP-18	19.41	700	171	0.216	2.86	34.3	460	1900	4.6	1.5	0.353	40	21.7	400	0.04	0.08	4.1	10	<0.1	2	41	136.5
02236	-2 mm	TP-19	17.71	3100	328	0.119	2.61	41.2	700	1800	4	1.2	0.43	40	23.8	400	0.06	0.12	3.3	10	<0.1	1.4	32	157.1
02241	-2 mm	TP-22	22.13	3200	326	0.213	2.27	56	900	2100	4.8	1.8	0.5	70	32.5	500	0.06	0.09	5.9	<10	<0.1	1.6	42	199.5
02243	-2 mm	TP-23	10.3	700	76	0.166	0.87	7.6	130	400	2.4	0.6	0.076	60	39.7	400	0.08	<0.02	1.2	<10	<0.1	0.5	11	29
02247	-2 mm	TP-24	14.17	800	126	0.144	1.25	30.6	250	700	3	1	0.181	50	27.2	700	0.06	<0.02	2.1	<10	<0.1	0.8	14	122.9
02249	-2 mm	TP-25	17.22	1500	200	0.192	1.91	31.8	360	1000	4	1.2	0.281	50	29.6	600	0.04	0.02	2.7	10	<0.1	1	21	119.6
02251	-2 mm	TP-26	16.44	1200	250	0.124	1.95	29.3	440	1400	4.1	0.8	0.251	40	20.3	300	0.05	0.05	2.4	<10	<0.1	0.7	19	105
02202	bulk	TP-01	8.69	200	70	0.04	7.22	10.6	170	400	1.6	0.2	0.166	10	7.9	<200	<0.02	0.09	1.1	20	<0.1	0.2	14	12.7
02204	bulk	TP-02	10.01	1000	147	0.106	5.38	33.4	1330	1500	3.8	0.8	0.268	40	27.2	<200	0.04	0.08	4.5	<10	<0.1	1.8	25	142.5
02206	bulk	TP-03	9.89	3000	400	0.124	5.71	29.8	1350	1400	5.2	0.6	0.303	50	28.8	200	0.02	0.07	4	<10	<0.1	1.5	29	127.2
02210	bulk	TP-05	13.64	6000	330	0.149	3.56	43	1180	1800	5.4	0.7	0.299	60	33.2	<200	0.03	0.07	6	<10	<0.1	1.6	39	155.9
02212	bulk	TP-06	13.48	1400	236	0.142	3.91	47	1190	1900	5.2	0.7	0.258	40	24.4	<200	0.03	0.08	5.8	<10	<0.1	1.7	35	177.3
02214	bulk	TP-07	12.73	4000	304	0.222	4.61	43.3	1040	1800	4.9	1.1	0.338	60	29.8	600	0.04	0.07	5	<10	<0.1	1.5	36	171.7
02218	bulk	TP-09	13.92	2500	209	0.176	3.8	33.5	700	1400	4.5	1.1	0.274	40	34.8	400	0.04	0.03	3.7	<10	<0.1	1.2	29	144.7
02222	bulk	TP-11	11.87	4500	272	0.157	4.31	28.5	850	1300	5.2	1.1	0.329	50	32.3	400	0.04	0.03	4.5	<10	<0.1	1.4	32	153.6
02223	bulk	TP-12	11.04	<100	83	0.03	13.06	13.3	100	400	0.6	<0.1	0.309	10	13.5	300	0.04	0.09	0.5	<10	<0.1	0.2	11	4.8
02225	bulk	TP-13	13.7	400	99	0.092	9.2	24.8	430	1400	2.8	0.7	0.251	30	16.8	300	0.07	0.07	2.9	<10	<0.1	1	28	81
02227	bulk	TP-14	16.58	1800	179	0.201	2.53	39.1	1080	2000	5.8	1.6	0.498	50	32.5	300	0.05	0.06	6.4	<10	<0.1	2	37	212
02229	bulk	TP-15	17.25	400	65	0.113	1.48	22.9	100	1500	4.9	1	0.171	50	11.1	200	0.05	0.03	2.2	<10	<0.1	0.9	27	150.4
02231	bulk	TP-16	11.5	1800	677	0.118	3.6	46.1	990	1600	6.2	0.8	0.184	40	20.8	<200	0.03	0.06	4.7	<10	<0.1	1.4	44	162
02233	bulk	TP-17	18.34	200	78	0.111	2.7	16.3	480	1500	3.3	0.8	0.251	40	20.8	500	0.07	0.03	5	10	<0.1	1.6	27	59.6
02235	bulk	TP-18	16.29	2200	319	0.198	3.68	40.7	810	2000	5	1.5	0.315	40	21.9	200	0.04	0.08	5.4	<10	<0.1	1.7	41	189.7
02237	bulk	TP-19	12.28	7100	300	0.138	5.3	30.3	860	1600	4.9	0.7	0.336	50	30.7	400	0.03	0.06	4.6	<10	<0.1	1.4	35	169.6
02242	bulk	TP-22	11.93	7600	269	0.183	4.8	42.3	1020	1600	5	0.8	0.339	50	42.9	500	0.03	0.06	4.9	<10	<0.1	1.6	38	171.5
02244	bulk	TP-23	10.79	4800	225	0.131	3.4	20.2	590	800	4	0.8	0.179	70	57.6	500	0.05	<0.02	2.9	<10	<0.1	1.1	22	81
02248	bulk	TP-24	14.01	3900	271	0.155	3.2	30.5	690	1200	4.6	1.1	0.316	40	25.7	300	0.03	<0.02	3.9	<10	<0.1	1.3	25	157.5
02250	bulk	TP-25	13.35	5200	293	0.211	4.16	30.8	650	1200	4.4	1.1	0.285	50	25.7	700	0.05	0.09	3	<10	<0.1	1.1	26	123.7
02252	bulk	TP-26	11.95	6400	324	0.148	3.56	32	670	1200	6	0.7	0.272	50	47.5	300	0.05	0.04	3.7	<10	<0.1	1.1	31	146.5

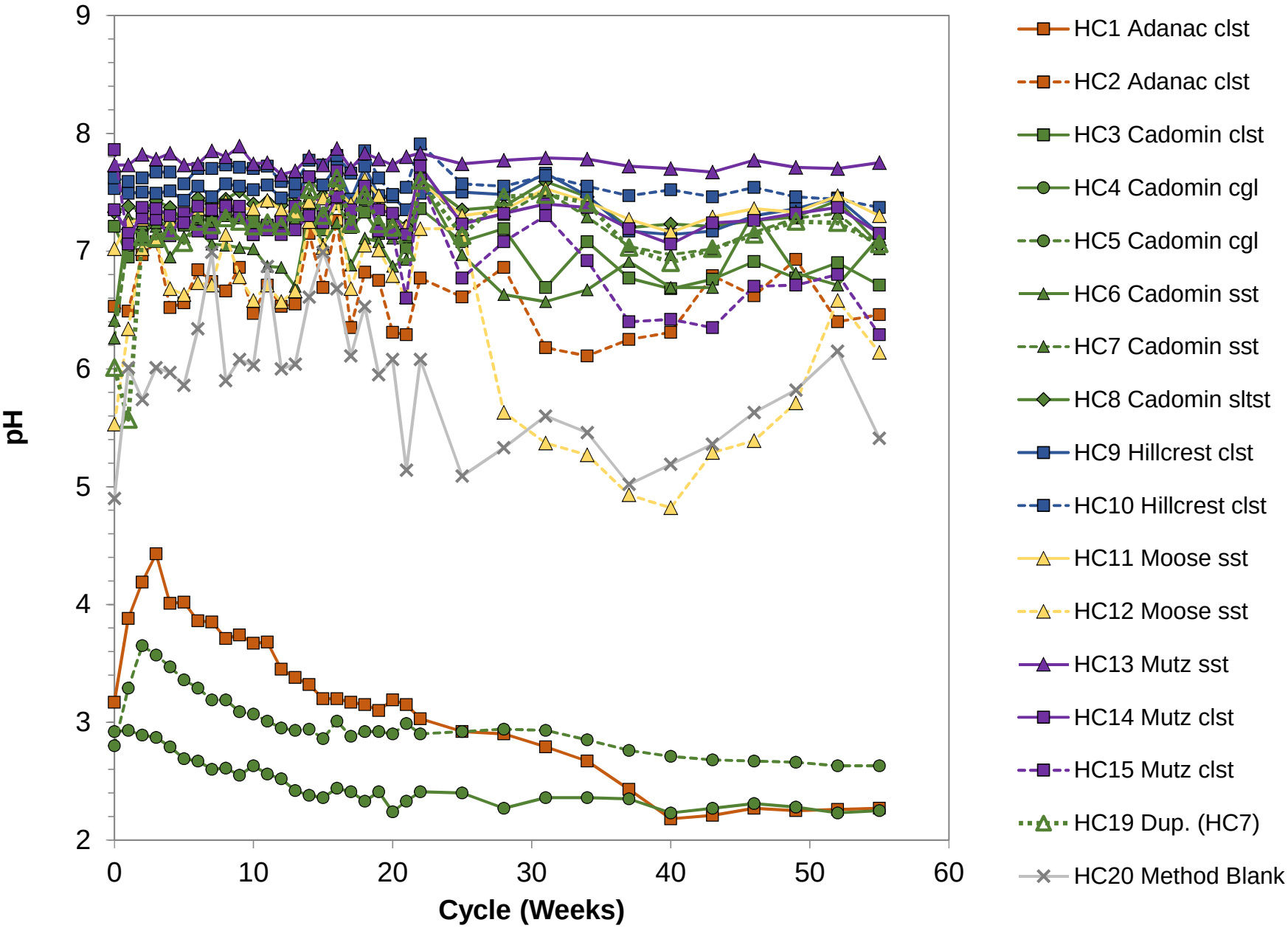
Appendix G – Static Test Results for CHPP Residues

Sample ID	Sample Origin	Acid Base Accounting															
		Paste pH Std. Units	Paste EC µS/cm	Total C %	Organic C %	TIC % as C	TIC kg CaCO3/t Calc.	Total S %	HCl-Extractable S %	Sulphide S % Calc.	Organic S % Calc.	AP kg CaCO3/t Calc.	Sobek NP kg CaCO3/t	Modified NP kg CaCO3/t	Fizz Test	NP/AP Ratio Calc.	NP/AP Classification Calc.
Seam 1 Reject Blend	ALS Newcastle	7.12	247	25.52	25.43	0.09	7.5	0.33	<0.01	0.14	0.18	4.4	#N/A	3.9	None	0.89	PAG
Seam 2 Reject Blend	ALS Newcastle	8.15	61.6	38.27	37.82	0.45	37.5	0.09	<0.01	0.02	0.06	0.6	#N/A	22.4	Slight	35.84	Non-PAG
Seam 4 Reject Blend	ALS Newcastle	8.06	84.5	32.73	32.56	0.17	14.2	0.1	<0.01	0.04	0.05	1.3	#N/A	17.9	None	14.32	Non-PAG

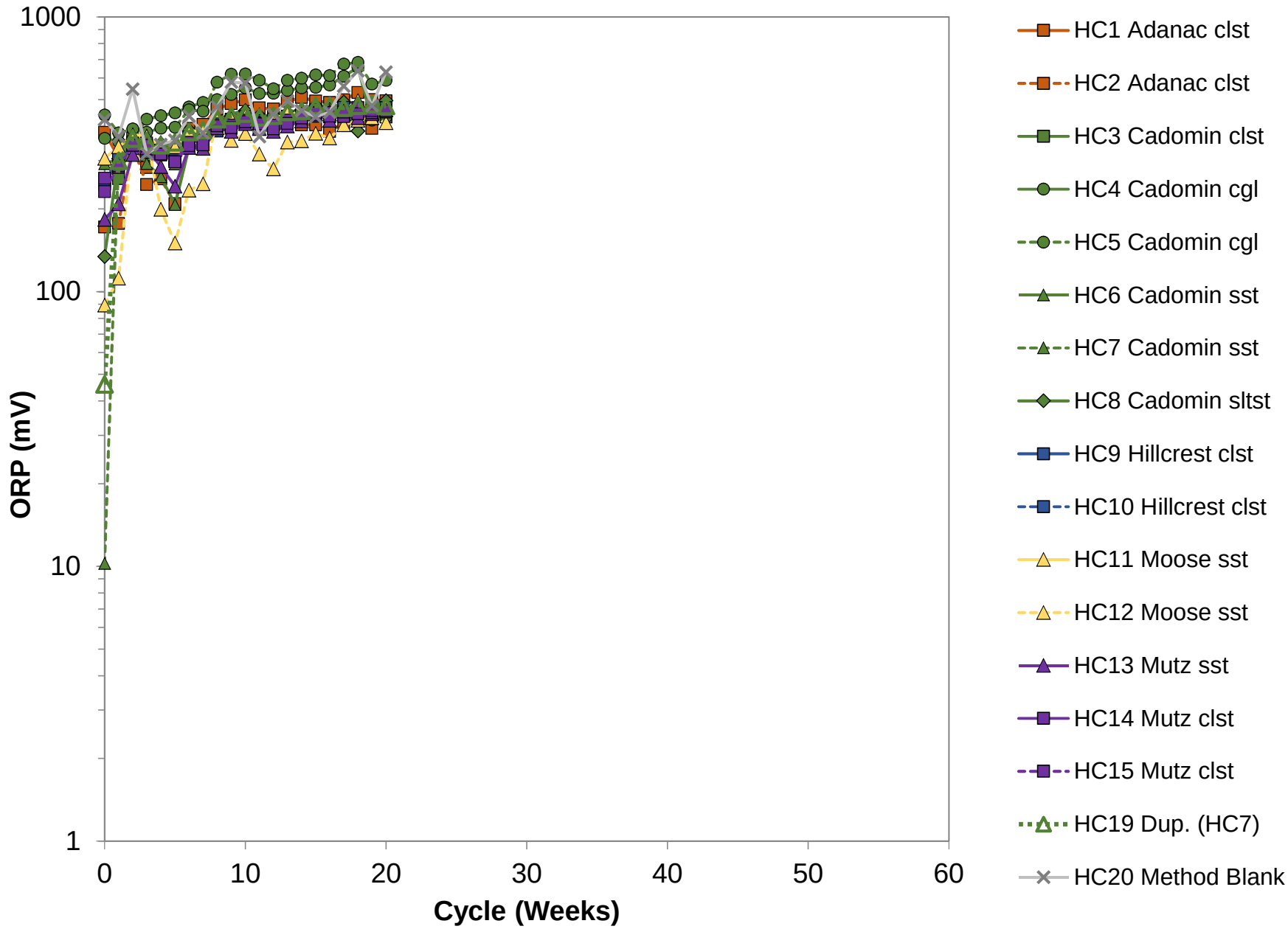
Sample ID	Element Analysis by Aqua Regia Digestion + ICP-MS																		
	Al mg/kg	Sb mg/kg	As mg/kg	Ba mg/kg	Bi mg/kg	B mg/kg	Cd mg/kg	Ca mg/kg	Cr mg/kg	Co mg/kg	Cu mg/kg	Ga mg/kg	Au mg/kg	Fe mg/kg	La mg/kg	Pb mg/kg	Mg mg/kg	Mn mg/kg	Hg mg/kg
Seam 1 Reject Blend	3000	0.69	1.5	268.6	0.31	<20	1.75	2200	18.7	4.9	43.12	0.8	<0.0002	6100	2.8	15.44	1100	94	0.168
Seam 2 Reject Blend	2500	0.18	0.4	373.7	0.22	<20	0.36	7800	7.9	1.4	30.87	0.8	<0.0002	9700	4.8	9.6	2600	118	0.391
Seam 4 Reject Blend	2200	0.24	0.2	234.5	0.29	<20	0.4	2300	8.9	2.6	32.27	0.7	0.0003	7000	3.3	12.19	1000	98	0.122

Sample ID	Element Analysis by Aqua Regia Digestion + ICP-MS (continued)																	
	Mo mg/kg	Ni mg/kg	P mg/kg	K mg/kg	Sc mg/kg	Se mg/kg	Ag mg/kg	Na mg/kg	Sr mg/kg	S mg/kg	Te mg/kg	Tl mg/kg	Th mg/kg	Ti mg/kg	W mg/kg	U mg/kg	V mg/kg	Zn mg/kg
Seam 1 Reject Blend	3.48	23.5	350	1300	3.3	2.7	0.346	50	21	1500	0.04	<0.02	2.1	<10	<0.1	1.1	19	123.9
Seam 2 Reject Blend	0.97	2.7	50	500	3.8	0.3	0.08	100	55.9	300	0.05	<0.02	2.6	<10	<0.1	0.6	7	36.7
Seam 4 Reject Blend	1.03	6.3	30	800	3.2	0.7	0.117	120	27.5	500	0.08	<0.02	1.6	<10	<0.1	0.6	10	35.6

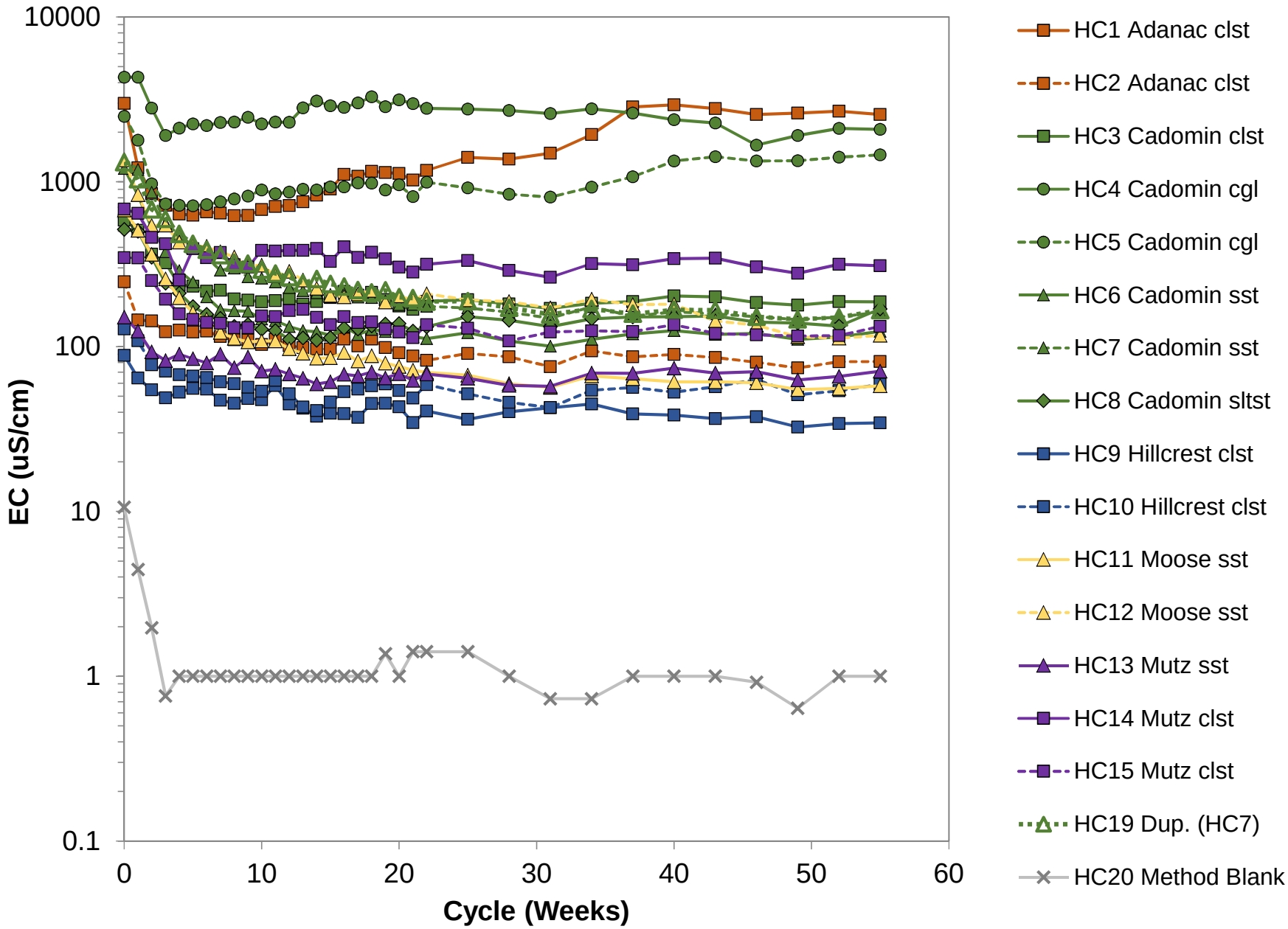
Appendix H – Waste Rock Humidity Cell Test Charts



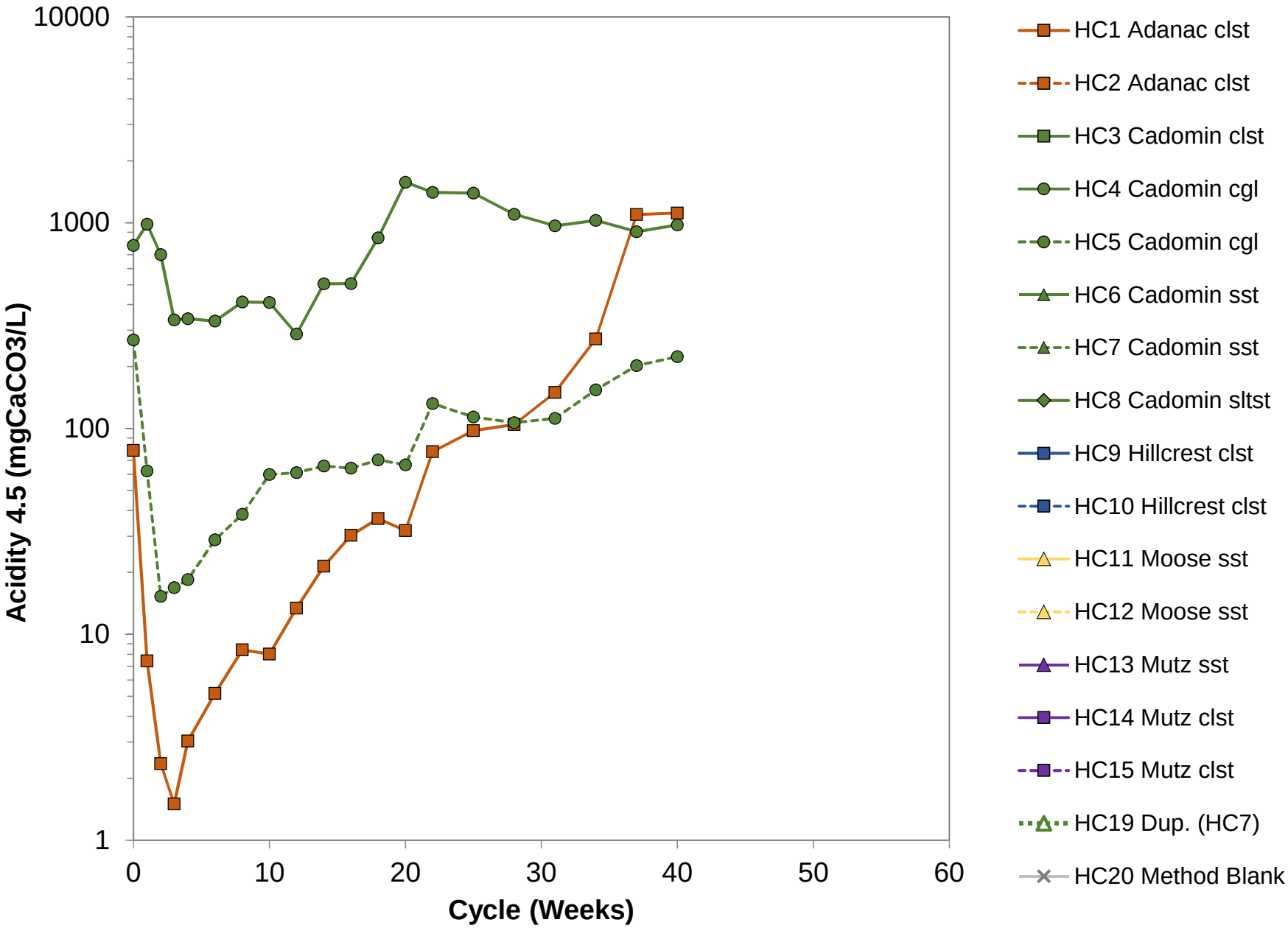
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



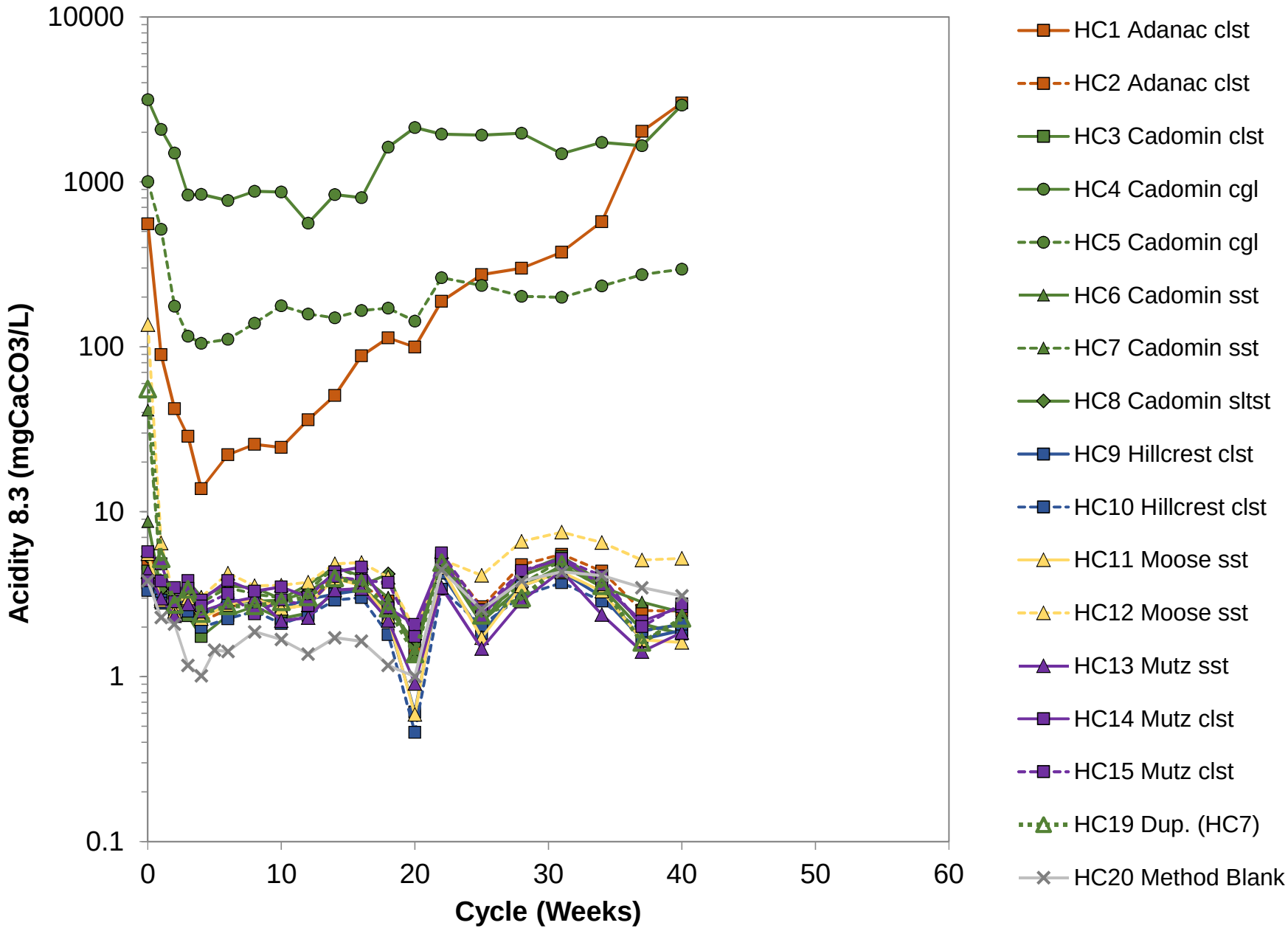
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



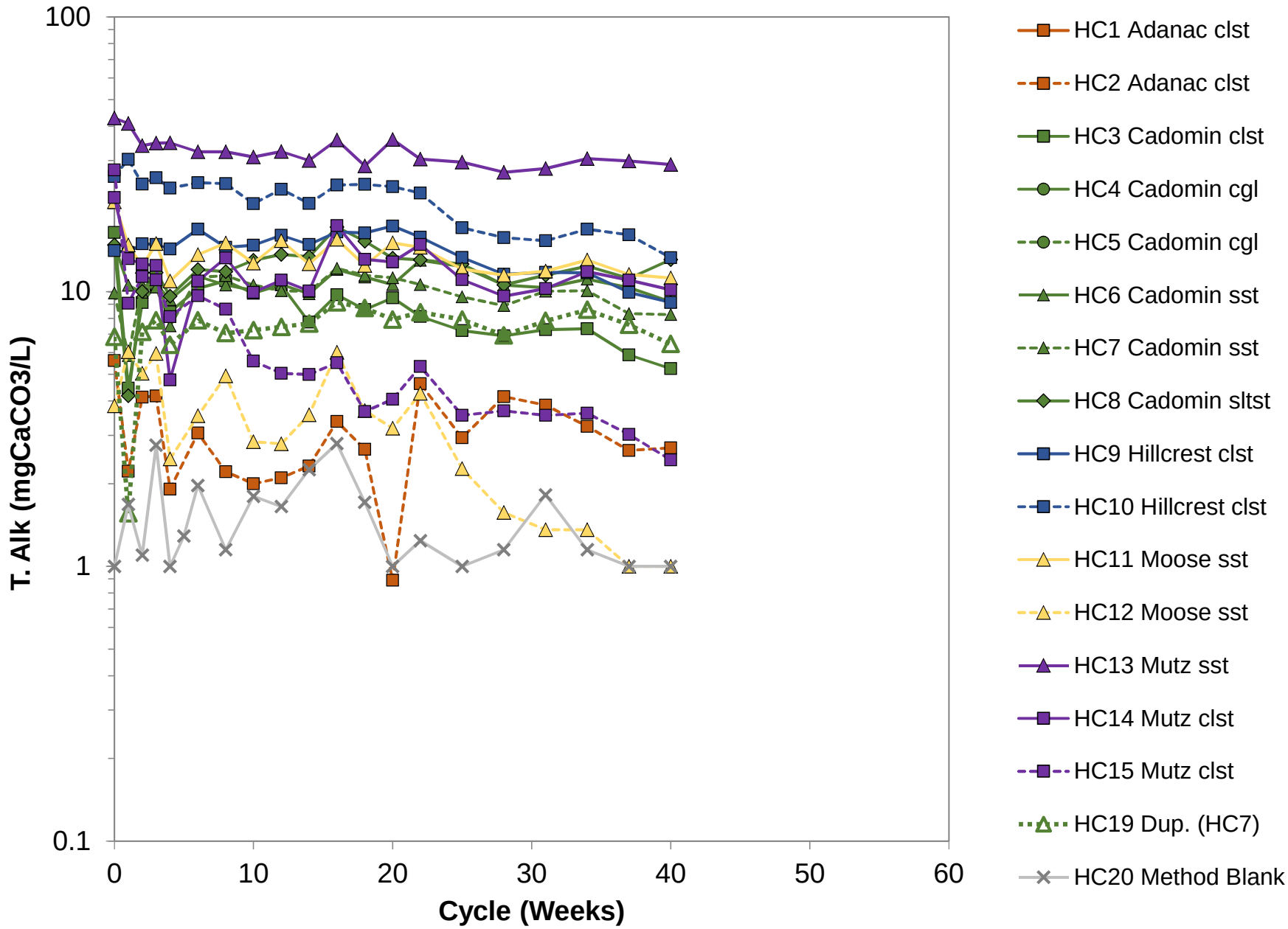
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



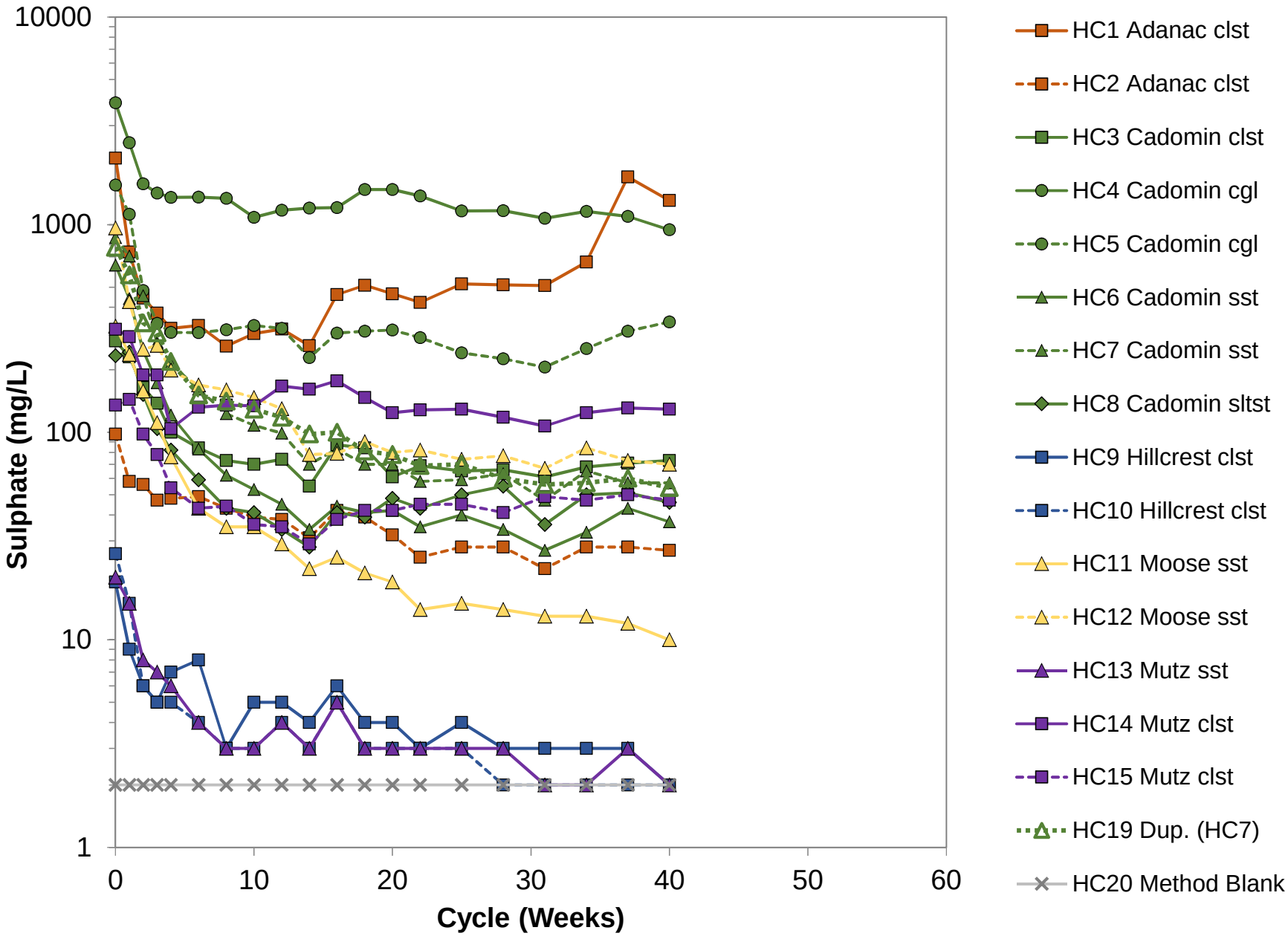
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



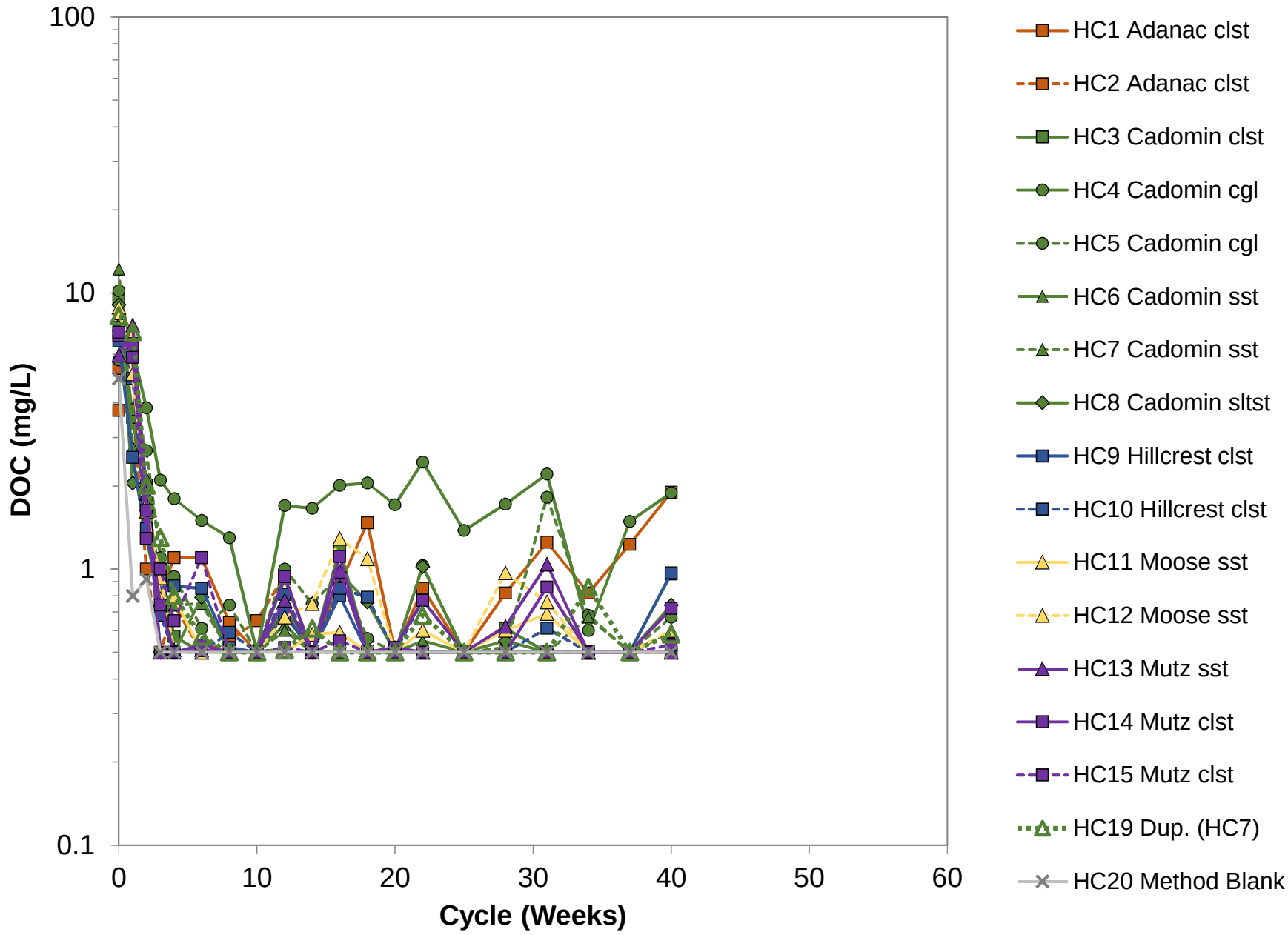
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



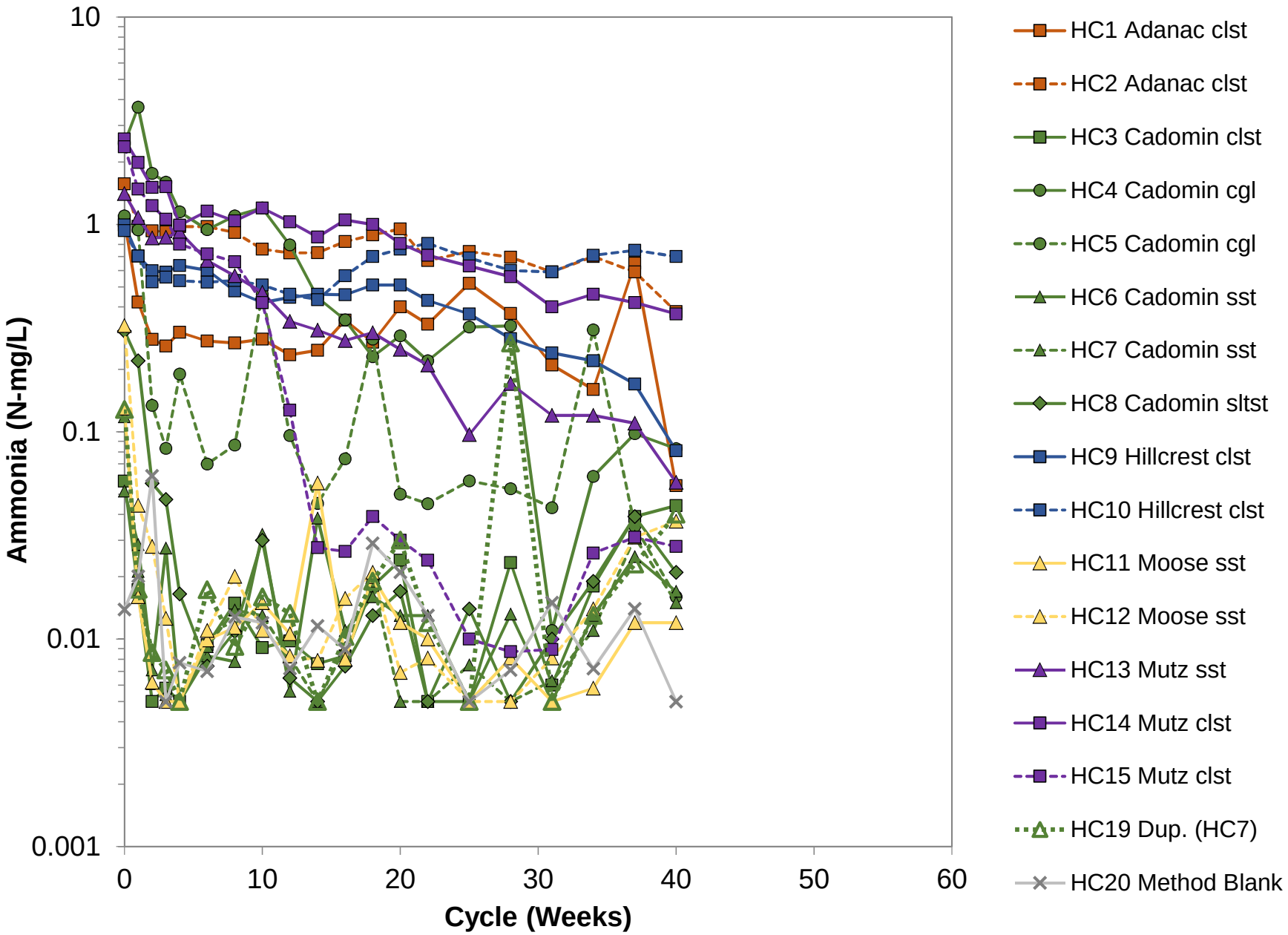
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



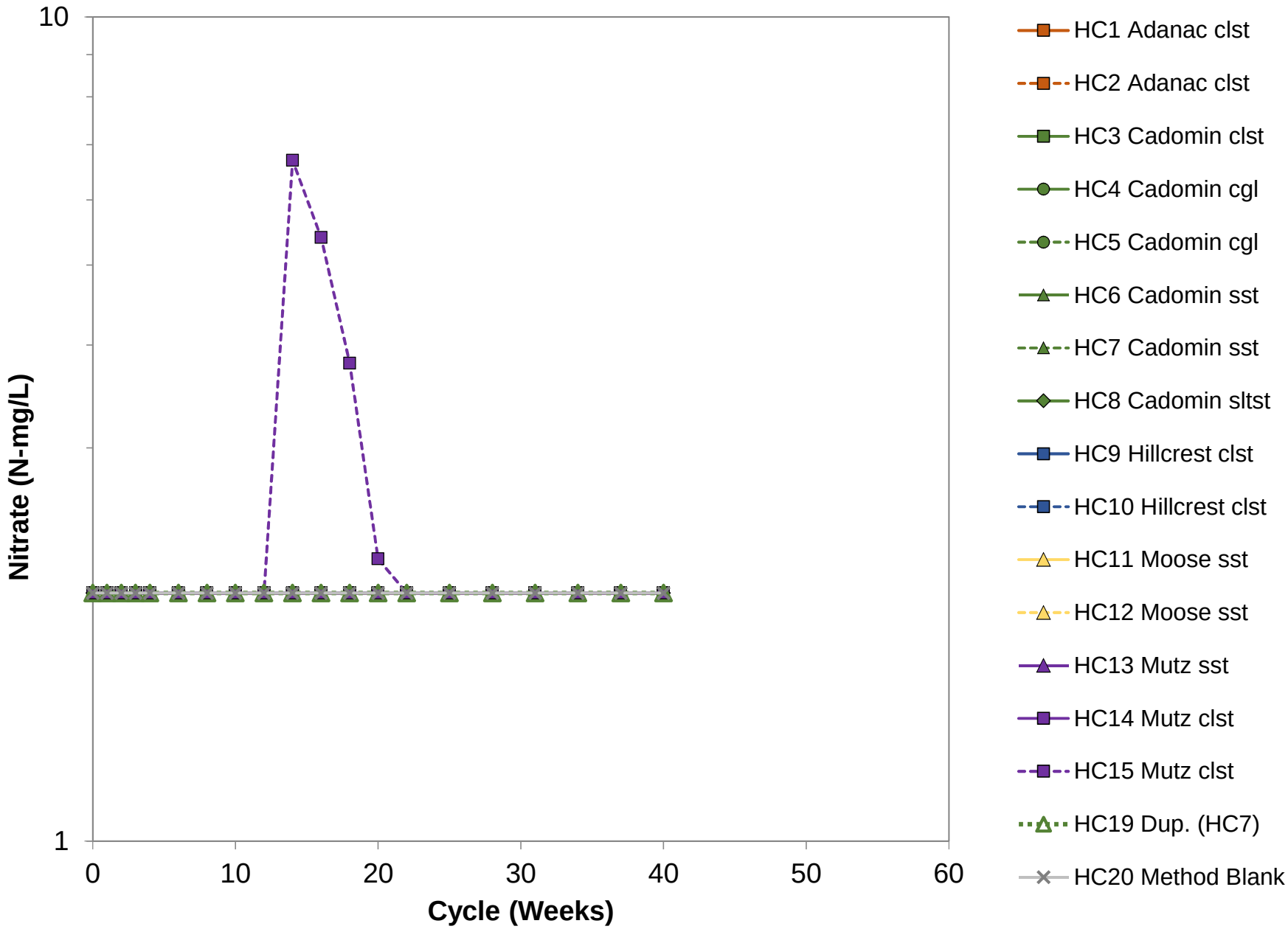
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



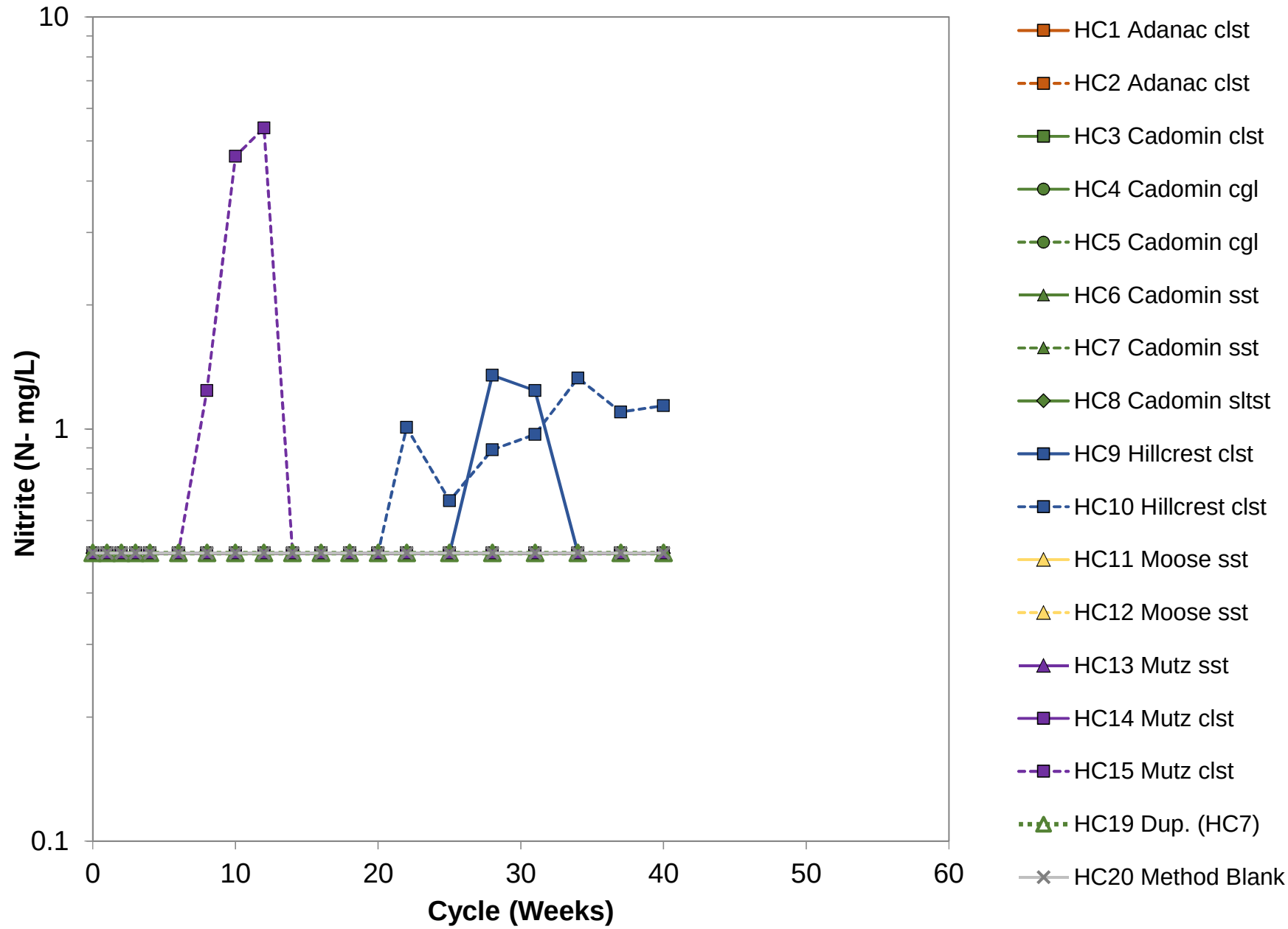
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



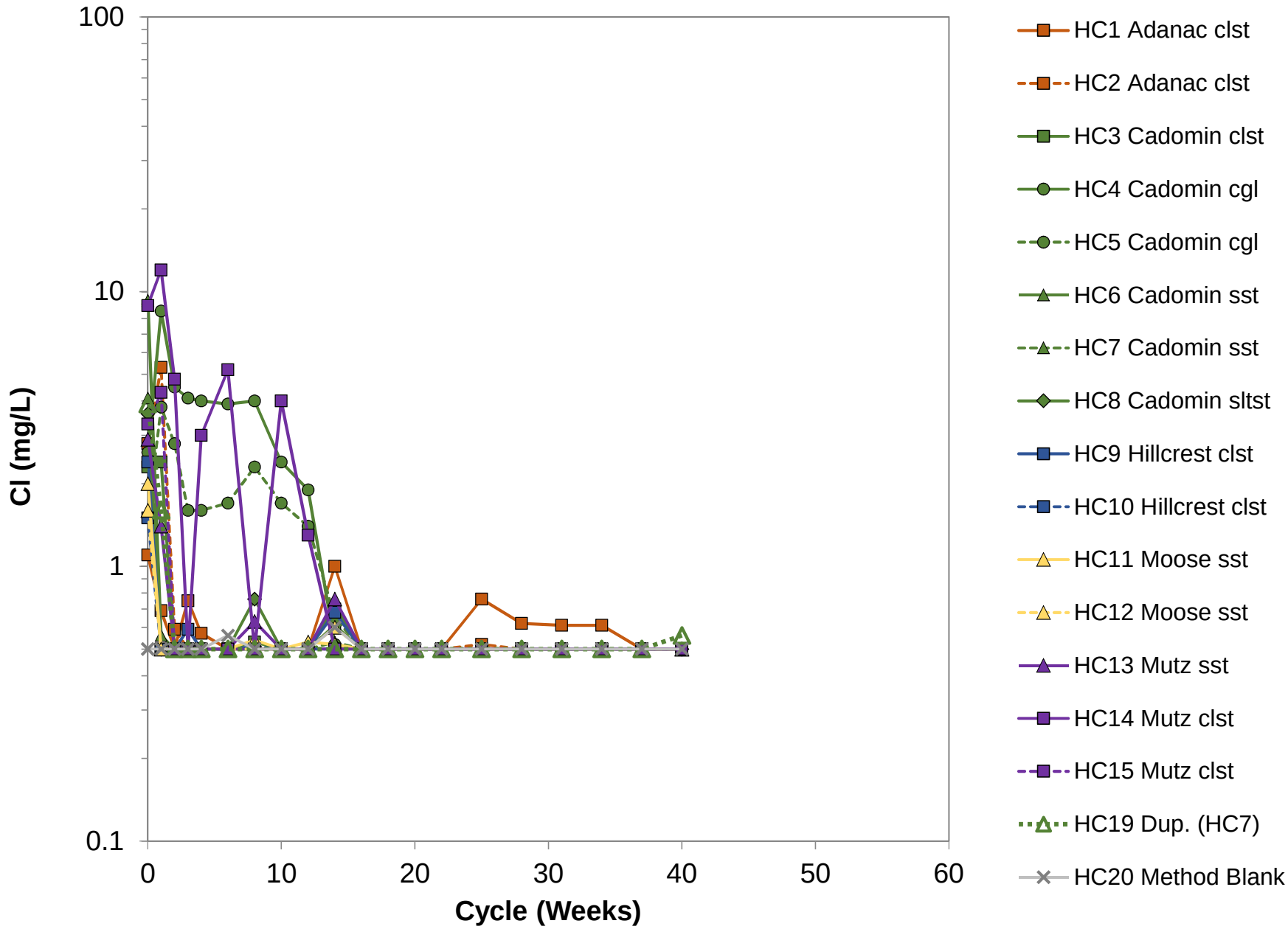
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



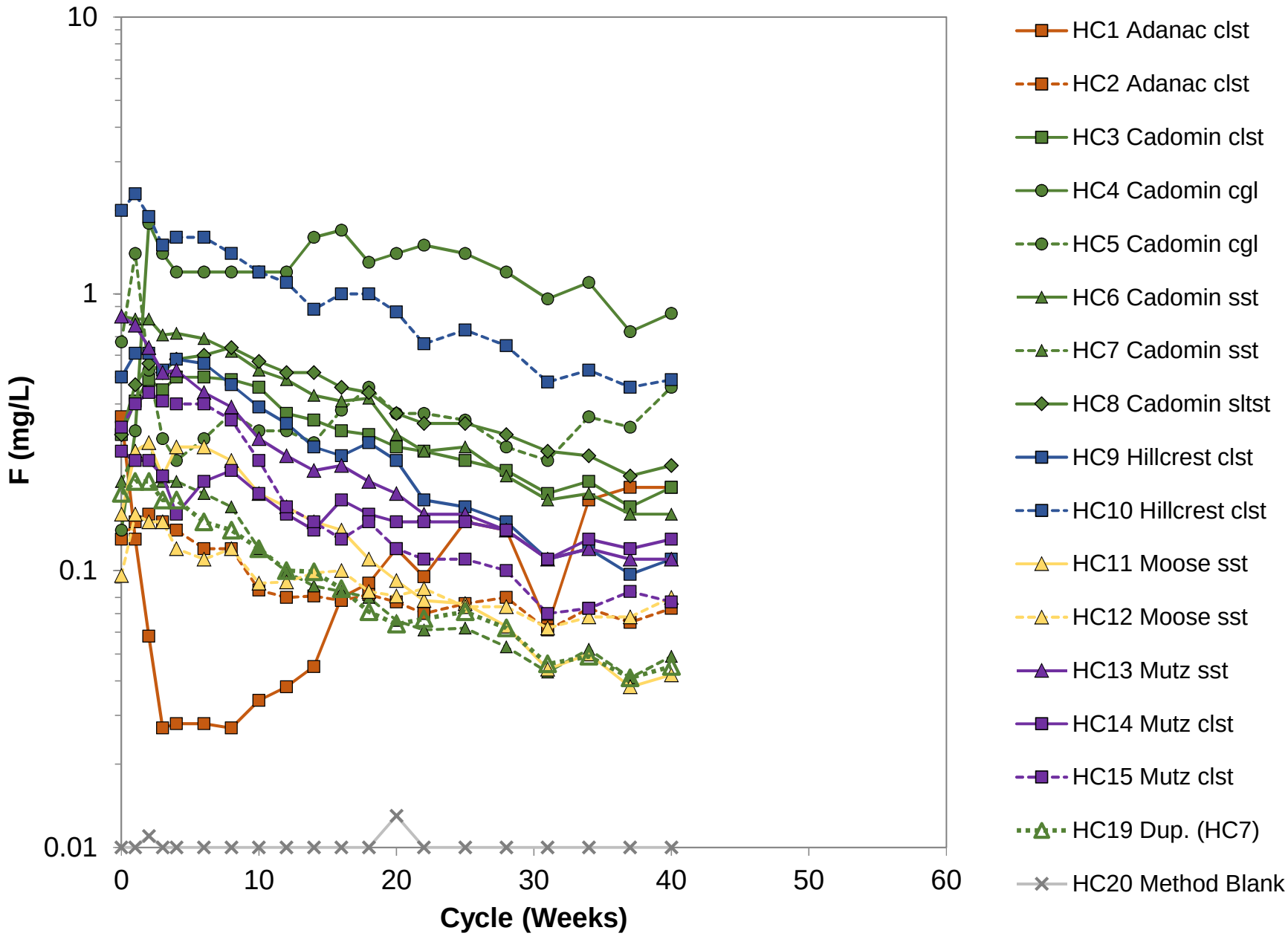
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



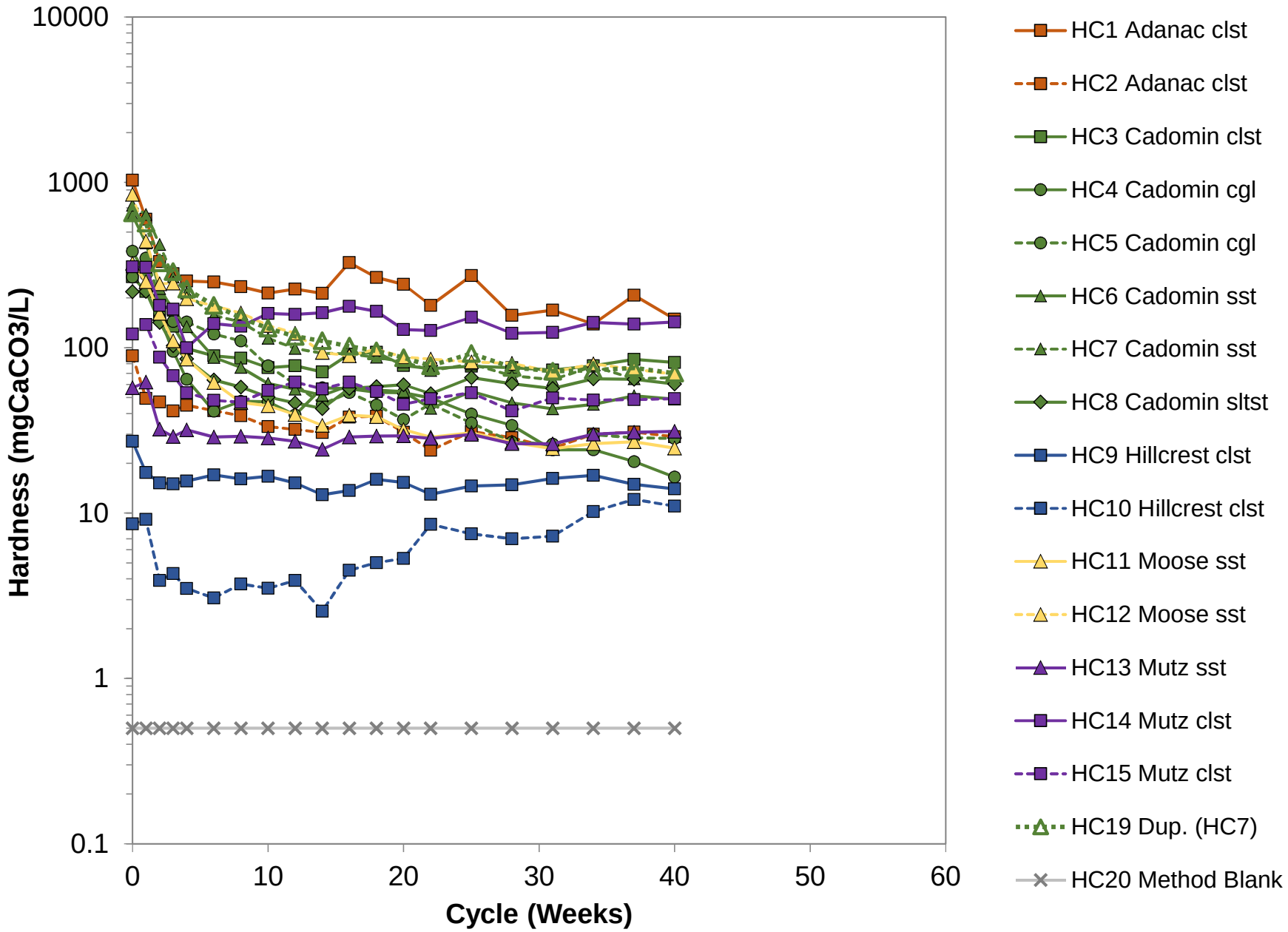
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



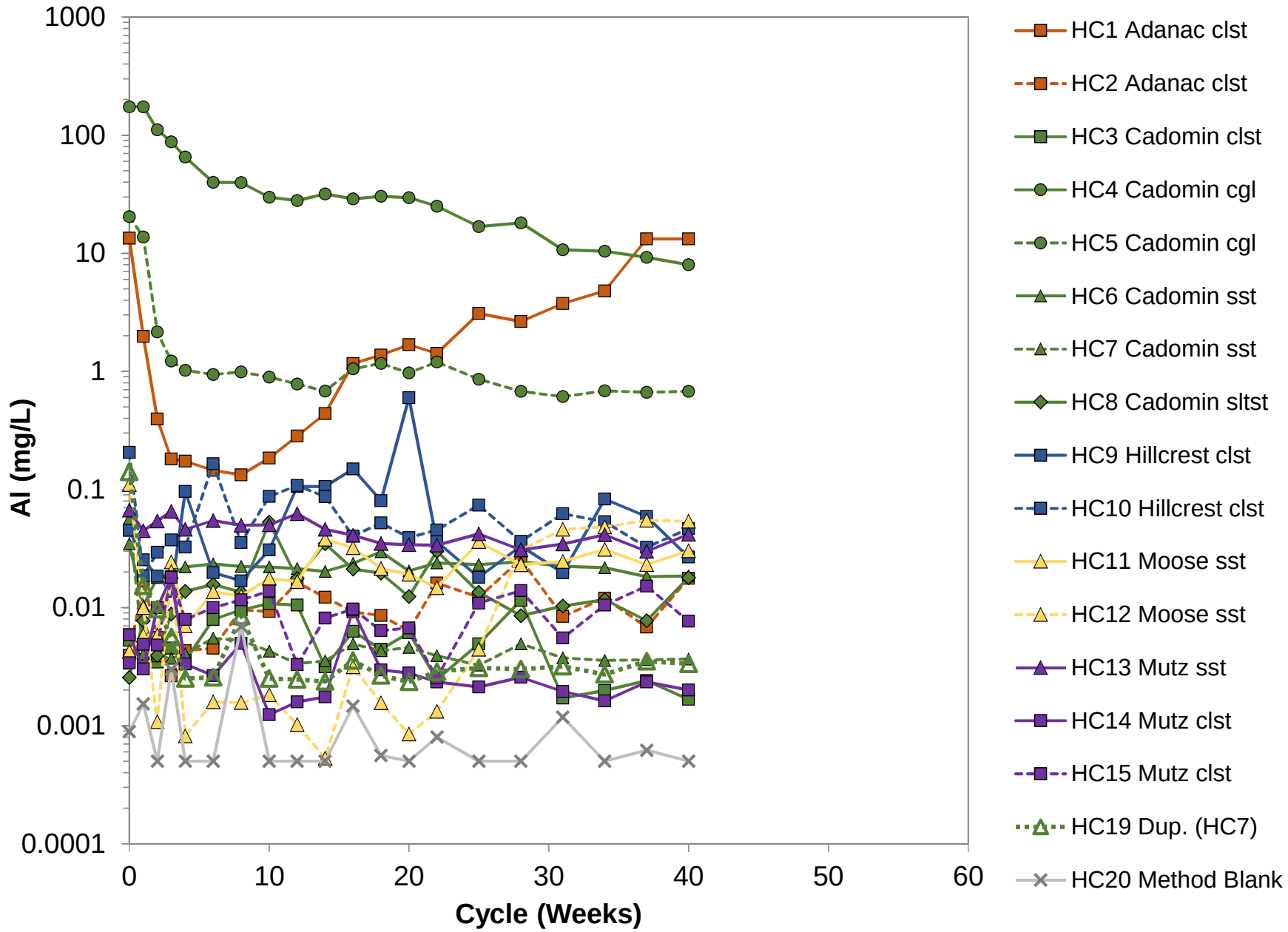
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



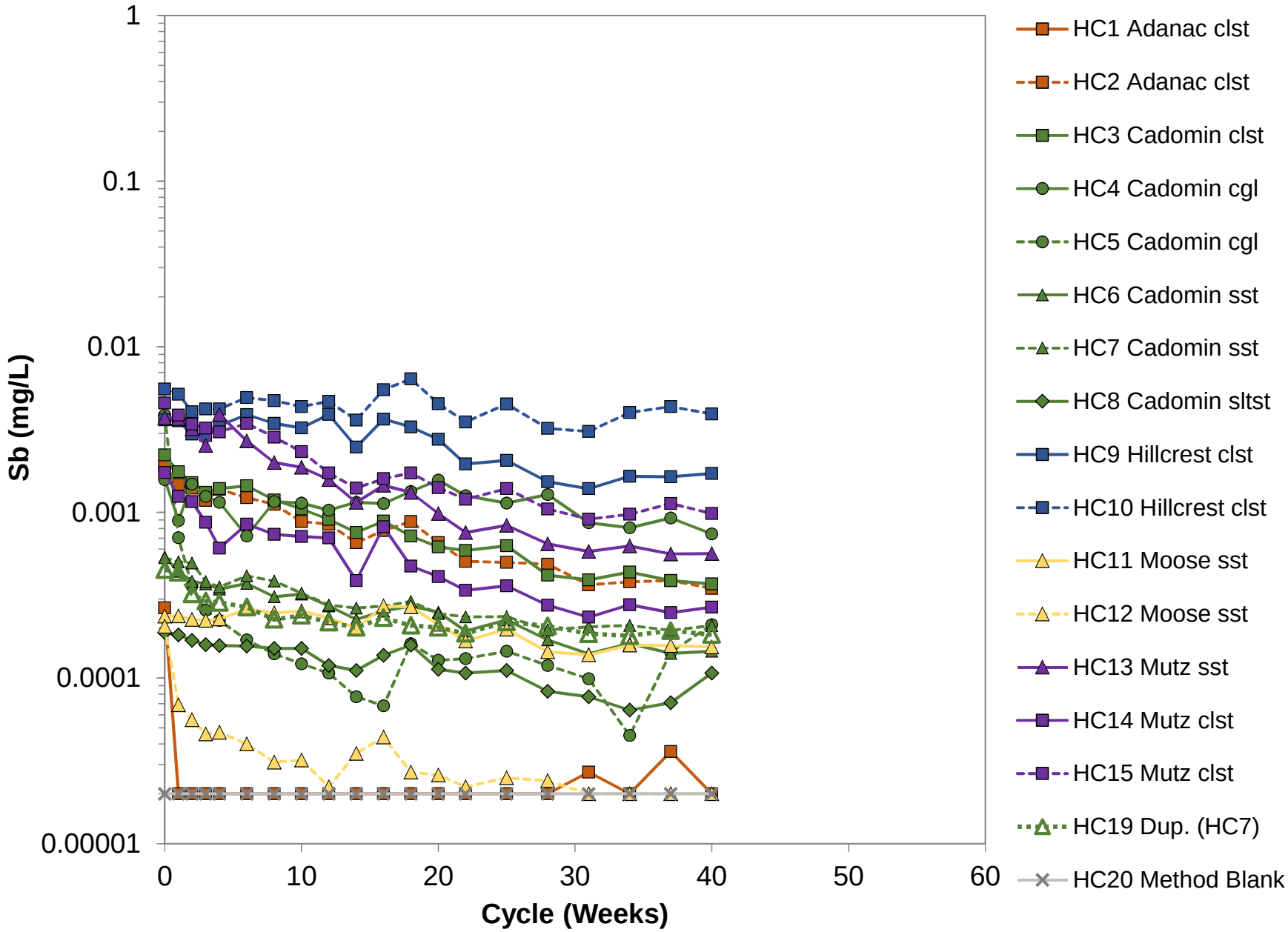
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



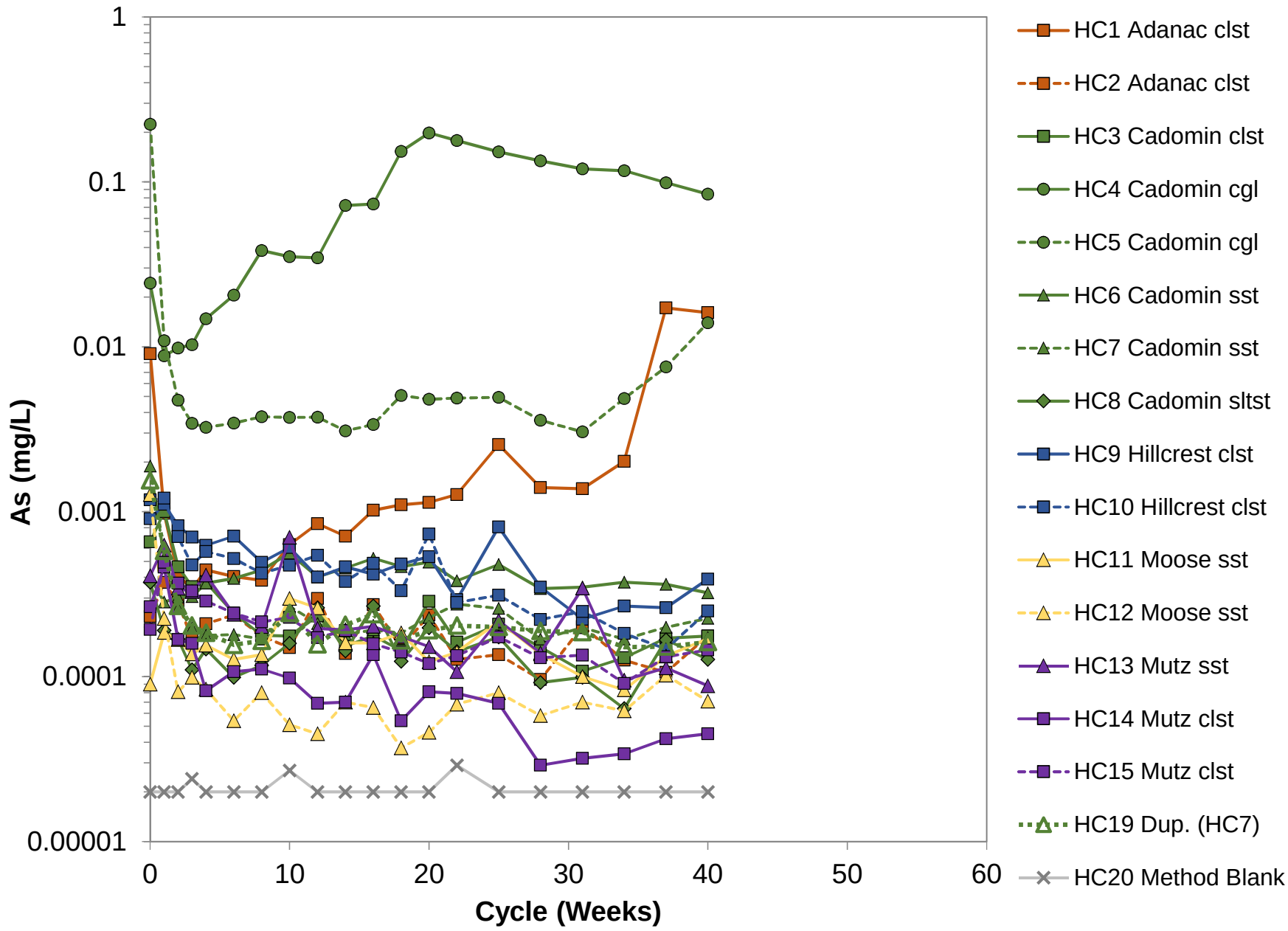
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



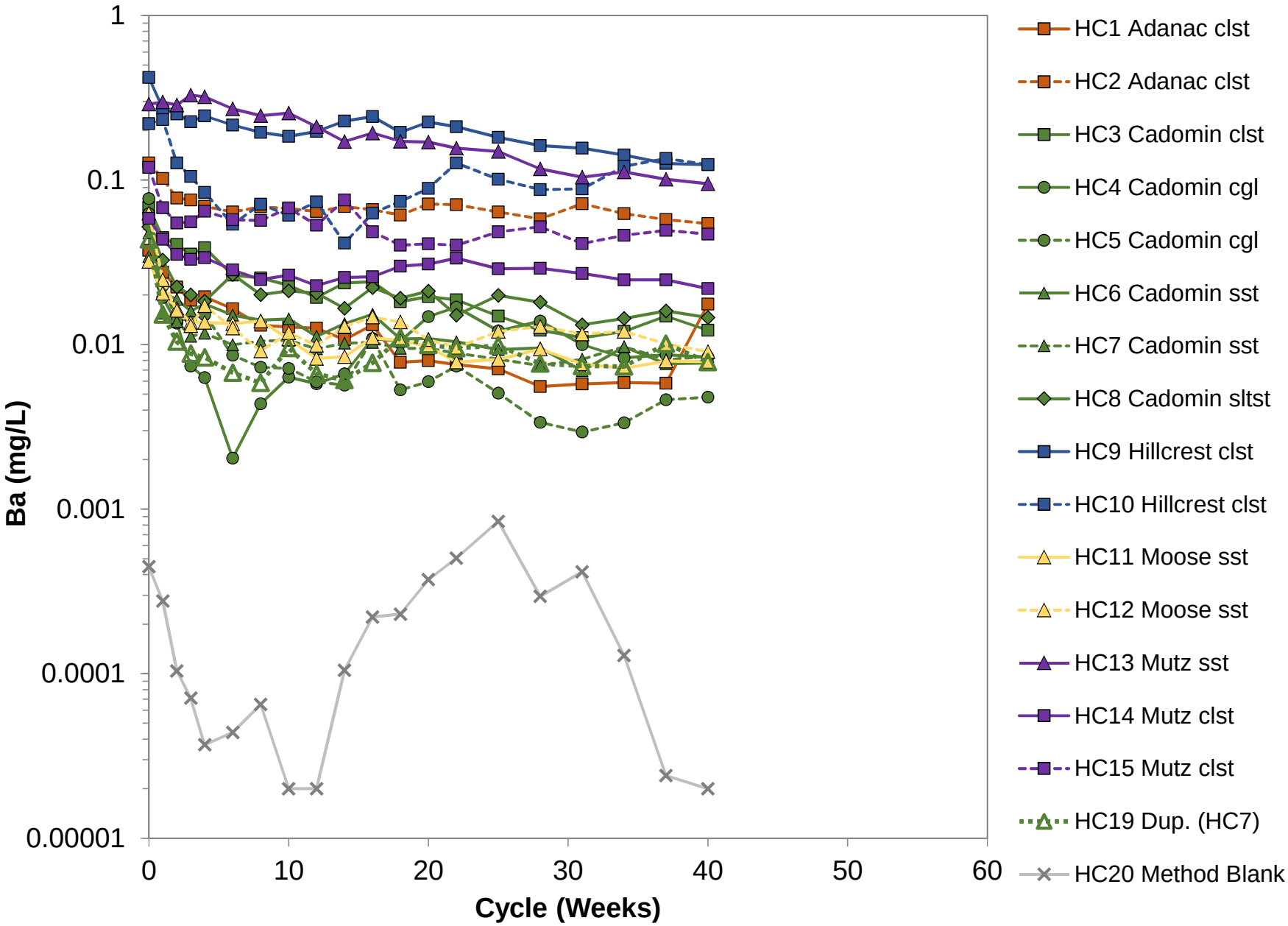
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



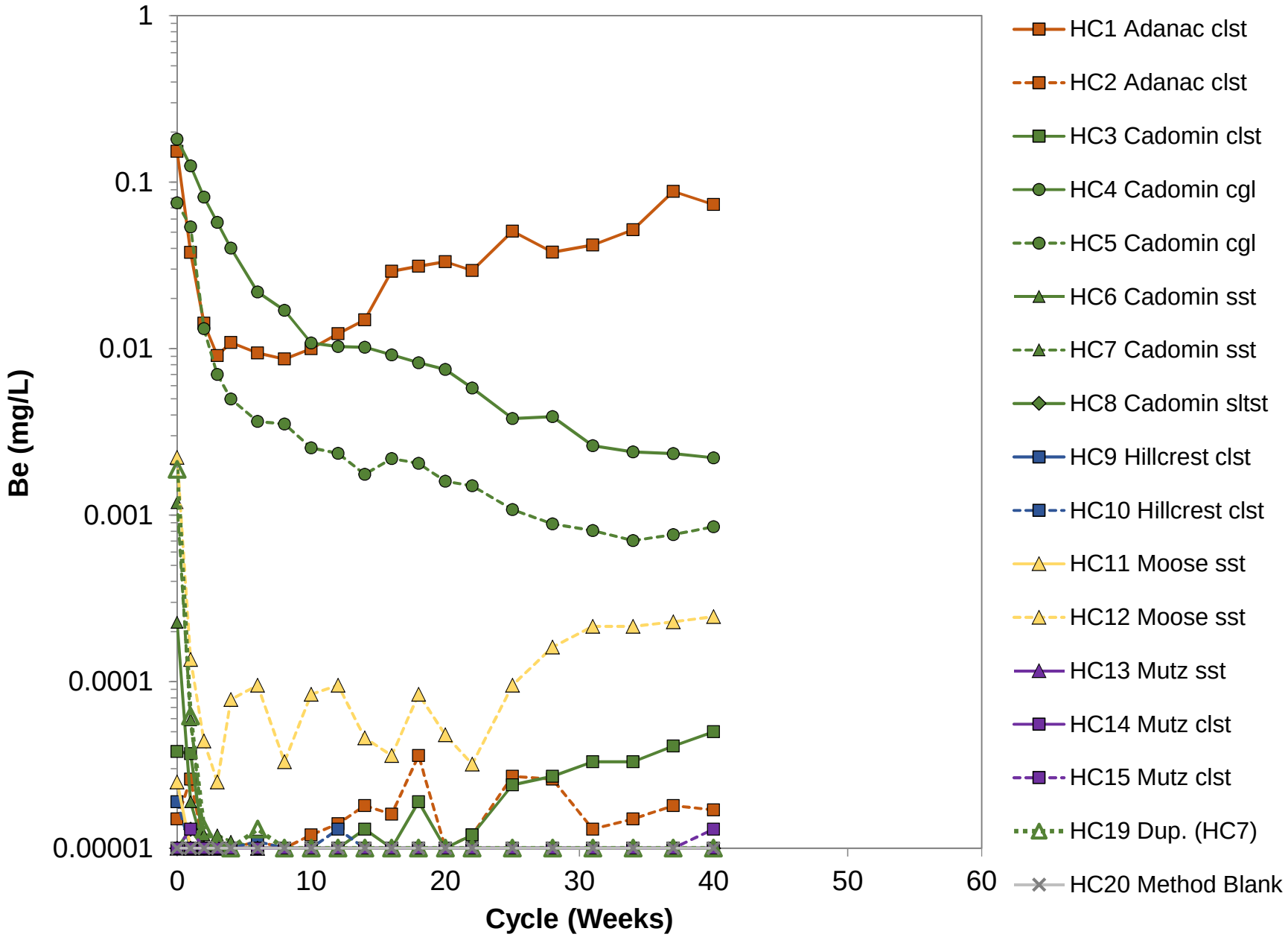
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



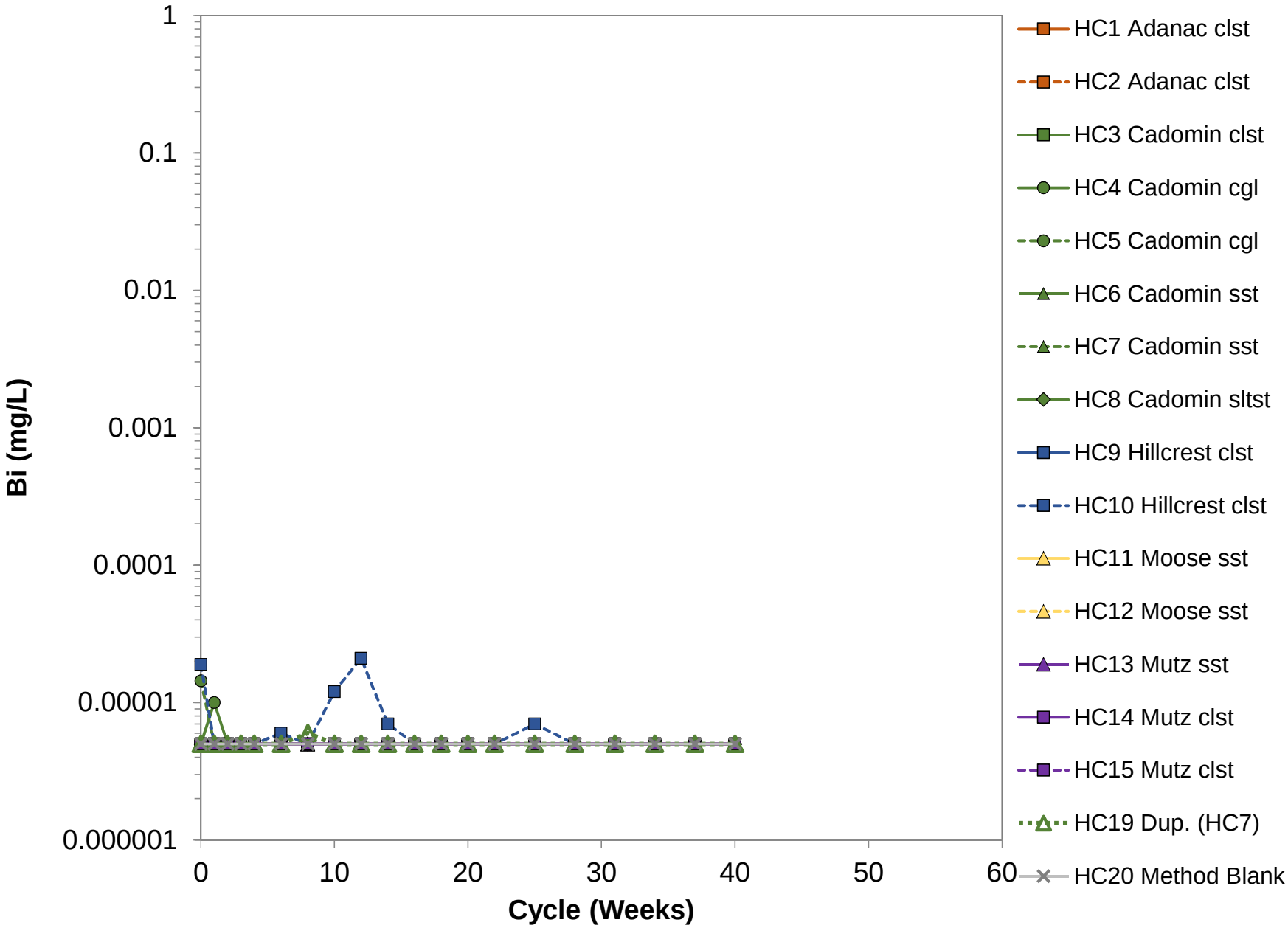
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



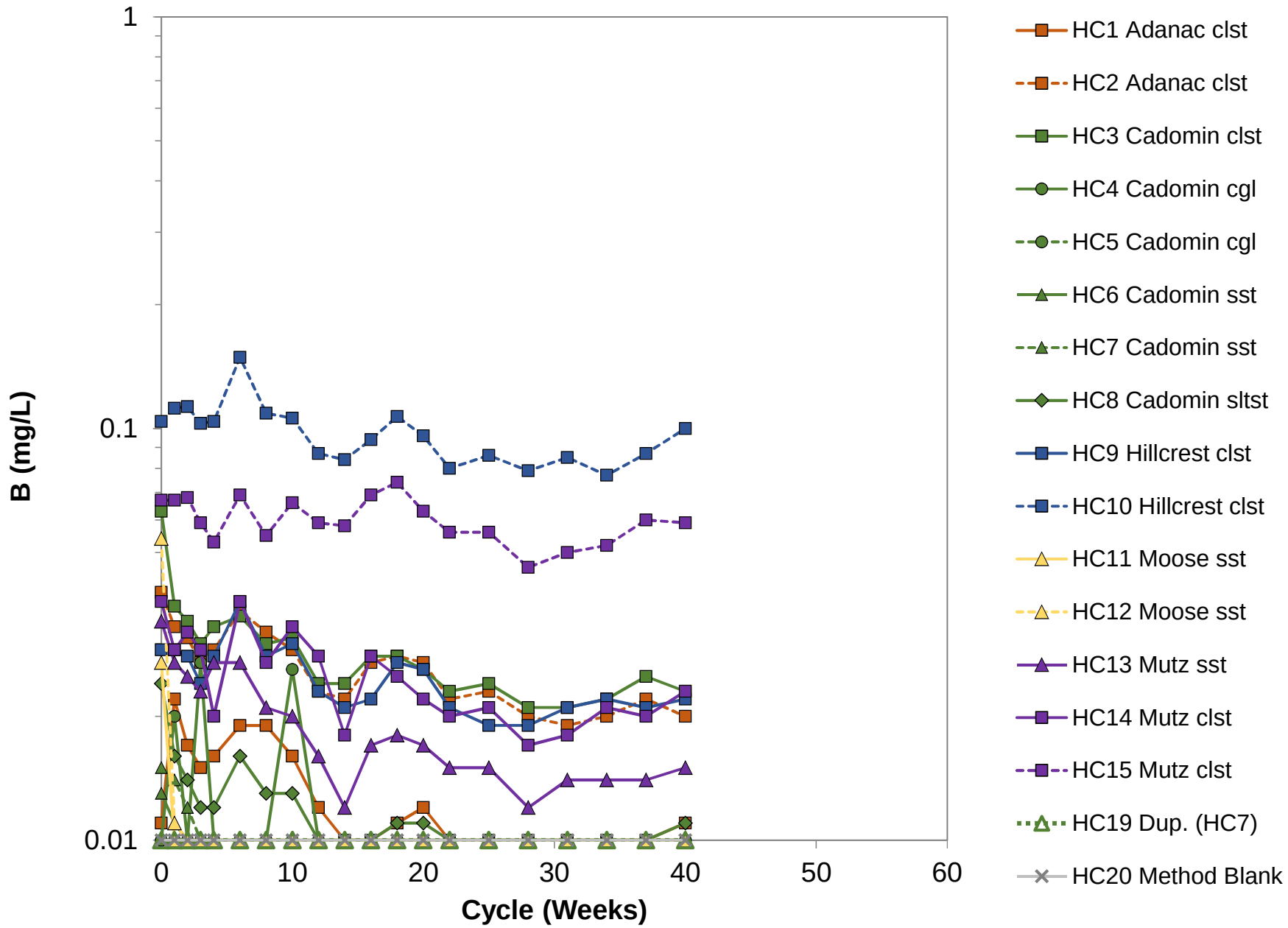
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



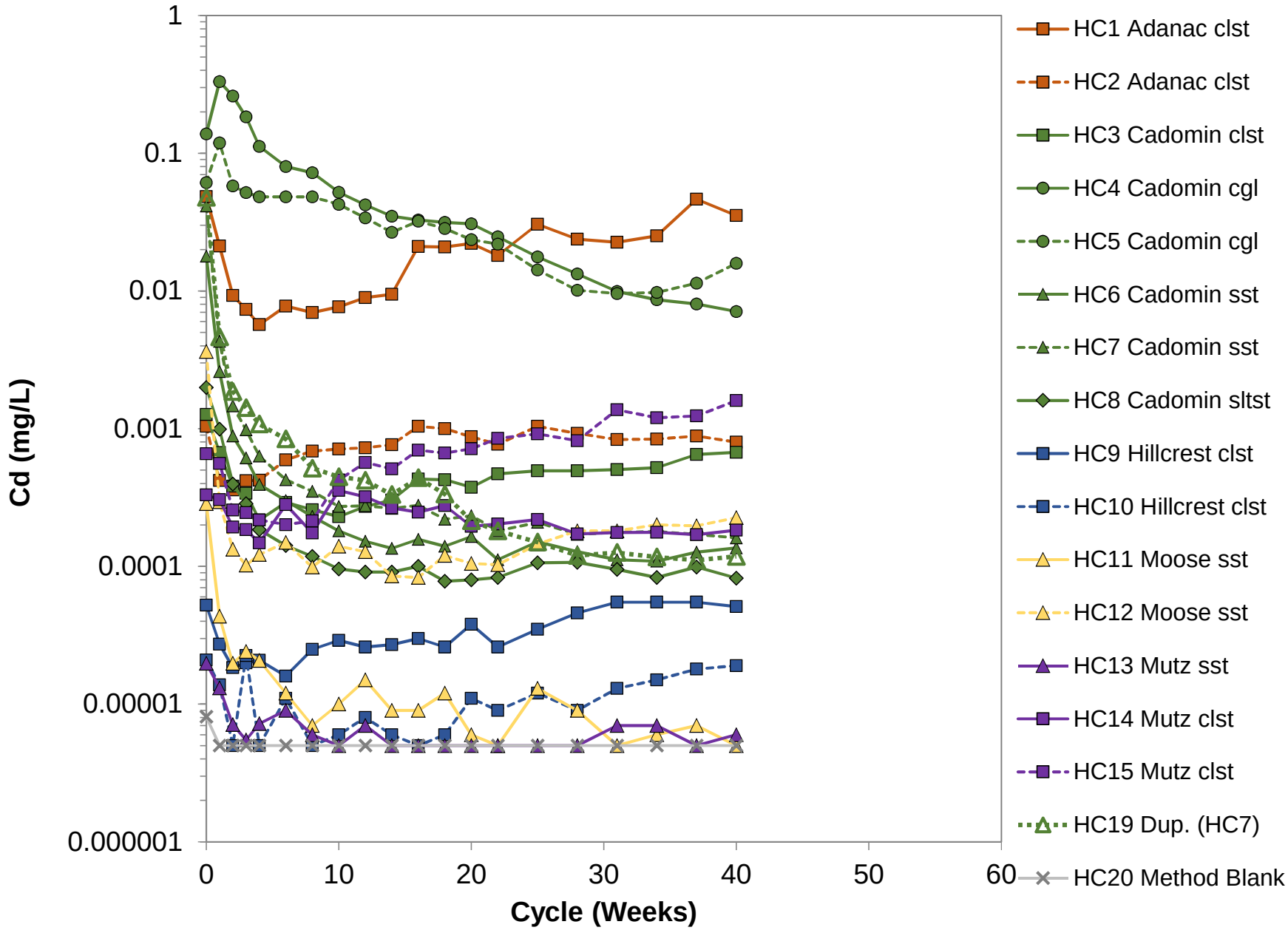
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



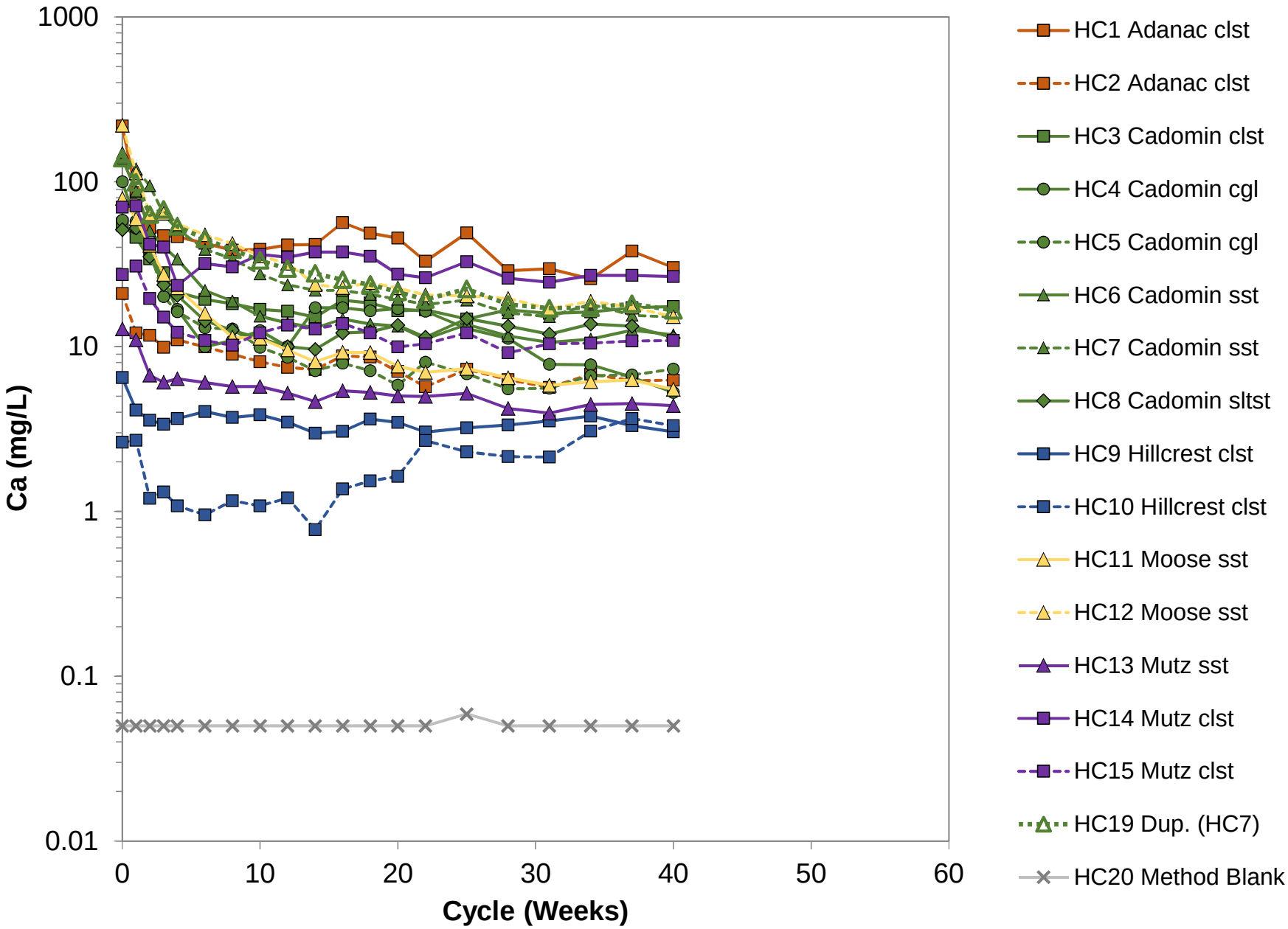
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



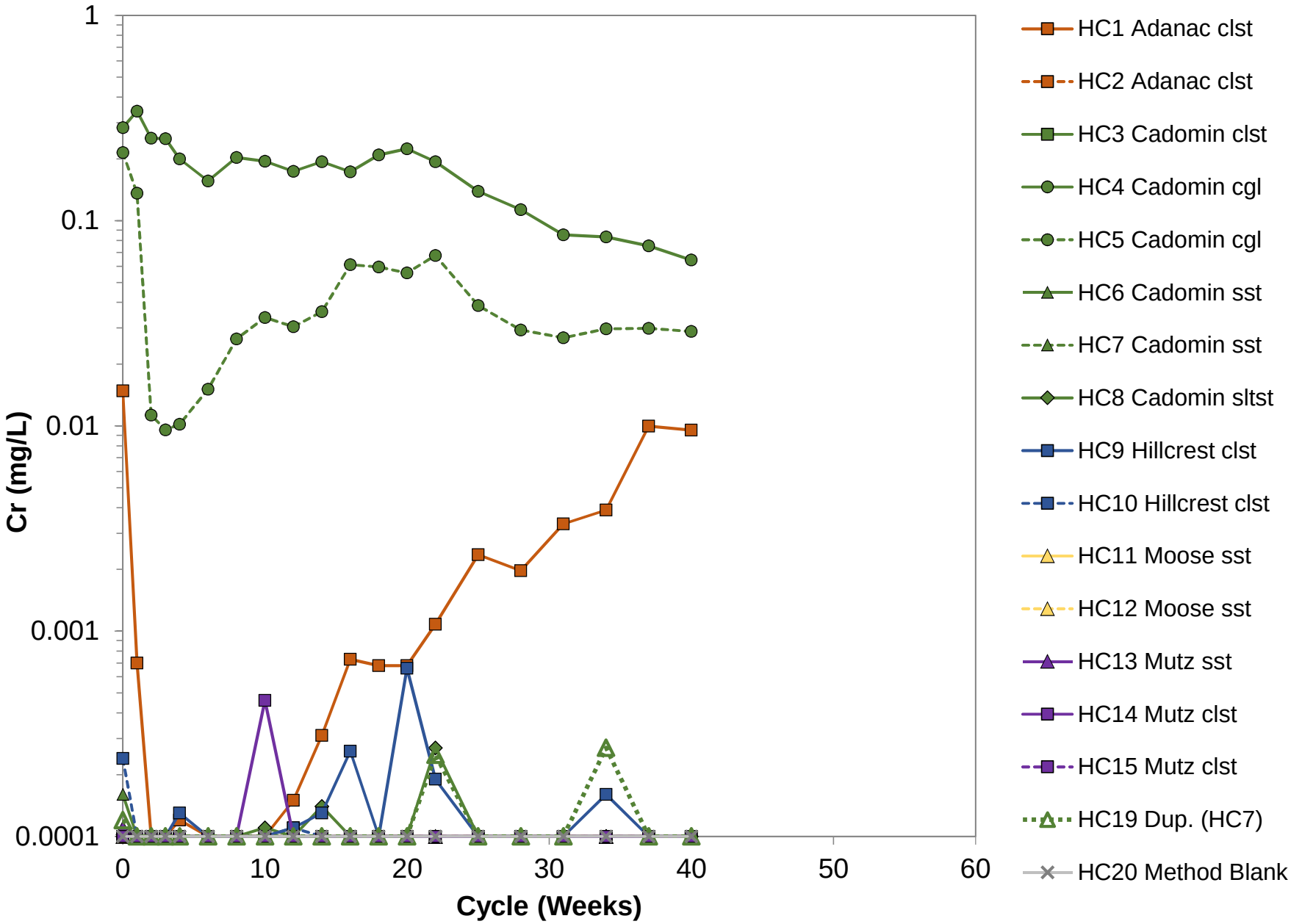
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



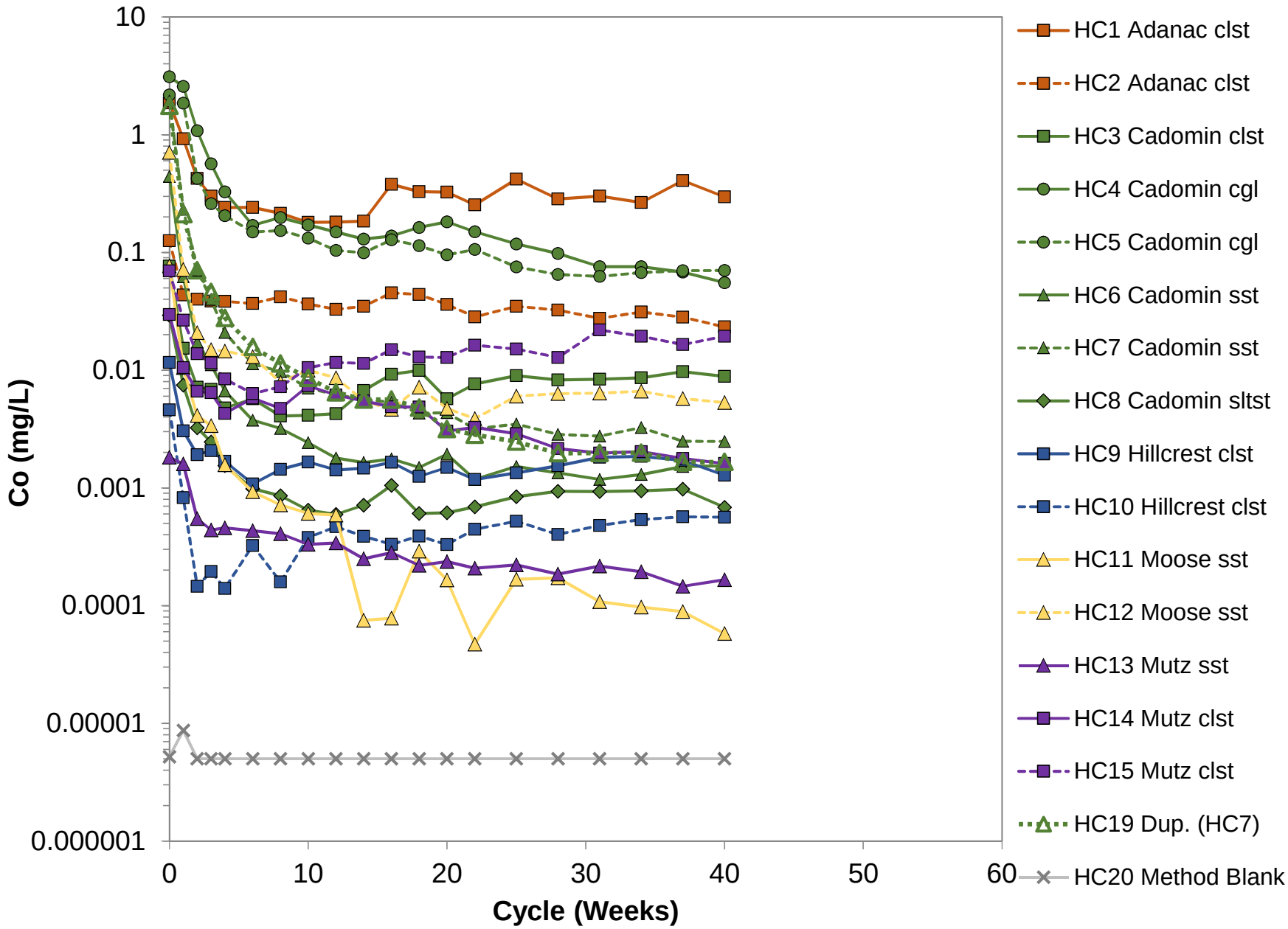
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



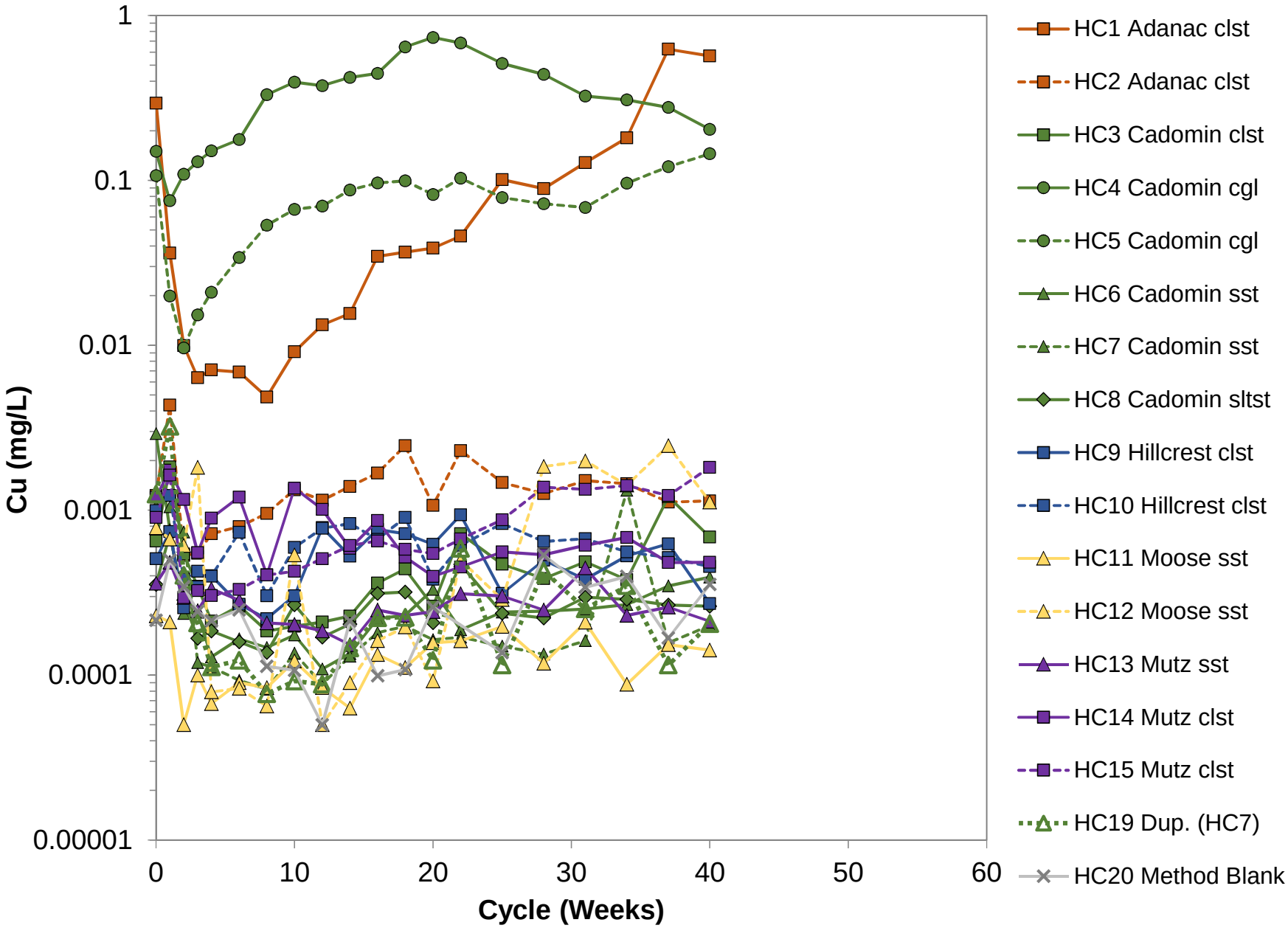
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



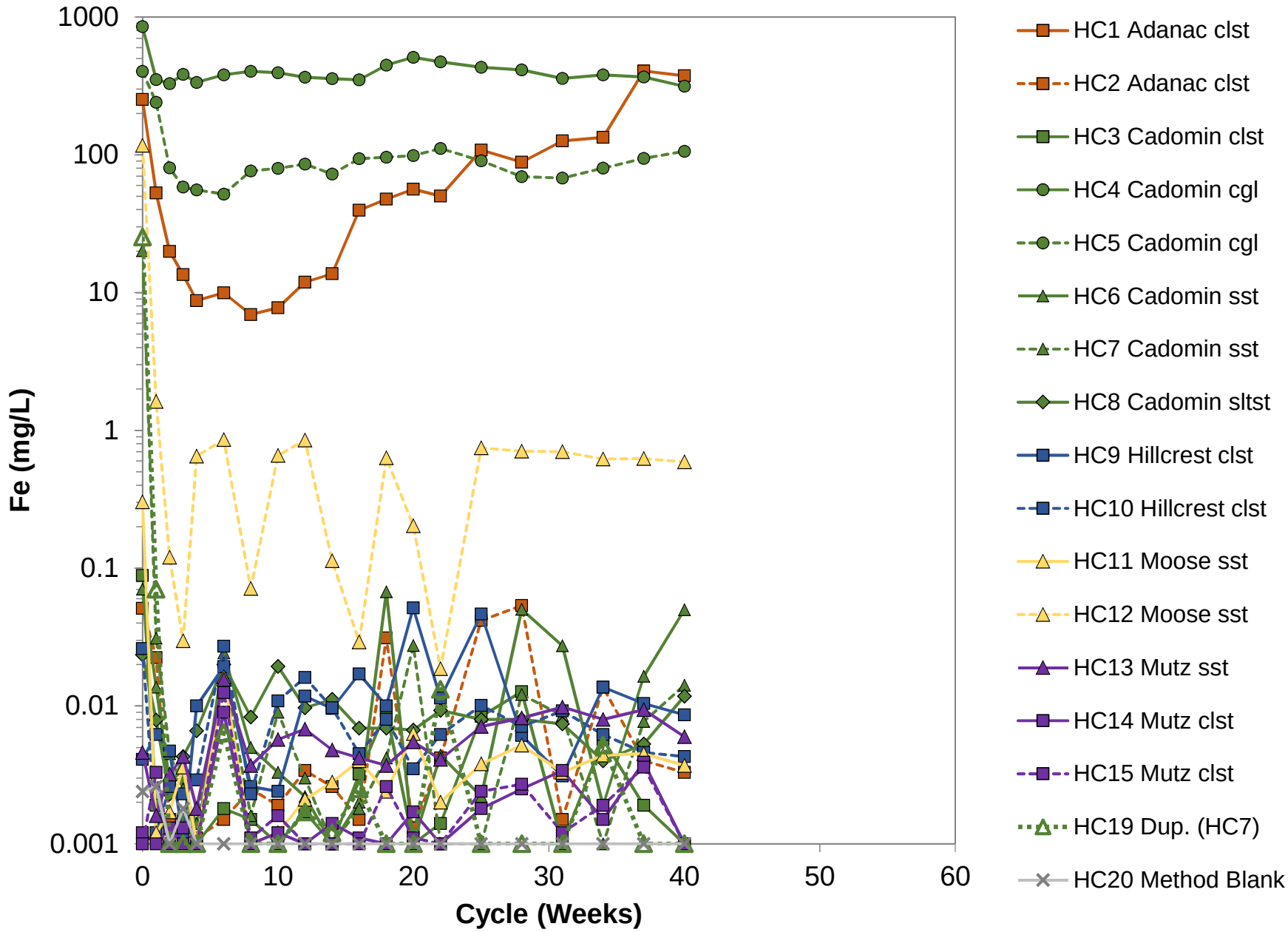
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



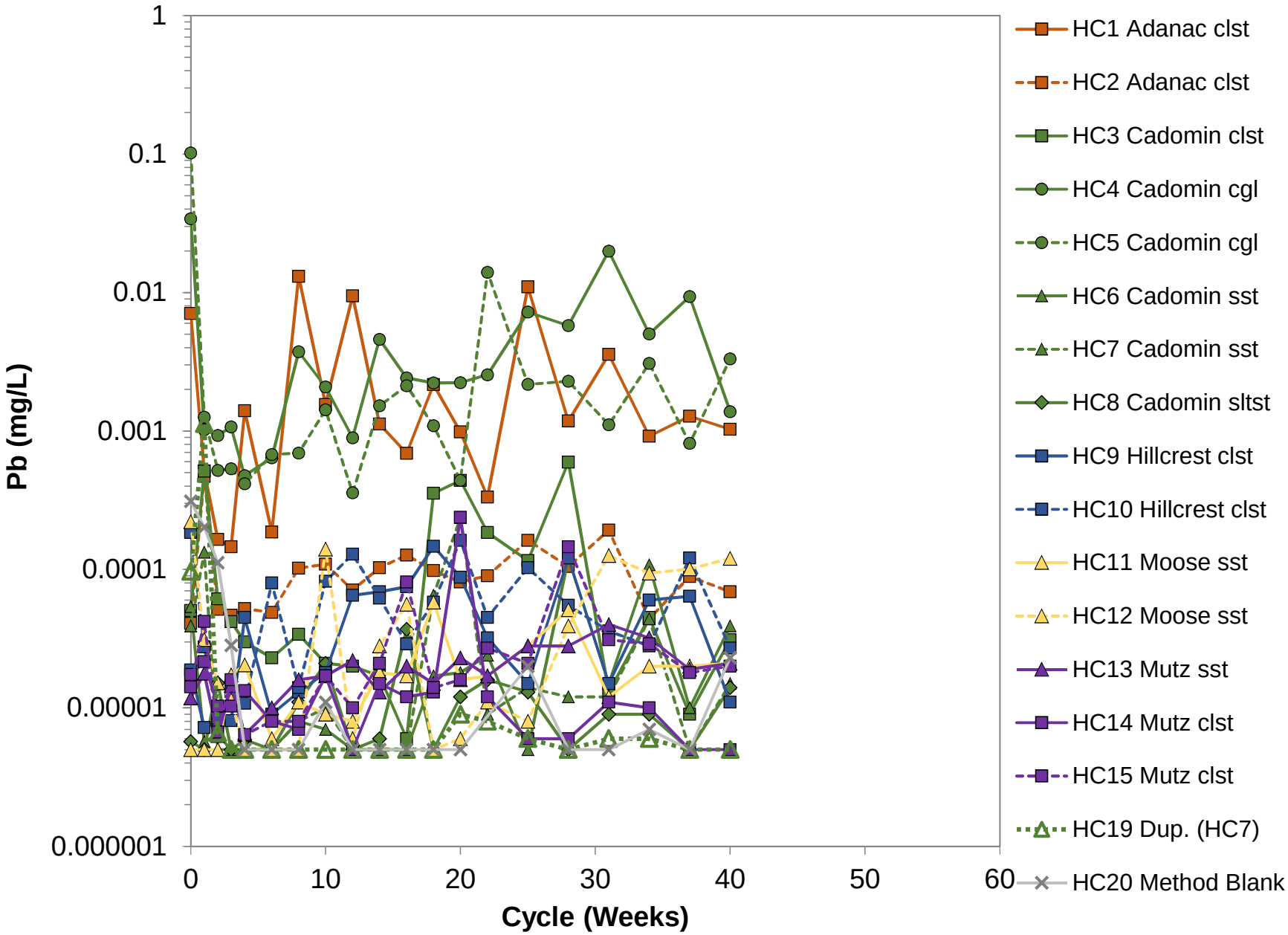
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



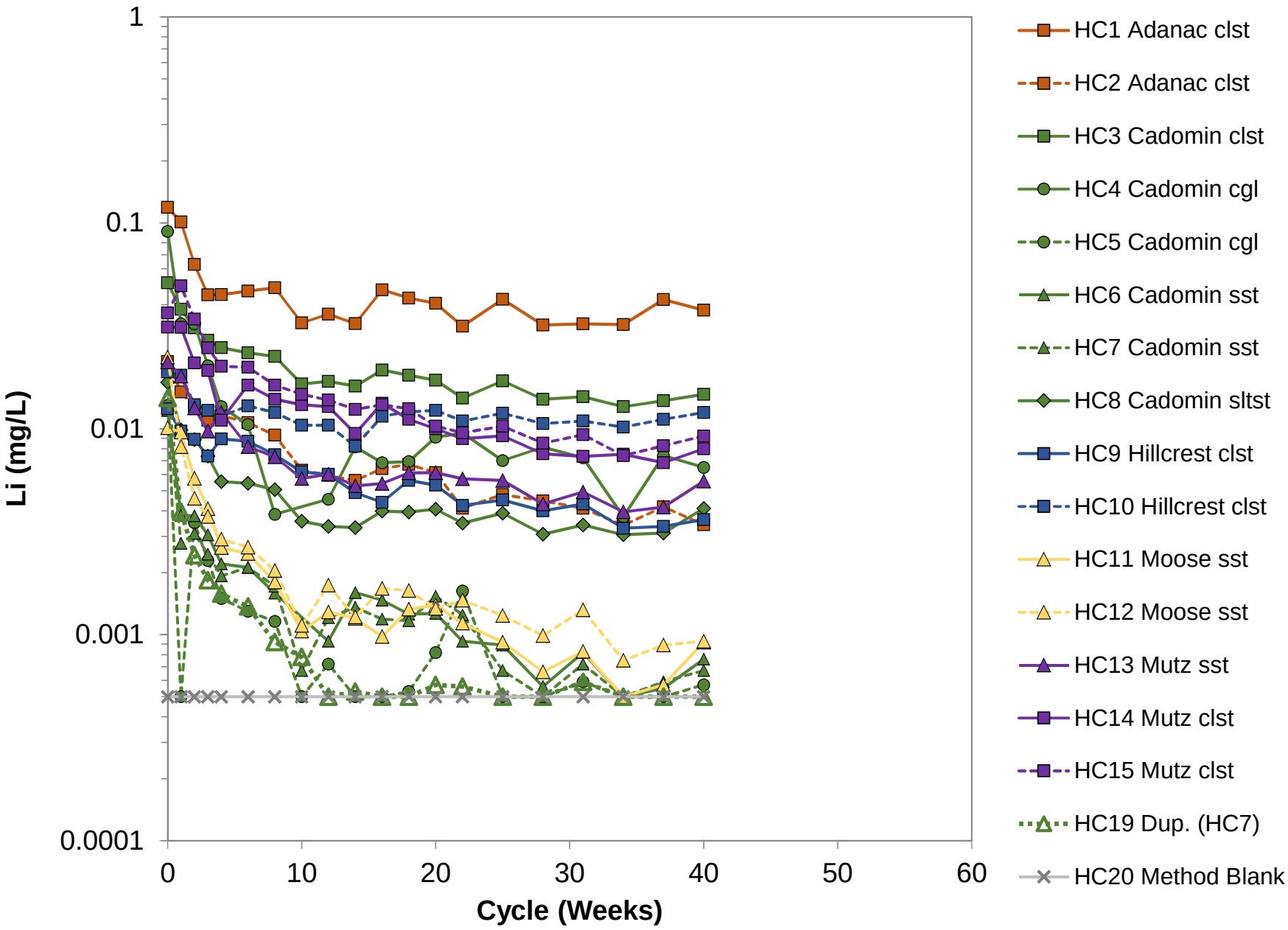
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



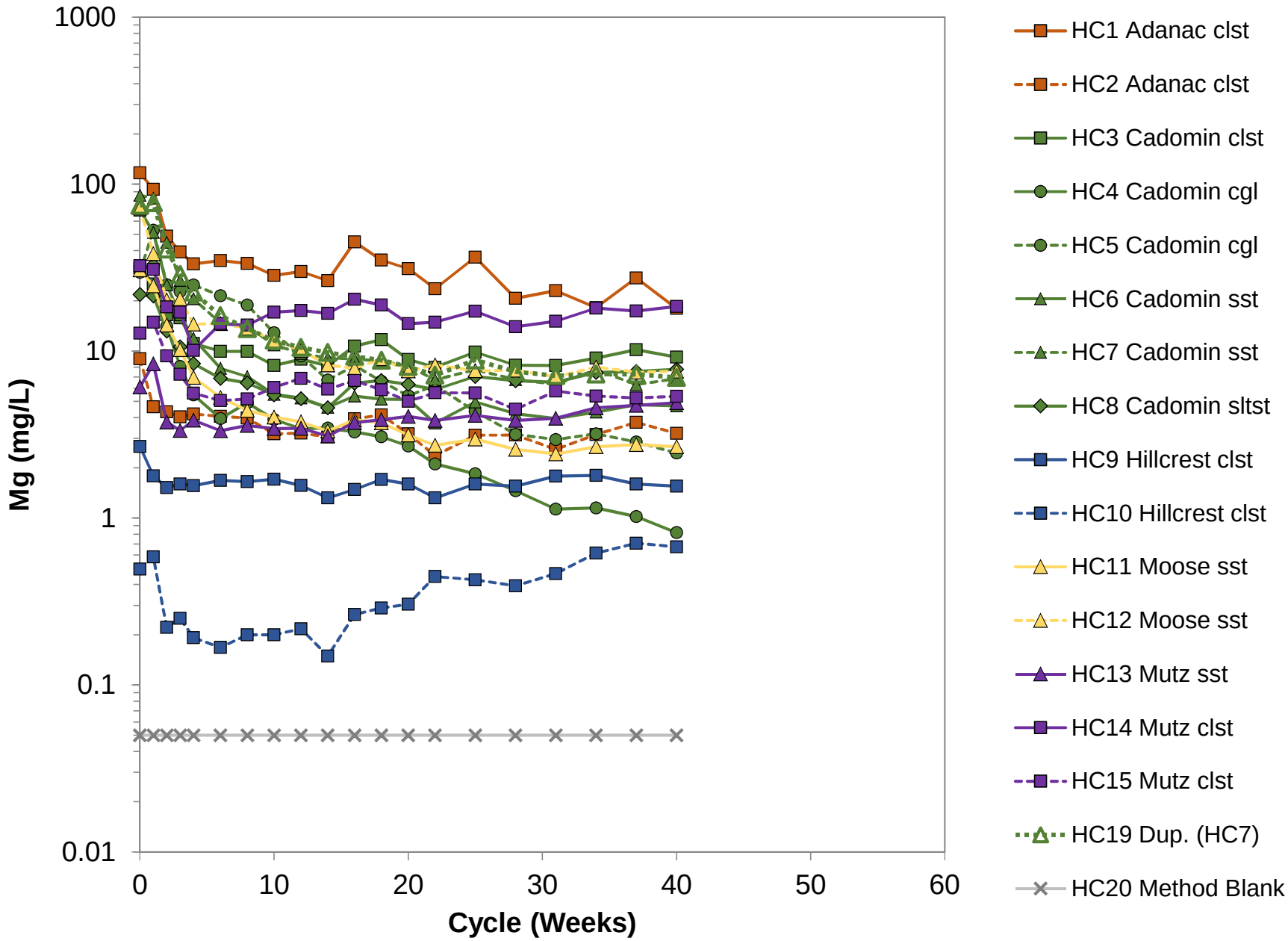
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



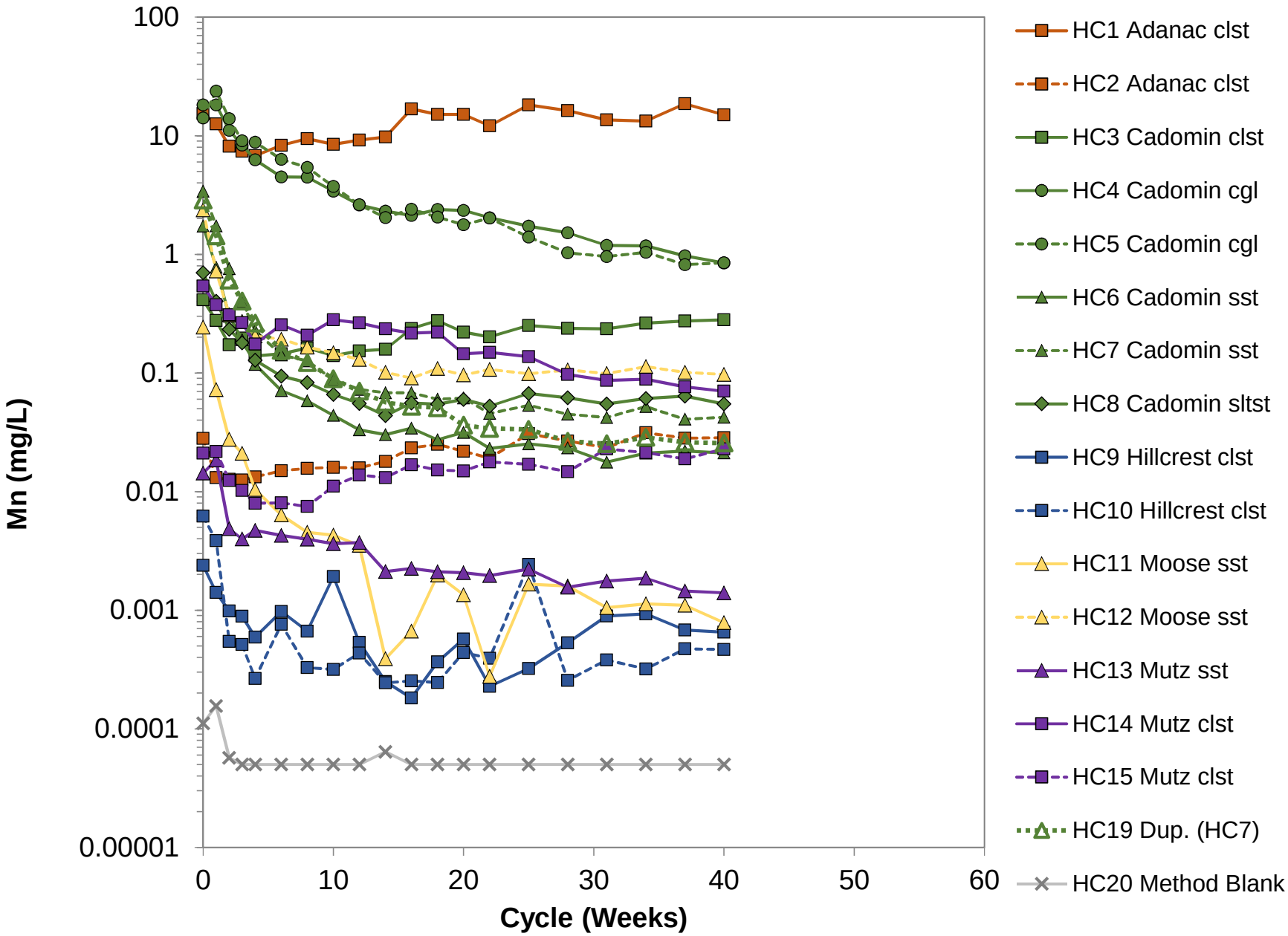
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



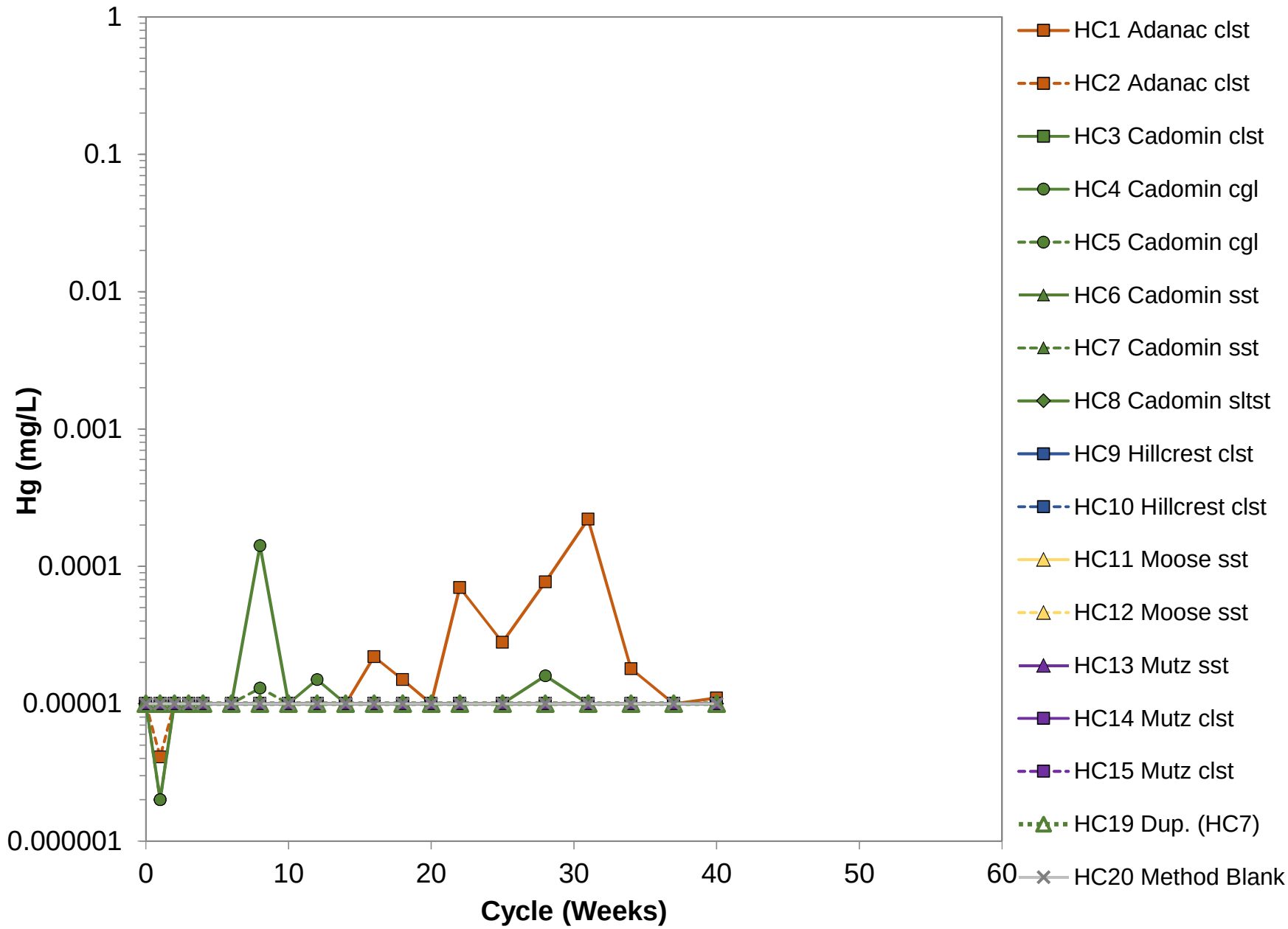
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



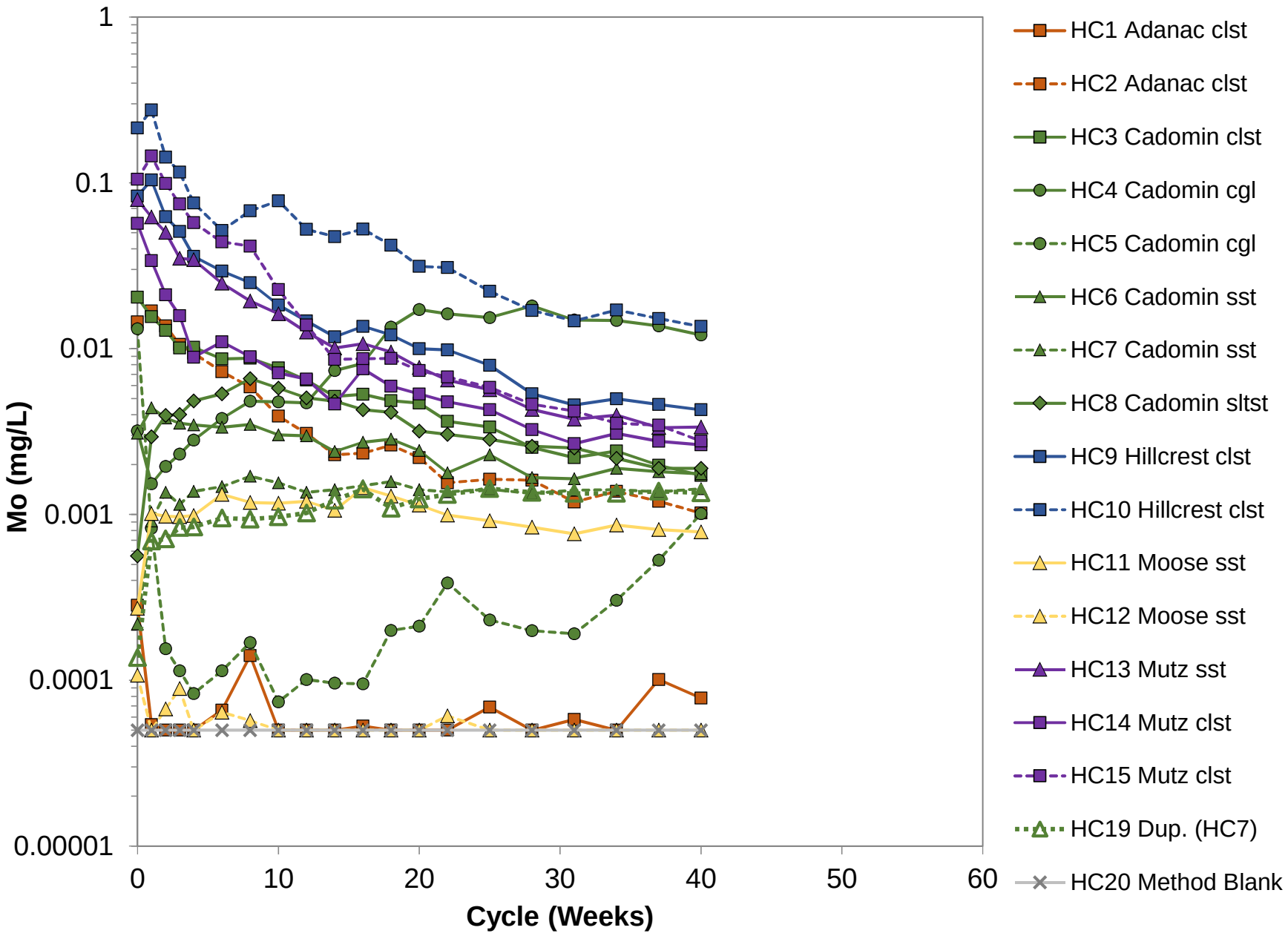
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



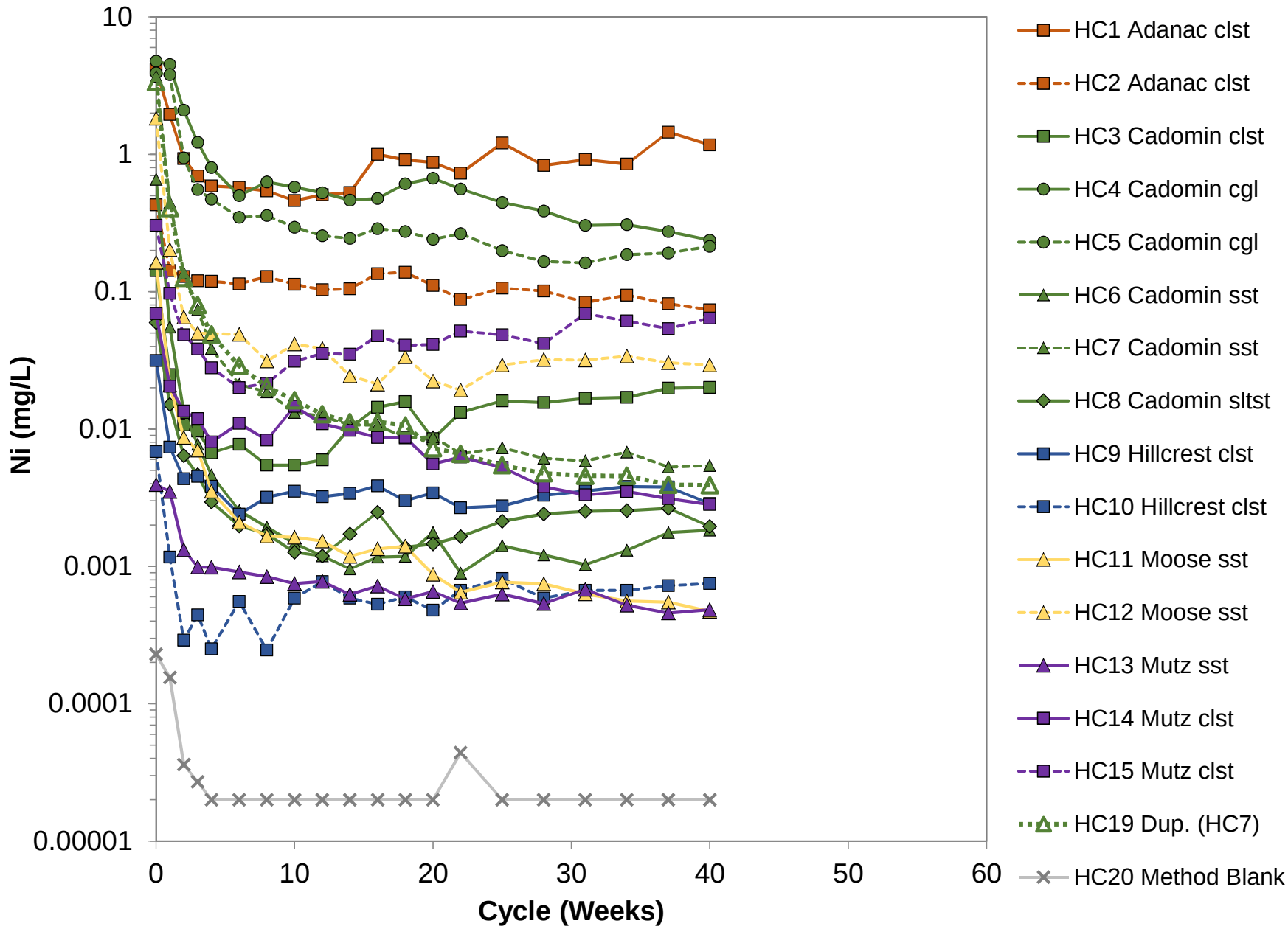
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



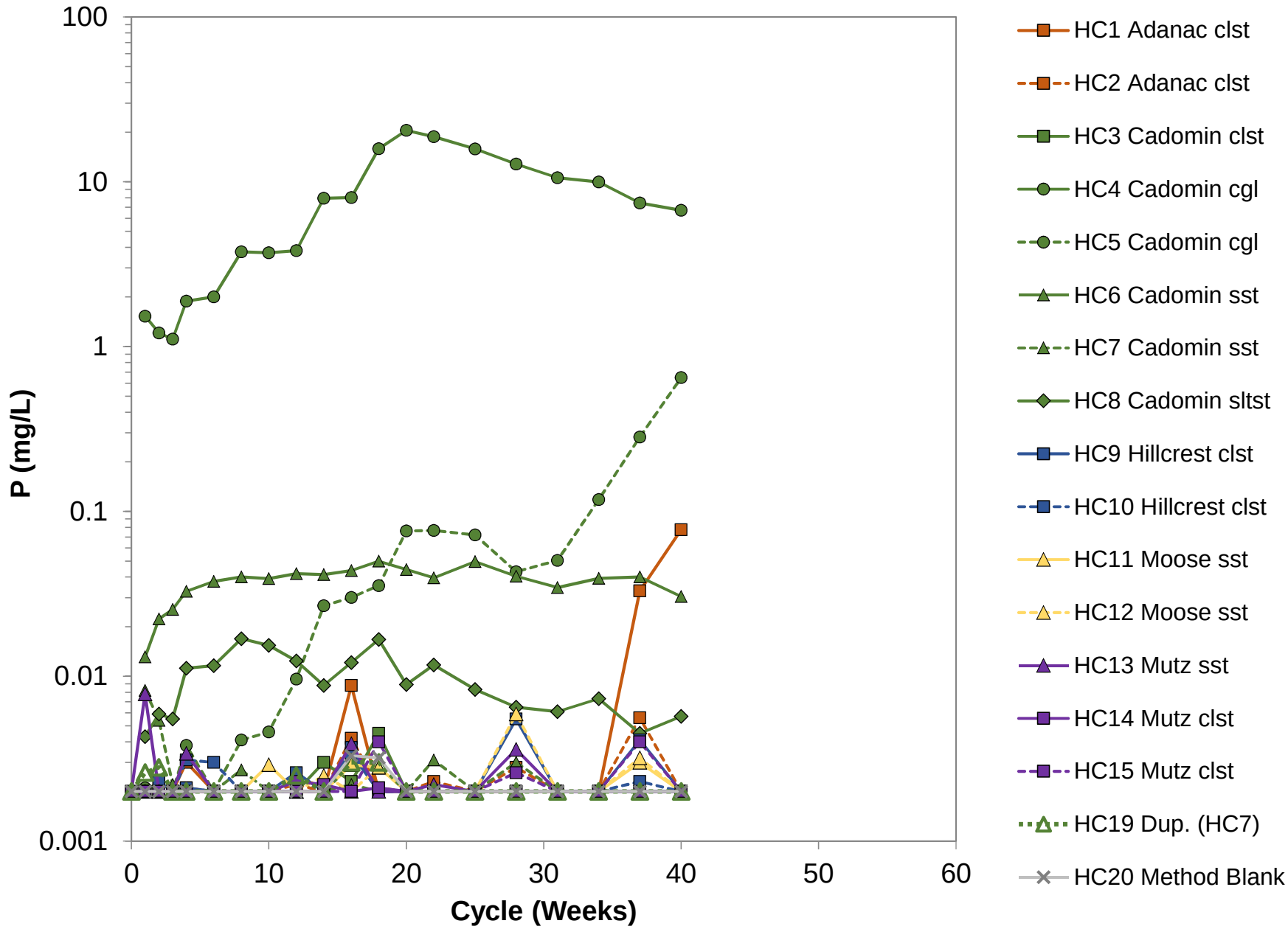
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



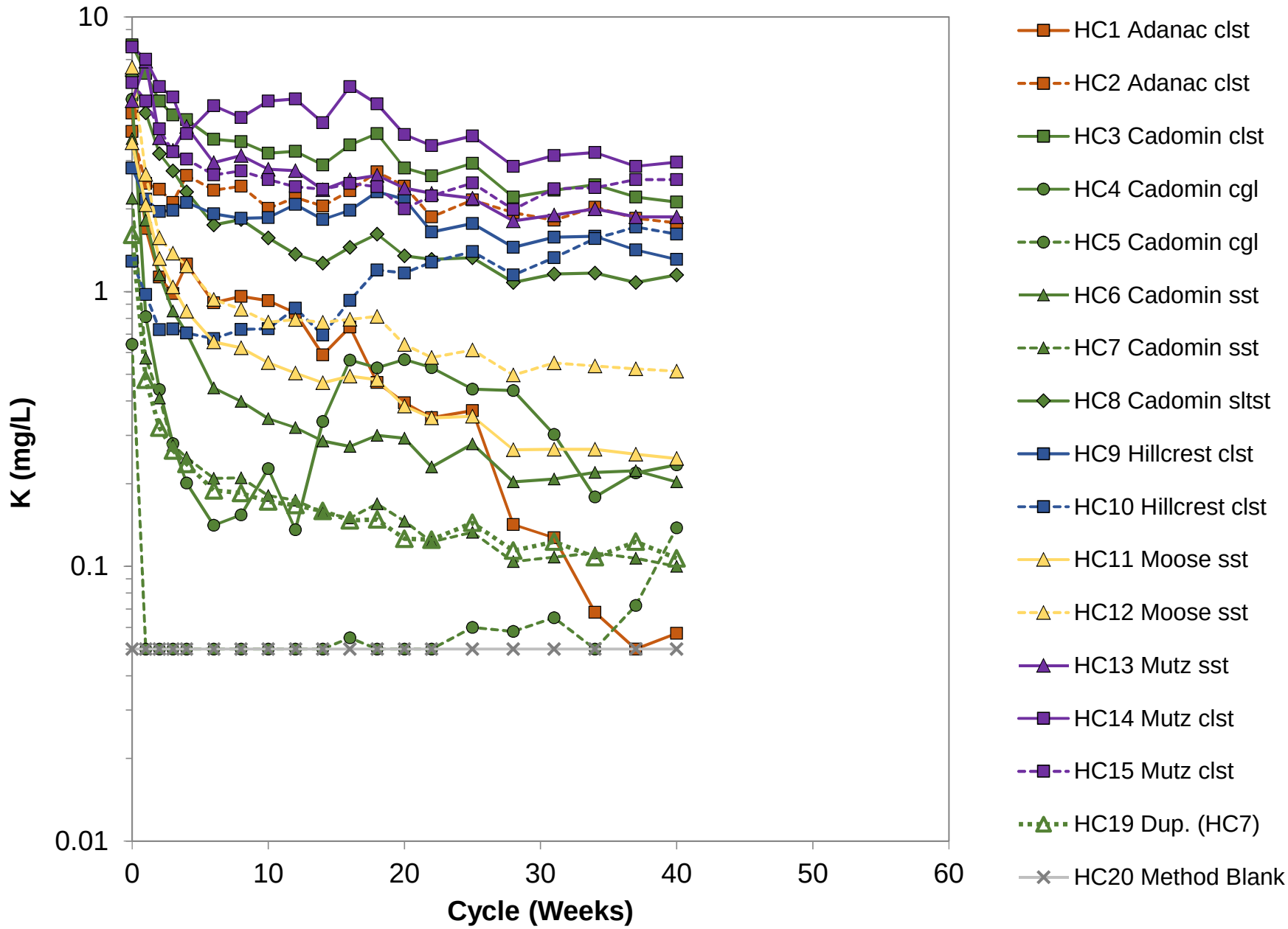
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



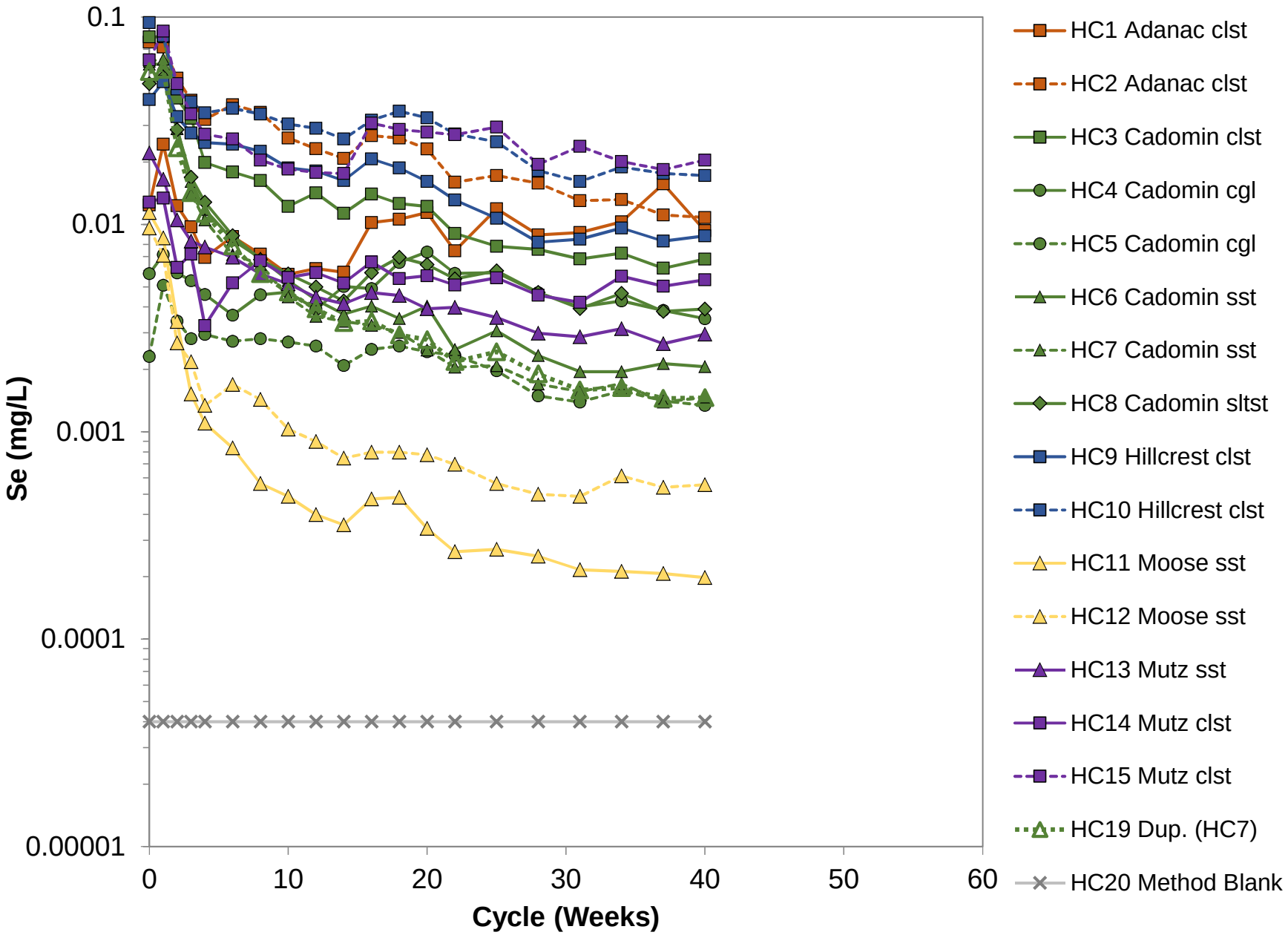
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



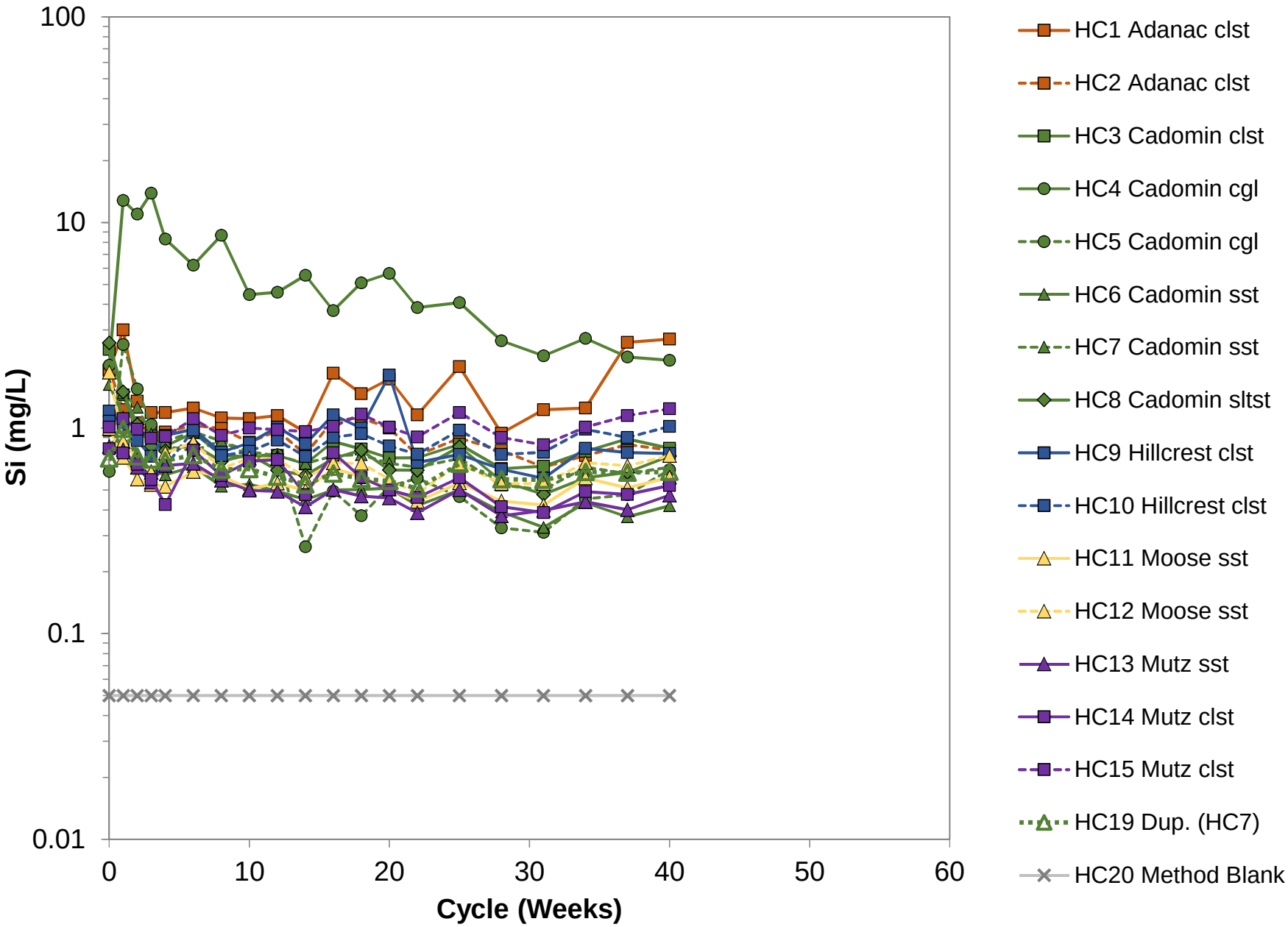
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



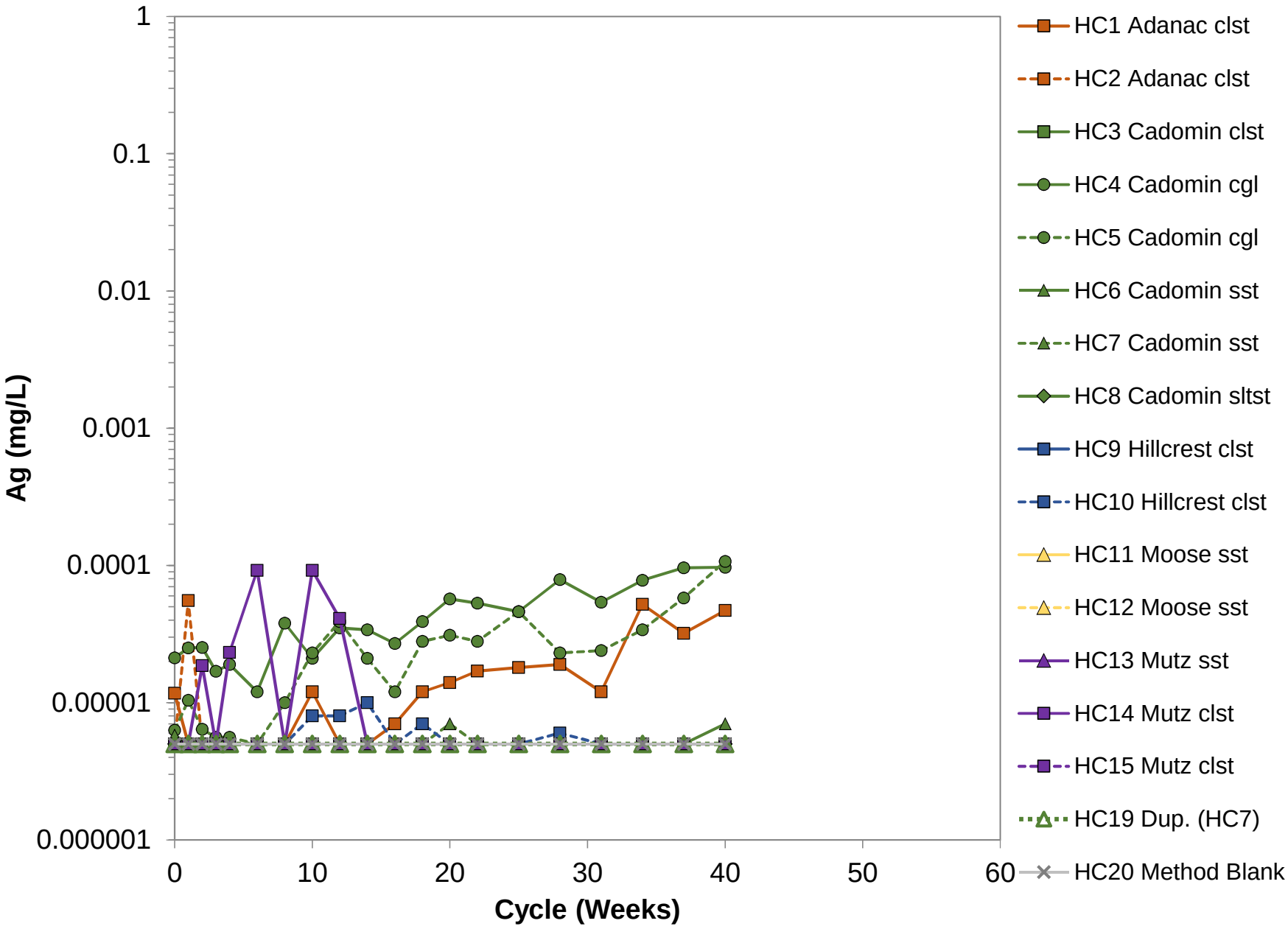
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



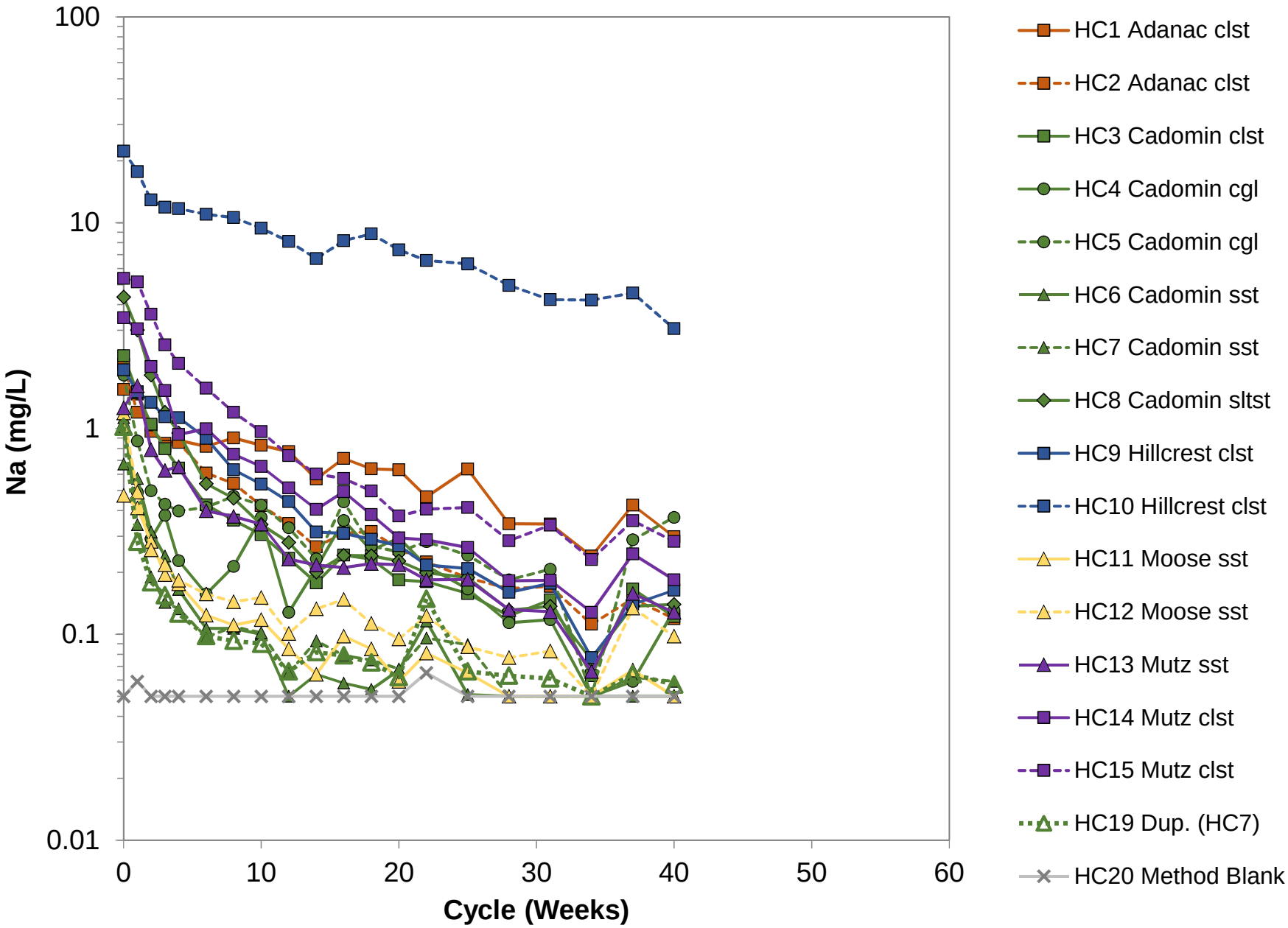
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



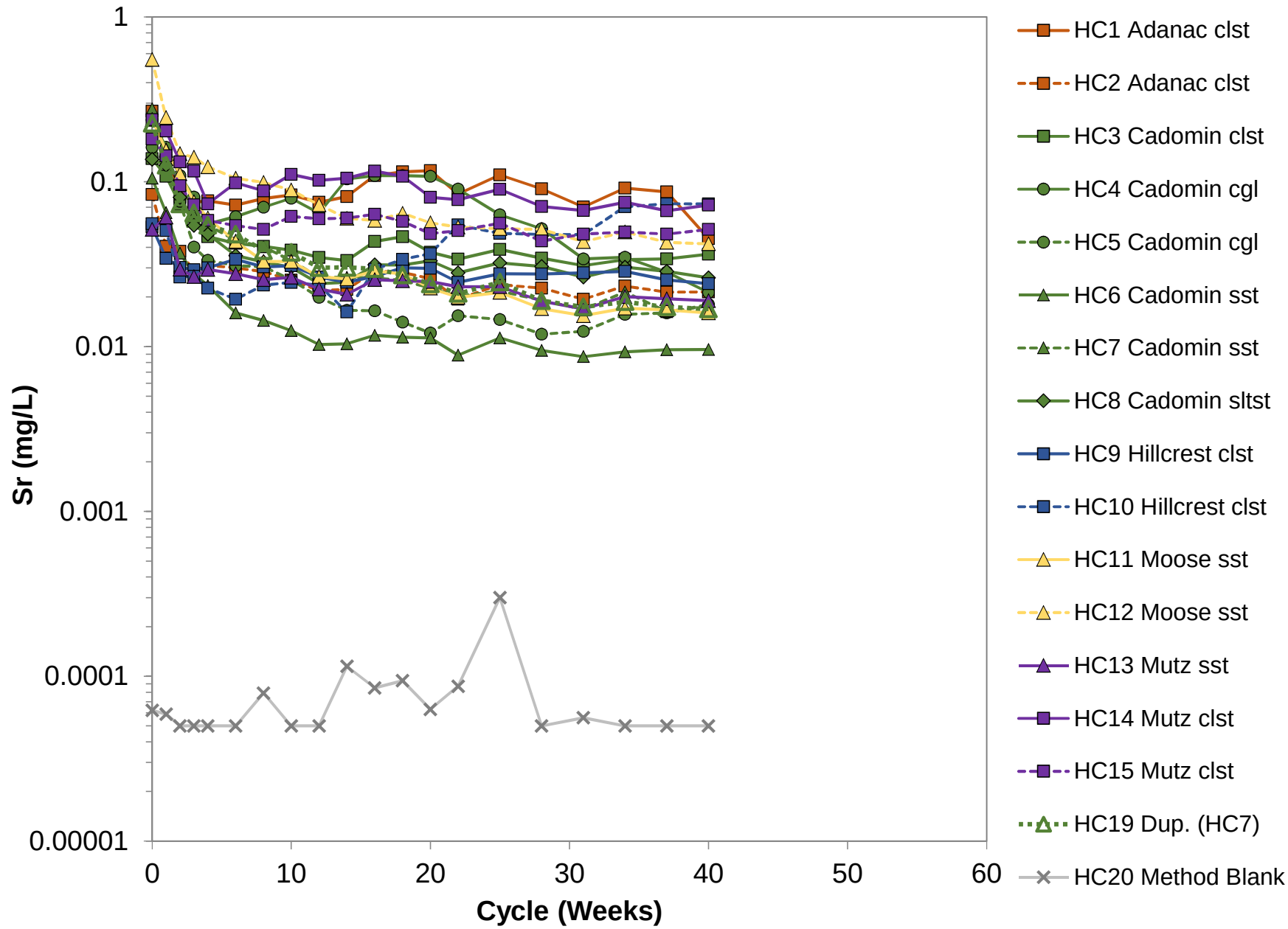
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



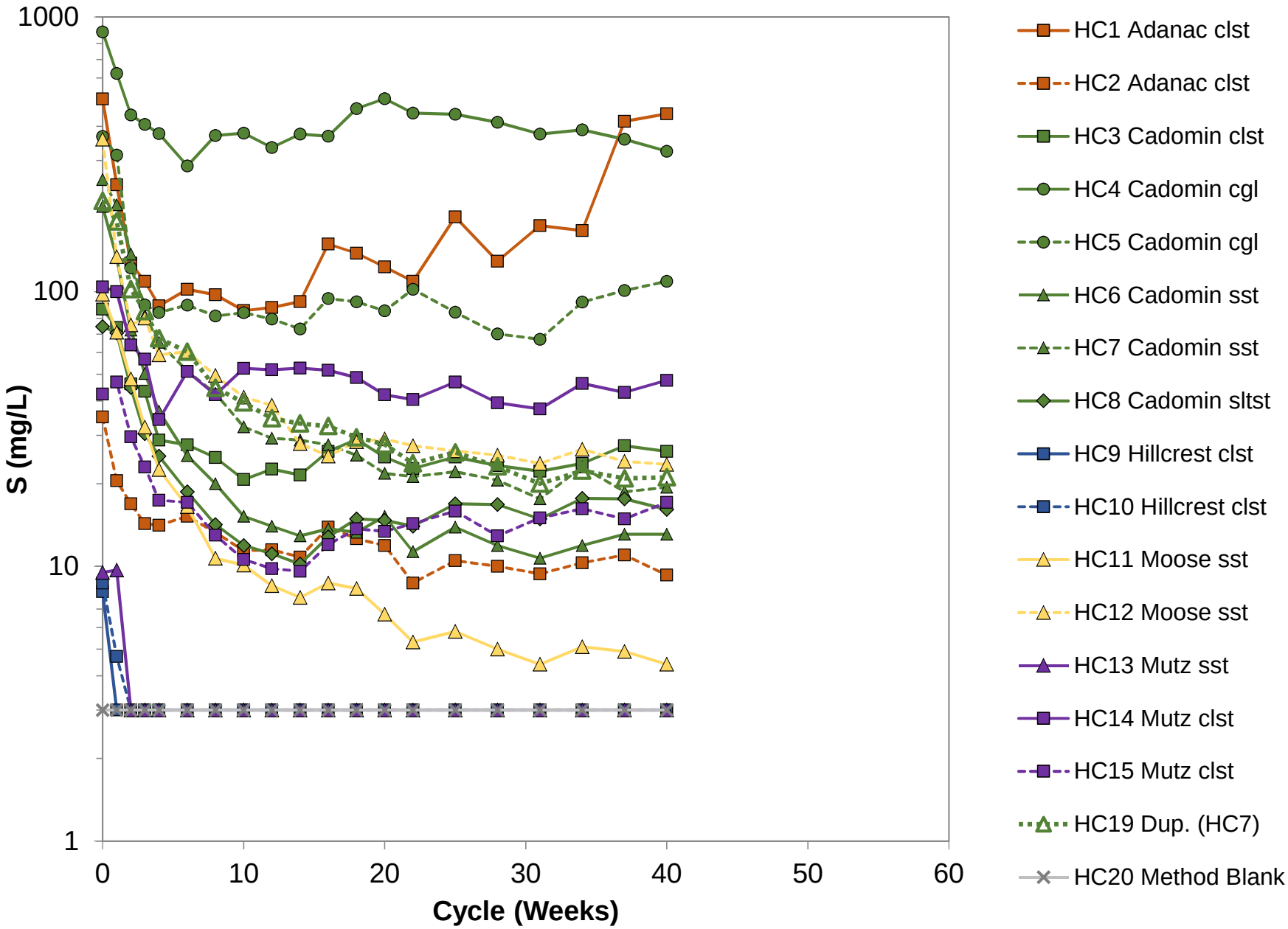
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



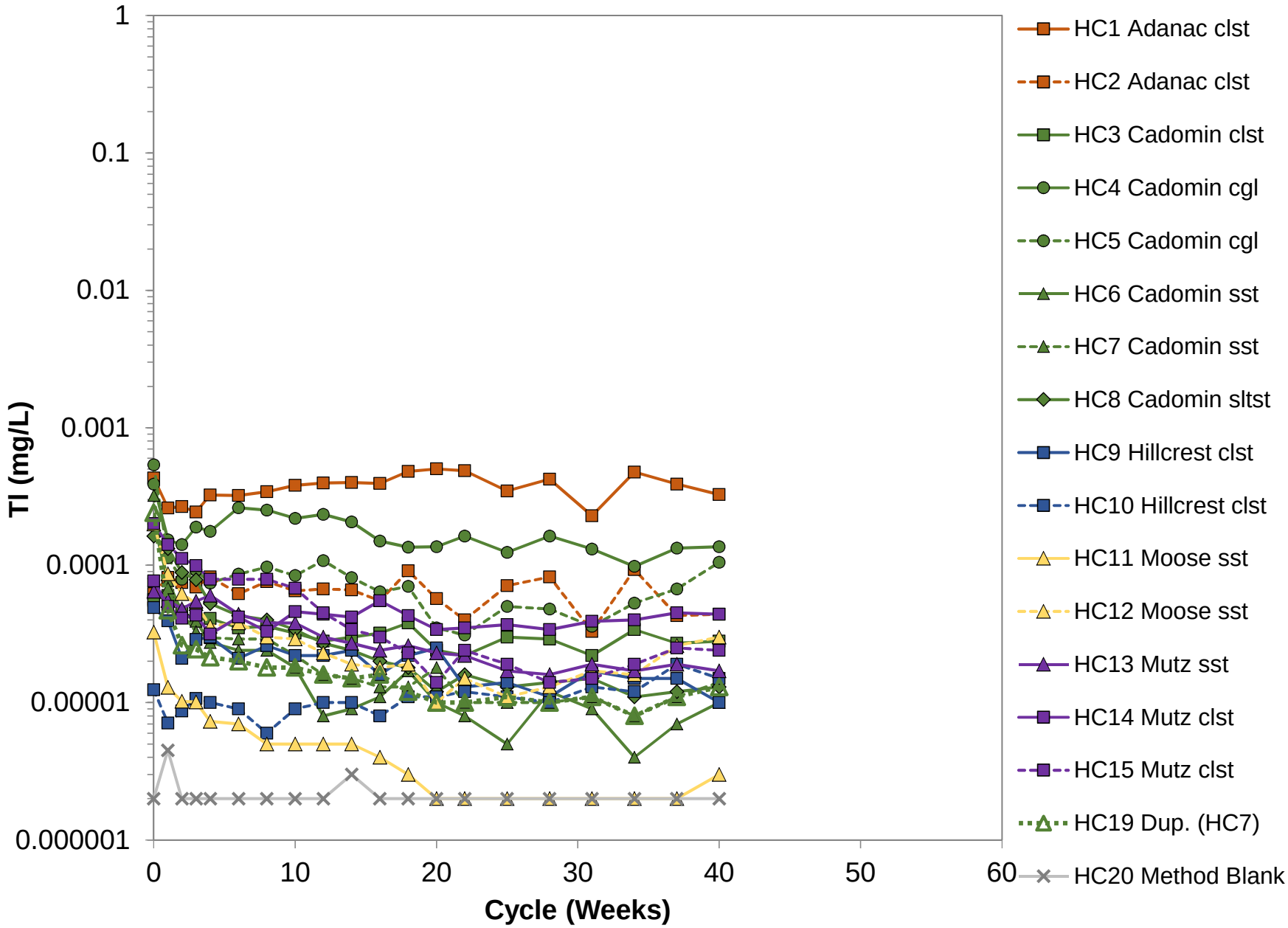
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



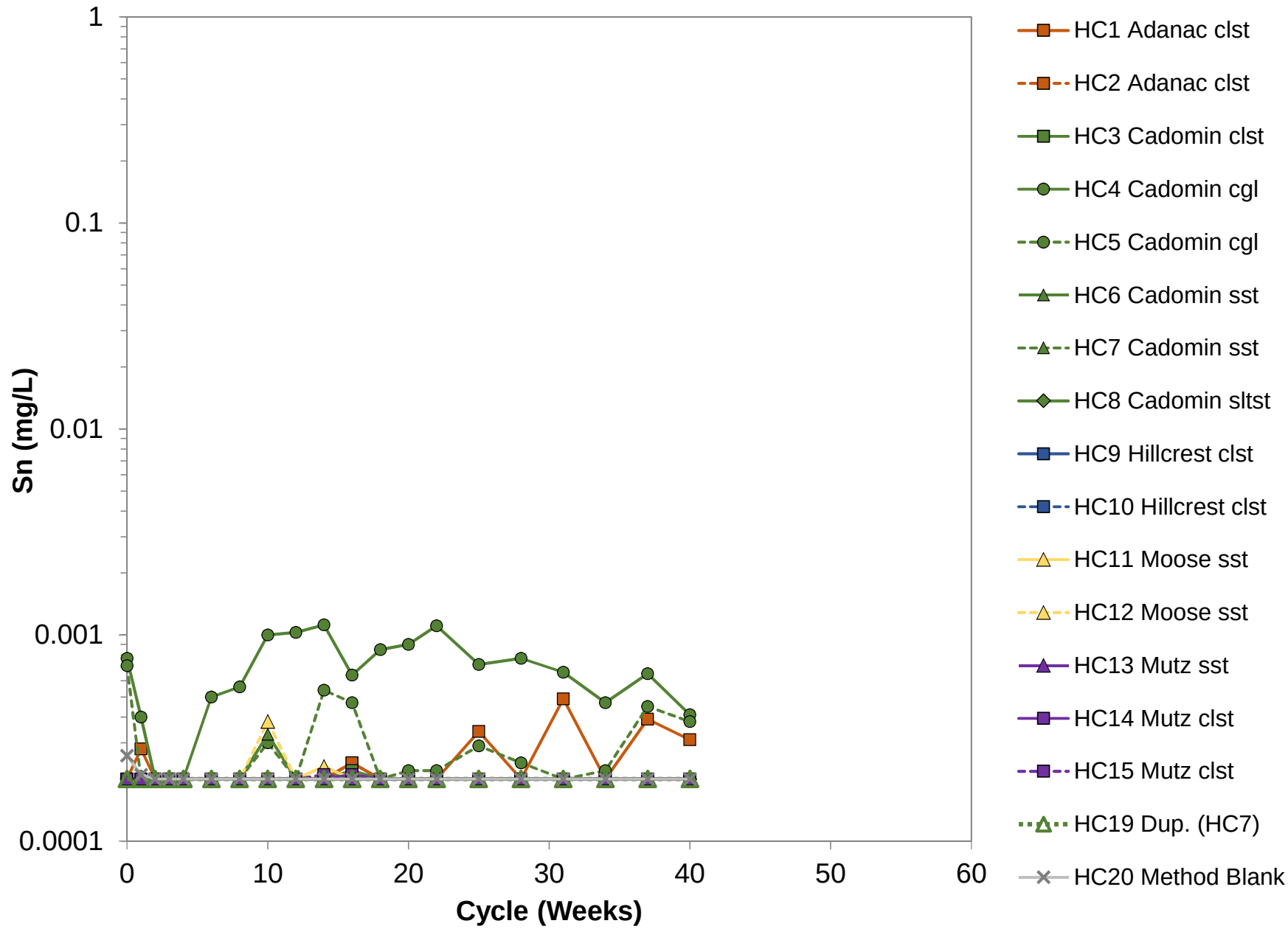
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



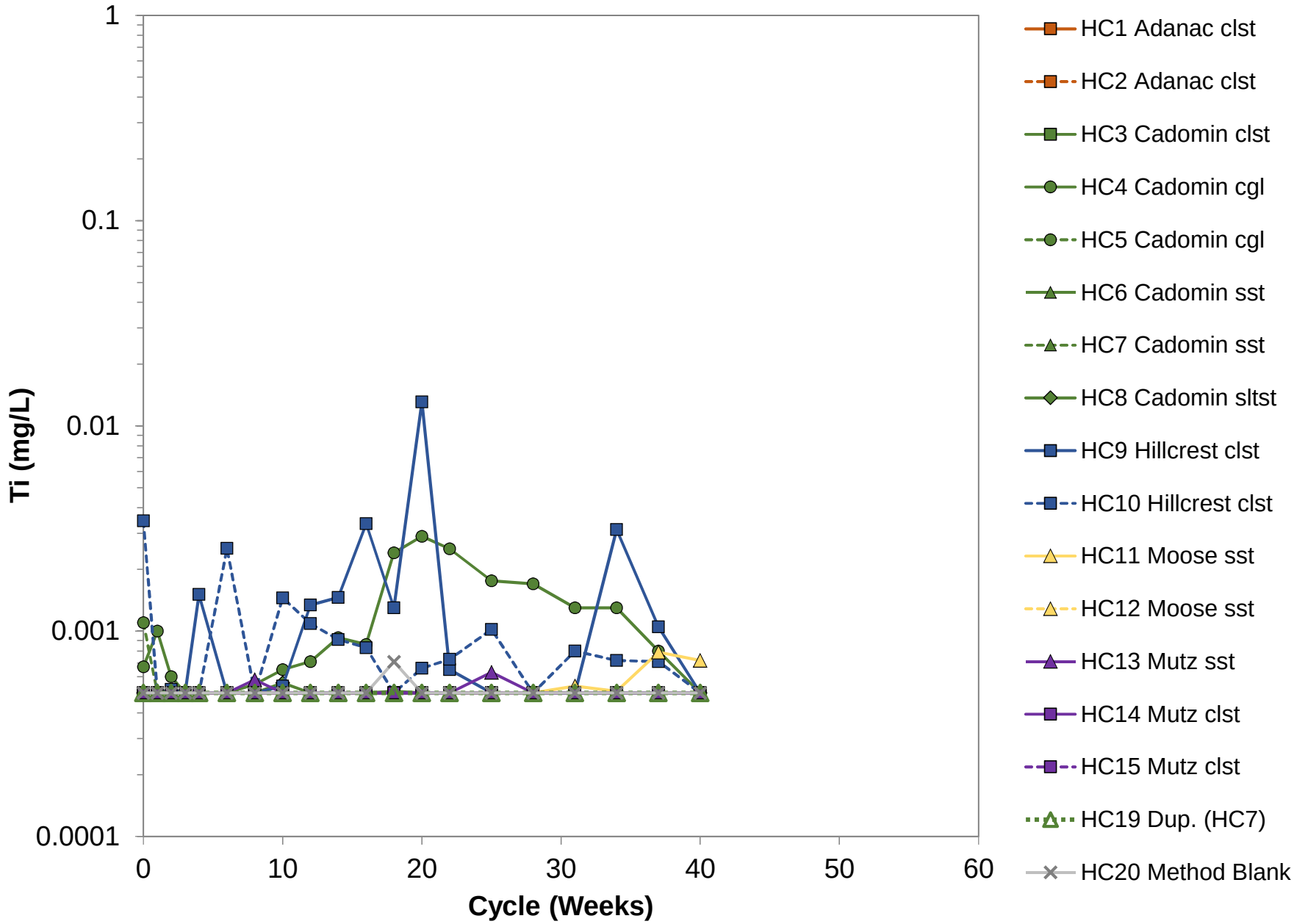
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



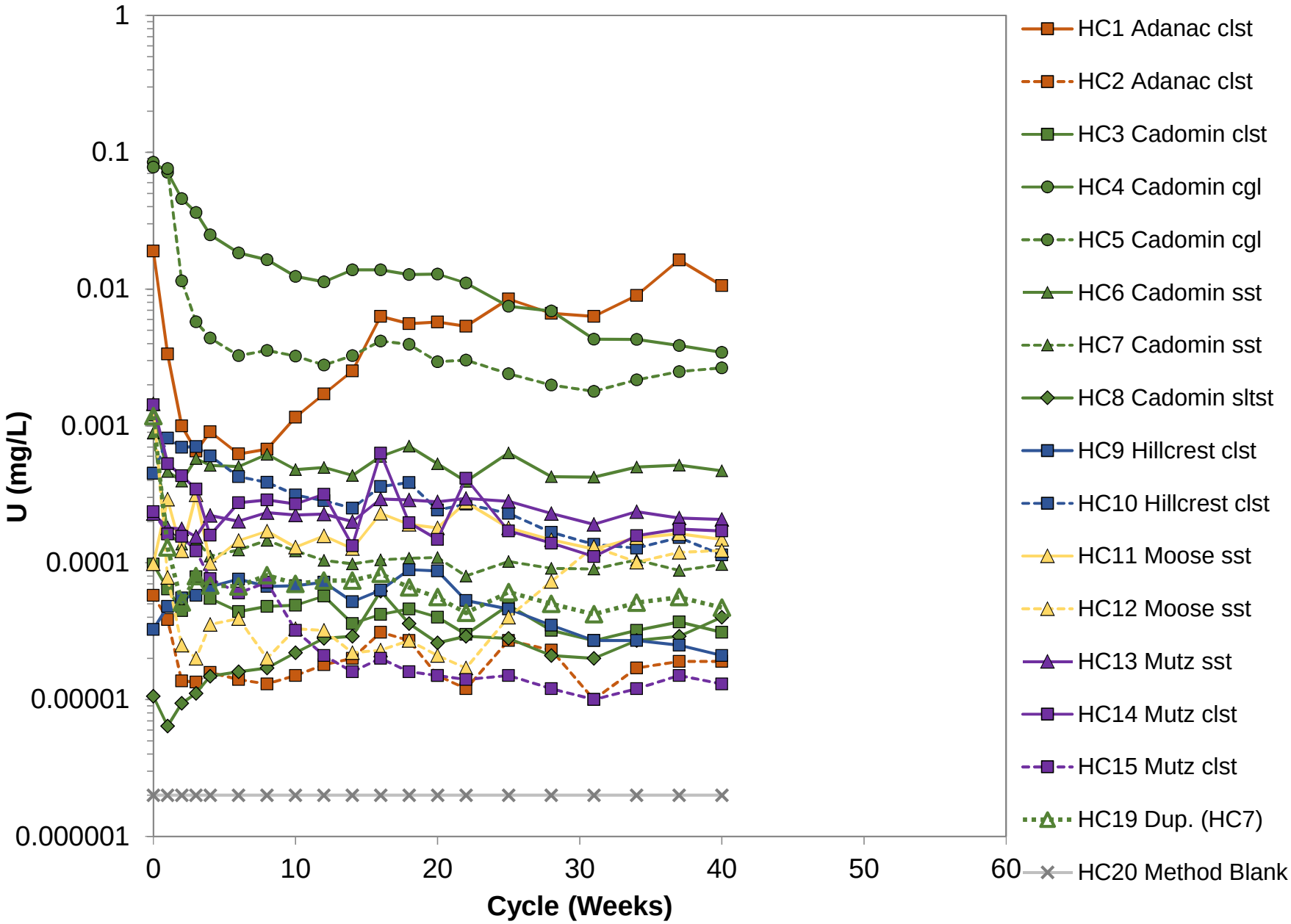
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



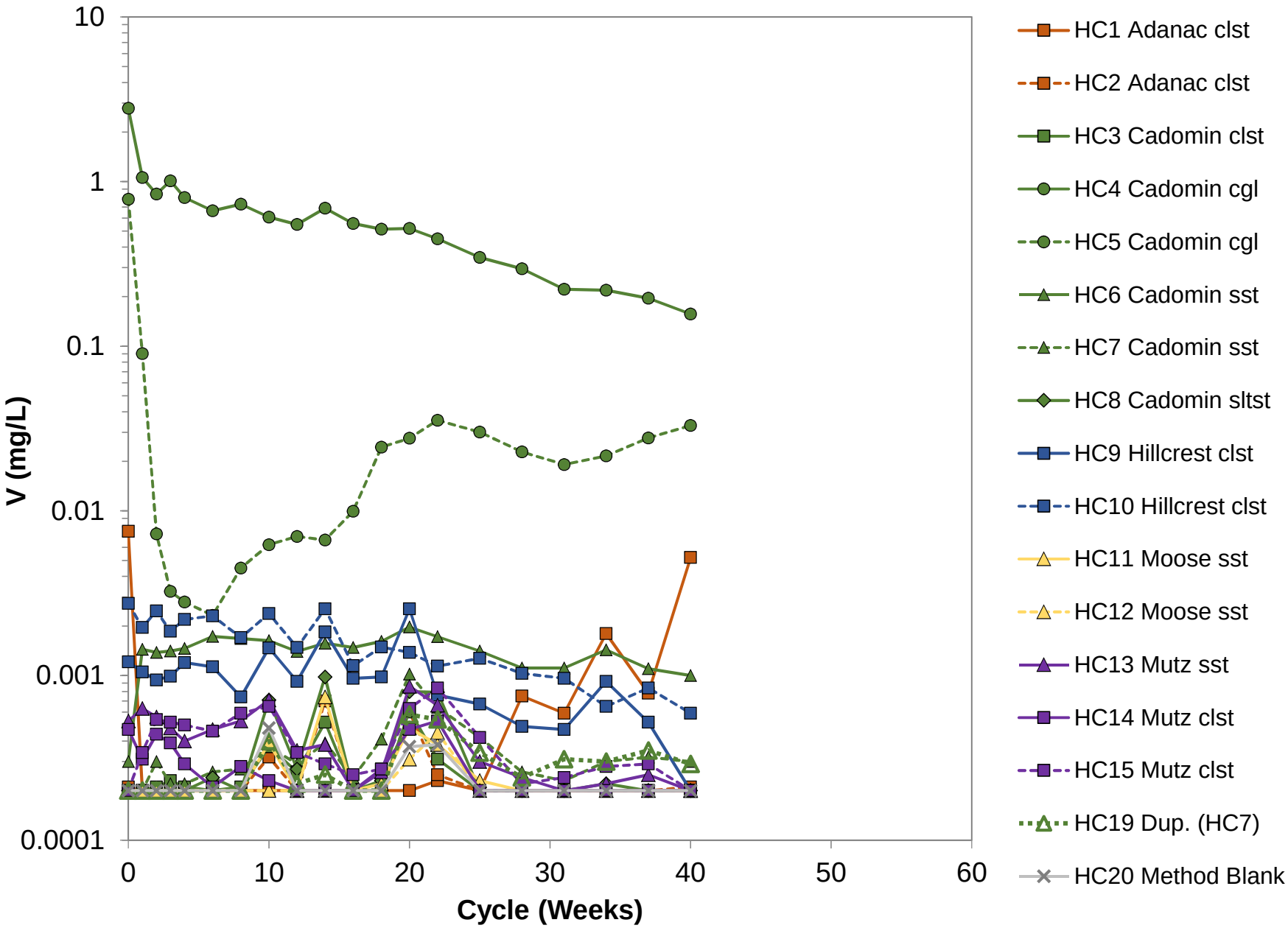
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



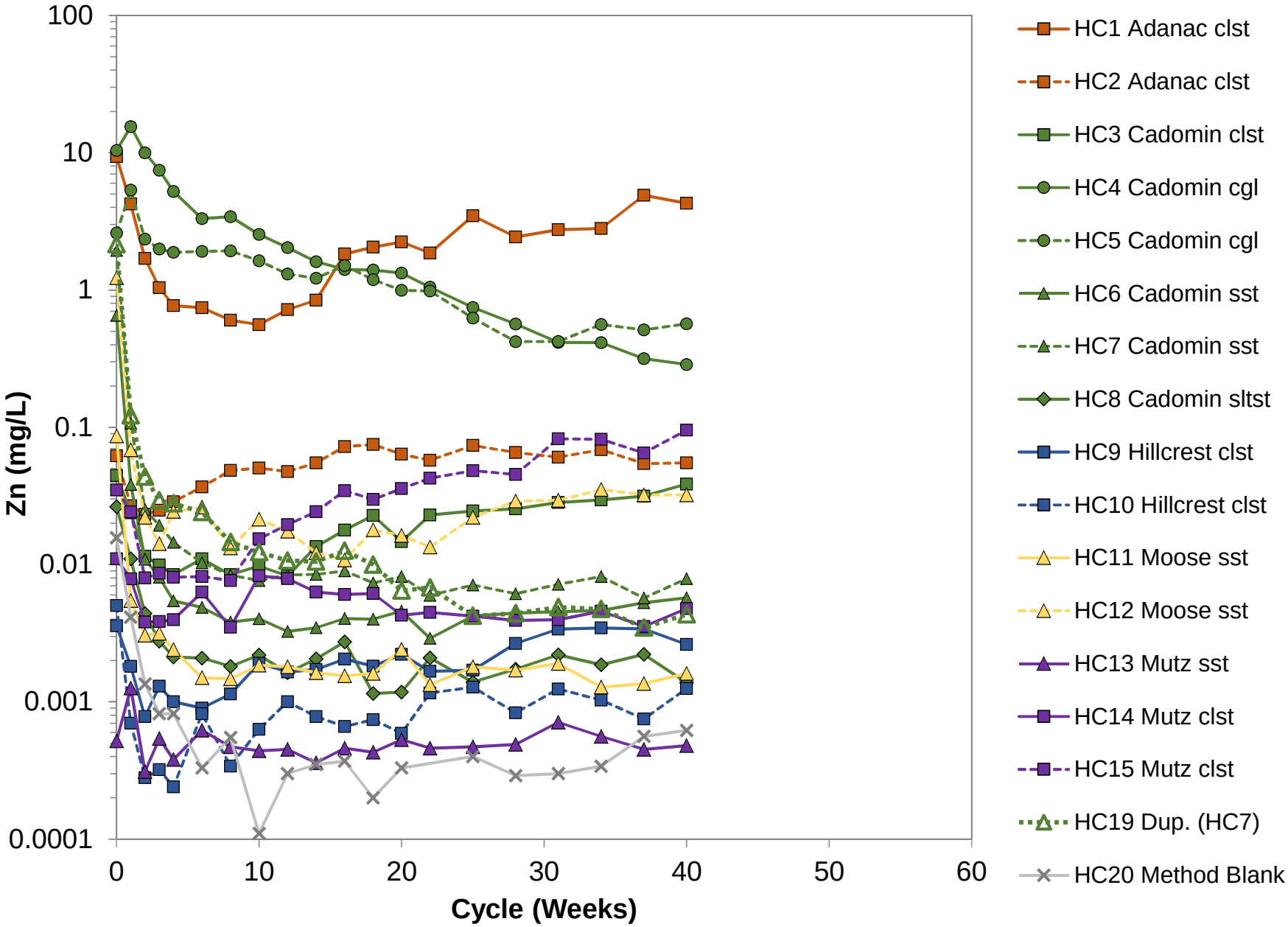
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



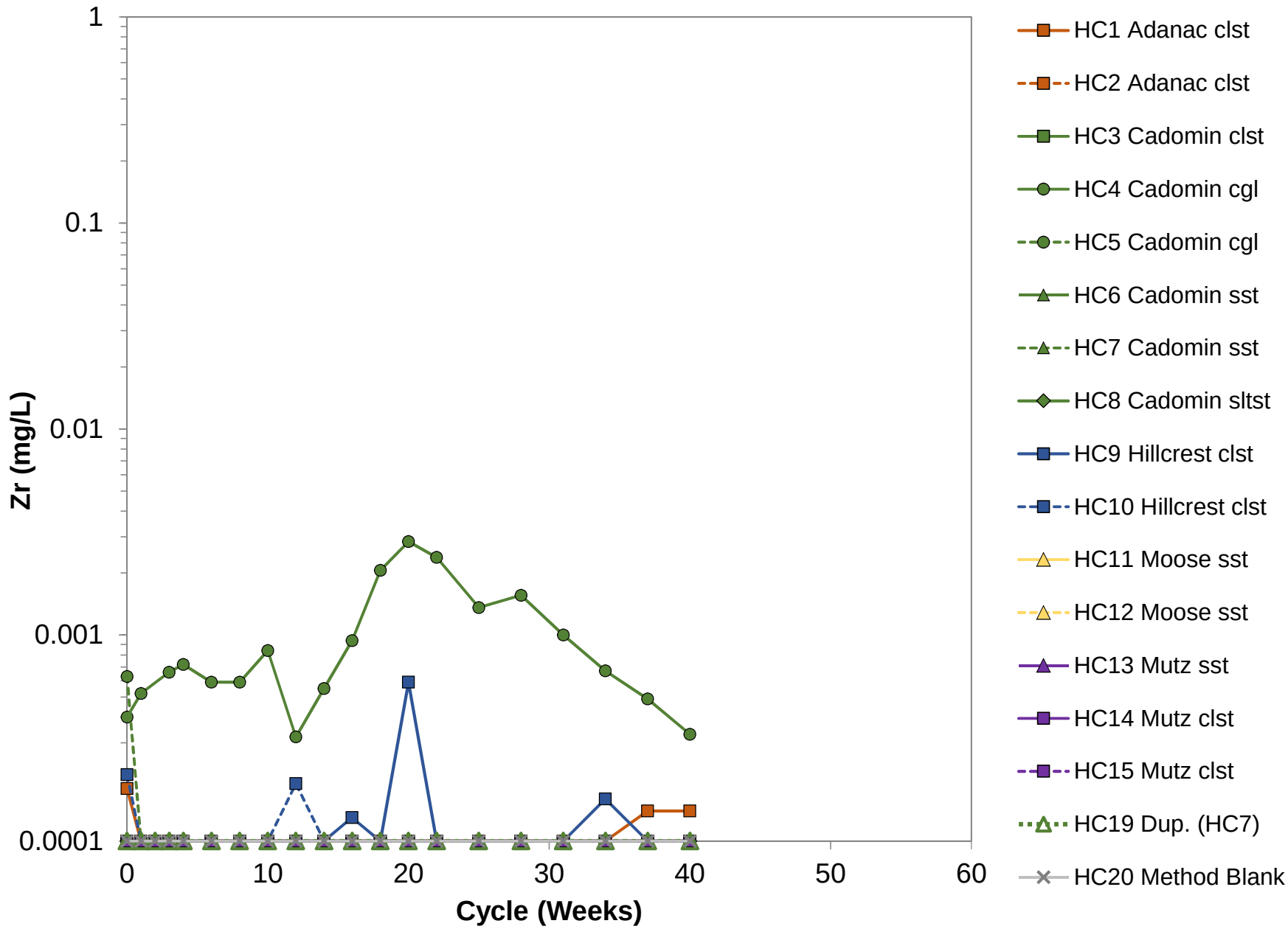
P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx

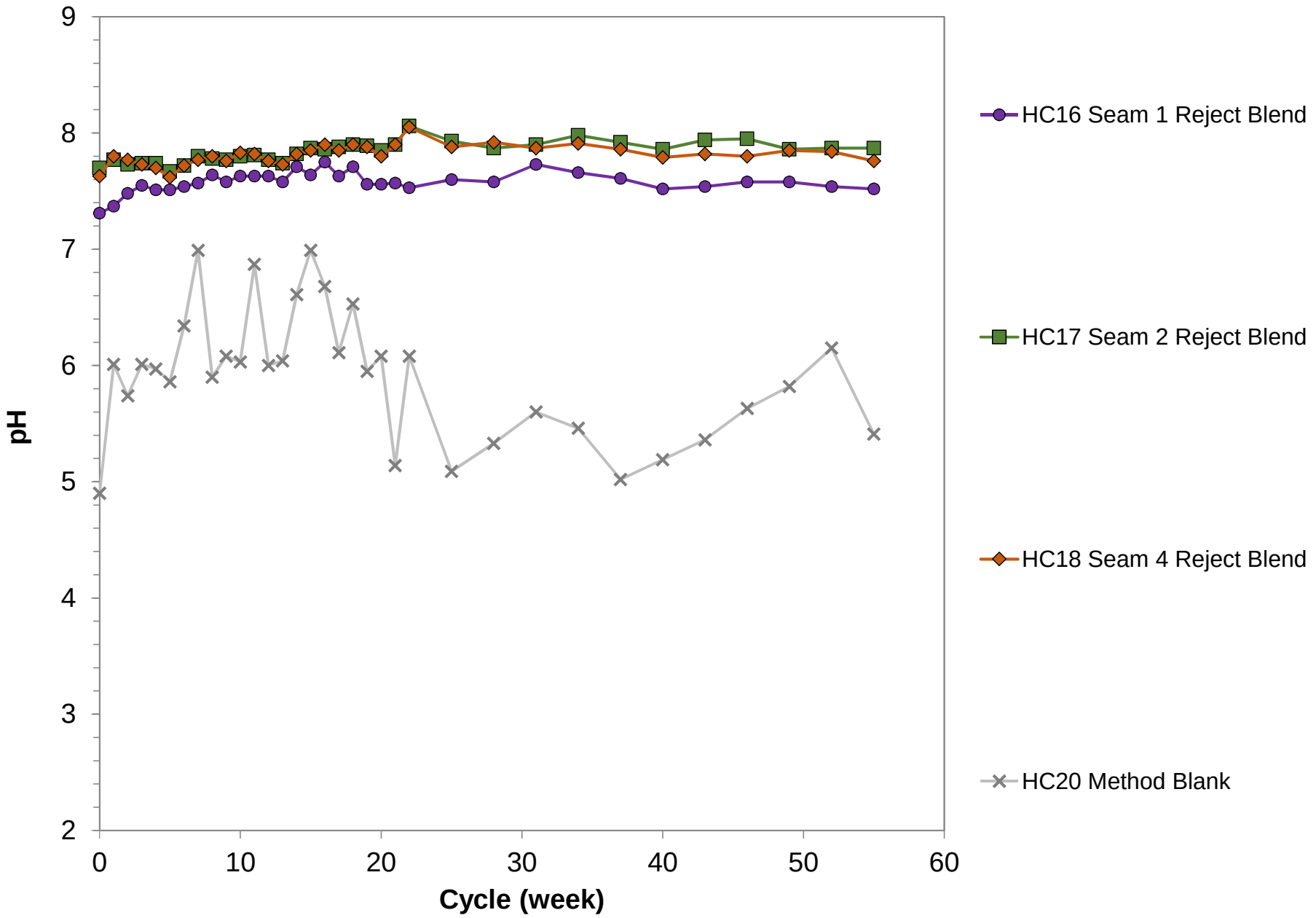


P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx

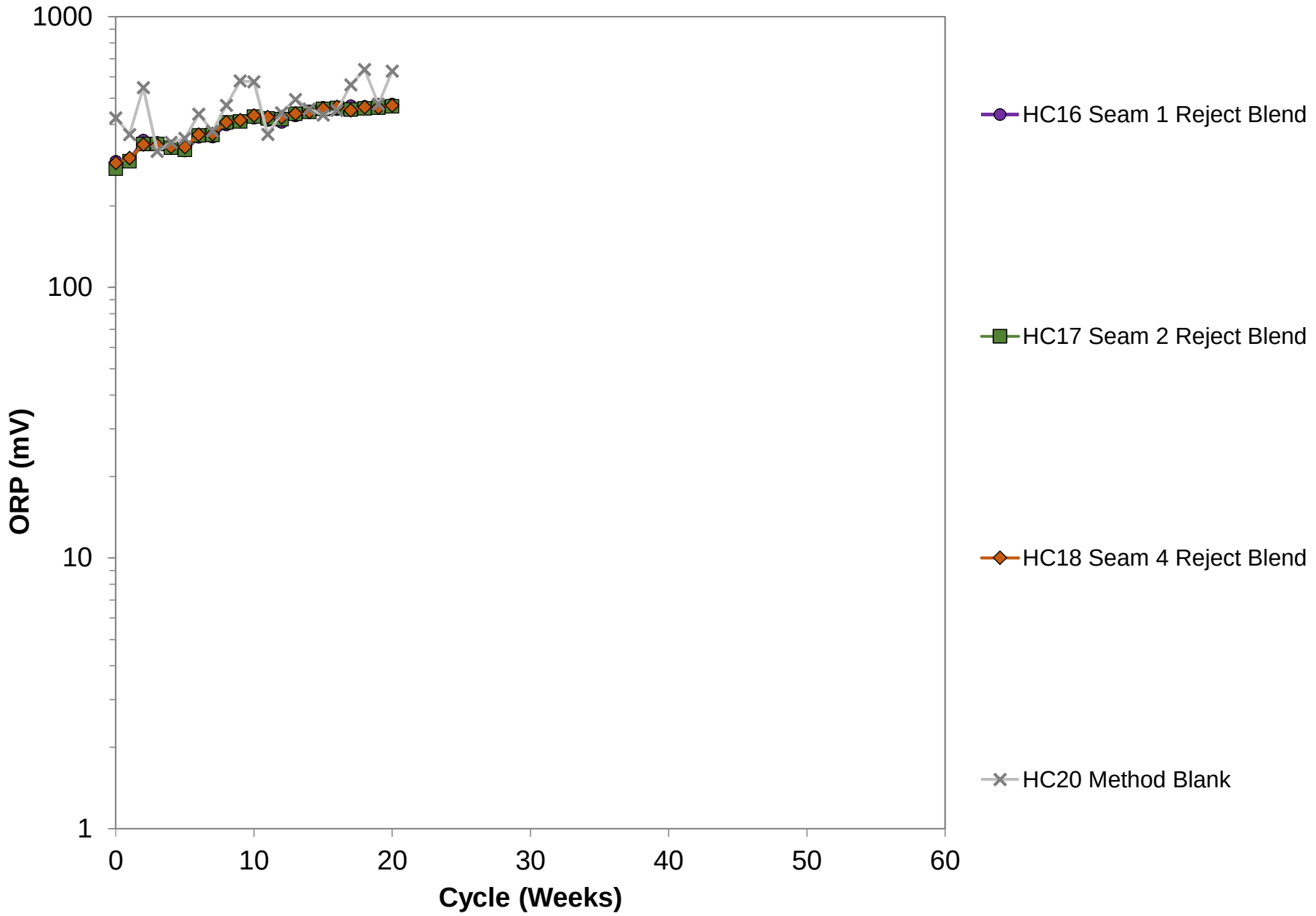


P:\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx

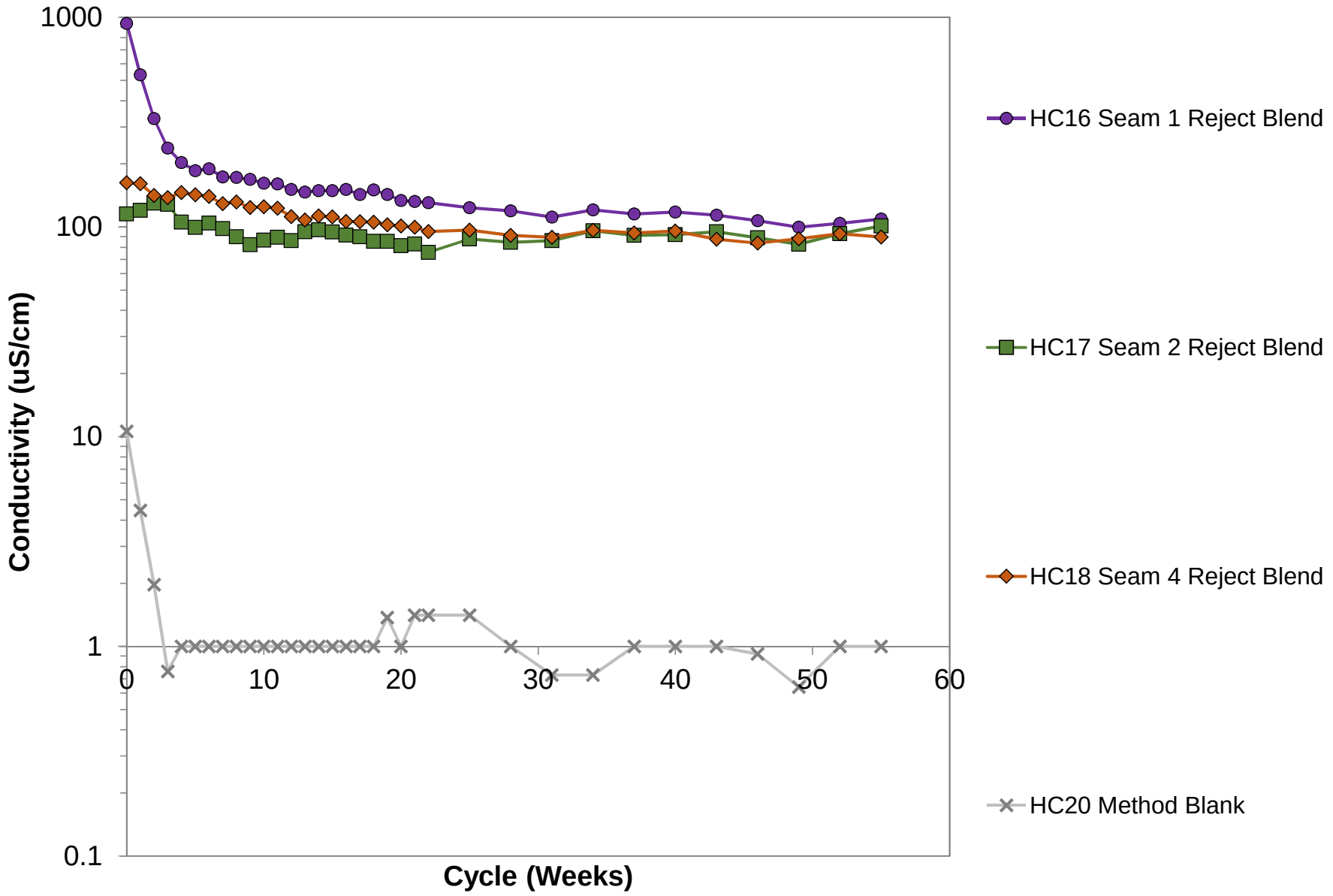
Appendix I – CHPP Residue Humidity Cell Test Charts



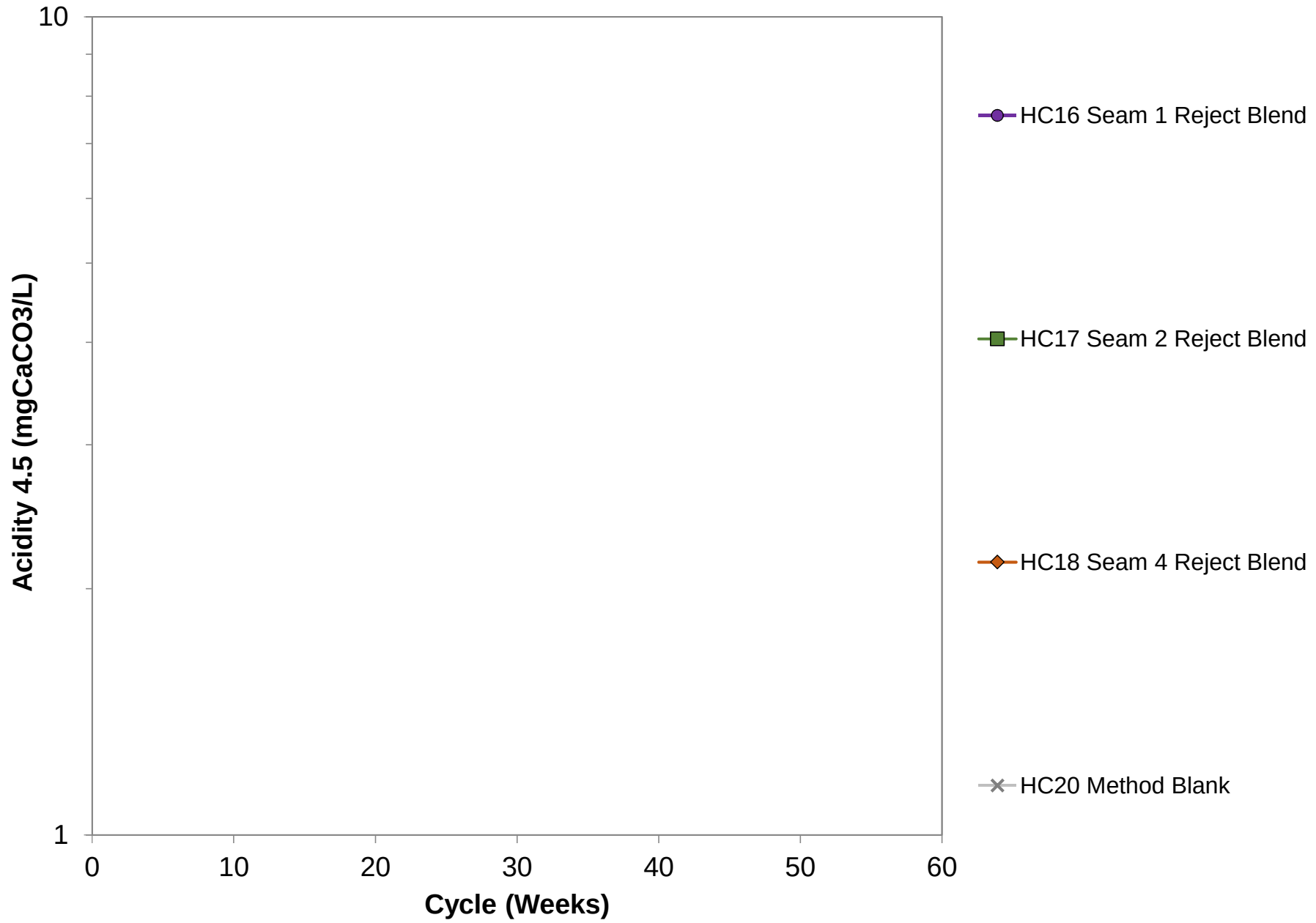
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



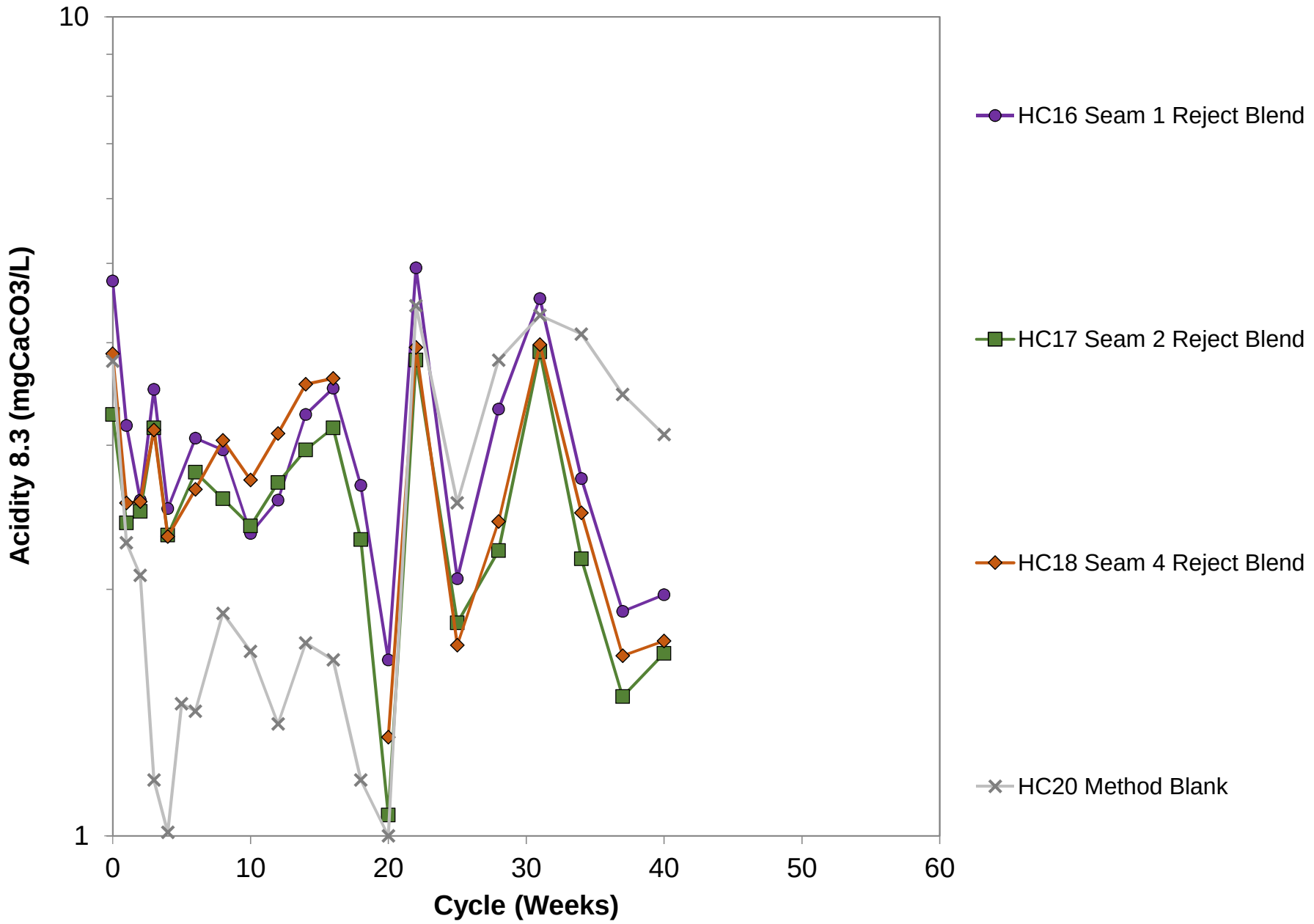
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



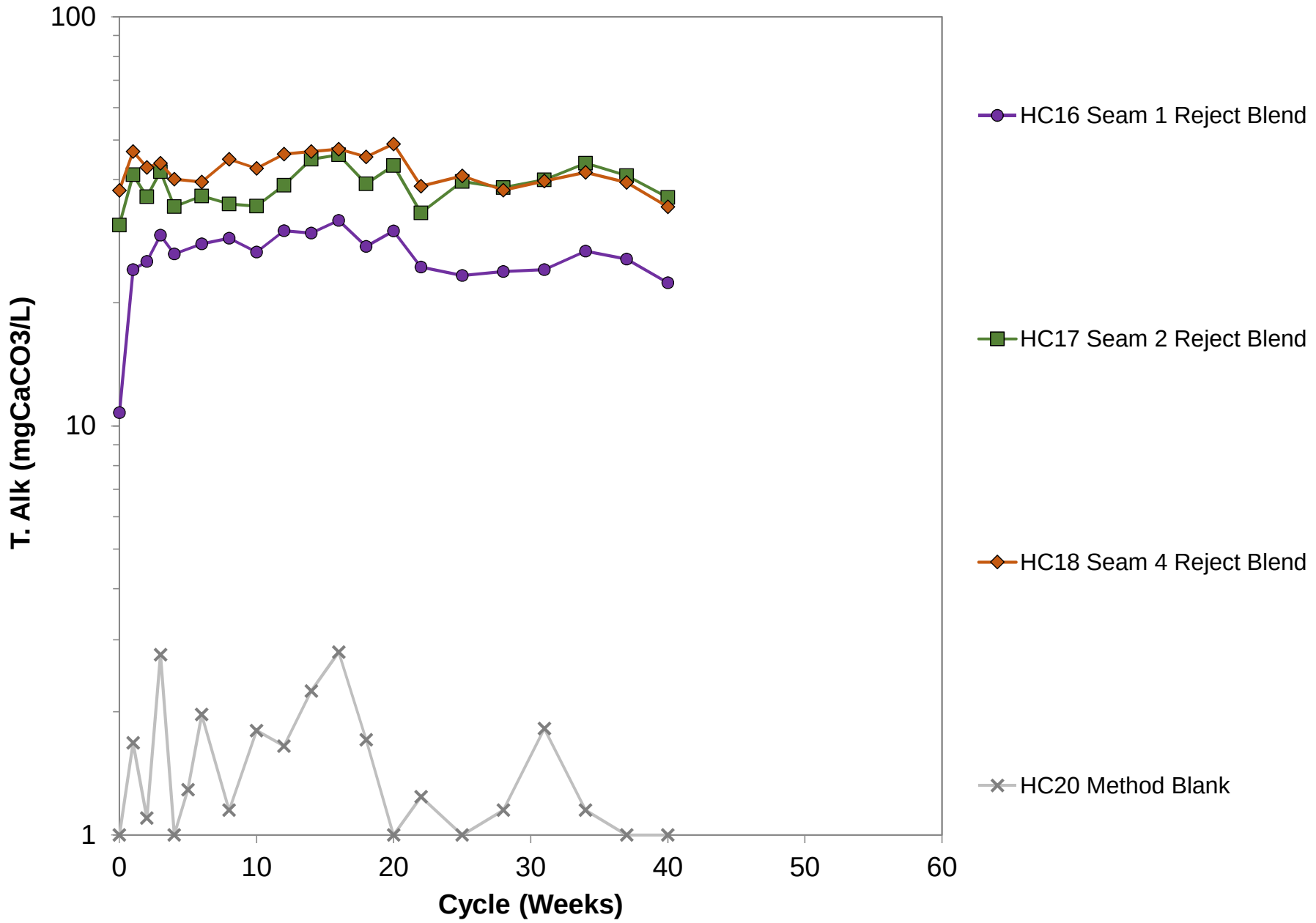
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



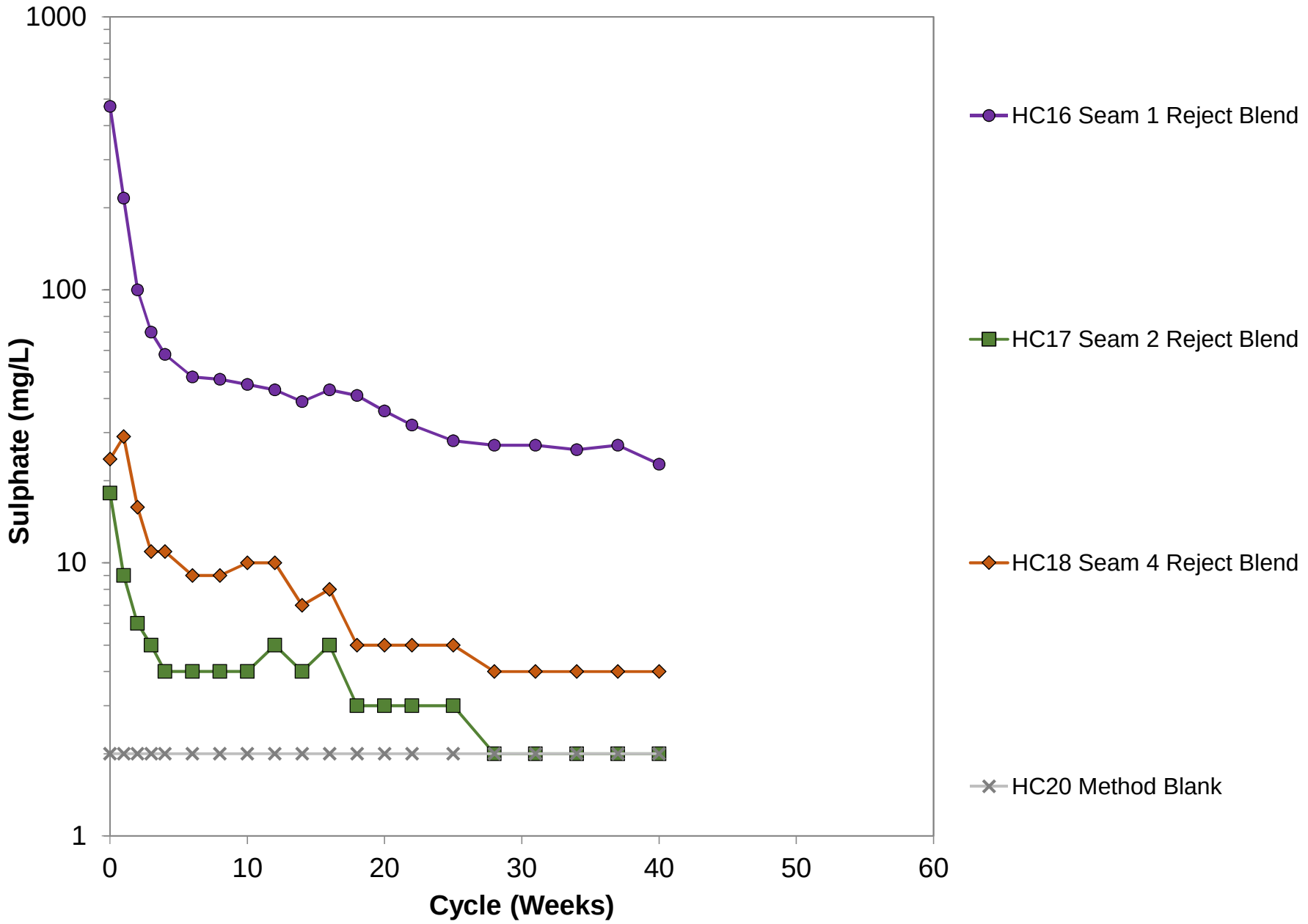
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



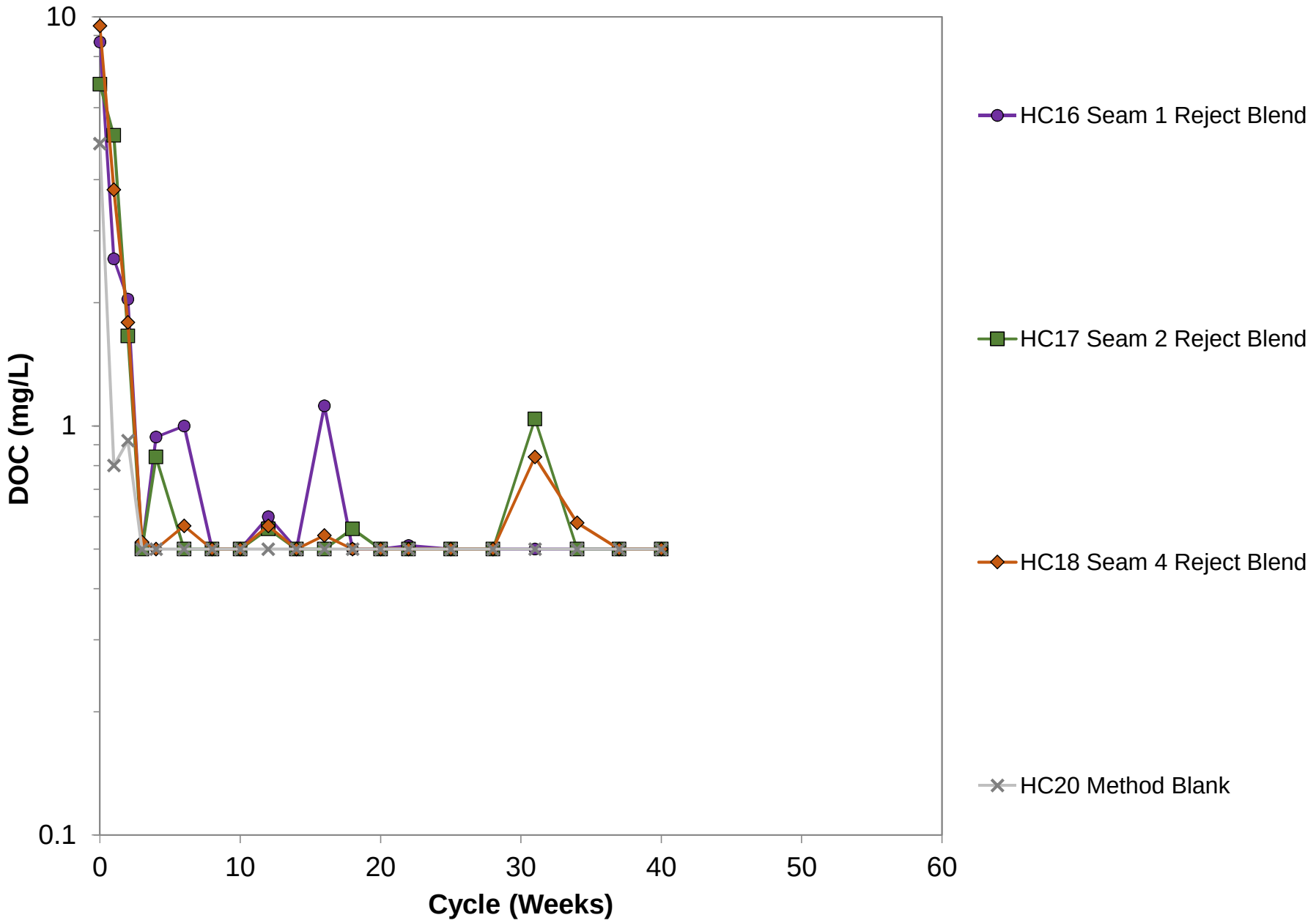
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



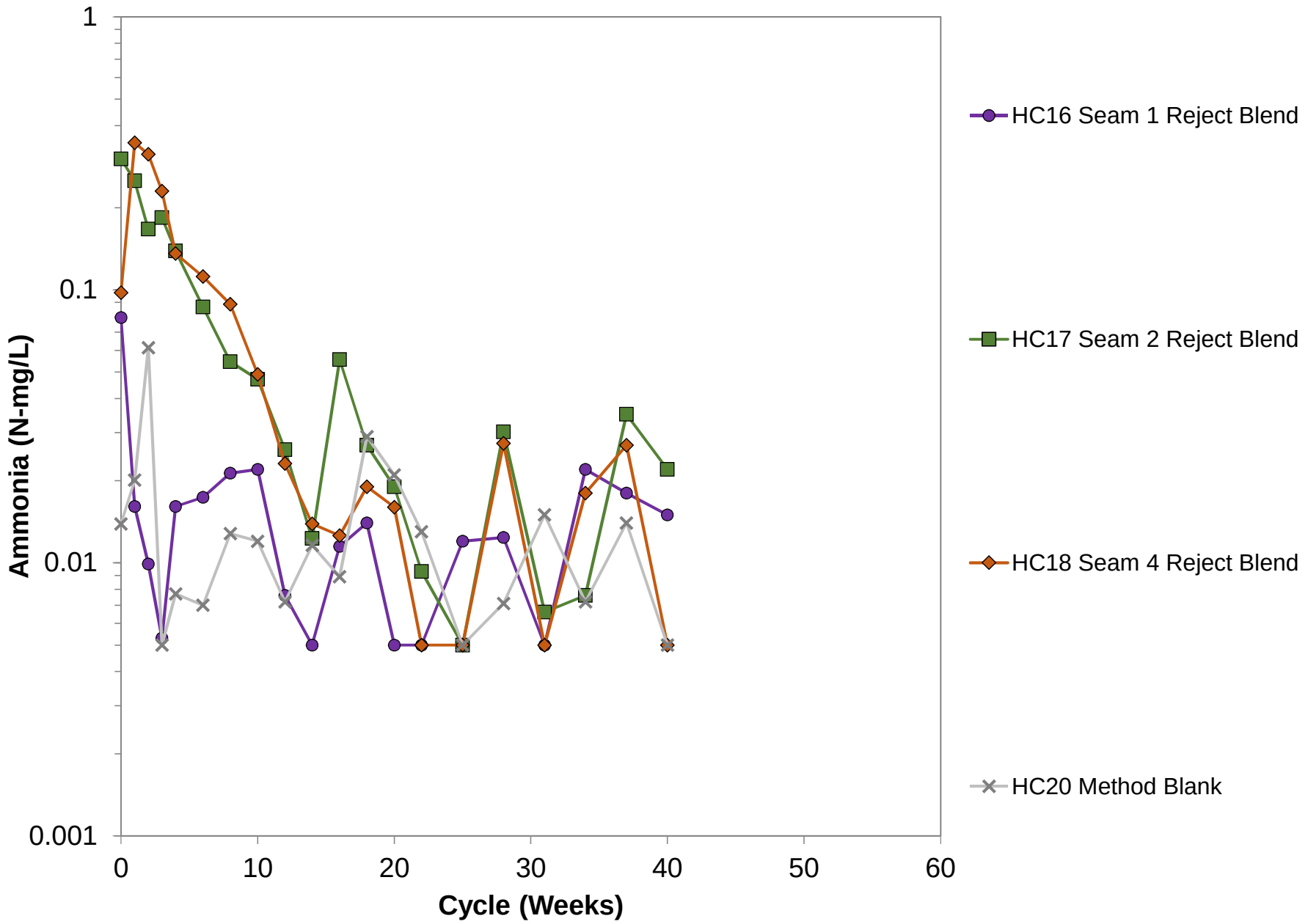
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



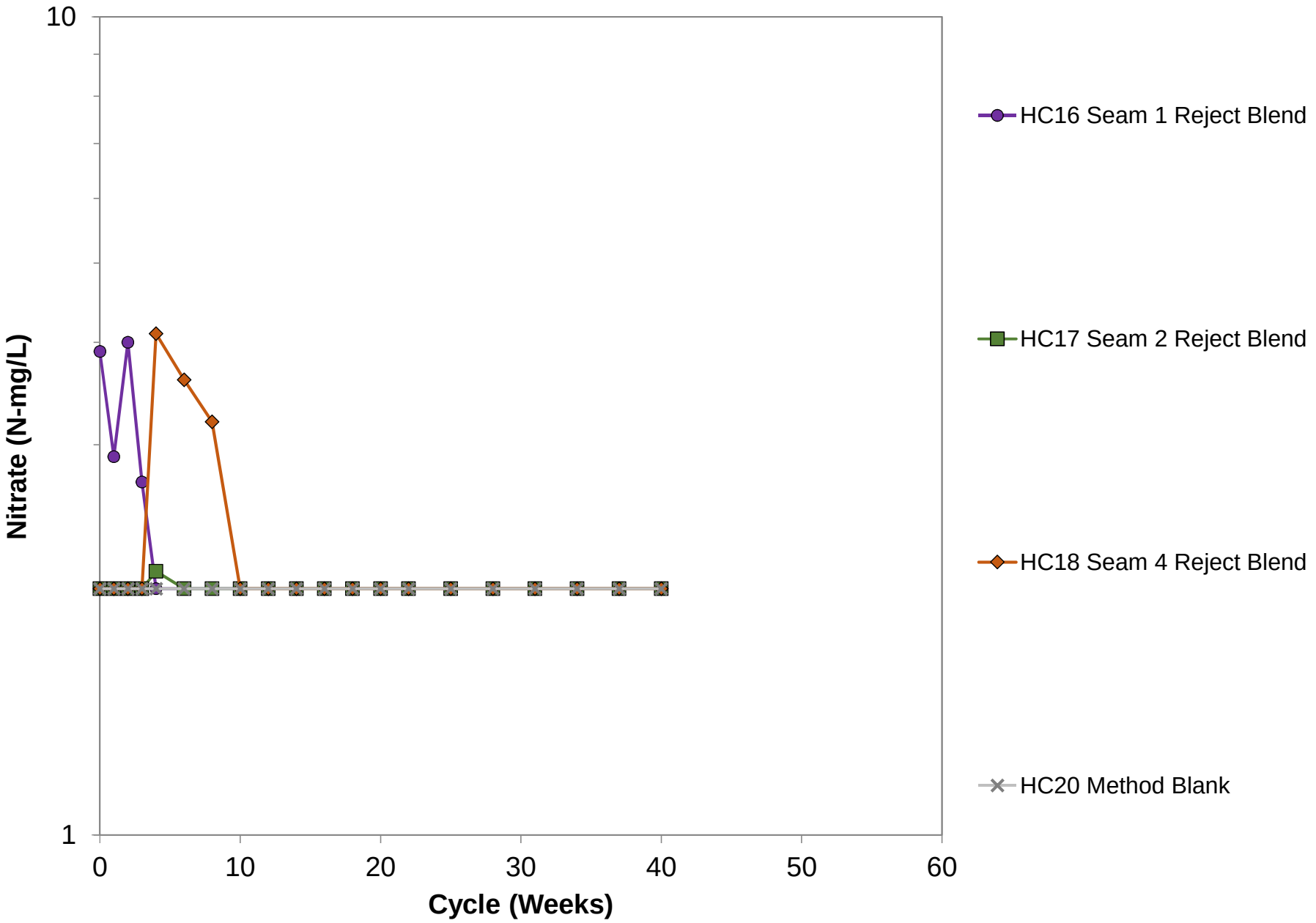
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



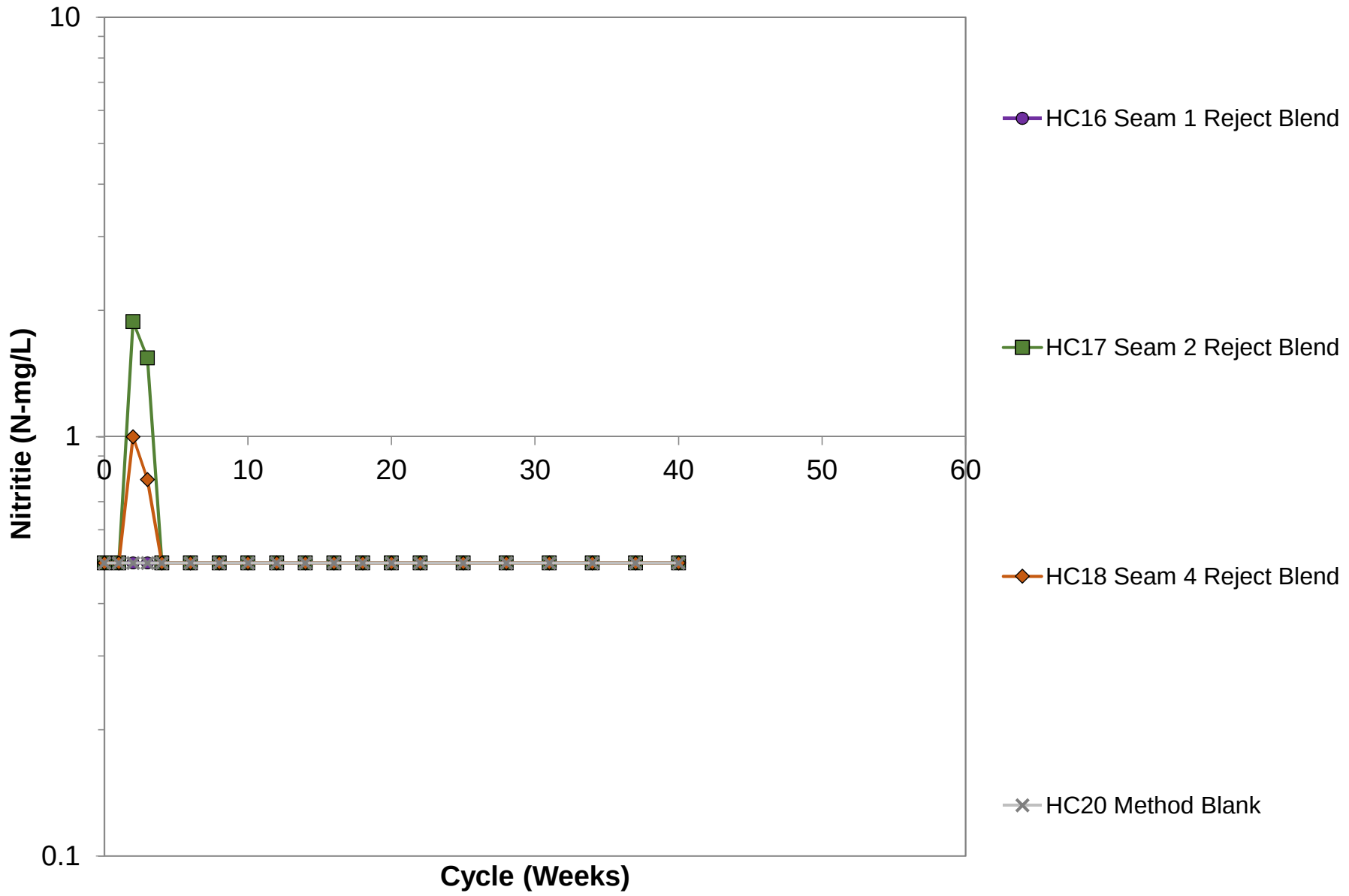
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



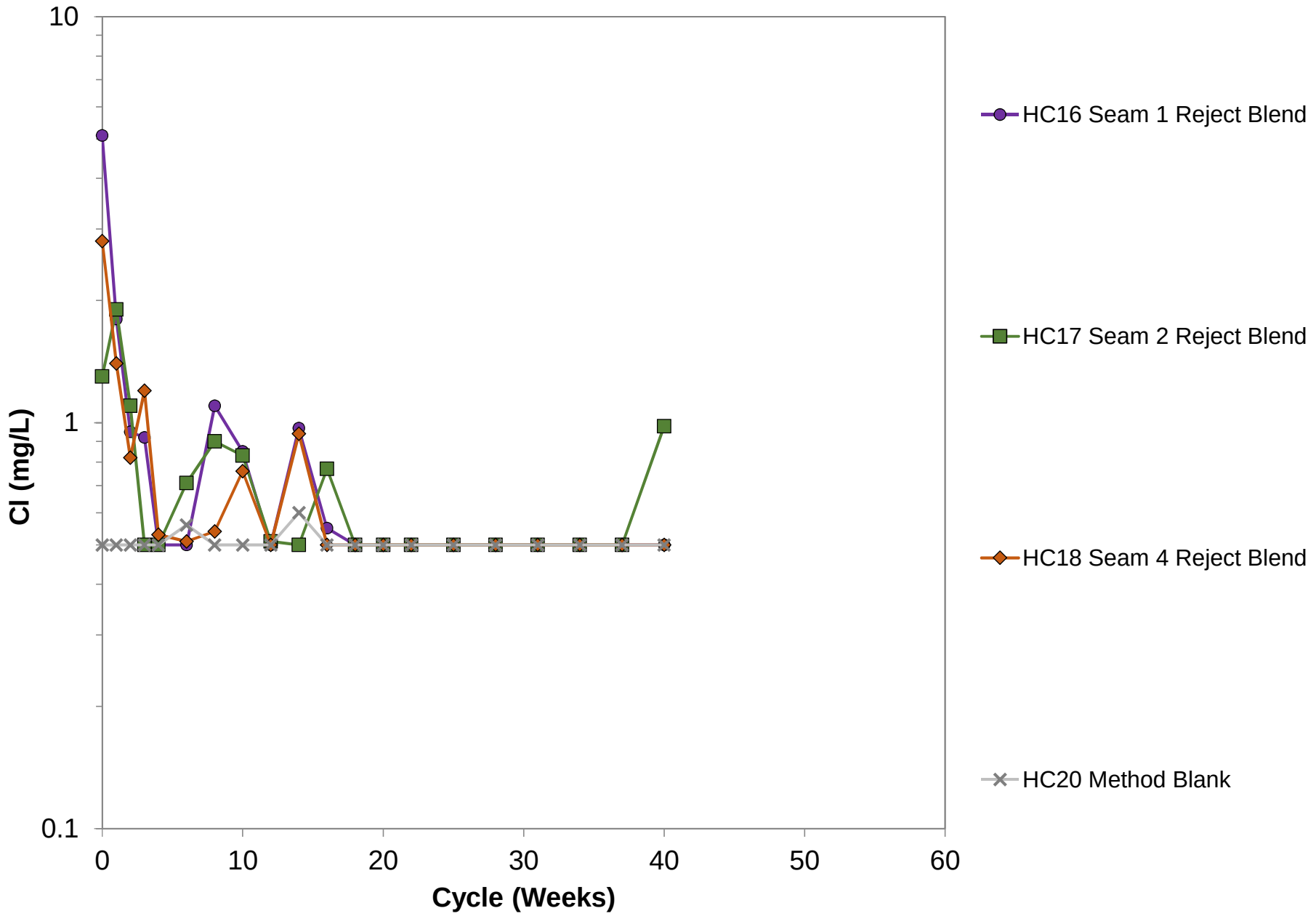
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



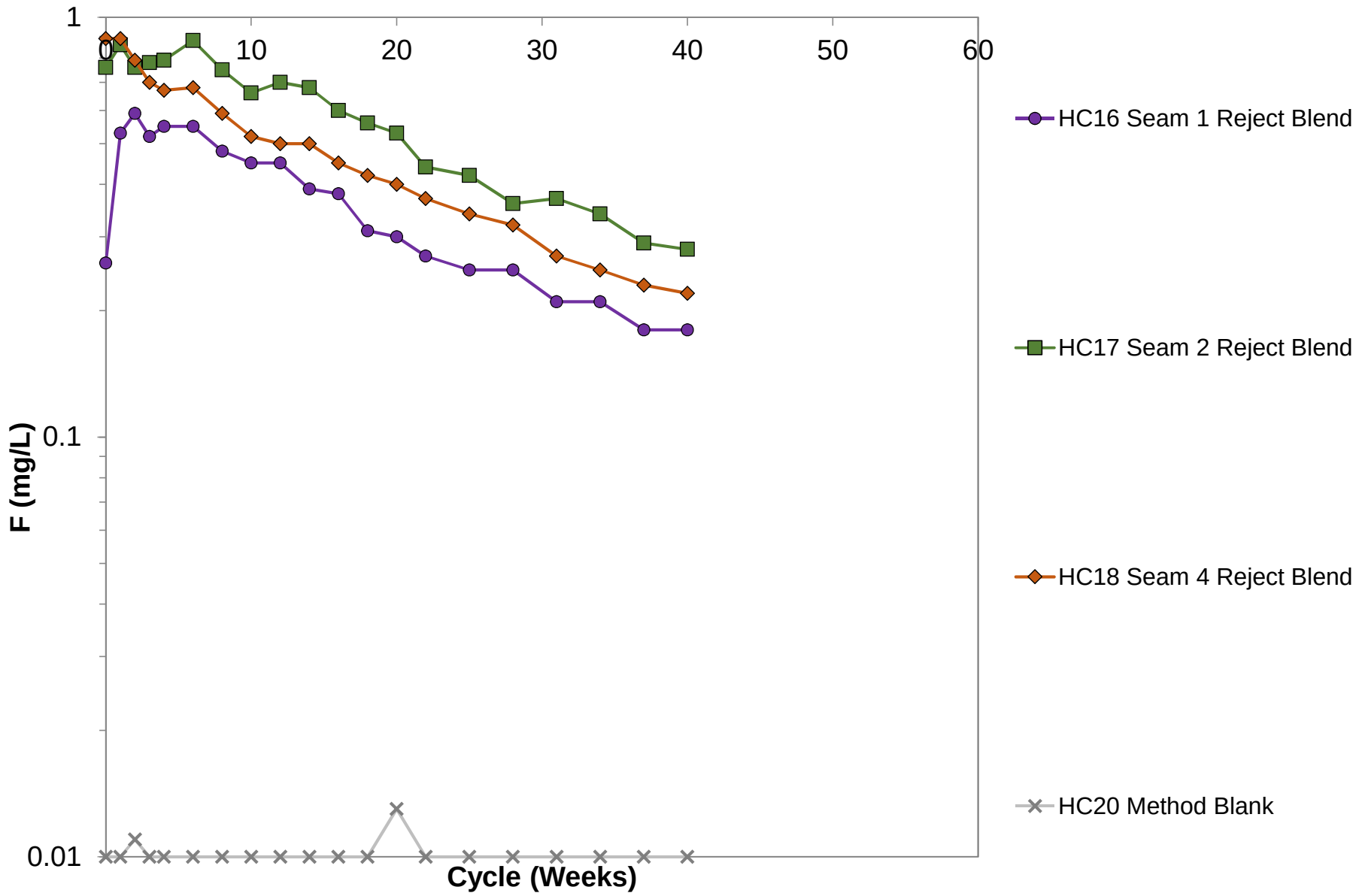
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



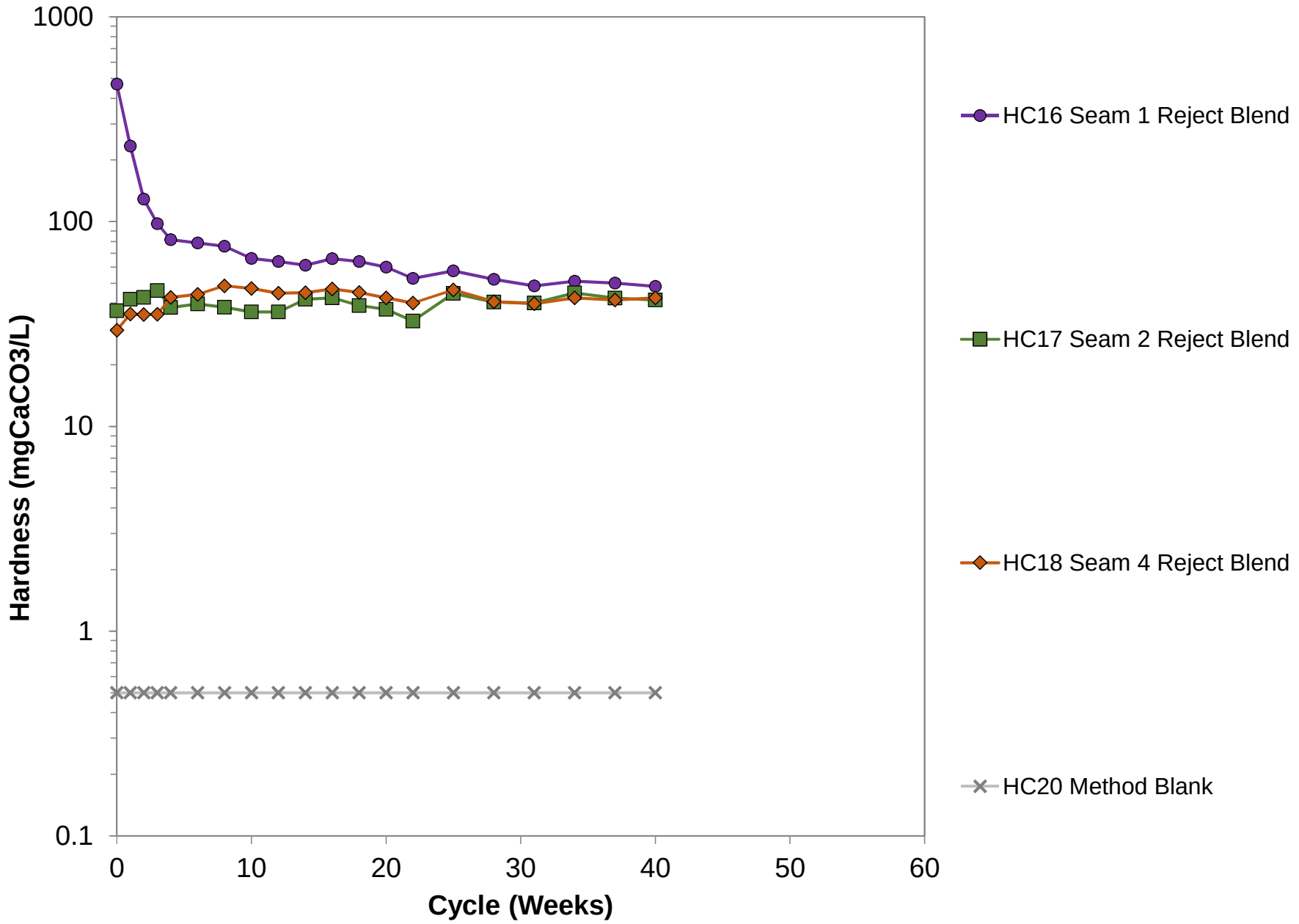
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



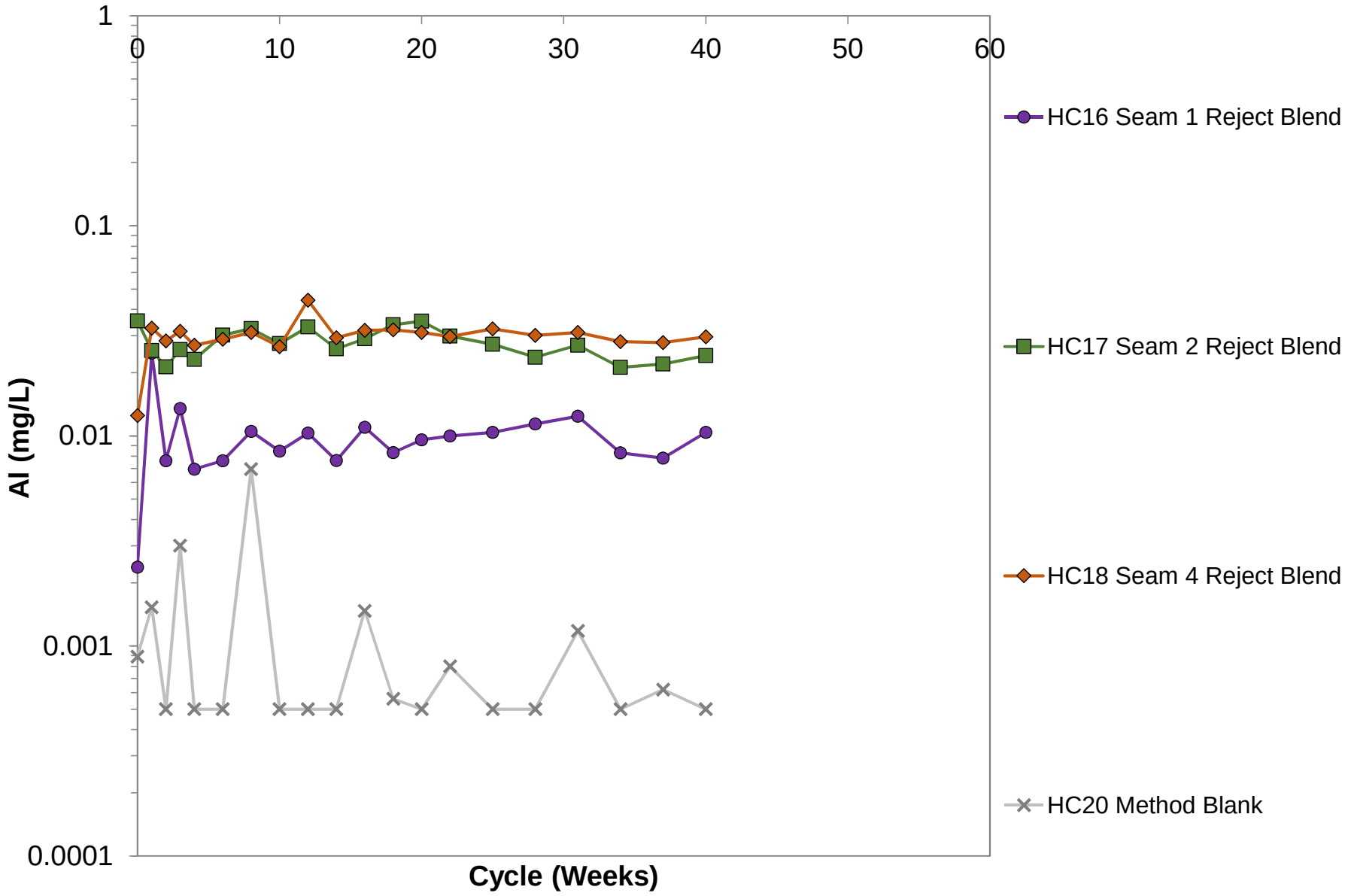
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



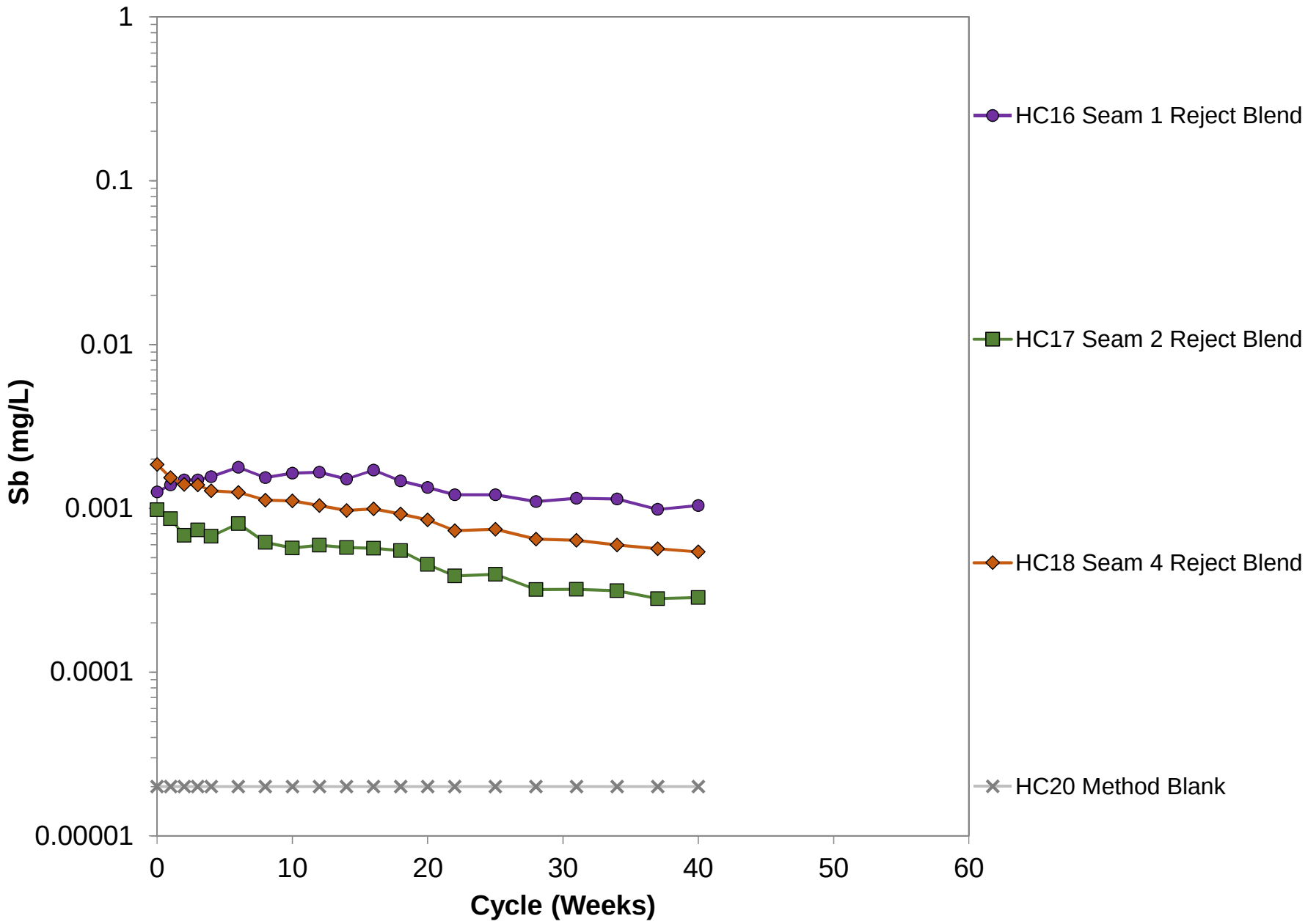
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



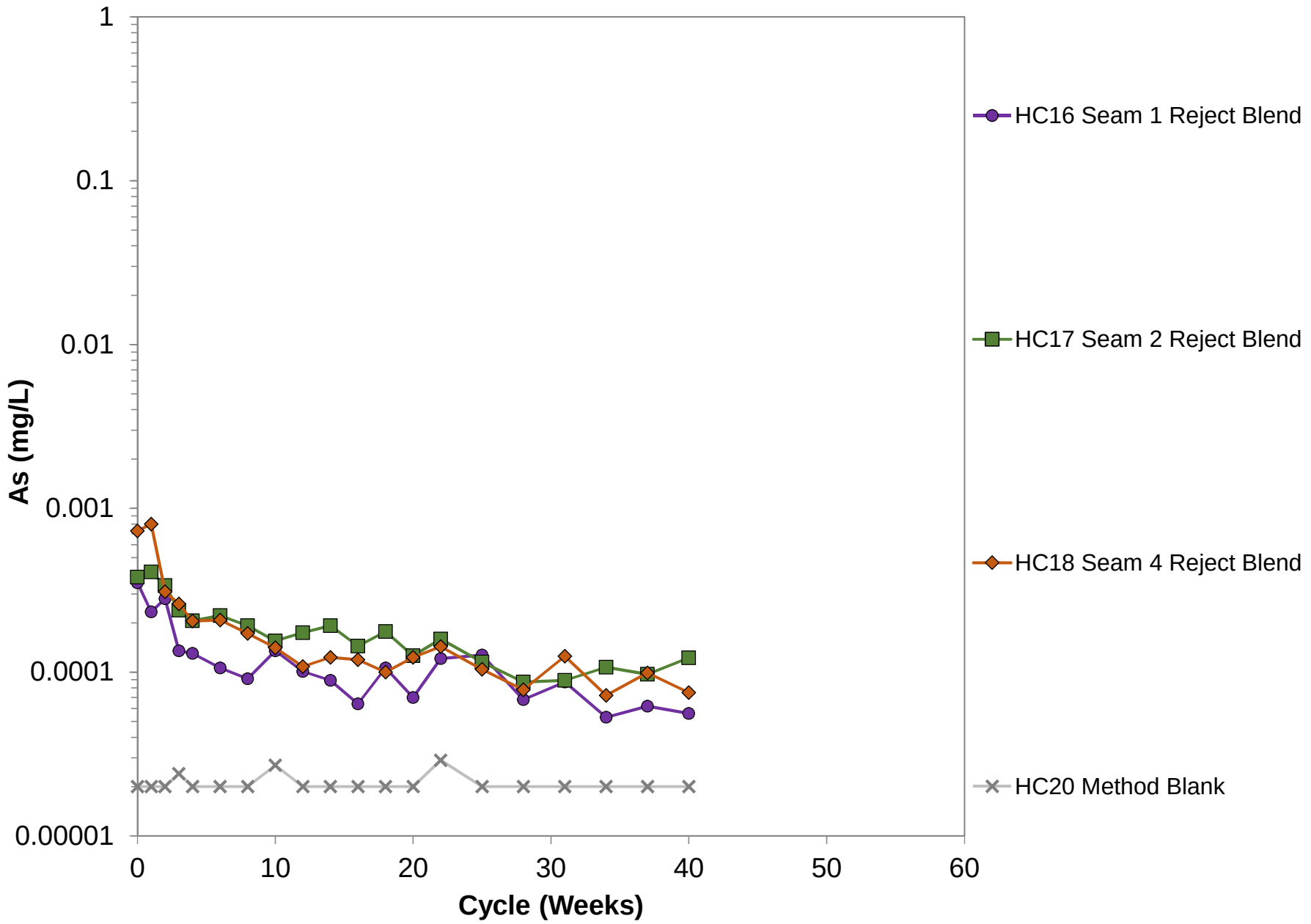
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



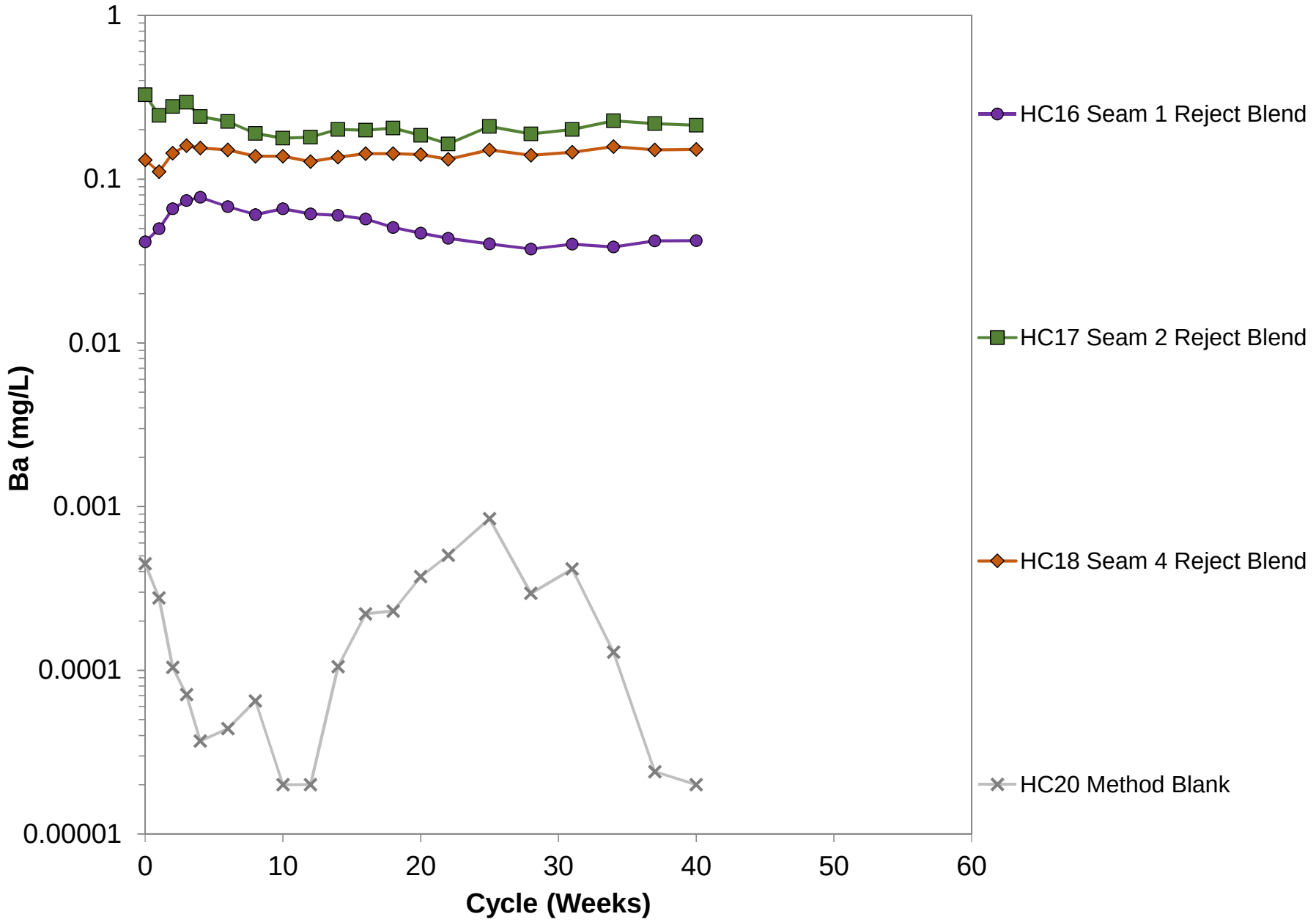
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



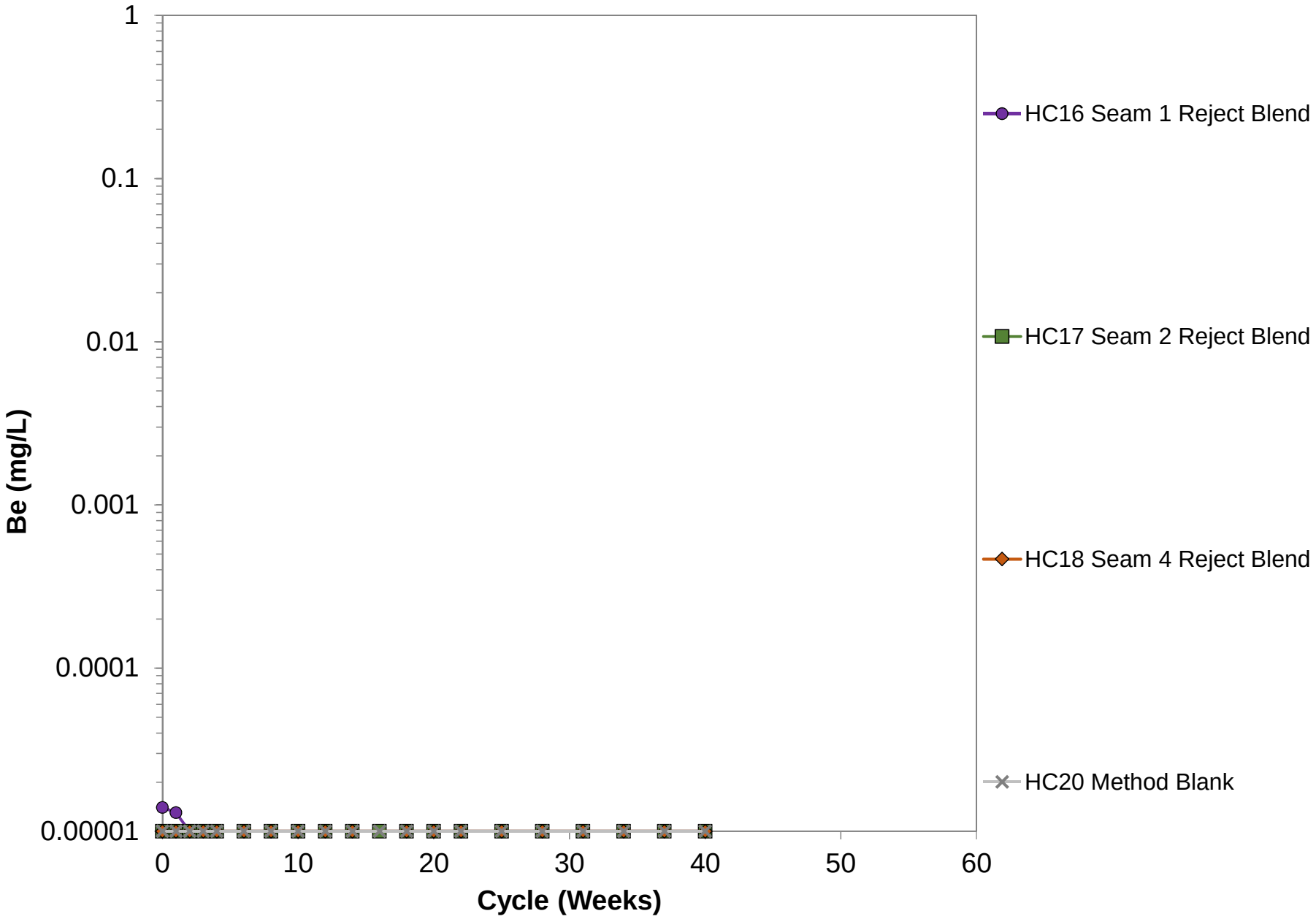
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



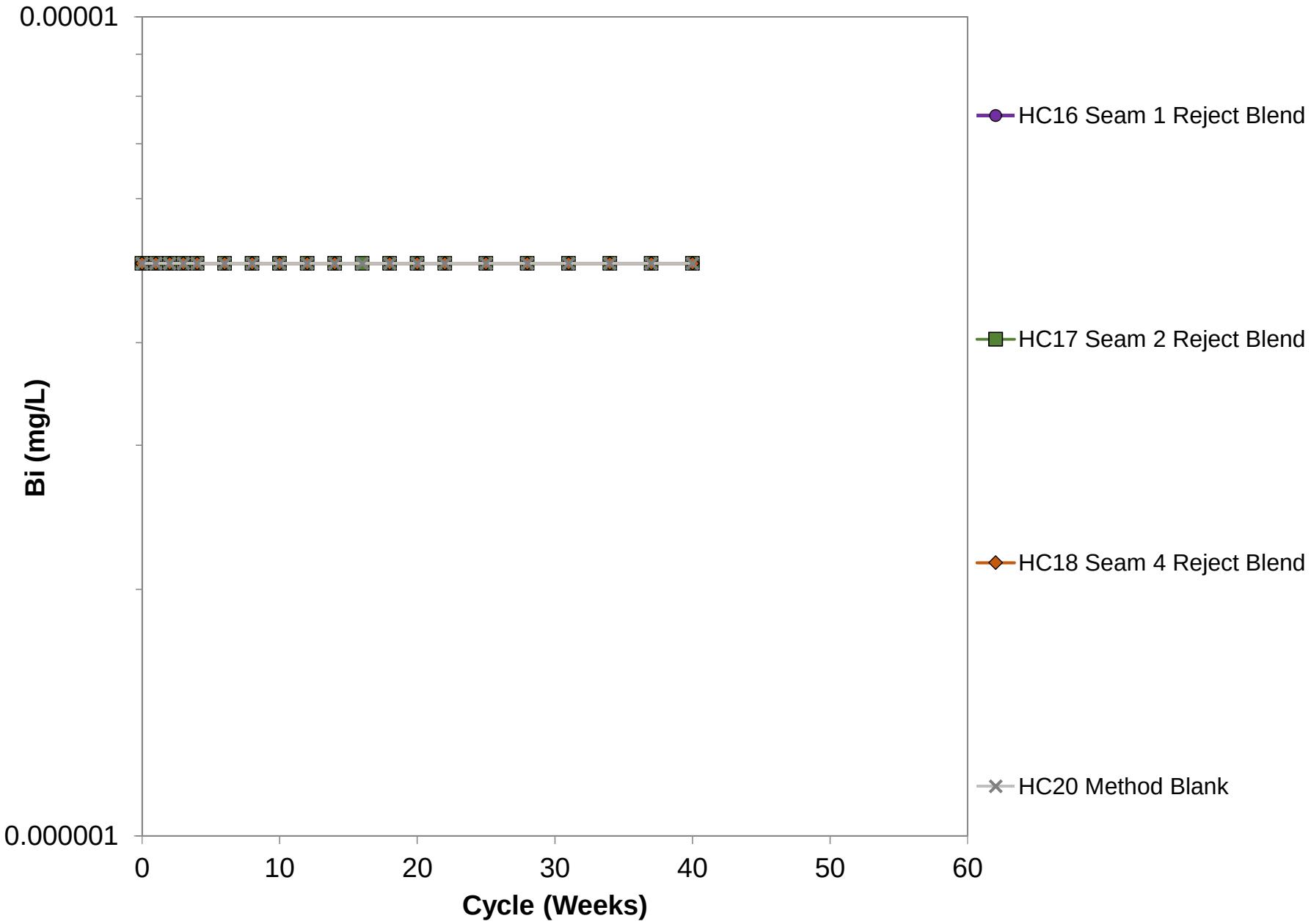
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



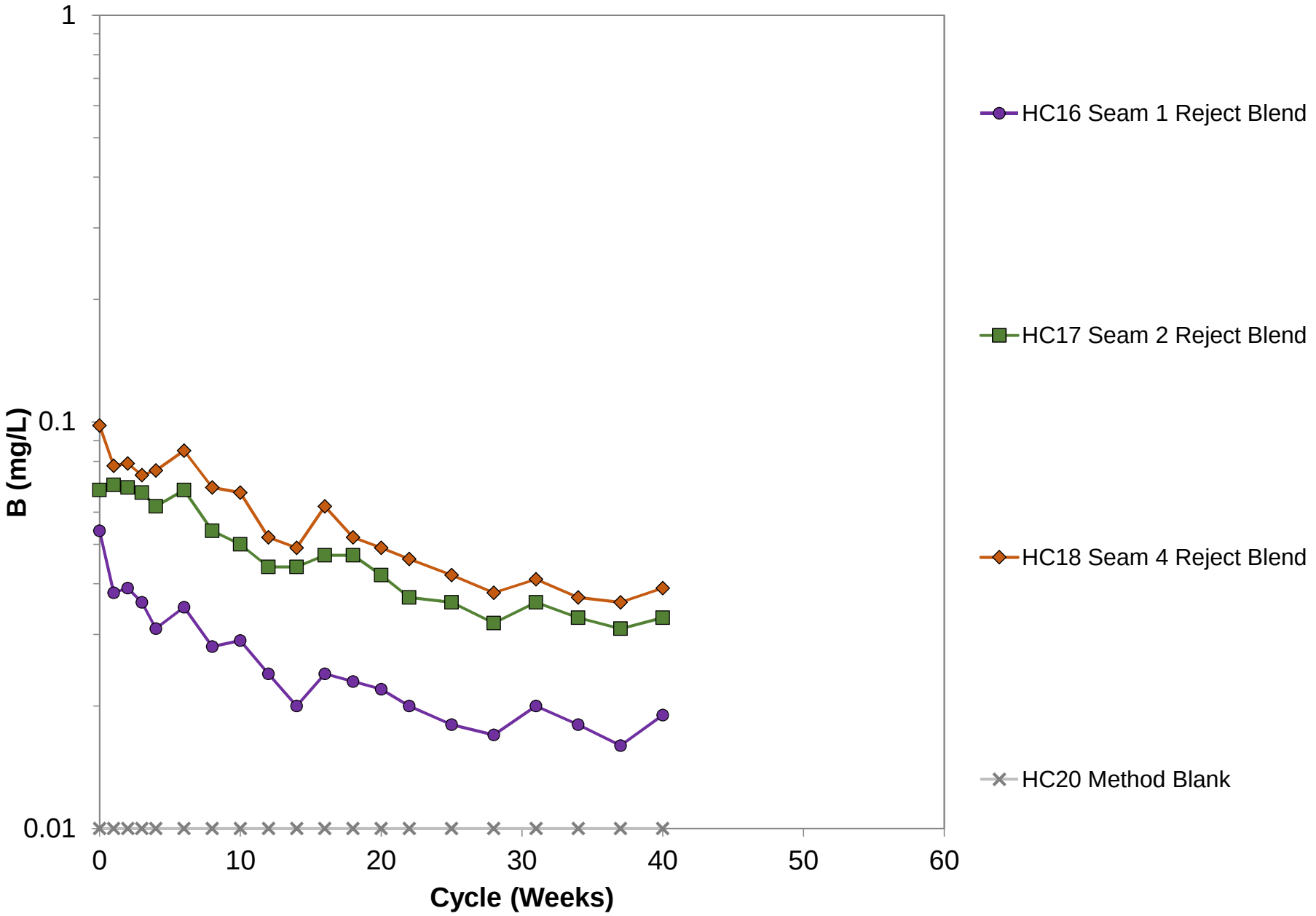
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



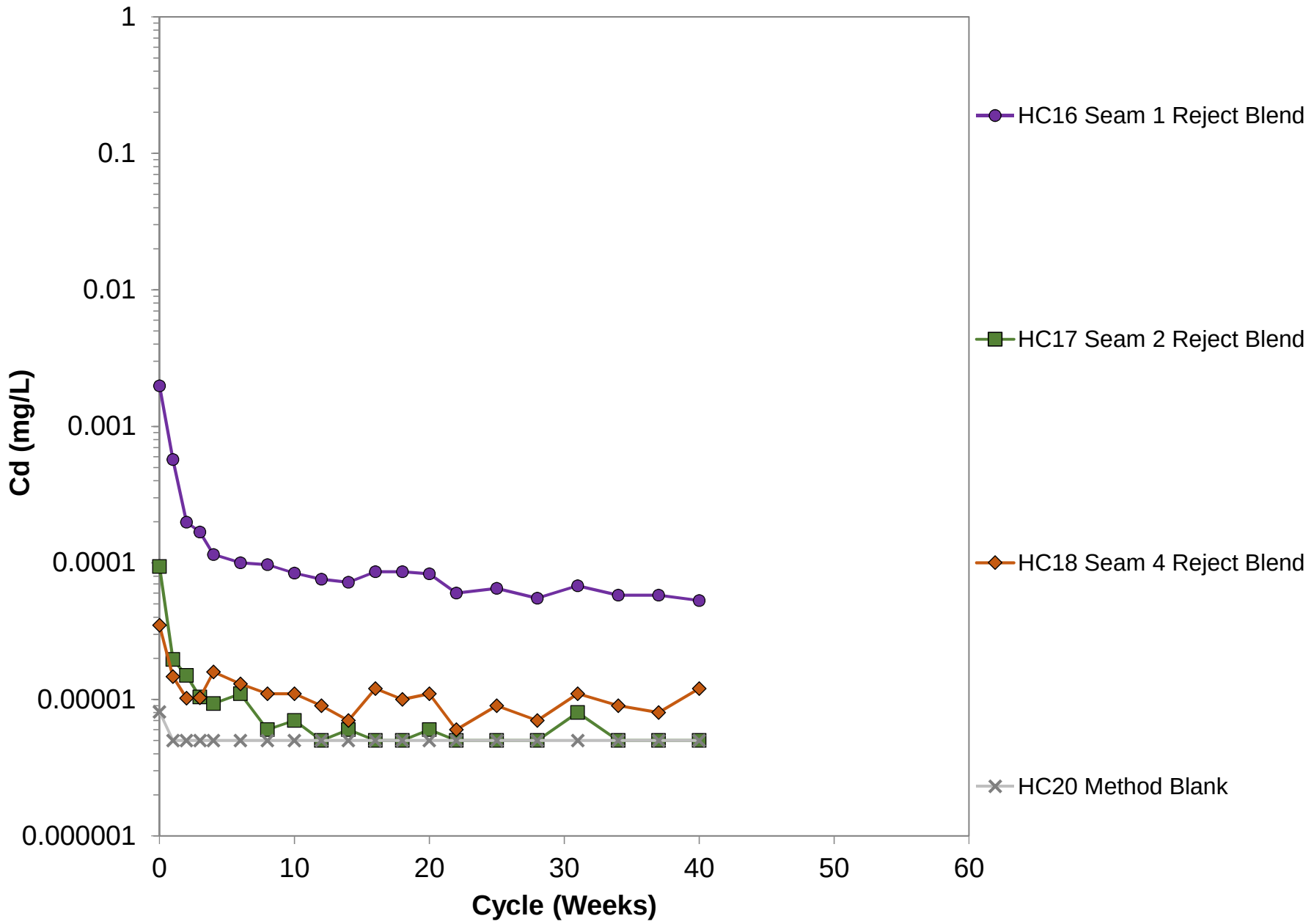
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



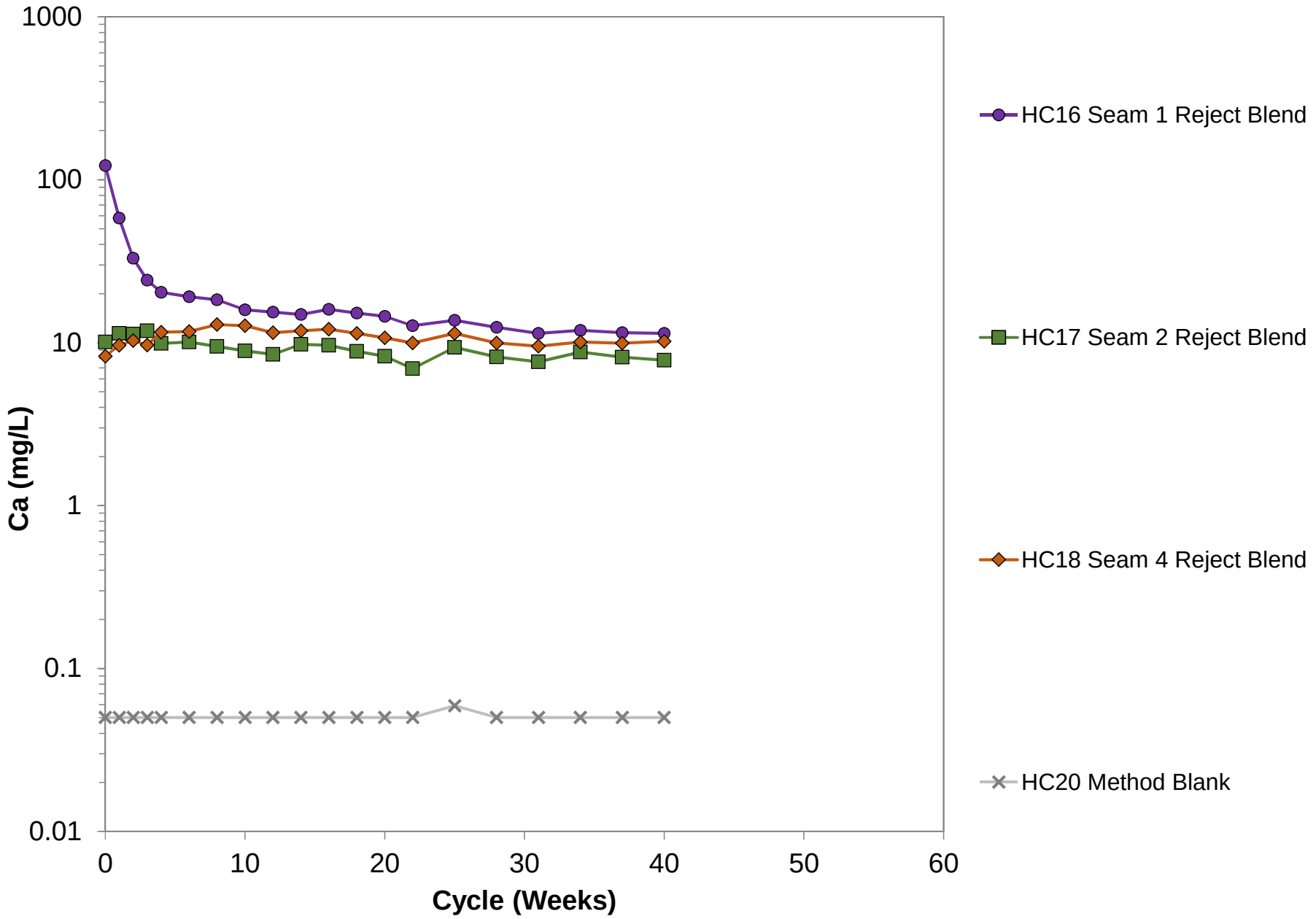
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



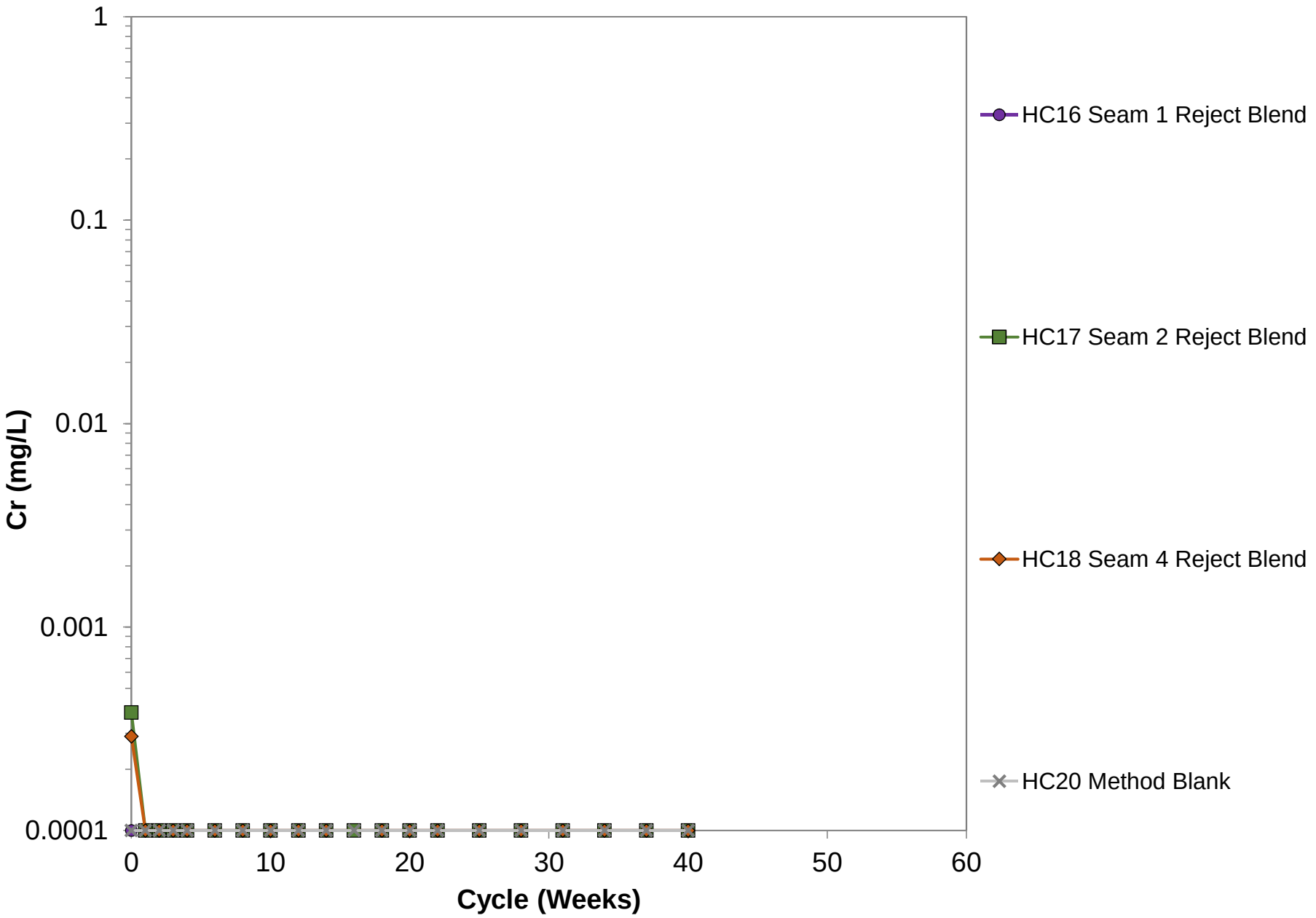
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



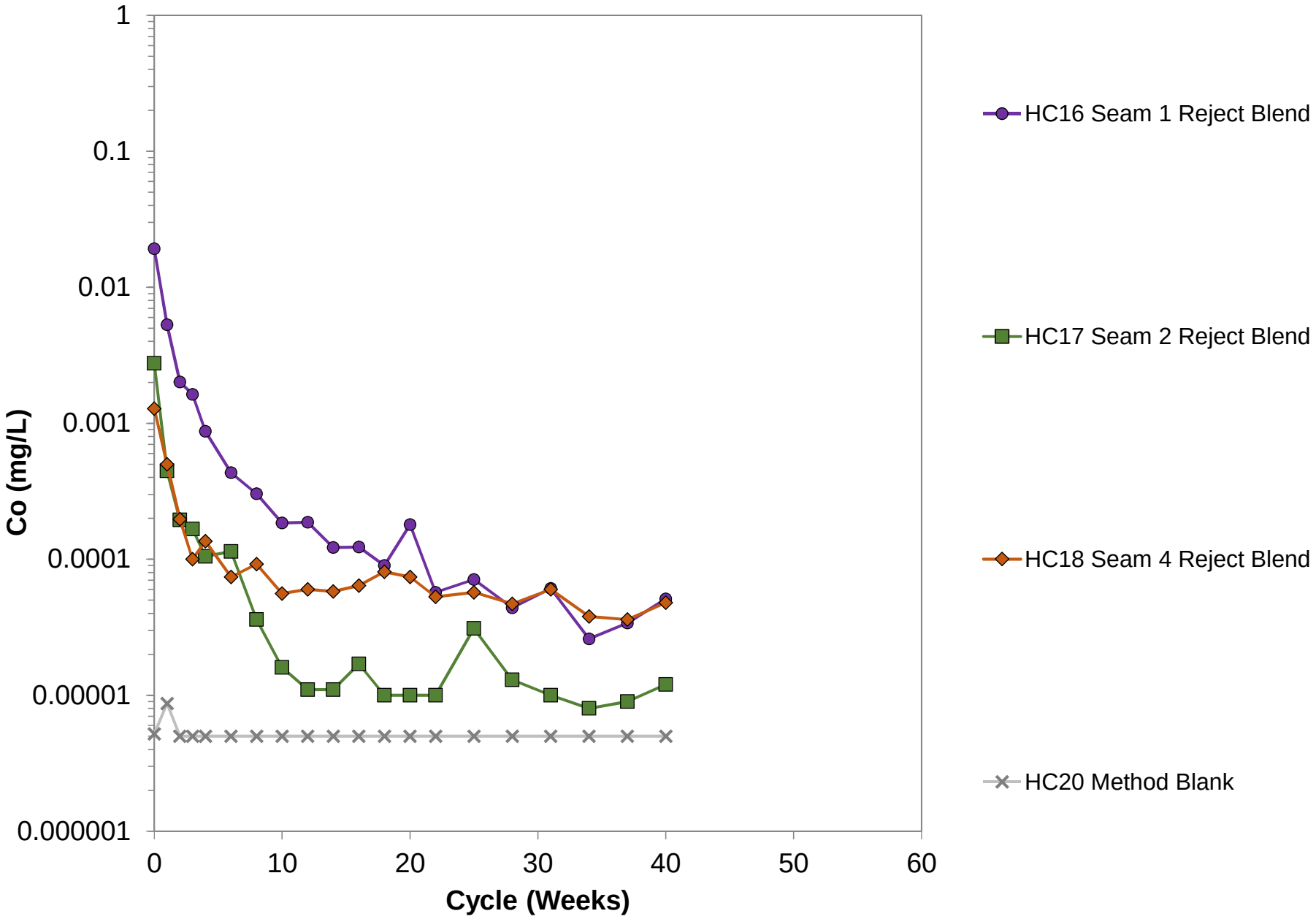
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



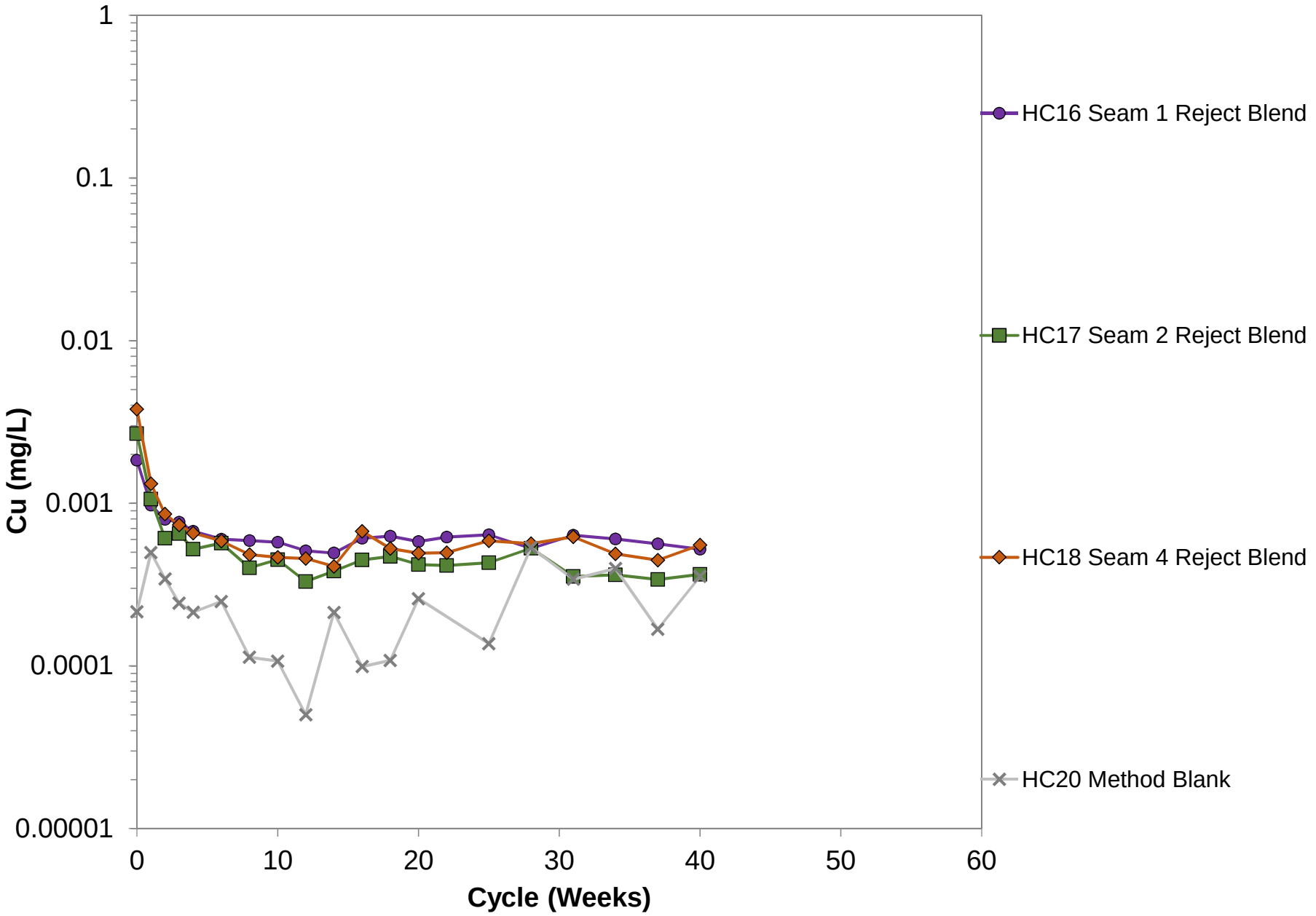
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



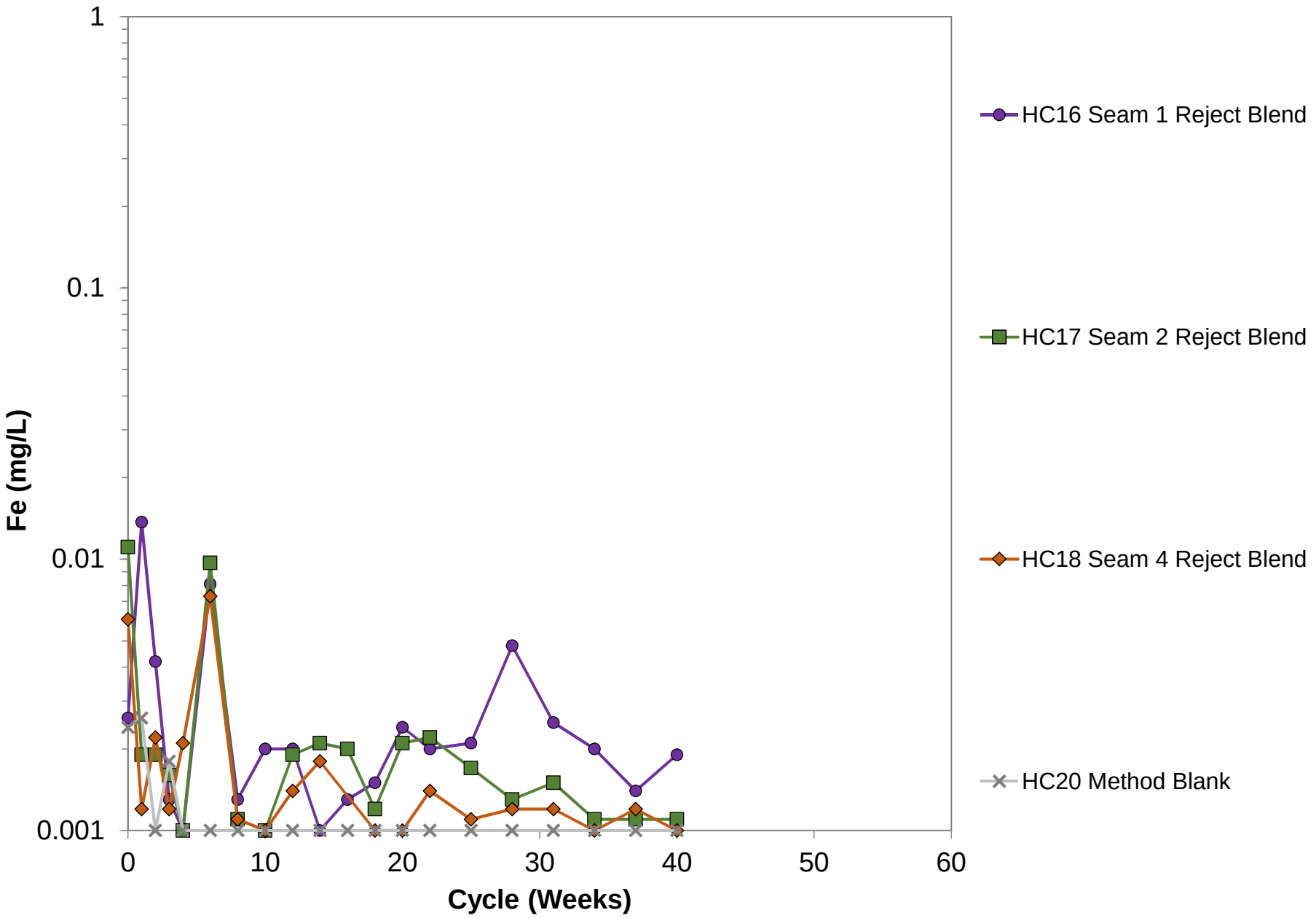
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



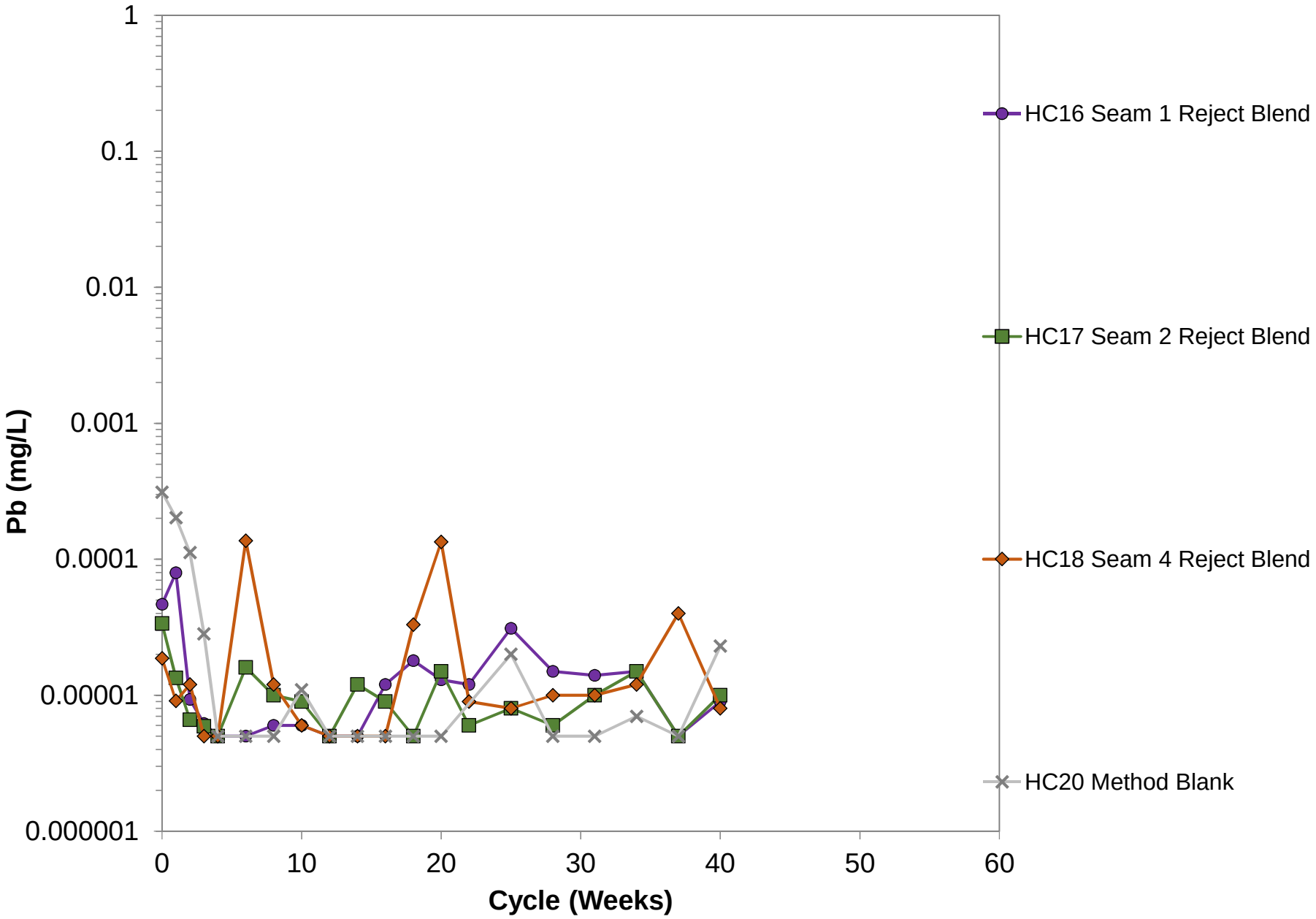
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



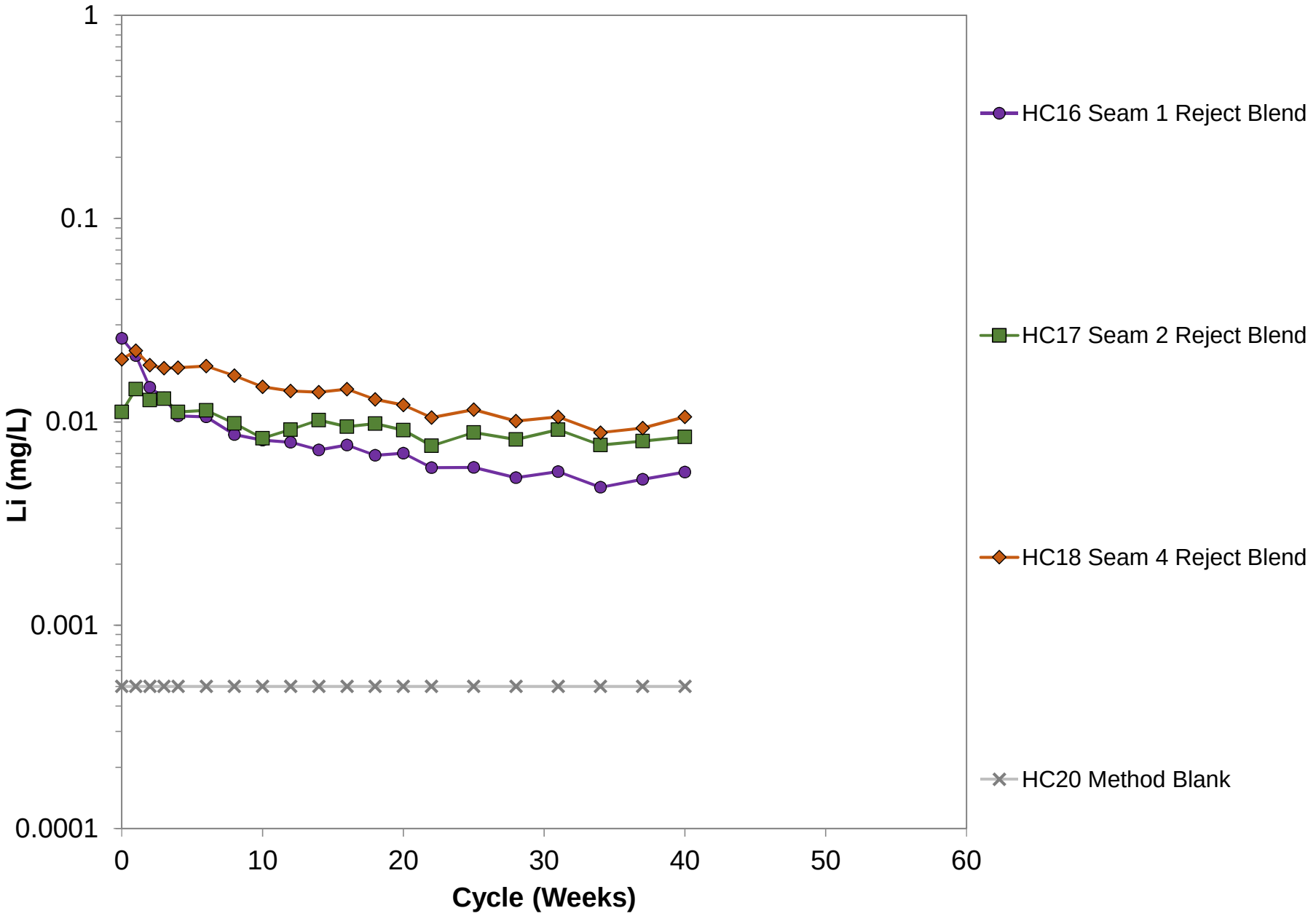
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



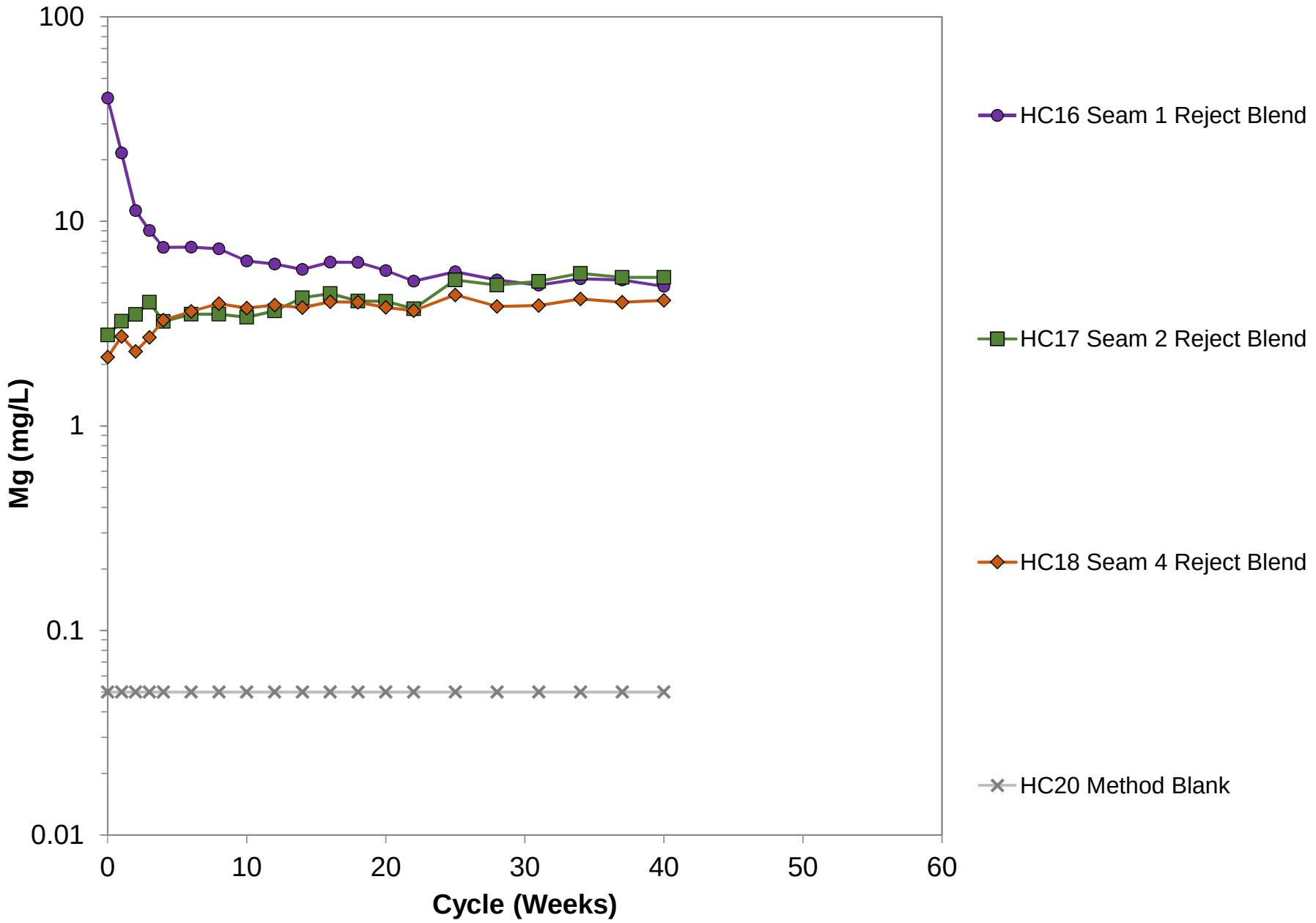
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



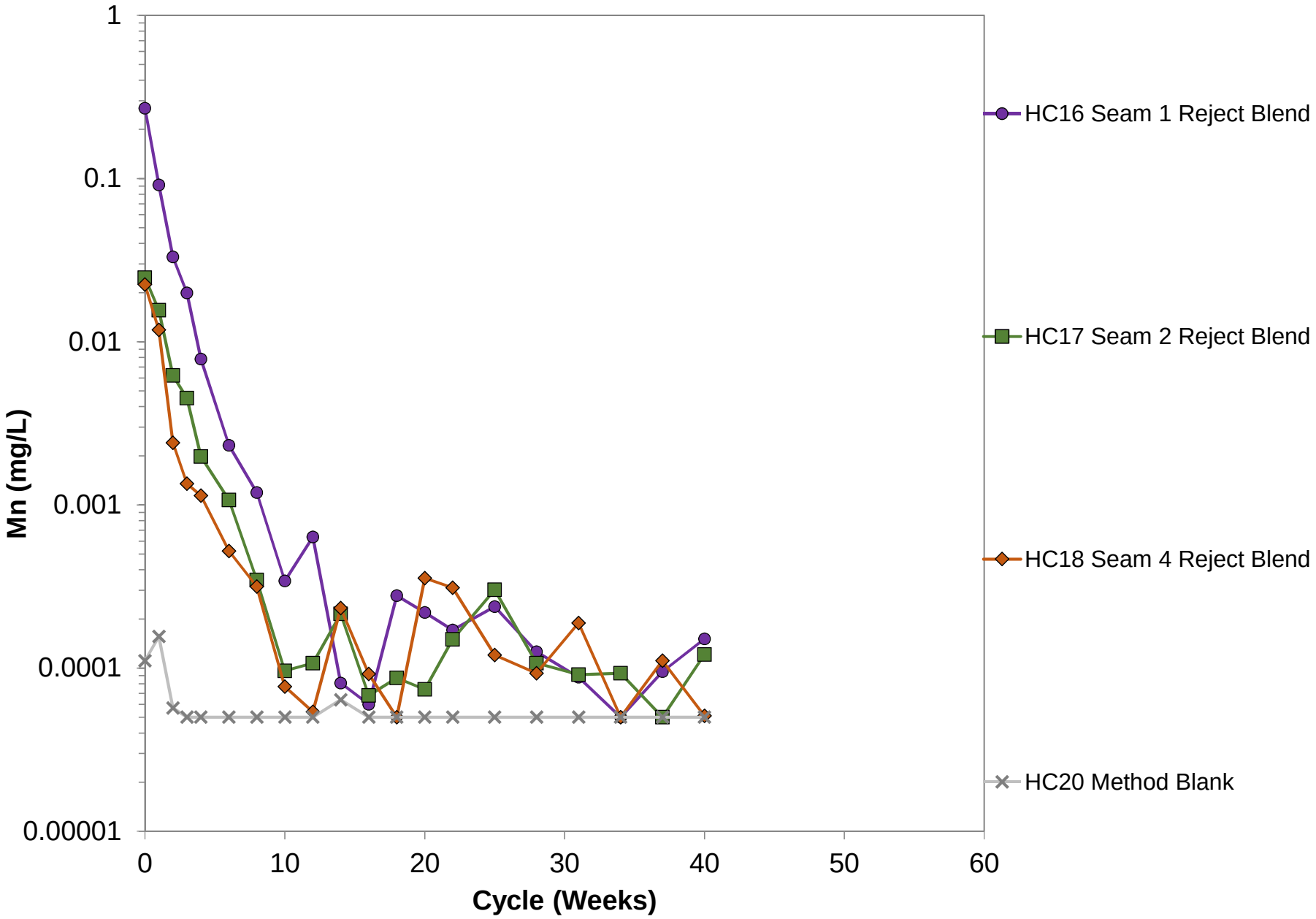
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



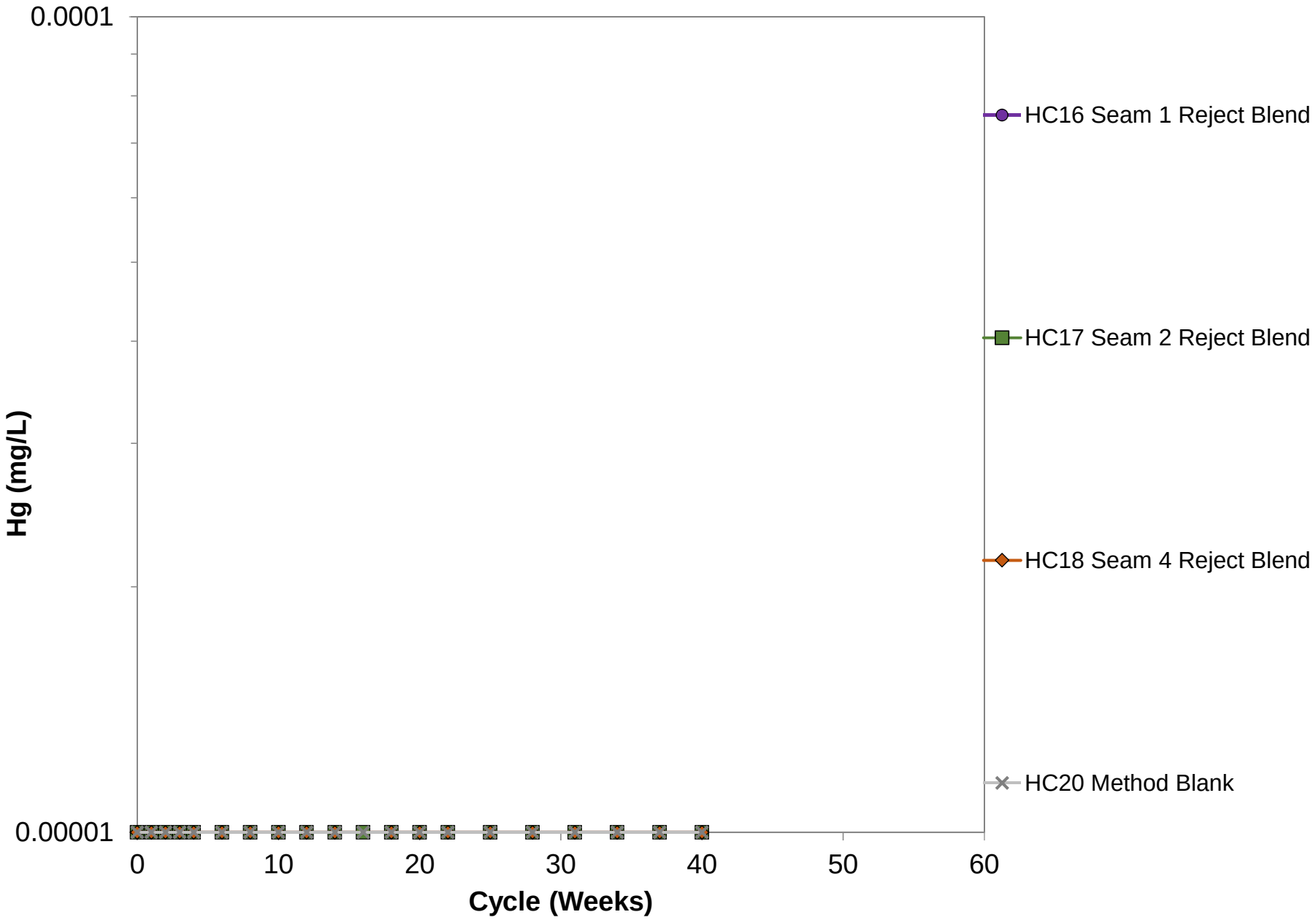
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



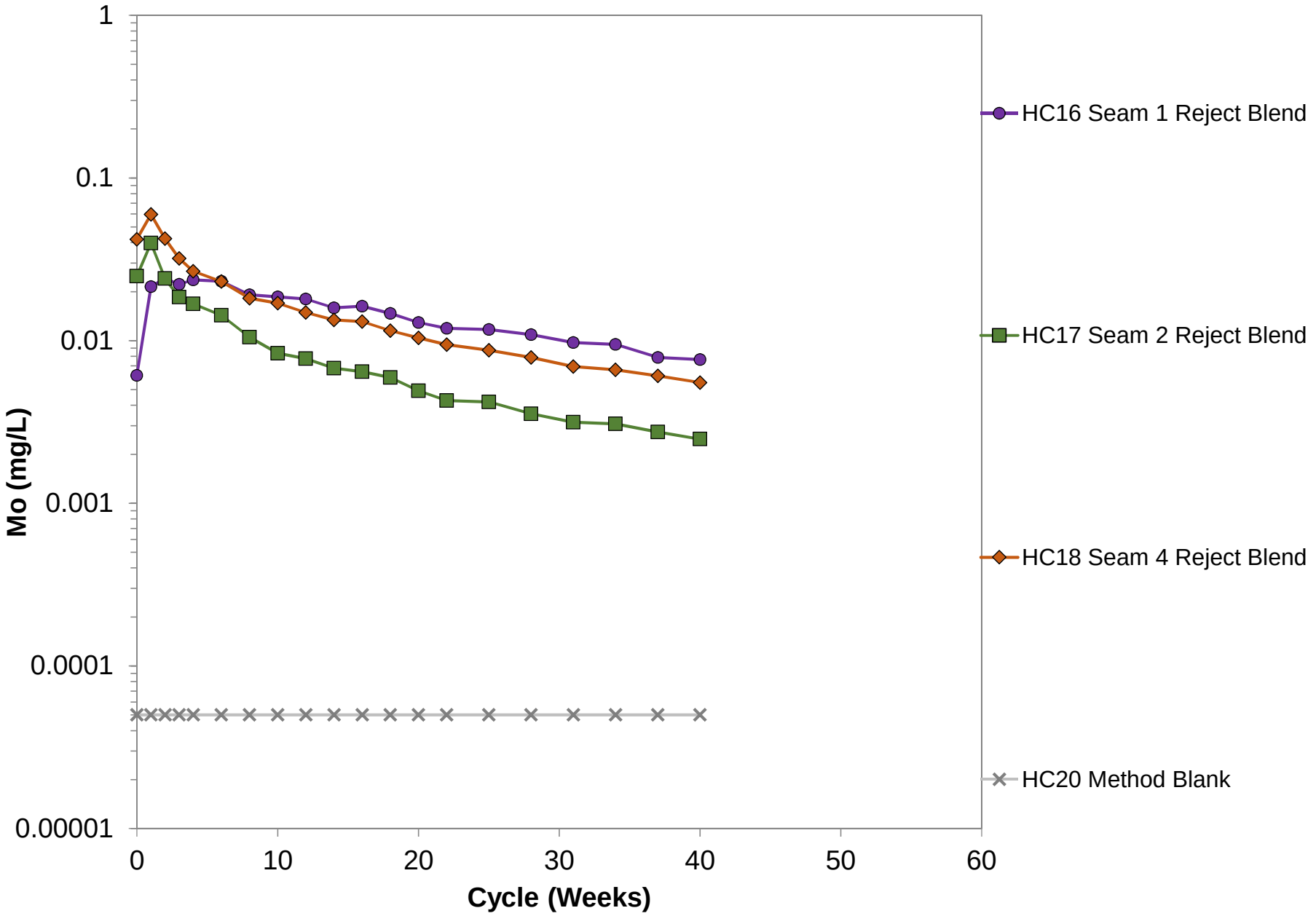
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



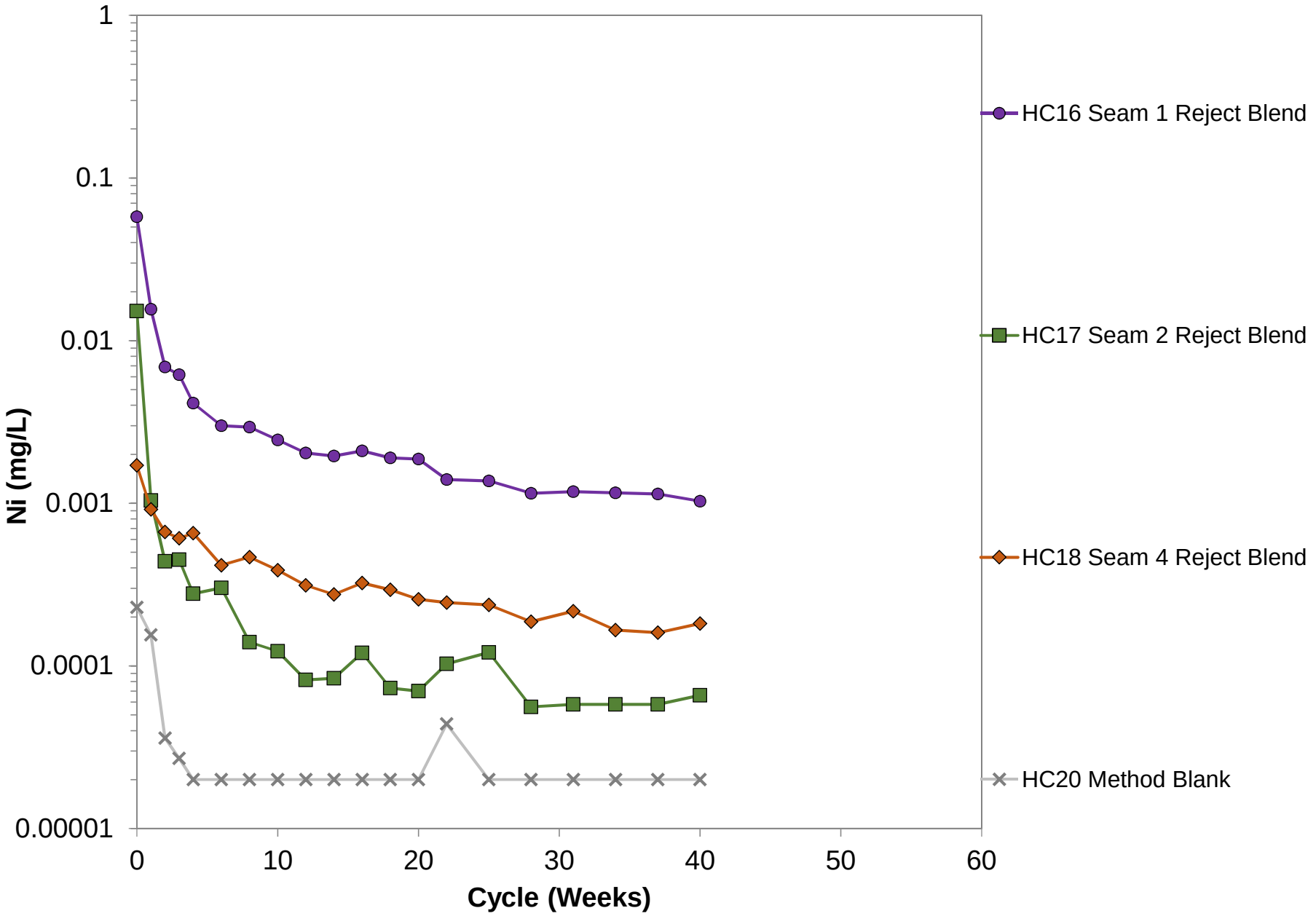
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



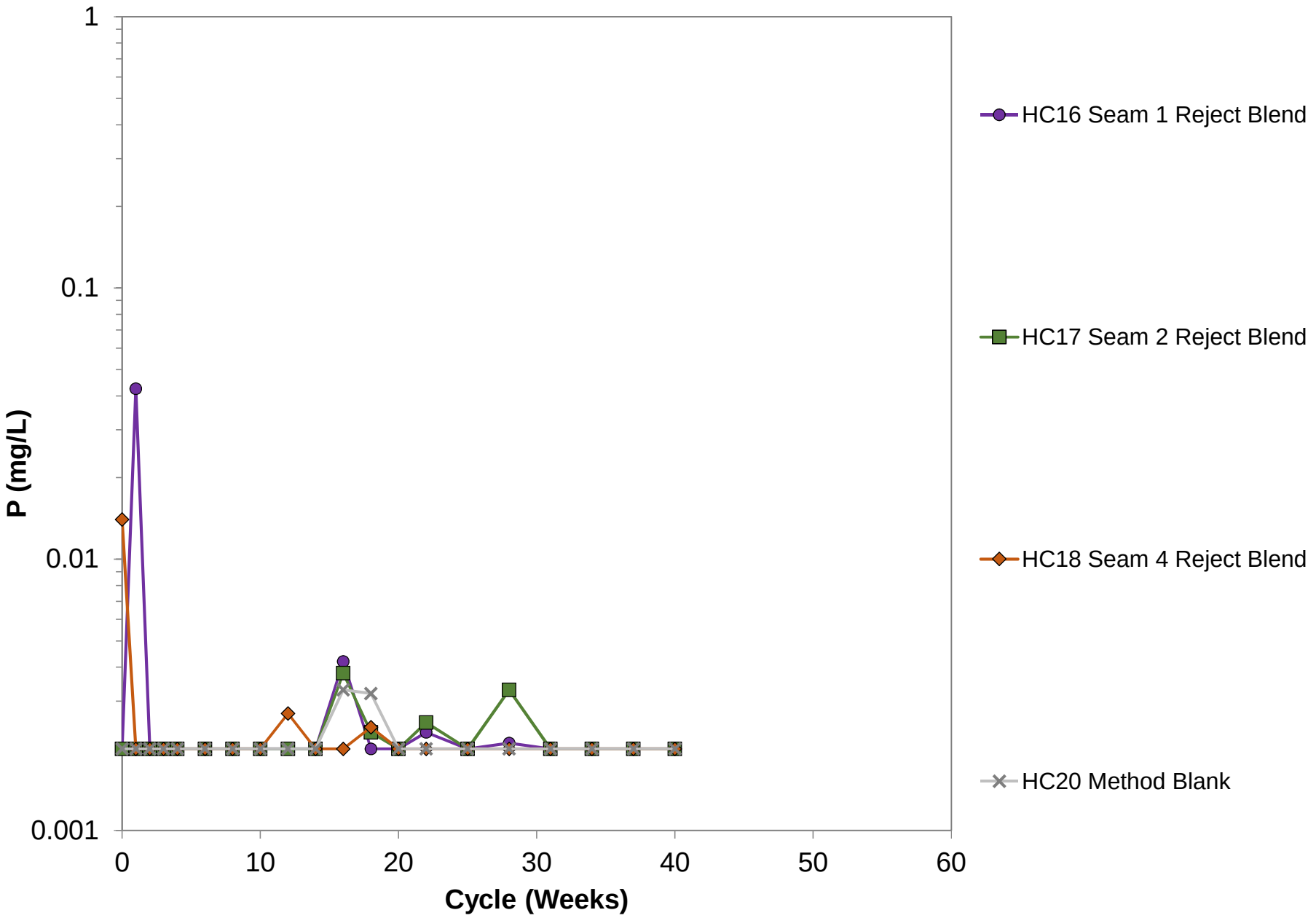
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



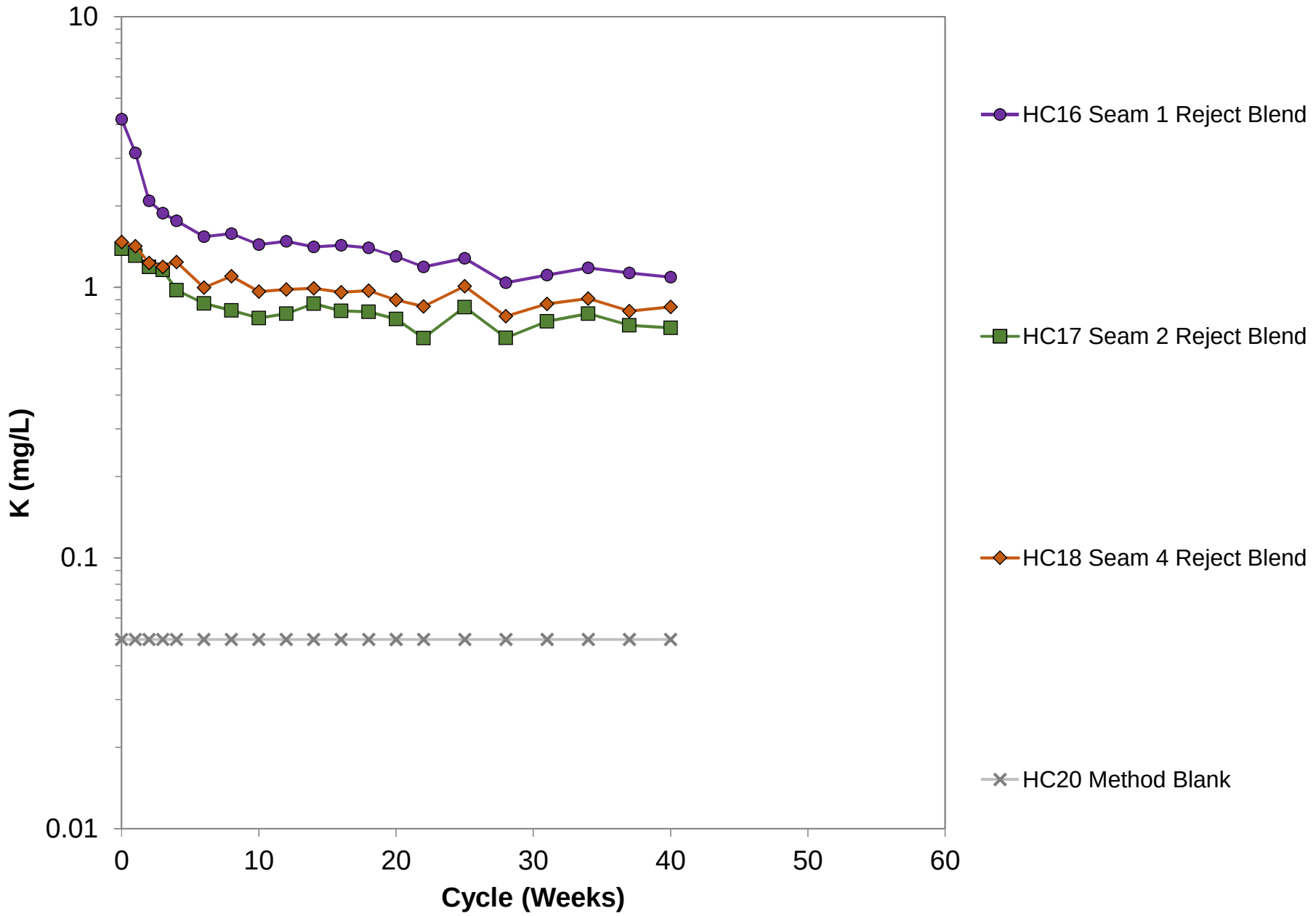
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



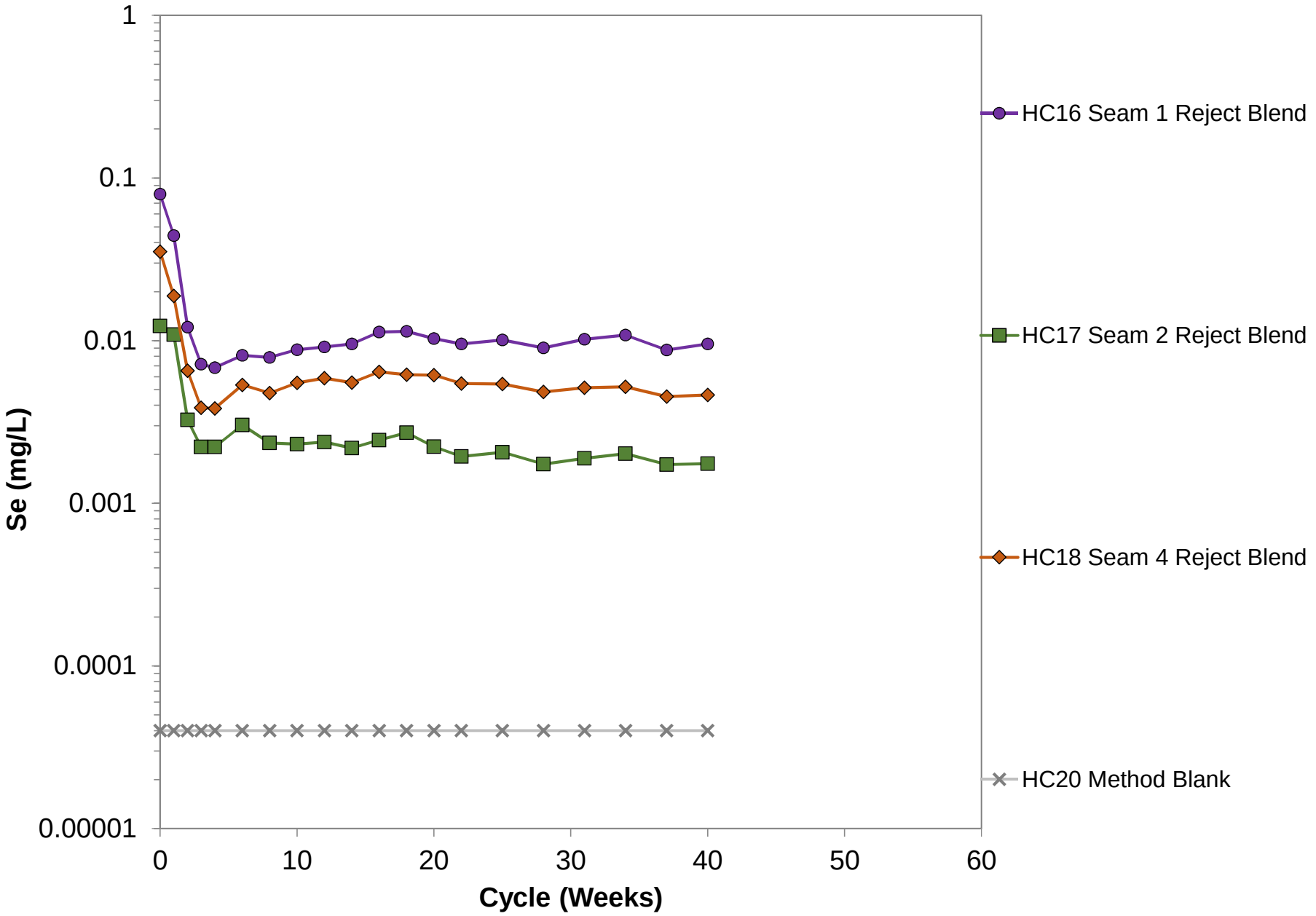
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



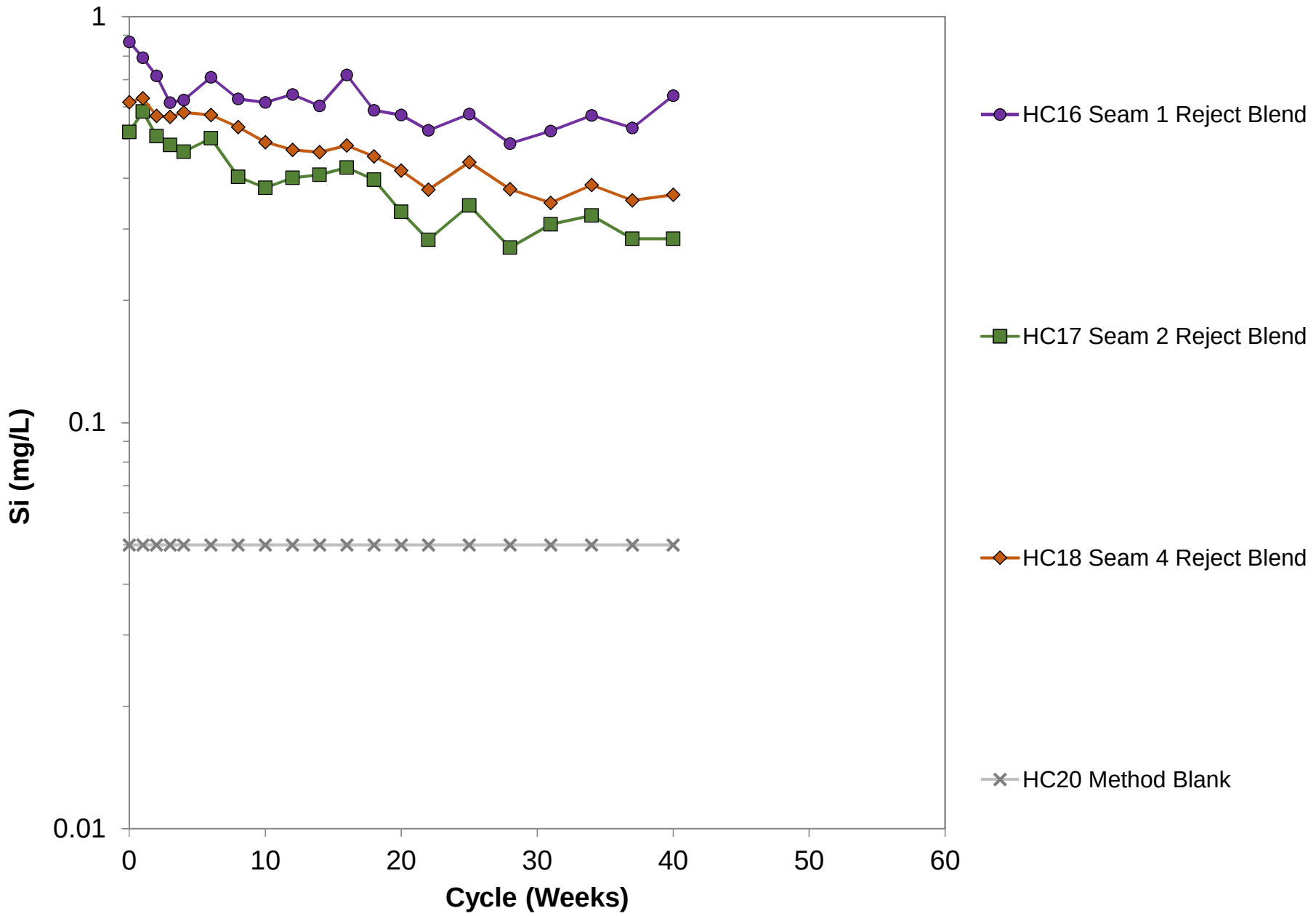
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



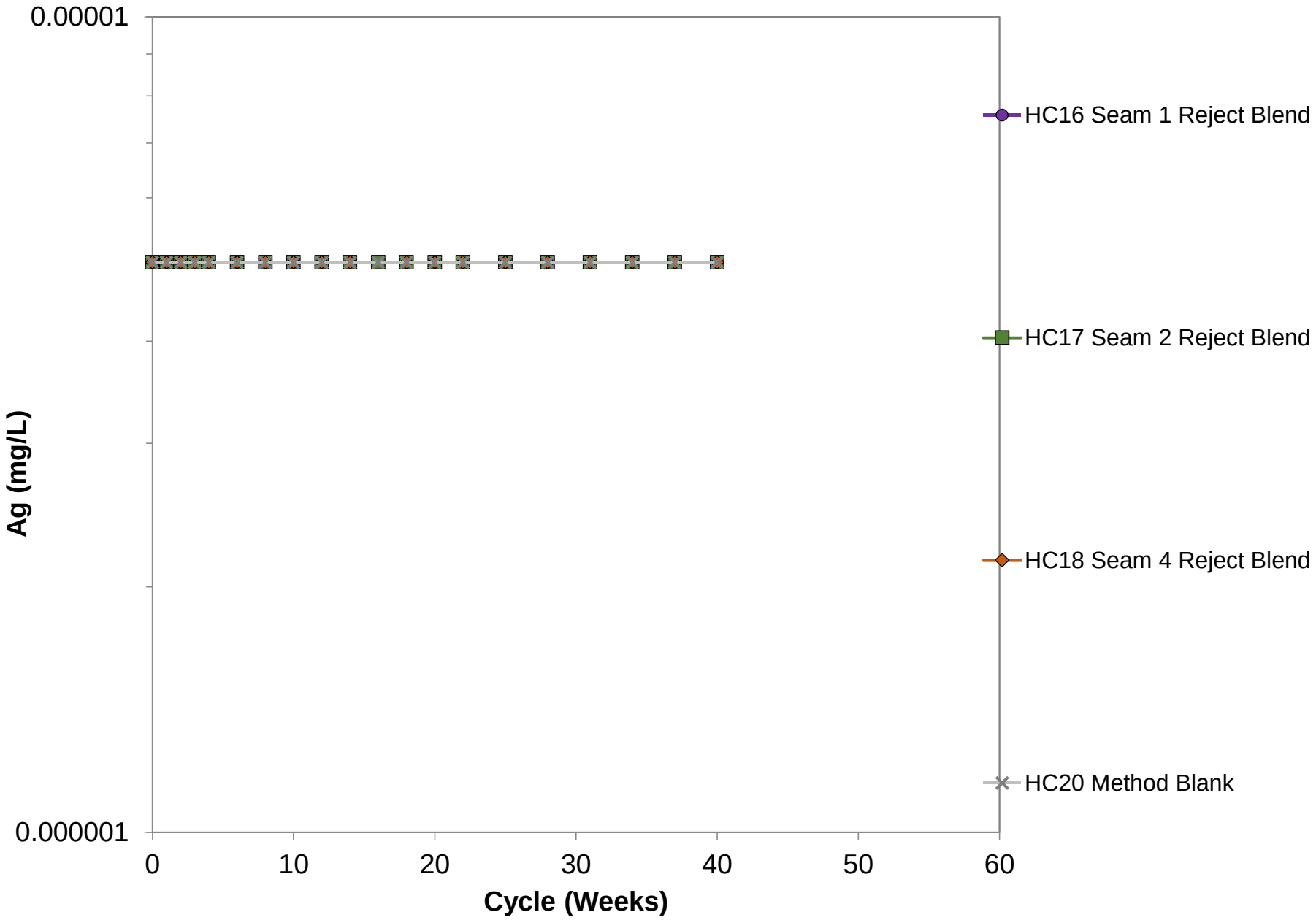
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



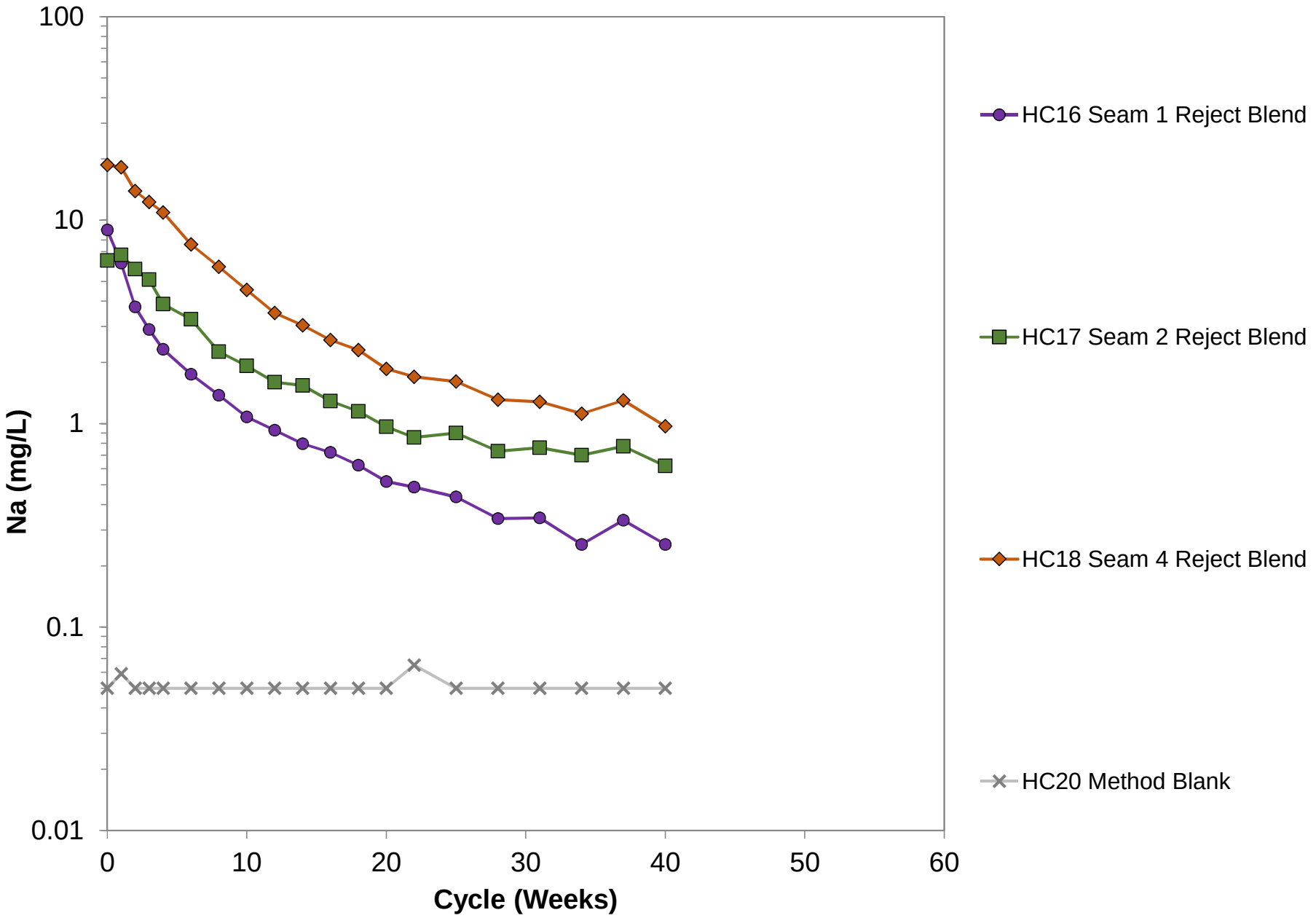
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



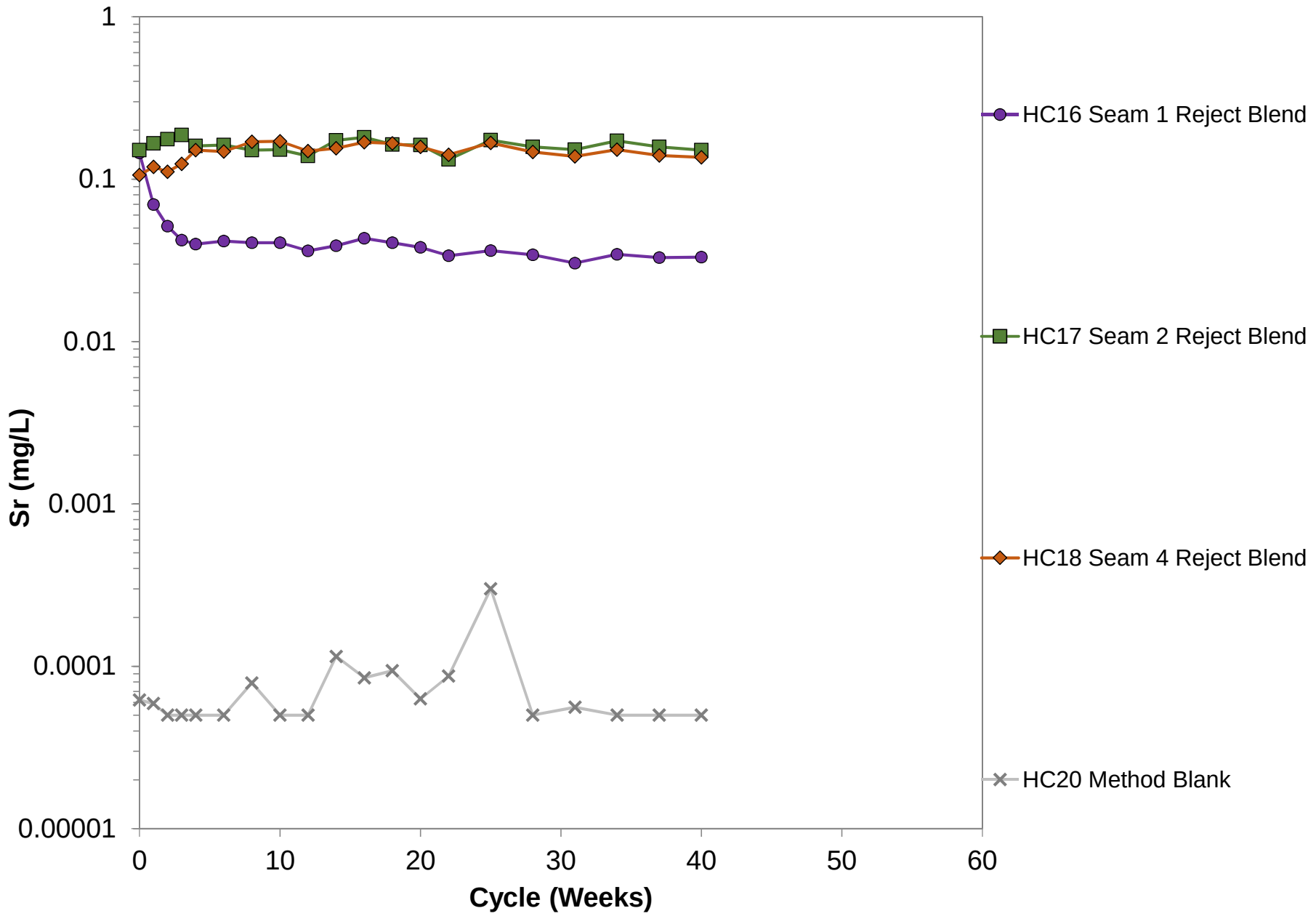
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



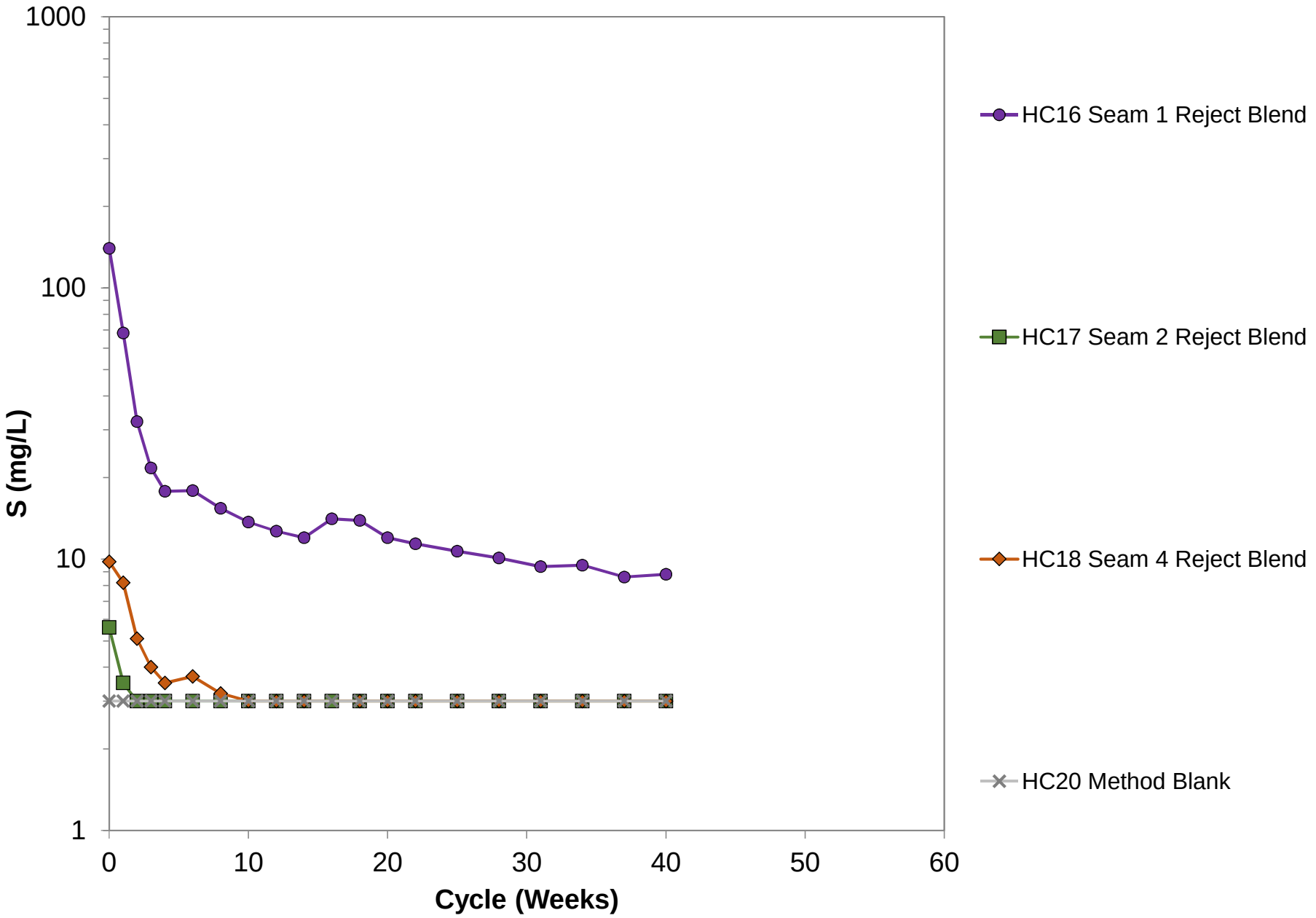
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



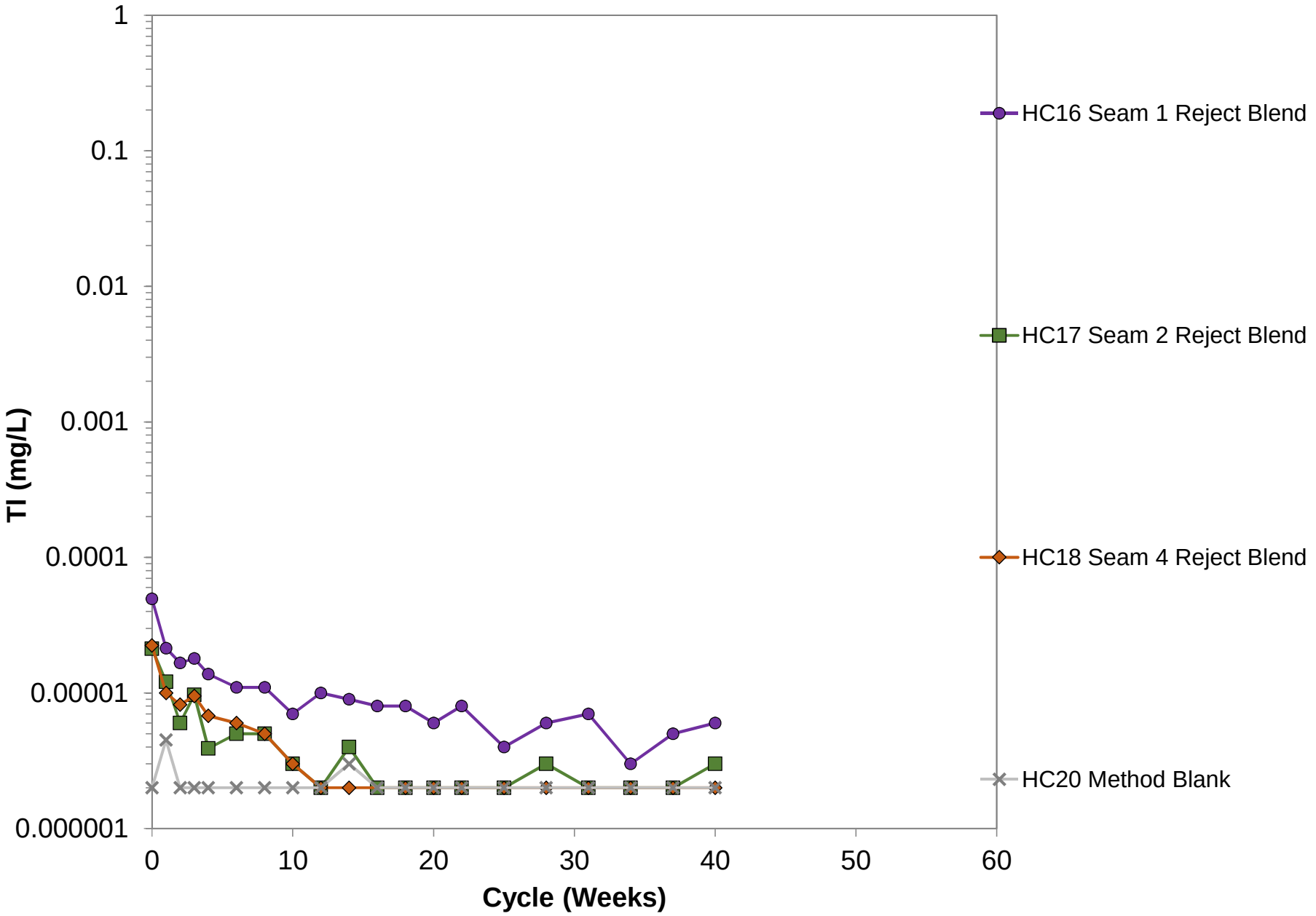
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



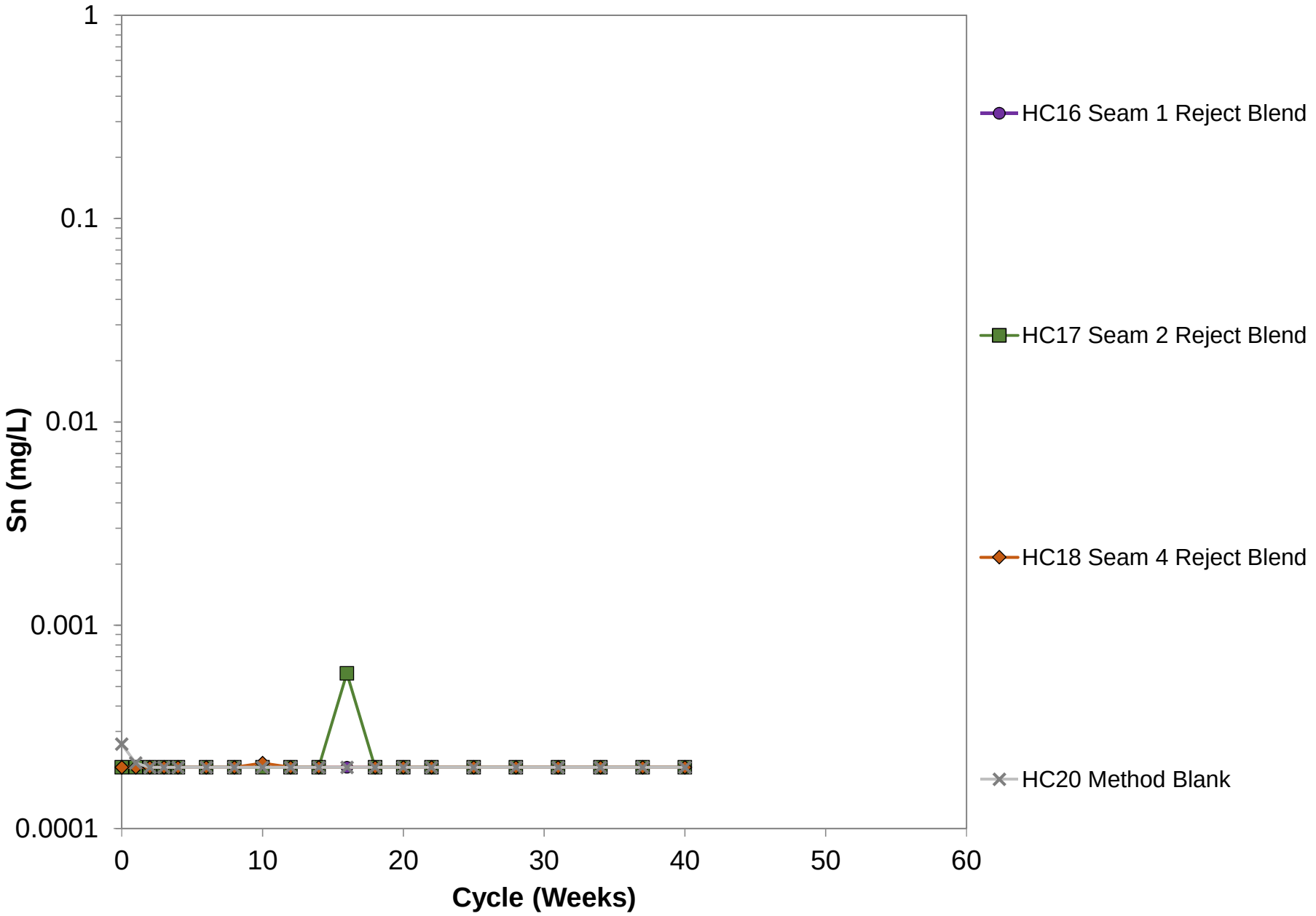
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



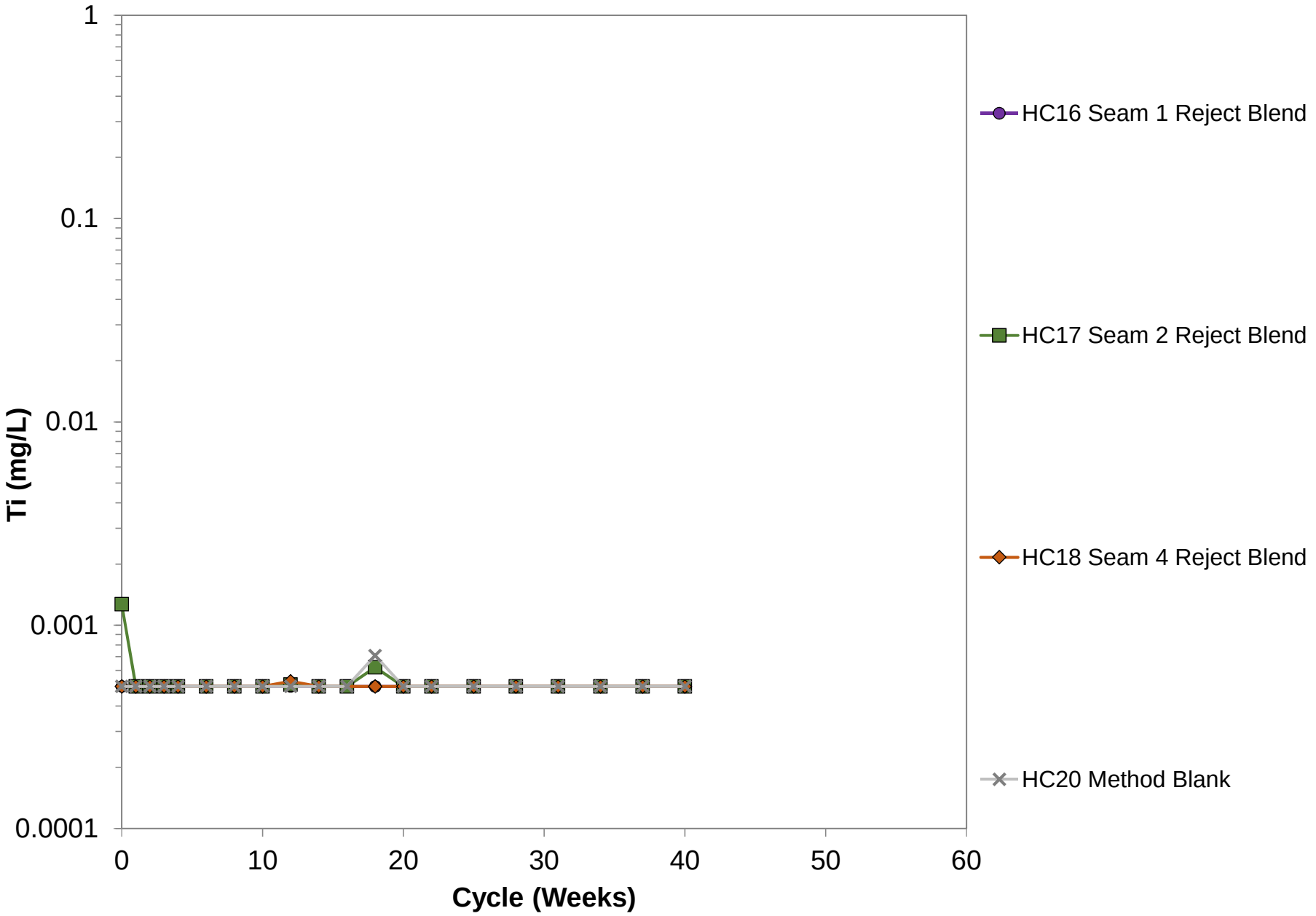
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



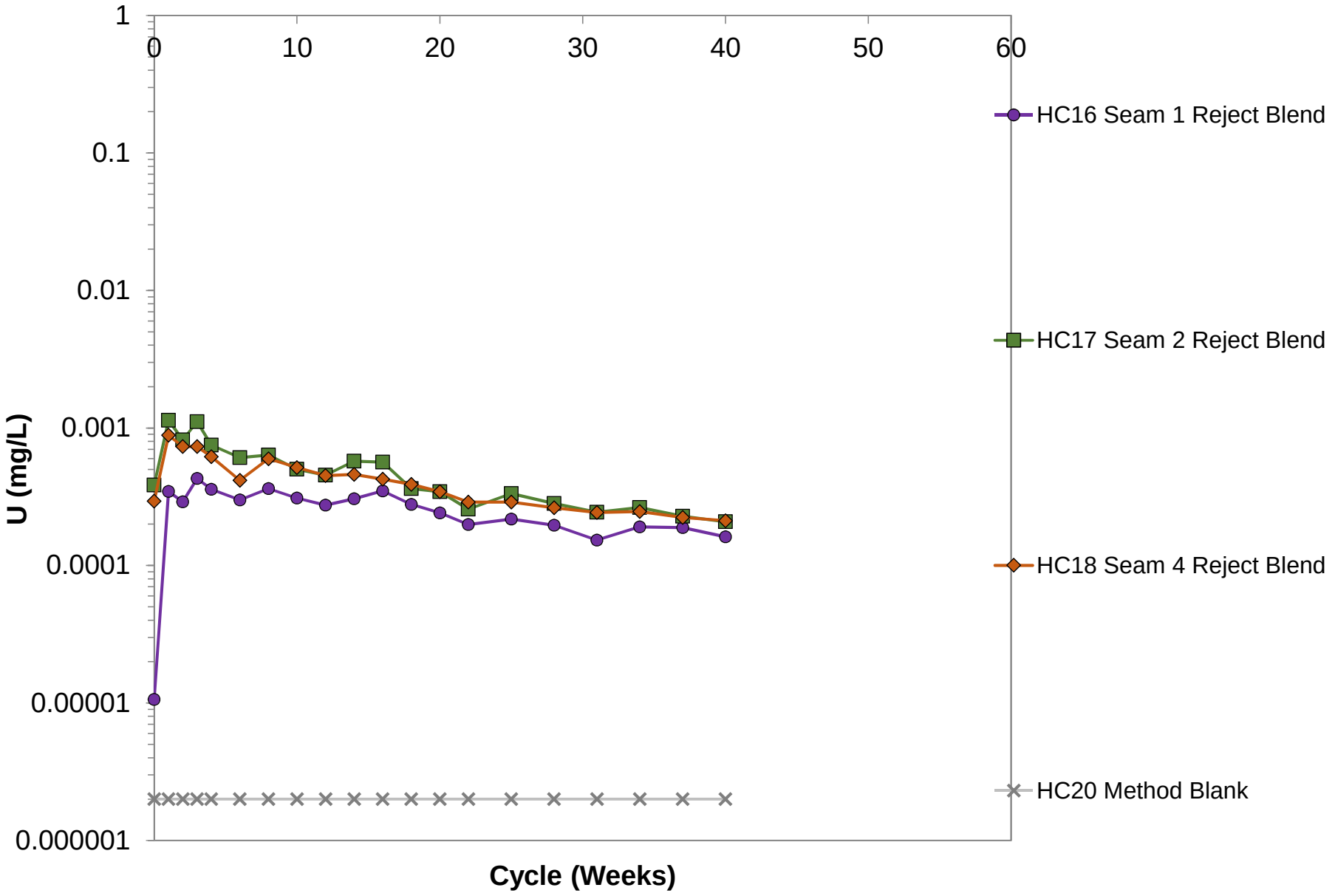
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



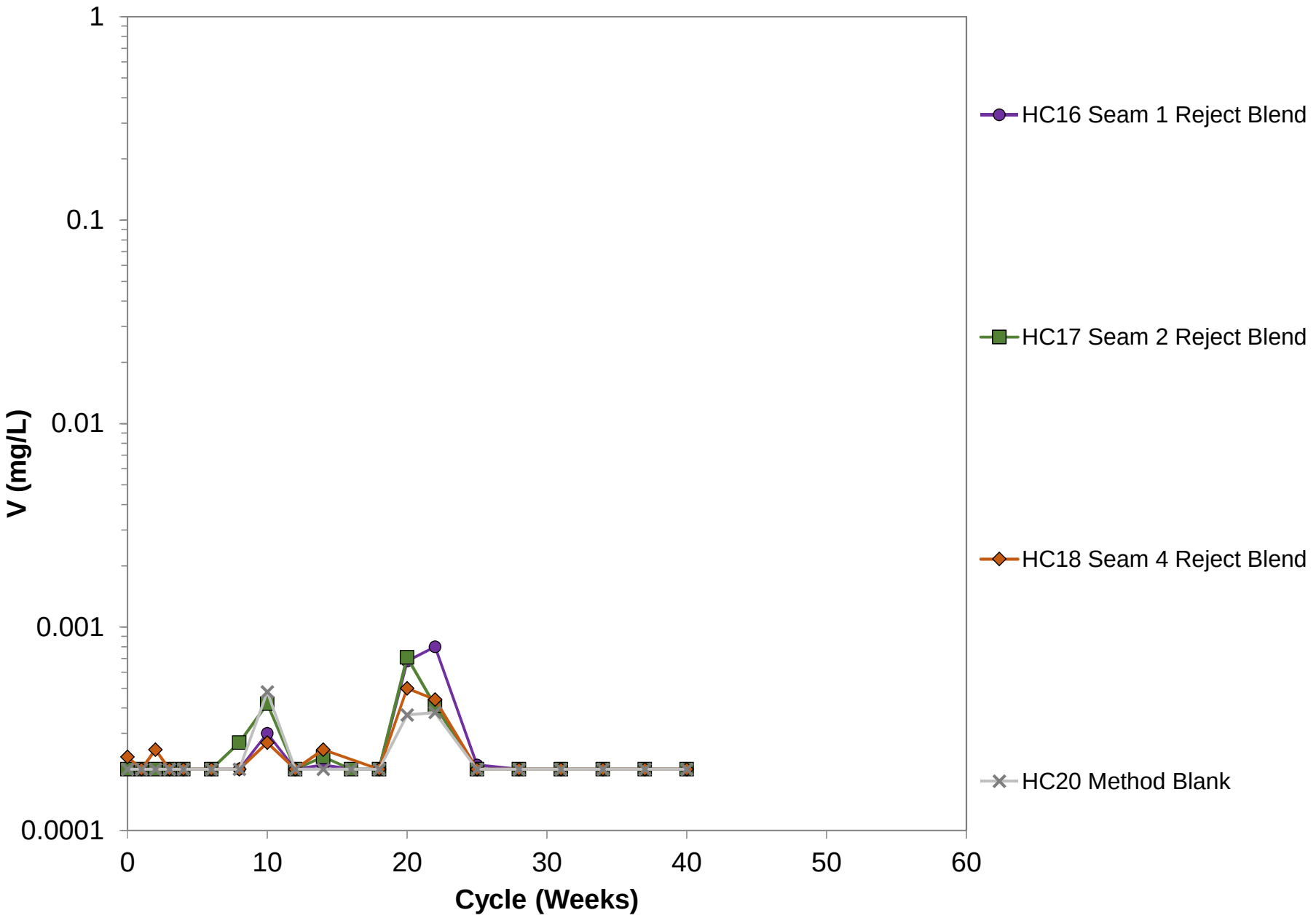
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



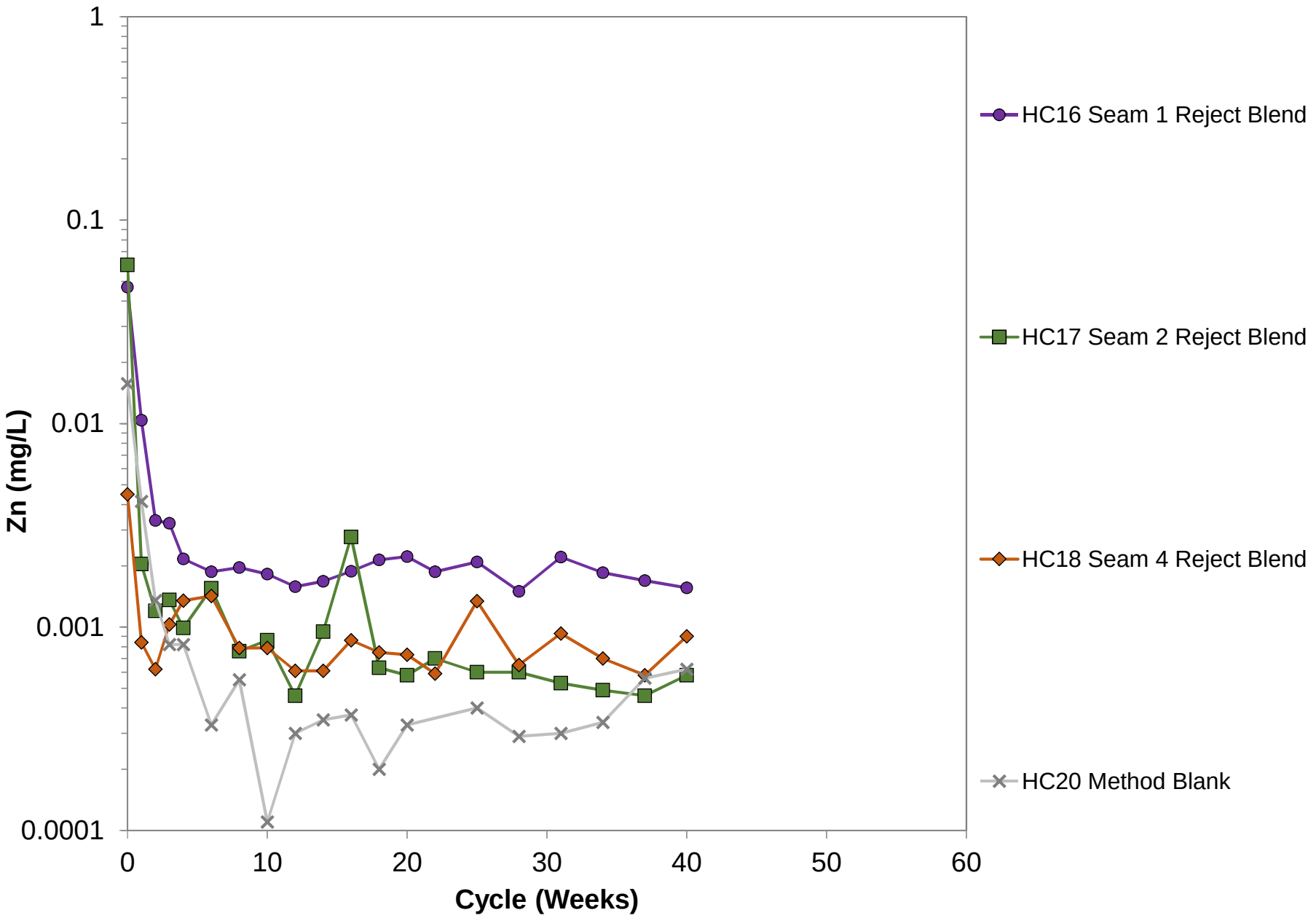
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



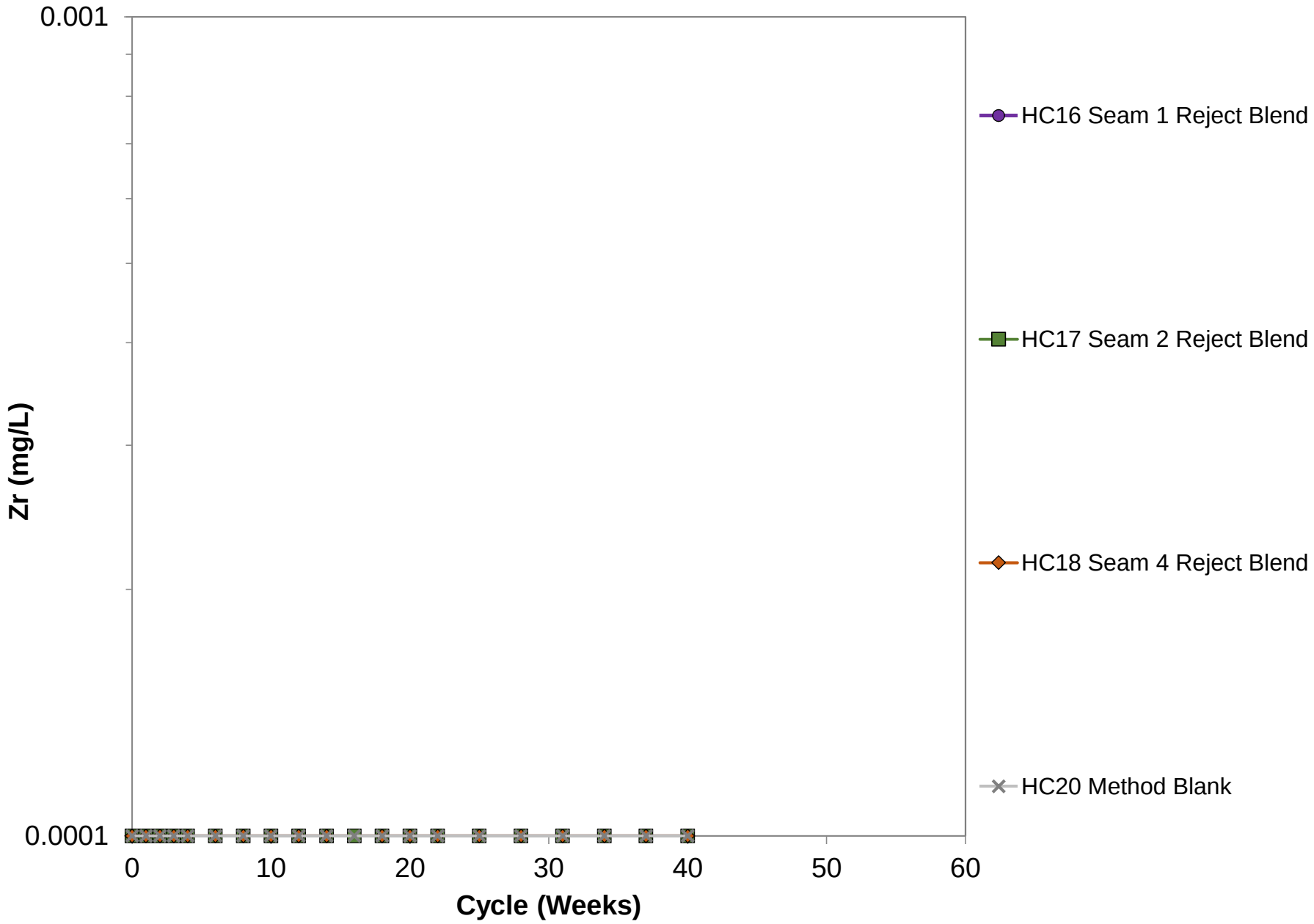
\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx



\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\HCT\[Grassy Mt._Conc Charts_1CM029008_rtc_rev00.xlsx

Appendix 10b

Water and Load Balance Model Report
(SRK, August 2016)

Grassy Mountain
Water and Load Balance Model

Prepared for

Millennium EMS Solutions Ltd.

Prepared by

SRK Consulting (Canada) Inc.
1CM029.011
August 2016

Grassy Mountain
Water and Load Balance Model

August 2016

Prepared for

Millennium EMS Solutions Ltd.
6111 – 91 Street
Edmonton, AB T6E 6V6
Canada

Tel: + 780 496 9048
Web: www.mems.ca

Prepared by

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2
Canada

Tel: +1 604 681 4196
Web: www.srk.com

Project No: 1CM029.011

File Name: Grassy_1CM029-011_WaterLoadBalance_Report_CAJ_MCN_SJD_20160810_FNL.docx

Copyright © SRK Consulting (Canada) Inc., 2016

srk consulting

Table of Contents

1 Introduction 1
2 Project Description 2
2.1 Site Description 2
2.2 Mine Plan and Infrastructure 2
2.3 Closure 3
2.4 Water Management Facilities 5
2.4.1 Sedimentation and Surge Ponds 5
2.4.2 Ditches 7
2.5 Applied Mitigations 8
2.5.1 Saturated Rock Zones 9
2.5.2 Contact Water Capture and Attenuation 9
2.5.3 Water Treatment 10
2.5.4 Mitigation of Pit Wall Runoff 11
3 Model Description 12
3.1 Model Platform and Timescale 12
3.2 Scenarios 12
3.2.1 Stochastic Water Balance 13
3.2.2 Deterministic Load Balance 13
3.3 Prediction Nodes and Parameters 13
3.4 Mine Life Milestones 15
3.5 Site Conceptual Model 15
4 Water Balance Inputs 17
4.1 Hydrology 17
4.1.1 Precipitation 17
4.1.2 Yield 19
4.2 Groundwater 19
4.3 Pond and Saturation Zone Capacities 20
4.4 Catchment Delineation 20
4.5 Waste Rock Placement 24
4.6 Site Water Demand 24
4.7 Saturated Zones 25
4.8 Pit Lake 26
5 Water Quality Inputs 27
5.1 Background Water Quality 27
5.2 Groundwater Quality 27

5.3 Geochemical Source Terms 28
5.3.1 Leaching Rates 28
5.3.2 Concentrations of Trace Elements 28
5.3.3 Blasting Residues 29
5.3.4 Application 29
5.4 Concentration Limits 31
6 Water Balance Results 32
6.1 In stream flows for Blairmore and Gold Creeks 32
6.2 Pit Lake Water Balance 32
6.3 Saturated Zone Residence Times 33
6.4 Discharge of Water Treatment Plant Effluent 34
7 Water Quality Results 35
7.1 Blairmore Creek Water Quality 35
7.2 Gold Creek Water Quality 38
7.3 Effluent Water Quality 42
7.3.1 Sedimentation and Surge Ponds 42
7.3.2 Other Mine Facilities 45
8 Model Evaluation 48
8.1 Model QA/QC 48
8.2 Sensitivity Analysis 48
8.2.1 Capture Efficiency 49
8.2.2 Attenuation Factor 51
8.2.3 Pit Wall Thickness 52
8.2.4 Leakage Rate from Saturation Zones 54
8.2.5 Leakage Rate from Pit Lake 55
9 Conclusions 57
10 References 59

List of Figures

Figure 2-1: Grassy Mountain Coal Project Site Map 4
Figure 2-2: Proposed Water Management Infrastructure 6
Figure 4-1 Catchment Delineation for End of Mine 23
Figure 6-1: Pit Lake Filling Time 32
Figure 6-2 Saturation Zone Residence Time 33
Figure 6-3 WTP Discharge to Nodes on Blairmore Creek 34
Figure 7-1: Predicted Sulphate Concentrations in Blairmore Creek 36
Figure 7-2: Predicted Nitrate Concentrations in Blairmore Creek 36
Figure 7-3: Predicted Cobalt Concentrations in Blairmore Creek 37
Figure 7-4: Predicted Selenium Concentrations in Blairmore Creek 37
Figure 7-5: Predicted Zinc Concentrations in Blairmore Creek 38
Figure 7-6: Predicted Sulphate Concentrations on Gold Creek 39
Figure 7-7: Predicted Nitrate Concentrations on Gold Creek 40
Figure 7-8: Predicted Cobalt Concentrations on Gold Creek 40
Figure 7-9: Predicted Selenium Concentrations on Gold Creek 41
Figure 7-10: Predicted Zinc Concentrations on Gold Creek 41
Figure 7-11: Predicted Sulphate Concentrations in Ponds 42
Figure 7-12: Predicted Nitrate Concentrations in Ponds 43
Figure 7-13: Predicted Cobalt Concentrations in Ponds 43
Figure 7-14: Predicted Selenium Concentrations in Ponds 44
Figure 7-15 Predicted Zinc Concentrations in Ponds 44
Figure 7-16: Predicted Sulphate Concentrations for Mine Facilities 45
Figure 7-17: Predicted Nitrate Concentrations for Mine Facilities 46
Figure 7-18: Predicted Cobalt Concentrations for Mine Facilities 46
Figure 7-19: Predicted Selenium Concentrations for Mine Facilities 47
Figure 7-20: Predicted Zinc Concentrations for Mine Facilities 47
Figure 8-1: Selenium Concentration in Blairmore Creek for Varying Capture Efficiency 50
Figure 8-2: Selenium Concentration in Blairmore Creek for Varying Capture Efficiency 50
Figure 8-3: Selenium Concentration in the Saturation Zone (Post-Attenuation) 51
Figure 8-4: Selenium Concentration in Blairmore Creek for Base Case Source Terms 52

Figure 8-5: Nitrate Concentrations in Pit Lake water for Varying Pit Wall Thickness 53
Figure 8-6: Nitrate Concentrations at Prediction Node GC-10 for Varying Pit Wall Thickness 54
Figure 8-7: Sulphate Concentration in Blairmore Creek for Varying Saturation Zone Leakage Rates 55
Figure 8-8: Sulphate Concentration in Gold Creek for Varying Pit Lake Leakage Rates 56

List of Tables

Table 2.1: Attenuation in Saturation Zone and Maximum Concentration in Effluent 9
Table 2.2: Estimated Post-Closure HDS Treatment Plant Effluent 10
Table 3.1: Summary of Model Scenarios 12
Table 3.2: Prediction Nodes 14
Table 3.3: Key Mine Dates 15
Table 4.1: Mean Annual Hydrology Inputs 17
Table 4.2: Monthly Distributions 18
Table 4.3: Annual Precipitation Frequency Analysis 18
Table 4.4: Yield Coefficients 19
Table 4.5: Infrastructure Summary 20
Table 4.6 Changes to Catchment Areas of Blairmore and Gold Creeks (Combined) 22
Table 4.7: Waste Rock Deposition Rates 24
Table 4.8: Site Water Demand 25
Table 4.9: Production Rates and Water Content of Coal 25
Table 4.10: Saturated Zone Volumes and Availability for Water Management 26
Table 5.1: Generation Rates for Sulphate and Selenium 28
Table 5.2: Blasting Residue Inputs 29
Table 5.3: Summary of Source Term by Rock Unit 30
Table 8.1: Sensitivity Cases Modelled 49

List of Appendices

Appendix A – Qualitative Assessment of Calcite Precipitation

Appendix B – Catchment Delineation Maps

Appendix C – Source Terms

Appendix D – Model Results

- D1 – Blairmore Creek Flow Predictions
- D2 – Gold Creek Flow Predictions
- D3 – Blairmore Creek Water Quality Predictions
- D4 – Gold Creek Water Quality Predictions
- D5 – Saturated Zone and Ponds Water Quality Predictions

1 Introduction

SRK Consulting (Canada) Inc. was retained Millennium EMS Solutions Ltd. (MEMS) on behalf of Benga Mining Limited (Benga), to generate a water and load balance model to support an Environmental Impact Assessment, Environmental Protection and Enhancement Act (EPEA) approval, Fence-line Water Act approval, and Water Act Licence applications for the Grassy Mountain Project. The Grassy Mountain Project is located 150 km south of Calgary, AB and 6.5 km north of the Town of Blairmore.

SRK developed a model that predicts flows and water quality over the mine life from construction through post-closure. The model results were used to assess water mitigation options and evaluate potential effects on receiving waters. The water quality predictions assume all of the mitigation measures are implemented and have the assumed effectiveness for removing or attenuating constituent loads.

The purpose of this report is to document the approach and assumptions that were used in the model to predict water quality and flows and present modelling results, including sensitivity analyses, and a discussion of the strengths and limitations of the modelling approach.

The report is structured as follows:

- Summary of model framework including mine infrastructure, water management strategy and applied mitigations (Section 2)
- Summary of the approach and key components of the model (Section 3)
- Water quantity model inputs (Section 4)
- Water quality model inputs (Section 5)
- Model evaluation (Section 6)
- Water quantity and quality results (Sections 7 and 8)
- Conclusions (Section 9)

Supporting data and full results are included in appendices.

2 Project Description

2.1 Site Description

The Grassy Mountain Coal Project (the Project), owned by Benga Mining Limited (Benga) a wholly owned subsidiary of Riversdale Resources Limited (Riversdale), is located 150 km south of Calgary, Alberta and 7 km north of the town of Blairmore, Alberta. The Project is located in the Rocky Mountains, in a valley between the High Rock Mountain Range which is on the provincial border between Alberta and British Columbia.

The property is flanked by Gold Creek to the east, and Blairmore Creek to the west. The two creeks are tributaries to the Crowsnest River. Figure 2-1 shows the project location and major water bodies.

2.2 Mine Plan and Infrastructure

The Project mine life is currently 24 years (Benga 2016, Section C.5), and includes the following processes:

- Mining coal by conventional open pit methods.
- Ex-pit disposal of waste rock until in-pit locations for backfilling become available. Three areas have been delineated: the North Rock Disposal Area (NRDA), the Central Rock Disposal Area (CRDA), and the South Rock Disposal Area (SRDA).
- Blending of potentially acid rock drainage generating (PAG) and non-PAG waste rock to mitigate prevent acid rock drainage (ARD) potential.
- Optimized pit and waste rock dump design and scheduling to allow the routing of contact water to saturated zones (SZs) in backfilled pits, and attenuation of nitrate, nitrite, and selenium in sub-oxic conditions. The hydraulic residence time of impacted water will be maximized within the SZs.
- Disposal of coarse and fine coal processing wastes as a combined filtered product in dedicated disposal areas at locations where contact water will report to the SZs.
- Water management to limit contact of clean water with waste piles.
- High efficiency capture of contact water.
- Active pumping of contact water from collection/surge ponds into SZs to enhance attenuation of selenium, nitrate and nitrite as needed.

Throughout the mine life, four sedimentation/release ponds, four surge ponds and numerous contact water ditches will be constructed in carefully selected locations to collect the contact water from the site. The sedimentation ponds will be used to settle total suspended solids (TSS) from surface runoff and pit water and then released to either Blairmore Creek or Gold Creek. If the quality does not meet the release criteria it can be directed towards the SZs as needed. The surge ponds will collect and store water as further management and treatment is required as part

of the selenium mitigation plan. This water will be pumped to the raw water pond for use in the coal wash plant or directed to the SZs.

2.3 Closure

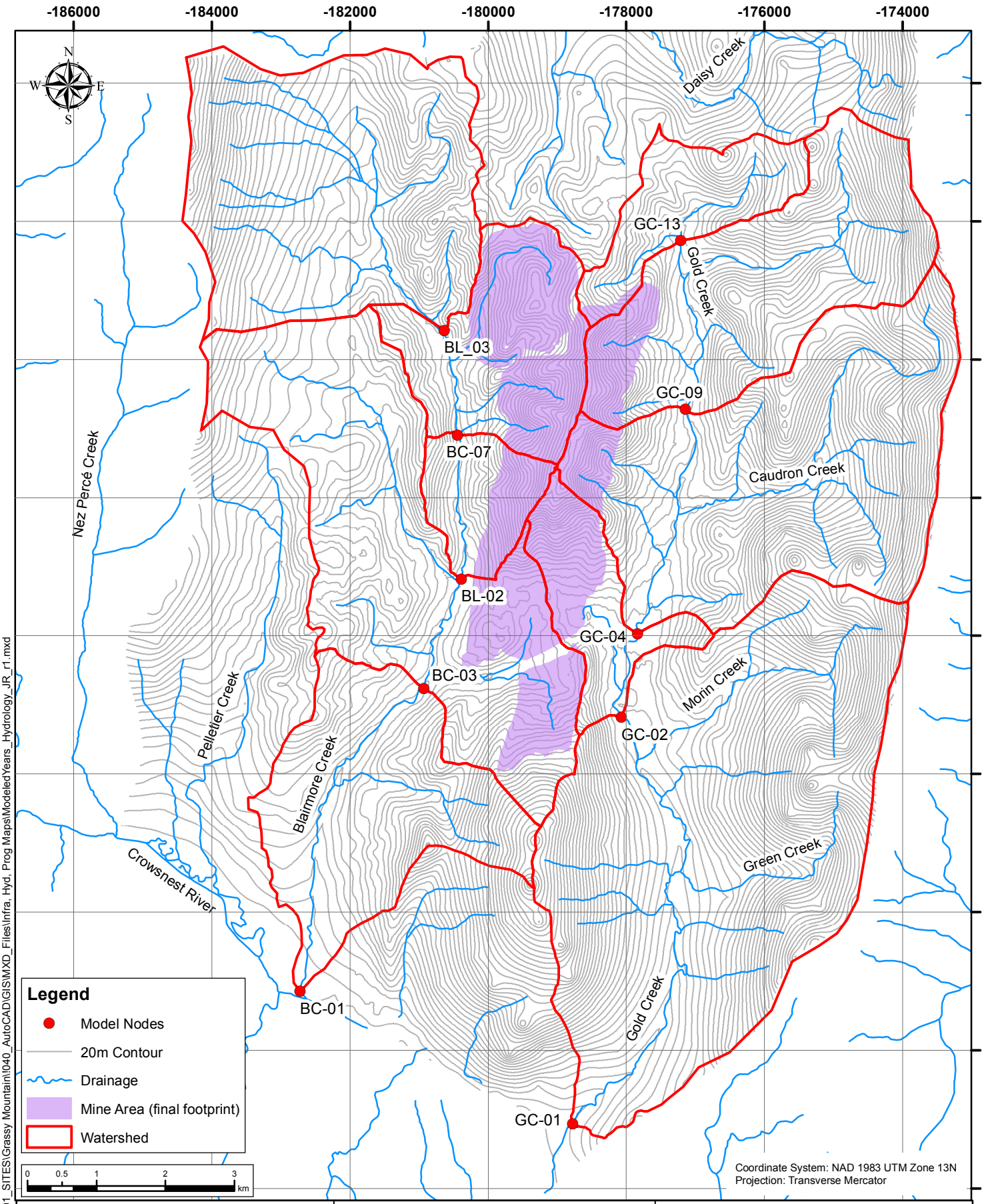
After the end of the mine life, all mining activities and associated coal processing will cease. Progressive reclamation of both in-pit and ex-pit waste rock (which will have been ongoing through the mine life) will be completed.

The sedimentation ponds and the SWSP will be decommissioned. All three disposal area surge ponds (NWSP, RWP, SESP) will remain in service after closure as it has been assumed that selenium will continue to leach out of the rock for a time period that extends beyond completion of reclamation.

After closure, the northern part of the pit will not be backfilled and a pit lake will be allowed to form. The pit lake will have a flood elevation of 1700 m. It will overflow towards Gold Creek via horizontal drains.

Activities that will continue to occur after closure include:

- The active management of the mitigation measures described in Section 2.5;
- Pumping of water from the surge ponds to the Saturated Zones, and treatment of the Saturated Zone effluent.
- Continued environmental monitoring to determine the need for ongoing active management.



Path: \\VAN-SVR0\Projects\01_SITES\Grassy Mountain\l040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Hydrology_JR_r1.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Grassy Mountain Coal Project Site Map and Watershed Delineation

Job No: 1CM029.011

Filename: ModeledYears_Hydrology_JR_r1

Grassy Mountain Coal Project

Date:	Approved:	Figure:
July 29, 2016	MC	2-1

2.4 Water Management Facilities

The water management strategy minimizes water diverted from streams, maximizes the separation of clean and contact water, and intercepts and conveys water with high selenium and nitrate concentrations to SZs for attenuation. The planned water management infrastructure is shown in Figure 2-2 and is based on the Project Description (Benga 2016).

Water collected in the pits during mining will be pumped to sedimentation ponds for storage prior to treatment or discharge. Water from the sedimentation ponds is intended to be captured, treated and released. If the quality does not meet the release criteria it can be directed towards the SZs as needed.

Water seeping from waste rock (placed in-pit or ex-pit) will either infiltrate into or be actively conveyed to the SZs.

2.4.1 Sedimentation and Surge Ponds

There are eight ponds in the water management system all of which are represented in the model. They are classified as either surge ponds or sedimentation ponds. Surge ponds collect and hold water that has passed through waste rock dumps for further management. Sedimentations ponds collect all other runoff water.

Ponds are assumed to be commissioned when mining in the upstream catchment commences. Ponds are decommissioned in closure (in 2043) if they are no longer needed for the storage of contact water.

Plant Site Sediment Pond (PSSP)

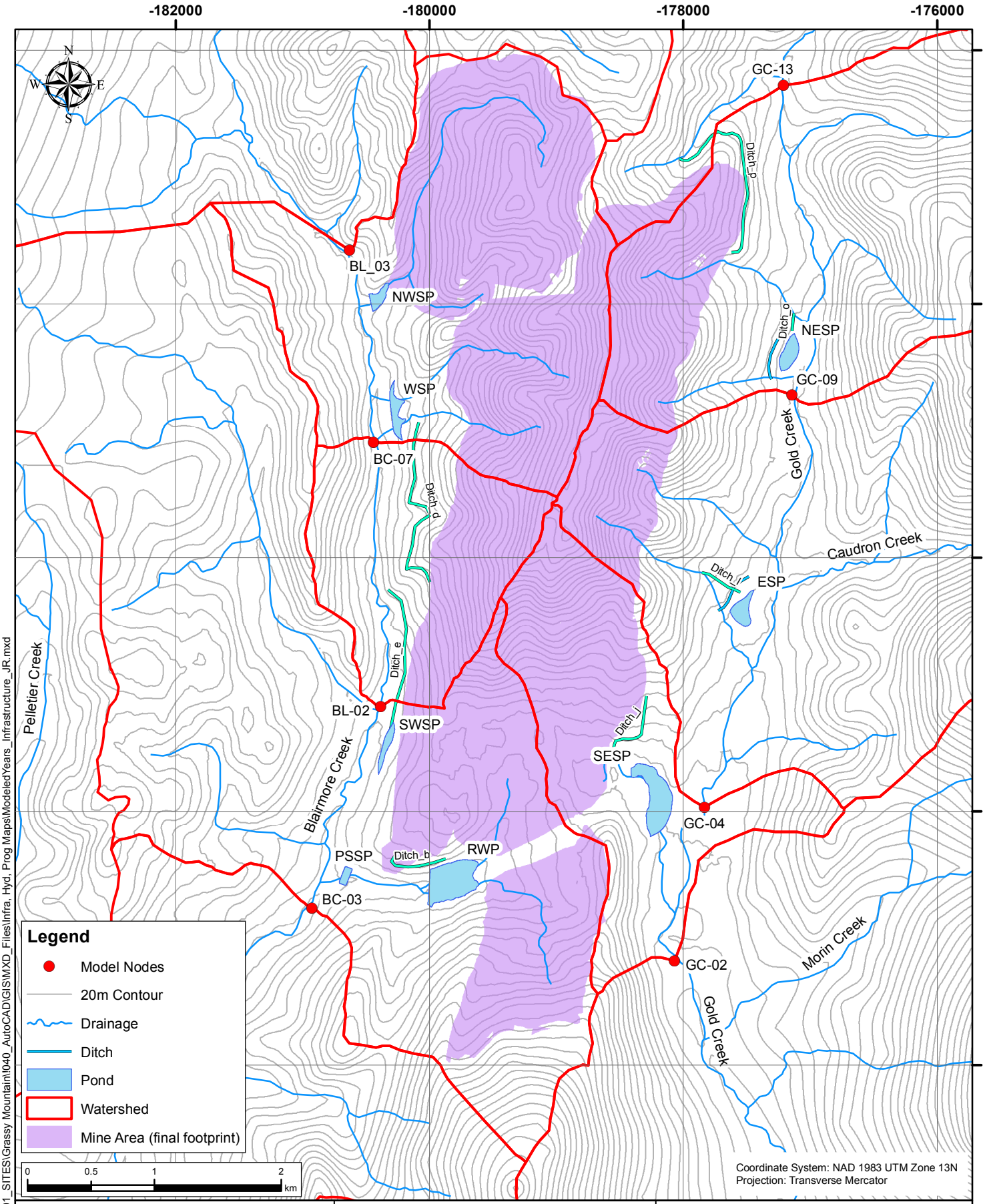
The PSSP is a sedimentation pond located south west of the plant site. It will receive runoff from the plant site. It discharges to Blairmore Creek. The PSSP is decommissioned after closure.

Raw Water Pond (RWP)

The RWP is a surge pond located southwest of the property. It receives impacted water from the ex-pit Central Rock Disposal Area and South Rock Disposal Area. This pond will act as the primary source of process water for the coal wash plant. The RWP receives pumped water from the SESP. Excess water from the RWP will also be pumped to the active SZ, and will continued to be pumped to the SZs after closure.

South East Surge Pond (SESP)

The SESP is a surge pond located southeast of the property. It will receive water from the ex-pit South Rock Disposal Area. Water reporting to the SESP will be directed to the RWP during both operations and closure.



srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Proposed Water Management Infrastructure

Job No: 1CM029.011

Filename: ModeledYears_Infrastructure_JR

Grassy Mountain Coal Project

Date: July 29, 2016

Approved: MC

Figure: 2-2

Path: \\VAN-SVR0\Projects\01_SITES\Grassy Mountain\l040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Infrastructure_JR.mxd

South West Surge Pond (SWSP)

The SWSP is a surge pond located in the Blairmore Creek watershed. The local topography does not allow a discharge point, and water from this pond will be pumped to the WSP prior to release. The SWSP is decommissioned after closure.

West Sediment Pond (WSP)

The WSP is a sedimentation pond located in the Blairmore watershed. Water collected from the western pits will be directed here and managed depending on its water quality. If the water quality is suitable for release, it will be discharged to Blairmore Creek. The WSP also receives pumped water from the SWSP. The WSP is decommissioned after closure.

North West Surge Pond (NWSP)

The NWSP is a surge pond that receives seepage from the ex-pit North Rock Disposal Area. Water that reports to the NWSP will be pumped to the nearest active SZ during operations and in closure.

East Sediment Pond (ESP)

The ESP is a sedimentation pond located in the Gold Creek watershed. Water collected from the eastern pits will be directed here and managed depending on its water quality. If the water quality is suitable for release, it will be discharged to Gold Creek. If the water quality is not suitable for release, water from the ESP will be directed to the SZ. The ESP is decommissioned after closure.

North East Sediment Pond (NESP)

The NESP is a sedimentation pond located in the Gold Creek watershed. It will receive flow pumped from nearby pits. It will also receive water from the final pit lake. The NESP water will be managed depending on its water quality. If the water quality is suitable for release, it will be discharged to Gold Creek. If the water quality is not suitable for release, water from the NESP will be directed to the SZ during operations and in closure.

2.4.2 Ditches

A series of ditches would be constructed to divert non-contact water away from the ponds, or to direct contact water towards the ponds. Three ditches are included in the water quality prediction model.

Ditch “d”

Ditch d will collect contact water from west side of the site. It will also intercept non-contact runoff from the watershed. The flows from Ditch d are directed to the WSP.

Ditch "j"

Ditch j will collect contact water from the southeast of the site. This will include runoff from pit walls and in-pit waste rock dumps. It will also intercept non-contact runoff from the watershed. The flows from Ditch j are directed to the SESP.

Ditch "o"

Ditch o will collect contact water from the east side of the site. This will include runoff from pit walls. It will also intercept non-contact runoff from the watershed. The flows from Ditch o are directed to the NESP.

2.5 Applied Mitigations

The objective of the mitigation applied in the model was to maintain sufficient flow in Blairmore and Gold creeks to not impact to fish, and to maintain water quality in the creeks such that predicted concentrations do not exceed the Alberta water quality objectives or the Site Performance Objective for selenium (Nautilus 2015).

The extent of the model mitigation measures were developed over multiple iterations of modelling efforts. Mitigation strategies and assumed parameters were adjusted in the model to achieve the modeling performance objectives in the downstream environment.

For example, the previous round of water quality predictions (SRK 2015) indicated that ARD related metals in the SZs discharge would remain problematic to downstream water quality without additional treatment. As a result, a Water Treatment Plant (WTP) was included as a mitigation measure in the current model.

In general, acid generating waste rock will be managed in such a way as to minimize the generation of acid and associated oxidation products at the source (SRK 2016a – Geochemical Characterization). In addition, the following mitigations were applied to contact water in the model:

1. Attenuation of selenium, nitrate and nitrite in a backfilled SZ,
2. Capture and management of contact water reporting to the foundation of external dumps,
3. Treatment of contact water routed through the SZ for metals removal in a WTP, and,
4. Mitigation of acidity generated by exposed pit walls at closure.

A high level description of each water quality mitigation is provided here. A full description is provided by SRK (2016b – Water Quality Management).

In addition, to mitigate impacts on the flow rates in Blairmore and Gold creeks, the effluent from the WTP was directed to multiple model nodes in Blairmore Creek (BC07, BL02, and BC03). The

flow rates were adjusted to be proportional to catchment area to best represent the relative base flow at each node.

A qualitative assessment of calcite precipitation indicated that calcite could precipitated in Blairmore and Gold Creeks (Appendix A). No mitigation for calcite precipitation has been included in the water quality prediction model.

2.5.1 Saturated Rock Zones

Three saturated rock zones will be developed during the mine life (SZ1, SZ2, and SZ3). SZ1 will be engineered and constructed to function as a semi-passive bioreactor for selenium attenuation. As pit areas are backfilled, the SZs area will increase. Impacted water will flow from the newest SZ to oldest. As the discharge from the SZs will be from the first zone established, this maximizes the residence time of water within the SZs.

SZs are assumed to attenuate 99% of selenium loading. This attenuation rate was based on previous modelling efforts (SRK 2015). In addition, selenium concentrations were capped: if the selenium concentration in SZs was higher than 1.5 mg/L prior to applying attenuation, the effluent concentration was limited to a maximum concentration of 0.015 mg/L. The SZ effluent is a major source of selenium to Blairmore creek. A cap was applied to the SZ attenuation based on modelling iterations indicating this this would be required to meet instream water quality objectives.

Similar logic was applied to nitrate and nitrite according to Table 2-2. The attenuation factors applied assume that a carbon source will be added if required to meet the concentrations used in the model.

Table 2.1: Attenuation in Saturation Zone and Maximum Concentration in Effluent

Parameter	Attenuation Factor	Max Effluent Concentration
Selenium	99%	0.015 mg/L
Nitrate	95%	1 mg/L
Nitrite	95%	0.05 mg/L

2.5.2 Contact Water Capture and Attenuation

In order to meet site specific selenium objectives, it will be necessary divert loadings in ex-pit waste rock runoff from entering the downstream receiving environment. This will be achieved through a combination of water capture and natural attenuation along subsurface flow paths in water that bypasses the capture system. Captured waste rock seepage will be pumped to surge ponds and then to SZs where selenium can be attenuated.

The model assumes that the contact water capture system combined with attenuation along the flow path will remove loads reporting to the downstream receiving environment at an efficiency of 95% for the NRDA and SRDS where runoff reports to Blairmore Creek, and 98% for the CRDA where runoff reports to Gold Creek. These capture efficiencies were selected through iterative

modelling efforts to meet water quality objectives in the downstream receiving environment. To achieve these capture efficiencies, additional measures may be required such as groundwater extraction wells, which will be confirmed by on-site monitoring during operations.

2.5.3 Water Treatment

Previous modelling efforts (SRK 2015), and early iterations of this modelling effort indicated that water in the SZs would require treatment for removal of some metals prior to release to the environment. This will be confirmed by on-site monitoring but at this point is expected to be required. The model assumed SZs discharge will be sent to a WTP for removal of metals, prior to release to the receiving environment.

The proposed treatment method is aeration, followed by high density sludge (HDS) lime treatment. Table 2-3 shows estimated HDS plant effluent concentrations for a post-closure water treatment of water from the SZs. The effluent concentration estimates are based on a general review of operational data of HDS water treatment plants and are only intended as an order of magnitude for treatment performance. Site-specific water treatment tests would be required to determine actual treatment performance that could be achieved for the Project.

Table 2.2: Estimated Post-Closure HDS Treatment Plant Effluent

Constituent	Effluent Concentration (mg/L)
SO_4	2,000
NO_2	0.005
Dissolved Ag	0.0001
Dissolved Al	0.1
Dissolved As	0.05
Dissolved Cd	0.0005
Dissolved Co	0.001
Dissolved Cu	0.005
Dissolved Fe	0.3
Dissolved Hg	0.00001
Dissolved Mn	0.1
Dissolved Ni	0.01
Dissolved Pb	0.01
Dissolved U	0.01
Dissolved Zn	0.02

During periods when a new phase of the SZ comes online, additional pumping from the SZ was implemented in the model to maintain the feed the WTP while the new portion is filling. This was done to reduce decreases in Blairmore Creek flows at those times.

Discharge of treated effluent from the WTP was distributed proportional to catchment size between the three nodes on Blairmore Creek (BC07, BL02 and BC03). This was done in an

attempt to return the contact water to the nodes generally from where it was collected to minimize changes in flow conditions. However, no effluent is directed to Gold Creek.

2.5.4 Mitigation of Pit Wall Runoff

In the model, water that has come into contact with the pit walls is assumed to be collected and treated via the SZs. If the water quality during operation proves to be adequate for release to the environment, the pit wall contact water will be sent to sediment ponds, treated for TSS and released to the environment.

In closure, all acid generating pit walls will be actively managed, by covering the acid-generating rock with non-acid generating rock. Early iterations of the current modelling effort indicated that the pit lake leakage and overflow would be a significant source of loadings to Gold Creek if the pit walls were not actively managed. The model now assumes that 80% of loadings generated by acidic rock types would be mitigated.

3 Model Description

3.1 Model Platform and Timescale

The water balance and quality model for the Grassy Mountain Project was developed using the GoldSim software package (version 11.1 GoldSim Technology Group 2014).

Flow inputs to the model are monthly averages. The model used a daily time step and results (flow and quality) were reported as monthly averages.

3.2 Scenarios

All scenarios adopted conservative assumptions in the characterization of loading sources and flows. This means that assumptions made in the model select from the higher range of possible values to reduce the likelihood of underestimating concentrations. The model was run for three scenarios (Table 3-1), including:

1. Base Case: The Base Case model predictions use generally conservative assumption combined with average hydrological conditions and base case source terms. Mitigation of water quality exceedances are applied in the model for Base Case conditions. The Base Case is the best judgement case and should be interpreted as order-of-magnitude estimate of the most likely future concentrations.

2. Stochastic Model Run: The stochastic water balance results evaluate the anticipated range of flows that result from annual variability in precipitation conditions.

3. Worst Case for water quality: The “Worst Case” predictions was run using the upper limit source terms with average hydrological conditions. The Worst Case was meant to screen for parameters that would be potentially problematic in the event that actual loading rates are higher than the base case. The results are intended as estimates of concentrations that are very unlikely to be exceeded.

The stochastic water balance and worst case scenarios build on the conservatism inherent in the Base Case scenario to provide a potential range of flows/volumes and upper limit concentrations for water quality outcomes.

Table 3.1: Summary of Model Scenarios

Scenario	Annual Precipitation	Source Terms
Scenario used for Effects Assessment		
Base Case	Average	Base Case
Scenario used to capture uncertainty and provide range out potential outcomes		
Stochastic Water Balance	Stochastic	Base Case
Worst Case Water Quality	Average	Upper Case

3.2.1 Stochastic Water Balance

A Monte Carlo simulation was used to generate a range of results for the water balance. Monte Carlo simulations are well suited for situations where the value of an input is variable but the probability distribution function of the input is known or can be estimated. The distribution of total annual precipitation was estimated for this project area. Although it is not possible to predict the rate of annual precipitation in any given year, it is possible to develop a probability distribution function describing the variability (Section 4.1.1).

In Monte Carlo simulations, total annual precipitation for each year is selected according to the probability distribution function for the site. Monthly distributions are then applied to the annual values and then downscaled for daily time steps. Runoff calculations are described in Section 4.1.

The water balance model was run stochastically for 1000 iterations to determine a probability distribution function of predictions of potential flow conditions at the predictions nodes. This range of results span a range of wet and dry years.

3.2.2 Deterministic Load Balance

The uncertainty in the water quality predictions results primarily from the input source terms because they vary over a wider range than the hydrological inputs. Water quality was predicted deterministically for the Base Case and Upper Case scenarios. Running the model with source terms for each case under average hydrological conditions encompasses the range of water quality predictions resulting from uncertainty in the source terms. Base case and Upper Case source terms were derived for the following sources: background surface water, groundwater, pit wall runoff, waste rock, and co-disposal of waste rock and rejects. For background surface and groundwater, the two cases are based on the average and 95th percentile of the monitoring data. Development of contact water source terms for these two cases is described by SRK (2016). The Worst Case was meant to screen for parameters that would be potentially problematic in the event that actual loading rates are higher than the base case. Assuming the Upper Case source term for all sources simultaneously results in a maximum prediction which is unlikely to be exceeded.

3.3 Prediction Nodes and Parameters

The water quality model was developed to support the regulatory applications that will be submitted for the Project. The prediction nodes were strategically chosen to best support the Project's life cycle from construction to post-closure.

Five predictions nodes were selected on each Blairmore and Gold creeks to resolve the water quality and stream flows for multiple reaches along each creek, and provide a special gradient of any project related effects.

The prediction nodes used in the model are presented in Figure 2-2, and their coordinates in order of upstream to downstream on each creek are in Table 3-1.

Table 3.2: Prediction Nodes

Creek	Location	Northing	Easting
Blairmore	BL-03	5508587	684163
	BC-07	5507128	684590
	BL-02	5505089	684975
	BC-03	5503445	684695
	BC-01	5498855	683630
Gold	GC-13	5510405	687315
	GC-09	5508019	687770
	GC-04	5504720	687606
	GC-02	5503491	687568
	GC-01	5497597	687810

Parameters modelled are listed below. All inputs and results for water quality concentrations are for the dissolved fraction.

- Silver
- Aluminum
- Arsenic
- Boron
- Barium
- Beryllium
- Bismuth
- Calcium
- Cadmium
- Chloride
- Cobalt
- Chromium
- Copper
- Fluoride
- Iron
- Mercury
- Potassium
- Lithium
- Magnesium
- Manganese
- Molybdenum
- Sodium
- Ammonia
- Nickel
- Nitrite
- Nitrate
- Phosphorus
- Lead
- Antimony
- Selenium
- Tin
- Sulfate
- Strontium
- Titanium
- Thallium
- Uranium
- Vanadium
- Zinc
- Zirconium

3.4 Mine Life Milestones

Table 3.3 shows mine life milestones.

Table 3.3: Key Mine Dates

Mine Date	Description
2017-2019	Pre-mining period.
2019	Operations begin.
2021	SZ1 comes online
2038	SZ2 comes online
2043	Closure begins, SZ3 comes online

3.5 Site Conceptual Model

The Grassy Mountain water quality model includes both empirical and mechanistic elements. The model inputs are empirical and wherever possible draw from site-specific data. The data is then utilized as inputs to governing mechanisms in the system being modeled. Mechanisms in the model were:

- Flows derived from annual precipitation, monthly runoff distribution and a yield coefficient,
- Mass loading rates derived from humidity cell test results, scaled to field conditions,
- Timing of seepage from waste rock predicted based on the wet up time of rock placed,
- Attenuation of selenium and nitrate in an engineered saturated rock fill,
- Operational water management including:
  - Processing,
  - Routing of contact water to water management facilities (e.g. surge ponds and SZs),
  - Groundwater interception and pump back,
  - Water treatment, and
  - Water reporting in-pit (*i.e.,* in-pit waste rock seepage) was routed to the SZ.

Mechanisms that were not modelled include:

- Site wide orographic effects.
  - An orographic correction was applied to the annual precipitation for catchments with headwaters in the Livingstone Mountain Range on the east side of Gold Creek to account for an increase in runoff from those catchments. However, orographic effects on precipitation were not accounted for elsewhere on site; and

  - A difference in runoff distribution from catchments at higher elevations. No data is available to resolve the difference in the timing of the runoff from higher elevations and therefore this mechanism was not included in the model.

- Waste rock hydrology was simplified. Runoff from waste rock disposal areas was assumed to accumulate in the waste rock pile, and seep out once the pile had wet up and field capacity of 3% had been reached. After the storage capacity of the waste rock was reached, runoff from the area responds immediately to changes in precipitation.
- Flows predicted include both interflow in gravel, and surface flow and does not make a distinction between these.

4 Water Balance Inputs

4.1 Hydrology

A predictive hydrology model was developed based on the hydrology analysis for the Project (SRK 2016c – Hydrology Report). Monthly surface runoff volumes are calculated based on annual precipitation, monthly runoff distribution and runoff coefficients. The mean annual precipitation (MAP), runoff distribution for undisturbed areas and evaporation were evaluated using site-specific and regional data (SRK 2016c – Hydrology Report).

4.1.1 Precipitation

Table 4-1 presents the MAP and mean annual evaporation used in the model taken from SRK (2016c – Hydrology Report). Analysis of measured flows in the Project area showed that using a single MAP for all watersheds was inadequate to reflect natural baseline conditions. Streams with headwaters in the Livingstone Mountain range tend to have higher runoffs, likely due to a combination having catchments with higher average elevations and terrain that results in greater yield. An orographic correction was applied to estimates of MAP in the model for creeks with headwaters in the Livingstone range.

The monthly runoff distribution is presented in Table 4-2. The monthly runoff distribution was applied to the annual precipitation to obtain effective monthly precipitation. This approach takes into account the accumulation of snow during winter months and release of snow as melt water during freshet.

Daily average precipitation was calculated by dividing the monthly precipitation by the number of calendar days in that month. The same approach was used to predict daily average evaporation. Table 4-2 presents the monthly distributions.

A Monte Carlo simulation was run to simulate different hydrological conditions. Table 4-3 presents the frequency distribution of annual precipitation used in the model (SRK 2016c – Hydrology Report). The same monthly runoff distribution in Table 4-2 was applied to all annual precipitation values.

Table 4.1: Mean Annual Hydrology Inputs

Parameter	Value
MAP (mm/year)	733
Evaporation (mm/year)	738

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\Report_AllTables.xlsx

Table 4.2: Monthly Distributions

Month	Runoff Distribution (%)	Evaporation Distribution (mm)
January	7%	9
February	6%	16
March	7%	40
April	8%	73
May	12%	110
June	15%	129
July	9%	135
August	8%	111
September	8%	65
October	6%	30
November	7%	11
December	7%	8

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\Report_AllTables.xlsx

Table 4.3: Annual Precipitation Frequency Analysis

Hydrological Condition	Return Period	Annual Precipitation [mm]
Wet	100	1283
	50	1202
	20	1090
	10	998
	5	896
Median	2	729
Dry	5	594
	10	533
	20	488
	50	441
	100	411

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\Report_AllTables.xlsx

4.1.2 Yield

Yield coefficients were used to estimate runoff from total precipitation and account for losses such as evapotranspiration, soil storage and infiltration from the different types of surfaces. Specific yield coefficients (Table 4.4) were assigned to each area at the site depending on the area's land use and surface characteristics.

The undisturbed coefficient was estimated using local gauge station data and topographical information. The mean annual runoff was estimated by dividing total flows at gauging stations by their catchment areas, as evaluated and verified in the hydrology impact assessment (SRK2016c – Hydrology Report). The undisturbed yield coefficient was estimated from ratio of the mean annual runoff and the MAP, and accounts for both surface water and groundwater reporting in stream. The remaining yield coefficients were estimated through best engineering judgement according to land use and surface cover characteristics.

Table 4.4: Yield Coefficients

Land Use	Yield Coefficient	Comment
Undisturbed and Reclaimed	0.51	Based on hydrology analysis which calculated in-stream yield for the project (SRK 2015a). Accounts for losses due to evapotranspiration, infiltration and storage.
Bare Waste Rock	0.6	Assumed value to account for losses due to evapotranspiration and storage. Although waste rock has higher surface infiltration than undisturbed ground, the yield coefficient accounts for water that reports to and is stored internal to the waste rock pile and eventually seeps out at the pile's foundation once the waste rock is wetted-up.
Bare Waste Rock Backfilled Area	0.6	Assumed value to account for losses due to evapotranspiration and storage.
Pit Walls	0.8	Assumed value applied to the open pit areas. Accounts for losses due to evapotranspiration and storage.
Ponded Areas	1	Value applied to water surface to account for direct precipitation.

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\Report_AllTables.xlsx

4.2 Groundwater

Groundwater reporting to prediction nodes in the model is accounted for by applying the yield coefficient based on measured in stream flows (SRK 2016c – Hydrology Report) to calculate flows from an upstream area, which includes groundwater contribution to base flows.

Groundwater model results (SRK 2016d – Groundwater Report) were used to estimate the amount of leakage out of the Pit Lake and from SZs. Leakage rates were calculated as a percentage of base flow provided by SRK (2016c – Hydrology Report), and were applied in the model to estimate the flow rate along this flow path between the water management facilities and the downstream prediction nodes. Leakage is conservatively assumed to reach the downstream environment immediately in the model, where in actuality, the travel time via groundwater flow paths would be on the order of years.

Leakage from the Pit Lake reports to Gold Creek at prediction node GC10. Leakage from the SZs reports to Blairmore Creek at multiple nodes according to the results of groundwater modelling.

4.3 Pond and Saturation Zone Capacities

Table 4.5 summarizes the critical water management infrastructure and respective capacities used in the model.

Table 4.5: Infrastructure Summary

Infrastructure	Capacity (m^3)
Northwest Surge Pond (NWSP)	35,300
West Sedimentation Pond (WSP)	109,000
Southwest Sedimentation Pond (SWSP)	34,000
Plant Site Sedimentation Pond (PSSP)	20,000
Northeast Sedimentation Pond (NESP)	115,000
East Sedimentation Pond (ESP)	125,000
Southeast Surge Pond (SESP)	280,000
Raw Water Pond (RWP)	1,200,000
SZ1 (1465m)	4,390,000
SZ2 (1636m)	2,600,000
SZ3 (1700m)	3,220,000

\\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\[ReportAllTables_1CM029-011_Rev01_MCN.xlsx]

4.4 Catchment Delineation

For modelling purposes, the project area and its surroundings were divided into sub-catchments. Catchment delineation was based on topographical data and surface infrastructure upstream of each prediction node in the model.

Catchments were divided such that each sub-catchment had a unique combination of flow path and source term. Sub-catchments were delineated for each prediction node in the model using topographical data. The undisturbed runoff within each catchment is assumed to flow through that catchment's node. The sub-catchments consisted of pits, in-pit waste rock placement, ex-pit waste rock placement, ponds, and undisturbed areas where runoff was diverted to a ditch or ponds.

Sub-catchments were delineated for project milestones. Changes in the sub-catchment area were linearly interpolated s for each time step over the mine life. Generally, as the mine footprint including pit and waste rock areas increase, the undisturbed area decreases.

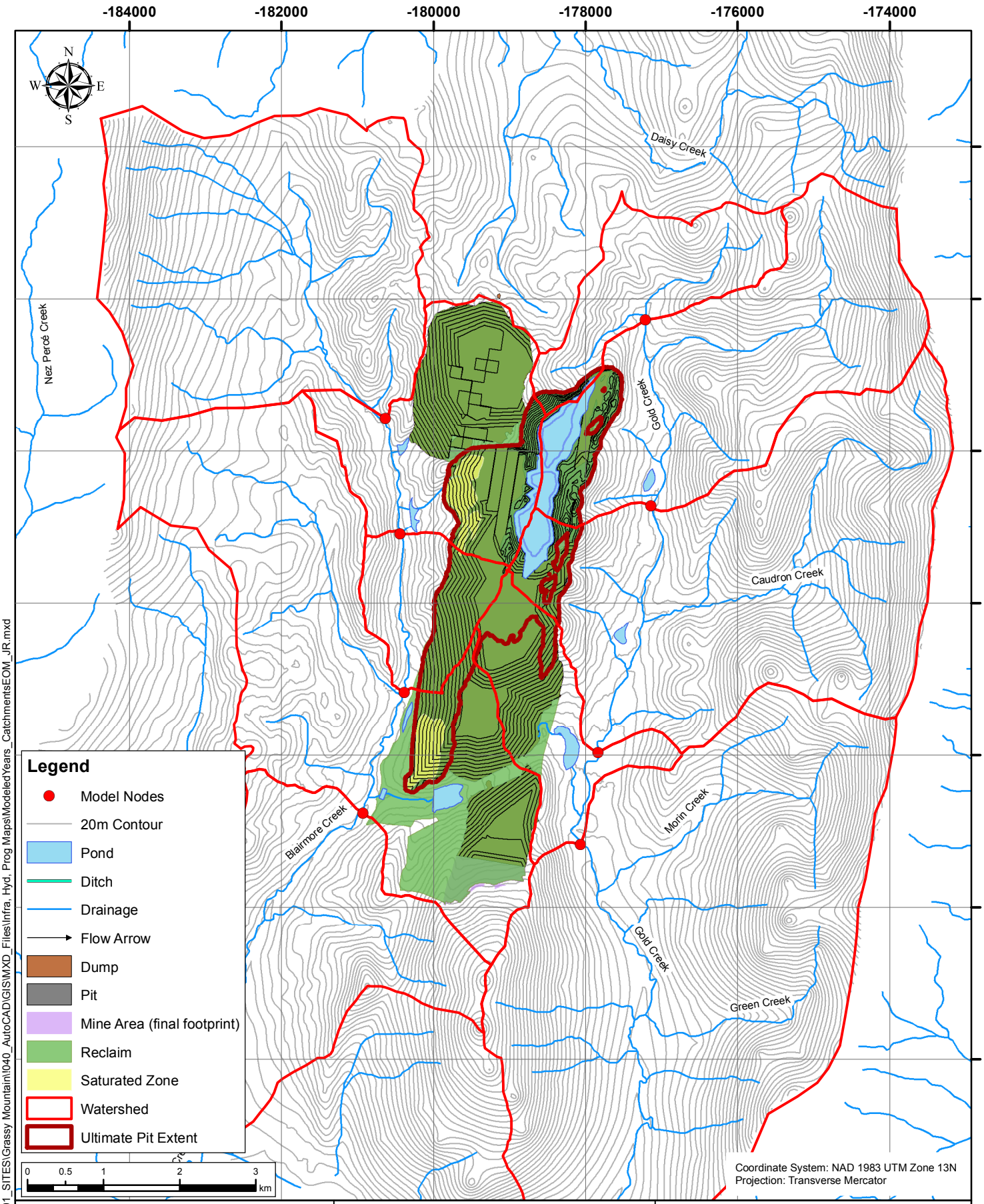
Figure 4-1 shows the catchment delineation for the End of Mine footprint. Appendix B provides the catchment delineations for key project dates, along with the areas used in the model to

calculate flows. A summary of the changes to upstream watershed areas and contributions by mine site discharges over the lifetime of the project is provided in Table 4.6. These areas area based on the total catchment areas contributing to flows at BC01 and GC01 (Figure 2-1).

Table 4.6 Changes to Catchment Areas of Blairmore and Gold Creeks (Combined) from Mine Site Development over the Project Life

Year	Undisturbed Area (km^2)	Diverted Natural Area (km^2)	In-Pit Dump Area (km^2)	Ex-Pit Dump Area (km^2)	Pit Area (km^2)	Reclaim Waste Rock Area (km^2)	Reclaimed Ex Pit Waste Rock Area (km^2)
2010	114.2	0.0	0.0	0.0	0.0	0.0	0.0
2019	110.5	1.9	0.0	0.8	0.8	0.0	0.0
2020	105.3	6.0	0.0	1.0	1.0	0.0	0.2
2023	103.9	5.1	0.1	1.8	2.2	0.1	0.6
2026	103.3	3.3	0.3	2.1	3.1	0.1	1.7
2030	103.0	1.9	0.6	2.2	3.3	0.5	2.4
2033	102.5	0.9	1.0	2.1	3.3	1.0	3.1
2038	101.8	0.6	1.5	1.1	2.5	2.2	4.2
2041	101.8	0.6	1.2	0.0	2.2	2.8	5.3
EOM	101.8	0.6	0.0	0.0	2.1	4.1	5.4

\\van-svr0.van.na.srk.ad\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\[CatchmentTables_1CM029-011_Rev00_MCN.xlsx]



Path: \\VAN-SVR0\Projects\01_SITES\Grassy Mountain\l040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_CatchmentsEOM_JR.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Catchment Delineation for End of Mine

Job No: 1CM029.011

Filename: ModeledYears_CatchmentsEOM_JR

Grassy Mountain Coal Project

Date:	Approved:	Figure:
July 29, 2016	MC	4-1

4.5 Waste Rock Placement

The mine plan waste rock placement was provided by MEMS. The yearly deposition rates are tabulated in Table 4.7. For modeling purposes, if a waste rock disposal area was located in more than one catchment, it was assumed that the placement of waste rock in each catchment was proportional to the relative areas of the dumps in each catchment.

Table 4.7: Waste Rock Deposition Rates

Year	SRDA	In-Pit	North	South	TOTAL
1/1/2018	0	0	0	0	0
1/1/2019	1,207,525	11,349	0	20,720,486	21,939,360
1/1/2020	5,223,616	0	0	16,587,794	21,811,410
1/1/2021	13,581,630	4,651,377	0	7,091,493	25,324,499
1/1/2022	29,380,182	7,030,842	0	0	36,411,024
1/1/2023	33,046,058	534,753	0	0	33,580,810
1/1/2024	23,678,635	0	10,518,886	1,826,401	36,023,922
1/1/2025	20,108,630	0	13,386,490	6,696,552	40,191,672
1/1/2026	4,556,419	30,998,124	8,630,174	829,334	45,014,050
1/1/2027	15,601,282	6,090,689	13,781,611	163,131	35,636,714
1/1/2028	6,022,194	17,511,062	19,124,718	1,644,209	44,302,183
1/1/2029	18,328,151	11,539,901	9,427,809	1,003,009	40,298,870
1/1/2030	22,215,426	11,959,079	9,303,621	3,174,938	46,653,063
1/1/2031	5,256,725	18,219,463	14,710,205	0	38,186,393
1/1/2032	7,708,767	16,200,711	21,510,246	0	45,419,725
1/1/2033	3,563,735	22,648,890	19,104,598	0	45,317,223
1/1/2034	2,352,274	21,775,178	15,033,767	0	39,161,219
1/1/2035	1,148,982	34,522,099	10,036,508	0	45,707,589
1/1/2036	535,350	35,072,995	10,022,273	0	45,630,619
1/1/2037	7,013,514	30,243,107	11,228,901	0	48,485,522
1/1/2038	0	33,975,761	11,474,038	0	45,449,799
1/1/2039	0	26,117,762	581,494	0	26,699,256
1/1/2040	0	21,227,019	0	0	21,227,019
1/1/2041	0	13,763,640	0	0	13,763,640

Z:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Inputs\[Input_RockDeposition_1CM029-011_Rev00_MCN.xlsx]

4.6 Site Water Demand

Water uses on site are tabulated in Table 4.8. The model assumes that water for these uses is sourced from the Raw Water Pond.

Table 4.8: Site Water Demand

Parameter	Value	Units
Plant Make-up Water	800,000	m^3/year
Dust Suppression Water	60,000	m^3/year

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\Report_AllTables.xlsx

Other minor water demands, such as potable water uses for the site, were not included in the model.

Water use within the Coal Processing Plant was modeled using input and output rates of coal to and from the coal wash plant, and the moisture content of each stream. The values used to calculate water entering and leaving the plant within the coal and the rejects are presented in Table 4.9.

Table 4.9: Production Rates and Water Content of Coal

Parameter	Value	Units
Raw Coal Moisture	5%	
Production Coal Moisture	10%	
Reject Moisture	18%	
Raw Coal Input Rate	4,905,600	tonne/year
Clean Coal Output Rate	4,000,000	tonne/year
Reject Proportion	45%	

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\Report_AllTables.xlsx

4.7 Saturated Zones

The capacity of the SZs to hold water is summarized in Table 4.10. The volumes available for water storage within the SZs assumed a void ratio of 25%. SZ1 increases in volume from the end of 2021 (Yr. 3) to 2032 (Yr. 14) and is used as the main water management facility as it becomes available. Additional storage capacity is added to the water management facility in 2038 (Yr. 20) when SZ2 is available. SZ3 is also increases the storage capacity when it becomes available at the end of 2042 (Yr. 24).

Table 4.10: Saturated Zone Volumes and Availability for Water Management

Saturated Zone	Date	Volume Available (m^3)
SZ1	1/1/2022	170,000
	1/1/2023	470,000
	6/1/2023	560,000
	1/1/2024	650,000
	1/1/2027	1,550,000
	6/1/2032	4,390,000
SZ2	1/1/2038	2,600,000
SZ3	1/1/2043	3,220,000

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\3_WLBalanceReport\020_Tables\Report_AllTables.xlsx

4.8 Pit Lake

A storage curve (volume and surface area vs elevation) was developed using a Digital Elevation Model of the region and Global Mapper (2016). Global Mapper calculated cut and fill volumes for an area delineated around the pit lake perimeter at 1 m intervals from the lowest point of the DEM of 1570 masl to the elevation of interest plus a 2 m buffer (1752 masl).

5 Water Quality Inputs

The development and application of water quality inputs are discussed here. The complete dataset of concentration based source terms is provided in Appendix C. Only dissolved concentrations, and not total concentrations, are modeled.

5.1 Background Water Quality

Source terms for background concentrations were developed using water quality data measured from the site. Concentrations below the method detection limit were included in the calculations as the detection limit, even if the detection limit varied with sampling period. The only exception to this rule was nitrite. Nitrite concentrations were consistently below the detection limit, and the lowest detection limit was used as the source term concentration.

Twelve samples collected from stations BC-01 and GC-01 from May 2013 to May 2016 were used to calculate average and 95th percentile statistics. These statistics were used as source term concentrations in the Base Case and Worst Case scenarios.

The water quality downstream of the site consists of both surface water and groundwater that has surfaced to the creeks. The background source term was applied to both undisturbed surface water flows as well as shallow groundwater which reported to the nodes.

The data set was used as provided to SRK by Hatfield Consultants. The data was assumed to be of good quality, and SRK did not perform any additional QA/QC procedures on the data. The data set has the limitation of containing a short data record with few samples that may not reflect the complete range of concentrations in the area.

5.2 Groundwater Quality

Groundwater source terms were developed from groundwater quality data provided to SRK by MEMS. The data was collected from 12 stations on site between February 2014 and March 2016. Values below the method detection limit were treated as having a concentration at the method detection limit. Average and 95th percentile statistics were calculated for each parameter from this dataset.

Due to limited data availability, certain parameters have not been analyzed for in groundwater including beryllium, bismuth, lithium, molybdenum, ammonia, phosphorus, tin, strontium, titanium, thallium, vanadium and zirconium. For these parameters no source term was included for groundwater and the concentration was assumed to be 0 mg/L. The data was assumed to be of good quality, and SRK did not perform any additional QA/QC procedures on the data. The data set has the limitation of containing a short data record with few samples that may not reflect the complete range of concentrations in the area.

5.3 Geochemical Source Terms

5.3.1 Leaching Rates

Generation rates for selenium and sulphate were developed by SRK (2016a – Geochemical Characterization) based on humidity cell data from site samples for waste rock, and for rejects co-disposed with waste rock (Table 5.1). Leaching rates are provided on annual basis and are based on the contributing volume of rock.

Table 5.1: Generation Rates for Sulphate and Selenium

Rock Type	Sulphate ($mg/m^3/yr$)		Selenium ($mg/m^3/yr$)	
	Base Case	Worst Case	Base Case	Worst Case
Waste Rock	24,000	73,000	3.2	9.4
Co-disposal of Waste Rock and Rejects	33,000	77,000	9.4	15

Source: \\VAN-SVR0.van.na.srk.ad\01_SITES\Grassy Mountain\1CM029.008_Geochem_Characterization\800_Kinetic_Testing\201604_SourceTerms\Se_SourceTerm_April2016_1CM029008_SJD_REV01.xlsx

The generation rate of selenium and sulphate for co-disposed waste rock and rejects is higher than waste rock alone. The co-disposed term is based on samples selected to represent the mix of 91% waste rock to 9% rejects by volume. This mix of waste rock to rejects was based on to total volume of waste rock place in pit (Section 4.5) and the calculated total volume of coal rejects produced from the proposed production rate. It was assumed that rejects will be placed at the nearest waste rock dump along the route back to the coal loading face (*i.e.,* in the pit after waste rock placement in the pit begins). The term developed for co-disposed waste rock and rejects was applied to all waste rock areas within the pit.

5.3.2 Concentrations of Trace Elements

Source concentrations for waste rock and pit walls were developed as described by SRK (2016a – Geochemical Characterization).

The uncertainty in the source term for waste rock is linked to the underlying effect of pH conditions that control metal solubility. Source concentrations were developed for pH at 7(±0.2), which represents a lowest reasonable pH in a carbonate buffering system in which pore gas carbon dioxide partial pressures exceed 10%, and pH at 8(±0.2), which represents the conditions as CO_2 partial pressures approach atmospheric (0.04%). The two pH cases result in different solubility effects. For example, pH at 7 is the worst case for pH but it doesn't yield the highest concentrations for all parameters.

The maximum concentrations from each of the pH at 7 and pH at 8 waste rock source terms were selected and were run combined with Base Case and Upper Case concentrations for other sources. This approach accounts for the uncertainties of field conditions. However, it also provides water chemistries that, if all parameters were looked at together, creates chemical impossibilities. Each parameter is evaluated independently.

5.3.3 Blasting Residues

For nitrate, nitrite and ammonia, loadings available for flushing from waste rock and blasted pit wall rubble were calculated based on the Ferguson and Leask (1988) method and site specific inputs for powder factor and explosives recipe. It is anticipated that 100% of wet holes will contain 80% of ammonium nitrate (MEMS 2015). Based on Ferguson and Leask, the following equation was applied to evaluate the amount of nitrogen loading from blasting:

$$M_N = S_{\%} V_w P_f ANFO_{\%} ANFO_N$$

Table 5.2 provides a description of the inputs used to calculate the mass of nitrogen released from blasting. It was assumed that the relative proportions of nitrogen to nitrate, ammonia and nitrite are 87%, 11% and 2 % respectively.

The inventory of nitrogen loadings were tracked in the model by accumulating the mass blasting residue available for flushing and amount flushed, allowing 40% of the inventory to be flushed each year. The model assumes a constant flushing rate, and does not account for differences between wet and dry years.

Table 5.2: Blasting Residue Inputs

Parameter	Description	Input
M_N	Mass of nitrogen released	Calculated (kg)
$S_{\%}$	Slurry use percent	5.1%
V_W	Volume of waste	Based on volume of waste rock placed (bank m^3)
P_f	Powder Factor	700 g/bank m^3
$ANFO_{\%}$	Percent of Ammonium Nitrate in ANFO	80%
$ANFO_N$	Percent Nitrogen in Ammonium Nitrate	35%

5.3.4 Application

Waste Rock

Loadings for waste rock areas are the sum of:

1. Direct loadings based on cumulative volume of waste rock placed in a Waste Rock Disposal Area (Section 5.2.1, applies only to selenium and sulphate loadings),

2. Concentration based loadings (Section 5.2.2, multiplied by flow to get loads, primarily for most parameters), and,

3. Direct loadings based on volume of waste rock placed annually (Section 5.2.3, applies only to nitrogen species for which an annual flushing rate is applied).

The flow used for determining the concentration based loadings from waste rock decreases as the Waste Rock Disposal Areas are reclaimed. A reduced runoff coefficient is used in the model to represent a reduction in the yield from the Waste Rock Disposal Area once a cover is placed.

Coal rejects are assumed to be mostly placed in pit. Areas where waste rock and rejects are co-disposed receives the same source term for concentration based loadings as that developed for waste rock alone. However, direct loadings for selenium and sulphate differ between waste rock and rejects co-disposal versus waste rock alone.

Pit Walls

Four pit wall source terms were developed as per SRK (2016a – Geochemical Characterization):

1. Acidic benched walls
2. Non-acid benched walls
3. Acidic un-benched walls
4. Non-acid un-benched walls.

A benched wall refers to a high wall above the seam package. The wall below the last seam mined is assumed to be not benched.

During operations, pit walls are assumed to be non-acid (*i.e.,* assumed they are actively being mined and are not exposed long enough to go acid before being mined) and benched (conservative in lieu of actually determining non-benched areas). Pit wall source terms are turned off when pit walls are covered by backfill, at which time the areas are assigned waste rock source terms.

In closure, pit walls in the pit lake area at the north end of the pit will remain exposed. Pit walls areas in closure are assigned source terms based on the rock types exposed. Table 5.3 summarizes the amount of each of the rock unit estimated in the pit walls at closure, along with whether the rock type was assumed to be benched or non-benched, and the percent of the rock type that was assumed to go acid. The model assumes that 80% of loadings generated by acidic rock types in exposed pit walls would be mitigated through active management.

Table 5.3: Summary of Source Term by Rock Unit

Rock Type	Percent of Pit Wall	Benched or Un-Benched	Percent Acid	Percent Non-Acid
Blairmore	26%	Benched	0%	100%
Cadomin Conglomerate	9%	Benched	100%	0%
Kootenay	22%	Benched	13%	87%
Fernie Passage Beds	2%	Benched	0%	100%
Moose Mountain	21%	Benched	50%	50%
Footwall	21%	Un-benched	50%	50%

5.4 Concentration Limits

A solubility limit for sulphate was applied globally in the model. Sulphate is constrained to 2030 mg/L under Base Case conditions and 2740 mg/L for Upper Case conditions.

Elevated concentrations in pit lake water may occur due to potential acidity. Pit lake water leaves the project area via two pathways:

1. As overflow to the NESP, and subsequently to Gold Creek, via horizontal drains after reaching the flood elevation
2. As leakage once the pit lake begins to fill. Pit lake leakage reports to Gold Creek at prediction node GC10.

Pit lake water will be neutralized as it flows through groundwater pathways and enters the creek with sufficient neutralization capacity. Concentration limits are applied for aluminum and iron at prediction node GC10 to represent assumed precipitate at neutral pH.

6 Water Balance Results

The water quality predictions are only valid if all of the mitigation measures described above are implemented and have the assumed effectiveness.

6.1 In stream flows for Blairmore and Gold Creeks

Stochastic modelling results for in stream flows for predictions nodes on Blairmore and Gold creeks are provided in Appendices C1 and C2, respectively. The evaluation of changes in flow and the impact of these changes are discussed by SRK (2016c – Hydrology Report) and Hatfield Consultants (2016).

6.2 Pit Lake Water Balance

The pit lake water balance indicates that the pit will flood to a spill elevation of 1700 m in 2055, approximately 13 years after it is allowed to begin filling (Figure 6-1). This conservatively assumes that no significant source of groundwater will contribute to the pit lake inflows.

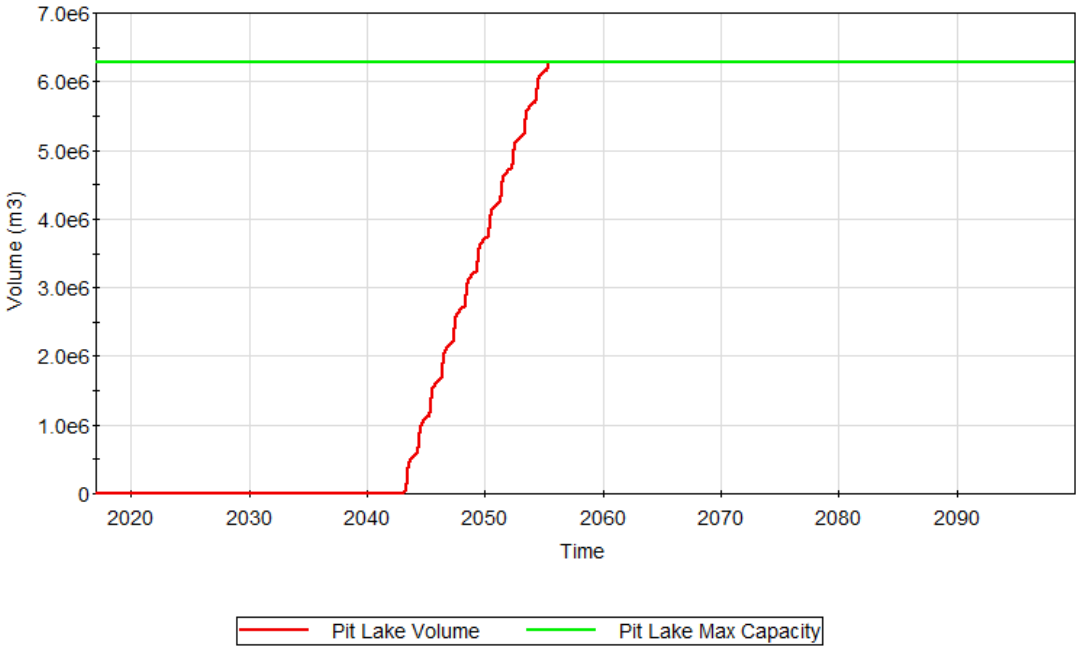


Figure 6-1: Pit Lake Filling Time

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

6.3 Saturated Zone Residence Times

Contact water will be directed to the most upstream operational SZ and will flow from the newest SZ to oldest. As the discharge from the SZs will be from the first zone established, this maximizes the residence time of water within the SZs.

The residence time of the combined SZs is estimated in the model as the total volume of operational SZs divided by the total inflow, once the SZs reach their spill elevation. The result of this estimation fluctuates seasonally (Figure 6-2) due to the variations in inflow. Higher flows result in shorter residence times. A constant inflow at the same rate as the closure peak flow would result in a retention time of 10 months, allowing for attenuation even during high flow periods.

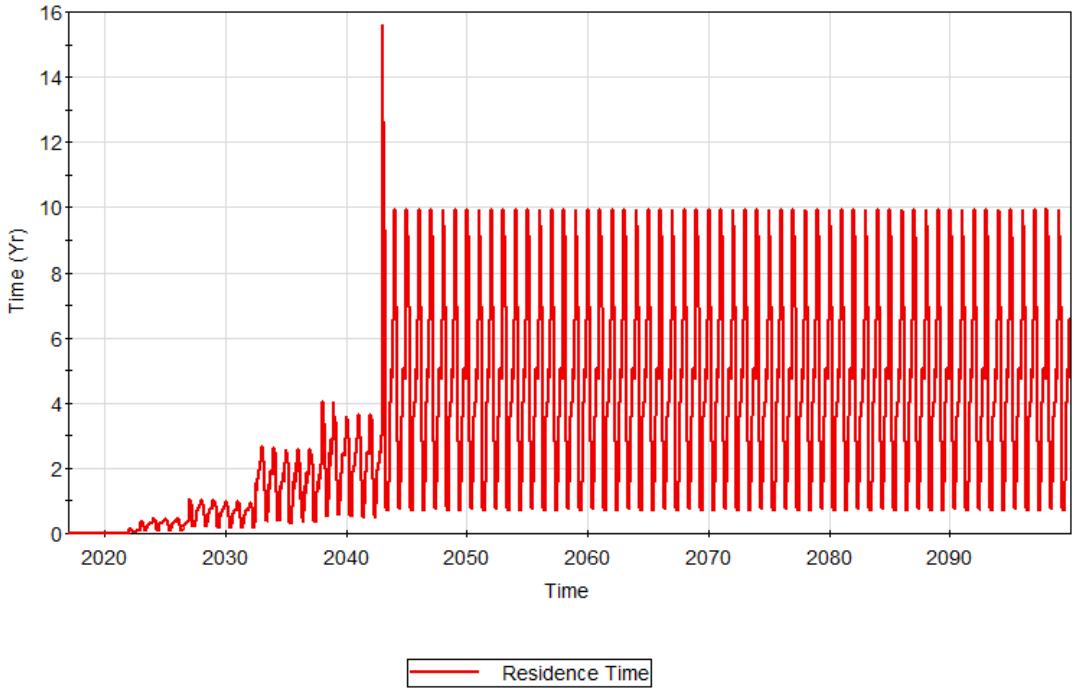


Figure 6-2 Saturation Zone Residence Time

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

6.4 Discharge of Water Treatment Plant Effluent

Discharge rates of effluent from the WTP to each node on Blairmore Creek are presented in Figure 6-3. Note that these are the flowrates released to each node and not the additive flow from the WTP to each node (*i.e.,* the cumulative flow rate to BL02 would be greater than BC07). The discharge from the WTP drops during 2027 and 2032 when additional storage capacity in the SZ is filling. In 2043, the drop in flow is mitigated by additional pumping from the SZ to maintain the feed the WTP.

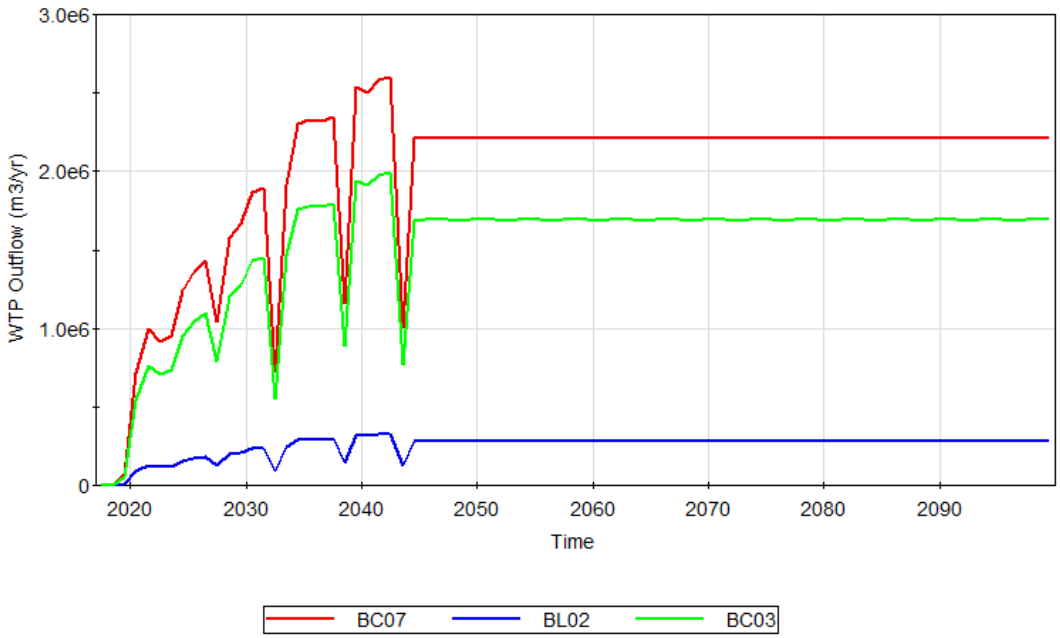


Figure 6-3 WTP Discharge to Nodes on Blairmore Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

7 Water Quality Results

Trends in water quality results for key parameters using base case source terms are discussed here, including sulphate, nitrate, cobalt, selenium and zinc. Results are annual averages for the Base Case scenario, and are for the dissolved fraction (*i.e.,* not total concentrations). Results showing the variability in the Base Case for the full list of parameters are presented in Appendix D.

Water quality predictions for:

- Prediction nodes on Blairmore Creek are presented in Figure 7-1 to Figure 7-5,
- Predictions nodes on Gold Creek are presented in Figure 7-6 to Figure 7-10,
- Sedimentation and surge ponds are presented in Figure 7-11 to Figure 7-15, and,
- Mine facilities including the Pit Lake, SZ and WTP effluent are presented in Figure 7-16 to Figure 7-20.

The evaluation of predicted water quality and the impact of potential changes in water quality are discussed by Hatfield Consultants (2016).

7.1 Blairmore Creek Water Quality

Contact water on-site is intercepted and directed to the SZs, which then is fed to the WTP. Treated effluent from the WTP is distributed proportional to catchment size to discharge locations along Blairmore Creek. This is done to minimize changes in flow conditions, and results in concentrations dominated by this source at all nodes in Blairmore Creek.

Dips in predicted concentrations observed in 2032, 2038 and 2043 correspond to periods when additional storage capacity is added as SZ1, SZ2 and SZ3 respectively come on line. No discharge from the SZs is predicted during 2027 and 2032 when additional capacity is filling. In 2043, the drop in concentration is less pronounced as additional pumping from the SZ maintains the feed to the WTP.

Sulphate to Blairmore Creek decreases at closure in 2043 (Figure 7-1) because the flow associated with the moisture content of coal rejects ceases to report to the SZs. As a results, the total load from the SZ, which is controlled by a solubility limit and is dependent on flow rate, decreases.

Nitrate concentrations decrease at all prediction nodes on Blairmore Creek as the soluble load flushes out of blasted rock, and the source of nitrate decreases.

Concentrations of dissolved cobalt, selenium and zinc show similar patterns of increase above background concentrations as the mine development expands. Concentrations of these parameters reach their maximum in closure when increased leakage rates from the SZs is predicted (SRK 2016d). They also reach steady state soon after closure, as the site is reclaimed.

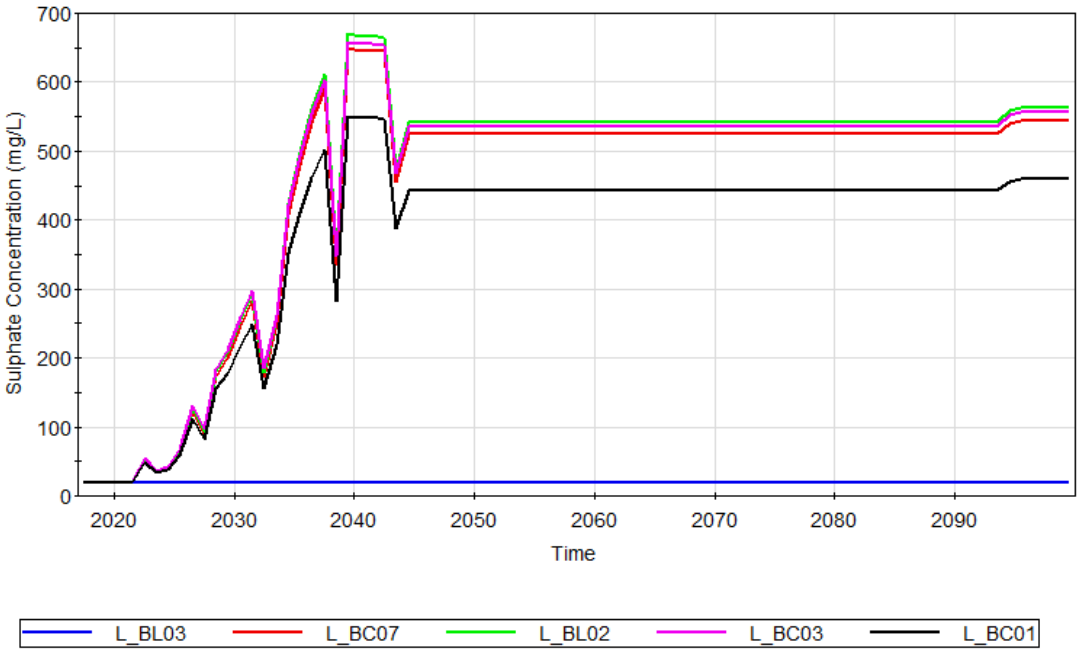


Figure 7-1: Predicted Sulphate Concentrations in Blairmore Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

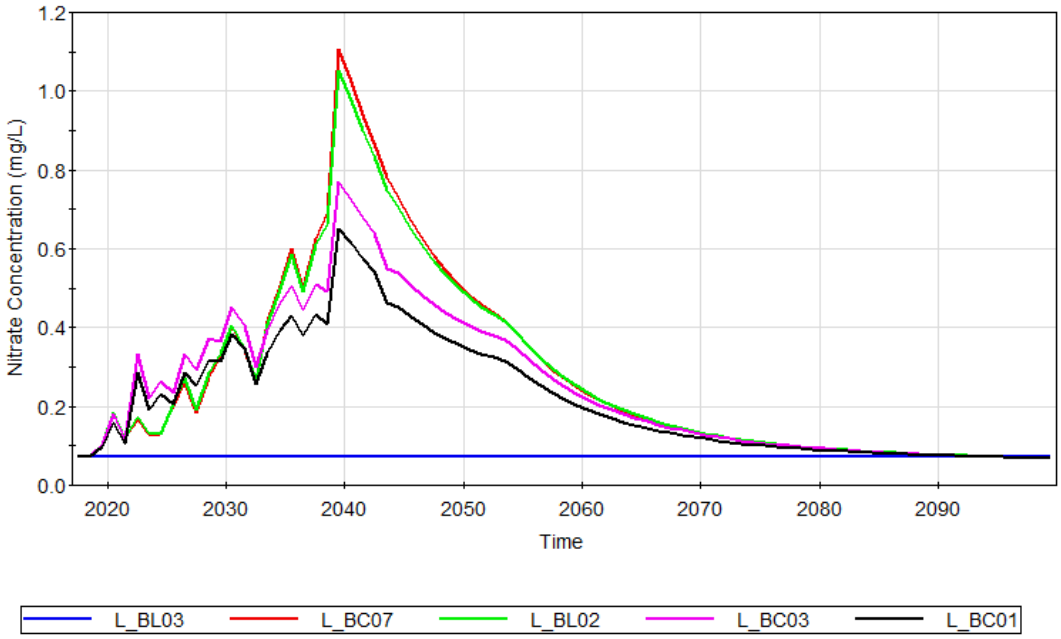


Figure 7-2: Predicted Nitrate Concentrations in Blairmore Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

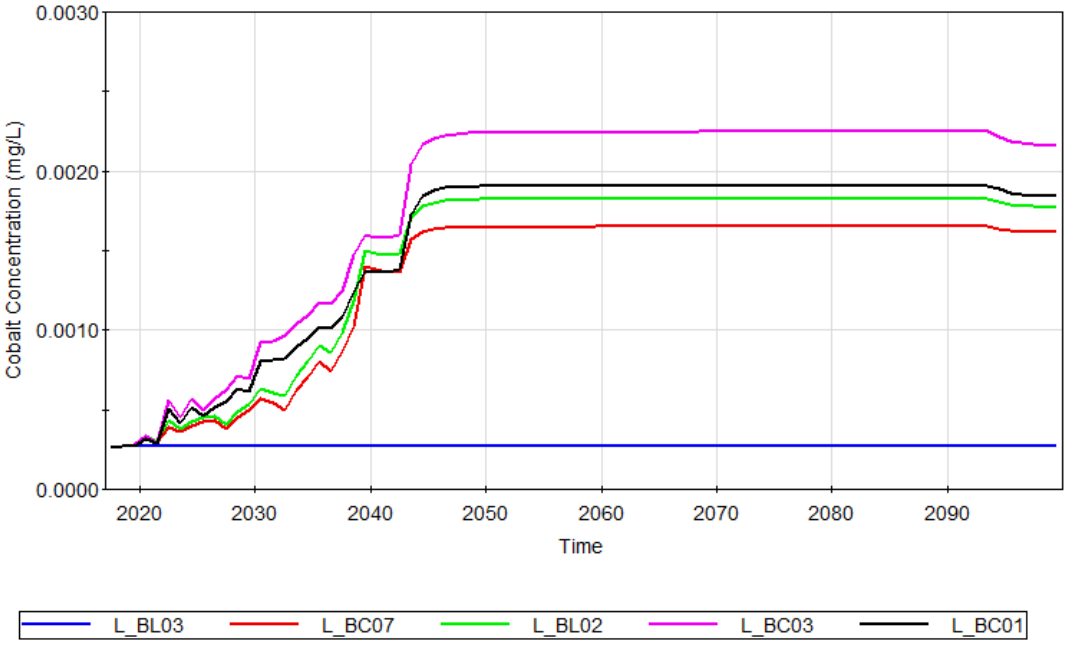


Figure 7-3: Predicted Cobalt Concentrations in Blairmore Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

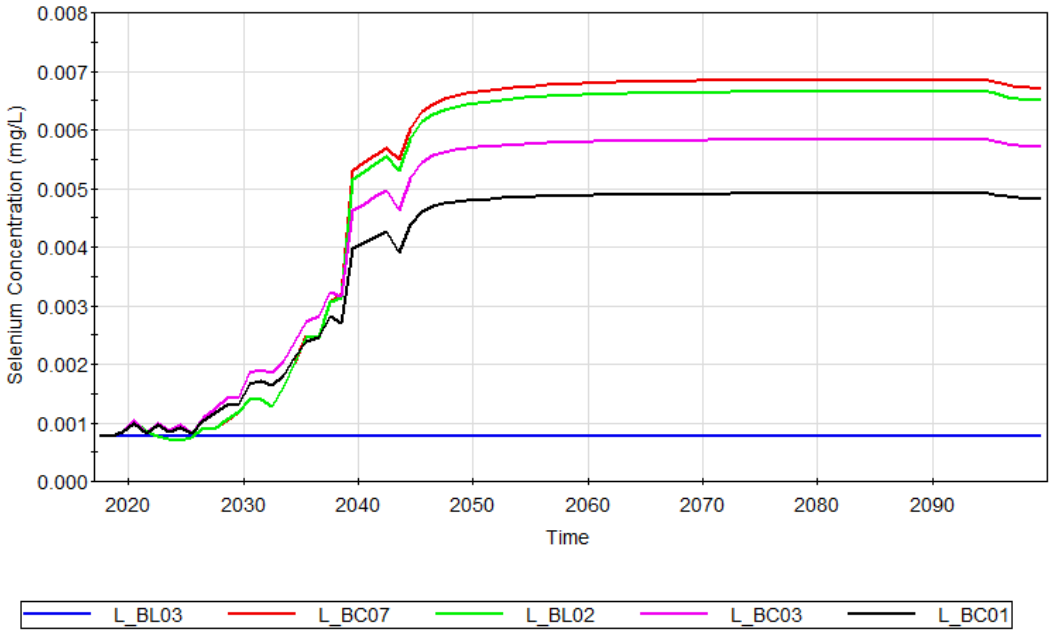


Figure 7-4: Predicted Selenium Concentrations in Blairmore Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

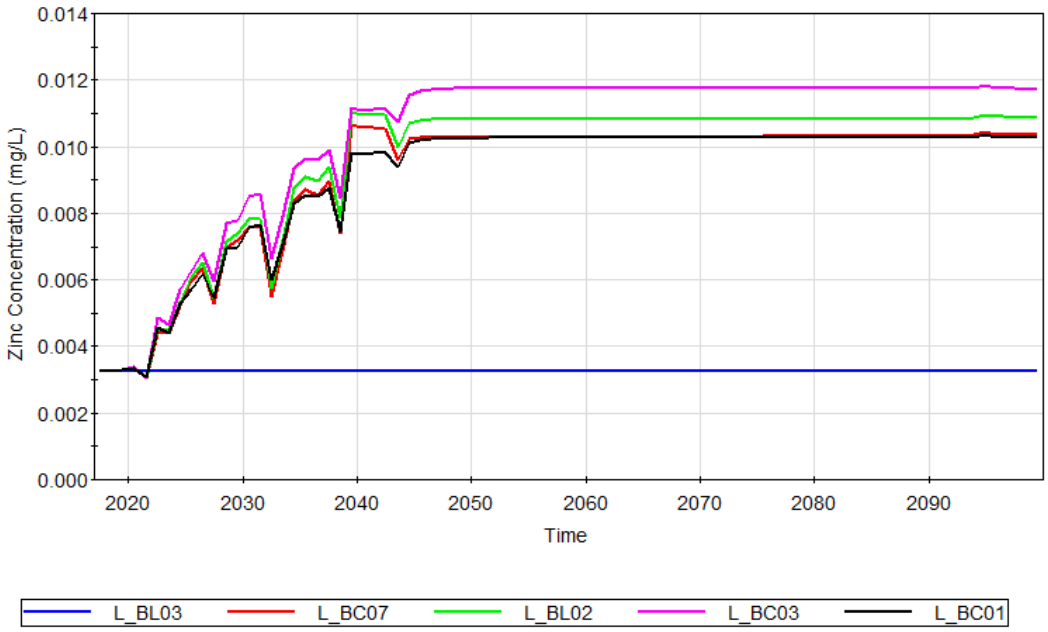


Figure 7-5: Predicted Zinc Concentrations in Blairmore Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

7.2 Gold Creek Water Quality

Prior to the wet up of waste rock in the Central Rock Disposal Area, no effects on water quality in Gold Creek are predicted.

Three phases are evident in the predicted trend of Gold Creek water quality:

1. Drainage from the Central Rock Disposal Areas that bypasses the seepage capture system flows to GC02, and results in increased flow (over pre-mining conditions) at the downstream node GC01. The timing of this contributor is based on the wet-up time of the waste rock pile. Waste rock begins to be placed in this dump when mining begins in 2019, at which time the placed waste rock begins to wet-up. In 2037, the waste rock dump's field capacity is predicted to be reached, at which time seepage from this area seeps into the Gold Creek. Monitoring data from other sites indicate that seepage can be expected earlier. A contact water capture system with a capture efficiency of 95% was implemented in the model.

2. Upon closure (2043), the pit lake begins to fill. Leakage from the pit lake begins immediately upon pit filling. Also, runoff from the small section of pit immediately upstream of the NESP is expected to runoff toward the NESP and subsequently to Gold Creek. Leakage from the pit lake and overflow from the NESP both flow to prediction node GC10, and results in increased (over pre-mining conditions) to all downstream prediction nodes.

3. The pit lake takes approximately 13 years to fill to an elevation of 1700 m and is allowed to drain by horizontal drains towards Gold Creek. At this time, concentrations of water quality parameters increase again, reflecting increased loadings from the pit lake water.

For most parameters, the highest concentrations in Gold Creek between 2037 and 2043 are predicted for GC02. After 2043, the highest concentrations are predicted for GC10, with a spatial gradient in concentrations to downstream nodes. The exception to this pattern is nitrate. Nitrate concentrations decrease at all prediction nodes on Gold Creek as the soluble load flushes out of blasted rock.

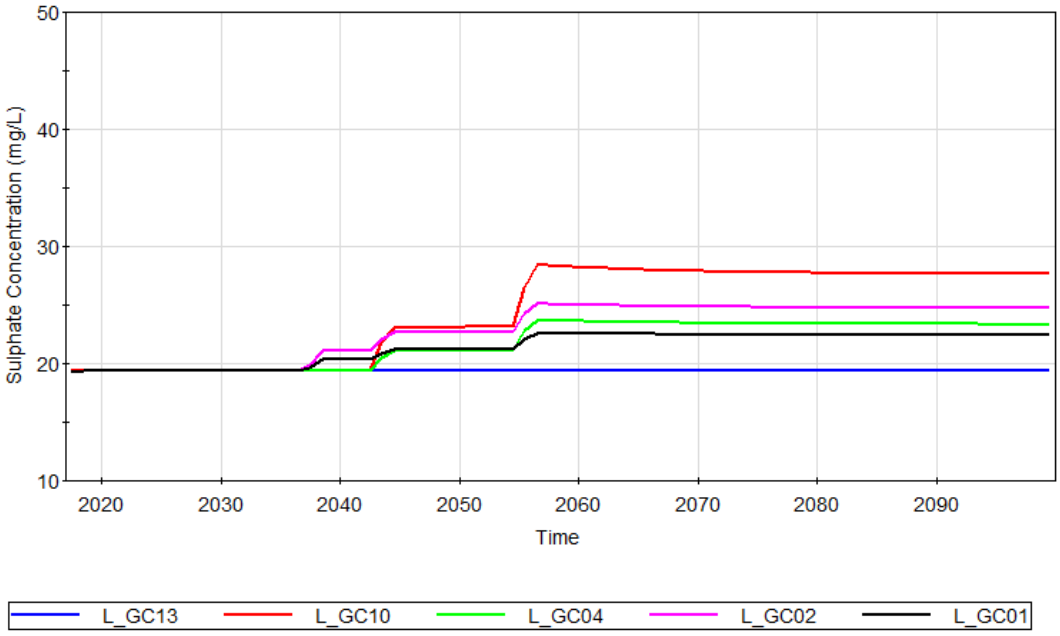


Figure 7-6: Predicted Sulphate Concentrations on Gold Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

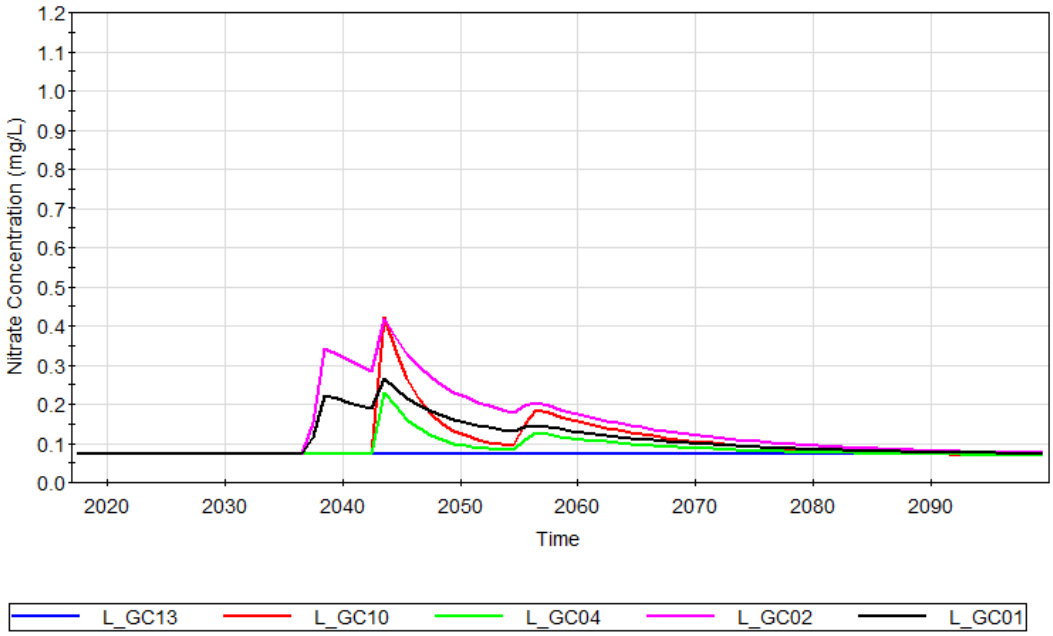


Figure 7-7: Predicted Nitrate Concentrations on Gold Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

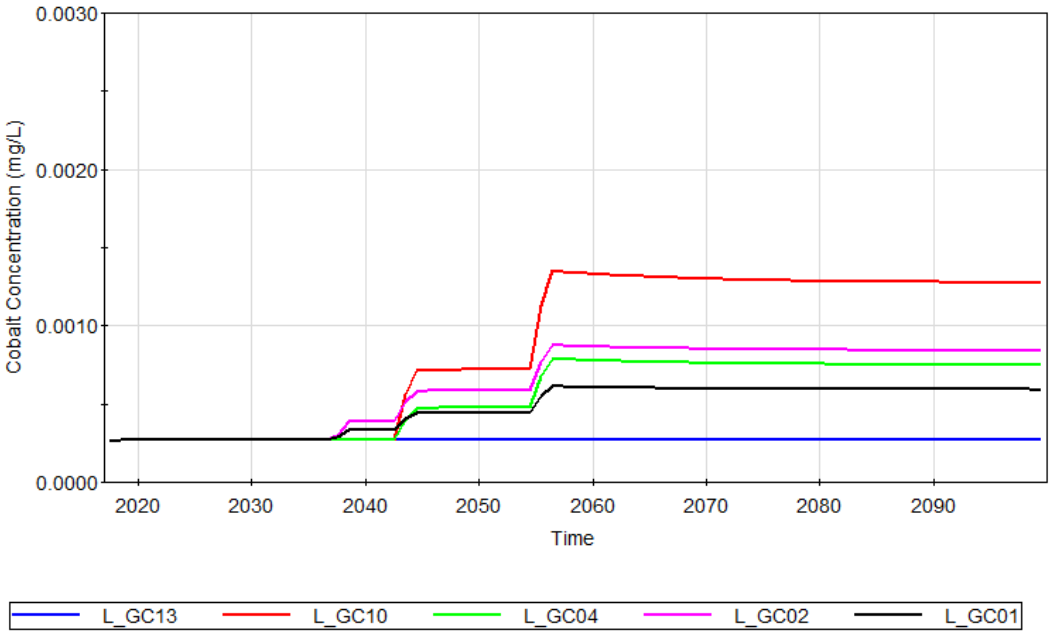


Figure 7-8: Predicted Cobalt Concentrations on Gold Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

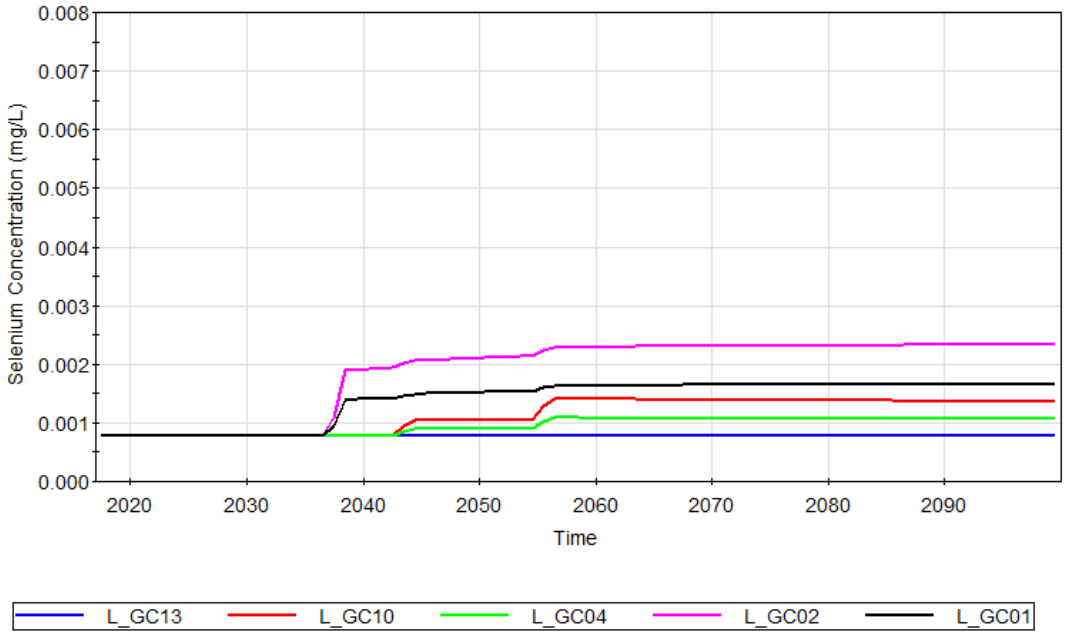


Figure 7-9: Predicted Selenium Concentrations on Gold Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

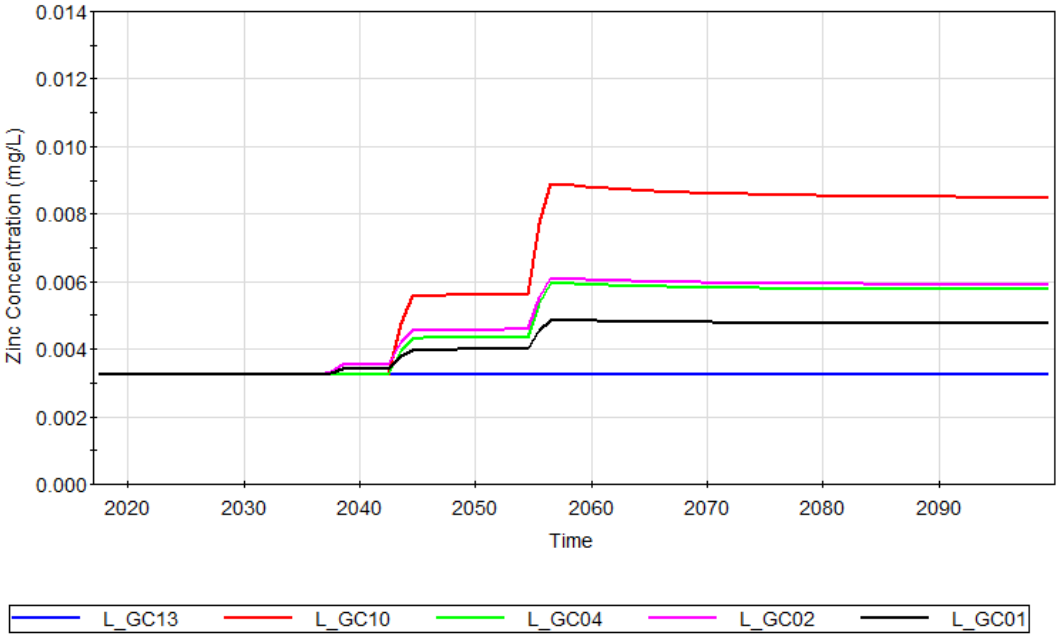


Figure 7-10: Predicted Zinc Concentrations on Gold Creek

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

7.3 Effluent Water Quality

7.3.1 Sedimentation and Surge Ponds

Water from the sedimentation ponds is intended to be captured, treated and released. If the quality does not meet the release criteria it can be directed towards the SZs as needed. The model conservatively assumes that pit wall runoff will need to be managed to the SZs.

Concentrations were generally low for sedimentation ponds. Only surge ponds that receive runoff from waste rock (NWSP, SESP and RWP) were predicted to have elevated parameter concentrations. Surge pond overflows were directed to the SZ during both the operations and closure phases of the mine.

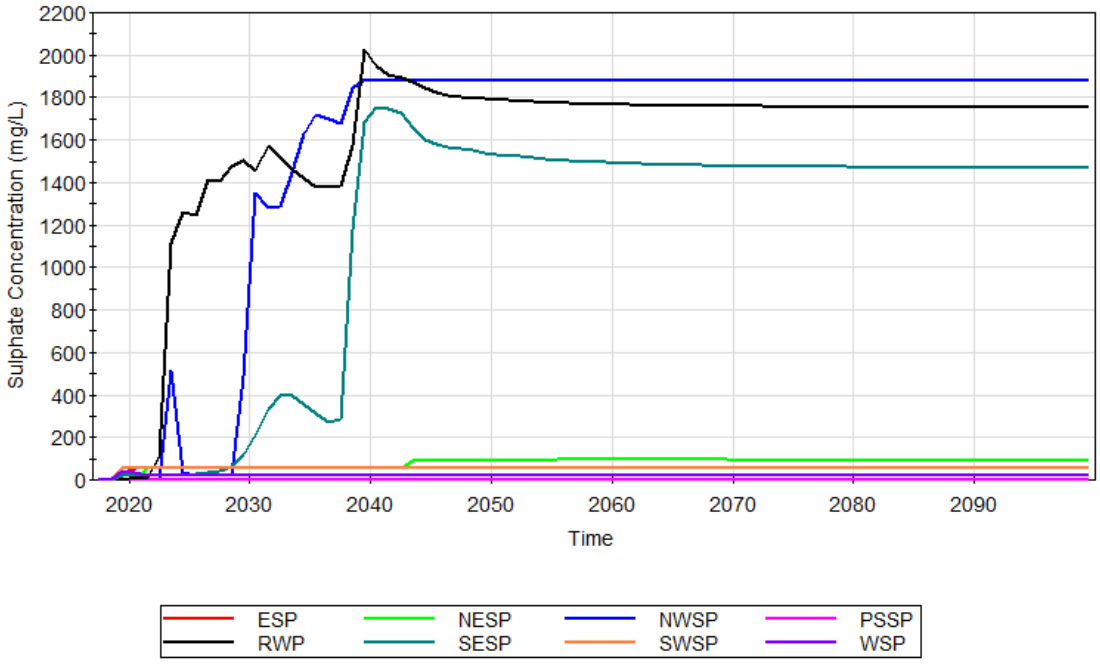


Figure 7-11: Predicted Sulphate Concentrations in Ponds

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

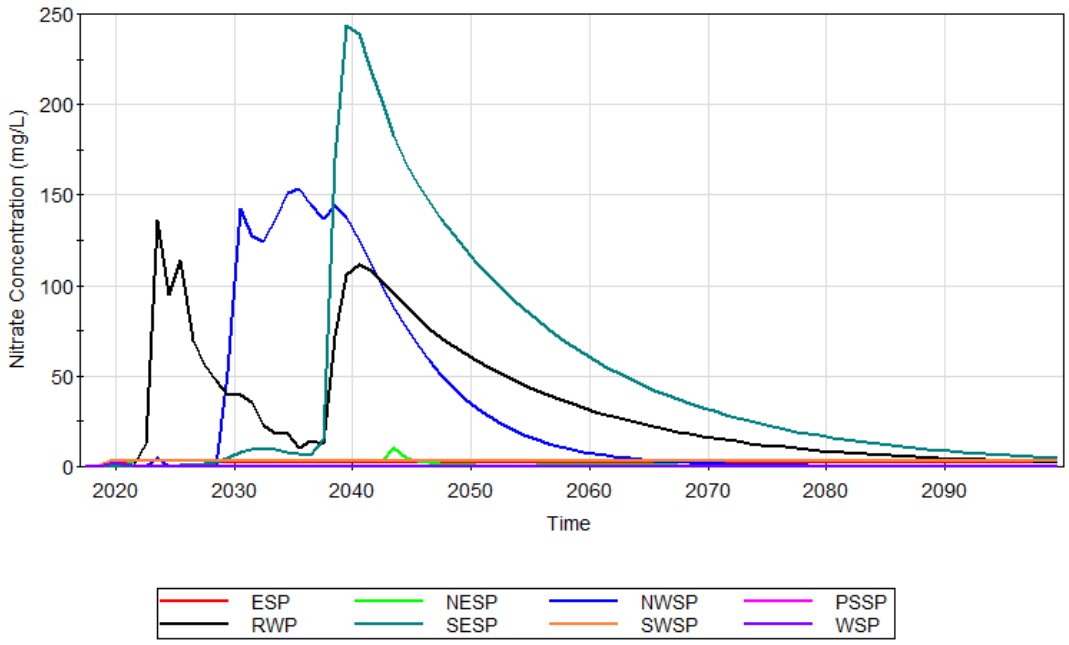


Figure 7-12: Predicted Nitrate Concentrations in Ponds

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

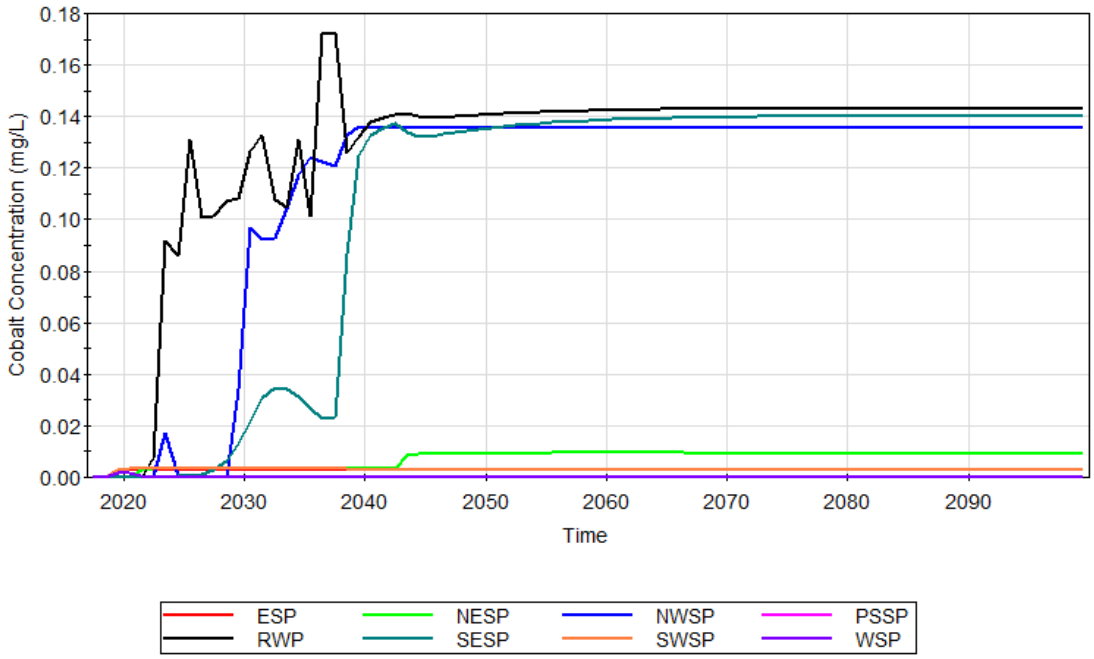


Figure 7-13: Predicted Cobalt Concentrations in Ponds

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

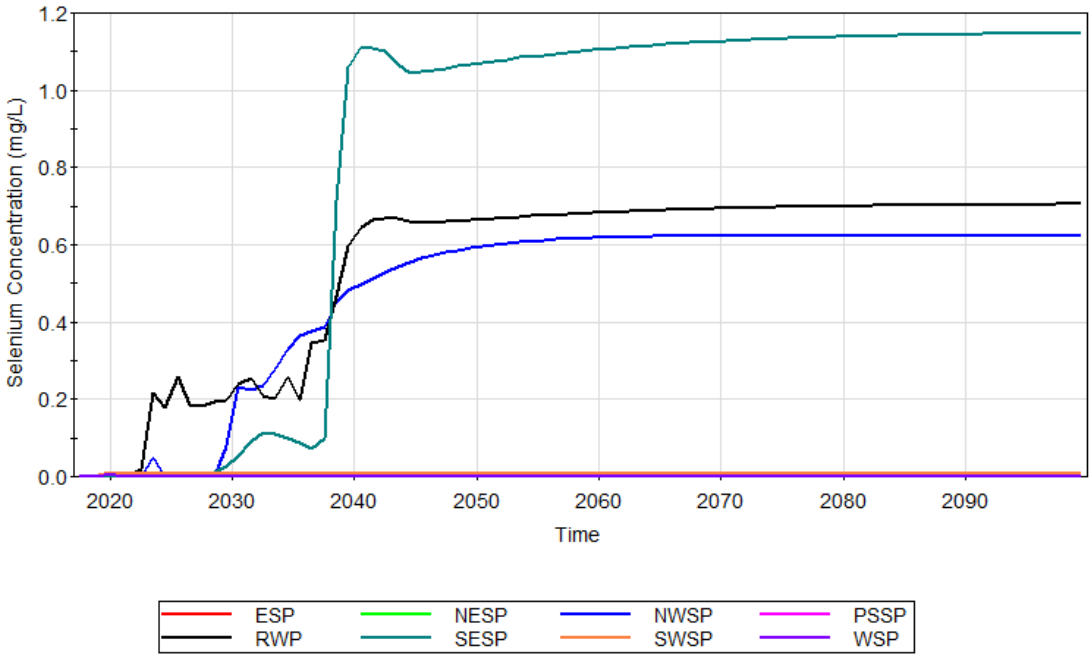


Figure 7-14: Predicted Selenium Concentrations in Ponds

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

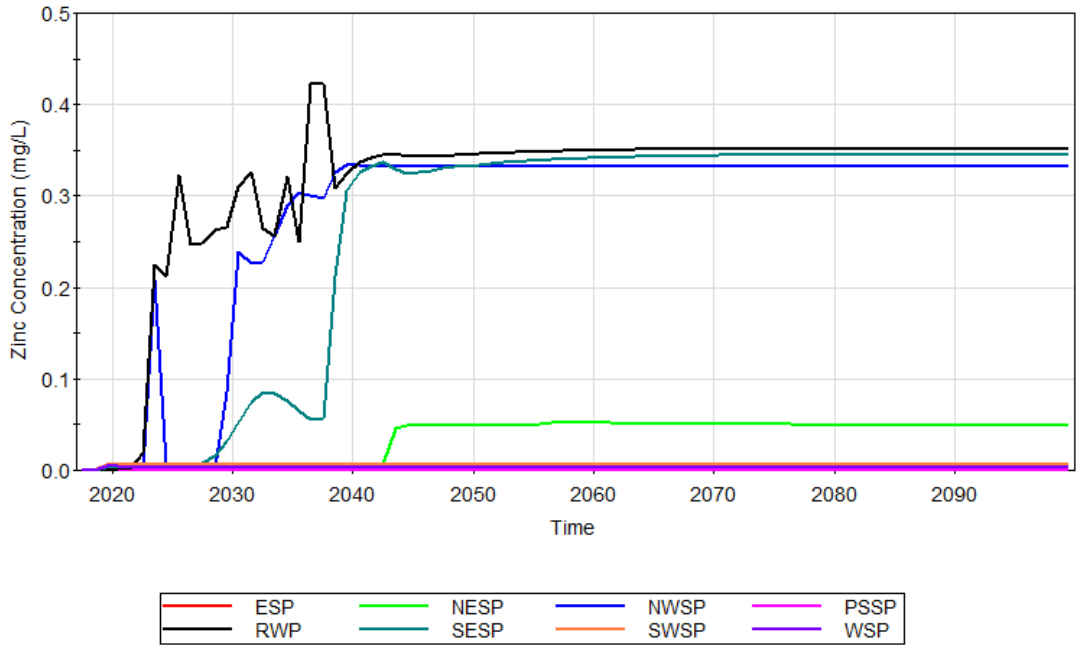


Figure 7-15 Predicted Zinc Concentrations in Ponds

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

7.3.2 Other Mine Facilities

Water from the SZs flows to Blairmore Creek as either leakage from the SZs or as treated effluent via the WTP.

The WTP is assumed to receive and treat water from the SZs. Prior to the SZ1 coming online, pit wall runoff was assumed to require collection and was directed to the WTP. This results in an initial spike in concentration in the WTP effluent prior to the commissioning of SZ1.

Effluent concentrations of parameters treated by the WTP (such as cobalt and zinc) are much lower than the predicted concentrations in the SZs. For parameters not treated by the WTP (such as sulphate, nitrate, and selenium), the WTP effluent concentrations are the same as the SZ concentrations. Because concentrations of these parameters are predicted to be the same, the results overlap in the figures.

Pit lake concentration predictions begin in the model upon closure, when the pit begins filling.

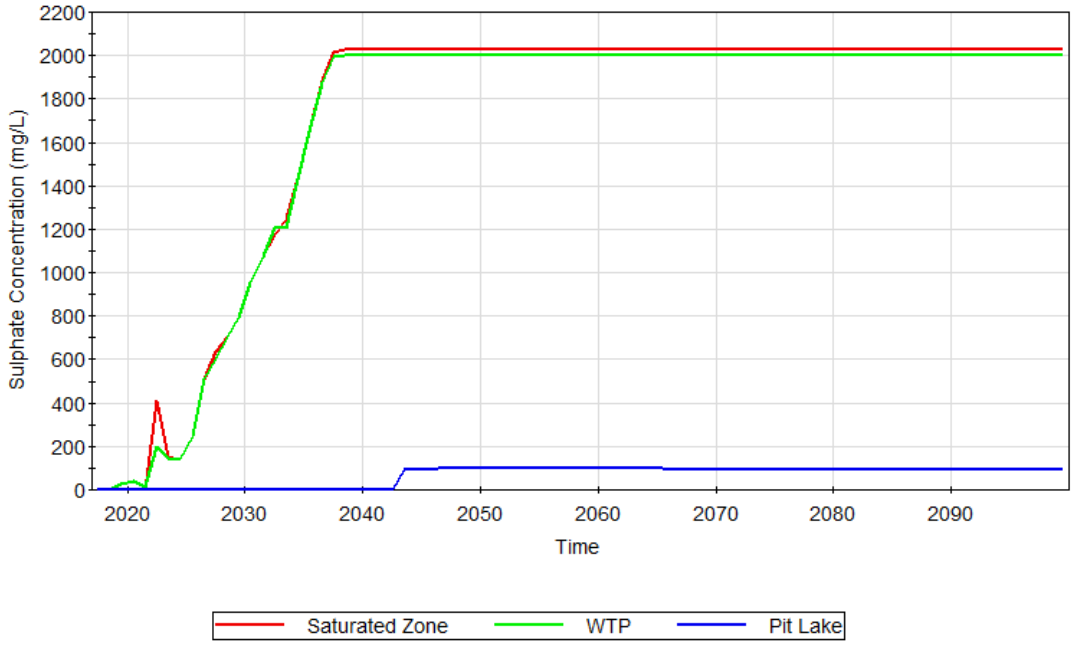


Figure 7-16: Predicted Sulphate Concentrations for Mine Facilities

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

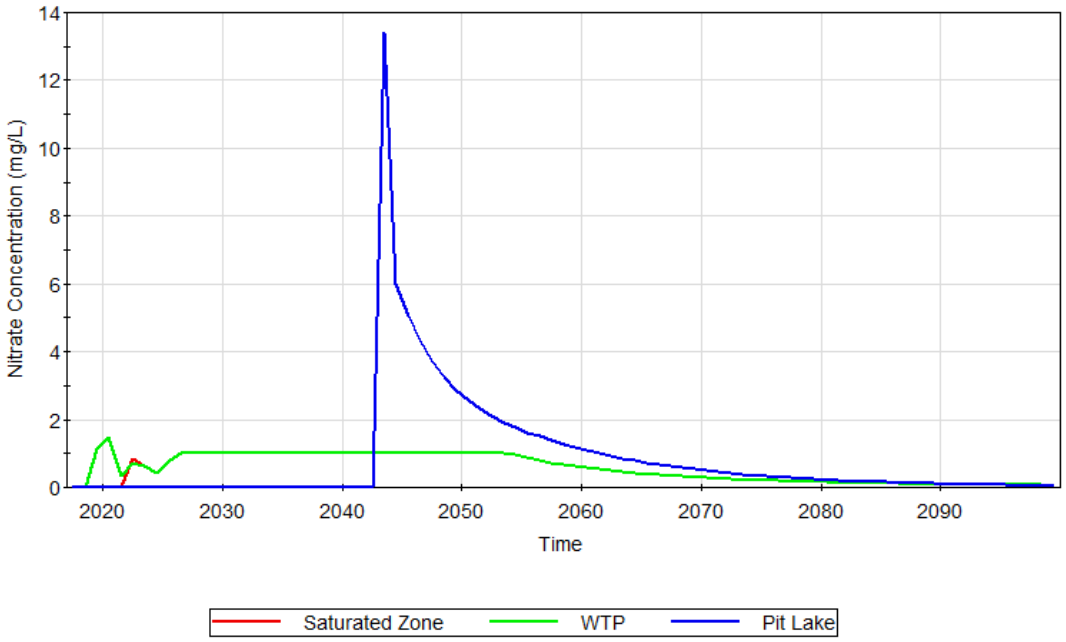


Figure 7-17: Predicted Nitrate Concentrations for Mine Facilities

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

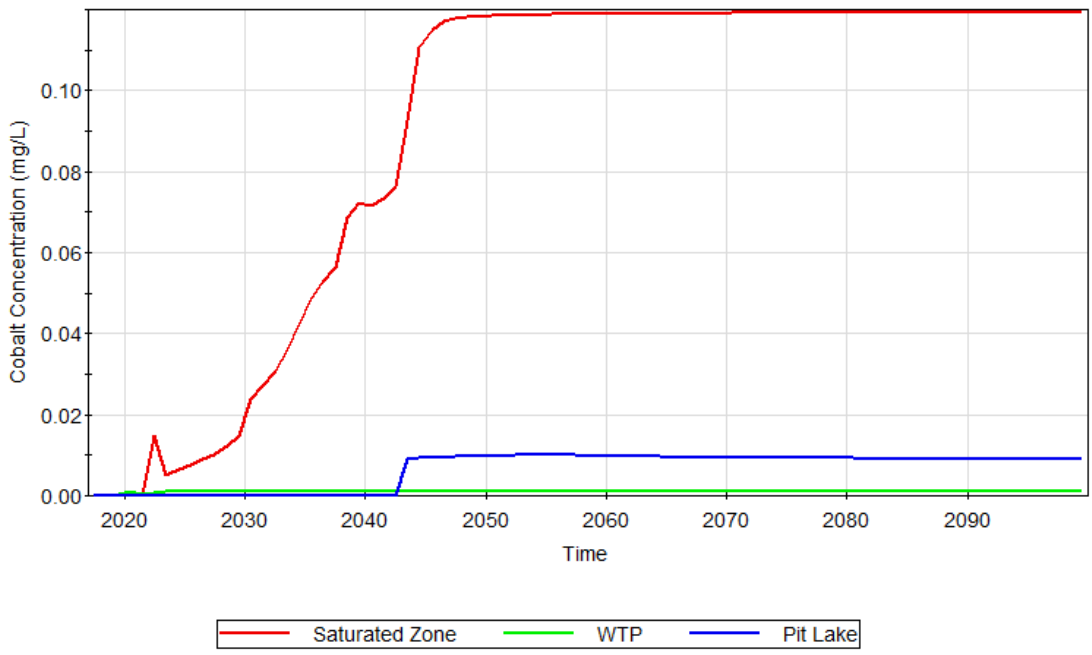


Figure 7-18: Predicted Cobalt Concentrations for Mine Facilities

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

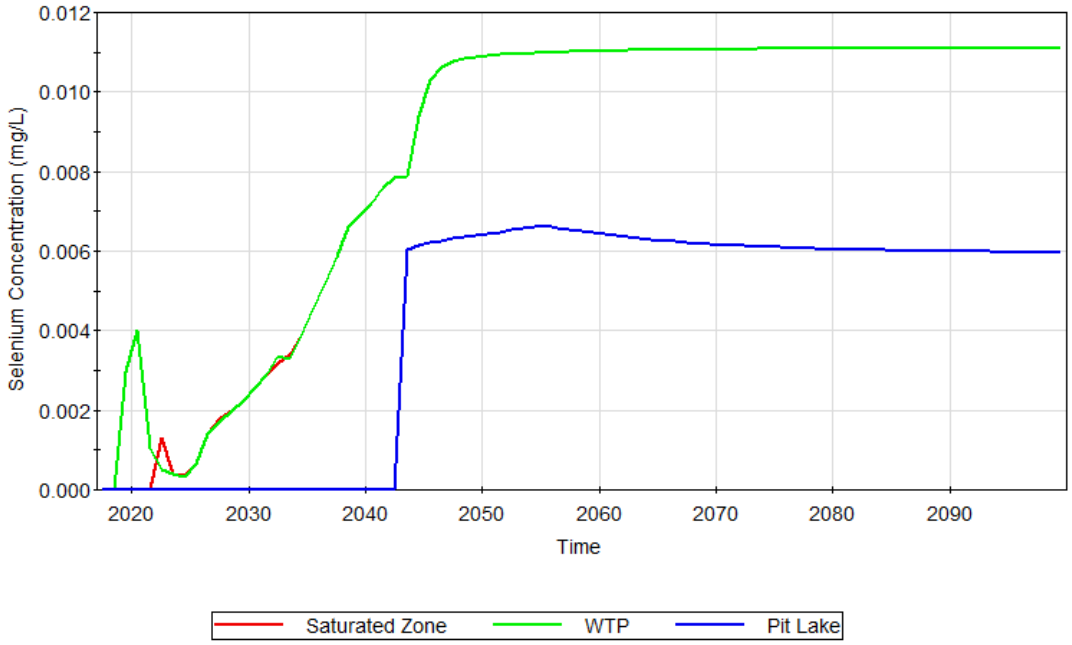


Figure 7-19: Predicted Selenium Concentrations for Mine Facilities

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

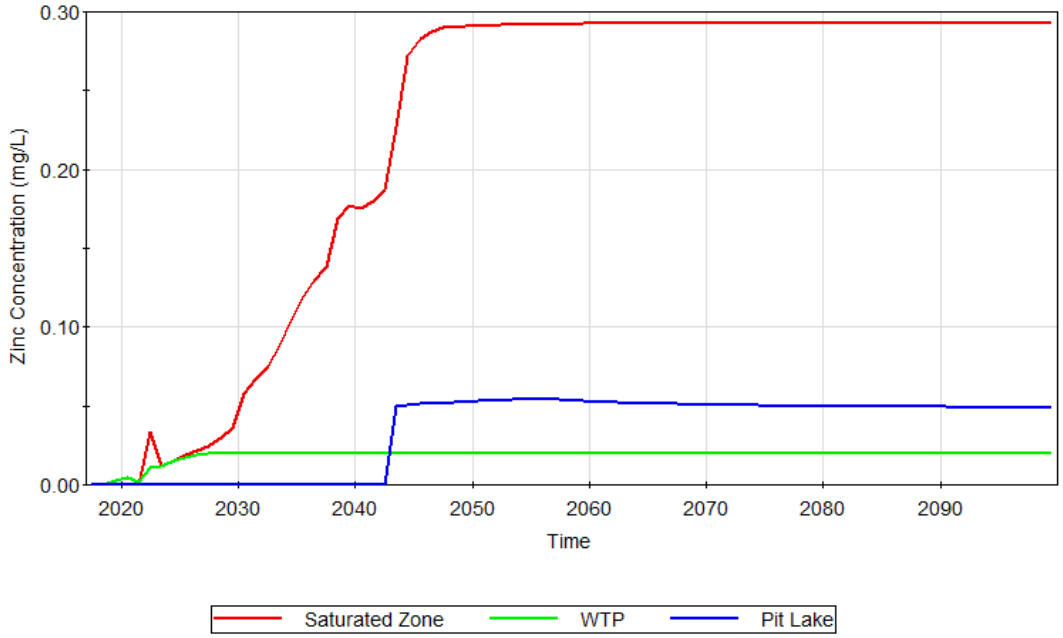


Figure 7-20: Predicted Zinc Concentrations for Mine Facilities

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

8 Model Evaluation

8.1 Model QA/QC

A thorough QA/QC procedure was used in evaluating the water and load balance model. Quality analysis of the model included the following:

- Verification that storages, inflows and outflows are correctly located and allocated to the right source and sink.
- Cross checking of flows to ensure they are not duplicated or missed.
- Checking of status elements and mine dates to ensure the timing of events is accurate according to the current mine plan.
- Verification of model functions and expressions to ensure they are working as intended.
- Professional judgement and experience to evaluate if results reflect the understanding of the project and model inputs.

8.2 Sensitivity Analysis

To account for uncertainty in the input parameters and to provide an understanding of how inputs affect the final results, a sensitivity analysis was completed. The analysis included variations in:

- Capture efficiency applied to contact water from the ex-pit waste rock disposal areas,
- Attenuation factor applied in the SZs,
- Pit wall thickness used to calculate the volume dependant generation rates of sulphate and selenium from the pit walls,
- Yield coefficient for reclaimed areas which, in the base case, assumes the objective of reclamation is stability only and not reduction in infiltration,
- Leakage rates from the pit lake and leakage rates from the SZs, input for both are based on the groundwater analysis.

Table 8.1 provides an outline of the scenarios modelled in the sensitivity analysis. The sensitivity range describes how much the variable that is being changed differs from the base case value. All of the sensitivity analysis scenarios were run under average hydrological conditions.

Table 8.1: Sensitivity Cases Modelled

Variable	Case	Description	Sensitivity Range
Capture Efficiency	1A	Base case capture efficiency	95% efficiency
	1B	Upper case capture efficiency	100% efficiency
	1C	Lower case capture efficiency	80% efficiency
Attenuation Factor	2A	Base case SZ attenuation factor	99% Se removal
	2B	Upper case SZ attenuation factor	99.9% Se removal
	2C	Lower case SZ attenuation factor	90% Se removal
Pit Wall Thickness	3A	Base case pit wall thickness	1 m
	3B	Upper case pit wall thickness	2 m
	3C	Lower case pit wall thickness	0.5 m
Leakage Rate from Saturation Zone	4A	Base case SZ leakage rate	x 1
	4B	Upper case SZ leakage rate	x 1.25
	4C	Lower case SZ leakage rate	x 0.75
Leakage Rate from Pit Lake	5A	Base case Pit Lake leakage rate	x 1
	5B	Upper case Pit Lake leakage rate	x 1.25
	5C	Lower case Pit Lake leakage rate	x 0.75

8.2.1 Capture Efficiency

The model sensitivity to the capture efficiency of ex-pit waste rock contact water was evaluated in the water quality at prediction node BC03 in Blairmore Creek. This prediction node is downstream of where contact water that has bypassed the capture system from the North, Central, and South rock disposal areas reports. Figure 8-1 presents the selenium concentrations at prediction node BC03 for capture efficiencies of 95% (Case 1A), 100% (Case 1B) and 80% (Case 1C) using Base Case source terms. Figure 8-2 the same sensitivity runs using Worst Case source terms.

The selenium concentration as predicted by the water and load balance model is very sensitive to the capture efficiency. With a capture efficiency of 100% using Base Case source terms (Figure 8-1, Case 1B), the selenium concentrations increased to 0.0035 mg/L at BC03 at closure and selenium concentrations do not return to background levels. A decrease in the capture efficiency from 95% to 80% leads to a more than twofold increase in concentration at closure, and concentrations would be higher with any further decrease in capture efficiency.

The sensitivity run completed using the Upper Case source terms show that predicted concentrations at with higher sources results in an approximate doubling at BC03. The system is highly sensitive to increased selenium loadings from the ex-pit waste rock disposal areas. Contact water from the ex-pit waste rock disposal areas is a significant source of load reporting to Blairmore Creek. Other sources include leakage from the SZs, water treatment effluent, and loads associated with natural sources (*i.e.,* background runoff).

The sensitivity of instream water quality to the ex-pit waste rock contact water capture efficiency demonstrates the need for this mitigation to work very well to achieve compliance.

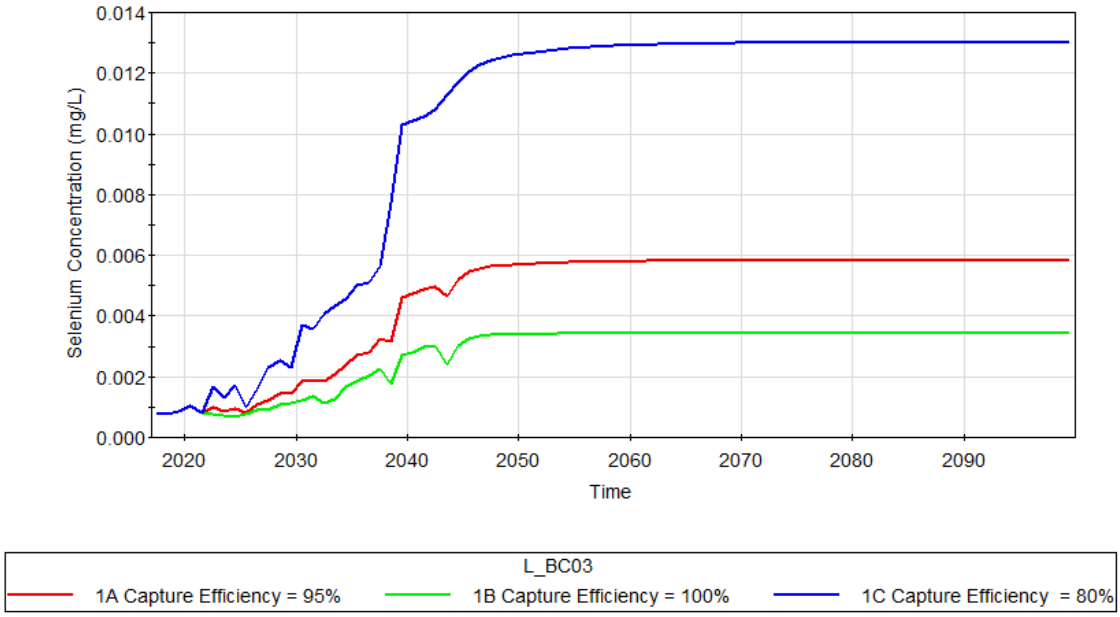


Figure 8-1: Selenium Concentration in Blairmore Creek for Varying Capture Efficiency of Ex-pit Waste Rock Contact Water using Base Case Source Terms

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

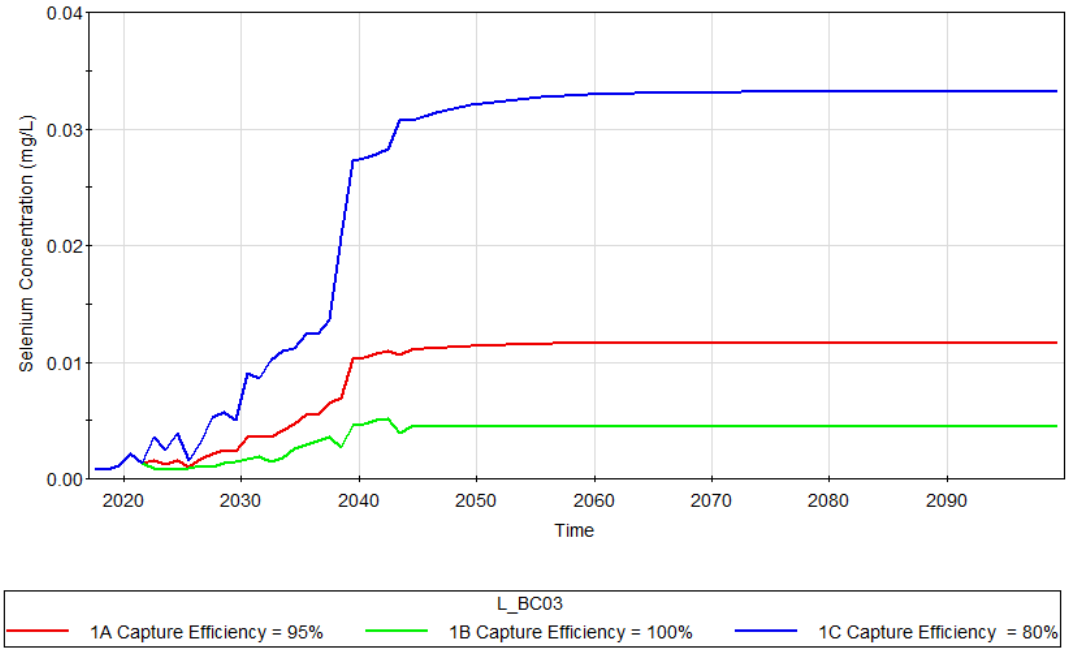


Figure 8-2: Selenium Concentration in Blairmore Creek for Varying Capture Efficiency of Ex-pit Waste Rock Contact Water using Worst Case Source Terms

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

8.2.2 Attenuation Factor

The attenuation factor for selenium impacts the concentration leaving the SZs. The model assumes that a maximum selenium concentration of 0.015 mg/L for the SZ effluent will be attained through engineering and addition of a carbon source if required. This maximum concentration was removed for this sensitivity analysis.

The sensitivity of the model was evaluated for the SZ effluent after attenuation is applied (Figure 8-3), and in Blairmore Creek at prediction node BC03 which is downstream of all effluent discharge from the water treatment plant (Figure 8-4). Attenuation factors of 99% (Case 2A), 99.9% (Case 2B) and 90% (Case 2C) were evaluated.

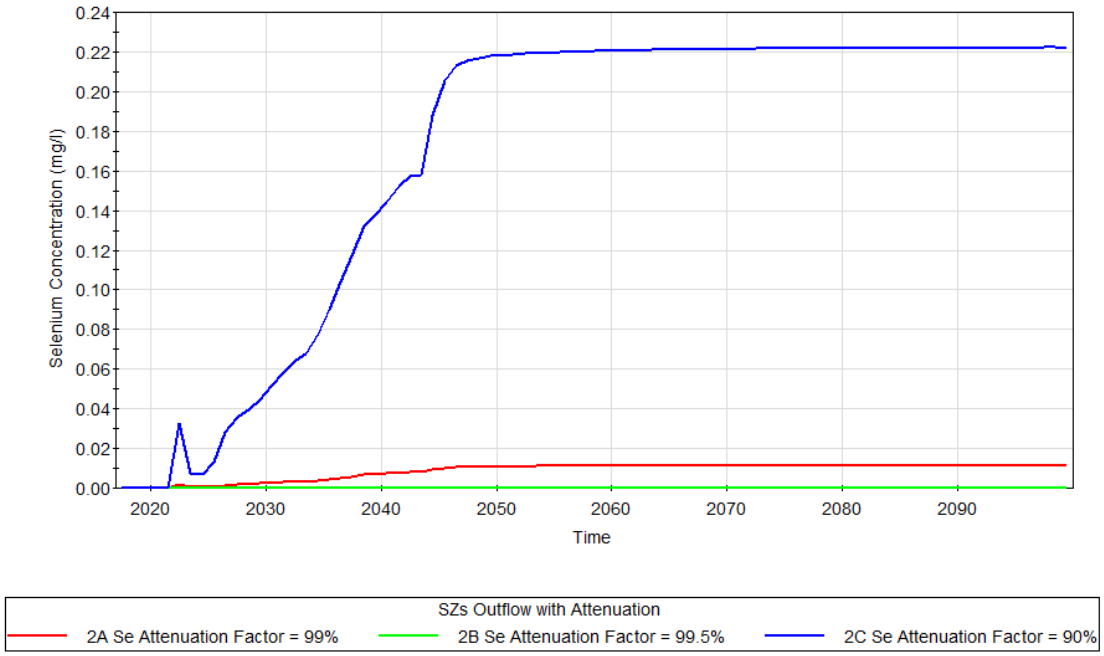


Figure 8-3: Selenium Concentration in the Saturation Zone (Post-Attenuation) for Base Case Source Terms for Varying Attenuation Factors for Selenium

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

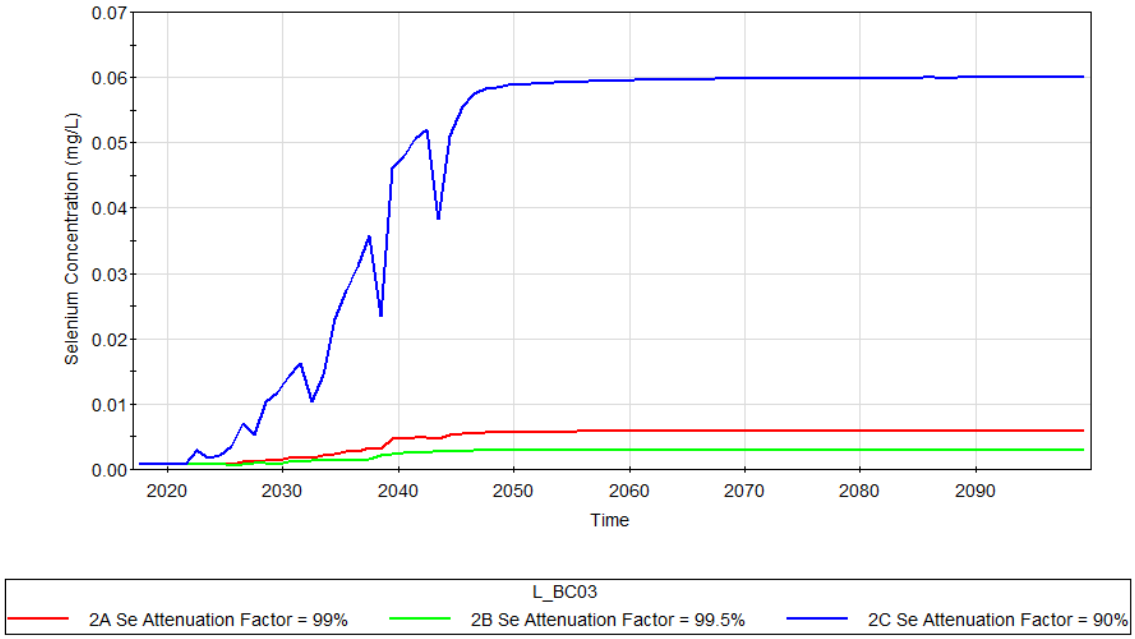


Figure 8-4: Selenium Concentration in Blairmore Creek for Base Case Source Terms for Varying Attenuation Factor for Selenium

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

As Figure 8-3 demonstrates, the SZ concentration is very sensitive to the attenuation factor. SZ water is a major source of selenium loads to Blairmore Creek via two flow paths: direct leakage from the SZs and via the water treatment plant effluent. The sensitivity of selenium concentrations in Blairmore Creek to the attenuation factor is shown in Figure 8-4. A decrease in attenuation from 99.9% to 99% attenuation doubles the concentrations at closure. A decrease in attenuation to 90% would result in much higher selenium concentrations.

The SZs will need to be engineered and a carbon source will be applied if necessary to achieve the performance required (SRK 2016b). However, this sensitivity highlights the need for effective mitigation and management of the engineered SZs.

8.2.3 Pit Wall Thickness

The sensitivity of model results to a change in pit wall thickness is evaluated for parameters for which generation rates are dependent on rock volume (*i.e.,* parameters associated with blasting residues). Results are evaluated in the pit lake (Figure 8-5) and downstream at node GC10 (Figure 8-6) for pit wall rubble thicknesses of 1 m (Case 3A), 2 m (Case 3B) and 0.5 m (Case 3C).

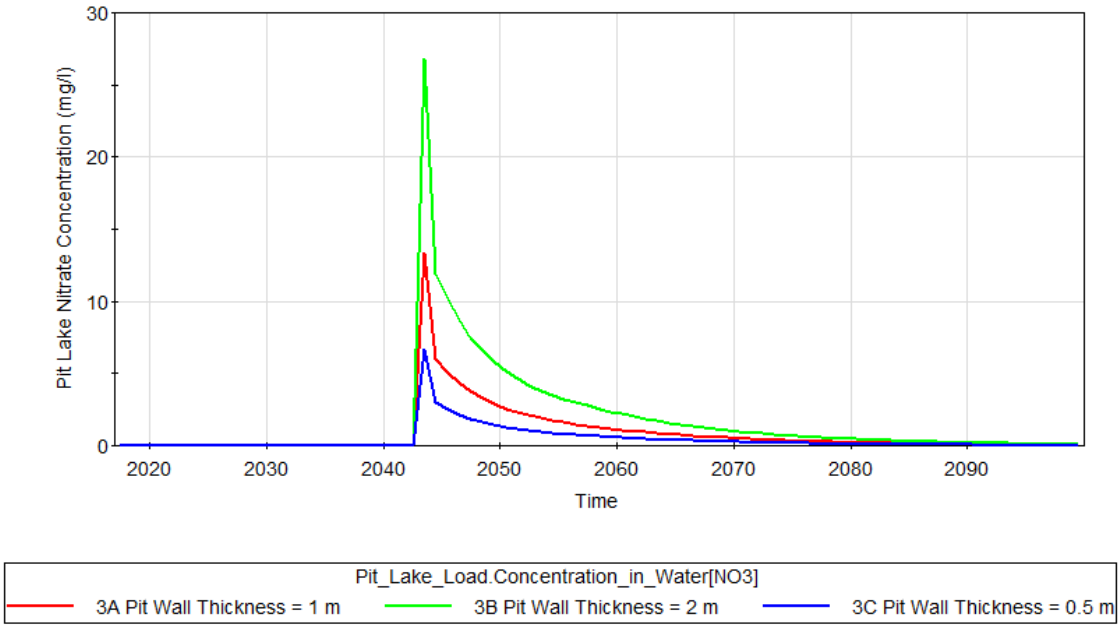


Figure 8-5: Nitrate Concentrations in Pit Lake water for Varying Pit Wall Thickness

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

Nitrate loads only appear during blasting, and as the pit lake fills and discharges the concentrations decay. Changing the pit wall thickness impacts the initial load to the pit wall and the rate of this decay.

Prediction node GC10 receives pit run-off and the overflow from the pit lake. The predicted concentrations at the prediction node are illustrated in Figure 8-6 and reflect the initial decay of the loads from pit walls, with a new peak in concentrations occurring in 2054 after the pit lake overflows. The nitrate concentrations in the creek are highly sensitive to the pit wall thickness. The predicted concentrations at the prediction node remain low even with a pit wall thickness of 2 m. A pit wall thickness of 1m was used in the model.

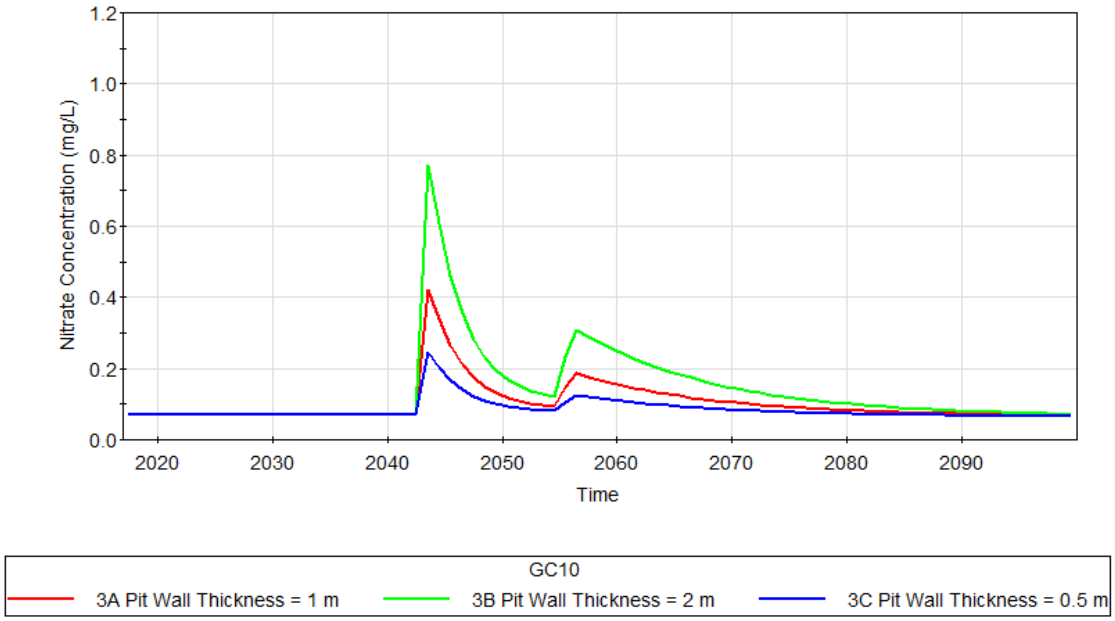


Figure 8-6: Nitrate Concentrations at Prediction Node GC-10 for Varying Pit Wall Thickness

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

8.2.4 Leakage Rate from Saturation Zones

The sensitivity of model results to a change in leakage rate from the SZs of 25% from base case conditions is evaluated for sulphate in Blairmore Creek at prediction node BC03, immediately downstream of the mine area. The results are presented in Figure 8-7 for the base case SZ leakage (Case 4A), an increase in leakage of 25% (Case 4B) and a decrease in leakage of 25% (Case 4C). The sulphate concentrations are not significantly impacted and the model is not very sensitive to this variable.

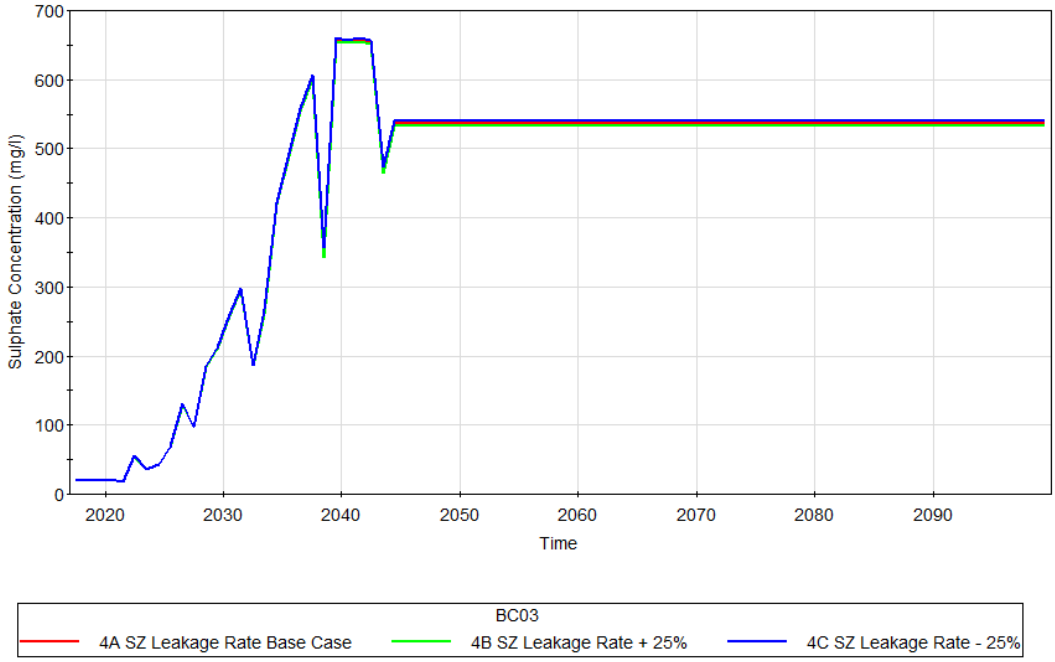


Figure 8-7: Sulphate Concentration in Blairmore Creek for Varying Saturation Zone Leakage Rates

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

8.2.5 Leakage Rate from Pit Lake

The sensitivity of model results to a change in leakage rate from the pit lake is evaluated for sulphate in Gold Creek at prediction node GC10, where pit lake leakage reports (Figure 8-8). The results are presented in Figure 8-8 for the base case pit lake leakage (Case 5A), an increase in leakage of 25% (Case 5B) and a decrease in leakage of 25% (Case 5C). The sulphate concentrations are not significantly impacted and the model is not very sensitive to this variable.

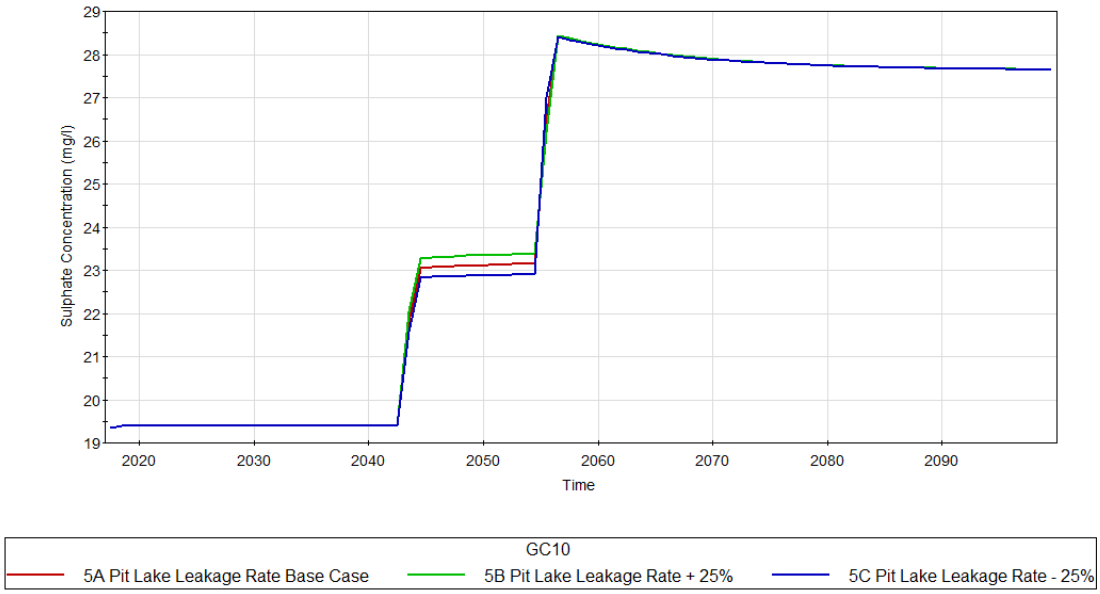


Figure 8-8: Sulphate Concentration in Gold Creek for Varying Pit Lake Leakage Rates

Source: P:\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\Task300_WaterLoadBalance\Model_Files\ GrassyMountainWQ_1CM029-011_Rev20_MCN_CAJ.gsm

9 Conclusions

SRK developed a water and load balance model to predict flows and water quality for the Grassy Project from construction to post-closure in support of various regulatory applications.

The model assessed options to mitigate potential effects on water quality resulting from the project. The predictions presented here are only valid if all the mitigation measures are implemented. The following mitigations options were implemented in the model:

1. Capture of contact water from the waste rock disposal areas combined with natural attenuation of seepage through groundwater flow paths with an efficiency of 95% load removal on the Blairmore Creek side and 98% load removal on the Gold Creek side,

2. Attenuation of 99% of selenium, 95% of nitrate and 95% of nitrite in the engineered SZs,

3. Treatment of any contact water that has been passed through the SZ for metals in a Water Treatment Plant, and,

4. Mitigation of 80% of loadings generated by acidic rock types in exposed pit walls at closure.

The water balance model was run stochastically to determine a probability distribution of potential flow conditions at the predictions nodes, including a range of wet and dry years. The water quality predictions were generated deterministically for a Base Case and Upper Case. Results for the full list of parameters were presented and trends in water quality were discussed for each Blairmore and Gold creeks. The following general conclusions were drawn:

- Discharge of water from the SZs via the WTP dominate water quality effects at prediction nodes on Blairmore Creek.
- Bypass of the contact water capture system and leakage and overflow from the pit lake dominate water quality effects at prediction nodes on Gold Creek.

Modelling geochemical source terms, groundwater flows and (to a lesser extent) surface water yields generate outputs that are conservative but are order-of-magnitude estimates. The water and load balance model is a tool to aid in decision making for water management strategies for the project. The results of the model for the Project point to the importance of effective implementation of mitigation measures.

Flow and water quality results from this work will be used to evaluate effects on toxicity of aquatic species and fish (Hatfield Consultants 2016).

This report, Grassy Mountain Water and Load Balance Model, was prepared by

<Original signed by>

Christina James, M.A.Sc., Senior Consultant

and

<Original signed by>

Marie-Christine Noël, B. Eng., Consultant

and reviewed by

<Original signed by>

Tom Sharp, PhD, PE, PEng, Principal Consultant

<Original signed by>

Stephen Day, PGeol, Corporate Consultant and Practice Leader

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Millennium EMS Solutions Ltd.. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

10 References

Hatfield Consultants Ltd. 2016. Riversdale Resource Grassy Mountain Coal Project: Surface Water Quality Environmental Impact Assessment Report. Prepared for Benga Mining Ltd. August 2016.

Millennium EMS Ltd. (MEMS). 2015. Email from Jim McQuaid. Explosive Usage. Received September 11, 2015.

Benga Mining Limited (Benga). 2016. Grassy Mountain Coal Project - Environmental Impact Assessment. Prepared by Benga Mining Limited operating as Riversdale Resources Ltd. Submitted to Alberta Energy Regulator and the Canadian Environmental Assessment Agency. August 2016.

Nautilus Environmental. 2015. Evaluation of uptake of selenium in waters associated with the Grassy Mountain project. Submitted to Hatfield Consultants.

SRK Consulting Ltd. (SRK) 2015. Grassy Mountain Coal Project Water Quality Prediction Model. Prepared by SRK for Millennium EMS Ltd. Project Number: 1CM029.010. November 2015.

SRK Consulting Ltd. (SRK) 2016a. Grassy Mountain Project Geochemical Characterization Report. Prepared by SRK for Millennium EMS Ltd. Project Number: 1CM029.008. August 2016.

SRK Consulting Ltd. (SRK) 2016b. Grassy Mountain Water Quality Management. Prepared by SRK for Millennium EMS Ltd. Project Number: 1CM029.011. August 2016.

SRK Consulting Inc. (SRK) 2016c. Grassy Mountain Surface Hydrology Baseline and Effects Assessment. Prepared by SRK for Benga Mining Ltd. Project Number: 1CM029.007. August 2016.

SRK Consulting Inc. (SRK) 2016d. Grassy Mountain Coal Project, Groundwater Numerical Model 2016. Prepared by SRK for Millennium EMS Ltd. Project Number: 1CM029.011. August 2016.

Appendix A – Qualitative Assessment of Calcite Precipitation

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532
vancouver@srk.com
www.srk.com

Memo

To:	File	**Client:**	Riversdale
From:	Stephen Day	**Project No:**	1CM029.008
Cc:		**Date:**	August 9, 2016
Subject:	Qualitative Assessment of Calcite Precipitation, Grassy Mountain Project - DRAFT		

1 Background

Calcite precipitation is an observed effect in creeks in the Elk Valley, British Columbia where waters containing dissolved calcium carbonate emerge from waste rock dumps and equilibrate with the atmosphere (MacGregor et al. 2012). Equilibration results in off-gassing of carbon dioxide which in turn increases pH and allows calcite to precipitate. Precipitation can occur over several kilometres of streams and can result in cementation of streambeds (Robinson and MacDonald 2014). Effects may be limited where waste rock dump waters are diluted by mixing with waters containing low levels of dissolved calcium carbonate. This results in dilution of the contact waters so that calcium and carbonate concentrations are below levels required to precipitate calcite.

Since the coal measures at Grassy Mountain are hosted by rocks containing sulphide and carbonate minerals, it is expected that weathering processes in waste rock will result in acid generation which will be internally neutralized by reaction with carbonate minerals. The resulting contact waters are therefore expected to contain dissolved calcium carbonate under CO_2 partial pressures exceeding the ambient atmosphere. Calcite precipitation can be expected as contact waters emerge and CO_2 off-gassing occurs.

2 Qualitative Assessment of Calcite Precipitation Potential

Baseline water chemistry in Blairmore and Gold Creeks has been determined to contain calcium and carbonate at concentrations yielding calcite saturation indices of 0.6 where 0 indicates the theoretical level at which calcite would precipitate. Therefore, the natural waters appear to have no capacity to prevent calcite precipitation in streams by dilution and management of the potential for calcite precipitation needs to be considered for the Project.

3 Mitigation Measures

Teck Coal (2014) has considered a number of measures to address potential for calcite precipitation downstream of locations where drainage emerges. These include active treatment to

precipitate calcite, measures to remove alkalinity (carbonate), passive cascade systems to encourage near source precipitation, and anti-scalants to prevent calcite precipitation.

SRK recommends that monitoring plans include surveys for calcite deposits using the methods described by Teck Coal (2013) as a basis for development of appropriate mitigation measures which may include treatment.

SRK Consulting (Canada) Inc.

Stephen Day, PGeol
Corporate Consultant (Geochemistry)

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Riversdale. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

4 References

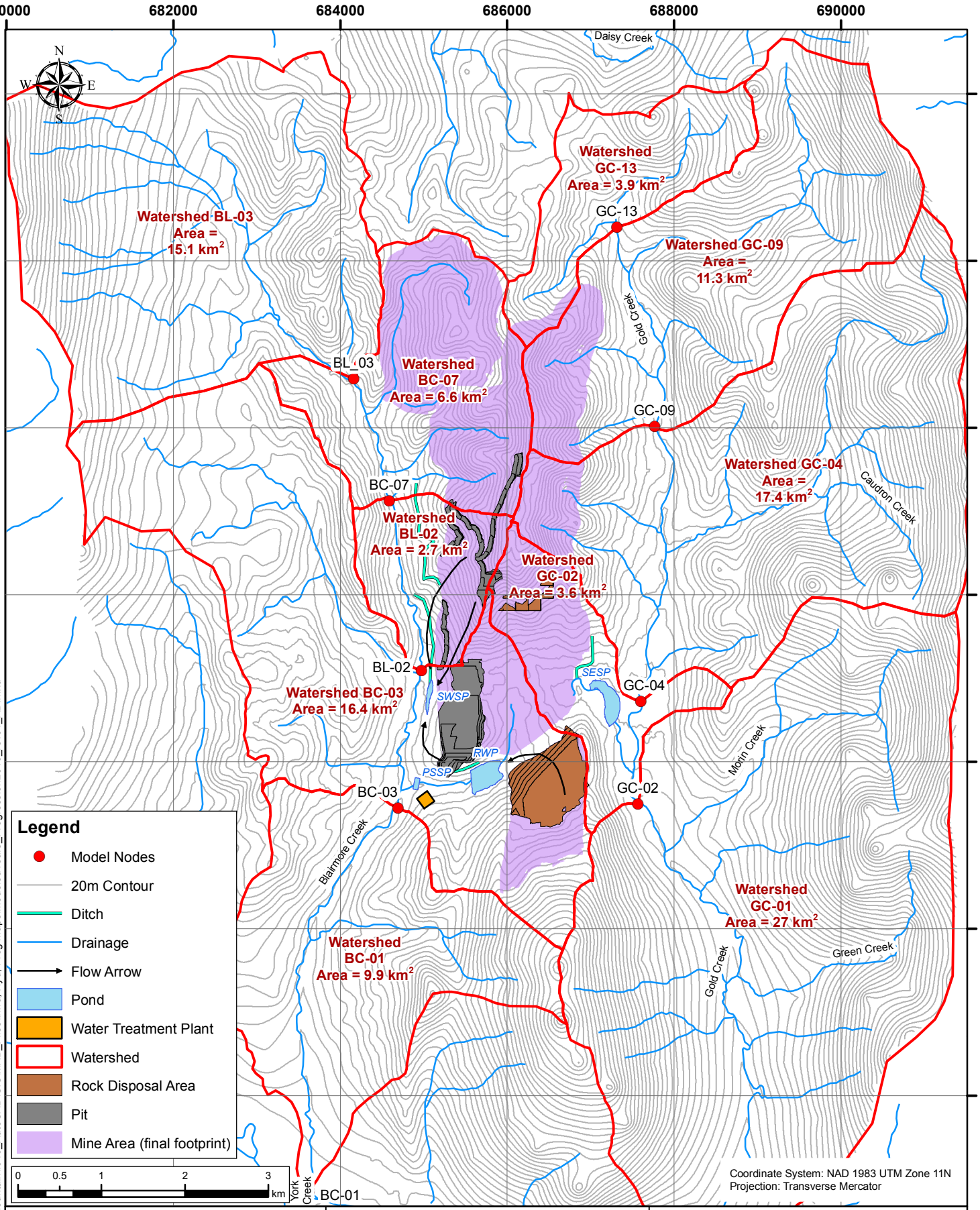
MacGregor, D., Day, S and Lopez, G. 2012. Investigations of Calcite Deposits in Streams Downstream of Coal Waste Rock Dumps, British Columbia and Alberta, Canada. Proceedings of the 9th International Conference on Acid Rock Drainage. Ottawa, ON, May 2012.

Robinson, M.D. and R.J. MacDonald. 2014. Teck Coal Ltd 2013 Calcite Monitoring Program – Elk Valley operations summary report. Prepared by Lotic Environmental Ltd. 12 pp + appendices. Available at http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/area-based-man-plan/annexes/j3_2013_calcite_monitoring_program.pdf (accessed Sep 18, 2015).

Teck Coal Ltd. 2013. Approach and Methodology to Monitor and Assess Calcite Impact. Available at http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/area-based-man-plan/annexes/j1_approach_methodology_monitor_assess_calcite_impact.pdf (accessed Sep 18, 2015).

Teck Coal Ltd. 2014. Elk Valley Water Quality Plan Annex J.2 Calcite Treatment Technologies. Available at http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/area-based-man-plan/annexes/j2_calcite_treatment_technologies.pdf (accessed Sep 18, 2015).

Appendix B – Catchment Delineation Maps



srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 1 (2019) Mine Progression

Job No: 1CM029.011

Filename: ModeledYears_Progression2019_rev01_AD

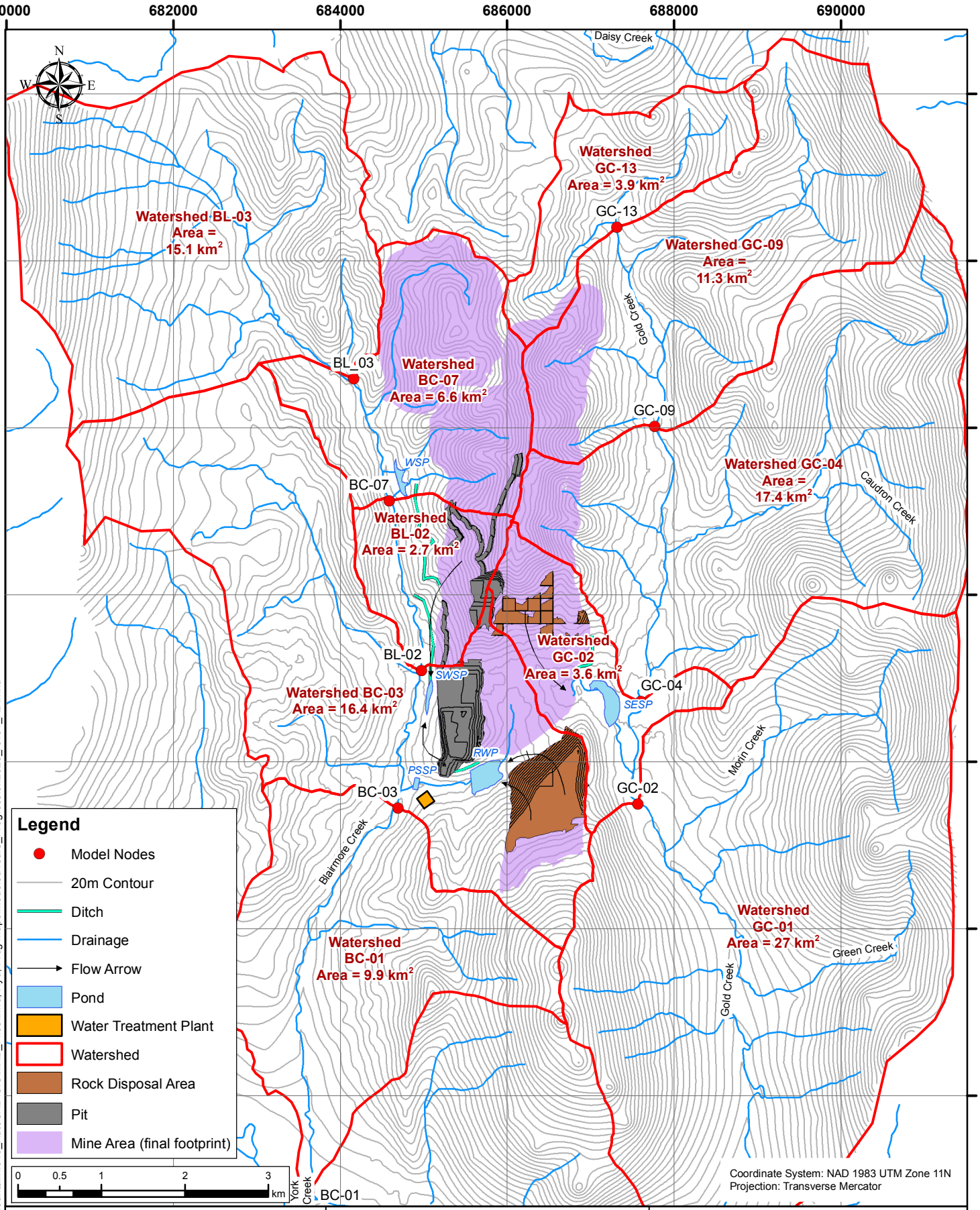
Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-1

Path: Z:\01_SITES\Grassy Mountain\1040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2019_rev01_AD.mxd



srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 2 (2020) Mine Progression

Job No: 1CM029.011

Filename: ModeledYears_Progression2020_rev01_AD

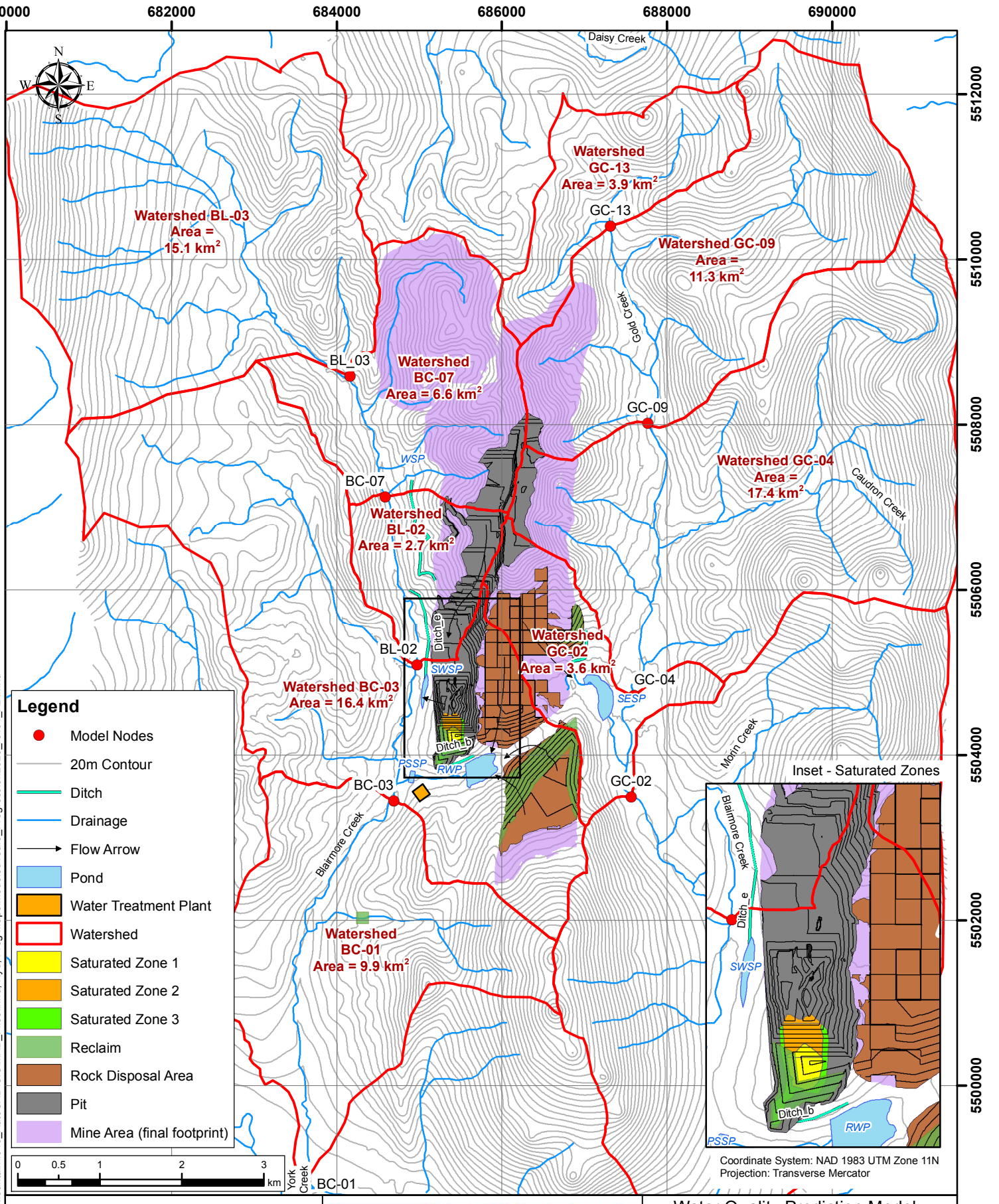
Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-2

Path: Z:\01_SITES\Grassy Mountain\1040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2020_rev01_AD.mxd



Path: Z:\01_SITES\Grassy Mountain\040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2023_rev01_AD.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 5 (2023)
Mine Progression

Job No: 1CM029.011

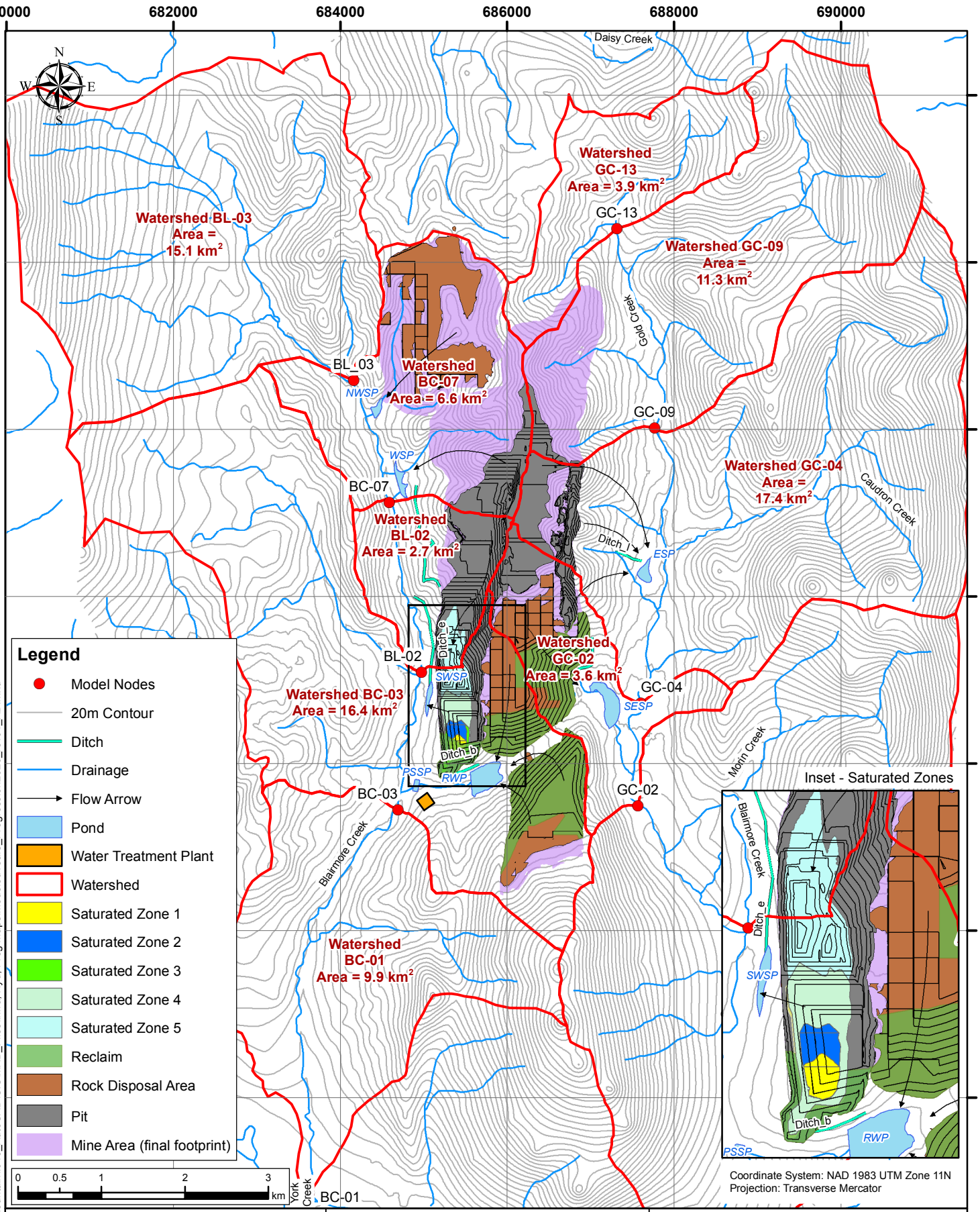
Filename: ModeledYears_Progression2023_rev01_AD

Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-3



Path: Z:\01_SITES\Grassy Mountain\1040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2026_rev01_AD.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 8 (2026) Mine Progression

Job No: 1CM029.011

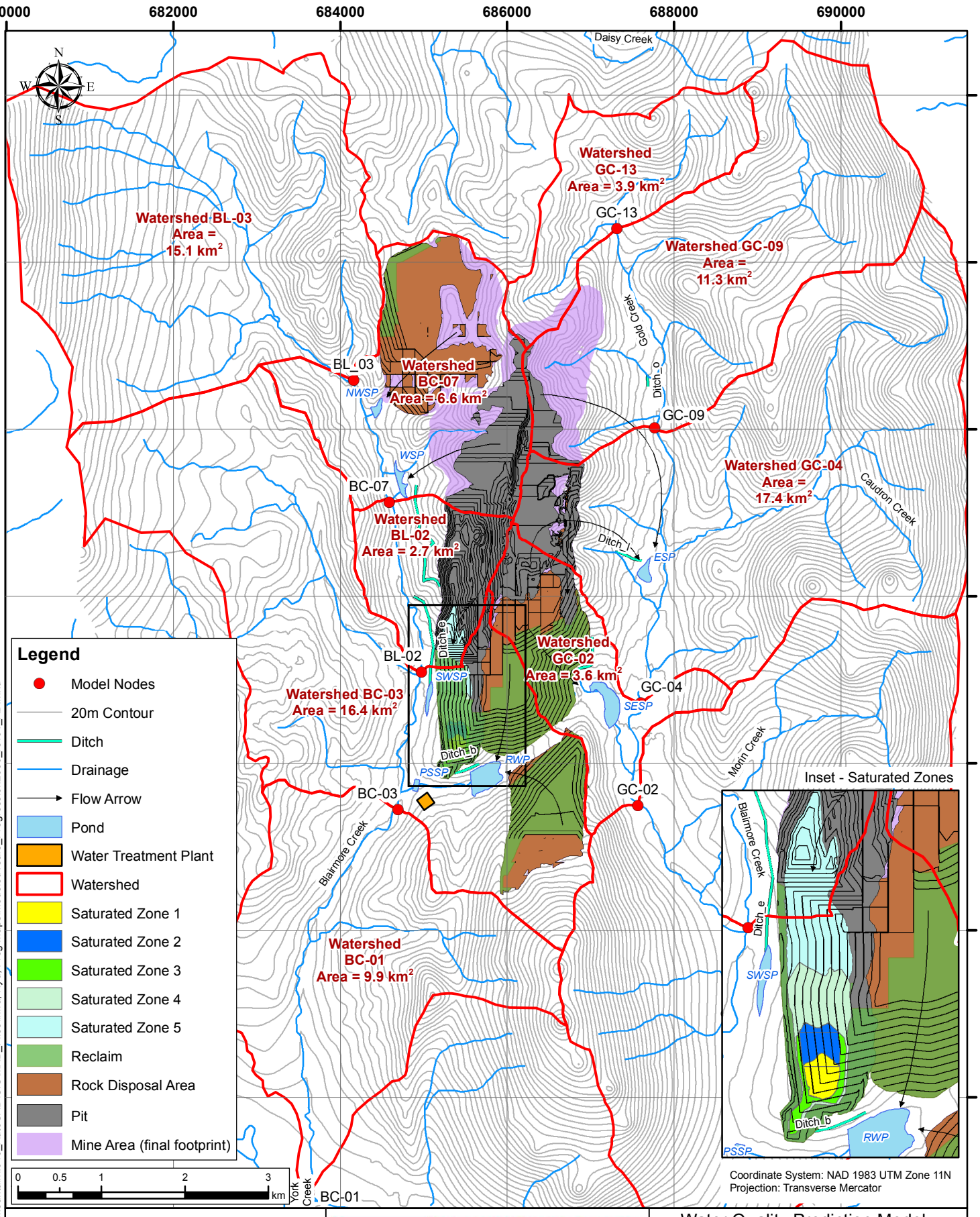
Filename: ModeledYears_Progression2026_rev01_AD

Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-4



Path: Z:\01_SITES\Grassy Mountain\1040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2030_rev01_AD.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 12 (2030) Mine Progression

Job No: 1CM029.011

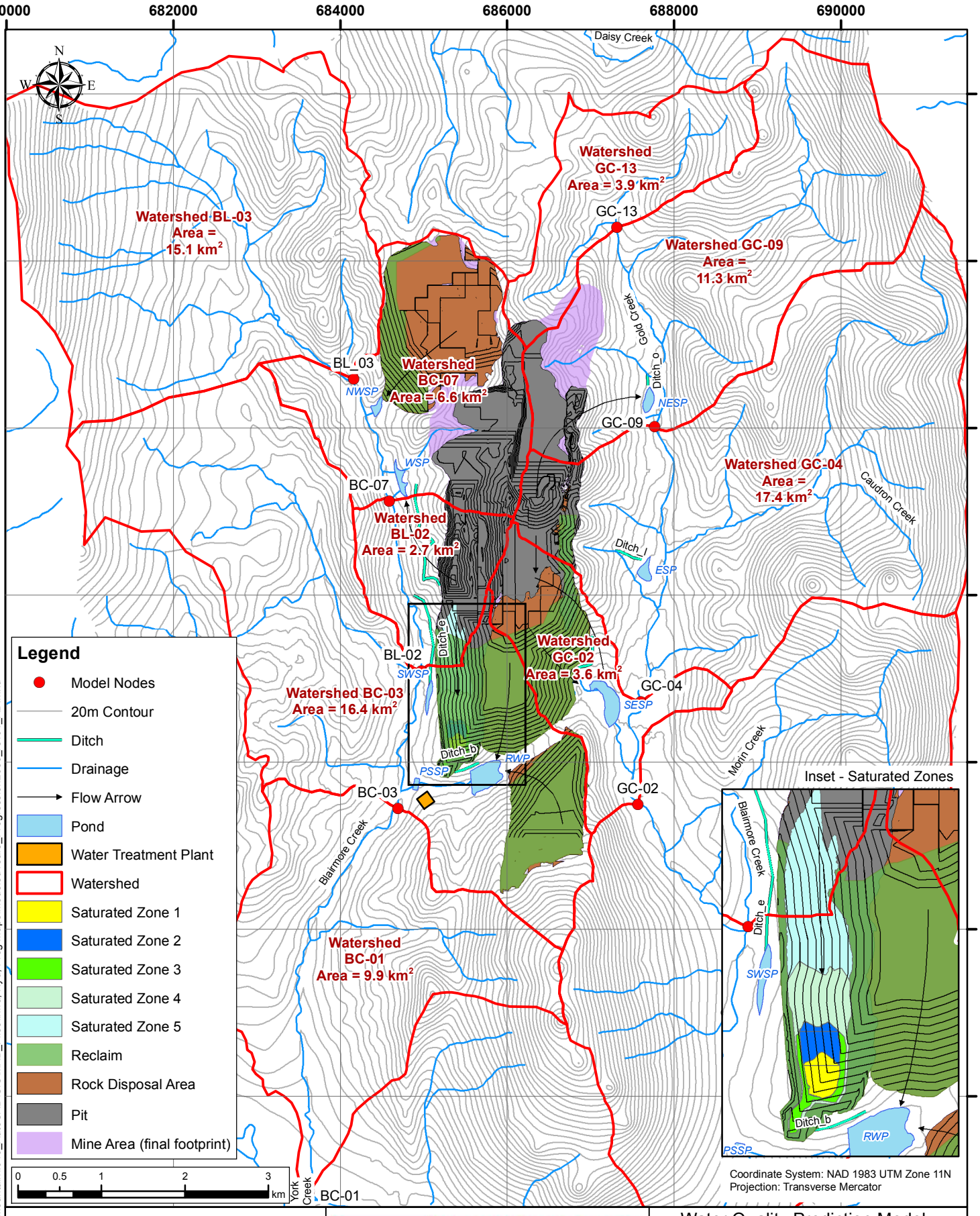
Filename: ModeledYears_Progression2030_rev01_AD

Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-5



Path: Z:\01_SITES\Grassy Mountain\040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2033_rev01_AD.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 15 (2033) Mine Progression

Job No: 1CM029.011

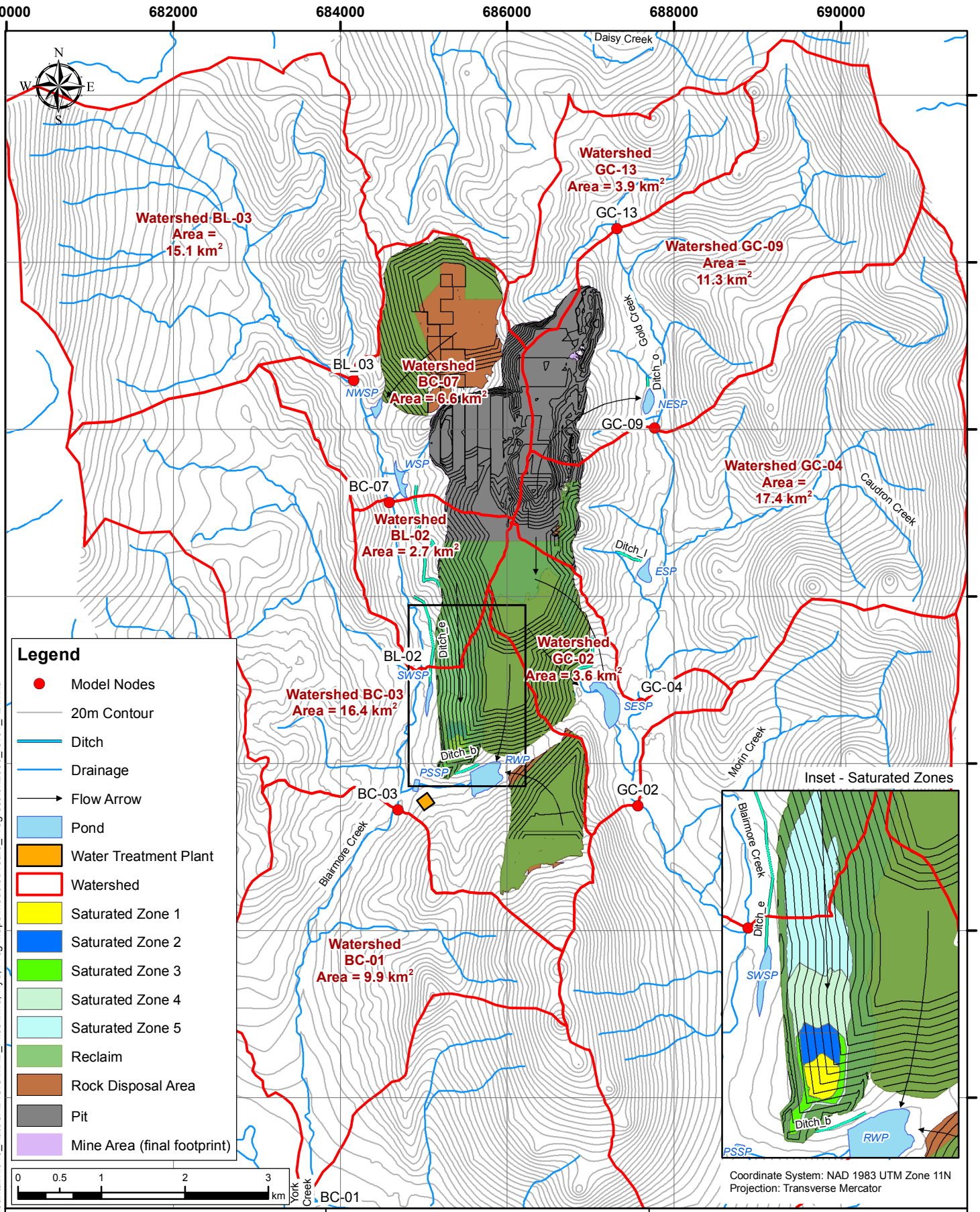
Filename: ModeledYears_Progression2033_rev01_AD

Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-6



Path: Z:\01_SITES\Grassy Mountain\1040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2038_rev01_AD.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 20 (2038) Mine Progression

Job No: 1CM029.011

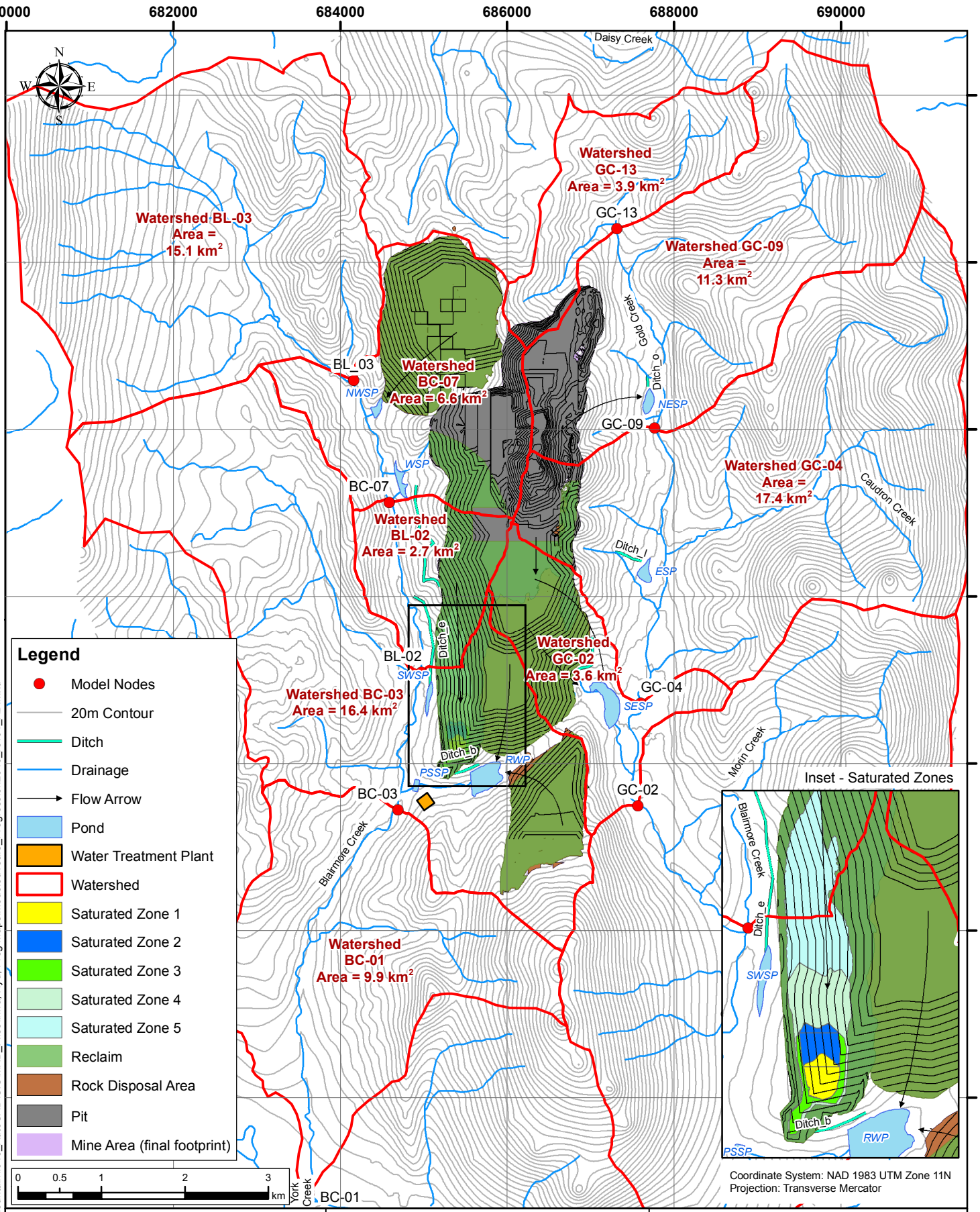
Filename: ModeledYears_Progression2038_rev01_AD

Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-7



Path: Z:\01_SITES\Grassy Mountain\1040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2040_rev01_AD.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 22 (2040) Mine Progression

Job No: 1CM029.011

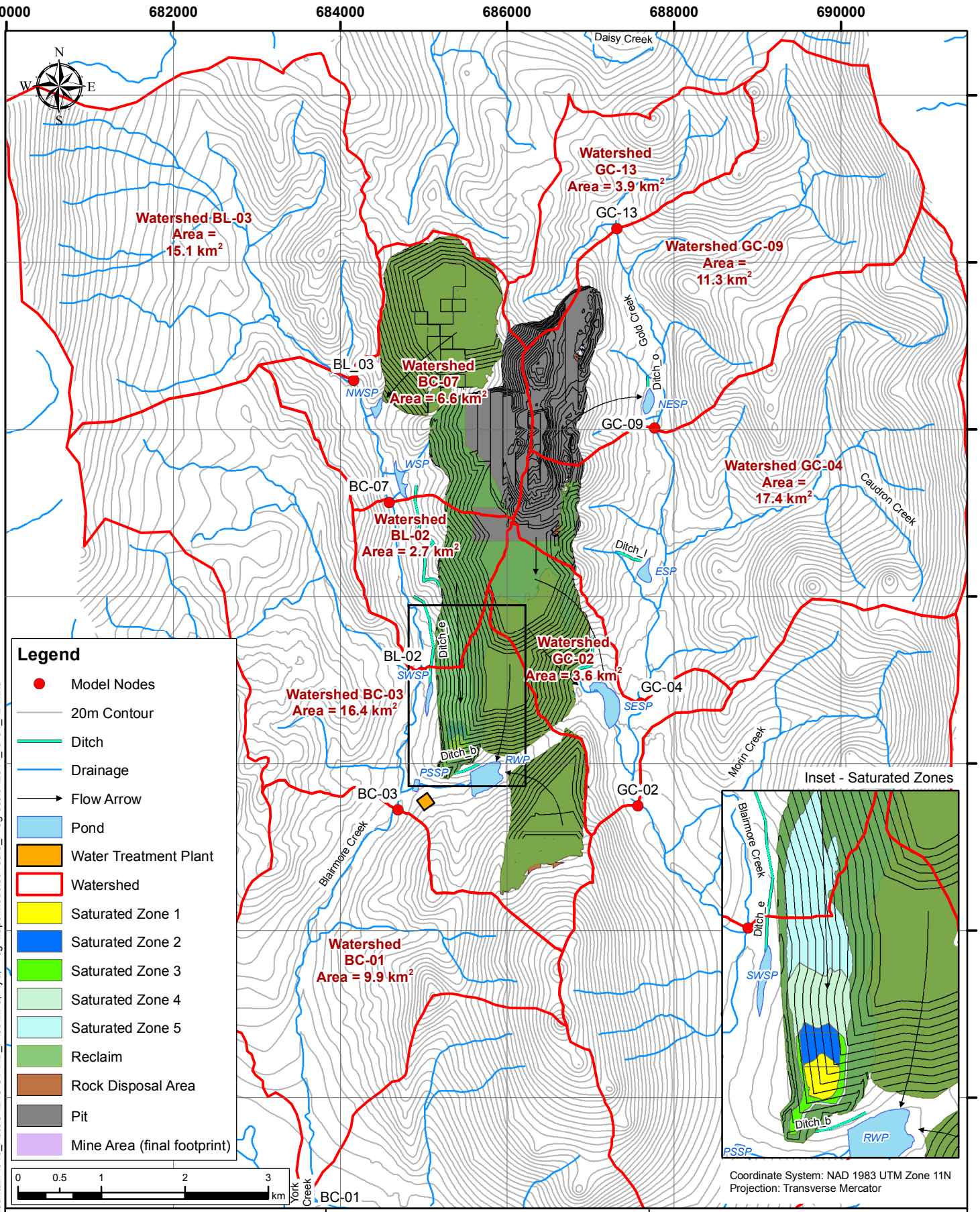
Filename: ModeledYears_Progression2040_rev01_AD

Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-8



Path: Z:\01_SITES\Grassy Mountain\1040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_Progression2041_rev01_AD.mxd

srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

Year 23 (2041) Mine Progression

Job No: 1CM029.011

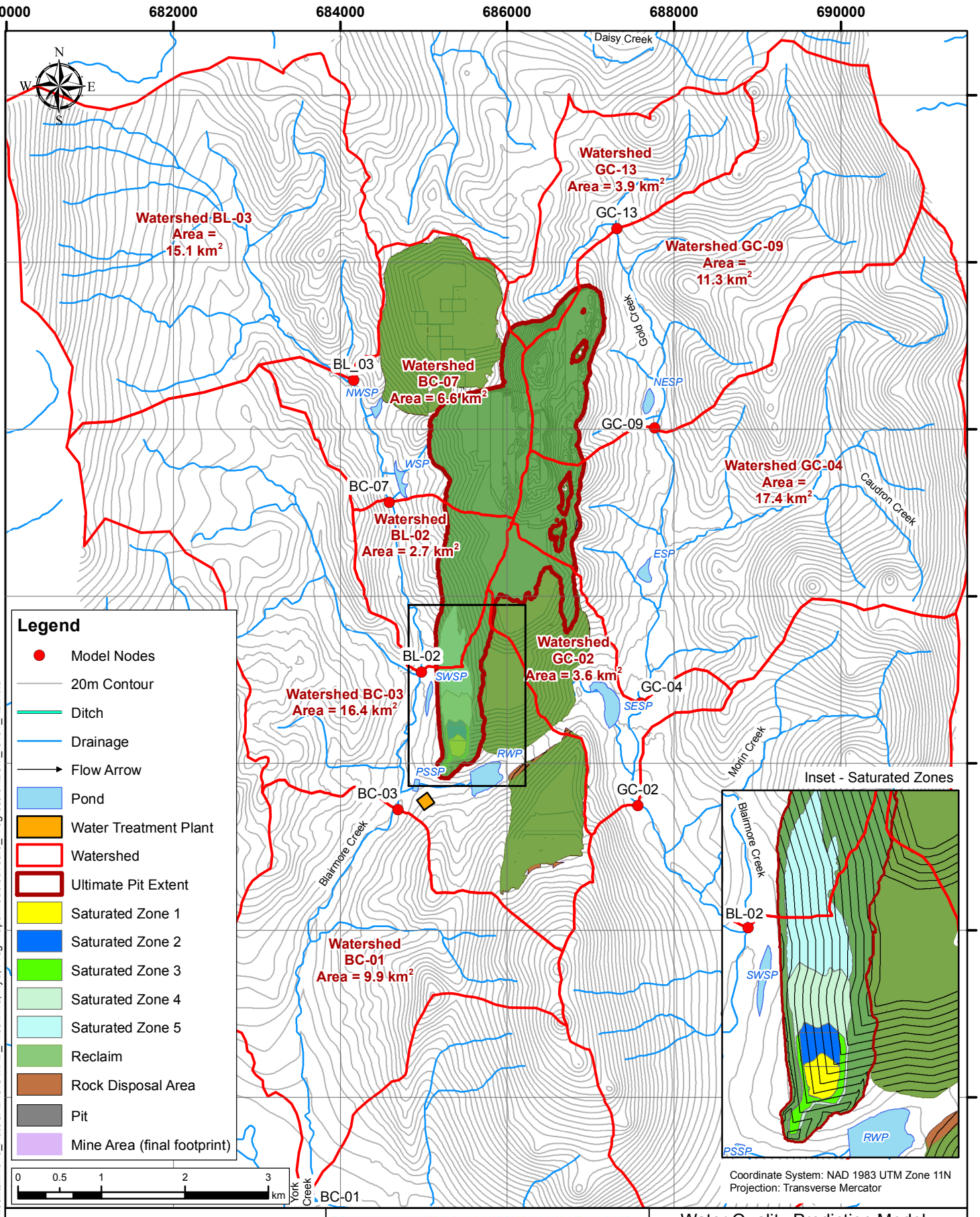
Filename: ModeledYears_Progression2041_rev01_AD

Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: B-9



srk consulting

RIVERSDALE RESOURCES

Water Quality Prediction Model

EOM
Mine Progression

Job No: 1CM029.011

Filename: ModeledYears_ProgressionEOM_rev01_AD

Grassy Mountain Coal Project

Date: Aug 10, 2016

Approved: MC

Figure: **B-10**

Path: Z:\01_SITES\Grassy Mountain\1040_AutoCAD\GIS\MXD_Files\Infra, Hyd, Prog Maps\ModeledYears_ProgressionEOM_rev01_AD.mxd

Appendix C – Source Terms

Parameter	Unit	Average Source Term	95th Percentile Source Term
Silver	mg/L	0.0000175	0.0000505
Aluminum	mg/L	0.00513	0.0141
Arsenic	mg/L	0.00019	0.000318
Boron	mg/L	0.015	0.0319
Barium	mg/L	0.0814	0.128
Beryllium	mg/L	0.000442	0.000725
Bismuth	mg/L	-	-
Calcium	mg/L	50.3	61.4
Cadmium	mg/L	0.0000132	0.0000302
Chloride	mg/L	0.425	0.618
Cobalt	mg/L	0.000267	0.000999
Chromium	mg/L	0.000519	0.00234
Copper	mg/L	0.000391	0.00107
Fluoride	mg/L	-	-
Iron	mg/L	0.0243	0.03
Mercury	mg/L	0.000000275	0.000000478
Potassium	mg/L	0.631	0.938
Lithium	mg/L	0.00417	0.005
Magnesium	mg/L	10.9	12.3
Manganese	mg/L	0.00484	0.0079
Molybdenum	mg/L	0.00113	0.00291
Sodium	mg/L	3.13	6.04
Ammonia	mg/L	0.05	0.05
Nickel	mg/L	0.000661	0.00156
Nitrite	mg/L	0.001	0.001
Nitrate	mg/L	0.0718	0.164
Phosphorus	mg/L	0.00265	0.00405
Lead	mg/L	0.0000542	0.0000725
Sulphur	mg/L	0.00182	0.002
Antimony	mg/L	0.000125	0.000235
Selenium	mg/L	0.000777	0.00123
Silicon	mg/L	-	-
Tin	mg/L	0.00426	0.0226
Sulphate	mg/L	19.4	25.1
Strontium	mg/L	-	-
TItanium	mg/L	0.000382	0.000769
Thallium	mg/L	0.0000442	0.0000725
Uranium	mg/L	0.000442	0.0006
Vanadium	mg/L	0.000328	0.000725
Zinc	mg/L	0.00325	0.00563
Zirconium	mg/L	-	-

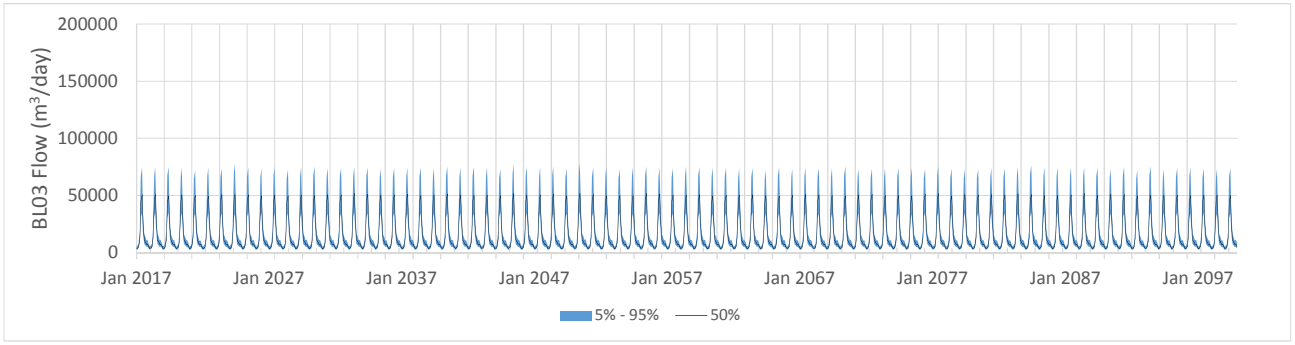
Parameter	Unit	Acidic Pit Wall				Non-Acidic			
		Benched		Non-Benched		Benched		Non-Benched	
		Base Case Source Term	Upper Case Source Term	Base Case Source Term	Upper Case Source Term	Base Case Source Term	Upper Case Source Term	Base Case Source Term	Upper Case Source Term
Silver	mg/L	0.000248	0.000359	0.0000112	0.0000161	0.0000287	0.000031	0.00000129	0.00000139
Aluminum	mg/L	28.6	82.7	1.29	3.72	0.0531	0.0531	0.0047	0.0177
Arsenic	mg/L	0.0339	0.654	0.00152	0.0294	0.000929	0.00119	0.0000418	0.0001
Boron	mg/L	0.0546	0.0567	0.00246	0.00255	0.105	0.195	0.00472	0.0181
Barium	mg/L	0.0417	0.059	0.00188	0.00266	0.125	0.548	0.00564	0.0413
Beryllium	mg/L	0.0216	0.242	0.000973	0.0109	0.00001	0.00001	0.00000259	0.00001
Bismuth	mg/L	0.0000272	0.0000283	0.00000122	0.00000128	-	-	-	-
Calcium	mg/L	57.9	176	2.61	7.9	65.4	137	2.94	6.17
Cadmium	mg/L	0.0856	0.141	0.00385	0.00635	0.000431	0.000431	0.0000375	0.000244
Chloride	mg/L	2.85	3	0.128	0.135	2.85	2.99	0.128	0.134
Cobalt	mg/L	0.561	1.58	0.0253	0.0713	0.0124	0.0441	0.000557	0.00605
Chromium	mg/L	0.217	0.625	0.00978	0.0281	0.000575	0.000731	0.0000259	0.0000329
Copper	mg/L	1.16	2.23	0.0523	0.101	0.00118	0.00118	0.000123	0.000329
Fluoride	mg/L	2.01	5.75	0.0905	0.259	0.908	1	0.0409	0.128
Iron	mg/L	878	2060	39.5	92.7	0.0041	0.0041	0.00185	0.0041
Mercury	mg/L	0.000058200	0.000256000	0.000002620	0.000011500	0.000050000	0.000050000	0.000002530	0.000002650
Potassium	mg/L	1.07	1.89	0.0483	0.0849	4.6	4.6	0.365	0.78
Lithium	mg/L	0.0388	0.179	0.00175	0.00806	0.0254	0.0313	0.00114	0.00323
Magnesium	mg/L	22.2	123	0.998	5.54	28.4	70.7	1.28	3.18
Manganese	mg/L	8.16	73.7	0.367	3.32	0.00225	0.00225	0.00225	0.00225
Molybdenum	mg/L	0.00212	0.0738	0.0000953	0.00332	0.0192	0.0882	0.000864	0.00454
Sodium	mg/L	1.34	2.18	0.0601	0.098	1.02	16	0.0461	0.719
Ammonia	mg/L	0.948	1.65	0.0427	0.0744	0.112	3.69	0.00505	0.166
Nickel	mg/L	2.17	5.01	0.0978	0.225	0.0237	0.161	0.00107	0.0188
Nitrite	mg/L	2.72	2.83	0.122	0.128	2.87	3.95	0.129	0.178
Nitrate	mg/L	10.9	11.3	0.489	0.51	11.2	12.9	0.505	0.581
Phosphorus	mg/L	0.944	61.7	0.0425	2.78	0.00387	0.00387	0.000627	0.00387
Lead	mg/L	0.0163	0.0343	0.000733	0.00154	0.000219	0.000252	0.00000985	0.0000292
Sulphur	mg/L	1160	2100	52.2	94.7	30.8	30.8	3.43	8.86
Antimony	mg/L	0.000741	0.00531	0.0000333	0.000239	0.00249	0.00596	0.000112	0.000769
Selenium	mg/L	0.0269	0.0529	0.00121	0.00238	0.0286	0.135	0.00129	0.00607
Silicon	mg/L	8.98	16.8	0.404	0.756	1.7	1.7	0.163	0.239
Tin	mg/L	0.00157	0.00358	0.0000707	0.000161	-	-	-	-
Sulphate	mg/L	4030	6220	181	280	222	583	9.99	26.2
Strontium	mg/L	0.3	0.448	0.0135	0.0202	0.153	0.182	0.00689	0.0169
TItanium	mg/L	0.00285	0.00804	0.000128	0.000362	-	-	-	-
Thallium	mg/L	0.000729	0.00195	0.0000328	0.0000877	0.0000969	0.000152	0.00000436	0.0000126
Uranium	mg/L	0.0376	0.0442	0.00169	0.00199	0.000492	0.000841	0.0000221	0.0000918
Vanadium	mg/L	0.151	1.51	0.00681	0.0678	0.00194	0.00374	0.0000875	0.000316
Zinc	mg/L	3.72	15	0.167	0.675	0.0253	0.0342	0.00114	0.0156
Zirconium	mg/L	0.000578	0.00639	0.000026	0.000288	-	-	-	-

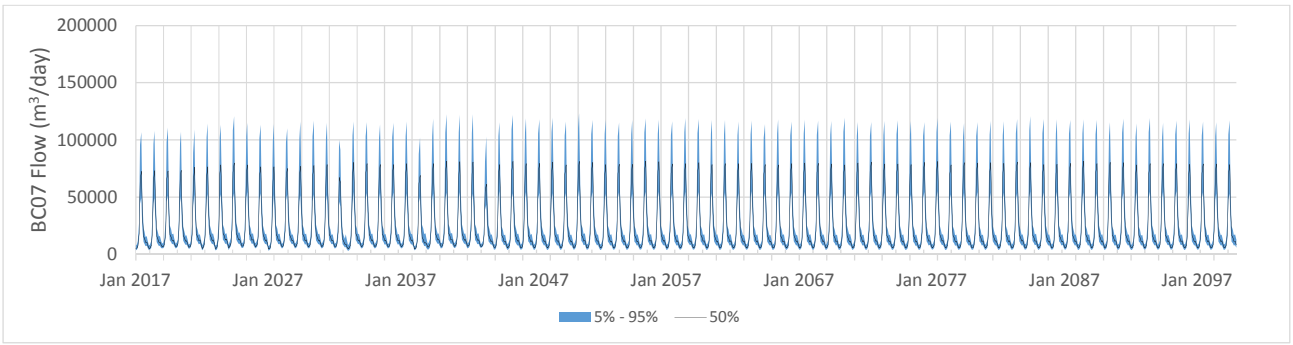
Parameter	Unit	pH 7	pH 8	Source Term
Silver	mg/L	0.0001	0.000092	0.0001
Aluminum	mg/L	0.0531	0.126	0.126
Arsenic	mg/L	0.00119	0.000749	0.00119
Boron	mg/L	0.195	0.121	0.195
Barium	mg/L	0.548	0.595	0.595
Beryllium	mg/L	0.00001	0.000089	0.000089
Bismuth	mg/L	-	-	-
Calcium	mg/L	190	109	190
Cadmium	mg/L	0.000431	0.00291	0.00291
Chloride	mg/L	2.82	8.12	8.12
Cobalt	mg/L	0.0441	0.147	0.147
Chromium	mg/L	0.001	0.000255	0.001
Copper	mg/L	0.00118	0.0021	0.0021
Fluoride	mg/L	1	0.828	1
Iron	mg/L	0.0041	0.0033	0.0041
Mercury	mg/L	0.00005	0.00005	0.00005
Potassium	mg/L	4.6	6.57	6.57
Lithium	mg/L	0.0313	0.0535	0.0535
Magnesium	mg/L	160	69.5	160
Manganese	mg/L	0.00225	0.067	0.067
Molybdenum	mg/L	0.0882	0.0839	0.0882
Sodium	mg/L	54	26.8	54
Ammonia	mg/L	Nitrogen Model	Nitrogen Model	Nitrogen Model
Nickel	mg/L	0.161	0.342	0.342
Nitrite	mg/L	Nitrogen Model	Nitrogen Model	Nitrogen Model
Nitrate	mg/L	Nitrogen Model	Nitrogen Model	Nitrogen Model
Phosphorus	mg/L	0.00387	0.0497	0.0497
Lead	mg/L	0.000252	0.000548	0.000548
Sulphur	mg/L	30.8	150	150
Antimony	mg/L	0.00596	0.00299	0.00596
Selenium	mg/L	Deposition	Deposition	Deposition
Silicon	mg/L	1.7	1.98	1.98
Tin	mg/L	-	-	-
Sulphate	mg/L	Deposition	Deposition	Deposition
Strontium	mg/L	0.182	0.339	0.339
TItanium	mg/L	-	-	-
Thallium	mg/L	0.000152	0.000114	0.000152
Uranium	mg/L	0.000841	0.000799	0.000841
Vanadium	mg/L	0.00374	0.00184	0.00374
Zinc	mg/L	0.0342	0.359	0.359
Zirconium	mg/L	-	-	-

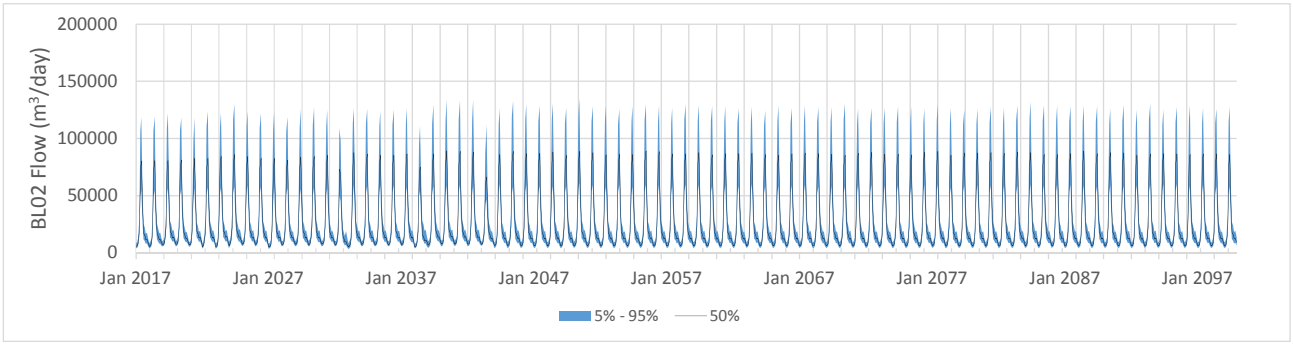
Parameter	Unit	Average Source Term	95th Percentile Source Term
Silver	mg/L	0.0000321	0.0001
Aluminum	mg/L	0.0725	0.23
Arsenic	mg/L	0.000668	0.0016
Boron	mg/L	0.0546	0.125
Barium	mg/L	0.655	2.54
Beryllium	mg/L	-	-
Bismuth	mg/L	-	-
Calcium	mg/L	58.6	102
Cadmium	mg/L	0.0000352	0.000100
Chloride	mg/L	2.15	6.85
Cobalt	mg/L	-	-
Chromium	mg/L	0.00709	0.0248
Copper	mg/L	0.00177	0.00321
Fluoride	mg/L	0.301	0.529
Iron	mg/L	0.317	1.45
Mercury	mg/L	0.0000125	0.0000325
Potassium	mg/L	3.76	8.36
Lithium	mg/L	-	-
Magnesium	mg/L	21.4	35.6
Manganese	mg/L	0.163	0.533
Molybdenum	mg/L	-	-
Sodium	mg/L	14.4	40.5
Ammonia	mg/L	-	-
Nickel	mg/L	0.00261	0.00743
Nitrite	mg/L	0.0202	0.05
Nitrate	mg/L	0.187	0.804
Phosphorus	mg/L	-	-
Lead	mg/L	0.00011	0.00025
Sulphur	mg/L	-	-
Antimony	mg/L	0.00083	0.00283
Selenium	mg/L	0.00112	0.0041
Silicon	mg/L	12.5	24.2
Tin	mg/L	-	-
Sulphate	mg/L	23.2	77.1
Strontium	mg/L	-	-
TItanium	mg/L	-	-
Thallium	mg/L	-	-
Uranium	mg/L	0.000897	0.00276
Vanadium	mg/L	-	-
Zinc	mg/L	0.00551	0.00605
Zirconium	mg/L	-	-

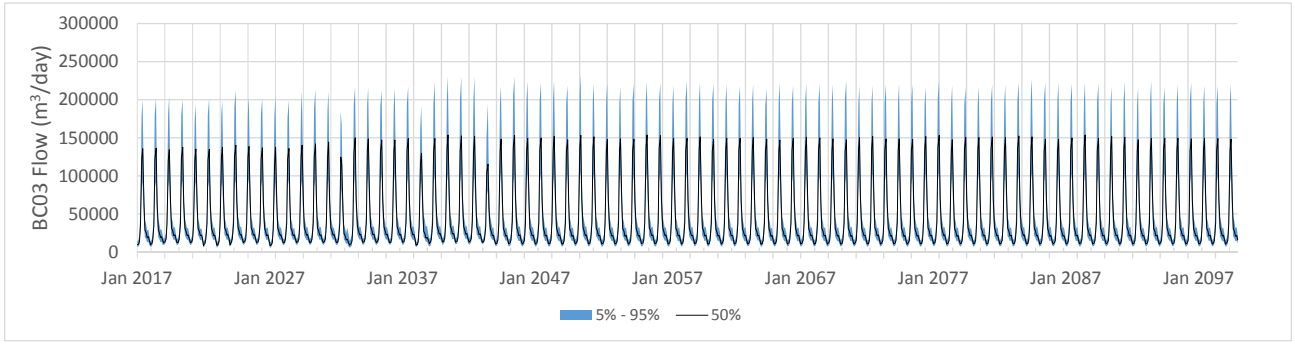
Appendix D – Model Results

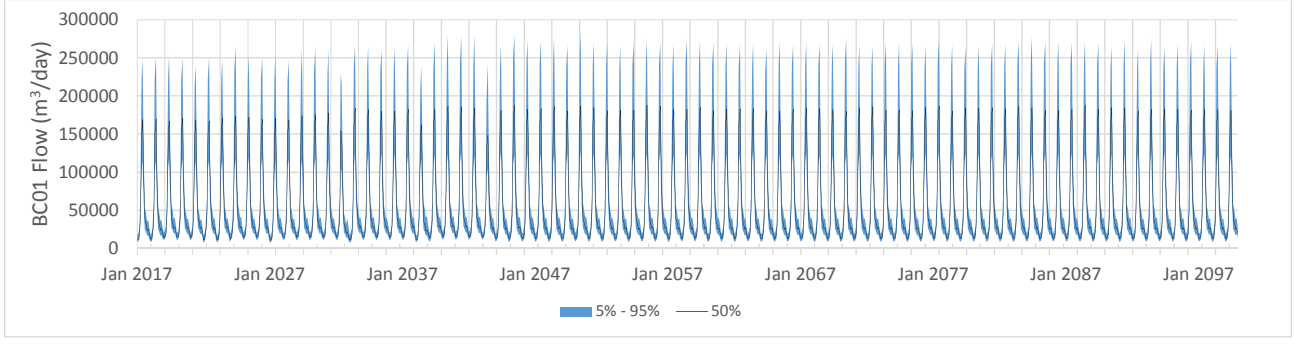
D1 – Blairmore Creek Flow Predictions


BL03 Flow (m³/day)
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

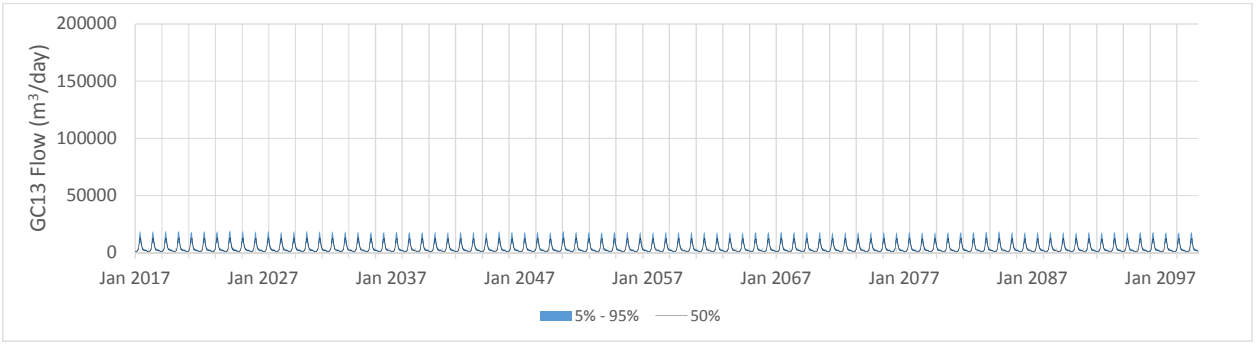

BC07 Flow (m³/day)
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

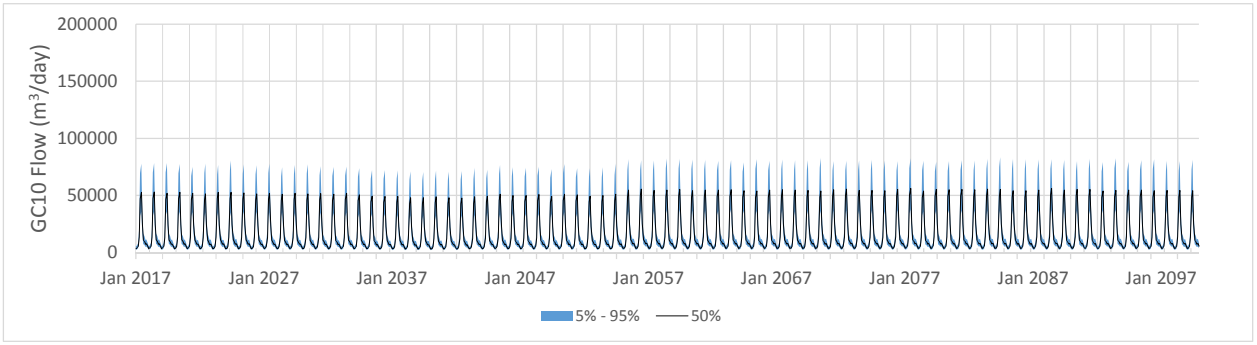

BL02 Flow (m³/day)
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

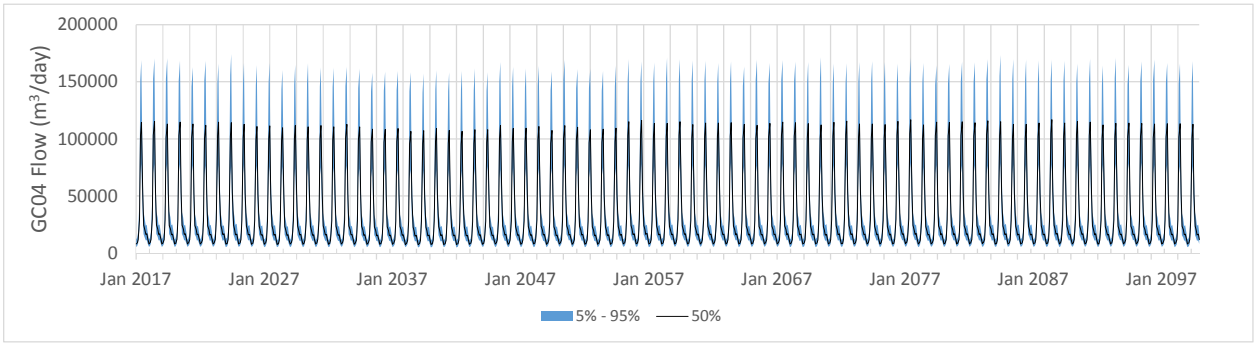

BC03 Flow (m³/day)
300000
250000
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

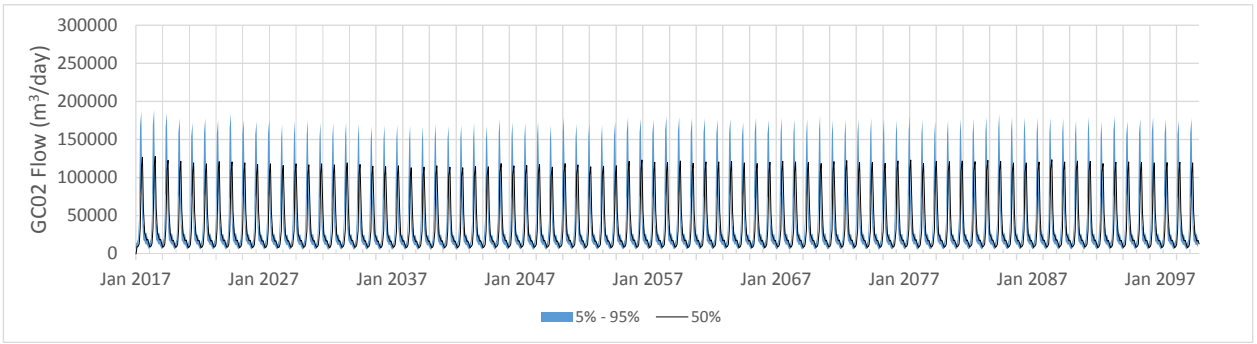

BC01 Flow (m³/day)
300000
250000
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

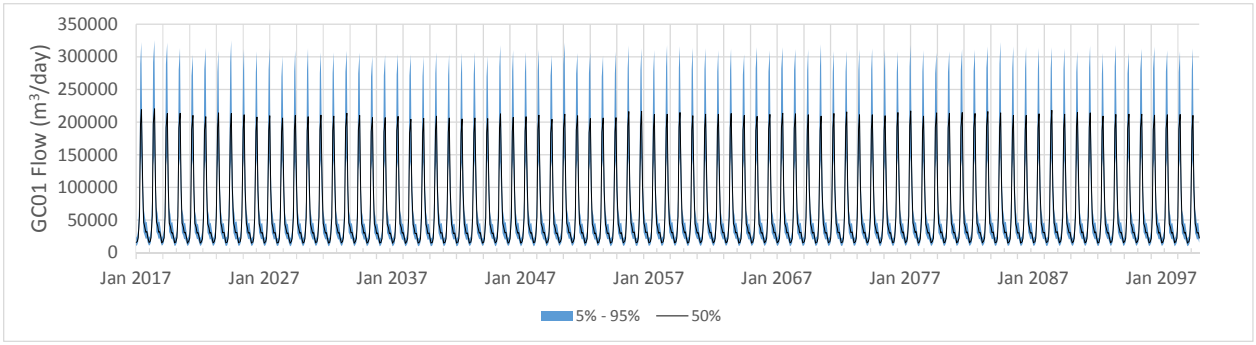
D2 – Gold Creek Flow Predictions


GC13 Flow (m³/day)
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

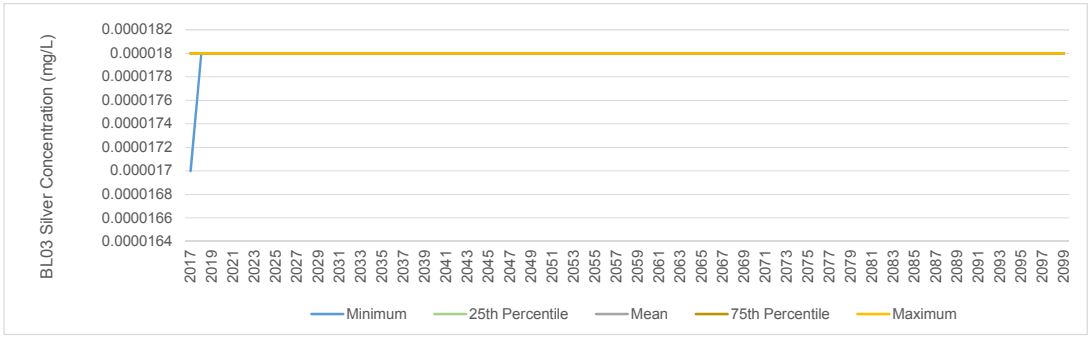

GC10 Flow (m³/day)
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

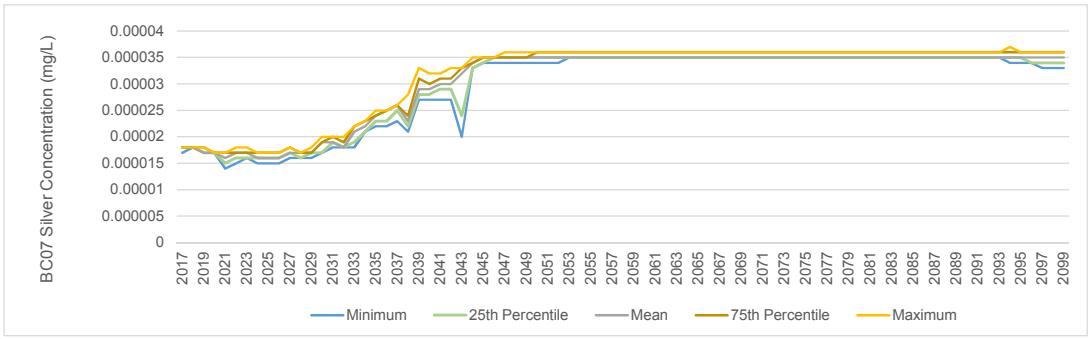

GC04 Flow (m³/day)
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

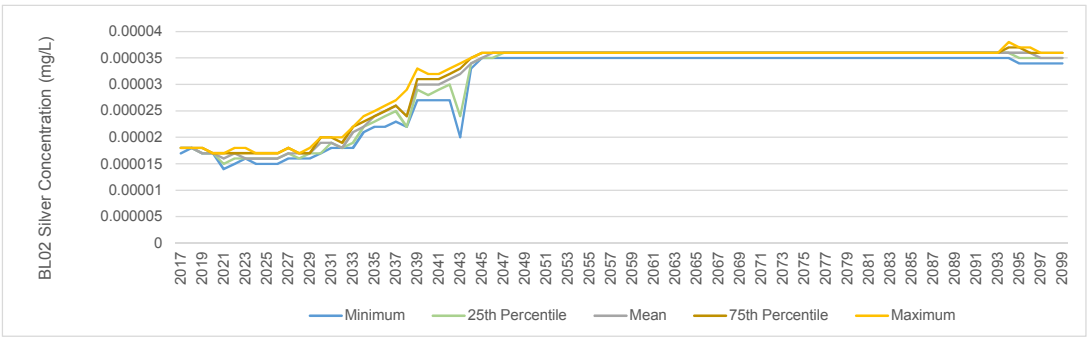

GC02 Flow (m³/day)
300000
250000
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

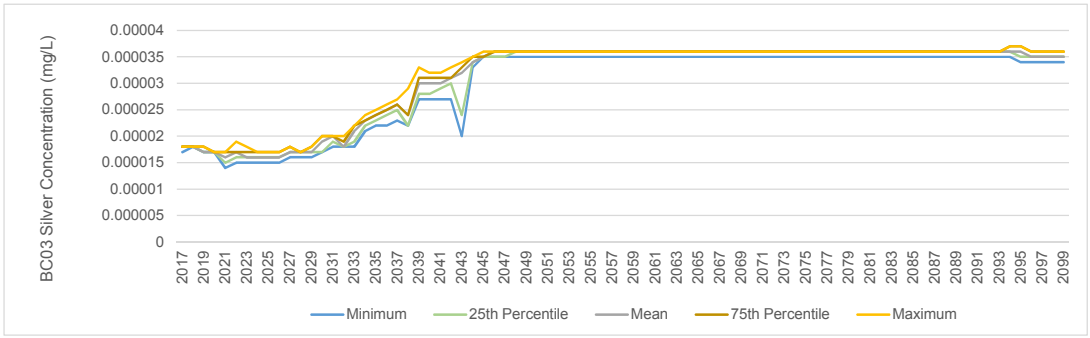

GC01 Flow (m³/day)
350000
300000
250000
200000
150000
100000
50000
0
Jan 2017
Jan 2027
Jan 2037
Jan 2047
Jan 2057
Jan 2067
Jan 2077
Jan 2087
Jan 2097
5% - 95%
50%

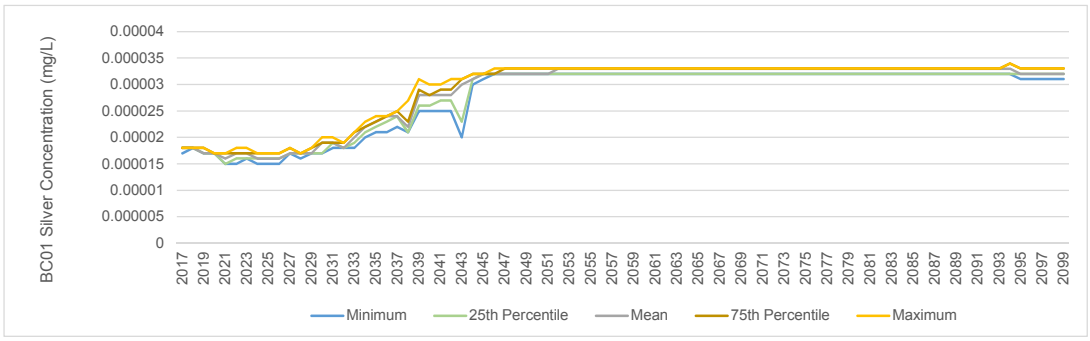
D3 – Blairmore Creek Water Quality Predictions

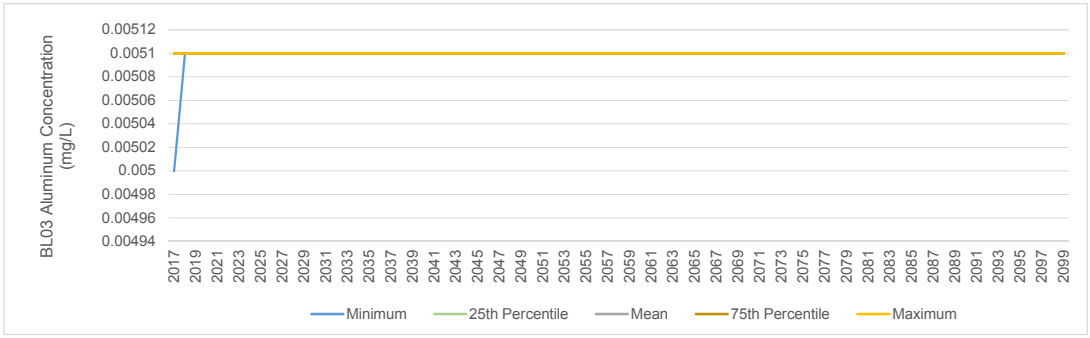

BL03 Silver Concentration (mg/L)
0.0000182
0.000018
0.0000178
0.0000176
0.0000174
0.0000172
0.000017
0.0000168
0.0000166
0.0000164
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

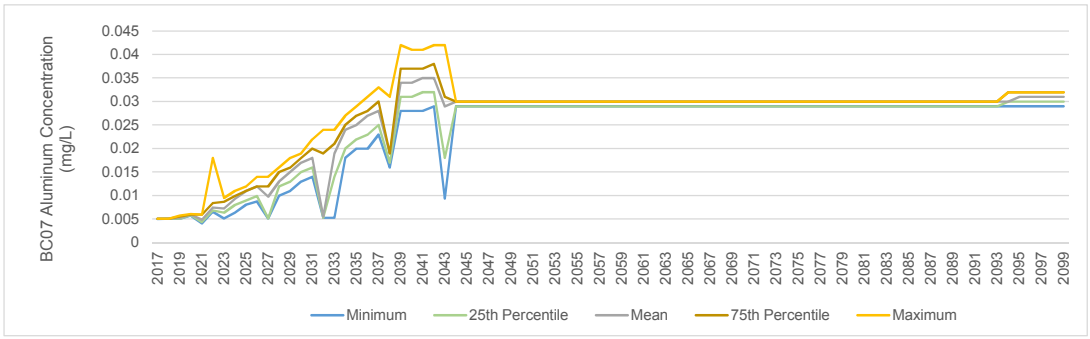

BC07 Silver Concentration (mg/L)
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

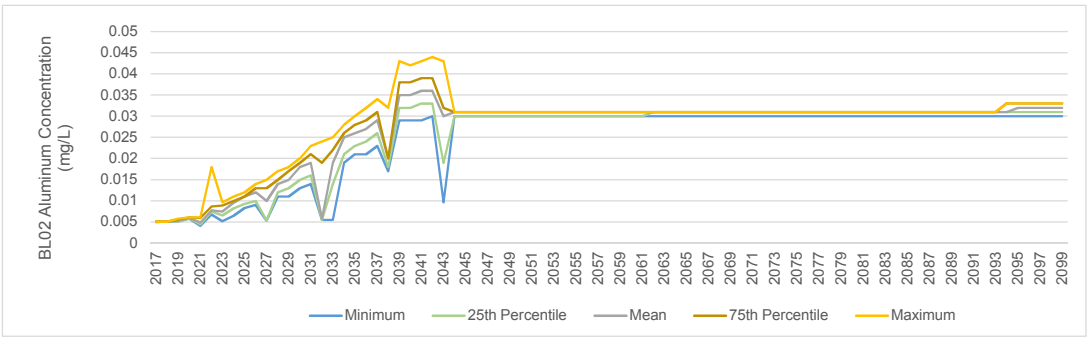

BL02 Silver Concentration (mg/L)
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

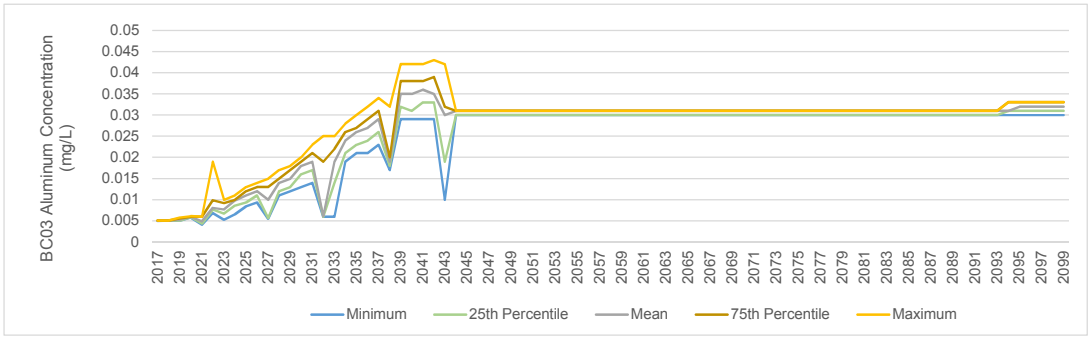

BC03 Silver Concentration (mg/L)
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

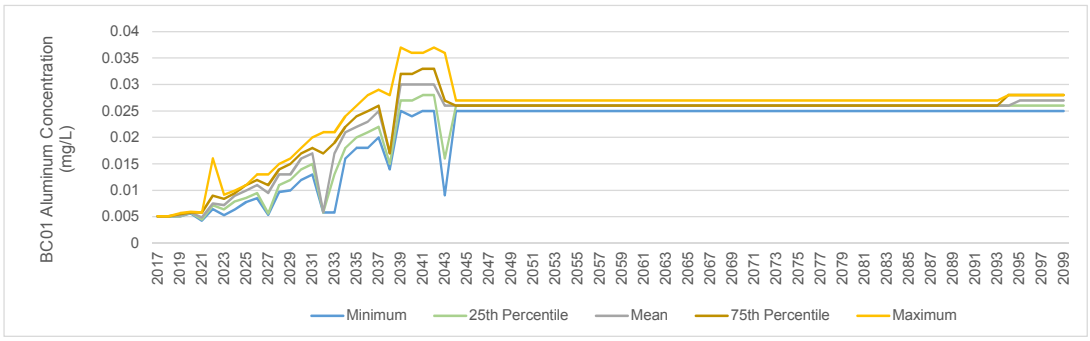

BC01 Silver Concentration (mg/L)
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

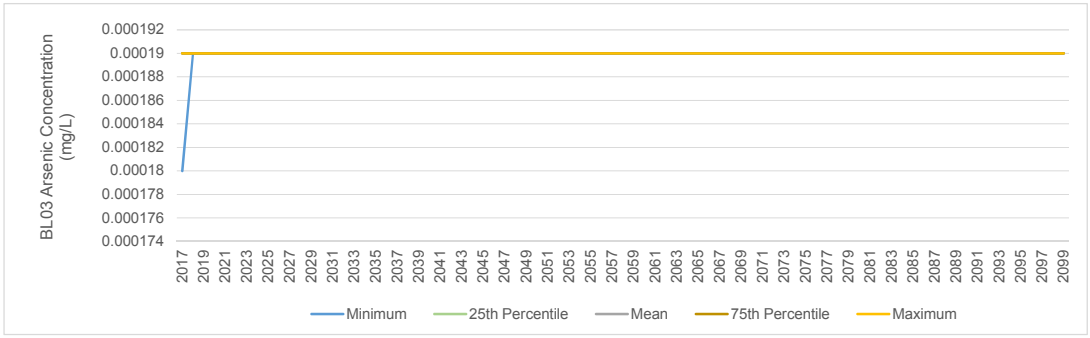

BL03 Aluminum Concentration (mg/L)
0.00512
0.0051
0.00508
0.00506
0.00504
0.00502
0.005
0.00498
0.00496
0.00494
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

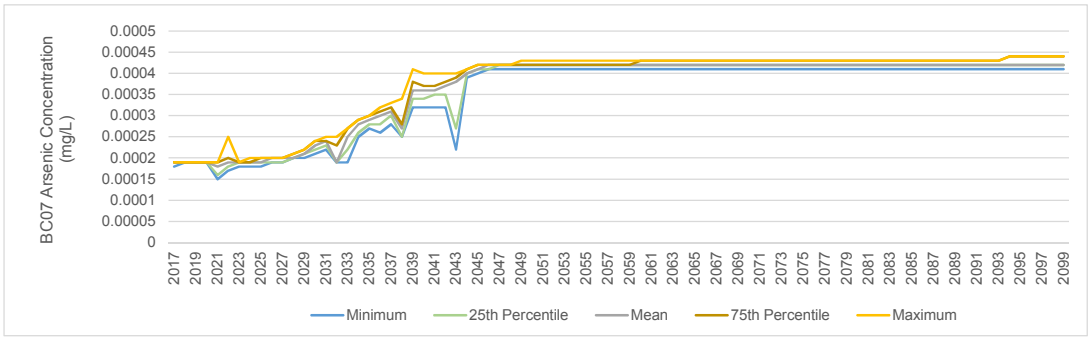

BC07 Aluminum Concentration (mg/L)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

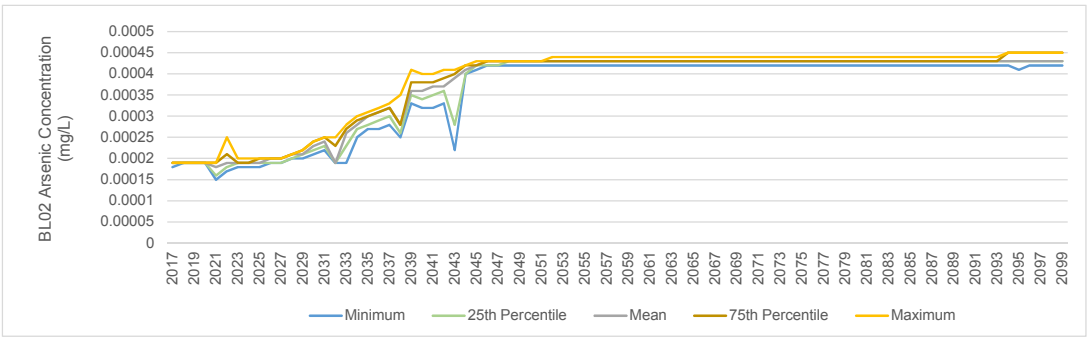

BL02 Aluminum Concentration (mg/L)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

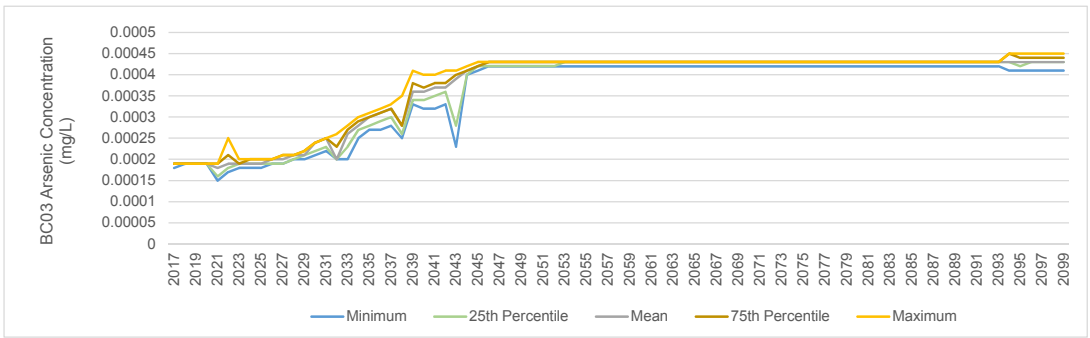

BC03 Aluminum Concentration (mg/L)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

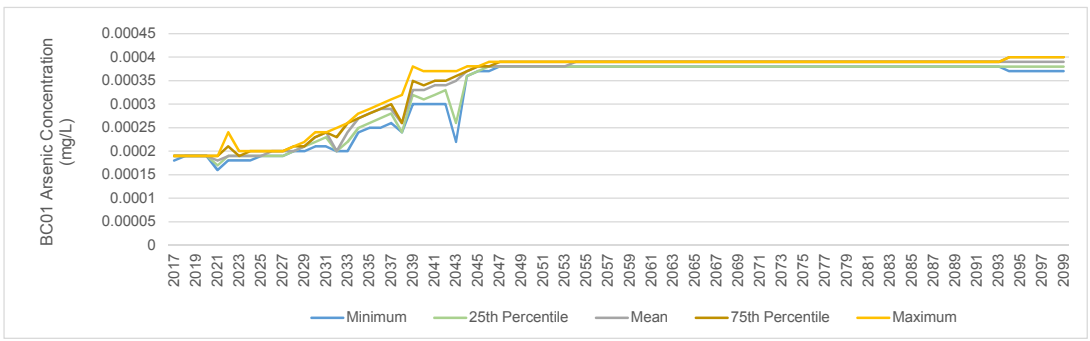

BC01 Aluminum Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

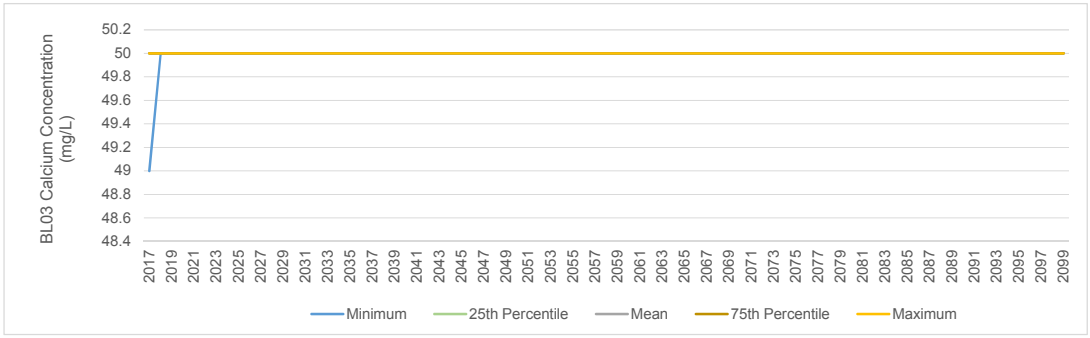

BL03 Arsenic Concentration (mg/L)
0.000192
0.00019
0.000188
0.000186
0.000184
0.000182
0.00018
0.000178
0.000176
0.000174
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

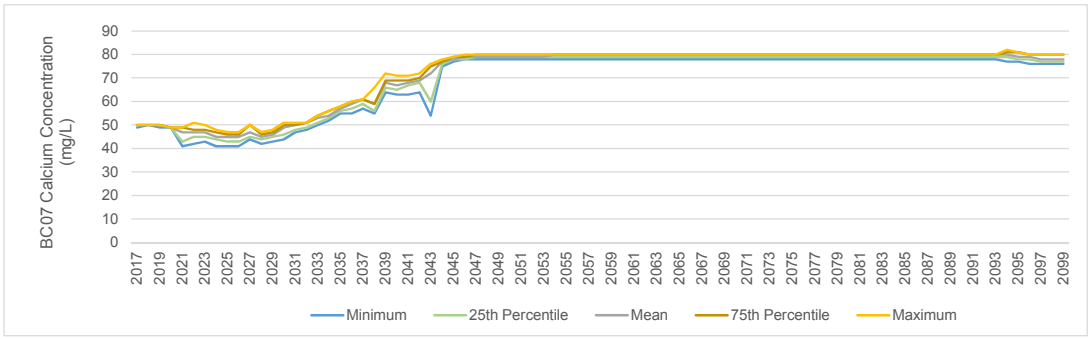

BC07 Arsenic Concentration (mg/L)
0.0005
0.00045
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

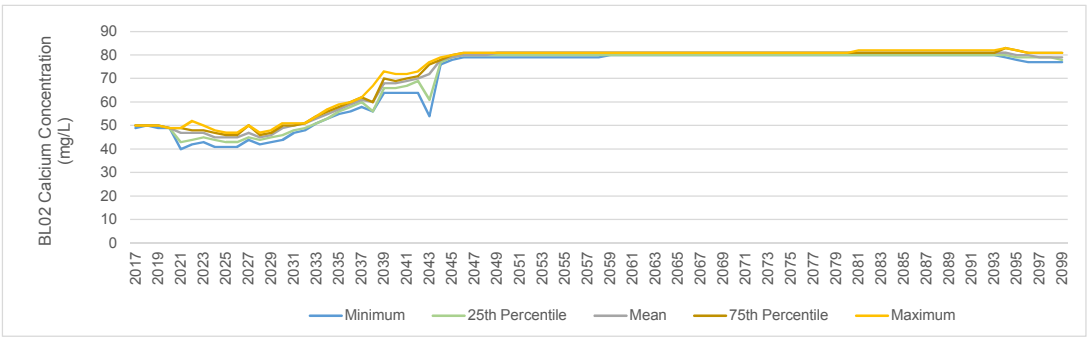

BL02 Arsenic Concentration (mg/L)
0.0005
0.00045
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

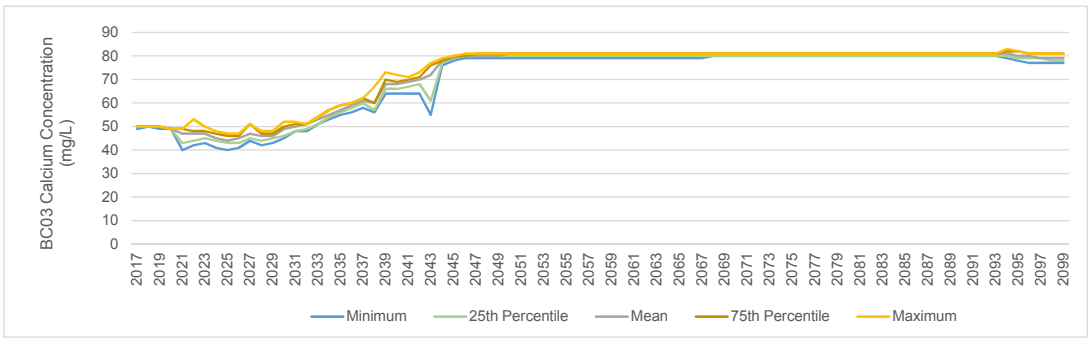

BC03 Arsenic Concentration (mg/L)
0.0005
0.00045
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

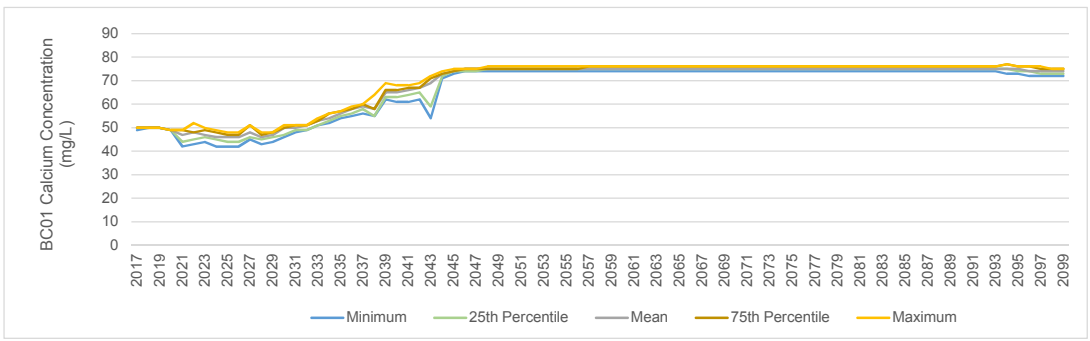

BC01 Arsenic Concentration (mg/L)
0.00045
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

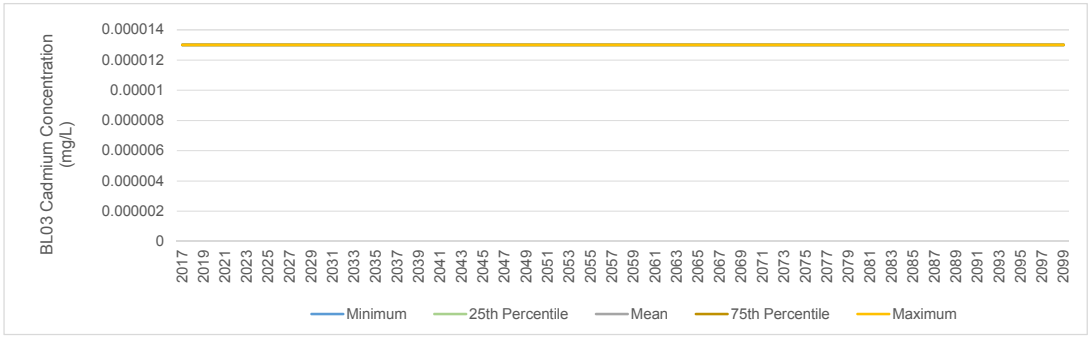

BL03 Calcium Concentration (mg/L)
50.2
50
49.8
49.6
49.4
49.2
49
48.8
48.6
48.4
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

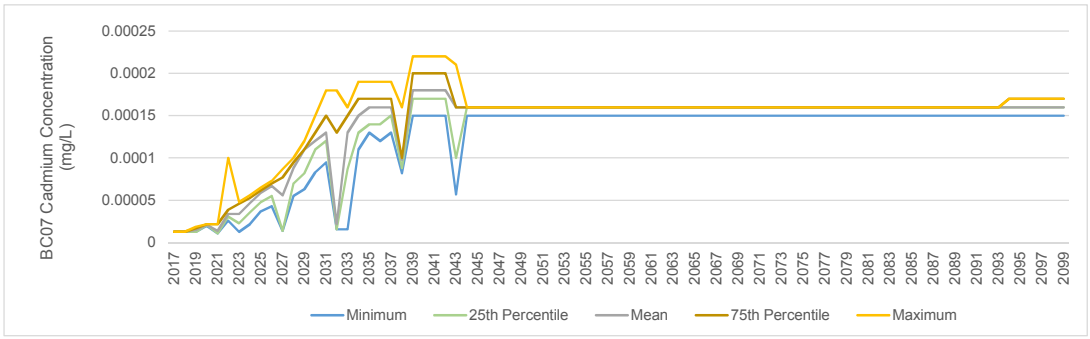

BC07 Calcium Concentration (mg/L)
90
80
70
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

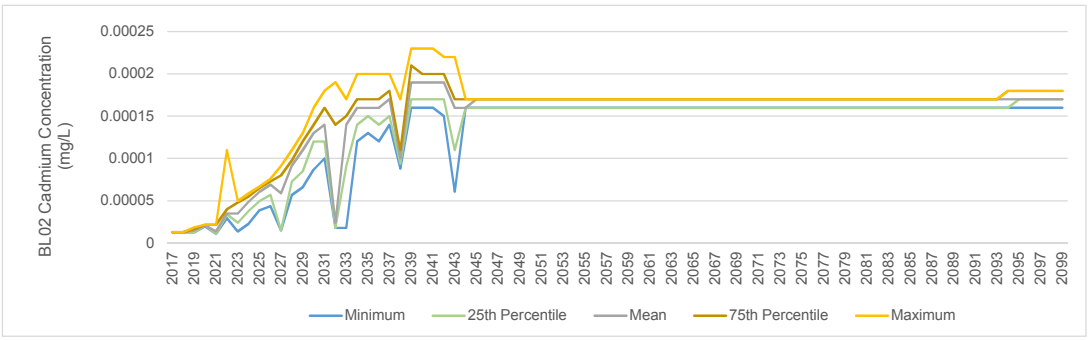

BL02 Calcium Concentration (mg/L)
90
80
70
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

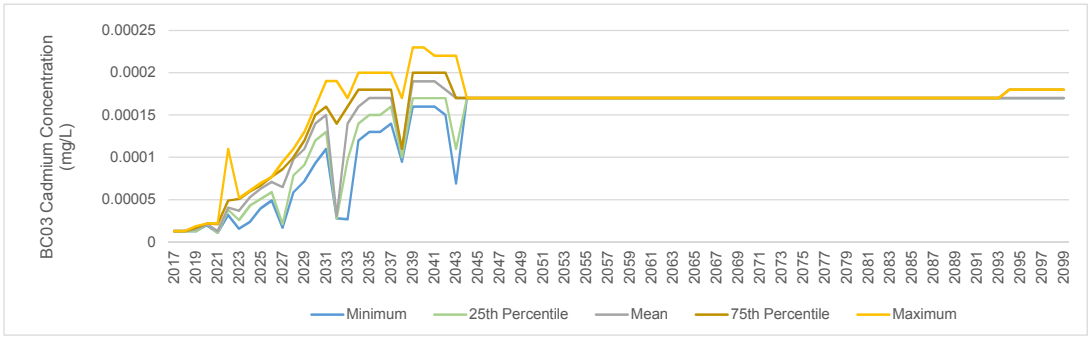

BC03 Calcium Concentration (mg/L)
90
80
70
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

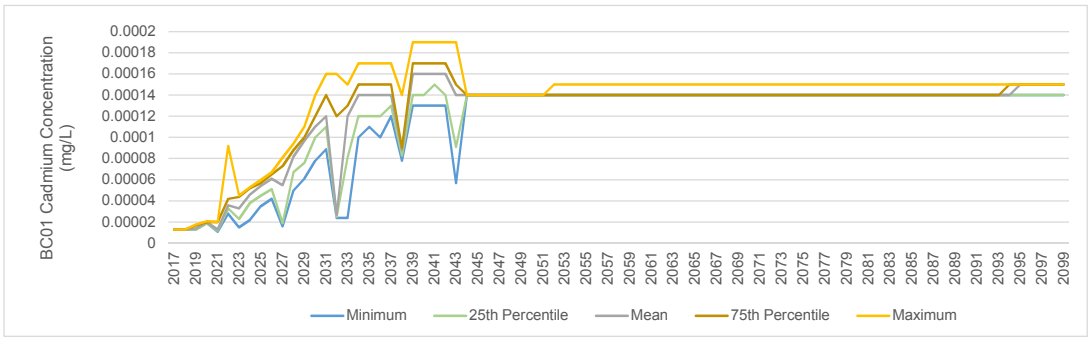

BC01 Calcium Concentration (mg/L)
90
80
70
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

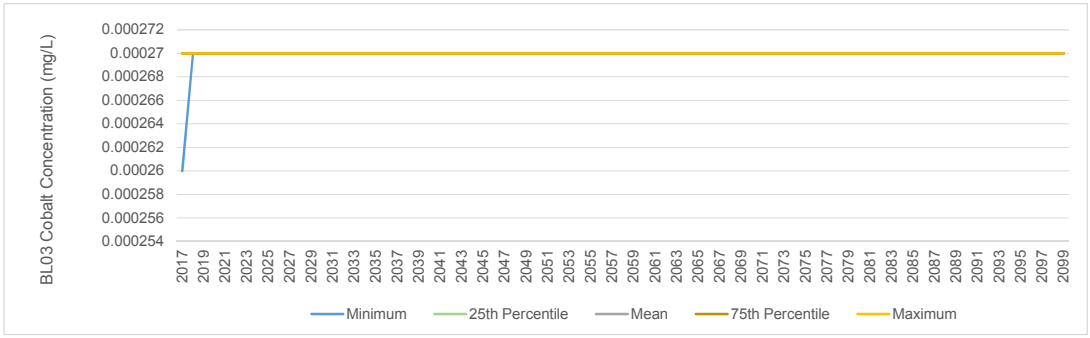

BL03 Cadmium Concentration (mg/L)
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

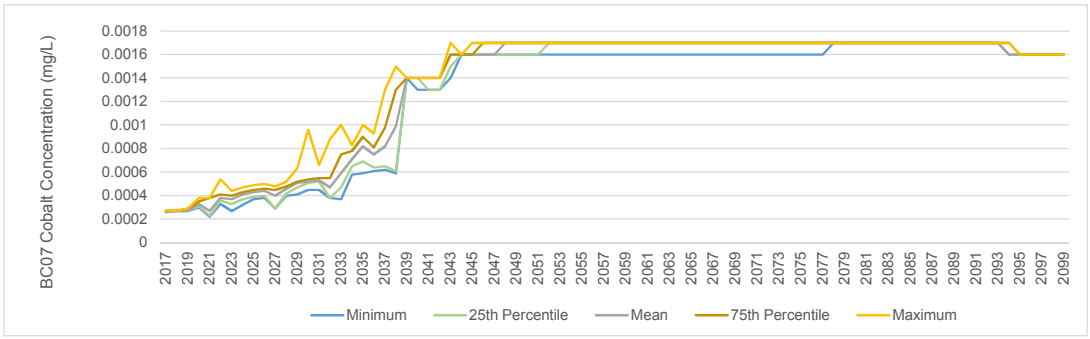

BC07 Cadmium Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

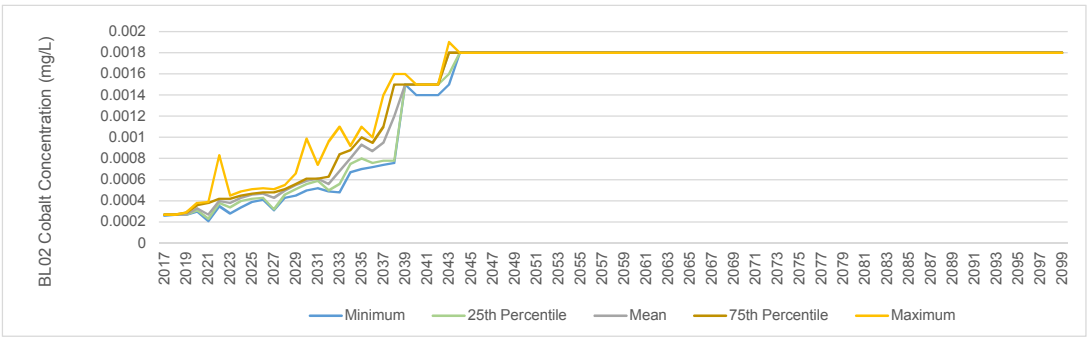

BL02 Cadmium Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

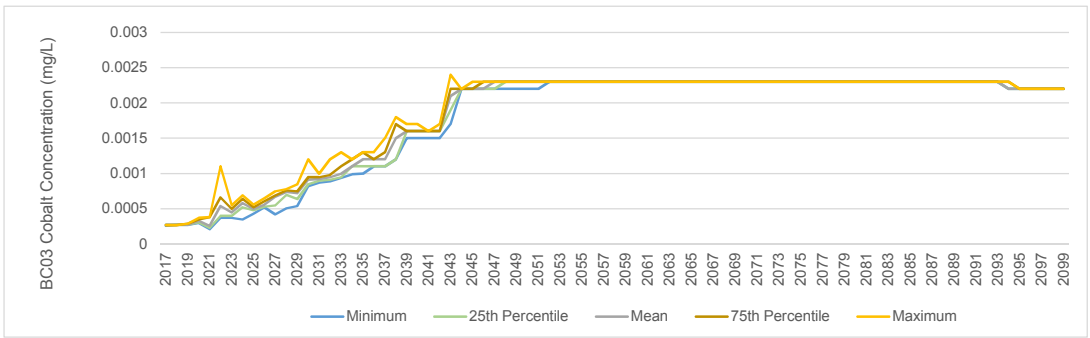

BC03 Cadmium Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

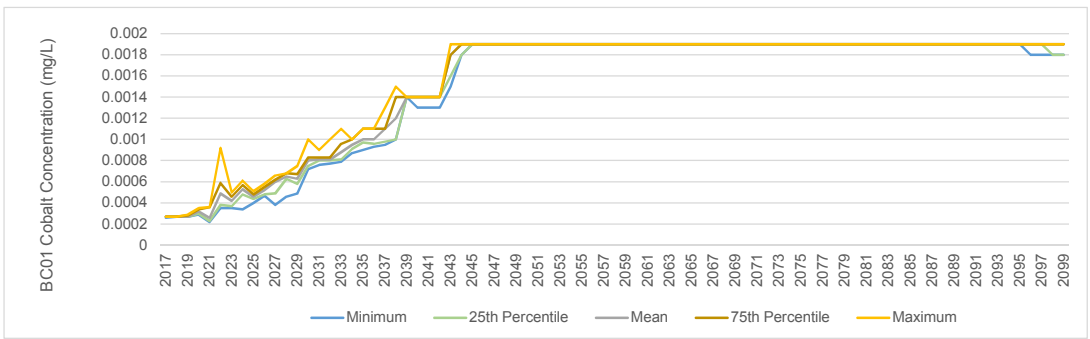

BC01 Cadmium Concentration (mg/L)
0.0002
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

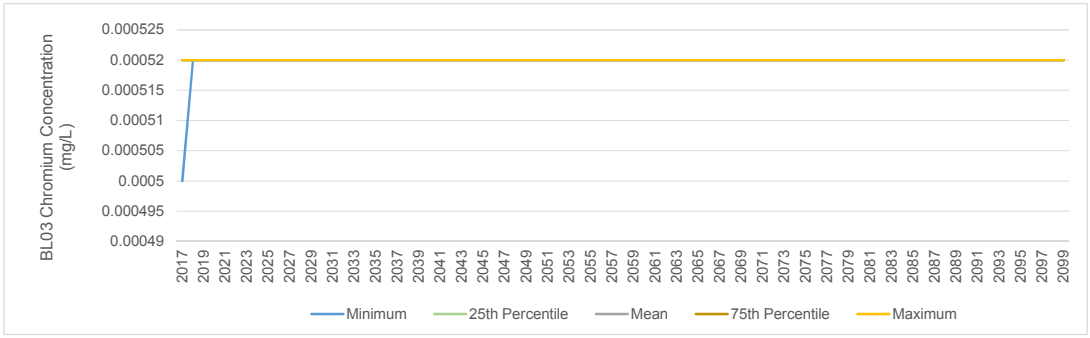

BL03 Cobalt Concentration (mg/L)
0.000272
0.00027
0.000268
0.000266
0.000264
0.000262
0.00026
0.000258
0.000256
0.000254
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

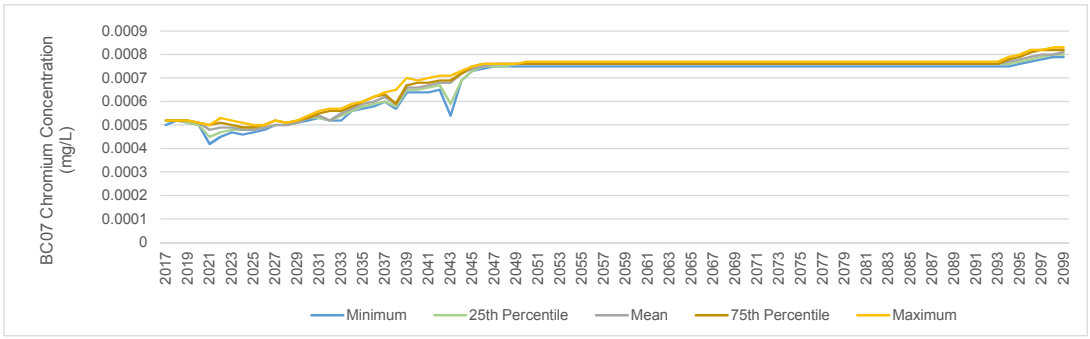

BC07 Cobalt Concentration (mg/L)
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

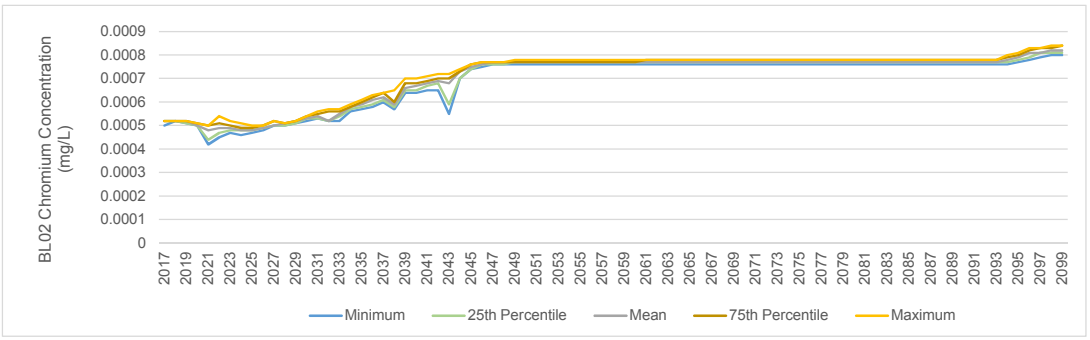

BL02 Cobalt Concentration (mg/L)
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

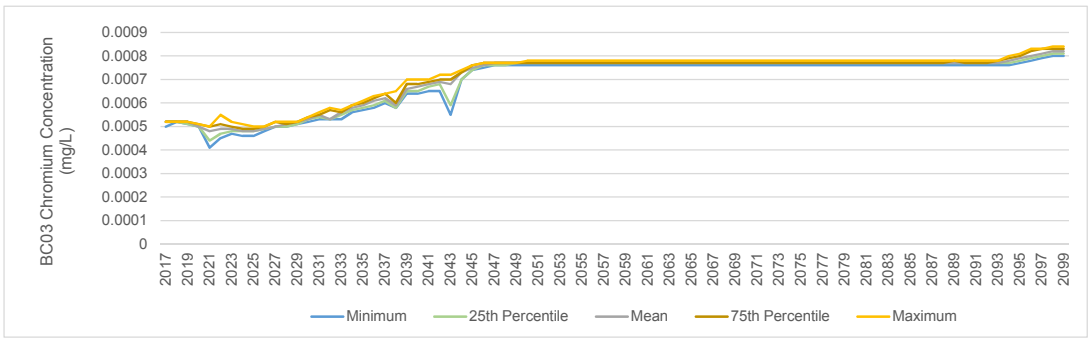

BC03 Cobalt Concentration (mg/L)
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

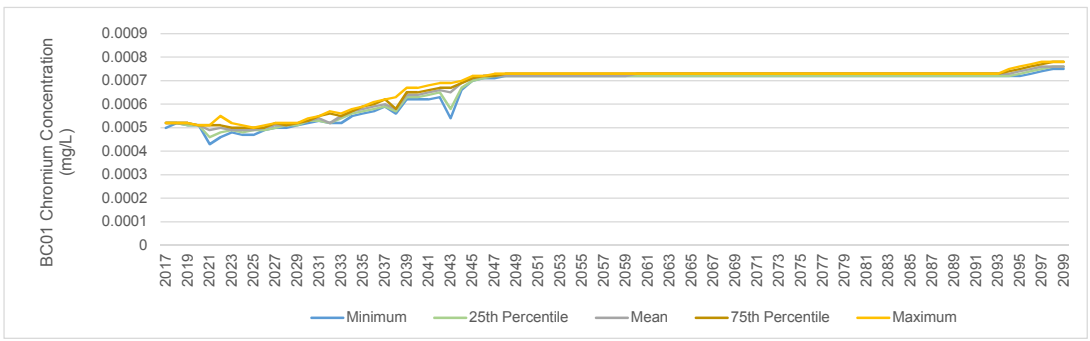

BC01 Cobalt Concentration (mg/L)
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

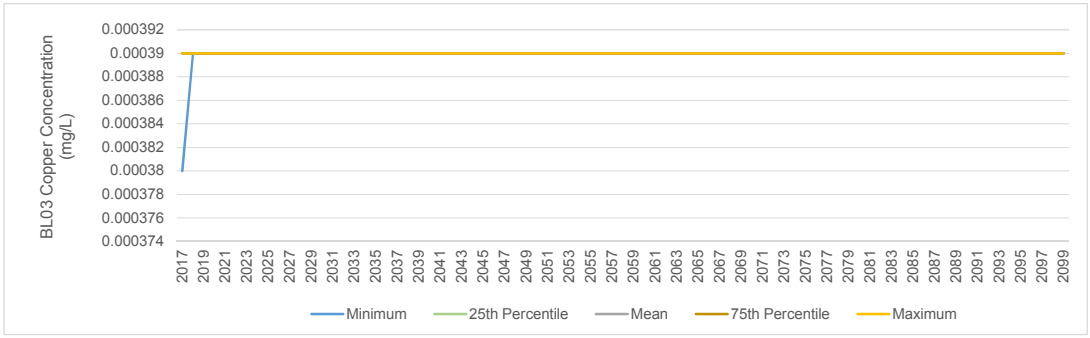

BL03 Chromium Concentration (mg/L)
0.000525
0.00052
0.000515
0.00051
0.000505
0.0005
0.000495
0.00049
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

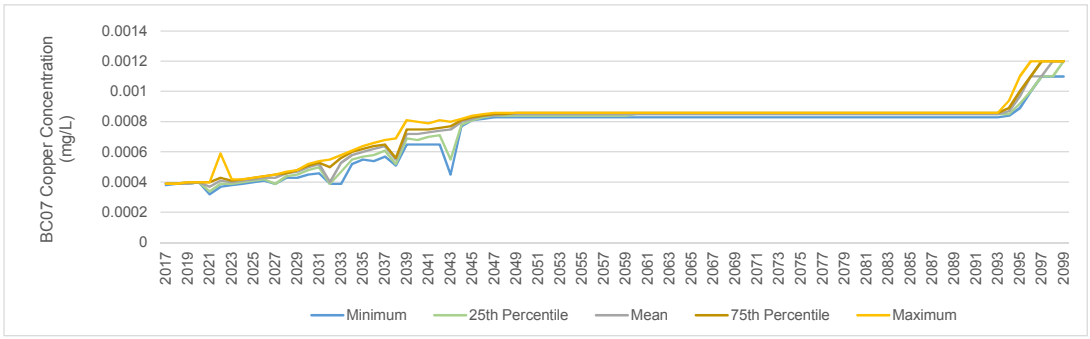

BC07 Chromium Concentration (mg/L)
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

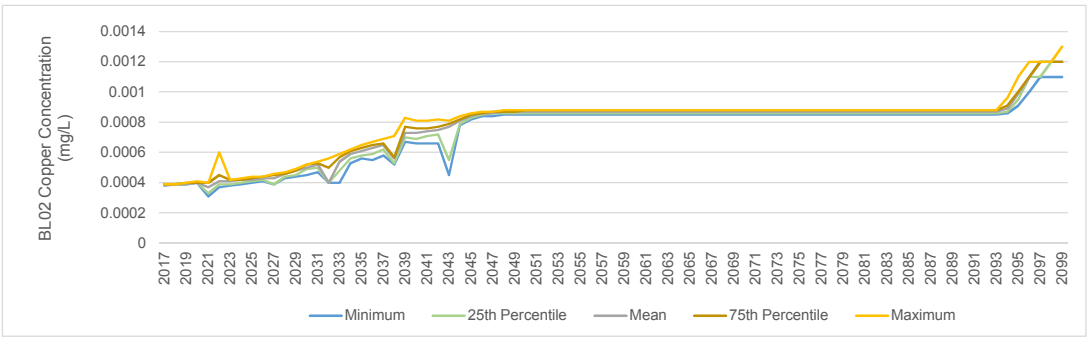

BL02 Chromium Concentration (mg/L)
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

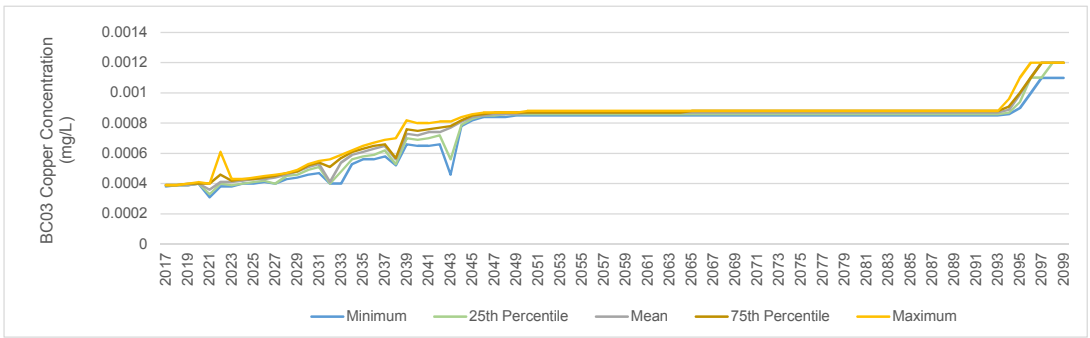

BC03 Chromium Concentration (mg/L)
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

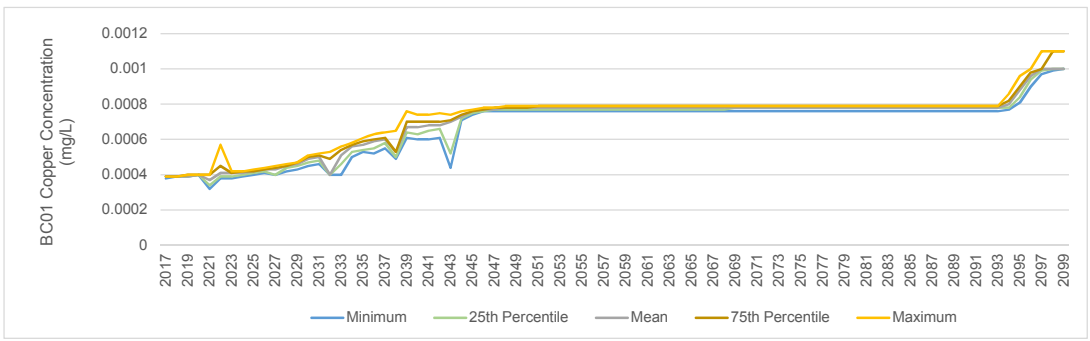

BC01 Chromium Concentration (mg/L)
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

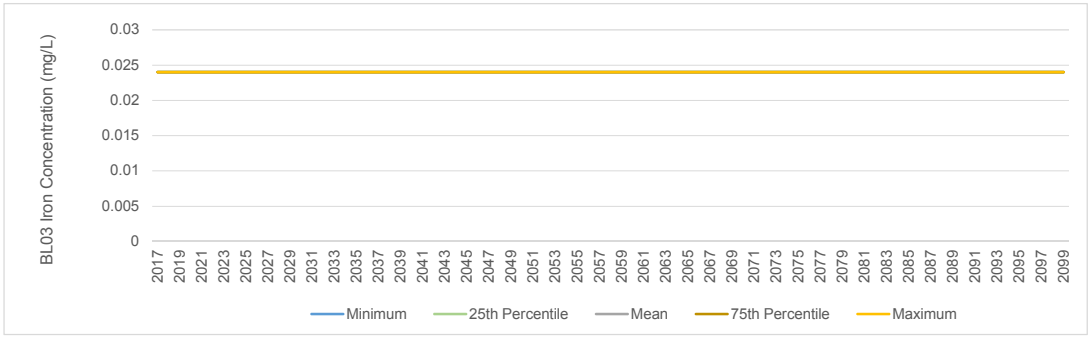

BL03 Copper Concentration (mg/L)
0.000392
0.00039
0.000388
0.000386
0.000384
0.000382
0.00038
0.000378
0.000376
0.000374
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

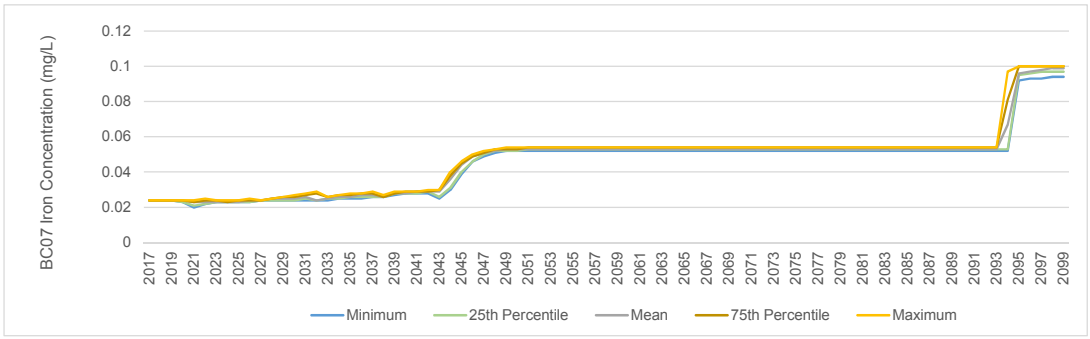

BC07 Copper Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

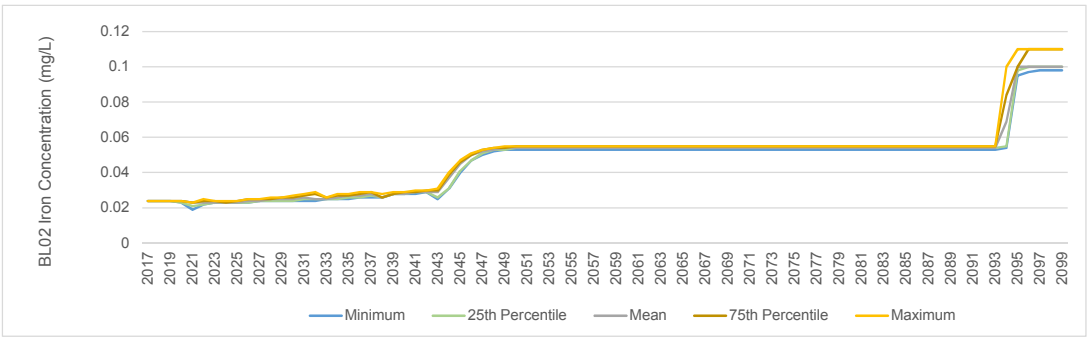

BL02 Copper Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

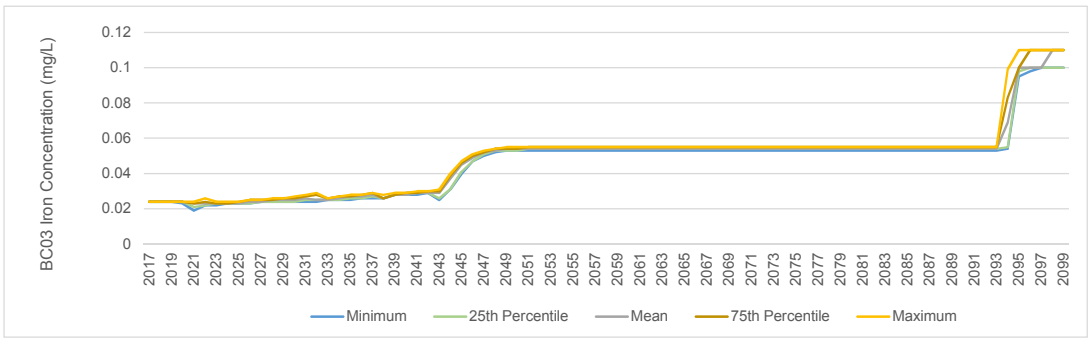

BC03 Copper Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

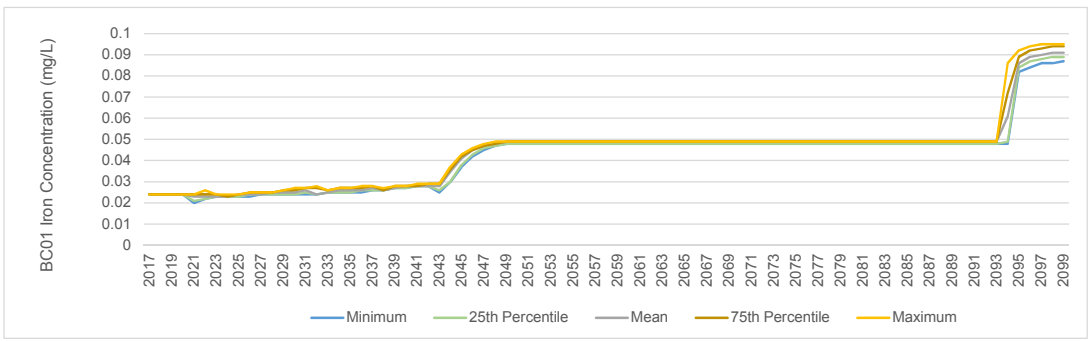

BC01 Copper Concentration (mg/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

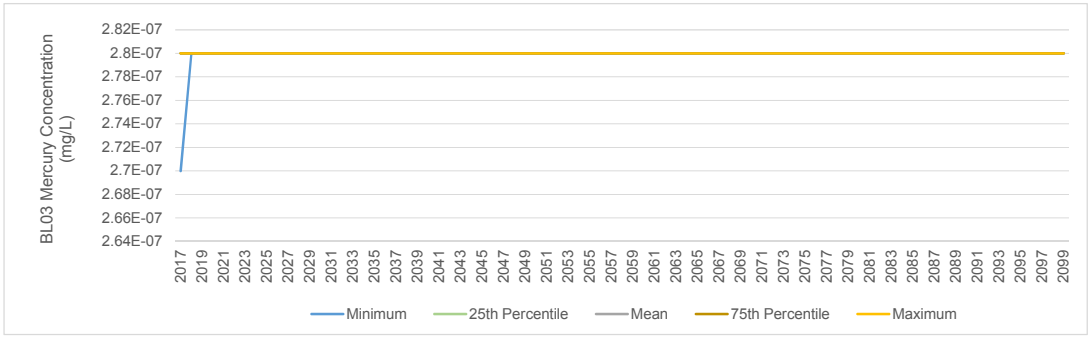

BL03 Iron Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

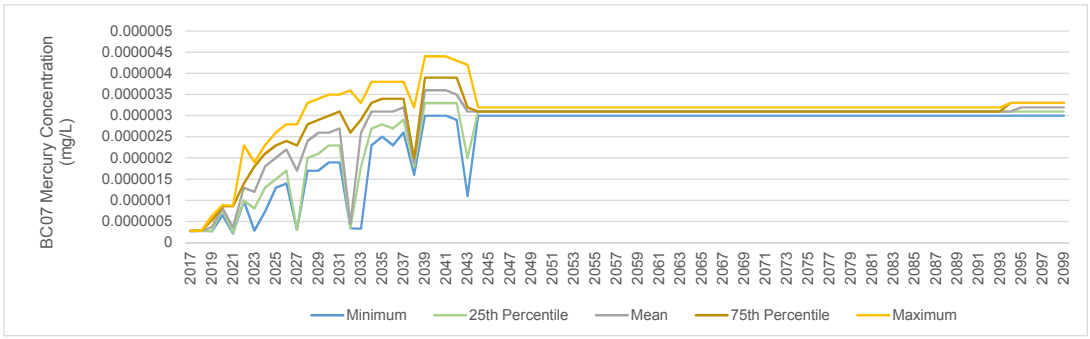

BC07 Iron Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

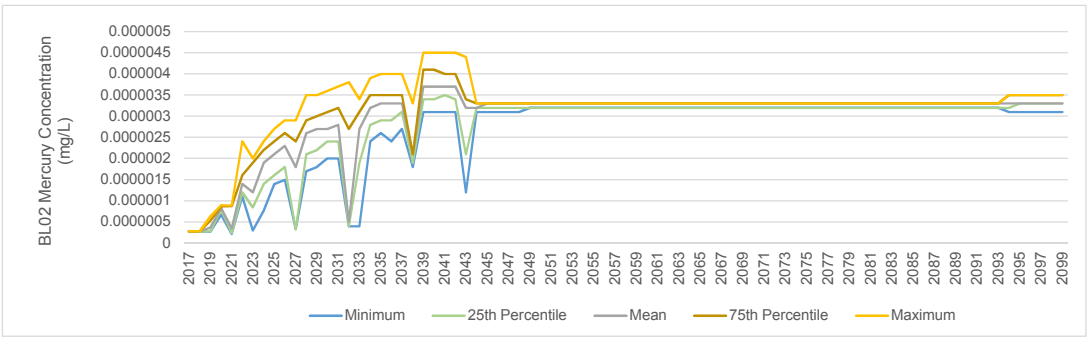

BL02 Iron Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

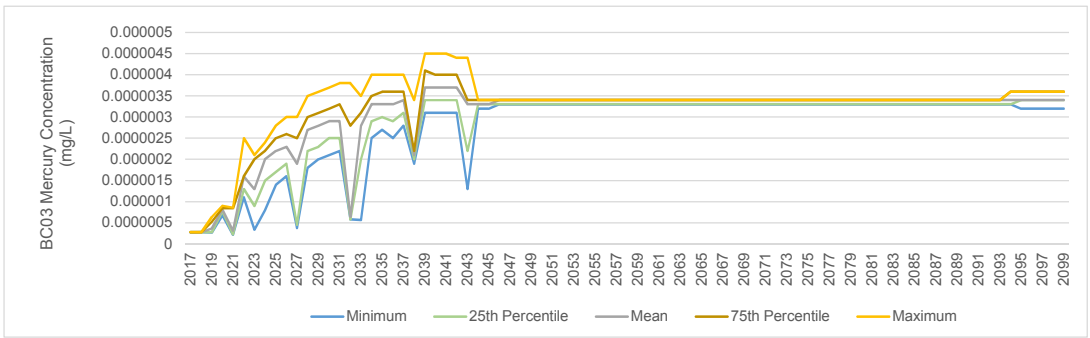

BC03 Iron Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

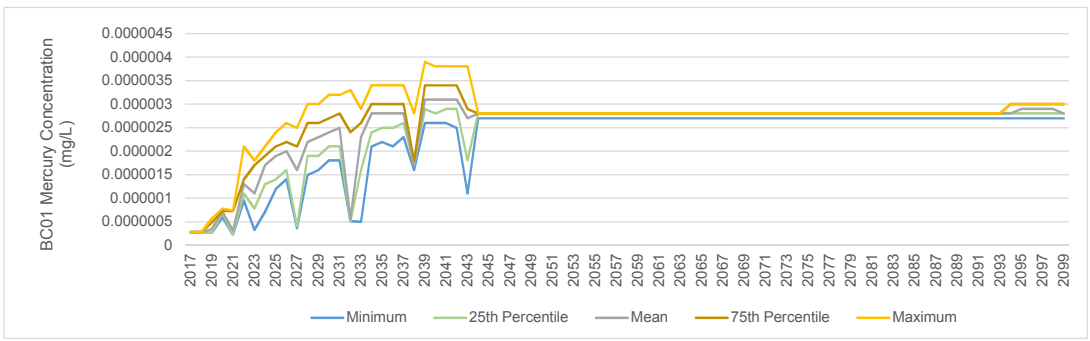

BC01 Iron Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

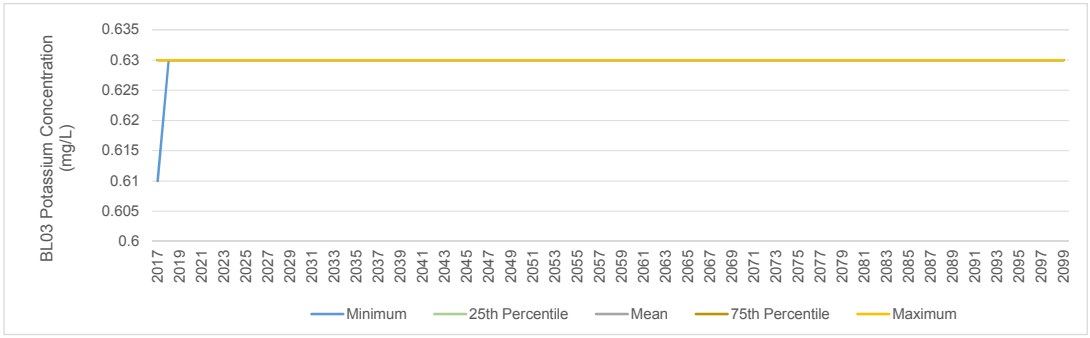

BL03 Mercury Concentration (mg/L)
2.82E-07
2.8E-07
2.78E-07
2.76E-07
2.74E-07
2.72E-07
2.7E-07
2.68E-07
2.66E-07
2.64E-07
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

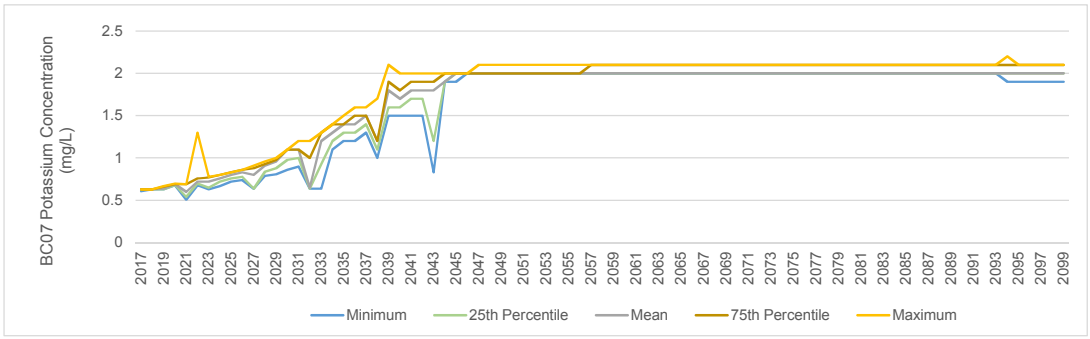

BC07 Mercury Concentration (mg/L)
0.000005
0.0000045
0.000004
0.0000035
0.000003
0.0000025
0.000002
0.0000015
0.000001
0.0000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

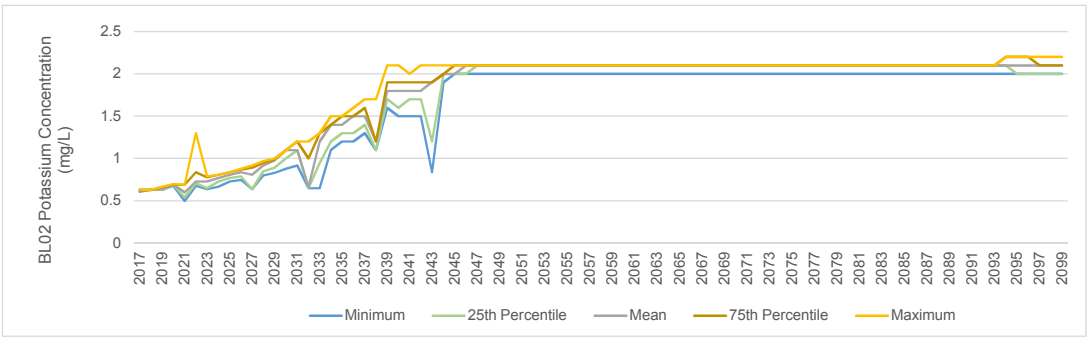

BL02 Mercury Concentration (mg/L)
0.000005
0.0000045
0.000004
0.0000035
0.000003
0.0000025
0.000002
0.0000015
0.000001
0.0000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

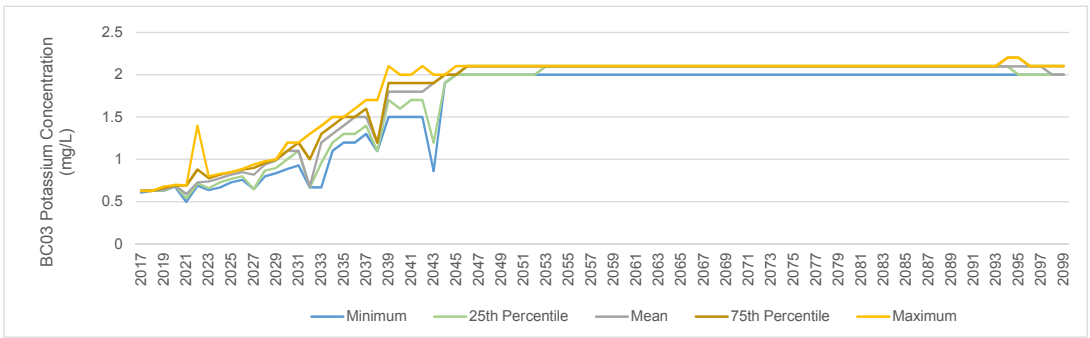

BC03 Mercury Concentration (mg/L)
0.000005
0.0000045
0.000004
0.0000035
0.000003
0.0000025
0.000002
0.0000015
0.000001
0.0000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

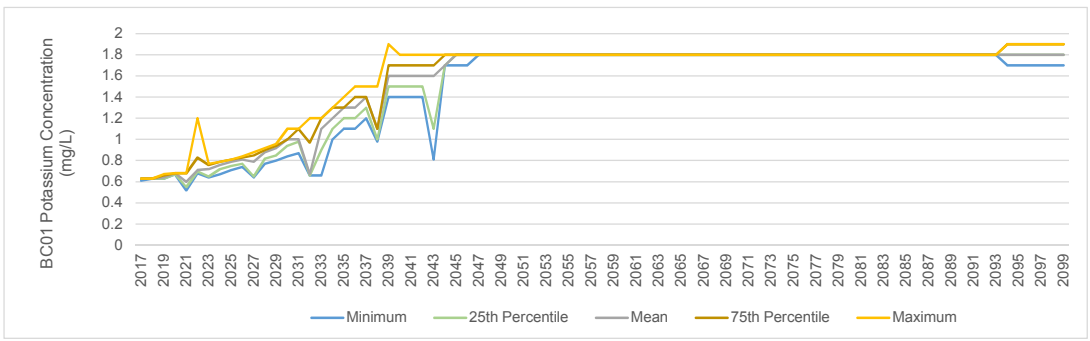

BC01 Mercury Concentration (mg/L)
0.0000045
0.000004
0.0000035
0.000003
0.0000025
0.000002
0.0000015
0.000001
0.0000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

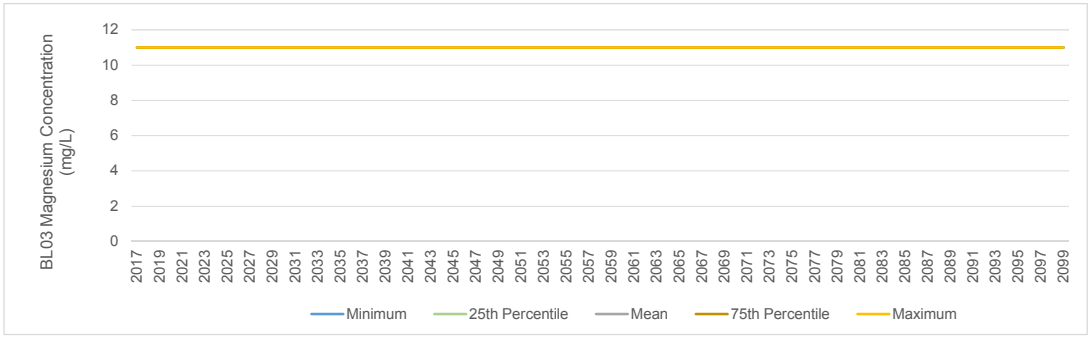

BL03 Potassium Concentration (mg/L)
0.635
0.63
0.625
0.62
0.615
0.61
0.605
0.6
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

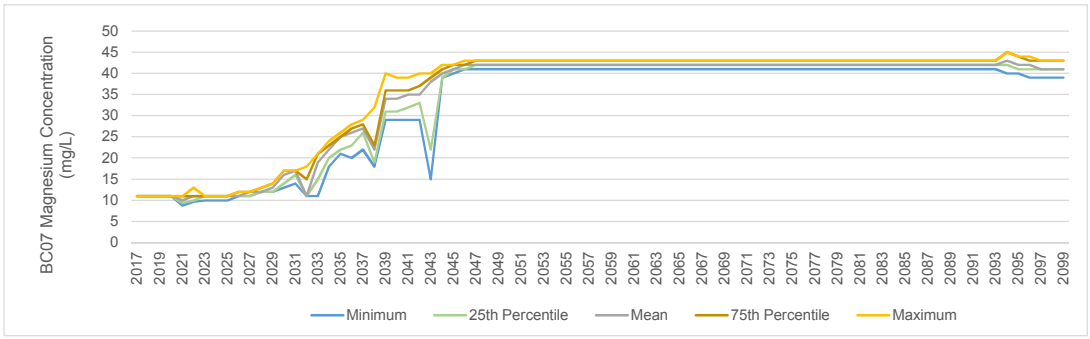

BC07 Potassium Concentration (mg/L)
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

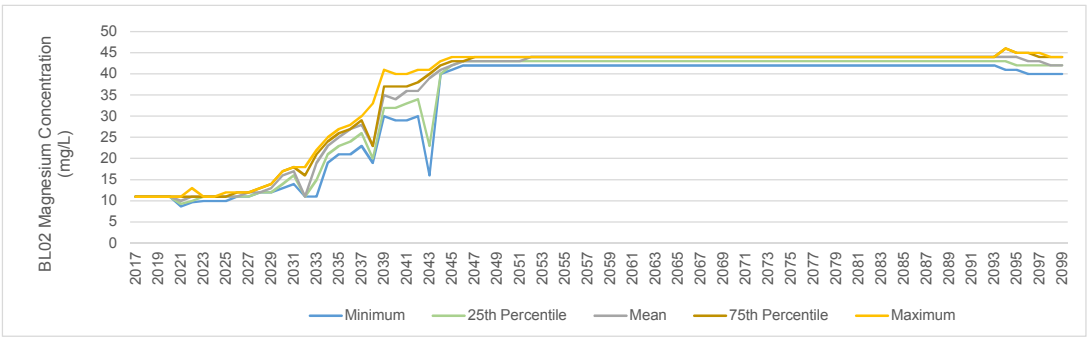

BL02 Potassium Concentration (mg/L)
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

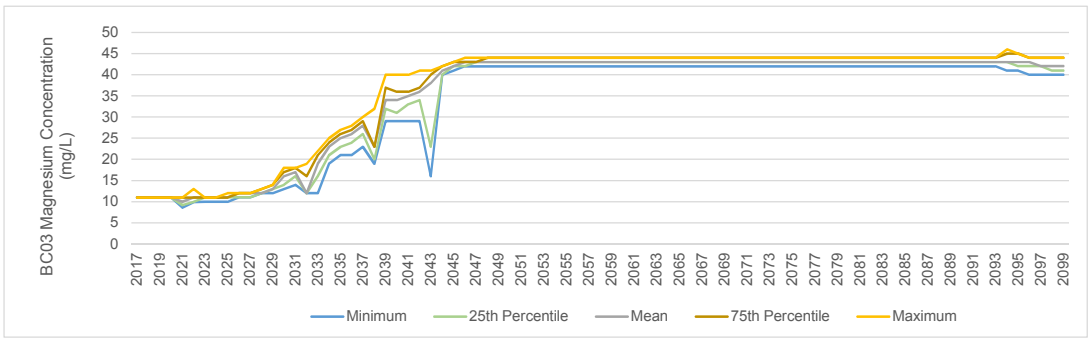

BC03 Potassium Concentration (mg/L)
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

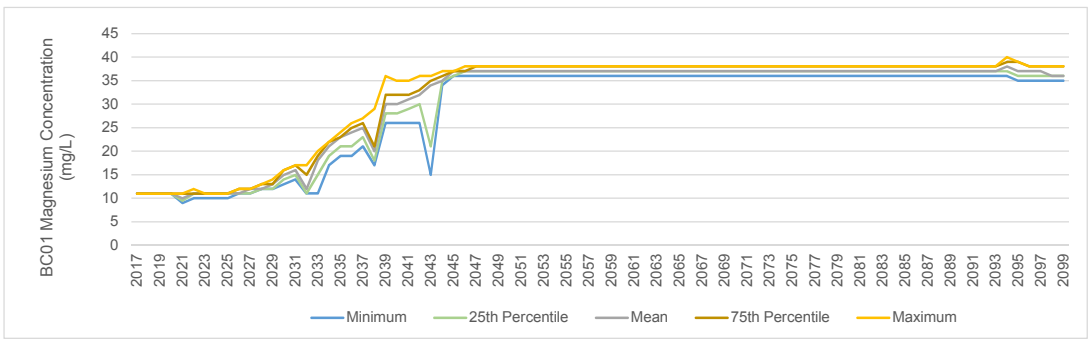

BC01 Potassium Concentration (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

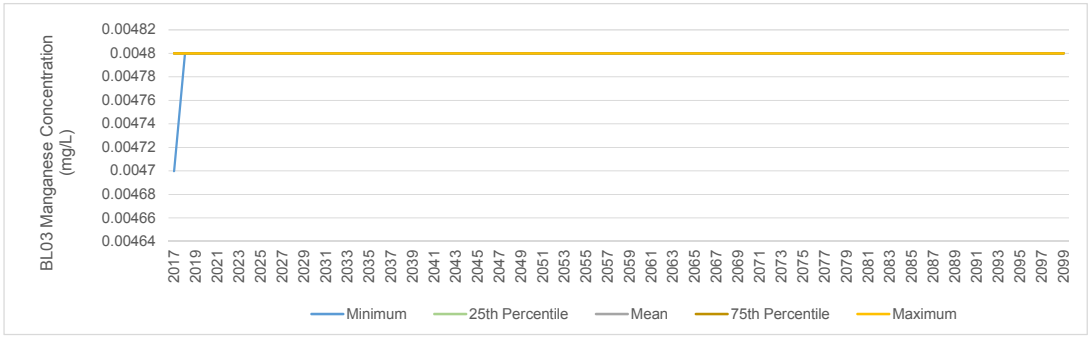

BL03 Magnesium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

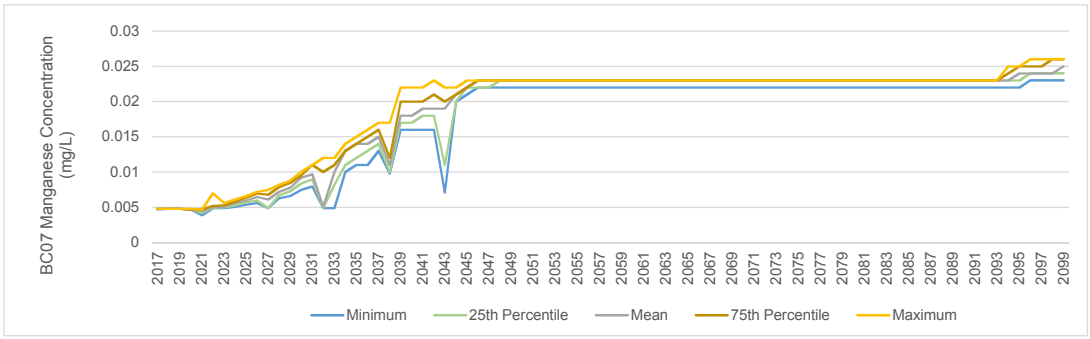

BC07 Magnesium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

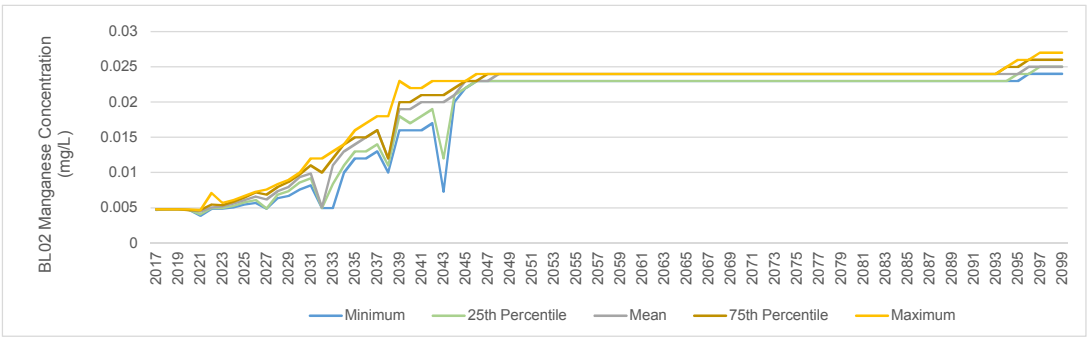

BL02 Magnesium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

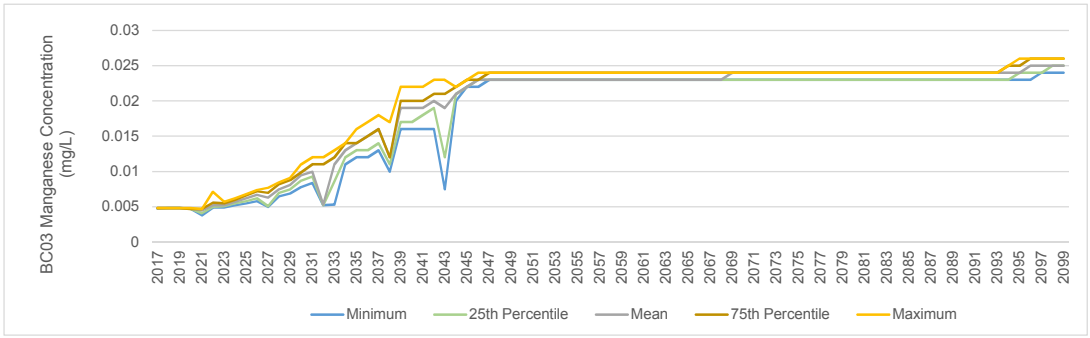

BC03 Magnesium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

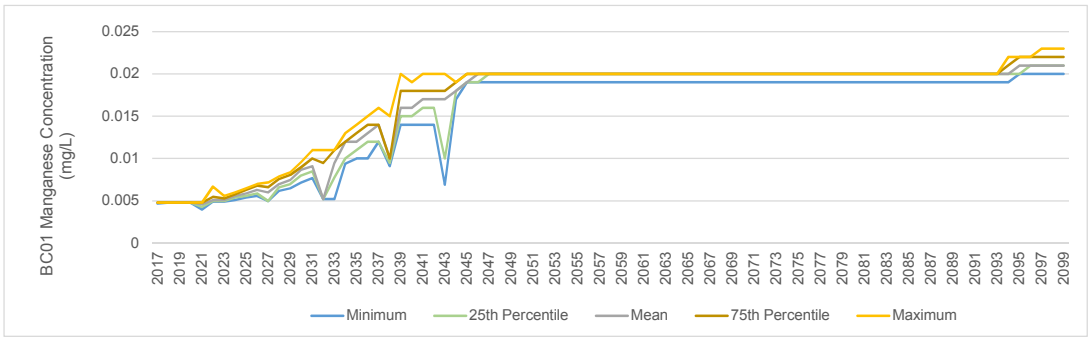

BC01 Magnesium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

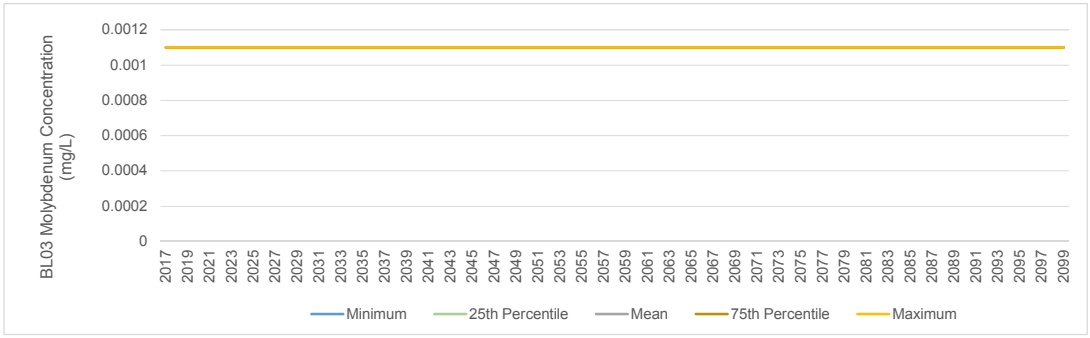

BL03 Manganese Concentration (mg/L)
0.00482
0.0048
0.00478
0.00476
0.00474
0.00472
0.0047
0.00468
0.00466
0.00464
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

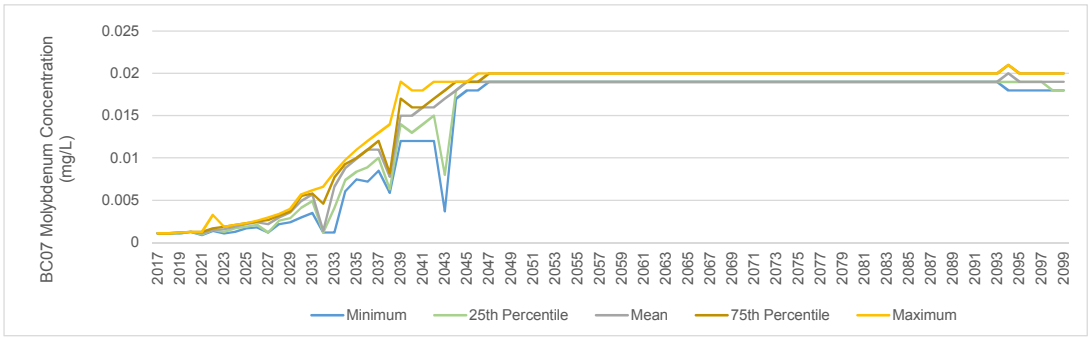

BC07 Manganese Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

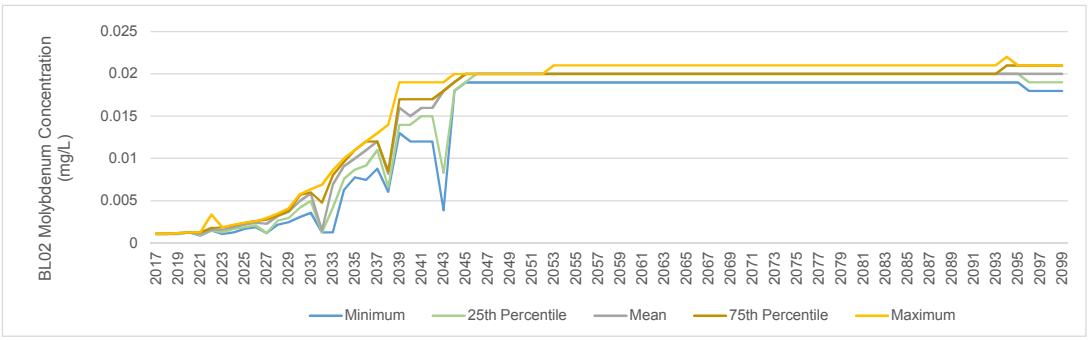

BL02 Manganese Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

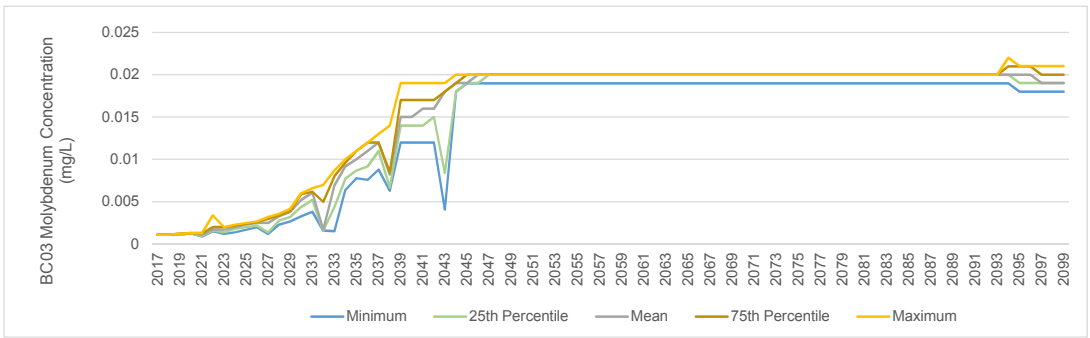

BC03 Manganese Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

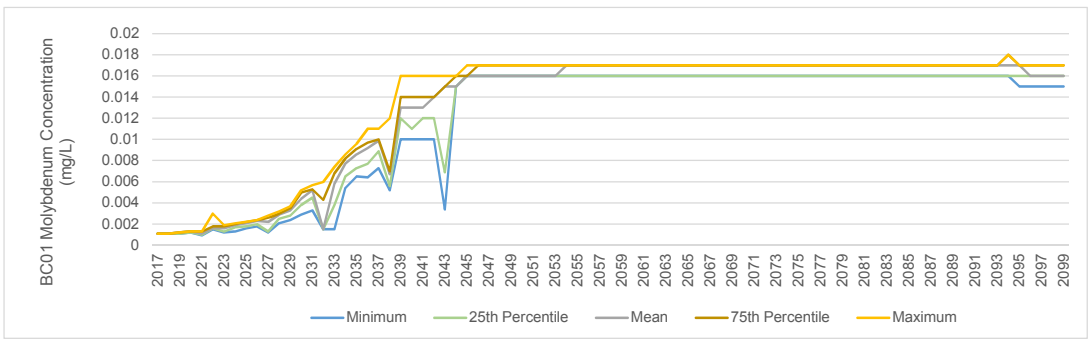

BC01 Manganese Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

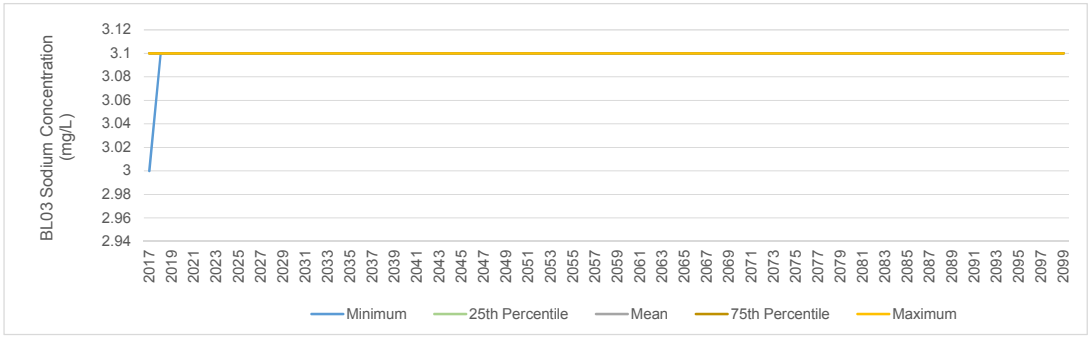

BL03 Molybdenum Concentration (mg/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

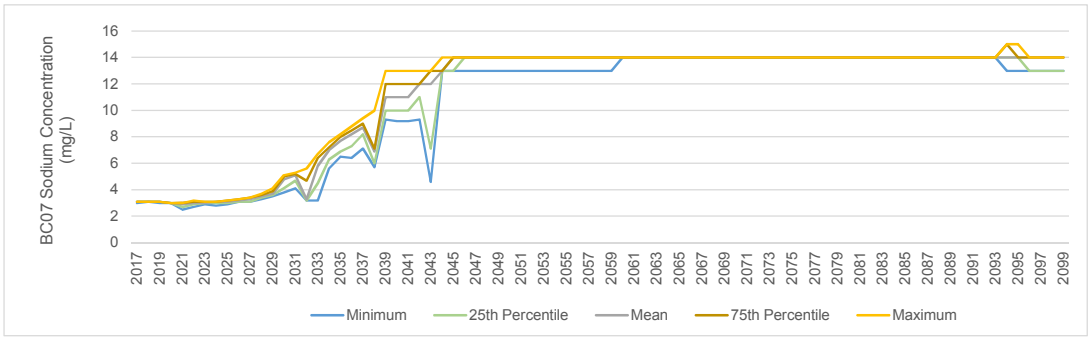

BC07 Molybdenum Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

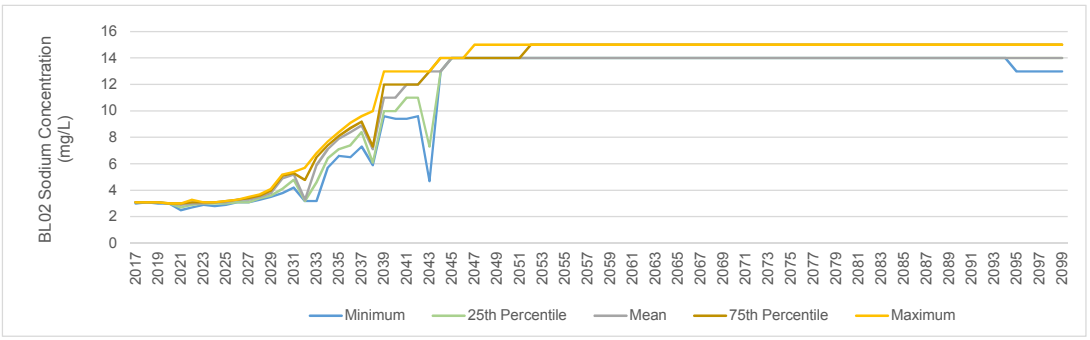

BL02 Molybdenum Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

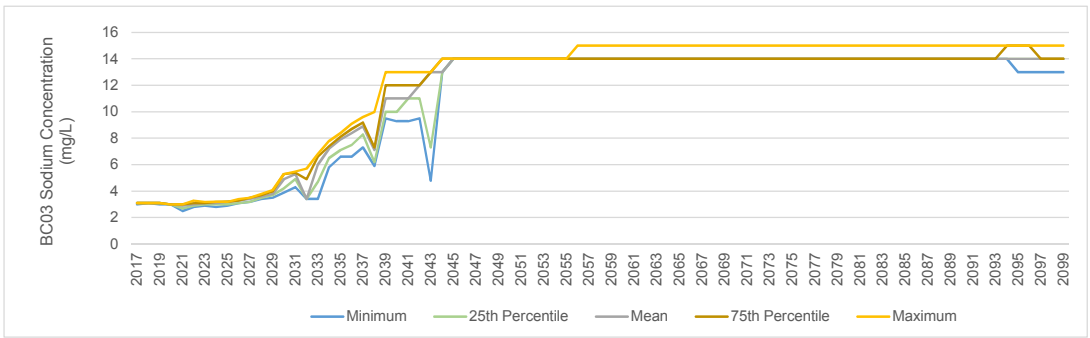

BC03 Molybdenum Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

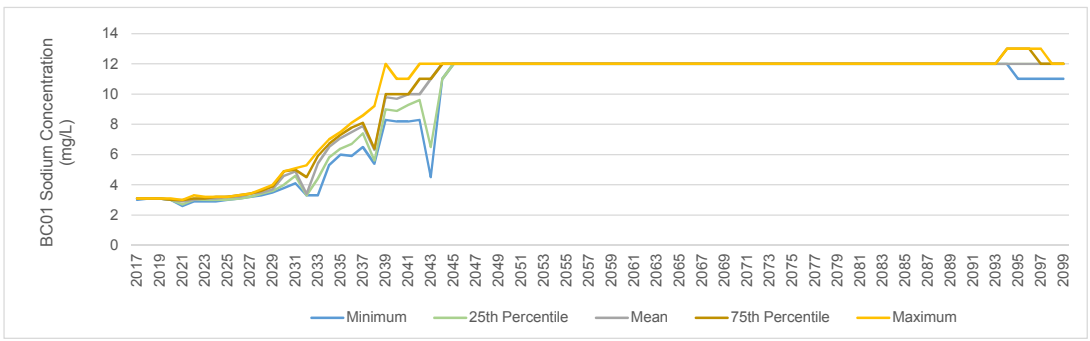

BC01 Molybdenum Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

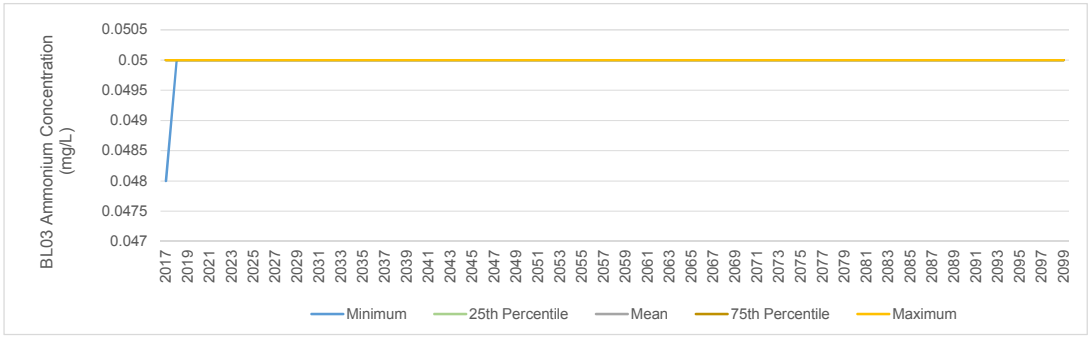

BL03 Sodium Concentration (mg/L)
3.12
3.1
3.08
3.06
3.04
3.02
3
2.98
2.96
2.94
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

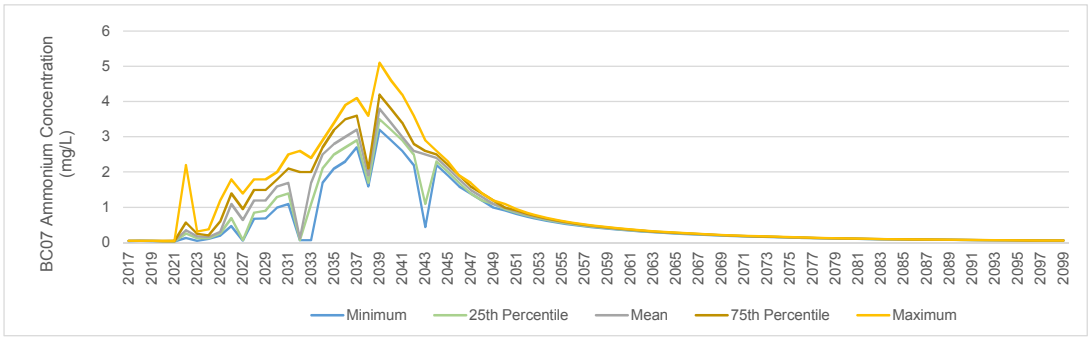

BC07 Sodium Concentration (mg/L)
16
14
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

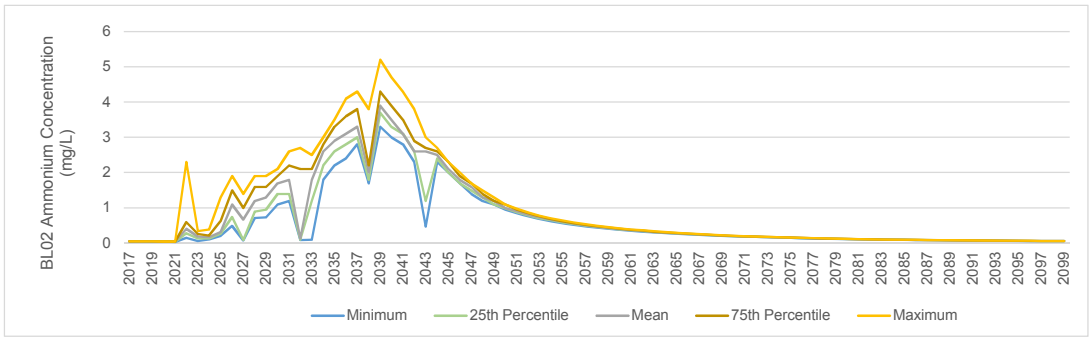

BL02 Sodium Concentration (mg/L)
16
14
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

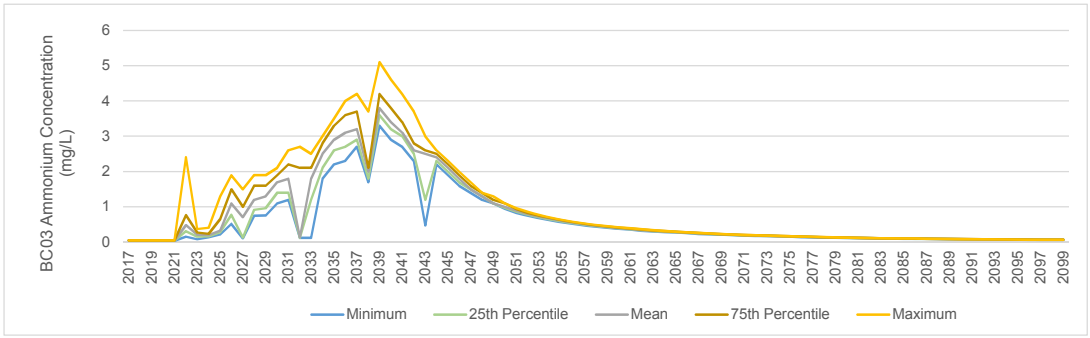

BC03 Sodium Concentration (mg/L)
16
14
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

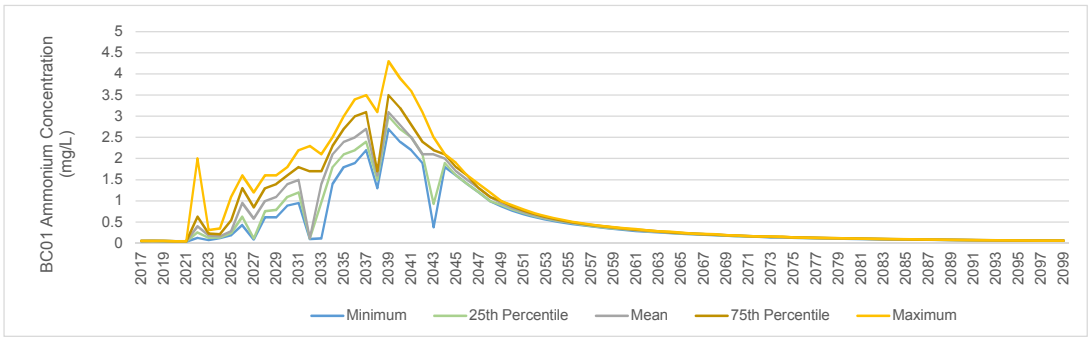

BC01 Sodium Concentration (mg/L)
14
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

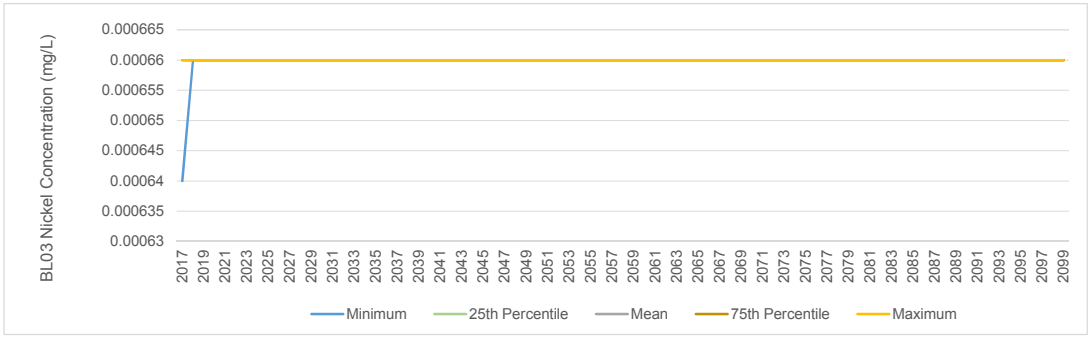

BL03 Ammonium Concentration (mg/L)
0.0505
0.05
0.0495
0.049
0.0485
0.048
0.0475
0.047
Minimum
25th Percentile
Mean
75th Percentile
Maximum

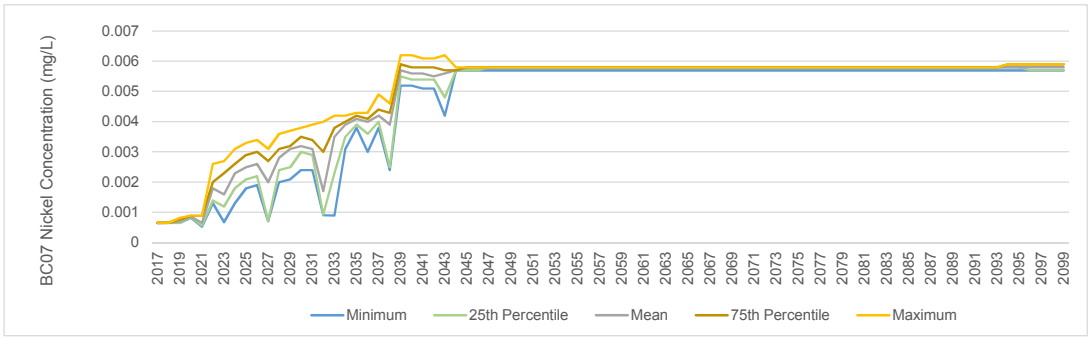

BC07 Ammonium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

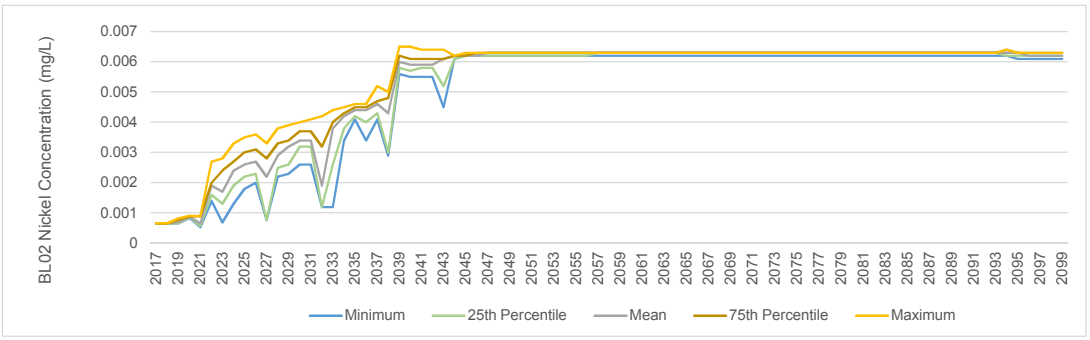

BL02 Ammonium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

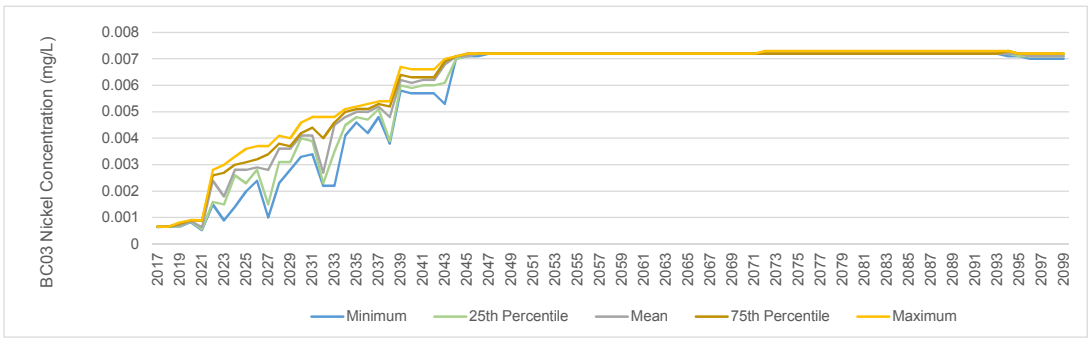

BC03 Ammonium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

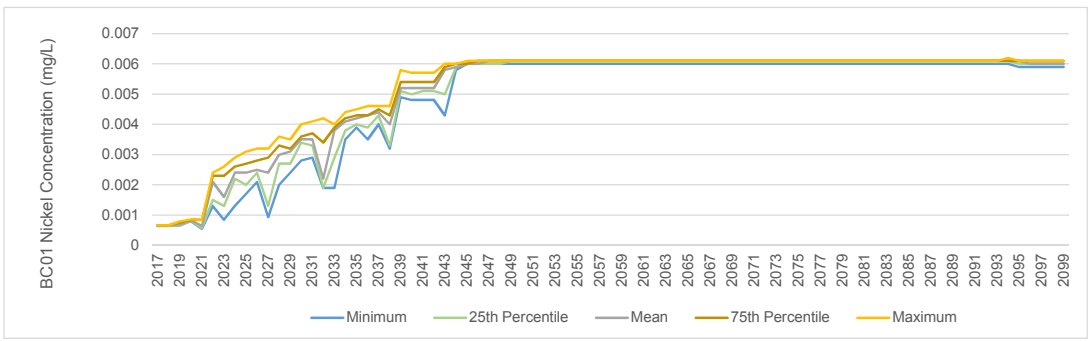

BC01 Ammonium Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

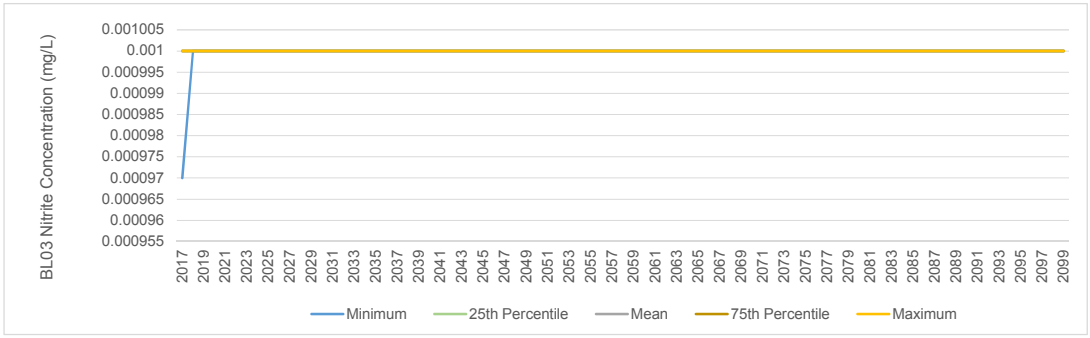

BL03 Nickel Concentration (mg/L)
0.000665
0.00066
0.000655
0.00065
0.000645
0.00064
0.000635
0.00063
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

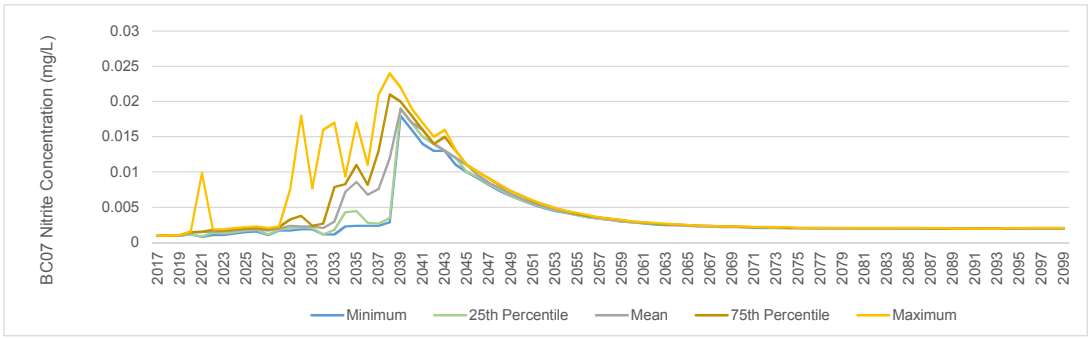

BC07 Nickel Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

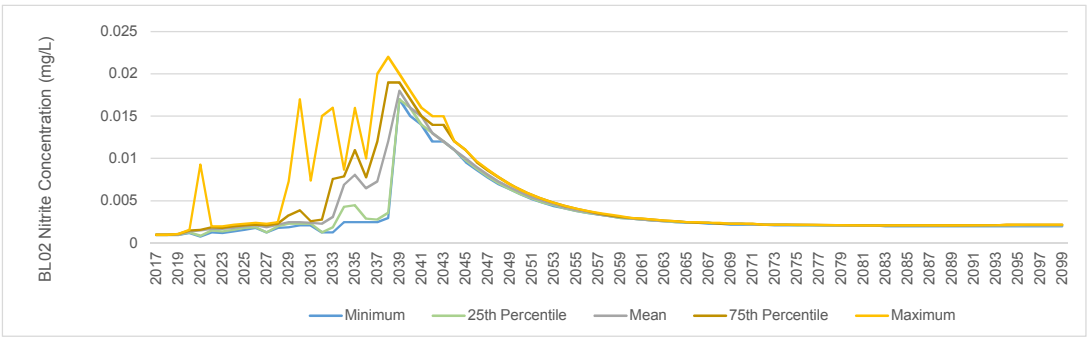

BL02 Nickel Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

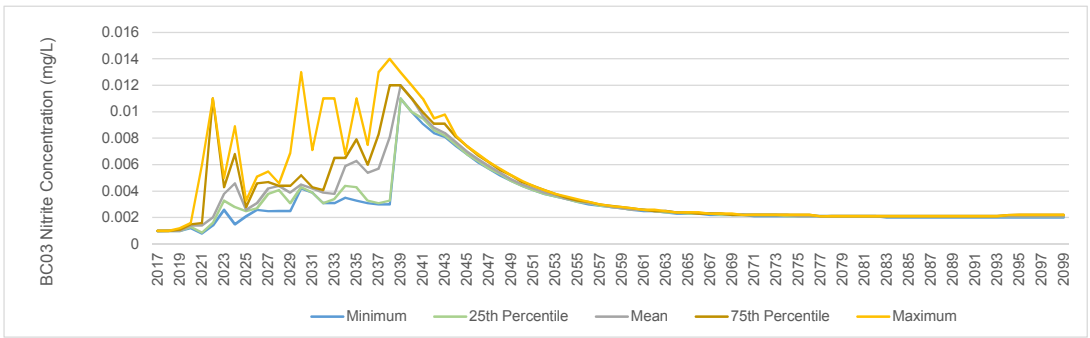

BC03 Nickel Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

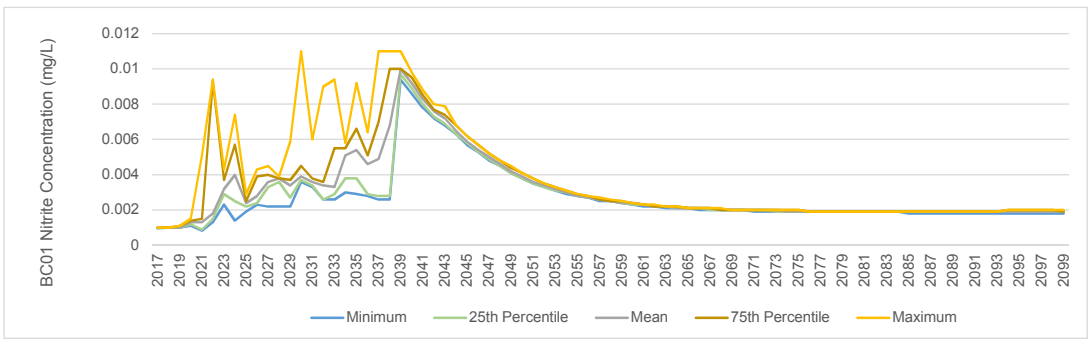

BC01 Nickel Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

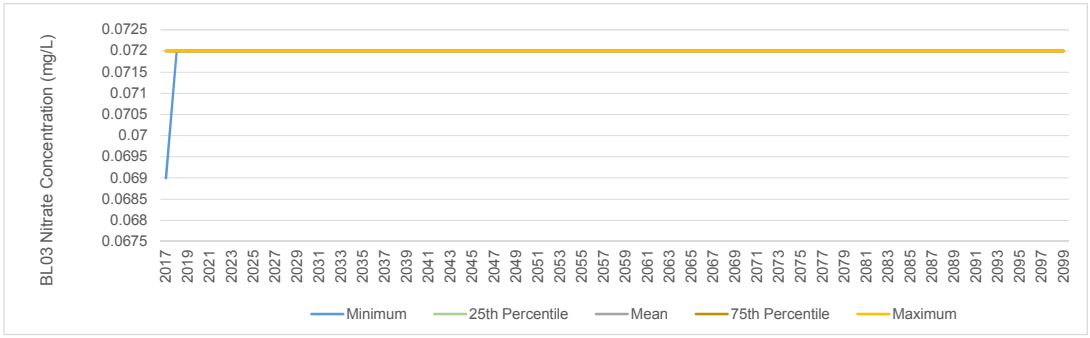

BL03 Nitrite Concentration (mg/L)
0.001005
0.001
0.000995
0.00099
0.000985
0.00098
0.000975
0.00097
0.000965
0.00096
0.000955
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

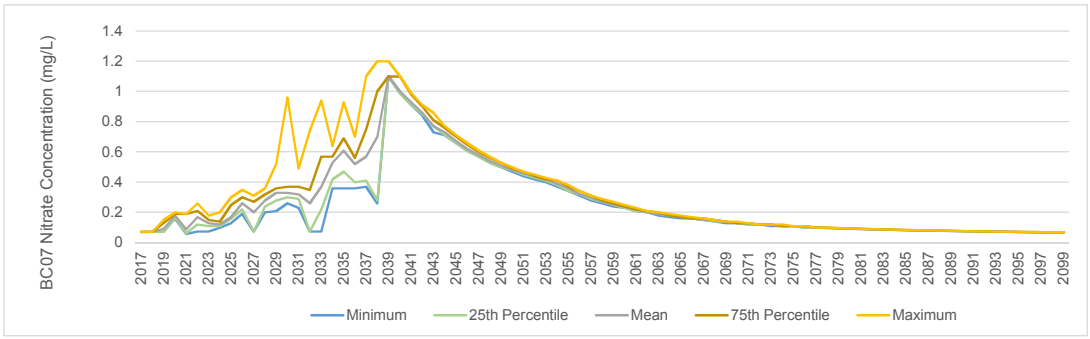

BC07 Nitrite Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

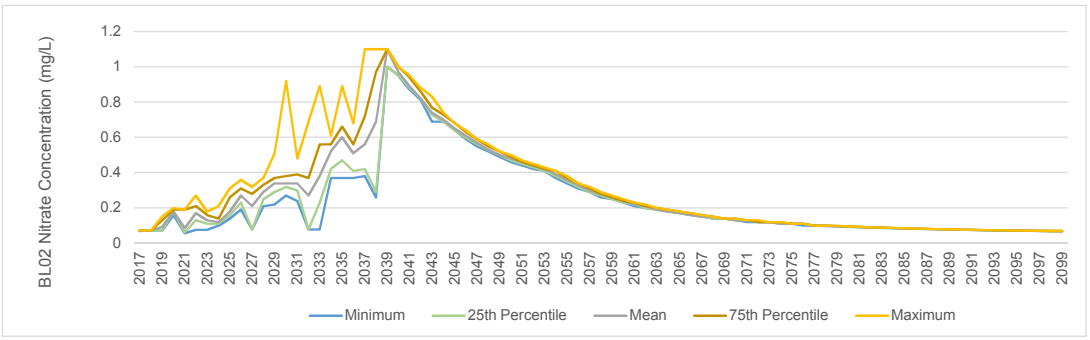

BL02 Nitrite Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

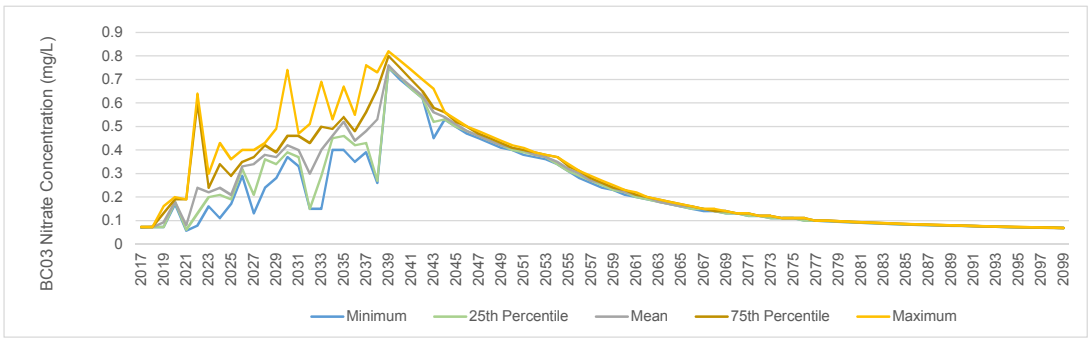

BC03 Nitrite Concentration (mg/L)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

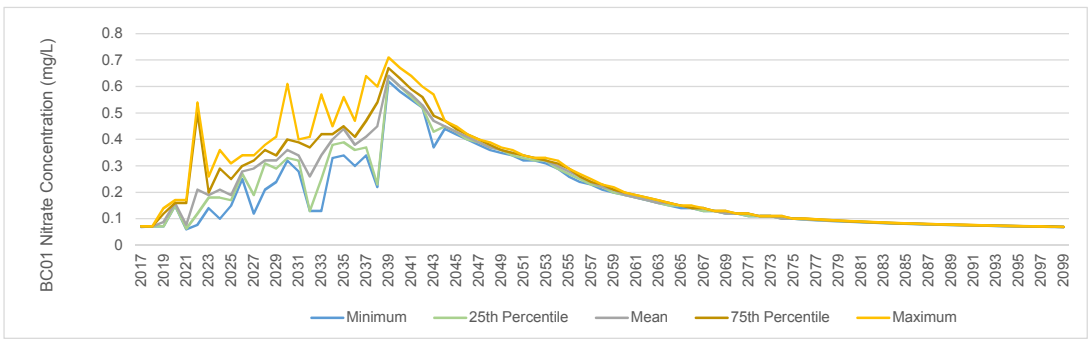

BC01 Nitrite Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

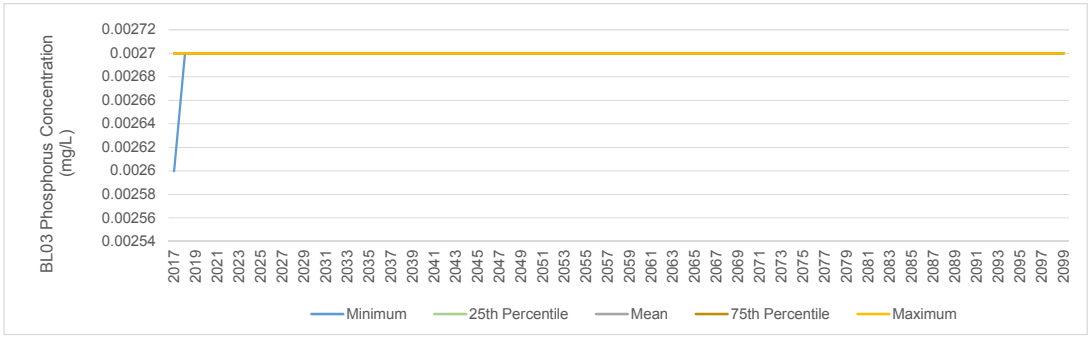

BL03 Nitrate Concentration (mg/L)
0.0725
0.072
0.0715
0.071
0.0705
0.07
0.0695
0.069
0.0685
0.068
0.0675
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

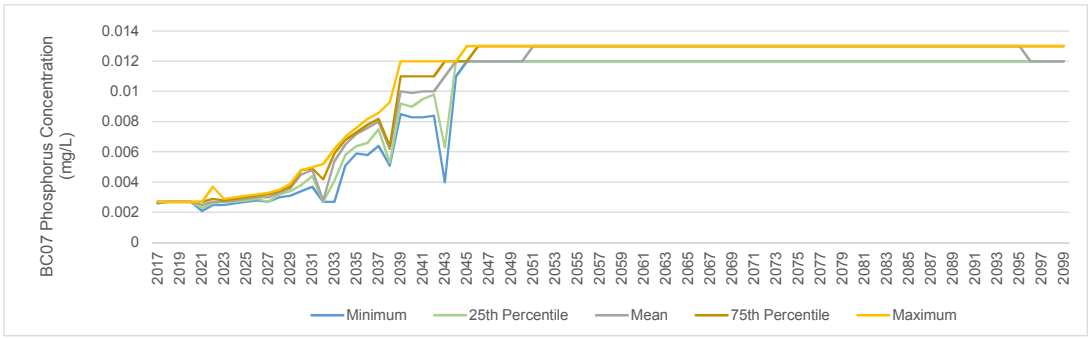

BC07 Nitrate Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

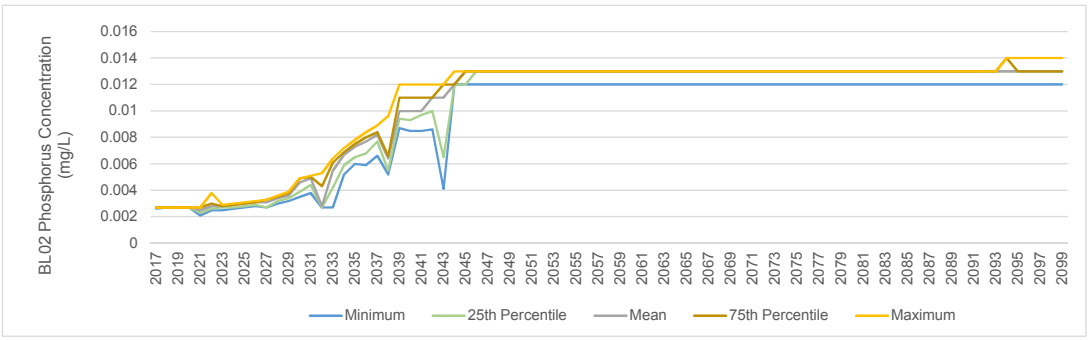

BL02 Nitrate Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

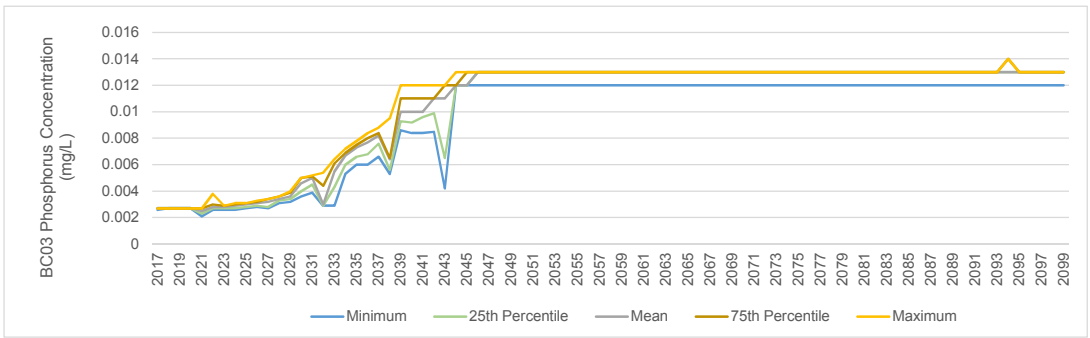

BC03 Nitrate Concentration (mg/L)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

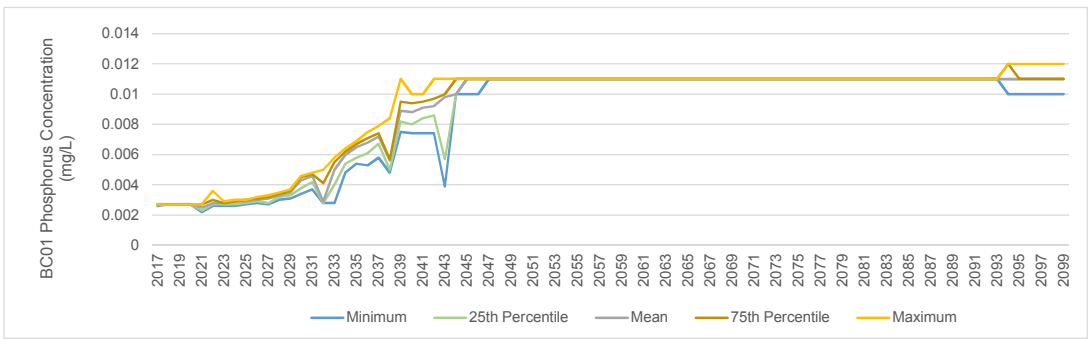

BC01 Nitrate Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

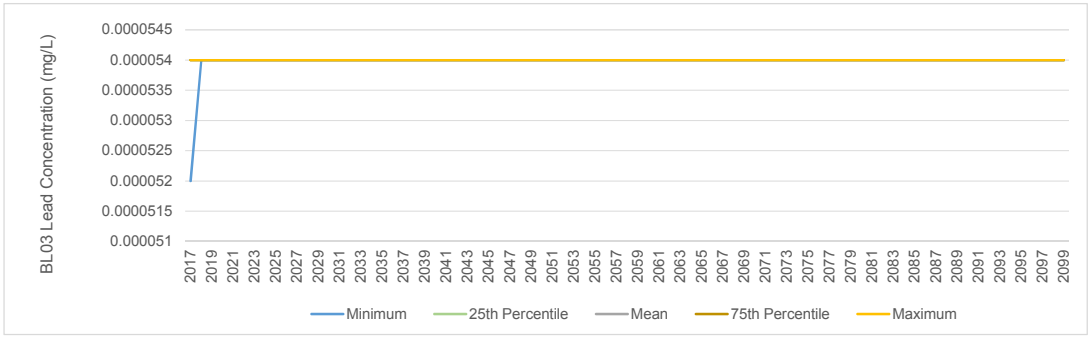

BL03 Phosphorus Concentration (mg/L)
0.00272
0.0027
0.00268
0.00266
0.00264
0.00262
0.0026
0.00258
0.00256
0.00254
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

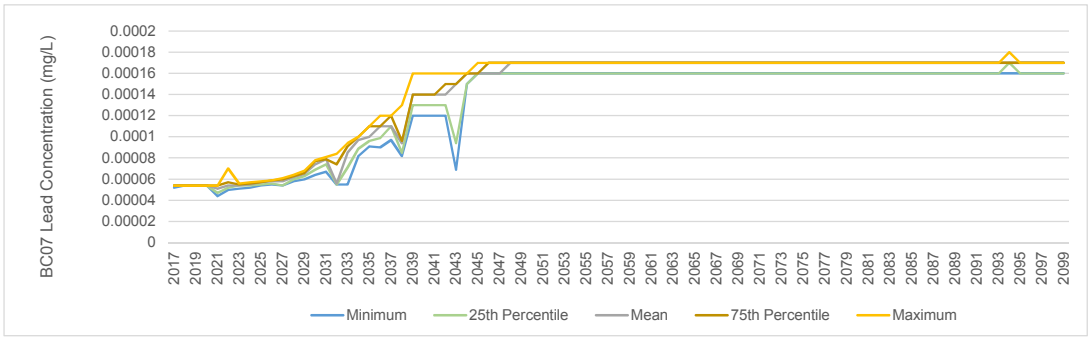

BC07 Phosphorus Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

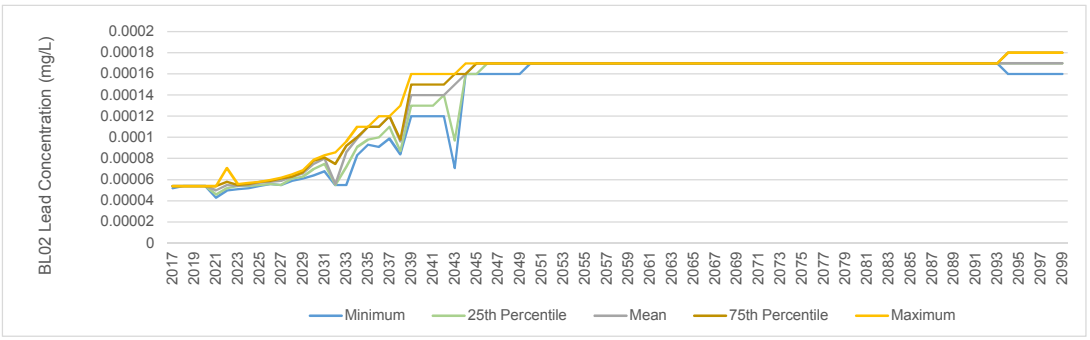

BL02 Phosphorus Concentration (mg/L)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

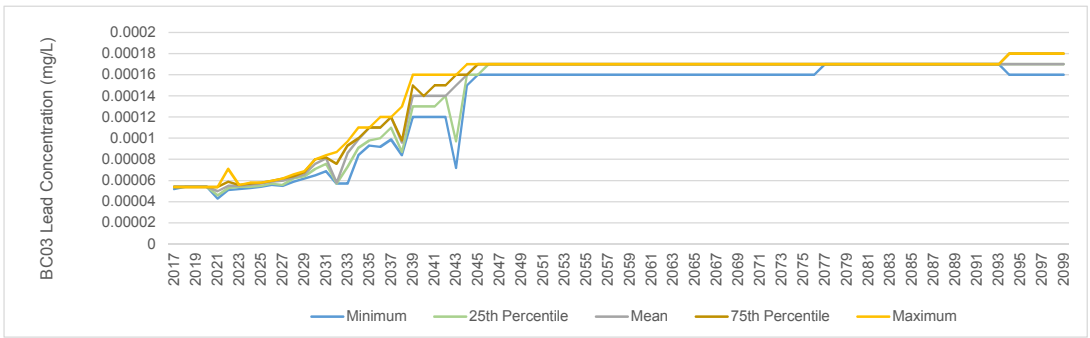

BC03 Phosphorus Concentration (mg/L)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

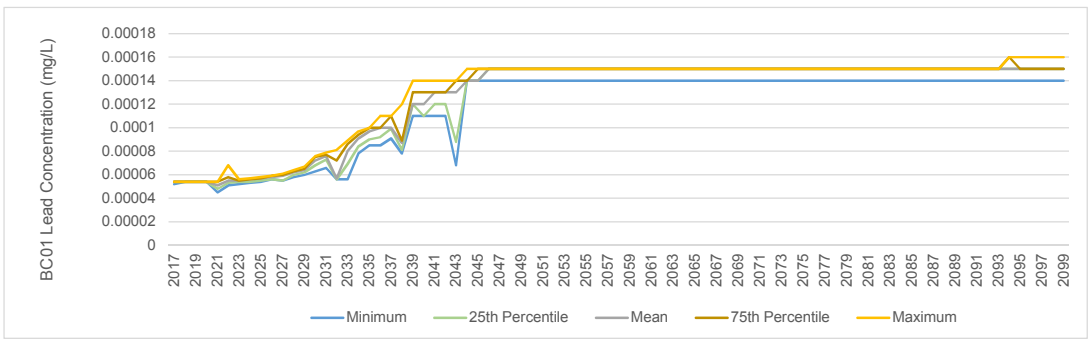

BC01 Phosphorus Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

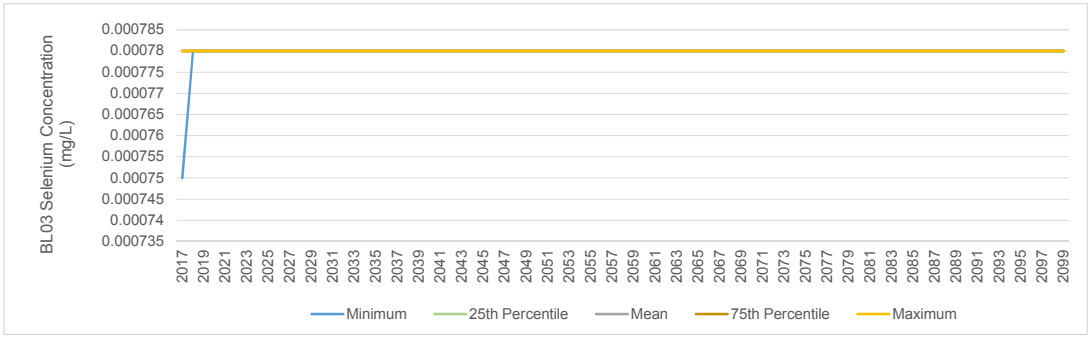

BL03 Lead Concentration (mg/L)
0.0000545
0.000054
0.0000535
0.000053
0.0000525
0.000052
0.0000515
0.000051
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

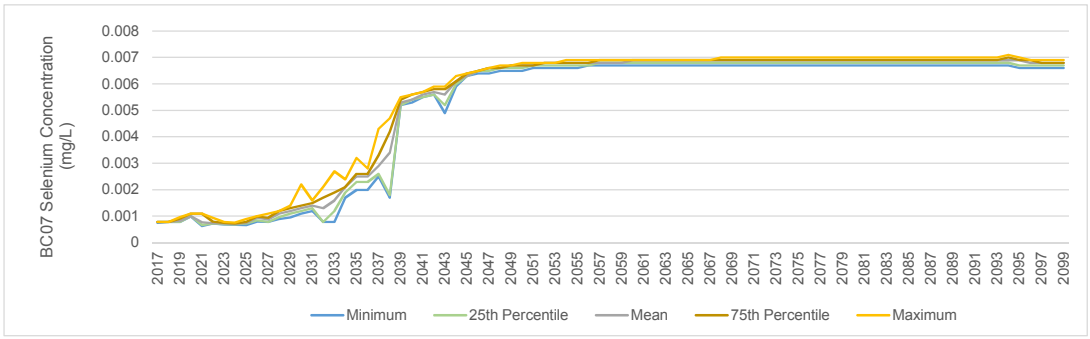

BC07 Lead Concentration (mg/L)
0.0002
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

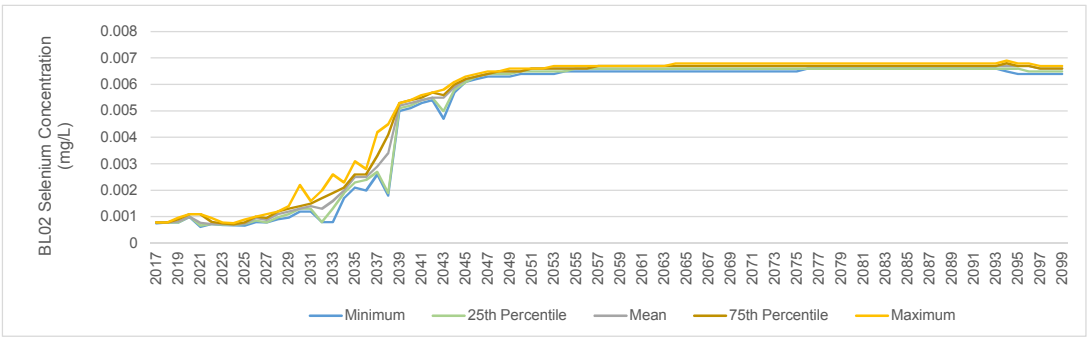

BL02 Lead Concentration (mg/L)
0.0002
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

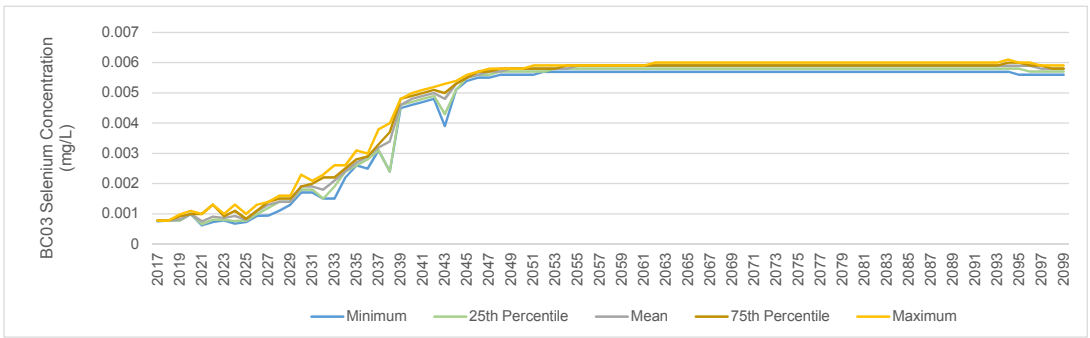

BC03 Lead Concentration (mg/L)
0.0002
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

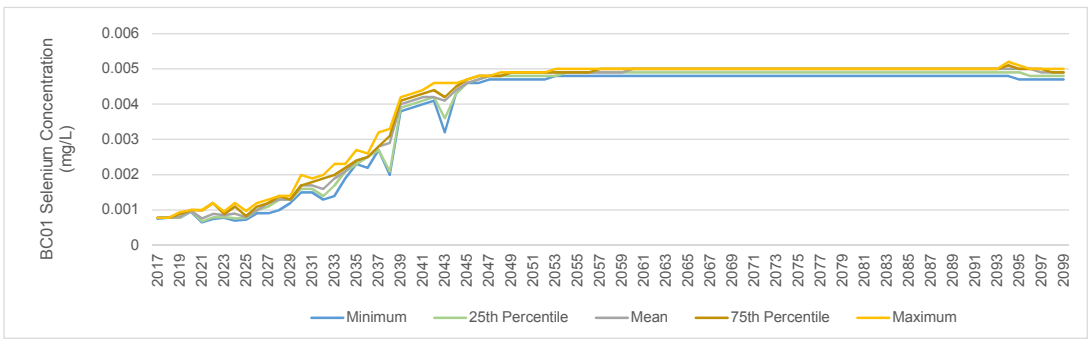

BC01 Lead Concentration (mg/L)
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

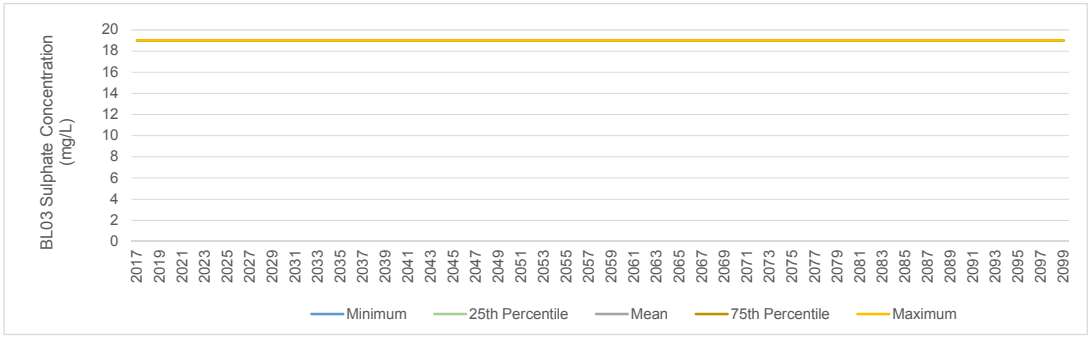

BL03 Selenium Concentration (mg/L)
0.000785
0.00078
0.000775
0.00077
0.000765
0.00076
0.000755
0.00075
0.000745
0.00074
0.000735
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

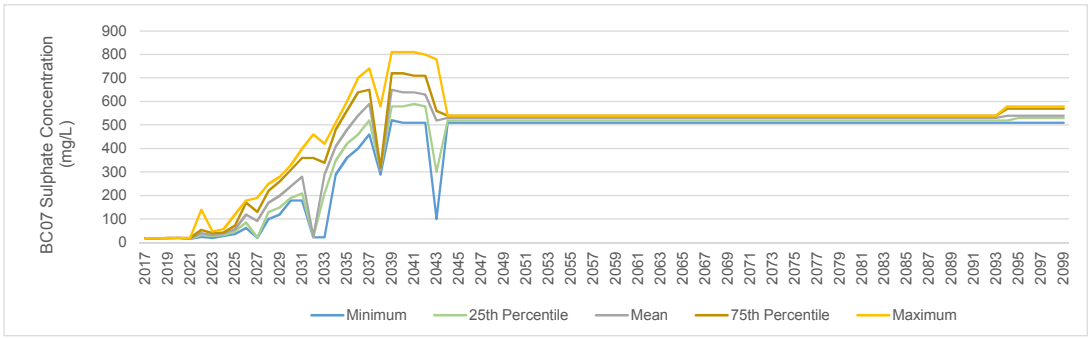

BC07 Selenium Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

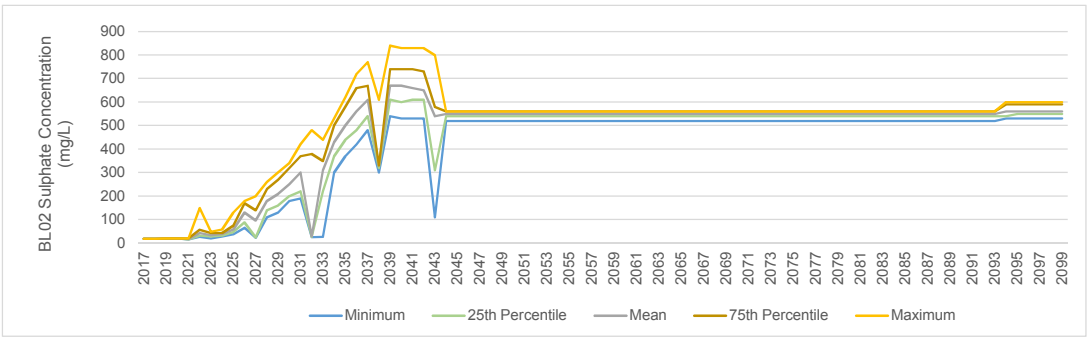

BL02 Selenium Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

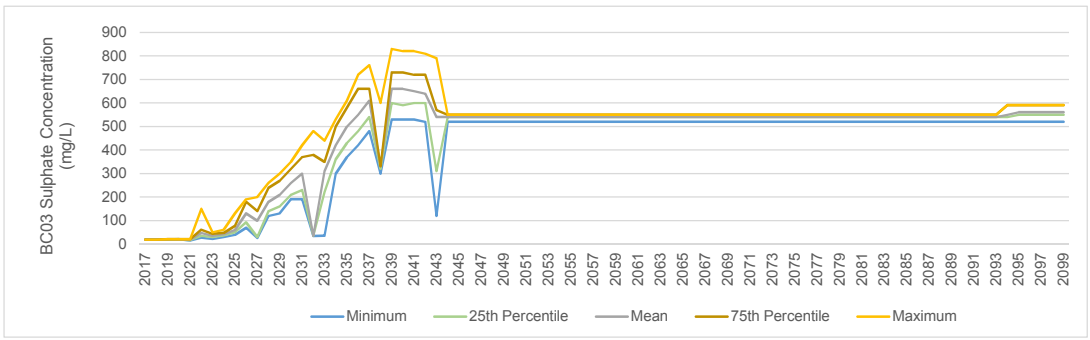

BC03 Selenium Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

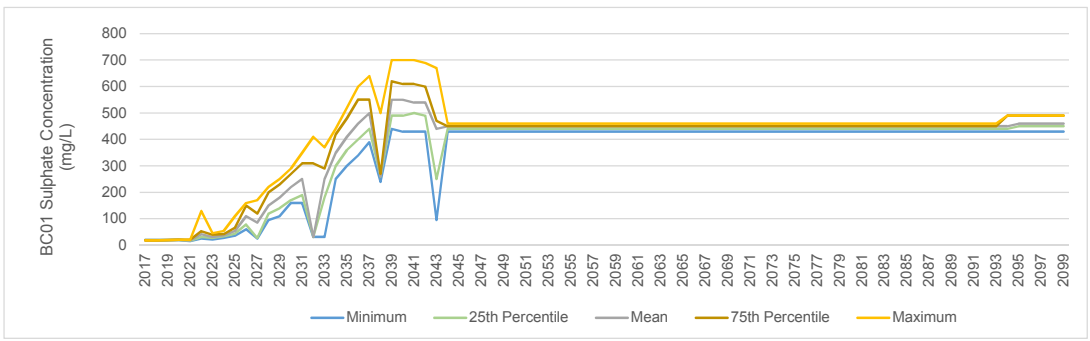

BC01 Selenium Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

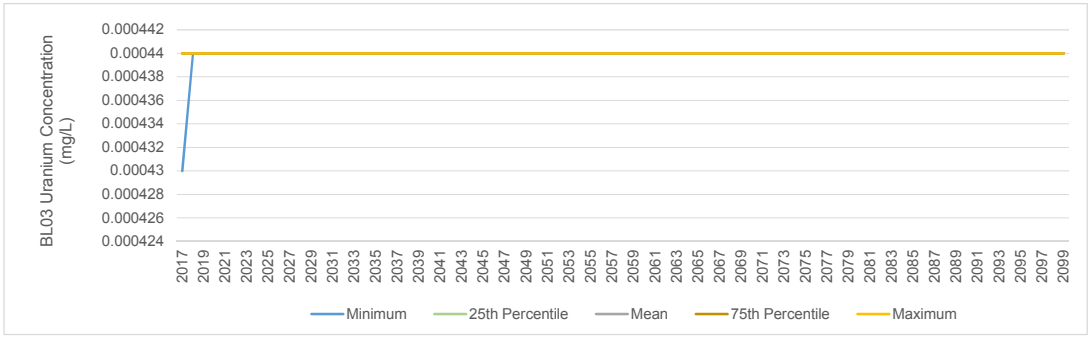

BL03 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

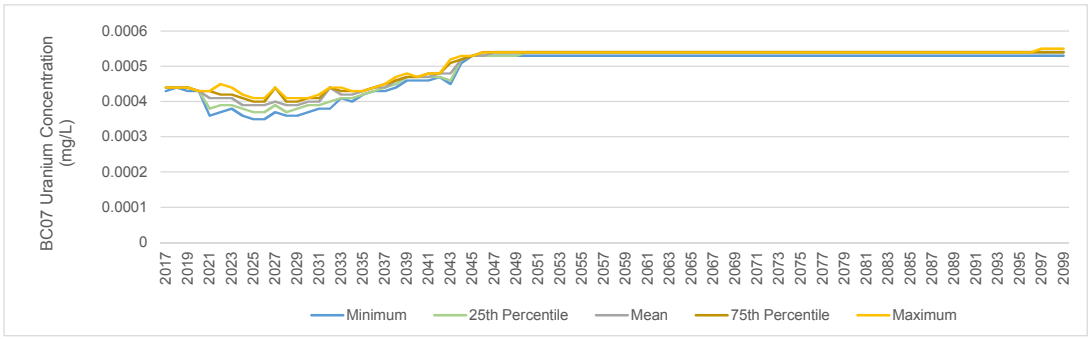

BC07 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

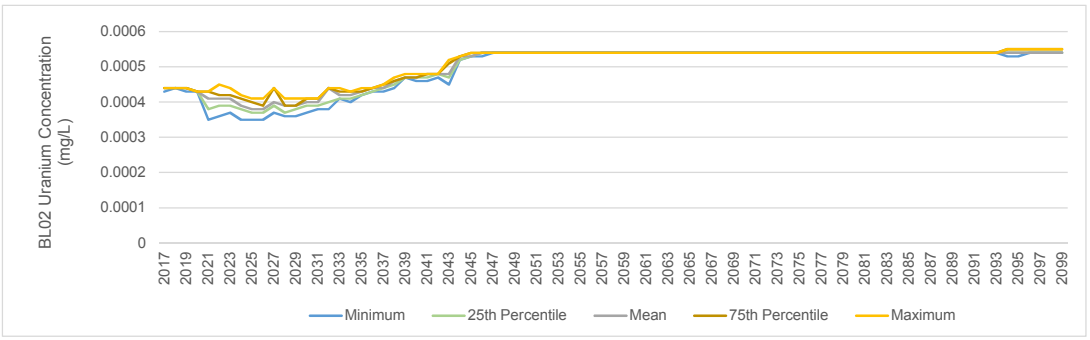

BL02 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

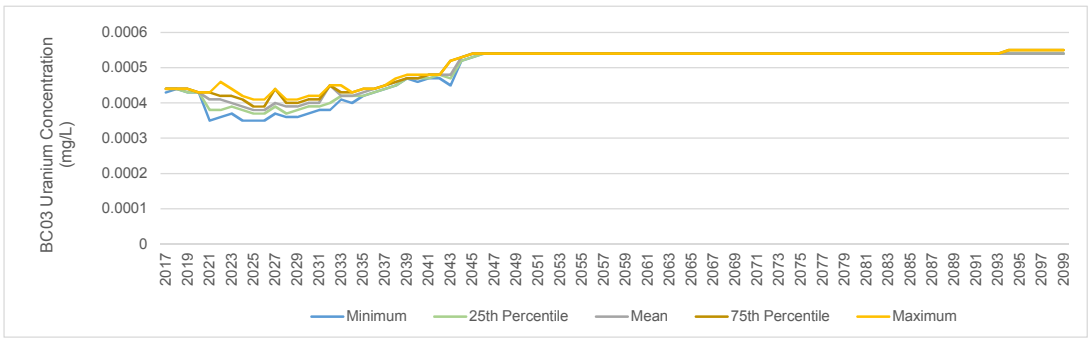

BC03 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

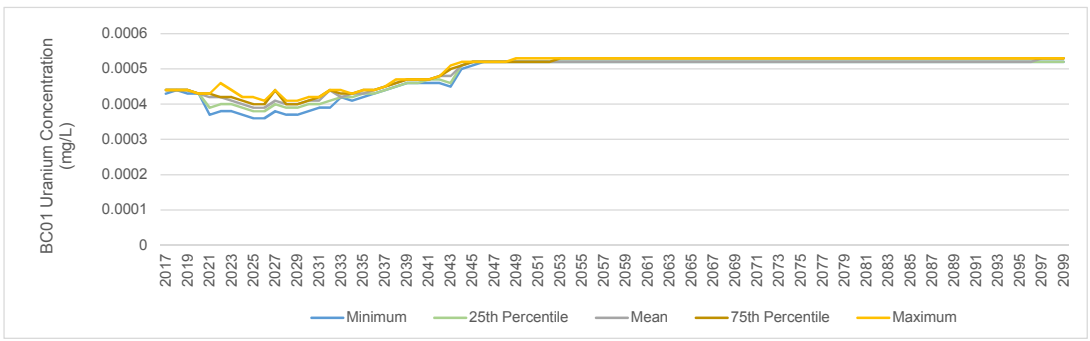

BC01 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

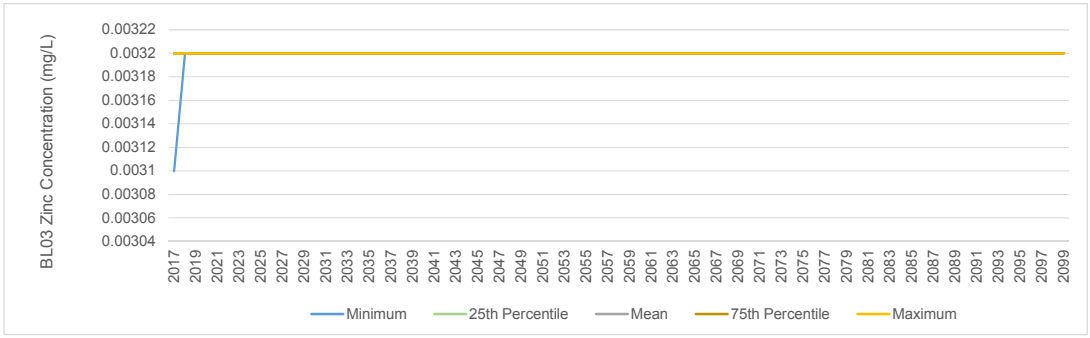

BL03 Uranium Concentration (mg/L)
0.000442
0.00044
0.000438
0.000436
0.000434
0.000432
0.00043
0.000428
0.000426
0.000424
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

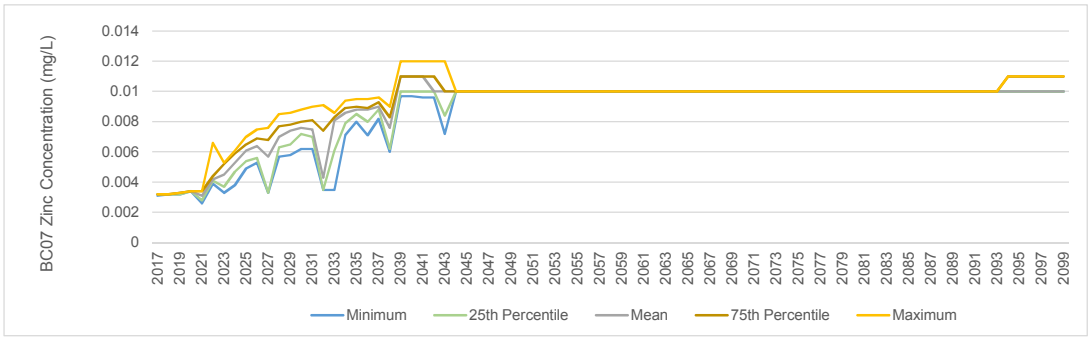

BC07 Uranium Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

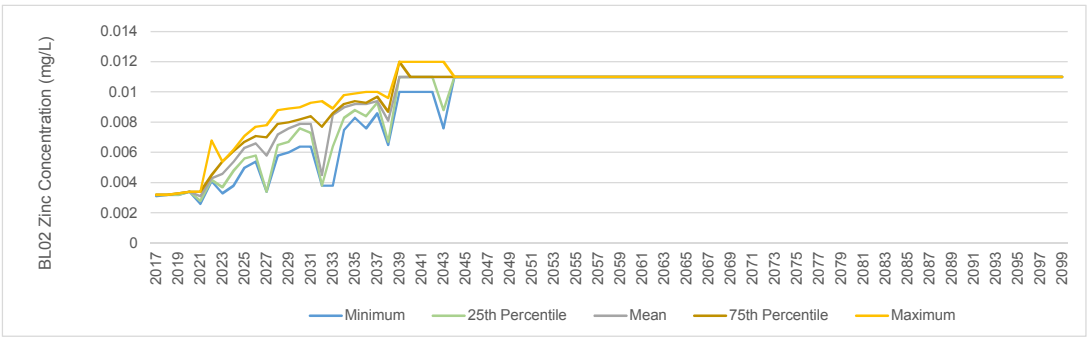

BL02 Uranium Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

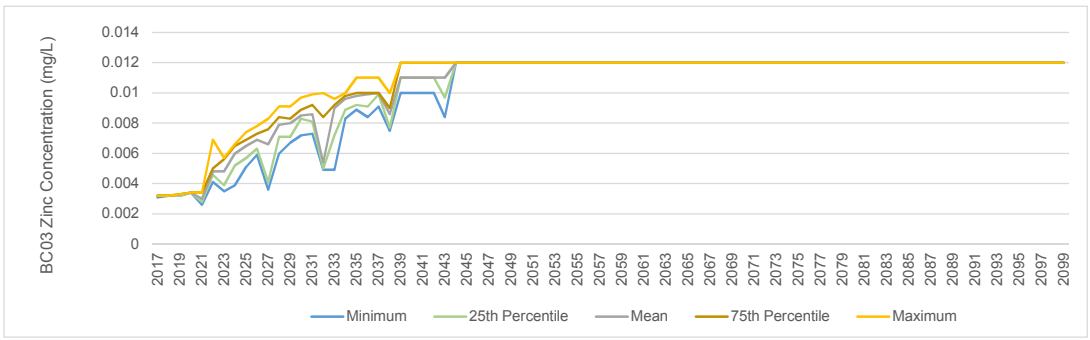

BC03 Uranium Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

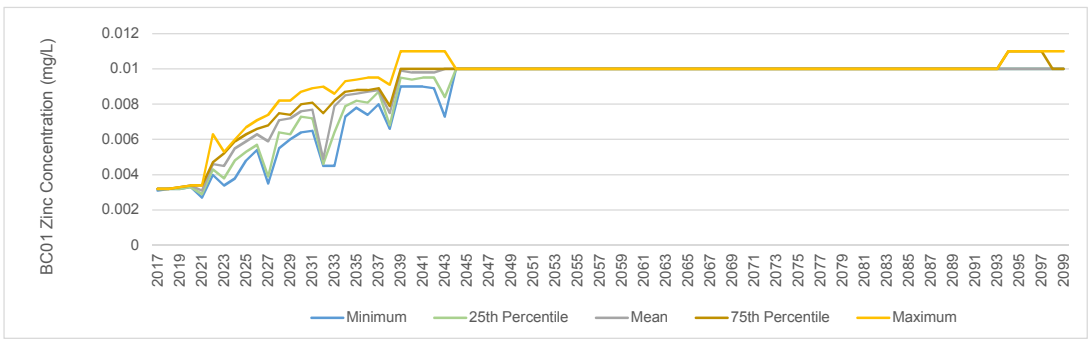

BC01 Uranium Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum


BL03 Zinc Concentration (mg/L)
0.00322
0.0032
0.00318
0.00316
0.00314
0.00312
0.0031
0.00308
0.00306
0.00304
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

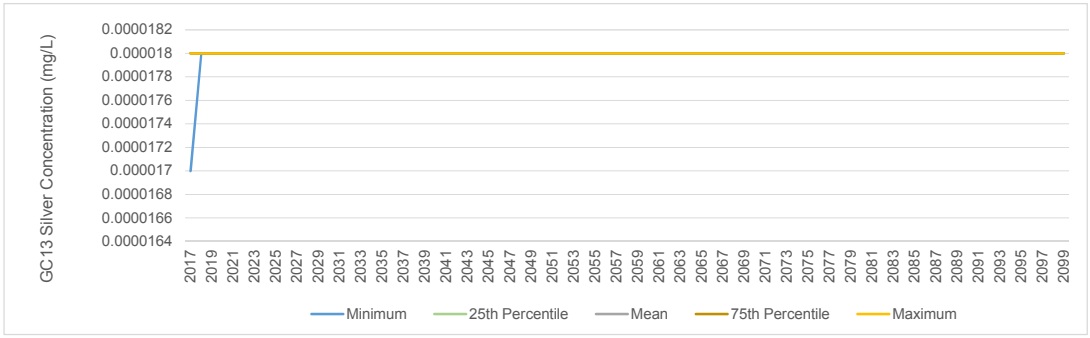

BC07 Zinc Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

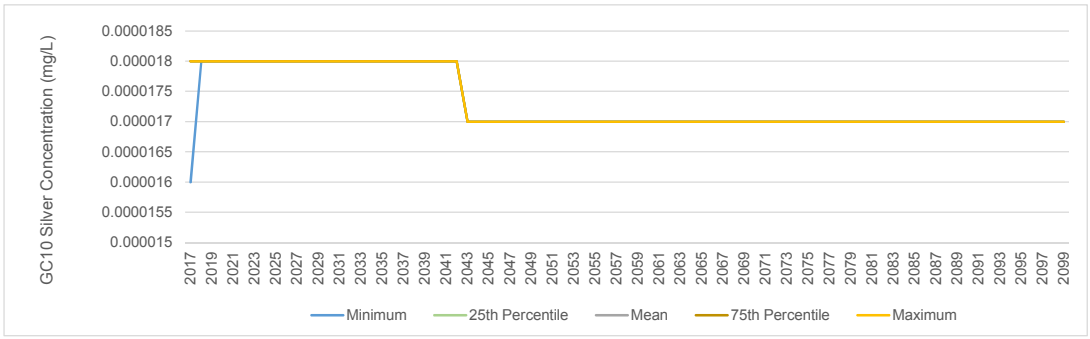

BL02 Zinc Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

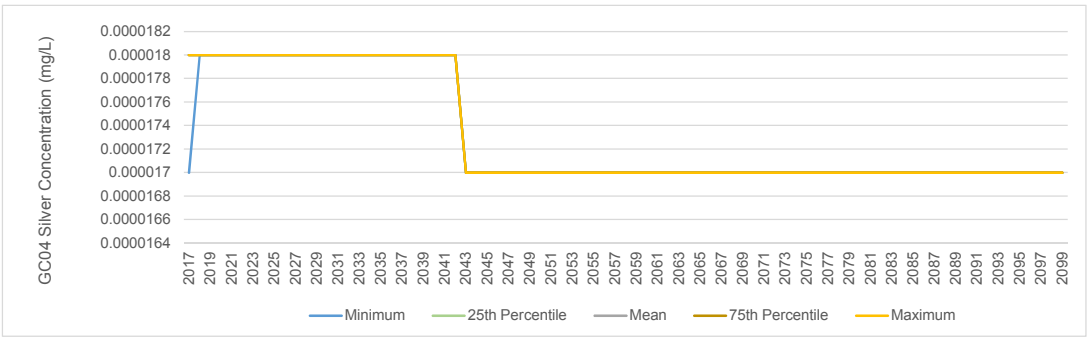

BC03 Zinc Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

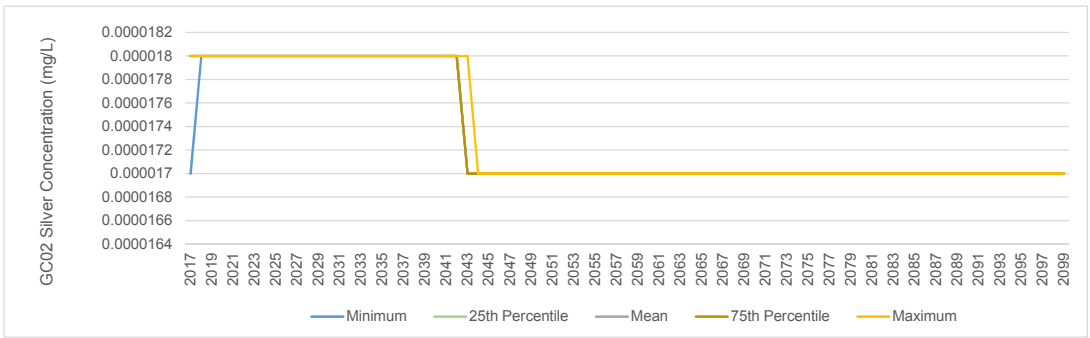

BC01 Zinc Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

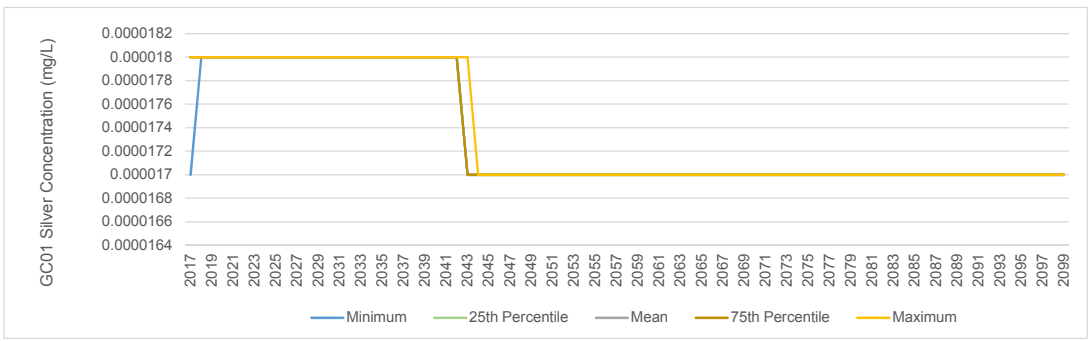
D4 – Gold Creek Water Quality Predictions

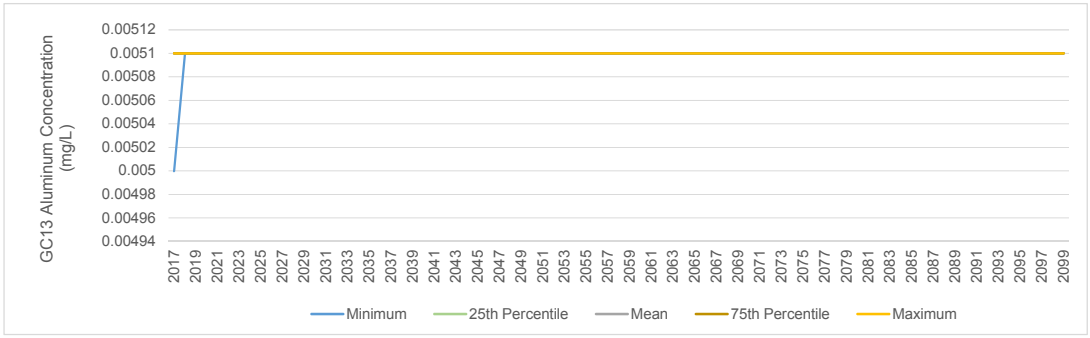

GC13 Silver Concentration (mg/L)
0.0000182
0.000018
0.0000178
0.0000176
0.0000174
0.0000172
0.000017
0.0000168
0.0000166
0.0000164
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

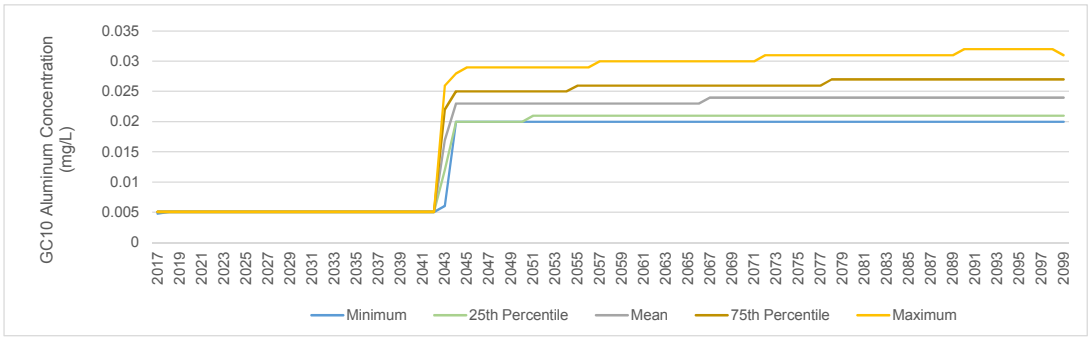

GC10 Silver Concentration (mg/L)
0.0000185
0.000018
0.0000175
0.000017
0.0000165
0.000016
0.0000155
0.000015
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

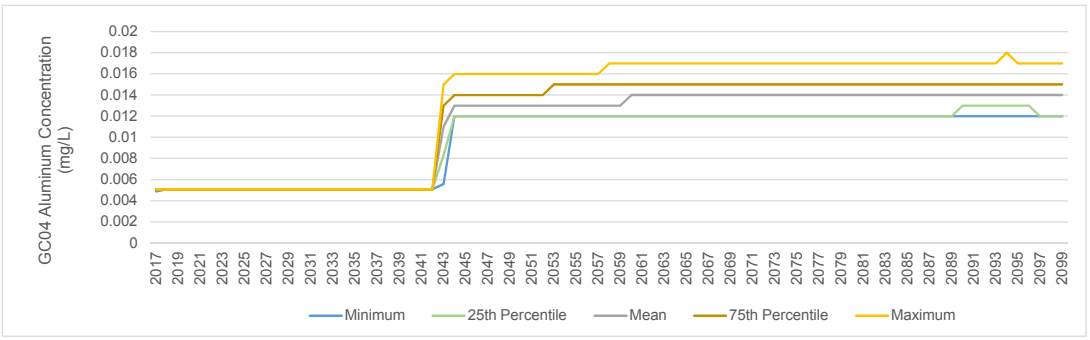

GC04 Silver Concentration (mg/L)
0.0000182
0.000018
0.0000178
0.0000176
0.0000174
0.0000172
0.000017
0.0000168
0.0000166
0.0000164
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

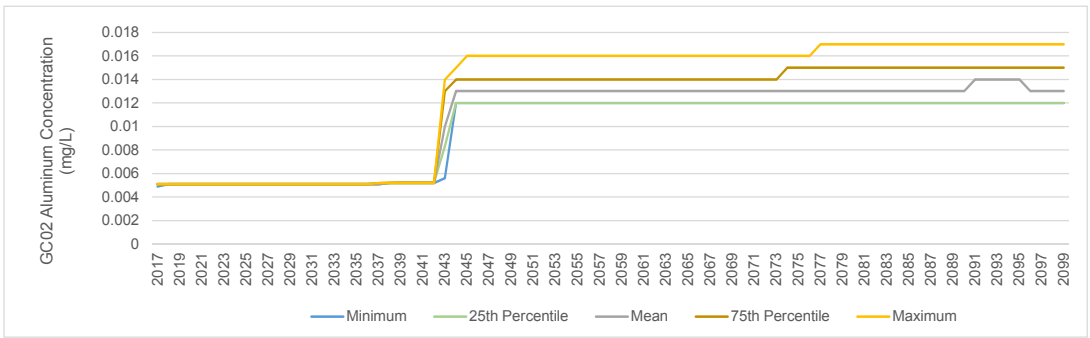

GC02 Silver Concentration (mg/L)
0.0000182
0.000018
0.0000178
0.0000176
0.0000174
0.0000172
0.000017
0.0000168
0.0000166
0.0000164
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

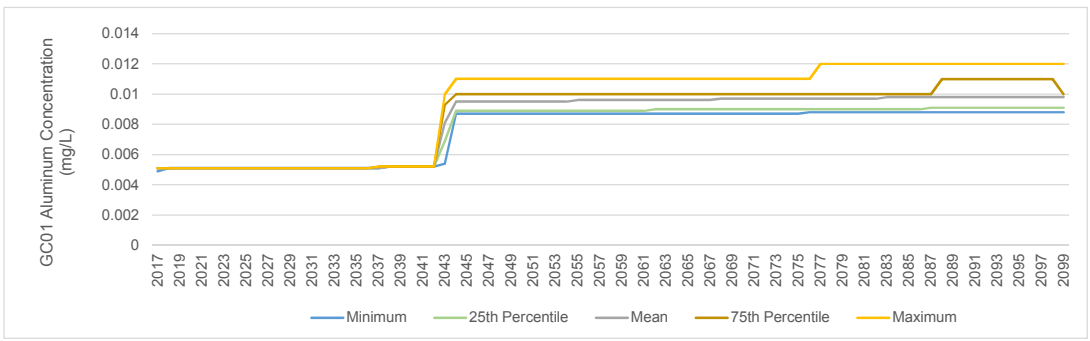

GC01 Silver Concentration (mg/L)
0.0000182
0.000018
0.0000178
0.0000176
0.0000174
0.0000172
0.000017
0.0000168
0.0000166
0.0000164
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

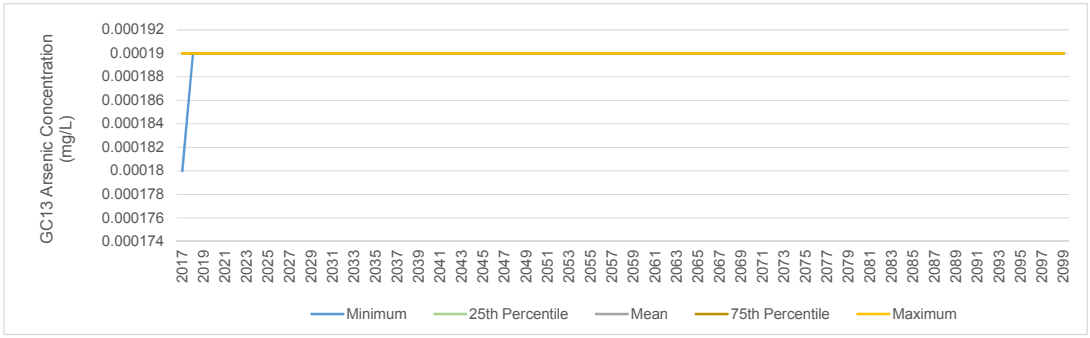

GC13 Aluminum Concentration (mg/L)
0.00512
0.0051
0.00508
0.00506
0.00504
0.00502
0.005
0.00498
0.00496
0.00494
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

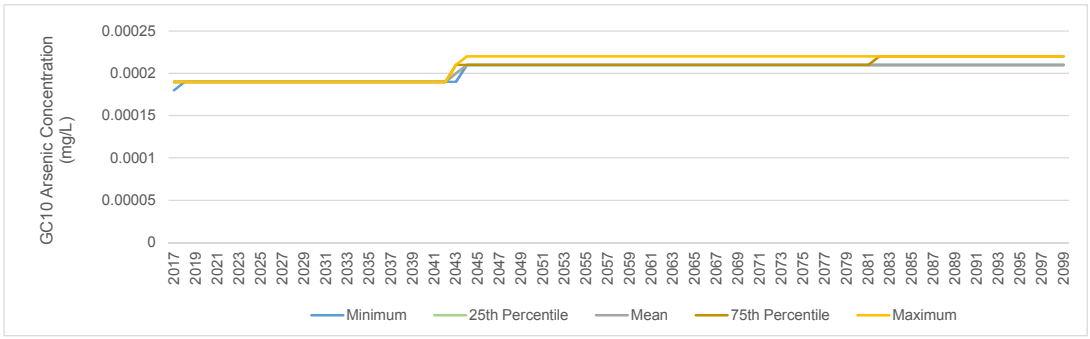

GC10 Aluminum Concentration (mg/L)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

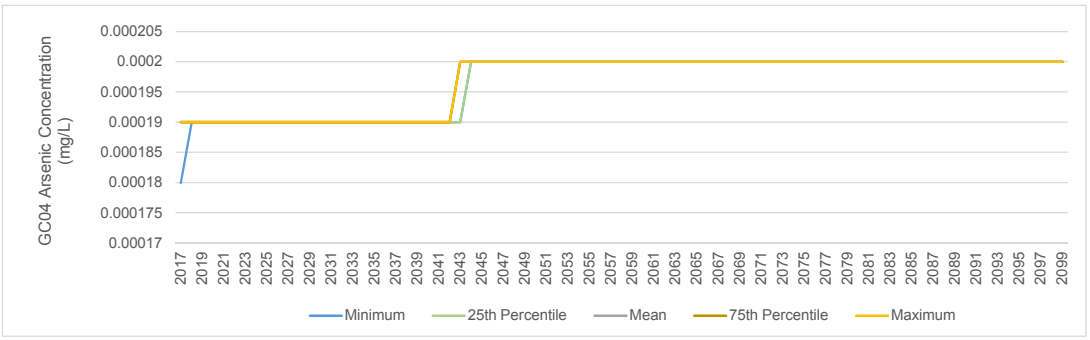

GC04 Aluminum Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

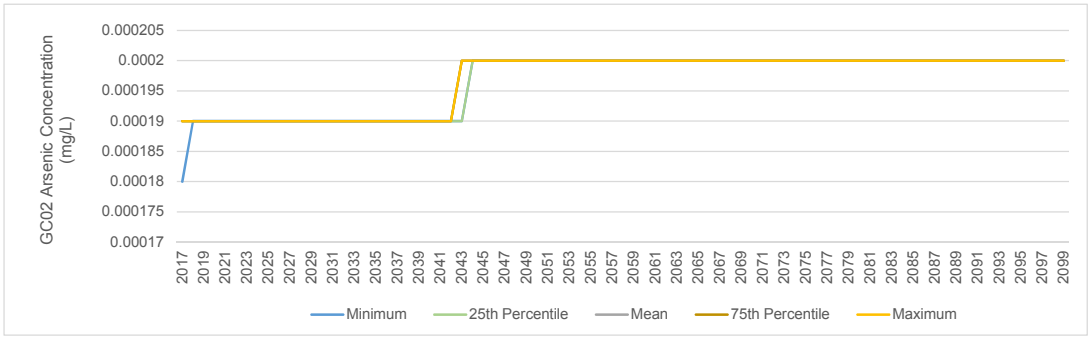

GC02 Aluminum Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

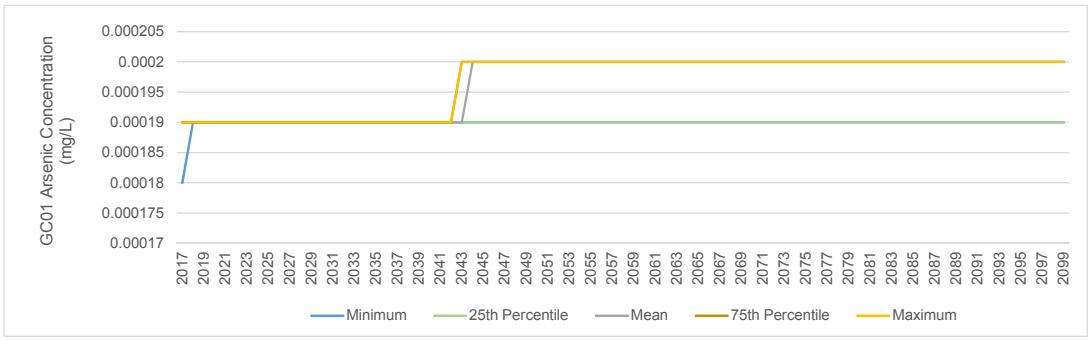

GC01 Aluminum Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

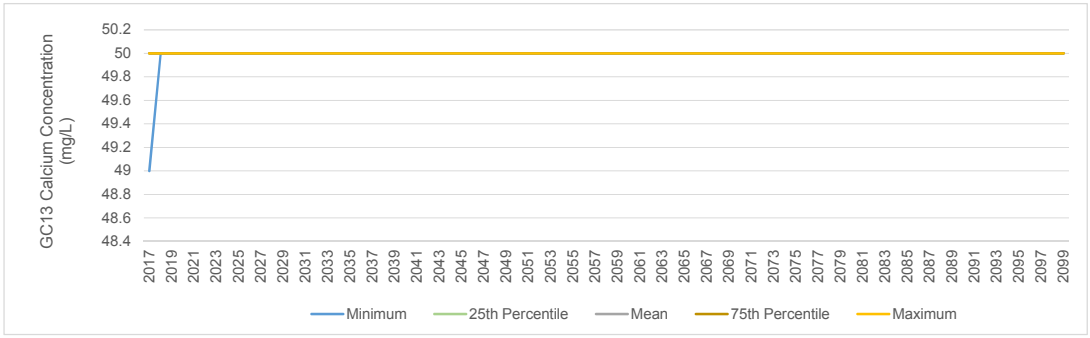

GC13 Arsenic Concentration (mg/L)
0.000192
0.00019
0.000188
0.000186
0.000184
0.000182
0.00018
0.000178
0.000176
0.000174
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

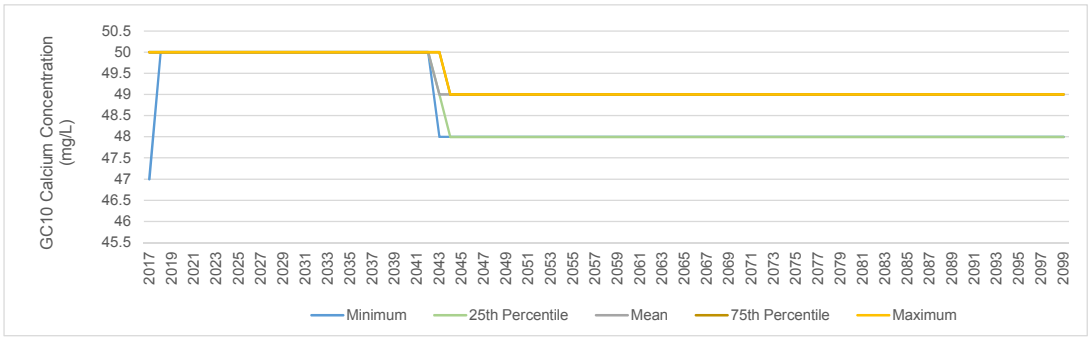

GC10 Arsenic Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

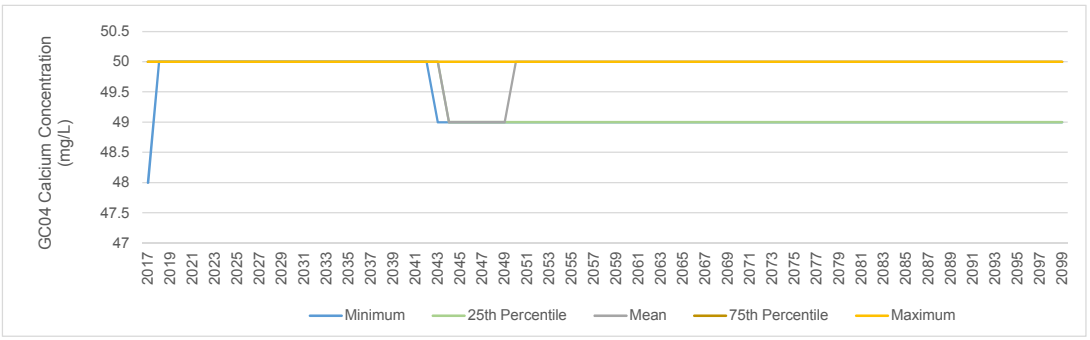

GC04 Arsenic Concentration (mg/L)
0.000205
0.0002
0.000195
0.00019
0.000185
0.00018
0.000175
0.00017
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

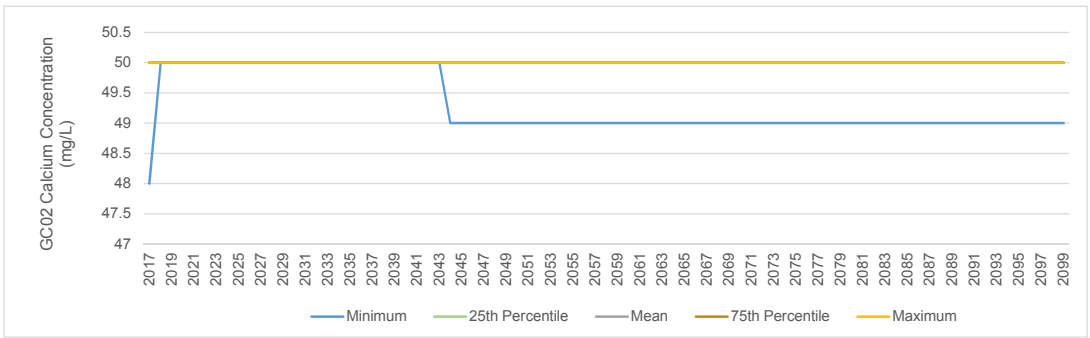

GC02 Arsenic Concentration (mg/L)
0.000205
0.0002
0.000195
0.00019
0.000185
0.00018
0.000175
0.00017
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

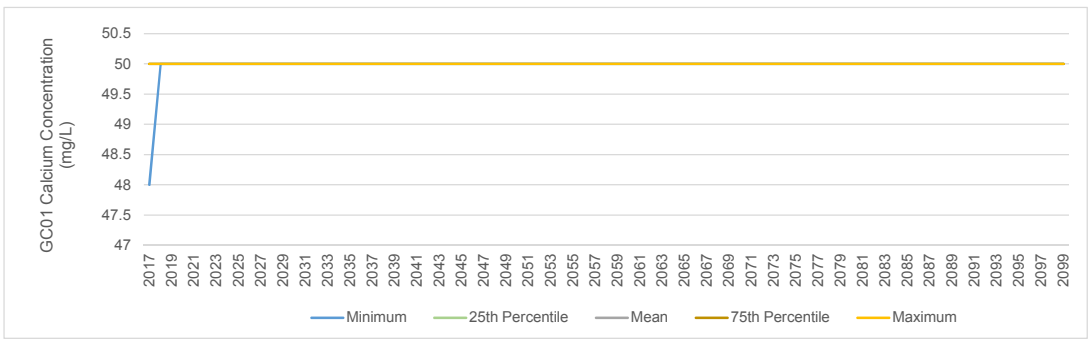

GC01 Arsenic Concentration (mg/L)
0.000205
0.0002
0.000195
0.00019
0.000185
0.00018
0.000175
0.00017
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

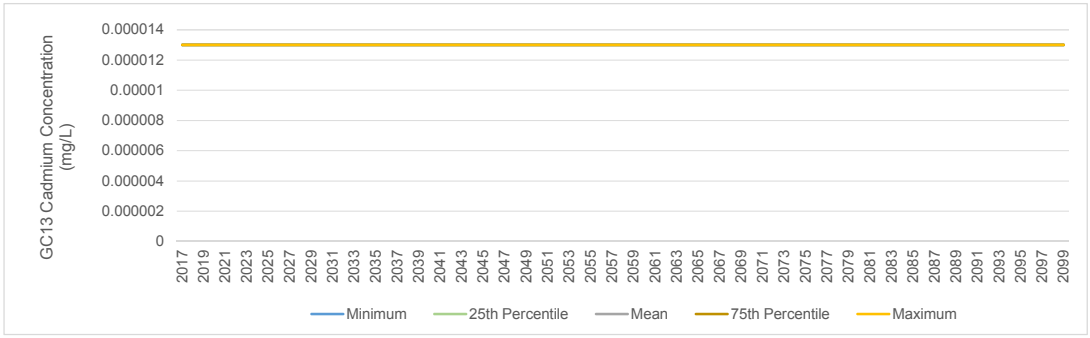

GC13 Calcium Concentration (mg/L)
50.2
50
49.8
49.6
49.4
49.2
49
48.8
48.6
48.4
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

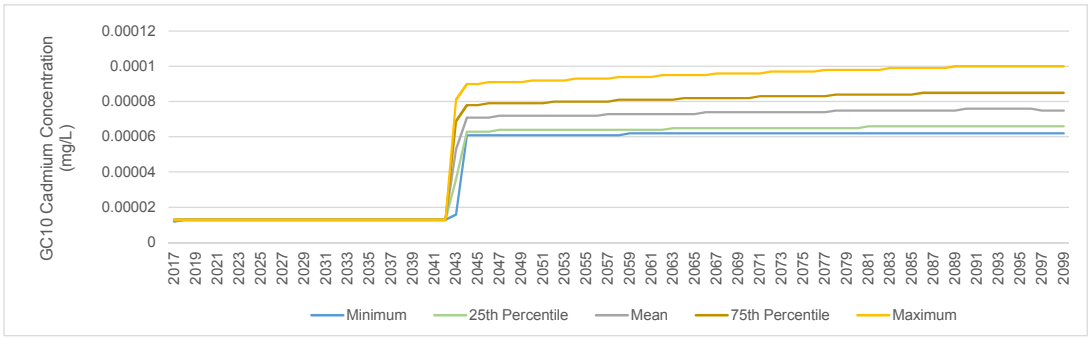

GC10 Calcium Concentration (mg/L)
50.5
50
49.5
49
48.5
48
47.5
47
46.5
46
45.5
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

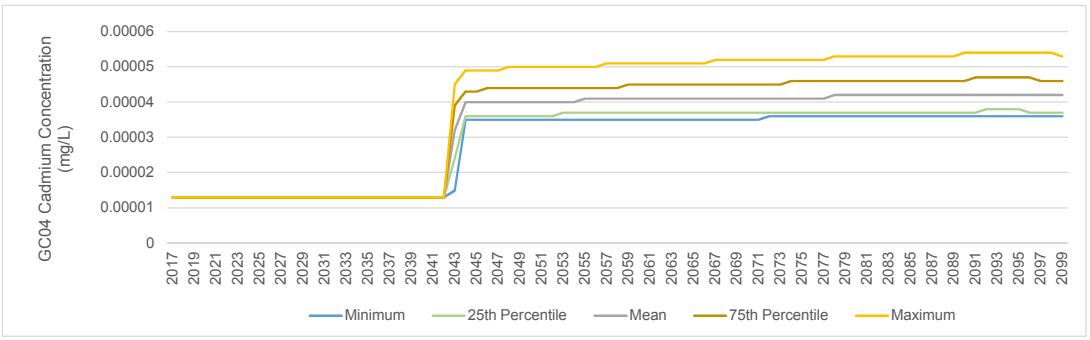

GC04 Calcium Concentration (mg/L)
50.5
50
49.5
49
48.5
48
47.5
47
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

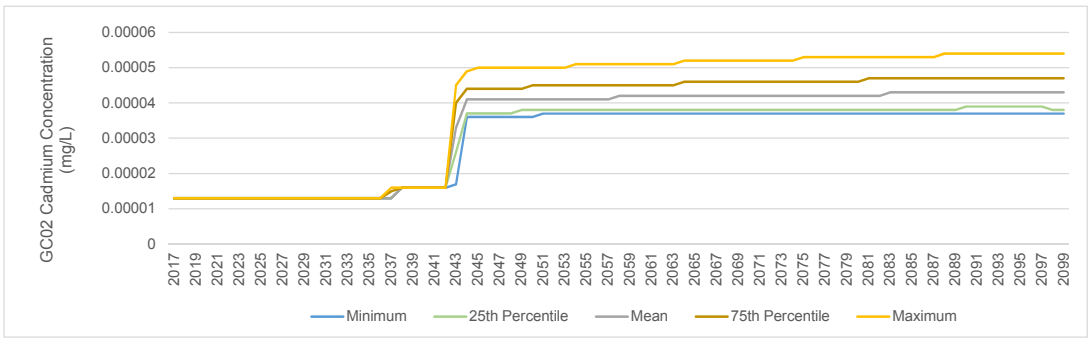

GC02 Calcium Concentration (mg/L)
50.5
50
49.5
49
48.5
48
47.5
47
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

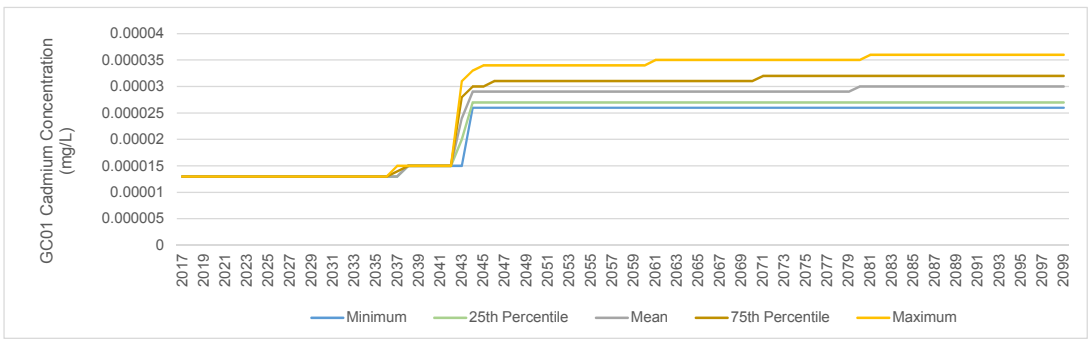

GC01 Calcium Concentration (mg/L)
50.5
50
49.5
49
48.5
48
47.5
47
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

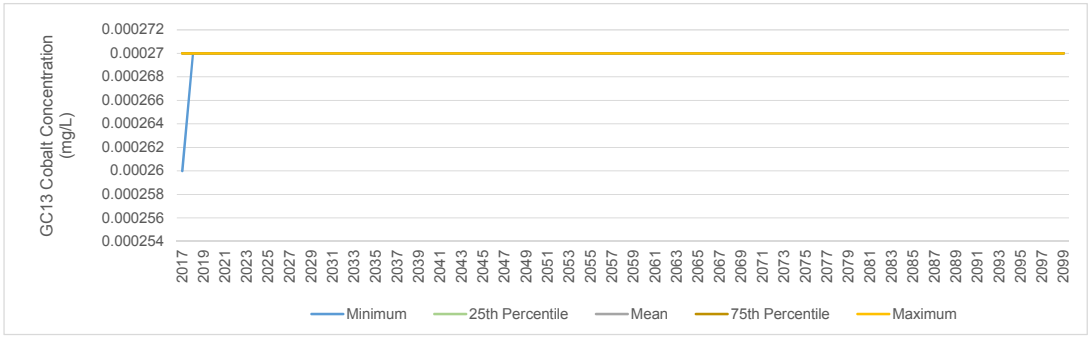

GC13 Cadmium Concentration (mg/L)
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

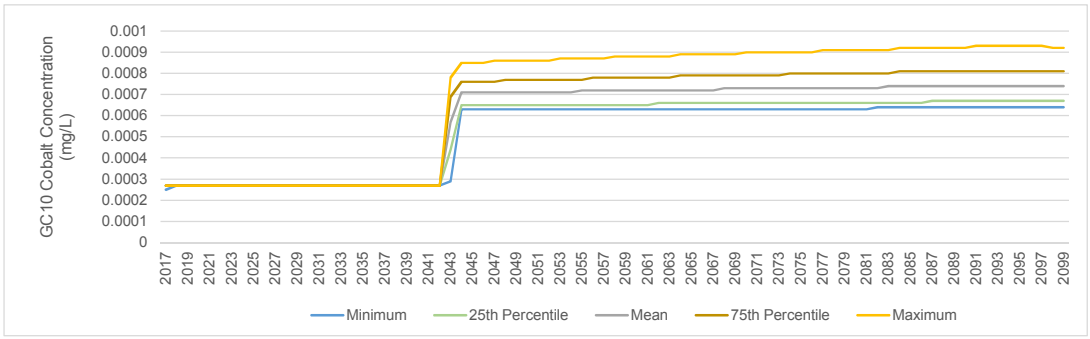

GC10 Cadmium Concentration (mg/L)
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

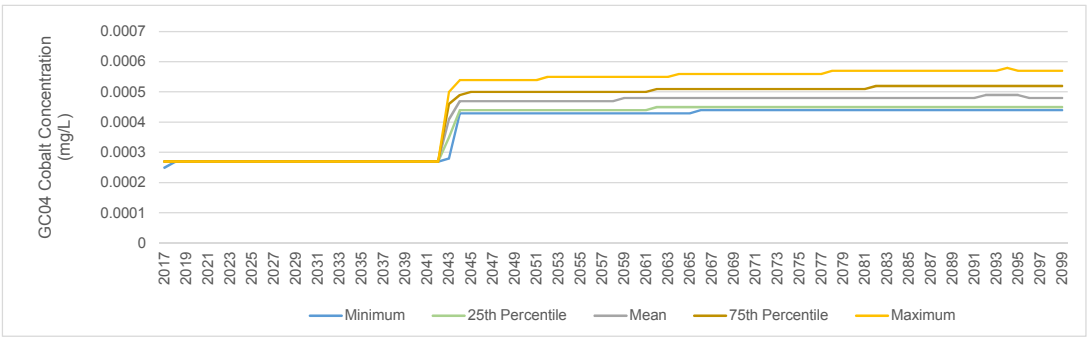

GC04 Cadmium Concentration (mg/L)
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

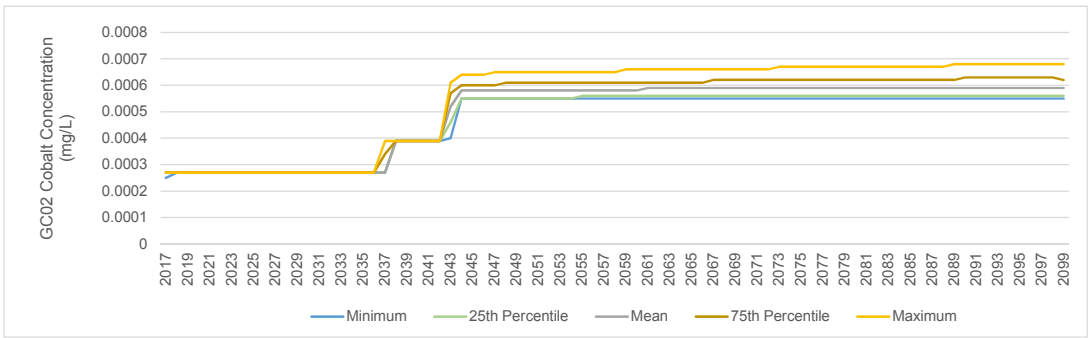

GC02 Cadmium Concentration (mg/L)
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

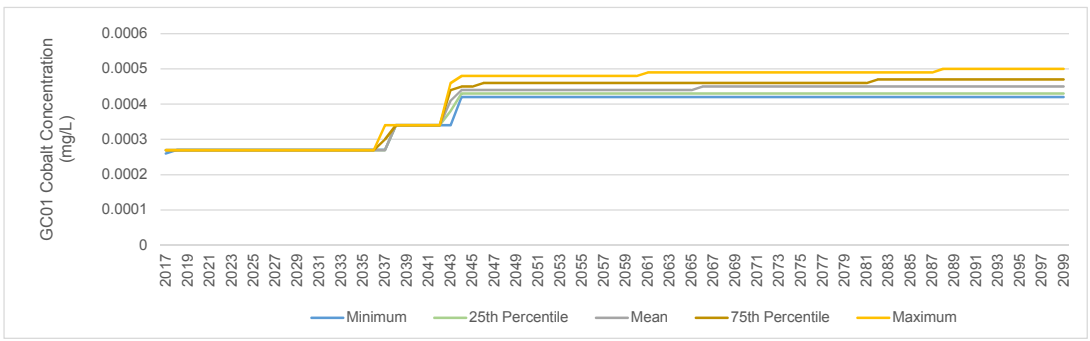

GC01 Cadmium Concentration (mg/L)
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

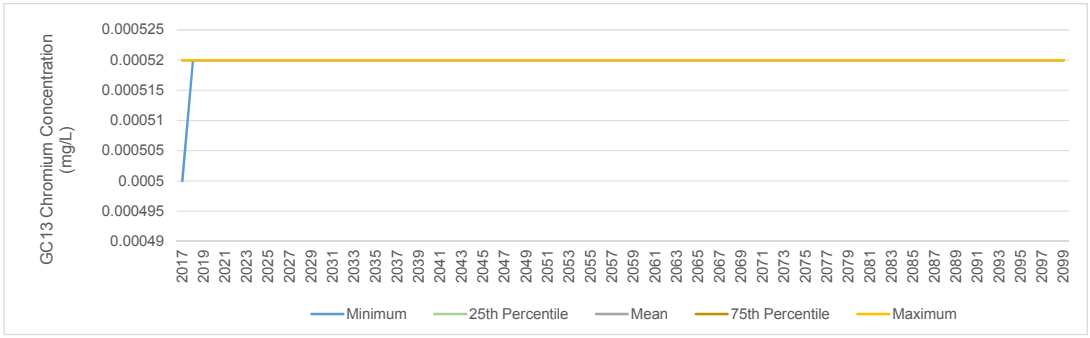

GC13 Cobalt Concentration (mg/L)
0.000272
0.00027
0.000268
0.000266
0.000264
0.000262
0.00026
0.000258
0.000256
0.000254
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

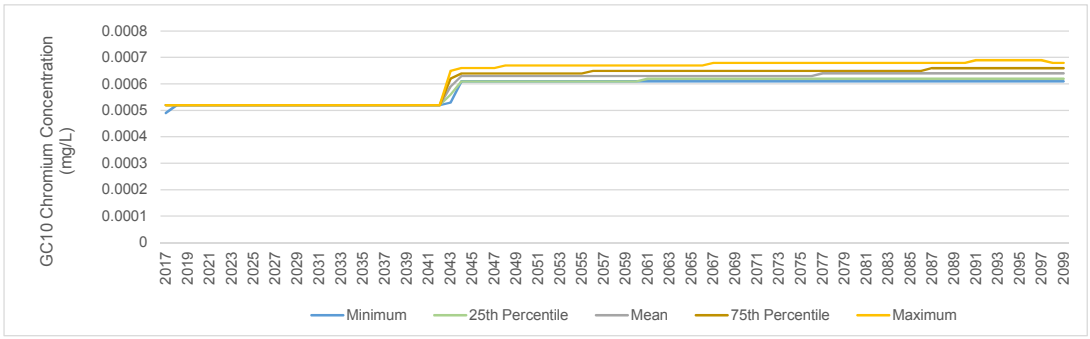

GC10 Cobalt Concentration (mg/L)
0.001
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

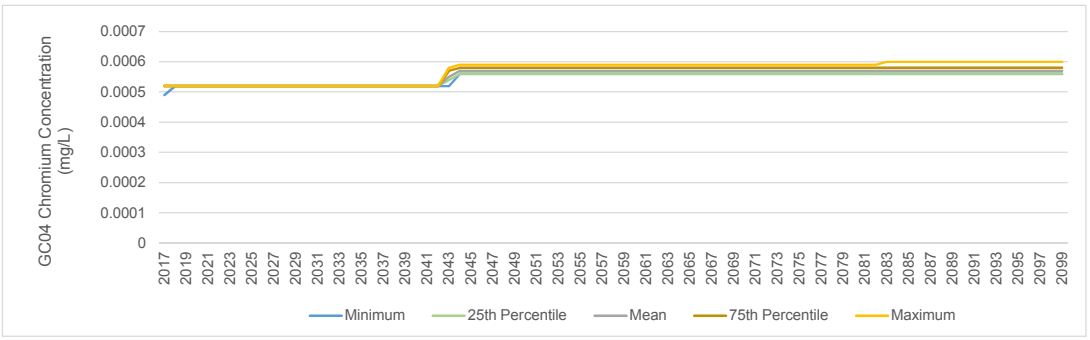

GC04 Cobalt Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

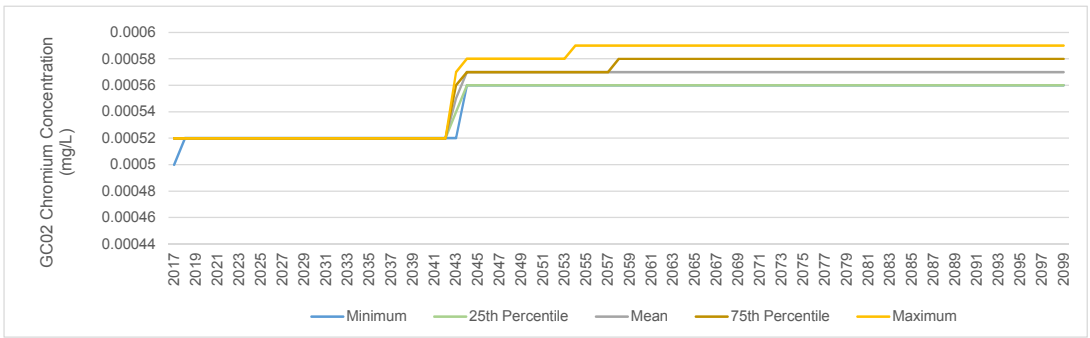

GC02 Cobalt Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

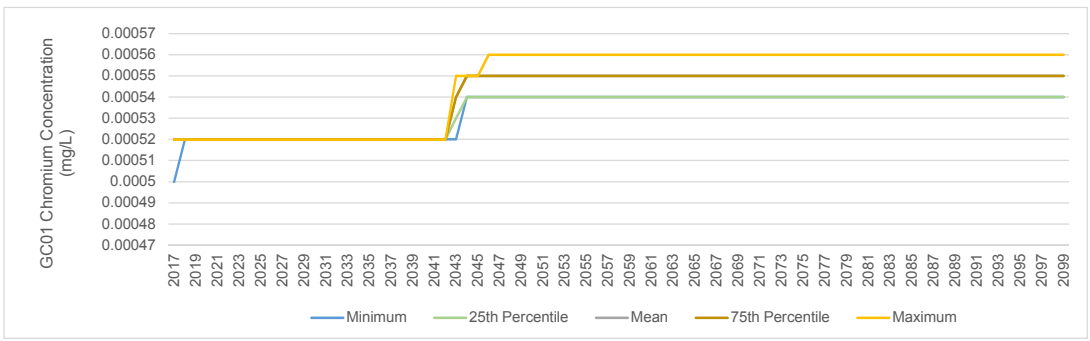

GC01 Cobalt Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

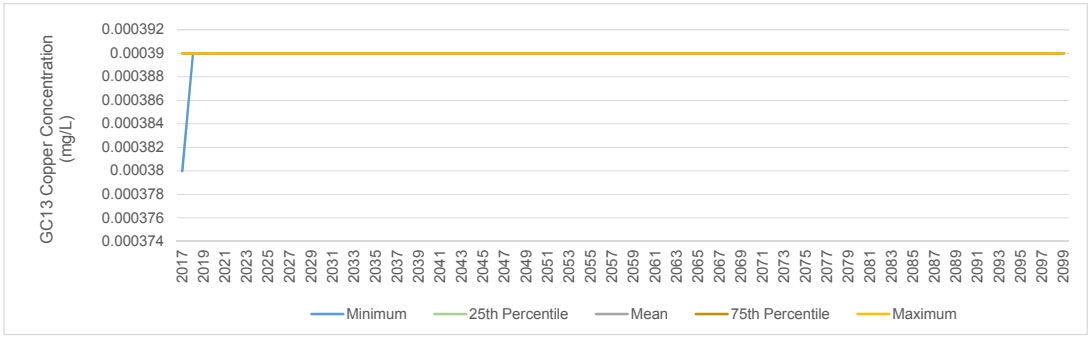

GC13 Chromium Concentration (mg/L)
0.000525
0.00052
0.000515
0.00051
0.000505
0.0005
0.000495
0.00049
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

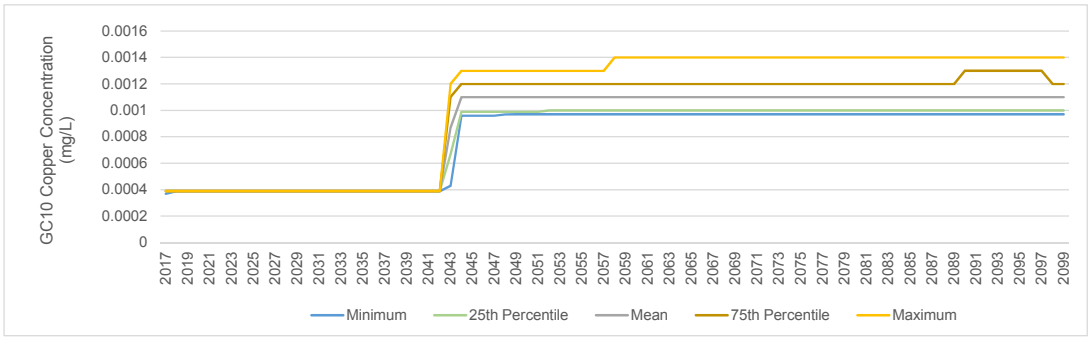

GC10 Chromium Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

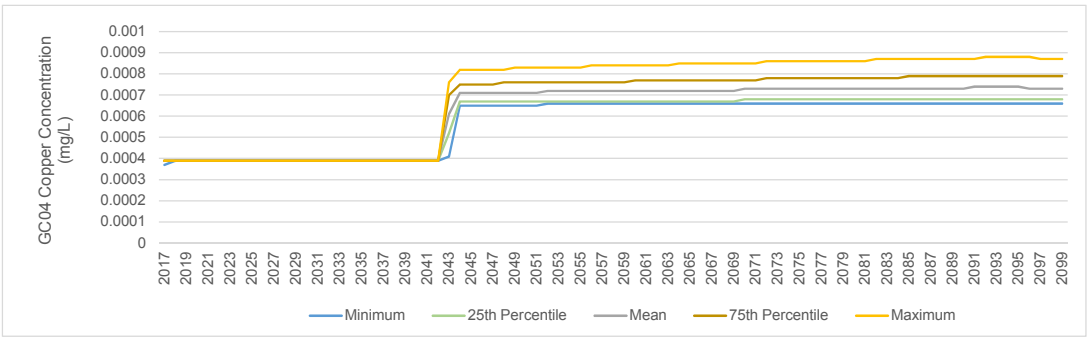

GC04 Chromium Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

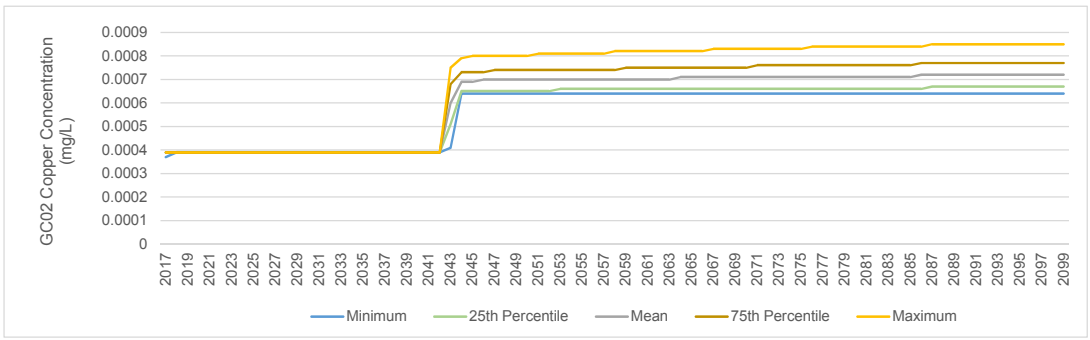

GC02 Chromium Concentration (mg/L)
0.0006
0.00058
0.00056
0.00054
0.00052
0.0005
0.00048
0.00046
0.00044
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

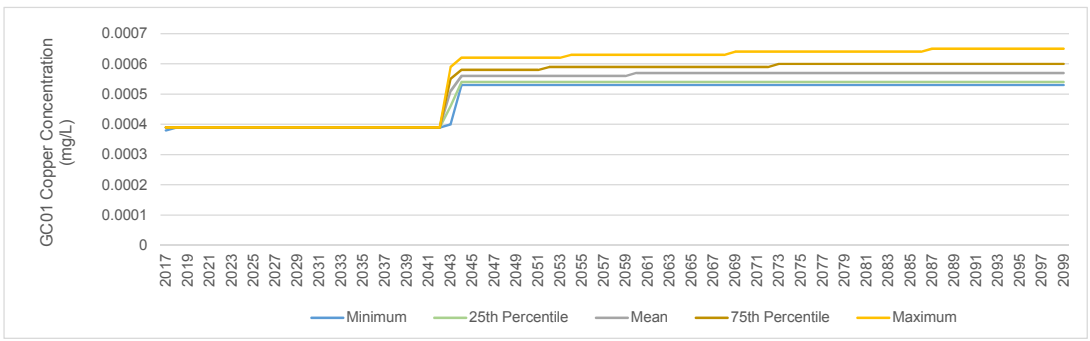

GC01 Chromium Concentration (mg/L)
0.00057
0.00056
0.00055
0.00054
0.00053
0.00052
0.00051
0.0005
0.00049
0.00048
0.00047
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

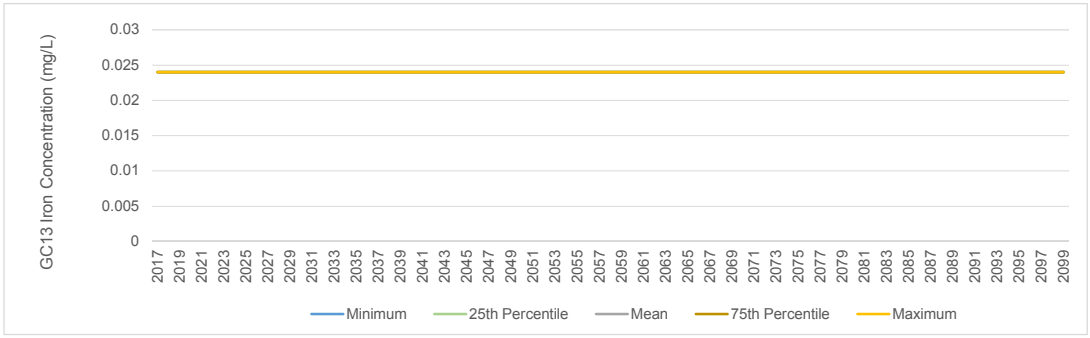

GC13 Copper Concentration (mg/L)
0.000392
0.00039
0.000388
0.000386
0.000384
0.000382
0.00038
0.000378
0.000376
0.000374
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

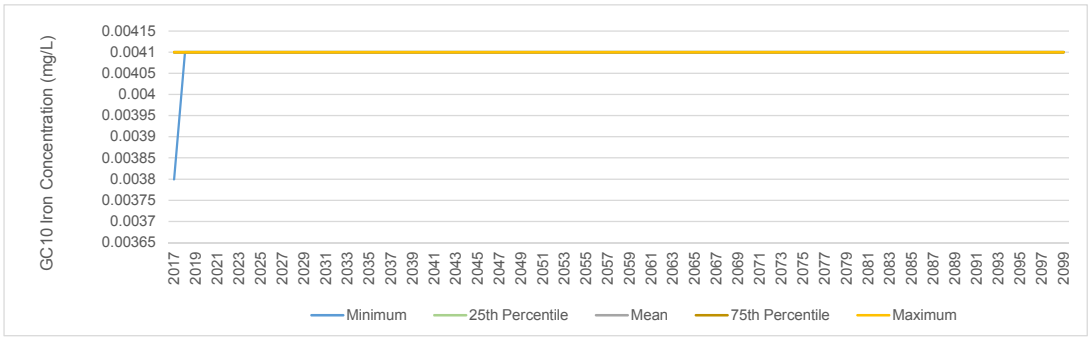

GC10 Copper Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

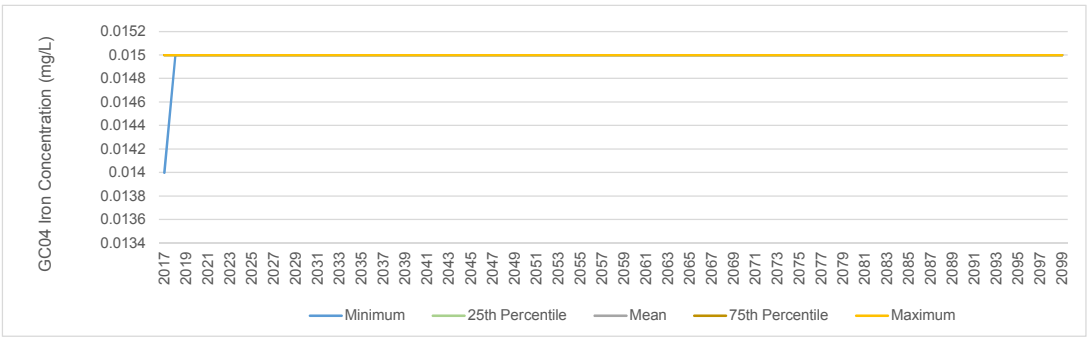

GC04 Copper Concentration (mg/L)
0.001
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

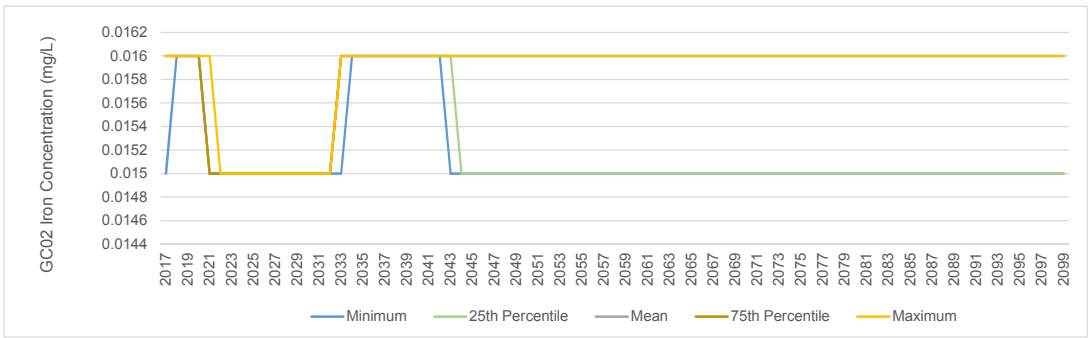

GC02 Copper Concentration (mg/L)
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

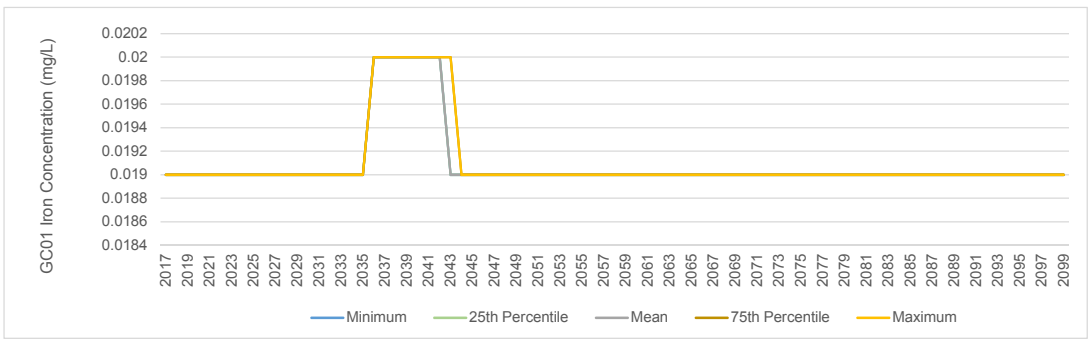

GC01 Copper Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

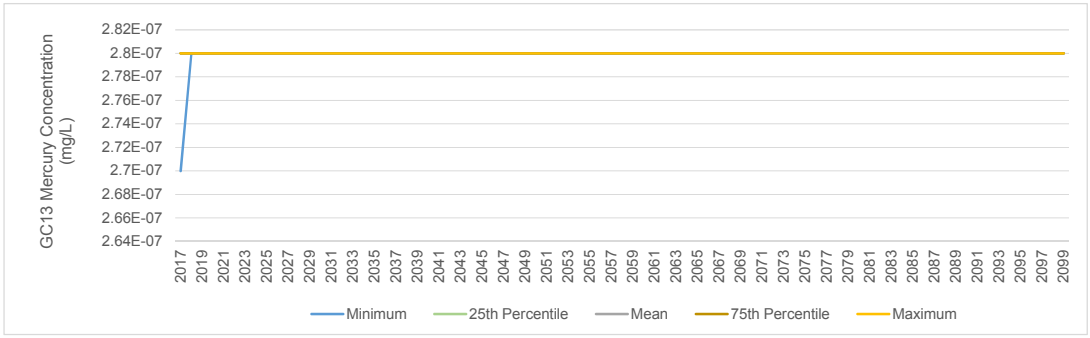

GC13 Iron Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

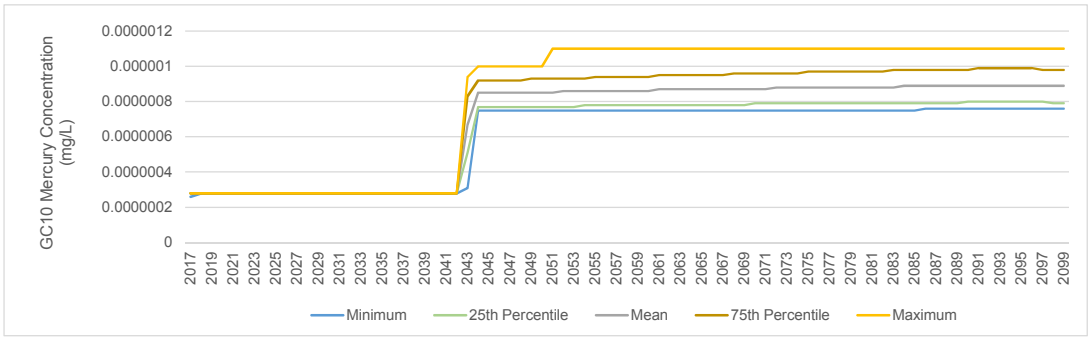

GC10 Iron Concentration (mg/L)
0.00415
0.0041
0.00405
0.004
0.00395
0.0039
0.00385
0.0038
0.00375
0.0037
0.00365
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

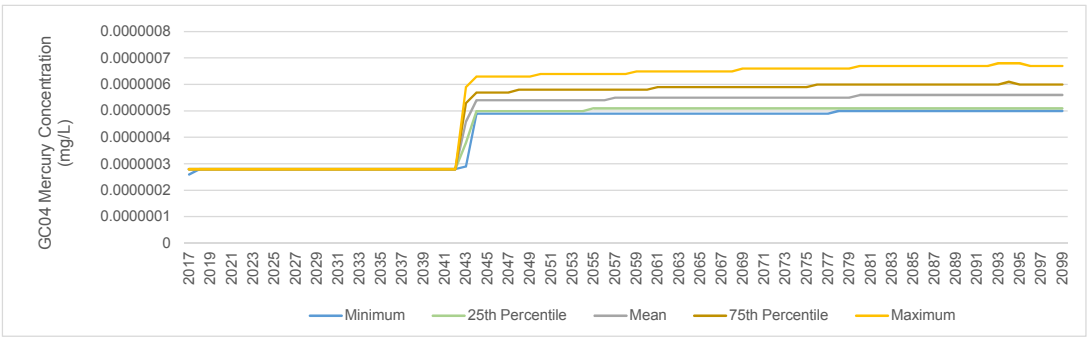

GC04 Iron Concentration (mg/L)
0.0152
0.015
0.0148
0.0146
0.0144
0.0142
0.014
0.0138
0.0136
0.0134
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

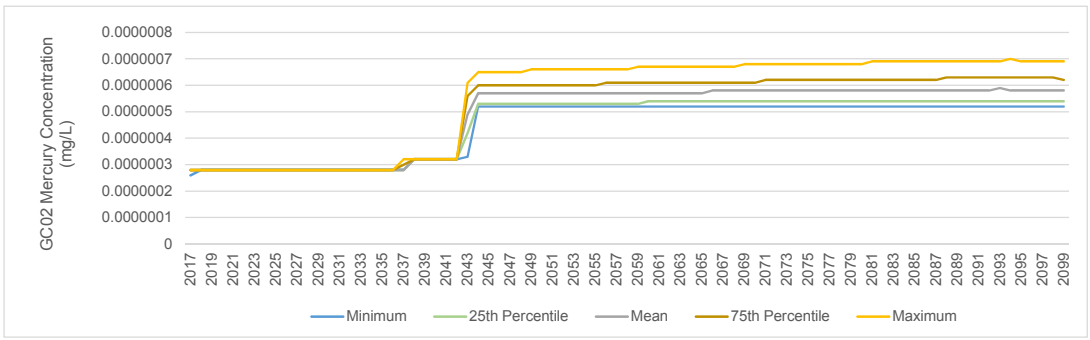

GC02 Iron Concentration (mg/L)
0.0162
0.016
0.0158
0.0156
0.0154
0.0152
0.015
0.0148
0.0146
0.0144
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

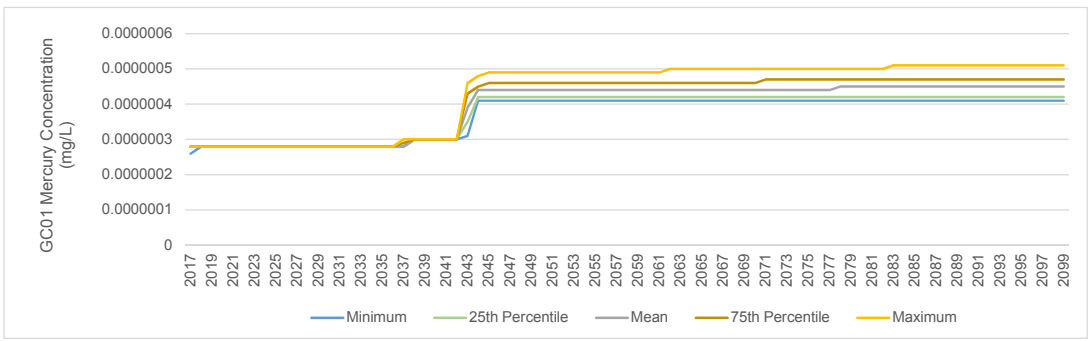

GC01 Iron Concentration (mg/L)
0.0202
0.02
0.0198
0.0196
0.0194
0.0192
0.019
0.0188
0.0186
0.0184
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

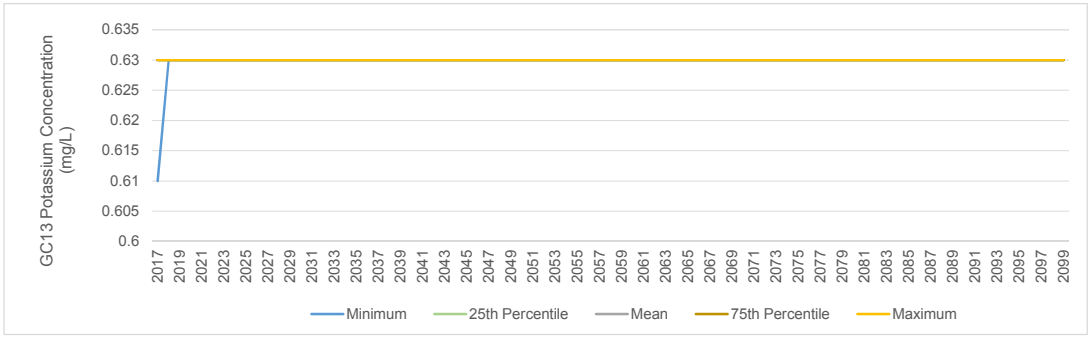

GC13 Mercury Concentration (mg/L)
2.82E-07
2.8E-07
2.78E-07
2.76E-07
2.74E-07
2.72E-07
2.7E-07
2.68E-07
2.66E-07
2.64E-07
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

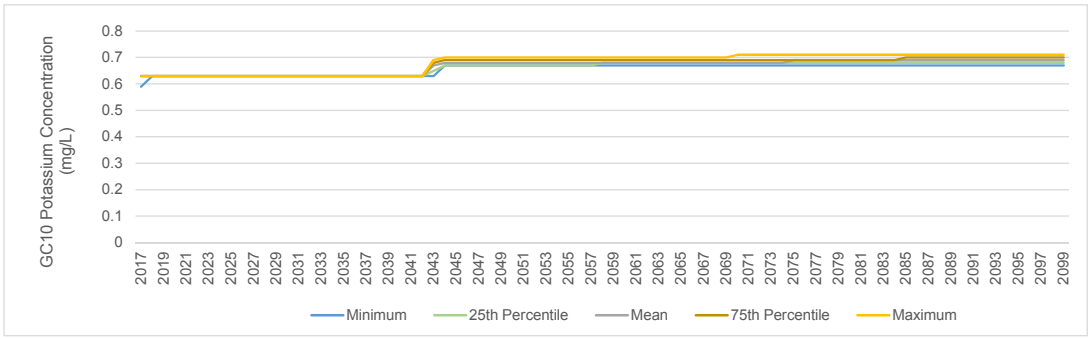

GC10 Mercury Concentration (mg/L)
0.0000012
0.000001
0.0000008
0.0000006
0.0000004
0.0000002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

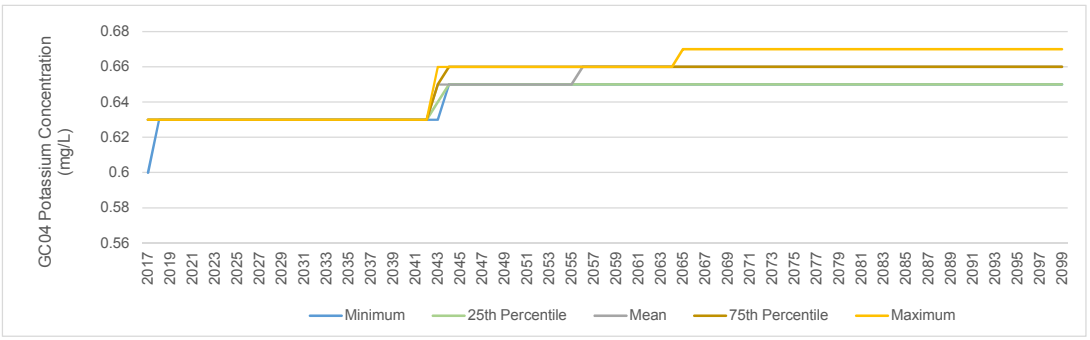

GC04 Mercury Concentration (mg/L)
0.0000008
0.0000007
0.0000006
0.0000005
0.0000004
0.0000003
0.0000002
0.0000001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

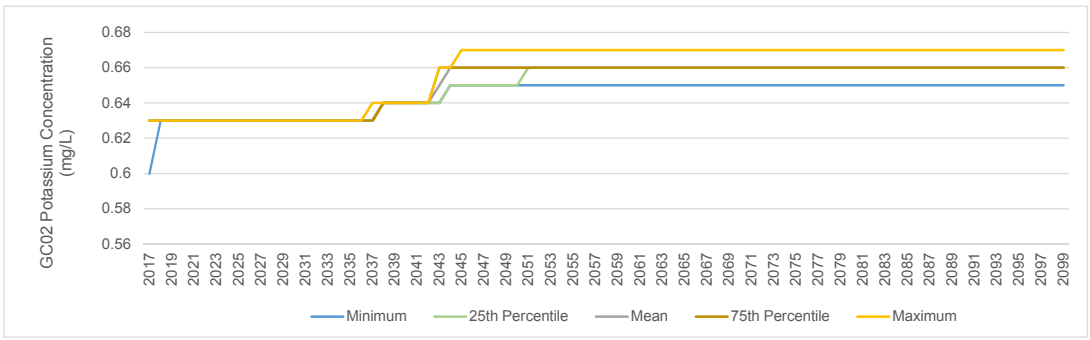

GC02 Mercury Concentration (mg/L)
0.0000008
0.0000007
0.0000006
0.0000005
0.0000004
0.0000003
0.0000002
0.0000001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

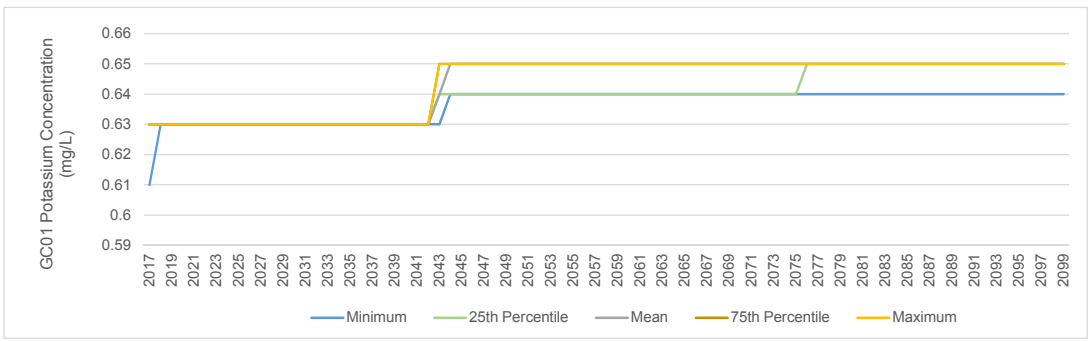

GC01 Mercury Concentration (mg/L)
0.0000006
0.0000005
0.0000004
0.0000003
0.0000002
0.0000001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

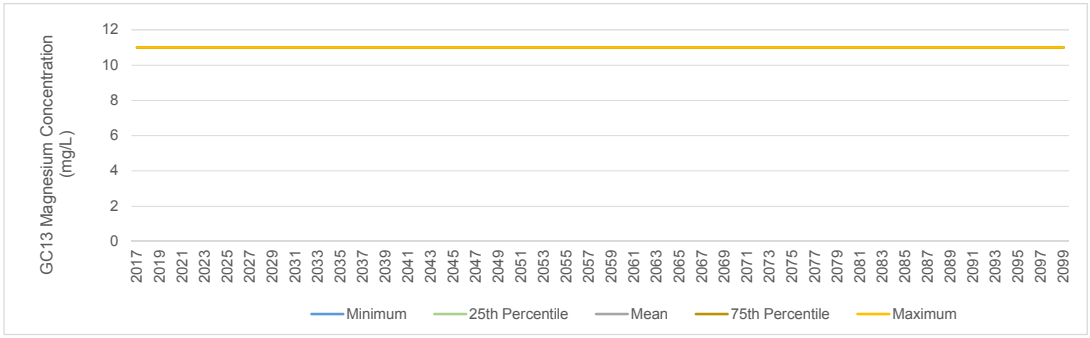

GC13 Potassium Concentration (mg/L)
0.635
0.63
0.625
0.62
0.615
0.61
0.605
0.6
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

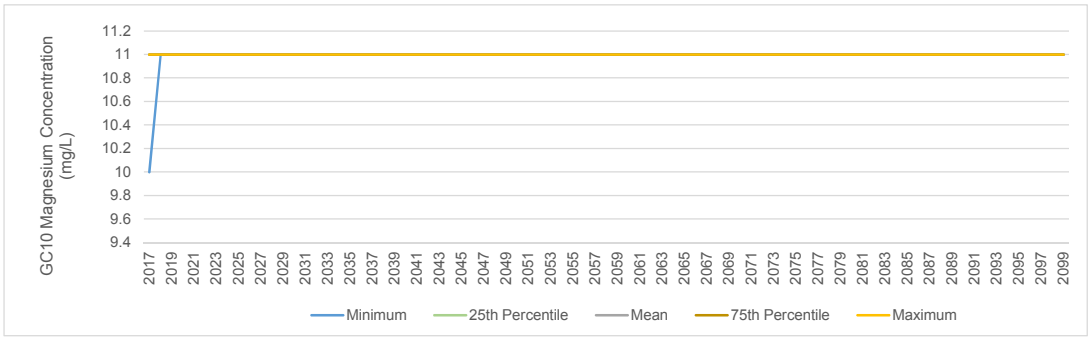

GC10 Potassium Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

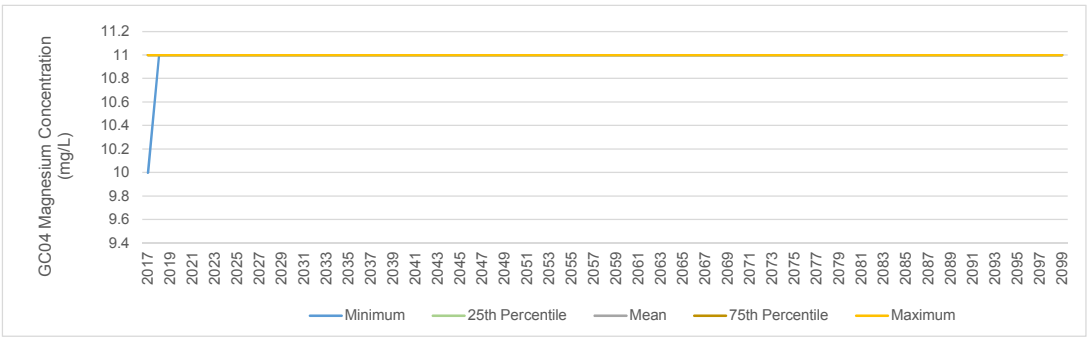

GC04 Potassium Concentration (mg/L)
0.68
0.66
0.64
0.62
0.6
0.58
0.56
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

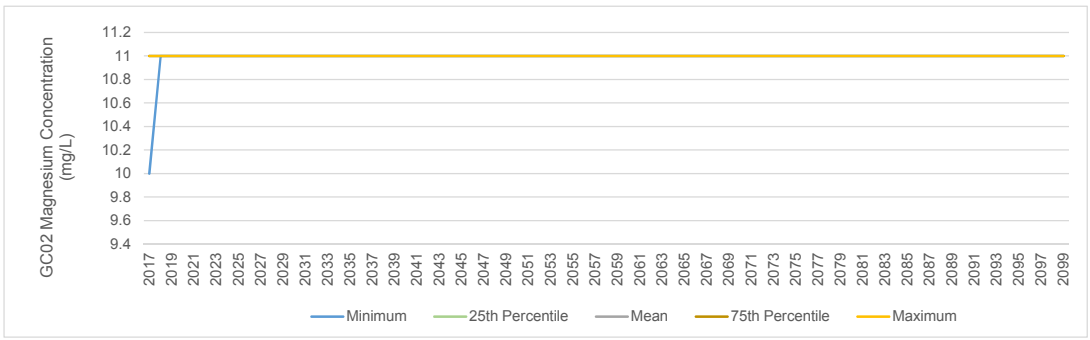

GC02 Potassium Concentration (mg/L)
0.68
0.66
0.64
0.62
0.6
0.58
0.56
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

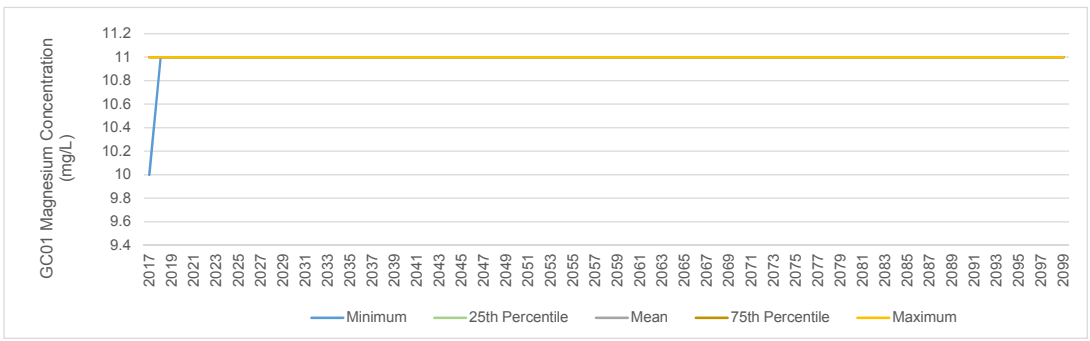

GC01 Potassium Concentration (mg/L)
0.66
0.65
0.64
0.63
0.62
0.61
0.6
0.59
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

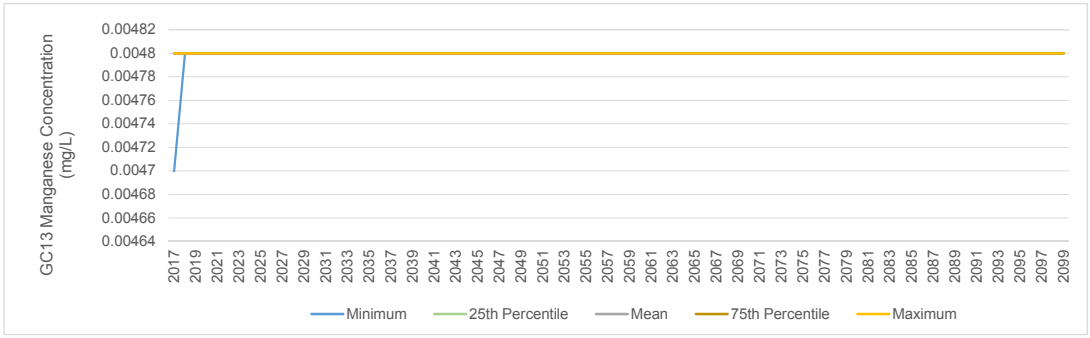

GC13 Magnesium Concentration (mg/L)
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

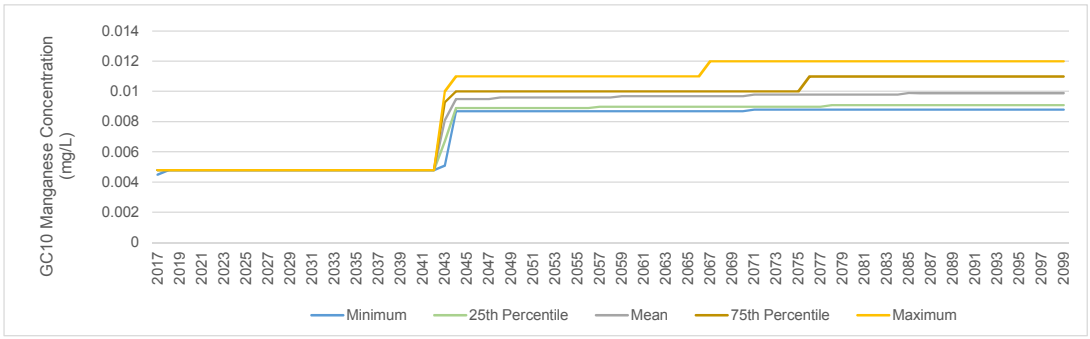

GC10 Magnesium Concentration (mg/L)
11.2
11
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

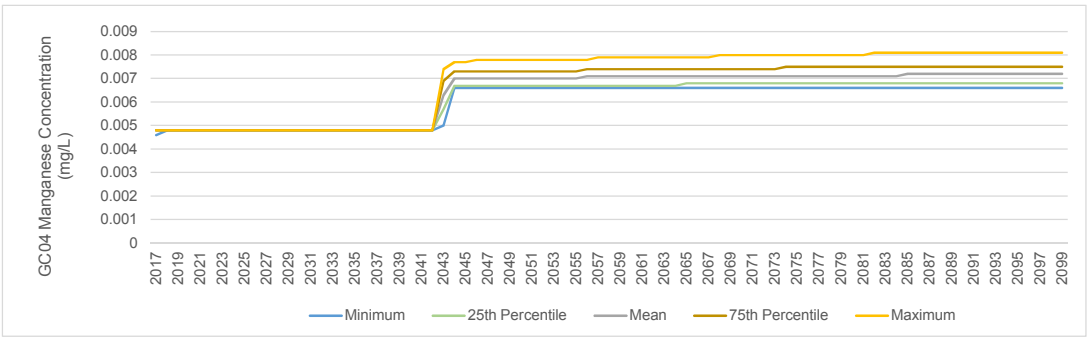

GC04 Magnesium Concentration (mg/L)
11.2
11
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

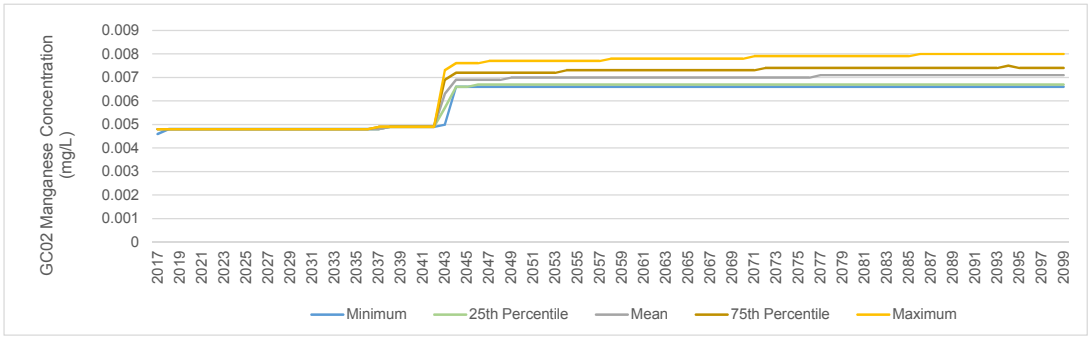

GC02 Magnesium Concentration (mg/L)
11.2
11
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

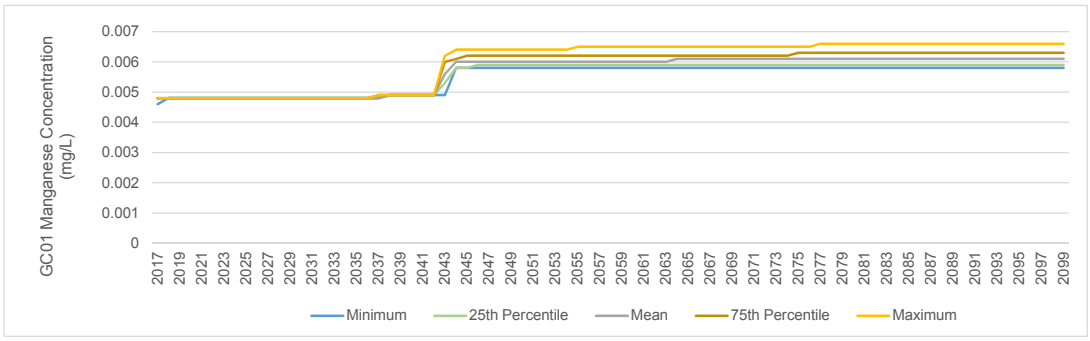

GC01 Magnesium Concentration (mg/L)
11.2
11
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

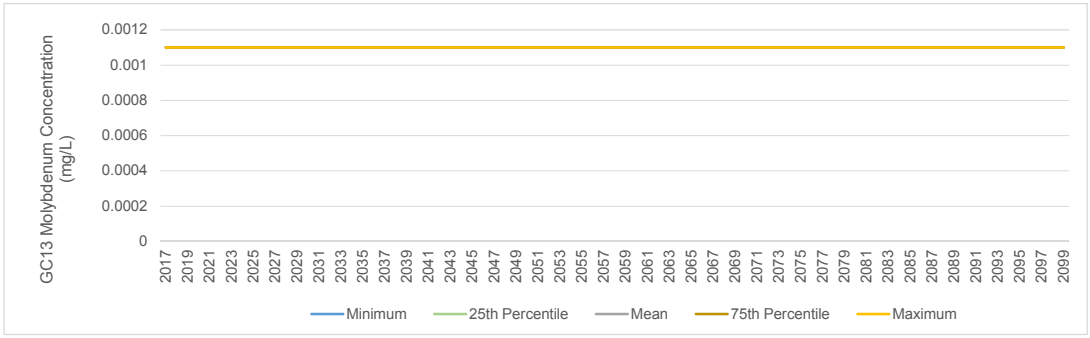

GC13 Manganese Concentration (mg/L)
0.00482
0.0048
0.00478
0.00476
0.00474
0.00472
0.0047
0.00468
0.00466
0.00464
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

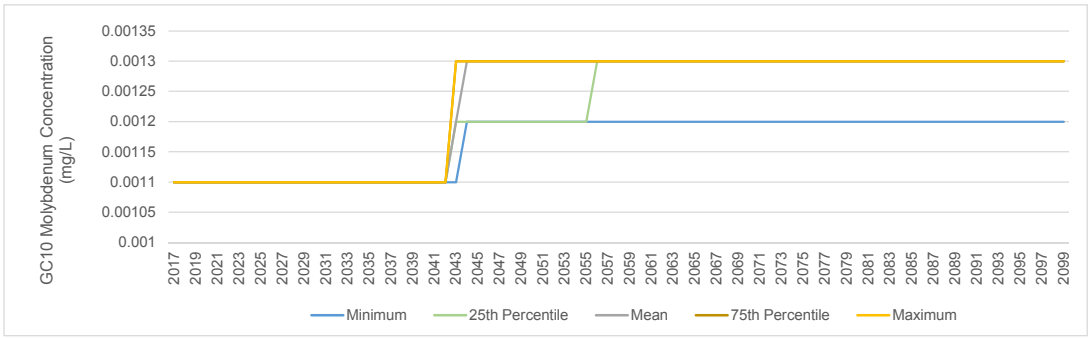

GC10 Manganese Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

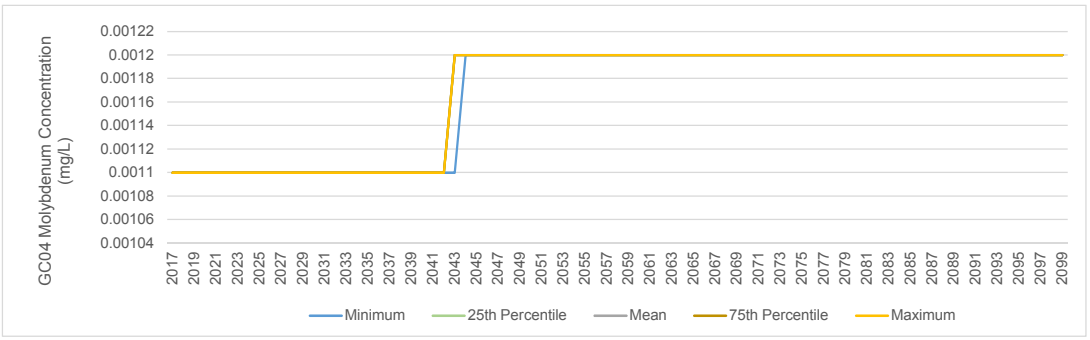

GC04 Manganese Concentration (mg/L)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

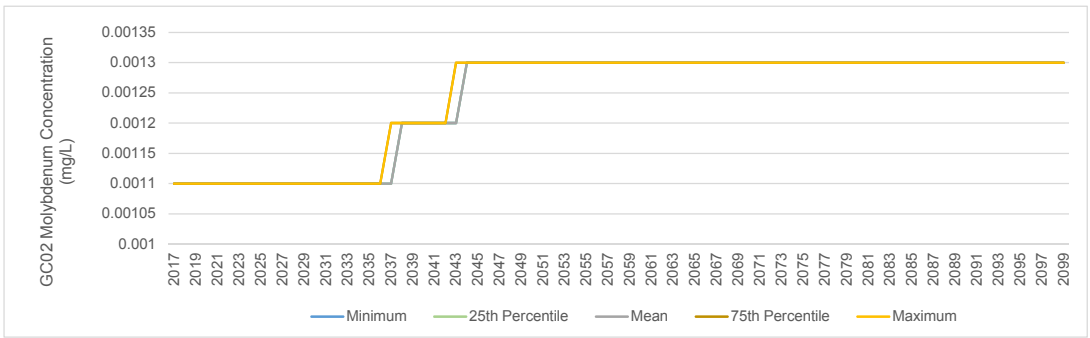

GC02 Manganese Concentration (mg/L)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

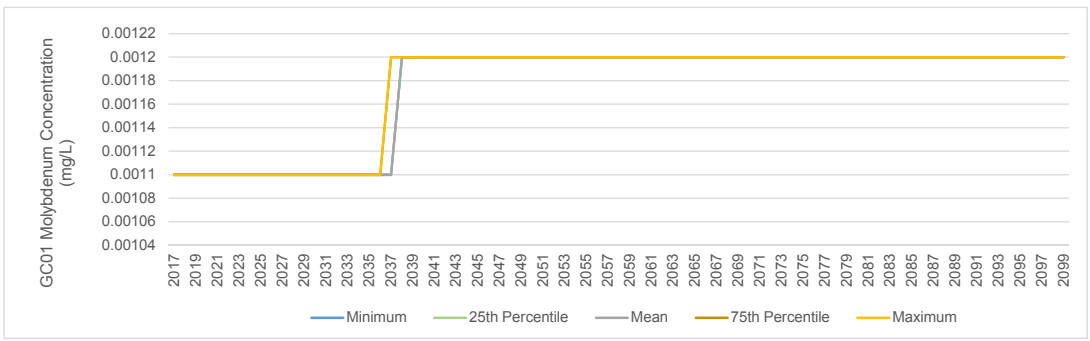

GC01 Manganese Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

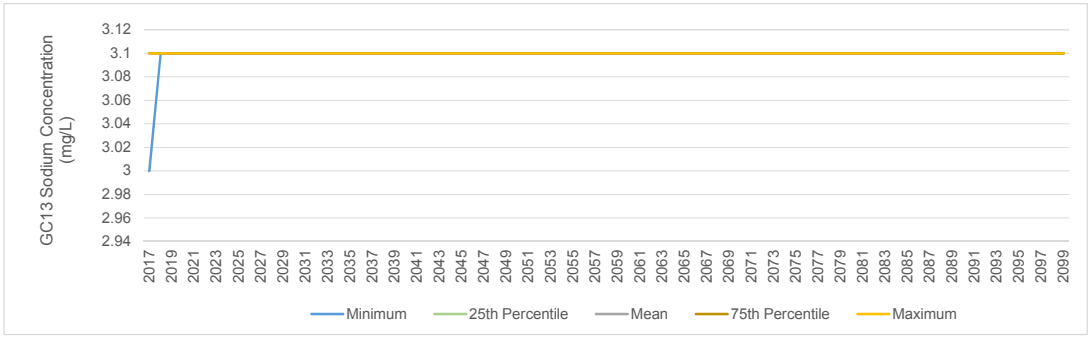

GC13 Molybdenum Concentration (mg/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

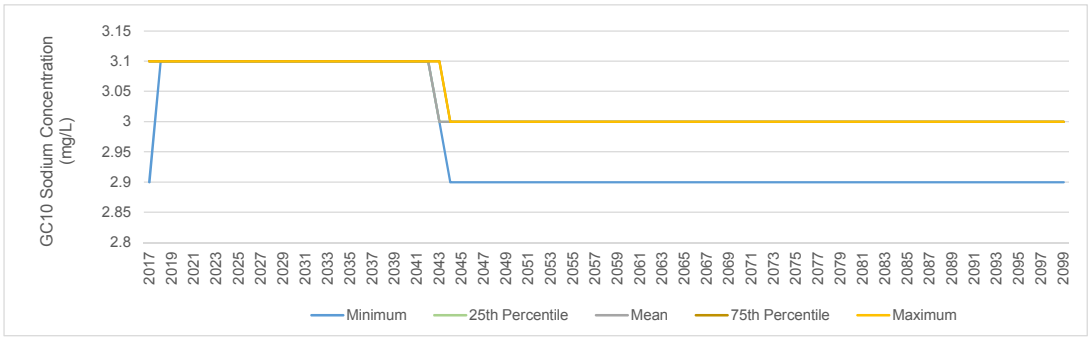

GC10 Molybdenum Concentration (mg/L)
0.00135
0.0013
0.00125
0.0012
0.00115
0.0011
0.00105
0.001
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

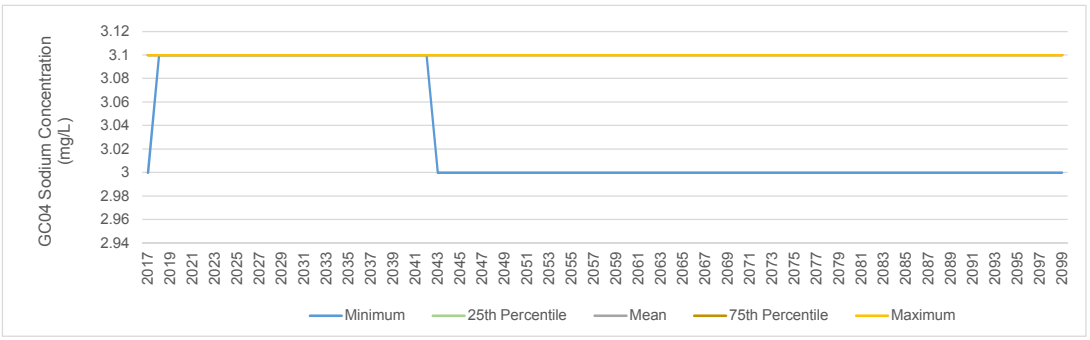

GC04 Molybdenum Concentration (mg/L)
0.00122
0.0012
0.00118
0.00116
0.00114
0.00112
0.0011
0.00108
0.00106
0.00104
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

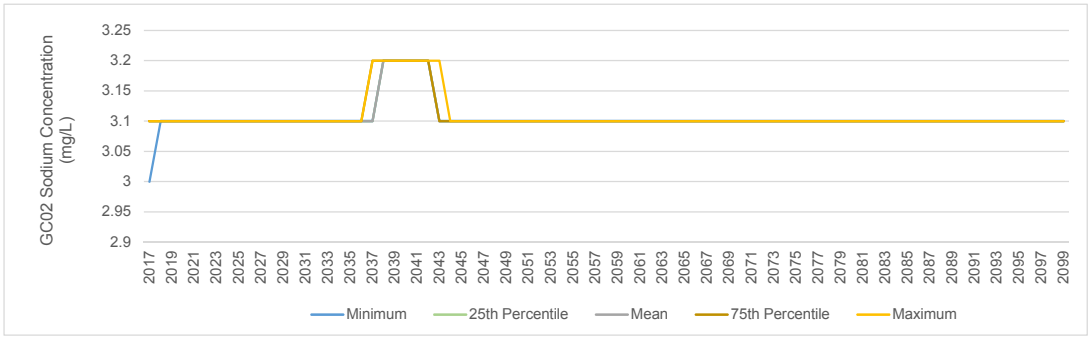

GC02 Molybdenum Concentration (mg/L)
0.00135
0.0013
0.00125
0.0012
0.00115
0.0011
0.00105
0.001
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

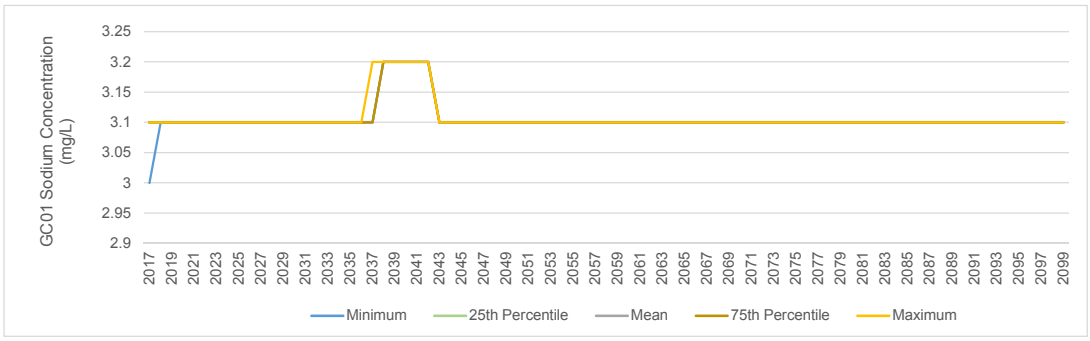

GC01 Molybdenum Concentration (mg/L)
0.00122
0.0012
0.00118
0.00116
0.00114
0.00112
0.0011
0.00108
0.00106
0.00104
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

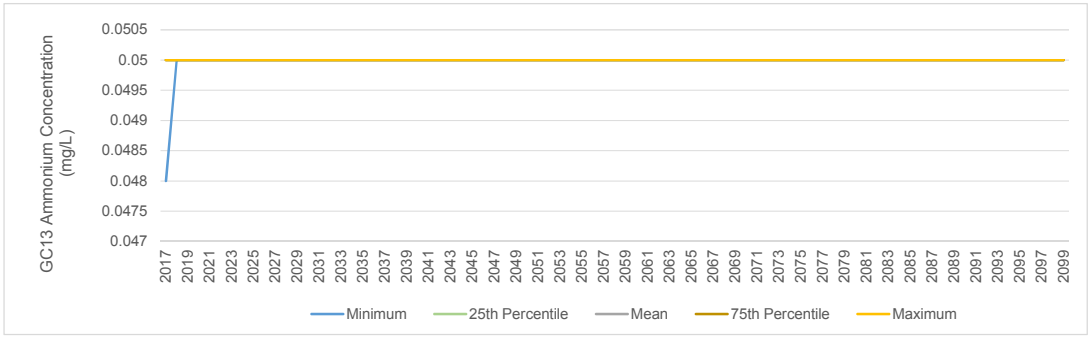

GC13 Sodium Concentration (mg/L)
3.12
3.1
3.08
3.06
3.04
3.02
3
2.98
2.96
2.94
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

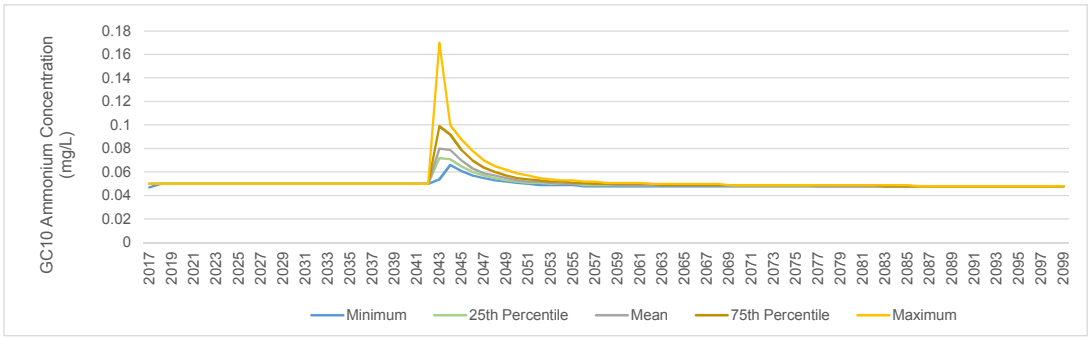

GC10 Sodium Concentration (mg/L)
3.15
3.1
3.05
3
2.95
2.9
2.85
2.8
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

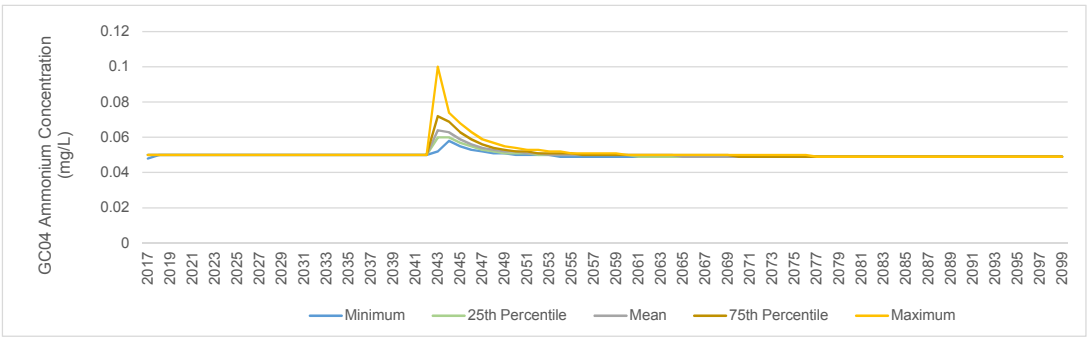

GC04 Sodium Concentration (mg/L)
3.12
3.1
3.08
3.06
3.04
3.02
3
2.98
2.96
2.94
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

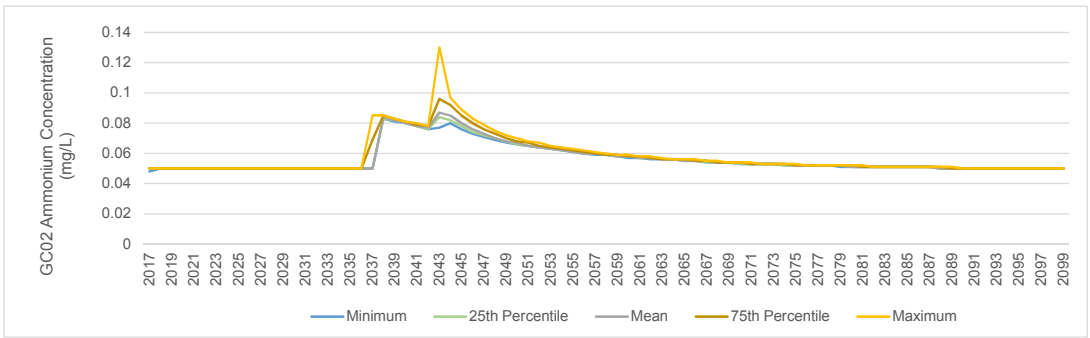

GC02 Sodium Concentration (mg/L)
3.25
3.2
3.15
3.1
3.05
3
2.95
2.9
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

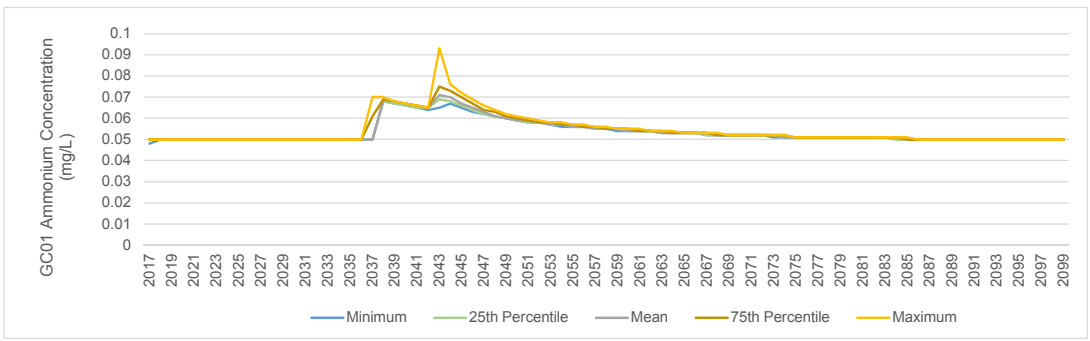

GC01 Sodium Concentration (mg/L)
3.25
3.2
3.15
3.1
3.05
3
2.95
2.9
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

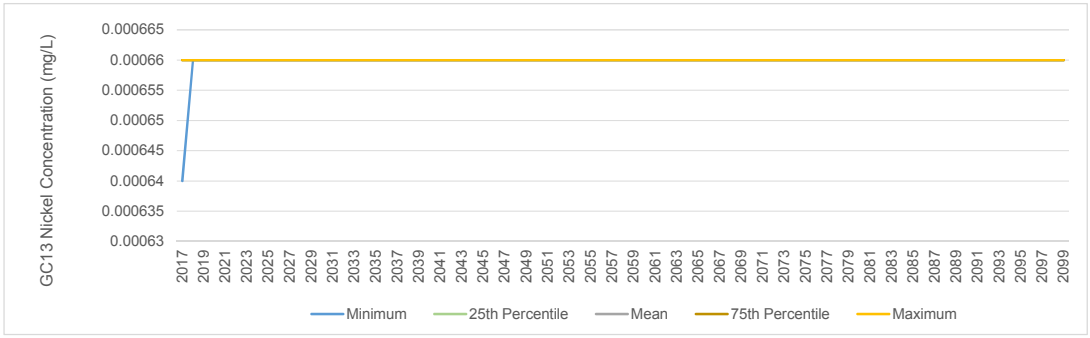

GC13 Ammonium Concentration (mg/L)
0.0505
0.05
0.0495
0.049
0.0485
0.048
0.0475
0.047
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

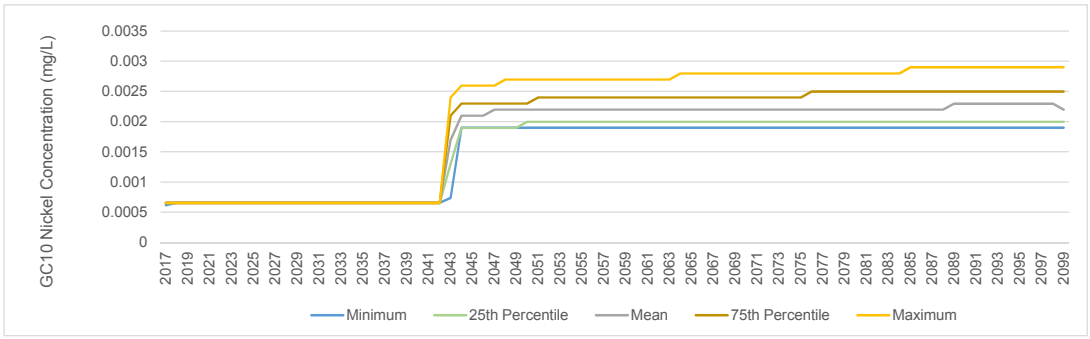

GC10 Ammonium Concentration (mg/L)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

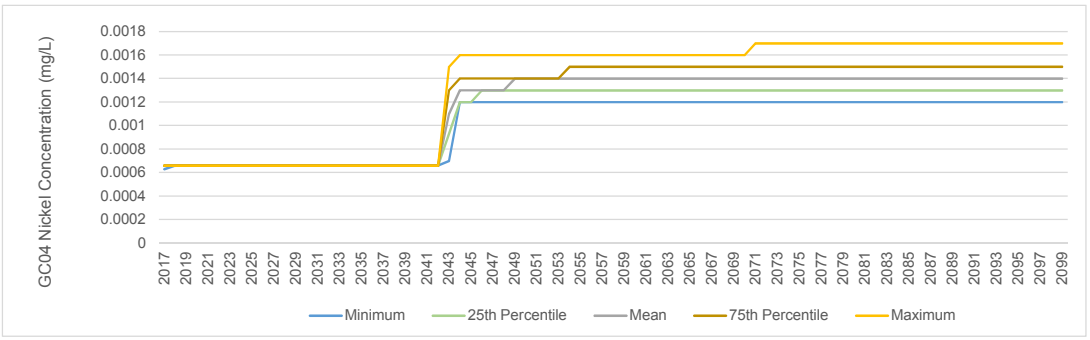

GC04 Ammonium Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

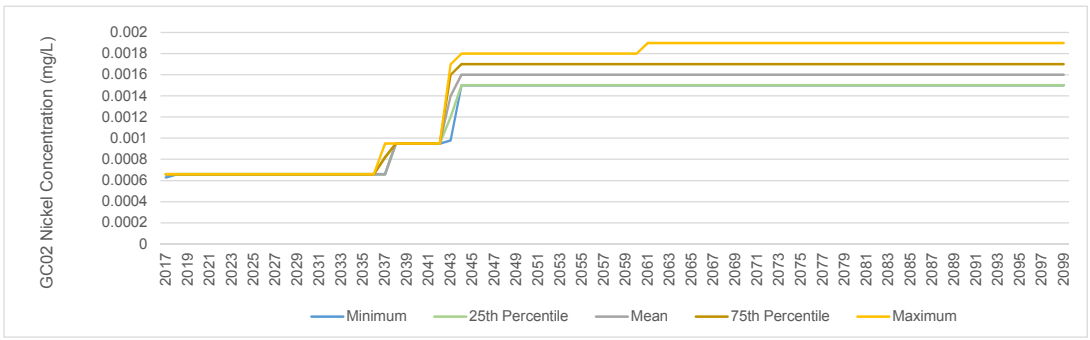

GC02 Ammonium Concentration (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

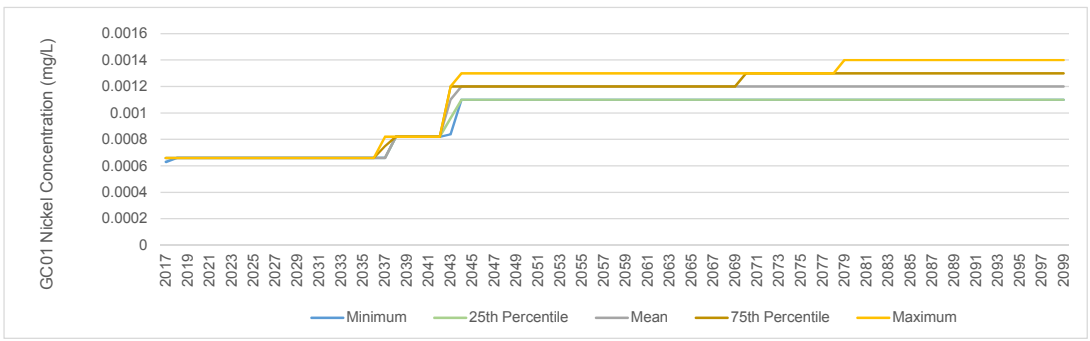

GC01 Ammonium Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

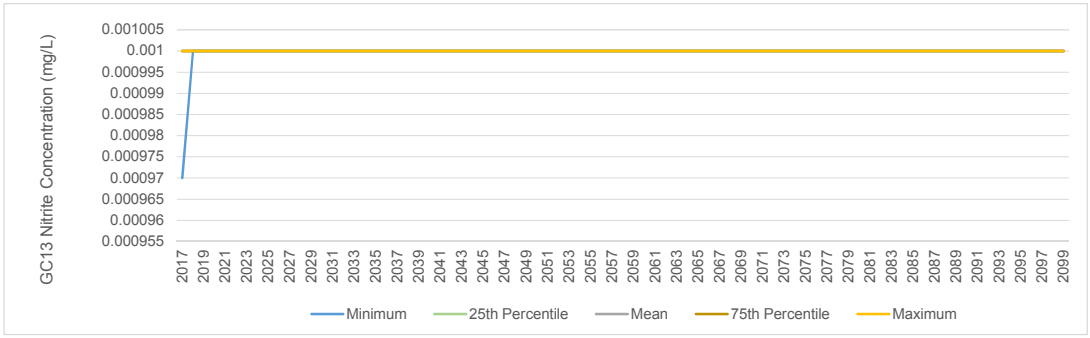

GC13 Nickel Concentration (mg/L)
0.000665
0.00066
0.000655
0.00065
0.000645
0.00064
0.000635
0.00063
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

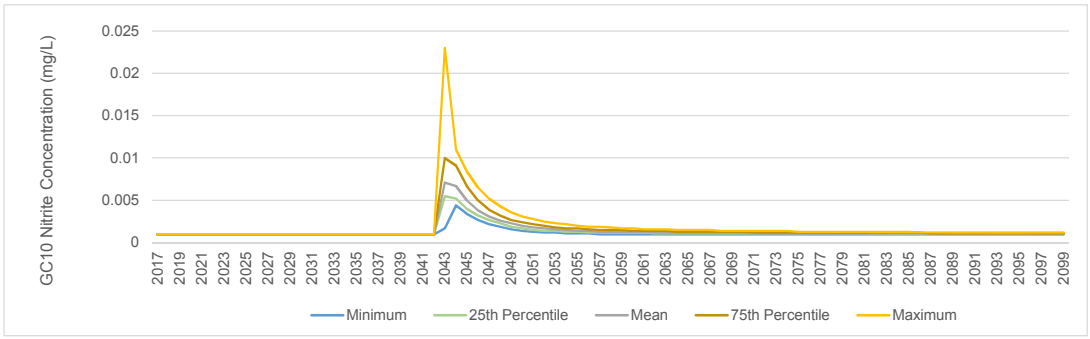

GC10 Nickel Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

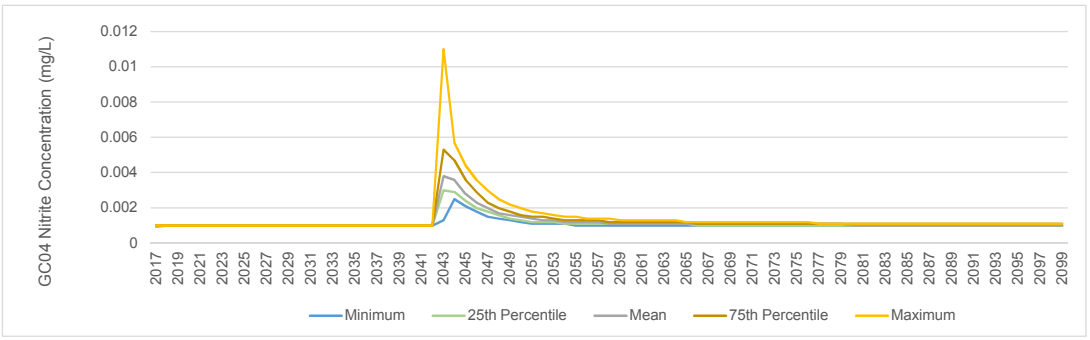

GC04 Nickel Concentration (mg/L)
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

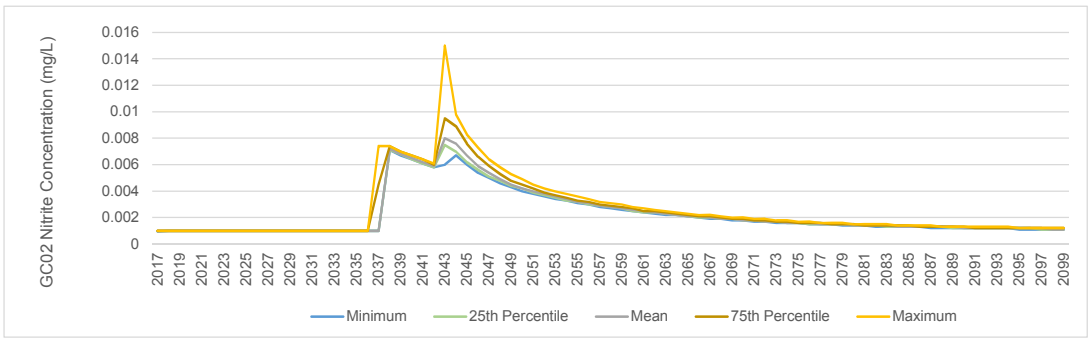

GC02 Nickel Concentration (mg/L)
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

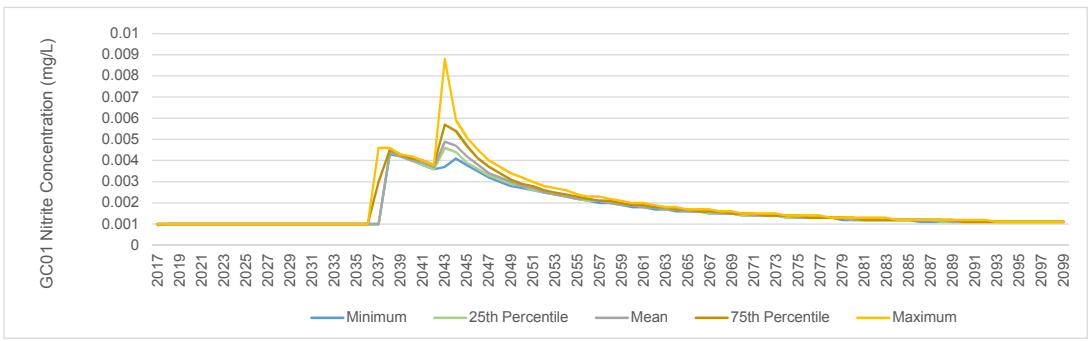

GC01 Nickel Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

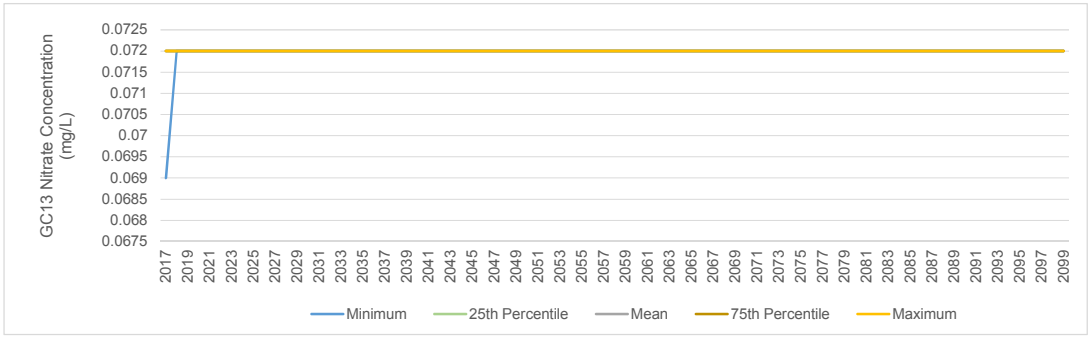

GC13 Nitrite Concentration (mg/L)
0.001005
0.001
0.000995
0.00099
0.000985
0.00098
0.000975
0.00097
0.000965
0.00096
0.000955
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

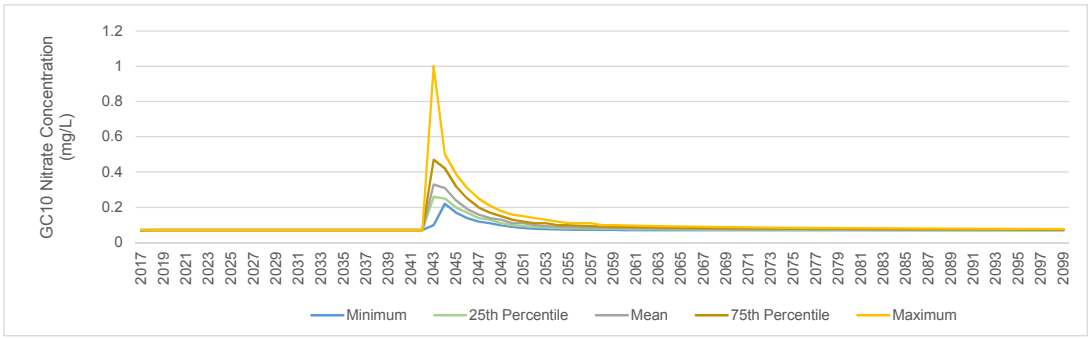

GC10 Nitrite Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

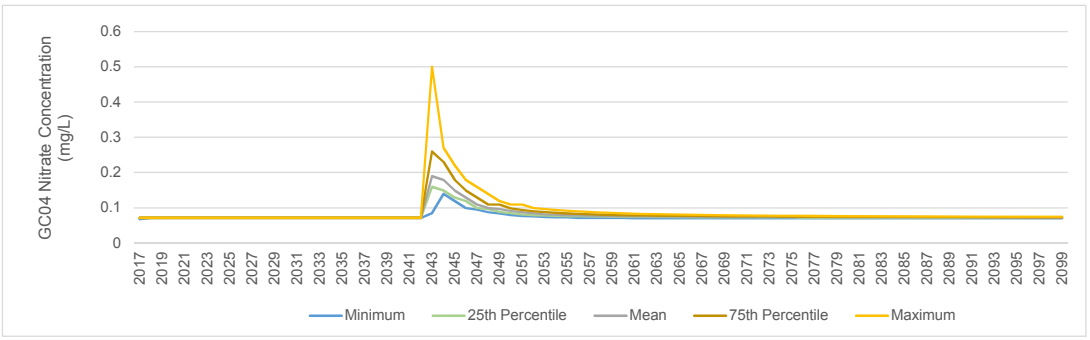

GC04 Nitrite Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

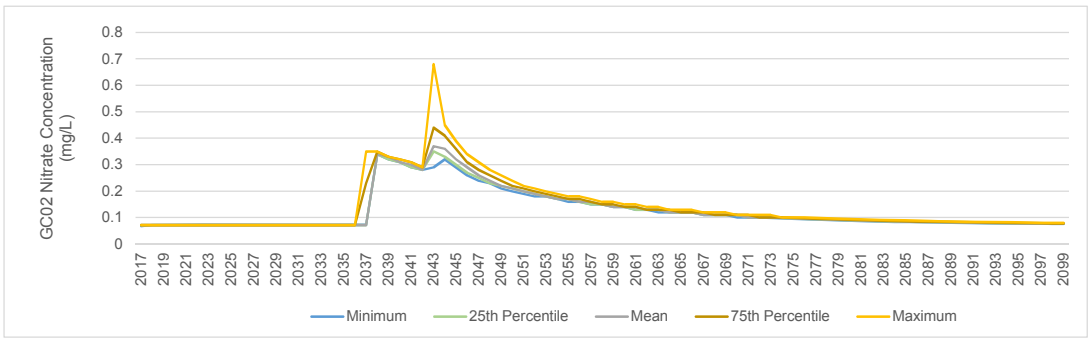

GC02 Nitrite Concentration (mg/L)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

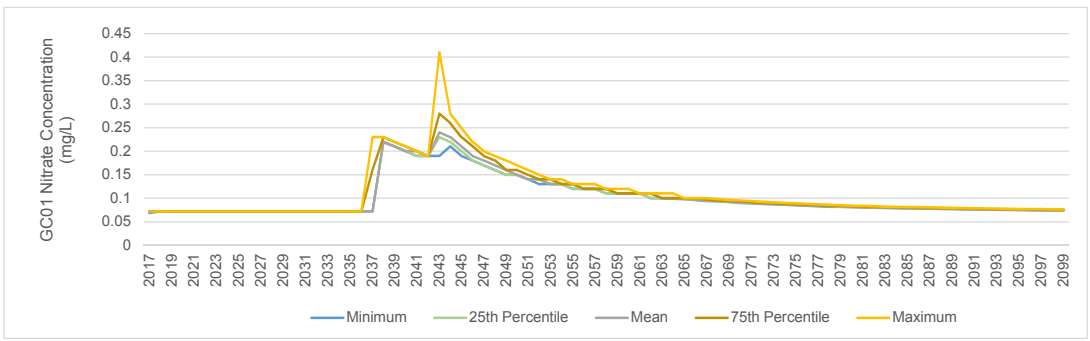

GC01 Nitrite Concentration (mg/L)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

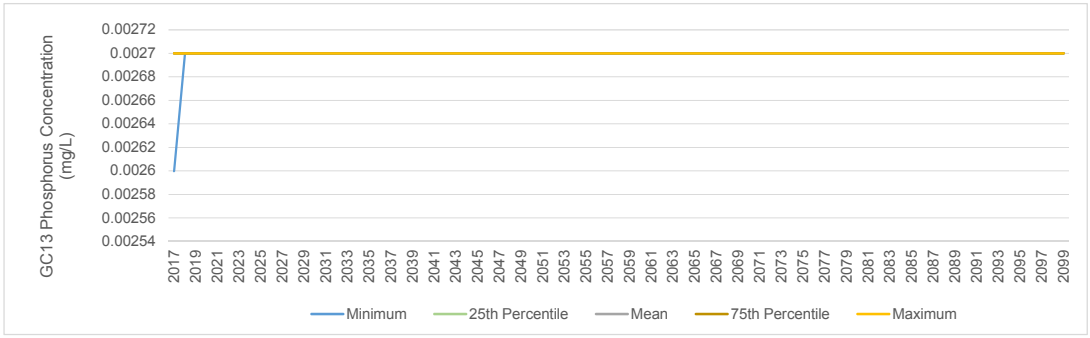

GC13 Nitrate Concentration (mg/L)
0.0725
0.072
0.0715
0.071
0.0705
0.07
0.0695
0.069
0.0685
0.068
0.0675
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

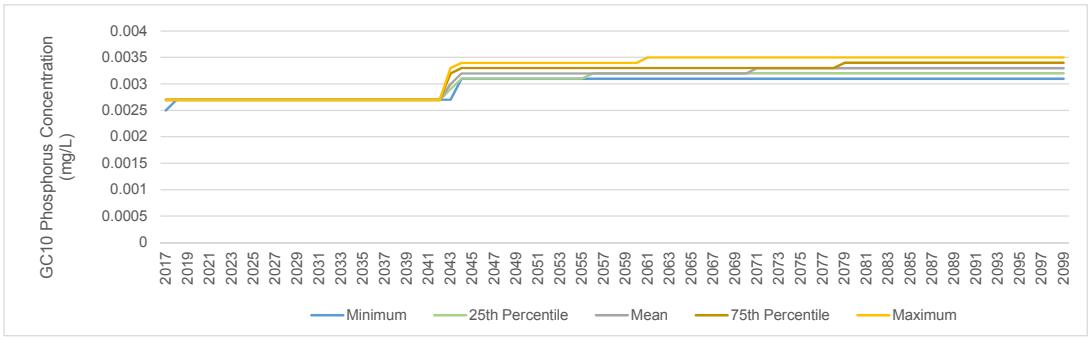

GC10 Nitrate Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

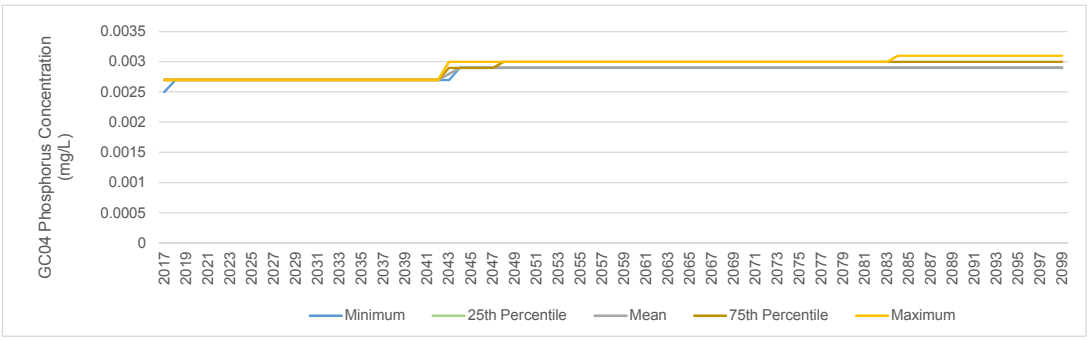

GC04 Nitrate Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

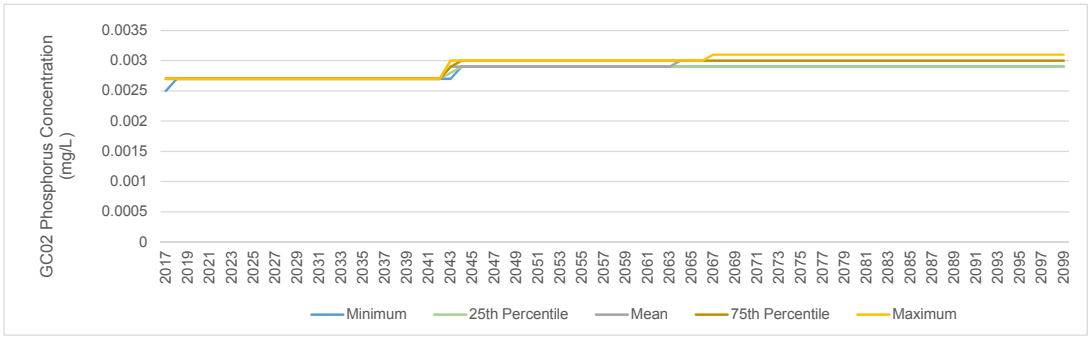

GC02 Nitrate Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

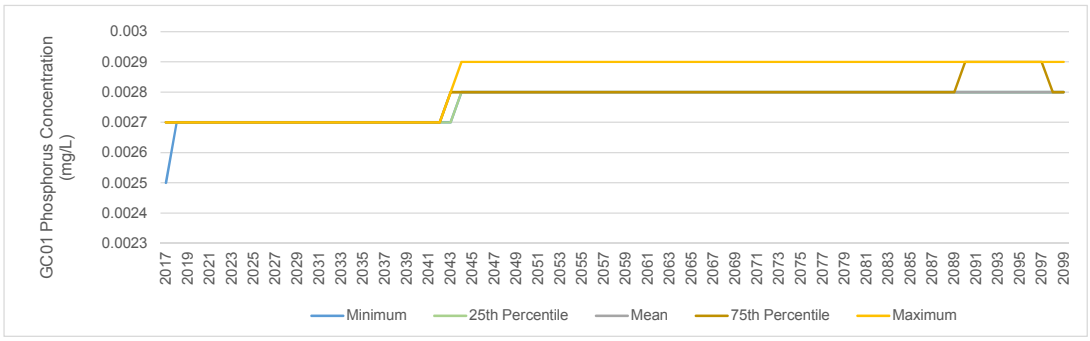

GC01 Nitrate Concentration (mg/L)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

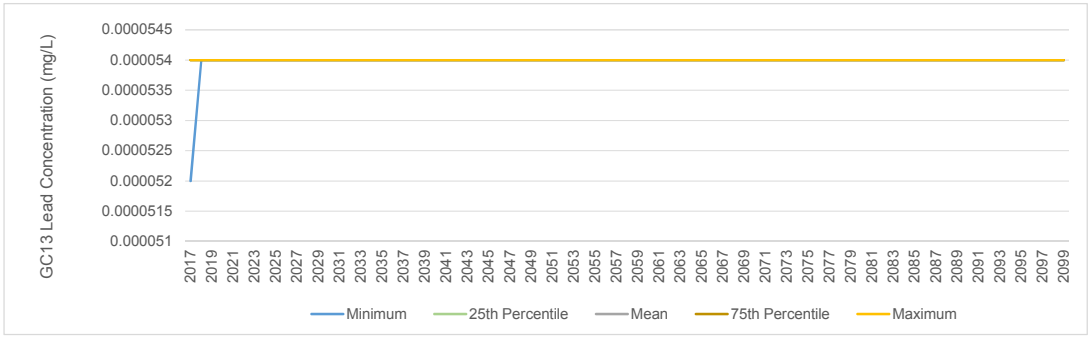

GC13 Phosphorus Concentration (mg/L)
0.00272
0.0027
0.00268
0.00266
0.00264
0.00262
0.0026
0.00258
0.00256
0.00254
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

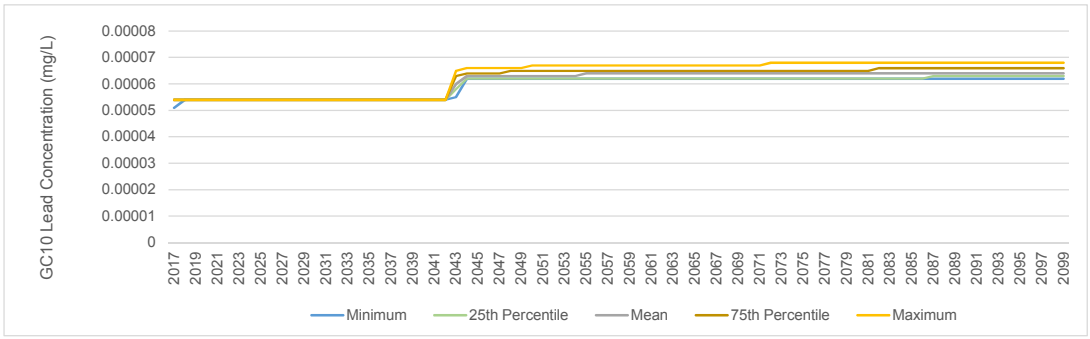

GC10 Phosphorus Concentration (mg/L)
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

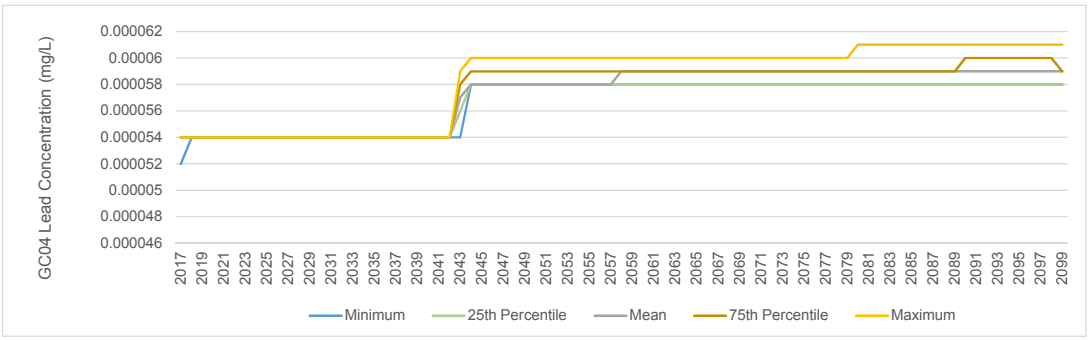

GC04 Phosphorus Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

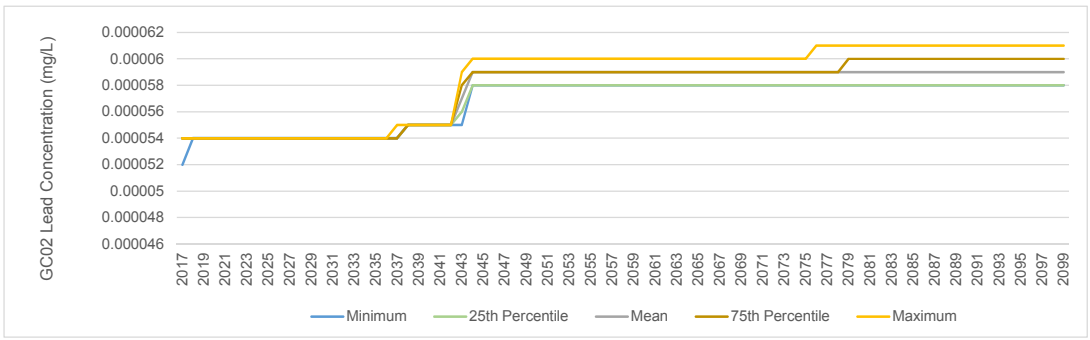

GC02 Phosphorus Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

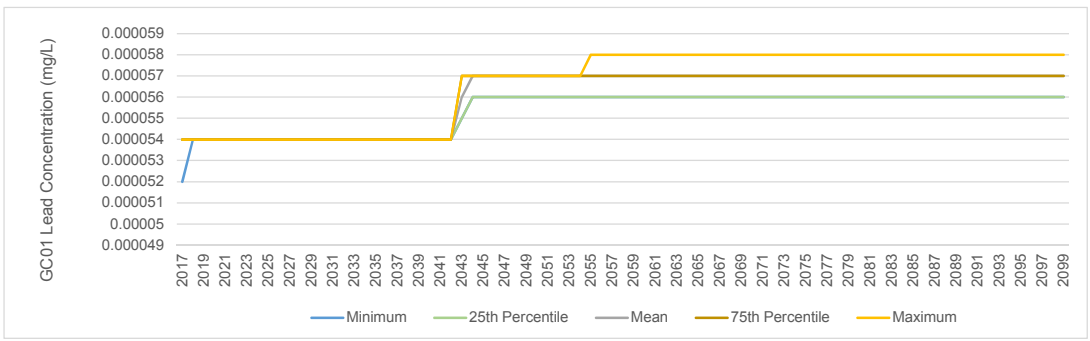

GC01 Phosphorus Concentration (mg/L)
0.003
0.0029
0.0028
0.0027
0.0026
0.0025
0.0024
0.0023
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

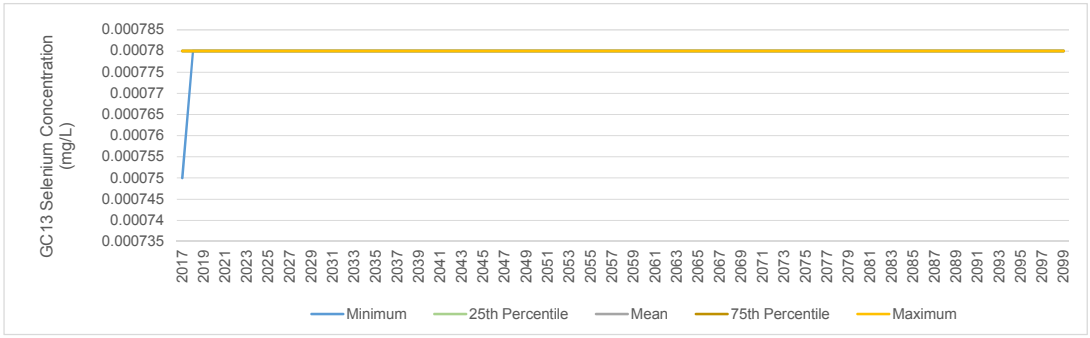

GC13 Lead Concentration (mg/L)
0.0000545
0.000054
0.0000535
0.000053
0.0000525
0.000052
0.0000515
0.000051
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

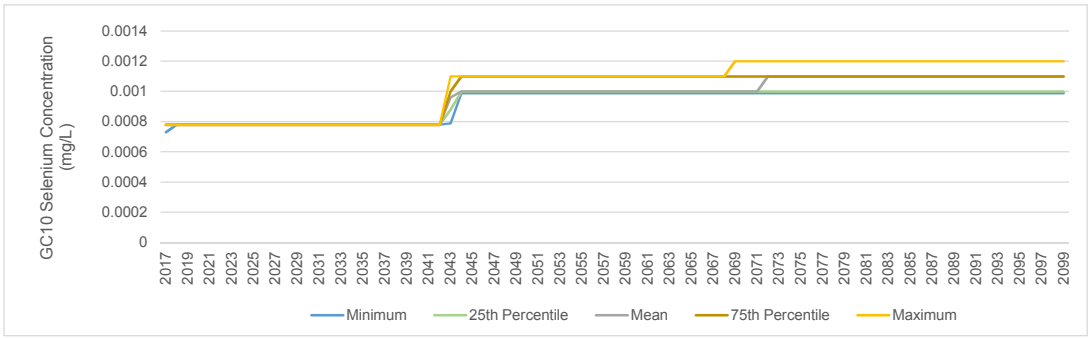

GC10 Lead Concentration (mg/L)
0.00008
0.00007
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

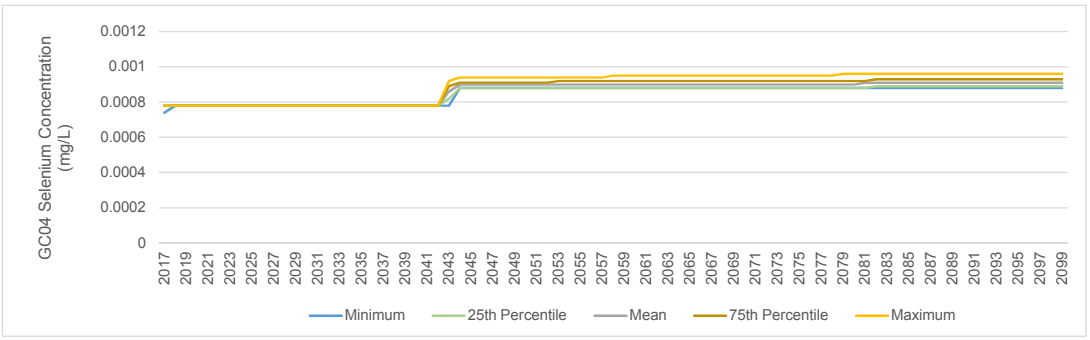

GC04 Lead Concentration (mg/L)
0.000062
0.00006
0.000058
0.000056
0.000054
0.000052
0.00005
0.000048
0.000046
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

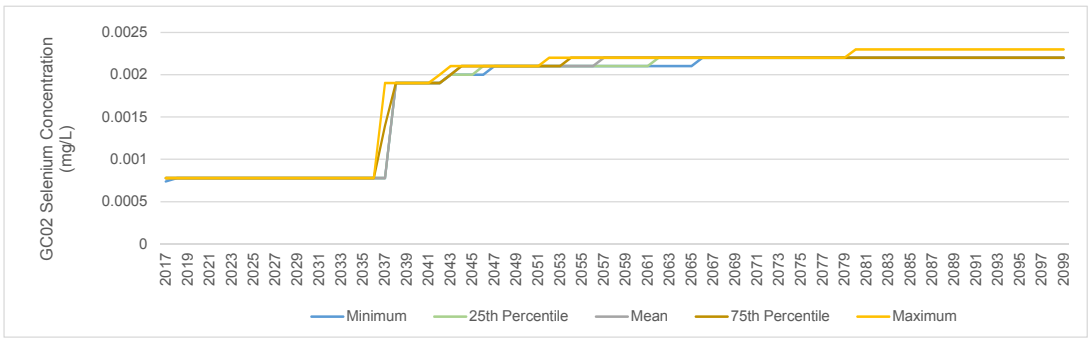

GC02 Lead Concentration (mg/L)
0.000062
0.00006
0.000058
0.000056
0.000054
0.000052
0.00005
0.000048
0.000046
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

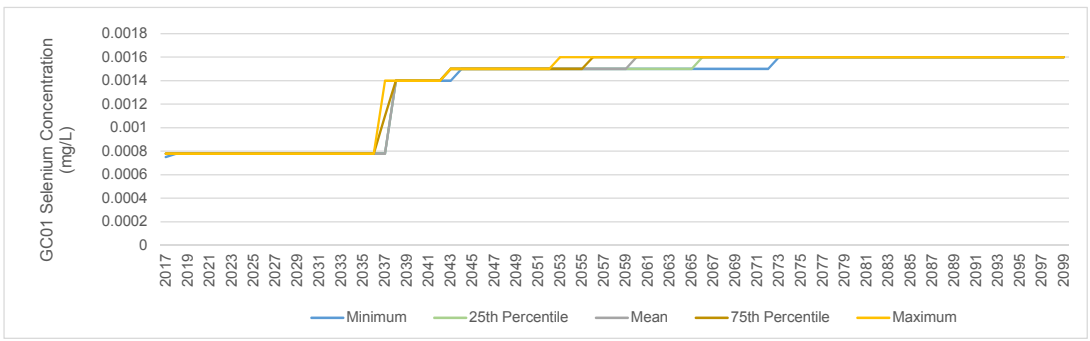

GC01 Lead Concentration (mg/L)
0.000059
0.000058
0.000057
0.000056
0.000055
0.000054
0.000053
0.000052
0.000051
0.00005
0.000049
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

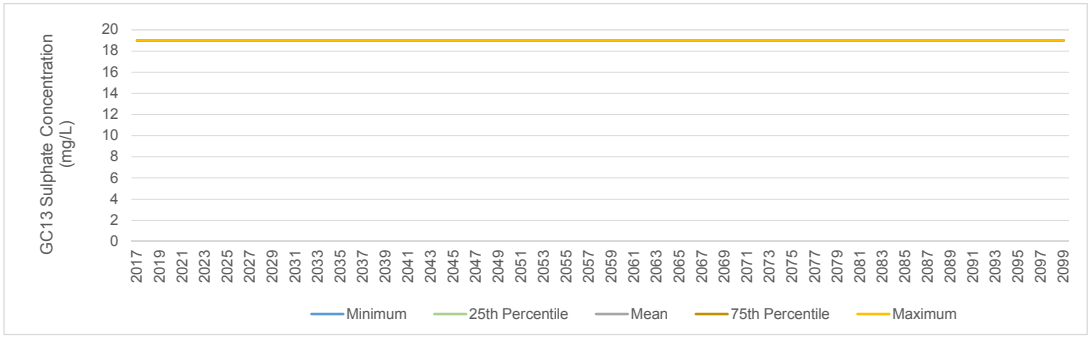

GC13 Selenium Concentration (mg/L)
0.000785
0.00078
0.000775
0.00077
0.000765
0.00076
0.000755
0.00075
0.000745
0.00074
0.000735
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

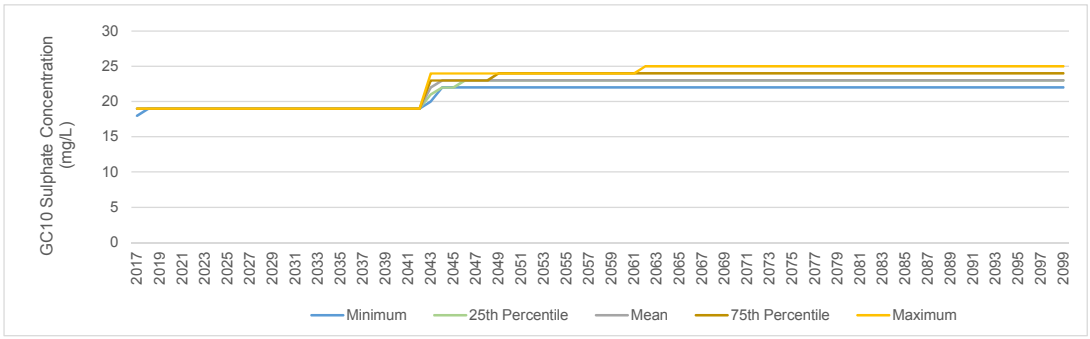

GC10 Selenium Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

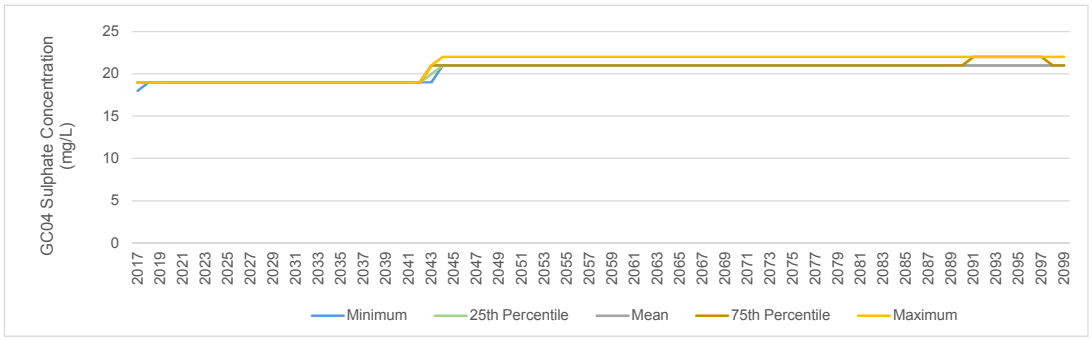

GC04 Selenium Concentration (mg/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

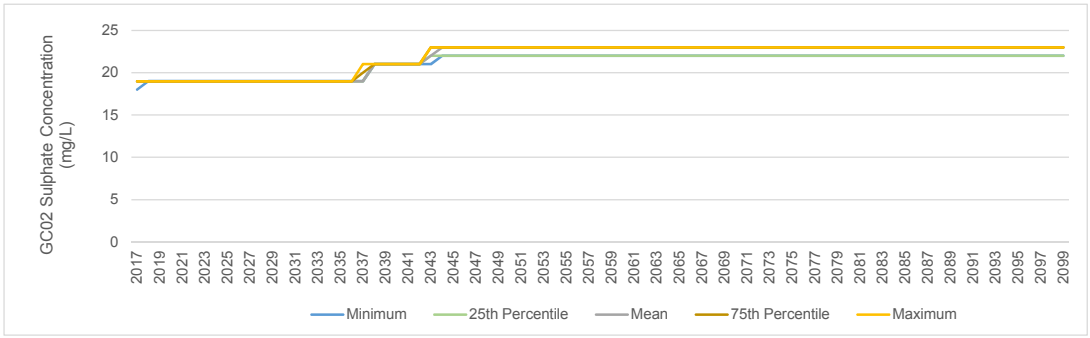

GC02 Selenium Concentration (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

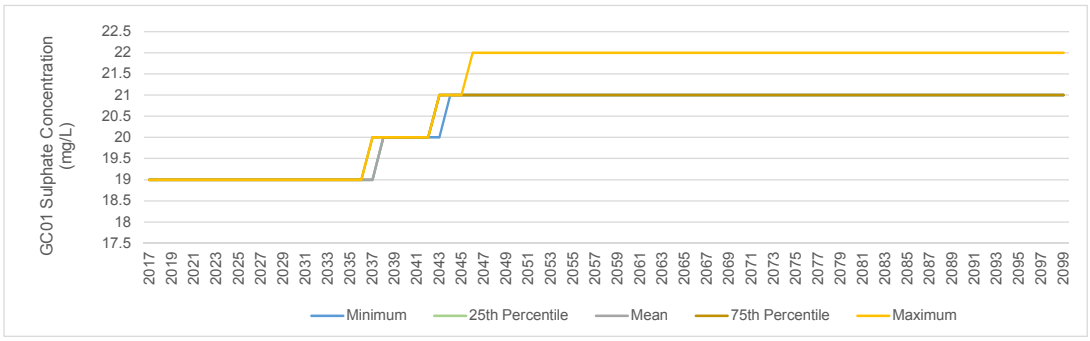

GC01 Selenium Concentration (mg/L)
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

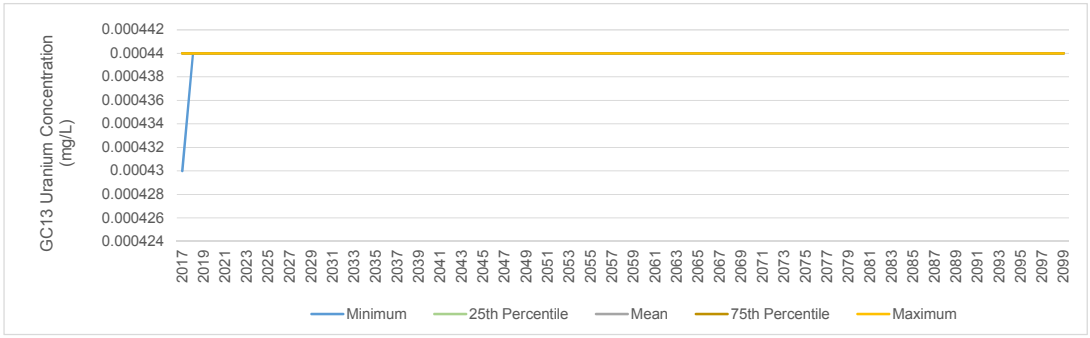

GC13 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

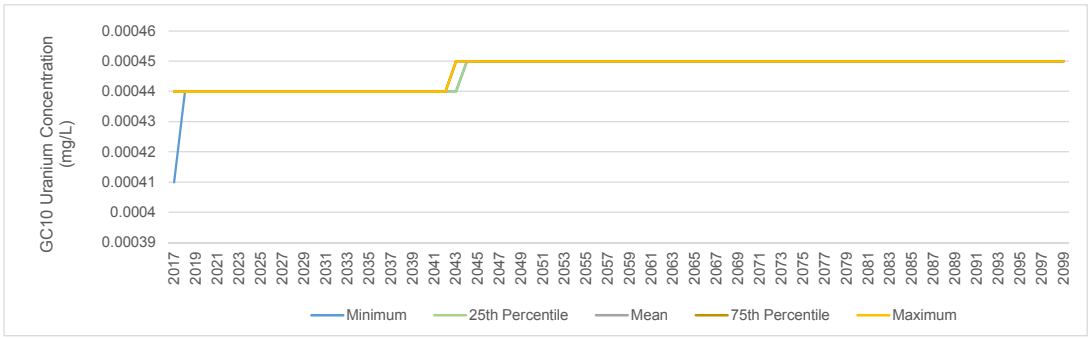

GC10 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

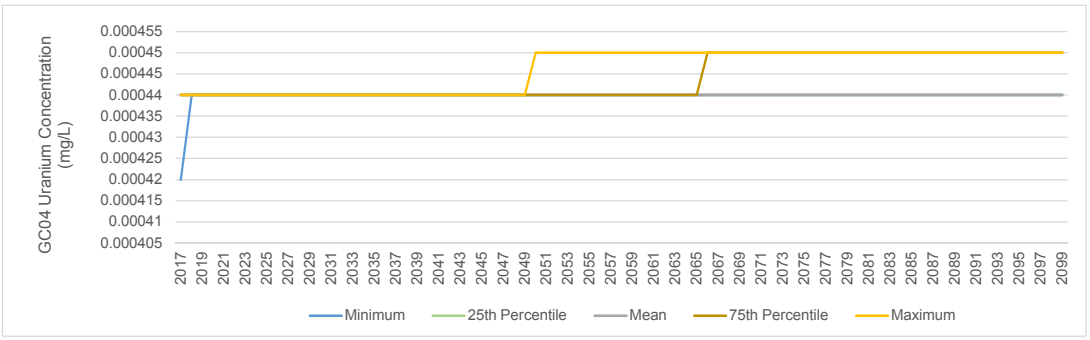

GC04 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

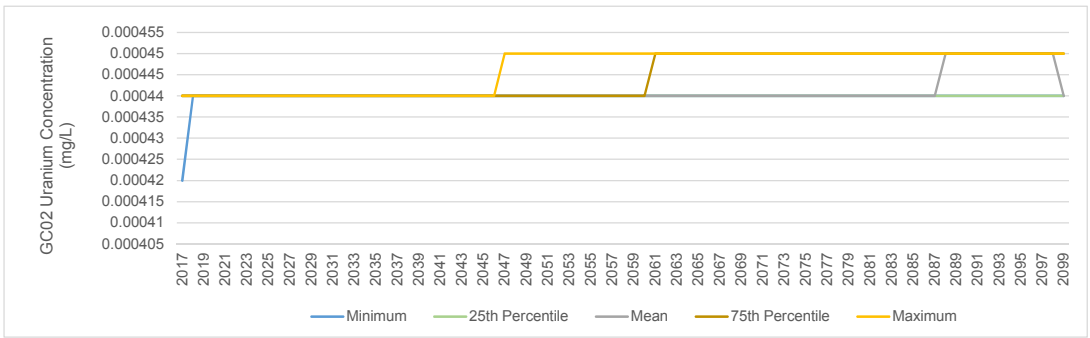

GC02 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

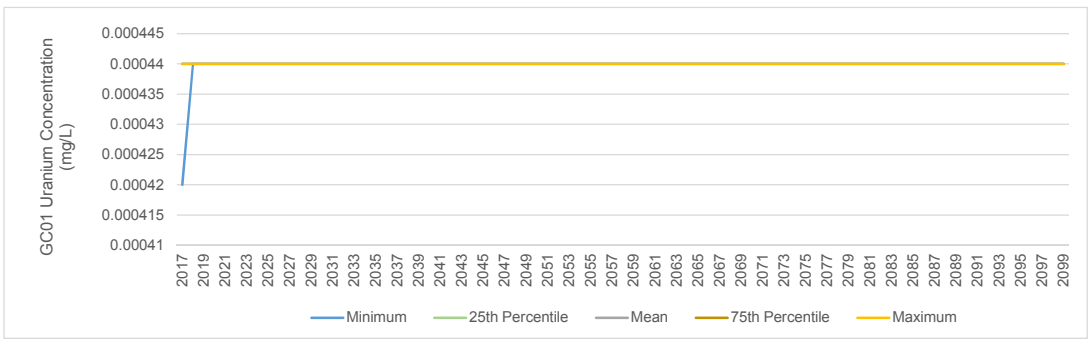

GC01 Sulphate Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

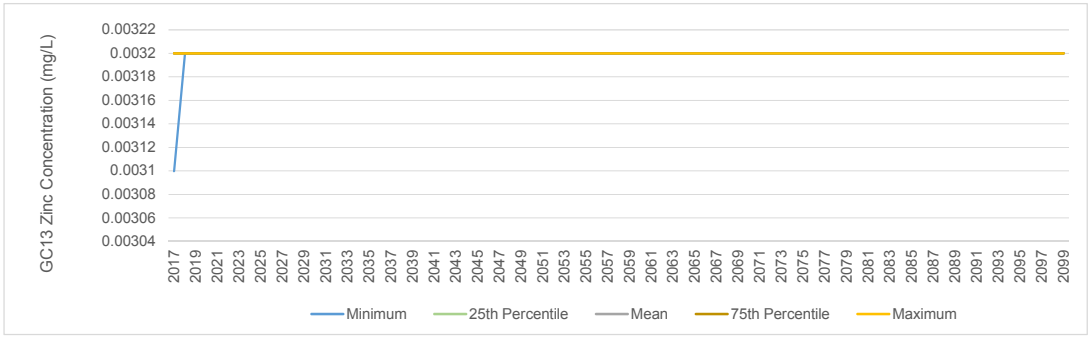

GC13 Uranium Concentration (mg/L)
0.000442
0.00044
0.000438
0.000436
0.000434
0.000432
0.00043
0.000428
0.000426
0.000424
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

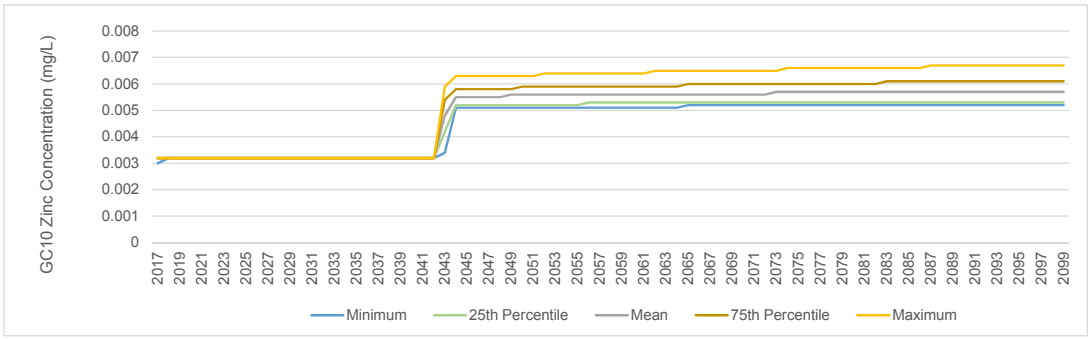

GC10 Uranium Concentration (mg/L)
0.00046
0.00045
0.00044
0.00043
0.00042
0.00041
0.0004
0.00039
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

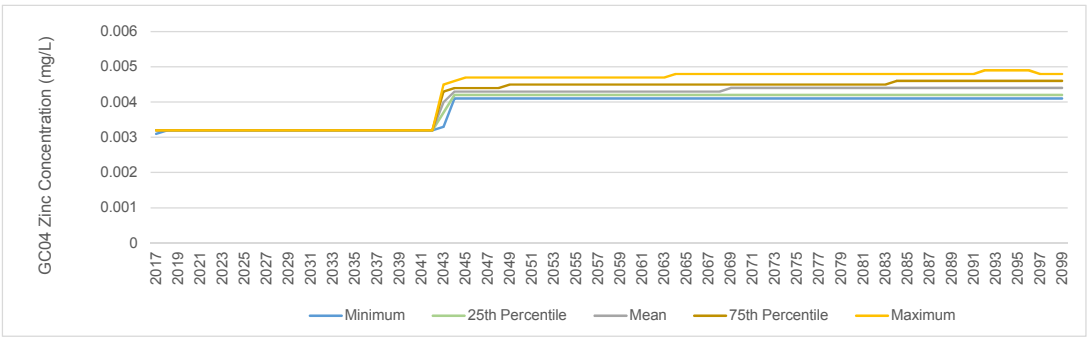

GC04 Uranium Concentration (mg/L)
0.000455
0.00045
0.000445
0.00044
0.000435
0.00043
0.000425
0.00042
0.000415
0.00041
0.000405
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

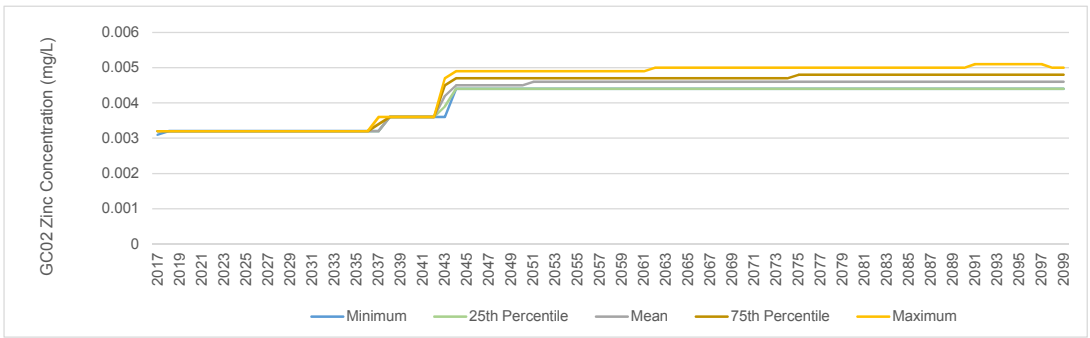

GC02 Uranium Concentration (mg/L)
0.000455
0.00045
0.000445
0.00044
0.000435
0.00043
0.000425
0.00042
0.000415
0.00041
0.000405
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

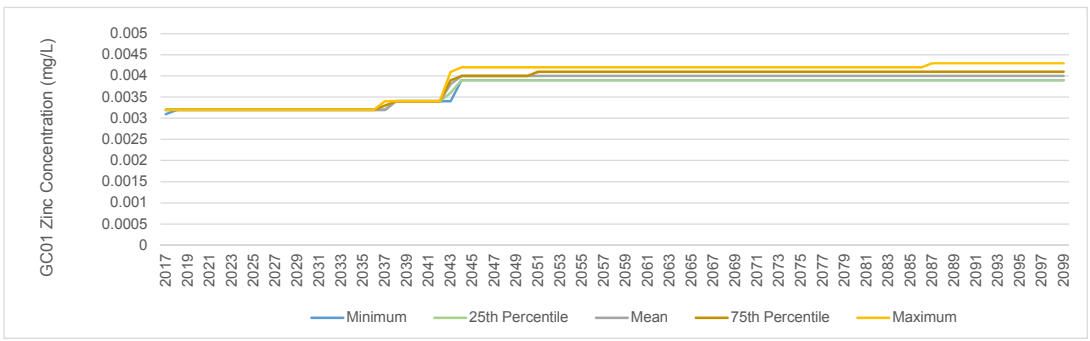

GC01 Uranium Concentration (mg/L)
0.000445
0.00044
0.000435
0.00043
0.000425
0.00042
0.000415
0.00041
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum


GC13 Zinc Concentration (mg/L)
0.00322
0.0032
0.00318
0.00316
0.00314
0.00312
0.0031
0.00308
0.00306
0.00304
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

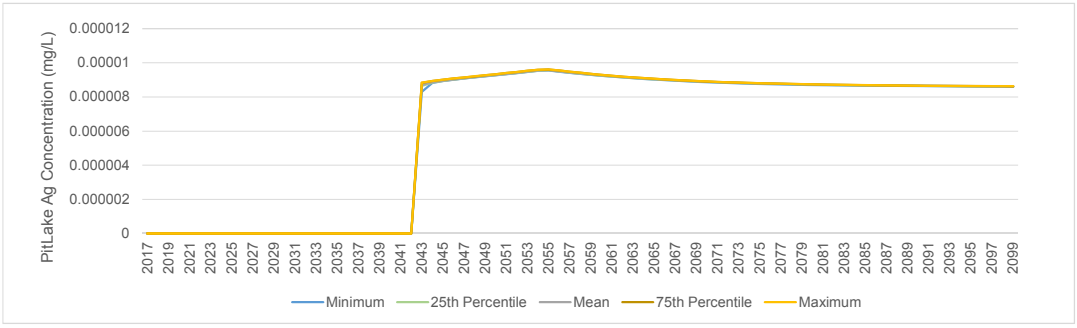

GC10 Zinc Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

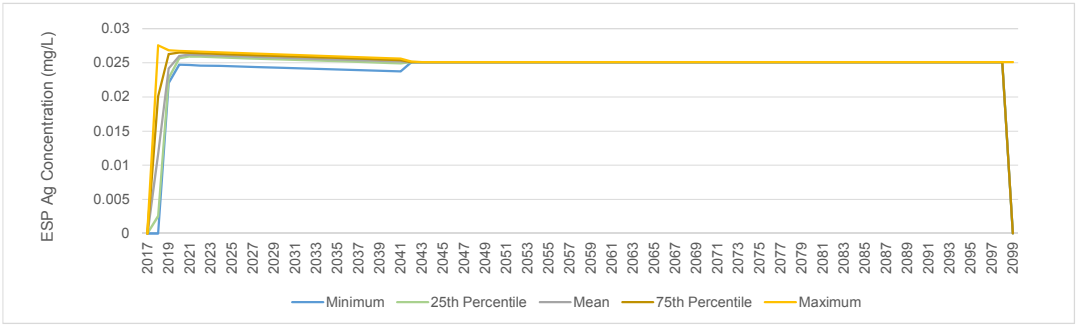

GC04 Zinc Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

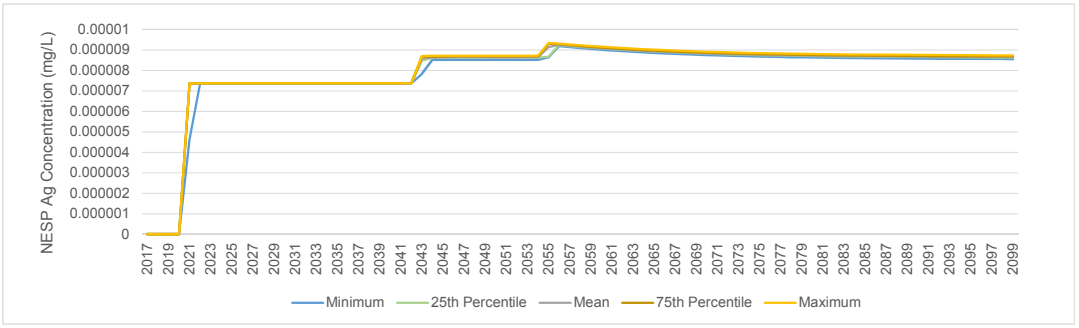

GC02 Zinc Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

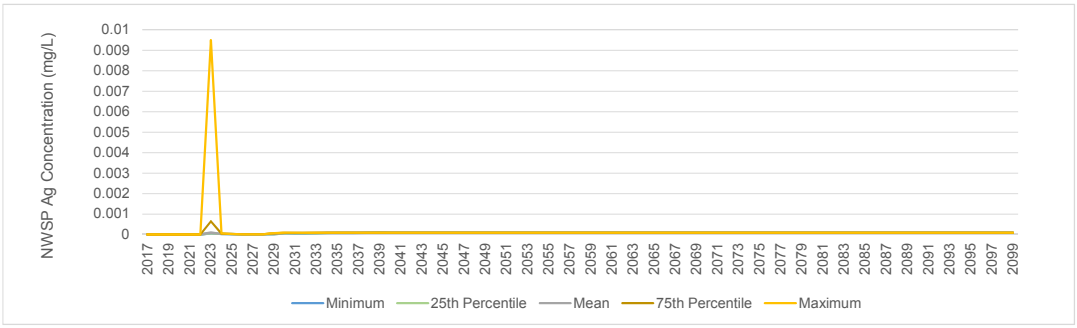

GC01 Zinc Concentration (mg/L)
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

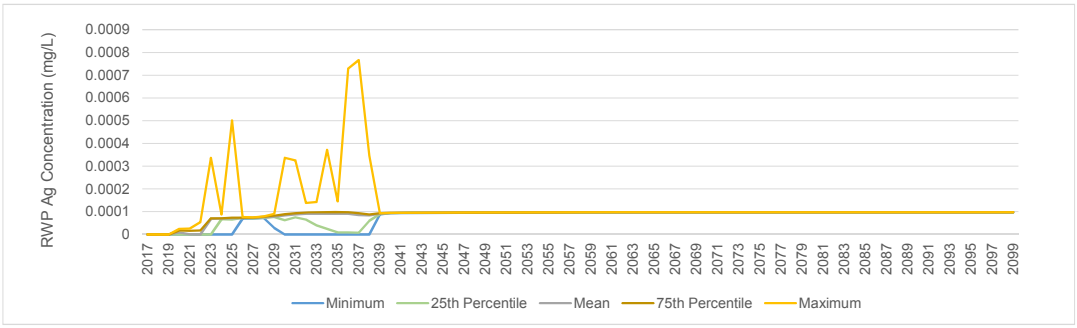
D5 – Saturated Zone and Ponds Water Quality Predictions

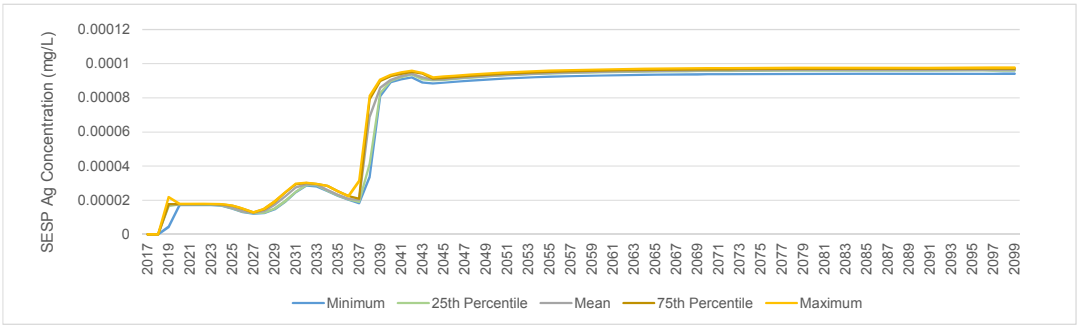

PitLake Ag Concentration (mg/L)
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

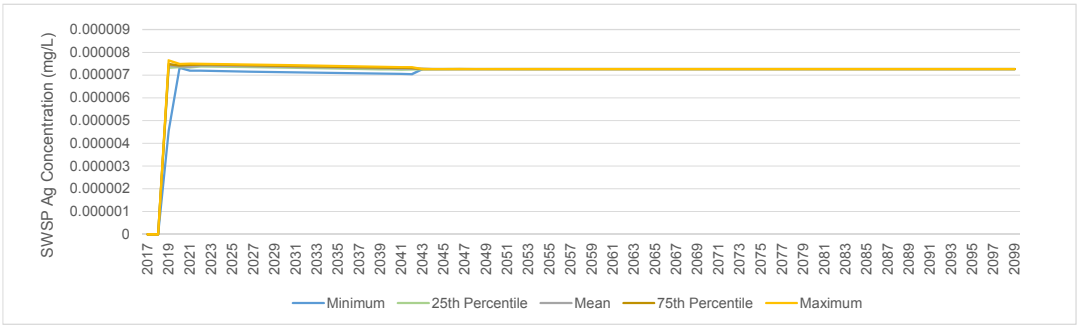

ESP Ag Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

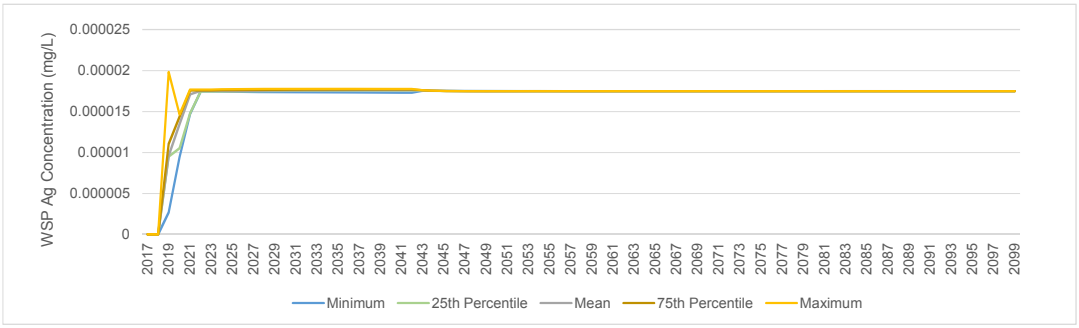

NESP Ag Concentration (mg/L)
0.00001
0.000009
0.000008
0.000007
0.000006
0.000005
0.000004
0.000003
0.000002
0.000001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

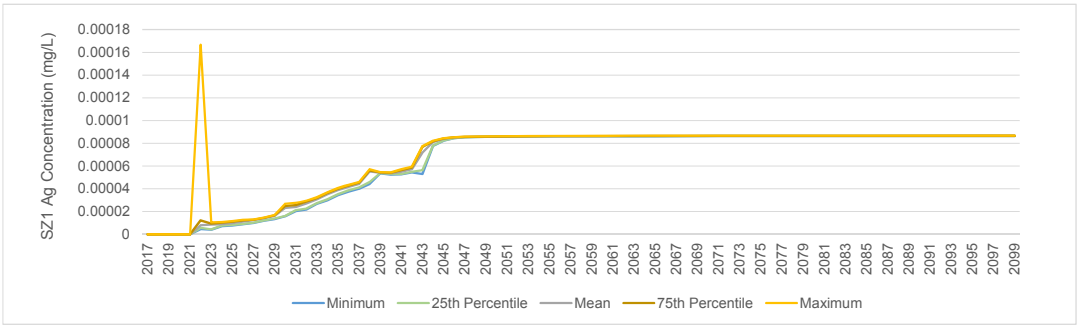

NWSP Ag Concentration (mg/L)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

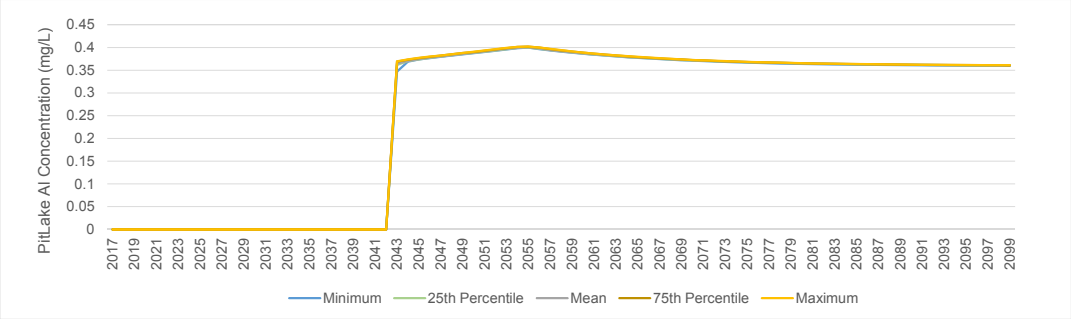

RWP Ag Concentration (mg/L)
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

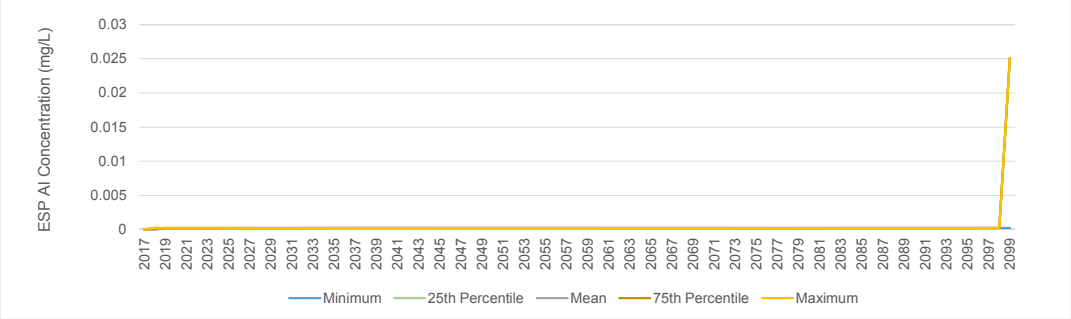

SESP Ag Concentration (mg/L)
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

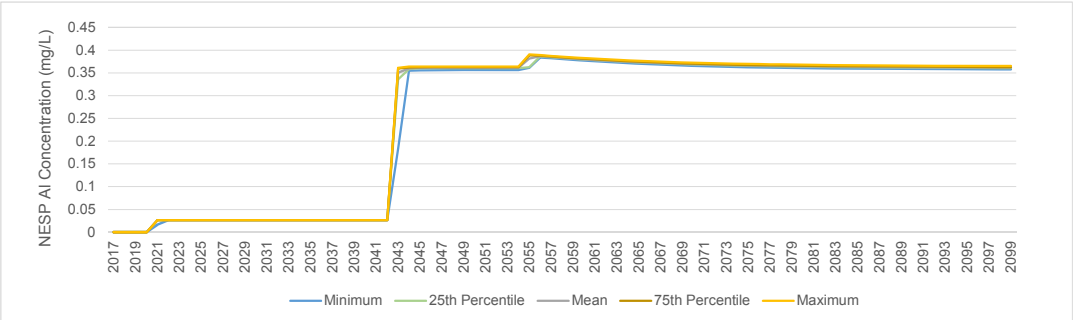

SWSP Ag Concentration (mg/L)
0.000009
0.000008
0.000007
0.000006
0.000005
0.000004
0.000003
0.000002
0.000001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

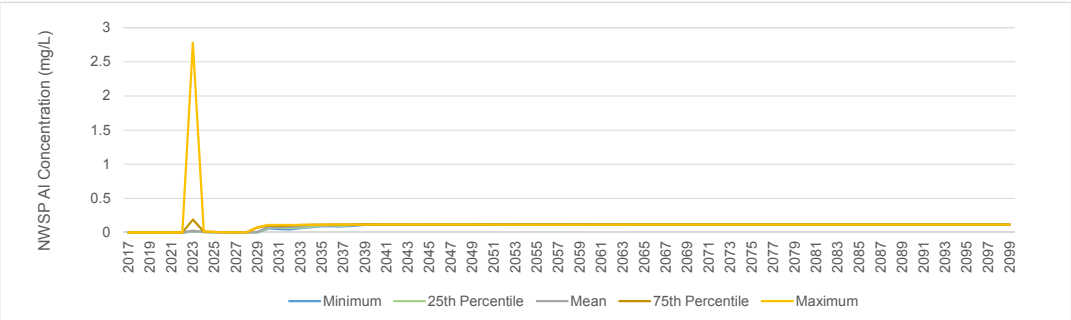

WSP Ag Concentration (mg/L)
0.000025
0.00002
0.000015
0.00001
0.000005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

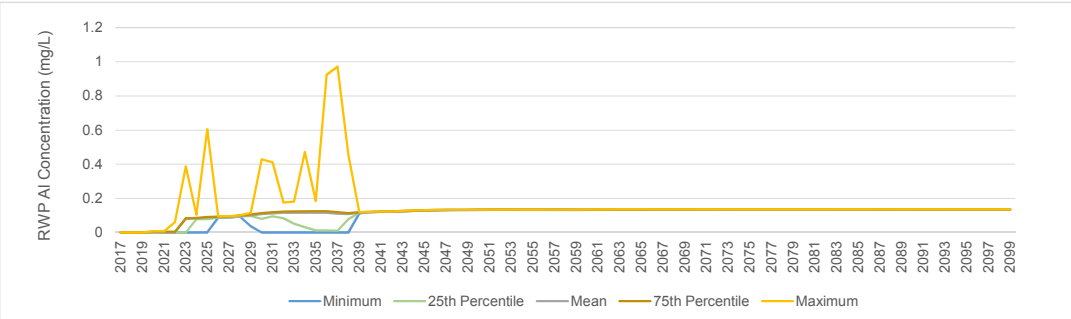

SZ1 Ag Concentration (mg/L)
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

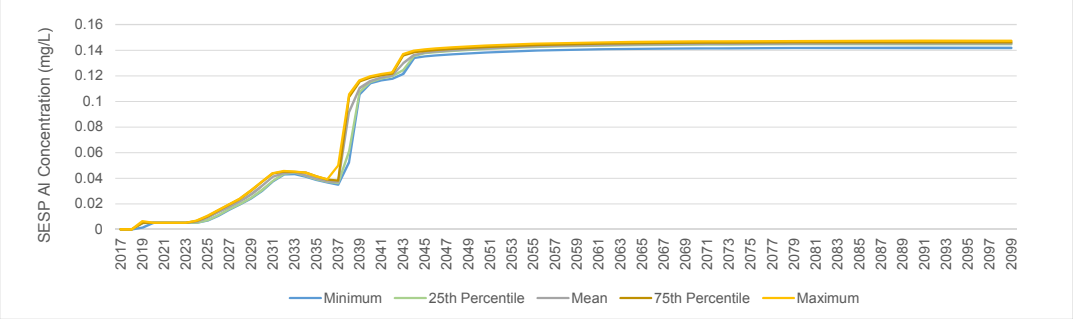

PitLake Al Concentration (mg/L)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

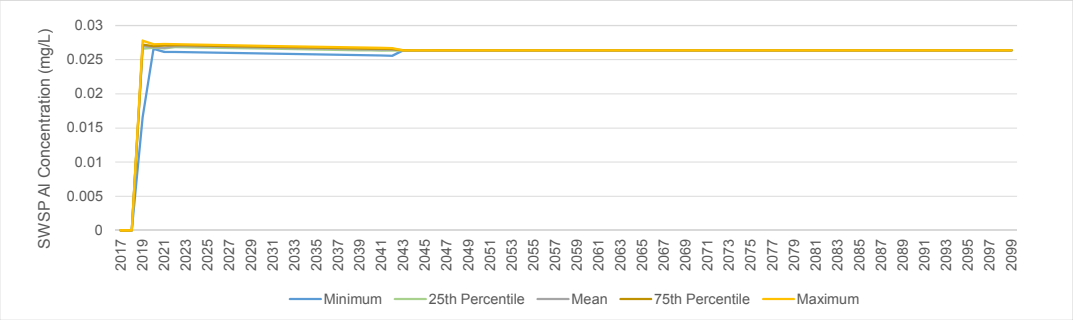

ESP Al Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

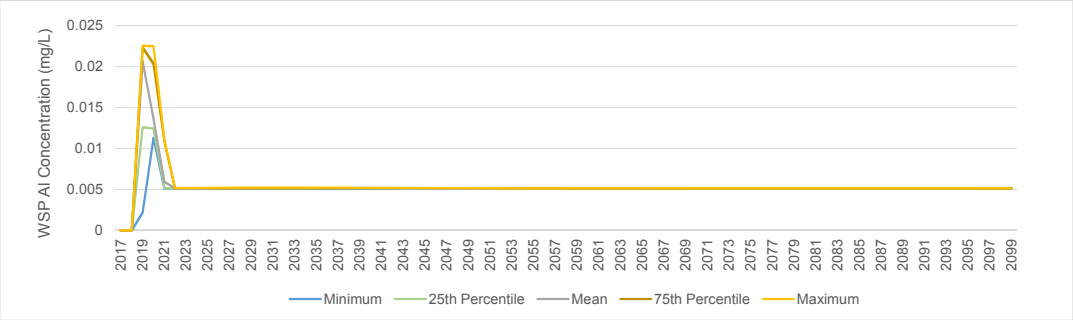

NESP Al Concentration (mg/L)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

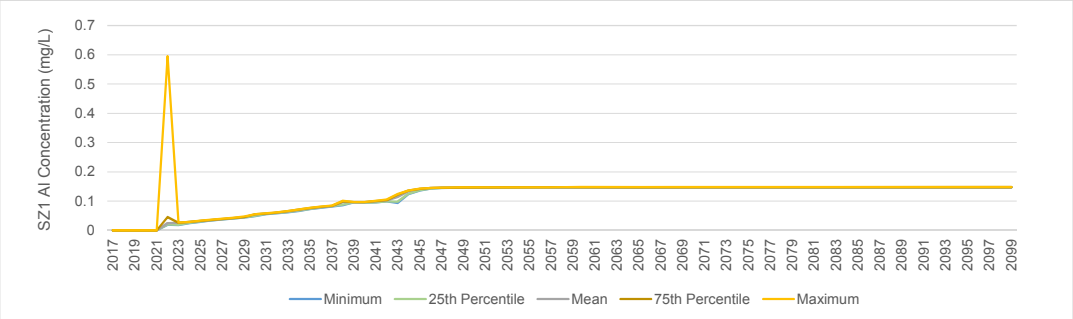

NWSP Al Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

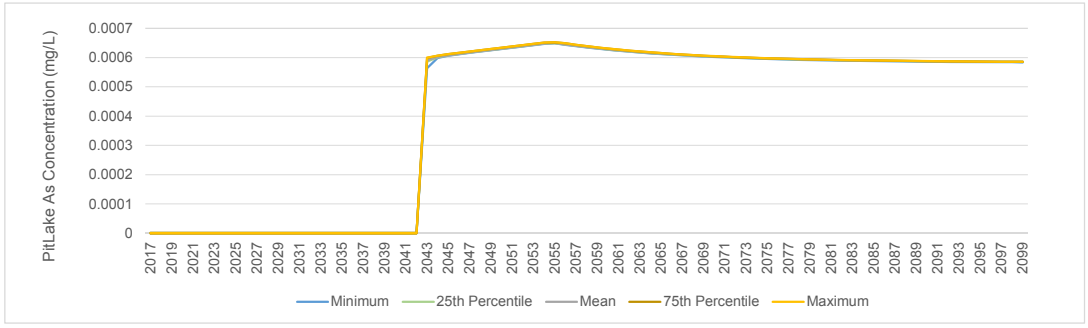

RWP Al Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

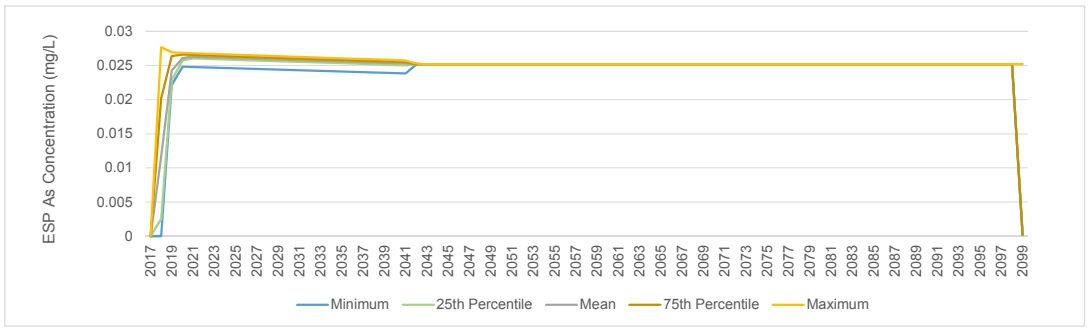

SESP Al Concentration (mg/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

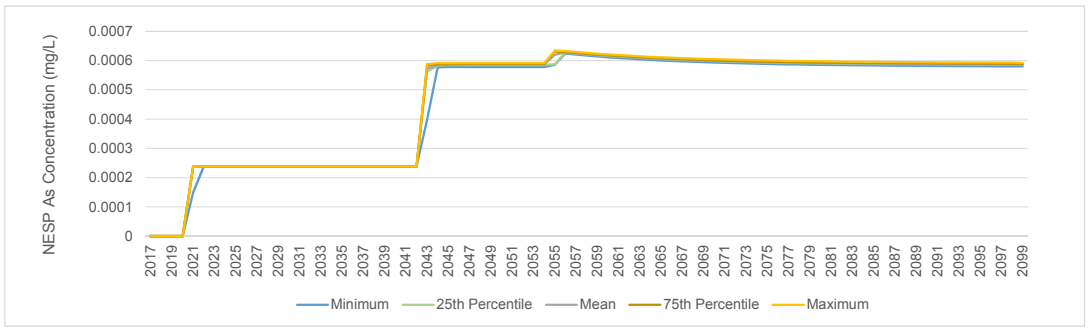

SWSP Al Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

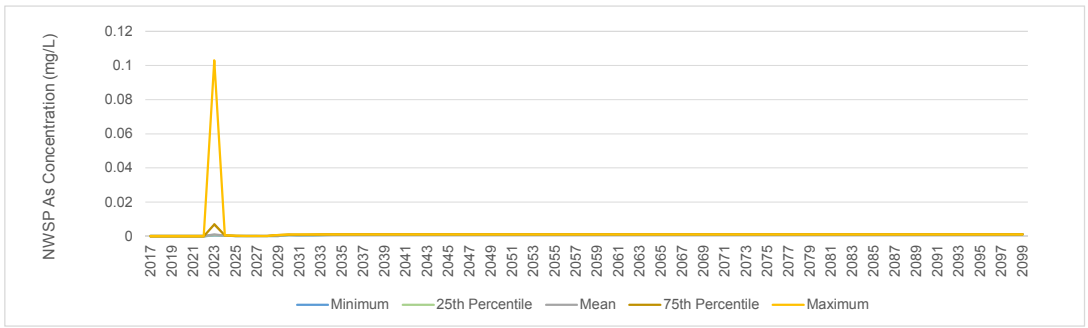

WSP Al Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

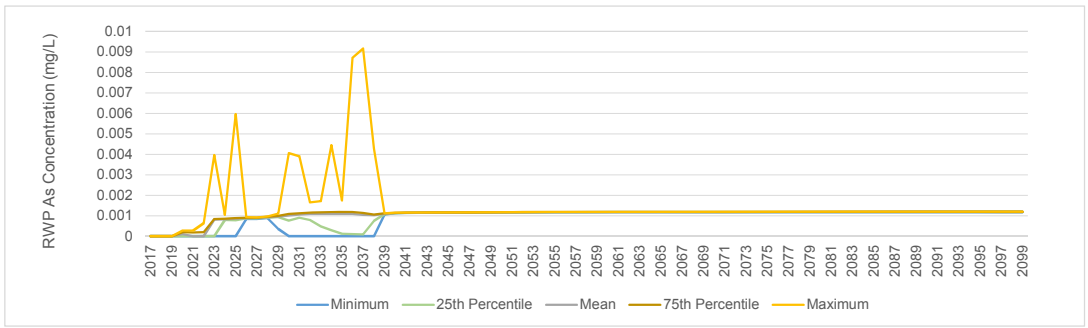

SZ1 Al Concentration (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

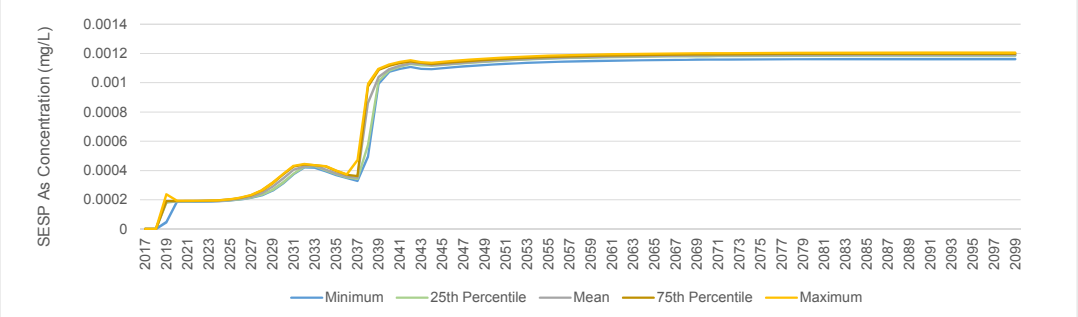

PitLake As Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

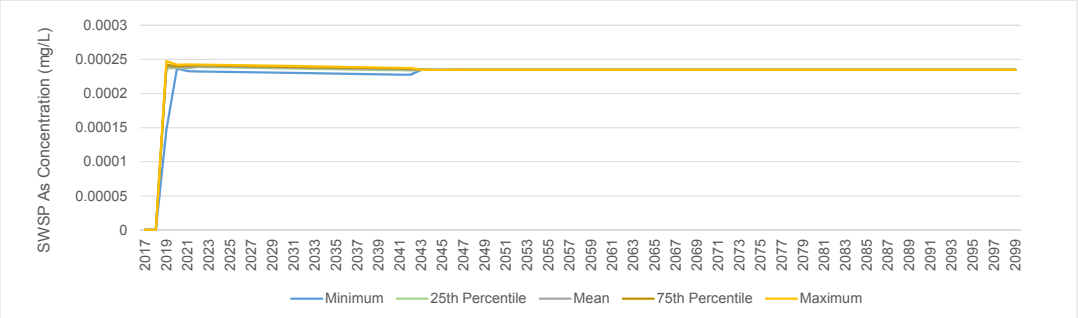

ESP As Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

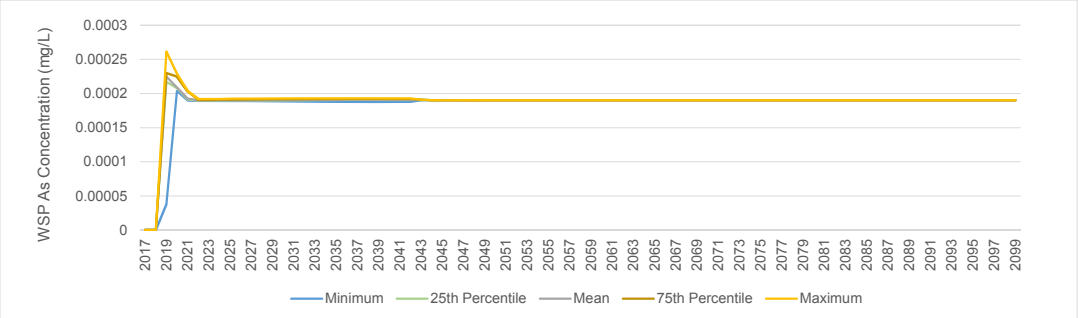

NESP As Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

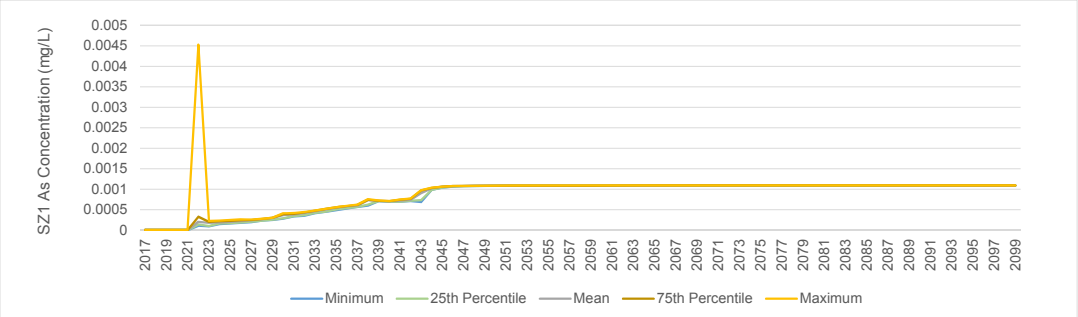

NWSP As Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

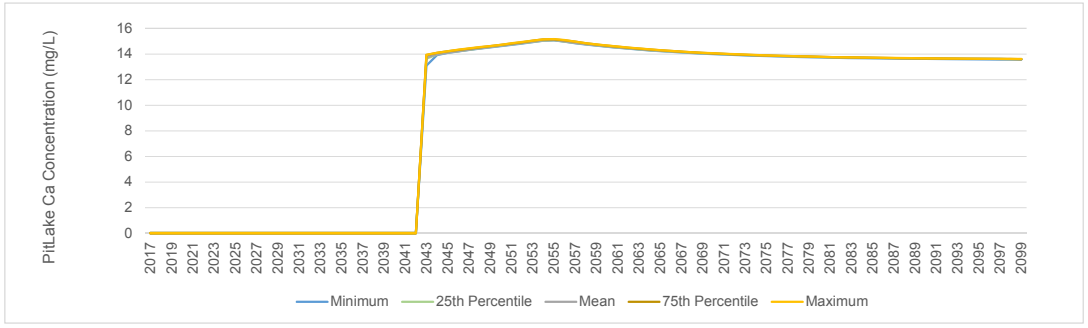

RWP As Concentration (mg/L)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

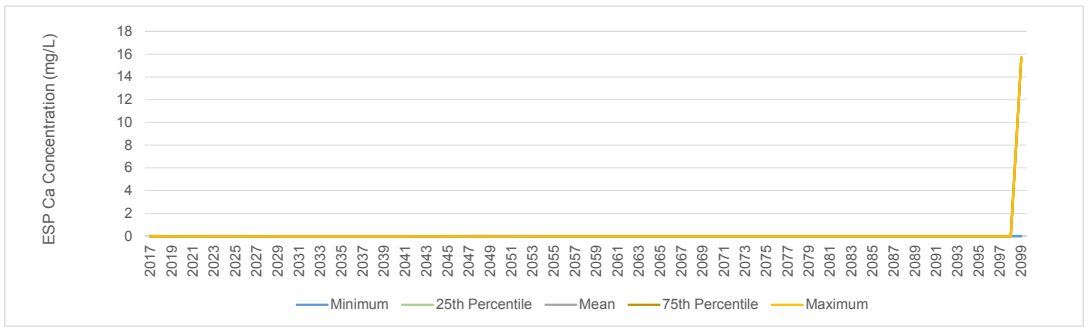

SESP As Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

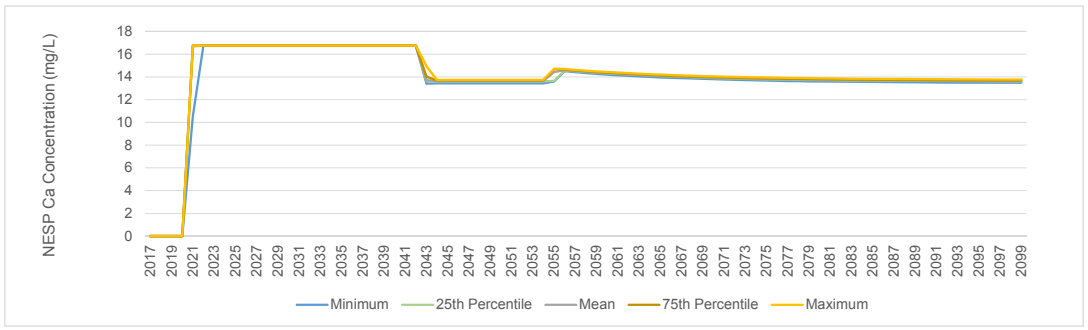

SWSP As Concentration (mg/L)
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

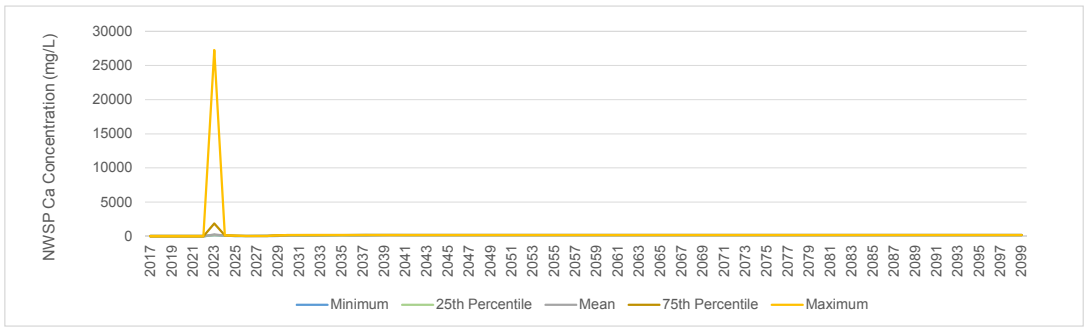

WSP As Concentration (mg/L)
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

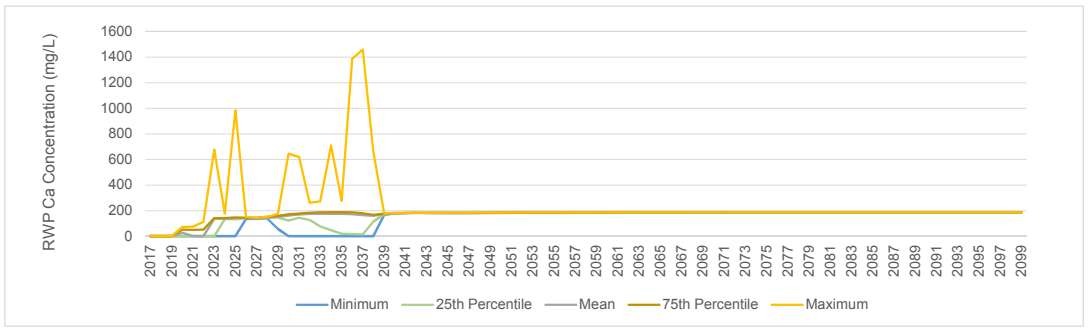

SZ1 As Concentration (mg/L)
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

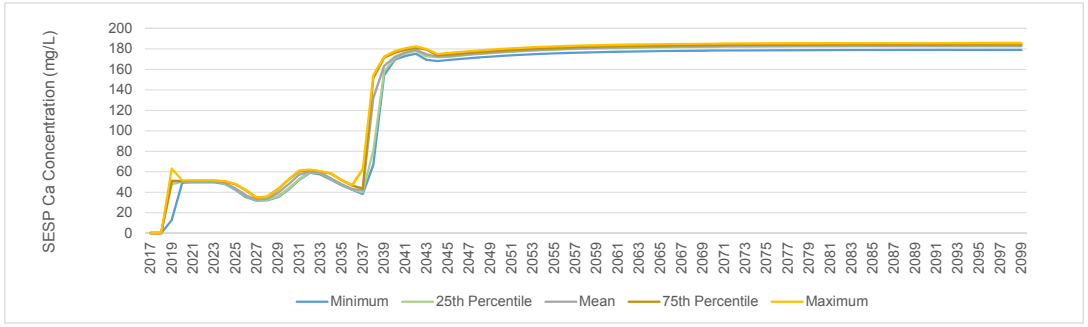

PitLake Ca Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

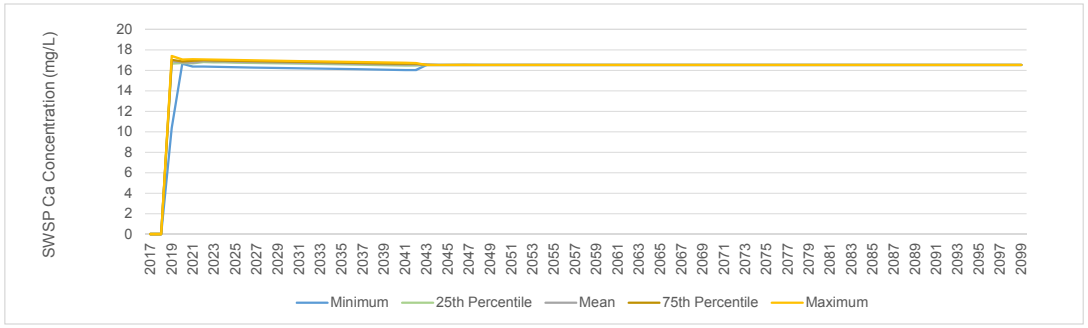

ESP Ca Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

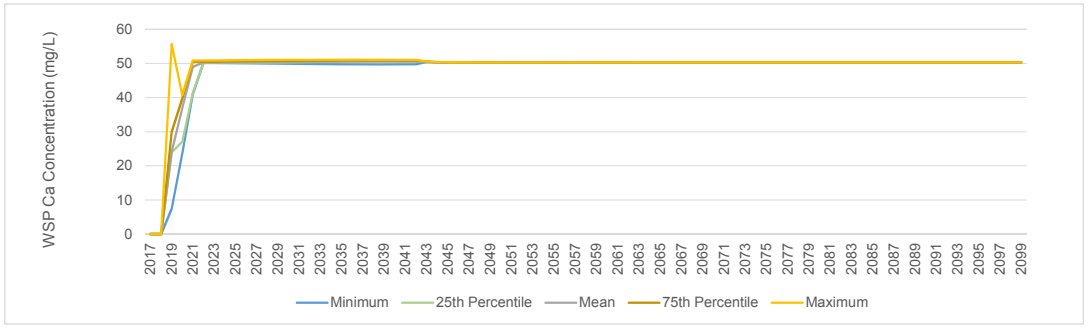

NESP Ca Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

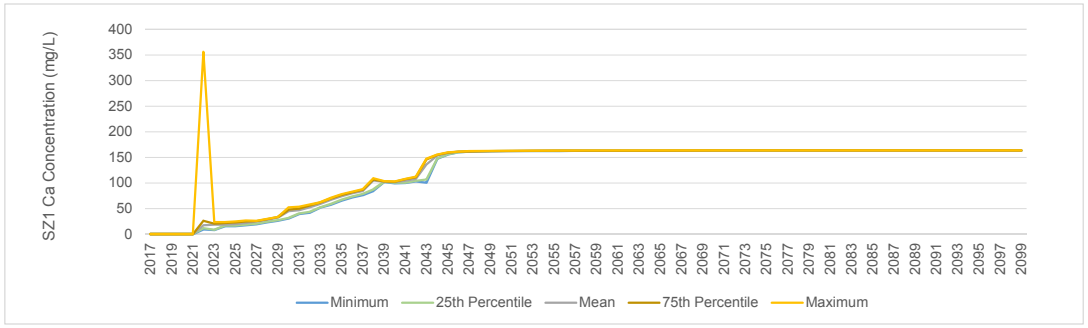

NWSP Ca Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

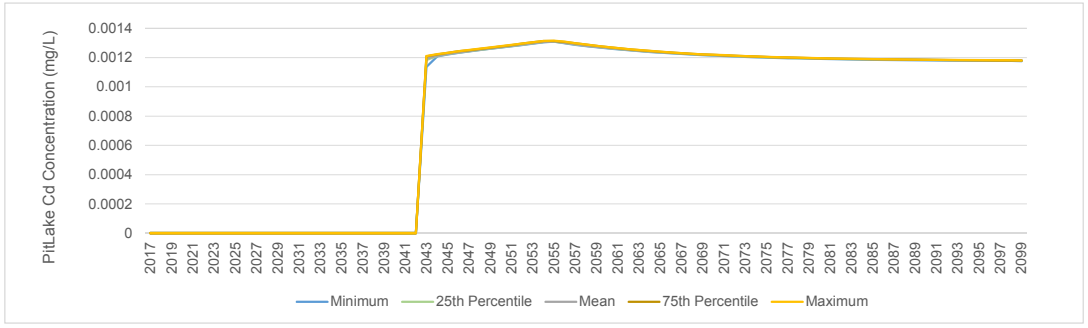

RWP Ca Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

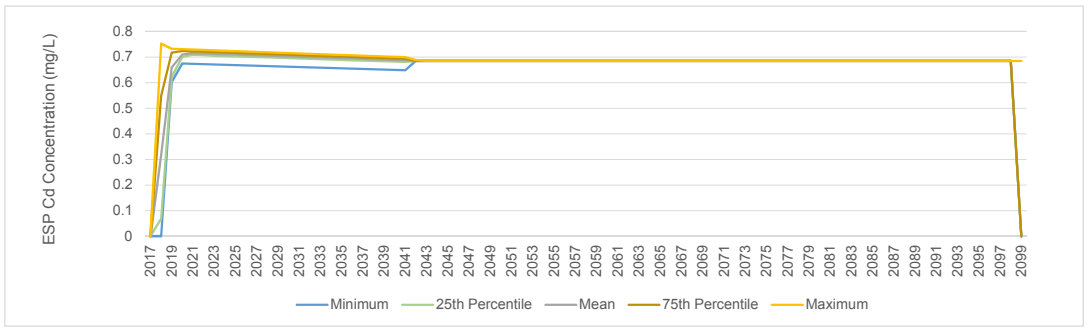

SESP Ca Concentration (mg/L)
200
180
160
140
120
100
80
60
40
20
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

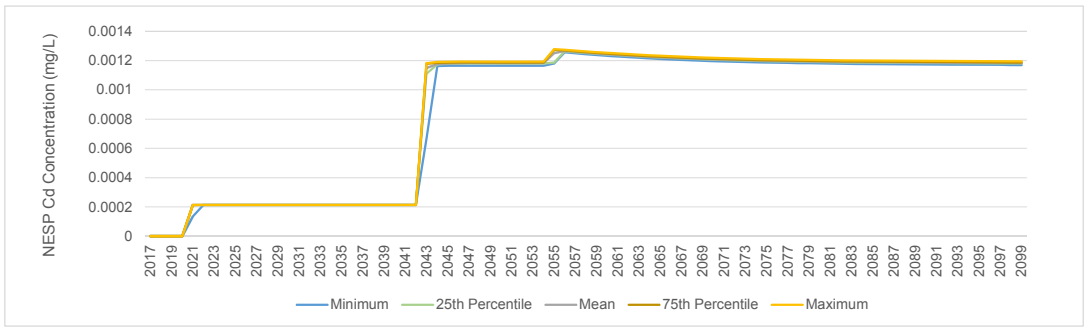

SWSP Ca Concentration (mg/L)
20
18
16
14
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

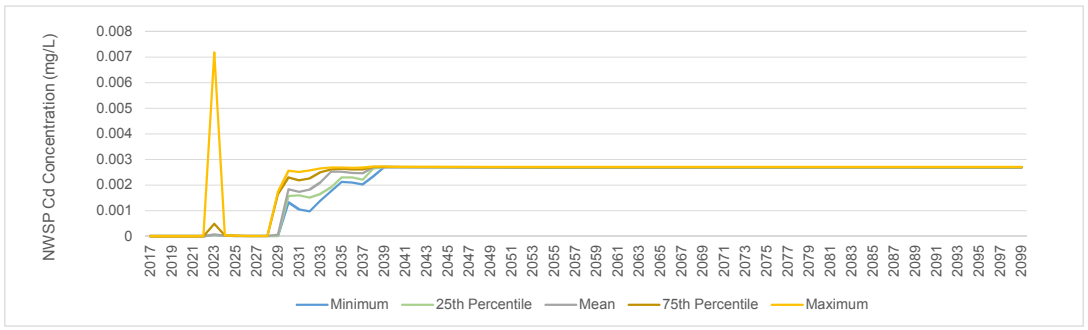

WSP Ca Concentration (mg/L)
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

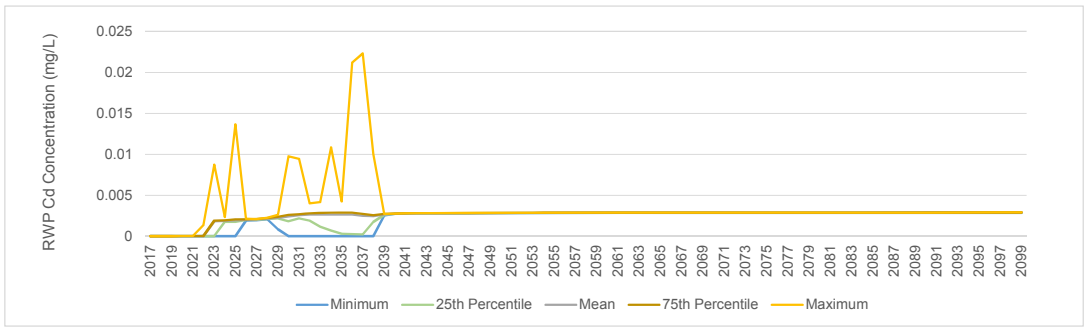

SZ1 Ca Concentration (mg/L)
400
350
300
250
200
150
100
50
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

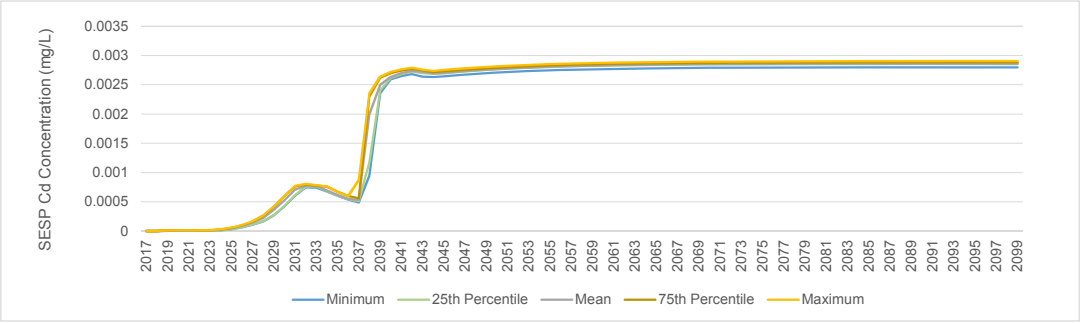

PitLake Cd Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

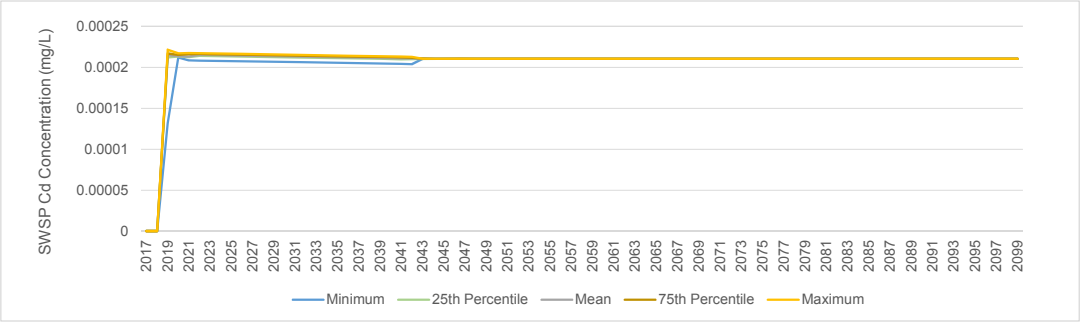

ESP Cd Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

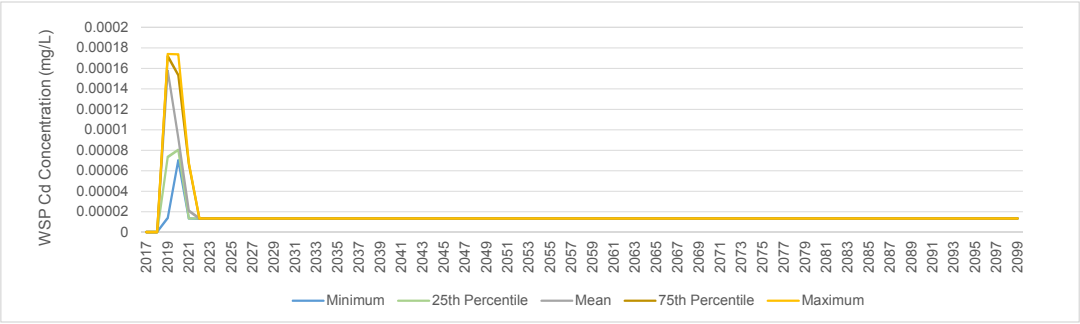

NESP Cd Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

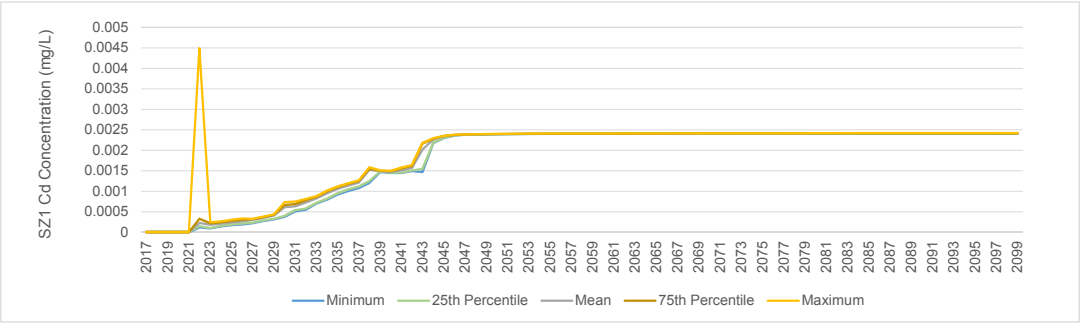

NWSP Cd Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

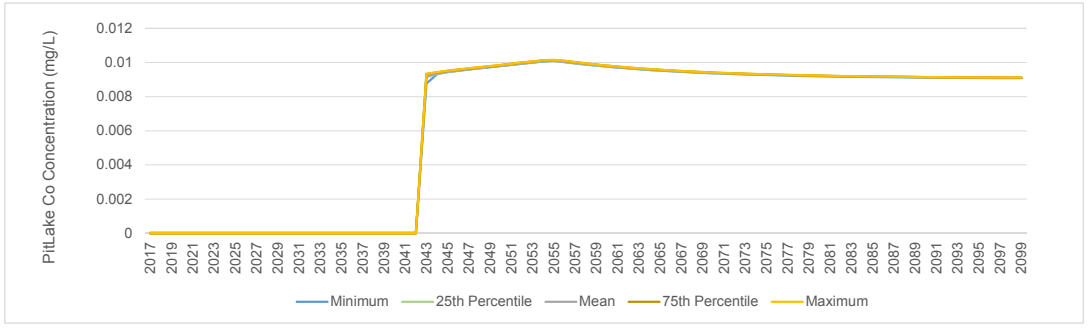

RWP Cd Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

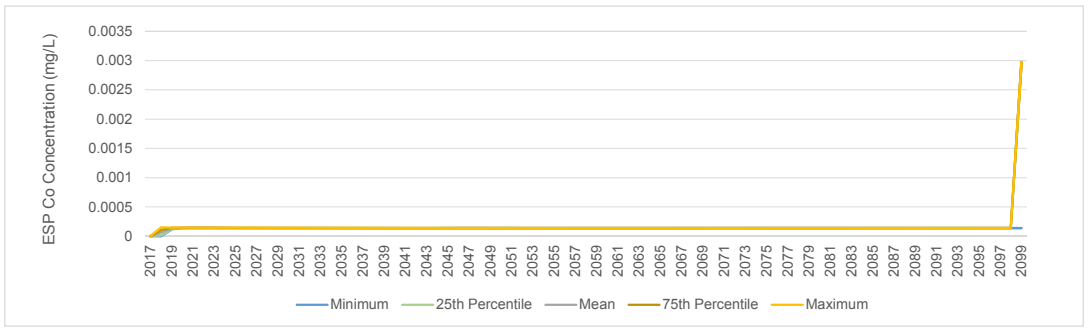

SESP Cd Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

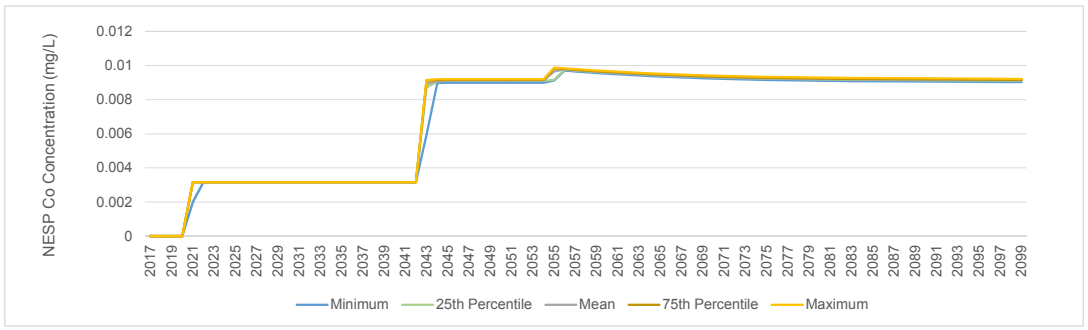

SWSP Cd Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

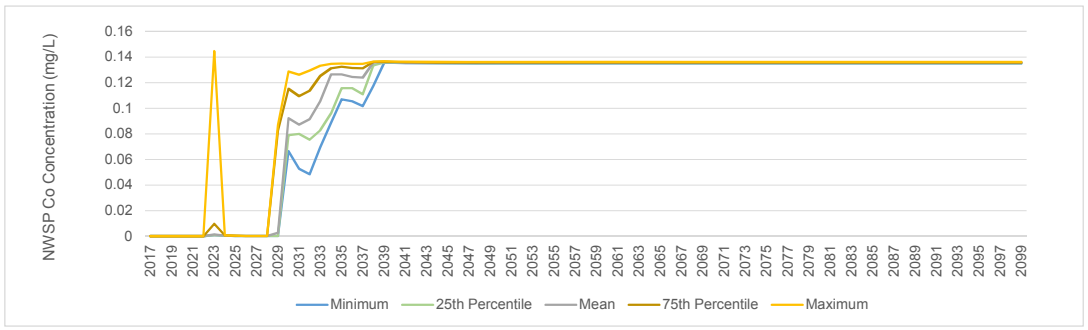

WSP Cd Concentration (mg/L)
0.0002
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

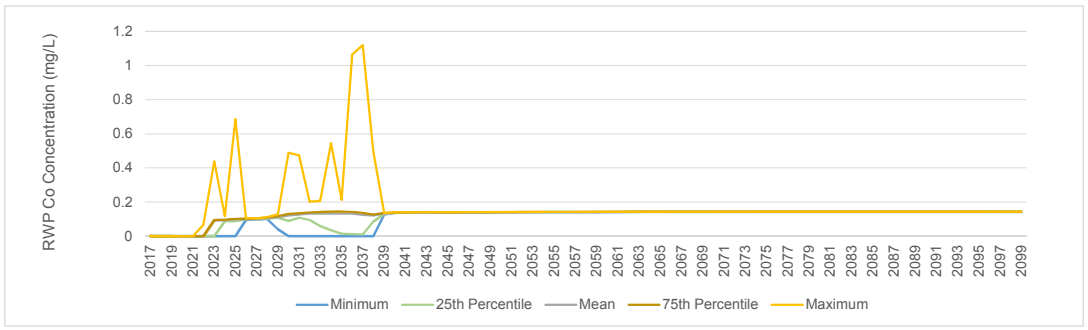

SZ1 Cd Concentration (mg/L)
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

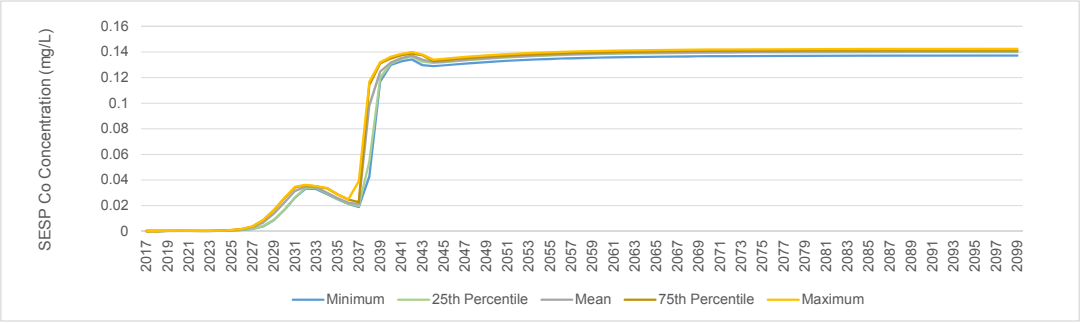

PitLake Co Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

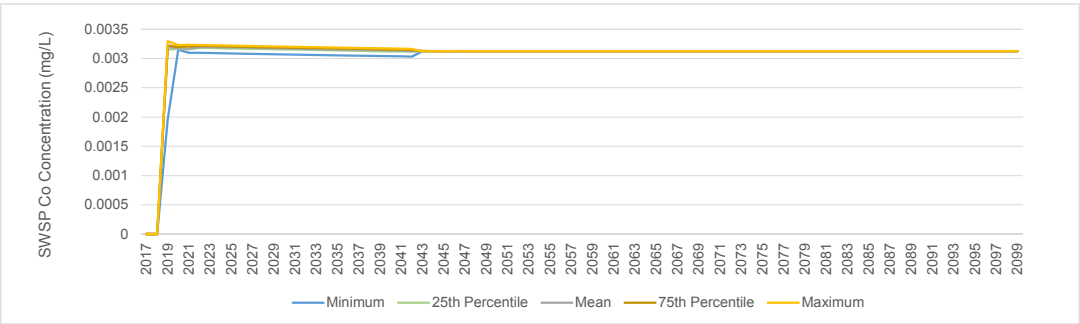

ESP Co Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

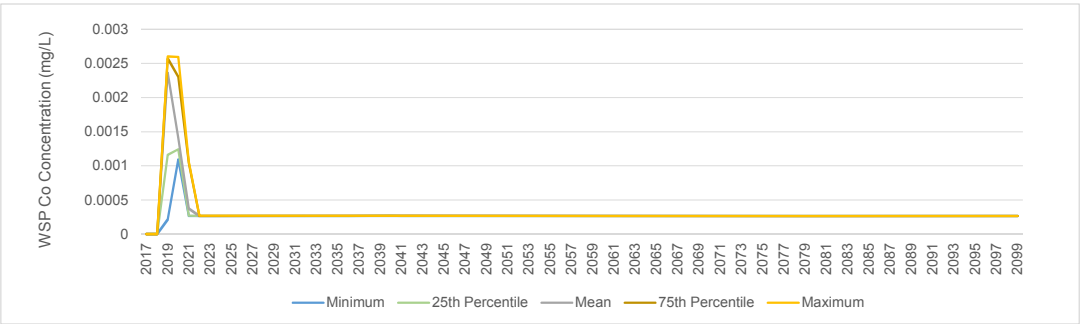

NESP Co Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

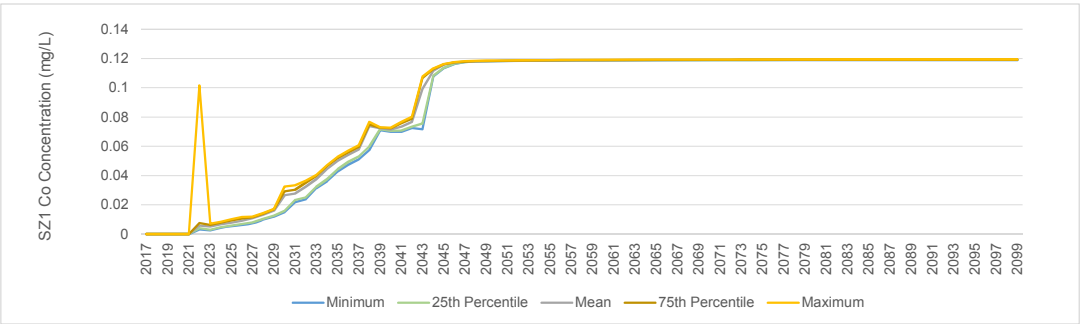

NWSP Co Concentration (mg/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

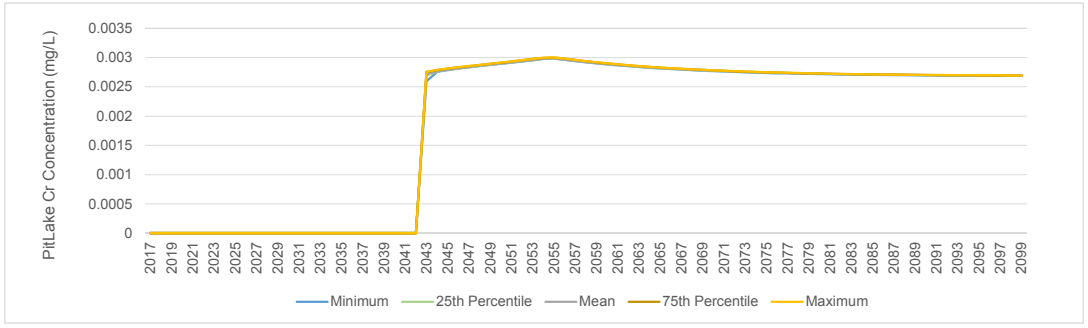

RWP Co Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

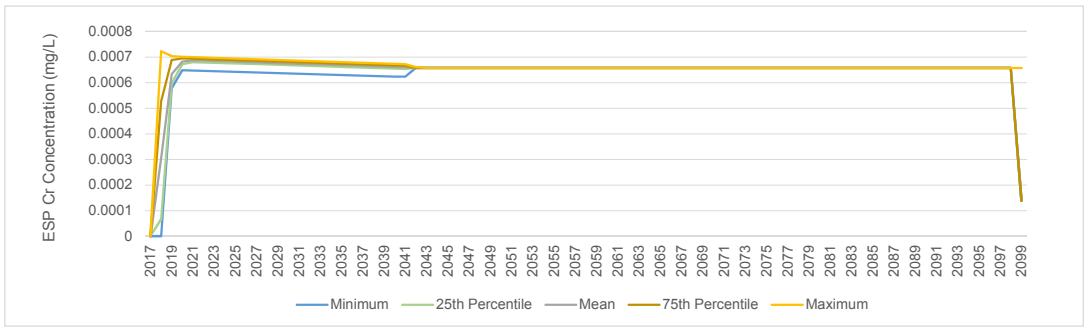

SESP Co Concentration (mg/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

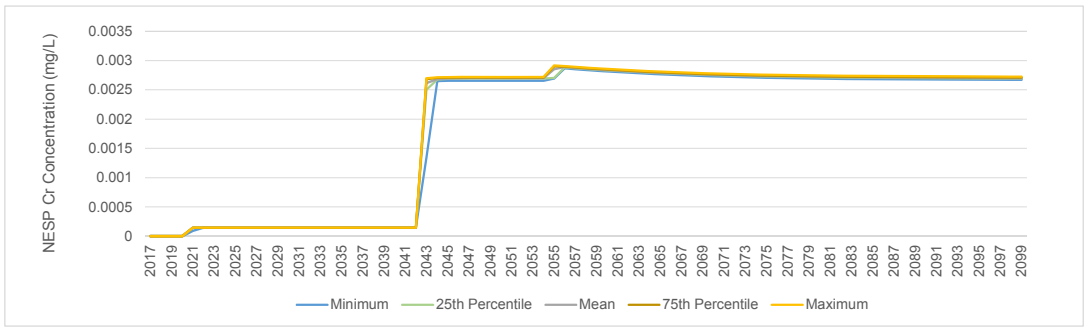

SWSP Co Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

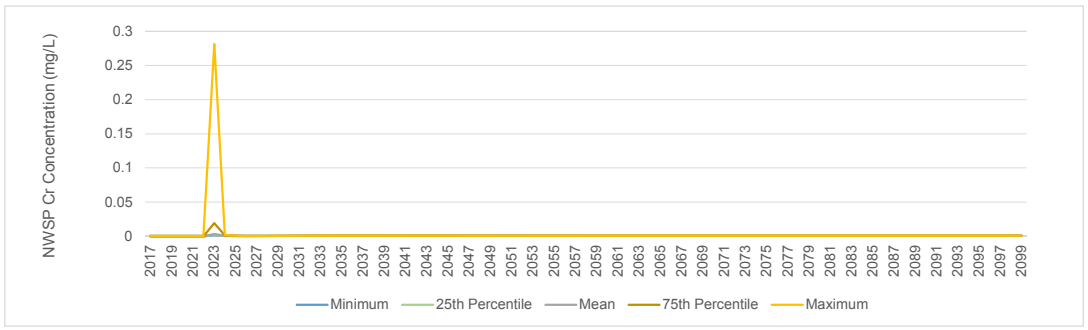

WSP Co Concentration (mg/L)
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

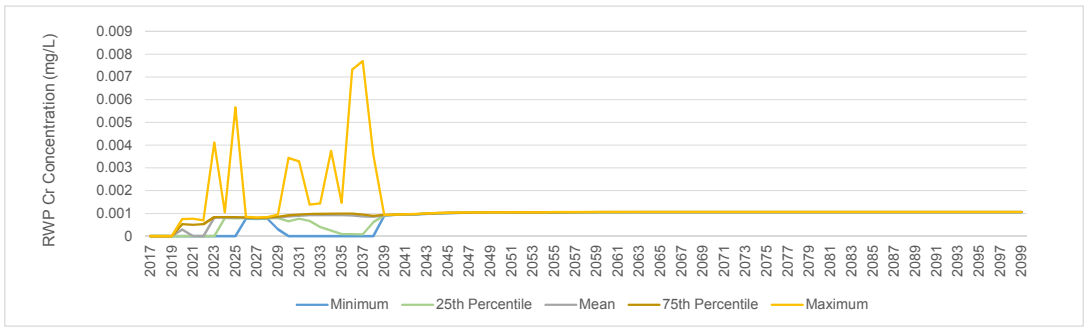

SZ1 Co Concentration (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

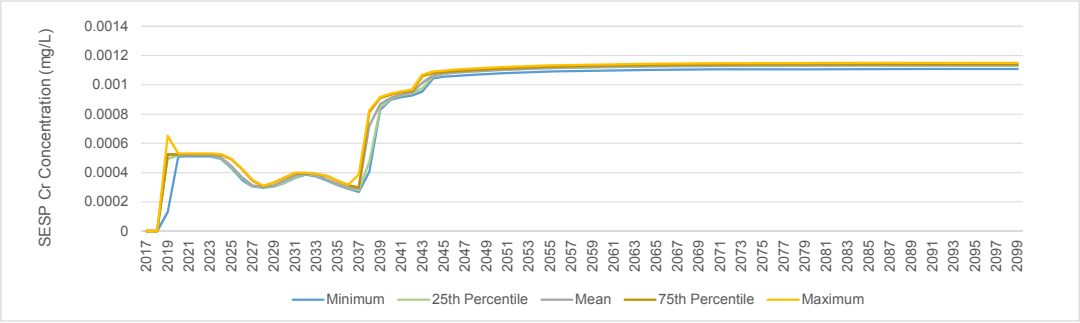

PitLake Cr Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

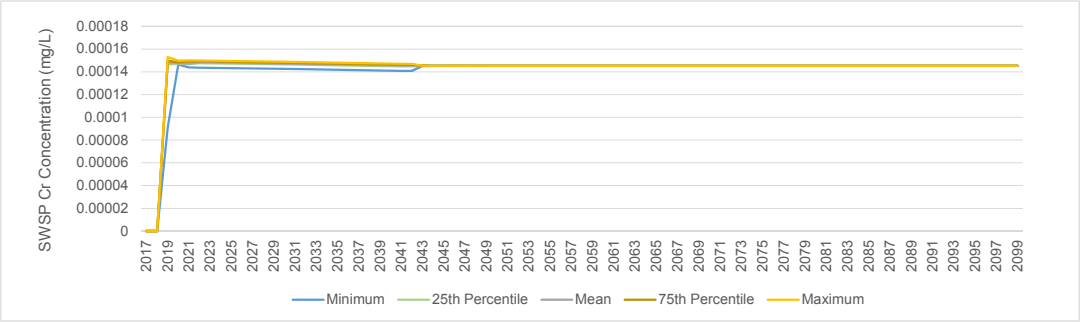

ESP Cr Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

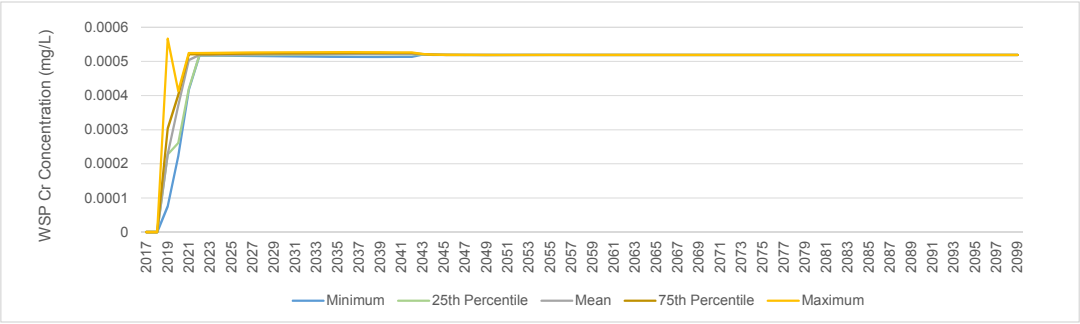

NESP Cr Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

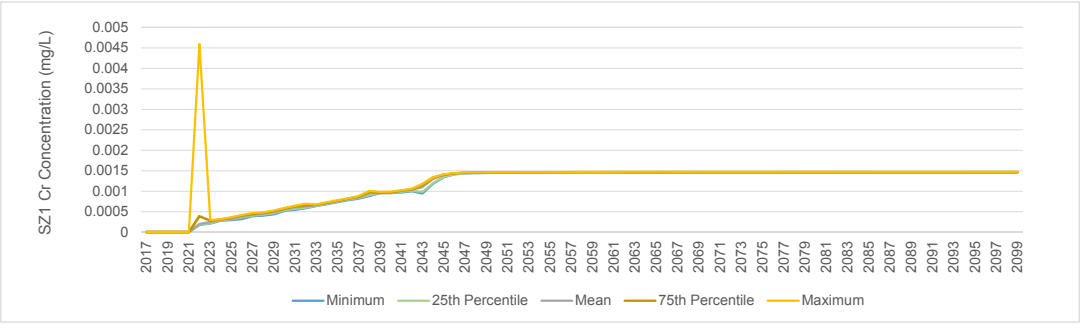

NWSP Cr Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

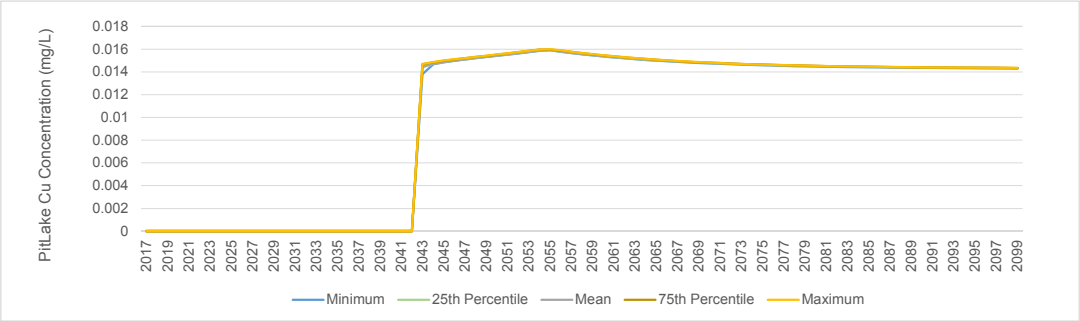

RWP Cr Concentration (mg/L)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

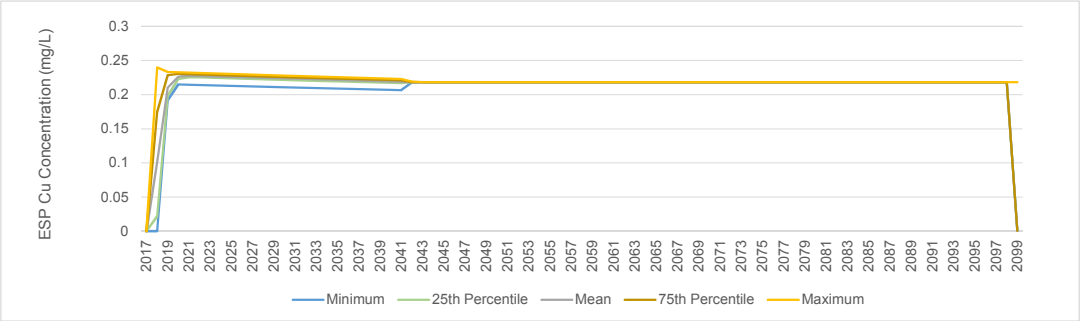

SESP Cr Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

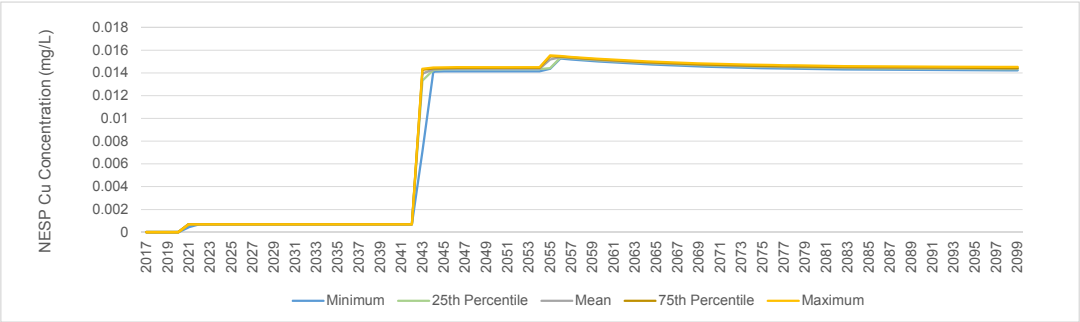

SWSP Cr Concentration (mg/L)
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

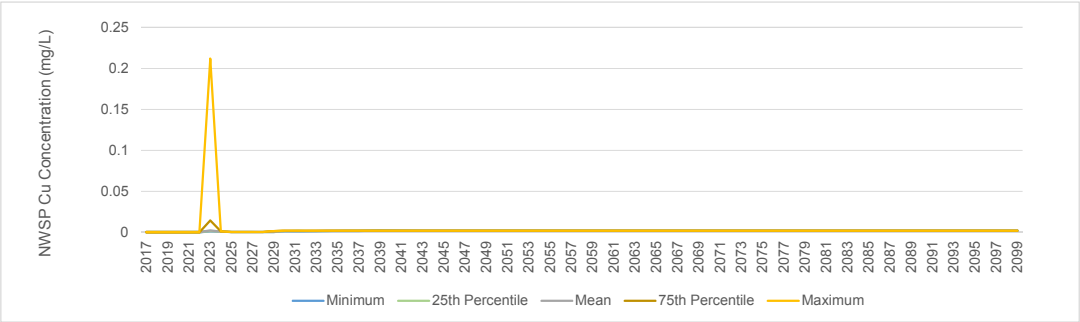

WSP Cr Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

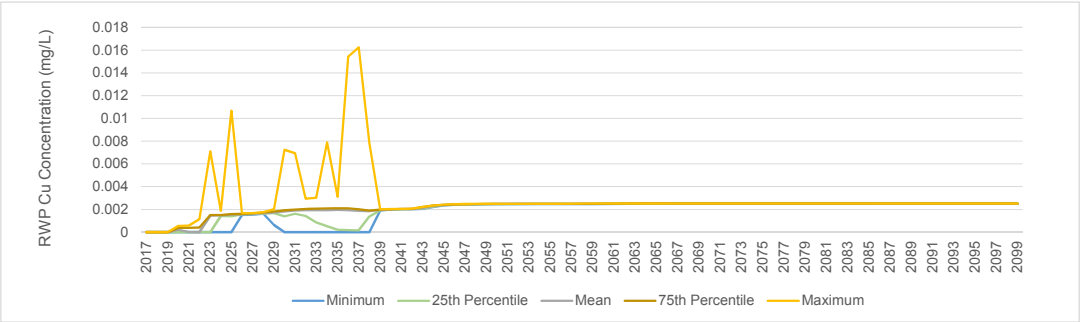

SZ1 Cr Concentration (mg/L)
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

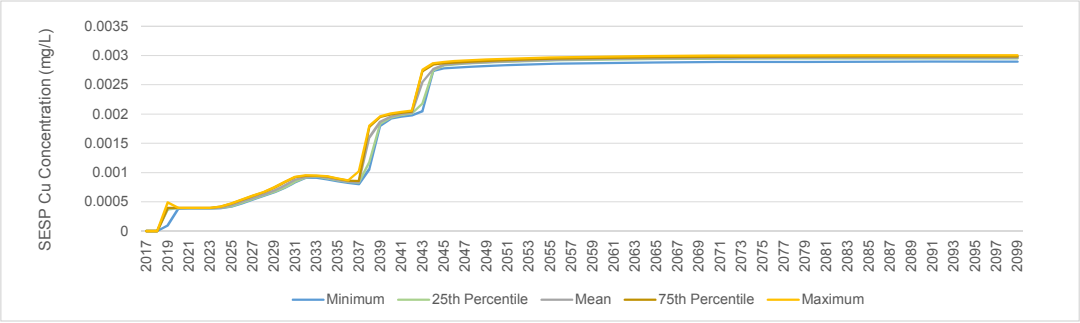

PitLake Cu Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

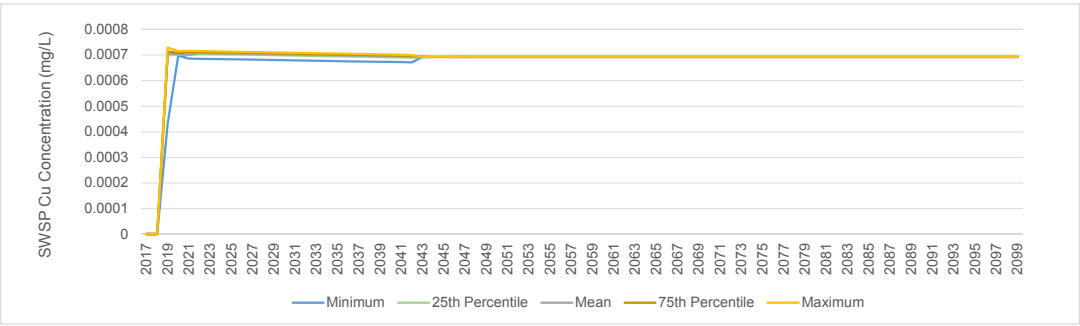

ESP Cu Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

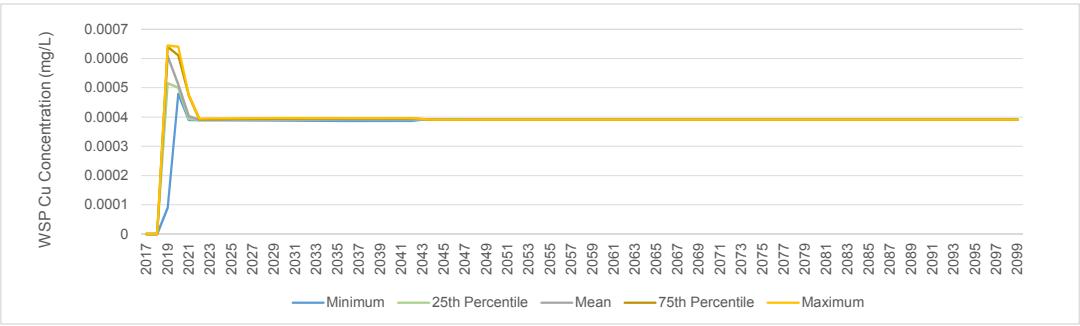

NESP Cu Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

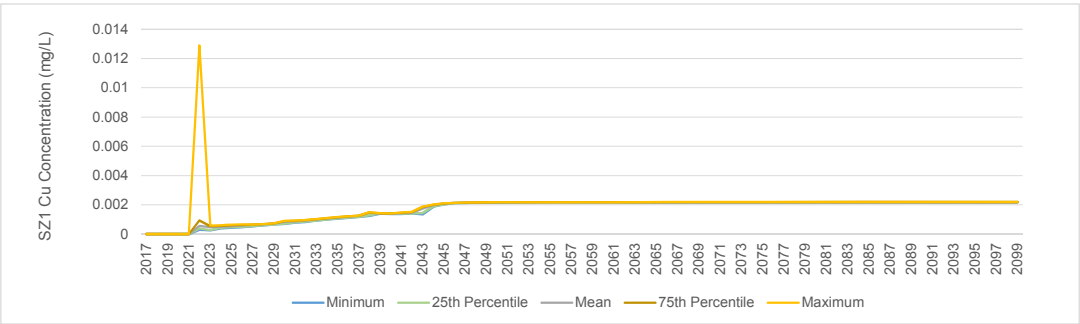

NWSP Cu Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

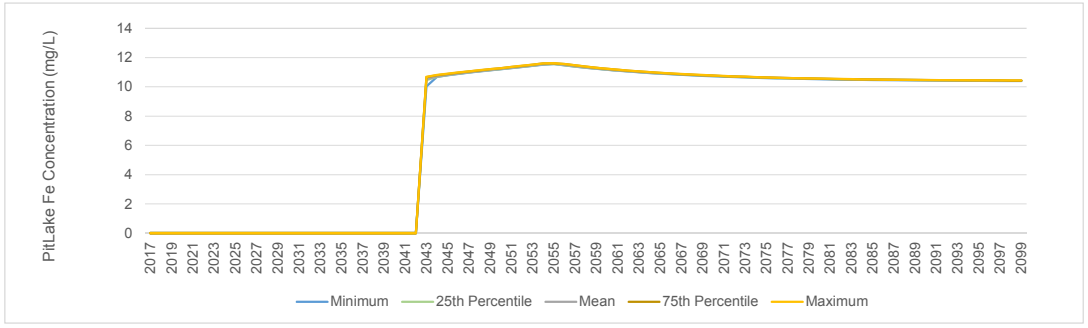

RWP Cu Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

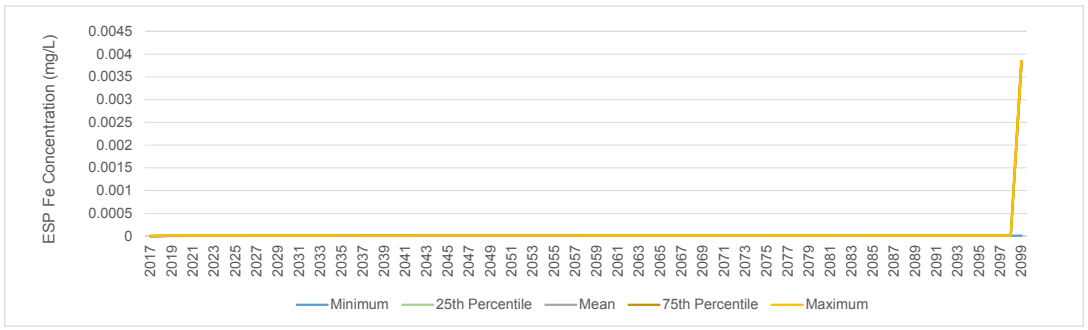

SESP Cu Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

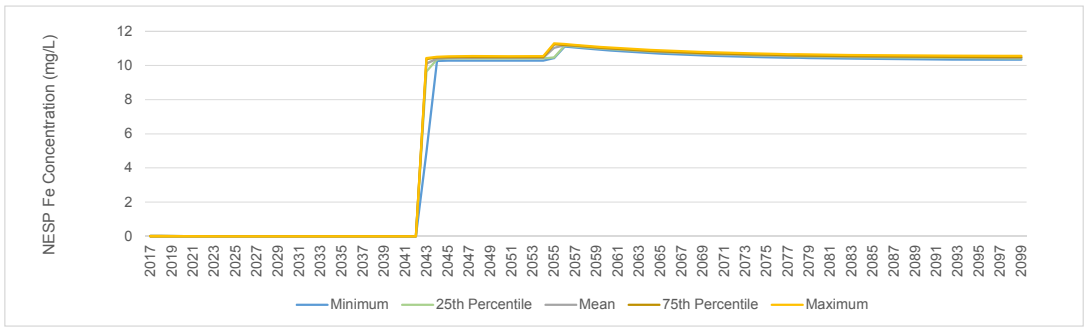

SWSP Cu Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

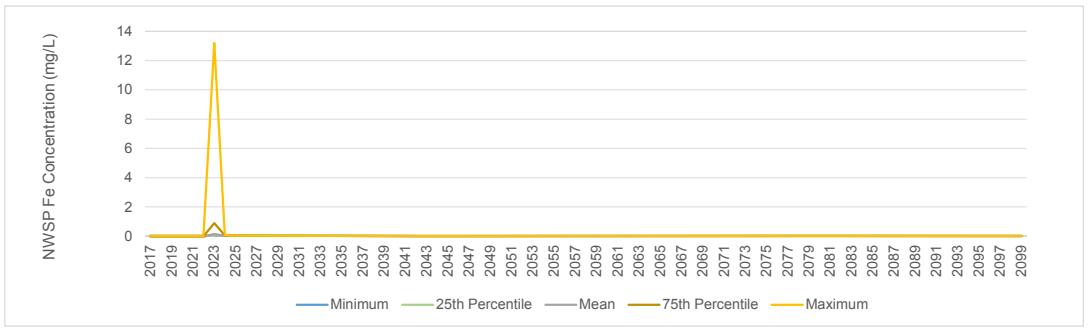

WSP Cu Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

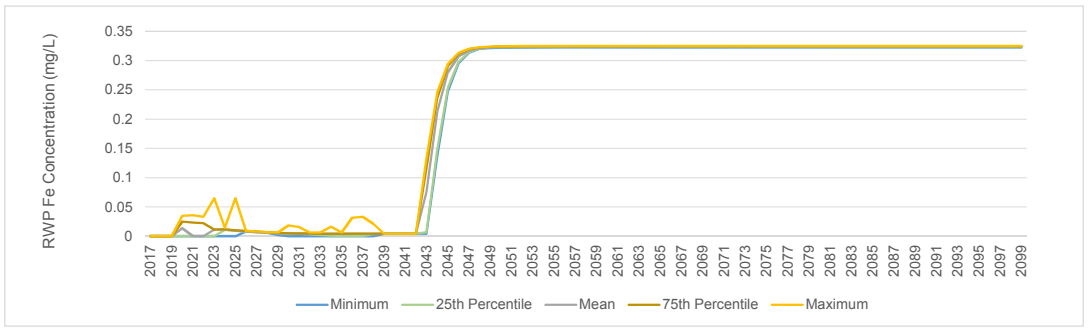

SZ1 Cu Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

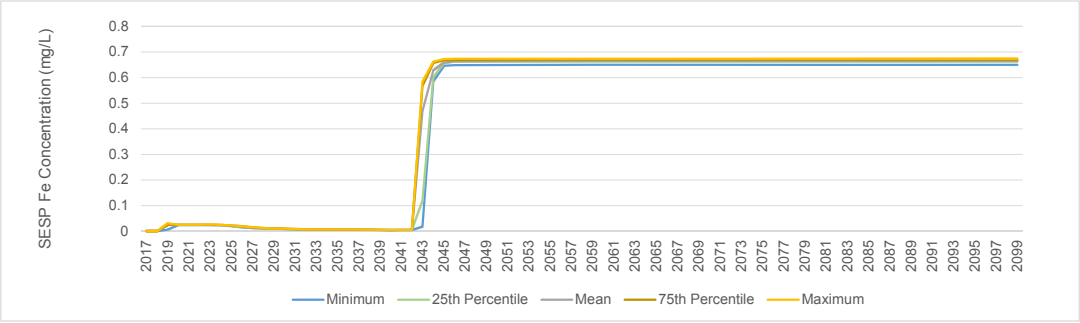

PitLake Fe Concentration (mg/L)
14
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

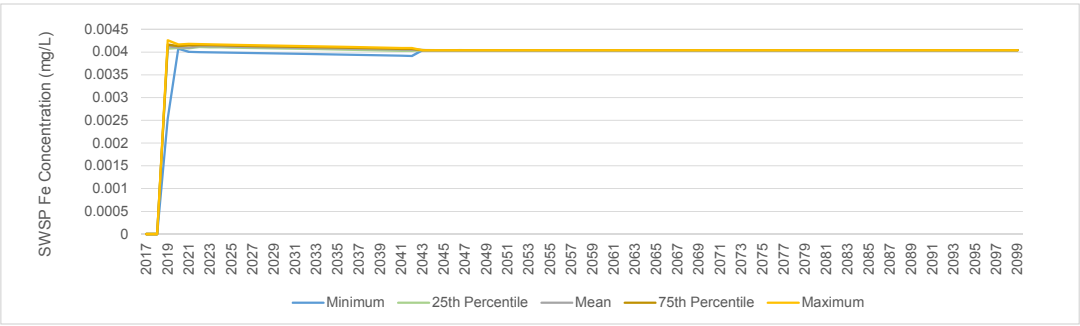

ESP Fe Concentration (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

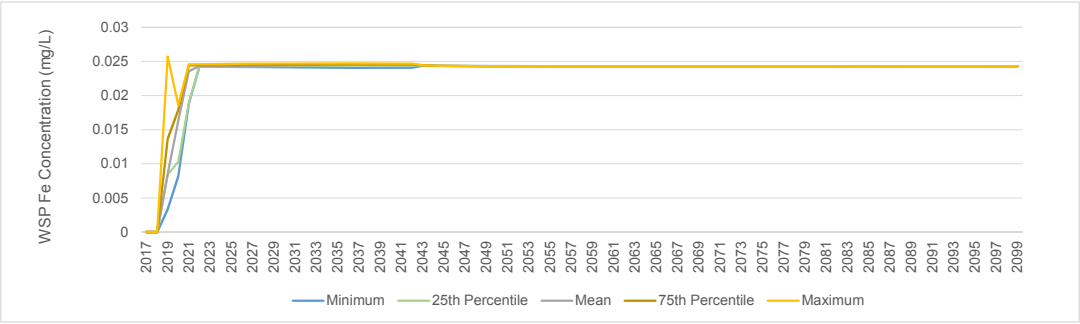

NESP Fe Concentration (mg/L)
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

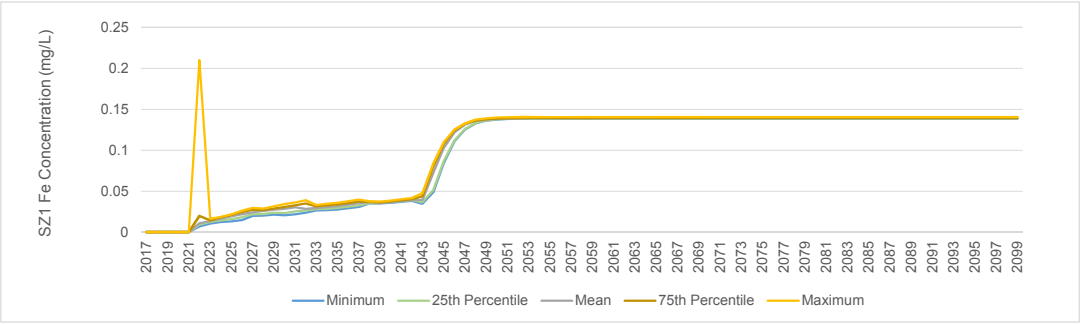

NWSP Fe Concentration (mg/L)
14
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

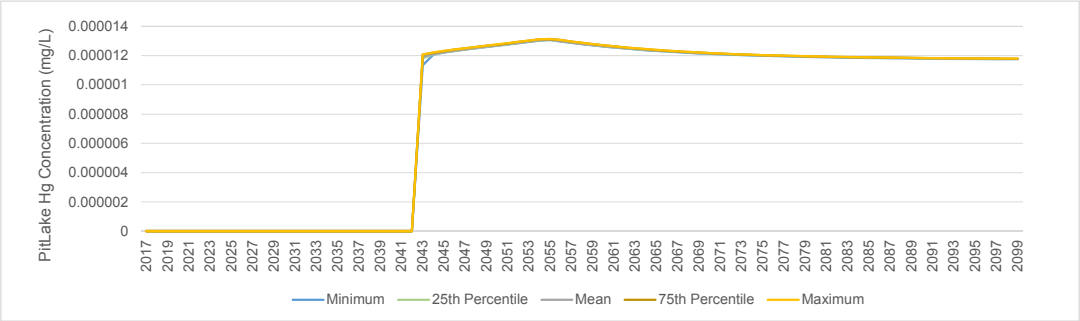

RWP Fe Concentration (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

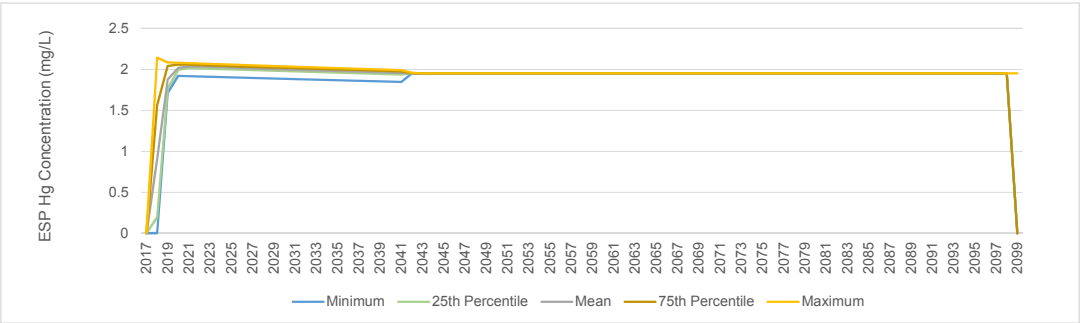

SESP Fe Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

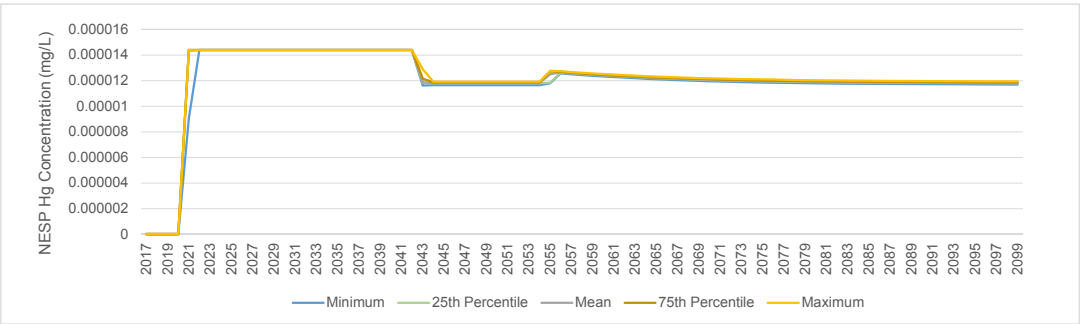

SWSP Fe Concentration (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

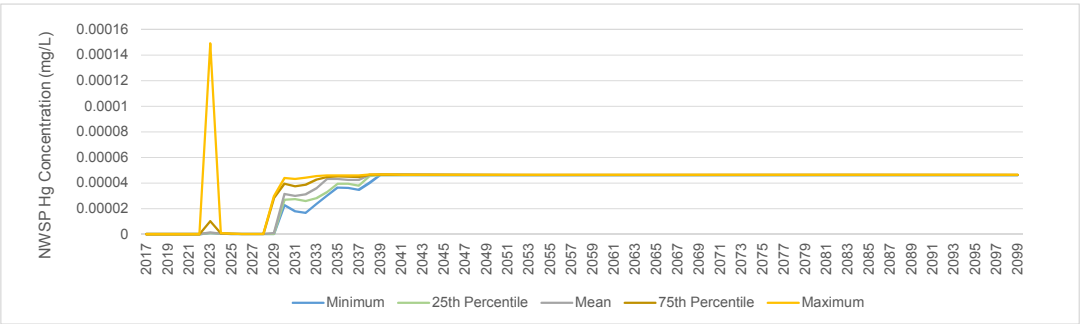

WSP Fe Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

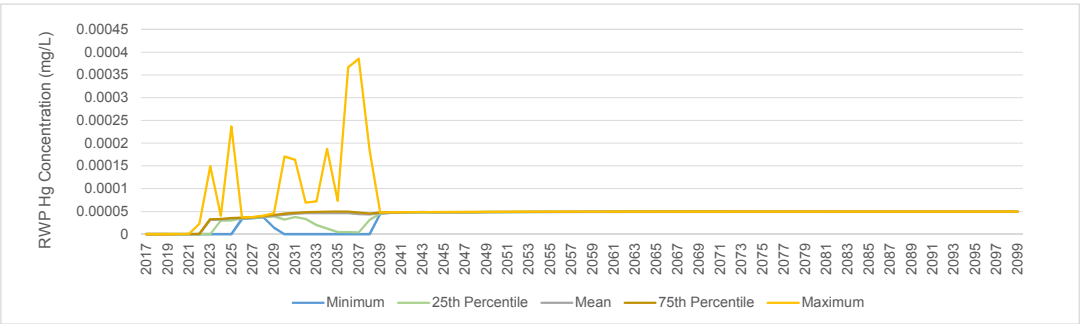

SZ1 Fe Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

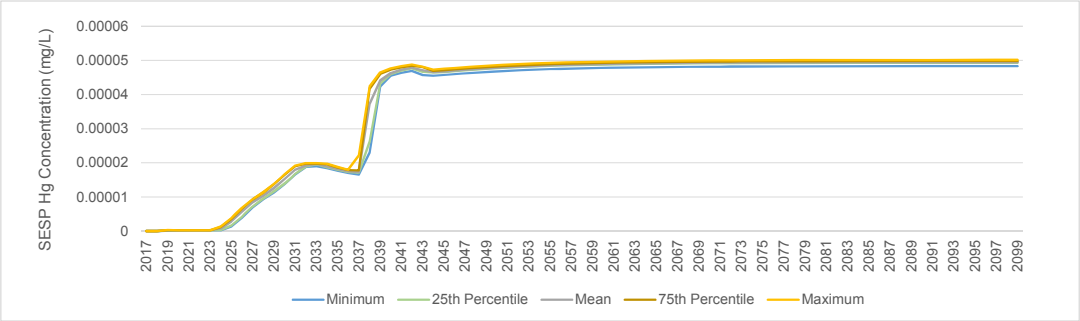

PitLake Hg Concentration (mg/L)
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

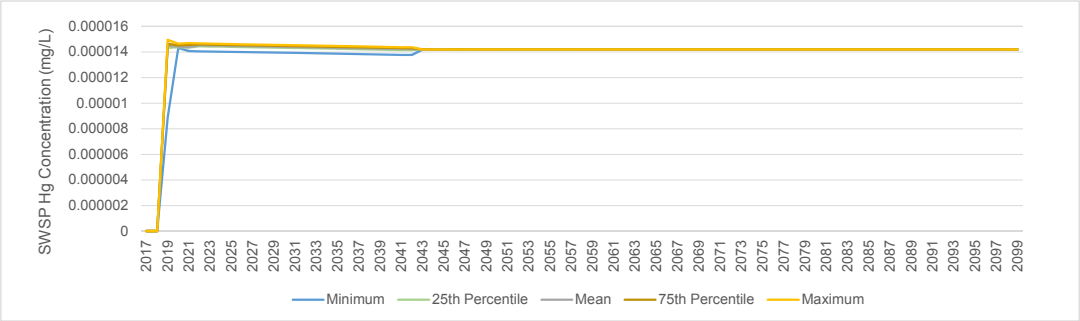

ESP Hg Concentration (mg/L)
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

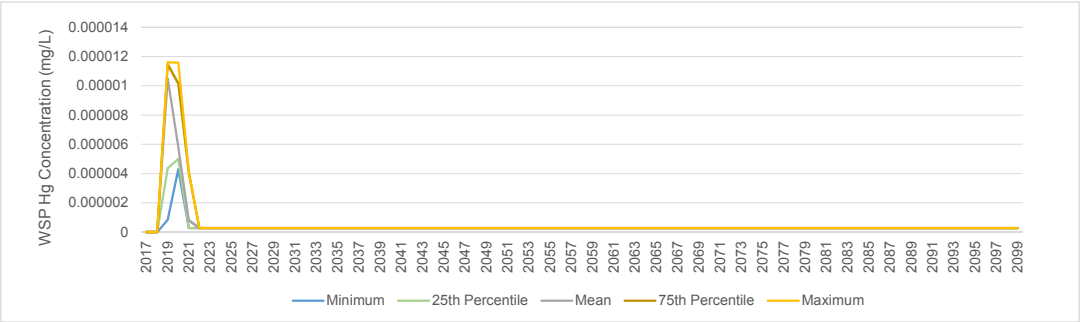

NESP Hg Concentration (mg/L)
0.000016
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

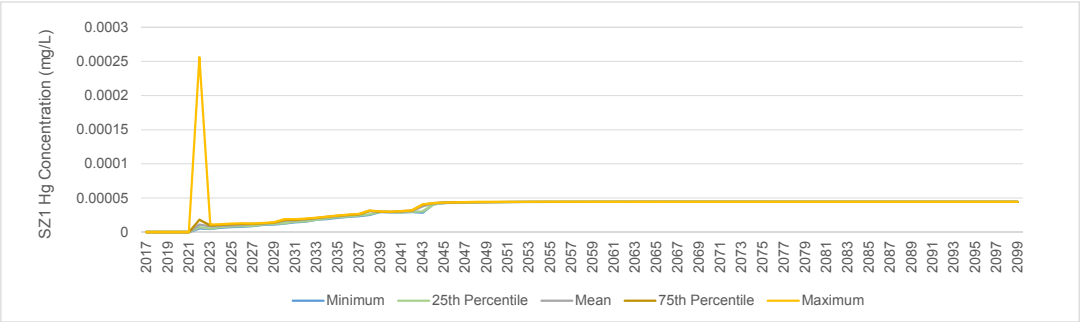

NWSP Hg Concentration (mg/L)
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

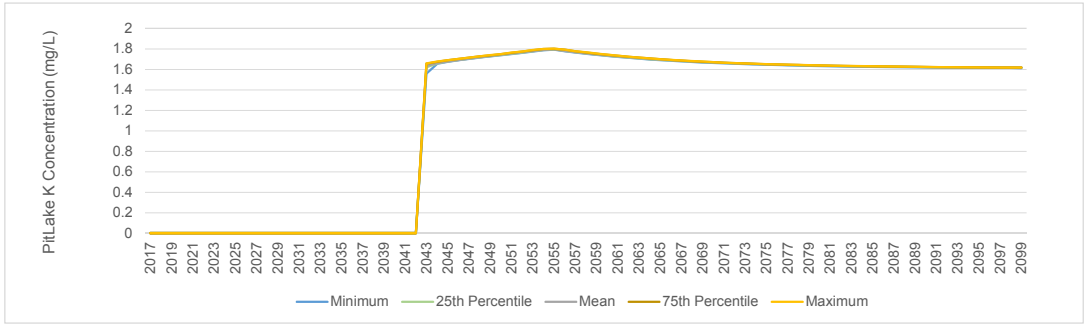

RWP Hg Concentration (mg/L)
0.00045
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

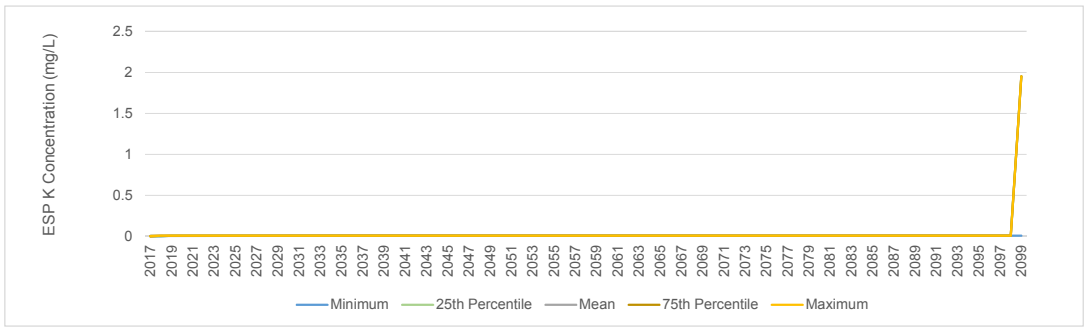

SESP Hg Concentration (mg/L)
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

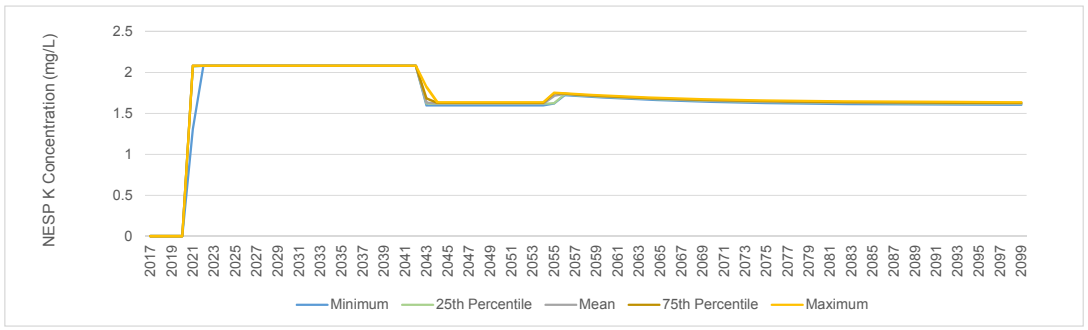

SWSP Hg Concentration (mg/L)
0.000016
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

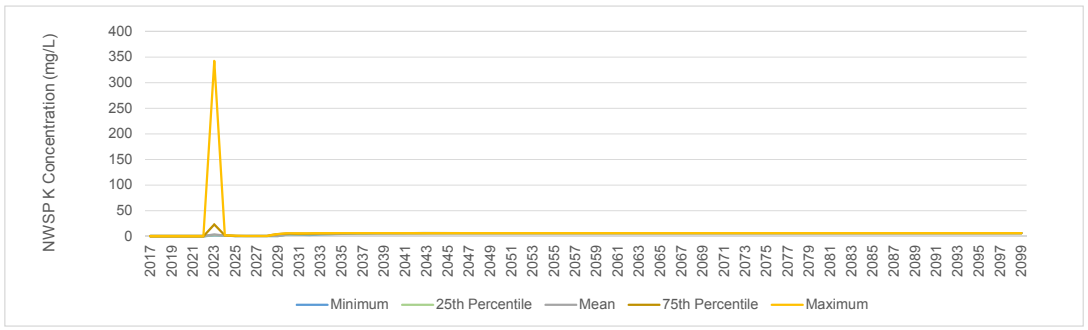

WSP Hg Concentration (mg/L)
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

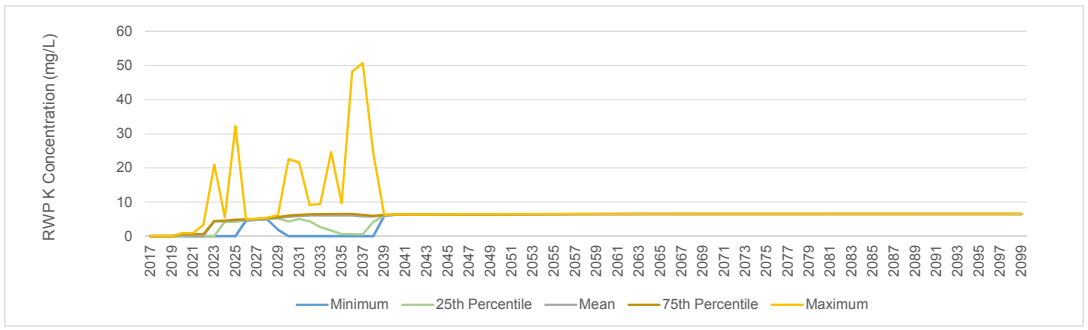

SZ1 Hg Concentration (mg/L)
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

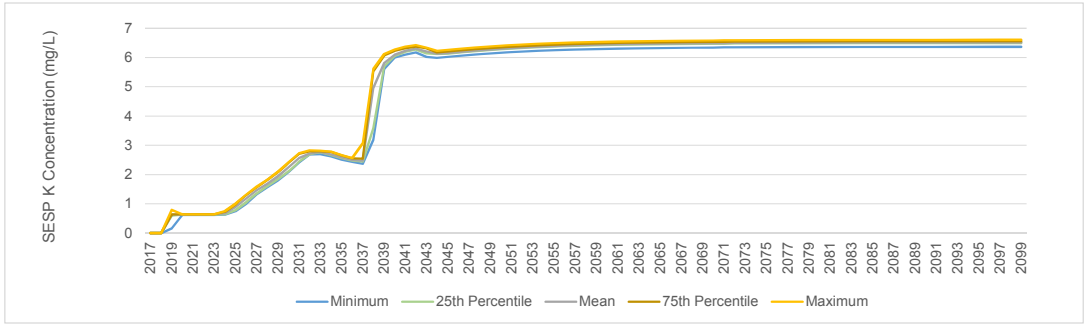

PitLake K Concentration (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

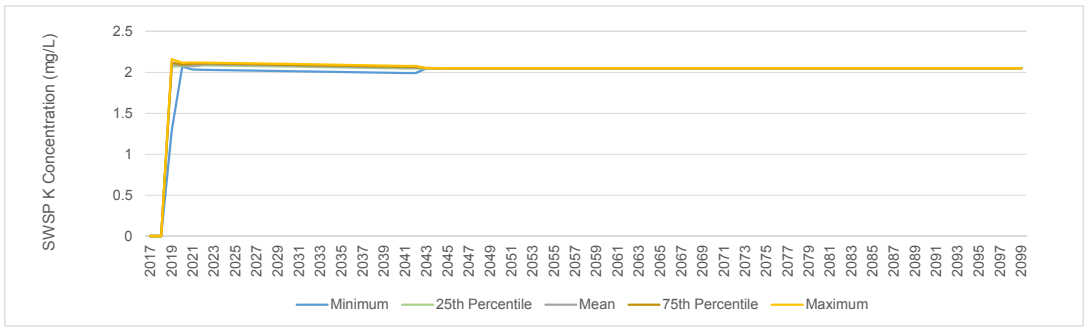

ESP K Concentration (mg/L)
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

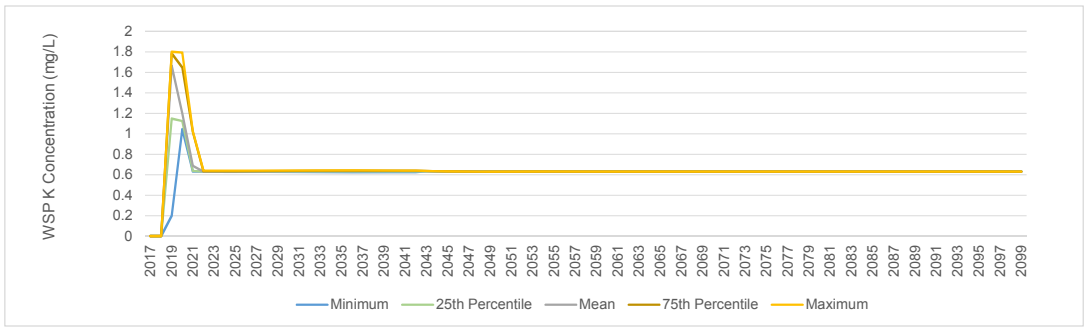

NESP K Concentration (mg/L)
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

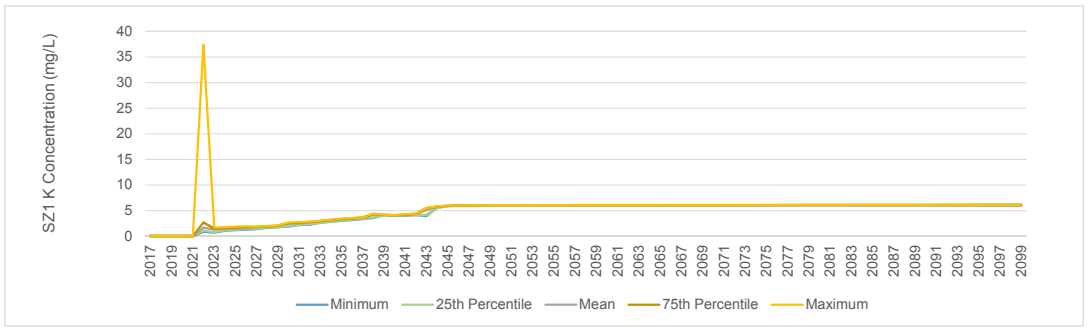

NWSP K Concentration (mg/L)
400
350
300
250
200
150
100
50
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

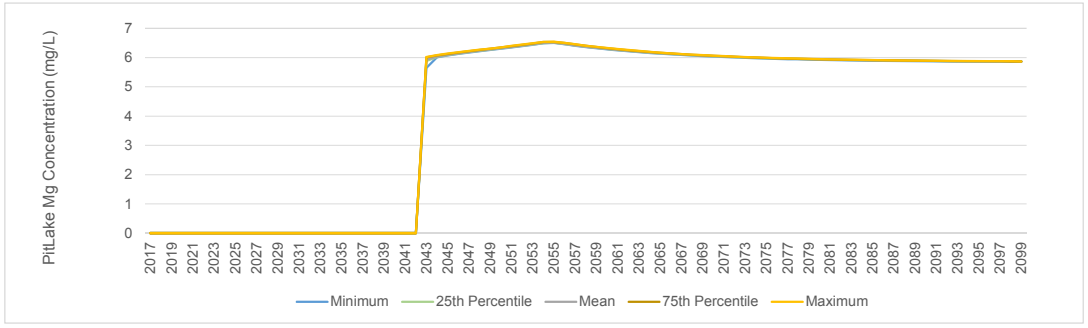

RWP K Concentration (mg/L)
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

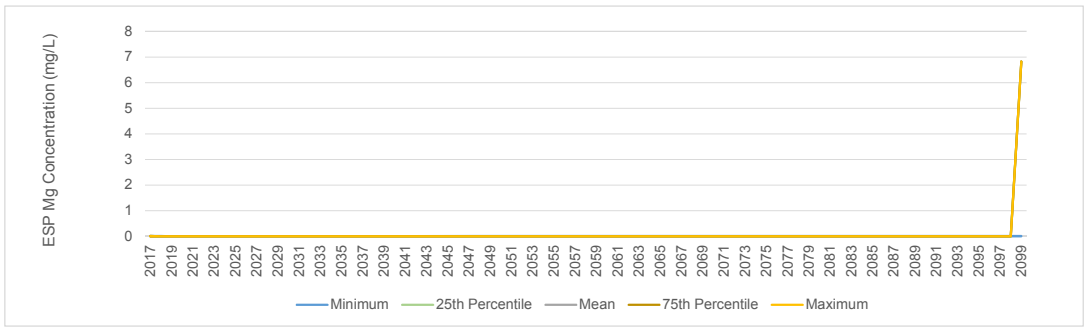

SESP K Concentration (mg/L)
0
1
2
3
4
5
6
7
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

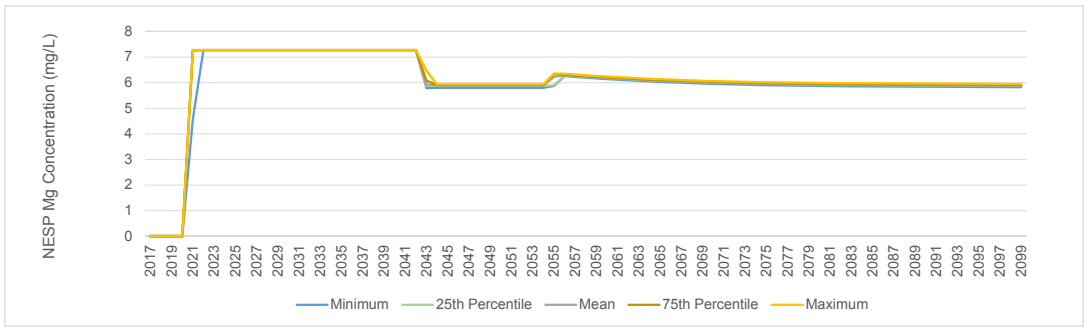

SWSP K Concentration (mg/L)
0
0.5
1
1.5
2
2.5
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

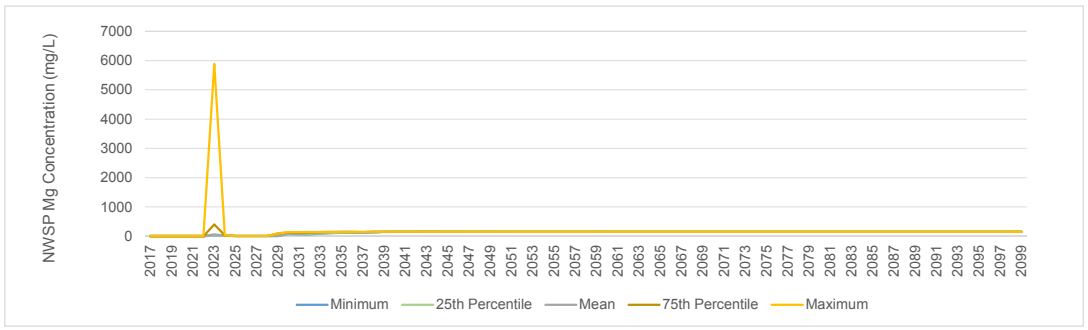

WSP K Concentration (mg/L)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

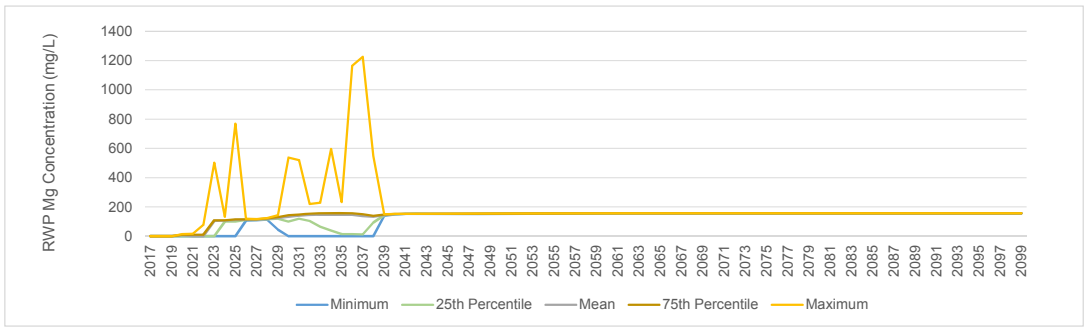

SZ1 K Concentration (mg/L)
0
5
10
15
20
25
30
35
40
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

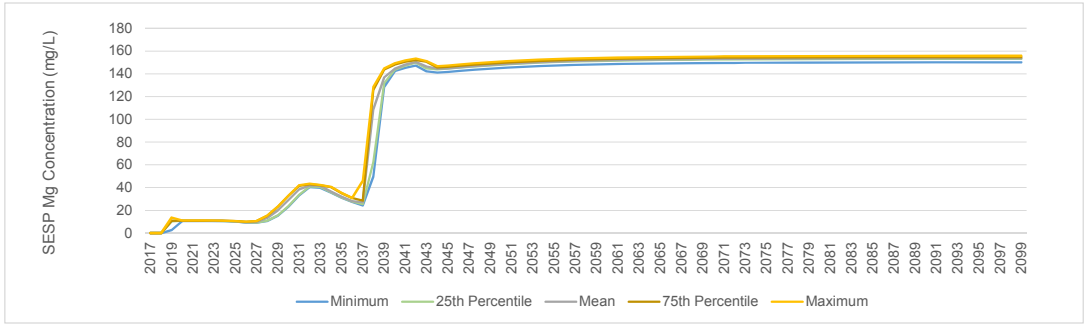

PitLake Mg Concentration (mg/L)
0
1
2
3
4
5
6
7
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

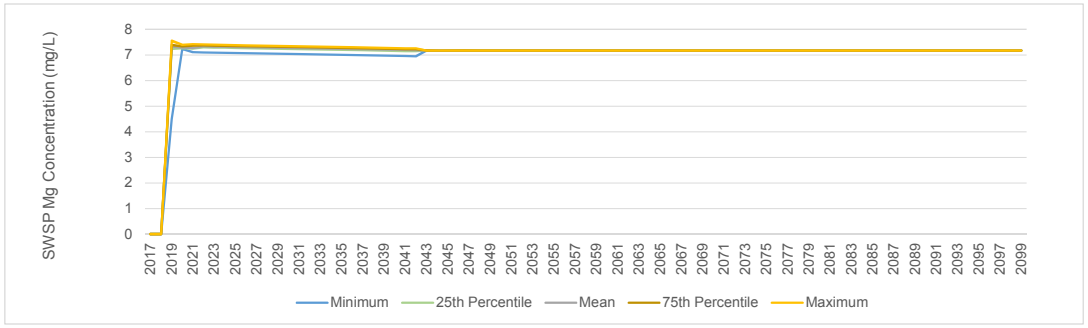

ESP Mg Concentration (mg/L)
0
1
2
3
4
5
6
7
8
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

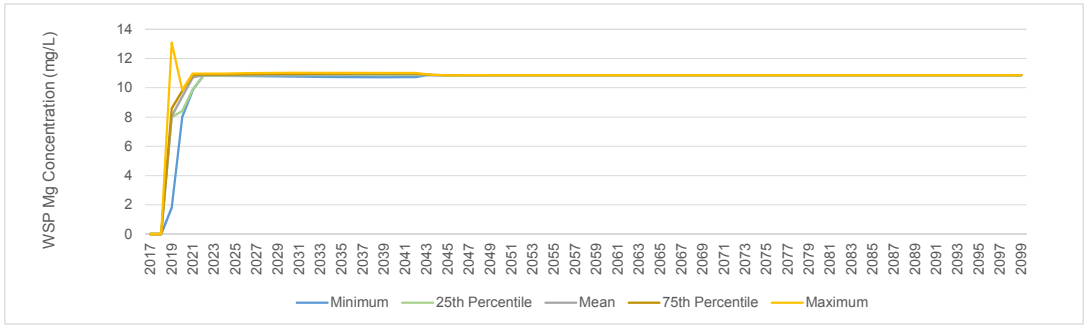

NESP Mg Concentration (mg/L)
0
1
2
3
4
5
6
7
8
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

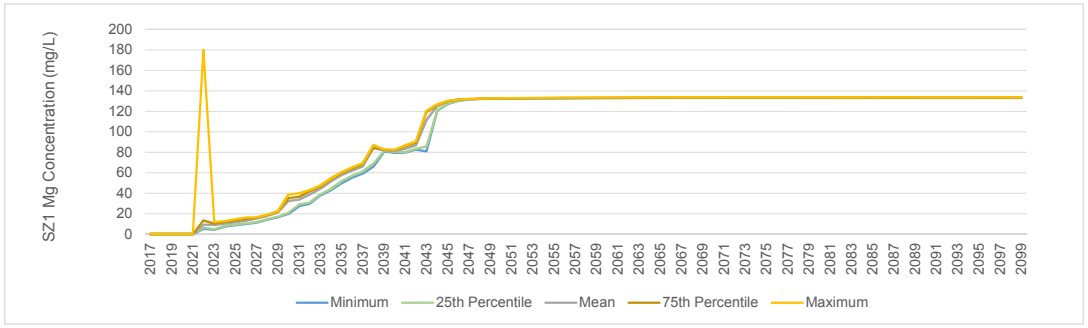

NWSP Mg Concentration (mg/L)
0
1000
2000
3000
4000
5000
6000
7000
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

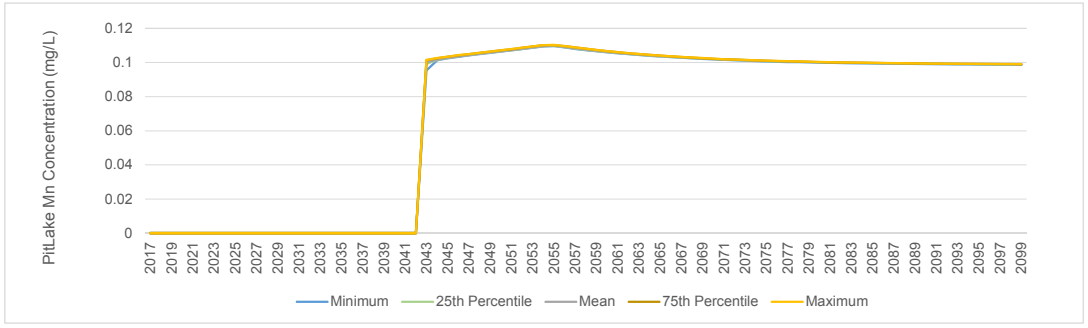

RWP Mg Concentration (mg/L)
0
200
400
600
800
1000
1200
1400
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

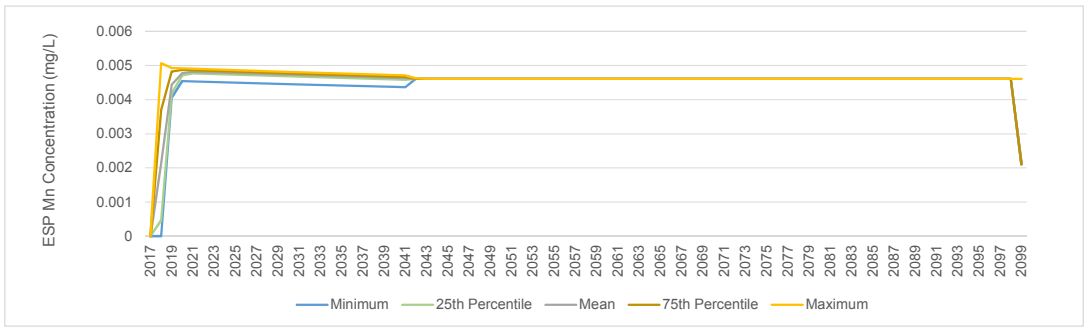

SESP Mg Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

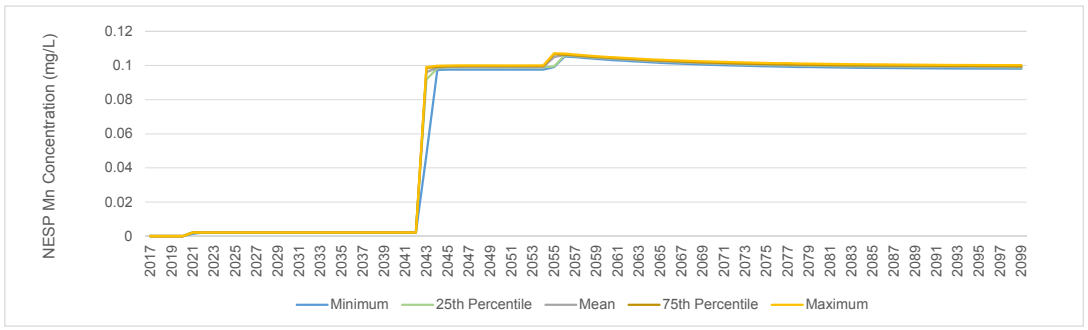

SWSP Mg Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

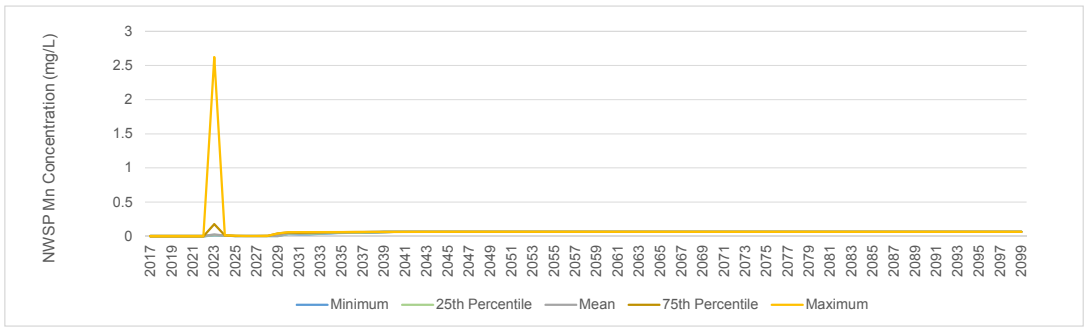

WSP Mg Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

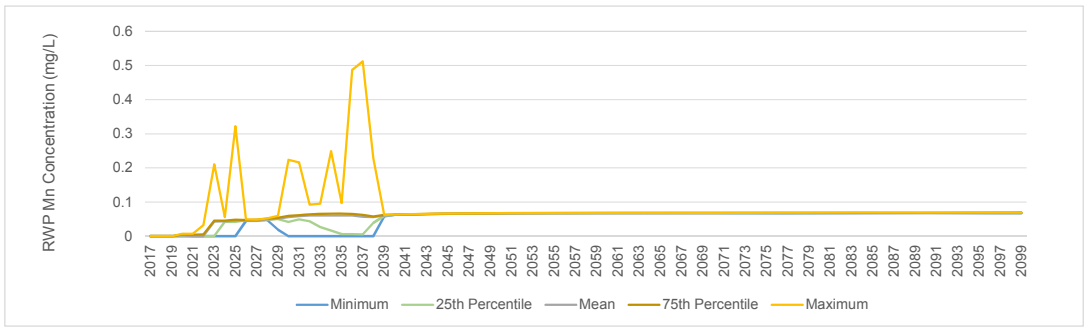

SZ1 Mg Concentration (mg/L)
Minimum
25th Percentile
Mean
75th Percentile
Maximum

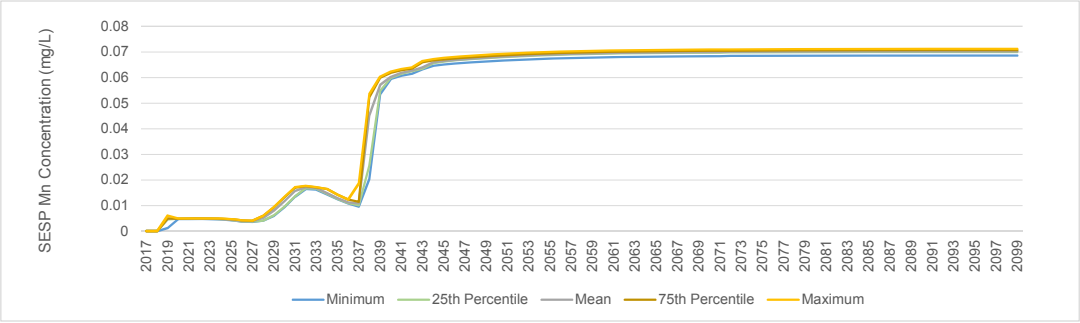

PitLake Mn Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

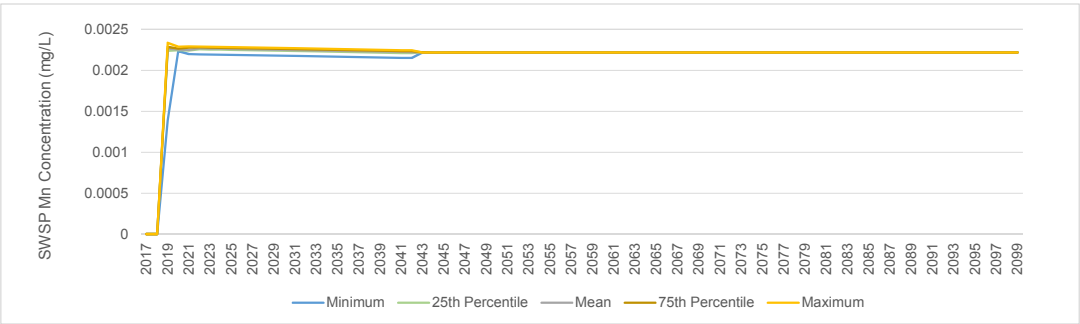

ESP Mn Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

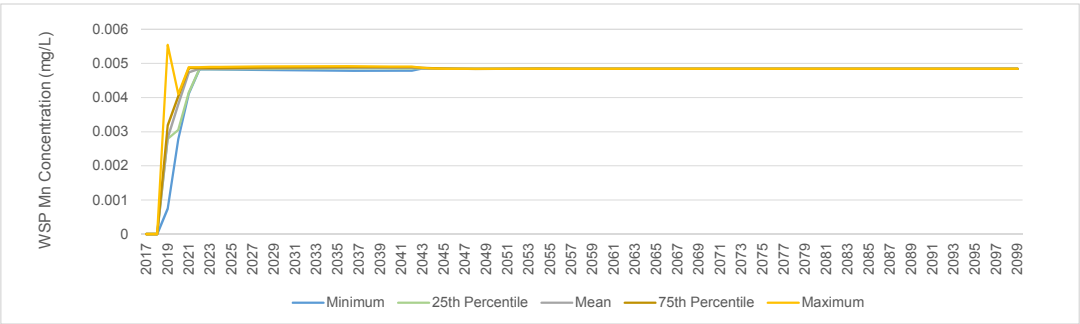

NESP Mn Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

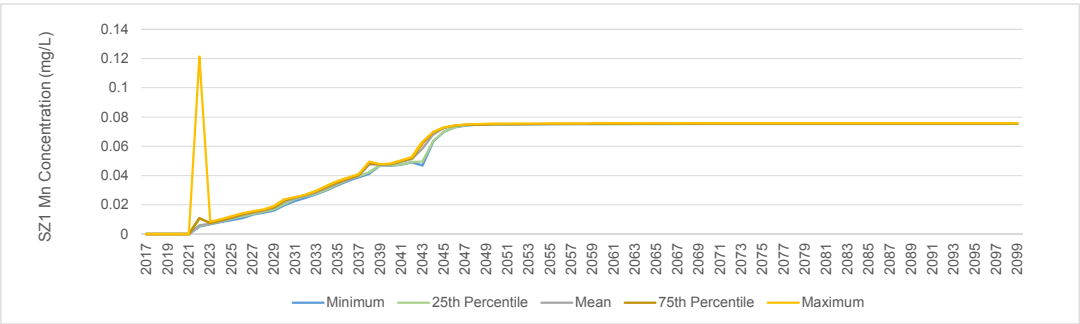

NWSP Mn Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

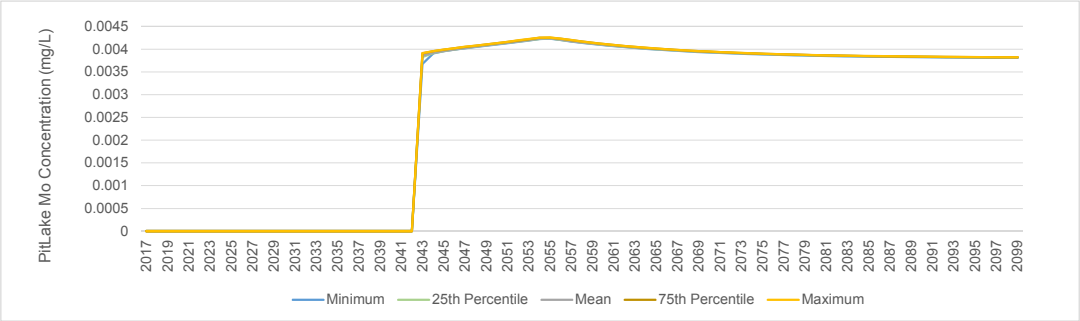

RWP Mn Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

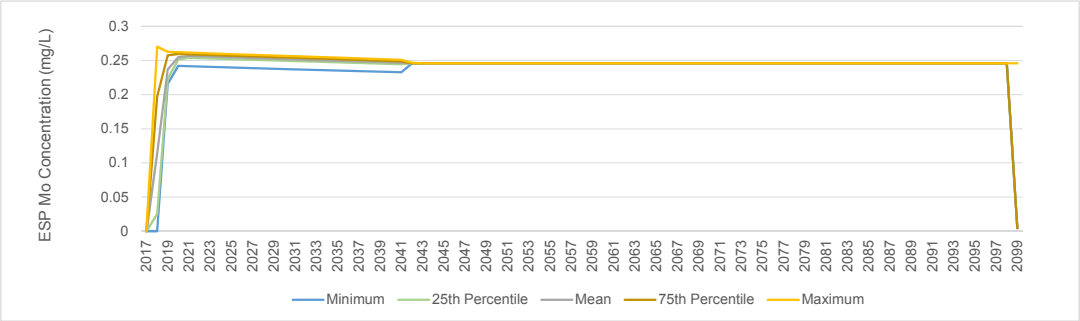

SESP Mn Concentration (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum


SWSP Mn Concentration (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

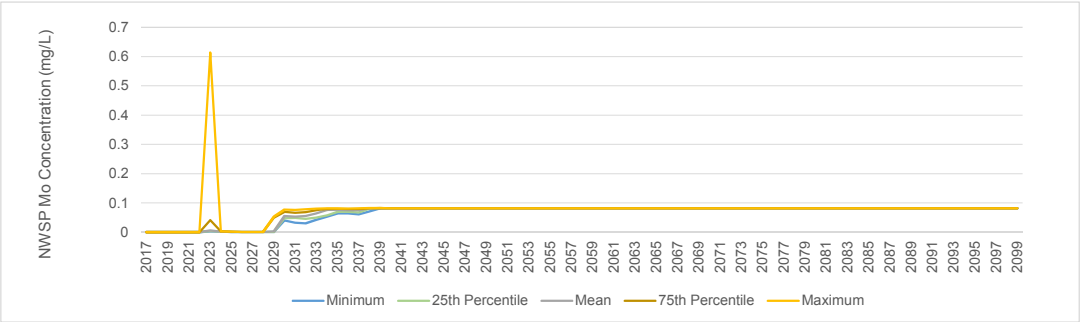

WSP Mn Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

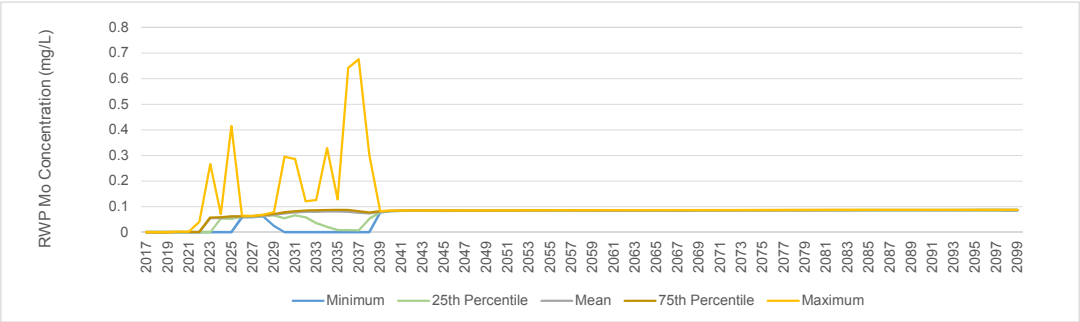

SZ1 Mn Concentration (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

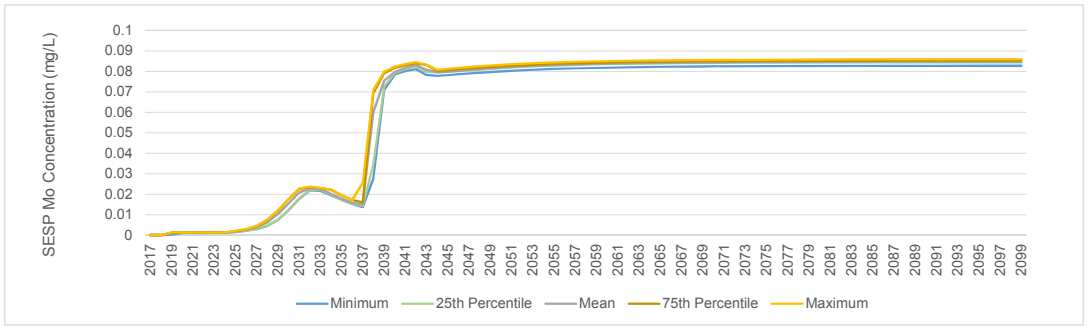

PitLake Mo Concentration (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

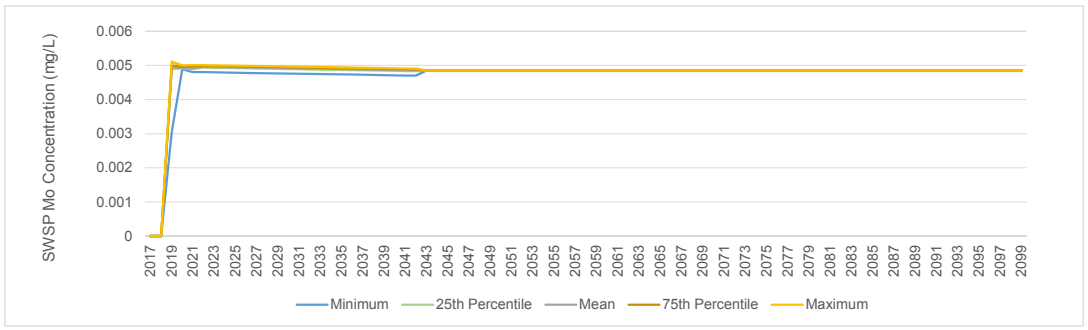

ESP Mo Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

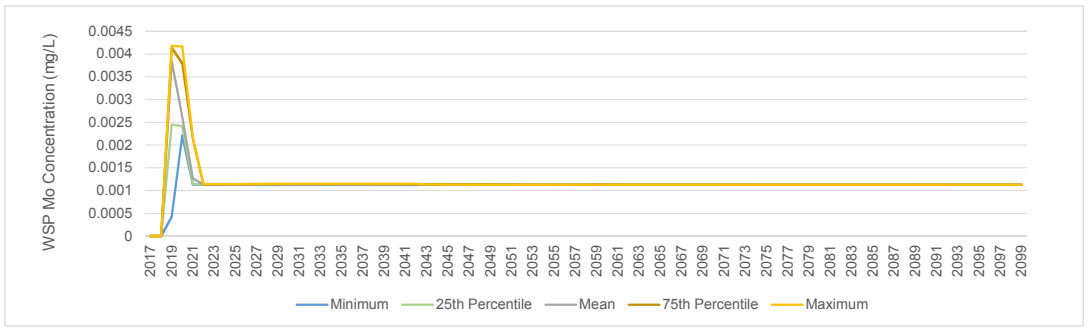
NESP Mo Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

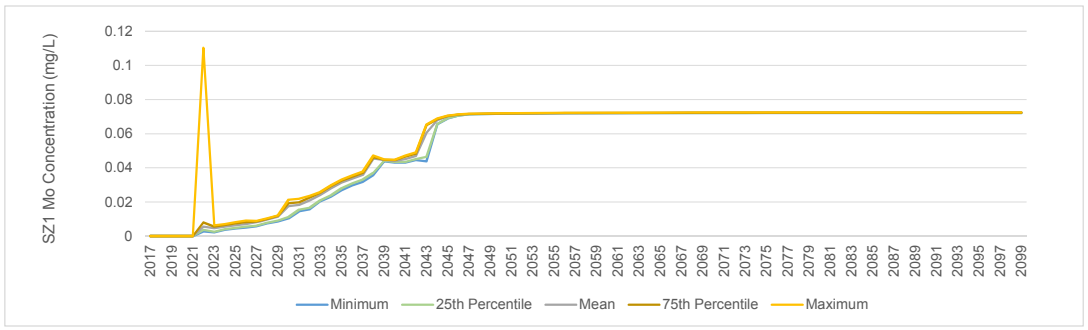

NWSP Mo Concentration (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

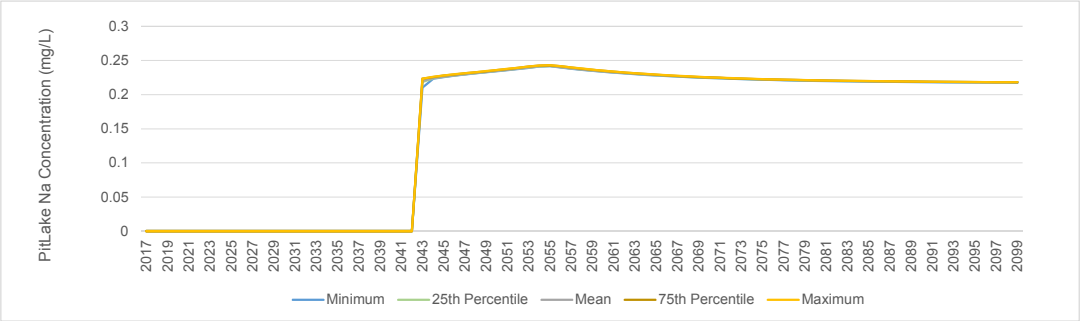

RWP Mo Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

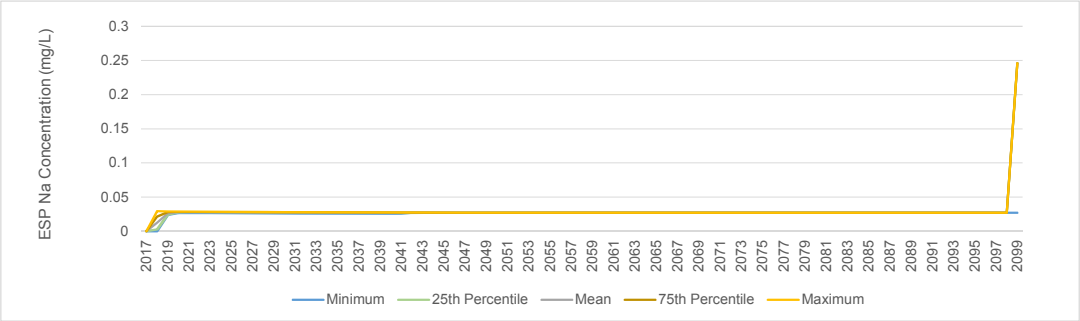

SESP Mo Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

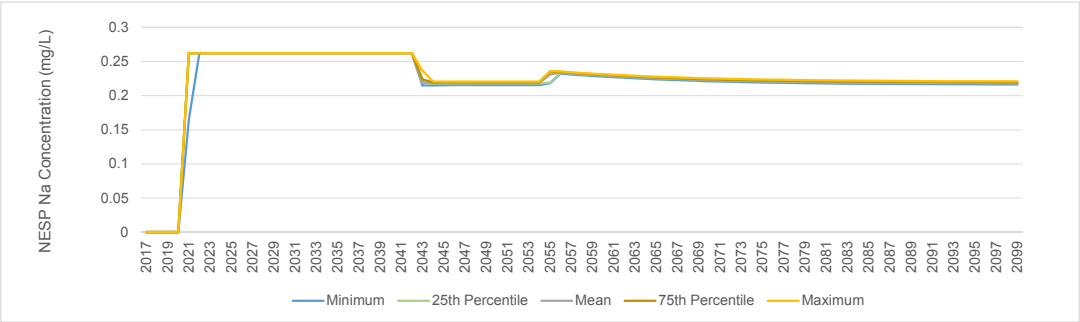

SWSP Mo Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

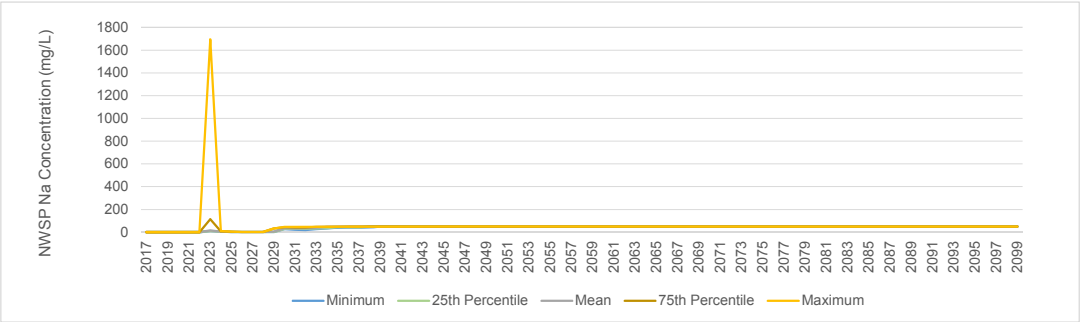

WSP Mo Concentration (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

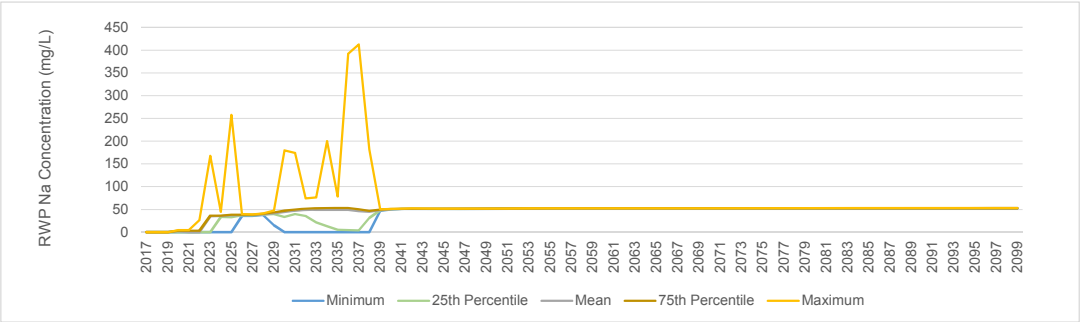

SZ1 Mo Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

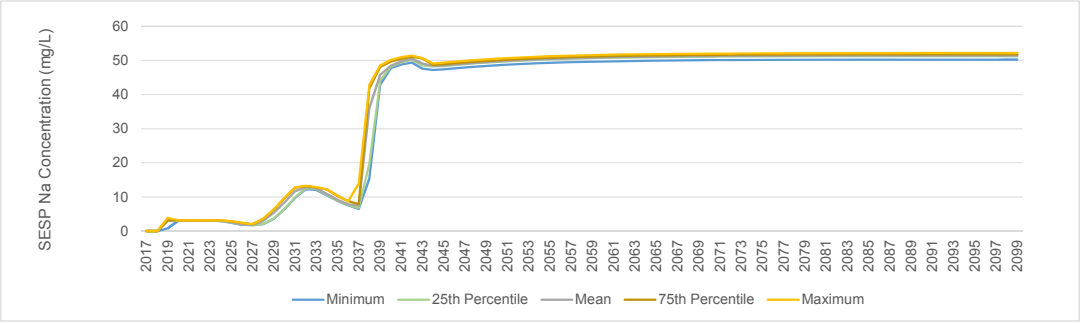

PitLake Na Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

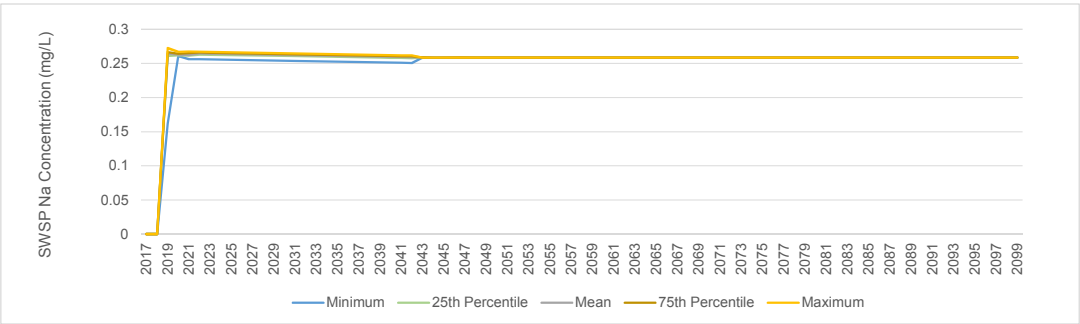

ESP Na Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

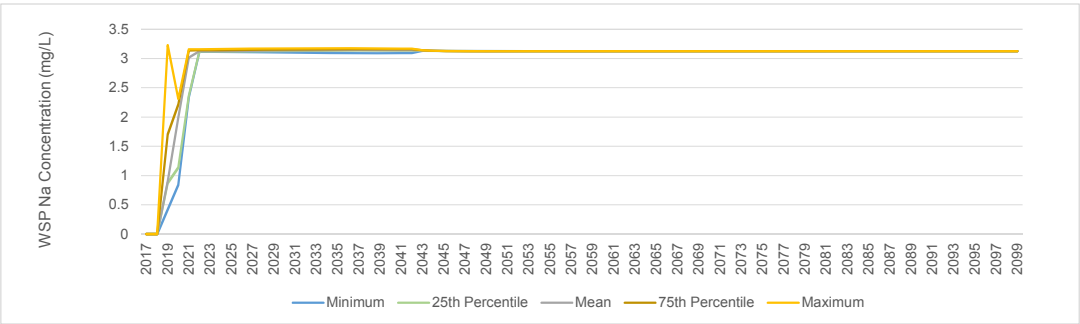

NESP Na Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

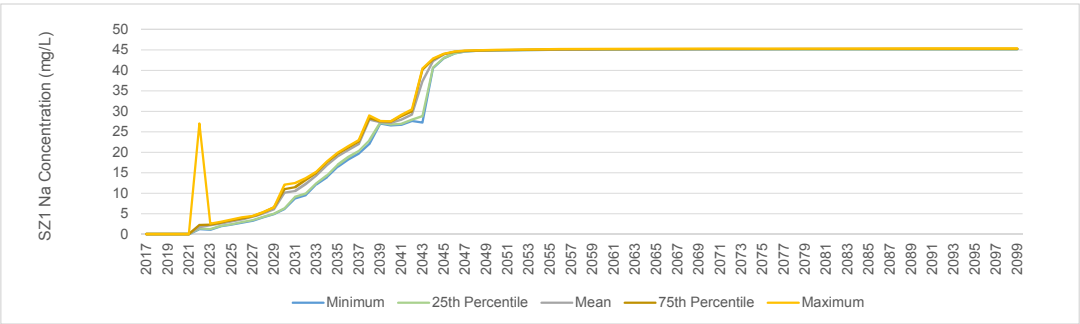

NWSP Na Concentration (mg/L)
1800
1600
1400
1200
1000
800
600
400
200
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

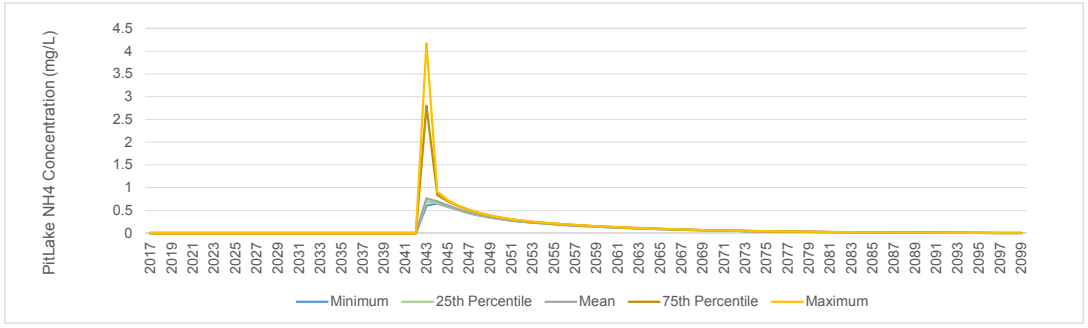

RWP Na Concentration (mg/L)
450
400
350
300
250
200
150
100
50
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

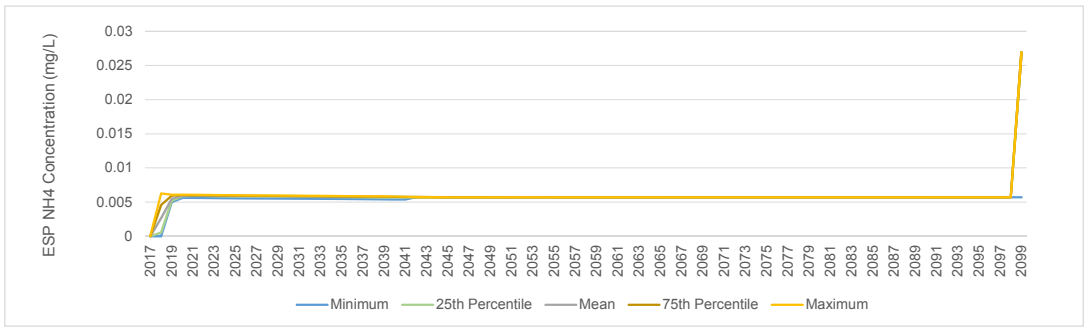

SESP Na Concentration (mg/L)
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

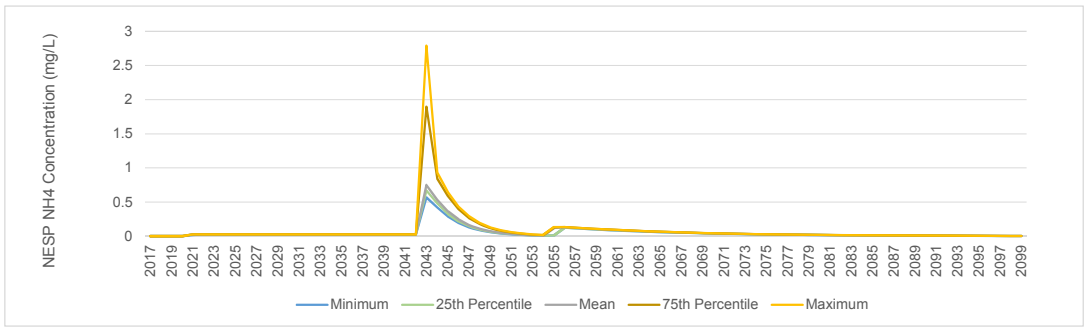

SWSP Na Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

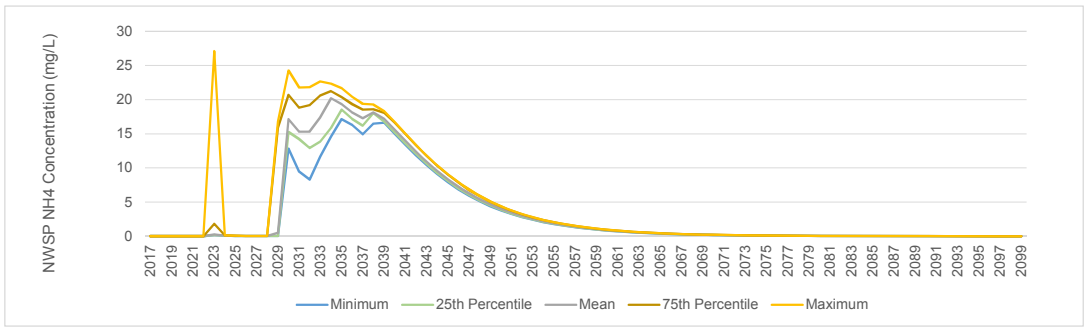

WSP Na Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

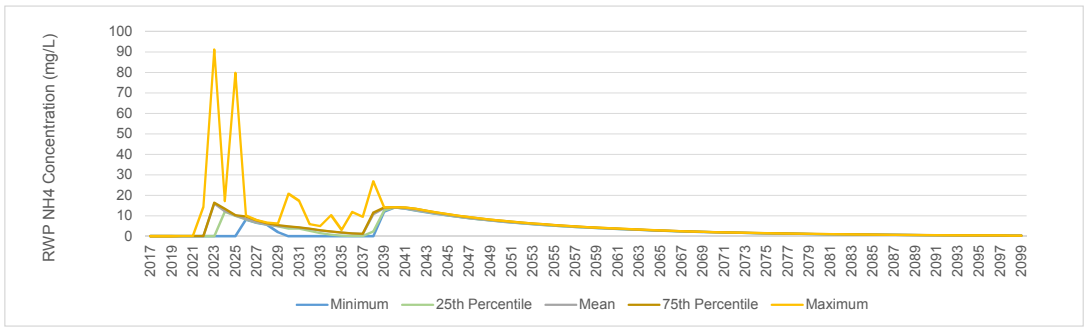

SZ1 Na Concentration (mg/L)
50
45
40
35
30
25
20
15
10
5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

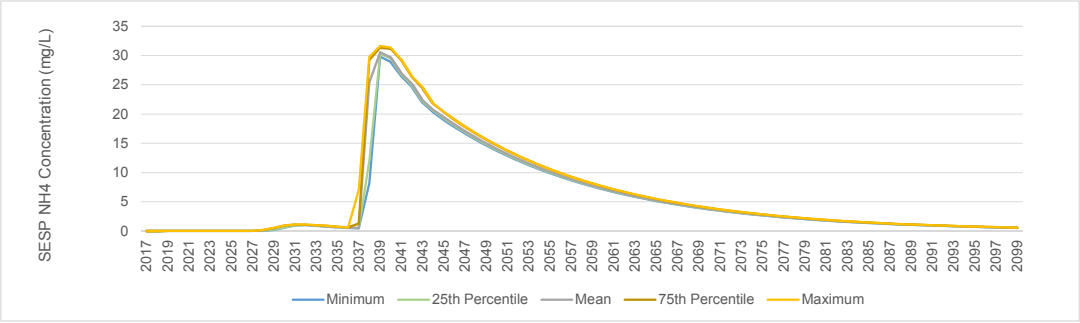

PitLake NH4 Concentration (mg/L)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

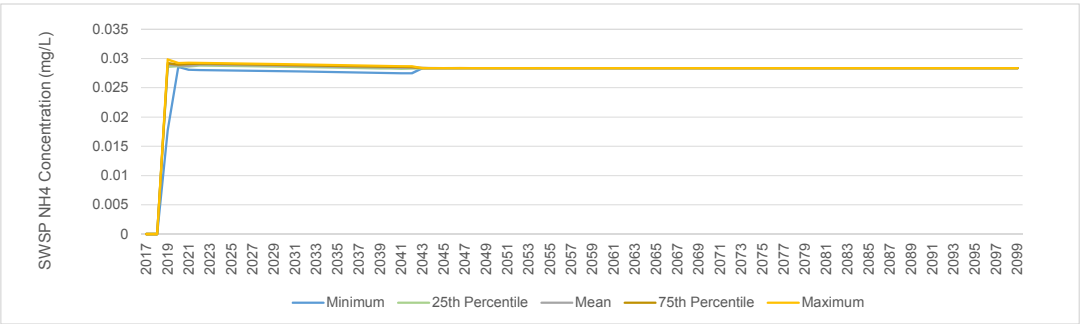

ESP NH4 Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

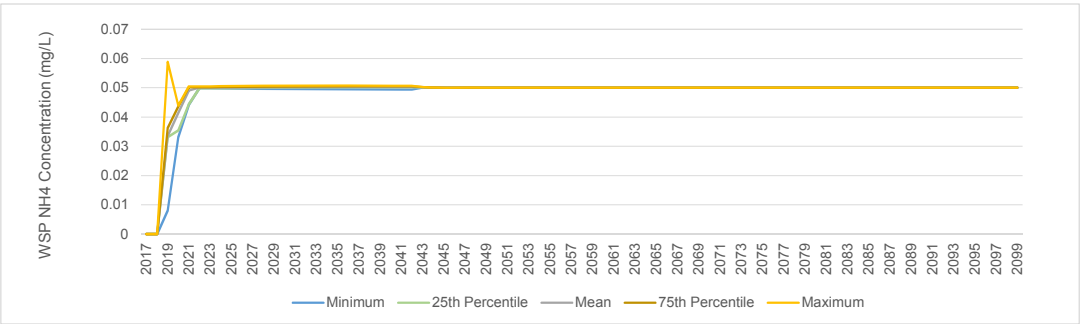

NESP NH4 Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

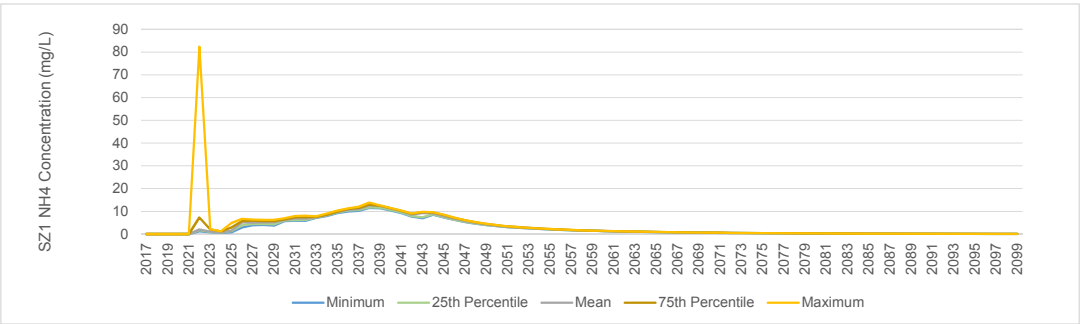

NWSP NH4 Concentration (mg/L)
30
25
20
15
10
5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

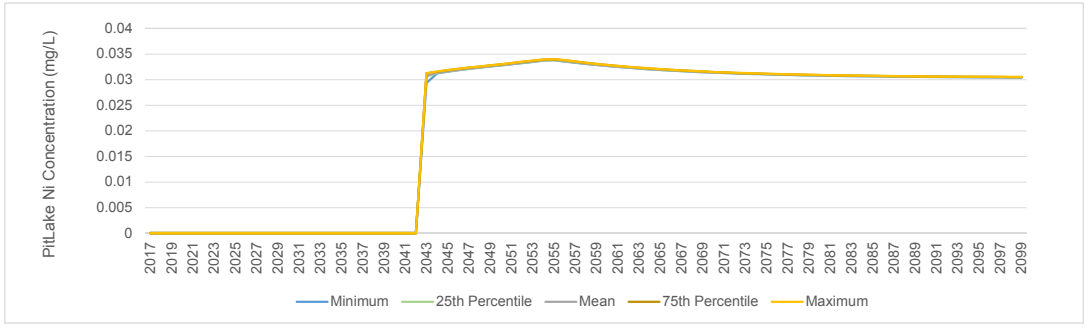

RWP NH4 Concentration (mg/L)
100
90
80
70
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

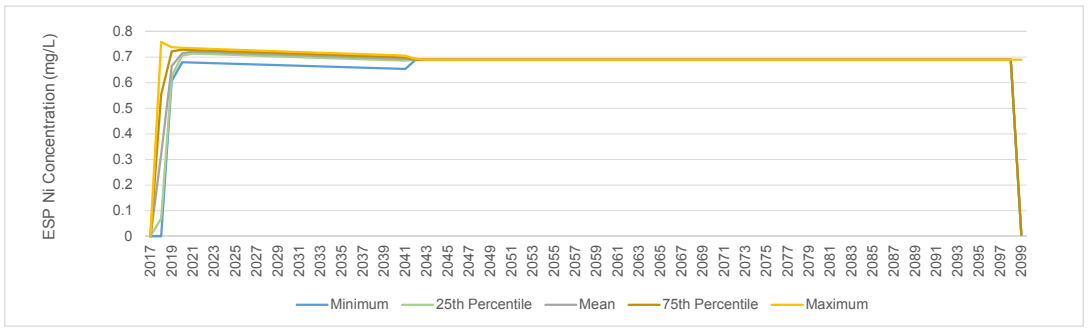

SESP NH4 Concentration (mg/L)
35
30
25
20
15
10
5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

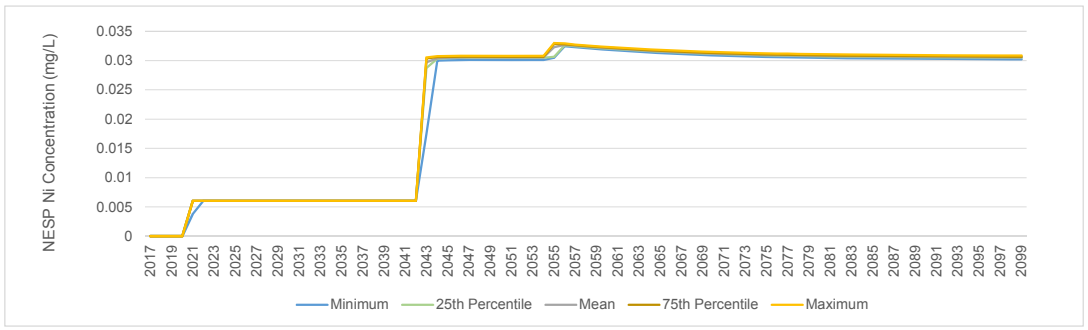

SWSP NH4 Concentration (mg/L)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

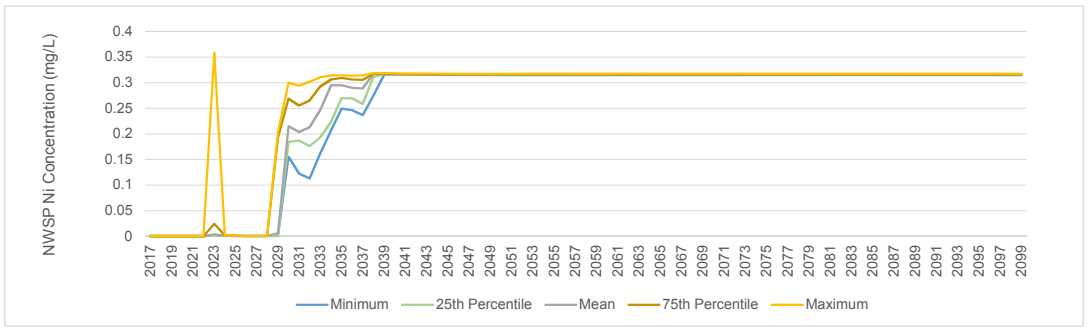

WSP NH4 Concentration (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

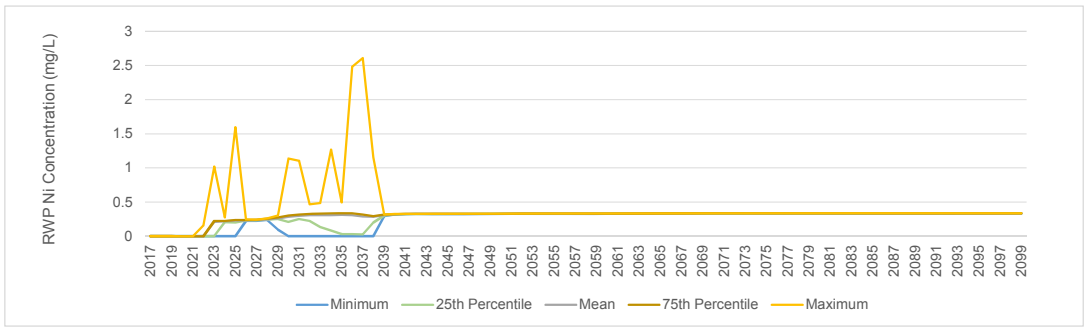

SZ1 NH4 Concentration (mg/L)
90
80
70
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

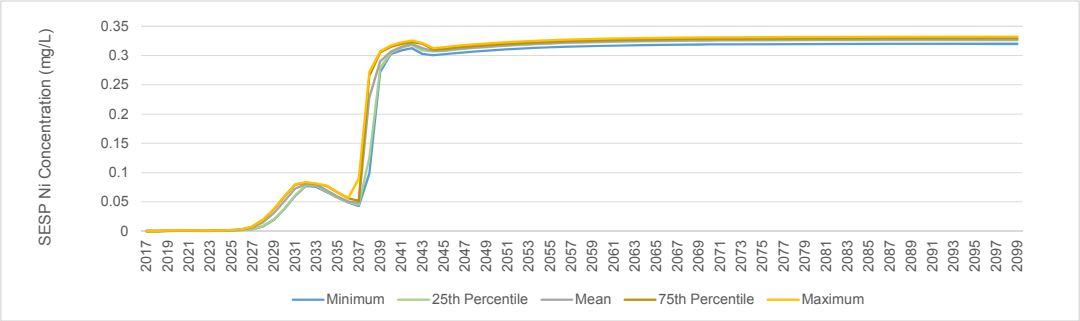

PitLake Ni Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

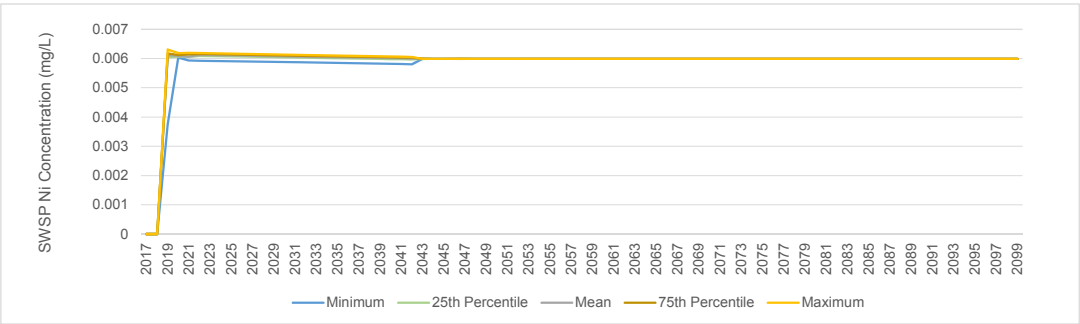

ESP Ni Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

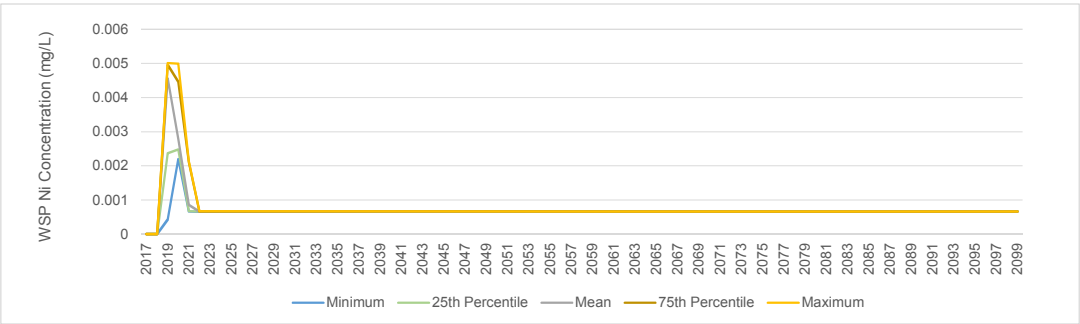

NESP Ni Concentration (mg/L)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

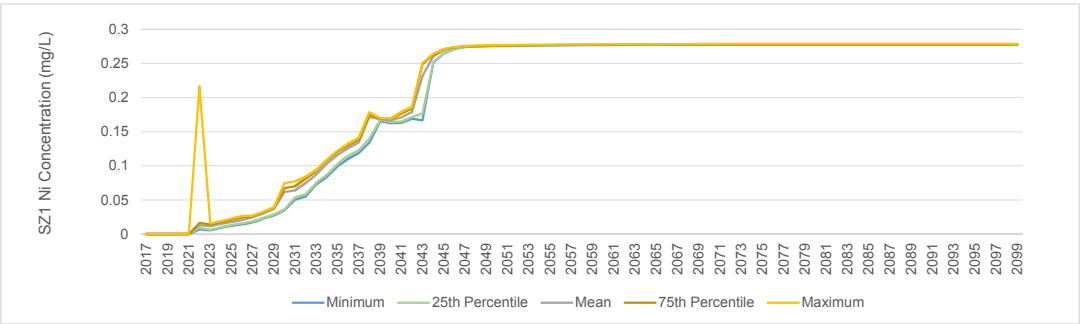

NWSP Ni Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

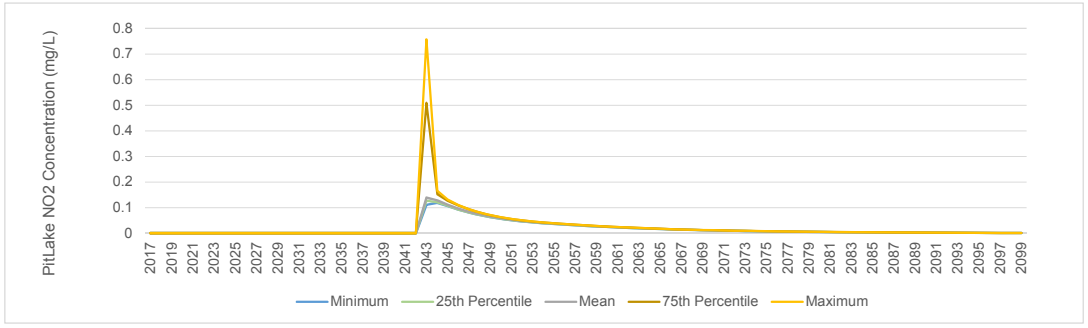

RWP Ni Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

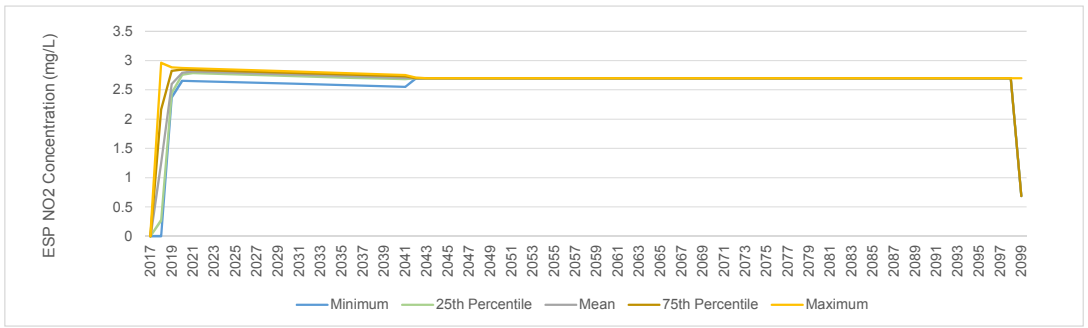

SESP Ni Concentration (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

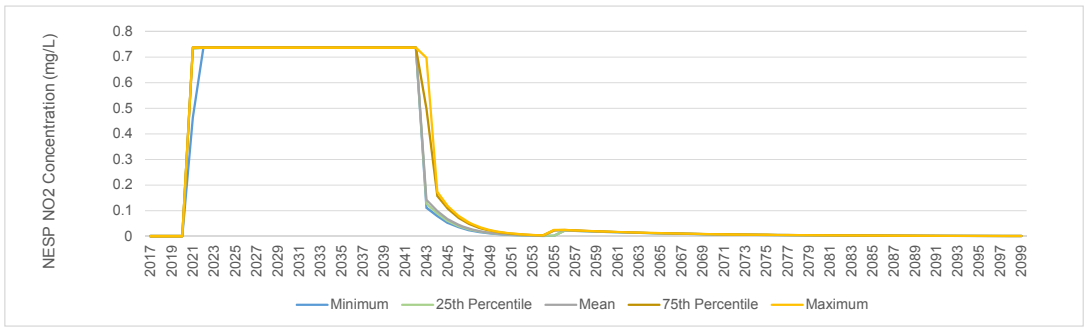

SWSP Ni Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

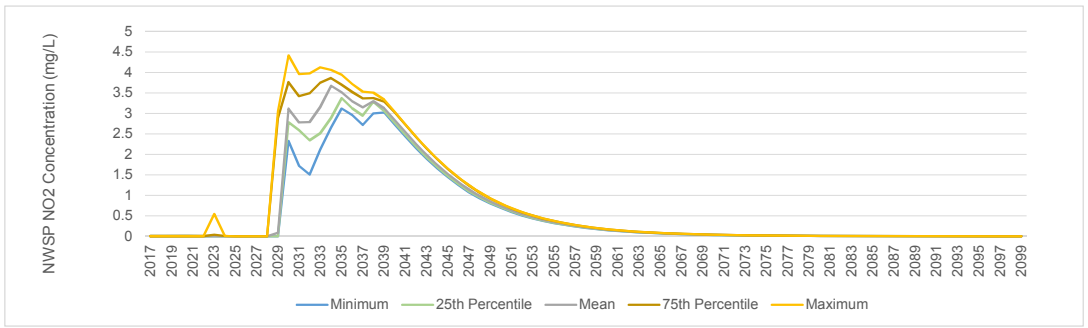

WSP Ni Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

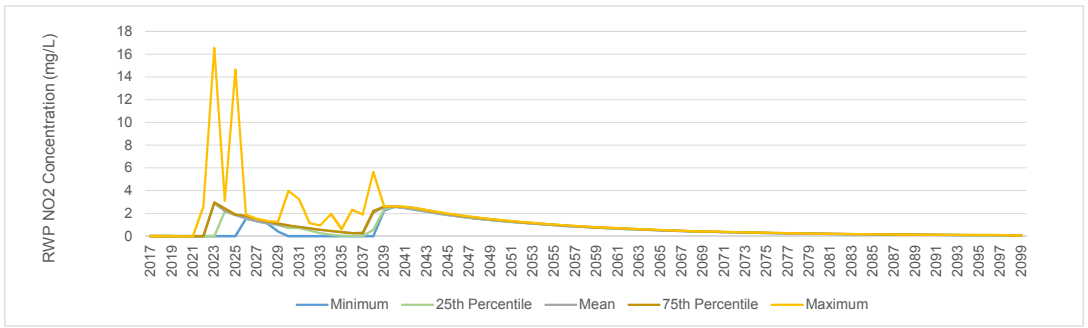

SZ1 Ni Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

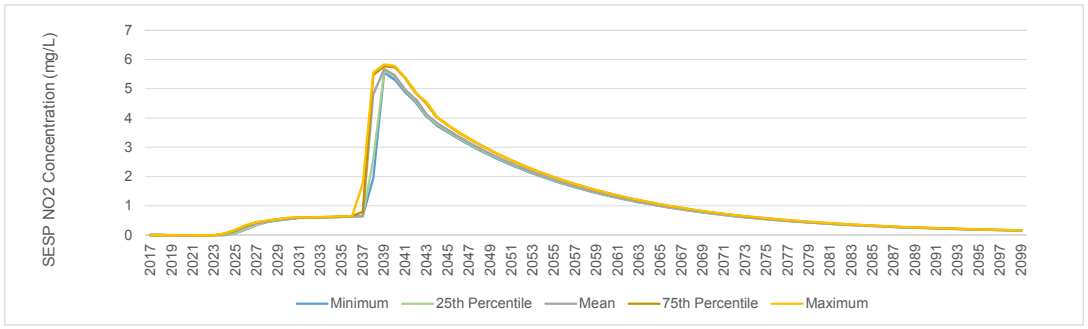

PitLake NO2 Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

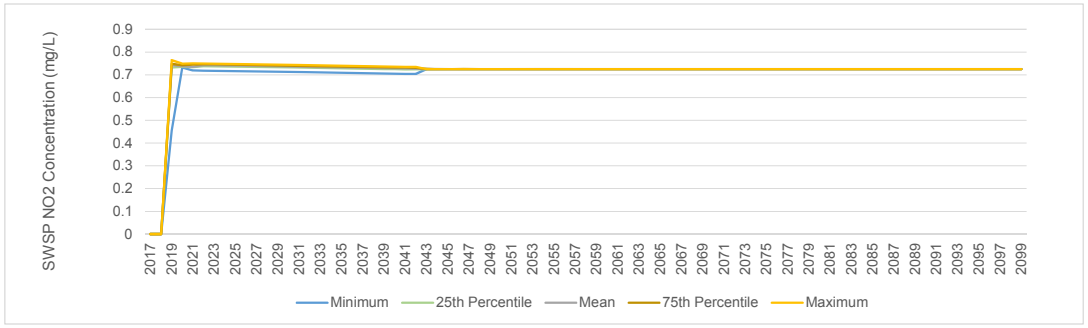

ESP NO2 Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

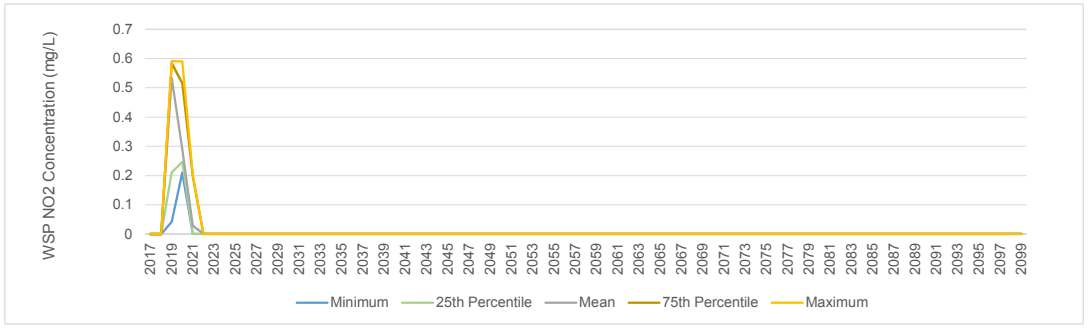

NESP NO2 Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

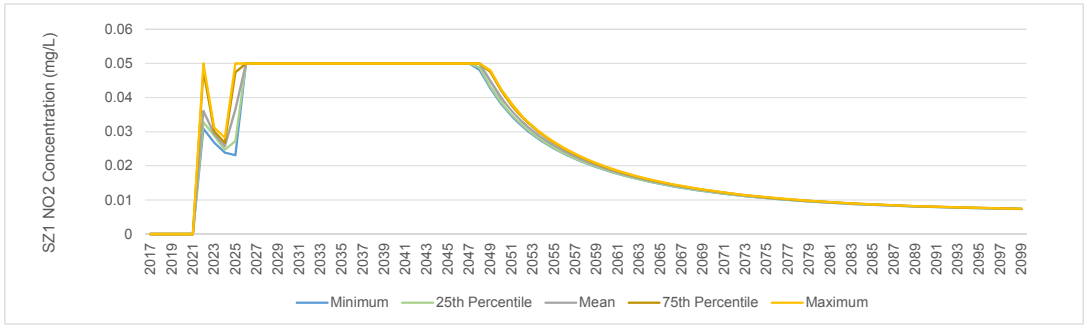

NWSP NO2 Concentration (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

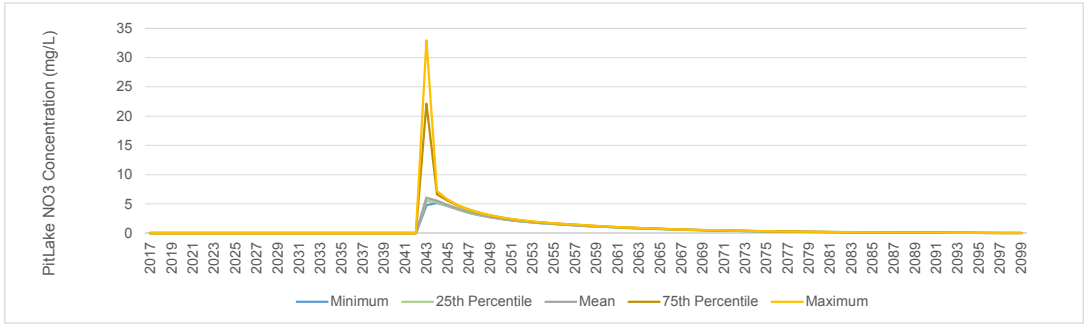

RWP NO2 Concentration (mg/L)
18
16
14
12
10
8
6
4
2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

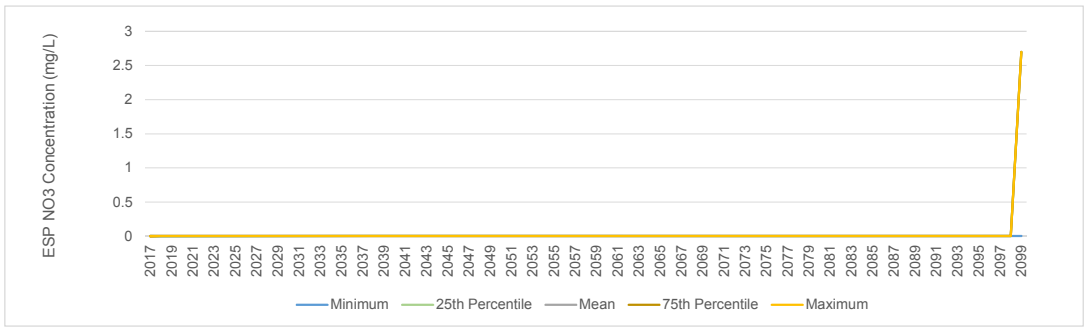

SESP NO2 Concentration (mg/L)
0
1
2
3
4
5
6
7
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

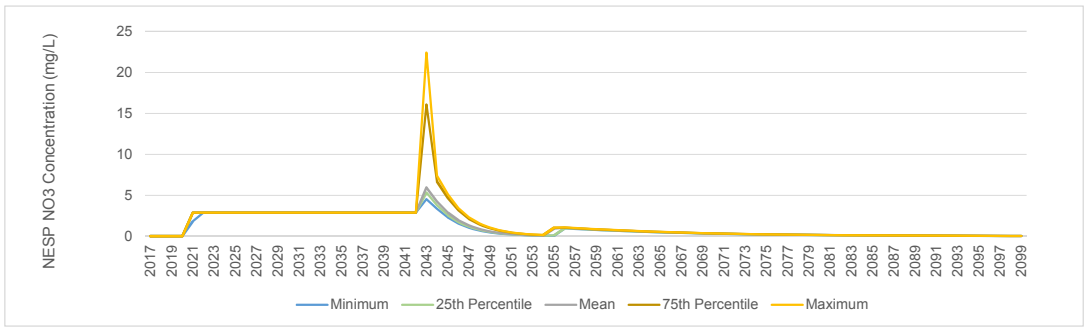

SWSP NO2 Concentration (mg/L)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

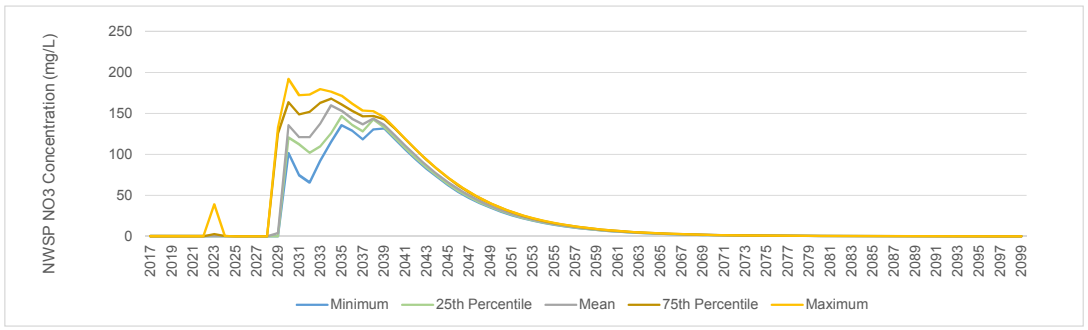

WSP NO2 Concentration (mg/L)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

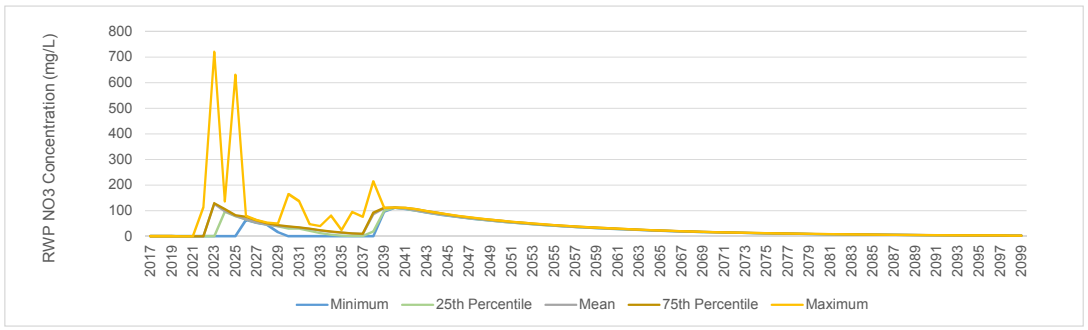

SZ1 NO2 Concentration (mg/L)
0
0.01
0.02
0.03
0.04
0.05
0.06
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

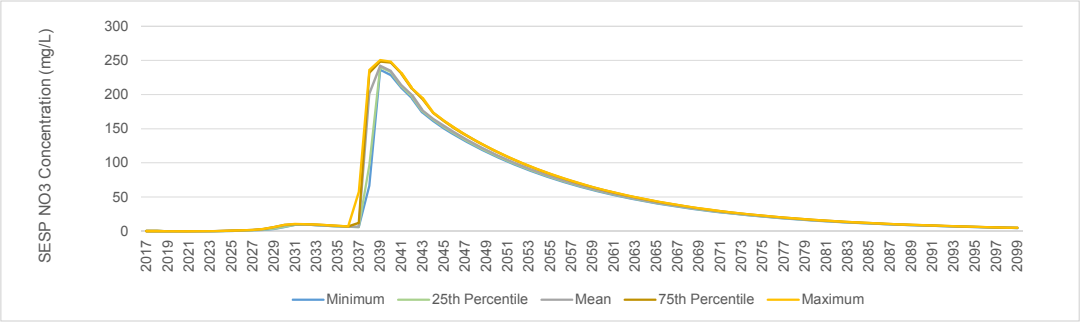

PitLake NO3 Concentration (mg/L)
35
30
25
20
15
10
5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

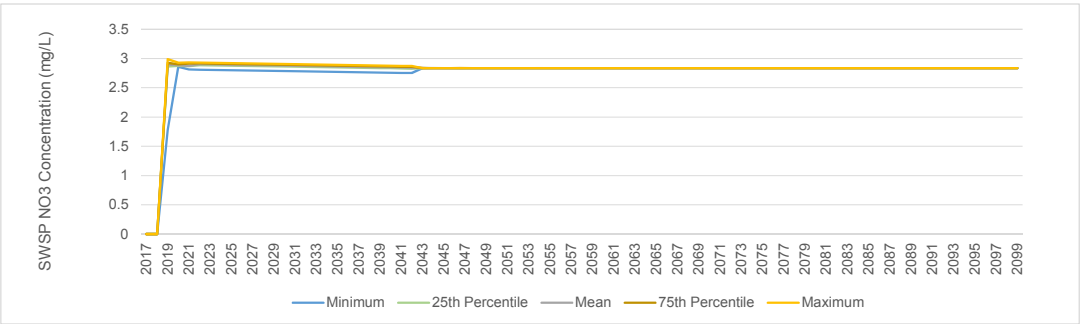

ESP NO3 Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

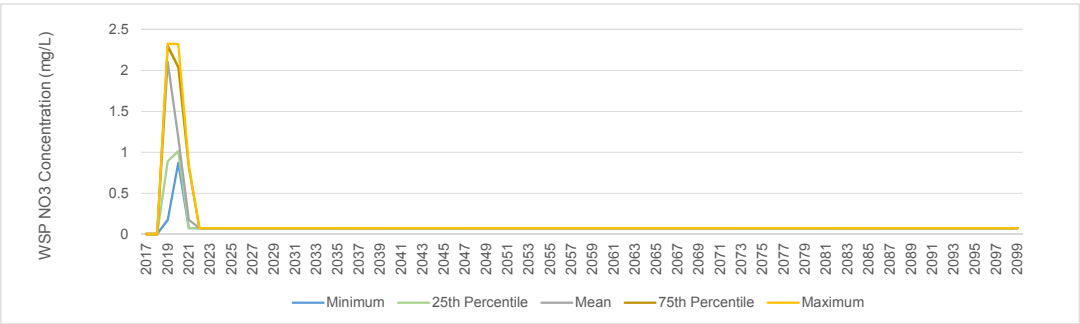

NESP NO3 Concentration (mg/L)
25
20
15
10
5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

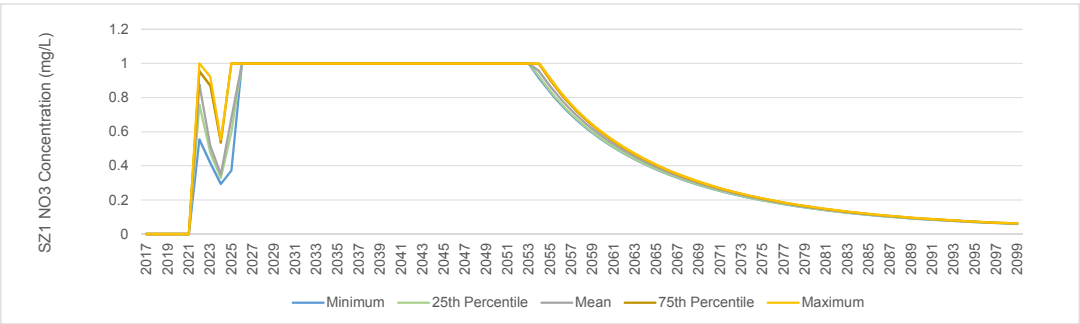

NWSP NO3 Concentration (mg/L)
250
200
150
100
50
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

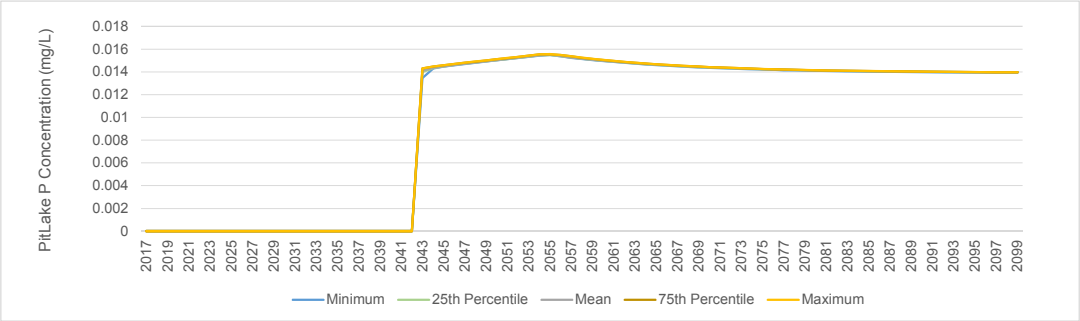

RWP NO3 Concentration (mg/L)
800
700
600
500
400
300
200
100
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

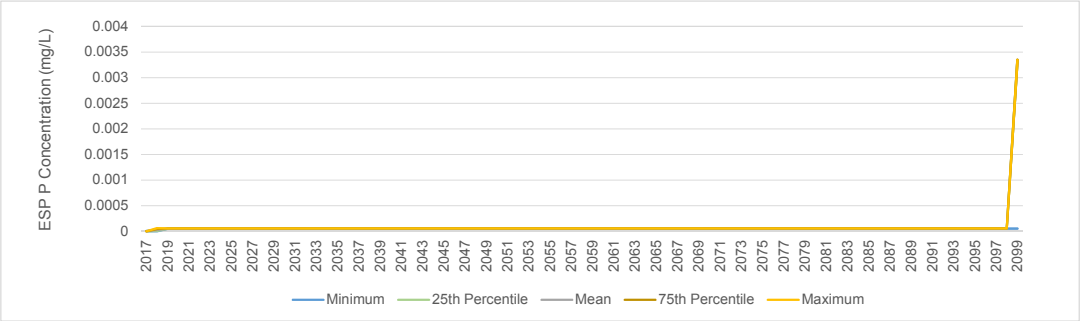

SESP NO3 Concentration (mg/L)
300
250
200
150
100
50
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

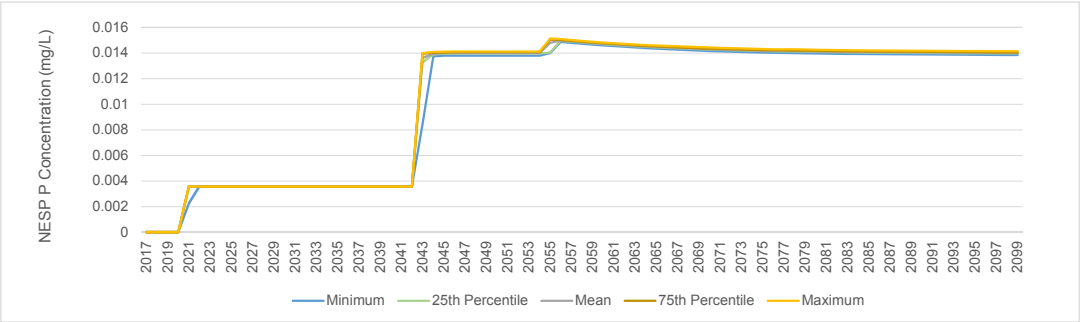

SWSP NO3 Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

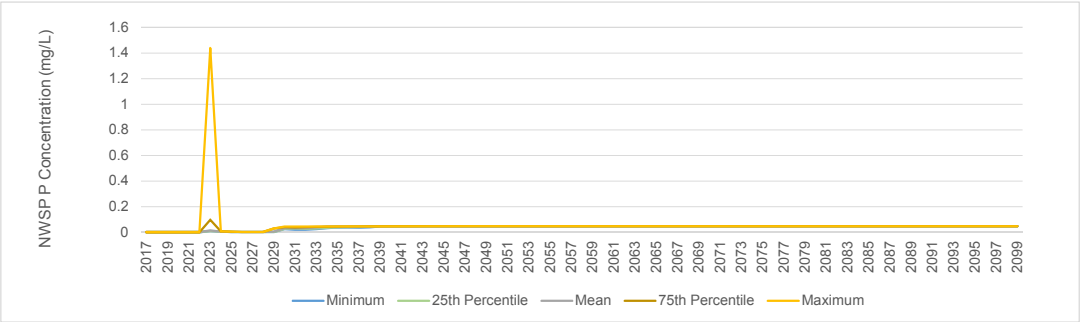

WSP NO3 Concentration (mg/L)
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

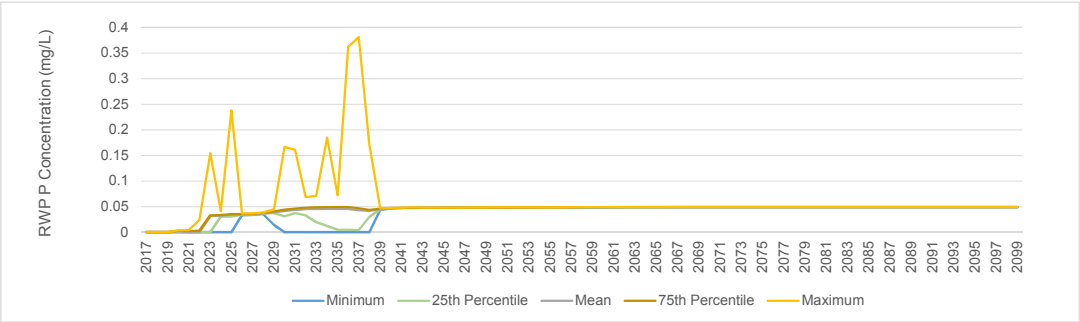

SZ1 NO3 Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

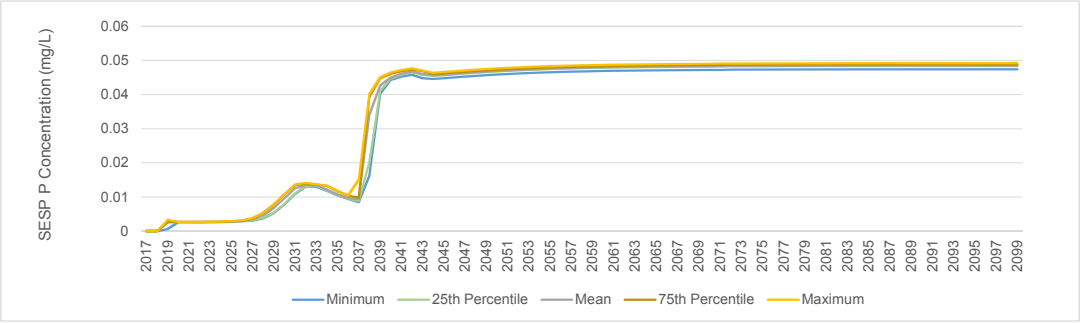

PitLake P Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

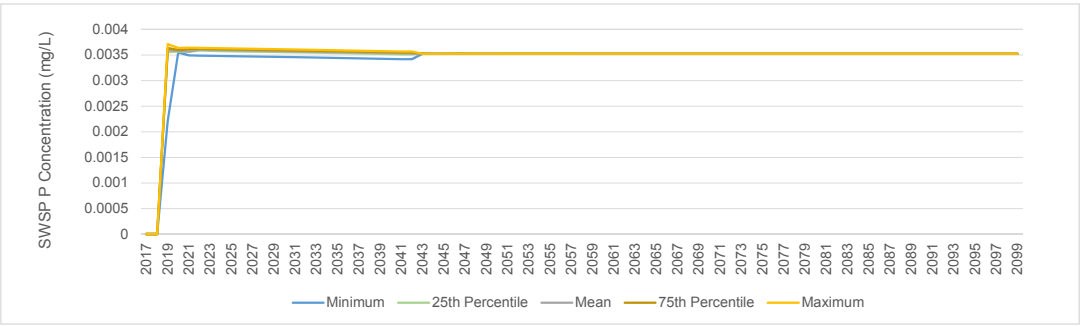

ESP P Concentration (mg/L)
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

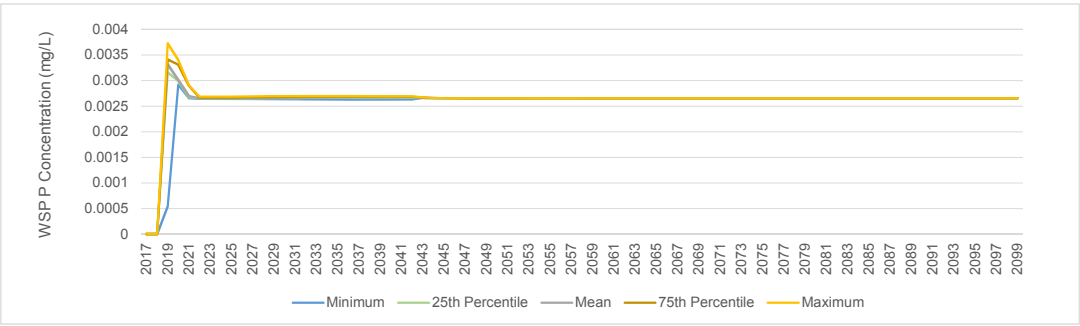

NESP P Concentration (mg/L)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

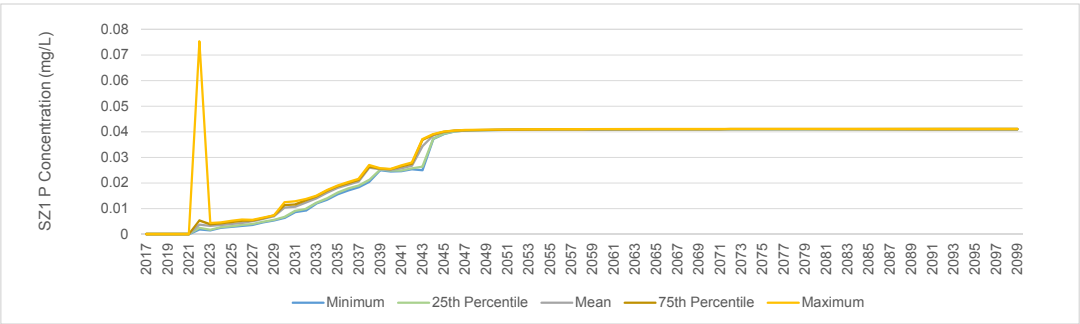

NWSP P Concentration (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

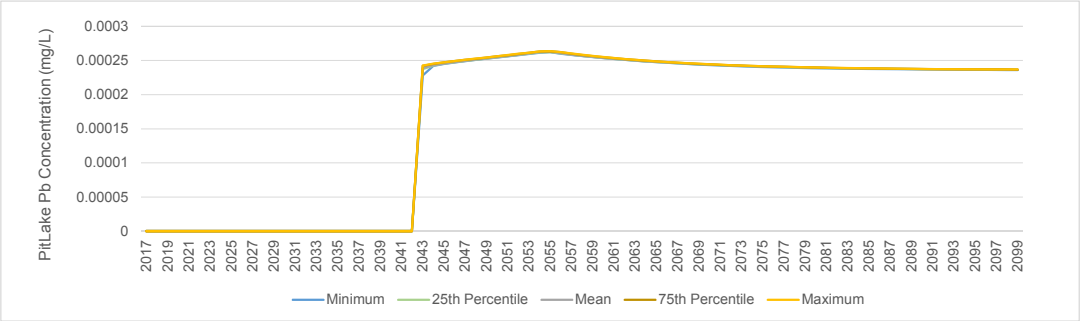

RWP P Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

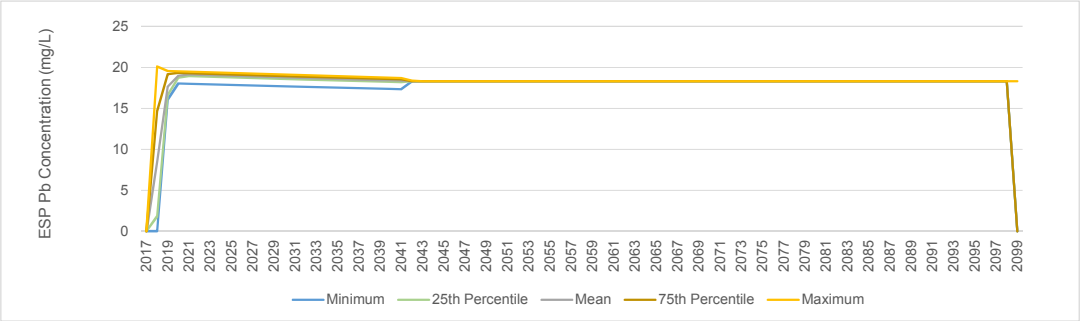

SESP P Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

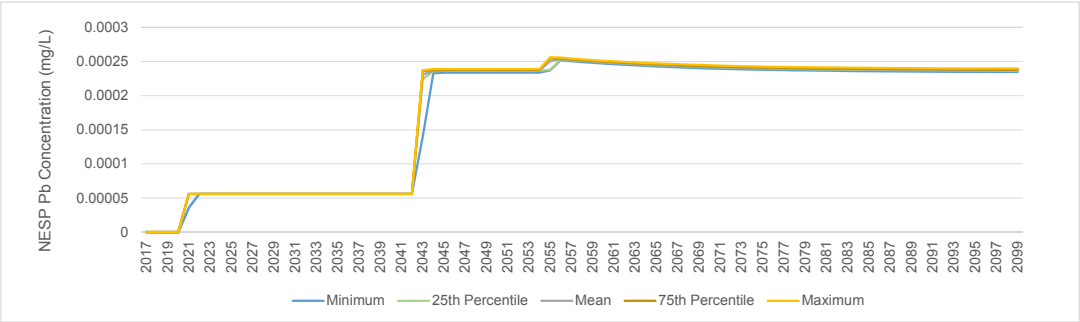

SWSP P Concentration (mg/L)
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

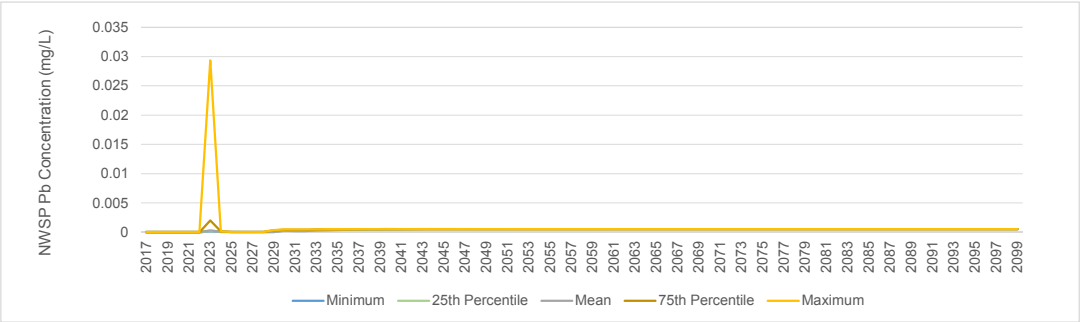

WSP P Concentration (mg/L)
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

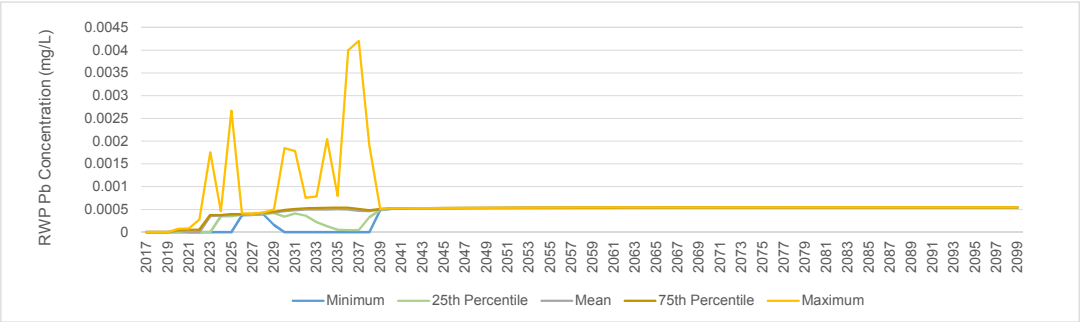

SZ1 P Concentration (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

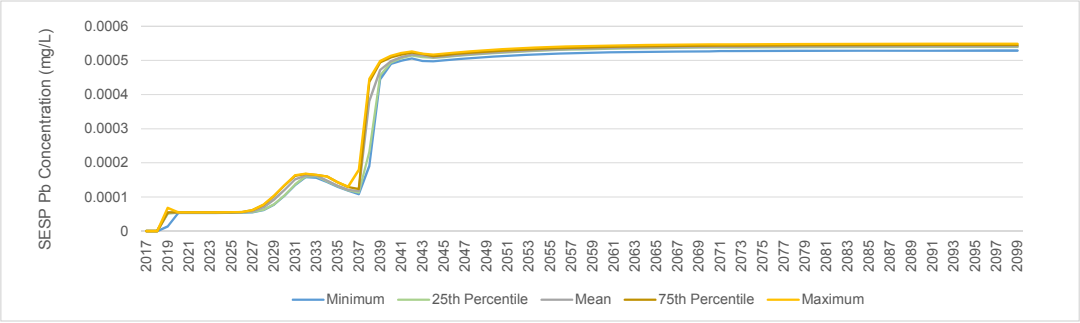

PitLake Pb Concentration (mg/L)
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

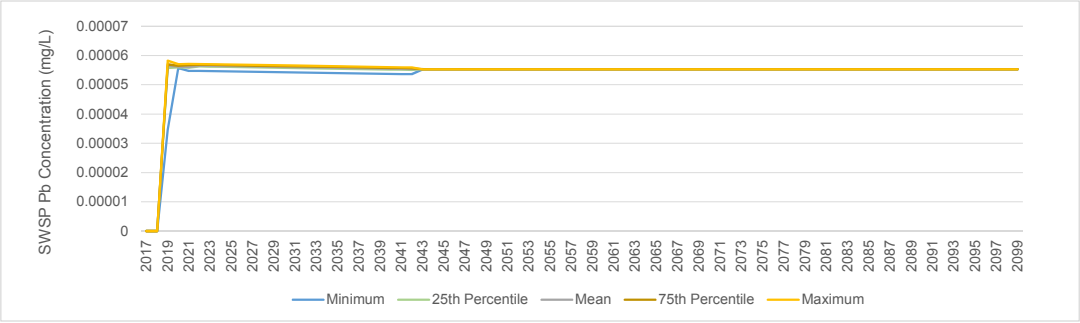

ESP Pb Concentration (mg/L)
25
20
15
10
5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

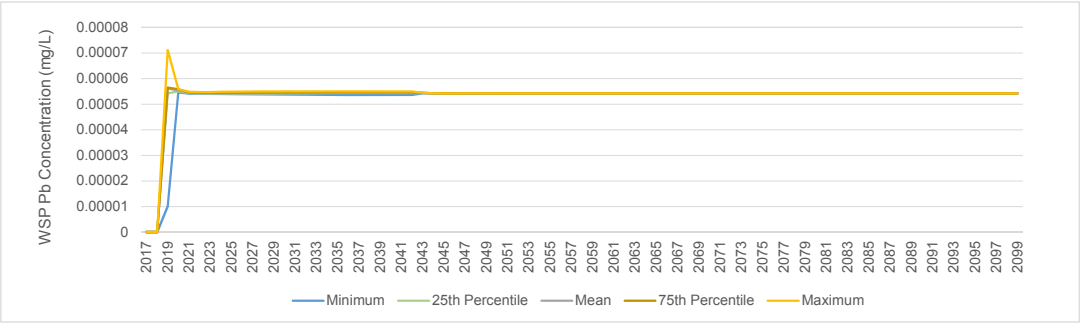

NESP Pb Concentration (mg/L)
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

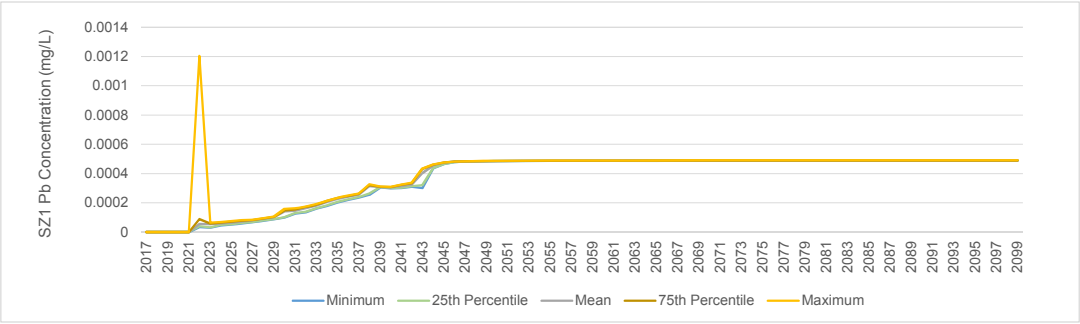

NWSP Pb Concentration (mg/L)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

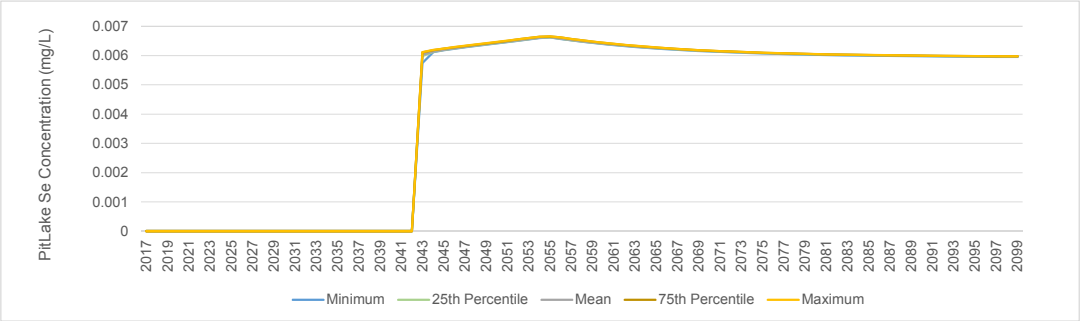

RWP Pb Concentration (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

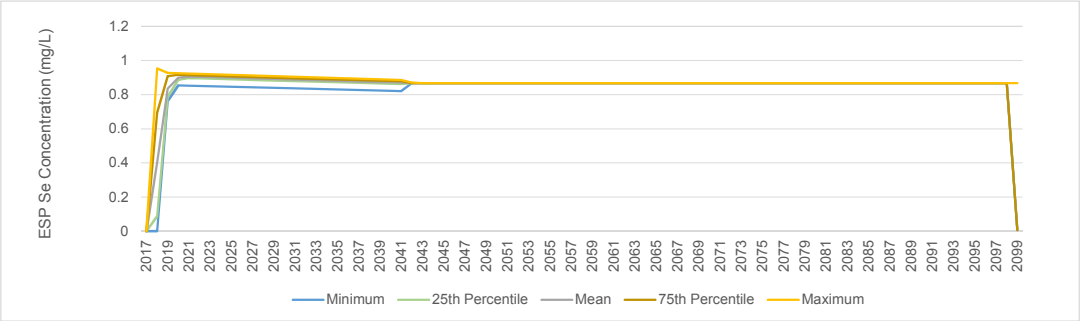

SESP Pb Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

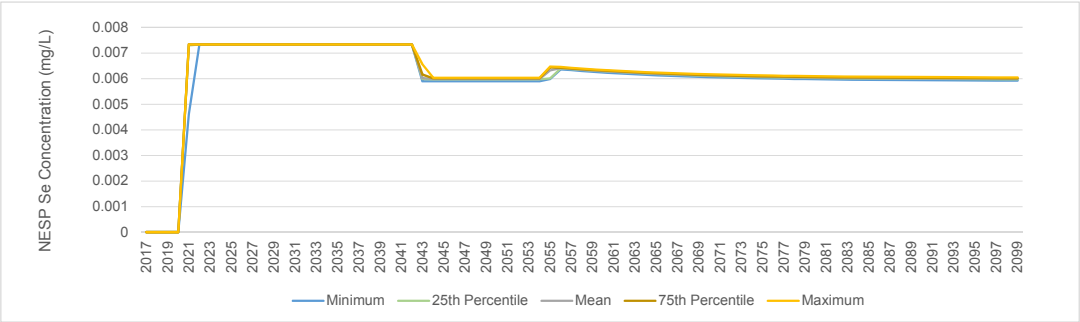

SWSP Pb Concentration (mg/L)
0.00007
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

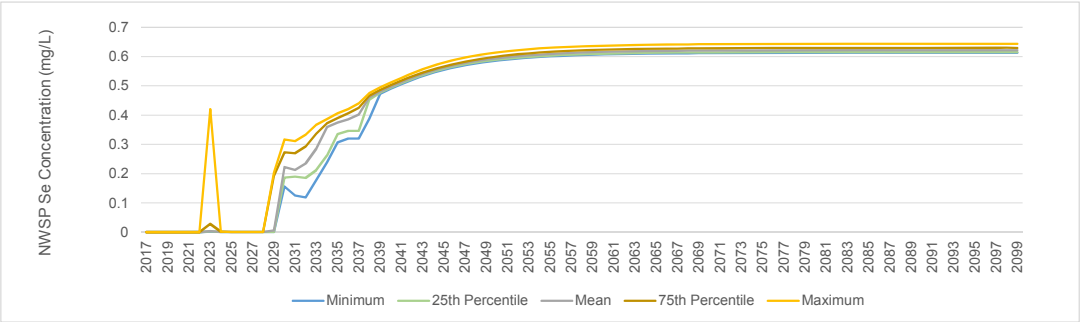

WSP Pb Concentration (mg/L)
0.00008
0.00007
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

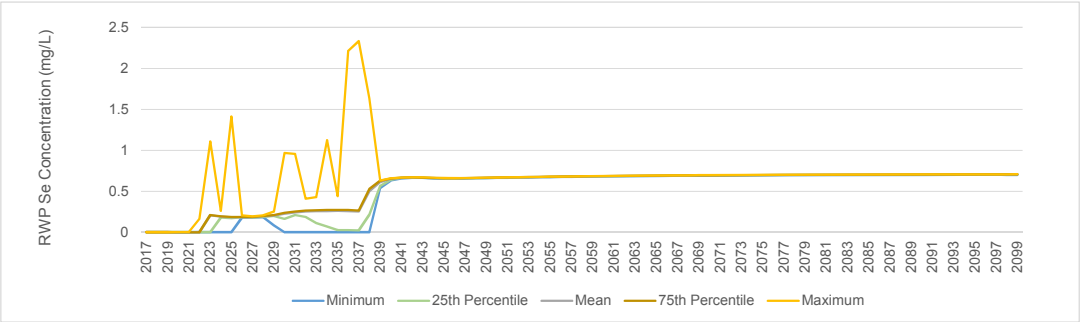

SZ1 Pb Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

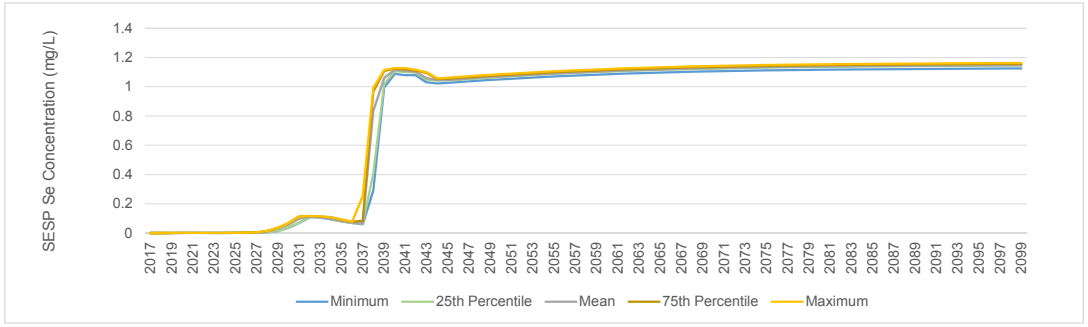

PitLake Se Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

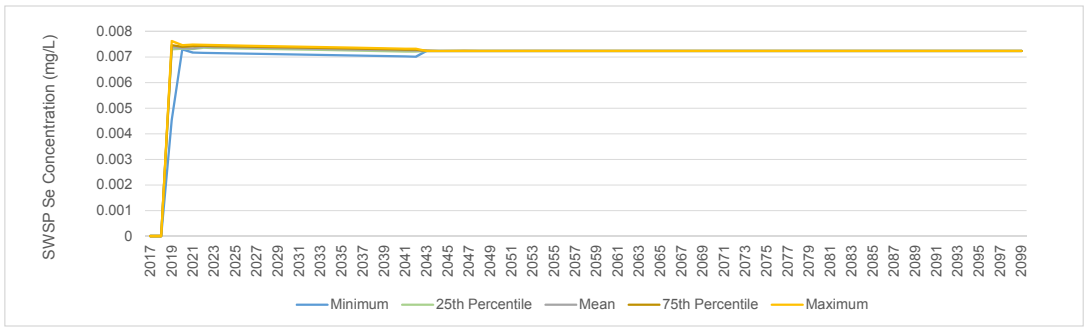

ESP Se Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

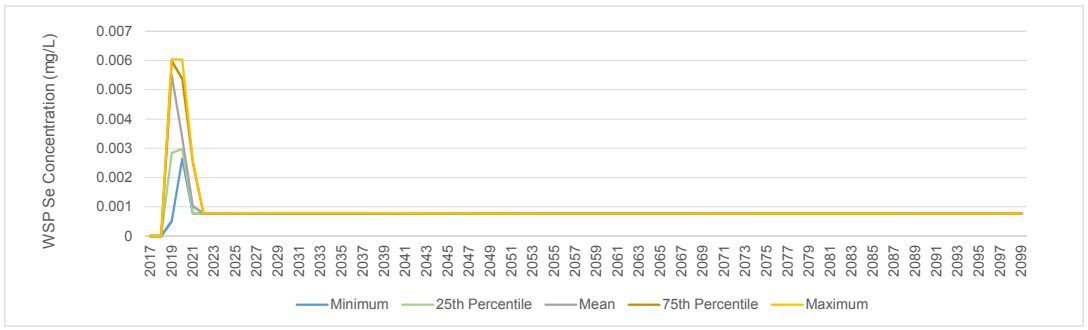

NESP Se Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

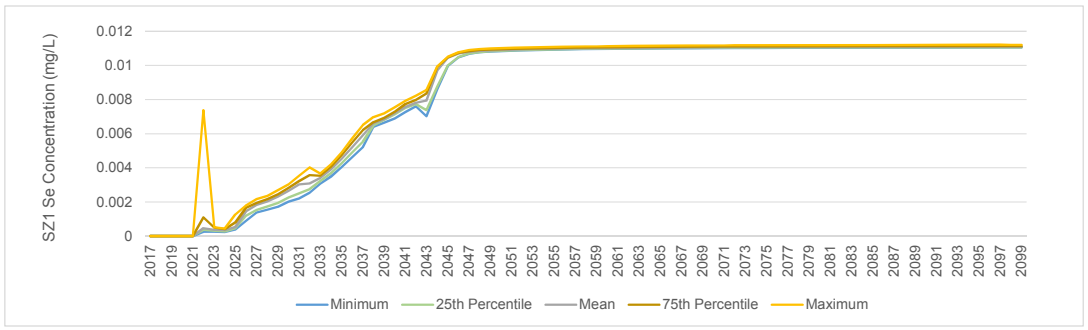

NWSP Se Concentration (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

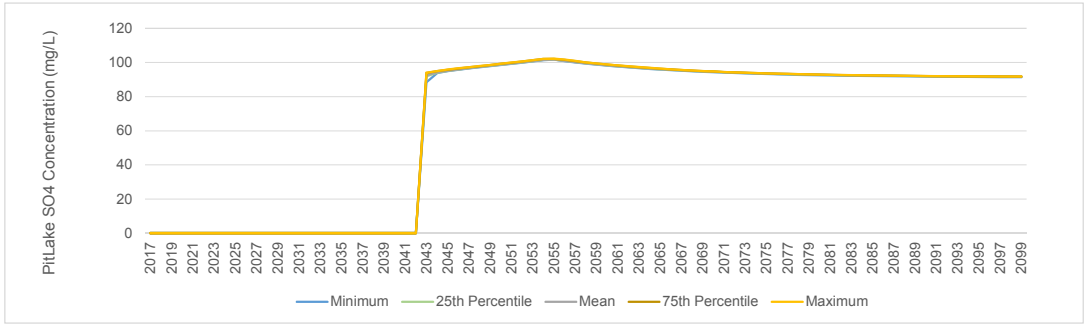

RWP Se Concentration (mg/L)
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

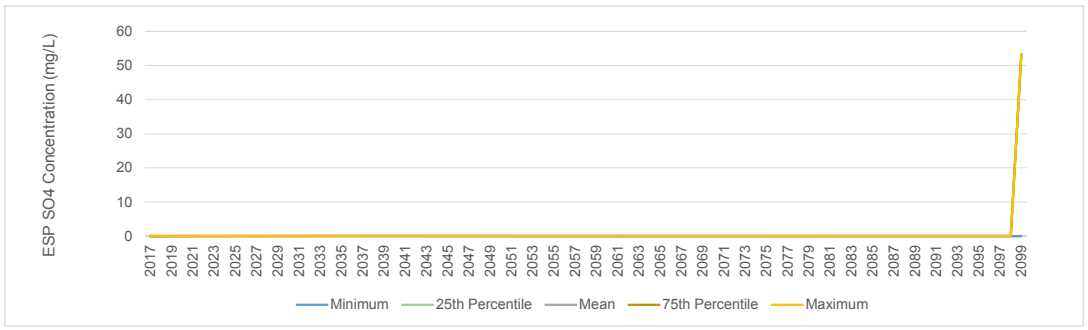

SESP Se Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

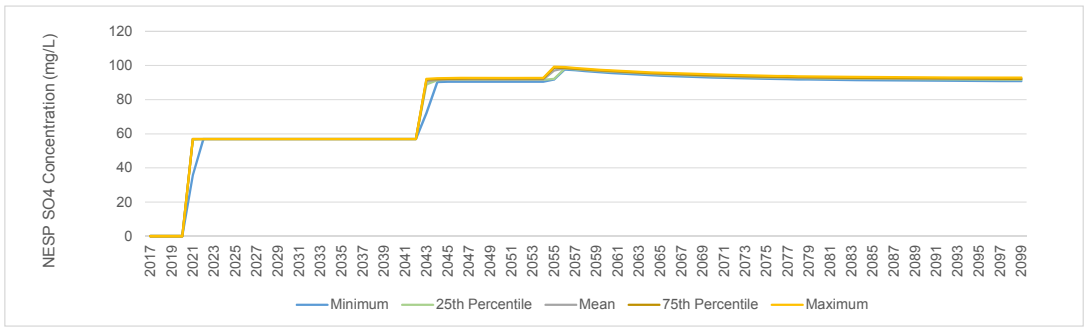

SWSP Se Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

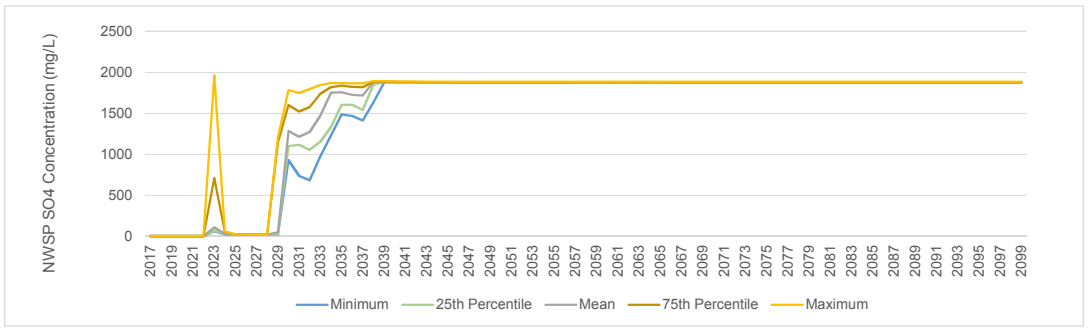

WSP Se Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

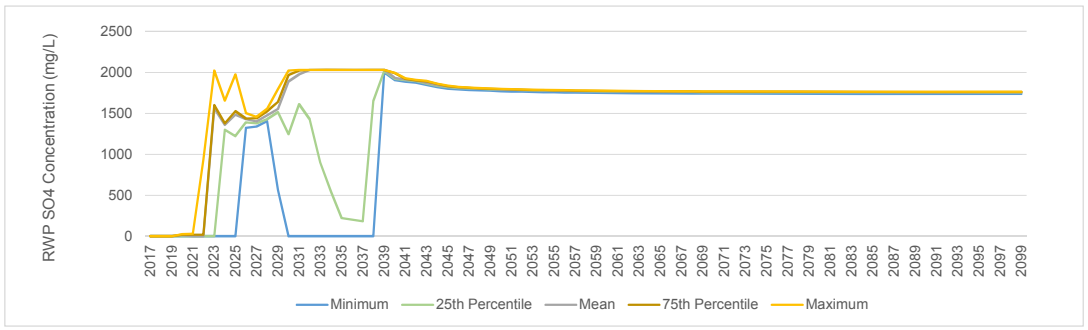

SZ1 Se Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

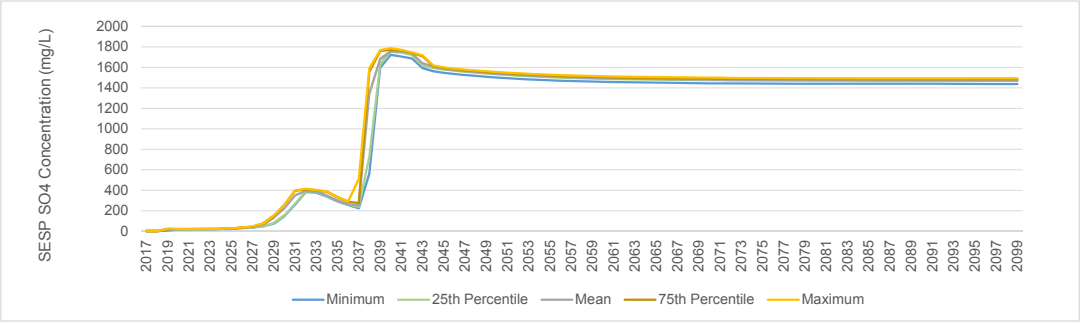

PitLake SO4 Concentration (mg/L)
120
100
80
60
40
20
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

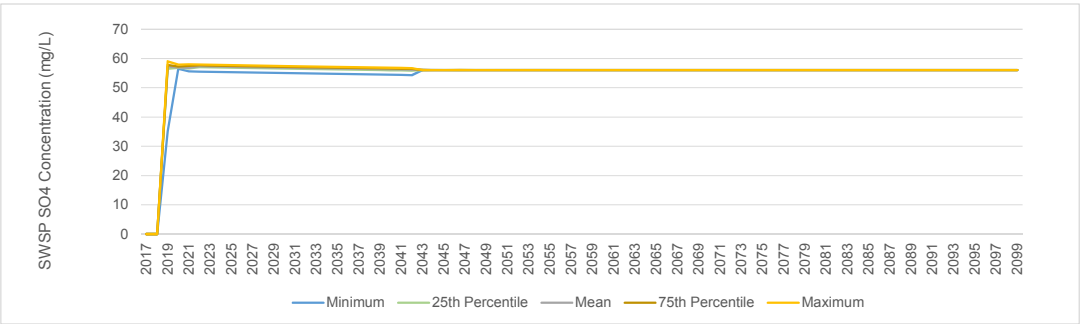

ESP SO4 Concentration (mg/L)
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

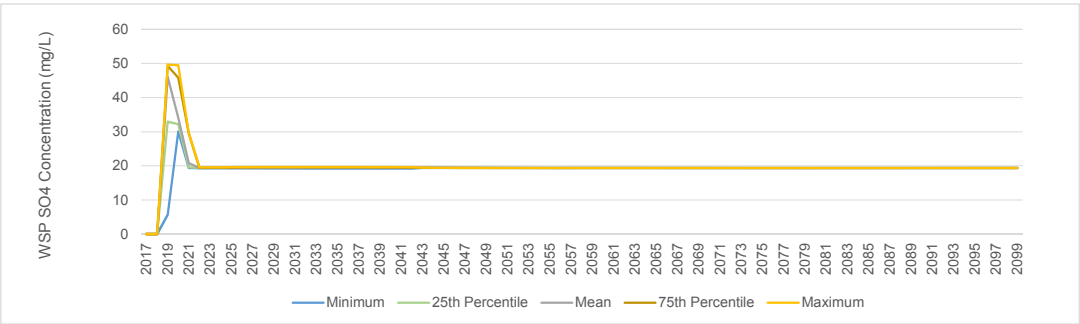

NESP SO4 Concentration (mg/L)
120
100
80
60
40
20
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

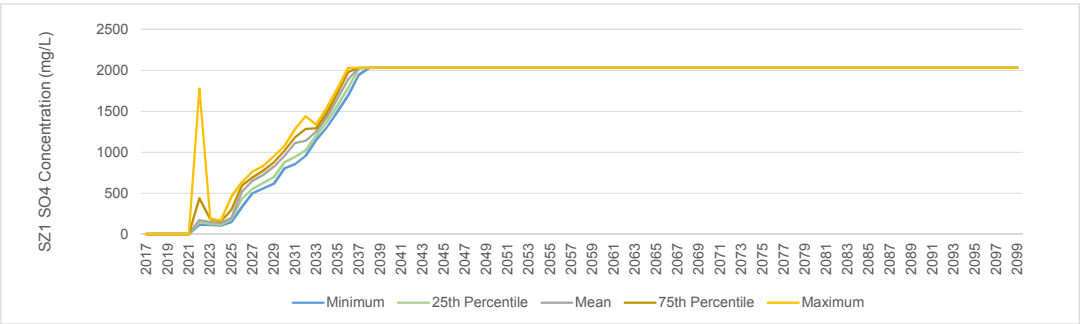

NWSP SO4 Concentration (mg/L)
2500
2000
1500
1000
500
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

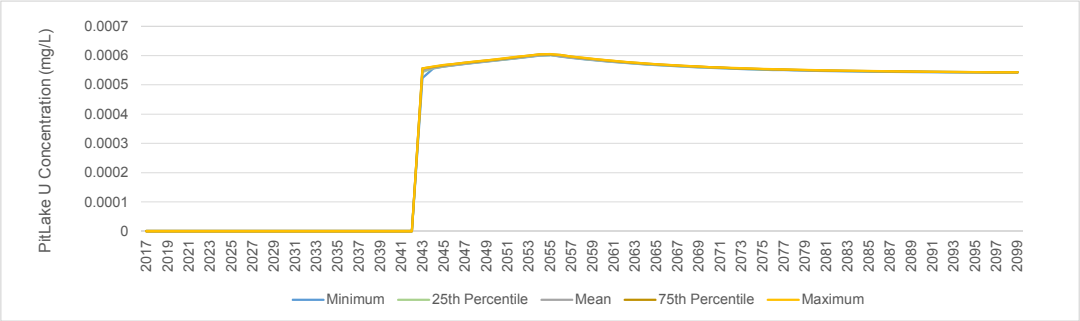

RWP SO4 Concentration (mg/L)
2500
2000
1500
1000
500
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

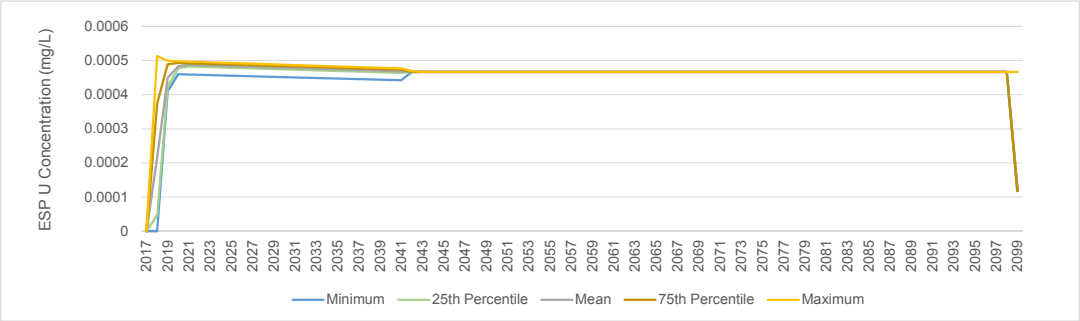

SESP SO4 Concentration (mg/L)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

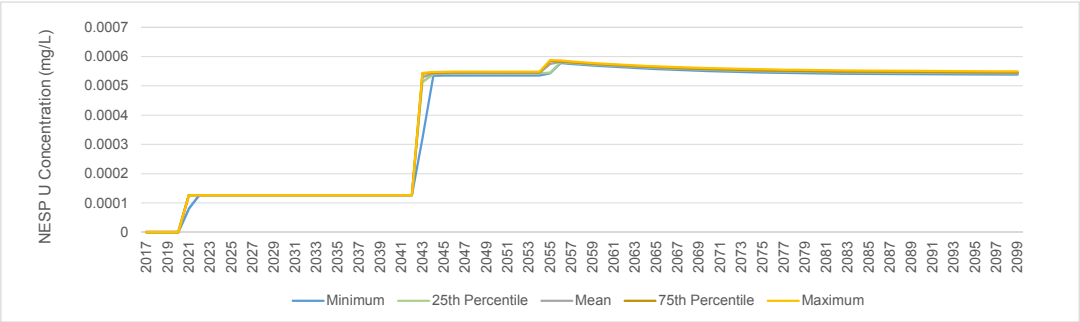

SWSP SO4 Concentration (mg/L)
70
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

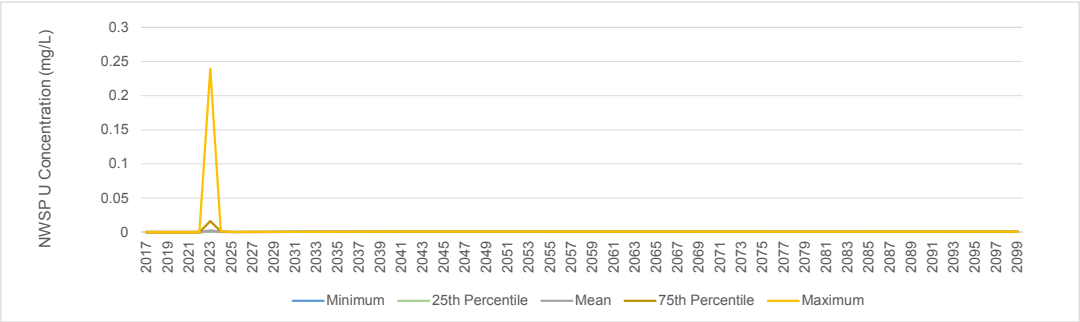

WSP SO4 Concentration (mg/L)
60
50
40
30
20
10
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

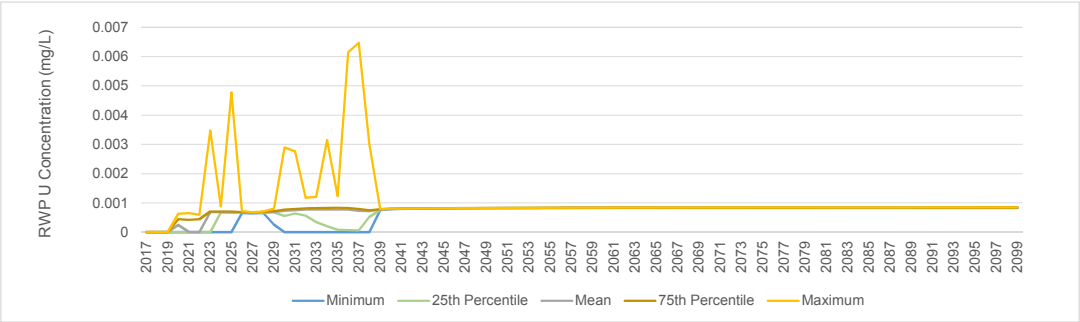

SZ1 SO4 Concentration (mg/L)
2500
2000
1500
1000
500
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

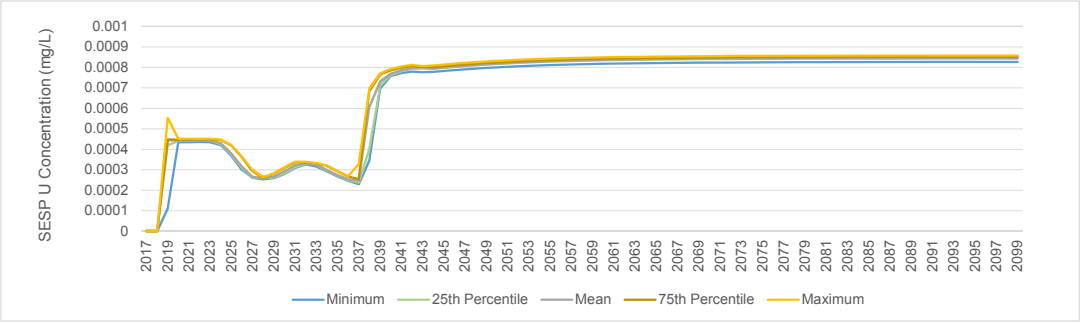

PitLake U Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

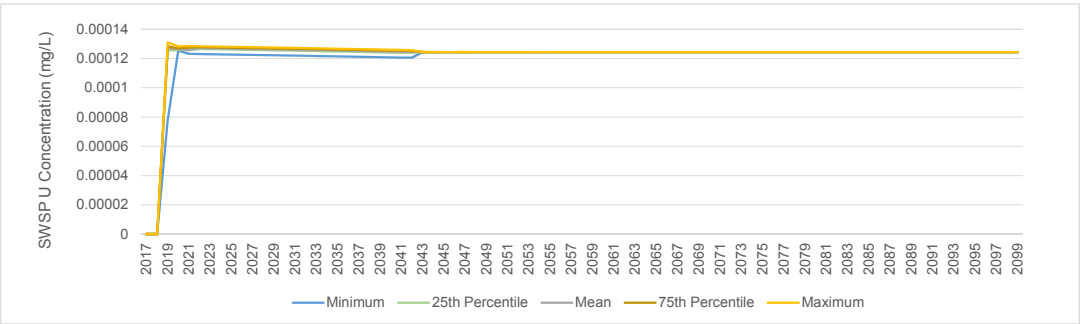

ESP U Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

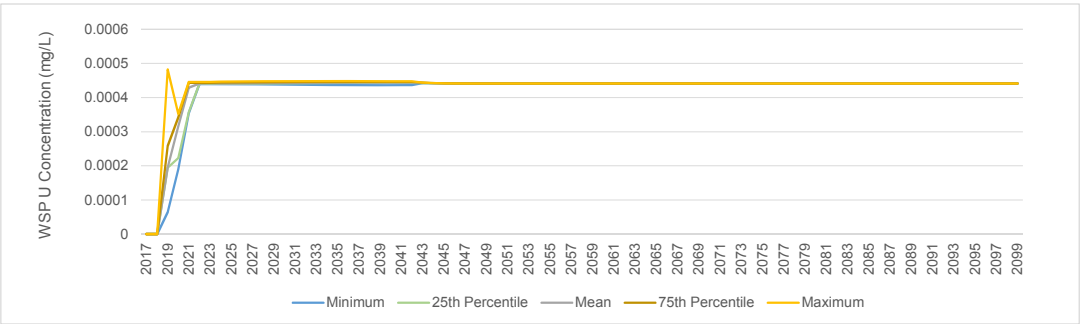

NESP U Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

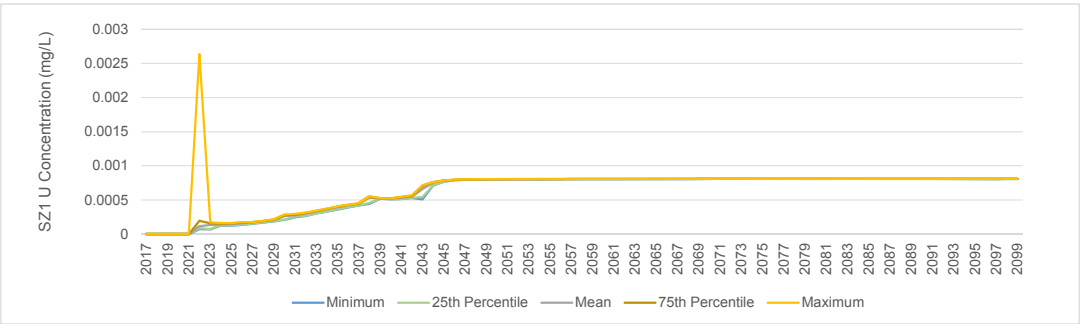

NWSP U Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

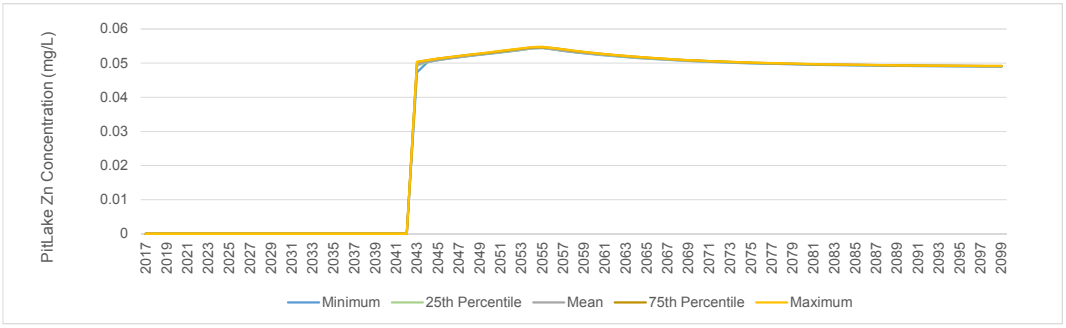

RWP U Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

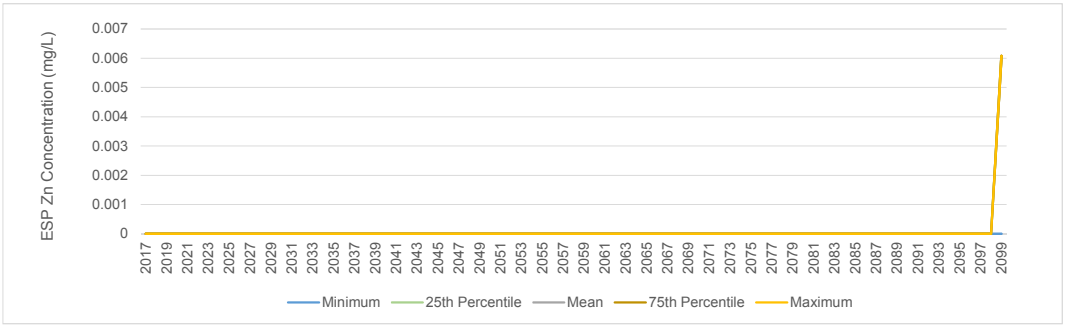

SESP U Concentration (mg/L)
0.001
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

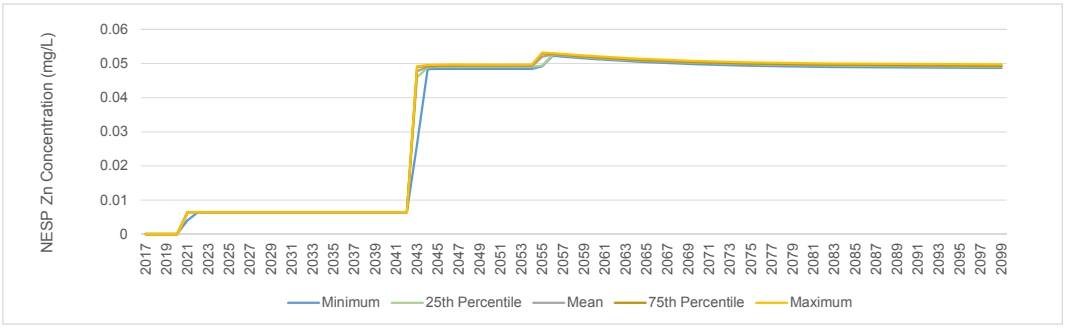

SWSP U Concentration (mg/L)
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

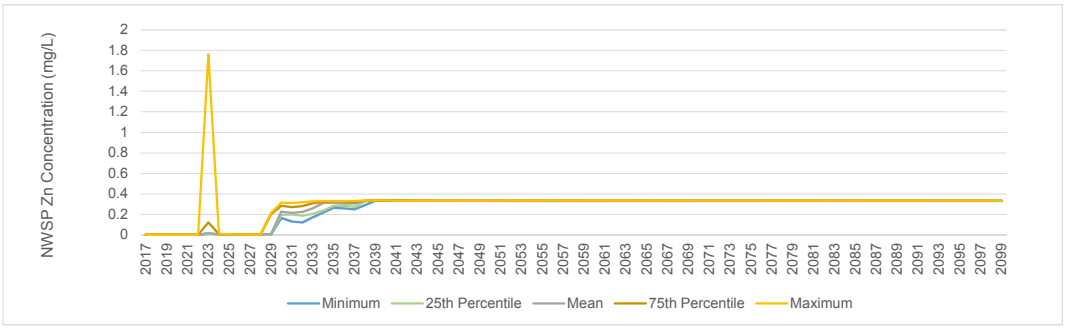

WSP U Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

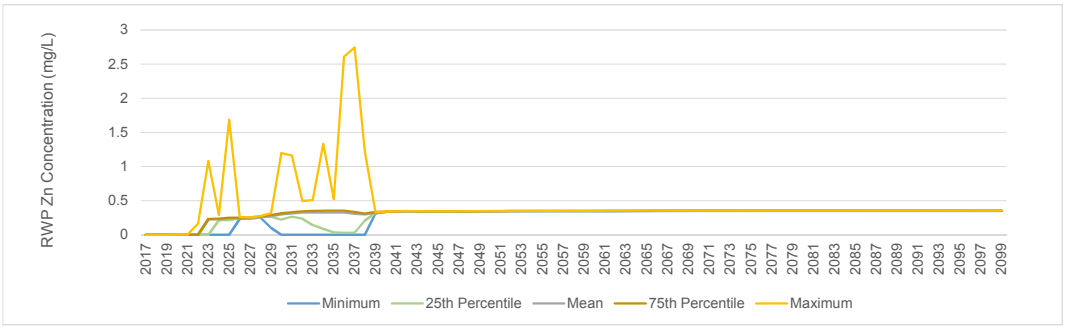

SZ1 U Concentration (mg/L)
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

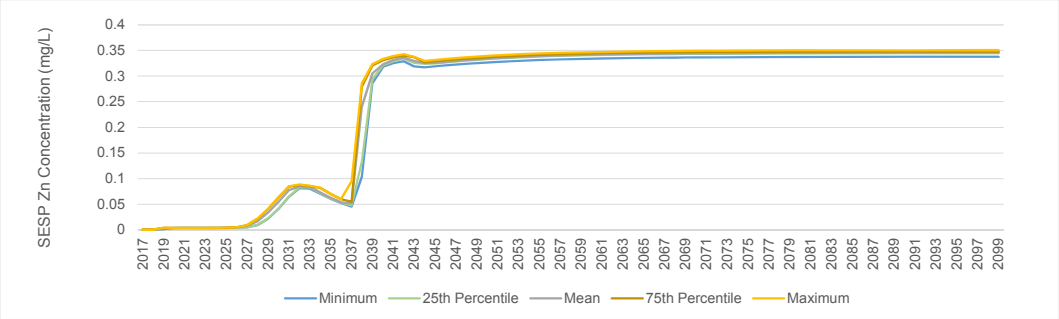

PitLake Zn Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

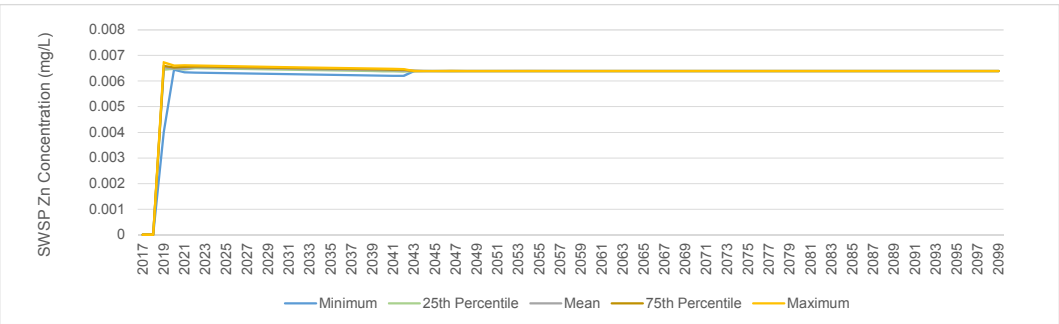

ESP Zn Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

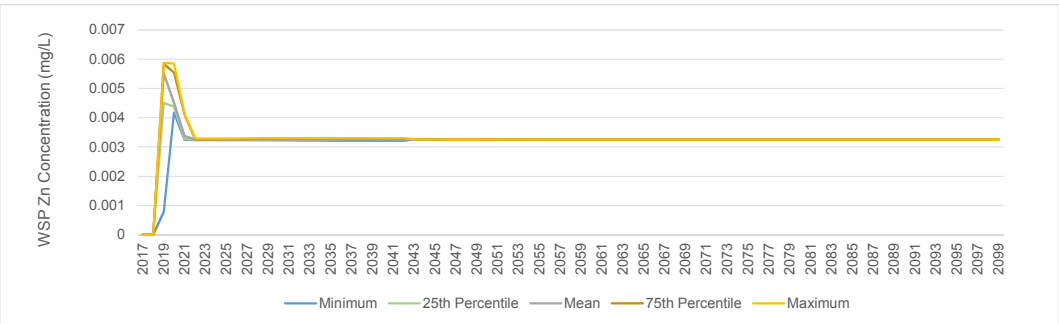

NESP Zn Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

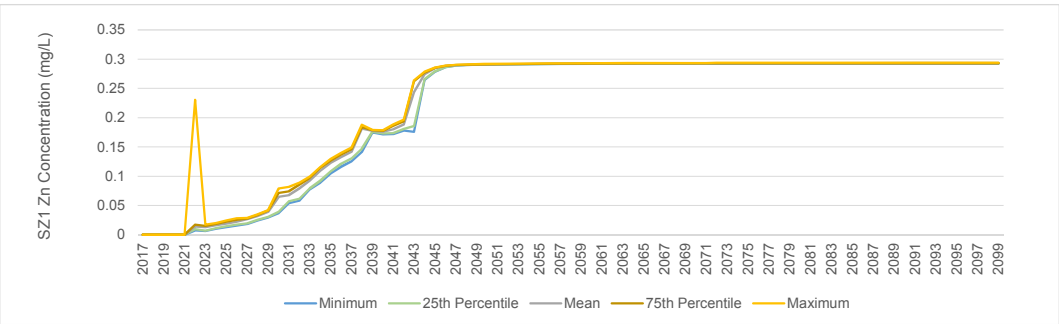

NWSP Zn Concentration (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum


RWP Zn Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum


SESP Zn Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum


SWSP Zn Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum


WSP Zn Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum


SZ1 Zn Concentration (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2017 2019 2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2067 2069 2071 2073 2075 2077 2079 2081 2083 2085 2087 2089 2091 2093 2095 2097 2099
Minimum
25th Percentile
Mean
75th Percentile
Maximum

Appendix 10c

Water Quality Management Report (SRK, August 2016)

Grassy Mountain
Water Quality Management

Prepared for

Millennium EMS Solutions Ltd.

Prepared by

SRK Consulting (Canada) Inc.
1CM029.011
August 2016

Grassy Mountain
Water Quality Management

August 2016

Prepared for

Millennium EMS Solutions Ltd.
6111-91 Street
Edmonton, AB T6E 6V6
Canada

Tel: +1 403 270 5008
Web: www.mems.ca

Prepared by

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2
Canada

Tel: +1 604 681 4196
Web: www.srk.com

Project No: 1CM029.011

File Name: Grassy_1CM029_011_Water_Quality_Management_Report_SRJ_TS_20160812_FNL.docx

Copyright © SRK Consulting (Canada) Inc., 2016

srk consulting

Executive Summary

This report describes water quality mitigation measures proposed for the Grassy Mountain Coal Project. SRK was retained by Millennium EMS Solutions Ltd (MEMS) and Riversdale Benga Mining Limited (Benga) to complete a conceptual evaluation of engineering measures that could be implemented for the Project to minimize or eliminate effects to water quality in creeks downstream of the Project. The intent of this management report was to develop mitigation concepts to a level appropriate for environmental effects assessment. Site-specific tests, field investigations, ongoing monitoring, and engineering assessments will be conducted to further refine the required performance of the proposed measures.

The water quality model developed for the Project was used to evaluate potential water quality effects in the downstream creeks as well as requirements for water quality mitigation measures. Results of the evaluation are summarized as follows:

- Selenium leaching from waste rock is the primary water quality parameter of concern in terms of protecting downstream water quality. Selenium concentrations expected in waste rock seepage and in the mine water are up to three orders of magnitude greater than generic guideline concentrations for freshwater aquatic life.
- Estimated waste rock seepage concentrations for a number of dissolved metals, including cobalt and zinc, are expected to be 5 to 50 times higher than applicable aquatic guideline concentrations.

Model predictions should be viewed as conservative but indicative of concentrations that could be observed in the field. Therefore, mitigation measures were developed to minimize water quality effects to downstream creeks, as predicted by the model.

Four categories of mitigation measures have been proposed:

1. Source control and mitigation;
2. Capture and collection of mine contact water to limit the flow of untreated mine water to Blairmore and Gold Creeks;
3. Removal of selenium and nitrate in saturated waste rock backfill; and
4. Treatment of water from the managed saturated zones to remove dissolved metals and nitrite.

Source control measures would be defined in the detailed mine design and implemented as part of the mine construction. Systems for capture and collection of mine water include surface collection of seepage from the toe of the waste rock, use of end-dumping techniques to establish a permeable layer at the base of the dump, use of collection ditches to capture shallow seepage where feasible, and installation and pumping of seepage capture wells across groundwater flow paths.

Removal of selenium and nitrate in saturated backfills is proposed to be implemented as a managed system, where reagents are added to the mine water to promote the sub-oxic or anoxic conditions required for the attenuation process. The concept of managed saturated fills was based on methods used for attenuation of nitrate, selenium, and other metals in full scale treatment applications at other mines.

The type and extent of treatment required to render water from saturated backfills suitable for discharge is uncertain. For this assessment, it was assumed that treatment for constituents such as cadmium, cobalt, iron, manganese, nickel, zinc, and nitrite would be required. The proposed treatment method is lime treatment using a High Density Sludge (HDS) process. HDS is a well-established process that is commonly used to treat mine water for dissolved metals for mining operations worldwide. An additional oxidation step may be required to ensure complete removal of nitrite.

Implementation of source control measures, seepage minimization and capture, and saturated backfills must be included as integral components of the detailed mine design and construction planning. Test work can be completed through the planning and construction phase to inform detailed design and development of operating procedures. Ongoing monitoring is required to evaluate the performance of the mitigation measures and to evaluate the need for additional mitigation measures or changes to exiting measures.

Requirements to treat water pumped from the saturated zones prior to discharge will be determined based on test work completed during early mine construction. Treatment of effluent from the saturated zones relies on established and conventional treatment processes and can therefore be implemented within a timeframe of approximately 24 months, which would be adequate time considering the Project development schedule.

Table of Contents

1 Introduction 6
1.1 Background and Scope 6
1.2 Interpretation of Model Results and Uncertainty 7
1.3 Report Organization 7
2 Mitigation Requirements 8
3 Water Quality Mitigation Measures 8
3.1 Source Control 8
3.1.1 Selenium Leaching 9
3.1.2 Acid Rock Drainage 9
3.1.3 Leaching of Explosives Residuals 10
3.2 Seepage Minimization and Capture 10
3.2.1 Seepage Minimization 11
3.2.2 Seepage capture 12
3.3 Selenium and Nitrate Mitigation in Managed Saturated Backfills 14
3.3.1 Process Description 14
3.3.2 Case Studies 16
3.4 Discharge Water Treatment 17
3.4.1 Treatment Requirements 17
3.4.2 Process Description 17
3.4.3 Operational Considerations 18
4 Implementation Schedule 19
4.1 Source Control 19
4.2 Seepage Minimization and Capture 19
4.3 Managed Saturated Backfills 20
4.4 Discharge Water Treatment 20
5 Conclusions 20
6 References 23

List of Figures

Figure 1: General Location of North, South East and South West Seepage Interception Systems 13

Figure 2: Schematic of Managed Saturated Backfill 15

1 Introduction

1.1 Background and Scope

This report describes water quality mitigation measures proposed for the Grassy Mountain Coal Project (the Project). SRK was retained by Millennium EMS Solutions Ltd (MEMS) and Riversdale Benga Mining Limited (Benga) to complete a conceptual evaluation of engineering measures that could be implemented for the Project to minimize or eliminate effects to water quality in creeks downstream of the Project. The intent of this management report was to develop mitigation concepts to a level appropriate for environmental effects assessment.

The Project, owned by Benga Mining Limited (Benga), a wholly owned subsidiary of Riversdale Resources Limited (Riversdale), is located 150 km south of Calgary, Alberta and 7 km north of the town of Blairmore, Alberta. The site was previously mined using underground and open pit methods during periods from 1909 to 1975. The Project proposed by Benga would involve an open pit coal mine, waste rock disposal areas, a Coal Handling and Processing Plant (CHPP), access and haul roads, and a coal product overland conveyor that will connect the CHPP area to a train load out facility.

SRK Consulting (Canada) Inc. (SRK) is undertaking a number of geo-environmental evaluations for the proposed Project, including:

- Geochemical characterization of mine wastes;
- Hydrological characterization and effects assessment;
- Water and load balance model for assessing potential water quality and flow effects; and
- Hydrogeological model assessment for evaluation of potential changes to the groundwater regime in the project area.

The assessments have informed Project design, including the development of water and waste management plans, and provided input to aquatic and fisheries effects assessment, human health effects assessment, water licensing, and water quality mitigation measures. The water quality mitigation measures proposed for implementation or as contingencies for the Project are described in this report.

The development of water quality mitigation measures was an iterative process carried out by SRK's water management specialists, hydrologists, hydrogeologists, geochemists and chemists in collaboration with the Project's aquatic toxicology and fisheries specialists (Hatfield Consulting [Hatfield]), MEMS, and Benga. Mitigation measures were evaluated in terms of implementation schedule, operational constraints, and feasibility to ensure that implementation could be accommodated within the Project development framework.

Water quality model predictions were generated for scenarios that included the preferred Project footprint, infrastructure layout, and development schedule. Hatfield reviewed the water quality predictions generated by SRK and identified parameter concentrations of concern. SRK then

investigated causes of elevated parameter concentrations flagged by Hatfield and identified possible mitigation measures, which were evaluated by MEMS and Benga.

The water quality mitigation measures described in this report are the end result of the assessment described above. Four categories of mitigation measures have been proposed:

1. Source control and mitigation;
2. Capture and collection of mine contact water to limit the flow of untreated mine water to Blairmore and Gold Creeks;
3. Removal of selenium in saturated waste rock backfill; and
4. Treatment of water from the managed saturated zones to remove dissolved metals and nitrite.

This report discusses capture of contact water, managed saturated zones for selenium removal, and treatment of mine water for dissolved metals. Options for source control and water quality mitigation are described in the geochemical characterization report (SRK 2016a) (provided in Appendix 10A of the application (Benga 2016)); a summary is provided in this report.

1.2 Interpretation of Model Results and Uncertainty

The water quality model for the Project was used to evaluate the water quality within and downstream of a legacy mine site (and the proposed Project) that covers more than 10 km^2, which will contain approximately 833 million of tonnes of waste rock. Although the geological, geochemical, meteorological, and hydrological conditions of the site have been appropriately characterized, the model by necessity simplifies representation of the leaching and contaminant transport processes that can occur at full scale.

To address uncertainty, input assumptions are made such that water quality predictions are higher than concentrations that would actually be observed in the field. As a result, water quality model results should be viewed as (generally) conservative estimates rather than as definitive indicators of future water quality. The effect on selection of mitigation measures is that required performance is greater than will probably actually be needed and implementation is earlier than in reality would be expected.

Discussion concerning the relative confidence in the predicted need for mitigation in terms of performance and timing is included in the discussion for each of the mitigation measures and in Section 4,.

1.3 Report Organization

This report is organized as follows:

- Section 2 summarizes estimated water quality mitigation requirements. The need for mitigation was based on results of the water quality model for the Project;

- Section 3 discusses the water quality mitigation measures that were proposed for the Project. The proposed mitigation measures are described at a conceptual level;
- Section 4 provides an overview of schedule considerations for implementing of the mitigation measures discussed in Section 3; and
- Section 5 provides a summary of conclusions,

2 Mitigation Requirements

The water quality model developed for the Project was used to evaluate potential water quality effects in the downstream creeks as well as requirements for water quality mitigation measures (SRK 2016b) (provided in Appendix 10B of the application (Benga 2016)). Results of the geochemical characterisation for the Project are summarizes as follows:

- Selenium leaching from waste rock is the primary water quality parameter of concern in terms of protecting downstream water quality. Selenium concentrations expected in waste rock seepage and in the mine water are up to three orders of magnitude greater than generic guideline concentrations for freshwater aquatic life. The rationale for derivation of leaching rates for selenium and other elements (*i.e.* geochemical source terms) are described in the report: Grassy Mountain Project, Geochemical Characterization Report (SRK 2016a) (provided in Appendix 10A of the application (Benga 2016)).
- Estimated waste rock seepage concentrations for a number of dissolved metals, including cobalt and zinc, are expected to be 5 to 50 times higher than applicable aquatic guideline concentrations.

The water quality model was used to identify the key sources of selenium and metal loadings and to estimate where, when, and to what extent mitigation would have to perform to prevent potential water quality effects. Unmitigated, the loadings of selenium and metals in mine water from the Project would cause exceedances of generic and site-specific aquatic life guidelines.

The following sections describe the mitigation concepts that were proposed for the Project and incorporated in the water quality model. The mitigation measures are presented as general concepts that will be considered for implementation at the Project. Engineering concepts have been developed at an appropriate level for the Project to allow this assessment to proceed. Site-specific tests, field investigations, ongoing monitoring, and engineering assessments will be conducted to further refine the required performance of the proposed measures. Other mitigation measures may be considered as site-specific information and revised model predictions become available

3 Water Quality Mitigation Measures

3.1 Source Control

Source control refers to measures that prevent water quality loadings from reporting to mine contact water in the first place. Options for, and selection of, source control measures for

selenium and metal leaching are discussed in (SRK 2016a) (provided in Appendix 10A of the application (Benga 2016)) and are summarized below.

3.1.1 Selenium Leaching

Passive measures to limit selenium leaching include:

- Subaqueous disposal of waste rock in backfilled pits and artificial impoundments to limit availability of oxygen and consequent oxidation of pyrite, which is assumed to be the source of leachable selenium.
- Measures to decrease the contact of water with wastes including covers on wastes.
- Treatment of contact waters in sub-oxic saturated zones of backfilled pits resulting in sequestration of selenium in adsorbed and precipitated forms.

If passive measures are impractical or ineffective, active management measures could be implemented. Active measures include:

- Enhancement of sub-oxic conditions in backfilled pits.
- Active management using water treatment plants.

These measures were identified in the Elk Valley Water Quality Plan (Teck Coal 2014a) and continue to be implemented at coal mining operations elsewhere in western Canada. Concepts proposed for active management of selenium for the Project are described in Section 3.3.

3.1.2 Acid Rock Drainage

Loadings of dissolved metals such as cadmium, zinc, and cobalt are strongly affected by the extent that accelerated oxidizing and local acidic conditions develop on site. Acidic conditions can develop when potentially acid generating (PAG) waste rock is exposed to atmospheric conditions. For some time, the acid generated will be neutralized by carbonates and other minerals present in the waste rock. Over time, PAG rock can become depleted in neutralizing minerals and will begin to produce acidic runoff. The acidic runoff leaches metals from the waste rock, resulting in contact water having high concentrations of dissolved metals. Therefore, management practices that reduce the likelihood of acid rock drainage (ARD) generation will also significantly reduce acidic dissolution of metals and consequently the likelihood of having to treat mine water for metals.

Options for management of PAG rock to address the potential for accelerated leaching associated with acidic conditions fall into the following technology groups:

- Exclusion of oxygen for oxidation by underwater disposal.
- Blending acid-consuming waste rock to offset acid generation potential.
- Limitation of water for leaching of acidic weathering products.
- Exclusion of oxygen by covers.

The applicability of each of the ARD management measures for implementation for the Project is discussed in (SRK 2016a) (Benga 2016, Appendix 10A). The first two were selected for the Project. Active water treatment for removal of dissolved metals is discussed in Section 3.4.

3.1.3 Leaching of Explosives Residuals

Assessment of potential water quality effects arising from the use of ammonium nitrate (AN)-based explosives using a generic prediction model developed in the Elk Valley (Ferguson and Leask 1988) has shown that mitigation for leaching of explosives residuals (primarily nitrate) may be needed.

The preferred approach is to minimize the residual AN in waste rock through explosives management practices including avoidance of spills, reduction of the time between loading ANFO into drilled holes and detonation, use of appropriate measures to limit loss in wet holes, minimization of misfires, and measures to recover explosives from misfires.

Nitrate loadings can also be addressed by the same treatment process that removes selenium in saturated backfills or in an active water treatment process. Conversion of nitrate to nitrogen gas occurs under the same conditions that convert selenium to less oxidized forms as described in Section 3.3.

3.2 Seepage Minimization and Capture

Minimization and capture of contact water surface flow and groundwater seepage – followed by removal of selenium in the managed saturation zones – are proposed as the primary water quality mitigation measures for the Project. Source term concentrations (*i.e.* expected waste rock seepage concentrations) are two to three orders of magnitude higher than aquatic guideline concentrations or selenium objectives developed for the Project. Therefore, selenium concentrations in the downstream creeks can be controlled only if a high proportion of contact water is collected and managed.

Seepage minimization and capture systems will be required irrespective of uncertainties in the water quality model predictions. The estimated selenium leaching rates are of a magnitude that demonstrate such systems will be required. Uncertainties in water quality model predictions, however, translate into uncertainties in the estimated performance required by the systems. The performance requirements predicted by the model should be interpreted as an indication of performance level rather than as a definitive design specification.

The water quality model conservatively estimated that a combined load capture and attenuation rate that results in an overall reduction of loadings by 95% is required to minimize the potential for downstream water quality effects. The details of the measures to achieve this target will be refined through engineering design and investigations.

The concept of “seepage capture” discussed in this section encompasses the following:

- Surface collection of seepage from the toe of the waste rock dump by:
  - Grading the waste rock foundations to facilitate effective drainage of infiltration and prevention of pooling under the waste rock dumps (purpose is to prevent infiltration water from seeping downward into the virgin ground and getting into the groundwater);
  - Use of end-dumping techniques to establish a coarse, permeable layer at the base of the dump; and
- Use of collection ditches to capture shallow seepage where feasible.
- Installation and pumping of seepage capture wells across expected deeper groundwater flow paths, with discharge directed to surge ponds.

Seepage minimization includes passive mitigation such as installation of covers to prevent water from infiltrating waste rock. Seepage reduction can also be achieved through the progressive reclamation of waste rock dumps, including re-contouring, proof-rolling, placement of a topsoil cover, and re-vegetation. This will encourage runoff, discourage ponding, and increase evapotranspiration.

Additional consideration concerning seepage minimization and capture are discussed below.

3.2.1 Seepage Minimization

Foundation preparation within the ex-pit dump areas is expected to include surface re-contouring, potentially localized lining along certain drainage paths, and effective placement of a sub-base granular layer through use of end-dumping techniques. The objective is to facilitate flow of contact water along the base of the waste rock dump and minimize infiltration into the foundation. Seepage that flows along the foundation can be collected in channels and in the surge ponds constructed downstream of the ex-pit dumps.

Installation of synthetic (i.e., plastic or geomembrane) covers on portions of the waste rock dumps was considered as a further method for reducing infiltration and hence the volume of seepage that must be captured. However, long-lasting synthetic covers can only be constructed on waste rock dumps areas with slopes no steeper than 3:1 (run to rise). At steeper angles, synthetic membranes and cover soils may not stay in place over time and slippage of the liner can cause stress on seams and the material itself. Although partial covers would reduce infiltration, they would not eliminate the need for seepage interception wells. Considering that the cost of covering significant portions of the waste rock dumps with synthetic liners are an order of magnitude greater than installation of seepage capture wells, it was assumed that synthetic liners would not be installed as part of the primary mitigation plan but could be considered in later iterations of the mitigation plan development.

3.2.2 Seepage capture

Seepage flowing from the toes of the waste rock storage areas would be collected in ditches and directed to surge ponds. Supplementary collection ditches may be required in additional areas downslope where seepage daylights at surface. These ditches would require additional ponds and pumping apparatus to pump to the surge ponds.

Seepage capture wells could be constructed across groundwater flow paths to capture seepage from ex-pit waste rock dumps with water being pumped to the surge ponds. Three target zones have been identified, based on review of existing ground surface contours and proposed waste rock storage area contours (Figure 1):

- Southwest of the north ex-pit waste rock dump where seepage would migrate towards Blairmore Creek;
- West of the south and central ex-pit waste rock dumps where seepage would migrate towards Blairmore Creek, and
- Southeast of the central waste dump where ex-pit dump seepage would migrate towards Gold Creek.

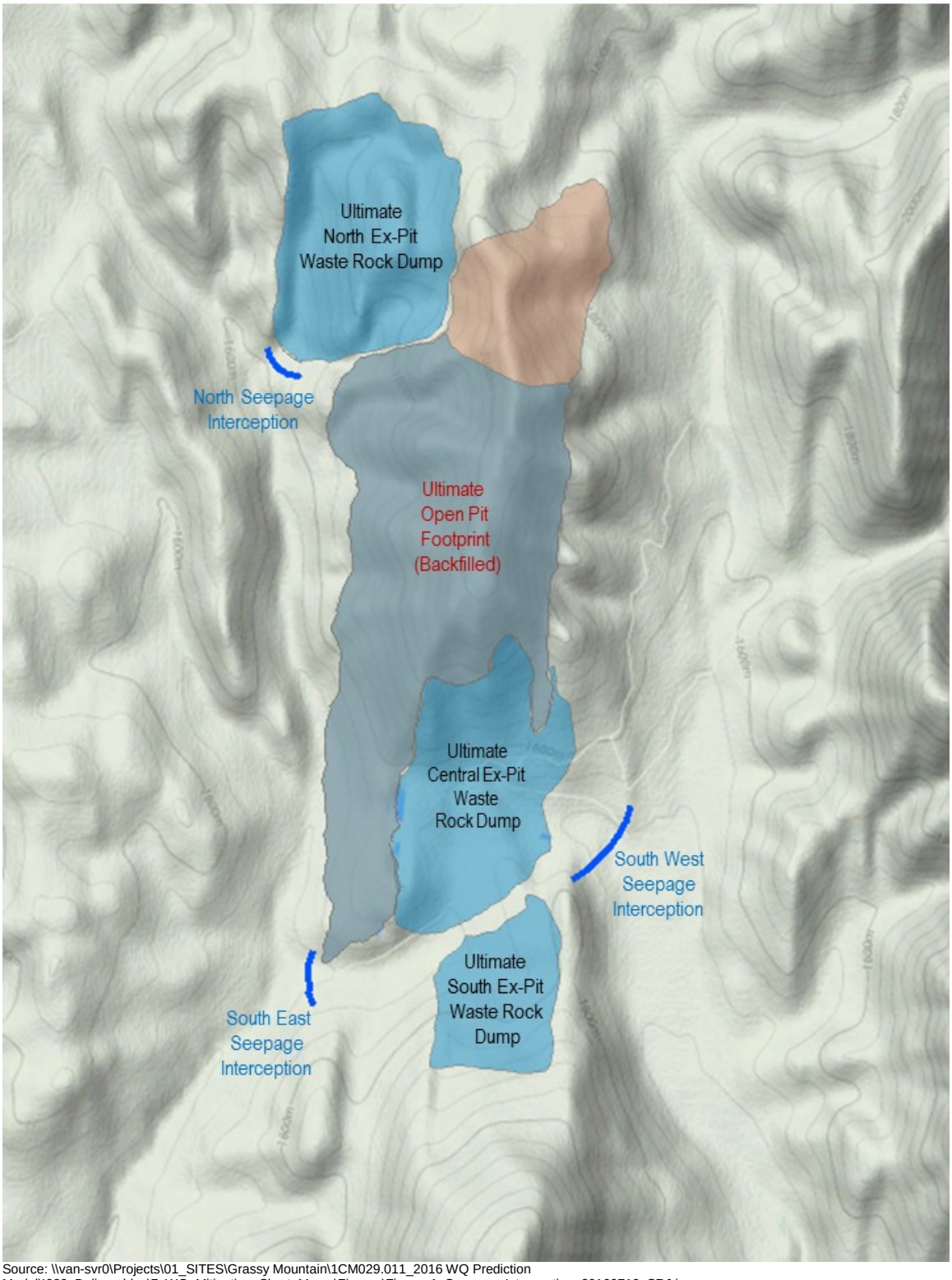
Conducting groundwater monitoring in advance of installing dewatering wells will help determine the need and extent of the program that may be required. The transects containing the seepage capture wells would be located an estimated minimum of 250 m below the toe of each waste rock dump, for safety considerations, in consideration of the need to access the wells regularly. The seepage capture wells would consist of wells that extend below the water table. The well spacing would be determined based on the detailed field investigation and hydrogeological assessment.

The hydrogeological assessment will determine if groundwater seepage from the waste rock storage areas is likely to extend to greater depths, and whether adequate drawdown from the seepage capture wells can capture the great majority of seepage. To compensate for those situations where heterogeneous fractured rock conditions do not provide for full capture, infill wells can be installed where monitoring indicates this is necessary. Based on a review of the limited available data, it is anticipated that seepage capture well yields will be low, typically in the range of 0.5 to 2 L/s, hence small submersible pumps and capture wells will be adequate (SRK 2016c).

Groundwater monitoring and surface water monitoring will be required to confirm that adequate capture is occurring. Monitoring will also be required around the remaining perimeters of the waste rock storage areas. In these areas, infiltration reporting to the waste rock storage areas is expected to drain to buried catchments underlying the waste rock. The presence of prominent geological structures in rock outcrop underlying the piles could provide a flow conduit to areas external to the piles; hence this will need to be monitored.

Extensive monitoring of surface waters in Gold Creek and Blairmore Creek will need to be conducted. Ultimately, it is these receptors that will determine if additional mitigation for the Project is required.

Capture of seepage is expected to be necessary for many years after the end of the operation.



Source: \\van-svr0\Projects\01_SITES\Grassy Mountain\1CM029.011_2016 WQ Prediction Model\!080_Deliverables\7_WQ_Mitigation_Short_Memo\Figures\Figure_1_Seepage_Interception_20160719_SRJ.jpg

Figure 1: General Location of North, South East and South West Seepage Interception Systems

3.3 Selenium and Nitrate Mitigation in Managed Saturated Backfills

3.3.1 Process Description

As discussed in Section 2, the water quality model results indicate that selenium concentrations in mine water at the Project could be two to three orders of magnitude higher than applicable guideline concentrations in the downstream creeks. In the water and load balance model, selenium attenuation in saturated backfills was assumed to amount to 99% or a final concentration of 0.015 mg/L (15 ppb), which ever was lower. Irrespective of uncertainties associated with the water quality model results, it can be concluded that highly effective selenium attenuation will be required for the Project in order to present water quality effects in the local creeks. The mitigation measure discussed here is not an evaluation of the expected performance of selenium or nitrate attenuation in saturated fills. Test-work and detailed engineering evaluation will be needed to determine the feasibility of the proposed measures; however, case studies (discussed in Section 3.3.2) of full scale applications utilizing the methods discussed demonstrate selenium attenuation performance on the order assumed in the water quality model.

The processes involved in attenuation of selenium and nitrate in saturated backfill zones are described in the geochemical assessment completed for the Project (SRK 2016a) (Benga 2016, Appendix 10A). The attenuation principle is simple: anoxic conditions promote the conversion of soluble selenate ions (SeO_4^{2-}) to selenite (SeO_3^{2-}) or elemental selenium metal (Se^0). Selenite is less soluble and tends to adsorb to mineral surfaces. Elemental selenium is insoluble. Therefore, the conversion of selenate causes the reduced selenium species to become attenuated within the saturated backfill. Nitrate (NO_3^-) is reduced to nitrogen gas (N_2).

The key to the attenuation process is the formation of sub-oxic conditions. Sub-oxic conditions are generated by microorganisms as they metabolize carbon and nutrients. Therefore, the presence of carbon and nutrients in the mine water is required for the process to work. The waste rock in the saturated backfill serve as a substrate for the microorganisms.

Waste rock contact water at coal mines typically contains dissolved organic carbon that can serve as a source of carbon for microorganisms; however, the dissolved carbon may not be easily metabolized or available to microorganisms. If the carbon is not suitable or adequate, sub-oxic conditions may not develop and selenium and nitrate may not become attenuated. If organic carbon in the mine water at the Project is unsuitable or inadequate for generating anoxic conditions in the saturated backfill zones a managed saturated backfill system may be required. The concept is illustrated in Figure 2. Managed saturated backfills simply consists of a system for adding an organic carbon source and nutrients to the mine water as it flow to the saturated backfill zones and a series of monitoring wells. This is identical to the process used in active water treatment plants for selenium removal such as the ABMet process developed by GE Water[1] only on a much larger scale.

[1] http://www.gewater.com/products/abmet-selenium-removal.html

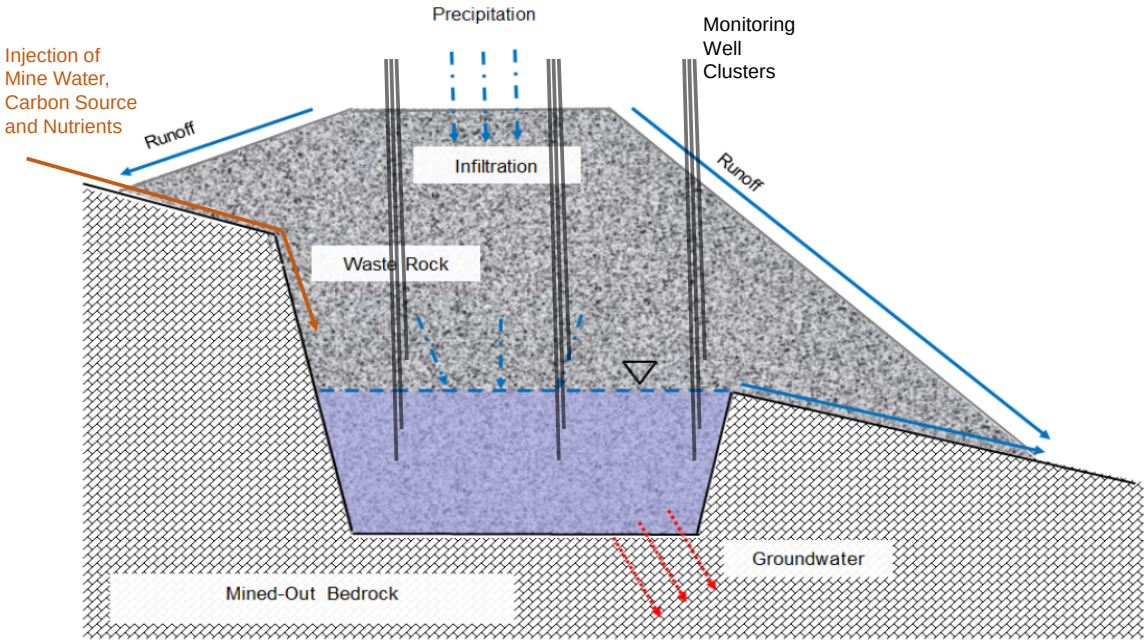


Figure 2: Schematic of Managed Saturated Backfill

Sources of organic carbon that have been used in similar applications include molasses and methanol (Paulson 2004; Park 2006; Martin 2009). The dose of organic carbon required depends primarily in the concentration of dissolved oxygen and nitrate in the mine water. Approximately 3 g of methanol is required to attenuate 1 g of nitrate.

The addition of a carbon source that is easily metabolized by microorganisms ensures that anoxic conditions can develop relatively rapidly and be sustained. The rate at which anoxic conditions are developed determine the time required for attenuation to occur and consequently the hydraulic residence time required. In an active water treatment plant the residence time required is on the order of hours. The residence time required for the saturated backfills to be implemented at the Project is unknown. However, case studies (discussed in Section 3.3.2) of full-scale treatment systems using the proposed process indicate that the hydraulic residence time required is on the order of a few weeks. Case studies that examined nitrate and selenium attenuation in passive saturated backfills estimated that hydraulic residence times of three months to three years are required for selenium attenuation to occur (SRK 2016a) (Benga 2016, Appendix 10A).

Sustaining anoxic conditions is important to prevent reversal of selenium attenuation. Monitoring wells within the saturated backfill zones would continuously record oxygen reduction potential (ORP), dissolved oxygen concentrations or other relevant process parameters. Direct operational monitoring of the managed saturated backfills would allow operators to refine carbon and nutrient doses.

If properly monitored and operated, the managed saturated backfill systems are expected to be both safe and reliable. However, if conditions within the saturated zones become excessively reducing, hydrogen sulphide gas may be generated as a by-product of sulphate reduction. Hydrogen sulphide gas is foul smelling and toxic. Because of the possibility of generating hydrogen sulphide, gas monitors may need to be installed at various locations within and adjacent to the saturated backfill zones.

Anoxic, or reducing, conditions promote the dissolution of certain constituents such as manganese, iron and arsenic provided that minerals containing such metals are present. Therefore, concentrations of these constituents may be elevated after the mine water has passed through the anoxic saturated zone. In addition, incomplete reduction of nitrate or incomplete oxidation of ammonia can result in elevated concentrations of nitrite, which is relatively toxic to aquatic life. Proposed treatment for removal of dissolved metals are discussed in Section 3.4.

Implementation of managed saturated backfills requires an improved understanding of the process kinetics and performance response to different process parameters. Development of test programs are discussed in Section 4.3.

3.3.2 Case Studies

The Geochemical Characterization Report for the Project touched on studies that have looked at passive mitigation of selenium and nitrate in saturated backfills (SRK 2016a) (Benga 2016, Appendix 10A). In this context, “passive” refers to situations where mine water at raw coal mines was routed through backfill zones without treatment, reagent addition or other intervention. Passive treatment relies on the serendipitous presence of organic carbon and nutrients to promote sub-oxic conditions required for attenuation to occur. However, in many cases it is advantageous to augment or control reaction rates. This section looks at case studies where the attenuation process has been implemented as engineered systems.

The concept of deliberately generating anoxic conditions in large in-situ reservoirs as for the purpose of water treatment dates back several decades. A review published by the Interstate Technology and Regulatory Cooperation Work Group (ITRC, 2000) summarized a number projects that aimed to attenuate nitrate in-situ using a carbon source to promote reducing conditions. Although waste rock has large pore space than consolidated soil the attenuation process is the same as the one proposed for the managed saturated backfill.

An applicable case study is the treatment of the Sweetwater Pit Lake by the Kennecott Uranium Company in Wyoming, USA (Paulson 2004). The Sweetwater Pit Lake was formed by the flooding of the Sweetwater open pit uranium mine following the end of mining and dewatering in April 1983. After flooding, concentrations of dissolved uranium and selenium were approximately 0.46 mg/L and 8.1 mg/L, respectively. The lake contained approximately 4.5 Mm^3 of water. The pit lake was treated using 549 tons of sugars, fats, proteins, alcohols, phosphates and nitrates from between the middle of October and the end of December 1999. Average concentrations of dissolved selenium in the pit lake dropped to 0.004 mg/L, a 99% reduction. Monitoring results from July, 2004 showed that the pit lake treatment remained effective for years following the treatment campaign.

The principal difference between the managed saturated backfill treatment concept proposed for the Project and the treatment of the Sweetwater Pit Lake is that the Grassy Mountain pits would be backfilled. Treatment of selenium in open water is more challenging because of ease with which oxygen can diffuse into the surface of the pit lake, because of the lack of a substrate for microorganisms and the lack of minerals for reduced selenite to adsorb to. Therefore, conditions within the saturated backfill are expected to be more amenable to selenium attenuation than the conditions in the Sweetwater Pit.

A field demonstration study carried out at the abandoned Tide Mine in Pennsylvania in 2004 demonstrated how a pool of underground mine water could be rendered anoxic by injecting a carbon source (molasses) and recirculating the water (Houston *et al,* 2005). Selenium removal was not a subject of the study. The extent of reducing conditions were tracked by monitoring concentrations of ferric and ferrous iron.

Martin (2009) reported on the in-situ treatment of a backfilled pit at the Beal Mountain Mine in Montana in 2002. Organic carbon was added to the pit during the filling period to attenuate nitrate and selenium in the mine water. Selenium concentrations were reduced from 0.042 to 0.047 mg/L to between 0.002 and 0.003 mg/L. In another application of bioremediation using organic carbon at the Anchor Hill Pit Lake in South Dakota, reducing conditions were generated but specific attenuation rates were not reported (Park, 2006).

The case studies summarized are intended to demonstrate that the concept proposed for selenium and nitrate attenuation in managed saturated backfills have been demonstrated in full scale applications. Therefore, the implementation of the proposed selenium attenuation process for the Project is expected to be focussed on adapting the technology to the site-specific conditions rather than on proof-of-concept.

3.4 Discharge Water Treatment

3.4.1 Treatment Requirements

The water quality model results for the Project indicated that effluent pumped from managed saturated backfills may contain elevated concentrations of cadmium, cobalt, iron, manganese, nickel, zinc, and nitrite. The requirement for treatment of water pumped from the saturated backfill zones are uncertain. At a minimum, aeration or oxidation followed by settling of solids would likely be required to remove constituents such as ferrous iron or nitrite. Such a treatment process could be constructed and operated semi-passively by allowing outflow from the saturated zones to cascade over a rockfall into a pond. However, it is also possible that active treatment for dissolved metals will be required as discussed below. Monitoring and test-work carried out to evaluate operating parameters for the managed saturated backfills is expected to reveal the type and extent of discharge treatment required.

3.4.2 Process Description

Water treatment using lime for removal of metals is a widely used treatment method used at many mine sites globally. The process is usually known as a High Density Sludge (HDS) process. The process works by adding lime to the process water, which raises the pH and

precipitates dissolved metals as solid metal hydroxides. In the process, lime slurry and mine water are fed into a reactor tank. Metals contained in the influent precipitate according to their solubility limits and the pH set-point in the neutralization tank. Precipitated metals are then collected as sludge in a clarifier. The treated effluent can be discharged to the environment. Sludge is typically stable under pH neutral conditions, is expected to be non-toxic and can be deposited in an onsite repository.

If required, water from the managed saturated backfill would be pumped to the water treatment plant. Over the life of the mine, the pumped flow may range between 500 m^3/day in 2017 up to 30,000 m^3/day towards the end of the mine life. Given the large range of potential flows, it is likely that two parallel process trains would be built in stages.

In order to precipitate all elevated metals of potential concern, a target pH around 10 will have to be reached. The lime consumption rate will be based off of this end target. However test work will have to be done to optimize plant design parameters.

The managed saturated backfill will act as the water treatment surge pond. The water elevation will be managed such that additional capacity will be available for large storm events or plant down time. A submersible pump will convey water from the managed saturated backfill to the water treatment plant. Large planned maintenance events will be scheduled during winter months when flow rates are expected to be lowest.

The reactor tanks will be aerated to oxidize iron facilitating the precipitation of ferric hydroxide. This will also facilitate the oxidization of nitrite to nitrate although additional oxidants may be required.

Overflow from the clarification process will be directed to locations in Blairmore Creek where flow is required to sustain fish habitat. Prior to discharge, the effluent may require a pH adjustment using carbon dioxide to lower the effluent pH. The effluent will be monitored for pH, turbidity and indicator metals onsite to ensure it meets the discharge guidelines. Under upset conditions the effluent can be directed back to the raw water pond or the far end of the saturated backfill zone.

The lime treatment process is simple and utilizes two reagents; lime and flocculent. The reagent consumption rates were estimated based on the worst case water quality and flow expected. Test work will be required to optimize operating conditions utilized in these estimations.

3.4.3 Operational Considerations

The HDS process is widely used at mine sites worldwide. The process will require the attention of one operator part time to make sure that the process is running smoothly. The operator will be responsible for tracking reagent usage, recording effluent parameters per licence requirements, testing process conditions and adjusting operational parameters.

The three major parameters to control are the lime dose, flocculent dose and the sludge recycle rate. The lime and flocculent dosing will be linked up to the feed flow rate and loading. Since no sudden flow changes are expected, these parameters will have to be adjusted over time to match

the change in influent flow. The sludge recycle rate is adjusted based on water quality. The solids amount in the neutralization tanks should be kept constant. During times of better water quality, less metal loading will lead to a lower solid production rates and the recycle will be increased. The opposite will happen when poorer water quality is present, the solids production will increase and less sludge recycle will be required.

4 Implementation Schedule

The time required to implement the mitigation measures discussed in Section 3 vary. Effective implementation requires that lead times for implementation is appropriately accounted for in the water management plan for the Project. Lead time includes tasks such as pilot and field scale trials, detailed design, procurement, construction, commissioning and transfer to operation. Monitoring is required before, during and after the implementation of the mitigation measures.

4.1 Source Control

Source control measures are typically integral components of the mine design and must therefore be considered at the mine design phase. Reservoirs for inundating waste rock are most often open pits. A decision to install covers on waste rock dumps may be made at any time during the design, operations or closure period for a Project. However, covers that include synthetic liners cannot be installed on slopes with an angle greater than about 1:3 (rise:run). Therefore, if synthetic liners are considered for source control then this should be considered during the design of the waste rock dump.

Options for implementing source control measures were evaluated through several iterations of the proposed mine design for the Project an incorporate to the best extent possible.

4.2 Seepage Minimization and Capture

The estimated timeline for implementation of seepage minimization and capture is 18 to 24 months. Initial implementation would include:

- A field investigation and drilling program to characterize the hydrogeology of the zones target for seepage capture, including the establishment of monitoring wells;
- Surface survey of dump foundation to evaluate ways to improve basal drainage;
- Detailed design of diversion, ditches, drainage layers, well fields, pumping systems and monitoring wells;
- Procurement of equipment and contractor services; and
- Construction.

The contact water capture system is envisioned to be constructed during the first phase of mine construction.

Ongoing operations include operation and maintenance of pumping systems as well as maintenance and sampling of monitoring wells. If ongoing monitoring indicates that additional wells are required to improve capture performance than additional wells could likely be installed and operational within three to six months.

4.3 Managed Saturated Backfills

The design and construction of managed saturated backfills include the development of specifications for water injection systems, reagent addition systems, wells for extracting water from the saturated zones, and monitoring wells. The primary implementation challenge associated with managed saturated backfills is to understand the process kinetics and define operational parameters and procedures. This involves the design and construction of test systems (pilot scale, field scale and full scale tests).

For the Project, test-work for evaluating operating parameters for the saturated backfills are envisioned to begin as soon as a decision is made to proceed with the Project:

- First step will be to begin pilot-scale test-work on site. Pilot trial can be configured in a number of different ways but would basically consists of a few tonnes of waste rock contained in an enclosure that would limit contact with the atmosphere. Selenium and nitrate rich water would be pumped through the pilot reactor under different operating conditions; and,
- When construction commences, a field scale test can be constructed. A field-scale test would include a saturated fill constructed from several thousand tonnes of waste rock submerged in a pond or other impoundment. Selenium and nitrate rich water would be pumped through the pilot reactor under different operating conditions;

Assuming that test work commences as soon as the Project is initiated, several years of test data would be available before a full scale system becomes operational.

4.4 Discharge Water Treatment

HDS plants are common and do not require specialized equipment or construction methods. HDS plants can typically be designed, constructed and commissioned within 24 months but could be fast-tracked in as little as 12 months depending on the equipment selection. The test-work completed for the managed saturated backfills is expected to reveal whether, or to what extent discharge water treatment is required. Therefore, assuming that test-work commences as soon as a decision is made to proceed with the Project, ample time should be available to implement discharge water treatment.

5 Conclusions

The water quality model for the Project indicated that water quality mitigation measures would be required to prevent adverse effects to water quality in the downstream creeks. Selenium associated with waste rock was identified as the primary parameter of concern, followed by dissolved metals and nitrite. The need for, and required performance of, water quality mitigation

measures are associated with varying levels of uncertainty, which should be considered when evaluating the proposed implementation.

Water quality monitoring and mitigation measures proposed for the Project include:

1. Source control and mitigation by mine design;
2. Capture and collection of mine contact water to limit the flow of untreated mine water to Blairmore and Gold Creeks;
3. Removal of selenium in managed saturated zones; and
4. Treatment of water flowing from the managed saturated zones to remove dissolved metals and nitrite.

The mitigation measures described in this report are presented as concepts that need to be evaluated further by detailed field studies and engineering assessments.

This report, Grassy Mountain Water Quality Management, was prepared by

SRK Consulting (Canada) Inc.

Original Signed By

Soren Jensen, P.Eng
Principal Consultant (Water Management)

Reviewed by:

Original Signed By

Stephen Day, PGeo
Corporate Consultant (Geochemistry)

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Millennium EMS Solutions Ltd. . Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

6 References

Houston, K.S. and P.N. Milionis (ARCADIS G&M, Inc., Newtown, PA); R.L. Eppley (Blacklick Creek Watershed Ass., Homer City, PA); J. M. Harrington and J.G. Harrington (ARCADIS, Denver, CO). . 2005. Field demonstration of In-Situ Treatment and Prevention of Acid Mine Drainage in the Abandoned Tide Mine, Indiana County, Pennsylvania. Proceedings, West Virginia Surface Mine Drainage Task Force Symposium; 26:1—9. http://www2.datashed.org/sites/default/files/tide_demo.pdf

Interstate Technology and Regulatory Cooperation Work Group (ITRC), 2000. *Emerging Technologies for Enhanced In Situ Biodenitrification (EISBD) of Nitrate-Contaminated Ground Water*. Prepared by Interstate Technology and Regulatory Cooperation Work Group Enhanced In Situ Biodenitrification Work Team.

Martin, A.J. 2009. Passive and Semi-Passive Treatment Alternatives for the Bioremediation of Selenium from Mine Waters. https://open.library.ubc.ca/cIRcle/collections/britishcolumbiaminereclamationsy/50878/items/1.0042571

Park, B.T. 2006. In-Situ Chemical and Biological Treatment Leading to Successful Water Discharge from Anchor Hill Pit Lake , Gilt Edge Mine Superfund Site, South Dakota, USA. 17th International Conference on Acid Rock Drainage (ICARD), March 26-30, 2006, St. Louis MO. R.I. Barnhisel (ed.) Published by the American Society of Mining and Reclamation (ASMR), 3134 Montavesta Road, Lexington, KY 40502

Paulson, O. Harrington, 2004. Bioremediation of the Sweetwater Pit Lake – Four Years Following Treatment. http://webapp1.dlib.indiana.edu/virtual_disk_library/index.cgi/6741585/FID3136/Extended%20Abstracts/Paulson_Oscar.html

SRK Consulting Ltd. 2016a. Grassy Mountain Project, Geochemical Characterization Report. Report Prepared for Millennium EMS Solutions Ltd: SRK, July 2016.

SRK Consulting Ltd. 2016b. Grassy Mountain Water and Load Balance Model. Report Prepared for Millennium EMS Solutions Ltd: SRK, July 2016.

SRK Consulting Ltd. 2016c. Grassy Mountain Coal Project Groundwater Numerical Model. Report Prepared for Millennium EMS Solutions Ltd: SRK, August 2016.

Teck Coal Ltd. 2014a. Elk Valley Water Quality Plan. Available at http://www.teckelkvalley.com/res/vpl/documents/_ces_portal_meta/_portal_pages/documents/elk_valley_water_quality_plan_teck_resources.pdf (accessed May 22, 2015)