REPORT

Sabina Gold & Silver Corporation Back River Project

Effluent Quality Criteria Report for Effluent Discharged from Tailings Facilities, Tailings Storage Facilities, or Reservoirs - Version 1

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1.0 INTRODUCTION

Sabina Gold & Silver Corp. (Sabina) owns the Back River Project (the Project), which is in the West Kitikmeot Region of Nunavut. The Project is a proposed multi-open pit (Umwelt, Llama, and Goose Main) and underground (Umwelt) gold mine with an estimated 28-year life from mobilization to post-closure. The construction phase is estimated to commence in 2021.

The objective of this report is to develop effluent quality criteria (EQC) for effluent discharged to Goose Lake from tailings facilities, tailings storage facilities, or other reservoirs as outlined in Part F, Condition 21 of the Draft Water Licence Framework.

1.1 Effluent Quality Criteria Terminology

Effluent quality criteria (EQC) represent concentrations of parameters at the point of discharge (i.e., end-of-pipe) that are calculated so water uses in the receiving environment are protected. Water quality guidelines (WQGs) represent concentrations of parameters in the receiving environment that are protective of water uses. Water quality guidelines are required to calculate EQC (Table 1). There are three types of EQC referenced in this report:

- Metal and Diamond Mining Effluent Regulations (MDMER) limits. The MDMER limits are discussed in Section 2.0.
- Water quality-based EQC. Water quality-based EQC are calculated so that water uses in the receiving environment are protected (i.e., concentrations of parameters remain below WQGs). Water quality-based EQC are discussed in Section 6.0.
- Technology-based EQC. Technology-based EQC are selected for parameters that are influenced by treatment or other mitigation technologies to be used at the Project. Technology-based EQC are discussed in Section 7.0.

Table 1: Effluent Quality Criteria and Water Quality Guidelines

Effluent Quality Criteria	Water Quality Guidelines

▪ Apply at end-of-pipe
▪ Typically, higher than water quality guidelines that apply in the receiving environment due to mixing and dilution
▪ Regulated under the Water Licence
▪ Enforced by Regulatory Agency / Inspector
▪ Can be water quality-based, technology-based, or Metal and Diamond Mining Effluent Regulation limits
	▪ Apply in the receiving environment
	▪ Can be:
	  ▪ Generic concentrations of parameters published by federal, provincial, and/or territorial government agencies
	  ▪ Site-specific concentrations of parameters developed for the Project based on local conditions and biota

1.2 Report Structure

The EQC Report is organized as follows:

- Section 2.0 presents the MDMER limits that apply to the Project.
- Section 3.0 presents the acute and chronic WQGs and site-specific water quality objectives (SSWQOs) for the protection of aquatic life in Goose Lake.
- Section 4.0 describes the hydrodynamic and water quality model of Goose Lake (Goose Lake Model) that was used to develop EQC for the Project.
- Section 5.0 describes the approach used to identify parameters of potential concern (POPC) and identifies the POPC for the Project.
- Section 6.0 describes the approach used to calculate water quality-based EQC and proposes water quality based EQC for the POPC.
- Section 7.0 proposes technology-based EQC for the Project.
- Section 8.0 presents a summary of the EQC for the Project.
- References Section presents a list of references cited in the report.

2.0 METAL AND DIAMOND MINING EFFLUENT REGULATIONS

The MDMER apply to metal and diamond mines in Canada. These regulations impose limits on releases of deleterious substances as well as prohibit the discharge of effluent that is acutely lethal to fish. The Project will align the proposed EQC with requirements under the MDMER, which for new mines come into force on 1 June 2021. That is, the Project will achieve the MDMER discharge limits (Table 2; [Government of Canada 2002]), or lower.

Table 2: Metal and Diamond Mining Effluent Regulations for New Mines as of 1 June 2021

Deleterious Substance	Units	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
pH	-	Between 6.0 and 9.5		
Total suspended solids	mg/L	15	22.5	30
Un-ionized ammonia	mg N/L	0.5	not applicable	1
Total arsenic	mg/L	0.1	0.15	0.2
Total copper	mg/L	0.1	0.15	0.2
Total lead	mg/L	0.08	0.12	0.16
Total nickel	mg/L	0.25	0.38	0.5
Total zinc	mg/L	0.4	0.6	0.8
Radium-226	Bq/L	0.37	0.74	1.11
Cyanide	mg/L	0.5	0.75	1

Source: Government of Canada (2002).

3.0 ACUTE AND CHRONIC WATER QUALITY GUIDELINES AND SITE-SPECIFIC WATER QUALITY OBJECTIVES

Effluent quality criteria were calculated so that:

- Concentrations of parameters at end-of-pipe remained below acute WQGs for the protection of aquatic life from the Canadian Council of Ministers of the Environment (CCME 1999) and the acute criterion for total ammonia from the United States Environmental Protection Agency (USEPA 2013).
- After mixing of the effluent in Goose Lake, concentrations of parameters remained below chronic WQGs for the protection of aquatic life from CCME (1999) and below SSWQOs.

Table 3 presents that acute and chronic WQGs and SSWQOs that were used to calculate EQC for the Project.

Table 3: Water Quality Guidelines and Site-specific Water Quality Objectives

Parameter [(a)]	Unit	Water Quality Guideline for the Protection of Aquatic Life [(b)]		Chronic Site-specific Water Quality Objective
		Acute	Chronic	
Major Ions				
Chloride	mg/L	640	120	-
Fluoride	mg/L	-	0.12	-
Nutrients				
Nitrate	mg-N/L	124	2.93	2.93 - 10 [(c,d)]
Nitrite	mg-N/L	-	0.06	-
Total ammonia	mg-N/L	14 – 20[(e)]	2.6 - 12 [(f)]	-
Total Metals				
Aluminium	mg/L	-	0.005 or 0.1 [(g)]	0.044 – 0.122 [(h)]
Arsenic	mg/L	-	-	0.01 [(i)]
Boron	mg/L	29	1.5	-
Cadmium	mg/L	0.0077 [(c)]	0.00004 – 0.0002 [(c)]	-
Chromium	mg/L	-	0.001 [(j)]	-
Copper	mg/L	-	-	0.0042 [(k)]
Iron	mg/L	-	0.3	-
Lead	mg/L	-	0.001 – 0.0034 [(c)]	-
Mercury	mg/L	-	0.000026	-
Molybdenum	mg/L	-	0.073	-
Nickel	mg/L	-	0.025 – 0.10 [(c)]	-
Selenium	mg/L	-	0.001	-
Silver	mg/L	-	0.00025	-
Thallium	mg/L	-	0.0008	-
Uranium	mg/L	0.033	0.015	-

Table 3: Water Quality Guidelines and Site-specific Water Quality Objectives

Parameter [a]	Unit	Water Quality Guideline for the Protection of Aquatic Life [b]		Chronic Site-specific Water Quality Objective
		Acute	Chronic	
Dissolved Metals [l]				
Manganese	mg/L	14.9 [c]	0.20 – 0.55 [m]	-
Zinc	mg/L	0.23 [n]	0.009 – 0.039 [o]	-
Other				
Cyanide	mg/L	-	0.005	-

(a) Only parameters with WQGs or SSWQOs are included in this table.

(b) CCME (1999).

(c) The WQG is hardness dependent. The acute WQG is based on a predicted discharge hardness concentration from Primary Pond of 1,034 mg/L as $CaCO_3$. The chronic WQG is based on predicted hardness concentrations that ranged from 13 to 104 mg/L as $CaCO_3$ in the Goose Lake model. Hardness concentrations are calculated from predicted calcium and magnesium concentrations in the model.

(d) The chronic SSWQO for nitrate is based on the generic WQG for the protection of aquatic life (CCME 1999) when hardness concentrations are less than 26 mg/L as $CaCO_3$, the hardness-dependent SSWQO (Rescan 2012) when hardness concentrations are between 26.4 and 94 mg/L as $CaCO_3$, and the maximum acceptable concentration in drinking water (Health Canada 2019) when hardness concentrations are greater than 94 mg/L as $CaCO_3$.

(e) The acute water quality criterion for total ammonia is temperature and pH dependent. The criterion is based on predicted water temperatures that ranged from 0 to 19.5 °C in the Goose Lake model and a pH 7.2, which was the maximum pH value for the body of Goose Lake (Golder 2019).

(f) The WQG for total ammonia is temperature and pH dependent. The WQG is based on predicted water temperatures that ranged from 0 to 19.5 °C in the Goose Lake model and a pH 7.2, which was the maximum pH value for the body of Goose Lake (Golder 2019).

(g) The WQG for total aluminum is pH dependent. The 0.005 mg/L guideline corresponds to a pH less than 6.5 and 0.1 mg/L corresponds to a pH greater than or equal to 6.5.

(h) The SSWQO for total aluminum is pH, DOC, and hardness dependent. The SSWQO is based on a pH of 6, DOC of 3.5 mg/L, and predicted hardness concentrations that ranged from 13 to 104 mg/L as $CaCO_3$ in the Goose Lake model.

(i) The SSWQO for total arsenic is from Appendix E1 of Sabina (2017).

(j) The WQG is for chromium VI.

(k) The SSWQO for total copper is from Golder (2016).

(l) Predicted concentrations of total manganese and zinc were conservatively compared to guidelines for the dissolved fractions of these two metals.

(m) The chronic dissolved manganese WQG is pH and hardness dependent. The WQG is based on a pH of 6.0 and predicted hardness concentrations that ranged from 13 to 104 mg/L as $CaCO_3$ in the Goose Lake model.

(n) The acute dissolved zinc WQG is hardness and DOC dependent. The WQG is based on a DOC of 3.5 mg/L and based on a predicted discharge hardness concentration from Primary Pond of 1,034 mg/L as $CaCO_3$.

(o) The chronic dissolved zinc WQG is pH, hardness and DOC dependent. The WQG is based on a pH of 7.2, DOC of 3.5 mg/L, which was the minimum DOC in Goose Lake, and predicted hardness concentrations that ranged from 13 to 104 mg/L as $CaCO_3$ in the Goose Lake model.

Note:

Values of pH and DOC used to calculate pH and DOC dependent guidelines were based on data collected in Goose Lake presented in the Aquatic Baseline Synthesis Report (Golder 2019).

Values of temperature, chloride, and hardness used to calculate temperature, chloride, and hardness dependent guidelines were based on the predicted value of temperature, chloride, or hardness from the Goose Lake model with effluent discharged from Primary Pond.

CCME = Canadian Council of Ministers of the Environment; $CaCO_3$ = calcium carbonate; DOC = dissolved organic carbon; WQG = water quality guideline; SSWQO = site-specific water quality objective; - = guideline not available.

3.1 Nitrate

The project proposes to use a hardness dependent SSWQO for nitrate to develop EQC. Rescan (2012) developed a nitrate SSWQO for the Ekati Diamond mine that is hardness dependent over a range of hardness concentrations from 10 to 160 mg/L as $CaCO_3$. This SSWQO was adopted for the Ekati Diamond Mine in May 2013 (WLWB 2013). The hardness dependent SSWQO for nitrate was also determined to be protective of aquatic life in Snap Lake at the De Beers Canada Inc. Snap Lake Mine (MVEIRB 2014) and in Lake N11 at the De Beers Canada Inc. Gahcho Kué Mine (MVLWB 2018). Hardness concentrations in Goose Lake are not predicted to exceed 160 mg/L as $CaCO_3$. As a result, the Project proposes:

- To maintain the CCME WQG for the protection of aquatic life for nitrate of 2.93 mg N/L when hardness concentrations are less than 26.4 mg/L as $CaCO_3$ in Goose Lake.
- To adopt the hardness dependent equation developed for the Ekati Diamond Mine as the SSWQO for nitrate in Goose Lake (Table 4; Rescan 2012) when hardness concentrations are greater than or equal to 26.4 mg/L as $CaCO_3$ in Goose Lake.

Table 4: Chronic Site-specific Water Quality Objective for Nitrate

Hardness (mg/L as CaCO3)	Chronic SSWQO (mg N/L)
<10	1.17
≥10 and ≤160	$e^{0.9518[\ln(\text{hardness})] - 2.032}$
>160	16.42

Source: Rescan (2012c).

< = less than; > = greater than; ≤ = less than or equal to; ≥ = greater than or equal to; $CaCO_3$ = calcium carbonate.

3.2 Total Aluminum

The current chronic WQG for total aluminum is the pH dependent guideline from CCME (1999). The Project proposes to use a modified version of the USEPA (2018) water quality criterion as a SSWQO to develop EQC because:

- Under baseline conditions, the pH is parts of Goose Lake is naturally less than 6.5. At these times, total aluminum has been measured at concentrations greater than the CCME WQG (i.e., greater than 0.005 mg/L) (Golder 2019).
- The SSWQO accounts for the effects of pH, dissolved organic carbon, and hardness concentrations on the bioavailability and toxicity of aluminum.
- Recent studies have supported the development of water quality-dependent criteria that incorporate several exposure and toxicity modifying factors to replace existing fixed-value aluminum water quality standards (Gensemer et al. 2018; DeForest et al. 2018; Santore et al. 2018).

4.0 GOOSE LAKE HYDRODYNAMIC AND WATER QUALITY MODEL

The calibrated three-dimensional (3D) Goose Lake Model (Golder 2021) was used to predict water quality during the operational period (Years 1 to 12; 2022 to 2033; SRK 2020, Appendix A) for the purpose of EQC development. The Goose Lake Model was run to:

- Step 1: Identify POPC for which EQC are proposed.
- Step 2: Estimate water quality in Goose Lake under different scenarios to derive proposed EQC, and to evaluate water quality of Goose Lake with the proposed EQC being used to define effluent discharge chemistry (i.e., to confirm the proposed EQC are protective of the receiving environment).

Model setup, assumptions, and inputs including bathymetric and meteorological data are consistent with Golder (2021). Modelled constituents as presented in Table 3 are also consistent with Golder (2021).

Hydrologic and water quality inputs to the model during the operational period include:

- Inflow (i.e., PN04, PN05, PN06, PN08, and PN09) rates and chemistries, which were obtained from the Water and Load Balance Model (SRK 2020).
- The assumption that PN04, PN05, PN06, PN08, and PN09 inflows to Goose Lake during operational period are natural.
- One mine-affected inflow (effluent discharge) to Goose Lake, which is from the Primary Pond and Llama Tailings Facility (SRK 2020). Separate model simulations were conducted for the Primary Pond discharge and the Llama Tailings Facility discharge.
- Lake outflows that were defined in terms of a stage-discharge relationship (Golder 2021).

Figure 1 presents the model mesh (Golder 2021), the location of inflows to Goose Lake, and the location of the lake outflow.

For Step 1, the Goose Lake Model was run for three scenarios to identify the POPC. These scenarios (i.e., scenarios POPC-1, POPC-2, and POPC-3) are described in Section 5.2.2.

For Step 2, approximately 50 scenarios were simulated using the Goose Lake Model. Each scenario was defined with a unique set of discharge characteristics (i.e., location, rate, chemistry, and period; Section 6.1). Results included daily timeseries concentrations of all modelled parameters during operations in Goose Lake at 100 m, 200 m, 500 m, and 1,000 m from the discharge location (Figure 2) and at the Goose Lake tail (closest to the lake outlet) (Figure 2).

An example of how concentrations are calculated is presented on Figure 2 and is described below:

- Daily concentrations of modelled parameters were extracted from the model from each mesh cell (with water entire year) located along each arc (e.g., 100 m from discharge point) (Figure 2).
- Daily profile concentrations were extracted from each vertical layer at each mesh cell.
- Maximum daily water column profile concentration and maximum concentration along each arc (e.g., 100 m from the discharge point) and Goose Lake tail were used for EQC assessment. Without an approved mixing zone dimension associated with the discharge, the approach of evaluating parameter concentrations at multiple distances from the discharge point was used to confirm that water quality across the main body of the lake remains acceptable through operations. This approach also accounted for the effect of ice formation on water quality (i.e., cryo-concentration) especially in the shallow areas of the lake.

Table 4 presents maximum daily concentrations (across the depth and along each arc) for the scenarios assessed for Step 1 (i.e., scenarios POPC-1, POPC-2, and POPC-3). Results of the final scenarios used to derive proposed EQC (Step 2) are presented in Section 6.0 and Appendix A.

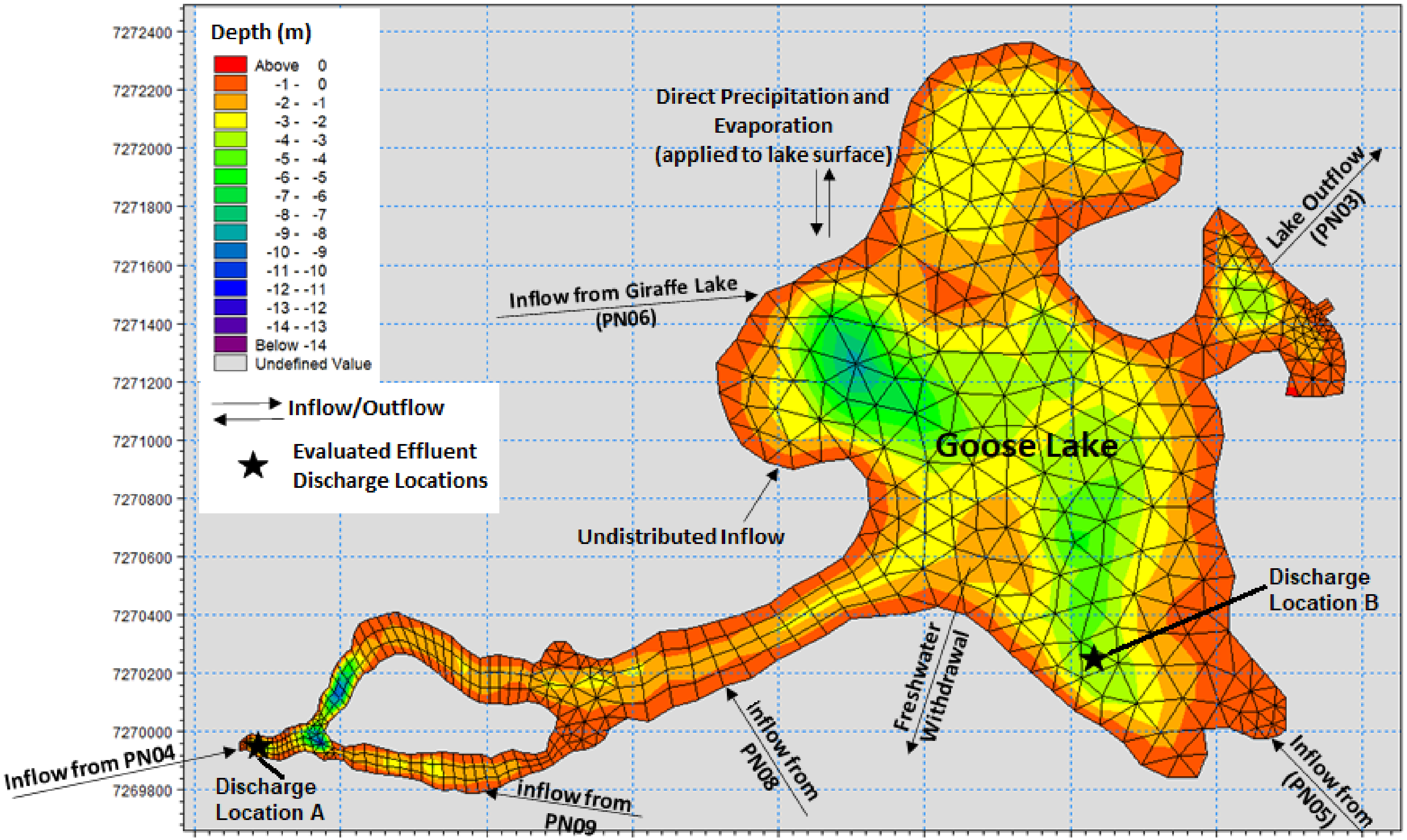


Figure 1: Goose Lake Model Mesh (Plan View) with Inflows and Outflows During Operational Period, and Two Evaluated Locations for Discharge

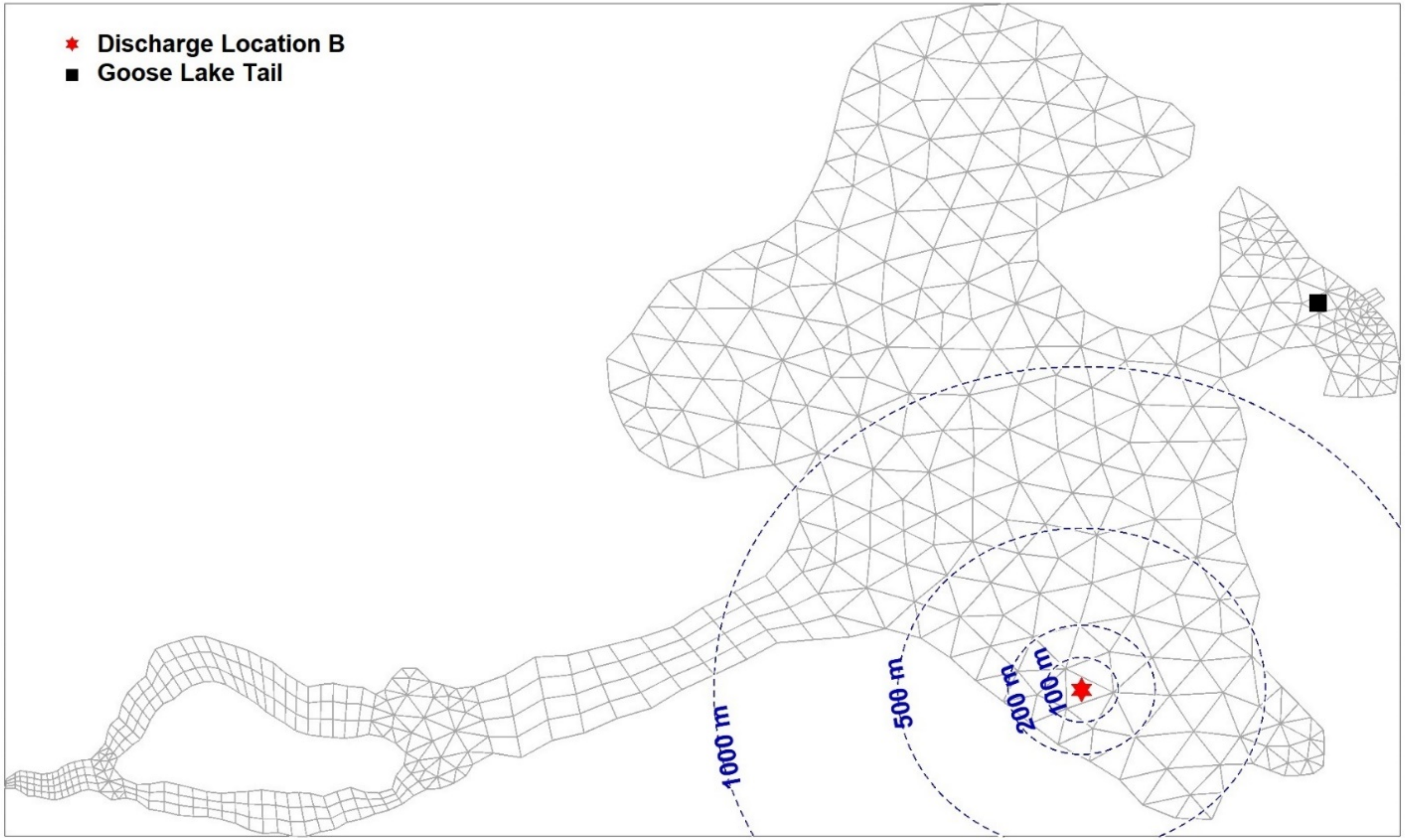


Figure 2: Location of Distance Arcs where Parameter Concentrations were Extracted for EQC Assessment in Goose Lake (for Discharge Location B) at 100 m, 200 m, 500 m, 1,000 m and at the Goose Lake Tail

Table 5: Predicted Maximum Concentration in Goose Lake at each Distance Arc from the Discharge Point the for POPC Scenarios

Parameter	Unit	100 m from Discharge Point			200 m from Discharge Point			500 m from Discharge Point			1,000 m from Discharge Point			Goose Lake Tail		
		POPC-1	POPC-3	POPC-2	POPC-1	POPC-3	POPC-2	POPC-1	POPC-3	POPC-2	POPC-1	POPC-3	POPC-2	POPC-1	POPC-3	POPC-2
Conventional Parameters																
Total dissolved solids	mg/L	152	752	152	168	773	168	134	694	134	164	838	164	149	821	149
Major Ions																
Chloride	mg/L	24	94	24	26	97	26	21	87	21	26	107	26	23	103	23
Fluoride	mg/L	0.082	0.081	0.082	0.088	0.088	0.088	0.073	0.072	0.073	0.094	0.094	0.094	0.087	0.087	0.087
Nutrients																
Nitrate	mg-N/L	6.0	2.4	6.0	6.6	2.6	6.6	5.3	2.1	5.3	6.5	2.6	6.5	5.8	2.2	5.8
Nitrite	mg-N/L	0.31	0.19	0.31	0.34	0.21	0.34	0.27	0.17	0.27	0.33	0.2	0.33	0.3	0.18	0.3
Total ammonia	mg-N/L	2.7	4.8	0.68	3.0	5.3	0.71	2.4	4.2	0.6	2.9	5.2	0.79	2.7	4.5	0.73
Total Metals																
Aluminum	mg/L	0.21	0.21	0.21	0.23	0.23	0.23	0.19	0.19	0.19	0.23	0.23	0.23	0.21	0.21	0.21
Arsenic	mg/L	0.0075	0.008	0.008	0.0082	0.0088	0.0087	0.0066	0.0071	0.0071	0.0082	0.0087	0.0087	0.0074	0.0079	0.0079
Boron	mg/L	0.0039	0.1	0.0039	0.0043	0.11	0.0043	0.0035	0.095	0.0035	0.0042	0.12	0.0042	0.0039	0.11	0.0039
Cadmium	mg/L	0.000026	0.000044	0.000026	0.000029	0.000045	0.000029	0.000023	0.000039	0.000023	0.000029	0.00005	0.000029	0.000026	0.000047	0.000026
Chromium	mg/L	0.00053	0.00075	0.00053	0.00059	0.00084	0.00059	0.00048	0.00067	0.00048	0.00059	0.00082	0.00059	0.00053	0.00074	0.00053
Copper	mg/L	0.0038	0.0062	0.0095	0.0042	0.0069	0.01	0.0033	0.0055	0.0084	0.0041	0.0068	0.01	0.004	0.0062	0.0093
Iron	mg/L	0.29	0.39	0.29	0.32	0.43	0.32	0.26	0.35	0.26	0.32	0.43	0.32	0.29	0.39	0.29
Lead	mg/L	0.00014	0.00026	0.0051	0.00015	0.00029	0.0056	0.00012	0.00023	0.0045	0.00015	0.00029	0.0054	0.00014	0.00026	0.0049
Manganese	mg/L	0.034	0.092	0.034	0.038	0.096	0.038	0.031	0.082	0.031	0.038	0.11	0.038	0.034	0.1	0.034
Mercury	mg/L	0.000014	0.000014	0.000014	0.000015	0.000014	0.000015	0.000013	0.000012	0.000013	0.000016	0.000016	0.000016	0.000015	0.000015	0.000015
Molybdenum	mg/L	0.00016	0.0062	0.00016	0.00018	0.0069	0.00018	0.00014	0.0055	0.00014	0.00018	0.0068	0.00018	0.00016	0.0058	0.00016
Nickel	mg/L	0.013	0.011	0.026	0.014	0.013	0.029	0.011	0.01	0.023	0.014	0.013	0.029	0.012	0.011	0.026
Selenium	mg/L	0.00029	0.00054	0.00029	0.00032	0.00059	0.00032	0.00026	0.00048	0.00026	0.00032	0.00059	0.00032	0.00029	0.00051	0.00029
Silver	mg/L	0.000025	0.000043	0.000025	0.000028	0.000045	0.000028	0.000022	0.000038	0.000022	0.000027	0.00005	0.000027	0.000025	0.000047	0.000025
Thallium	mg/L	0.00012	0.00021	0.00012	0.00013	0.00022	0.00013	0.00011	0.00019	0.00011	0.00013	0.00025	0.00013	0.00012	0.00023	0.00012
Uranium	mg/L	0.000036	0.000049	0.000036	0.000039	0.000051	0.000039	0.000031	0.000043	0.000031	0.000039	0.000056	0.000039	0.000035	0.000053	0.000035
Zinc	mg/L	0.0036	0.01	0.028	0.0039	0.011	0.031	0.0032	0.0092	0.024	0.0039	0.012	0.03	0.0035	0.011	0.027
Other																
Cyanide (free)[(a)]	mg/L	0.0011	0.0011	0.0042	0.0012	0.0013	0.0046	0.0010	0.001	0.0037	0.0012	0.0013	0.0045	0.0011	0.0012	0.0041

(a) Free cyanide was assumed to be 10% of the total cyanide concentration (Sabina 2020).

5.0 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN

Parameters of potential concern are parameters that require EQC in a Water Licence. Sections 5.1 and 5.2 describe the process used to identify POPC.

5.1 Parameters of Interest

To start, an initial list of parameters that are typically associated with mining activities was considered. The initial list of parameters included conventional parameters, major ions, nutrients, metals and metalloids, and others (Table 6).

Table 6: Initial List of Parameters

Group	Parameter	Group	Parameter
Conventional	Acidity	Metals and metalloids	Aluminum
	Alkalinity		Antimony
	Specific conductivity		Arsenic [(a)]
	Hardness		Barium
	Organic carbon		Beryllium
	pH [(a)]		Bismuth
	Total dissolved solids		Boron
	Total suspended solids [(a)]		Cadmium
	Water temperature		Cesium
Major Ions	Bicarbonate		Chromium
	Calcium		Cobalt
	Carbonate		Copper [(a)]
	Chloride		Iron
	Fluoride		Lead [(a)]
	Hydroxide		Lithium
	Magnesium		Manganese
	Potassium		Mercury
	Sodium		Molybdenum
	Sulphate		Nickel [(a)]
Nutrients	Nitrate		Rubidium
	Nitrite		Selenium
	Phosphorus		Silver
	Total ammonia		Strontium
Others	Cyanide [(a)]		Tin
	Total petroleum hydrocarbons		Titanium
			Thallium
			Uranium
			Vanadium
			Zinc [(a)]

(a) Metal and Diamond Mining Effluent Regulations deleterious substances (Government of Canada 2002).

A list of parameters of interest (POI) was identified by eliminating parameters from Table 6 because:

- The parameter was represented by a total value. Dissolved concentrations of parameters have not been used in this assessment. Instead, total concentrations have been used because they include dissolved fractions and WQGs are expressed most frequently as total concentrations, except for manganese and zinc. Predicted concentrations of total manganese and zinc were conservatively compared to guidelines for the dissolved fractions of these two metals.
- The parameter did not have a toxicity-based guideline or a SSWQO. In Table 6, the parameters that do not have a toxicity-based guideline or SSWQO are specific conductivity, total dissolved solids, total organic carbon (TOC), hardness, alkalinity, acidity, bicarbonate, carbonate, hydroxide, calcium, magnesium, sodium, sulphate, phosphorus, and total antimony, barium, beryllium, bismuth, lithium, rubidium, strontium, tin, titanium, and vanadium.

Hardness and TOC are not typically regulated parameters, but they are exposure and toxicity modifying factors (ETMFs), which influence the toxicity of certain parameters. They have not been included in the final list of POI.

Values of temperature, total suspended solids (TSS), pH, and total petroleum hydrocarbons will be influenced by treatment or other mitigation technologies to be used by the Project. Consequently, relevant EQC for these parameters based on technology-based derivation are discussed in Section 7.0; these parameters have not been included in the screening presented in this section of the EQC Report.

In this report, total phosphorus was not considered a POI because total phosphorus does not have a toxicity-based guideline. However, Sabina commits to reviewing the baseline nutrient concentrations in Goose Lake, including total phosphorus concentrations, reviewing predicted total phosphorus concentrations in the discharges to Goose Lake in operations, and determining whether total phosphorus should be a POI. If total phosphorus is identified as a POI, Sabina commits to simulating total phosphorus concentrations in Goose Lake and developing EQC for total phosphorus following the methods described in this report.

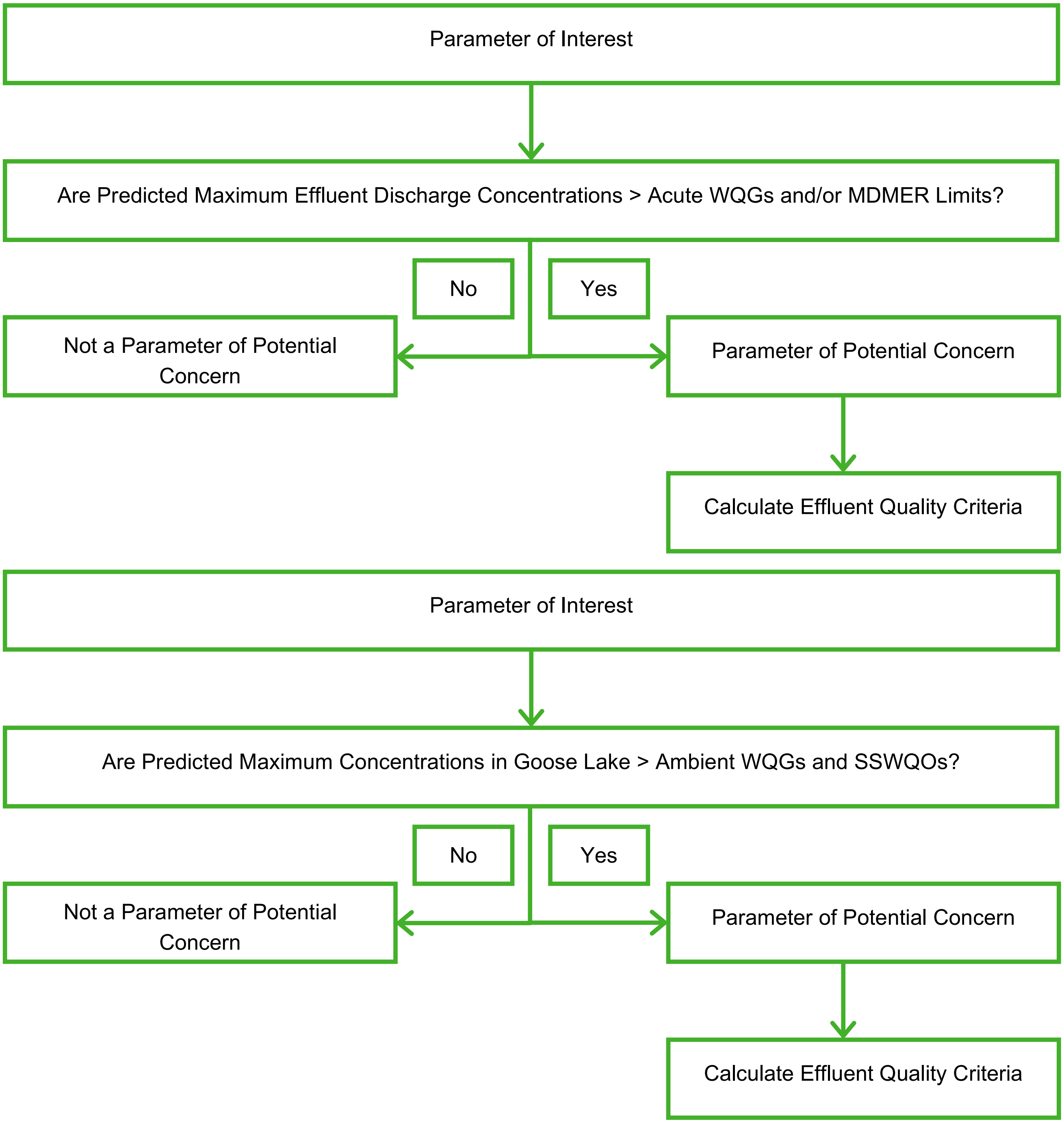
Based on the parameter evaluation outlined above, the list of POI for effluent discharges from tailings facilities, tailings storage facilities, and reservoirs is:

- Major ions: chloride and fluoride
- Nutrients: nitrate, nitrite, and total ammonia
- Total metals and metalloids: aluminum, arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, uranium, and zinc
- Others: cyanide

5.2 Parameters of Potential Concern

The list of POI was reduced to a list of POPC based on a multi-step screening process (Figure 3). The screening process involved two comparisons:

- Predicted maximum effluent discharge concentrations were compared to acute WQGs and MDMER limits to identify if effluent concentrations have the potential to cause acute toxicity at end-of-pipe and/or are greater than MDMER limits.
- Predicted concentrations in Goose Lake were compared to WQGs and SSWQOs to identify if the potential exists for chronic effects to aquatic life in Goose Lake because of effluent discharges from tailings facilities, tailings storage facilities, and reservoirs.



MDMER = Metal and Diamond Mining Effluent Regulations; SSWQO = site-specific water quality objective; WQG = water quality guideline.

Figure 3: Screening Process to Identify Parameters of Potential Concern

5.2.1 Comparing Predicted Discharge Concentrations to Acute Water Quality Guidelines and Metal and Diamond Mining Effluent Regulation Limits

The first screening step in identifying POPC for the Project was to compare predicted POI concentrations in the discharges from the Primary Pond and the Llama Tailings Facility to acute WQGs and MDMER Limits, to identify if discharge concentrations have the potential to cause acute toxicity at end-of-pipe and/or are greater than MDMER limits.

Tables 7 and 8 provide comparisons of predicted maximum Primary Pond and Llama Tailings Facility discharge concentrations to acute WQGs and MDMER limits. If predicted maximum discharge concentrations were greater than acute WQGs and/or MDMER limits (i.e., indicated by a “Yes” in Tables 7 and 8), then the parameter was identified as a POPC, and EQC were calculated for that parameter. If predicted maximum discharge concentrations were less than acute WQGs and/or MDMER limits (i.e., indicated by a “No” in Tables 7 and 8), then the parameter was not identified as a POPC.

From the first screening step, these parameters were identified as POPC:

- Major ions: chloride
- Total metals: zinc

From the first screening step, these parameters were not identified as POPC:

- Nutrients: nitrate
- Total metals: arsenic, boron, cadmium, copper, lead, manganese, nickel, and uranium

Table 7: Step 1 - Comparison of Predicted Maximum Primary Pond Discharge Concentrations to Acute Water Quality Guidelines and Metal and Diamond Mining Effluent Regulation Limits

Parameter of Interest	Unit	Maximum Primary Pond Discharge Concentration [(a)]	Acute WQGs [(b)]	MDMER Limits [(c)]	Are Maximum Primary Pond Discharge Concentrations > Acute WQGs (Yes/No)?	Are Maximum Primary Pond Discharge Concentrations > MDMER Limits (Yes/No)?
Major Ions						
Chloride	mg/L	280	640	-	No	n/a
Fluoride	mg/L	0.05	-	-	n/a	n/a
Nutrients						
Nitrate	mg-N/L	97	124	-	No	n/a
Nitrite	mg-N/L	4.9	-	-	n/a	n/a
Total ammonia	mg-N/L	44	14 - 20	-	**Yes**	n/a
Total Metals						
Aluminum	mg/L	1.2	-	-	n/a	n/a
Arsenic	mg/L	0.092	-	0.1	n/a	No
Boron	mg/L	0.012	29	-	No	n/a
Cadmium	mg/L	0.000051	0.0077	-	No	n/a
Chromium	mg/L	0.0014	-	-	n/a	n/a
Copper	mg/L	0.0065	-	0.1	n/a	No
Iron	mg/L	1.4	-	-	n/a	n/a
Lead	mg/L	0.00033	-	0.08	n/a	No
Manganese	mg/L	0.17	14.9	-	No	n/a
Mercury	mg/L	0.000021	-	-	n/a	n/a
Molybdenum	mg/L	0.00033	-	-	n/a	n/a

Table 7: Step 1 - Comparison of Predicted Maximum Primary Pond Discharge Concentrations to Acute Water Quality Guidelines and Metal and Diamond Mining Effluent Regulation Limits

Parameter of Interest	Unit	Maximum Primary Pond Discharge Concentration [(a)]	Acute WQGs [(b)]	MDMER Limits [(c)]	Are Maximum Primary Pond Discharge Concentrations > Acute WQGs (Yes/No)?	Are Maximum Primary Pond Discharge Concentrations > MDMER Limits (Yes/No)?
Nickel	mg/L	0.024	-	0.25	n/a	No
Selenium	mg/L	0.00089	-	-	n/a	n/a
Silver	mg/L	0.000028	-	-	n/a	n/a
Thallium	mg/L	0.000056	-	-	n/a	n/a
Uranium	mg/L	0.00019	0.033	-	No	n/a
Zinc	mg/L	0.0085	0.23	0.4	No	No
Others						
Cyanide	mg/L	0.0027	-	0.5	n/a	No

(a) SRK (2020).

(b) Table 3.

(c) The MDMER limits are the maximum authorized monthly mean concentration for new mines that come into force on 1 June 2021 from the Government of Canada (2002).

MDMER = Metals and Diamond Mining Effluent Regulation Limits; WQG = water quality guideline; - = WQG or MDMER limit are not available; n/a = not applicable.

Table 8: Step 1 - Comparison of Predicted Maximum Llama Tailings Facility Discharge Concentrations to Acute Water Quality Guidelines and Metal and Diamond Mining Effluent Regulation Limits

Parameter of Interest	Unit	Maximum Llama Tailings Facility Discharge Concentration [(a)]	Acute WQGs [(b)]	MDMER Limits [(c)]	Are Maximum Llama Tailings Facility Discharge Concentrations > Acute WQGs (Yes/No)?	Are Maximum Llama Tailings Facility Discharge Concentrations > MDMER Limits (Yes/No)?
Major Ions						
Chloride	mg/L	3,700	640	-	**Yes**	n/a
Fluoride	mg/L	0.05	-	-	n/a	n/a
Nutrients						
Nitrate	mg-N/L	48	124	-	No	n/a
Nitrite	mg-N/L	3.4	-	-	n/a	n/a
Total ammonia	mg-N/L	110	14 - 20	-	**Yes**	n/a
Total Metals						
Aluminum	mg/L	2.7	-	-	n/a	n/a
Arsenic	mg/L	0.1	-	0.1	n/a	No
Boron	mg/L	4.1	29	-	No	n/a
Cadmium	mg/L	0.00094	0.0077	-	No	n/a
Chromium	mg/L	0.0084	-	-	n/a	n/a
Copper	mg/L	0.059	-	0.1	n/a	No
Iron	mg/L	5.2	-	-	n/a	n/a
Lead	mg/L	0.0047	-	0.08	n/a	No
Manganese	mg/L	3.1	14.9	-	No	n/a
Mercury	mg/L	0.000047	-	-	n/a	n/a
Molybdenum	mg/L	0.17	-	-	n/a	n/a
Nickel	mg/L	0.054	-	0.25	n/a	No

Table 8: Step 1 - Comparison of Predicted Maximum Llama Tailings Facility Discharge Concentrations to Acute Water Quality Guidelines and Metal and Diamond Mining Effluent Regulation Limits

Parameter of Interest	Unit	Maximum Llama Tailings Facility Discharge Concentration [(a)]	Acute WQGs [(b)]	MDMER Limits [(c)]	Are Maximum Llama Tailings Facility Discharge Concentrations > Acute WQGs (Yes/No)?	Are Maximum Llama Tailings Facility Discharge Concentrations > MDMER Limits (Yes/No)?
Selenium	mg/L	0.0	-	-	n/a	n/a
Silver	mg/L	0.00094	-	-	n/a	n/a
Thallium	mg/L	0.0047	-	-	n/a	n/a
Uranium	mg/L	0.0015	0.033	-	No	n/a
Zinc	mg/L	0.32	0.23	0.4	**Yes**	No
Others						
Cyanide	mg/L	0.5	-	0.5	n/a	No

(a) SRK (2020).

(b) Table 3.

(c) The MDMER limits are the maximum authorized monthly mean concentration for new mines that come into force on 1 June 2021 from the Government of Canada (2002).

MDMER = Metals and Diamond Mining Effluent Regulation Limits; WQG = water quality guideline; - = WQG or MDMER limit are not available; n/a = not applicable.

5.2.2 Comparison of Predicted Maximum Concentrations in Goose Lake to Ambient Water Quality Guidelines and Site-specific Water Quality Objectives

The second and final step in the screening process to identify POPC for the Project was to compare predicted maximum concentrations in Goose Lake for the POI to ambient WQGs and SSWQOs. If maximum concentrations in Goose Lake were predicted to be greater than ambient WQGs or SSWQOs, then the parameter was identified as a POPC and EQC were calculated for the parameter.

The comparison was completed for three discharge scenarios:

- POPC-1: Discharge from Primary Pond to the main body of Goose Lake at a rate of 1,900 m^3/d and an annual discharge period from 1 July to 30 September (Table 9)
- POPC-2: Discharge from Llama Tailings Facility to the main body of Goose Lake at a rate of 1,900 m^3/d and an annual discharge period from 1 July to 30 September (Table 10)
- POPC-3: Discharge concentrations set at maximum authorized monthly mean concentrations from MDMER limits and discharged to the main body of Goose Lake at a rate of 1,900 m^3/d and an annual discharge period from 1 July to 30 September (Table 11)

The comparison was completed for maximum concentrations in Goose Lake at 1,000 m from the discharge point. As presented in Table 5, maximum concentrations in Goose Lake at 1,000 m from the discharge point were predicted to be higher than maximum concentrations at 100 m, 200 m, and 500 m from the discharge point and at the outlet of Goose Lake.

In the second step of the screening process, parameters with maximum concentrations in Goose Lake at 1,000 m from the discharge point that were greater than chronic, ambient WQGs and SSWQOs (indicated by a “Yes” in Tables 9, 10, and 11) were identified as POPC. Parameters with maximum concentrations in Goose Lake at 1,000 m from the discharge point that were less than chronic, ambient WQGs and SSWQOs (indicated by a “No” in Tables 9, 10, and 11) were not considered POPC.

From the second screening step, these parameters were identified as POPC:

- Nutrients: nitrate and nitrite
- Total metals: aluminum, copper, iron, and lead

From the second screening step, these parameters were not identified as POPC:

- Major ions: chloride and fluoride
- Total metals: arsenic, boron, cadmium, chromium, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, and uranium

Table 9: Step 2 – Comparison of Predicted Maximum Concentrations in Goose Lake with Effluent Discharge from Primary Pond to Ambient Water Quality Guidelines and Site-specific Water Quality Objectives

Parameter of Interest	Predicted Maximum Concentration in Goose Lake with Effluent Discharge from Primary Pond (a)	Ambient WQGs and SSWQOs (b)	Are Predicted Concentrations in Goose Lake > Ambient WQGs and SSWQOs in Goose Lake (Yes/No)?
Major Ions			
Chloride	26	120	No
Fluoride	0.094	0.12	No
Nutrients			
Nitrate	6.5	2.93	**Yes**
Nitrite	0.33	0.06	**Yes**
Total ammonia	2.9	12	No
Total Metals			
Aluminum	0.23	0.005	**Yes**
Arsenic	0.0082	0.010	No
Boron	0.0042	1.5	No
Cadmium	0.000029	0.00016	No
Chromium	0.00059	0.001	No
Copper	0.0041	0.0042	No
Iron	0.32	0.3	**Yes**
Lead	0.00015	0.0033	No
Manganese	0.038	0.55 (c)	No
Mercury	0.000016	0.000026	No
Molybdenum	0.00018	0.073	No
Nickel	0.014	0.097	No
Selenium	0.00032	0.001	No
Silver	0.000027	0.00025	No
Thallium	0.00013	0.0008	No
Uranium	0.000039	0.015	No
Zinc	0.0039	0.038 (c)	No
Others			
Cyanide	0.012	-	n/a
Free cyanide	0.0012	0.005	No

(a) The predicted maximum concentrations in Goose Lake are at 1,000 m from the discharge point (Table 5). The effluent was discharged to the main body of Goose Lake at a discharge rate of 1,900 m^3/d with an annual discharge period from 1 July to 30 September.

(b) The WQGs for total cadmium, total lead, dissolved manganese, total nickel, and dissolved zinc were calculated based on predicted ambient hardness concentrations in Goose Lake (i.e., predicted hardness concentrations that occurred at the same time as the predicted maximum concentrations of total cadmium, lead, manganese, nickel, and zinc).

(c) The WQGs for manganese and zinc are dissolved guidelines. Predicted concentrations of total manganese and zinc were conservatively compared to guidelines for the dissolved fractions of these two metals.

SSWQO = site-specific water quality objective; WQG = water quality guideline.

Table 10: Step 2 – Comparison of Predicted Maximum Concentrations in Goose Lake with Effluent Discharge from Llama Tailings Facility to Ambient Water Quality Guidelines and Site-specific Water Quality Objectives

Parameter of Interest	Predicted Maximum Concentration in Goose Lake with Effluent Discharge from Llama Tailings Facility (a)	Ambient WQGs and SSWQOs (b)	Are Predicted Concentrations in Goose Lake > Ambient WQGs and SSWQOs in Goose Lake (Yes/No)?
Major Ions			
Chloride	107	120	No
Fluoride	0.094	0.12	No
Nutrients			
Nitrate	2.6	2.9	No
Nitrite	0.2	0.06	**Yes**
Total ammonia	5.2	12	No
Total Metals			
Aluminum	0.23	0.005	**Yes**
Arsenic	0.0087	0.01	No
Boron	0.12	1.5	No
Cadmium	0.00005	0.00037	No
Chromium	0.00082	0.001	No
Copper	0.0068	0.0042	**Yes**
Iron	0.43	0.3	**Yes**
Lead	0.00029	0.0051	No
Manganese	0.11	1.1 (c)	No
Mercury	0.000016	0.000026	No
Molybdenum	0.0068	0.073	No
Nickel	0.013	0.126	No
Selenium	0.00059	0.001	No
Silver	0.00005	0.00025	No
Thallium	0.00025	0.0008	No
Uranium	0.000056	0.015	No
Zinc	0.012	0.42 (c)	No
Others			
Cyanide	0.013	-	n/a
Free cyanide	0.0013	0.005	No

(a) The predicted maximum concentrations in Goose Lake are at 1,000 m from the discharge point (Table 5). The effluent was discharged to the main body of Goose Lake at a discharge rate of 1,900 m^3/d with an annual discharge period from 1 July to 30 September.

(b) The WQGs for total cadmium, total lead, dissolved manganese, total nickel, and dissolved zinc were calculated based on predicted ambient hardness concentrations in Goose Lake (i.e., predicted hardness concentrations that occurred at the same time as the predicted maximum concentrations of total cadmium, lead, manganese, nickel, and zinc).

(c) The WQGs for manganese and zinc are dissolved guidelines. Predicted concentrations of total manganese and zinc were conservatively compared to guidelines for the dissolved fractions of these two metals.

SSWQO = site-specific water quality objective; WQG = water quality guideline.

Table 11: Step 2 – Comparison of Maximum Predicted Concentrations in Goose Lake with Effluent Discharge at Metal and Diamond Mining Effluent Regulations to Ambient Water Quality Guidelines and Site-specific Water Quality Objectives

Parameter of Interest	Predicted Maximum Concentration in Goose Lake with Effluent Discharge Set at MDMER Limits (a)	Ambient WQGs and SSWQOs (b)	Are Predicted Concentrations in Goose Lake > Ambient WQGs and SSWQOs in Goose Lake (Yes/No)?
Total Metals			
Arsenic	0.0087	0.01	No
Copper	0.01	0.0042	**Yes**
Lead	0.0054	0.0033	**Yes**
Nickel	0.029	0.097	No
Zinc	0.03	0.038 (c)	No
Others			
Cyanide	0.045	-	n/a
Free cyanide	0.0045	0.005	No

(a) The predicted maximum concentrations in Goose Lake are at 1,000 m from the discharge point (Table 5). The effluent was discharged to the main body of Goose Lake at a discharge rate of 1,900 m^3/d with an annual discharge period from 1 July to 30 September.

(b) The WQGs for total lead, total nickel, and dissolved zinc were calculated based on predicted ambient hardness concentrations in Goose Lake (i.e., predicted hardness concentrations that occurred at the same time as the predicted maximum concentrations of total lead, nickel, and zinc). The predicted hardness concentrations in Goose Lake were based on effluent discharge from the Primary Pond.

(c) The WQG for zinc is a dissolved guideline. Predicted concentrations of total zinc were conservatively compared to guidelines for the dissolved fraction.

SSWQO = site-specific water quality objective; WQG = water quality guideline.

5.2.3 Summary of Parameters of Potential Concern

For the effluent discharged from tailings facilities, tailings storage facilities, or other reservoirs, EQC should be developed for 12 water quality-based parameters (Table 12).

Table 12: Parameters of Potential Concern

Parameter of Potential Concern	Rationale
Major Ions	
Chloride	▪ Predicted maximum concentrations of chloride in the Llama Tailings Facility discharge were greater than the acute WQG (Table 7)
Nutrients	
Nitrate	▪ When effluent was discharged from the Primary Pond, predicted maximum concentrations of nitrate in Goose Lake were greater than the chronic WQG (Table 8)
Nitrite	▪ When effluent was discharged from the Primary Pond or Llama Tailings Facility, predicted maximum concentrations of nitrite in Goose Lake were greater than the chronic WQG (Tables 8 and 9)
Total ammonia	▪ Predicted maximum concentrations of total ammonia in the Primary Pond and Llama Tailings Facility discharge were greater than the acute water quality criterion ▪ Unionized ammonia is a deleterious substance under MDMER
Total Metals	
Aluminum	▪ When effluent was discharged from the Primary Pond or Llama Tailings Facility, predicted maximum concentrations of total aluminum in Goose Lake were greater than the chronic WQG (Tables 8 and 9)
Arsenic	▪ Total arsenic is a deleterious substance under MDMER
Copper	▪ When effluent was discharged from Llama Tailings Facility, predicted maximum concentrations of total copper in Goose Lake were greater than the chronic, ambient WQG (Table 9) ▪ When effluent concentrations were set at MDMER limits, predicted maximum concentrations of total copper in Goose Lake were greater than the chronic, ambient WQG (Table 10) ▪ Total copper is a deleterious substance under MDMER
Iron	▪ When effluent was discharged from the Primary Pond or Llama Tailings Facility, predicted maximum concentrations of total iron in Goose Lake were greater than the chronic WQG (Tables 8 and 9)
Lead	▪ When effluent concentrations were set at MDMER limits, predicted maximum concentrations of total lead in Goose Lake were greater than the chronic, ambient WQG (Table 10) ▪ Total lead is a deleterious substance under MDMER
Nickel	▪ Total nickel is a deleterious substance under MDMER
Zinc	▪ Predicted maximum concentrations of total zinc in the Llama Tailings Facility discharge were greater than the acute WQG (Table 7) ▪ Total zinc is a deleterious substance under MDMER
Others	
Cyanide	▪ Cyanide is a deleterious substance under MDMER

MDMER = Metal and Diamond Mining Effluent Regulation Limits; WQG = water quality guideline.

6.0 WATER QUALITY-BASED EFFLUENT QUALITY CRITERIA

After POPC have been identified for the Project, the next steps to set water quality-based EQC are:

- Calculate water quality-based EQC for POPC.
- Compare calculated water quality-based EQC to acute WQGs to prevent acute toxicity at the final point of discharge.
- Compare calculated water quality-based EQC to predicted discharge concentrations to determine whether the EQC are reasonably and consistently achievable.
- Propose water quality-based EQC for POPC.

6.1 Calculation of Effluent Quality Criteria

Two types of EQC were calculated for the Project:

- Maximum authorized concentration in a grab sample, which represents the maximum concentration of a parameter measured in a single grab sample of the discharge.
- Maximum authorized monthly mean concentration, which represents the average concentration of a parameter that the Project may release into the receiving environment, determined by averaging all composite or grab samples collected from the final discharge point during each month.

6.1.1 Maximum Authorized Monthly Mean Concentration

For POPC that were identified in Section 5.0, maximum authorized monthly mean concentrations were determined by using the Goose Lake Model to identify constant concentrations of parameters that the Project could discharge from the Primary Pond and Llama Tailings Facility to Goose Lake such that parameter concentrations in Goose Lake would remain below WQGs and SSWQOs, except for total ammonia. Approximately 50 Goose Lake Model scenarios were performed, which are described below:

- Discharge location: two locations in Goose Lake were evaluated for the effluent discharge (location A in the neck of Goose Lake, and location B in the main body of the lake; Figure 1).
- Discharge rate: two effluent discharge rates were evaluated including 1,900 and 2,500 m^3/d.
- Discharge chemistry: several effluent concentrations for POPC were evaluated.
- Discharge period: two discharge periods during the open water season were evaluated, including 1 July to mid-October and 1 July 1 to 30 September.

6.1.1.1 Total Ammonia

Ammonia exists in two forms, ionized and un-ionized, dependent mainly on pH and temperature. Together, these two forms make up total ammonia. It is the un-ionized portion that is more toxic to aquatic life, and it is more prevalent at higher pH values and higher temperatures (Environment Canada and Health Canada 2001). The maximum authorized monthly mean concentration of total ammonia was calculated by accounting for the MDMER limit for un-ionized ammonia of 0.5 mg N/L, the acute criterion for the protection of aquatic life from the USEPA (2013), and the chronic WQG in Goose Lake. The acute and chronic total ammonia guidelines are pH and temperature dependent. As the pH of the water increases, the guideline decreases and as the temperature of the water increases, the guideline decreases.

To identify a maximum authorized monthly mean concentration:

- Total ammonia concentrations from Equation 1 were compared to the acute criterion for the protection of aquatic life from the USEPA (2013) over a pH range from 6.0 to 9.0 and a water temperature of 20 °C.
- Total ammonia concentrations were selected that were below the acute criterion.
- Constant total ammonia concentrations were tested in the Goose Lake Model to identify a concentration that would maintain concentrations in Goose Lake below the chronic WQG.
- Un-ionized ammonia concentrations were calculated from the proposed EQC using Equation 1 (CCME 1999) to make sure that the MDMER limit for un-ionized ammonia was not exceeded.

$$Un - ionized\ ammonia = \frac{1}{10^{\left(0.0901821 + \frac{2729.92}{T} - pH\right)} + 1} \times Total\ ammonia \qquad \text{Eq.1}$$

Where:

T = temperature (°C)

6.1.2 Maximum Authorized Concentration in a Grab Sample

For each POPC, the maximum authorized concentration in a grab sample was calculated following guidance from the United States Environmental Protection Agency (USEPA 1991). The maximum authorized concentration in a grab sample was calculated assuming that concentrations of parameters in the discharge will have a log normal distribution and a coefficient of variation of 0.6. With these assumptions, the maximum authorized concentration in a grab sample is two times the maximum authorized monthly mean concentration. If the resulting maximum authorized concentration in a grab sample was greater than an acute WQG, the maximum authorized concentration in a grab sample was reduced (Section 6.3).

6.2 Results of Effluent Quality Criteria Calculations

Effluent quality criteria (Table 13) were calculated for the discharge location in the main body of the lake (Location B; Figure 1), a discharge rate of 1,900 m^3/d, and an annual discharge period from 1 July to 30 September.

Table 13: Calculated Water Quality-Based Effluent Quality Criteria

Parameter of Potential Concern	Calculated Effluent Quality Criteria	
	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Grab Sample
Major Ions		
Chloride, mg/L	600	1,200 (b)
Nutrients		
Nitrate, mg-N/L	60	120
Nitrite, mg-N/L	0.6	1.2
Total ammonia, mg-N/L	6	12

Table 13: Calculated Water Quality-Based Effluent Quality Criteria

Parameter of Potential Concern	Calculated Effluent Quality Criteria	
	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Grab Sample
Total Metals		
Aluminum, mg/L	0.5	1.0
Arsenic, mg/L	0.1 [a]	0.2 [a]
Copper, mg/L	0.008	0.016
Iron, mg/L	1	2
Lead, mg/L	0.02	0.04
Nickel, mg/L	0.25 [a]	0.5 [a]
Zinc, mg/L	0.4 [a, c]	0.8 [a, c]
Others		
Cyanide, mg/L	0.5 [a]	1.0 [a]

(a) MDMER limits (Government of Canada 2002).

(b) The calculated maximum authorized concentration in a grab sample exceeds the acute WQG for chloride (Table 16).

(c) The calculated EQC exceed the acute WQG for dissolved zinc (Table 16).

EQC = effluent quality criteria; MDMER = Metal and Diamond Mining Effluent Regulations; WQG = water quality guideline.

6.2.1 Total Ammonia Effluent Quality Criteria

Table 14 presents the total ammonia acute criterion for the protection of aquatic life from the USEPA (2013) over a pH range from 6.0 to 9.0 and a water temperature of 20 °C. The EQC for total ammonia were selected based on maintaining the pH of the effluent and the pH in Goose Lake between 6.0 and 7.3. The EQC for total ammonia are proposed to be 6 mg-N/L and 12 mg-N/L.

At total ammonia concentrations of 6 mg-N/L and 12 mg-N/L, over a pH range from 6.0 to 7.3, and a water temperature of 20 °C, the un-ionized ammonia concentrations are less than the MDMER limit of 0.5 mg-N/L (Table 15). At a constant discharge concentration of 6 mg-N/L, total ammonia concentrations in Goose Lake are predicted to remain below the chronic WQG for the protection of aquatic life from CCME (1999) (Appendix A).

Table 14: Total Ammonia Acute Criterion for the Protection of Aquatic Life

pH	Water Temperature (°C)	Acute Criterion for Total Ammonia (mg-N/L) [(a)]
6.0	20	25.5
6.1	20	25.2
6.2	20	24.7
6.3	20	24.1
6.4	20	23.5
6.5	20	22.7
6.6	20	21.8
6.7	20	20.7
6.8	20	19.5
6.9	20	18.2
7.0	20	16.8
7.1	20	15.3
7.2	20	13.7
7.3	20	12.2
7.4	20	10.7
7.5	20	9.2
7.6	20	7.9
7.7	20	6.7
7.8	20	5.6
7.9	20	4.7
8.0	20	3.9
8.1	20	3.2
8.2	20	2.7
8.3	20	2.2
8.4	20	1.8
8.5	20	1.5
8.6	20	1.2
8.7	20	1.0
8.8	20	0.9
8.9	20	0.7
9.0	20	0.6

(a) USEPA (2013).

Table 15: Un-ionized Ammonia Concentrations

pH	Water Temperature (°C)	Total Ammonia Concentration of 6 mg-N/L	Total Ammonia Concentration of 12 mg-N/L
		Un-ionized Ammonia (mg-N/L) [(a)]	Un-ionized Ammonia (mg-N/L) [(a)]
6.0	20	0.002	0.005
6.1	20	0.003	0.006
6.2	20	0.004	0.008
6.3	20	0.005	0.009
6.4	20	0.006	0.012
6.5	20	0.008	0.015
6.6	20	0.009	0.019
6.7	20	0.012	0.024
6.8	20	0.015	0.030
6.9	20	0.019	0.038
7.0	20	0.024	0.047
7.1	20	0.030	0.059
7.2	20	0.037	0.075
7.3	20	0.047	0.094

(a) Un-ionized ammonia concentrations were calculated using Equation 1.

6.3 Comparison of Calculated Effluent Quality Criteria to Acute Water Quality Guidelines

Table 16 presents a comparison of the calculated EQC to acute WQGs. Because the calculated maximum authorized concentration in a grab sample for chloride is greater than the acute WQG, the Project proposes to reduce the maximum authorized concentration in a grab sample for chloride from 1,200 mg/L to 640 mg/L. Because the calculated EQC for total zinc are greater than the acute WQG, the Project proposes to reduce the maximum authorized monthly mean concentration from 0.4 mg/L to 0.2 mg/L and the maximum authorized concentration in a grab sample from 0.8 mg/L to 0.23 mg/L.

Table 16: Comparison of Calculated Effluent Quality Criteria to Acute Water Quality Guidelines

Parameter of Potential Concern	Calculated Effluent Quality Criteria		Acute WQG	Is the Maximum Authorized Monthly Mean Concentration > Acute WQG (Yes/No)?	Is the Maximum Authorized Concentration in a Grab Sample > Acute WQG (Yes/No)?
	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Grab Sample			
Major Ions					
Chloride, mg/L	600	1,200	640	No	**Yes**
Nutrients					
Nitrate, mg-N/L	60	120	124	No	No
Nitrite, mg-N/L	0.6	1.2			
Total ammonia, mg-N/L	6	12	12.2	No	No
Total Metals					
Aluminum, mg/L	0.5	1.0	-	n/a	n/a
Arsenic, mg/L	0.1 [a]	0.2 [a]	-	n/a	n/a
Copper, mg/L	0.008	0.016	-	n/a	n/a
Iron, mg/L	1	2	-	n/a	n/a
Lead, mg/L	0.02	0.04	-	n/a	n/a
Nickel, mg/L	0.25 [a]	0.5 [a]	-	n/a	n/a
Zinc, mg/L	0.4 [a]	0.8 [a]	0.23	**Yes**	**Yes**
Others					
Cyanide, mg/L	0.5 [a]	1.0 [a]	-	n/a	n/a

(a) MDMER limits (Government of Canada 2002).

"-"= acute WQG is not available; MDMER = Metal and Diamond Mining Effluent Regulations; WQG = water quality guideline; n/a = not applicable.

6.4 Comparison of Effluent Quality Criteria to Predicted Effluent Concentrations

The comparison of EQC to predicted effluent concentrations shows that the Project may need water treatment for chloride, nutrients, and total aluminium, iron, and zinc (Table 17). The proposed EQC for all POPC are equal to or less than MDMER limits.

Table 17: Comparison of Proposed Effluent Quality Criteria to Predicted Effluent Discharge Concentrations

Parameter of Potential Concern	Proposed Effluent Quality Criteria		Predicted Maximum Concentrations in Primary Pond	Predicted Maximum Concentrations in Llama Tailings Facility	Are Predicted Effluent Concentrations > Maximum Authorized Monthly Mean Concentrations (Yes/No)?	Are Predicted Effluent Concentrations > Maximum Authorized Concentrations in a Grab Sample (Yes/No)?
	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Grab Sample				
Major Ions						
Chloride, mg/L	600	640	280	3,700	**Yes**	**Yes**
Nutrients						
Nitrate, mg-N/L	60	120	97	48	**Yes**	No
Nitrite, mg-N/L	0.6	1.2	4.9	3.4	**Yes**	**Yes**
Total ammonia, mg-N/L	6	12	44	110	**Yes**	**Yes**
Total Metals						
Aluminum, mg/L	0.5	1.0	1.2	2.7	**Yes**	**Yes**
Arsenic, mg/L	0.1 [(a)]	0.2 [(a)]	0.092	0.1	No	No
Copper, mg/L	0.008	0.016	0.0065	0.059	No	No
Iron, mg/L	1	2	1.4	5.2	**Yes**	**Yes**
Lead, mg/L	0.02	0.04	0.00033	0.0047	No	No
Nickel, mg/L	0.25 [(a)]	0.5 [(a)]	0.024	0.054	No	No
Zinc, mg/L	0.20	0.23	0.0085	0.32	No	**Yes**
Others						
Cyanide, mg/L	0.5 [(a)]	1.0 [(a)]	0.0027	0.5	No	No

(a) MDMER limits (Government of Canada 2002).

6.5 Proposed Effluent Quality Criteria

Table 18 presents the proposed water quality-based EQC for the Project. The proposed EQC for all POPC are equal to or less than MDMER limits.

Table 18: Proposed Water Quality-Based Effluent Quality Criteria

Parameter of Potential Concern	Proposed Effluent Quality Criteria	
	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Grab Sample
Major Ions		
Chloride, mg/L	600	640
Nutrients		
Nitrate, mg-N/L	60	120
Nitrite, mg-N/L	0.6	1.2
Total ammonia, mg-N/L	6	12
Total Metals		
Aluminum, mg/L	0.5	1.0
Arsenic, mg/L	0.1 [(a)]	0.2 [(a)]
Copper, mg/L	0.008	0.016
Iron, mg/L	1	2
Lead, mg/L	0.02	0.04
Nickel, mg/L	0.25 [(a)]	0.5 [(a)]
Zinc, mg/L	0.20	0.23
Others		
Cyanide, mg/L	0.5 [(a)]	1.0 [(a)]

(a) MDMER limits (Government of Canada 2002); MDMER = Metal and Diamond Mining Effluent Regulations.

7.0 TECHNOLOGY-BASED EFFLUENT QUALITY CRITERIA

Values of pH, TSS, and total petroleum hydrocarbons (TPH) in the discharge may be influenced by treatment and mitigation technologies to be used at the Project. Relevant EQC for these parameters are discussed below.

7.1 pH

The MDMER limits include a pH range between 6.0 and 9.5. It is proposed that the MDMER limits be applied as EQC for effluent discharged from tailings facilities, tailings storage facilities, or other reservoirs.

7.2 Total Suspended Solids

The MDMER limits include a maximum authorized monthly mean concentration and a maximum authorized concentration in a grab sample for TSS of 15 and 30 mg/L. It is proposed that the MDMER limits be applied as EQC for effluent discharged from tailings facilities, tailings storage facilities, or other reservoirs.

7.3 Total Petroleum Hydrocarbons

It is proposed that the maximum authorized monthly mean concentration and the maximum authorized concentration in a grab sample for TPH be set at 3 mg/L and 6 mg/L, which are the same values as other mines in Nunavut (i.e., Agnico Eagle Mines Limited Water Licence No.: 2AM-WTP1830).

8.0 SUMMARY

Table 19 presents the proposed EQC for the Project. The proposed EQC for all POPC are equal to or less than MDMER limits.

Table 19: Proposed Water Quality and Technology-Based Effluent Quality Criteria

Parameter of Potential Concern	Effluent Quality Criteria	
	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Grab Sample
Major Ions		
Chloride, mg/L	600	640
Nutrients		
Nitrate, mg-N/L	60	120
Nitrite, mg-N/L	0.6	1.2
Total ammonia, mg-N/L	6	12
Total Metals		
Aluminum, mg/L	0.5	1.0
Arsenic, mg/L	0.1 [a]	0.2 [a]
Copper, mg/L	0.008	0.016
Iron, mg/L	1	2
Lead, mg/L	0.02	0.04
Nickel, mg/L	0.25 [a]	0.5 [a]
Zinc, mg/L	0.20	0.23
Others		
Cyanide, mg/L	0.5 [a]	1.0 [a]
pH	6.0 – 9.5	
Total suspended solids, mg/L	15 [a]	30 [a]
Total petroleum hydrocarbons, mg/L	3	6

(a) MDMER limits (Government of Canada 2002); MDMER = Metal and Diamond Mining Effluent Regulations.

9.0 CLOSURE

The reader is referred to the Study Limitations section, which follows the text and forms an integral part of this report.

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

Signature Page

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https://golderassociates.sharepoint.com/sites/136792/project files/6 deliverables/2.0 issued/20412211-081-r-rev0-2400/20412211-081-r-rev0-2400-eqc_report_27may_21.docx

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STUDY LIMITATIONS

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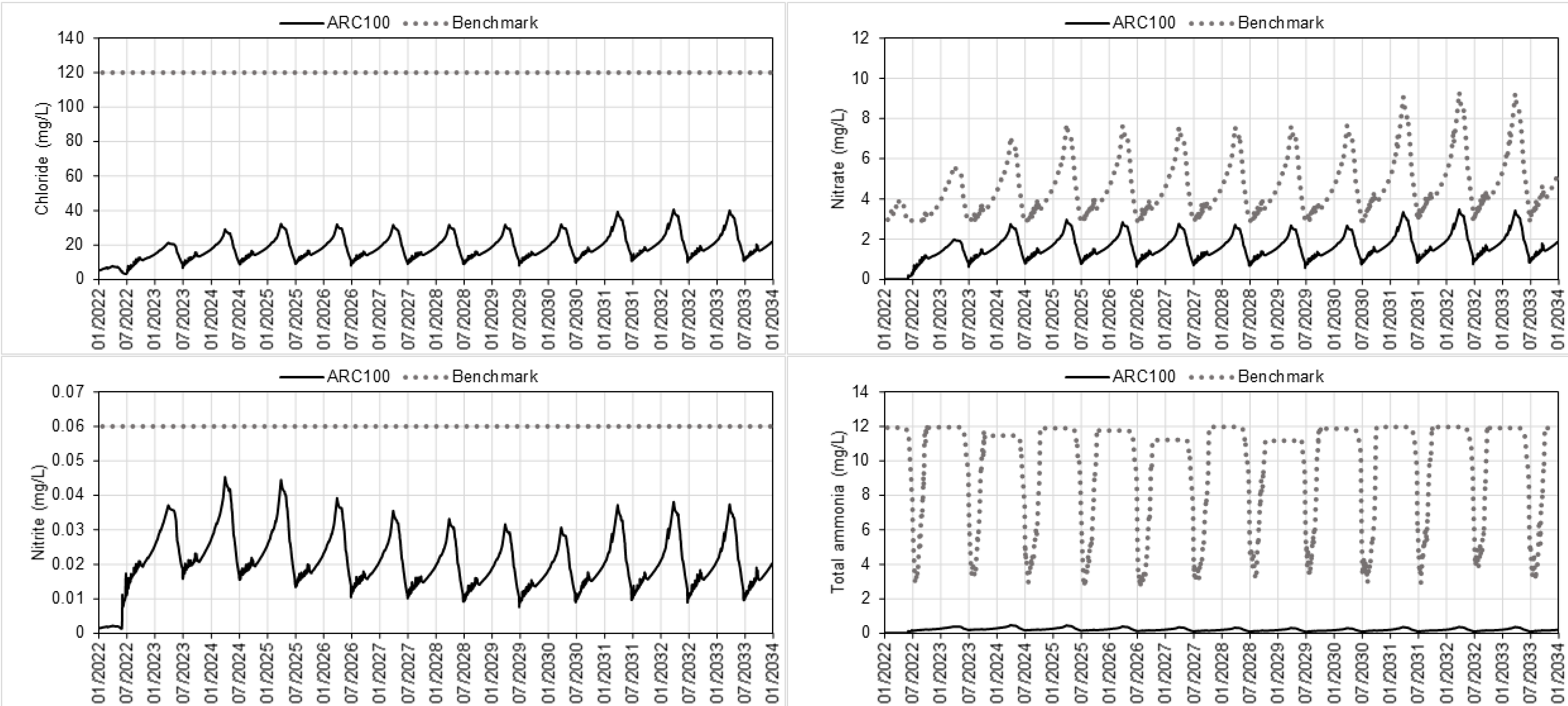
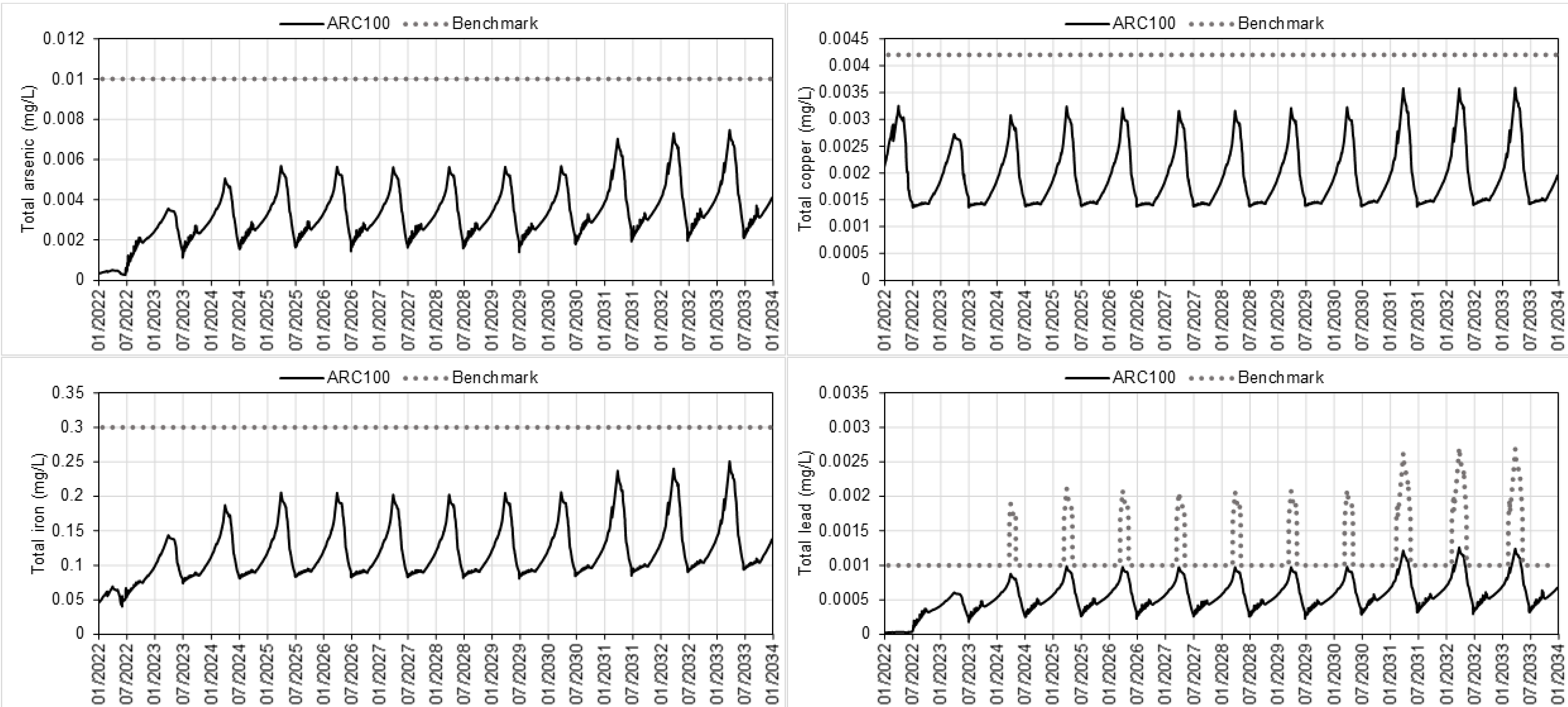
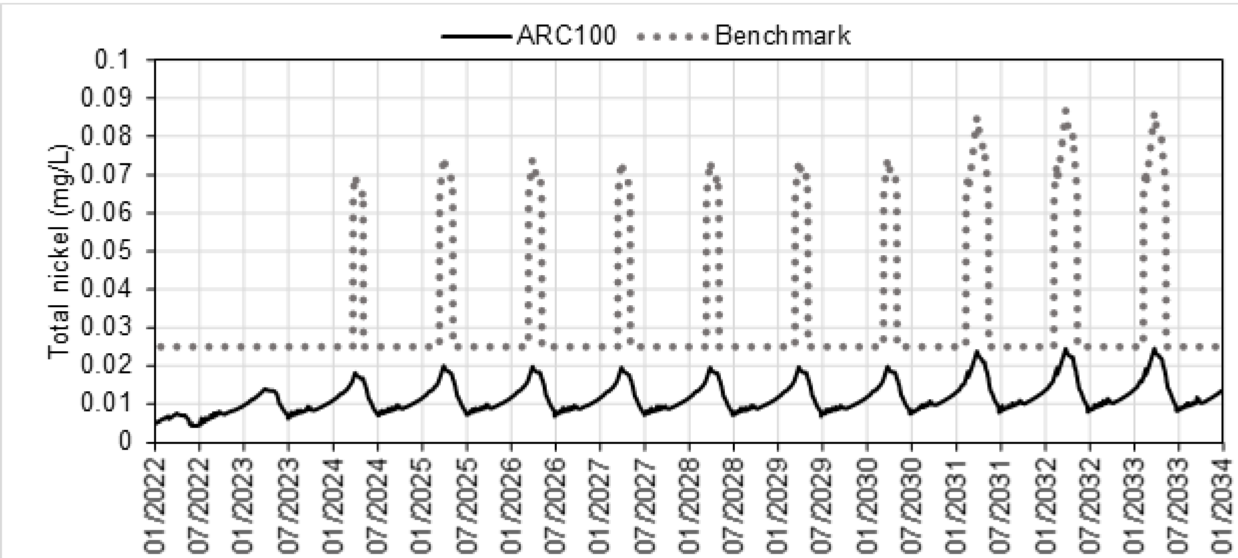
APPENDIX A

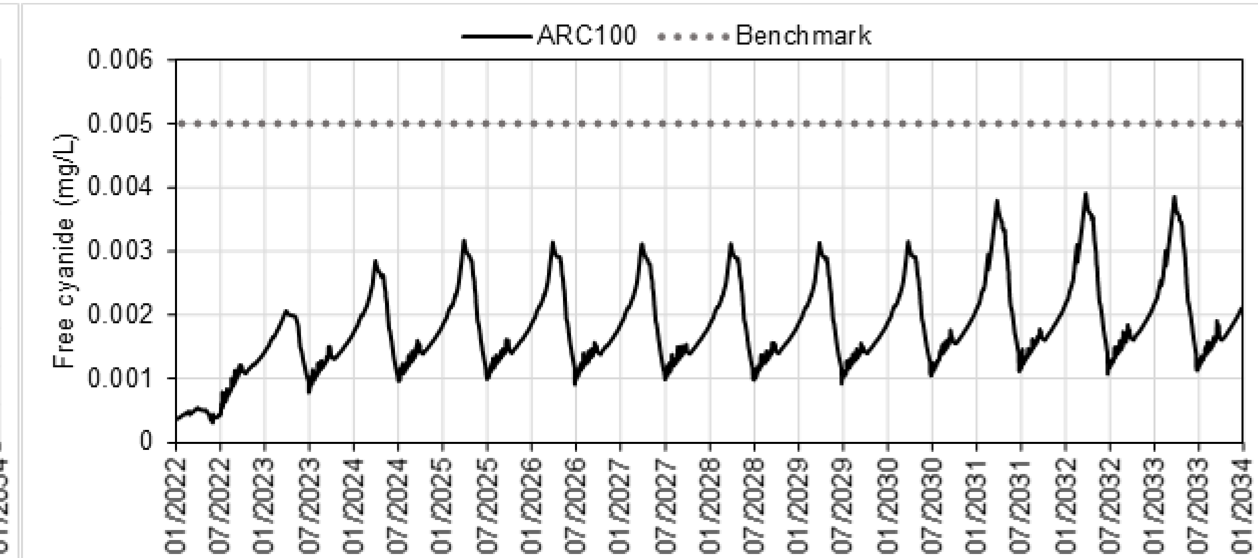
Goose Lake Hydrodynamic and Water Quality Model Results

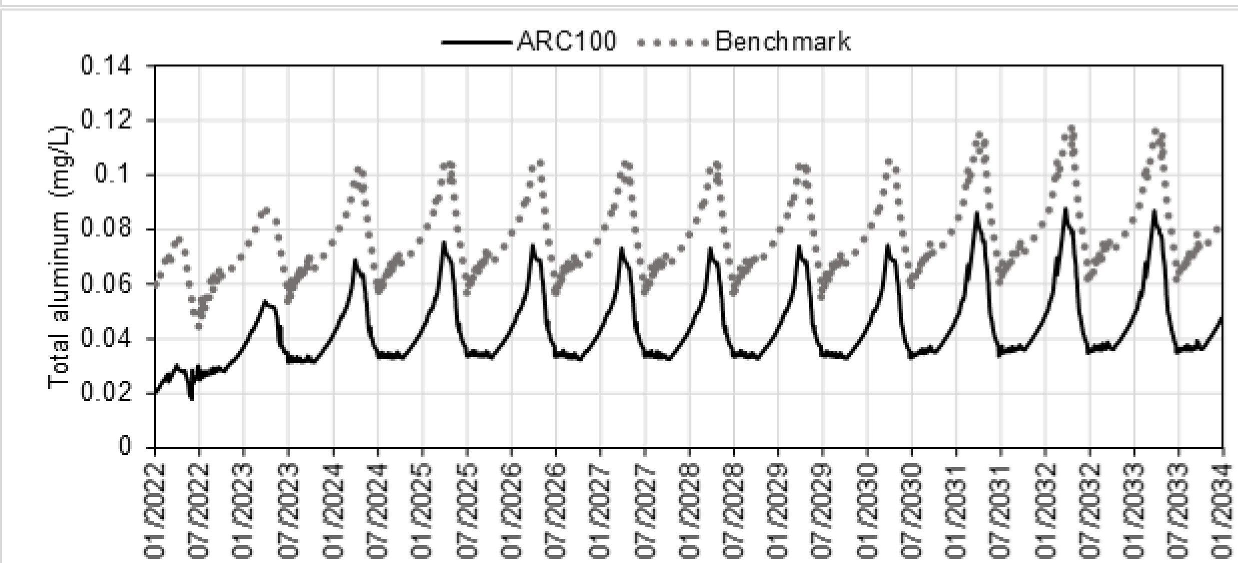
Figure A-1: Predicted Daily Timeseries Concentrations of POPC for Proposed EQC at the Edge of the Arc 100 m from Discharge Point




ARC100
Benchmark
Total arsenic (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034
ARC100
Benchmark
Total copper (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
ARC100
Benchmark
Total iron (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
ARC100
Benchmark
Total lead (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0


ARC100
Benchmark
Total nickel (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034


ARC100
Benchmark
Free cyanide (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034


ARC100
Benchmark
Total aluminum (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034

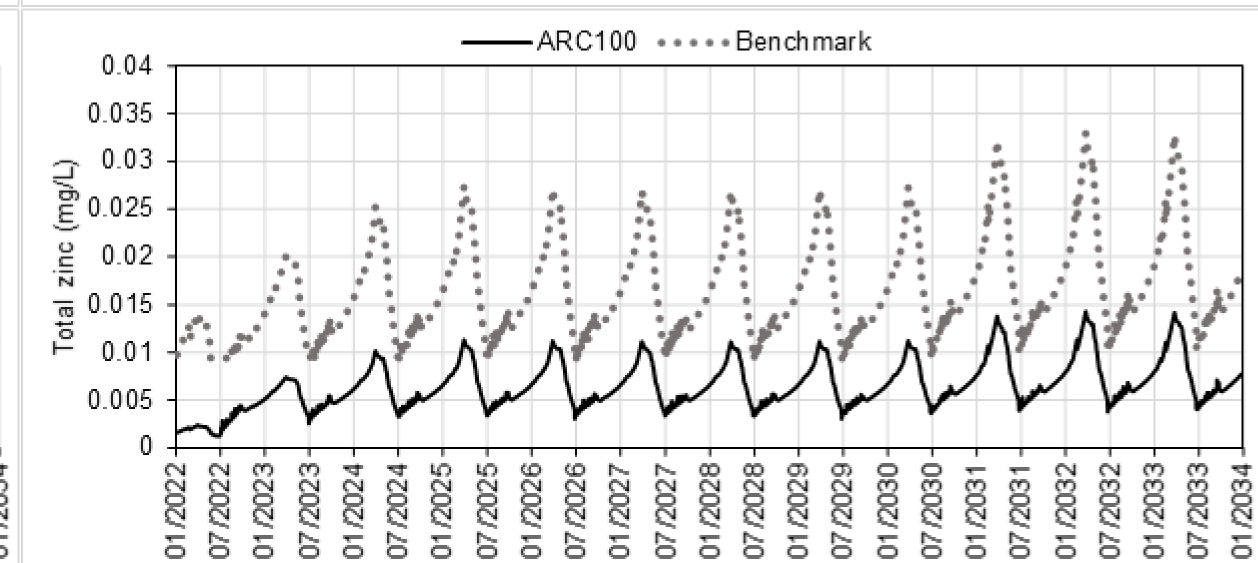
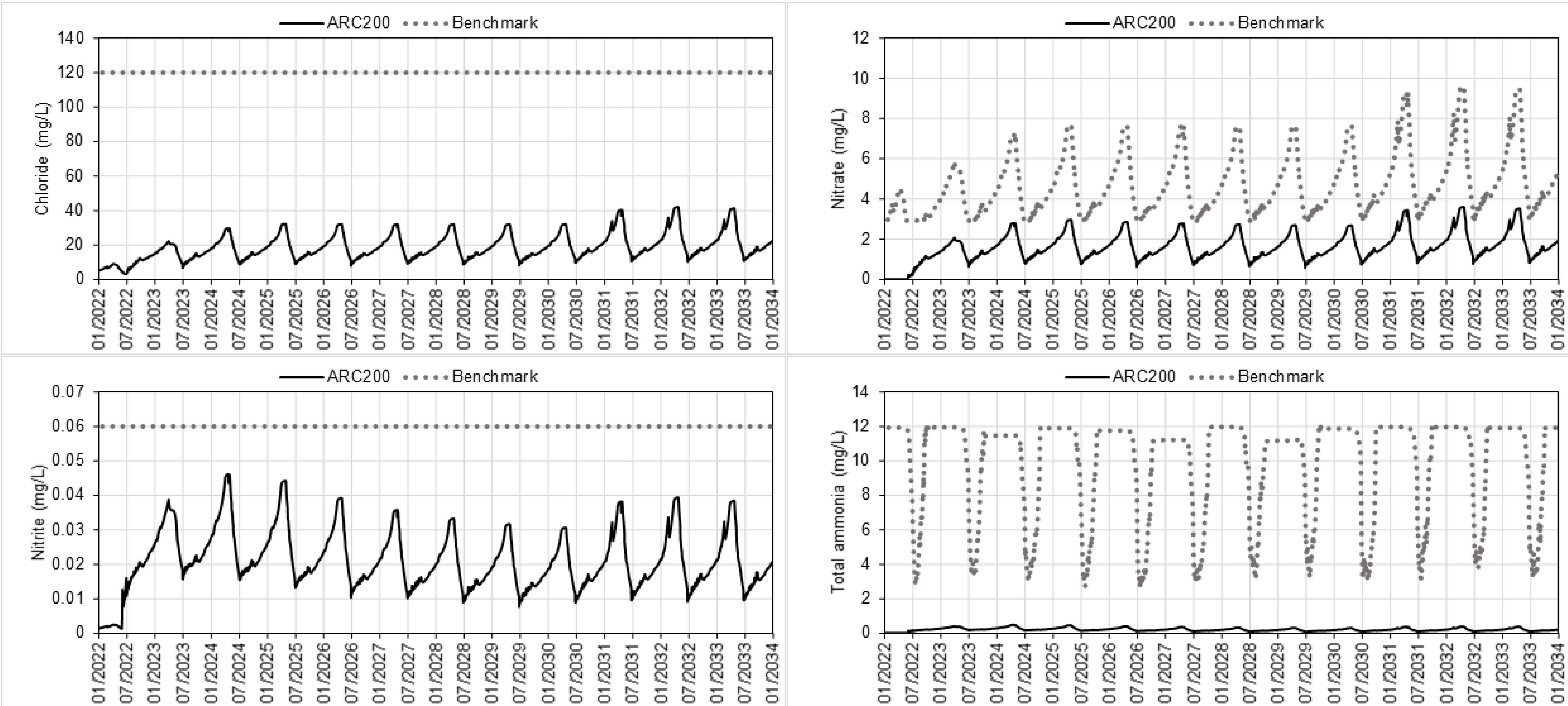
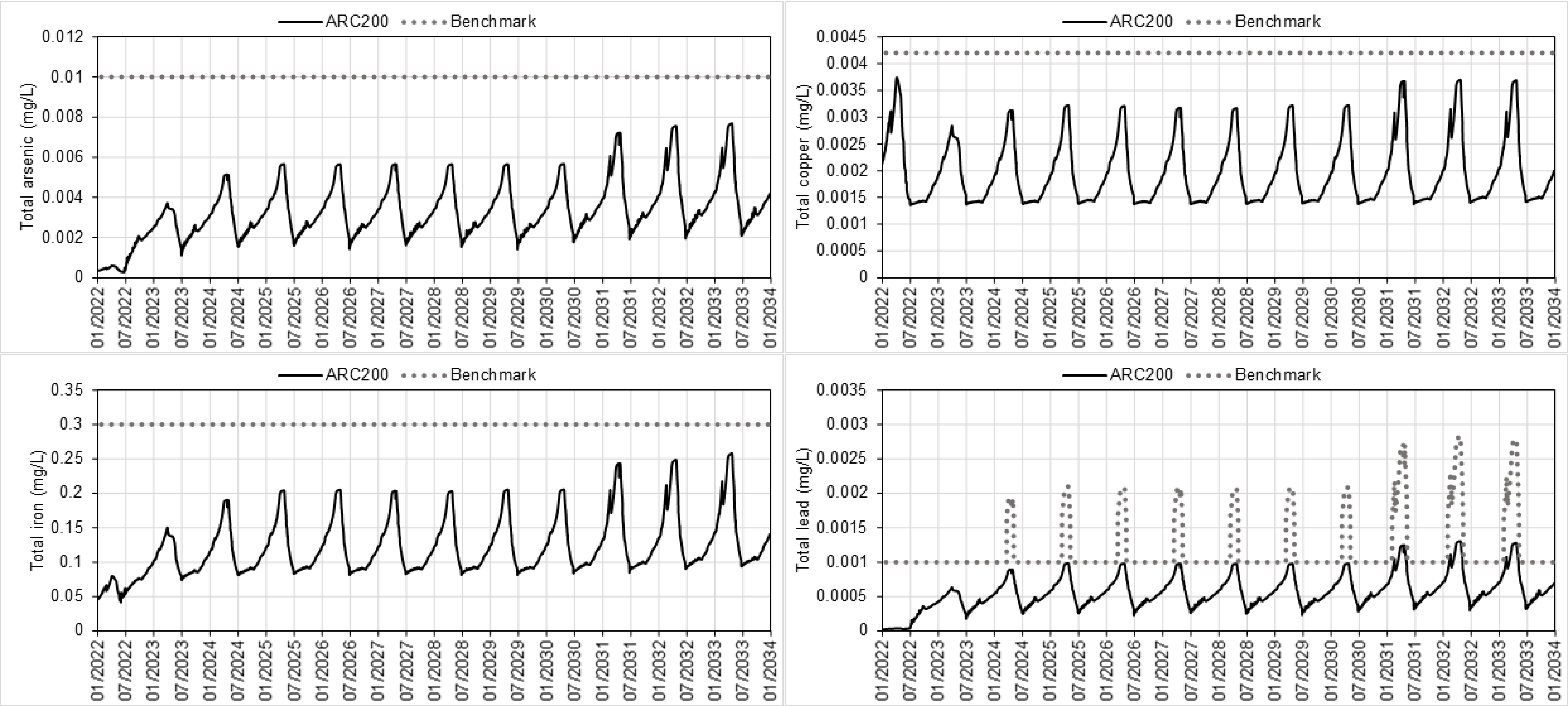

ARC100
Benchmark
Total zinc (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034

Figure A-2: Predicted Daily Timeseries Concentrations of POPC for Proposed EQC at the Edge of the Arc 200 m from Discharge Point




ARC200
Benchmark
Total arsenic (mg/L)
Total copper (mg/L)
Total iron (mg/L)
Total lead (mg/L)
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
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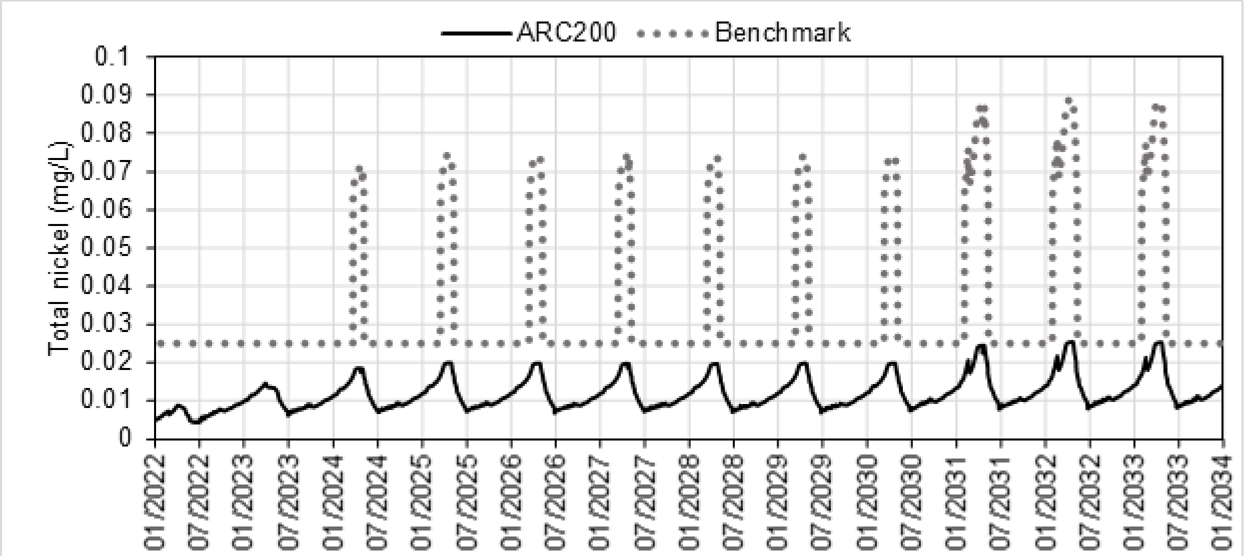
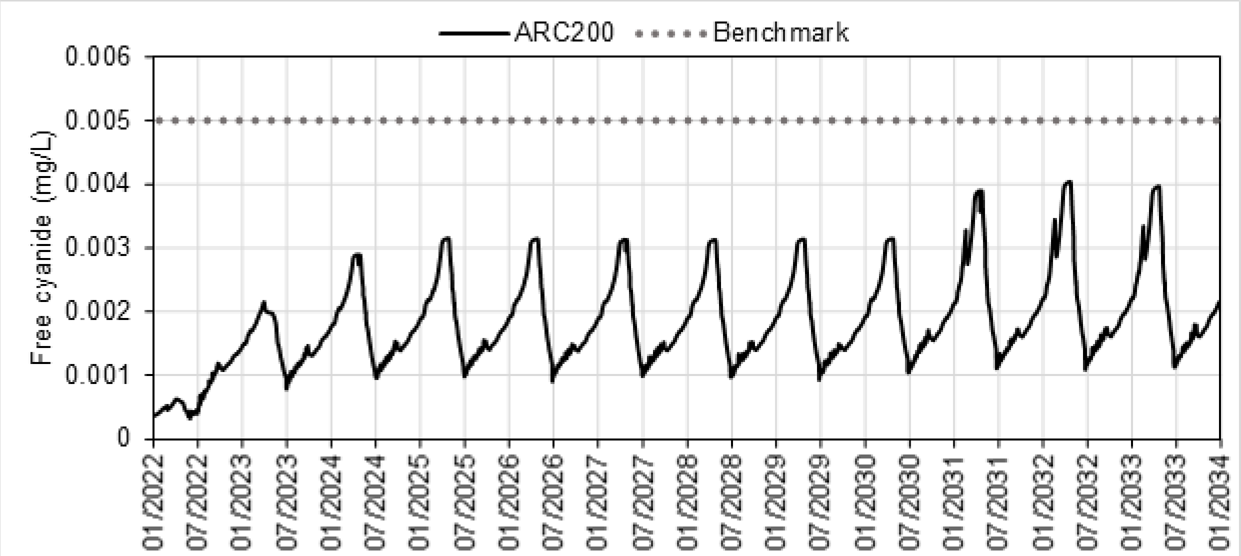
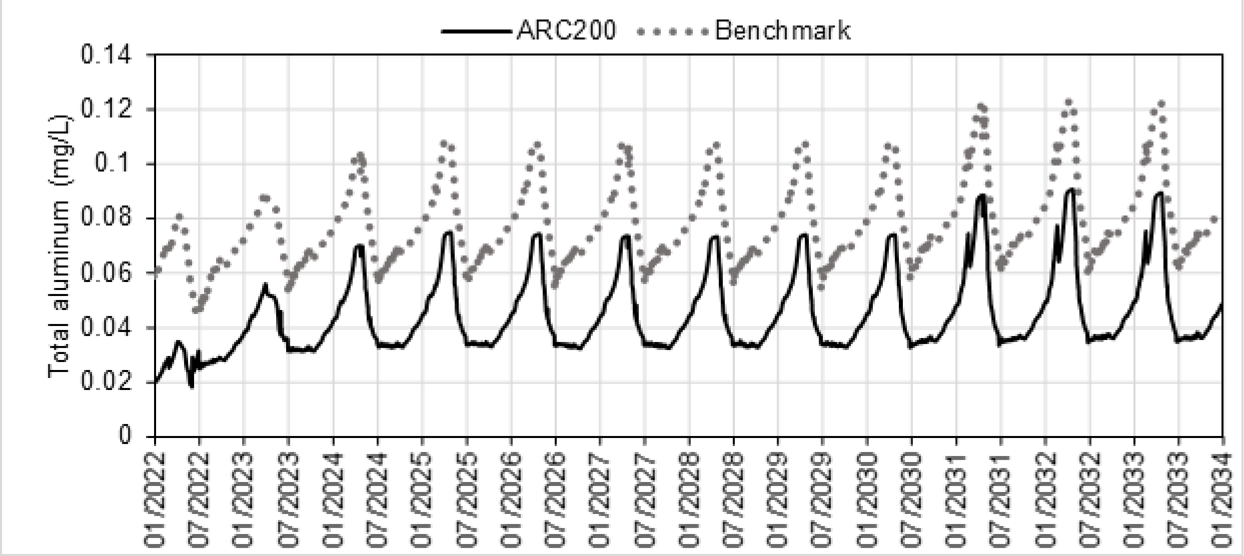
01/2033
07/2033
01/2034


ARC200
Benchmark
Total nickel (mg/L)


ARC200
Benchmark
Free cyanide (mg/L)


ARC200
Benchmark
Total aluminum (mg/L)

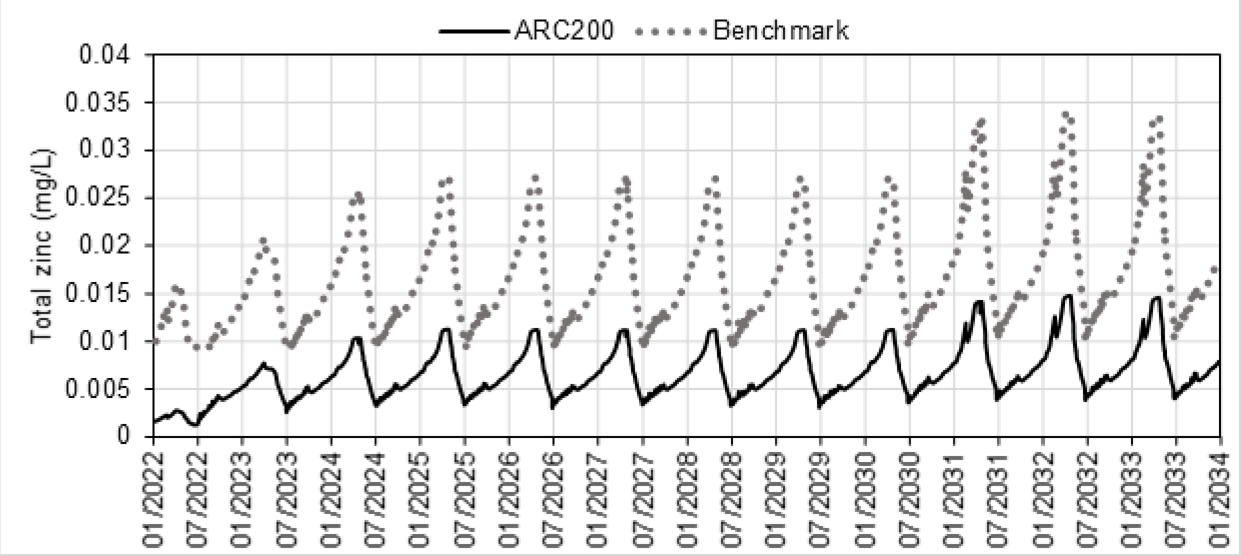
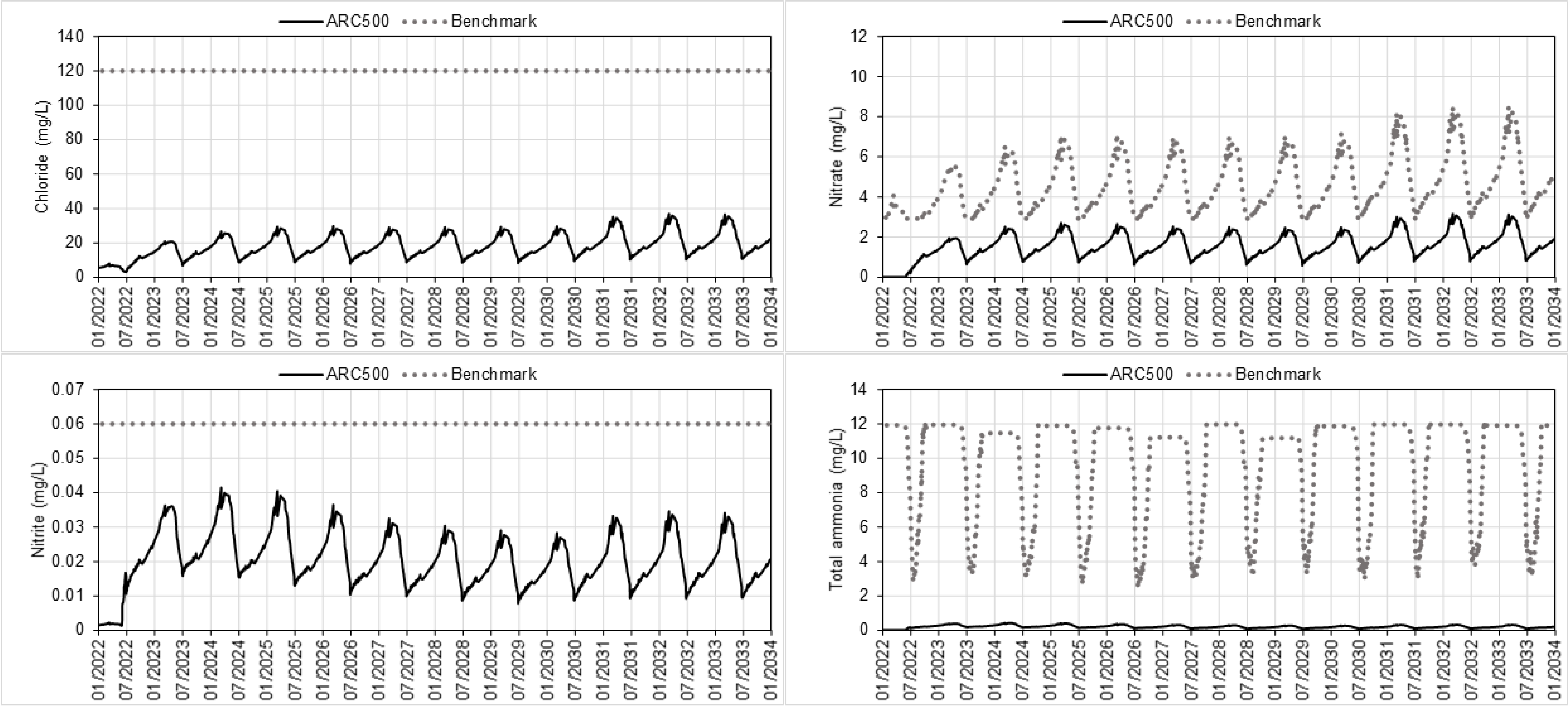
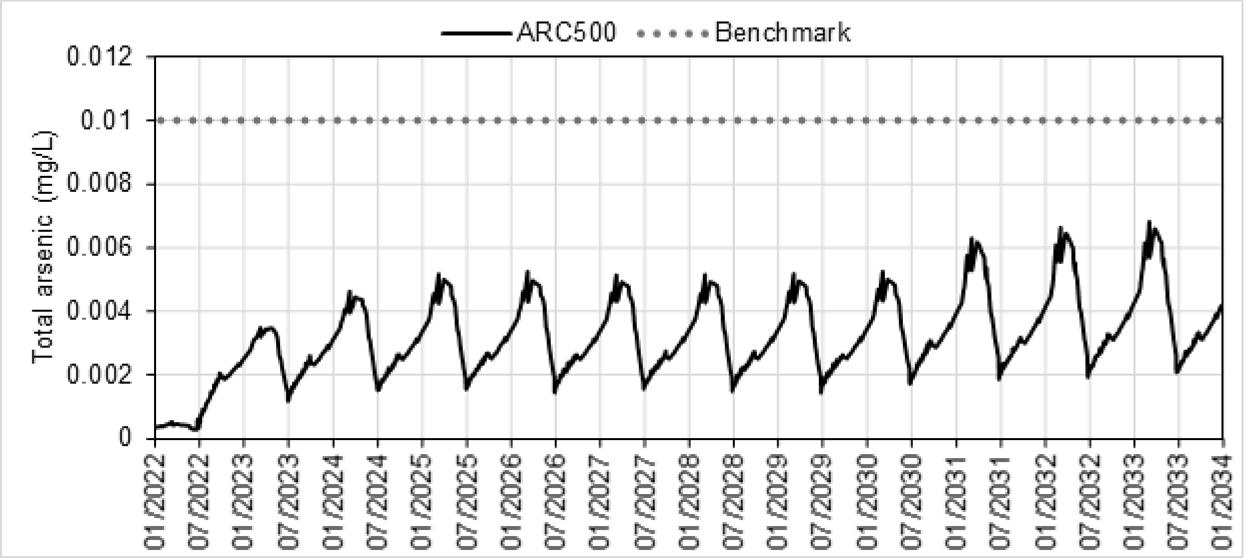
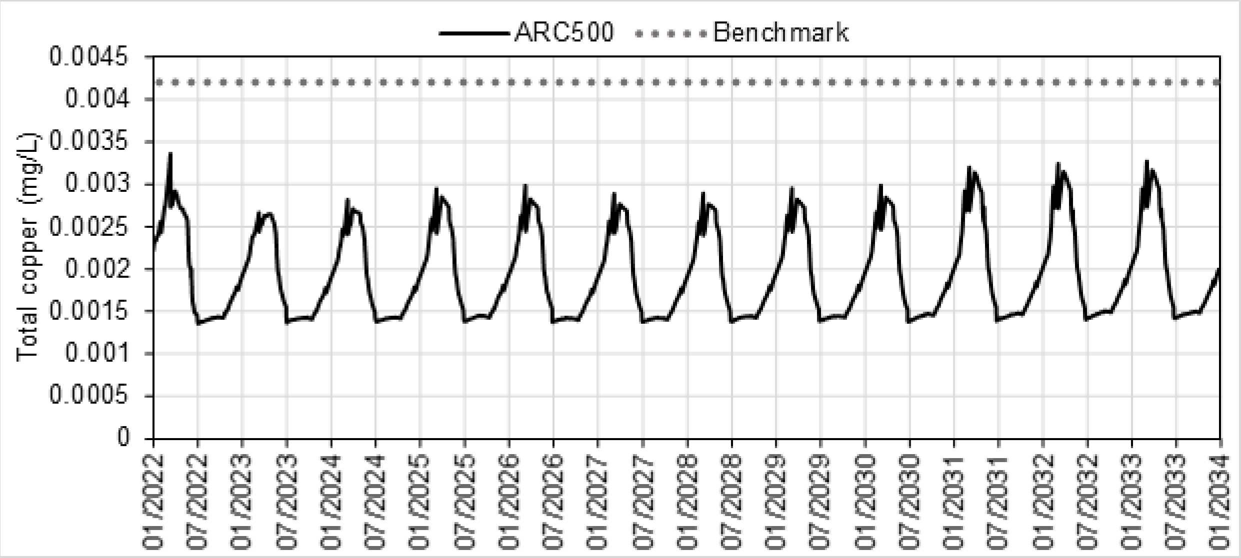
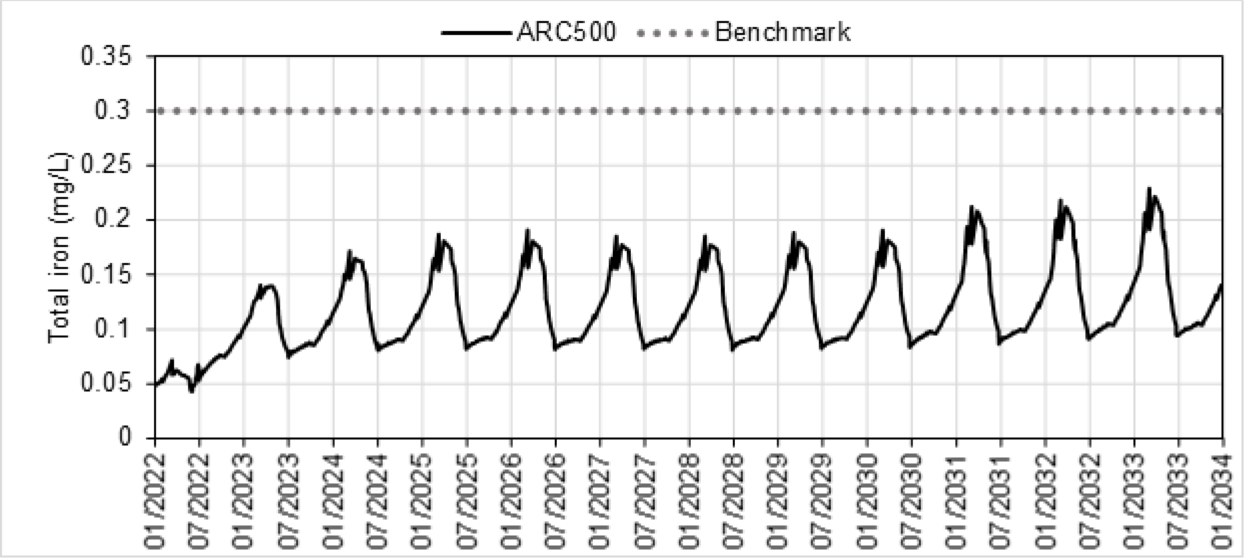

ARC200
Benchmark
Total zinc (mg/L)

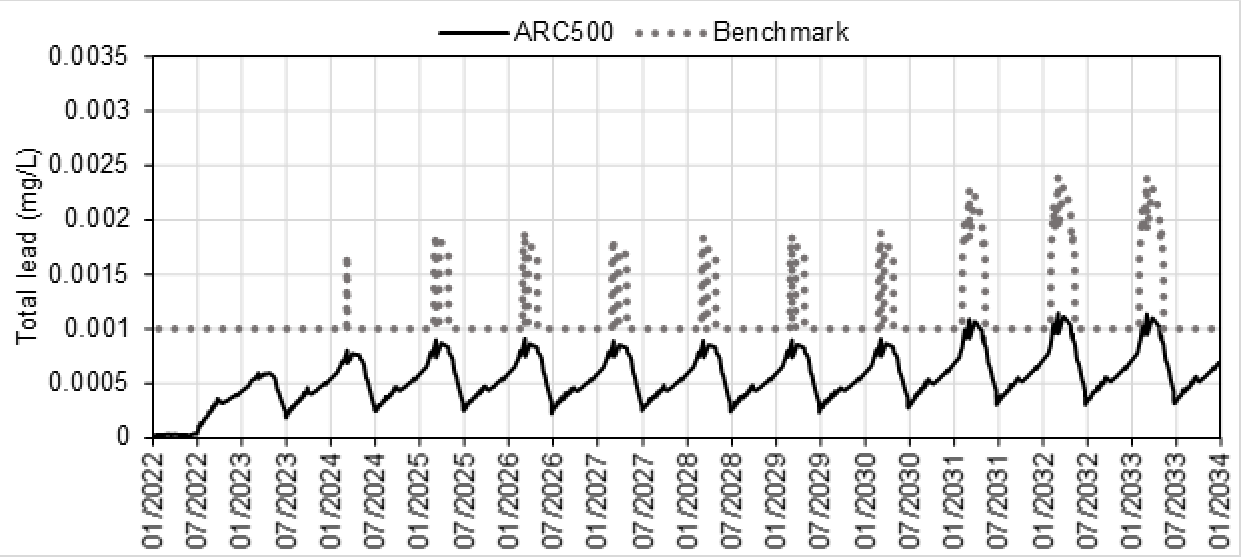
Figure A-3: Predicted Daily Timeseries Concentrations of POPC for Proposed EQC at the Edge of the Arc 500 m from Discharge Point




ARC500
Benchmark
Total arsenic (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034


ARC500
Benchmark
Total copper (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034


ARC500
Benchmark
Total iron (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034


ARC500
Benchmark
Total lead (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034

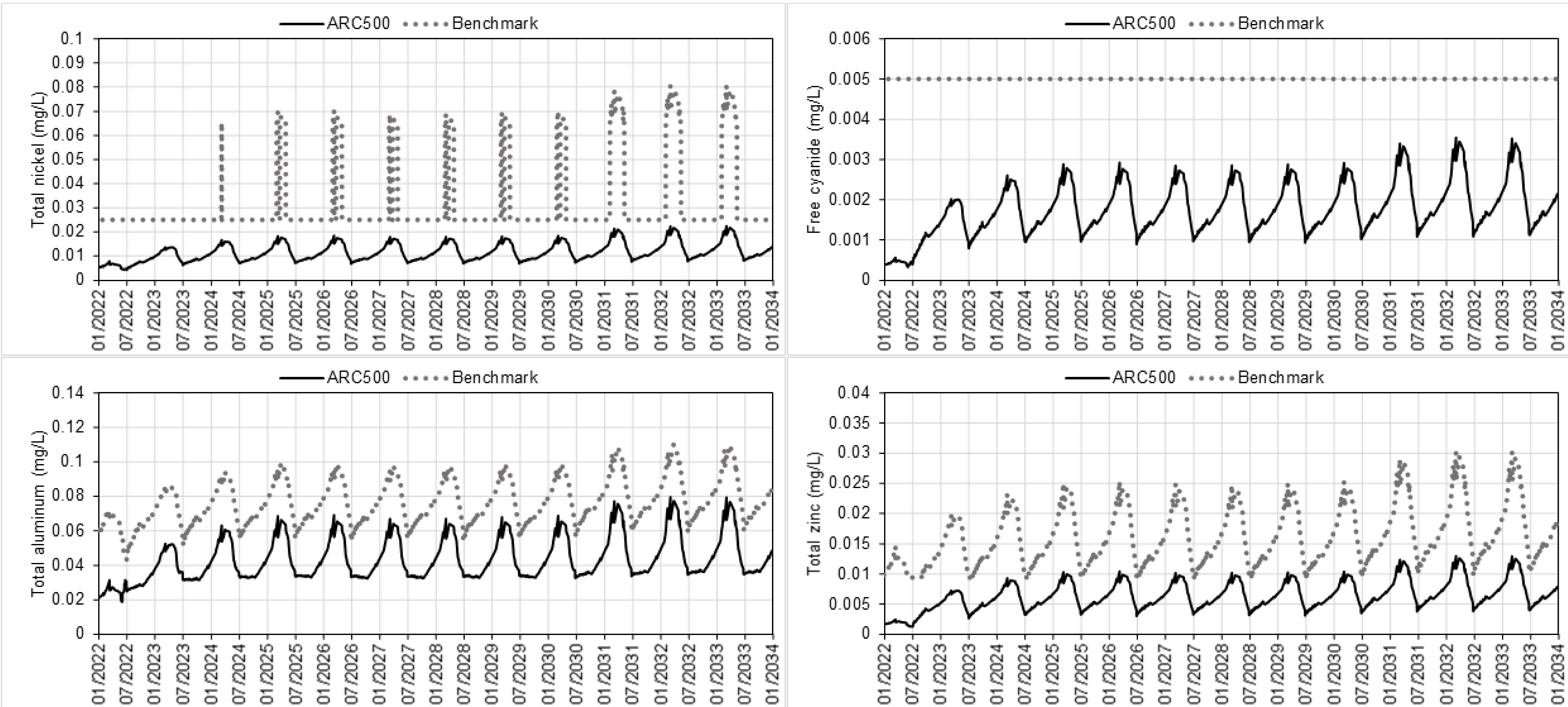
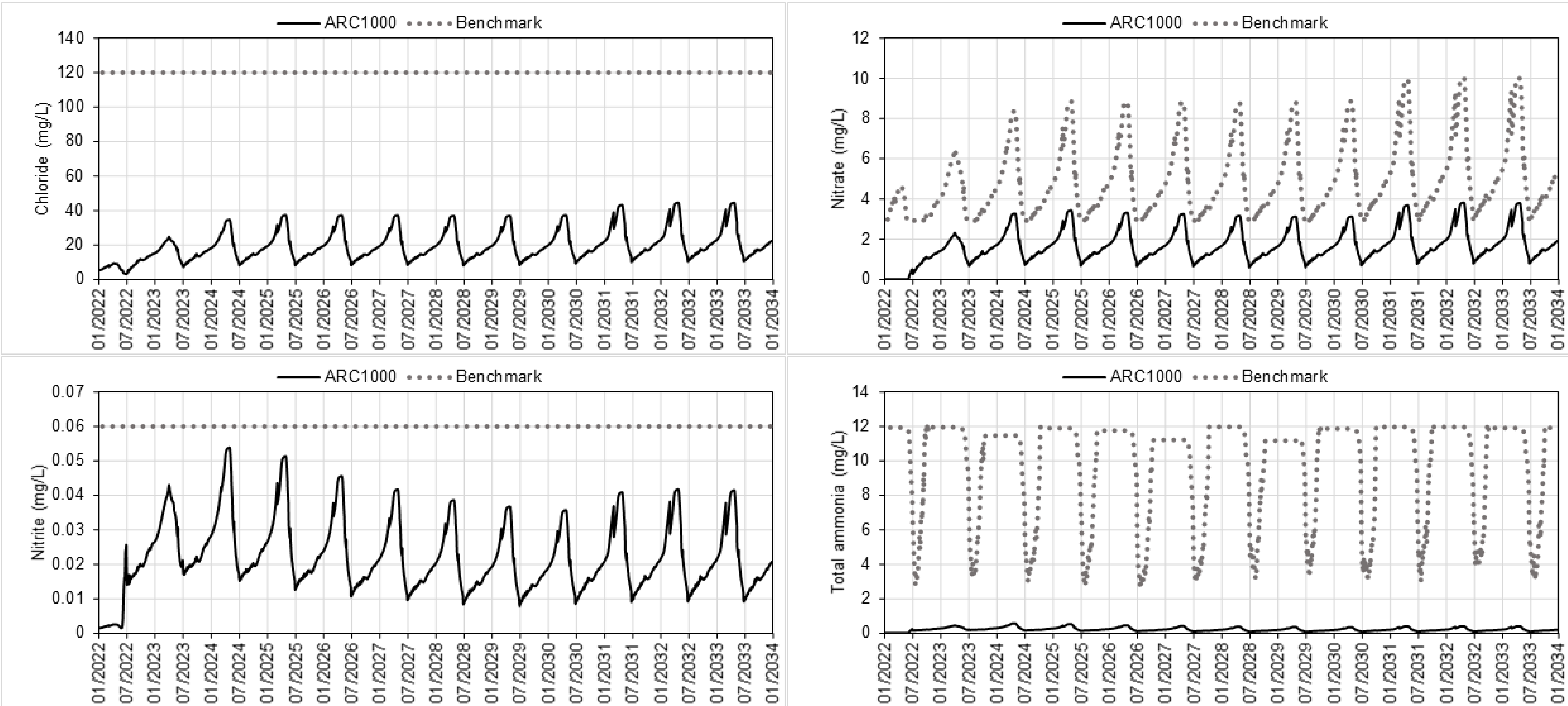
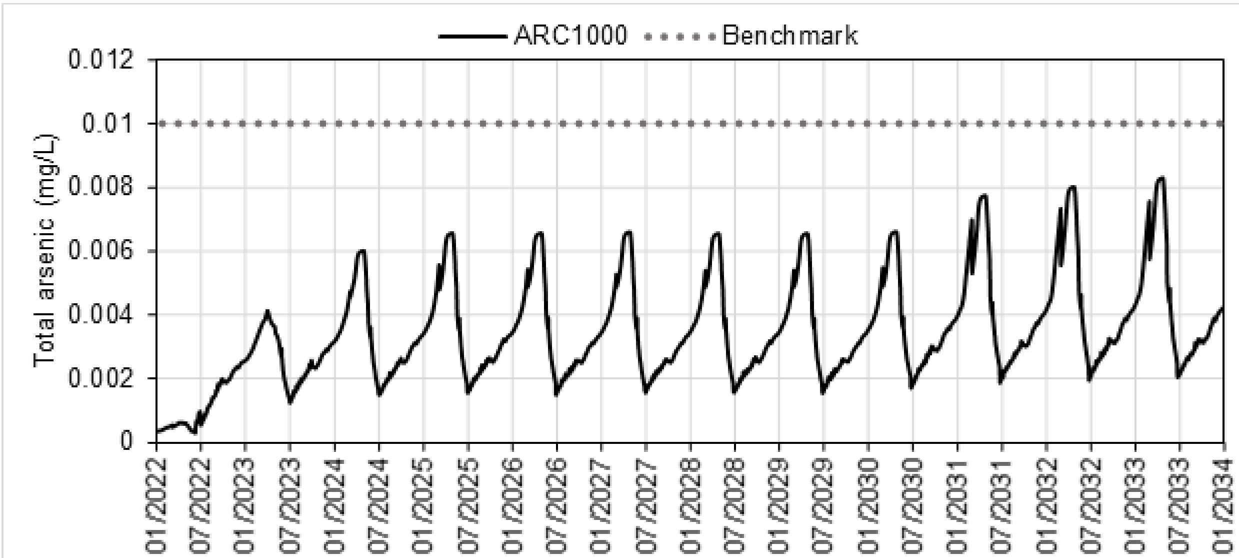
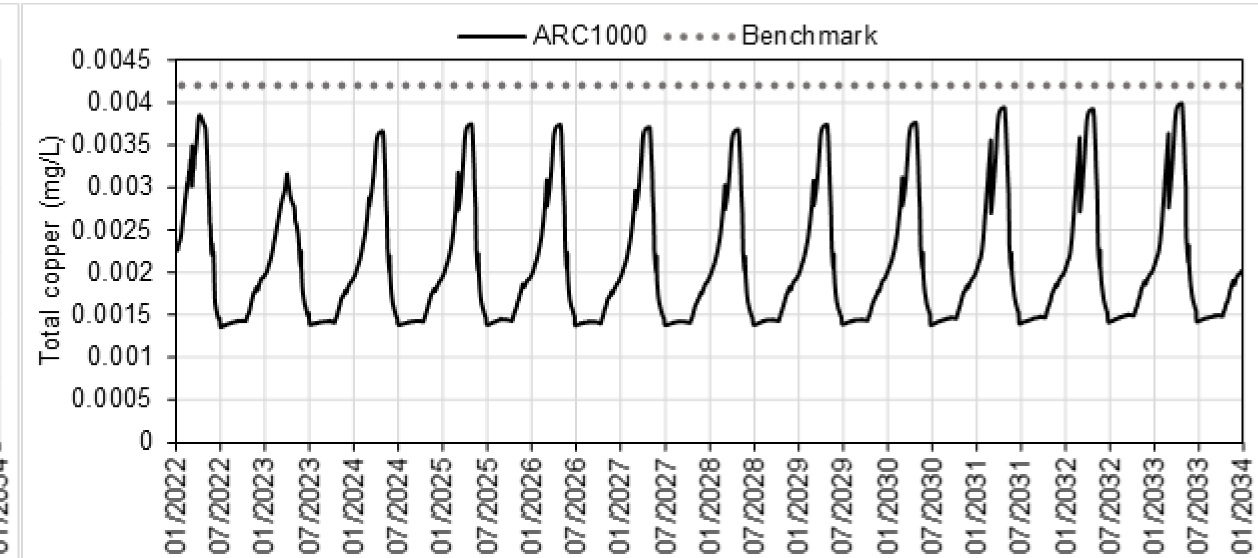
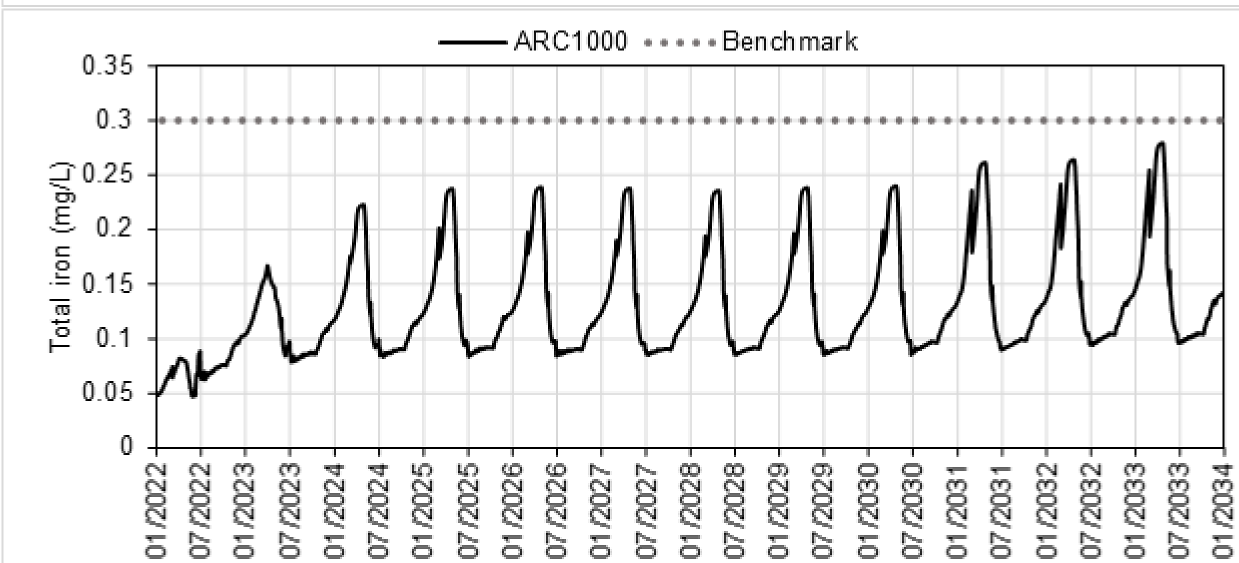

ARC500
Benchmark
Total nickel (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Free cyanide (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
Total aluminum (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Total zinc (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034

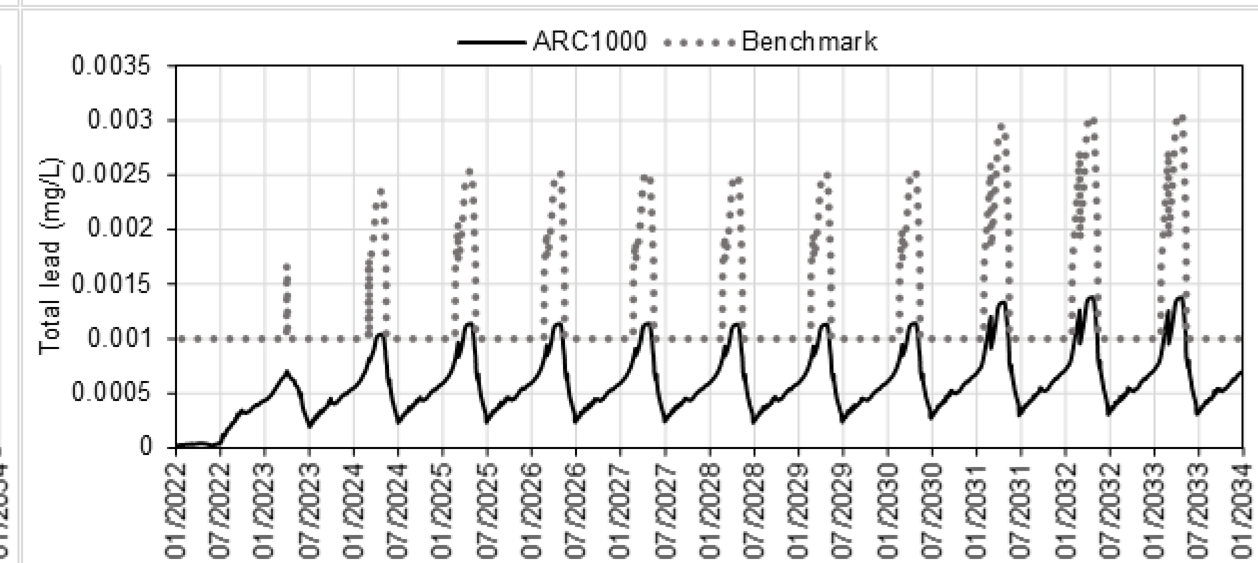
Figure A-4: Predicted Daily Timeseries Concentrations of POPC for Proposed EQC at the Edge of the Arc 1,000 m from Discharge Point

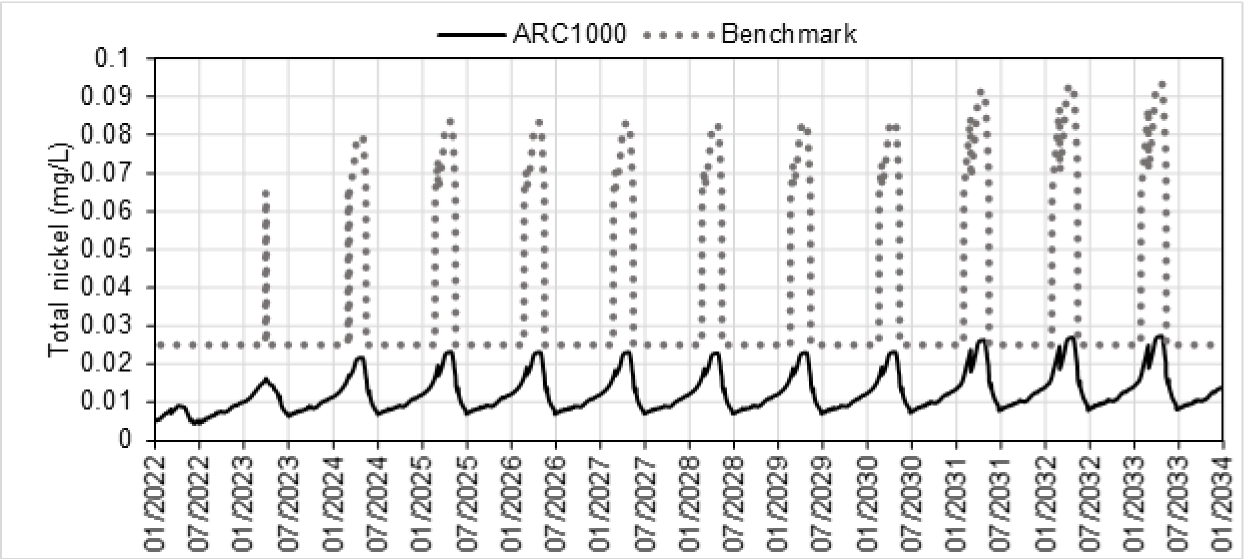


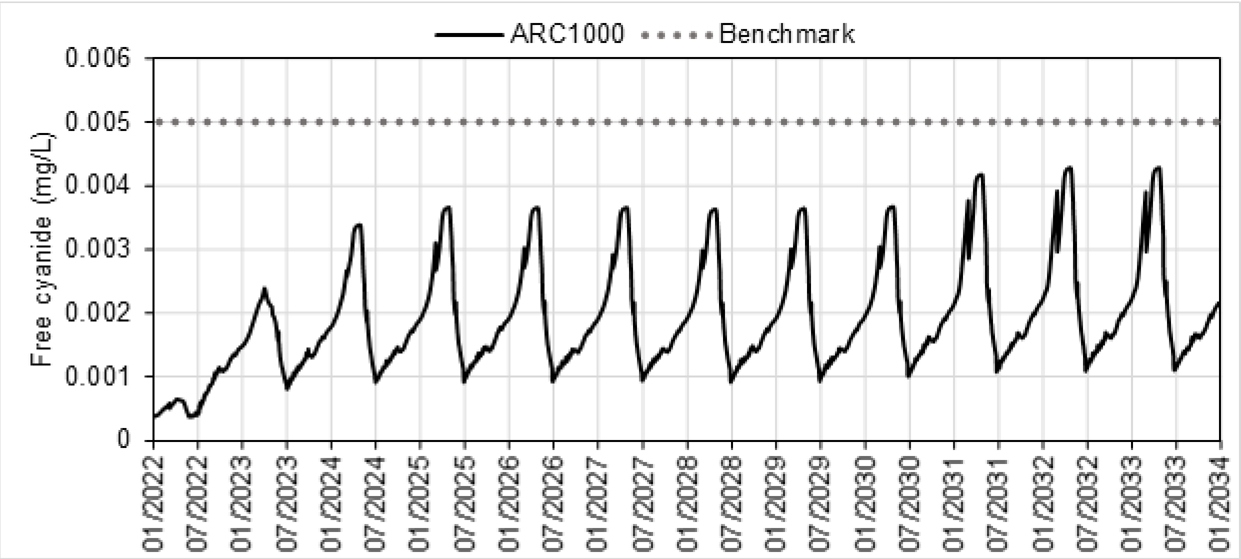

ARC1000
Benchmark
Total arsenic (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034

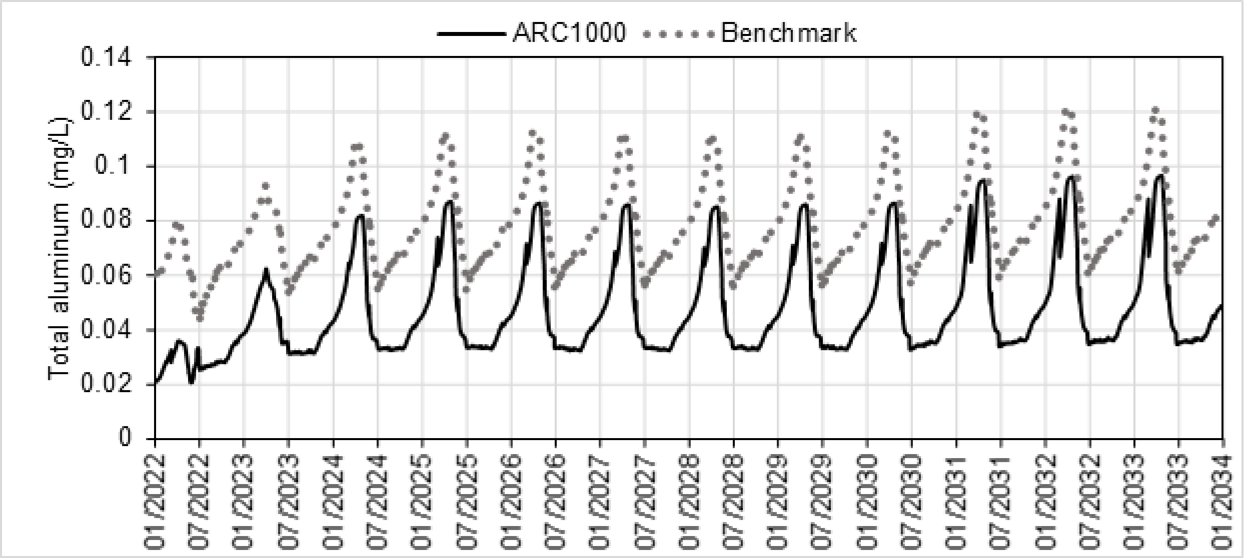

ARC1000
Benchmark
Total copper (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034


ARC1000
Benchmark
Total iron (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034


ARC1000
Benchmark
Total lead (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/2022 07/2022 01/2023 07/2023 01/2024 07/2024 01/2025 07/2025 01/2026 07/2026 01/2027 07/2027 01/2028 07/2028 01/2029 07/2029 01/2030 07/2030 01/2031 07/2031 01/2032 07/2032 01/2033 07/2033 01/2034


ARC1000
Benchmark
Total nickel (mg/L)


ARC1000
Benchmark
Free cyanide (mg/L)


ARC1000
Benchmark
Total aluminum (mg/L)

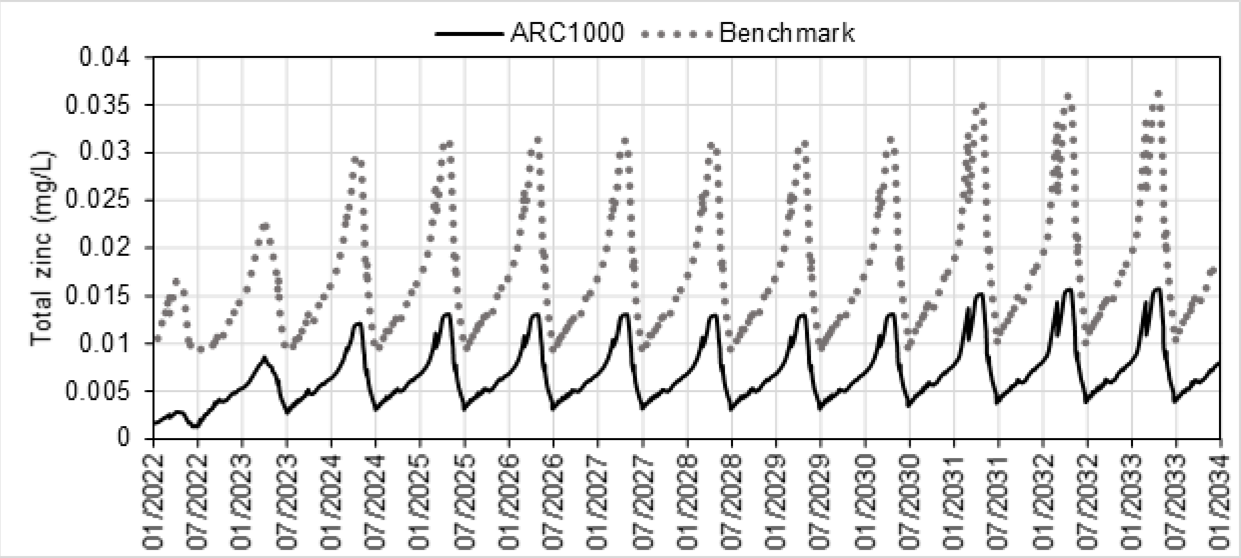
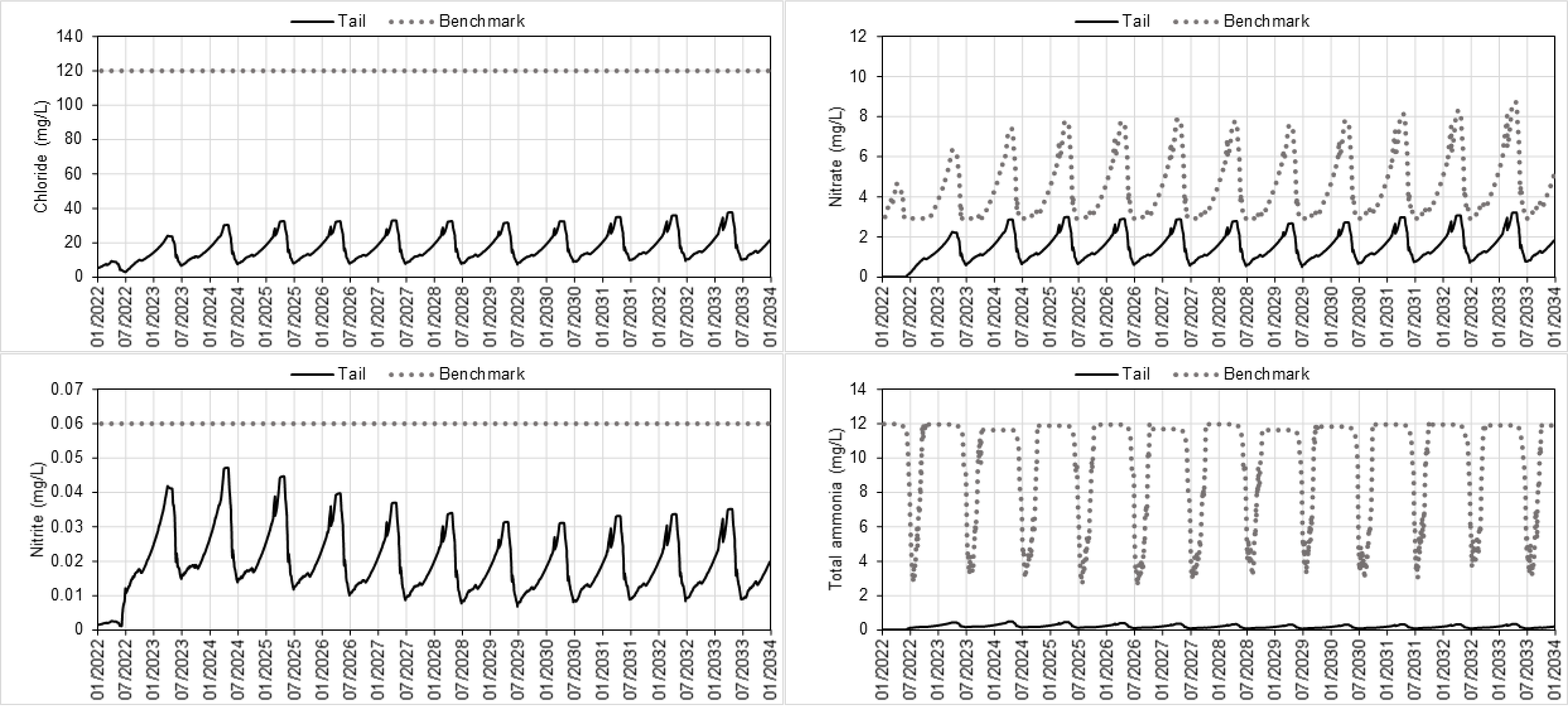
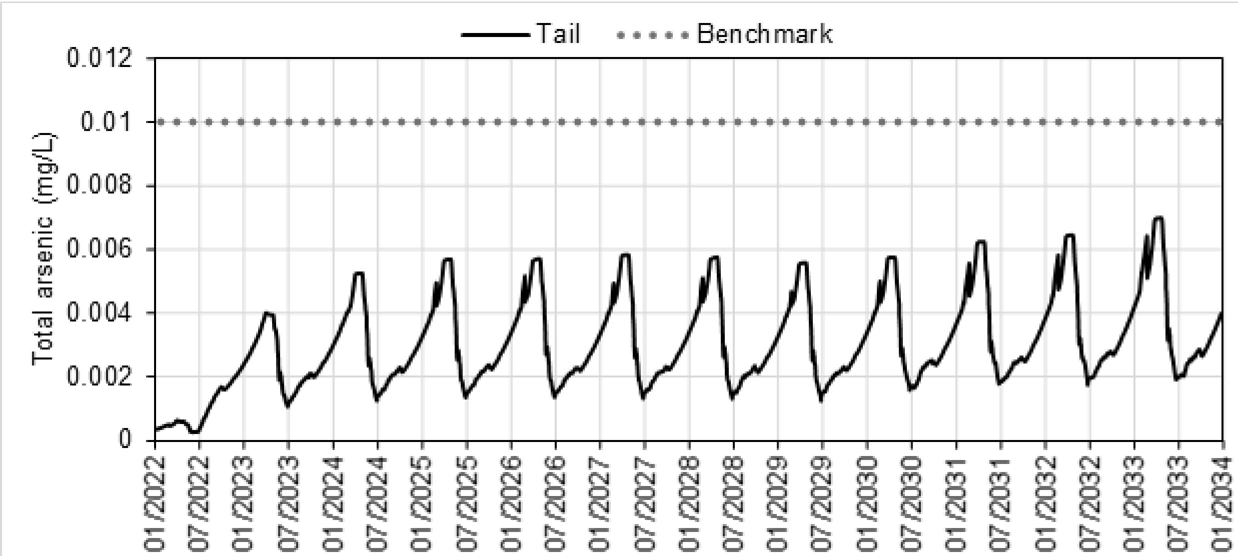
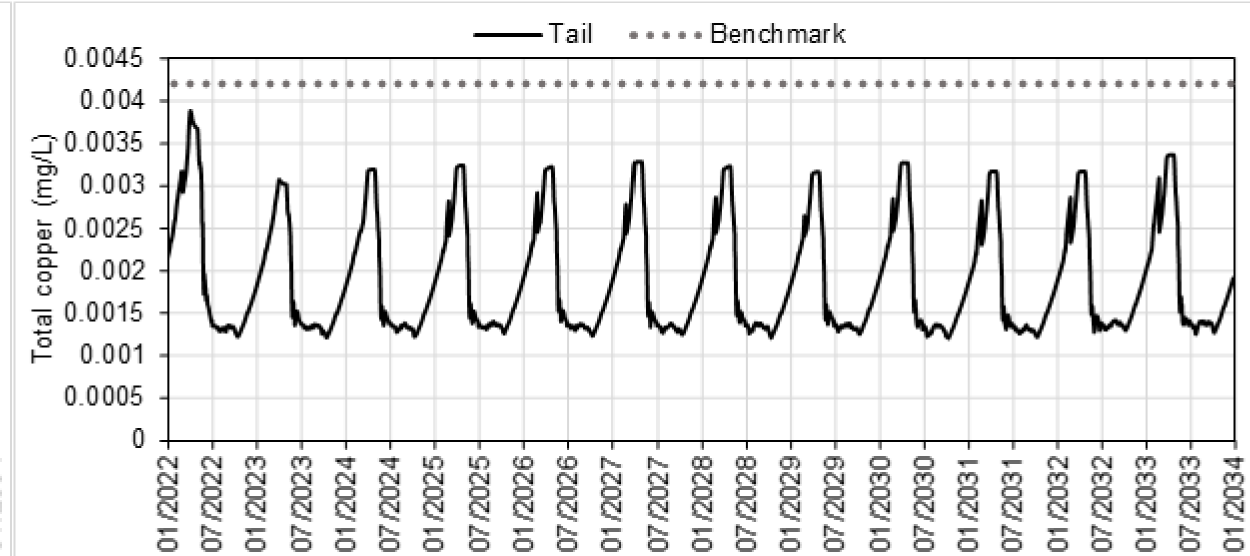

ARC1000
Benchmark
Total zinc (mg/L)

Figure A-5: Predicted Daily Timeseries Concentrations of POPC for Proposed EQC at the Goose Lake Tail




Tail
Benchmark
Total arsenic (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034


Tail
Benchmark
Total copper (mg/L)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
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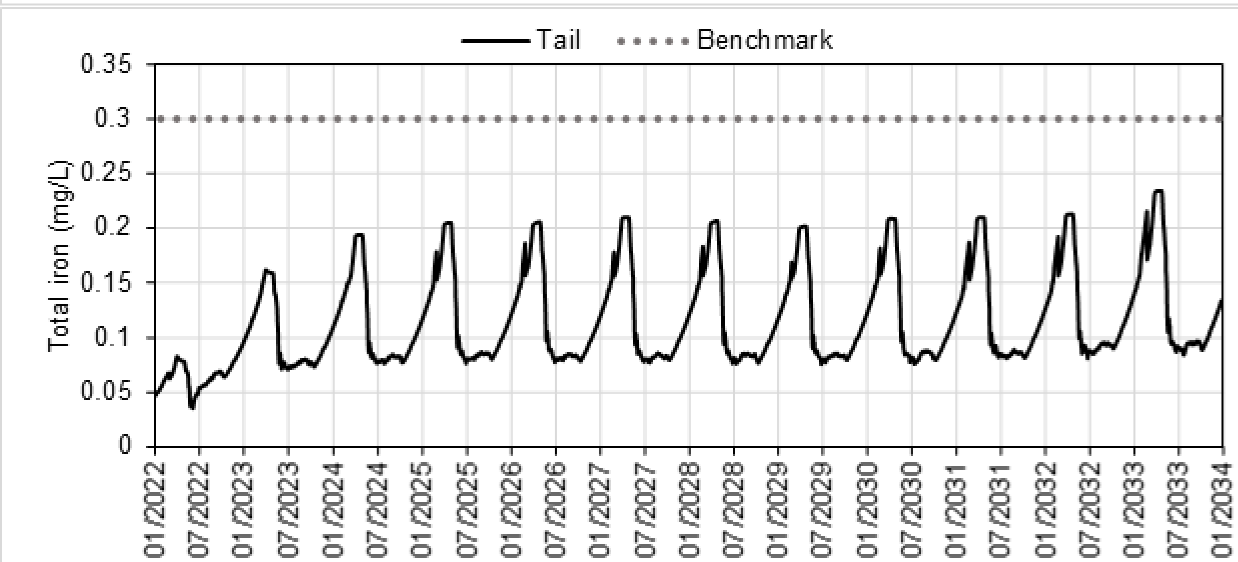
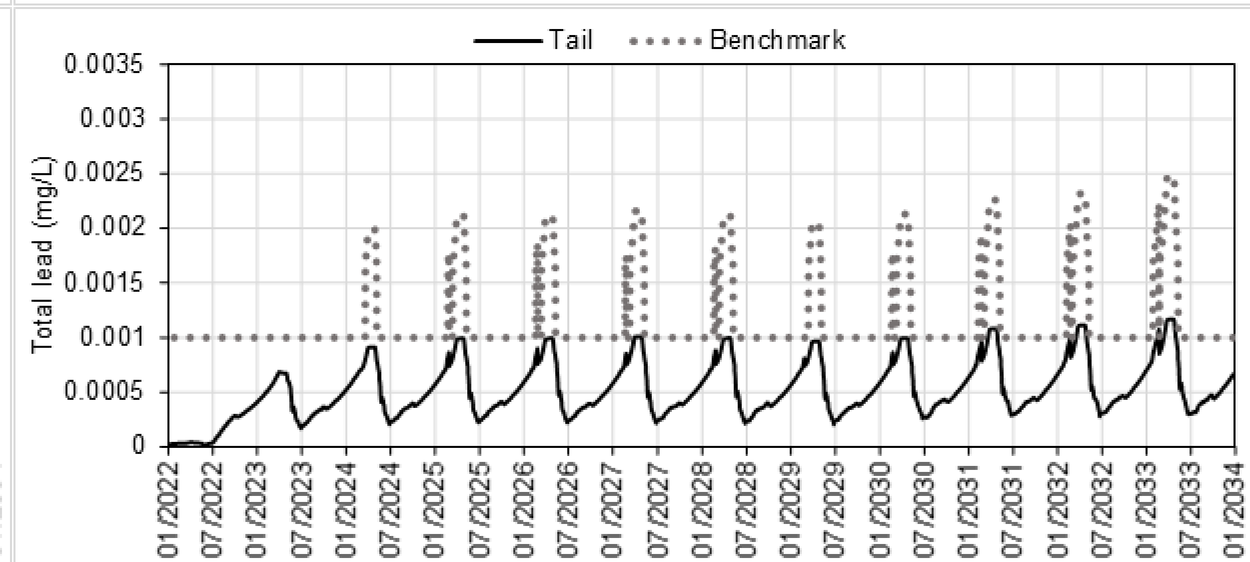
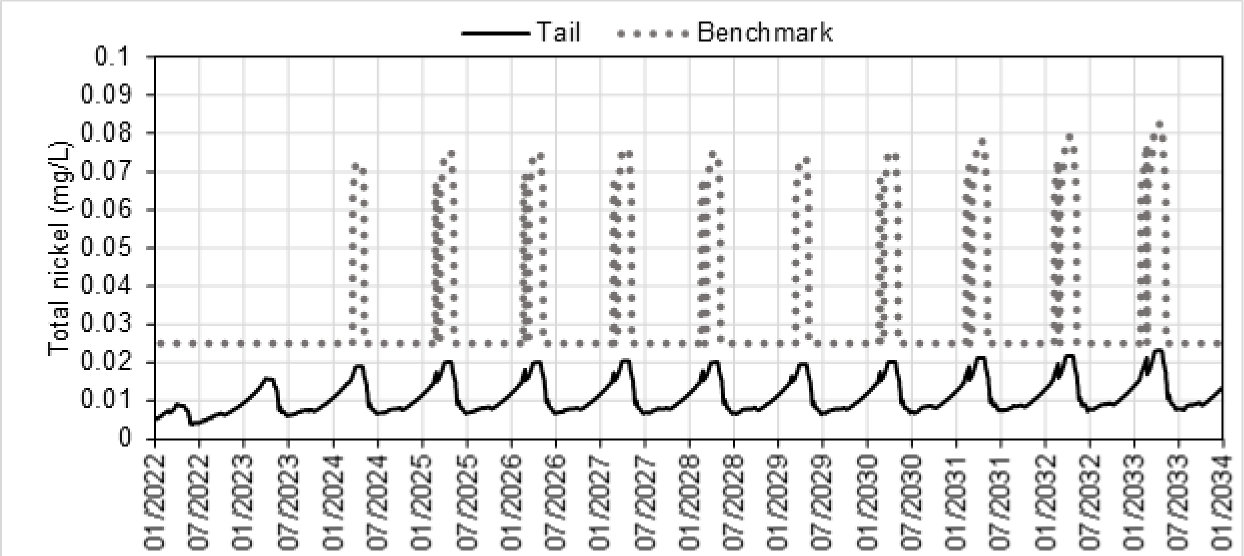
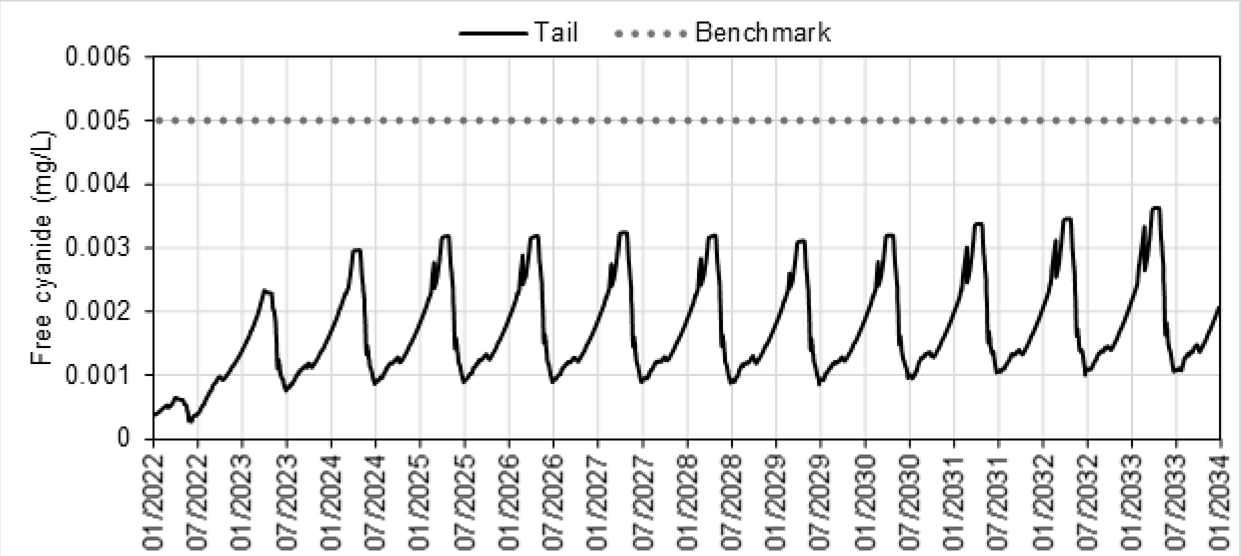
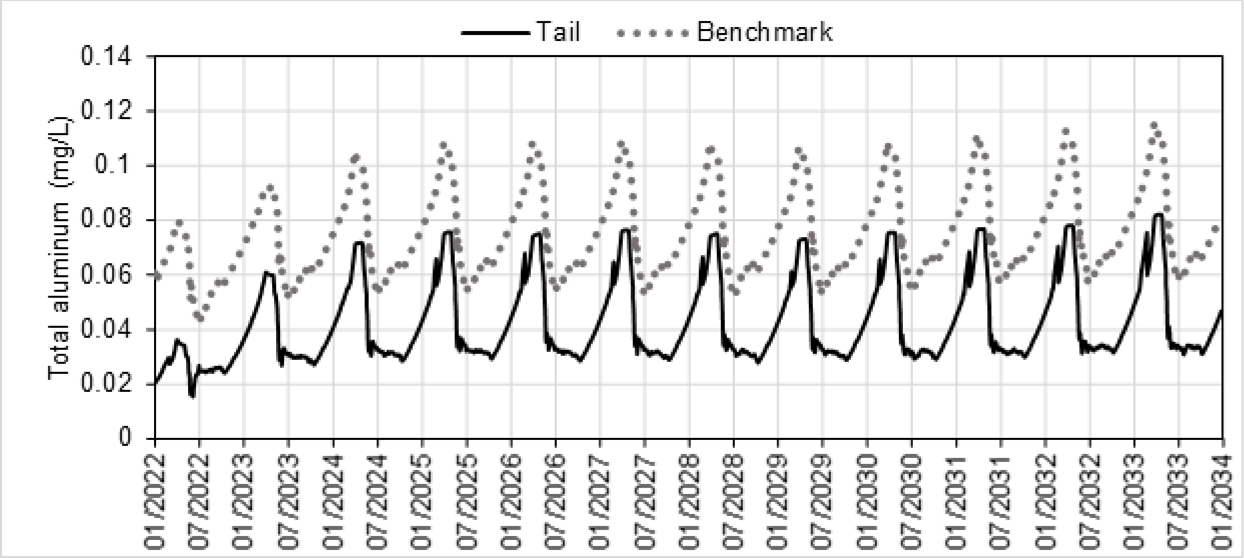
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034


Tail
Benchmark
Total iron (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034


Tail
Benchmark
Total lead (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034


Tail
Benchmark
Total nickel (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034


Tail
Benchmark
Free cyanide (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034


Tail
Benchmark
Total aluminum (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
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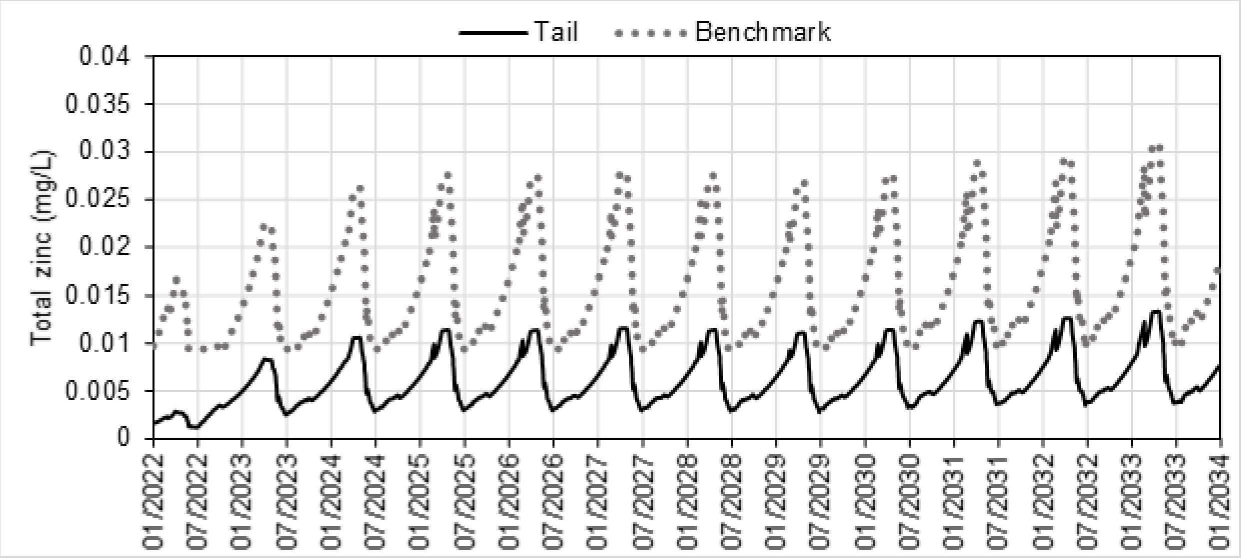
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034


Tail
Benchmark
Total zinc (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
01/2022
07/2022
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
07/2026
01/2027
07/2027
01/2028
07/2028
01/2029
07/2029
01/2030
07/2030
01/2031
07/2031
01/2032
07/2032
01/2033
07/2033
01/2034

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