2020 Elk Valley Regional Water Quality Model Update – Annex C

Water Quality Modelling - Set-up and Calibration Report

Rev0

March 2021

Teck

This report was prepared with assistance from:

GOLDER ASSOCIATES LTD.

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1 Part 1: Set-up

1.1 Introduction and Background

The set-up and calibration of the water quality component of the 2020 Regional Water Quality Model (RWQM) is described in this report. The RWQM was initially developed in 2014 to support the development of the Elk Valley Water Quality Plan (EVWQP). It was subsequently updated in 2017 pursuant to Section 9.9 of *Environmental Management Act* (EMA) permit 107517 and used to develop the 2019 Implementation Plan Adjustment (2019 IPA). The need to update the RWQM every three years is identified in EMA Permit 107517; hence, the 2020 RWQM Update has been undertaken to continue to meet this permit condition.

The RWQM is a planning model that supports water quality and broader environmental assessments, as well as development of the IPA. Similar to its predecessors, the 2020 RWQM can simulate historical and future aqueous concentrations of nitrate, selenium, sulphate, cadmium and other water quality constituents at Compliance Points, Order Stations and other locations within the Fording River and Elk River watersheds. It has been calibrated to historical information and used to evaluate how water quality constituent concentrations may change in future as a result of mining in the Elk Valley and the implementation of water quality management and mitigation.

This report (Annex C) is one of five documents included in the March 2021 submission to the British Columbia (BC) Ministry of Environment and Climate Change Strategy (ENV) and the BC Ministry of Energy, Mines and Low Carbon Innovation (EMLI). The other four documents consist of:

- The 2020 RWQM Update Report - this is the main report, which includes a description of the 2020 RWQM Update, a discussion of model performance, future projections that include the water quality management measures included in the 2019 IPA and a discussion on key uncertainties and how they will be addressed to support future model updates.
- Annex A: Geochemical Source Term Methods and Inputs for the 2020 Update of the Elk Valley Regional Water Quality Model - this report includes a description of the geochemical models for constituent release and updates made to the geochemical source terms used to define constituent loading rates in the Elk Valley.
- Annex B: 2020 RWQM Update: Hydrology Modelling – Set-up, Calibration and Future Projections Report - this report includes a description of updates made to the flow component of the 2020 RWQM, details on the performance of the updated flow component and the methods used to generate future flows.
- Annex D: 2020 RWQM Update: Water Quality – Model Projections Comparison Report - the report includes the methods used to generate projections of future concentrations of nitrate, selenium, sulphate and cadmium at Compliance Points, Order Stations and other selected locations in the Elk Valley, along with the resulting projections for the permitted development and the water quality mitigation measures included in the 2019 IPA.

1.2 Overview

The 2020 RWQM is a regional planning and assessment tool that has been developed based on the concepts outlined in the conceptual model (Section 1.3). The purpose of the RWQM is to estimate how water quality conditions in the Elk Valley could change as a result of mining and water quality management activity, at the scale of individual tributaries, at mine operations and throughout the valley.

At its core, the 2020 RWQM consists of four components:

- a hydrology component (known as the Flow Component; FC) that is used to estimate total water flow in tributary watersheds and in the Fording River and Elk River;
- geochemical source terms that are used to numerically represent the release of nitrate, selenium, sulphate, and other constituents from waste rock, pit walls and other mine areas (e.g., tailings storage facilities and coarse coal reject piles);
- mine information, including historical mine site data and future-looking permitted mine plans; and
- a water quality constituent transport component (known as the Water Quality Component; WQC) that is used to estimate constituent concentrations in mine-affected tributaries, in the Elk River and Fording River, and in Koocanusa Reservoir.

These same four components were part of the 2014 RWQM and the 2017 RWQM, although the content of each component has changed with each model update. As previously noted, the geochemical source terms and the FC are described in Annexes A and B, respectively. The set-up and calibration of the WQC is outlined herein in Sections 1.4 and 2.1, respectively. Key changes to the WQC, relative to the 2017 RWQM, are summarized in Table 1.2-1.

The WQC is a mass balance model developed using a commercially available, general-purpose simulation software platform called GoldSim (GoldSim Technology Group 2014), as outlined in Section 1.4. Inputs to the WQC include the flow estimates from the FC, the geochemical source terms, and mine site information, together with water quality monitoring information from undisturbed areas. The geochemical source terms and the flow information generated by the FC are independently derived. They are brought together in the WQC to estimate constituent concentrations in the receiving environment downstream of mine operations (i.e., in mine-affected tributaries, the Fording River, the Elk River, and Koocanusa Reservoir).

Table 1.2-1: Summary of Key Changes to the Water Quality Component of the 2020 Regional Water Quality Model

Description	2017 RWQM	2020 RWQM
Spatial scale and level of spatial detail	• Model domain spans from Elk River upstream of GHO through to Koocanusa Reservoir, inclusive of Fording River watershed and the reservoir itself • All five operations (FRO, GHO, LCO, EVO and CMO) explicitly represented in the model framework • Model contains a total of 96 individual watersheds, sub-watersheds and catchments	• Model domain unchanged • Four of five operations (FRO, GHO, LCO and EVO) explicitly represented in the model framework • CMO no longer included in model framework; flow and loads from CMO defined using outputs from the CMO Water and Load Balance Model (SRK 2021) • Level of spatial detail increased at each operation; model contains a total of 154 individual watersheds, sub-watersheds and catchments
Historical waste rock deposition	• Based on available data records	• Based on available data records • Checked and adjusted with aerial photography and survey information
Mine water management activities represented in the model framework	• Pit pumping • Clean water diversions • Mine water diversions • Consumptive water use in coal processing	• Pit pumping • Clean water diversions • Mine water diversions / pumping • Consumptive water use in coal processing • Use of water for dust suppression
Period for model calibration	• Nitrate: 2006 to 2016 • Other constituents: 2004 to 2016	• Nitrate: 2006 to 2019 • Other constituents: 2004 to 2019
Hydraulic lag (or Lag time)	• Referred to as “initial lag” • Defined time period between waste rock deposition and detection of released constituents at downstream monitoring station in receiving environment • Fixed, spoil-specific value defined based on measured nitrate concentrations at downstream monitoring station	• Term “initial lag” replaced with “hydraulic lag” (lag time) • Definition is unchanged: defined time period between waste rock deposition and detection of released constituents at downstream monitoring station in receiving environment • Unchanged: defined using measured nitrate concentrations • Fixed, spoil-specific value for older spoils (i.e., those present prior to 2015), including those that continue to receive waste rock • Variable for new spoils, starting at 0 to 1 year and increasing over time to a fixed value based on changing spoil geometry (namely height)

Table 1.2-1: Summary of Key Changes to the Water Quality Component of the 2020 Regional Water Quality Model

Description	2017 RWQM	2020 RWQM
Leaching efficiency	• Referred to as "adjusted leach time" • Defined as the time period over which soluble constituents wash out of a given volume of waste rock • Defined as a fixed value of 10 years with equal proportion of soluble constituents being release each year	• Term "adjusted leach time" replaced with "leaching efficiency" • Defined as a percent loss per year, rather than a fixed time period • Percent loss per year is defined as 20% for most spoils, with a few exceptions that are outlined herein • Model includes functionality to allow leaching efficiency to vary over time as spoil height changes
Nitrate release from waste rock	• Annual release rate based on estimated nitrate content in explosives residue accompanying each volume of waste rock placed into a spoil • Nitrate release subject to lag and leaching efficiency • Annual load released transformed into weekly rates using catchment-specific weekly loading distributions	• Same as in 2017, except for change in leaching efficiency outlined above and estimates of explosive residue to account for recent improvements in blasting practices; the latter item was applied taking into consideration when changes to blasting practices occurred and how efficient the changes have been at reducing explosive residuals
Selenium and sulphate release from waste rock	• Catchment-specific initial lag between waste rock placement and detection of selenium or sulphate in the receiving environment, with value set to the same duration as calculated for nitrate. • Catchment-specific release rates, which are then modified as required through calibration • Annual release rates transformed into weekly rates using catchment-specific weekly loading distributions	• Release of selenium and sulphate from waste rock consists of two components: initial soluble load and oxidative release • Oxidative release is defined using the same approach as in 2017 • Initial soluble load is the release of an immediately soluble component of selenium and sulphate that arrives with waste rock as it is placed in the spoil. It results from mineral oxidation prior to blasting, during blasting and prior to placement in a spoil. • Initial soluble load is calculated using the same spoil-specific selenium and sulphate release rates as applied to the oxidative component, multiplied by the oxidation time prior to placement in the spoil • Initial soluble load is subject to lag and leaching efficiency, similar to nitrate

Table 1.2-1: Summary of Key Changes to the Water Quality Component of the 2020 Regional Water Quality Model

Description	2017 RWQM	2020 RWQM
Cadmium release from waste rock	• Operation-specific source term for cadmium • Defined largely as a set of monthly concentrations	• Source term is defined based on cadmium to sulphate ratios, which vary based on Morrissey content in each spoil • Released cadmium is then subject to attenuation as it moves through the spoil and through the receiving environment • Tributary-specific attenuation rates are defined on a monthly basis using monitoring data
Loading distributions	• Annual release rates are transformed into weekly release rates based on catchment-specific weekly loading distributions • Catchment-specific weekly loading distributions defined using historical monitored flows and concentrations • Catchment-specific weekly loading distributions are fixed (i.e., repeat the same 52-week distribution from year to year)	• Annual release rates are transformed into weekly release rates based on how normalized weekly waste rock flows compare to normalized long-term average waste rock flows, rather than being calculated using fixed weekly loading distributions; normalized in this context refers to waste rock flow divided by waste rock area (i.e., net percolation) • Allows for a more dynamic response in constituent release from year to year and creates more consistency between constituents
Constituent inventory in waste rock	• Not included	• Total constituent inventory in each waste rock spoil is tracked. Inventory is calculated as a function of mass by weight (e.g., "x" milligrams of selenium per kilogram of waste rock) minus constituent mass released from the spoil over time
Surface water – groundwater partitioning (i.e., at any given location, a portion of the total watershed flow may be travelling through shallow groundwater pathways, with the remaining portion travelling at surface)	• Not considered during model calibration • Implicitly accounted for in mitigation planning through the use of water availability, which defines the proportion of total watershed flow that is accessible at a given intake	• Considered in model calibration and mitigation planning • Specified as either a percent of total flow or in absolute terms (e.g., m^3/day), depending on data available for each location of interest

Table 1.2-1: Summary of Key Changes to the Water Quality Component of the 2020 Regional Water Quality Model

Description	2017 RWQM	2020 RWQM
Constituent release from pit walls	• Pit walls divided into five categories to account for influence of Morrissey Formation and potential acid generation • Separate release rates developed for each category of pit wall	• Pit walls divided into four categories, rather than five, to simplify data analysis and information transfer • Change involved combining non-PAG, benched sub-Mist Mountain Formation and benched Mist Mountain Formation into single category, referred to as benched Mist Mountain Formation
Rehandle of historical waste materials	• Rehandle of waste materials results in a short-term, immediate release of constituents in addition to that which would otherwise occur if the materials were not rehandled. • The movement of this “extra” load into the receiving environment was not subject to lag or leaching efficiency	• Rehandle of waste materials results in a short-term, immediate release of constituents in addition to that which would otherwise occur if the materials were not rehandled. • The movement of this “extra” load into the receiving environment is subject to lag time and leaching efficiency, with both hydrologic processes being defined by the characteristics of the spoil into which the rehandled material is placed.
Instream sinks for nitrate and selenium	• Included instream sinks between specified monitoring locations in the Elk River and Fording River mainstems • Instream sinks included in model to reflect trends observed in monitored data collected from both rivers, and to maintain a bass balance through the system • Instream sinks applied to nitrate and selenium only	• Continue to be applied to selenium and nitrate, with rates of loss adjusted to reflect updated model calibration
Retention areas	• Retention areas are included in the Cataract Creek, Porter Creek and Erickson Creek catchments, as well as between EVO Dry Creek and Harmer Creek, to dampen seasonal variation in model projections, thereby better matching monitored information	• Retention areas continue to be applied in specific areas to dampen seasonal variation in model projections, thereby better matching monitored information • Retention areas are included in Henretta Creek, Cataract Creek, Eagle Pond, Porter Creek, upper Line Creek, Erickson Creek, EVO Dry Creek and Harmer Creek catchments, as well as in the upper Fording River

Table 1.2-1: Summary of Key Changes to the Water Quality Component of the 2020 Regional Water Quality Model

Description	2017 RWQM	2020 RWQM
Non-preferential flow reservoirs	• Not included	• Non-preferential flow reservoirs have been added to account for the non-uniform nature in which water likely moves along the larger groundwater flow paths connecting Kilmarnock Creek to the Fording River and West Line Creek to Line Creek, which can result in the temporary storage and more gradual release of some of the water moving along these flow paths
Interflow reservoirs	• Not included	• Interflow reservoirs have been added to account for the temporary storage and gradual release of water from adjacent banks and subsurface flow paths that occur along the mainstems of the Elk River, Fording River, Line Creek and Michel Creek

The WQC is calibrated to historical conditions, as outlined in Section 1.5. This process involves simulating historical water quality conditions in the Elk Valley and comparing model output to monitoring results. The model is then adjusted, as required, in an iterative fashion, to achieve a good fit to the measured data. The adjustment typically involves modification of the geochemical source terms, through the application of calibration factors, and adjustments to the FC to improve model performance. The process of calibration provides an opportunity to refine both of these inputs to the WQC to allow for a better match to historical water quality measurements at monitoring locations throughout the Elk Valley.

During the calibration process, data gaps and areas for potential future refinement are identified. These items form the basis for future monitoring recommendations and key uncertainty identification and reduction, which are summarized in the main 2020 RWQM Update Report.

Once calibrated, the WQC is used to project future constituent concentrations in the Elk Valley, as outlined in Annex D.

1.3 Conceptual Model

A broad, general description of the conceptual model upon which the 2020 RWQM is based is provided in this section. The conceptual model is a description of the general mechanisms responsible for the release of nitrate, selenium, sulphate, and other constituents from mine operations and how they migrate downstream. It also includes a description of how water moves through waste rock, and how waste rock spoils influence runoff characteristics, as well as general flow characteristics through the river system. The conceptual model is depicted in Figure 1.3-1 and described below.

Greater detail on the conceptual model for constituent release from mine operations is outlined in Annex A, with constituent-specific summaries provided below in Section 1.4.2.1. More detail on water flow through waste rock and the hydrology of the Elk Valley is provided in Annex B.

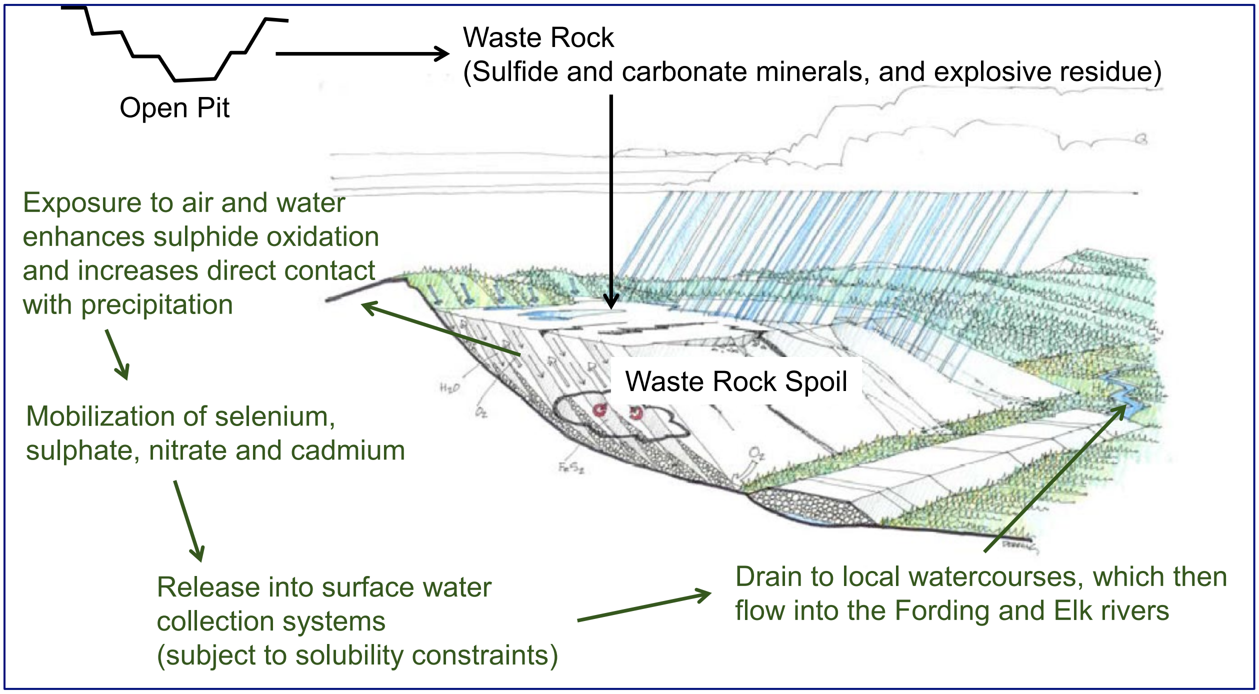

Figure 1.3-1: Release of Constituents from Mine Operations

Coal is present in the Elk Valley as strata or seams interlayered with sandstone, siltstone and mudstone. This rock contains sulphide and carbonate minerals that contain substances such as selenium, sulphate and cadmium. Atmospheric exposure of these minerals (primarily iron sulphide) through mining can enhance the release of these substances to the environment, through the processes described below:

- Accessing ore bodies requires blasting of the rock surrounding the seams. Blasting leaves nitrate-containing explosives residue on this surrounding rock and along pit walls. Subsequent placement of the surrounding rock (commonly referred to as waste rock) in spoils facilitates the exposure and release of nitrate residues along with the rock's geological constituents.
- Oxidation of sulphide minerals (mainly pyrite) and other geochemical reactions are triggered when rock is exposed to the atmosphere, and to moisture along pit walls and in waste rock spoils. Pyrite oxidation, combined with the presence of pH-buffers, such as carbonate minerals, results in sulphate formation and the release of metals, metalloids and non-metals such as selenium.
- Cadmium originates from oxidation of sphalerite (another sulphide mineral), rather than pyrite. Release of this constituent is correlated to sulphate release, but it is also a function of the cumulative percentage of potentially acid generating (PAG) waste rock present in the spoil and the application of PAG management practices. PAG waste rock is that which typically originates from the Morrissey Formation.

- Oxidation of sulphide minerals occurs within waste rock spoils, but also before arrival at the spoil (i.e., prior to blasting, during blasting and during transport). This oxidative process results in waste rock arriving at the spoil with an initial soluble load of sulphate, selenium and other constituents that is readily available for mobilization, similar to nitrate blasting residuals.
- Runoff water from rain and snowmelt mobilizes dissolved constituents generated by the above-mentioned processes, at levels that depend on their solubility. Solubility is of limited importance for nitrate but can be a limiting factor to varying degrees for sulphate, selenium, cadmium, and other constituents.
- A high proportion of total precipitation infiltrates into waste rock spoils. Water travels vertically through spoils. Flows from the base of the spoil are more consistent than infiltration into the spoil (i.e., show less seasonal variation). Travel times through spoils vary, as does the time for a spoil to reach a sufficient degree of saturation such that it begins to release water. The wet-up period for new rock placed appears to be short, in the order of a year or two.
- There is a hydrologically controlled delay (hydraulic lag) between the placement of waste rock and the appearance of load in the receiving environment. The length of the hydraulic lag is dependent on spoil characteristics, local climate and other factors. The hydraulic lag for new spoils tends to be relatively short at first, in the order of 1 to 2 years, based on the analysis of monitoring data collected for the Elk Valley and other mines. Lag times then increase quickly as spoil geometry, particularly spoil height, increases, with lag times becoming more consistent and constant over time as spoil heights approach 100 to 200 m. A general rule of thumb developed for the Elk Valley is that it takes in the order of 1 year for water to travel vertically through 10 m of waste rock in a spoil.
- Although it can take some time for a particle of water to travel vertically from the top of a mature spoil to the bottom of the spoil and into the receiving environment, the time required for a spoil to respond to a change in annual climatic conditions is relatively short. In other words, water flow through a waste rock spoil follows a piston-type pattern, wherein infiltration into the top of a spoil results in a pressure wave that travels relatively quickly through the spoil and pushes older water out from the base of the spoil. Pressure waves move through a spoil in a matter of weeks, compared to the 10+ years in may take a drop of water to travel through a mature spoil.
- Waste rock spoils in the Elk Valley are, on average, 100 to 200 m thick, although variations in thickness can exist within an individual spoil due to construction methods and the variability in the underlying topography. The large thickness of waste rock dumps dampens the effects of episodic recharge events, resulting in a dampening of the annual hydrograph compared to a natural area.
- Runoff from upstream areas that flows into the side of a spoil (referred to as “run-on”) is conveyed through coarser materials accumulating along the base of the spoils as a result of segregation during end dumping. These coarser materials form zones of relatively higher hydraulic conductivity that readily transmit water through the base of the spoil. They are referred to as rock drains. As upstream waters move through these waste rock drains, they mix with the waters descending vertically though the dump, resulting in seasonal variations in the concentrations of the water emerging from the rock drain toe.

- As with waste rock, coal refuse facilities contain sulphide and carbonate minerals and can undergo the same oxidation processes. However, since these facilities are rich in organic carbon and tend to consist of finer particles, oxygen penetration and oxidation are limited to the near surface layer. Nevertheless, some amount of selenium, sulphate, cadmium and other constituents are also released from these piles and dissolve into runoff water.
- Contact water draining from waste rock spoils and coal refuse facilities discharges to local watercourses, which in turn drain into the Fording River, Michel Creek or Elk River.
- The Fording River, Michel Creek and Elk River are, on a regional scale, gaining systems that increase in flow with distance downstream. There is a net discharge of groundwater to surface water as baseflow.
- Precipitation and flows vary with elevation and from north to south. There is a snowmelt dominated seasonal flow pattern throughout the watershed.

As the above processes occur, the release of constituents continues until the source material is depleted. Depletion occurs more quickly for nitrate (which is highly soluble and readily available for transport), than for sulphate, selenium and other constituents (which are less soluble and must first be released through oxidation).

1.4 Model Set-Up

The geographic extent of the 2020 RWQM is shown in Figure 1.4-1. Locations where the WQC is used to estimate constituent concentrations are called modelling nodes. The 2020 RWQM includes approximately 100 individual modelling nodes, located at the outlets of individual mine pits, in individual mine-affected tributaries and in regional mainstems. Modelling nodes in the Elk River and Fording River mainstems, as well as calibration nodes in mine-affected tributaries, are shown in Figures 1.4-1 to 1.4-5 and summarized in Table 1.4-1.

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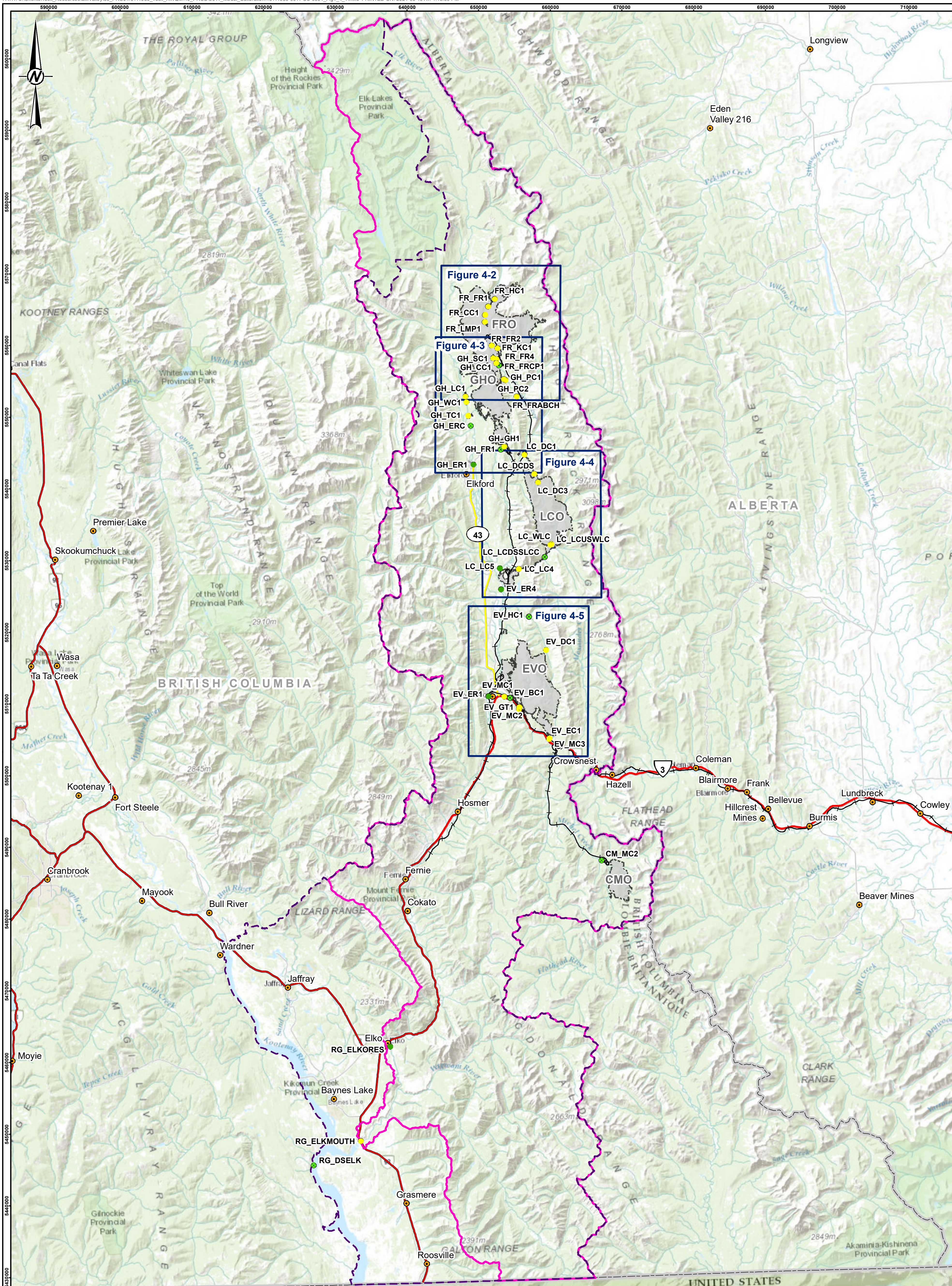

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- EMA PERMIT 107517 COMPLIANCE STATION
- MODELLING NODE
- CITY/TOWN/COMMUNITY
- CANADIAN PACIFIC RAILWAY
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- MINE PERMIT BOUNDARY
- ELK RIVER WATERSHED BOUNDARY
- DESIGNATED AREA (GEOGRAPHIC EXTENT OF THE MODEL)

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NOTE(S)

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2. TECK WATER NETWORK AND WATER MANAGEMENT DATA, 2019-09-26
3. BASEMAP: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 11N

TECK COAL LIMITED

PROJECT
2020 REGIONAL WATER QUALITY MODEL UPDATE

YYYY-MM-DD	2020-07-23
DESIGNED	PR
PREPARED	PR/RRD
REVIEWED	CG
APPROVED	AS

TITLE
GEOGRAPHIC EXTENT OF THE REGIONAL WATER QUALITY MODEL AND LOCATION OF SELECTED WATER QUALITY

PROJECT NO.	CONTROL	REV.	FIGURE
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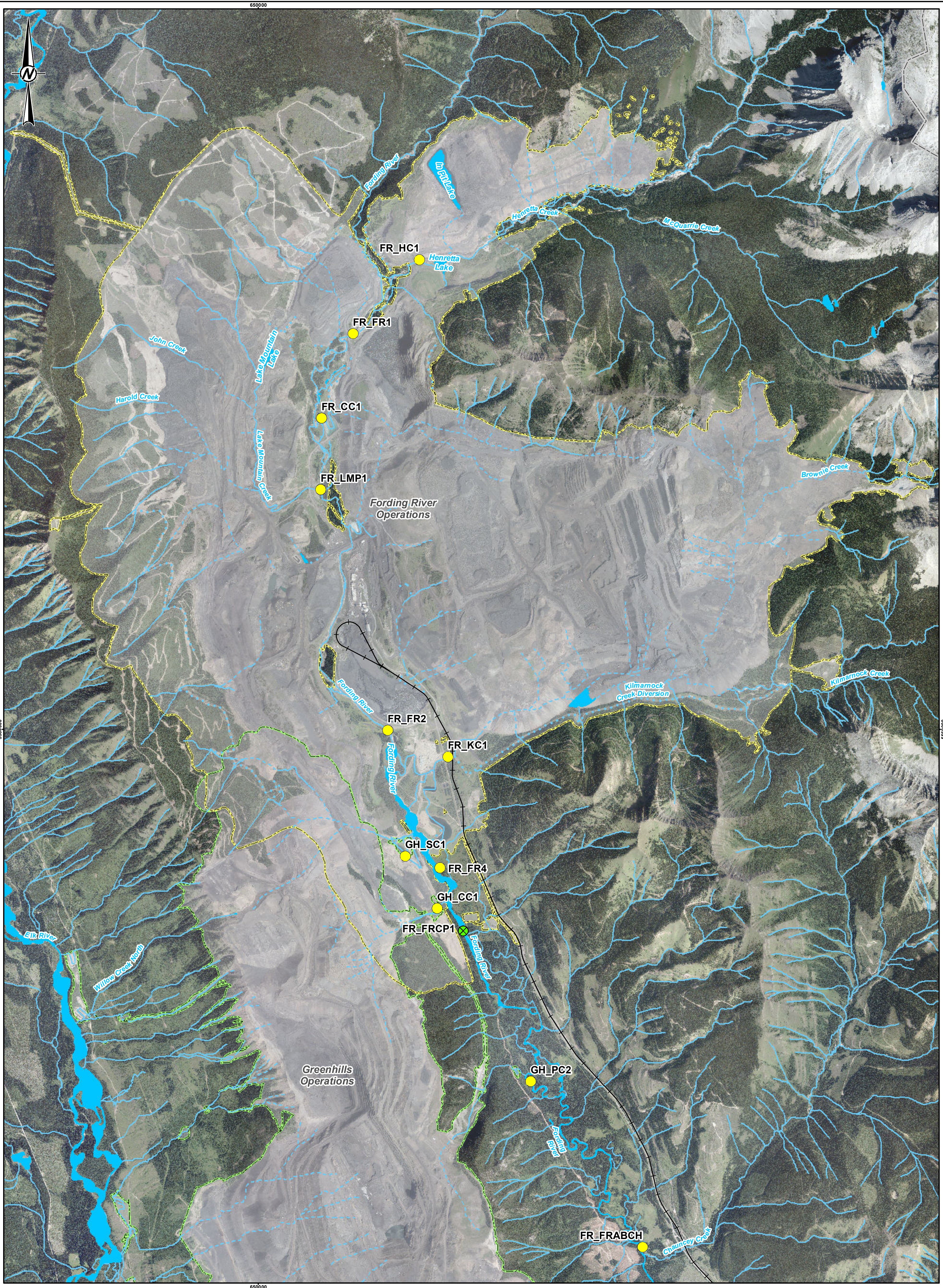

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- CANAL OR DITCH
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- SUBSURFACE FLOW WATERCOURSE
- WATERBODY
- C-3 PERMIT BOUNDARY - FRO
- C-137 PERMIT BOUNDARY - GHO

0 1,000 2,000

1:50,000 METRES

NOTE(S)

REFERENCE(S)

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3. IMAGERY: ORTHO IMAGERY PROVIDED BY TECK, 2019. ADDITIONAL IMAGERY BY MICROSOFT BING © 2018 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.
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PROJECT

2020 REGIONAL WATER QUALITY MODEL UPDATE

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PREPARED	PR/RRD
REVIEWED	CG
APPROVED	AS

TITLE

FORDING RIVER OPERATIONS – MAINSTEM AND SELECTED TRIBUTARY MODELLING NODES

PROJECT NO.	CONTROL	REV.	FIGURE
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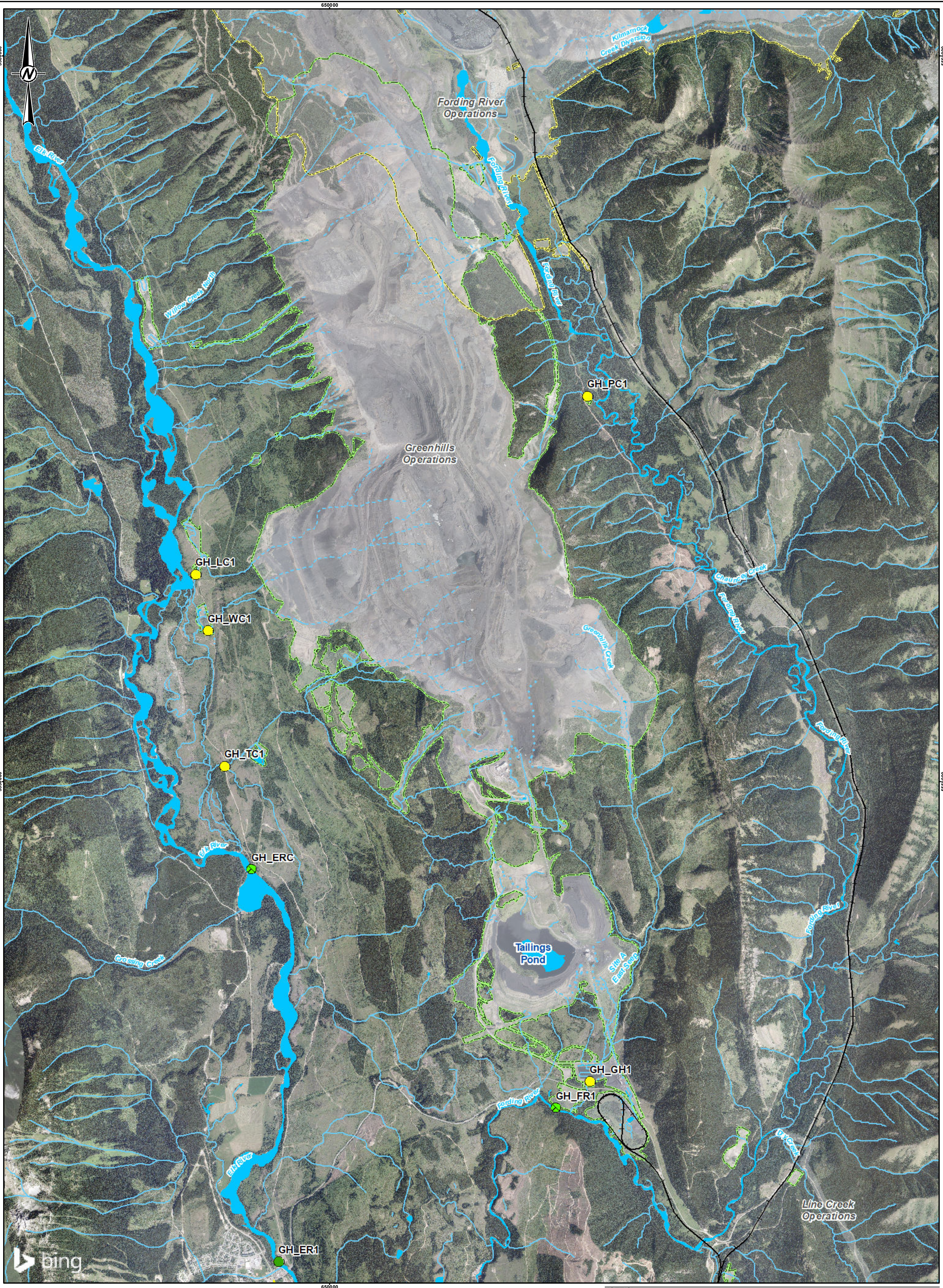

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- WATERBODY
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- C-137 PERMIT BOUNDARY - GHO

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NOTE(S)

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TECK COAL LIMITED

PROJECT

2020 REGIONAL WATER QUALITY MODEL UPDATE

YYYY-MM-DD	2021-03-19
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PREPARED	PR/RRD
REVIEWED	CG
APPROVED	AS

TITLE

GREENHILLS OPERATIONS - MAINSTEM AND SELECTED TRIBUTARY MODELLING NODES

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- SUBSURFACE FLOW WATERCOURSE
- WATERBODY
- C-129 PERMIT BOUNDARY

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CLIENT
TECK COAL LIMITED

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PREPARED	PR/RRD
REVIEWED	CG
APPROVED	AS

PROJECT
2020 REGIONAL WATER QUALITY MODEL UPDATE

TITLE
LINE CREEK OPERATIONS - MAINSTEM AND SELECTED TRIBUTARY MODELLING NODES

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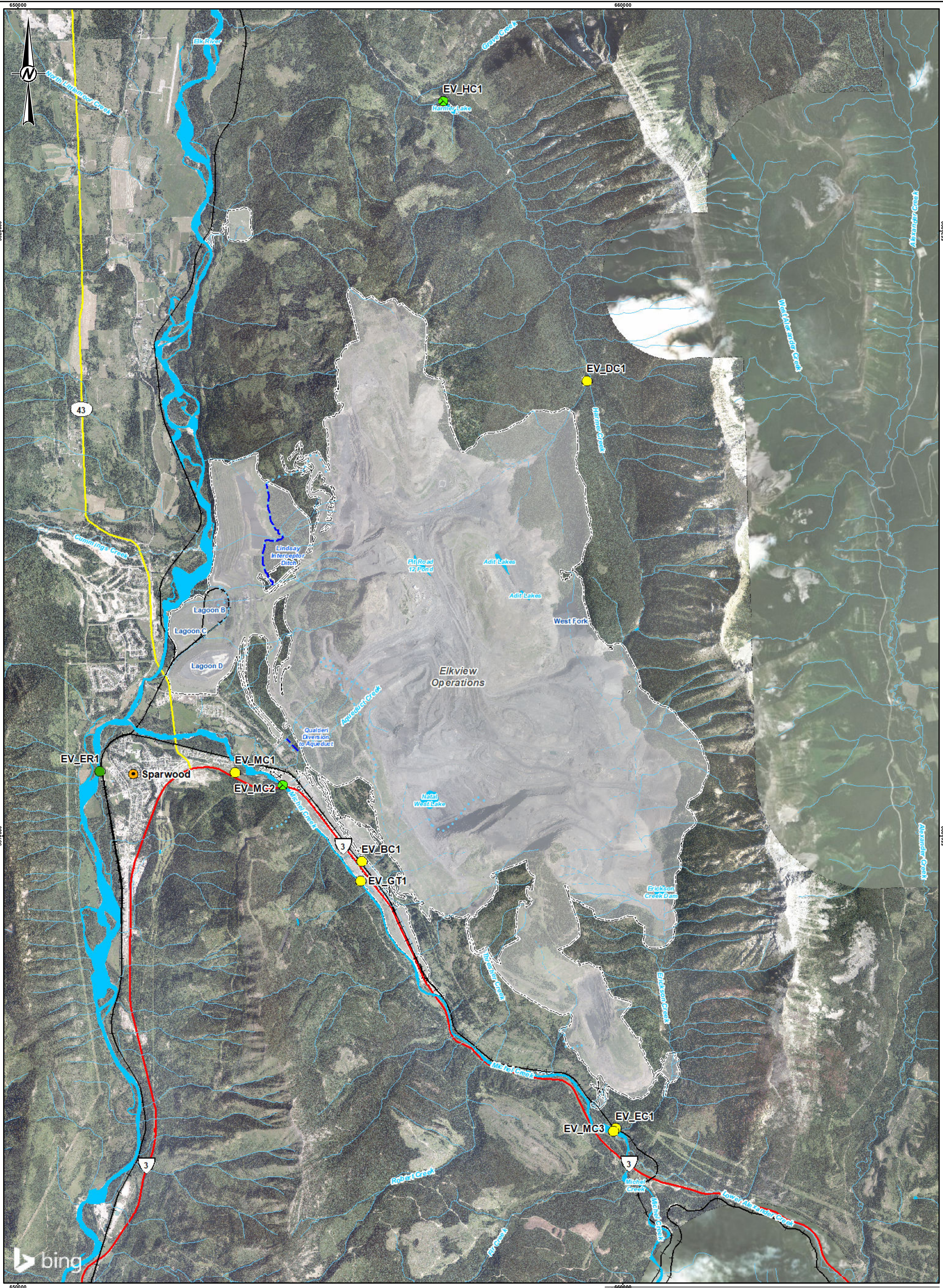

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- EMA PERMIT 107517 COMPLIANCE STATION
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- CANADIAN PACIFIC RAILWAY
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- CANAL OR DITCH
- SURFACE FLOW WATERCOURSE
- SUBSURFACE FLOW WATERCOURSE
- WATERBODY
- ELKVIEW OPERATIONS C-2 PERMIT BOUNDARY

0 1,000 2,000

1:60,000 METRES

NOTE(S)

REFERENCE(S)
1. BASE DATA: CANVEC, 2018
2. TECK WATER NETWORK AND WATER MANAGEMENT DATA PROVIDED BY TECK. 2019-09-26
3. IMAGERY: ORTHO IMAGERY PROVIDED BY TECK, 2019. ADDITIONAL IMAGERY BY MICROSOFT BING © 2018 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 11N

TECK COAL LIMITED

Teck

YYYY-MM-DD	2021-03-19
DESIGNED	PR
PREPARED	PR/RRD
REVIEWED	CG
APPROVED	AS

PROJECT
2020 REGIONAL WATER QUALITY MODEL UPDATE

TITLE
ELKVIEW OPERATIONS - MAINSTEM AND SELECTED TRIBUTARY MODELLING NODES

PROJECT NO.	CONTROL	REV.	FIGURE
18111630	0011	0	1.4-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0

Table 1.4-1: Water Quality Modelling Nodes Located in the Elk River, Fording River and Mine-affected Tributaries, which are used in Model Calibration

Operation or General Location	Node ID	Node Description	Location[(a)]	
			Easting	Northing
Fording River Operations	FR_HC1	Henretta Creek u/s of Fording River (E216778)	652219	5566469
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	650871	5564287
	FR_LMP1	Lake Mountain Pond	650858	5563301
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	652612	5559619
	GH_SC1	Swift Creek Settling Pond Decant (E221329)	652024	5558252
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	652464	5557531
Greenhills Operations	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	653547	5555316
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	653577	5545871
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	648153	5552859
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257796)	648322	5552086
	GH_TC1	Thompson Creek at LRP Road (E102714)	648550	5550218
Line Creek Operations	LC_DC3	LCO Dry Creek u/s of East Tributary (E288273)	658294	5540918
	LC_DCDS	LCO Dry Creek d/s of Sedimentation Ponds (E295210)	657766	5542073
	LC_DC1	LCO Dry Creek near mouth (at bridge) (E288270)	656379	5544775
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	660125	5532281
	LC_WLC	West Line Creek (E261958)	660004	5532209
	LC_LCDSSLCC	**LCO Compliance Point - Line Creek immediately d/s of South Line Creek confluence (E297110)**	**659218**	**5530522**
	LC_LC4	Line Creek u/s of Process Plant (0200044)	655604	5528824
Elkview Operations	EV_EC1	Erickson Creek at Mouth (0200097)	659868	5505171
	EV_GT1	Gate Creek Sediment Pond Decant (E206231)	655654	5509261
	EV_BC1	Bodie Creek Sediment Pond Decant (E102685)	655676	5509584
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	659398	5517530
	EV_HC1	**EVO Harmer Compliance Point – Harmer Spillway (E102682)**	**657031**	**5522167**

Table 1.4-1: Water Quality Modelling Nodes Located in the Elk River, Fording River and Mine-affected Tributaries, which are used in Model Calibration

Operation or General Location	Node ID	Node Description	Location[a]	
			Easting	Northing
Fording River	FR_FR1	Fording River d/s of Henretta Creek (0200251)	651304	5565451
	FR_FR2	Fording River u/s of Kilmarnock Creek (0200201)	651781	5559984
	FR_FR4	Fording River between Swift and Cataract creeks (0200311)	652503	5558088
	FR_FRCP1	Fording River, 525 m d/s of Cataract Creek (E300071)	652823	5557220
	FR_FRABCH	**FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (E223753)**	**655293**	**5552865**
	GH_PC2	Fording River d/s of Porter Creek (E287431)	653751	5555147
	GH_FR1	**GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (0200378)**	**653111**	**5545516**
	LC_LC5	**Fording River d/s of Line Creek (0200028)**	**652977**	**5528919**
Michel Creek	**CM_MC2**	**CMO Compliance Point - Michel Creek d/s of CMO near Andy Goode Creek Junction (E258937)**	**667186**	**5488211**
	EV_MC3	Michel Creek u/s of Erickson Creek (0200203)	659833	5505120
	EV_MC2	**EVO Michel Creek Compliance Point (E300091)**	**654378**	**5510851**
	EV_MC1	Michel Creek u/s of Highway 43 Bridge (0200425)	653590	5511060
Elk River	**GH_ER1**	**Elk River u/s of Boivin Creek (u/s of Fording River) (E206661)**	**649295**	**5543393**
	GH_ERC	**GHO Elk River Compliance Point - Elk River, 220 m d/s of Thompson Creek (E300090)**	**648926**	**5548802**
	EV_ER4	**Elk River u/s of Grave Creek (from Fording River to Michel Creek) (0200389)**	**653149**	**5525960**
	EV_ER1	**Elk River d/s of Michel Creek (0200393)**	**651354**	**5511080**
	RG_ELKORES	**Elk River at Elko Reservoir (E294312)**	**637660**	**5462188**
	RG_ELKMOUTH	Elk River at Highway 93 near Elko; ECCC station BC08NK0003	633583	5449048
Koocanusa Reservoir	**RG_DSELK**	**Koocanusa Reservoir - South of the Elk River (E300230)**	**627022**	**5445670**

[a] NAD 83, Zone 11.

ID = Identification; CMO = Coal Mountain Operations; EVO = Elkview Operations; LCO = Line Creek Operations; FRO = Fording River Operations; GHO = Greenhills Operations; d/s = downstream; u/s = upstream; m = metre.

Note: Sites in **bold** correspond to Order Stations and Compliance Points listed in EMA Permit 107517; Order Stations are also underlined.

The WQC is a mass balance model. It is used to estimate constituent concentrations at a given location by adding together incoming loads, subtracting any losses that result from mitigation or other load removal mechanisms (sinks), and dividing by total flow. Mathematically, this approach is expressed as:

$$C_x = \frac{\sum_{i=1}^{n} R_{x,i} - S_x}{\sum_{i=1}^{n} q_i} \qquad \text{Eq. 1}$$

Where:

C_x	=	predicted concentration of constituent 'x' at a given location (mass per unit volume)
$R_{x,i}$	=	mass of constituent 'x' associated with source 'i' reporting to a given location, expressed as a rate (mass per unit time)
S_x	=	mass of constituent 'x' removed by sinks present in the immediate watershed draining to a given location (e.g., active water treatment or a saturated rock fill [SRF]), expressed as a rate (mass per unit time)
q_i	=	flow rate of source 'i' (volume per unit time)
n	=	number of sources influencing the location in question

Sources considered in the WQC consist of:

- waste rock;
- pit walls;
- coal refuse;
- discharge from tailings storage facilities;
- rehandled waste rock and other rehandled materials; and
- drainage from natural areas.

Sinks include instream losses and removal of mass through treatment or other mitigation.

The WQC also accounts for the influence of:

- changes to deep groundwater flows in relation to the development of deep mine pits (e.g., Swift Pit);
- pit filling (i.e., the temporary disruption of runoff flow as a mine pit fills with water after mining is complete);
- diversion of water in support of water quality management (i.e., directing water around spoil areas and conveyance of mine-affected water to treatment); and
- dispersion and/or differential travel times (i.e., mine-affected water moving at different rates through surface and groundwater flow paths) downstream of some spoils, which result in reduced seasonal variability in loads to the receiving environment in some areas (such as that which occurs in Erickson Creek).

Each of these elements, including how water flow rates are defined in the WQC, is discussed in more detail below, followed by a summary of the water quality management measures considered in the 2020 RWQM.

1.4.1 Water Flow

The denominator in Equation 1 is total water flow. This term (i.e., total water flow) is defined using output from the FC for most of the geographic area covered by the 2020 RWQM. When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period. Estimates of future flow conditions are developed using climate information from 2000 to 2019. The climate information is run repeatedly through the FC, so that each year in the future simulation period experiences climate conditions equivalent to those recorded from 2000 to 2019. This approach results in 20 individual estimates of flow for each week of each future year (i.e., produces 20 individual flow realizations). The default setting of the WQC is to directly use the 20 individual flow realizations, running each one through the model framework to produce 20 individual estimates of constituent concentration at each model node for each week of each future year. This information is summarized by calculating median (P50), 10th percentile (P10) and 90th percentile (P90) weekly values. It is also used to calculate monthly average values, which are then summarized by calculating P10, P50 and P90 monthly average statistics across the 20 realizations for comparison to SPOs and compliance limits.

The WQC can develop projections of potential future water quality using individual future flow timeseries, rather than all 20 flow realizations. This capacity is likely to be used when evaluating the relative merits of multiple mitigation scenarios or other similar endeavours, because it will result in faster model run times and reduced computational complexity. Nevertheless, the final mitigation configuration or project design selected from such a process would be evaluated using the 20 flow realizations outlined above to identify how it may influence future water quality conditions.

Water quality management activity can affect the flow at a given location, because it may involve conveyance of water to treatment and subsequent release elsewhere in the system. Similarly, clean water diversions can result in water bypassing a given modelling node and reporting to a node farther downstream. Water quality management activities are not included in the FC, unless they are already constructed or involve a fundamental change to water use at a given operation. This approach has been adopted to allow for the efficient evaluation of different water quality management activities on instream conditions without having to loop through both the FC and the WQC when looking at each potential management scenario.

The flow estimates (historical and future) generated by the FC are based on total watershed yield, as outlined in Annex B. Therefore, they include water travelling at surface and that travelling through local groundwater systems that discharge to local tributaries, the Fording River and/or the Elk River.

The southern geographic extent of the 2020 RWQM is the Canadian portion of Koocanusa Reservoir (i.e., the downstream extent of the model domain is the international border). Monitored flow data are used to generate flow inputs for the Bull River and Kootenay River. These data originate from Environment Canada monitoring stations and are combined with Elk River data from the FC to define total flow at the Koocanusa Reservoir modelling node, for both historical simulations and future projections. The reservoir is modelled as a riverine system, with concentrations being a function of total incoming flow and load. The

RWQM does not account for water storage within the reservoir, or the influence of dam operations on retention times, outflow rates and storage volumes.

Further details about the FC are provided in Annex B.

1.4.2 Loading from Mine Areas

The first term in the numerator in Equation 1 relates to loading sources. There are two categories of loading sources considered by the WQC: natural loading sources and those related to mine areas. Methods used to estimate loading from mine areas are outlined below; those related to estimating loading from natural areas are described in Section 1.4.3.

Loading from mine areas originates from the following sources, with waste rock being the largest loading source:

- waste rock
- pit walls
- coal refuse
- discharge from tailings storage facilities
- rehandled waste rock and other materials

As outlined below, constituent release from each of these sources is estimated using geochemical source terms and mine site information.

Geochemical source terms developed as part of the 2020 RWQM Update are outlined in Annex A. They are typically catchment or tributary specific and replace those used in previous versions of the RWQM (e.g., the 2017 RWQM; Teck 2017). Some of the source terms previous developed have not been updated, such as those related to rehandled waste rock and other rehandled materials.

The mine site information used in the WQC includes waste rock deposition rates, pit wall areas over time, explosives usage and other similar information obtained from mine site personnel and review of mine plans.

1.4.2.1 Waste Rock

The methods used in the WQC to estimate constituent release from waste rock are outlined below by constituent.

1.4.2.1.1 Nitrate

The conceptual model for nitrate release from waste rock is as follows (see Annex A for more detail):

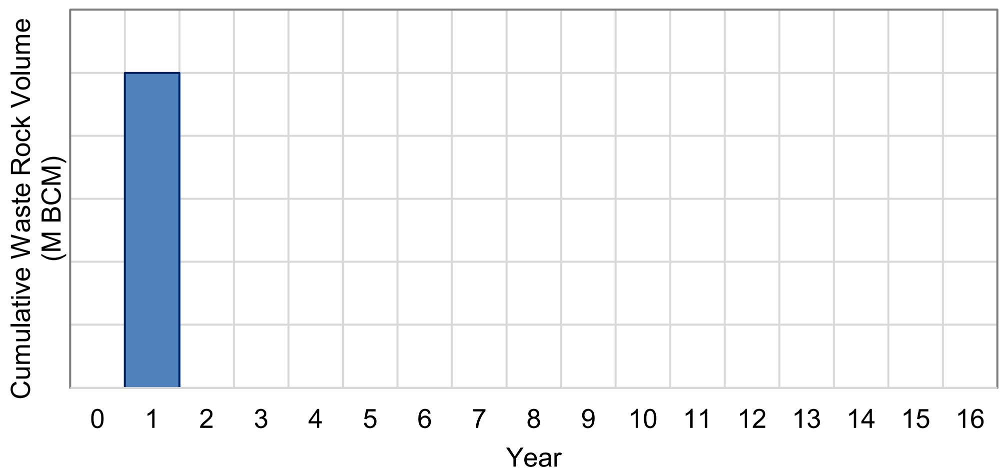
- Nitrate released from waste rock originates from explosives residue that is generated during blasting.
- The amount (or mass) of nitrate transported into a spoil with a given volume of waste rock is a function of:
  - type of explosive used (i.e., ammonium nitrate and fuel oil [ANFO] mixture or emulsion blend)

  - mass of explosive used per unit of waste rock generated (known as powder factor)
  - amount of explosive remaining after detonation, which is influenced by whether the blast hole was lined and whether the liner maintained its integrity up to detonation[1]
  - concentration of nitrate in the explosives used
- Once in the spoil, the nitrate dissolves into water percolating through the spoil, and is gradually leached out of the spoil over time. The rate at which nitrate is washed out of a given volume of waste rock is dependent on leaching efficiency. The higher the leaching efficiency, the faster the nitrate washes out of the spoil.
- In the 2017 RWQM, the rate at which nitrate washed out of a spoil was referred to as adjusted leach time, rather than leaching efficiency. Although both terms refer to the same concept, adjusted leach time was defined as a set time period (i.e., 10 years), with nitrate washing out evenly over that time period (i.e., 10% per year for 10 years). In the 2020 RWQM, leaching efficiency is defined as a percentage of the remaining mass that leaches out each year (typically 20% per year), which results in a longer nitrate "tail" more consistent with observations.
- Although nitrate dissolves into water percolating through the spoil, there is a time delay or lag between when waste rock is placed in a spoil and when nitrate can be detected at a downstream monitoring location. This lag is hydrologically driven, is catchment-specific, is related to the slow movement of water through the spoil and/or underlying groundwater system and is referred to as the hydraulic lag (t_{HL}). Hydraulic lag was first introduced in the 2017 RWQM, although it was referred to as initial lag time (T_{IL}) in the 2017 RWQM Update, a term that has subsequently been replaced with hydraulic lag (or lag time).
- The hydraulic lag for new spoils tends to be relatively short at first, in the order of 1 to 2 years. Lag times then increase as spoil geometry, particularly spoil height, increases, with lag times becoming more consistent and constant over time as spoil heights approach 100 to 200 m. A general rule of thumb developed for the Elk Valley is that it takes in the order of 1 year for water to travel vertically through 10 m of waste rock in a spoil.
- The mass of nitrate detected at a downstream monitoring location is higher during high flow conditions and lower during low flow conditions, relative to that which occurs under average flow conditions. The change in mass detected is directly proportional to the change in flow.

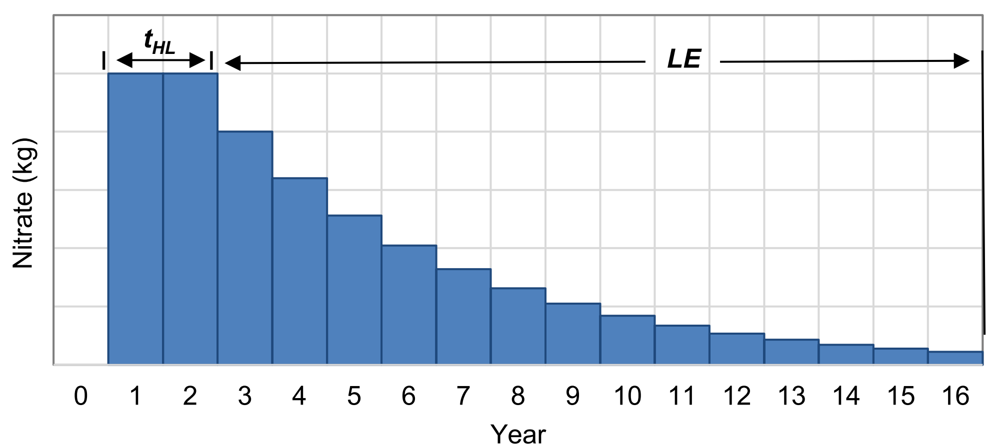
The concepts related to hydraulic lag and leaching efficiency are illustrated in Figure 1.4-6, based on a hypothetical spoil built over a single year. The cumulative volume of waste rock in the spoil is shown in the top panel, followed by the total mass of nitrate in the spoil in the second panel and the mass of nitrate detectable at a downstream monitoring point in the third panel, based on average flow conditions.

[1] The handling and use of explosives have changed over time, recently resulting in a decrease in the amount of nitrate transported to spoils.

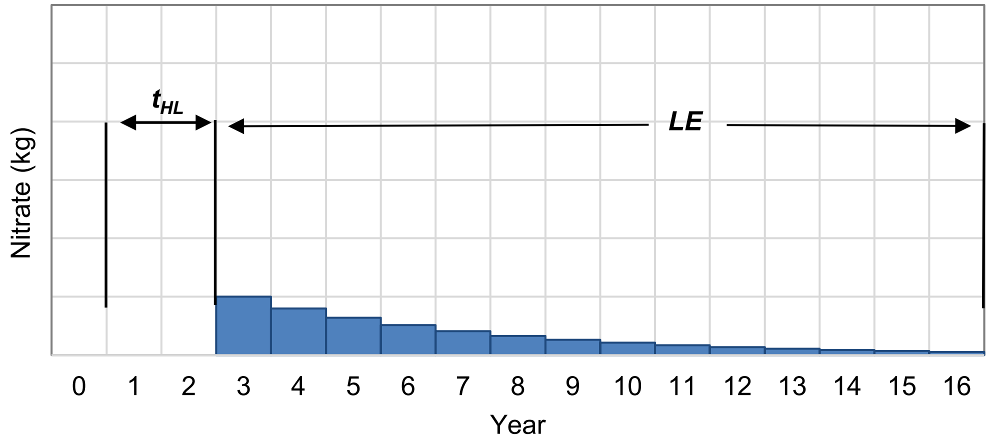
(a) Cumulative Waste Rock Volume in the Spoil



(b) Mass of Nitrate in the Spoil



(c) Mass of Nitrate Detected at a Downstream Monitoring Location



LE = leaching efficiency.

Figure 1.4-6: Conceptual Representation of Nitrate Release from a Hypothetical Waste Spoil Build in a Single Year

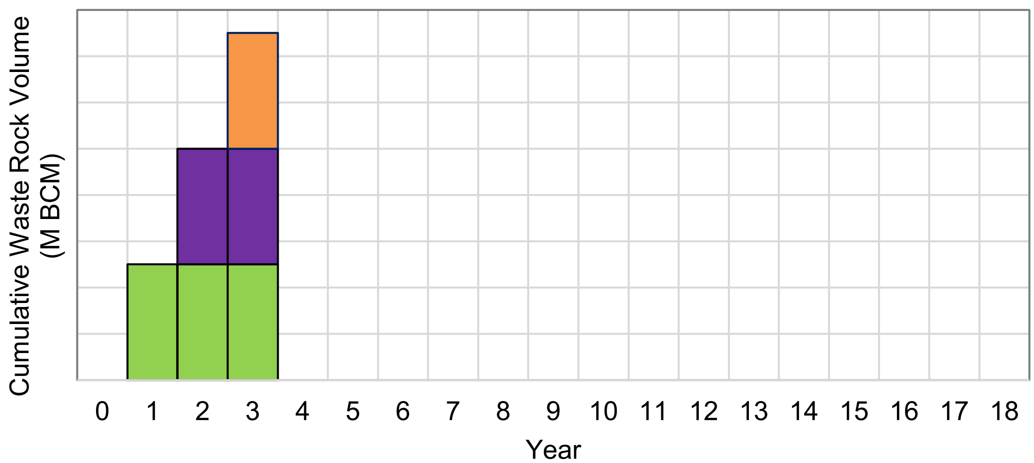
In the second panel (Figure 1.4-6b), the mass of nitrate in the spoil stays relatively constant over the hydraulic lag time (t_{HL}). In this hypothetical example, the hydraulic lag time is assumed to be 2 years, corresponding to conditions expected in a new spoil. Once that has passed, nitrate starts being released from the spoil, disappearing over time. The rate at which nitrate is released from the spoil is referred to as the leaching efficiency (LE) and is shown as 20% per year in the figure, the default rate used in the 2020 RWQM.

In the third panel (Figure 1.4-6c), nitrate mass from the spoil starts being detected at a downstream location after the hydraulic lag time (t_{HL}) has passed. Thus, the spoil is created in Year 1, and nitrate begins to be detected in Year 3.

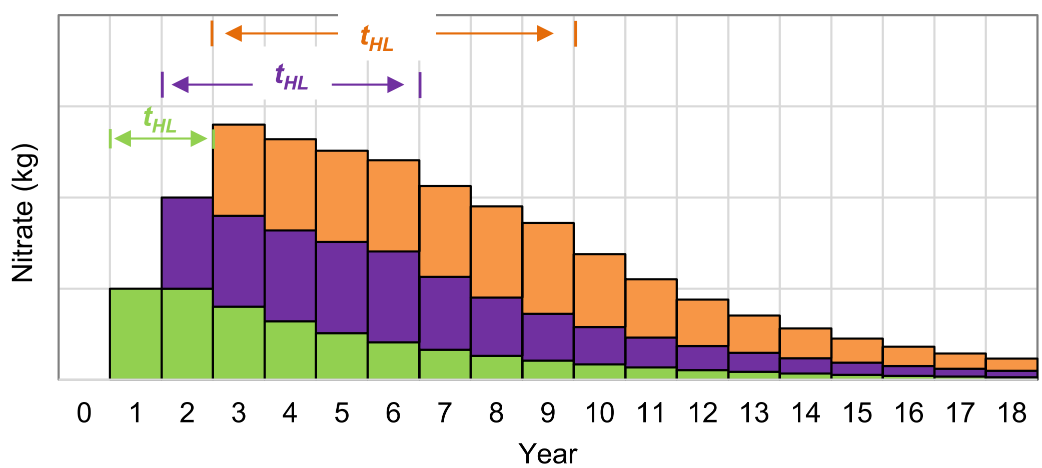
The same concepts applied to a hypothetical spoil constructed in equal lifts over a three-year period, with constant exposure to average flow conditions are illustrated in Figure 1.4-7. As each lift is added, it contributes nitrate mass to the spoil, which gradually leaches out at a rate dictated by leaching efficiency (shown here as 20%). However, as the spoil increases in size (notably in height) with each lift, the hydraulic lag of the spoil increases, which affects the rate at which the mass associated with subsequent lifts is released from the spoil and detected in the downstream environment.

Unlike the 2017 RWQM, the 2020 RWQM no longer tracks the change in nitrate mass associated with each yearly volume of waste rock placed into a spoil. Instead, the model tracks the total cumulative nitrate mass in the spoil over time, accounting for mass added through spoil growth and mass lost through wash out.

(a) Cumulative Waste Rock Volume in the Spoil



(b) Mass of Nitrate in the Spoil



(c) Mass of Nitrate Detected at a Downstream Monitoring Location

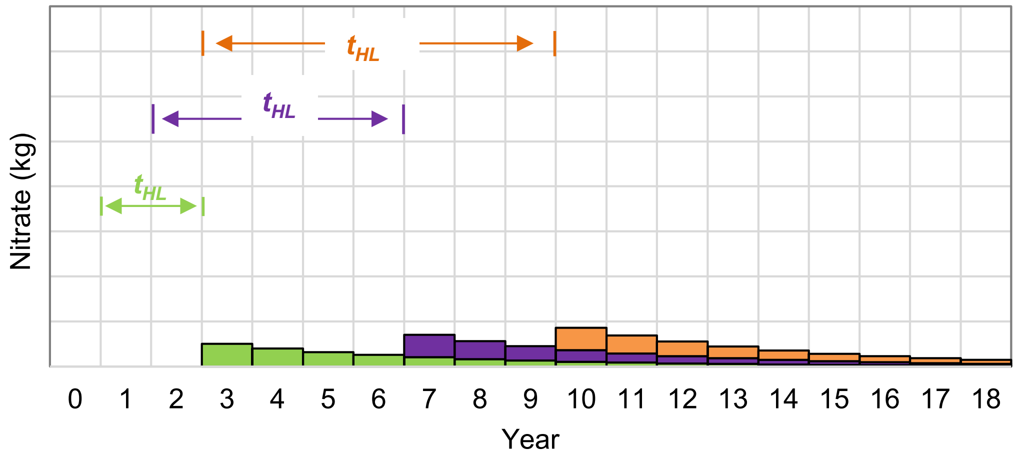


Figure 1.4-7: Conceptual Representation of Nitrate Release from a Hypothetical Waste Spoil Build Over Three Years

These concepts are represented in the WQC using eight equations. The first five equations are used to estimate how much nitrate is introduced into a spoil, which is a function of the type and amount of explosive used, whether blast holes are lined and whether the liners maintained their integrity until detonation. The remaining three equations are then used to calculate how much nitrate is released from a spoil, which is a function of the total nitrate mass in the spoil and leaching efficiency.

With respect to the first five equations, Equation 2 is used to calculate the total mass of nitrate entering a spoil each year from lined and unlined blast holes. Equation 3 is used to calculate the mass of nitrate originating from unlined blast holes, whereas Equations 4 to 6 are used to calculate the mass of nitrate originating from lined blast holes. The format of these five equations is as follows:

$$M_{total,j} = M_{unlined,j} + M_{lined,j} \qquad \text{Eq. 2}$$

Where:

$M_{total,j}$ = total mass of nitrate associated with waste rock deposited in year ‘j’ (kilogram [kg])

$M_{unlined,j}$ = total mass of nitrate originating from unlined blast holes in year ‘j’ (kg)

$M_{lined,j}$ = total mass of nitrate originating from lined blast holes in year ‘j’ (kg)

$$M_{unlined,j} = V_j F_{P,j} f_{R,j} \times \left(f_{ANFO,j}\, n_{ANFO,j} C_{N,ANFO} + \left[1 - f_{ANFO,j}\right] n_{emul,j} C_{N,emul}\right) \times F_c \qquad \text{Eq. 3}$$

Where:

V_j = volume of waste rock deposited in year ‘j’ (bank cubic metre [BCM])

$F_{P,j}$ = powder factor (mass of explosive used per unit of waste rock generated) in year ‘j’ (kilograms per bank cubic metre [kg/BCM])

$f_{R,j}$ = fraction of explosives remaining after detonation in year ‘j’ (unitless)

$f_{ANFO,j}$ = fraction of the total explosives used in year ‘j’ that were in the form of ANFO (unitless)

$n_{ANFO,j}$ = fraction of ANFO placed in unlined holes in year ‘j’ (unitless)

$C_{N,ANFO}$ = concentration of nitrogen in ANFO (gram of nitrogen per gram of ammonium nitrate and fuel oil mixture [g N/g ANFO])

$n_{emul,j}$ = fraction of emulsion placed in unlined holes in year ‘j’ (unitless)

$C_{N,emul}$ = concentration of nitrogen in emulsion (gram of nitrogen per gram of emulsion [g N/g emulsion])

F_c = calibration factor (unitless)

$$M_{lined,j} = M_{pre,j} + M_{blast,j} \qquad \text{Eq. 4}$$

Where:

$M_{pre,j}$ = mass of nitrate released from lined holes because of pre-blast mechanisms in year ‘j’(kg)

$M_{blast,j}$ = mass of nitrate released from lined holes because of blast mechanisms (kg) (Teck 2021)

$$M_{pre,j} = V_j F_{P,j} f_{R,j} \times \left(f_{ANFO,j}\left[1 - n_{ANFO,j}\right] C_{N,ANFO} + \left[1 - f_{ANFO,j}\right]\left[1 - n_{emul,j}\right] C_{N,emul}\right) \times F_c \times \left(1 - k_{liner}\right) \qquad \text{Eq. 5}$$

Where:

k_{liner} = fraction of effective blast hole liners (unitless)

$$M_{blast,j} = V_j F_{P,j} \times \left(f_{ANFO,j}\left[1 - n_{ANFO,j}\right] C_{N,ANFO} + \left[1 - f_{ANFO,j}\right]\left[1 - n_{emul,j}\right] C_{N,emul}\right) \times F_c \times k_{blast} \qquad \text{Eq. 6}$$

Where:

k_{blast} = fraction of misfires (unitless)

The values assigned to the terms in the above-noted equations are defined as follows:

- Powder factors, fraction of ANFO used, fractions of ANFO and emulsion placed into unlined holes, annual waste rock deposition schedules and nitrogen concentrations in both ANFO and emulsion are derived from mine site information and mine plans.
- The fraction of explosives remaining after detonation (also referred to as nitrogen loss factors) are derived as described in Annex A and are listed in Table 1.4-2.
- The fraction of blast hole liners that prevent all in-hole leaching of explosive products is modelled to be 0.50, based on field testing completed to date on installed liners (Annex A). This value will be refined with additional field testing. Currently, this model input can be adjusted to understand the sensitivity of this value on planning and design decision making going forward.
- The fraction of misfires is assumed to be 0.00001 (or 0.001%) based on historical tracking of misfires at Elk Valley Mines (Annex A and Teck 2021).

With respect to the remaining three equations, Equations 7 and 8 are used to calculate the rate at which nitrate is released from a spoil each year, considering the total mass of nitrate in the spoil, hydraulic lag time and leaching efficiency. Equation 9 scales the annual estimate based on how climate conditions in a given week compare to the long-term average, in terms of net percolation out of the spoil. The use of net percolation is new to the 2020 RWQM Update; in the 2017 RWQM, this scaling for climatic conditions was accomplished through a flow comparison at regionally selected nodes. The use of a climate-driven FC facilitates the change and makes the scaling more spoil-specific and dynamic. For reference, net percolation is defined as the flow rate at the base of the spoil normalized to spoil area. The format of these four equations is as follows:

$$R_{NO3,j} = M_{spoil,j} \times LE \qquad \text{Eq. 7}$$

Where:

$R_{NO3,j}$ = rate of nitrate mass released from a spoil in year ‘j’ (kg/y)

$M_{spoil,j}$ = total mass of nitrate in the spoil in year ‘j’ that is susceptible to release after accounting for hydraulic lag (kg)

LE = leaching efficiency, expressed as percent per year (%/y)

$$M_{spoil,j} = \sum_{j=0}^{j=j-t_{HL}-t_C} M_{total,j} - \sum_{j=0}^{j=j-t_{HL}-t_C-1} R_{NO3,j} \qquad \text{Eq. 8}$$

Where:

t_{HL} = hydraulic lag time between placement of waste rock and detection of mass at a downstream monitoring location (y)

t_c = calibration offset for hydraulic lag (y)

$$R_{NO_3,k,j} = R_{NO_3,j} \times \left(\frac{net\ percolation_{k,j}}{net\ percolation_{AVG}}\right)\varphi_1 \qquad \text{Eq. 9}$$

Where:

$R_{NO_3,k,j}$	=	climate-adjusted, weekly nitrate release rate from a given spoil in week 'k' of year 'j' (kilograms per day [kg/d])
Net percolation$_{k,j}$	=	net percolation from a given spoil in week 'k' of year 'j' (millimetres [mm])
Net percolation$_{avg}$	=	average annual net percolation over the period of record (mm)
φ_1	=	unit conversion factor of 0.00274 (year per day [y/d])

The values assigned to the terms in the equations above are defined as follows:

- Catchment-specific hydraulic lag times and leaching efficiencies, derived as described in Annex A, are listed in Table 1.4-2. Valley-wide average hydraulic lag times and leaching efficiencies, along with nitrogen loss factors, are used when insufficient data were available to derive unique, catchment-specific values.
- Calibration factors for nitrate loading and hydraulic lag time offsets were derived and set during the calibration process to improve model performance (i.e., to have simulated results more closely match measured data), as detailed in Section 2.1.

Unlike the 2017 RWQM, a single equation is used in the 2020 RWQM to convert annual release rates into climate-adjusted weekly release rates. This change in functionality more closely links constituent release to waste rock flow, rather than using fixed weekly loading distributions and climate adjustments linked to changes at regional nodes. This change allows the 2020 RWQM to account for and respond to changes to climate, such as those that change the timing and magnitude of spring freshet; it also results in consistency among constituents (i.e., nitrate, selenium, sulphate and cadmium all follow the same loading distribution) more accurately.

Table 1.4-2: Hydraulic Lag Time, Leaching Efficiency and Nitrogen Loss Factors by Catchment (Prior to Calibration)

Operation	Node ID	Description	Hydraulic Lag Time Prior to Calibration (y)	Leaching Efficiency (%)	Nitrogen Loss Factor Prior to Calibration (%)
FRO	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	4	20%	6%
	FR_HC1	Henretta Creek u/s of Fording River (E216778)	8	20%	8%
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	7	20%	8%

Table 1.4-2: Hydraulic Lag Time, Leaching Efficiency and Nitrogen Loss Factors by Catchment (Prior to Calibration)

Operation	Node ID	Description	Hydraulic Lag Time Prior to Calibration (y)	Leaching Efficiency (%)	Nitrogen Loss Factor Prior to Calibration (%)
GHO	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	8	10%	2%
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	7	20%	2%
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	3	20%	5%
	GH_SC1	Swift Creek Sediment Pond Decant (E221329)	7	20%	5%
	GH_TC1	Thompson Creek at LRP Road (E102714)	7	20%	1%
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257796)	3	20%	3%
LCO	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	5	20%	8%
	LC_WLC	West Line Creek (E261958)	16	10%	4%
EVO	EV_BC1; EV_GT1	Bodie Creek Sediment Pond Decant (E102685); Gate Creek Sediment Pond Decant (E206231)	3	20%	6%
	EV_DC1; EV_HC1	EVO Dry Creek Sediment Pond Decant (E298590); EVO Harmer Compliance Point – Harmer Spillway (E102682)	8	20%	4%
	EV_EC1	Erickson Creek at Mouth (0200097)	12	20%	7%
Valley-wide Average	All other tributaries		8	20%[(a)]	5%

EVO = Elkview Operations; FRO = Fording River Operations; GHO = Greenhills Operations; LCO = Line Creek Operations;% = percent; y = year.

(a) Exceptions are: Lake Mountain Pit, Lake Pit (prior 2017) with a leaching efficiency of 10%.

1.4.2.1.2 Selenium and Sulphate

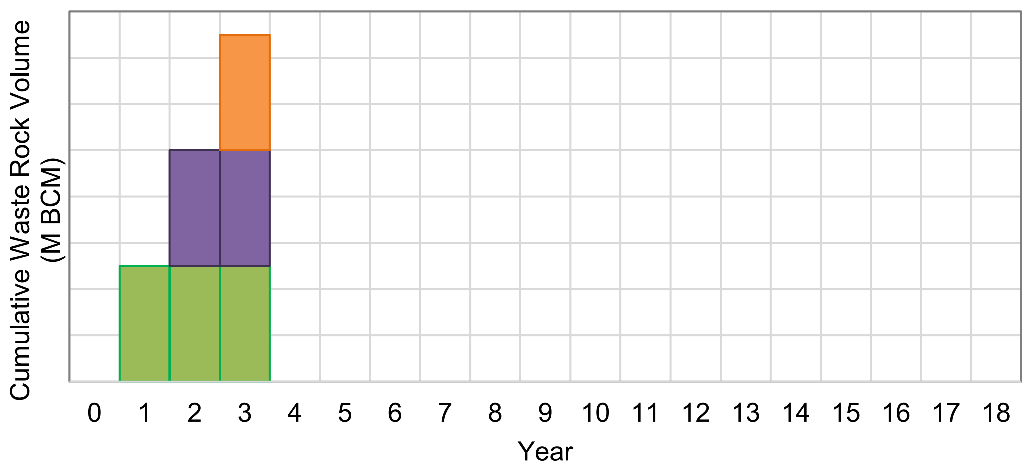
The conceptual model for selenium and sulphate release from waste rock is as follows (see Annex A for more detail):

- Selenium and sulphate contained in drainage from waste rock spoils originate from oxidation of minerals contained in waste rock.
- The oxidation process occurs when the minerals contained in the waste rock are exposed to aerobic conditions, and it occurs both prior to and following placement of waste rock in a spoil.
- The amount (or mass) of selenium and sulphate released through oxidation prior to waste rock placement in the spoil is referred to the initial soluble load, whereas the mass of selenium and sulphate released after waste rock placement in the spoil is referred to as the oxidative load. The total mass of selenium and sulphate released from a waste rock spoil is the sum of the initial soluble load plus the oxidative load, with the former generally being a much smaller proportion of the total load than the latter.
- Similar to nitrate, the initial soluble load of selenium and sulphate is finite, readily dissolves into water percolating through the spoil and is gradually leached out of the spoil over time. The time period over which it leaches out of a given volume of waste rock is dependent on leaching efficiency.
- The on-going oxidative load that occurs after placement of waste rock in the spoil is a function of cumulative waste rock volume in the spoil and selenium and sulphate release rates defined in terms of mass released per volume of waste rock per year. It begins as soon as waste rock is placed in a spoil, and selenium and sulphate released through on-going oxidation readily dissolve into water percolating through the spoil.
- As with nitrate, there is time delay or hydraulic lag between when waste rock is placed in a spoil and when selenium and sulphate can be detected at a downstream monitoring location. The lag is hydraulically driven, is consistent among constituents, and is best defined using nitrate data.
- There is sufficient source material in waste rock spoils that selenium and sulphate release will continue over a longer time frame than nitrate. That said, the source material from which the selenium and sulphate originate is finite, and the release of both constituents will not continue indefinitely.
- The transport of load from a spoil is higher during high flow conditions and lower during low flow conditions, relative to that which occurs under average flow conditions. The change in release rate is directly proportional to the change in flow.
- Sulphate is subject to a solubility limit (2,530 milligrams per litre [mg/L]), whereas selenium is not.

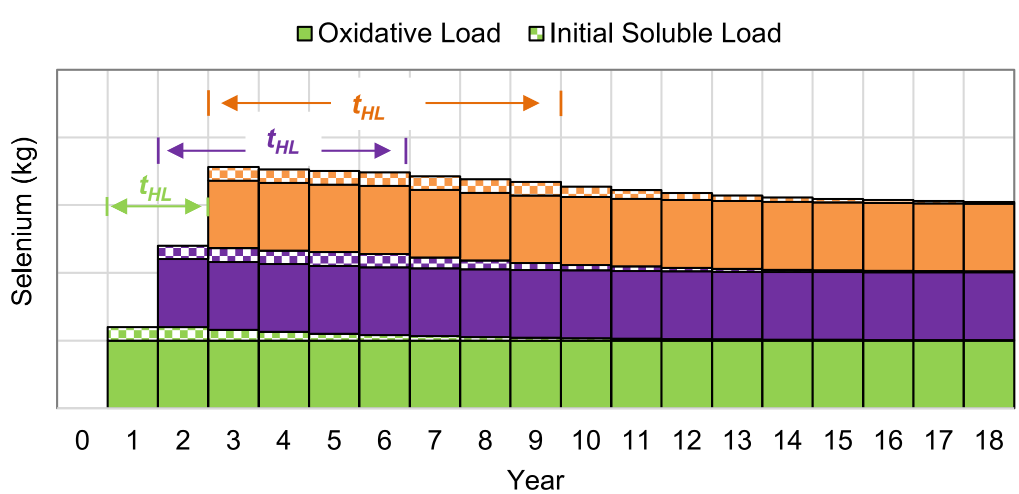
These concepts are illustrated in Figure 1.4-8, based on a hypothetical spoil constructed in equal lifts over a three-year period, with constant exposure to average flow conditions. As each lift is added, it contributes an initial soluble load as well as selenium and sulphate source material to the spoil, which begins to oxidize. Selenium and sulphate begin to report to the receiving environment after the hydraulic lag time has elapsed.

Similar to nitrate, the initial soluble load is released from the spoil based on leaching efficiency, which is shown in this figure as 20% per year. The rate at which the on-going oxidative load of selenium and sulphate is release from the spoil is correlated to the cumulative volume of waste rock in the spoil, and it does not decline over the 18-year timeframe presented in the figure. As shown in the third panel, the total mass of selenium and sulphate reporting to a downstream monitoring location is the summation of the initial soluble load and the on-going oxidative load.

(a) Cumulative Waste Rock Volume in the Spoil



(b) Mass of Selenium or Sulphate in the Spoil and Available Dissolution and Export



(c) Mass of Selenium or Sulphate Detected at a Downstream Monitoring Location

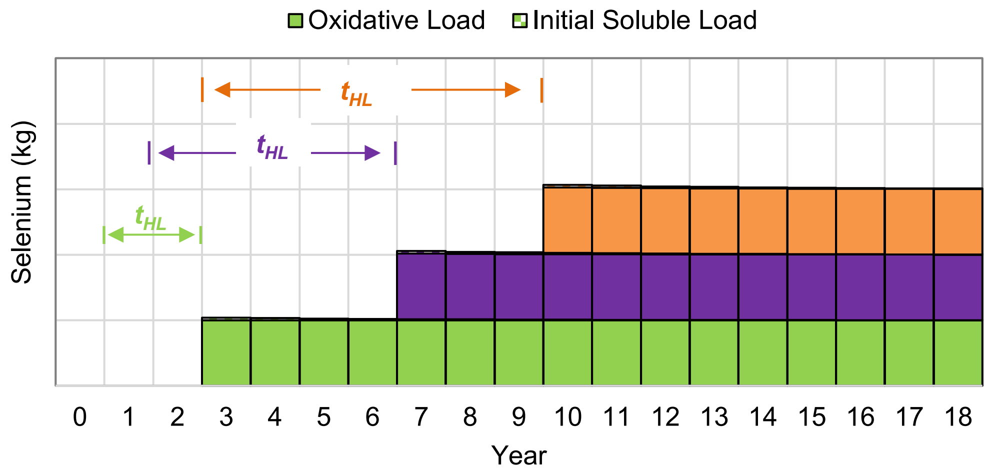


Figure 1.4-8: Conceptual Representation of Selenium or Sulphate Release from a Hypothetical Waste Spoil Build Over Three Years

These concepts are represented in the WQC using eight nested equations. Equation 10 is used to calculate the total annual rate of selenium or sulphate release from waste rock, based on the rates of release of the initial soluble load and the on-going oxidative load. Equations 11 to 13 are used to calculate the rate of release of the initial soluble load. Equation 11 is used to define the amount of initial soluble load entering the spoil each year. Equations 12 and 13 are used calculate the rate of release of the initial soluble load, considering the total amount of initial soluble load that has entered the spoil and that which has already washed out.

Equation 14 is used to calculate the rate of release from on-going oxidation. Equation 15 scales the total annual release rate (as defined using Equation 10) based on how climate conditions in each year compare to long-term average and converts it into a weekly release rate, following the same approach as described above with reference to nitrate. Equation 16 is used to convert the weekly release rate into a concentration. Equation 17 is used to compare the calculated concentration to established solubility limits, and adjusts the mass released accordingly. These eight equations are as follows:

$$R_{total,j} = R_{ISL,j} + R_{OL,j} \qquad \text{Eq. 10}$$

Where:

$R_{total,j}$ = annual rate of selenium or sulphate release from waste rock in year ‘j’ (kg/y)

$R_{ISL,j}$ = annual rate of selenium or sulphate release based on initial soluble load in year ‘j’ (kg/y)

$R_{OL,j}$ = annual rate of selenium or sulphate release based on on-going oxidation in year ‘j’ (kg/y)

$$M_{ISL,j} = R_{ISL}V_j \times (T_{PBPD} + t_c) \quad \text{Eq. 11}$$

Where:

$M_{ISL,j}$	=	total mass of selenium or sulphate entering a spoil as initial soluble load in year ‘j’ (kg)
R_{ISL}	=	geochemical source term governing the rate of selenium or sulphate generation from waste rock prior to placement in a spoil (kg/BCM/y)
V_j	=	volume of waste rock deposited in year ‘j’ (BCM)
T_{PBPD}	=	time between initial atmospheric exposure, including blasting and excavation, and placement of waste rock in a spoil (y)
t_c	=	calibration offset for the time period between atmospheric exposure and placement in a spoil (y)

$$R_{ISL,j} = M_{spoil,j} \times LE_j \quad \text{Eq. 12}$$

Where:

$M_{spoil,j}$	=	total initial soluble load of selenium or sulphate contained within a spoil in year ‘j’ (kg)
LE_j	=	leaching efficiency in year “j”, expressed as percent per year (%/y)

$$M_{spoil,j} = \sum_{j=0}^{j=j-t_{HL}-t_C} M_{ISL,j} - \sum_{j=0}^{j=j-t_{HL}-t_c-1} R_{ISL,j} \quad \text{Eq. 13}$$

Where:

t_{HL}	=	hydraulic lag between placement of waste rock and detection of mass at a downstream monitoring location (y)
t_c	=	calibration offset for hydraulic lag (y)

$$R_{OL,j} = R_{OL}F_cV_{(j-t_{HL}-t_c)} \quad \text{Eq. 14}$$

Where:

$R_{OL,j}$	=	annual rate of selenium or sulphate release due to on-going oxidation in year ‘j’ (kg/y)
R_{OL}	=	geochemical source term governing selenium or sulphate release from waste rock following placement in a spoil (kg/BCM/y)
F_c	=	calibration factor (unitless)
$V_{(j-t_{HL}-t_c)}$	=	cumulative volume of waste rock in year ‘j-t_{HL}-t_c’ (BCM)

$$R_{total,k,j} = R_{total,j} \times \left(\frac{net\ percolation_{k,j}}{net\ percolation_{AVG}}\right) \varphi_1 \quad \text{Eq. 15}$$

Where:

$R_{total,k,j}$	=	climate-adjusted, weekly release rate for selenium or sulphate from waste rock in week 'k' of year 'j' (kg/d)
net percolation$_{k,j}$	=	net percolation in week 'k' of year 'j' (millimetres [mm])
net percolation$_{avg}$	=	average annual net percolation over the period of record (mm)
φ_1	=	unit conversion factor of 0.00274 (y/d)

$$C_{k,j} = \frac{R_{total,k,j}}{Q_{k,j}} \varphi_2 \quad \text{Eq. 16}$$

Where:

$C_{k,j}$	=	concentration of selenium or sulphate in water draining from waste rock in week 'k' of year 'j' (mg/L)
$Q_{k,j}$	=	flow draining from the waste rock spoil in week 'k' of year 'j' (m^3/s)
φ_2	=	unit conversion factor of 0.01157 ($m^3 \cdot d \cdot mg/L/s/kg$)

$$If\ C_{k,j} \leq SL\ Then\ R_{total,k,j,s} = R_{total,k,j}\ Else\ R_{total,k,j,s} = SL \times Q_{k,j} \quad \text{Eq. 17}$$

Where:

$R_{total,k,j,s}$	=	weekly, solubility checked release rate for sulphate from waste rock in week 'k' of year 'j' (kg/d)
SL	=	solubility limit for sulphate of 2,530 mg/L (value defined as outlined in Annex A)

The values assigned to the terms in the equations above are defined as follows:

- Cumulative waste rock volumes are derived from mine site information and review of mine plans.
- The geochemical source terms governing selenium and sulphate generation (as related to initial soluble load) and release (as related to on-going oxidation) were derived as outlined in Annex A and are listed in Tables 1.4-3 and 1.4-4.
- Hydraulic lag (t_{HL}) and the calibration offset on the hydraulic lag (t_c) are the same as those defined for nitrate.
- The scaling of annual release rates to account for climate and the translation of annual release rates into weekly release rates is calculated in the same manner as described above for nitrate.
- Calibration factors associated with selenium and sulphate release rates were derived and set during the calibration process to improve model performance (i.e., to have simulated results more closely match measured data), as detailed in Section 2.1.

Table 1.4-3: Annual Selenium Release Rates from Waste Rock (Prior to Calibration)

Operation	Node ID	Description	Selenium (mg/BCM/y)				
			Lower Limit on Mean	5% Confidence Limit	Mean	95% Confidence Limit	Upper Limit on Mean
Initial Soluble Load							
Valley-wide Average	All tributaries		-	-	7.1	-	-
Oxidative Load							
FRO	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	1.1	1.3	1.7	2.0	2.7
	FR_HC1	Henretta Creek u/s of Fording River (E216778)	3.1	3.8	4.4	5.0	7.5
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	2.4	2.8	3.5	4.1	4.9
GHO	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	3.3	3.7	4.6	5.5	6.0
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	3.2	3.6	4.4	5.0	6.0
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	0.32	0.78	1.8	2.7	4.3
	GH_SC1	Swift Creek Sediment Pond Decant (E221329)	3.6	4.5	5.1	5.8	6.9
	GH_TC1	Thompson Creek at LRP Road (E102714)	0	2.6	6.9	11	30
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257796)	1.6	2.6	3.6	4.7	9.4
LCO	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	2.4	3.4	5.6	7.9	11
	LC_WLC	West Line Creek (E261958)	5.4	6.1	7.7	9.3	13
EVO	EV_BC1; EV_GT1	Bodie Creek Sediment Pond Decant (E102685); Gate Creek Sediment Pond Decant (E206231)	1.6	2.0	5.2	8.3	16
	EV_DC1; EV_HC1	EVO Dry Creek Sediment Pond Decant (E298590); EVO Harmer Compliance Point – Harmer Spillway (E102682)	2.3	2.4	2.6	2.8	3.0
	EV_EC1	Erickson Creek at Mouth (0200097)	1.4	1.4	1.6	1.8	1.8
Valley-wide Average	All other tributaries		2.3	2.9	4.1	5.3	9.0

ID = identification; mg/BCM/y = milligrams per bank cubic metre per year.
Source: Annex A.

Table 1.4-4: Annual Sulphate Release Rates from Waste Rock (Prior to Calibration)

Operation	Node ID	Description	Sulphate (g/BCM/y)				
			Lower Limit on Mean	5% Confidence Limit	Mean	95% Confidence Limit	Upper Limit on Mean
Initial Soluble Load							
Valley-wide Average	All tributaries		-	-	19	-	-
Oxidative Load							
FRO	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	3.9	4.7	5.3	5.9	7.9
	FR_HC1	Henretta Creek u/s of Fording River (E216778)	19	21	27	33	45
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	8.4	9.7	10	11	14
GHO	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	10	11	14	17	18
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	17	20	22	24	28
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	2.4	5.9	14	23	34
	GH_SC1	Swift Creek Sediment Pond Decant (E221329)	8.4	12	13	15	21
	GH_TC1	Thompson Creek at LRP Road (E102714)	15	17	33	49	98
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257796)	14	23	39	55	88
LCO	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	12	14	17	19	43
	LC_WLC	West Line Creek (E261958)	10.5	12	14	16	22
EVO	EV_BC1; EV_GT1	Bodie Creek Sediment Pond Decant (E102685); Gate Creek Sediment Pond Decant (E206231)	0	4.4	23	43	72
	EV_DC1; EV_HC1	EVO Dry Creek Sediment Pond Decant (E298590); EVO Harmer Compliance Point – Harmer Spillway (E102682)	12	13	15	17	18
	EV_EC1	Erickson Creek at Mouth (0200097)	8.1	8.3	8.9	9.4	9.6
Valley-wide Average	All other tributaries		11	13	19	26	39

ID = identification; g/BCM/y = grams per bank cubic metre per year.
Source: Annex A.

1.4.2.1.3 Dissolved Cadmium

The conceptual model for cadmium release from waste rock is as follows (see Annex A for more details):

- Cadmium occurs as a chalcophile element in the Elk Valley. Chalcophile elements are those elements that have a low affinity for oxygen and prefer to bond with sulphur forming insoluble sulphides.
- Cadmium contained in drainage from waste rock spoils originates from oxidation of sphalerite, rather than pyrite (which is the source of selenium).
- Release of cadmium from waste rock is correlated to sulphate release, the cumulative percentage of potentially acid generating (PAG) waste rock present in the spoil and the application of PAG management practices. PAG waste rock is that which typically originates from the Morrissey Formation.
- Cadmium released through oxidation readily dissolves into water percolating through the spoil.
- Once released from the spoil, cadmium concentrations in waste rock flows are influenced by two removal processes: co-precipitation with calcite and adsorption to streambed sediment. Adsorption is a pH-influenced process that begins to shift once pH levels drop below 7. Streams in the Elk Valley tend to be alkaline in nature, so pH levels below 7 are a rare occurrence. Similarly, the dissolution of calcite tends to occur under conditions not commonly observed in the Elk Valley (i.e., low pH levels or shifts in the calcium / carbonate equilibrium that trigger the dissolution of calcite).

These concepts are represented in the WQC using two equations. Equation 18 is used to calculate the weekly release rate of cadmium from waste rock. Equation 19 is used to calculate cadmium concentrations in downstream surface waters (i.e., at monitoring locations) taken into consideration attenuation along the flow path. The format of these two equations is as follows:

$$R_{Cd,k,j} = MSRRR \times R_{total,k,j} \qquad \text{Eq. 18}$$

Where:

$R_{Cd,k,j}$	=	weekly release rate for cadmium from waste rock in week ‘k’ of year ‘j’ (kg/d)
$MSRRR$	=	metal sulphate release rate ratio, defined with reference to the presence or absence of PAG management (unitless)
$R_{total,k,j}$	=	calibrated, weekly release rate for sulphate from waste rock in week ‘k’ of year ‘j’ (kg/d)

$$C_{Cd,k,j} = \frac{R_{Cd,k,j}\left(100 - f_{LR,Cd,j} \times F_c\right)}{Q_{T,k,j}} \qquad \text{Eq. 19}$$

Where:

$C_{Cd,k,j}$ = concentration of cadmium in week 'k' of year 'j' (mg/L)

$f_{LR,Cd,j}$ = load reduction factor for cadmium in week 'k' of year 'j' (unitless)

F_c = monthly calibration factor (unitless)

$Q_{T,k,j}$ = total flow in week 'k' of year 'j' (m^3/s)

The values assigned to the terms in the equations above are defined as follows:

- Metal (i.e., cadmium) sulphate release rate ratios were derived as outlined in Annex A and are listed in Table 1.4-5.
- Geochemical source terms governing release of sulphate from waste rock were derived as outlined in Annex A and are listed in Table 1.4-4. Calibration factors associated with sulphate release rates were derived and set during the calibration process by comparing simulated results to observed data, as detailed in Section 2.1.
- Monthly, catchment-specific attenuation factors (i.e., load reduction factors) were derived as outlined in Annex A and are listed in Annex A, Table 35.
- Monthly calibration factors associated with cadmium attenuation were derived and set during the calibration process to improve model performance (i.e., to have simulated results more closely match measured data), as detailed in Section 2.1.

Table 1.4-5: Cadmium Sulphate Release Rate Ratios

Percent Morrissey Formation in Spoil	Pre-PAG Management[(a)]	Post-PAG Management[(a)]
	Average	Average
0%	0.000006	0.000006
1%	0.000007	0.000006
5%	0.000012	0.000006
10%	0.000015	0.000005
15%	0.000017	0.000005
20%	0.000019	0.000005
25%	0.000020	0.000005
30%	0.000021	0.000004

[(a)] PAG management started at all operations in 2018, except at Fording River Operations (FRO). PAG management at FRO started in 2019.

PAG = potentially acid generating;% = percent.

Source: Annex A.

1.4.2.1.4 Other Constituents Relevant to the Assessment of Selenium, Sulphate and Nitrate

The 2020 RWQM can simulate the concentrations of other constituents, beyond nitrate, selenium, sulphate and cadmium. In particular, it is used to simulate the concentrations of major ions, the results of which are then used to estimate hardness and total dissolved solids (TDS) levels. Hardness is a toxicity modifying factor for sulphate, nitrate and cadmium, and estimates of hardness are used to calculate the values of the nitrate and cadmium Site Performance Objectives at, for example, the Fording River downstream of Greenhills Creek (GH_FR1) and at the mouth of the Fording River (LC_LC5).

Geochemical source terms for alkalinity, chloride, potassium, and sodium are defined as constant, concentration-based values. These source terms are summarized in Table 1.4-6 and are changed into a weekly loading rates in the WQC using Equation 20. This approach is identical to that used in the 2017 RWQM and its predecessors.

$$R_{i,k,j} = C_{i,k,j} Q_{k,j} (1/\varphi_2) \qquad \text{Eq. 20}$$

Where:

$R_{i,k,j}$ = weekly loading rate for constituent 'i' from waste rock in week 'k' of year 'j' (kg/d)

$C_{i,k,j}$ = annual concentration of constituent 'i' in water draining from waste rock in week 'k' of year 'j' (mg/L)

$Q_{k,j}$ = flow draining from the waste rock spoil in week 'k' of year 'j' (m^3/s)

φ_2 = unit conversion factor of 0.011574 ($m^3 \cdot d \cdot mg/L/s/kg$)

Table 1.4-6: Other Constituent Concentrations in Waters Draining from Waste Rock Spoils

Constituent	Units	Concentration
Alkalinity	mg $CaCO_3$/L	330
Chloride	mg/L	4.4
Potassium	mg/L	4.8
Sodium	mg/L	8.4

mg $CaCO_3$/L = milligrams of calcium carbonate per litre; mg/L = milligrams per litre.
Source: Annex A.

Calcium, magnesium, and total dissolved solids (TDS) concentrations are calculated from the concentrations of other constituents to achieve an ion balance using the following equations (SRK 2014):

$$C_{Ca} = \left(\frac{40}{4.2}\right) \times \left(\frac{C_{Alkalinity}}{50} + \frac{2 \times C_{SO_4}}{96} + \frac{C_{NO_3}}{14} + \frac{C_{Na}}{23} + \frac{C_K}{39}\right) \qquad \text{Eq. 21}$$

$$C_{Mg} = 1.18 \times \frac{24}{40} \times C_{Ca} \qquad \text{Eq. 22}$$

The magnesium calculation is based on a magnesium-to-calcium molar ratio of 1.18, which is the average ratio observed in waste rock drainage throughout the Elk Valley. TDS concentrations (C_{TDS}, in mg/L) are estimated from the sum of all major ions:

$$C_{TDS} = C_{Ca} + C_{Mg} + C_K + C_{Na} + \left(\frac{C_{Alkalinity}}{50}\right) \times 61 + C_{SO_4} + C_{NO_3} + C_{Cl} \qquad \text{Eq. 23}$$

Harness concentrations (C_{Hard}, in mg/L as $CaCO_3$) are estimated as follows:

$$C_{Hard} = 2.5 * C_{Ca} + 4.1 * C_{Mg} \qquad \text{Eq. 24}$$

1.4.2.1.5 Constituent Inventory: Selenium, Sulphate and Cadmium

Inventory tracking for selenium, sulphate and cadmium is incorporated into WQC of the 2020 RWQM. Inventory tracking has been incorporated into the 2020 RWQM to reflect the finite nature of the source material from which these constituents originate. Inventory tracking is focused on the release of constituents from on-going oxidation that occurs after waste rock placement in a spoil, as a comparable level of inventory tracking for nitrate and selenium and sulphate related to initial soluble load is already accounted for in the equations outlined above.

The model tracks the mass inventory of each constituent in each waste rock spoil based on yearly waste rock placement, constituent content in that waste rock and annual release rates. Constituent content can be defined using either the potential inventory (PI) or the available inventory (AI). The PI is the total available mass of a constituent that could be released if the entire rock mass were to be broken down by weathering processes. The AI is the fraction of the PI that is available for weathering (i.e., the effective mass of each constituent that is available for weathering). PI and AI estimates for Elk Valley waste rock are outlined in Table 1.4-7; derivation of these values is discussed in Annex A.

Table 1.4-7: Potential and Available Constituent Inventories

Constituent	Inventory	Statistic[a]	Units	Value
Cadmium	Potential	Low	mg/kg	2.1
		Average	mg/kg	2.1
		High	mg/kg	2.2
	Available	Low	mg/kg	0.94
		Expected	mg/kg	0.96
		Worst Case	mg/kg	2
Selenium	Potential	Low	mg/kg	2.2
		Average	mg/kg	2.3
		High	mg/kg	2.3

Table 1.4-7: Potential and Available Constituent Inventories

Constituent	Inventory	Statistic[a]	Units	Value
Selenium	Available	Low	mg/kg	1.0
		Expected	mg/kg	1.0
		Worst Case	mg/kg	2.1
Sulphate (as S)	Potential	Low	%	0.12
		Average	%	0.13
		High	%	0.14
	Available	Low	%	0.056
		Expected	%	0.06
		Worst Case	%	0.13

[a] Potential inventory and available inventory statistics (e.g., low, expected, and worst case) are calculated as described in Annex A.
mg/kg = milligrams per kilogram of waste rock;% = percent of waste rock by mass
Source: Annex A.

Two equations are used to track constituent inventory. Equation 25 is used to calculate the incoming inventory with each waste rock placement. Equation 26 is used to calculate the total inventory in the spoil, accounting for incoming inventory and constituent release. These two equations are as follows:

$$M_{i,j} = V_j \times I_{i,j} \times \rho_{wr} \qquad \text{Eq. 25}$$

Where:

$M_{i,j}$ = mass of constituent 'i' associated with the volume of waste rock deposited in a spoil in year 'j' (kg)

V_j = volume of waste rock deposited in a spoil in year 'j' (BCM)

$I_{i,j}$ = inventory (potential or available) of constituent 'i' in waste rock deposited in year "j" (milligrams per kilogram [mg/kg])

ρ_{wr} = density of waste rock (2,500 kilograms per bank cubic metre [kg/BCM])

$$M_{spoil,i,j} = \sum_{j=0}^{j=j} M_{i,j} - \sum_{j=0}^{j=j-1} R_{i,j} \qquad \text{Eq. 26}$$

Where:

$M_{spoil,i,j}$ = total mass of constituent 'i' in a spoil in year 'j' (kg)

$R_{i,j}$ = annual rate of release of constituent 'i' from a spoil in year 'j', prior to climate-adjustment (e.g., $R_{total,\,j}$ from Equation 11 for sulphate and selenium) (kg/y)

Once the constituent inventory is exhausted, release rates drop to zero.

Release rates prior to climate adjustment are used in Equation 26 to avoid over or underestimation of the time frame over which the constituent inventory is consumed when running multi-year low or high flow scenarios, respectively.

1.4.2.1.6 Selenium and Sulphate Release Rates Subject to First Order Decay

First order decay of selenium and sulphate release rates has been incorporated into the WQC of the 2020 RWQM. It has been incorporated into the 2020 RWQM to reflect results from humidity cell tests, which indicate that selenium and sulphate release rates decrease as sulphide minerals are depleted (Annex A). This functionality is used at present only for sensitivity analyses because monitoring records in the Elk Valley do not yet show the same level of change to selenium and sulphate release rates as observed in the laboratory.

Decay of selenium and sulphate release rates is simulated assuming first-order kinetics and is applied in the model when waste rock placement in each catchment ends. Decay rates are outlined in Table 1.4-8; derivation of these values is discussed in Annex A.

Table 1.4-8: Rate of Decay Applied to Selenium and Sulphate Release Rates Once Spoiling in a Catchment Ceases

Year	Fraction of Initial Release Rate			
	Default Setting	Highest Decay	Average Decay	Lowest Decay
0	1	1	1	1
1	1	0.97	0.98	0.99
10	1	0.71	0.81	0.86
20	1	0.50	0.66	0.75
30	1	0.35	0.53	0.65
40	1	0.25	0.43	0.56
50	1	0.18	0.35	0.48
60	1	0.12	0.28	0.42
70	1	0.087	0.23	0.36
80	1	0.062	0.18	0.31
90	1	0.043	0.15	0.27
100	1	0.031	0.12	0.23
110	1	0.022	0.10	0.20
120	1	0.015	0.079	0.17
130	1	0.011	0.064	0.15
140	1	0.0076	0.052	0.13
150	1	0.0054	0.042	0.11

Table 1.4-8: Rate of Decay Applied to Selenium and Sulphate Release Rates Once Spoiling in a Catchment Ceases

Year	Fraction of Initial Release Rate			
	Default Setting	Highest Decay	Average Decay	Lowest Decay
160	1	0.0038	0.034	0.10
170	1	0.0027	0.028	0.084
180	1	0.0019	0.022	0.073
190	1	0.0013	0.018	0.063
200	1	0.00094	0.015	0.054

Source: Annex A.

1.4.2.1.7 Submerged Waste Rock

Changes in release rates following waste rock submergence have been incorporated into the 2020 RWQM. As water levels in backfilled pits rise, residual nitrate and oxidative products that have accumulated on waste rock not regularly subjected to water flow are dissolved into solution, and oxidation below the water surface ceases. This process is represented in the 2020 RWQM by an initial flush of residual nitrate and accumulated oxidative products when submerged. Thereafter, the submerged waste rock ceases to be a source of selenium, sulphate, cadmium, or nitrate. The constituents released when submerged are available for transport out of the backfilled pit. The mass released as submergence occurs is estimated using Equation 27, which is as follows:

$$L_{i,k} = \frac{net\ percolation_{k,j}}{net\ percolation_{AVG}} \cdot (1-p) \cdot V_{Submerged,k} \cdot R_i \cdot \left(t_{Submerged} - t_{Placement}\right) \qquad \text{Eq. 27}$$

Where:

$L_{i,k}$ = mass loading of constituent ‘i’ released following waste rock submergence in week ‘k’ (kg/d)

$net\ percolation_{k,j}$ = net percolation in week ‘k’ of year ‘j’ (millimetres [mm])

$net\ percolation_{AVG}$ = average annual net percolation over the period of record (mm)

p = the proportion of waste rock not contacted by meteoric water (unitless); estimated to be 0.5, as outlined in Annex A

$V_{Submerged,k}$ = volume of waste rock inundated by water in week ‘k’ (BCM)

R_i = valley-wide average geochemical release rate for constituent ‘i’ (kg/BCM/y), as developed for pit walls without consideration of hydraulic lag

$t_{Submerged}$ = time when submergence of waste rock occurs (y)

$t_{Placement}$ = time when waste rock was placed (y)

The numerical approach assumes that the release following submergence occurs instantaneously (i.e., no consideration of leaching efficiency). Following this initial flush, the load released from submerged waste rock is assumed to be zero, as long as the rock in question remains submerged. This process is applied in the 2020 RWQM to future mining activity; it is not a process that is modelled to occur during the calibration period.

1.4.2.2 Pit Walls and Other Mine-affected Areas

In the 2020 RWQM, pit walls are divided into four categories:

- benched non potentially acid generating (PAG) Mist Mountain Formation (MMF)
- unbenched non-PAG MMF
- benched PAG Morrissey Formation (MF)
- unbenched PAG MF

In the 2017 RWQM, five categories were used: the four listed above and benched non-PAG sub-MMF. The latter category has been combined with the benched non-PAG MMF category in the 2020 RWQM.

Benched non-PAG MMF is the most common type of pit wall; it is also used in the model to represent other mine-affected areas, which include haul roads, plant sites, maintenance areas and all other mine-affected areas not otherwise identified as waste rock, coal refuse, tailings, pits or pit wall.

The geochemical source terms defined for each category are described in Annex A and have been incorporated into WQC as outlined below.

1.4.2.2.1 Benched Non-PAG MMF Pit Walls

Most pits at Teck’s operations contain predominately benched non-PAG MMF pit walls. The conceptual model for constituent release from benched non-PAG MMF pit walls is similar to that described above for waste rock. Weathering of exposed minerals results in the release of selenium, sulphate, and other constituents. Nitrate from explosive residue on the pit wall surfaces dissolves into solution and is washed away during precipitation events. Key differences involve the absence of a hydraulic lag between exposure and presence of constituent mass at downstream monitoring locations, an absence of an initial soluble load of selenium and sulphate, and nitrate release from pit walls not being subject to leaching efficiency. Neither hydraulic lag nor leaching efficiency are applied because pit walls are fully exposed surfaces. Consequently, there is not the same type of slow percolation of water across pit wall surfaces as there is as water moves through a spoil. Similarly, there is no time delay between pit wall formation and exposure, as there is with waste rock between exposure prior to blasting, oxidation during blasting and placement in a spoil; hence, the absence of initial soluble load with pit walls.

Based on the shared elements between the conceptual model for constituent release from waste rock and that from pit walls, benched non-PAG MMF pit wall areas, haul roads maintenance areas, and other mine-affected areas not classified as pit walls, mine pits, waste rock, tailings, or coal refuse, are converted to a waste rock equivalent volume as follows:

$$V_{W,j} = A_{W,j} \qquad \text{Eq. 28}$$

Where:

$V_{W,j}$	=	effective cumulative volume of exposed benched non-PAG MMF pit wall in year ‘j’ (BCM)
$A_{W,j}$	=	exposed area of benched non-PAG MMF pit wall and other mine-affected areas in year ‘j’ (square metre [m^2])
d	=	assumed reactive surface thickness (metre [m])

The value of d is assumed to be 2 m (Annex A).

The constituent load released from the waste rock equivalent volume is then calculated in a similar manner to that outlined above for waste rock (Section 1.4.2.1), without the application of hydraulic lag time, leaching efficiency or initial soluble load.

For nitrate, the absence of lag time and leaching efficiency means that all the available nitrate associated with benched non-PAG MMF pit walls reports to the receiving environment in that same year. Thus, release rates are calculated using Equations 2 to 6, and 9, with the term V_j in Equations 3, 5 and 6 replaced with $V_{W,j}$, and the term $R_{NO3,j}$ in Equation 9 replaced with $Mt_{otal,j}$.

Sulphate and selenium loading from benched non-PAG MMF pit walls and other mine-affected areas defined as outlined above is calculated in a similar manner, again without the application of lag time:

$$R_{W,k,j} = \alpha R_W V_{W,j} F_c \varphi_1 \qquad \text{Eq. 29}$$

Where:

$R_{W,k,j}$	=	rate of selenium or sulphate release from benched non-PAG MMF pit walls in week ‘k’ of year ‘j’ (kg/d)
α	=	weekly loading distribution factor (unitless)
R_W	=	annual selenium or sulphate release rate for benched non-PAG MMF pit walls (kg/BCM/y)
F_c	=	calibration factor (unitless)
$V_{W,j}$	=	effective cumulative volume of exposed benched non-PAG MMF pit wall in year ‘j’ (BCM)
φ_1	=	unit conversion factor of 0.00274 (y/d)

Annual release rates (R_W) for exposed benched non-PAG MMF pit walls and other mine-affected areas defined as outlined above are set to the values shown in Table 1.4-9, with cadmium release being a function of sulphate release as per the approach outlined above. Watershed-specific values were not used because pit wall release rates are expected to be consistent from operation to operation because rock characteristics are uniform (Annex A). Calibration and weekly distribution factors are set equivalent to those outlined above for waste rock in the same catchment, and adjustments for flow conditions and checks on solubility limits are completed as per the process outlined in Section 1.4.2.1.2.

The concentration of major ions in waters draining from exposed benched non-PAG MMF pit walls and other mine-affected areas defined as outlined above are set to the values shown in Table 1.4-6.

Table 1.4-9: Annual Release Rates of Selenium and Sulphate from Benched non-PAG MMF Pit Walls (Prior to Calibration)

Constituent	Units	Release Rate
Selenium	mg/BCM/yr	4.1
Sulphate	g/BCM/yr	19

mg/BCM/yr = milligrams per bank cubic metre per year; g/BCM/yr = grams per bank cubic metre per year.
Source: Annex A.

1.4.2.2.2 Other Pit Wall Categories

Pits containing unbenched non-PAG MMF, benched PAG MF and unbenched PAG MF are less common at Teck's operations, but occur at the following locations:

- Cougar Pit Phases 3 to 6 at GHO
- Burnt Ridge North, Mount Michael, North Line Extension, and Mine Services Area West pits at LCO
- Baldy Ridge, Natal, Cedar and Adit pits at EVO

The total flow from each pit is estimated using the FC and is divided amongst the four pit wall types based on relative area. Constituent loads associated with flow from unbenched non-PAG MMF, benched PAG MF and unbenched PAG MF are calculated using the concentrations in Table 1.4-10.

Table 1.4-10: Constituent Concentrations in Waters Draining from Other Pit Walls

Constituent	Units	Unbenched non-PAG MMF	Benched PAG MF	Unbenched PAG MF
Alkalinity	mg $CaCO_3$/L	1.5	1	0
Cadmium	mg/L	0.0000046	0.14	0.00012
Chloride	mg/L	0.051	14	0.048
Nitrate	mg N/L	-[(a)]	-[(a)]	-[(a)]
Potassium	mg/L	0.14	8.8	0.01
Selenium	mg/L	0.0004	0.042	0.00004
Sodium	mg/L	0.016	16	0.02
Sulphate	mg/L	1.2	3981	7.4

[(a)] Nitrate loads associated with flow from unbenched non-PAG MMF, benched PAG MF and unbenched PAG MF are calculated using the concentrations in Appendix B, Table B-7.
MMF = Mist Mountain Formation; MF = Morrissey Formation; PAG = potential acid generating; mg $CaCO_3$/L = milligrams of calcium carbonate per litre; mg N/L = milligrams of nitrogen per litre; mg/L = milligrams per litre.
Calcium and magnesium concentrations calculated as per Equations 21 and 22.
Source: Annex A.

At locations downstream of PAG MF pit wall types where acidic runoff has mixed with other water, acidity and net alkalinity are calculated to assess whether the water has the potential to be acidic. This assessment is conducted using the following equations:

$$Acidity\left({}^{mgCaCO_3}/_{L}\right) = \left(Al\frac{3}{27} + Fe\frac{3}{55.9} + Mn\frac{2}{55}\right) \times 50 \qquad \text{Eq. 30}$$

$$Net\ Alkalinity\left({}^{mgCaCO_3}/_{L}\right) = Alkalinity\left({}^{mgCaCO_3}/_{L}\right) - Acidity\left({}^{mgCaCO_3}/_{L}\right) \qquad \text{Eq. 31}$$

Where:

Al	=	concentration of aluminum (mg/L)
Fe	=	concentration of iron (mg/L)
Mn	=	concentration of manganese (mg/L)

If net alkalinity is positive, constituent concentrations are reduced to the concentrations in benched non-PAG MMF walls, with one exception. Cadmium concentrations are set to the values presented in Table 1.4-11.

If net alkalinity is negative, constituent concentrations, as calculated by the WQC, are used.

Table 1.4-11: Constituent Concentration Constraints Based on Net Alkalinity

Constituent	Units	Concentration		
		Net Alkalinity <0	0 <Net Alkalinity <70	Net Alkalinity >70
Cadmium	mg/L	-	0.008	0.004

mg/L = milligrams per litre; <= less than; >= greater than.
Source: Annex A.

1.4.2.3 Coal Refuse

Weathering processes in coal refuse are similar to waste rock; however, oxygen penetration into coal refuse tends to be limited, based on gas measurements collected from the Greenhills Area A coal refuse pile (Annex A). Consequently, release rates developed for waste rock are not used for coal refuse. Instead, constituent concentrations in waters flowing through coal refuse are estimated using measured concentrations in drainage from the Greenhills Area A coal refuse pile. Load rates from coal refuse are calculated by multiplying the flow through the refuse by the assigned concentration. Data from the Greenhills Area A coal refuse are considered an appropriate valley-wide analog because bulk mineralogy and chemical composition of coal refuse are comparable at all operations (Annex A). Estimated water quality from the coal refuse is provided in Table 1.4-12.

Table 1.4-12: Constituent Concentrations in Waters Draining from Coal Refuse

Constituent	Units	Concentration
Alkalinity	mg $CaCO_3$/L	524
Cadmium	mg/L	0.000043
Calcium	mg/L	346
Chloride	mg/L	26
Hardness	mg/L	1,763
Magnesium	mg/L	219
Nitrate	mg N/L	0.05
Potassium	mg/L	5.7
Selenium	mg/L	0.0037
Sodium	mg/L	9.0
Sulphate	mg/L	1,400
Total dissolved solids	mg/L	2,646

mg $CaCO_3$/L = milligrams of calcium carbonate per litre; mg/L = milligrams per litre; mg N/L = milligrams of nitrogen per litre.
Source: Annex A.

1.4.2.4 Discharge from Tailings Storage Facilities

Six sources of tailings water are included in the 2020 RWQM:

- EVO: Lagoon D and the West Fork Tailings Storage Facility (WFTF)
- FRO: South Tailings Pond, Turnbull South Pit, and a future facility
- GHO tailings storage facility

Other tailings facilities present in the Elk Valley are not explicitly included in the model as they are not actively used. Seepage from these historical facilities is expected to be minimal and accounted for through model calibration. Constituent concentrations in tailings water discharged from all tailings facilities are based on model calculations, except for nitrate and selenium. Nitrate and selenium concentrations in water discharged from tailings facilities are set to fixed values, reflective of information collected from the South Tailings Facility at FRO. Selenium is assigned a constant concentration of 1.5 µg/L. Nitrate is assigned a concentration of 0.07 mg/L if influent nitrate levels are less than 15 mg/L, or a concentration of 7.5 mg/L if influent nitrate levels are above this threshold. The derivation of these values is outlined in Annex A.

1.4.2.5 Rehandle of Historical Waste Materials

Rehandle of historical waste materials has occurred in the past and is planned at FRO, GHO, and EVO. Rehandled materials include waste rock, hot waste rock (i.e., waste rock that is currently burning), plant refuse, and tailings.

Rehandle of waste materials results in a short-term, immediate release of constituents in addition to that which would otherwise occur if the materials were not rehandled. The movement of this “extra” load into the receiving environment is subject to lag time and leaching efficiency, with both hydrologic processes being defined by the characteristics of the spoil into which the rehandled material is placed. The application of lag time and leaching efficiency to the load from rehandle of waste materials is new in the 2020 RWQM.

Release rates from rehandled materials have not changed from the 2017 RWQM. They are based on leach tests results, with constituents divided into one of two groups depending on whether the geochemical source term describing their release was expressed as a function of waste rock volume or as a concentration (Annex A).

For constituents with source terms that are a function of waste volume (including nitrate, selenium, and sulphate), loadings to downstream areas are estimated using the following equation:

$$L_{Rh,j} = \alpha R_{Rh} V_{Rh,j} \varphi_1 \qquad \text{Eq. 32}$$

Where:

$L_{Rh,j}$	=	weekly mass loading from a given rehandled material in year ‘j’ (kg/d)
α	=	weekly loading distribution factor
R_{Rh}	=	short-term release rate from the rehandled material (kg/BCM)
$V_{Rh,j}$	=	volume of rehandled material deposited in year ‘j’ (BCM)
φ_1	=	unit conversion factor of 0.00274 (y/d)

Annual release rates (R_{Rh}) are applied valley-wide independent of operation or catchment; they are as outlined in Table 1.4-13. Weekly loading distributions are as per those applied to waste rock in the same catchment and are defined as outlined in Section 1.4.2.1.

Table 1.4-13: Annual Release Rates from Rehandled Waste Materials

Constituent	Units	Waste Rock	Hot Waste Rock	Refuse	Tailings
Cadmium	mg/m^3	0.043	0.26	0.4	0.12
Calcium	mg/m^3	16,000	220,000	33,000	85,000
Chloride	mg/m^3	510	5,100	3,400	2,000
Magnesium	mg/m^3	6,300	100,000	11,000	34,000
Nitrate	mg/m^3	1,500	1,000	4,500	230
Selenium	mg/m^3	15	30	22	77
Sodium	mg/m^3	480	1,400	840	1,500
Sulphate	mg/m^3	26,000	710,000	56,000	180,000

Source: Annex A.
Hardness and total dissolved solids are calculated internally within the model based on relevant major ions.
mg/m^3 = milligrams per cubic metre.

Sulphate loadings from rehandled waste materials (Equation 32) are added to the loadings from waste rock (Equation 15), and an initial estimate of the concentrations in water draining from the waste rock spoil is calculated, as per Equation 16. These estimates are compared to the geochemical solubility limit of 2,530 mg/L (defined as outlined in Annex A); concentrations are set equal to the solubility limit, if required, so that predicted concentrations of sulphate in waters draining from waste rock spoils do not exceed the solubility limit (as per Equation 17).

For constituents with source terms that are expressed as a concentration, loading is estimated by multiplying the flow draining from the affected spoil with the maximum of the concentration assigned to the rehandled materials themselves (Table 1.4-14) or the waste rock that makes up the rest of the spoil (Table 1.4-6). These values are then transformed into weekly loading rates using Equation 15.

The source terms governing the release of constituents from rehandle of historical waste materials are applied in the 2020 RWQM as follows:

- Source terms for rehandled waste rock are applied to rehandled volumes greater than 2 million BCM.
- Source terms for burning waste rock, refuse and tailings are applied to rehandled volumes greater than 10,000 BCM.

These thresholds reflect the fact that rehandling of small amounts of waste materials regularly occurs as part of mining and would be captured in the measured data used to develop the source terms applied to waste rock spoils as outlined in Section 1.4.2.1.

Table 1.4-14: Constituent Concentrations in Drainage from Rehandled Waste Materials

Constituent	Units	Waste Rock	Hot Waste Rock	Refuse	Tailings
Alkalinity	mg $CaCO_3$/L	33	38	15	35
Potassium	mg/L	2.8	1.1	1.3	2.4

Source: Annex A.
mg $CaCO_3$/L = milligrams of calcium carbonate per litre; milligrams per litre.

1.4.3 Loading from Natural Areas

Surface flows from unaffected watershed areas are assigned monthly source term concentrations derived from the geometric mean of monitored data from undisturbed watersheds in the region. A geometric mean was used to generate these monthly average values to avoid potential biases introduced by occasional high values that may be related to spring freshet. Upstream loadings are then determined by multiplying the flow by the source term concentration.

Water quality in flows from unaffected watershed areas were defined as follows:

- Data collected prior to 2014 from the Fording River upstream of FRO were used to define water quality conditions in unaffected watershed areas in tributaries at FRO and GHO that drain directly to the Fording River. Data from the Fording River upstream of FRO were also used to define upstream water quality conditions in that river.

- Data from the Elk River upstream of GHO were used to define water quality conditions in unaffected watershed areas in tributaries at GHO that drain directly to the Elk River. Data from the Elk River upstream of GHO were also used to define upstream water quality conditions in that river.
- Data collected prior to 2013 from LCO Dry Creek, along with information from the East Tributary, were used to define water quality conditions in unaffected watershed areas in LCO Dry Creek.
- Data from Harmer Creek upstream of EVO were used to define water quality conditions in unaffected watershed areas in EVO Dry Creek, Harmer Creek and Grave Creek.
- Data from the following watersheds were grouped and used to define background water quality conditions in unaffected watershed areas in tributaries at LCO (except for LCO Dry Creek) and EVO (except for EVO Dry Creek, Harmer Creek and Grave Creek), and upstream water quality conditions in Line Creek and Michel Creek:
    - Grace Creek
    - Ewin Creek
    - LCO Dry Creek (data collected prior to 2013, with additional data to the end of 2019 from East Tributary)
    - Fording River upstream of FRO
    - Line Creek upstream of LCO
- Data collected from the Kootenay River were used to define background water quality conditions in all tributaries to Koocanusa Reservoir except for the Elk River.

A summary of the resulting geometric mean concentrations used to define water quality in non-mining affected areas is outlined in Appendix A, Tables A-1 to A-12.

1.4.4 Dust Suppression

The WQC includes a consumptive loss term for water diverted for use in dust suppression at FRO, GHO, LCO and EVO. Water used for dust suppression is modelled as being diverted from the following representative locations[2]:

- FRO: Kalmikoff Pond, Shandley Pit, Liverpool Ponds, and Kilmarnock Settling Ponds
- GHO: Phase 3, Phase 4/5, and Phase 6 pits
- LCO: Horseshoe Ridge Pit, Burnt Ridge South Pit, Mine Services Area West Pit, and North Line Extension Pit
- EVO: Breaker Lake, Natal Pit, Bodie Creek, Adit Pit, Baldy Ridge Pit, and the EVO SRF

Rates of water use for dust suppression are estimated based on site information.

[2] Locations in addition to those listed above may be used as a source of dust suppression water. The list is intended to be representative in nature with the effects of dust suppression reflected in the model results.

Constituent mass associated with the water used for dust suppression is assumed to remain in the watershed from which the water originates. In other words, it is assumed that the water diverted for dust suppression is largely used to suppress dust within the watershed from which the diversion originates. The water evaporates, but the load remains and reports to the watershed outlet. Thus, dust suppression has a concentrating effect on constituents.

1.4.5 Pits Acting as Local Groundwater Sinks

The bottom elevations of certain mine pits in current mine plans will be low enough for those pits to act as local groundwater sinks, drawing water away from surrounding areas. These pits consist of:

- FRO: Turnbull South Pit and Swift Pit
- GHO: Phases 3 to 7 pits
- EVO: Adit Pit, Baldy Ridge Pit, Cedar Pit, and Natal Pit

Groundwater inflows to each pit are defined as outlined in Annex B and are summarized below.

At FRO, groundwater inflow to:

- Turnbull South Pit is predicted to peak at approximately 830 m^3/d in 2016, and to stabilize at approximately 470 m^3/d in 2029 when mining activities are complete.
- Swift Pit is projected to peak at approximately 18,300 m^3/d in 2037, and then stabilize over the longer-term at a rate of approximately 14,200 m^3/d.

At GHO, groundwater inflow to:

- Phases 3 to 6 pits is projected to peak at approximately 1,590 m^3/d in 2027, and to stabilize over the longer term at a rate of approximately 1,150 m^3/d.
- Phase 7 Pit is projected to peak at approximately 450 m^3/d in 2041, and then stabilize over the longer-term at a rate of approximately 420 m^3/d.

At EVO, groundwater inflow to:

- Adit Pit is projected to peak at approximately 210 m^3/d in 2053, and then stabilize over the longer-term at a rate of approximately 130 m^3/d.
- Baldy Ridge Pit is projected to peak at approximately 480 m^3/d in 2042, and then stabilize over the longer-term at a rate of approximately 460 m^3/d.
- Cedar Pit is projected to peak and then remain at approximately 130 m^3/d from 2043 onward.
- Natal Pit is projected to peak at approximately 600 m^3/d in 2036, and to stabilize at approximately 570 m^3/d in 2037 after mining activities are complete.

Loading associated with these groundwater inflows is estimated assuming fully advective flow (i.e., load is calculated by multiplying the groundwater flow by the concentration in the creek or river from which the groundwater flow originates). The estimated loadings do not consider attenuation or decay along the groundwater pathway.

Groundwater inflows into other pits (e.g., the Mount Michael and Burnt Ridge North pits at LCO) were not included in the model because they are unlikely to reach depths that would affect stream flows in neighbouring tributaries (i.e., are unlikely to act as local groundwater sinks to the extent that they could appreciably affect surface flows in adjacent streams).

1.4.6 Filling of Pits with Water

The approach used to model the filling of mine pits in the WQC of the 2020 RWQM is as follows:

- Prior to the end of mining in a given pit (i.e., prior to pit filling), influent flows are as dictated by the FC output, and are assumed to immediately exit the pits (i.e., pit discharge is equivalent to pit inflow).
- During pit filling, influent flow rates are as dictated by the FC output, with no water being discharged from the pit.
- Once full, influent flows are as dictated by the FC output, with inflow and outflow rates being equivalent.

This approach differs from that described in the *Elk Valley Water Quality Plan 2019 Implementation Plan Adjustment* (2019 IPA; Teck 2019), in that pits are no longer filled only using average flow rates. The change in approach reflects the shift from using low, average, and high flow estimates to generate future water quality projections to one based on using 20 individual flow realizations that reflect climate conditions from 2000 to 2019.

Filling of the following mine pits with water is explicitly represented in the 2020 RWQM:

- FRO: Turnbull South Pit, Eagle 6 Pit North, Eagle 6 Pit West, Eagle 4 Pit and Swift Pit
- GHO: Cougar Phases 3 to 7 pits
- LCO: Horseshoe Ridge Pit, North Line Extension Pit, Mine Services Area West Pit, North Line Creek Pit, Burnt Ridge North 3 Pit and Mount Michael 3 Pit
- EVO: Cedar Pit, South Pit, F2 Pit, Baldy Ridge Pit, Adit Pit and Natal Pit West

These pits are explicitly represented in the 2020 RWQM because of their large size and the longer timeframe over which they fill with water. These pits are modelled using reservoir elements. Each reservoir element has a set volume reflective of the space available to fill with water, and they begin to fill with water once activity in each pit is complete. Water decants from these reservoirs to the receiving environment once full. Information on the characteristics of these pits was obtained from a review of available mine plan information.

Concentrations of constituents within these flooded pits are calculated as a mass balance of incoming flows mixing with existing pit volumes, minus outflows. Upstream loadings to each pit are calculated as outlined in Sections 1.4.2 and 1.4.3, as appropriate. As noted above, these pits are treated as fully mixed basins; consequently, “reservoir” elements within GoldSim are used to track constituent mass and water volume over time. Concentrations in flooded pits are calculated as constituent mass divided by volume, and the mass exiting each reservoir is calculated as concentration in the pit multiplied by its outflow rate.

For smaller pits (e.g., Cedar Pit at EVO), loading from upstream waste rock and coal refuse, as well as from contributing pit walls and backfilled (i.e., in-pit) waste rock, is routed directly to the receiving environment within the model. These smaller pits are not explicitly included in the model, because of their small size, and the shorter timeframe over which they will fill with water and discharge.

1.4.7 Surface Water – Groundwater Partitioning in Mine-Influenced Tributaries

Total watershed yield flows via surface and groundwater pathways. At a regional scale, all of the drainage makes its way into the Fording River and the Elk River, reporting to and mixing within the river mainstems. However, the geology of the Elk Valley is heterogeneous, and the proportion of total watershed yield that is at surface varies by location and time of year. Most or all of the total flow will be at surface at locations with geological constraints, such as bedrock near surface. At other locations, where sands and gravels are more prevalent, a greater proportion of the total flow will travel via shallow groundwater pathways, particularly in winter.

Explicit representation of these two flow pathways was not included in the 2017 RWQM or its predecessors. Focus was placed on tracking total watershed yield (i.e., total flow), and it was assumed that constituents released from mine operations and other areas mixed completely in the total flow.

The 2020 RWQM continues to be largely focused on estimating and then tracking total flow. At specific locations in mine-influenced tributaries, explicit representation of the division of flow between surface and groundwater pathways has been included in the model. The volume of water traveling through the ground at any point in time is calculated based on flow thresholds that are expressed as a percentage of total flow up to a maximum flow rate (or threshold). The flow thresholds are defined based on available monitoring information, including knowledge of the local geology. They are summarized in Table 1.4-15, and derived as outlined in Annex B.

Surface water – groundwater partitioning is explicitly built into the 2020 RWQM to assist with model calibration. It is also included because of its relevance to water quality mitigation planning, in terms of informing engineering considerations for capturing the appropriate proportion of mine-influenced water.

Surface water – groundwater partitioning of load in the WQC matches, with two exceptions, that of water flow in the FC. In other words, the FC produces estimates of total watershed yield and is calibrated to measured surface flow data, taking into consideration groundwater flows at each calibration location. At most monitoring locations, constituents released from mine features and via water management activities mix completely within the total watershed yield by the time water reports to the downstream monitoring location, based on analysis of available information. Thus, the measured constituent concentrations at surface are representative of constituent concentrations at surface and in the underlying groundwater flow (i.e., in the total flow). Load partitioning between surface and groundwater pathways at these locations mirror those of the water itself (i.e., load follows flow).

Explicit accounting for surface water – groundwater load partitioning is more relevant to the calibration of the WQC in those few situations where mixing between surface water and groundwater flows is incomplete at downstream monitoring stations. At those locations, measured constituent concentrations at surface are not representative of constituent concentrations in the total flow and assuming otherwise results in an overestimation of loading to downstream systems. There are two locations in the 2020

RWQM where load partitioning between surface water and groundwater differs from the partitioning of flow: the existing monitoring locations near the mouths of West Line Creek and Greenhills Creek.

Table 1.4-15: Flow Thresholds Used to Define Surface Water - Groundwater Partitioning in the 2020 Regional Water Quality Model

Operation	Node ID	Description	Groundwater Flow	
			Percentage of Total Flow	Maximum Flow Rate (m^3/d)
FRO	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	60%	4,000
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	• When total flow <60,000 m^3/d, 100% to bypass to a max of 16,500 m^3/d • When total flow >60,000 m^3/d, then 30% to bypass to a max of 26,900 m^3/d	
	GH_SC1	Swift Creek Sediment Pond Decant (E221329)	2%	1,000
GHO	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	30%	6,000
	GH_TC1	Thompson Creek at LRP Road (E102714)	80%	5,000
LCO	LC_DCEF	East Tributary of LCO Dry Creek (E288274)	80%	69,120
	LC_DC1	LCO Dry Creek near mouth (at bridge) (E288270)	50%	8,000
	LC_WLC	West Line Creek (E261958)	60%	10,000
EVO	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	• When total flow <20,000 m^3/d, 100% to bypass to a max of 2,000 m^3/d • When total flow >20,000 m^3/d, then 10% to bypass to a max of 5,000 m^3/d	
	EV_HC1	EVO Harmer Compliance Point – Harmer Spillway (E102682)	5%	5,000
	EV_GV1	Grave Creek at bridge	5%	5,000
	EV_EC1	Erickson Creek at Mouth (0200097)	15%	34,560

EVO = Elkview Operations; FRO = Fording River Operations; GHO = Greenhills Operations; LCO = Line Creek Operations; ID = identification; m^3/d = cubic metres per day;% = percent.
Source: Annex B.

At West Line Creek, constituent concentrations in groundwater are approximately 0.56 of those in surface water (Figure 1.4-9), based on a review of the available monitoring data. This ratio is used to define the partitioning of load between surface water and groundwater at this location, as per the following equation:

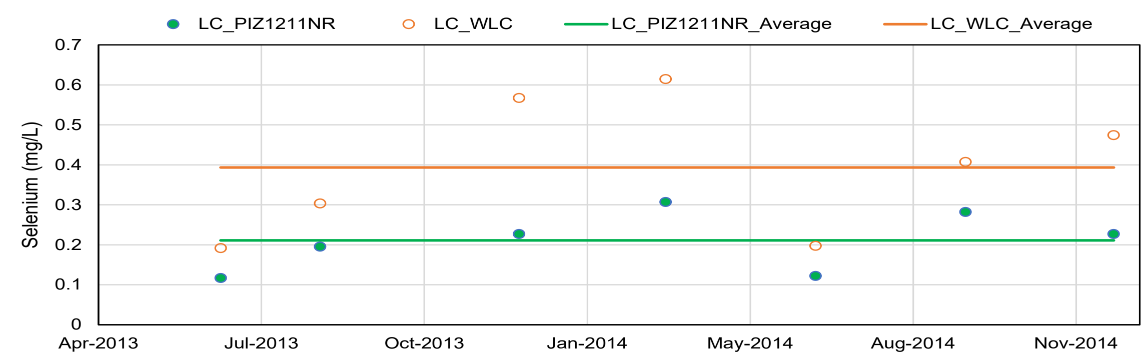
$$L_{GW,x,y} = Q_{GW,y} \times r_{GWSW,y} \times C_{SW,x,y} \qquad \text{Eq. 33}$$

Where:

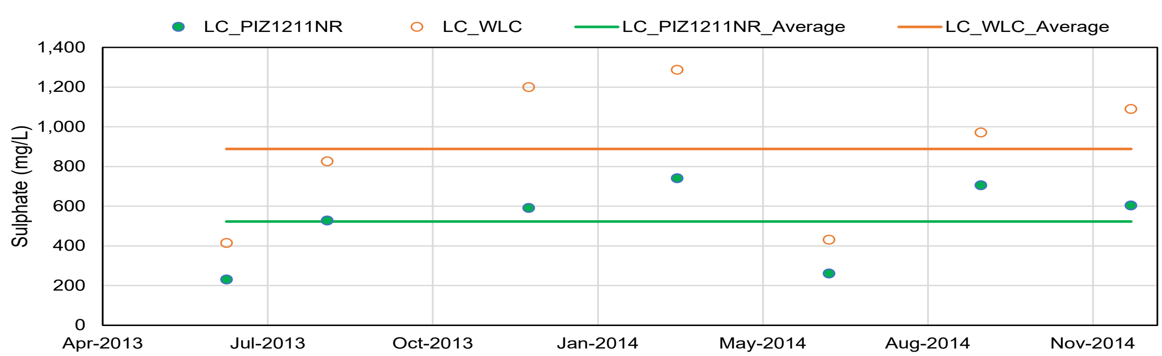
$L_{GW,x,y}$	=	loading of constituent 'x' in groundwater at location 'y' (kg/d)
$Q_{GW,y}$	=	groundwater flow at location 'y' (m^3/d)
$r_{GWSW,y}$	=	ratio of constituent "x" concentration in groundwater versus surface water at location 'y' (unitless)
$C_{SW,x,y}$	=	concentration of constituent 'x' in surface water at location 'y' (mg/L)
φ	=	unit conversion factor of 0.001 (litres per cubic metre [L/m^3]·mg)

At Greenhills Creek, the loading ratio between groundwater and surface water was defined based on the proportion of the total groundwater flow that could be attributed to mine-influenced water. This ratio was calculated based on a total groundwater flow of 6,000 m^3/d, with the mine-influenced portion being 600 m^3/d (SNC 2021a).

(a) Selenium



(b) Sulphate



Source: Teck 2020a.

Figure 1.4-9: Measured Concentrations of Selenium and Sulphate in West Line Creek

1.4.8 Use of Retention Areas to Dampen Seasonal Variability in Mine-Affected Tributaries

Dampened seasonal variation in measured concentrations of nitrate, selenium, sulphate, and other constituents, relative to monitored concentrations in other areas, have been noted for the following eight catchments included in the WQC:

- Henretta Creek
- Cataract Creek
- Eagle Pond
- Porter Creek
- Erickson Creek
- EVO Dry Creek
- Harmer Creek
- Upper Line Creek

These patterns can not be explained solely by the dampened seasonal contributions from waste rock areas and the use of retention areas in the model are required to replicate these patterns. Using selenium and sulphate concentrations in Porter Creek as examples, constituent concentrations at the mouth of Porter Creek tend to be relatively consistent from one season to the next, as shown in Figures 1.4-10 and 1.4-11 Figures of measured constituent concentrations in the other aforementioned creeks are included in Appendix B.

Processes that could be responsible for dampened seasonal variability in constituent concentrations include temporary retention of mass in Henretta Lake (Henretta Creek), Eagle Pond (Eagle Pond), or in beaver dammed areas (EVO Dry Creek and Harmer Creek), as well as dispersion and dilution that occurs as waters pass through shallow gravels (Erickson, Cataract, Upper Line and Porter creeks) as they travel from the spoil areas to the lower reaches of each tributary.

Retention areas in the form of reservoirs are included in the WQC to reproduce the observed dampening of seasonal variability in constituent concentrations, but not flow. The size of each reservoir, expressed as residence time under average annual flows, is:

- two weeks for Eagle Pond
- one month for Henretta Creek, Cataract Creek, EVO Dry Creek, Harmer Creek and Upper Line Creek
- three months for Porter Creek
- six months for Erickson Creek

Sizing the retention reservoirs based on average annual flow conditions results in longer retention times during low flow periods (e.g., winter) and shorter retention times during high flow periods (e.g., freshet). The reservoirs are used to slow the movement of constituent mass from the point of release to the creek mouth without affecting water flow rates. In other words, each reservoir acts as a completely mixed basin, with outgoing flow set equal to incoming flow. Constituent mass released from an upstream spoil in each week mixes with that released over the preceding and proceeding weeks, thereby resulting in a dampening of variability in the mass reporting to the creek mouth. The effect that the retention reservoirs have on projected concentrations is illustrated in Figures 1.4-10 and 1.4-11.

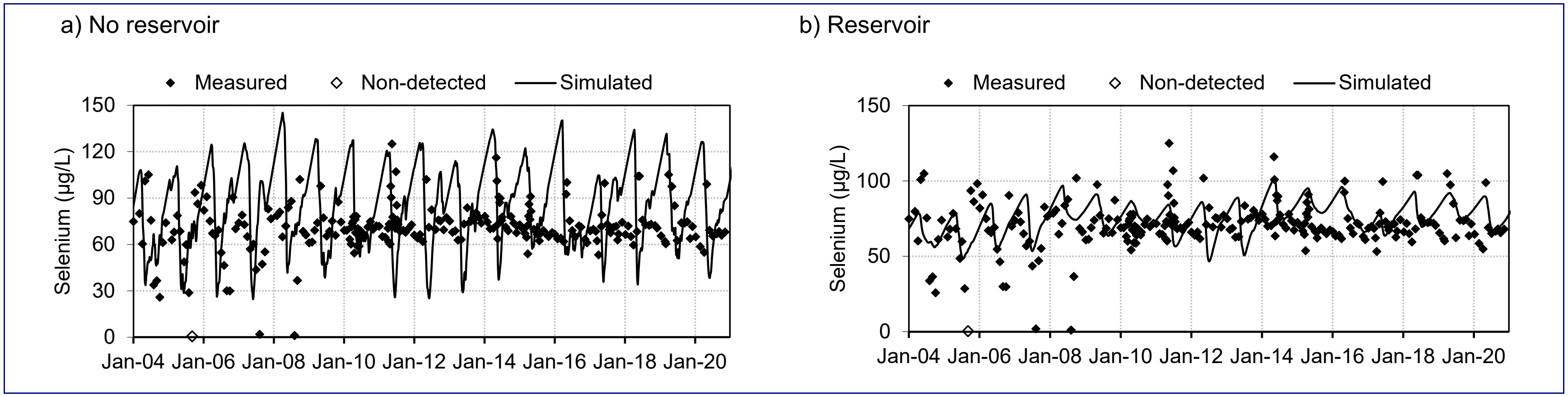
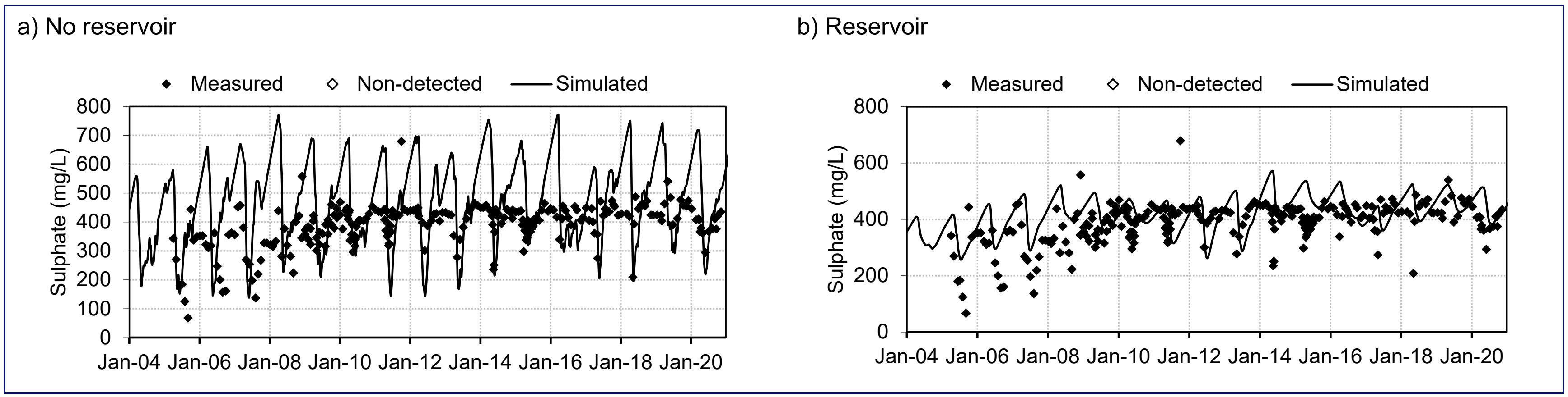


Figure 1.4-10: Simulated and Measured Selenium Concentrations in Porter Creek, 2004-2020



Note:

When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses 20 sets of weekly estimates generated by the FC. In these figures, projected concentrations in 2020 are based on median conditions.

Figure 1.4-11: Simulated and Measured Sulphate Concentrations in Porter Creek, 2004-2020

1.4.9 Accounting for Delay and Dispersion Between Kilmarnock Creek and the Fording River and Between West Line Creek and Line Creek

1.4.9.1 Kilmarnock Creek and the Fording River

Mass balance investigations conducted in Kilmarnock Creek and along the Fording River downstream of Kilmarnock Creek indicate that waters from Kilmarnock Creek travel along subsurface pathways as they move to the Fording River. Analysis of the data collected to date suggests that there are three dominant flow paths (SNC 2021):

- A flow path that joins Kilmarnock Creek to the Fording River upstream of the FRO Compliance Point; travel times along this flow path appear to be in the order of 1 year. This flow path is referred to as Flow Path 2 by SNC (2021b).
- A flow path that joins Kilmarnock Creek to the Fording River upstream of Porter Creek; travel times along this flow path appear to be in the order of 1 year. This flow path is a component of Flow Path 1, as described by SNC (2021b).
- A second, slower flow path that joins Kilmarnock Creek to the Fording River upstream Porter Creek, with travel times in the order of 6 to 7 years. This flow path is the other component of Flow Path 1 described by SNC (2021b).

Most of the flow from Kilmarnock Creek (i.e., 65%) appears to be travelling along the quicker flow path that joins Kilmarnock Creek to the Fording River upstream of Porter Creek. Of the remaining 35%, 15% appears to be reporting to the Fording River upstream of the FRO Compliance Point, with the remaining 20% traveling to the Fording River via the slower flow path that reports upstream of Porter Creek. All three flows paths are explicitly included in the 2020 RWQM, and two types of reservoirs are being used in the WQC to account for dispersion and delay along each flow path.

First, retention reservoirs are being used to account for the dispersion and delay experienced by all mass moving along each flow path. The residence times assigned to each retention reservoir as follows:

- A reservoir with an average residence time of 4 months is positioned on the flow path that joins Kilmarnock Creek to the Fording River upstream of the FRO Compliance Point. The reservoir was sized such that residence times remained at or below 2 years during winter low flow conditions, or no more than double the travel time estimated by SNC (2021b); thus, residence time in the reservoir ranges from 3 weeks during peak freshet flow conditions to no more than 2 years, with a median residence time of 6 months over the calibration period.
- A similarly sized reservoir is included on the flow path that joins Kilmarnock Creek to the Fording River upstream of Porter Creek. It was sized using the same rationale as outlined above.
- A reservoir with an average residence time of 2 years is included for the second, slower flow path that joins Kilmarnock Creek to the Fording River upstream of Porter Creek. This reservoir was sized such that residence times remained at or below 12 years during winter low flow conditions, or no more than double the travel time estimated by SNC (2021b); thus, residence time in the reservoir ranges from 4 months during peak freshet flow conditions to no more than 12 years, with a median residence time of 3 years months over the calibration period.

These three retention reservoirs are computationally identical to those described in Section 1.4.8. They are configured as completely mixed basins that only affect the movement of mass along each flow path (i.e., they are fixed volume reservoirs, with inflows equal to outflows). They serve to dampen seasonal variability in constituent concentrations (thereby accounting for dispersion) and delay the rate at which mass released from Kilmarnock Creek reaches the Fording River.

Non-preferential flow reservoirs are the second type of reservoir included in the model framework between Kilmarnock Creek and the Fording River. They serve to represent the following concepts:

- Movement of water and mass along each of the three flow paths is not uniform. Instead, each flow path consists of preferential and non-preferential sub-pathways.
- Travel along the preferential sub-pathway dominates, and the characteristics of the preferential sub-pathway dictate the bulk properties of the flow path overall, such as pathway length and overall travel time.
- Movement of water and mass along non-preferential sub-pathways is more prevalent during higher flow conditions when more water is moving between Kilmarnock Creek and the Fording River (i.e., more water and mass is being pushed into the non-preferential sub-pathways).
- Movement along non-preferential sub-pathways is slower than that along the preferential sub-pathway, and, as flow rates decline, water and mass migrate from the non-preferential sub-pathways to the preferential sub-pathway. The net result is an offset in the arrival of some of the water and mass leaving Kilmarnock Creek relative to that moving only along the preferential sub-pathway.
- The amount of water and mass affected by movement along non-preferential sub-pathways is small, and the offset in the arrival of water is minor, in terms of its ability to affect instream flows in the Fording River.

The non-preferential flow reservoirs are placed downstream of the retention reservoirs described above. There is one non-preferential flow reservoir present on the flow path between Kilmarnock Creek and the Fording River upstream of the FRO Compliance Point. A second non-preferential flow reservoir is included in the WQC between Kilmarnock Creek and the Fording River upstream of Porter Creek.

Water flow into each non-preferential flow reservoir is defined as a function of total upstream flow. It is calculated as follows:

$$When\ Q_{us} < Q_T, Q_{in} = Min(Q_{us}, Q_T * 10\%) \qquad \text{Eq. 34}$$

$$When\ Q_{us} > Q_T, Q_{in} = Min(Q_T * 10\%, Q_{mi}) \qquad \text{Eq. 35}$$

Where:

Q_{us} = Total upstream flow (m^3/d)

Q_T = Flow threshold (m^3/d)

Q_{in} = Inflow to the interflow reservoir (m^3/d)

Q_{mi} = Maximum inflow rate to the interflow reservoir (m^3/d)

In the case of the first non-preferential flow reservoir (i.e., that on the flow path between Kilmarnock Creek and the Fording River upstream of the FRO Compliance Point), total upstream flow is equivalent to 15% of the flow draining from Kilmarnock Creek (i.e., the flow draining from Kilmarnock Creek and travelling along Flow Path 2). With respect to the second non-preferential flow reservoir, total upstream flow is equivalent to combined total of that travelling along both components of Flow Path 1. In other words, flow and load exiting the two retention reservoirs present between Kilmarnock Creek and the Fording River upstream of Porter Creek are combined within the model framework, and the second non-preferential reservoir is linked to the combined output.

Outflow rates from each non-preferential flow reservoir are set to 2.5% of the reservoir water volume; thus, the non-preferential flow reservoirs work on a drawdown function analogous to how outflows from waste rock spoils are now modelled.

Constituent mass entering each non-preferential flow reservoir is a function of inflow rate multiplied by upstream concentration, as calculated within the WQC. Constituent mass leaving each non-preferential flow reservoir is a function of outflow rate multiplied by constituent concentration in the reservoir, with mass being conserved in each reservoir (i.e., there is no transformation, precipitation, settling or loss of mass occurring within the non-preferential flow reservoir).

The flow threshold (Q_T) and the maximum inflow rate (Q_{mi}) are location-specific and set to have little overall effect on total flow. The values currently assigned to these variables are outlined in Table 1.4-16; they are considered calibration parameters.

Table 1.4-16: Non-Preferential Flow Reservoirs Included in the 2020 Regional Water Quality Model Between Kilmarnock Creek and the Fording River

Operation or General Location	Node ID	Node Description (EMS ID)	Inflow Rates	Release Rate
Fording River Operations	FR_KC1 to FR_FRCP1	Flow path that joins Kilmarnock Creek to the Fording River u/s of the FRO Compliance Point	• When flow <10,000 m^3/d, 100% to storage up to max of 1,000 m^3/d • When flow >10,000 m^3/d, 10% to storage up to max of 2,000 m^3/d	2.5% per week
	FR_KC1 to GH_PC2	Flow path that joins Kilmarnock Creek to the Fording River u/s of Porter Creek	• When flow <40,000 m^3/d, 100% to storage up to max of 4,000 m^3/d • When flow >40,000 m^3/d, 10% to storage up to max of 10,000 m^3/d	

ID = identification; FRO = Fording River Operations; u/s = upstream; <= less than; >greater than; m^3/d = cubic metres per day;% = percentage.

1.4.9.2 West Line Creek and Line Creek

The 2020 RWQM explicitly accounts for the subsurface connection between West Line Creek and Line Creek, whereby a portion of the total watershed yield generated in the West Line Creek sub-catchment bypasses the West Line Creek monitoring station and reports to Line Creek in the vicinity of the LCO Compliance Point (see Table 1.4-15). Calibration of the FC suggests that flow along this subsurface pathway may be in the order of 60% of the total watershed yield from West Line Creek (see Annex B). Travel times along this flow path are estimated to be in the order of 2 years (SNC 2021c).

The delay in the movement of mass along the subsurface flow path connecting West Line Creek to Line Creek is primarily represented within the WQC using a material delay element. Dispersion and consideration of non-preferential sub-pathways are accounted for using a single non-preferential flow reservoir, positioned downstream of the delay element. The non-preferential flow reservoir has a similar configuration to that described above in Section 1.4.9.2; however, Equations 34 and 35 have been replaced with a single equation, which specifies that all water and mass moving along this flow path is subject to movement through the non-preferential flow reservoir. This approach was found to be effective, although it is acknowledged that it differs from that used to model water and mass movement along the subsurface flow pathways joining Kilmarnock Creek to the Fording River.

1.4.10 Accounting for Non-Preferential Flow Between Chauncey Creek, Ewin Creek and the Fording River

The lower portions of Chauncey Creek and Ewin Creek are located on valley-fill sediments. SNC (2021b) indicated that a notable proportion of the flow moving through lower Chauncey Creek goes to ground, reporting to the Fording River some distance downstream from its surface confluence with the Fording River. The effect was less pronounced in Ewin Creek, with proportionally more of the water draining from this catchment appearing to remain at surface and discharging via its confluence into the Fording River.

As noted above in reference to the subsurface connections between Kilmarnock Creek and the Fording River, subsurface flow will occur along a combination of preferential and non-preferential sub-pathways, with travel along non-preferential sub-pathways resulting in an offset in the arrival time of some water and mass. Two non-preferential flow reservoirs are included in the 2020 RWQM to capture this process, one at the outlet of each creek. The two reservoirs are configured in the same manner as outlined above in Section 1.4.9, with one exception. At Chauncey Creek, the value of 10% shown in Equation 35 was changed to a value of 40% to help improve model performance and reflect the fact that a larger proportion of the total yield from Chauncey Creek, relative to that from Ewin Creek, is travelling subsurface.

It is acknowledged that, in the 2020 RWQM, flow estimates for Chauncey Creek and Ewin Creek are derived using calibration parameters from other catchments (see Annex B for details). As flow monitoring in these creeks continues and the available dataset becomes more robust, direct calibration of the FC to these two tributaries will become possible, and it may result in adjustments to the configuration of the two non-preferential flow reservoirs associated with these two creeks, both of which have a minor influence on overall model performance.

Table 1.4-17: Non-Preferential Flow Reservoirs Included in the 2020 Regional Water Quality Model Between Chauncey Creek, Ewin Creek and the Fording River

Operation or General Location	Node ID	Node Description (EMS ID)	Inflow Rates	Release Rate
Fording River Operations	Chauncey Creek	Flow path that joins Chauncey Creek to the Fording River	• When flow <10,000 m^3/d, 100% to storage up to max of 4,000 m^3/d • When flow >10,000 m^3/d, 40% to storage up to max of 8,000 m^3/d	-
	Ewin Creek	Flow path that joins Ewin Creek to the Fording River	• When flow <20,000 m^3/d, 100% to storage up to max of 2,000 m^3/d • When flow >20,000 m^3/d, 10% to storage up to max of 4,000 m^3/d	

ID = identification; FRO = Fording River Operations; <= less than; >greater than; m^3/d = cubic metres per day;% = percentage.

1.4.11 Interflow Reservoirs in Mainstems

A third type of reservoir included in the 2020 RWQM are interflow reservoirs. They are computationally similar to the non-preferential flow reservoirs included on the subsurface flow paths between Kilmarnock Creek and the Fording River. They are included at locations along the mainstems of the Fording River, Elk River, Michel Creek and Line Creek.

Interflow reservoirs serve to represent the differential movement of water (and, by association, mass) that can occur due to bank storage and exchange between the water column and the underlying hyporheic zone, as well as the exchange that occurs between the water column and underlying shallow groundwater flow paths oriented in a parallel direction to mainstem flow (exchange that occurs as surface water passes through gaining and losing river reaches). The interflow reservoirs are designed around the concept that offsets in water movement created by bank storage and exchanges between surface water and shallow groundwater / the hyporheic zone are small; they are insufficient to materially alter mainstem hydrographs, which typically reflect the summation of upstream tributary inputs.

Similar to the non-preferential flow reservoirs outlined in Section 1.4.9.1, the interflow reservoirs are represented in the model framework using GoldSim reservoir elements. Water flow into each reservoir is a function of total upstream flow and defined using Equations 34 and 35. Outflow rates are set to 2.5% of the reservoir water volume, and constituent mass entering an interflow reservoir is a function of inflow rate multiplied by upstream concentration, as calculated within the WQC. Constituent mass leaving an interflow reservoir is a function of outflow rate multiplied by constituent concentration in the interflow reservoir, with mass being conserved in each reservoir.

The flow threshold (Q_T) and the maximum inflow rate (Q_{mi}) included in Equations 34 and 35 are location-specific calibration parameters. They are set such that (1) inflows to the interflow reservoir are always a fraction of the total upstream flow, and (2) total instream flow upstream and downstream of the interflow reservoir is largely unchanged (i.e., the interflow reservoir has little to no effect on total instream flow).

Equation 34 is configured to reflect the understanding that upstream flow will preferentially go into the ground (i.e., the interflow reservoir) until flow rates exceed base infiltration rates (as represented by 10% of the flow threshold). Once flow rates exceed base infiltration rates, water will travel both at surface and into the ground. Equation 35 is intended to replicate the process whereby, as flows continue to increase, the wetted width of the channel expands, water begins to infiltrate through newly wetted areas, and the total volume of water flowing into the ground increases.

Locations where interflow reservoirs are included in the 2020 RWQM are shown in Figure 1.4-12. They are summarized in Table 1.4-18. Interflow reservoirs were inserted at these locations to improve model performance; they are intended to capture the influences of bank storage and surface water / shallow groundwater exchange that occur both at and upstream of the selected locations (i.e., between model nodes). At Elko Reservoir, the configuration of Equation 35 was changed. The value of 10% was replaced with a value of 15%, as detailed in Table 1.4-18. This change was made to improve model performance.

Table 1.4-18: Interflow Reservoirs Included in the 2020 Regional Water Quality Model

Operation or General Location	Node ID	Node Description (EMS ID)	Inflow Rates	Release Rate
Line Creek Operations	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	• When flow <40,000 m^3/d, 100% to storage up to max of 4,000 m^3/d • When flow >40,000 m^3/d, 10% to storage up to max of 10,000 m^3/d	2.5% per week
	LC_LC4	Line Creek upstream of the Processing Plant (0200044)	• When flow <50,000 m^3/d, 100% to storage up to max of 5,000 m^3/d • When flow >50,000 m^3/d, 10% to storage up to max of 7,500 m^3/d	
Fording River	FR_FRDSCC1	Fording River d/s of Clode Creek	• When flow <20,000 m^3/d, 100% to storage up to max of 2,000 m^3/d • When flow >20,000 m^3/d, 10% to storage up to max of 8,000 m^3/d	2.5% per week
	GH_PC2	Fording River d/s of Porter Creek (E287431)	• When flow <200,000 m^3/d, 100% to storage up to max of 20,000 m^3/d • When flow >200,000 m^3/d, 10% to storage up to max of 40,000 m^3/d	
	LC_FRDSDC	Fording River d/s of Dry Creek (E288272)	• When flow <300,000 m^3/d, 100% to storage up to max of 30,000 m^3/d • When flow >300,000 m^3/d, 10% to storage up to max of 45,000 m^3/d	
	GH_FR1	GHO Fording River Compliance Point (0200378)	• When flow <125,000 m^3/d, 100% to storage up to max of 12,500 m^3/d • When flow >125,000 m^3/d, 10% to storage up to max of 18,750 m^3/d	
	LC_LC5	Fording River downstream of Line Creek (0200028)	• When flow <225,000 m^3/d, 100% to storage up to max of 22,500 m^3/d • When flow >225,000 m^3/d, 10% to storage up to max of 33,750 m^3/d	
Michel Creek	EV_MC3	Michel Creek u/s of Erickson Creek (0200203)	• When flow <600,000 m^3/d, 100% to storage up to max of 60,000 m^3/d • When flow >600,000 m^3/d, 10% to storage up to max of 90,000 m^3/d	2.5% per week
	EV_MC2a	Michel Creek upstream of Gate Creek (E310168)	• When flow <450,000 m^3/d, 100% to storage up to max of 45,000 m^3/d • When flow >450,000 m^3/d, 10% to storage up to max of 67,500 m^3/d	
Elk River	GH_ERC	GHO Elk River Compliance Point - Elk River, 220 m d/s of Thompson Creek (E300090)	• When flow <2,000,000 m^3/d, 100% to storage up to max of 200,000 m^3/d • When flow >2,000,000 m^3/d, 10% to storage up to max of 300,000 m^3/d	2.5% per week
	EV_ER4	Elk River upstream of Grave Creek (0200027)	• When flow <1,200,000 m^3/d, 100% to storage up to max of 120,000 m^3/d • When flow >1,200,000 m^3/d, 10% to storage up to max of 180,000 m^3/d	
	RG_ELKORES	Elk River at Elko Reservoir (RG_ELKORES; E294312)	• When flow <3,000,000 m^3/d, 100% to storage up to max of 450,000 m^3/d • When flow >3,000,000 m^3/d, 15% to storage up to max of 675,000 m^3/d	

- = no node ID; ID = identification; d/s = downstream; FRO = Fording River Operations; LCO = Line Creek Operations; u/s = upstream; <= less than; >greater than; m^3/d = cubic metres per day;% = percentage.

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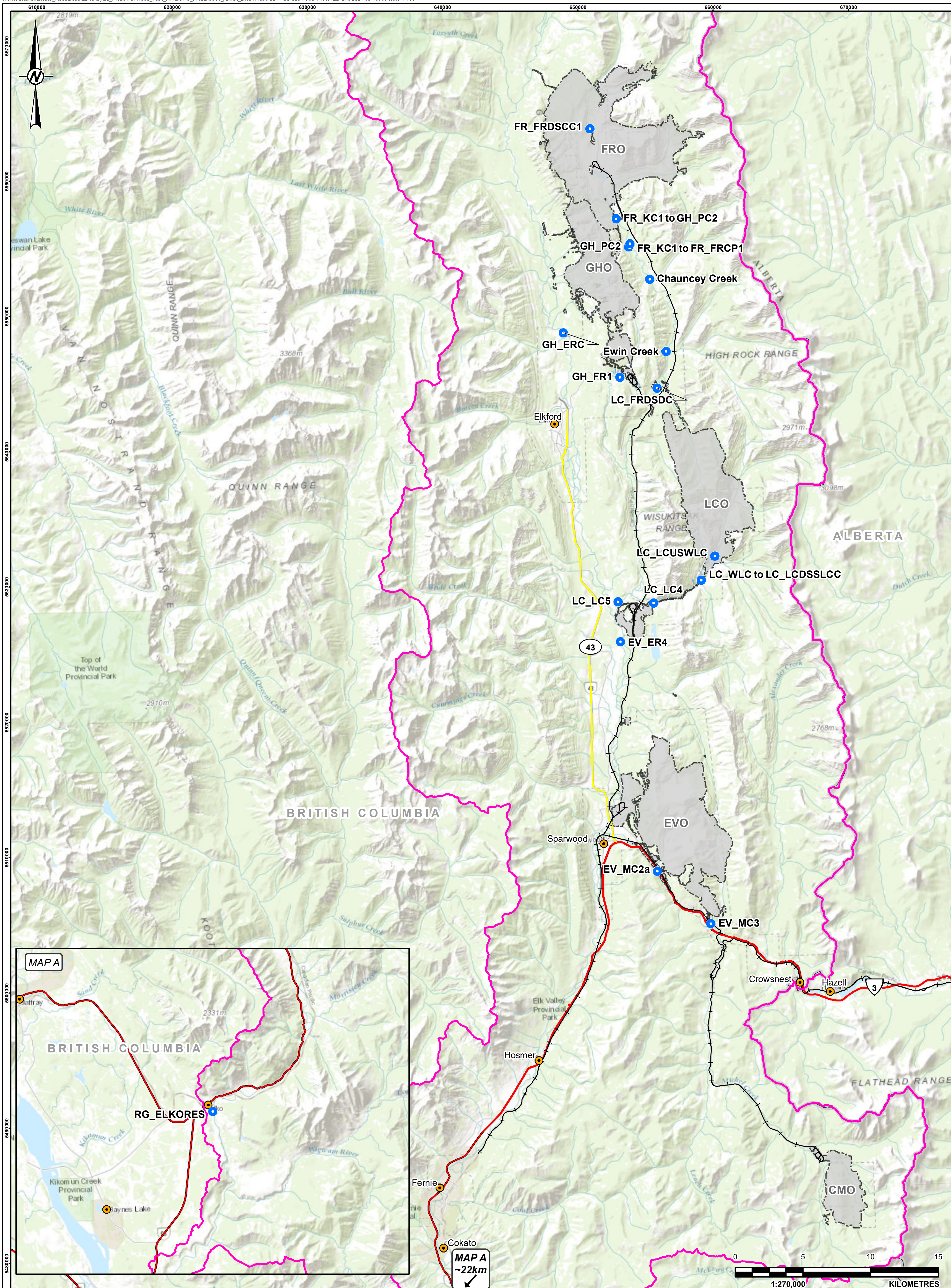

LEGEND

- INTERFLOW RESERVOIR
- CITY/TOWN/COMMUNITY
- CANADIAN PACIFIC RAILWAY
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- MINE PERMIT BOUNDARY
- ELK RIVER WATERSHED BOUNDARY

NOTE(S)

REFERENCE(S)

1. BASE DATA: CANVEC, 2018
2. TECK WATER NETWORK AND WATER MANAGEMENT DATA, 2019-09-26
3. BASEMAP: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 11N

TECK COAL LIMITED

PROJECT
2020 REGIONAL WATER QUALITY MODEL UPDATE

YYYY-MM-DD	2020-07-14
DESIGNED	PR
PREPARED	PR/RRD
REVIEWED	CG
APPROVED	AS

TITLE
LOCATION OF INTERFLOW RESERVOIRS

PROJECT NO.	CONTROL	REV.	FIGURE
18111630	0014	0	1.4-12

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1.4.12 Retention Area in the Fording River Downstream of Porter Creek

A retention reservoir similar in construction to those outlined above in Section 1.4.8 is included in the Fording River downstream of Porter Creek at GH_PC2. It has been included in the 2020 RWQM to improve model performance beyond that which can be achieved with instream reservoirs. The retention reservoir is intended to represent the larger-scale differential movement of mass (relative to that described by an interflow reservoir) that occurs as a result of pronounced, but variable surface water – groundwater partitioning in the upper Fording River, where a notable proportion of the total river flow travels via subsurface pathways and areas of groundwater recharge and discharge occur in short succession. The movement of mass through the subsurface is likely to be slower than that at surface, while the exchange of surface flow and groundwater through gaining and losing reaches of the river leads to mixing between the two flow components. The net result being that spring freshet flows at surface are likely mixing with and diluting older mine-affected flows released the previous winter but still contained in the shallow subsurface, and vice versa.

For greater clarification, the purpose of an interflow reservoir is to numerically represent the small net offsets in water movement that can occur in the river and creek mainstems due to bank storage and shallow groundwater interchange. With respect to the latter process, the interchange is conceptualized as following a “pressure wave” dynamic, wherein water entering the shallow groundwater in a recharge zone triggers a dampened release of water in a connected discharge zone. The retention reservoir applies to mass only and serves to capture the larger process of dispersion as mass is moving in and out of the shallow groundwater system and mixing within the overlying water column.

The retention reservoir at GH_PC2 has a one-week retention time based on average flows. It was sized as part of model calibration and represents the bulk mixing processes that occur along the Fording River mainstem upstream of Porter Creek.

1.4.13 Instream Losses of Nitrate and Selenium

The RWQM maintains a mass balance as it simulates the transport of constituents downstream in the Fording River and Elk River. In the past and during the 2020 update, a consistent and increasing over-estimation of measured selenium and nitrate concentrations with distance downstream in the Fording River and Elk River has been noted, particularly in low flow periods.

In modelling terms, over-estimation of measured constituent concentrations is referred to as the model having a positive bias, whereas an under-estimation is referred to as negative bias. One of the modelling objectives is to minimize bias, positive or negative, to avoid the model over- or under-estimating constituent concentrations. The loss or removal of mass within a model is referred as a sink. If constituent mass is removed during instream transport, it is referred to as an instream sink (i.e., a loss of mass that occurs instream after release). Incorporating an instream sink in a model is an explicit (transparent) means of representing instream loss of constituent mass as water travels downstream to reduce positive model bias and thereby improve model performance in terms of replicating measured instream data.

Following a similar approach to that used in the 2017 RWQM Update, available monitoring data were reviewed, and mass balance calculations were undertaken using monitored selenium, sulphate and nitrate concentrations and corresponding flow measurements. The objective of the exercise was to determine how the total calculated incoming load to a given point in the Fording River or Elk River compared to that calculated based on flow and concentration data collected at the point itself. As detailed in Appendix C, the evaluation considered two locations on the Fording River and three on the Elk River. It was conducted using data from 2016 to 2019, and mass balance calculations were completed for each month of the year.

Results of the evaluation were as follows (see Appendix C for details):

- Between December and March, the total calculated incoming load was higher than calculated instream load, and the difference between the incoming load and the instream load was less for sulphate than for nitrate or selenium.
- In the Fording River:
    - Between December and March, total calculated incoming selenium, nitrate, and sulphate loads were, on average, 30, 33, and 20% higher than calculated instream loads, respectively.
    - From January to December, total calculated incoming selenium, and nitrate loads were, on average, 8 and 6% lower than calculated instream loads, and total calculated incoming sulphate loads were, on average, 1% higher than calculated instream loads.
- In the Upper Elk River:
    - Between December and March, total calculated incoming selenium, nitrate, and sulphate loads were, on average, 60, 55, and 22% higher than calculated instream loads, respectively.
    - From January to December, total calculated incoming selenium, nitrate, and sulphate loads were, on average, 42, 27 and 23% higher than calculated instream loads, respectively.
- In the Lower Elk River:
    - Between December and March, total calculated incoming selenium, nitrate, and sulphate loads were, on average, 55, 68, and 39% higher than calculated instream loads, respectively.
    - From January to December, total calculated incoming selenium, nitrate, and sulphate loads were, on average, 35, 41 and 23% higher than calculated instream loads, respectively.

Sulphate is a conservative constituent. Thus, differences in the sulphate mass balance calculations between incoming and instream loads can be used to estimate error or uncertainty in the method that would be common to all three constituents, such as flow measurement inaccuracy. Differences in the selenium and nitrate mass balances are higher than those noted for sulphate and are suggestive of removal or loss mechanisms that may be affecting these constituents.

More specifically, the results of the mass balance calculations would suggest December to March loss mechanisms in the order of:

- 10% for selenium and 13% for nitrate in the Fording River
- 38% for selenium and 33% for nitrate in the Upper Elk River
- 16% for selenium and 29% for nitrate in the lower Elk River

Addressing over-estimation is required to achieve a good model calibration. Instream sinks continue to be included in the RWQM in the Fording and Elk rivers to address the over-prediction of selenium and nitrate concentrations, an approach that is consistent with the 2017 RWQM.

With the sinks in place, concentrations of selenium or nitrate at a given river node are calculated as:

$$C_{x,y} = \frac{L_{T,y}\left(100 - f_{LR,x,y}\right)}{Q_{T,y}} \qquad \text{Eq. 36}$$

Where:

$C_{x,y}$ = concentration of constituent 'x' at location 'y' (mg/L)

$L_{T,y}$ = total influent load at location 'y' (grams per second [g/s])

$f_{LR,x,y}$ = load reduction factor for constituent 'x' at location 'y' (unitless)

$Q_{T,y}$ = total flow at location 'y' (m^3/s)

Between September and April, the load reduction factor was assigned an initial value between 5 and 15%. This value was then adjusted during the model calibration to improve model performance. At other times of the year, the load reduction factor is set to zero, and the instream sinks are inactive.

The values assigned to the loss reduction factors, following calibration, are shown in Table 1.4-19. With one exception, they are between 5 and 15%. They represent the mass removed at each point in the system and are independent of one another.

Table 1.4-19: Load Reduction Factors Applied in the Fording River and Elk River

Node ID	Description	Load Reduction Factor (%)			
		Nitrate		Selenium	
		2017	2020	2017	2020
FR_FR2	Fording River upstream of Kilmarnock Creek	-	-	-	15%
FR_FR4	Fording River d/s of Swift Creek and u/s of Cataract Creek	10%	-	10%	15%
FR_FRCP1	FRO Compliance Point	5%	-	5%	-
Kilmarnock Creek	Water travelling from Kilmarnock Creek to the Fording River mainstem (i.e., sink applied along the flow paths joining Kilmarnock Creek to the Fording River)	-	15%	-	15%
LC_FRDSDC	Fording River d/s of Dry Creek	10%	-	10%	5%
LC_LC5	Fording River d/s Line Creek	5%	-	5%	5%
GH_ERC	GHO Elk River Compliance Point	40%	35%	40%	35%
EV_ER4	Elk River u/s Grave Creek	5%	10%	5%	10%
EV_ER2	Elk River u/s Michel Creek	10%	15%	10%	15%
EV_ER1	Elk River d/s of Michel Creek	10%	15%	10%	15%

"-" = no load reduction; d/s = downstream; FRO = Fording River Operations; GHO = Greenhills Operations; u/s = upstream.

Initially, the loss reduction factors were applied only from December to March. However, that approach resulted in odd seasonal patterns in the simulated results, wherein constituent concentrations would begin to increase in the fall and early winter and then abruptly decline when the instream sink became active. Lengthening the period over which the instream sinks applied addressed this issue.

A mass balance investigation was initiated following the 2017 RWQM Update and continues today. It is focused on the Fording River near Kilmarnock Creek and the Elk River near Greenhills Operations, and includes a more regional component that is focused on selenium and nitrate load removal resulting from diffusive fluxes and loss across the hyporheic zone (SNC 2021b; SRK 2021). The data generated from these programs suggests that the observed losses may be due, at least in part, to reduction that occurs in the groundwater flow paths between the tributary measurement points and the river and/or in the river sediments themselves (SRK 2021). Work in this area of study continues, and results produced therefrom will be incorporated into future model updates as they become available.

In the Elk River upstream of the Fording River, the loss reduction factor is set to 35% and applies year-round. This value is consistent with that generated from the analysis of available monitoring data, and its use is supported by the performance of the model in this area. In other words, use of a smaller value results in continued over-prediction of instream winter concentrations.

Mass loading estimates from the GHO Elk River tributaries to the Elk River are small compared to the Fording River and Michel Creek, and it is an area of higher uncertainty from both a monitoring and modelling perspective. Flows in the area are difficult to monitor, as a large proportion of the water moving from the lower tributaries to the Elk River travels subsurface. There is also some uncertainty related to historical pit pumping to these tributaries. Monitoring efforts focused on the GHO Elk River tributaries will continue to reduce uncertainty and strengthen the basis for the load reduction factor applied to this area.

The selenium and nitrate sink applied to water leaving Kilmarnock Creek is new to the 2020 RWQM. It applies year-round to all three of the flow paths outlined above in Section 1.4.9. The instream sink is representative of selenium and nitrate loss processes that occur as water moves through the subsurface, analogous to that which occurs in an SRF.

1.4.14 Water Quality Mitigation Measures

There are three types of water quality mitigation measures incorporated into the 2020 RWQM. They consist of source control, load removal and water management to support load removal. Source control consists of waste rock placement (i.e., the ability to place waste rock in one watershed instead of another) and improvements in blasting practices to reduce nitrate loss to the environment from explosives use. Load removal includes:

- active water treatment
- water treatment using saturated rock fills (SRFs)
- consumptive water use (excluding dust suppression)

Water management to support load removal includes:

- clean water diversions
- conveyance of mine-affected water to mitigation

The approach used to incorporate these measures into the WQC of the 2020 RWQM is described below, understanding that they are incorporated as individual features that can be turned on or off when simulating future conditions.

1.4.14.1 Source Control

Source control can be accomplished through modifications to waste rock placement and spoil design. Within the 2020 RWQM framework, change to waste rock placement can be achieved by updating planned waste rock deposition rates in affected catchments. These changes are made in consultation with mine site engineering and require manual modification of the waste rock input files linked to the WQC. The updated information is then used by the model when simulating future water quality conditions in the Elk Valley.

This functionality can be used to assess water quality changes that result from changes to waste rock placement. Waste rock deposition rates in the current model are as per permitted mine plans.

Changes to spoil design and its effect on constituent release has not been explicitly built into the 2020 RWQM. It can be accomplished by altering the rate of constituent release from differently designed spoils, based on the results of field trials and other source of information. The current model set-up does not include this type of source term modification.

Source control through improved blasting practices is accounted for in the methods used to estimate nitrate content in incoming waste rock to each spoil, most notably by accounting for the use of liners and their effectiveness at reducing blasting residuals (see Section 1.4.2.1.1).

1.4.14.2 Load Removal

1.4.14.2.1 Active Water Treatment Facilities

Active water treatment facilities (AWTFs) are incorporated into the WQC of the 2020 RWQM. As per the 2019 IPA (Teck 2019), these facilities or equivalents thereof (see SRFs) are distributed through the model framework as follows:

- two areas targeted for mitigation at FRO
- two areas targeted for mitigation at LCO
- one area targeted for mitigation at GHO
- one area targeted for mitigation at EVO

Consistent with the 2019 IPA, AWTF sizing is defined by hydraulic capacity and nitrate design load removal. Hydraulic capacity, expressed in terms of cubic metres per day (m^3/d), refers to the amount of water a facility can treat. With biological active water treatment, the projected nitrate load entering a facility influences retention time and removal performance; there is a limit to the nitrate load a facility can receive while still achieving the desired level of treatment. This limit is referred to as the nitrate design load removal, expressed in terms of kilograms per day (kg/d), and is the maximum nitrate mass that a facility can accept and still achieve expected removal rates.

Effluent concentrations for the West Line Creek (WLC) AWTF were updated in the WQC to incorporate monitored effluent concentrations rather than projected concentrations from the time the facility was commissioned until the end of 2019. At all other treatment facilities and at the WLC AWTF from 2020 onward, effluent concentrations for selenium are unchanged from the 2019 IPA and are listed in Table 1.4-20. Effluent concentrations for nitrate are also unchanged from the 2019 IPA. The effluent concentration for nitrate is 2 mg N/L at all treatment facilities, except WLC. At the WLC AWTF, the projected effluent concentration for nitrate is 1 mg N/L, based on operational experience at the facility.

Table 1.4-20: Effluent Selenium Concentrations Considering Improvement Over Time

Treatment Facility	Effluent Selenium Concentration		
	20 µg/L or 95% removal if influent greater than 400 µg/L	30 µg/L or 95% removal if influent greater than 600 µg/L	20 µg/L
West Line Creek	to December 31, 2024	-	from January 1, 2025 onward
Fording River South	-	to December 31, 2024	from January 1, 2025 onward
Elkview	-	to December 31, 2024	from January 1, 2025 onward
Fording River North	-	to December 31, 2025	from January 1, 2026 onward
Greenhills	-	-	from December 31, 2031 onward
LCO Dry Creek	-	-	from December 31, 2037 onward

LCO = Line Creek Operations; µg/L = micrograms per litre; - = not applicable.

Loading from AWTFs to downstream environments is calculated by multiplying the effluent concentration by the flow through the AWTF:

$$L_{ef,x} = C_{ef,x} Q_{ef} \qquad \text{Eq. 37}$$

Where:

$L_{ef,x}$ = loading of constituent 'x' in the treated effluent from the active water treatment facility (kg/d)

$C_{ef,x}$ = concentration of constituent 'x' in the treated effluent (mg/L)

Q_{ef} = flow through the active water treatment facility (m³/d)

φ = unit conversion factor of 0.001 (litres per cubic metre [L/m³]·mg)

The load removed by a given facility is calculated based on the difference between the incoming load and the outgoing load calculated using Equation 37.

Source waters targeted for treatment are directed to each treatment facility sequentially in a predetermined order[3], until the hydraulic capacity is reached, the nitrate design load removal of the

[3] Source order is as per the 2019 IPA. It does not change over time and is based on average selenium concentrations, moving from the source with the highest average selenium concentration to the source with the lowest.

treatment facility is reached, or all available sources are treated. If the hydraulic capacity or the nitrate design load removal of the treatment facility is reached before all available sources are treated, then excess water bypasses the treatment facility and continues to be discharged to the receiving environment through the source tributary.

1.4.14.2.2 Saturated Rock Fills

The EVO SRF is incorporated into the WQC of the 2020 RWQM. The effluent concentrations included in the model are based on monitored effluent concentrations from the EVO SRF (rather than projected concentrations) from the time the facility was commissioned until the end of 2019. From 2020 onward, the EVO SRF is represented in the model as described in the *Operations Application for the Elkview Operations Saturated Rock Fill Phase 2 Project* (Teck 2020b).

In short, water for the EVO SRF is sourced from Erickson Creek and/or Natal Pit up to a combined capacity of 20,000 m^3/d. Additional water passively reports to the EVO SRF as surface or shallow subsurface flow from local runoff inputs within the F2 Pit watershed. Erickson Creek is prioritized to meet the full design capacity of the EVO SRF (when streamflow conditions in the creek allow), with make-up water sourced from Natal Pit up to a maximum intake capacity of 10,000 m^3/d.

A removal efficiency of 90% for nitrate and selenium is assumed at the EVO SRF. Rationale for the effluent predictions is based on the results from the Phase 1 Trial and are described in greater detail in Teck (2020b). Discharge from the EVO SRF is directed to Erickson Creek and Bodie Creek Rock Drain. The conveyance system is designed so that Erickson Creek net intake and outfall flows are approximately equal, with the balance returned to Bodie Rock Drain

1.4.14.2.3 Consumptive Water Use

The WQC includes a consumptive loss term for water diverted for use in coal processing at FRO, GHO, and EVO.

At FRO, consumptive water losses (e.g., water lost with clean coal, through dryer usage, and other mechanisms within the process plant) are estimated at 3,000 m^3/d based on South Tailings Pond (STP) water balance results. In other words, consumptive water losses at FRO are estimated as the water remaining from STP inflows after consideration of process flows to the wash plant, tailings water outflows [water in dredged tailings], and seepage from the STP.

Consumptive water losses at GHO and EVO are estimated at 3,000 m^3/d and 2,700 m^3/d, respectively, based on process plant/tailings storage facility water balance results, as reported by site staff.

Constituent mass associated with the consumed water is assumed in the model to be lost from the system.

1.4.14.3 Water Management to Support Load Removal

1.4.14.3.1 Clean Water Diversions

Clean water diversions can be used to support load removal measures. As incorporated in the model, they operate by diverting unaffected water around waste rock spoils and other mine-affected areas, which reduces the amount of mine-affected water that may require treatment. However, during low flow conditions or at other times of the year, operation of a clean water diversion may hinder effective operation of a mitigation measure due to a lack of available water for treatment. Consequently, the implementation and operation of clean water diversions will be site-specific and may be variable over time (e.g., the clean water diversion may be in operation through some months of the year but not others).

Areas considered for potential clean water diversions are incorporated as separate watersheds in the 2020 RWQM. When a diversion is activated in the model, water draining from this area is routed around adjacent and downstream waste rock spoils, and discharges at the mouth of the tributary in question. The size of the diversion (i.e., the maximum flow rate it can convey) is a user-defined input to the model, as is the collection efficiency of the system (i.e., the efficiency with which it can capture and convey water, after accounting for leakage). In the model, clean water lost to leakage is assumed to flow along the original drainage path, into the downstream mine-affected area.

1.4.14.3.2 Collection and Conveyance of Mine-Affected Water and Treated Effluent

Conveyance of mine-affected water involves collecting mine contact water downstream of spoils and conveying it to an AWTF or comparable mitigation measure. Sources of mine-affected water are defined as separate watersheds in the 2020 RWQM, and water from these areas can be routed to an AWTF or comparable mitigation measure, up to its design capacity. The proportion of the total flow that is available for capture in each target watershed is a user defined input, that includes two components: water availability and intake efficiency.

The proportion of total watershed yield that is captured or planned to be captured at each intake location for conveyance to an AWTF or comparable mitigation measure is referred to as water availability. The values assigned to water availability in the RWQM were initially set based on the proportion of total watershed yield that is assumed to be readily available as surface flow; they can be changed (increased) to simulate enhanced capture of mine-influenced water where and when desired. Such enhancements could reflect the potential capture of some of the subsurface flow that would otherwise be inaccessible at a surface intake or the placement of an intake in a more effective location within the same watershed where less water is travelling subsurface. Intake efficiency is the estimated percentage of available surface flow that can be captured by an intake and conveyed.

In the 2020 RWQM, surface water availability and intake efficiency are assigned the values listed in Table 1.4-21, reflective of the 2019 IPA (Teck 2019) and the EVO SRF Application (Teck 2020b). It is acknowledged that investigations at the Kilmarnock Creek intake are ongoing and that assumptions related to water availability at this location will be subject to review and update as part of the next IPA.

The 2020 RWQM has been configured to produce a plot for each intake location showing when the collection of surface flow only may be insufficient to meet the specified water availability, based on what is known of surface water – groundwater partitioning at each location. This information can then be used to identify or develop management strategies to optimize load collection to support compliance with permit limits, which may include groundwater collection, directing additional sources to the treatment facility and/or relocating the intake to a location where more of the total watershed yield is at surface.

Table 1.4-21: Water Availabilities and Intake Efficiency

Treatment Facility	Sources Targeted for Treatment	Water Availability until December 31, 2033	Water Availability from January 1, 2034 onward	Intake Efficiency	Source
Fording River North	Clode Creek, Swift North Spoil and Swift Pit	80%	95%	95%	2019 IPA
Fording River South	Swift Creek and Cataract Creek, via Swift Intake	95%	95%	95%	2019 IPA
	Kilmarnock Creek	75%	95%	95%	
Greenhills	West Spoil (Leask, Wolfram and Thompson Creeks)	95%		95%	2019 IPA
	Greenhills Creek North	75%		95%	2019 IPA
West Line Creek	West Line Creek and Line Creek upstream of West Line Creek	95%		95%	2019 IPA
	Mine Services Area West	90%		95%	2019 IPA
LCO Dry Creek	Dry Creek	99%		95%	2019 IPA
Elkview	Natal Pit	100%		95%	EVO SRF Application
	Erickson Creek	95%		95%	

LCO = Line Creek Operations;% = percent.

Treated effluent from an AWTF or comparable mitigation measure is modelled as an input to the modelling node immediately downstream of the discharge point from that facility or comparable measure. The constituent load transported with the treated effluent is defined as previously described.

1.4.15 Model Assumptions

Some of the key assumptions incorporated into the WQC of the 2020 RWQM that relate to the release of constituents are summarized in Table 1.4-22. The assumptions reflect, where relevant, the conceptual model discussed in Section 1.3. The assumptions in Table 1.4-22 are organized by subject, with a cross-reference to the report section in which they are discussed.

Table 1.4-22: Summary of Water Quality Model Assumptions

Subject	Assumptions	Report Section
Release from waste rock	There is a catchment-specific time-lag between the placement of waste rock and the release of material from the spoil. The hydraulic lag time is defined with reference to monitoring data for nitrate and is applied unchanged to the release of other constituents (e.g., selenium and sulphate). The release of nitrate and the initial soluble load of selenium and sulphate that arrives in the spoil with new waste rock are both dependent on the leaching efficiency of the spoil, which is defined in terms of percent release per year (e.g., 20%/yr). Although there is a finite amount of all constituents in each spoil, nitrate is readily available and highly soluble. Consequently, the release of nitrate is expected to cease much earlier than that of selenium, sulphate and other constituents released through the on-going oxidation of minerals contained in the waste rock. Release rates for nitrate, selenium, sulphate and cadmium are loading based, dependent on the volume of waste rock deposited into a spoil. Release rates for other constituents tend to be subject to solubility constraints. They are defined using concentration-based values that do not vary with time. Loading of these constituents into downstream system is more directly dependent on spoil area than spoil volume. Concentrations of sulphate in waste rock drainage waters are subject to solubility limits. Once the solubility limit is reached, projected concentrations are set equivalent to the solubility limit. The release of selenium, sulphate and nitrate from waste rock is climate dependent and proportional to flow, with greater amounts of constituent mass being released in higher flow periods and lower amounts of constituent mass released in low flow periods, compared to the average.	1.4.2.1
Release from pit walls	Exposed pit walls are divided into one of four categories, each with its own unique constituent release rates: • benched non-PAG MMF • unbenched non-PAG MMF • benched PAG MF • unbenched PAG MF Mine-affected areas not identified as waste rock, coal refuse, tailings, pits, or pit wall (such as haul roads, plant sites and maintenance areas) are assumed to be analogous to benched non-PAG MMF. Constituent release from all pit wall types, except benched non-PAG MMF, is concentration-based, and defined using constant concentrations. Release from benched non-PAG MMF occurs in a manner similar to that of waste rock. Areas of exposed benched non-PAG MMF are converted to an equivalent volume of waste rock by multiplying the benched pit wall area by a reactive surface thickness; the reactive surface thickness is assumed to be 2 m. Catchment-specific release rates for selenium and sulphate are not used; pit wall release rates are expected to be consistent from operation to operation because rock characteristics are uniform. Release of nitrate, selenium, and sulphate from benched non-PAG MMF is climate dependent and proportional to flow, with greater amounts of constituent mass being released in higher flow periods and lower amounts of constituent mass released in low flow periods, compared to the average. Releases from pit walls are not subject to lag time or leaching efficiency; they occur as soon as the pit wall is exposed.	1.4.2.2
Release from coal refuse	Release rates from coal refuse are concentration-based, constant over time and not subject to lag time or leaching efficiency.	1.4.2.3

Table 1.4-22: Summary of Water Quality Model Assumptions

Subject	Assumptions	Report Section
Release from tailing storage facilities	Constituent concentrations in tailings water are based on a mass balance of incoming sources, except for nitrate and selenium; selenium and nitrate are assigned fixed concentrations derived from monitoring data collected at the South Tailings Pond at FRO. Except for nitrate and selenium, constituent concentrations in tailings water are not subject to attenuation or decay.	1.4.2.4
Release from rehandled historical waste materials	Rehandling of historical waste materials is anticipated to result in an immediate release of constituents in addition to that which would otherwise occur if the materials were not rehandled. Like nitrate, the “extra” load released immediately after rehandling is subject to the lag time and leaching efficiency of the spoil into which the rehandled material is placed. Source terms governing the release of constituents from rehandle of historical waste materials are applied valley-wide, independent of operation or catchment. Source terms governing the release of constituents from rehandle of historical waste materials are applied as follows to reflect the fact that rehandling of small amounts of waste materials regularly occurs as part of mining and would be captured in the measured data used to develop source terms for native waste rock: • Source terms for rehandled waste rock are applied to rehandled volumes greater than 2 million BCM. • Source terms for burning waste rock, refuse and tailings are applied to rehandled volumes greater than 10,000 BCM.	1.4.2.5
Release from natural areas	Surface flows within a given watershed area not affected by coal mine development are assigned monthly source term concentrations derived from the geometric mean of monitored data collected from undisturbed watersheds in the region.	1.4.3
General setup	The influence of activities related to forestry, roadways and railways on water quality are represented in the measured water quality data available to describe existing conditions in the area. Consequently, they are not explicitly modelled.	
	Loss terms for nitrate and selenium are applied in reaches of the Fording River and Elk River, as well as along subsurface flow paths joining Kilmarnock Creek to the Fording River. Watercourses and flooded pits are completely vertically and laterally mixed.	1.4.9
Effluent quality from active water treatment facilities	Nitrate and selenium concentrations in treated effluent are as specified in Section 1.4.11.	1.4.11

AWTF = active water treatment facility; EVO = Elkview Operations; FRO = Fording River Operations; LCO = Line Creek Operations; MMF = Mist Mountain Formation, MF = Morrissey Formation; PAG = potentially acid generating; WFTF = West Fork Tailings Storage Facility; WLC = West Line Creek; BCM = bank cubic metre; m = metre; mg/L = milligrams per litre; mg N/L = milligrams of nitrogen per litre;% = percent.

2 Part 2: Calibration

2.1 Model Calibration

2.1.1 Overview

The set-up of the WQC of the 2020 RWQM has changed from that included in the 2017 RWQM. As outlined in Section 1.2, the level of spatial detail in the 2020 RWQM has increased at each operation, historical waste rock deposition has been updated and use of water for dust suppression, surface water – groundwater partitioning and a number of interflow reservoirs have been included in the model framework. In addition, selenium and sulphate release from waste rock has been updated to include an initial soluble load, and cadmium release from waste rock has been updated to correlate to sulphate release, the cumulative percentage of PAG waste rock present in the spoil and the application of PAG management practices. The catchment-specific geochemical source terms have been updated as outlined in Annex A, and the methods used to estimate flows from waste rock spoils and natural areas have been updated as outlined in Annex B. All of these changes can influence model performance and necessitated a recalibration of the WQC.

Calibration involved simulating historical water quality conditions in the Elk Valley and comparing model output to measured data. The model was then adjusted as required, in an iterative fashion, to achieve a good fit to the measured data. Goodness of fit was evaluated visually and through the use of error and bias statistics, which are described below in Section 2.1.2. The goal of the calibration process was to reduce model error and bias, such that simulated concentrations reflected historical patterns in measured concentrations, in terms of replicating seasonal variability, the range of measured concentrations over the calibration period and long-term temporal trends (if present). The calibration was deemed complete when efforts expended on iteration no longer yield appreciable or notable gains in model performance.

The adjustments involved modification of the geochemical source terms and the FC of the 2020 RWQM to improve model performance. As previously noted, the flow estimates developed using the FC are independently derived from the geochemical source terms. The process of calibration provided an opportunity to refine both inputs to the WQC to allow for a better match to historical water quality measurements at monitoring locations throughout the Elk Valley.

Changes to the FC included alterations to the waste rock hydrology module; specifically, the adoption of a reservoir drawdown approach to the simulation of water flow through a spoil. Other changes included modifications to runoff and recession coefficients to improve the replication of measured flows, which then helped to improve the performance of the WQC. The resulting configuration of the FC is outlined in Annex B and not discussed further herein.

With respect to geochemical source terms, the calibration process started with the values identified in Section 1.4. These values were then adjusted, where required, through application of a calibration factor to improve model performance, with a focus on release rates from waste rock. Waste rock is the largest source of nitrate, selenium, sulphate, and cadmium to the receiving environment, so alterations to waste rock release rates had the largest effect on model performance. The altered values developed through the calibration process were checked against the confidence intervals included with the initial geochemical source terms to confirm that they were reasonable.

The calibration period spanned from 2004 to 2019 for most constituents, although error and bias statistics were calculated using data from the 2004 to 2018 time period. Measured information from 2019 was not included when generating the calibration statistics, because it was still considered preliminary data at the time the calibration was initiated. The one exception was nitrate; the calibration period for nitrate spanned from 2006 to 2019, coincidental with the availability of explosives use data, with error and bias statistics calculated considering information from 2006 to 2018.

As outlined in more detail below, after calibration, the WQC is able to match concentrations in the Fording River and Elk River, in terms of simulating seasonal patterns, longer-term patterns and observed ranges in concentrations. The model is also able to match seasonal and longer-term patterns in constituent concentrations in most mine-affected tributaries. Overall, the performance of the 2020 RWQM is better than that of the 2017 RWQM, in both the river mainstems and in mine-affected tributaries.

2.1.2 Methods

2.1.2.1 Calibration Nodes

Calibration nodes were selected to correspond to locations with monitoring records and the potential to be affected by mining operations. They include locations on Line Creek, Michel Creek, the Fording River, and the Elk River, as well as at the mouths of incoming tributaries, as listed in Table 2.1-1. Greater focus was placed on matching historical patterns in measured concentrations at locations with longer monitoring records (Table 2.1-2), then confirming that model results were reasonable at locations with shorter periods of records.

A calibration node is also included for Koocanusa Reservoir. Water quality monitoring in Koocanusa Reservoir began in 2013. Water quality samples are collected weekly from March 15th to July 15th and monthly for the remainder of the year when access is not restricted by safety concerns related to ice cover and flowing water. The samples are collected from five monitoring locations(Figure 2.1-1). One location, Koocanusa Reservoir downstream of Kikkoman Creek (RG_KERRRD, E300095), is located upstream of the Elk River. The other four monitoring locations are located downstream of the Elk River; they consist of the following:

- Koocanusa Reservoir south of the Elk River (RG_DSELK; E300230)
- Koocanusa Reservoir west of Grasmere (RG_GRASMERE; E300092)
- Koocanusa Reservoir upstream of Gold Creek (RG_USGOLD; E300093)
- Koocanusa Reservoir upstream of the Canada/US border (RG_BORDER; E300094)

Prior to 2019, samples were collected from a single point at each monitoring location. Since 2019, samples have been collected from the same single point at each monitoring location, as well as from up to four additional locations positioned along the RG_DSELK, RG_USGOLD and RG_BORDER transects.

During the completion of the 2019 IPA (Teck 2019), it was identified that constituent concentrations are similar for the four downstream transects; however, they can vary from one location to another (Figure 2.1-2). As a result, data from the four downstream transects were pooled and used for comparison to simulated concentrations. This approach was adopted, because the simulated concentrations produced by the WQC represent fully mixed concentrations after influent from the Elk

River mixes with inflows from the Kootenay River and Bull River, and average concentrations across the four stations provide the best estimate of the fully mixed concentrations being modelled.

The reservoir is modelled as a riverine system, with concentrations being a function of total incoming flow and load. The RWQM does not account for water storage within the reservoir, or the influence of dam operations on retention times, outflow rates and storage volumes. A separate module that will integrate with the 2020 RWQM is currently being developed that accounts for the effects of reservoir storage and drawdown on water quality at Teck's monitoring locations in the reservoir.

Table 2.1-1 Modelling Nodes Considered in the Calibration of the Water Quality Component

Operation / General Location	Node ID	Node Description (EMS ID)	Location[a]	
			Easting	Northing
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	652219	5566469
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	650871	5564287
	FR_LMP1	Lake Mountain Pond	650858	5563301
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	652612	5559619
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	652024	5558252
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	652464	5557531
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	653547	5555316
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	653577	5545871
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	648153	5552859
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	648322	5552086
	GH_TC1	Thompson Creek at LRP Road (E102714)	648550	5550218
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	658294	5540918
	LC_DCDS	Dry Creek d/s of Sedimentation Ponds	657766	5542073
	LC_DC1	Dry Creek near mouth (at bridge) (E288270)	657766	5542073
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	660125	5532281
	LC_WLC	West Line Creek (E261958)	660004	5532209
	LC_LC3	Line Creek d/s of West Line Creek (0200337)	660090	5532023
	LC_LCDSSLCC	**LCO Compliance Point (Line Creek d/s of South Line Creek confluence) (E297110)**	**659218**	**5530522**
	LC_LC4	Line Creek u/s of Process Plant (0200044)	655604	5528824
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	659868	5505171
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	655654	5509261
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	655676	5509584
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	659398	5517530
	EV_HC1	**EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (E102682)**	**657031**	**5522167**
Fording River	FR_FR1	Fording River d/s of Henretta Creek (0200251)	651304	5565451
	FR_FR2	Fording River u/s of Kilmarnock Creek (0200201)	651781	5559984
	FR_FR4	Fording River between Swift and Cataract Creeks (0200311)	652503	5558088
	FR_FRCP1	Fording River, 525 m d/s of Cataract Creek (E300071)	652823	5557220
	GH_PC2	Fording River d/s of Porter Creek (E287431)	653751	5555147
	FR_FRABCH	**FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (E223753)**	**655293**	**5552865**
	LC_FRDSDC	Fording River d/s of Dry Creek (E288272)	655857	5544699
	GH_FR1	**GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (0200378)**	**653111**	**5545516**
	LC_LC5	**Fording River d/s of Line Creek (0200028)**	**652977**	**5528919**

Table 2.1-1 Modelling Nodes Considered in the Calibration of the Water Quality Component

Operation / General Location	Node ID	Node Description (EMS ID)	Location[a]	
			Easting	Northing
Michel Creek	**CM_MC2**	**CMO Compliance Point (Michel Creek d/s of CMO near Andy Goode Creek junction) (E258937)**	**667186**	**5488211**
	EV_MC3	Michel Creek u/s of Erickson Creek (0200203)	659833	5505120
	EV_MC2	**EVO Michel Creek Compliance Point (E300091)**	**654378**	**5510851**
	EV_MC1	Michel Creek u/s of Highway 43 Bridge (0200425)	653590	5511060
Elk River	**GH_ERC**	**GHO Elk River Compliance Point - Elk River, 220 m d/s of Thompson Creek (E300090)**	**648926**	**5548802**
	<u>GH_ER1</u>	**Elk River u/s of Boivin Creek (u/s of Fording River; E206661)**	**649295**	**5543393**
	<u>EV_ER4</u>	**Elk River u/s of Grave Creek (from Fording River to Michel Creek) (0200389)**	**653149**	**5525960**
	EV_ER2	Elk River u/s of Michel Creek (0200111)	652094	5512616
	<u>EV_ER1</u>	**Elk River d/s of Michel Creek (0200393)**	**651354**	**5511080**
	<u>RG_ELKORES</u>	**Elk River at Elko Reservoir (E294312)**	**637660**	**5462189**
	RG_ELKMOUTH	Elk River at Highway 93 near Elko; ECCC station BC08NK0003	633583	5449048
Koocanusa Reservoir	**<u>RG_DSELK</u>[b]**	**Koocanusa Reservoir - South of the Elk River (E300230)**	**627022**	**5445670**

[a] NAD 83, Zone 11.

[b] Calibration of the WQC of the 2020 RWQM considered measured data at the four monitoring stations located downstream of the Elk River: RG_DSELK, RG_GRASMERE, RG_USGOLD and RG_BORDER.

ID = Identification; CMO = Coal Mountain Operations; d/s = downstream; ECCC = Environment and Climate Change Canada; u/s = upstream; m = metre.

Note: Sites in **bold** font correspond to Order Stations and Compliance Points listed in EMA Permit 107517; Order Stations are indicated by <u>underlined</u> font.

Table 2.1-2 Measured Data Used in the Calibration of the Water Quality Component of the Regional Water Quality Model

Operation / General Location	Node ID	Node Description (EMS ID)	Monitoring Station(s)	Nitrate		Selenium		Sulphate		Cadmium	
				Sample Count[a]	Date Range	Sample Count[a]	Date Range	Sample Count[a]	Date Range	Sample Count[a]	Date Range
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	FR_HC1	260 (-)	(2006 - 2018)	290 (-)	(2004 - 2018)	276 (-)	(2005 - 2018)	195 (19)	(2010 - 2018)
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	FR_CC1	207 (-)	(2006 - 2018)	234 (-)	(2004 - 2018)	219 (-)	(2005 - 2018)	150 (27)	(2010- 2018)
	FR_LMP1	Lake Mountain Pond	FR_NGD1; FR_LMP1	214 (-)	(2006 - 2018)	240 (-)	(2004 - 2018)	227 (-)	(2005 - 2018)	164 (11)	(2010 - 2018)
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	FR_KC1	217 (-)	(2006 - 2018)	244 (-)	(2004 - 2018)	231 (-)	(2005 - 2018)	160 (8)	(2010 - 2018)
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	FR_SC1; GH_SC1; GH_SC2	230 (-)	(2006 - 2018)	242 (-)	(2004 - 2018)	258 (-)	(2005 - 2018)	146 (5)	(2010- 2018)
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	GH_CC1; GH_CC1A	237 (-)	(2006 - 2018)	257 (-)	(2004 - 2018)	260 (-)	(2005 - 2018)	144 (9)	(2010 - 2018)
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	GH_PC1; GH_PC1A	223 (-)	(2006 - 2018)	234 (1)	(2004 - 2018)	246 (-)	(2005 - 2018)	136 (25)	(2010 - 2018)
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	GH_GH1; GH_GH1A	230 (-)	(2006 - 2018)	240 (-)	(2004 - 2018)	253 (1)	(2005 - 2018)	143 (45)	(2010 - 2018)
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	GH_LC1; GH_LC2	199 (3)	(2006 - 2018)	191 (-)	(2004 - 2018)	213 (-)	(2005 - 2018)	149 (52)	(2010 - 2018)
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	GH_WC1; GH_WC2	226 (-)	(2006 - 2018)	211 (-)	(2005 - 2018)	248 (-)	(2005 - 2018)	152 (65)	(2010 - 2018)
	GH_TC1	Thompson Creek at LRP Road (E102714)	GH_TC1; GH_TC2	375 (-)	(2006 - 2018)	371 (-)	(2004 - 2018)	404 (-)	(2005 - 2018)	258 (45)	(2010 - 2018)
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	LC_DC3	177 (1)	(2011 - 2018)	178 (1)	(2010 - 2018)	178 (1)	(2010 - 2018)	178 (2)	(2010 - 2018)
	LC_DCDS	Dry Creek d/s of Sedimentation Ponds	LC_DCDS	162 (8)	(2013 - 2018)	162 (-)	(2013 - 2018)	162 (-)	(2013 - 2018)	162 (2)	(2013 - 2018)
	LC_DC1	Dry Creek near mouth (at bridge) (E288270)	LC_DC1; GH_DC1	251 (42)	(2006 - 2018)	258 (6)	(2004 - 2018)	278 (1)	(2005 - 2018)	187 (5)	(2010 - 2018)
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	LC_LCUSWLC	310 (1)	(2006 - 2018)	306 (-)	(2004 - 2018)	304 (-)	(2005 - 2018)	219 (-)	(2010 - 2018)
	LC_WLC	West Line Creek (E261958)	LC_WLC	343 (-)	(2006 - 2018)	364 (-)	(2004 - 2018)	333 (-)	(2005 - 2018)	263 (1)	(2010 - 2018)
	LC_LC3	Line Creek d/s of West Line Creek (0200337)	LC_LC3; SP22	505 (-)	(2006 - 2018)	567 (-)	(2004 - 2018)	495 (-)	(2005 - 2018)	336 (-)	(2010 - 2018)
	LC_LCDSSLCC	**LCO Compliance Point (Line Creek d/s of South Line Creek confluence) (E297110)**	**LC_LCDSSLCC**	**218 (-)**	**(2014 - 2018)**	**198 (-)**	**(2014 - 2018)**	**196 (-)**	**(2014 - 2018)**	**188 (-)**	**(2014 - 2018)**
	LC_LC4	Line Creek u/s of Process Plant (0200044)	LC_LC4	346 (-)	(2006 - 2018)	376 (-)	(2004 - 2018)	347 (-)	(2005- 2018)	276 (32)	(2009 - 2018)
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	EV_EC1	215 (-)	(2006 - 2018)	251 (-)	(2004 - 2018)	252 (-)	(2004 - 2018)	151 (63)	(2010 - 2018)
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	EV_GT1; EV_GT1A	232 (-)	(2006 - 2018)	266 (-)	(2004 - 2018)	259 (-)	(2004 - 2018)	191 (17)	(2010 - 2018)
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	EV_BC1; EV_BC1A	305 (-)	(2006 - 2018)	353 (-)	(2004 - 2018)	347 (-)	(2004 - 2018)	224 (42)	(2009 2018)
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	EV_DC1	116 (-)	(2006 - 2018)	123 (-)	(2004 - 2018)	122 (-)	(2004 - 2018)	105 (8)	(2010 - 2018)
	EV_HC1	**EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (E102682)**	**EV_HC1; EV_HC1A**	**277 (-)**	**(2006 - 2018)**	**316 (-)**	**(2004 - 2018)**	**315 (-)**	**(2004 - 2018)**	**221 (17)**	**(2010 - 2018)**
Fording River	FR_FR1	Fording River d/s of Henretta Creek (0200251)	FR_FR1	152 (-)	(2006 - 2018)	134 (-)	(2004 - 2018)	128 (-)	(2004 - 2018)	106 (29)	(2010 - 2018)
	FR_FR2	Fording River u/s Kilmarnock Creek (0200201)	FR_FR2	275 (1)	(2006 - 2018)	250 (-)	(2004 - 2018)	242 (-)	(2004 - 2018)	216 (8)	(2010 - 2018)
	FR_FR4	Fording River between Swift and Cataract Creeks (0200311)	FR_FR4; GH_FR	335 (-)	(2006 - 2018)	372 (2)	(2004 - 2018)	356 (-)	(2004 - 2018)	194 (19)	(2010 - 2018)
	FR_FRCP1	Fording River, 525 m d/s of Cataract Creek (E300071)	FR_FRCP1	155 (-)	(2015 - 2018)	155 (-)	(2015 - 2018)	155 (-)	(2015 - 2018)	155 (21)	(2015 - 2018)
	GH_PC2	Fording River d/s of Porter Creek (E287431)	GH_PC2	81 (-)	(2012 - 2018)	143 (1)	(2009 - 2018)	81 (-)	(2012 - 2018)	68 (-)	(2012 - 2018)
	FR_FRABCH	**FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (E223753)**	**FR_FRABCH; FR_FRABCHF**	**71 (-)**	**(2013 - 2018)**	**72 (-)**	**(2013 - 2018)**	**71 (-)**	**(2013 - 2018)**	**71 (1)**	**(2013 - 2018)**
	LC_FRDSDC	Fording River d/s of Dry Creek (E288272)	LC_FRDSDC	160 (-)	(2011 - 2018)	160 (-)	(2011 - 2018)	160 (-)	(2011 - 2018)	160 (1)	(2011 - 2018)
	GH_FR1	**GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (0200378)**	**GH_FR1**	**308 (-)**	**(2006 - 2018)**	**333 (2)**	**(2004 - 2018)**	**316 (-)**	**(2005 - 2018)**	**232 (23)**	**(2007- 2018)**
	LC_LC5	**Fording River d/s of Line Creek (0200028)**	**LC_LC5**	**303 (-)**	**(2006 - 2018)**	**281 (-)**	**(2004 - 2018)**	**309 (-)**	**(2005 - 2018)**	**199 (19)**	**(2010 - 2018)**
Michel Creek	**CM_MC2**	**CMO Compliance Point (Michel Creek d/s of CMO near Andy Goode Creek junction) (E258937)**	**CM_MC2**	**398 (-)**	**(2006 - 2018)**	**408 (-)**	**(2005 - 2018)**	**399 (-)**	**(2006 - 2018)**	**305 (52)**	**(2010 - 2018)**
	EV_MC3	Michel Creek u/s of Erickson Creek (0200203)	EV_MC3	261 (2)	(2006 - 2018)	295 (2)	(2004 - 2018)	298 (-)	(2004 - 2018)	205 (21)	(2010 - 2018)
	EV_MC2	**EVO Michel Creek Compliance Point (E300091)**	**EV_MC2**	**212 (-)**	**(2014 - 2018)**	**217 (-)**	**(2014 - 2018)**	**210 (-)**	**(2014 - 2018)**	**203 (2)**	**(2014 - 2018)**
	EV_MC1	Michel Creek u/s of Highway 43 Bridge (0200425)	EV_MC1	208 (-)	(2006 - 2016)	251 (-)	(2004 - 2016)	193 (-)	(2004 - 2014)	94 (16)	(2010- 2014)

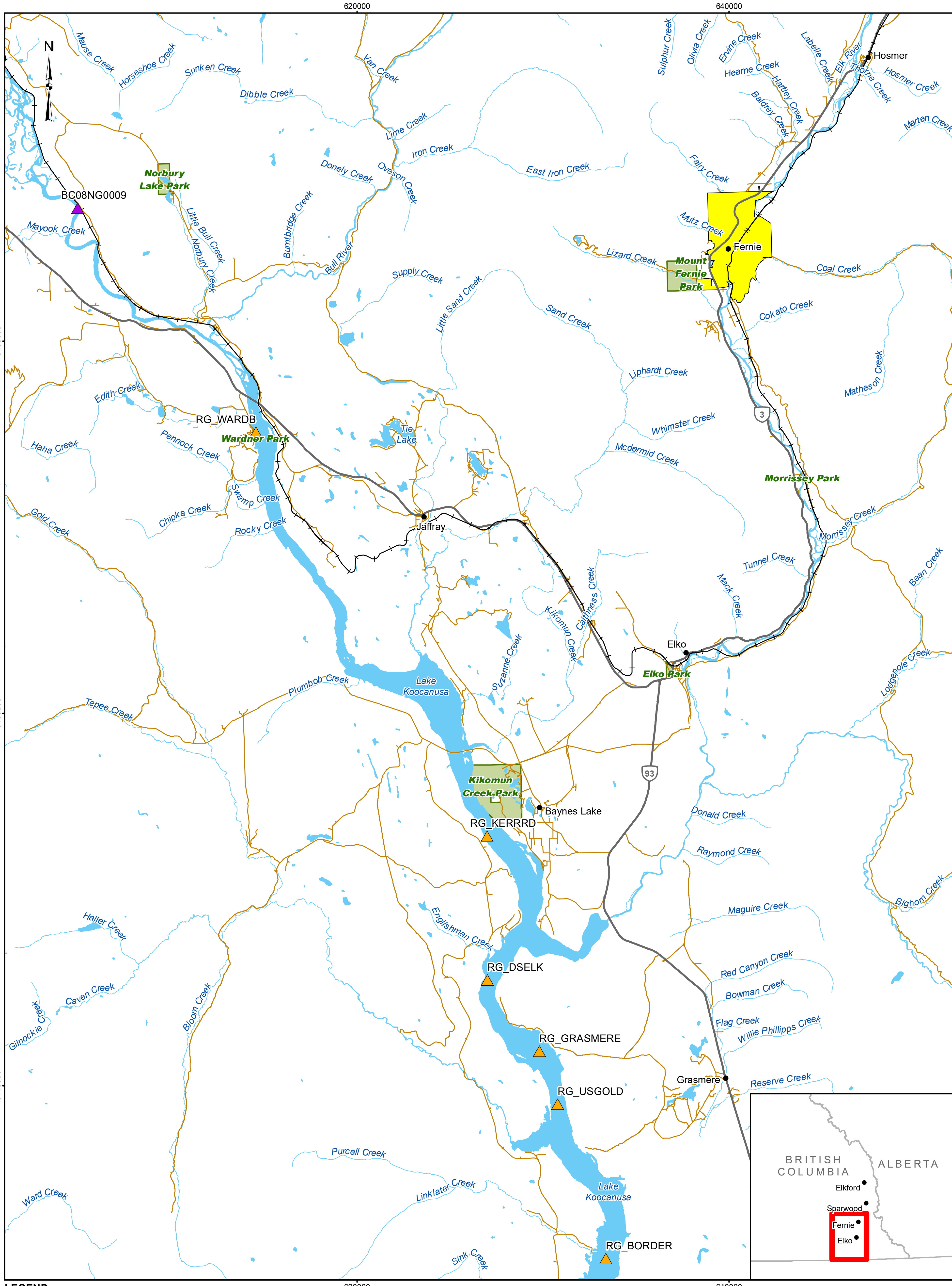
Table 2.1-2 Measured Data Used in the Calibration of the Water Quality Component of the Regional Water Quality Model

Operation / General Location	Node ID	Node Description (EMS ID)	Monitoring Station(s)	Nitrate		Selenium		Sulphate		Cadmium	
				Sample Count[(a)]	Date Range	Sample Count[(a)]	Date Range	Sample Count[(a)]	Date Range	Sample Count[(a)]	Date Range
Elk River	**GH_ERC**	GHO Elk River Compliance Point - Elk River, 220 m d/s of Thompson Creek (E300090)	GH_ERC	135 (-)	(2014 - 2018)	136 (-)	(2014 - 2018)	135 (-)	(2014 - 2018)	136 (30)	(2014 - 2018)
	GH_ER1	**Elk River u/s of Boivin Creek (u/s of Fording River; E206661)**	**GH_ER1**	**256 (8)**	**(2006 - 2018)**	**285 (7)**	**(2004 - 2018)**	**265 (-)**	**(2005 - 2018)**	**193 (104)**	**(2007 - 2018)**
	EV_ER4	**Elk River u/s of Grave Creek (from Fording River to Michel Creek) (0200389)**	**EV_ER4; LC_ELKDS**	**269 (-)**	**(2006 - 2018)**	**304 (-)**	**(2004 - 2018)**	**303 (-)**	**(2004 - 2018)**	**210 (49)**	**(2010 - 2018)**
	EV_ER2	Elk River u/s of Michel Creek (0200111)	EV_ER2	188 (-)	(2006 - 2018)	220 (-)	(2004 - 2018)	221 (-)	(2004 - 2018)	127 (52)	(2010 - 2018)
	EV_ER1	**Elk River d/s of Michel Creek (0200393)**	**BC08NK0004; EV_ER1**	**535 (-)**	**(2006 - 2018)**	**672 (-)**	**(2004 - 2018)**	**686 (-)**	**(2004 - 2018)**	**565 (23)**	**(2004 - 2018)**
	RG_ELKORES	**Elk River at Elko Reservoir (E294312)**	RG_ELKORES	154 (-)	(2009 - 2018)	155 (-)	(2009 - 2018)	155 (-)	(2009 - 2018)	154 (7)	(2009 - 2018)
	RG_ELKMOUTH	Elk River at Highway 93 near Elko; ECCC station BC08NK0003	BC08NK0003; RG_ELKMOUTH	346 (-)	(2007 - 2018)	433 (-)	(2004 - 2018)	449 (-)	(2004 - 2018)	424 (29)	(2004 - 2018)
Koocanusa Reservoir	**RG_DSELK[(b)]**	**Koocanusa Reservoir - South of the Elk River (E300230)**	**RG_DSELK**	**377 (-)**	**(2013 - 2018)**	**77 (-)**	**(2014 - 2018)**	**377 (-)**	**(2013 - 2018)**	**378 (202)**	**(2013 - 2018)**

[(a)] Sample count = total sample number (number of non-detects).
[(b)] The sample count includes measured data at the four stations located downstream of the Elk River: RG_DSELK, RG_GRASMERE, RG_USGOLD and RG_BORDER.
ID = Identification; CMO = Coal Mountain Operations; d/s = downstream; ECCC = Environment and Climate Change Canada; u/s = upstream; m = metre.

Note: Sites in **bold** font correspond to Order Stations and Compliance Points listed in EMA Permit 107517; Order Stations are indicated by underlined font.

Document Path: I:\CLIENTS\TECK_COAL\18111630\Mapping\Products\WaterQuality\18111630_FIG_2.1-1_Water_Quality_Monitoring_Stations_in_the_Kootenay_River_and_Lake_Koocanusa.mxd



LEGEND

- POPULATED PLACE
- PRIMARY HIGHWAY
- LOCAL ROAD
- RAILROAD
- WATERCOURSE
- PARK / PROTECTED AREA
- WATER BODY
- POPULATED PLACE

WATER QUALITY MONITORING STATIONS

- ENVIRONMENT CANADA
- TECK

5 0 5

SCALE 1:200,000 KILOMETRES

REFERENCE

PARKS AND HYDROGRAPHY OBTAINED FROM IHS MARKIT CANADA LIMITED. ROADS AND POPULATED PLACES OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 11 DATUM: NAD 83

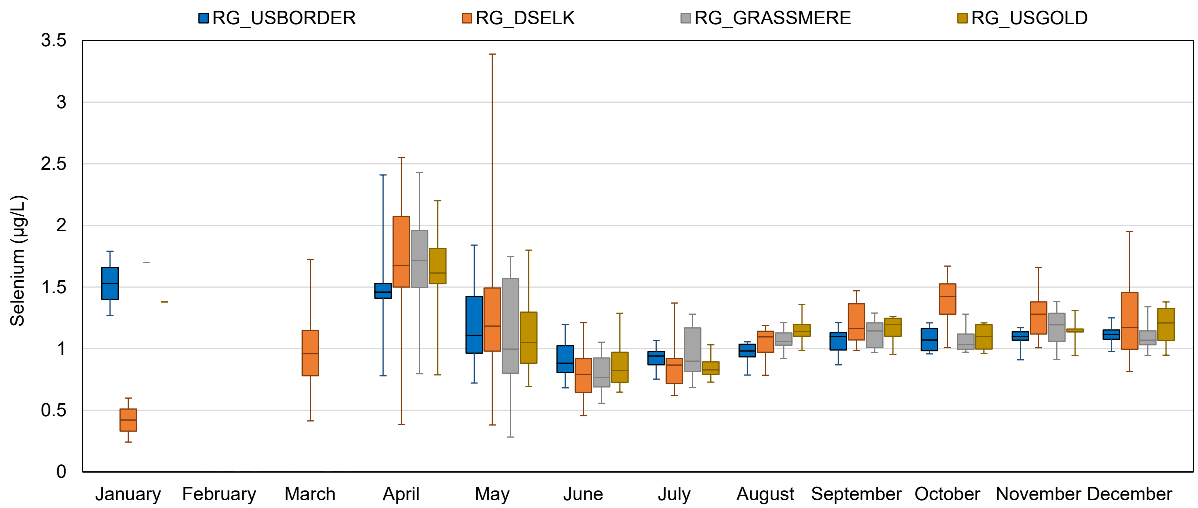
2020 REGIONAL WATER QUALITY MODEL UPDATE

TITLE

WATER QUALITY MONITORING STATIONS IN THE KOOTENAY RIVER AND LAKE KOOCANUSA

Teck

PROJECT		18111630	FILE No.	5000
DESIGN	AS	14 June 2018	SCALE AS SHOWN	REV. 0
GIS	LB/RRD	27-Jan-2021		
CHECK	AS	24 Aug. 2018	**FIGURE: 2.1-1**	
REVIEW	JPB	24 Aug. 2018		



Note:
The box and whisker plot shows minimum, 25th percentile, median, 75th percentile and maximum weekly selenium concentrations.

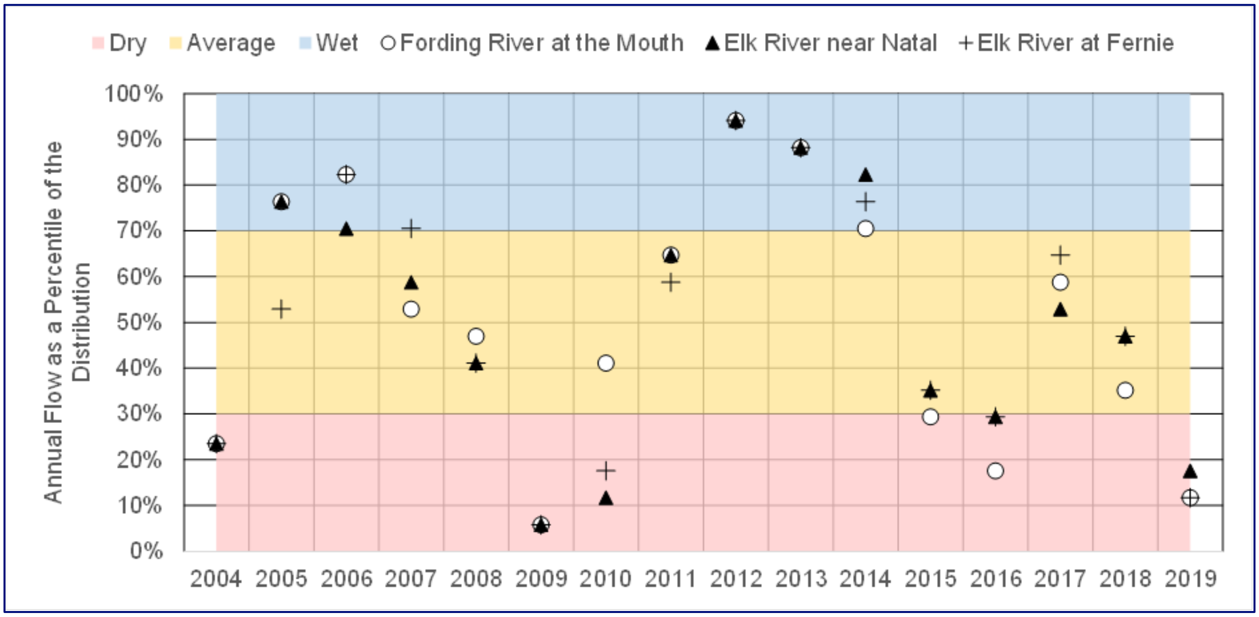
Figure 2.1-2 Monthly Average Measured Selenium Concentrations in Koocanusa Reservoir, 2014-2019

2.1.2.2 Calibration Period

The calibration was completed with a focus on 2004 to 2019 for all constituents except nitrate. Measured data from most instream locations were available during this period (Table 2.1-2), as was mine site information, such as waste rock deposition rates. The nitrate calibration was completed with a focus on 2006 to 2019, because during this period blasting information (i.e., the powder factor and% total explosive present as ANFO) was available to better define nitrate content in explosives and associated residuals.

The calibration period covers a range of wet and dry years. The occurrence of wet and dry hydrologic years[4] at the mouth of the Fording River, the Elk River near Natal, and the Elk River at Fernie, as percentiles of measured annual flow for 2004 to 2019 are illustrated in Figure 2.1-3. For illustrative purpose, a given October through September hydrologic year was considered dry if its flow was below the 30th percentile, and wet if its flow was above the 70th percentile. Hydrologic years of 2004, 2009, 2010, 2015, 2016 and 2019 were dry years, and 2005, 2006, 2012, 2013 and 2014 were wet years. The 2012 hydrologic year was the wettest year in the calibration period. Further information on flow characteristics during the calibration period can be found in Annex B.

[4] Hydrologic year is defined as October to September. For example, the 2018 hydrologic year begins in October 2017 and ends in September 2018. It includes one complete hydrologic cycle, from winter freeze up, snow accumulation, spring melt and then late summer recession.



Note:
A hydrologic year is from October to September. For illustrative purpose, each hydrologic year is categorized as follows: no shading = "dry" (flow below the 30th percentile); light grey shading = "average" (flow between the 30th and 70th percentile); and dark grey shading = "wet" (flow above the 70th percentile).

Figure 2.1-3 Classification of Flow Conditions in each Hydrologic Year (i.e., October to September) from 2004 to 2019, Based on Annual Average Flows

2.1.2.3 Calibration Processes

One calibration process was applied to nitrate, selenium, sulphate, and cadmium. The objective of this process was to match seasonal and annual changes in measured constituent concentrations as accurately as possible, with any remaining discrepancy typically resulting from a small over-estimation by the model. This approach was used to avoid under predicting concentrations when the model is used to project future conditions, in alignment with regulatory guidance and anticipated future use of the model in supporting environmental assessments. At the same time, efforts were made to reduce model error and bias, to the extent possible and reasonable, to avoid the overdesign of water quality mitigation. Residual bias and error in the model are, and will continue to be, considered when making management decisions.

The calibration process for nitrate, selenium, sulphate, and cadmium consisted of the following three-steps:

1. Setting up the model as described in Section 1.4
2. Simulating historical conditions and comparing simulated results to measured data in terms of visual fit and calibration statistics (i.e., error and bias estimates), with calibration factors initially set at 1.0
3. Adjusting, in an iterative fashion, calibration factors associated with the geochemical source terms to improve model fit and/or working to improve estimates of instream flow produced by the FC

For the first step, the WQC of the 2020 RWQM was configured with known waste rock volumes, pit wall areas and simulated flow data. Waste rock volumes and pit wall areas used for model calibration were derived from mine site information and mine plans. Simulated flow data were generated using the FC of the 2020 RWQM, as discussed in Annex B. Release rates were set to the median or average catchment-specific values described in Annex A and summarized in Section 1.4. Lag times and leaching efficiencies were set to those values outlined in Section 1.4, as well.

In the second step, model performance was evaluated through a visual comparison of simulated and measured data, along with examination of error and bias. The visual comparison involved generating time series plots to determine if simulated results replicated the range of measured concentrations and matched seasonal and yearly trends in the measured data. The examination of error and bias involved generating the statistics outlined below to assess goodness of fit.

Model error was calculated as the average absolute difference observed between individual simulated and measured data points over the entire calibration period, as per the following equation:

$$Error = \frac{\sum |C_{Modelled} - C_{Measured}|}{n} \qquad \text{Eq. 38}$$

Where:

$C_{Modelled}$	=	the modelled concentration
$C_{Measured}$	=	the measured concentration
n	=	the number of paired modelled and measured data points

Error provides an indication of model accuracy, in terms of its ability to simulate a given concentration at a given time. Error was also expressed as a percentage, to allow comparisons between watercourses with differing instream concentrations. For example, error for Stream A may be 1 µg/L, and 10 µg/L for Stream B. These values could suggest that the model is more accurate at simulating conditions in Stream A; however, if average ambient concentrations in Streams A and B are 2 and 150 µg/L, respectively, then the model is actually more accurate in Stream B, because the percent error for Stream B is 7% (i.e., 10/150) rather than 50%.

Model bias was calculated as the average difference between the individual simulated and measured data points over the entire calibration period, using the following equation:

$$Bias = \frac{\sum (C_{Modelled} - C_{Measured})}{n} \qquad \text{Eq. 39}$$

Bias provides an indication of whether simulated data tend to be higher or lower than measured data. As with error, bias is also expressed as relative bias, calculated using the following equation:

$$Relative\ Bias = \frac{Bias + \overline{C_{Measured}}}{\overline{C_{Measured}}} \qquad \text{Eq. 40}$$

As with percent error, relative bias allows comparisons to be made among watercourses with differing ambient concentrations.

The calibration statistics were generated by comparing simulated concentrations directly to available weekly or monthly grab sampling data. This approach resulted in a comparison of weekly model output to instantaneous measurements, thereby assuming that the grab samples were representative of average conditions over the entire period between sampling events, be that a week or a month.

Although the model is run on an internal daily time-step to maintain model stability and to allow for accurate tracking of mass transfer within the system, model output consists of a concentration exported every week. Weekly outputs were chosen, because input flow rates were averages that did not change over the course of a week. Similarly, waste rock volumes, the main driver controlling the release of constituents to the receiving environment, were based on annual inputs that were linearly interpolated over the calendar year. As a result, simulated concentrations varied little over a given week despite the daily time-step, because of the format of the inputs used to drive the model.

The third and final step in the calibration process consisted primarily of adjusting the calibration factors included in Equations 3, 5, 6, and 8 for nitrate, 11, 13, and 14 for selenium and sulphate and 19 for cadmium and then returning to Step 2 in an iterative fashion to reduce error while maintaining a slight bias towards over-predicting instream concentrations. The outcome was a distinct set of calibration factors for each watershed that are intended to address:

- uncertainty in the geochemical source terms developed as outlined in Annex A
- differences between the measured flow data used to generate the geochemical source terms and the simulated flow information used to run the WQC of the 2020 RWQM

Changes to the FC of the 2020 RWQM were also made as part of the calibration process. Changes to the FC included modifications to the reservoir drawdown approach used to simulate water flow through a spoil, and modifications to runoff and recession coefficients to improve the replication of measured flows, which then helped to improve the performance of the WQC.

2.1.2.4 Bias Correction

2.1.2.4.1 Koocanusa Reservoir

The 2020 RWQM tends to over-estimate measured concentrations of nitrate, selenium, and sulphate in Koocanusa Reservoir as outlined below in Section 2.1.3 and Appendix B. To date, the over-estimation of measured nitrate and sulphate concentrations has not affected use of the tool for mitigation planning purposes and supporting environmental assessments, because projected concentrations now and into the future remain well below Site Performance Objectives (SPO). In contrast, projected selenium concentrations are much closer to or exceed the SPO, which limits the effectiveness of RWQM for use in planning and assessment activities. Selenium concentrations in Koocanusa Reservoir were bias corrected to address this issue

To correct for bias, projected selenium concentrations in Koocanusa Reservoir were reduced using the following equation:

$$C_{Se} = \frac{\left(\sum_{i=1}^{n} R_{Se,i}\right) / Relative\ Bias}{\sum_{i=1}^{n} q_i} \qquad \text{Eq. 41}$$

Where:

C_{Se} = projected concentration of selenium in Koocanusa Reservoir (mass per unit volume)

$R_{Se,i}$ = mass of selenium associated with source 'i' reporting to Koocanusa Reservoir, expressed as a rate (mass per unit time)

q_i = flow rate of source 'i' (volume per unit time)

n = number of sources entering Koocanusa Reservoir

Simulated concentrations from June to December were reduced by the corresponding monthly average relative bias value listed in Table 2.1-3, while simulated concentrations in April and May were increased. Monthly average relative bias values could not be calculated for January, February, and March, due to a lack of measured data in winter. Projected concentrations in Koocanusa Reservoir for these three months were reduced by the annual average relative bias calculated over the entire period.

Relative bias values for Koocanusa Reservoir were calculated using Equations 39 and 40; they are summarized in Table 2.1-3 and shown in Figure 2.1-4.

Table 2.1-3 Relative Bias Values Calculated for Selenium in Koocanusa Reservoir, based on Simulated and Measured Data from 2013 to 2018

Month	Relative Bias
January	1.8
February	-
March	2.3
April	0.87
May	1.0
June	1.1
July	1.2
August	1.7
September	1.6
October	1.5
November	1.6
December	1.9
Annual	1.2

- = Relative bias was not calculated due to limited or no measured data (i.e., less than 3 samples available for the month in question).

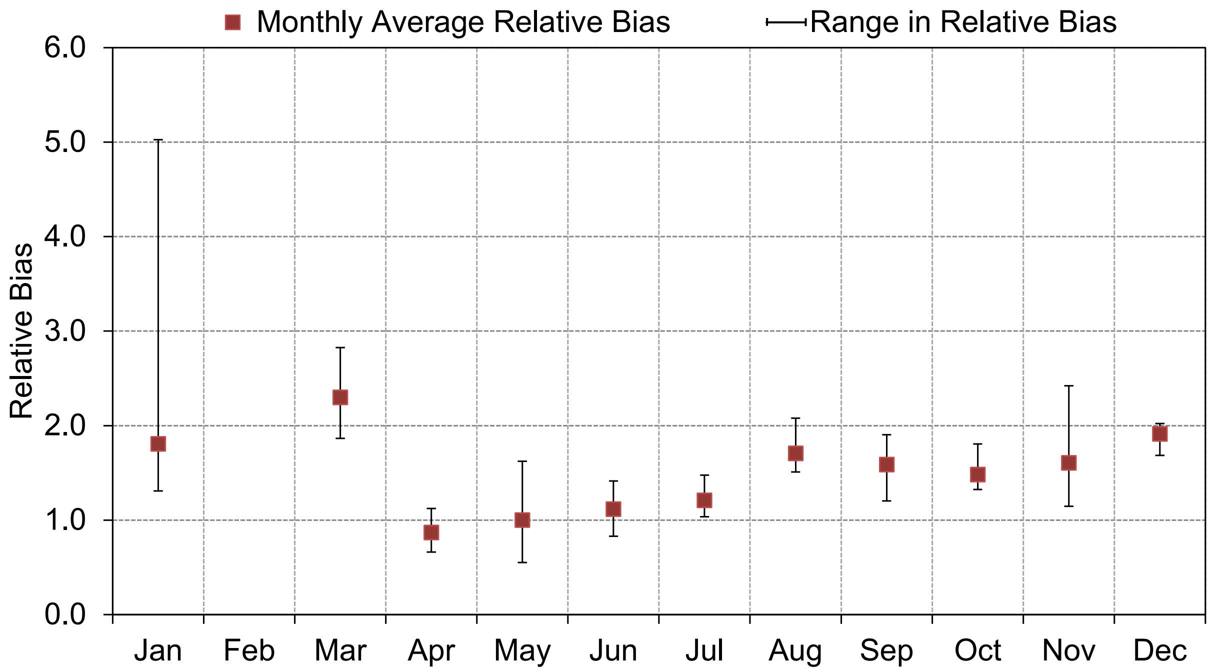


Figure 2.1-4 Monthly Relative Bias Values Calculated for Selenium in Koocanusa Reservoir, based on Simulated and Measured Data from 2013 to 2019

2.1.2.4.2 Michel Creek

The 2020 RWQM tends to over-estimate measured concentrations of nitrate, selenium, and sulphate at most locations in Michel Creek, as outlined below in Section 2.1.3. The over-estimation of measured concentrations in Michel Creek occurs at the following locations:

- Michel Creek upstream of Erickson Creek (EV_MC3; 0200203)
- Michel Creek downstream of Erickson Creek (EV_MC3a)
- Michel Creek upstream of Gate Creek (EV_MC2a)
- Michel Creek upstream of Highway 43 Bridge (EV_MC1; 0200425)

The 2020 RWQM also tends to over-estimate measured concentrations of nitrate, selenium, and sulphate at the EVO Michel Creek Compliance Point (EV_MC2; E300091) in 2019. However, the same level of over-estimation is not apparent when comparing modelled to measured data at this location prior to 2019.

Simulated concentrations produced by the WQC represent fully mixed conditions. Sampling at the EVO Michel Creek Compliance Point prior to 2019 involved collecting water from the right downstream bank, which is the same side of the creek channel that Gate Creek and Bodie Creek enter from. Transect sampling completed in the fall of 2018 identified that complete mixing is not always accomplished by the time waters pass the EVO Michel Creek Compliance Point. Measured concentrations were higher in the sample collected from the right downstream bank compared to those measured in sample collected from the middle of the channel and from the left downstream bank. Since 2019, water quality sampling procedures at EVO have been updated to generate information more representative of fully mixed conditions. Thus, the over-estimation of measured concentrations noted at this location in 2019 provides a better indication of model performance than comparisons to earlier information.

While over estimation occurs for all constituents, projected selenium concentrations are much closer to or exceed the compliance limit, which limits the effectiveness of the 2020 RWQM for use in planning and assessment activities. Selenium concentrations in Michel Creek were bias corrected to address this issue.

To correct for bias, projected selenium concentrations at the EVO Michel Creek Compliance Point were adjusted using Equation 41. Simulated concentrations were reduced by the monthly average relative bias values listed in Table 2.1-4. These values were generated as outlined in the following two steps:

1. Monthly average relative bias values were calculated using Equations 39 and 40 for each of the following three locations in Michel Creek (Figure 2.1-X):
    - Michel Creek upstream of Gate Creek (EV_MC2a)
    - Michel Creek upstream of Highway 43 Bridge (EV_MC1; 0200425)
    - EVO Michel Creek Compliance Point (EV_MC2; E300091) using simulated and measured concentrations from 2019 only
2. An average value from the three locations was calculated for each month and used to bias correct modelled selenium concentrations at the EVO Michel Creek Compliance Point.

Data from Michel Creek upstream of Erickson Creek were not used in the bias correction calculations, because concentrations upstream of Erickson Creek are an order of magnitude lower than those at the EVO Michel Creek Compliance Point. Data from the EVO Michel Creek Compliance Point prior to 2019 were not used in the bias correction calculations, because measured data prior to 2019 may not be representative of fully mixed conditions.

Table 2.1-4 Relative Bias Values Calculated for Selenium in Lower Michel Creek, based on Simulated and Measured Data from 2004 to 2019

Month	Relative Bias[(a)]
January	1.5
February	1.3
March	1.3
April	1.3
May	1.7
June	1.4
July	1.5
August	1.4
September	1.6
October	1.9

Month	Relative Bias[a]
November	1.8
December	1.5
Annual	1.5

[a] Relative bias values are averages calculated using simulated and measured data from three monitoring locations: Michel Creek upstream of Highway 43 Bridge (EV_MC1), EVO Michel Creek Compliance Point (EV_MC2) and Michel Creek upstream of Gate Creek (EV_MC2a).

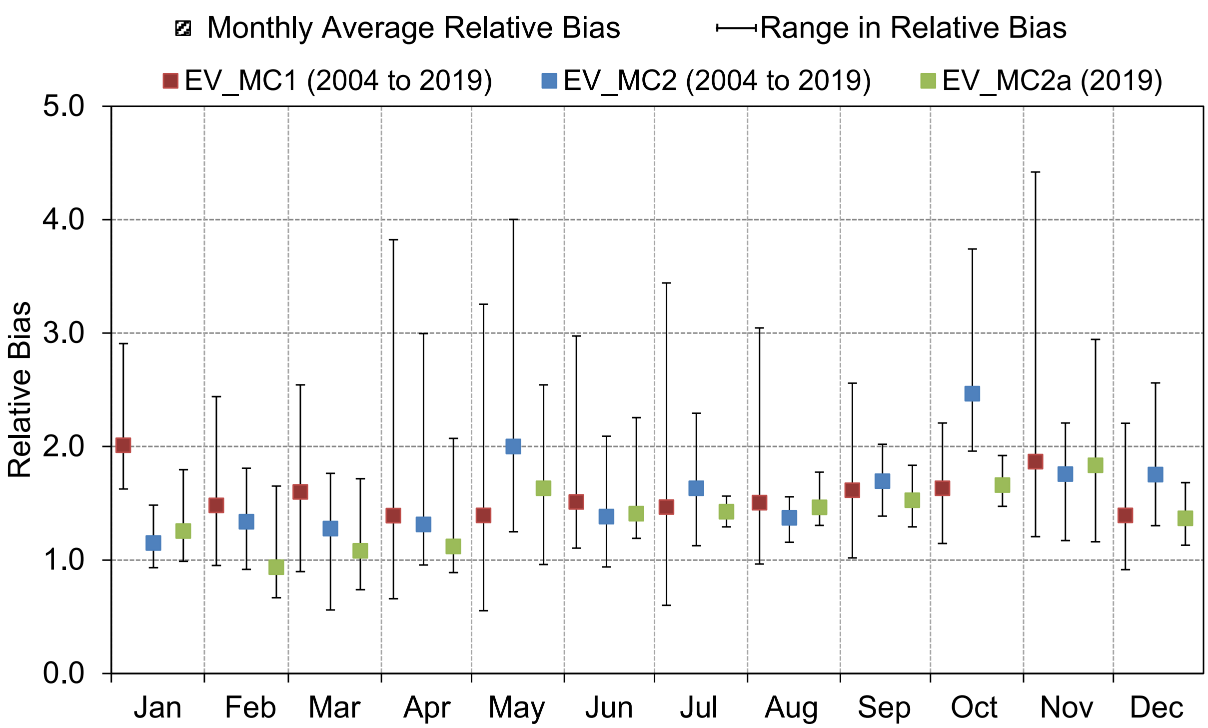


Figure 2.1-5 Monthly Relative Bias Values Calculated for Selenium at Three Locations in Michel Creek: Michel Creek upstream of Highway 43 Bridge (EV_MC1); EVO Michel Creek Compliance Point (EV_MC2) and Michel Creek upstream of Gate Creek (EV_MC2a)

2.1.2.5 EVO Dry Creek and Harmer Creek

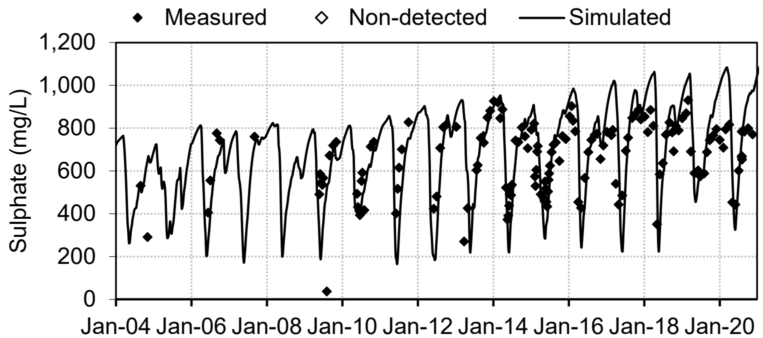
In the Harmer Creek catchment, the WQC was initially calibrated in an upstream to downstream fashion, beginning with EVO Dry Creek then progressing to lower Harmer Creek. This approach resulted in a reasonable calibration in EVO Dry Creek, but the overestimation of constituent concentrations at the EVO Harmer Compliance Point (EV_HC1) (Figure 2.1-6). In their study of the Harmer Creek catchment, Lorax (2019) noted that the system does not contain notable sinks or other similar processes that would result in a loss of mass between the monitoring point at the mouth of EVO Dry Creek and EV_HC1. They also noted that the flow monitoring station at the mouth of EVO Dry Creek (EV_DC1) is subject to interference and likely inaccurate.

Pursuant to the recommendations of Lorax (2019), the calibration process in the Harmer Creek catchment was changed to focus on replicating constituent concentrations at EV_HC1, then using the resulting information to inform flow rates from EVO Dry Creek. More specifically, constituent release rates from the EVO Dry Creek spoil were calibrated to replicate measured concentrations at EV_HC1. The rate of mixing that occurred between water released from the EVO Dry Creek spoil and that from undisturbed areas was then adjusted, so that simulated constituent concentrations at the mouth of EVO Dry Creek matched measured concentrations at this location.

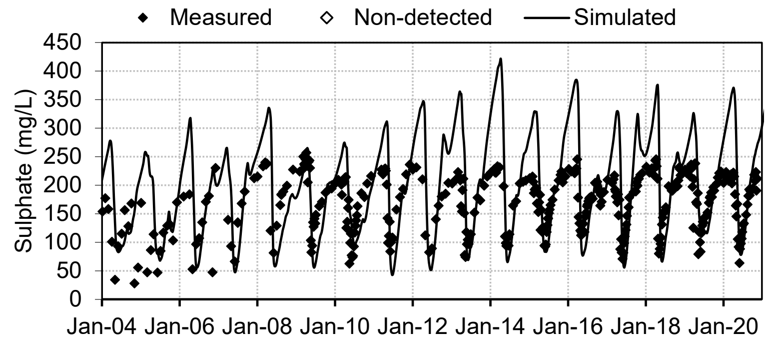
Based on this approach, it would appear as though 25% of the water estimated by the FC to be draining from the EVO Dry Creek sub-catchment does not report to EV_DC1 and instead travels via surface and/or subsurface flow pathways directly to EV_HC1. In other words, the WQC is configured such that 25% of the water estimated by the FC to be draining from the EVO Dry Creek sub-catchment is not available for mixing with the constituent load released from the EVO Dry Creek spoil within the EVO Dry Creek sub-catchment and would not be affected by an intake placed at EV_DC1. The water bypassing EV_DC1 would originate from undisturbed areas of the sub-catchment.

(a) Model Performance based on an Upstream to Downstream Approach to Calibration

EVO Dry Creek Sediment Pond Decant (EV_DC1)

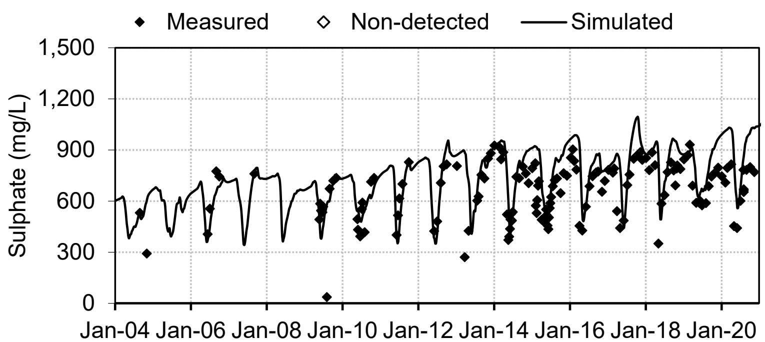


EVO Harmer Compliance Point (Harmer Creek Dam Spillway; EV_HC1)

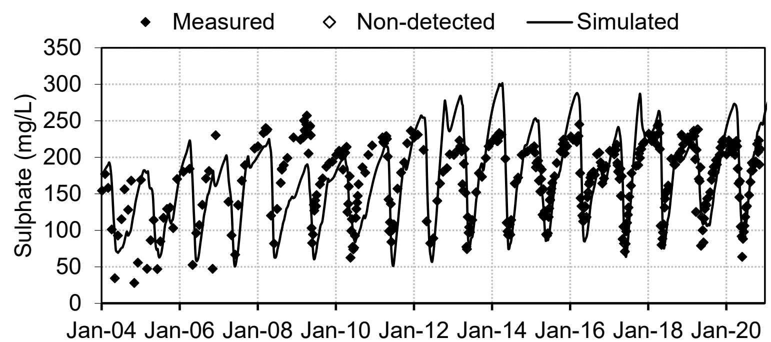


(b) Model Performance based on a Downstream to Upstream Approach to Calibration and Modification to Water Flows Reporting to the EVO Dry Creek Sediment Pond

EVO Dry Creek Sediment Pond Decant (EV_DC1)



EVO Harmer Compliance Point (Harmer Creek Dam Spillway; EV_HC1)



Note:

When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-6 Sulphate Concentrations in EVO Dry Creek and Harmer Creek, 2004-2020

2.1.3 Results

Results of the model calibration, consisting of comparisons between measured and simulated historical water quality conditions at the calibration nodes are presented in this section. Final values assigned to the calibration factors, along with error and bias statistics, are also presented for nitrate, selenium, sulphate, and cadmium.

2.1.3.1 Nitrate

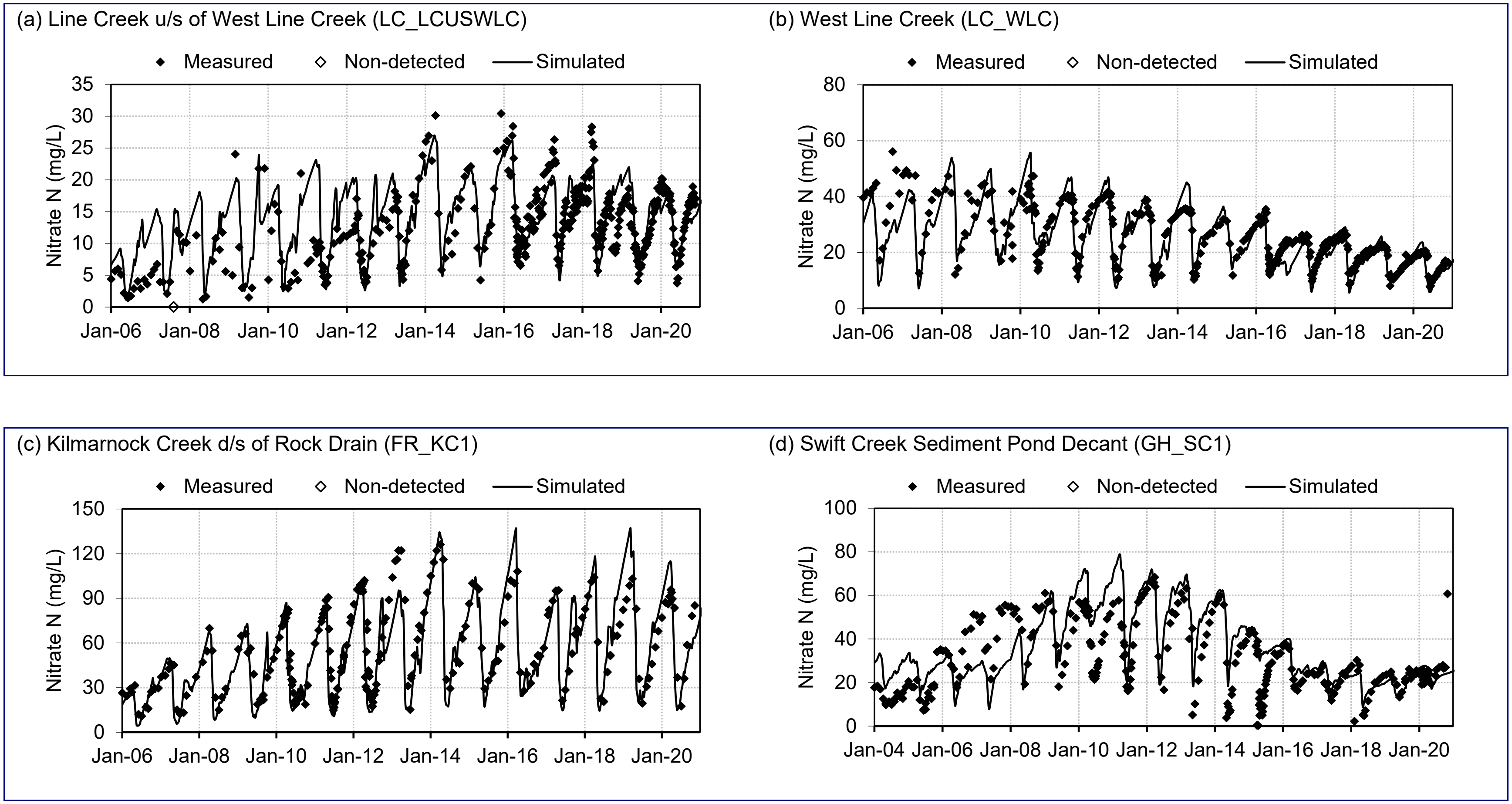
2.1.3.1.1 Tributaries

Simulated results in mine affected tributaries to the Fording River and Elk River matched reasonably well with measured data, in terms of replicating the range of measured concentrations and matching seasonal, yearly, and longer-term trends. Comparisons of model output to monitored data are shown for selected tributaries in Figure 2.1-7; comparable plots for all modelled tributaries are included in Appendix B.

The ability of the model to replicate seasonal and long-term patterns in measured nitrate concentrations is reflected in the relative bias statistics, which range from 0.8 to 1.4 (Table 2.1-5). The error statistics in some tributaries (e.g., Kilmarnock Creek, Cataract Creek, Erickson Creek) were also small, in the order of 15 to 30%, comparable to the 20% threshold used in many analytical laboratories to identify split samples as being different from one another. In other tributaries, such as Clode Creek, model error was larger, ranging from 34 to 69%. In a few tributaries at GHO, simulated trends did not follow observed trends as closely throughout the calibration period (Figure 2.1-8), likely as a result of uncertainty in the simulated flows and/or pumping records available from the mine site. Nevertheless, model performance overall has improved relative to the 2017 RWQM, including in the GHO tributaries (see Appendix B).

The WQC, like any model, is a simplification of the natural system being represented. Factors contributing to model error include uncertainties in the distribution of blasting residue within the waste rock spoils, and how evenly blasting residue is washed off materials within the spoils. The model assumption is that blasting residuals are evenly distributed and wash off at a consistent rate over time (e.g., 20% per year). In reality, conditions are likely to be more heterogeneous, leading to small scale variability in nitrate release rates and downstream concentrations that are not replicated by the model.

Values assigned to the calibration factors related to lag time and amount of nitrate residual contained in the waste rock are provided in Table 2.1-6. They were reviewed by SRK, and were found to be appropriate (i.e., were reasonable given the level of uncertainly inherent in the lag time estimates and site-specific variability in powder factors).



Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2006 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-7 Nitrate Concentrations in Line Creek, West Line Creek, Kilmarnock Creek, and Swift Creek, 2006-2020

Table 2.1-5 Error and Bias Results for Nitrate Calibration, 2006-2018

Operation / General Location	Node ID	Node Description (EMS ID)	Bias[a] (mg/L)	Relative Bias[b]	Error[c] (mg/L)	Percent Error[d]
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	0.55	1.1	1.5	34%
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	7.8	1.3	17	54%
	FR_LMP1	Lake Mountain Pond	-0.0072	0.99	0.77	62%
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	-4.3	0.92	11	20%
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	6.7	1.2	11	35%
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	2.9	1.1	4.7	15%
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	0.86	1.4	1.6	65%
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	-0.55	0.85	1.5	39%
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	-4.2	0.84	10	39%
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	-2.9	0.89	12	46%
	GH_TC1	Thompson Creek at LRP Road (E102714)	1.3	1.2	3.5	43%
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	-0.74	0.8	2.1	55%
	LC_DCDS	Dry Creek d/s of Sedimentation Ponds	-0.59	0.84	2.1	55%
	LC_DC1	Dry Creek near mouth (at bridge) (E288270)	0.039	1.0	0.62	69%
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	1.3	1.1	3.3	27%
	LC_WLC	West Line Creek (E261958)	-1.9	0.93	5.2	20%
	LC_LC3	Line Creek d/s of West Line Creek (0200337)	0.24	1.0	2.9	22%
	LC_LCDSSLCC	LCO Compliance Point (Line Creek d/s of South Line Creek confluence) (E297110)	-0.46	0.95	1.7	18%
	LC_LC4	Line Creek u/s of Process Plant (0200044)	0.52	1.1	1.6	23%
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	0.83	1.1	1.4	14%
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	-5.4	0.81	10	38%
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	-1.6	0.96	13	34%
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	0.52	1.1	0.92	23%
	EV_HC1	EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (E102682)	0.11	1.1	0.25	26%
Fording River	FR_FR1	Fording River d/s of Henretta Creek (0200251)	0.15	1.1	1.0	38%
	FR_FR2	Fording River u/s Kilmarnock Creek (0200201)	0.83	1.1	2.2	28%
	FR_FR4	Fording River between Swift and Cataract Creeks (0200311)	0.79	1.1	2.7	35%
	FR_FRCP1[e]	Fording River, 525 m d/s of Cataract Creek (E300071)	-1.4	0.9	2.9	20%

Table 2.1-5 Error and Bias Results for Nitrate Calibration, 2006-2018

Operation / General Location	Node ID	Node Description (EMS ID)	Bias[a] (mg/L)	Relative Bias[b]	Error[c] (mg/L)	Percent Error[d]
Fording River	GH_PC2	Fording River d/s of Porter Creek (E287431)	-0.38	0.98	3.2	18%
	FR_FRABCH	FRO Compliance Point (Fording River, 100 m u/s of above Chauncey Creek) (E223753)	-0.19	0.99	2.5	14%
	LC_FRDSDC	Fording River d/s of Dry Creek (E288272)	0.49	1.0	1.6	15%
	GH_FR1	GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (0200378)	0.75	1.1	1.3	15%
	LC_LC5	Fording River d/s of Line Creek (0200028)	-0.027	1.0	1.1	15%
Michel Creek	**CM_MC2**	CMO Compliance Point (Michel Creek d/s of CMO near Andy Goode Creek junction) (E258937)	0.65	1.3	0.85	40%
	EV_MC3	Michel Creek u/s of Erickson Creek (0200203)	0.14	1.7	0.2	92%
	EV_MC2	EVO Michel Creek Compliance Point (E300091)	-0.5	0.81	0.99	37%
	EV_MC1	Michel Creek u/s of Highway 43 Bridge (0200425)	0.45	1.4	0.6	49%
Elk River	**GH_ERC**	GHO Elk River Compliance Point - Elk River, 220 m d/s of Thompson Creek (E300090)	0.086	1.2	0.16	45%
	GH_ER1	Elk River u/s of Boivin Creek (upstream of Fording River; E206661)	0.0043	1.0	0.081	34%
	EV_ER4	Elk River u/s of Grave Creek (from Fording River to Michel Creek) (0200389)	0.1	1.0	0.64	24%
	EV_ER2	Elk River u/s of Michel Creek (0200111)	0.14	1.1	0.5	26%
	EV_ER1	Elk River d/s of Michel Creek (0200393)	0.19	1.1	0.42	24%
	RG_ELKORES	Elk River at Elko Reservoir (E294312)	0.0075	1.0	0.19	14%
	RG_ELKMOUTH	Elk River at Highway 93 near Elko; ECCC station BC08NK0003	0.033	1.0	0.17	16%
Koocanusa Reservoir	**RG_DSELK[f]**	Koocanusa Reservoir - South of the Elk River (E300230)	0.066	1.2	0.1	37%

[a] Bias represents the average difference between simulated and measured concentrations. A positive bias indicates that modelled concentrations are greater, on average, than measured concentrations, whereas a negative bias indicates the reverse.

[b] A relative bias greater than one indicates that modelled concentrations are greater, on average, than measured concentrations, whereas a negative bias indicates the reverse.

[c] The error represents the average absolute difference between simulated and measured concentrations.

[d] The percent error represents the ratio of the error to the average measured concentration.

[e] Simulated concentrations at FR_FRCP1 reflect fully mixed conditions, whereas measured data collected during low flow periods reflect primarily the quality of Cataract Creek water; hence, the difference between simulated concentrations and measured data during low flow periods.

[f] The comparison of simulated to measured data considers measured data at the four stations located downstream of the Elk River: RG_DSELK, RG_GRASMERE, RG_USGOLD and RG_BORDER.

ID = Identification; CMO = Coal Mountain Operations; d/s = downstream; ECCC = Environment and Climate Change Canada; u/s = upstream; m = metre; milligrams per litre.

Note: Sites in **bold** font correspond to Order Stations and Compliance Points listed in EMA Permit 107517; Order Stations are indicated by underlined font.

Table 2.1-6 Lag Adjustments and Calibration Factors for Nitrate, 2006-2018

Operation / General Location	Node ID	Node Description	Lag Time (y)	Adjusted Lag Time (y)[(a)]	Nitrogen Loss Factor (%)	Calibration Factor	Calibrated Nitrogen Loss Factor (%)
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	8	10	8%	0.6	5%
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	4	4	6%	1.2	7%
	FR_LMP1	Lake Mountain Pond	8	8	5%	0.7	4%
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	7	12	8%	1.5	12%
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	7	7	5%	1.3	6%
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	8	10	2%	0.9	2%
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	8	3	5%	0.5	3%
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	7	6	2%	0.6	1%
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	3	3	5%	0.8	4%
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	3	3	3%	0.9	2%
	GH_TC1	Thompson Creek at LRP Road (E102714)	7	7	1%	1.8	3%
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	Variable[(b)]	Variable[(b)]	5%	0.8	4%
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	9	5	8%	0.3, 0.9, 0.8[(c)]	2%, 7%, 6%[(c)]
	LC_WLC	West Line Creek (E261958)	16	14	4%	0.9	3%
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	12	8	7%	0.8	6%
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	3	3	6%	2.0	12%
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	3	3	6%	1.2	7%
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	8	8	4%	0.3	1%

u/s = upstream; d/s = downstream; ID = Identification; y = year;% = percentage.

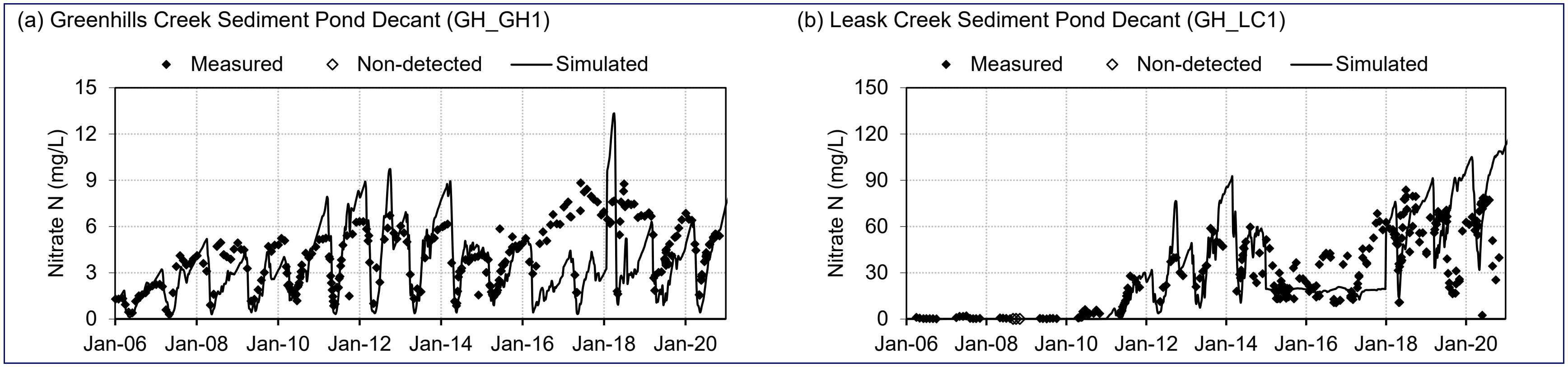
(a) Variable = starting at 0 to 1 year and increasing over time to a fixed value based on changing spoil geometry (namely height).

(b) A calibration factor of 0.3 was applied to the Upper Line Creek sub-catchments, 0.9 was applied to the Horseshoe Ridge Pit, No Name Creek, Mine Services Area West, North Line Creek and Centre Line Creek sub-catchments and 0.8 was applied to Horseshoe Creek sub-catchments.

2.1.3.1.2 Fording River and Elk River

The 2020 RWQM is able to accurately reflect seasonal and longer-term annual trends in nitrate concentrations in both the Fording River and Elk River, as well as simulate the range in measured concentrations (Figure 2.1-9). The model tends to over-predict nitrate concentrations during lower winter flow periods in the lower Fording River and most of the Elk River, when measured concentrations peak. Model performance overall has improved relative to the 2017 RWQM, with a higher degree of accuracy (see Appendix B). Error and bias statistics (Table 2.1-5) indicate low bias, and average error ranging from 14% to 45% at compliance points and Order Stations in the Fording River and Elk River.

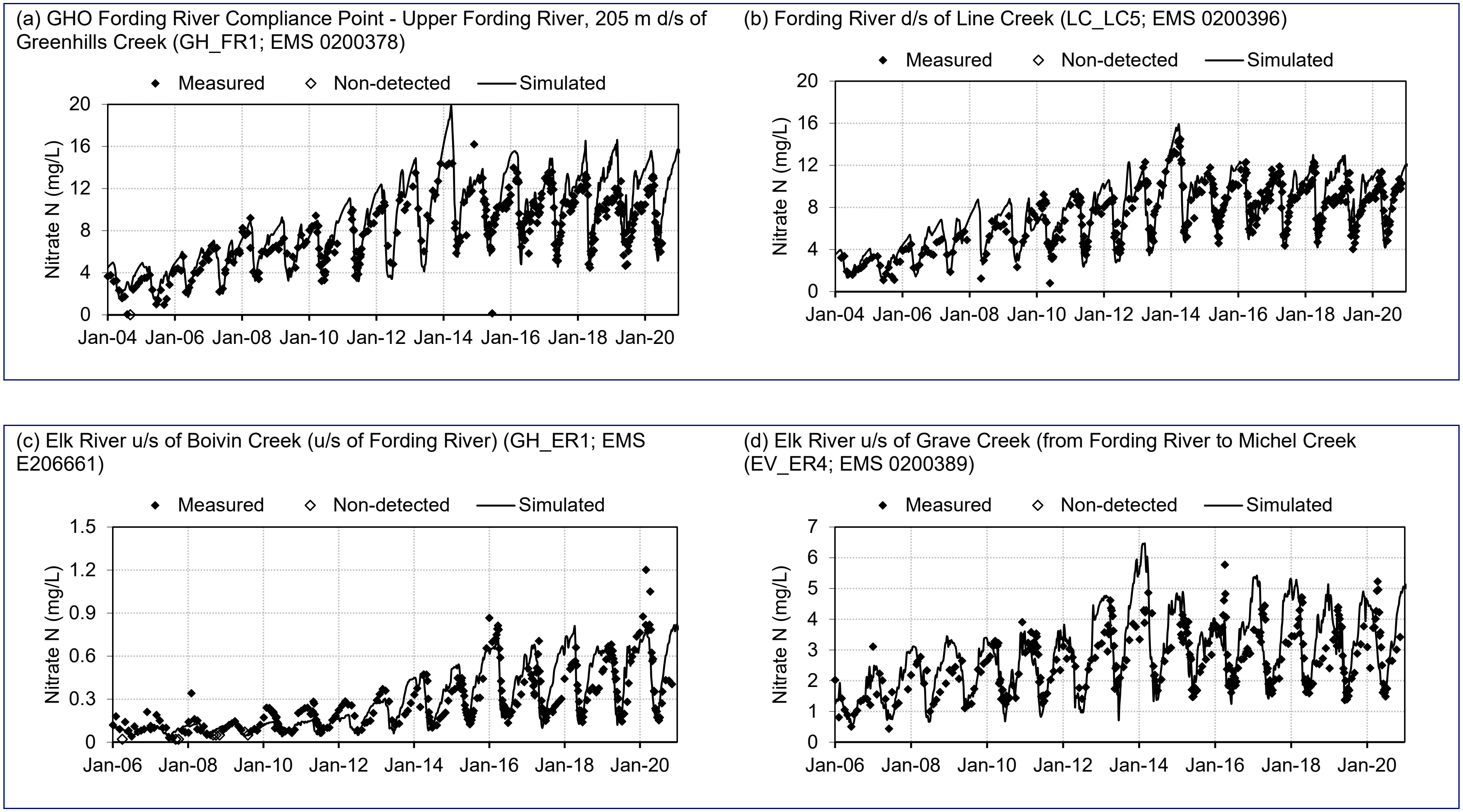
Monthly relative bias is shown in Figure 2.1-10, which illustrates the previously noted tendency for over-prediction mainly during low flow months. Each data point on the figure represents the average relative bias, calculated using Equation 38, for the given month over the calibration period (e.g., every January from 2006 to 2018), while the bars represent the range of the monthly relative bias values for the given month. A relative bias value greater than 1 indicates that the simulated concentration is greater than the measured concentration. For example, the high maximum bias value reported in May for the Fording River downstream of Line Creek and those reported in April and October for the Elk River upstream of Boivin Creek result from low measured concentrations that were not reflected in the simulated results in May 2010, April 2016, and October 2007, respectively.



Note:

When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2006 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-8 Nitrate Concentrations in Greenhills Creek and Leask Creek, 2006-2020

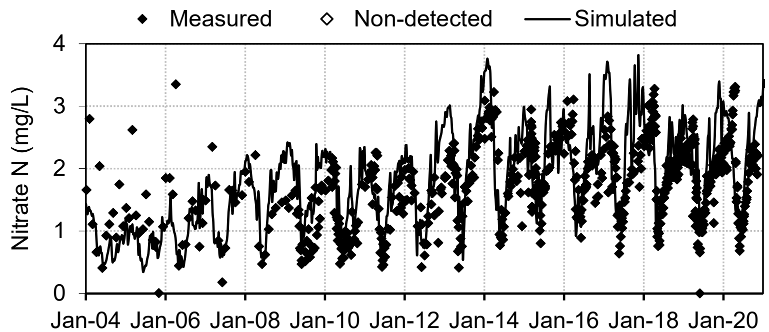


Note:

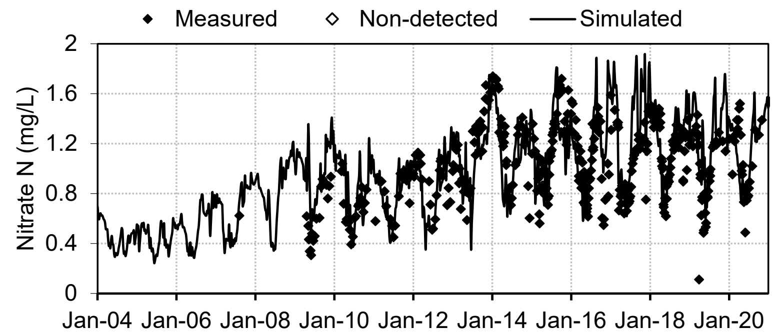
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2006 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-9 Nitrate Concentrations in the Fording River and Elk River, 2006-2020

(e) Elk River d/s of Michel Creek (EV_ER1; EMS 0200393)



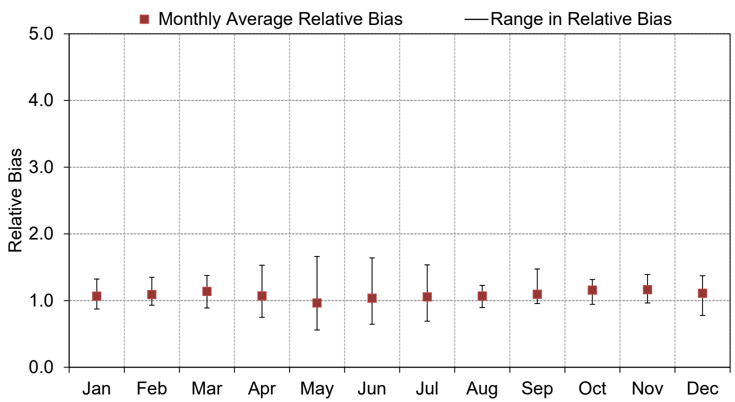
(f) Elk River at Highway 93 near Elko (RG_ELKMOUTH)



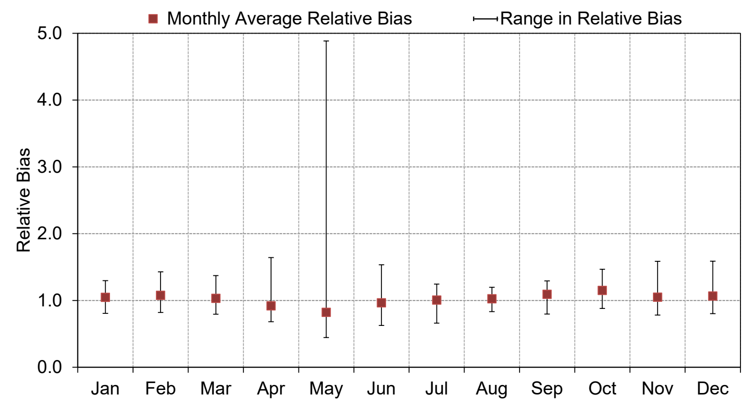
Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2006 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-9 Nitrate Concentrations in the Fording River and Elk River, 2006-2020

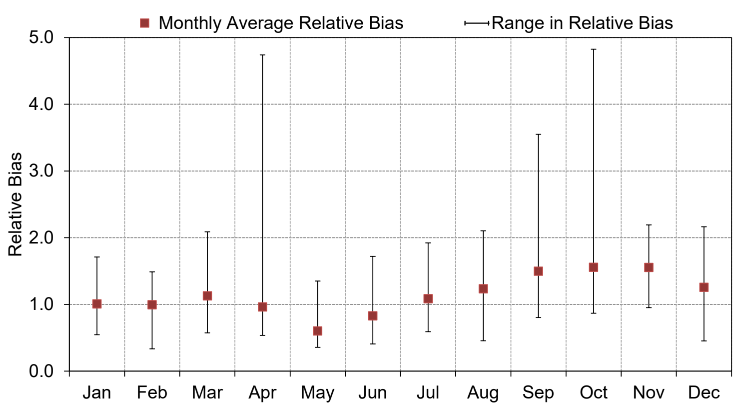
(a) GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (GH_FR1; EMS 0200378)



(b) Fording River d/s of Line Creek (LC_LC5; EMS 0200396)



(c) Elk River u/s of Boivin Creek (u/s of Fording River) (GH_ER1; EMS E206661)



(d) Elk River u/s of Grave Creek (from Fording River to Michel Creek (EV_ER4; EMS 0200389)

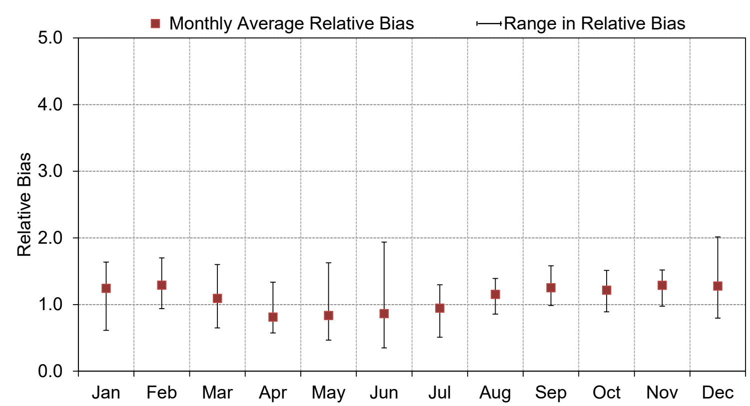
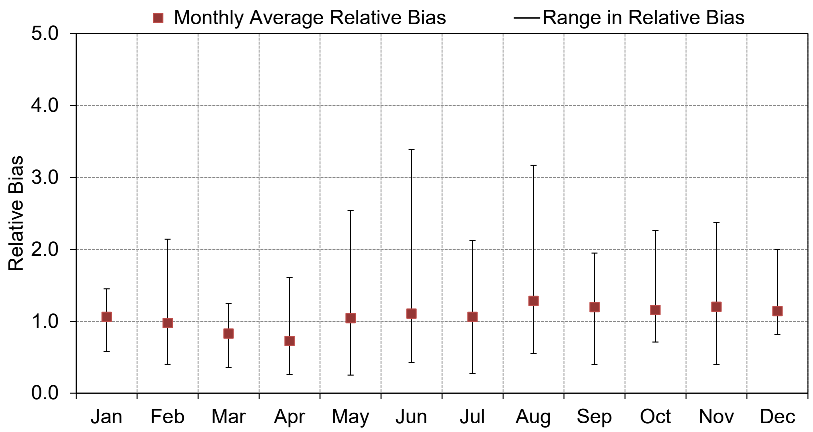


Figure 2.1-10 Nitrate Bias Values in the Fording River and Elk River, 2006-2018

(e) Elk River d/s of Michel Creek (EV_ER1; EMS 0200393)



(f) Elk River at Highway 93 near Elko (RG_ELKMOUTH)

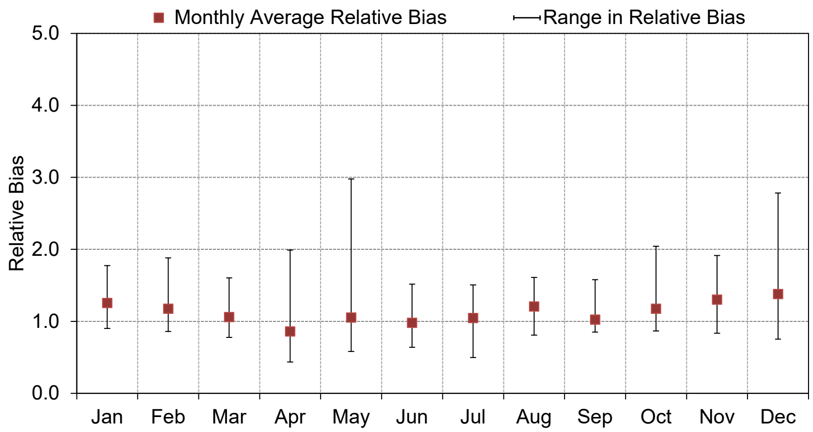


Figure 2.1-10 Nitrate Bias Values in the Fording River and Elk River, 2006-2018

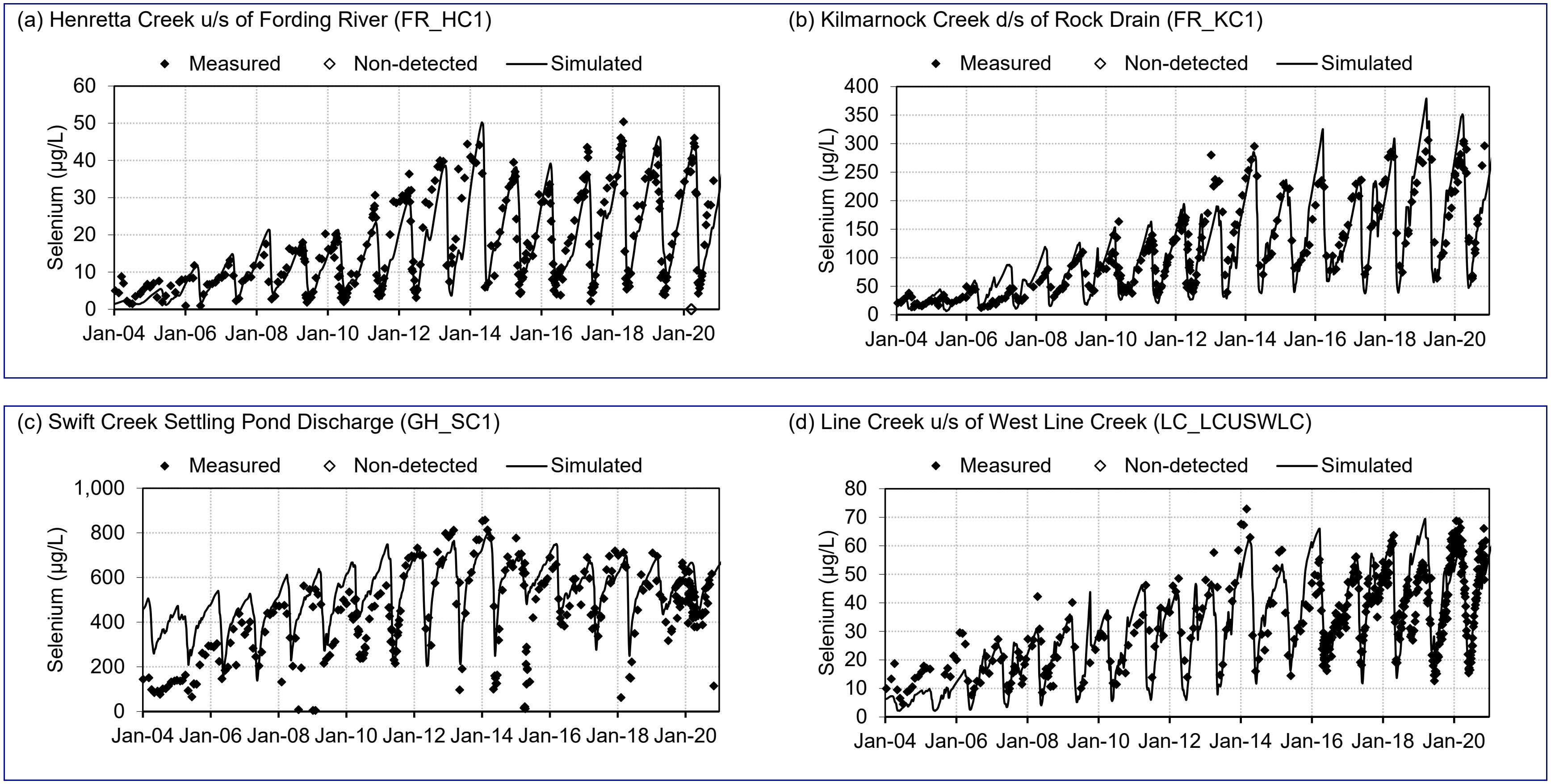
2.1.3.2 Selenium

2.1.3.2.1 Tributaries

As with nitrate, simulated selenium concentrations produced using the 2020 RWQM for mine affected tributaries to the Fording River and Elk River matched reasonably well with measured data, in terms of replicating the range of measured concentrations and matching seasonal, yearly, and longer-term trends (see Figure 2.1-11 and additional plots included in Appendix B). The range of relative bias statistics is between 0.8 and 1.3, with model error ranging from 16 to 56% (Table 2.1-7). The performance of the model in simulating selenium concentrations in mine-affected tributaries is better than that of the 2017 RWQM (see Appendix B) and supports the intended purpose for the model as a planning and assessment tool. Error in the calibration stems partially from the fact that the model outputs are weekly average concentrations, whereas the measured data are instantaneous concentrations collected through grab sampling. They are, therefore, likely to be more variable than the model output.

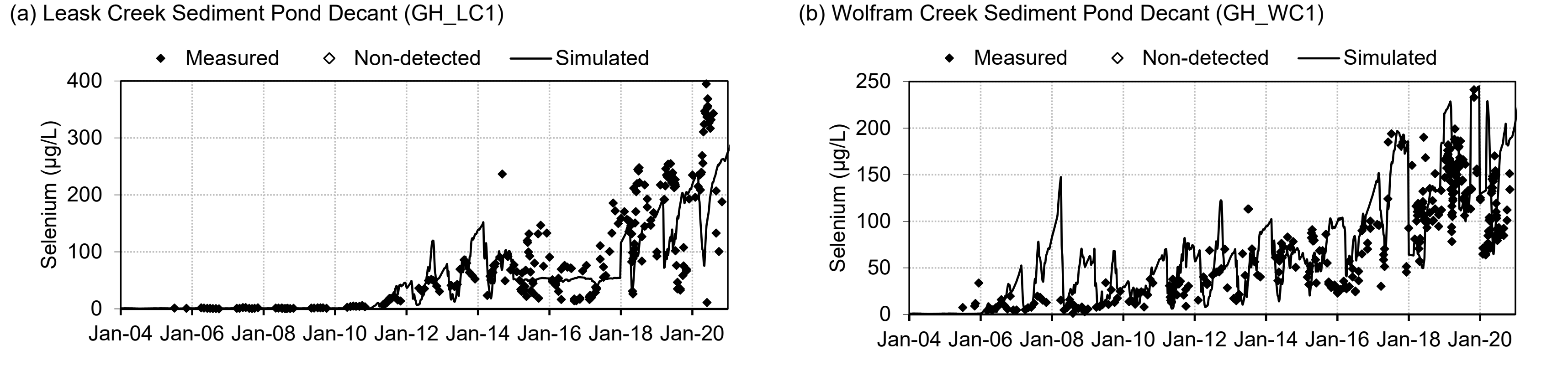
In a few tributaries at GHO, the simulated trends did not follow the observed trends as closely throughout the calibration period (Figure 2.1-12), likely as a result of uncertainty in the simulated flows and/or pumping records available from mine site water management activities. These differences did not adversely affect the ability of the model to simulate measured concentrations in the Fording River and lower Elk River (Section 2.1.3.2.2, Figure 2.1-13).

Values assigned to the calibration factors applied to the waste rock are provided in Table 2.1-8. The resulting calibrated release rates typically fall within or just outside the confidence intervals developed around the average values that were used to initiate the calibration process. Where exceptions occur, they are expected to be due to differences in the flow data used to generate the geochemical source terms and those used as input in the WQC (output from the FC of the 2020 RWQM).



Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-11 Selenium Concentrations in Henretta Creek, Kilmarnock Creek, Swift Creek and Line Creek, 2004-2020



Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-12 Selenium Concentrations in Leask Creek and Wolfram Creek, 2004-2020

Table 2.1-7 Error and Bias Results for Selenium Calibration, 2004-2018

Operation / General Location	Node ID	Node Description	Bias[a] (µg/L)	Relative Bias[b]	Error[c] (µg/L)	Percent Error[d]
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	0.81	1.0	5.5	34%
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	9.9	1.1	41	49%
	FR_LMP1	Lake Mountain Pond	-2.8	0.86	9.5	47%
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	-5.7	0.94	26	26%
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	110	1.3	133	33%
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	34	1.1	76	16%
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	5.2	1.1	16	22%
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	1.6	1.0	25	31%
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	-14	0.78	28	44%
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	5.3	1.1	31	56%
	GH_TC1	Thompson Creek at LRP Road (E102714)	-7.7	0.89	20	28%
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	0.091	1.0	3.7	56%
	LC_DCDS	Dry Creek d/s of Sedimentation Ponds	0.39	1.1	3.4	51%
	LC_DC1	Dry Creek near mouth (at bridge) (E288270)	-0.056	0.98	1.7	56%
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	1.1	1.0	6.5	20%
	LC_WLC	West Line Creek (E261958)	-24	0.94	75	18%
	LC_LC3	Line Creek d/s of West Line Creek (0200337)	-4.7	0.92	16	28%
	LC_LCDSSLCC	LCO Compliance Point (Line Creek d/s of South Line Creek confluence) (E297110)	3.8	1.1	8.7	21%
	LC_LC4	Line Creek u/s of Process Plant (0200044)	2.0	1.1	7.6	24%
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	18	1.2	20	19%
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	2.4	1.0	37	32%
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	0.9	1.0	45	31%
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	-15	0.89	29	21%
	EV_HC1	EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (E102682)	-2.3	0.92	8.2	28%
Fording River	FR_FR1	Fording River d/s of Henretta Creek (0200251)	-0.34	0.97	4.1	37%
	FR_FR2	Fording River u/s of Kilmarnock Creek (0200201)	4.5	1.2	7.3	27%
	FR_FR4	Fording River between Swift and Cataract Creeks (0200311)	8.4	1.2	14	40%
	FR_FRCP1[e]	Fording River, 525 m d/s of Cataract Creek (E300071)	-49	0.61	63	51%

Table 2.1-7 Error and Bias Results for Selenium Calibration, 2004-2018

Operation / General Location	Node ID	Node Description	Bias[a] (µg/L)	Relative Bias[b]	Error[c] (µg/L)	Percent Error[d]
Fording River	GH_PC2	Fording River d/s of Porter Creek (E287431)	0.33	1.0	11	19%
	FR_FRABCH	FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (E223753)	-1.5	0.98	11	15%
	LC_FRDSDC	Fording River d/s of Dry Creek (E288272)	2.1	1.1	6.4	17%
	GH_FR1	GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (0200378)	-0.23	0.99	5.9	17%
	LC_LC5	Fording River d/s of Line Creek (0200028)	-0.31	0.99	4.8	16%
Michel Creek	**CM_MC2**	CMO Compliance Point (Michel Creek d/s of CMO near Andy Goode Creek junction) (E258937)	5.3	2.0	5.3	100%
	EV_MC3	Michel Creek u/s of Erickson Creek (0200203)	0.87	1.7	0.99	79%
	EV_MC2	EVO Michel Creek Compliance Point (E300091)	-4.9	0.66	5.3	37%
	EV_MC1	Michel Creek u/s of Highway 43 Bridge (0200425)	4.3	1.6	4.6	60%
Elk River	**GH_ERC**	GHO Elk River Compliance Point - Elk River, 220 m d/s of Thompson Creek (E300090)	0.56	1.3	0.85	52%
	GH_ER1	Elk River u/s of Boivin Creek (u/s of Fording River; E206661)	-0.031	0.98	0.42	30%
	EV_ER4	Elk River u/s of Grave Creek (from Fording River to Michel Creek) (0200389)	-0.017	1.0	2.5	24%
	EV_ER2	Elk River u/s of Michel Creek (0200111)	0.11	1.0	1.9	23%
	EV_ER1	Elk River d/s of Michel Creek (0200393)	0.63	1.1	1.7	21%
	RG_ELKORES	Elk River at Elko Reservoir (E294312)	0.29	1.0	0.9	14%
	RG_ELKMOUTH	Elk River at Highway 93 near Elko; ECCC station BC08NK0003	0.23	1.0	0.76	16%
Koocanusa Reservoir	**RG_DSELK**[f]	Koocanusa Reservoir - South of the Elk River (E300230)	0.012	1.0	0.16	14%

[a] Bias represents the average difference between simulated and measured concentrations. A positive bias indicates that modelled concentrations are greater, on average, than measured concentrations, whereas a negative bias indicates the reverse.

[b] A relative bias greater than one indicates that modelled concentrations are greater, on average, than measured concentrations, whereas a negative bias indicates the reverse.

[c] The error represents the average absolute difference between simulated and measured concentrations.

[d] The percent error represents the ratio of the error to the average measured concentration.

[e] Simulated concentrations at FR_FRCP1 reflect fully mixed conditions, whereas measured data collected during low flow periods reflect primarily the quality of Cataract Creek water; hence, the difference between simulated concentrations and measured data during low flow periods.

[f] The comparison of simulated to measured data considers measured data at the four stations located downstream of the Elk River: RG_DSELK, RG_GRASMERE, RG_USGOLD and RG_BORDER.

ID = Identification; CMO = Coal Mountain Operations; d/s = downstream; ECCC = Environment and Climate Change Canada; u/s = upstream; m = metre; µg/L = micrograms per litre.

Note: Sites in **bold** font correspond to Order Stations and Compliance Points listed in EMA Permit 107517; Order Stations are indicated by underlined font.

Table 2.1-8 Loading Rates and Calibration Factors for Selenium, 2004-2018

Operation / General Location	Node ID	Node Description	Average Loading Rate (mg/BCM/yr)	Confidence Interval (mg/BCM/yr)[a]	Calibration Factor	Calibrated Loading Rate (mg/BCM/yr)
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	4.4	3.1 to 7.5	0.5	2.2
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	1.7	1.1 to 2.7	0.8	1.3
	FR_LMP1	Lake Mountain Pond	4.1	2.3 to 8.7	0.3	1.2
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	3.5	2.4 to 4.9	1.1	3.8
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	5.1	3.6 to 6.9	1.0	5.1
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	4.6	3.3 to 6.0	0.7	3.2
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	4.1	2.3 to 8.7	0.4	1.7
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	4.4	3.2 to 6.1	0.6	2.7
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	1.8	0.3 to 4.3	0.7	1.2
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	3.6	1.6 to 9.4	0.2	0.73
	GH_TC1	Thompson Creek at LRP Road (E102714)	6.9	0 to 30	0.5	3.5
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	4.1	2.3 to 8.7	0.5	2.1
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	5.6	2.4 to 11	0.3 & 0.4[b]	1.7 & 2.2[b]
	LC_WLC	West Line Creek (E261958)	7.7	5.4 to 13	0.6	4.6
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	1.6	1.4 to 1.8	1.1	1.8
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	5.2	1.6 to 16	1.1	5.7
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	5.2	1.6 to 16	0.7	3.6
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	2.6	2.3 to 3.0	0.5	1.3

u/s = upstream; d/s = downstream; ID = identification; mg/BCM/yr = milligrams per bank cubic metre per year.

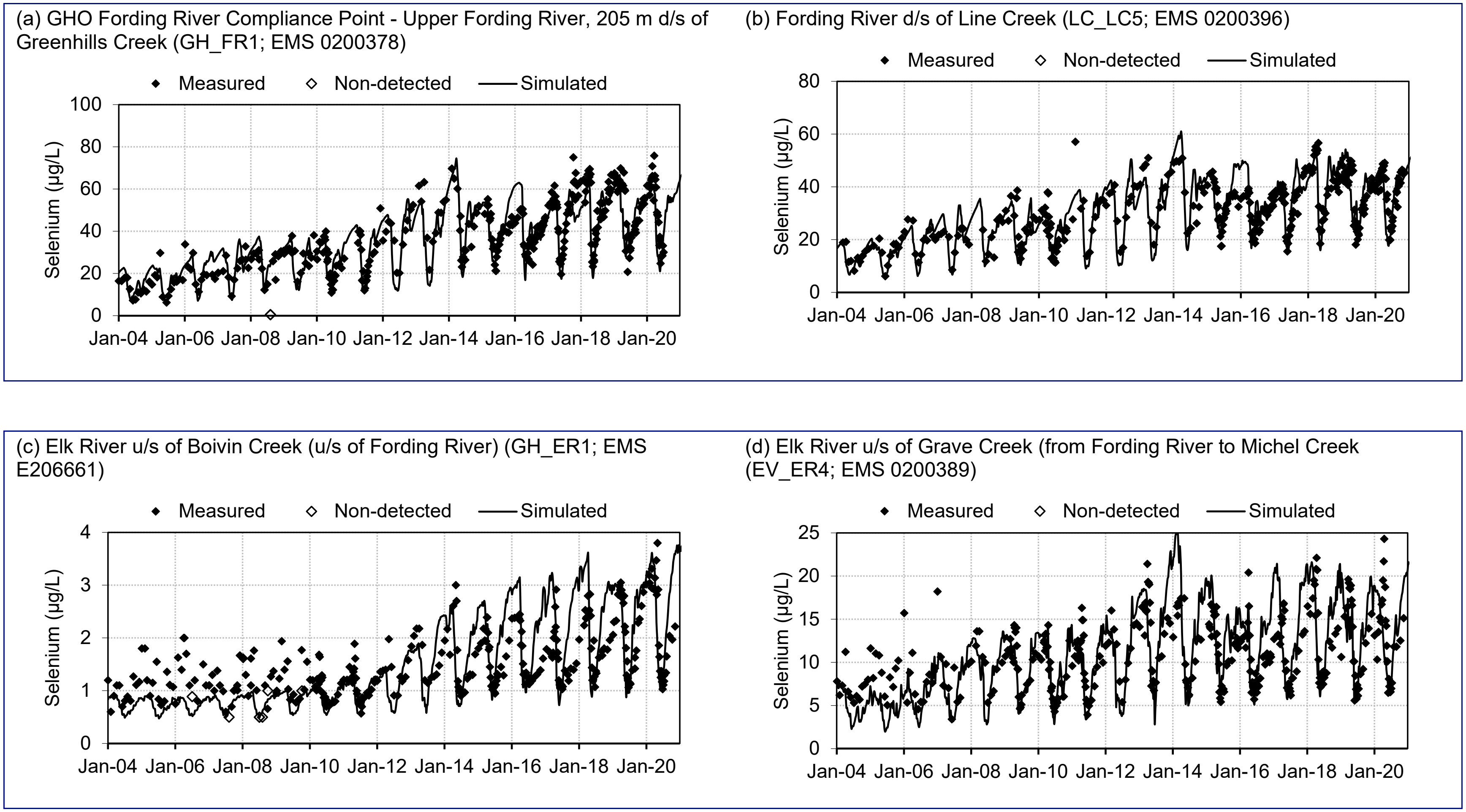
[a] Confidence interval represents the lower and upper confidence limits for average loading rates.

[b] A calibration factor of 0.3 was applied to the Upper Line Creek and Horseshoe Creek sub-catchments and 0.4 was applied to the Horseshoe Ridge Pit, No Name Creek, Mine Services Area West, North Line Creek and Centre Line Creek sub-catchments.

2.1.3.2.2 Fording River and Elk River

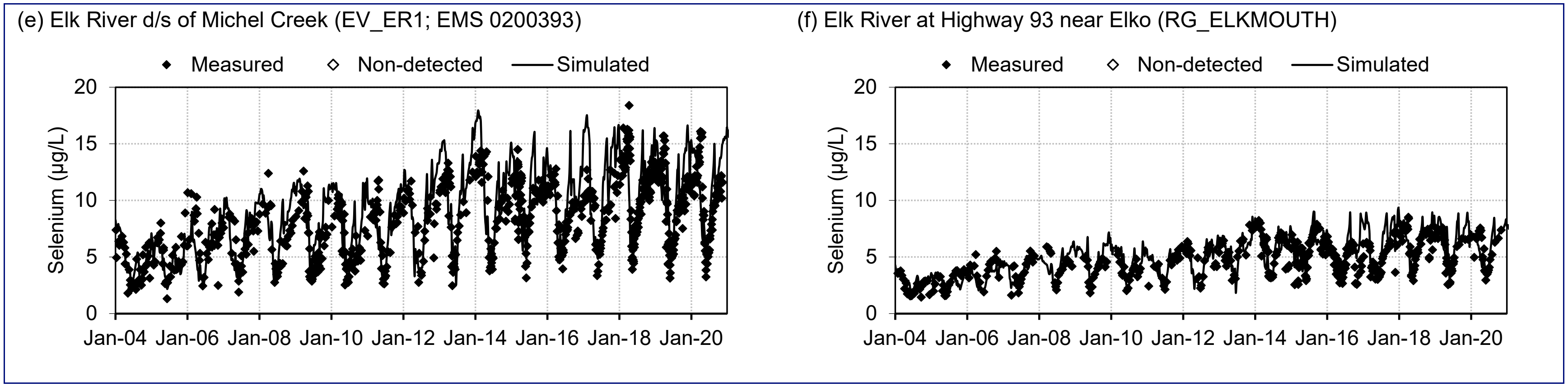
Simulated results in the Fording River and Elk River matched reasonably well with the range of measured concentrations and seasonal, yearly, and longer-term trends (Figure 2.1-13 and Appendix B). A near-neutral to positive bias was maintained throughout the Fording River and Elk River (Table 2.1-7). Model error in the Fording River ranged from 14 to 40%; in the Elk River, it ranged from 14% to 52% (Table 2.1-7), with some over-prediction of concentrations in winter. Overall, the performance of the 2020 RWQM is better than to the 2017 RWQM, as illustrated in the plots included in Appendix B.

Monthly relative bias for locations in the Fording River and Elk River are shown in Figure 2.1-14. These results indicate that the model typically over-predicts, to some extent, between August and March and under-predicts between April and July in some reaches.



Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

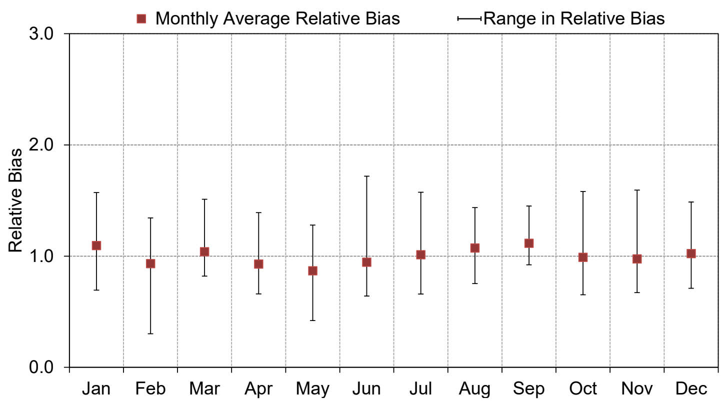
Figure 2.1-13 Selenium Concentrations in the Fording River and Elk River, 2004-2020



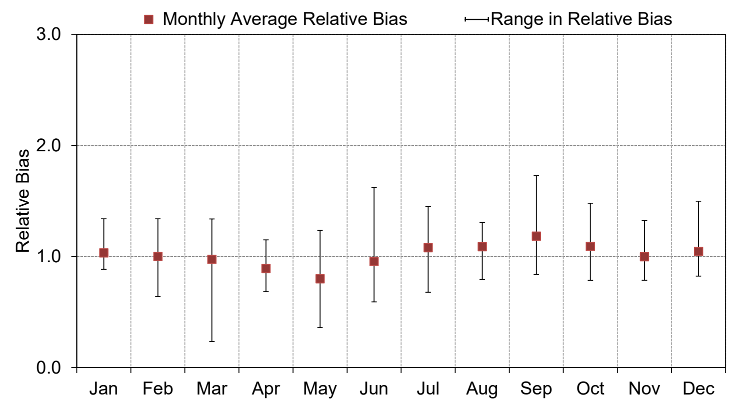
Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-13 Selenium Concentrations in the Fording River and Elk River, 2004-2020

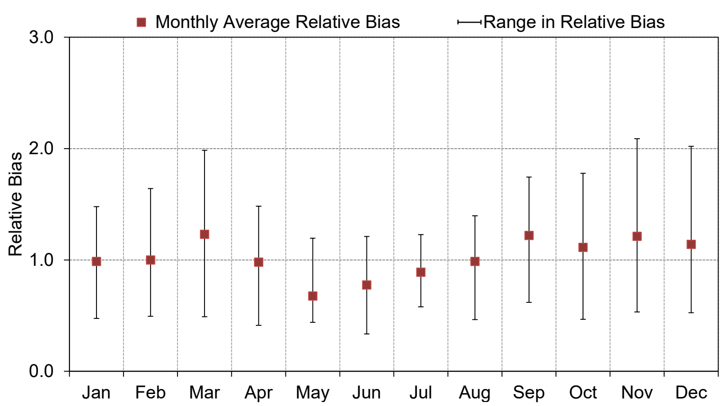
(a) GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (GH_FR1; EMS 0200378)



(b) Fording River downstream of Line Creek (LC_LC5; EMS 0200396)



(c) Elk River u/s of Boivin Creek (u/s of Fording River) (GH_ER1; EMS E206661)



(d) Elk River u/s of Grave Creek (from Fording River to Michel Creek (EV_ER4; EMS 0200389)

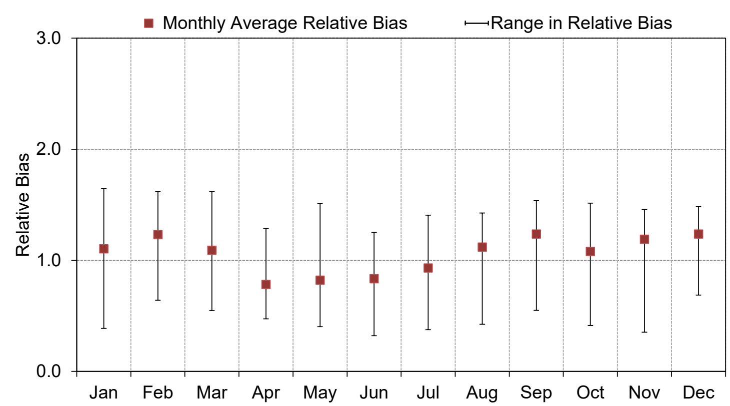
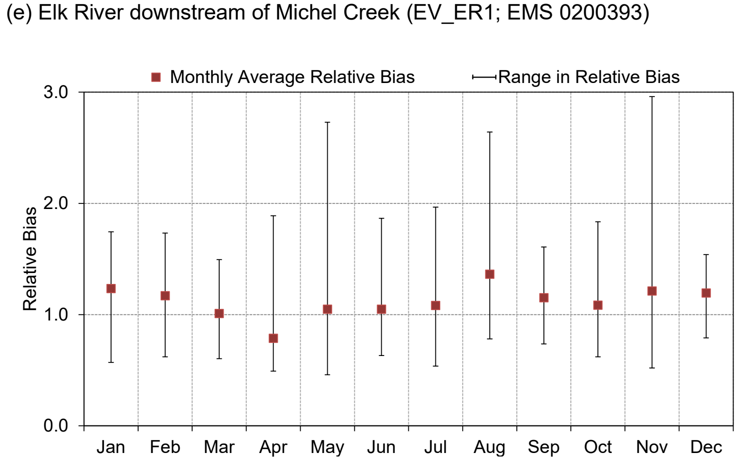


Figure 2.1-14 Selenium Bias Values in the Fording River and Elk River, 2004-2018



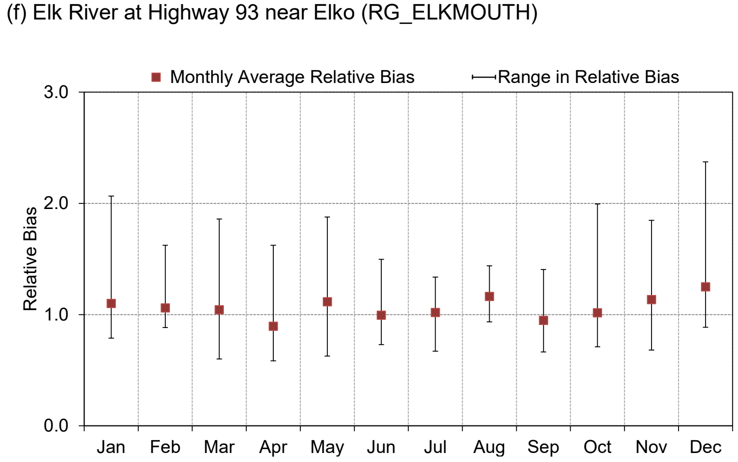


Figure 2.1-14 Selenium Bias Values in the Fording River and Elk River, 2004-2018

2.1.3.3 Sulphate

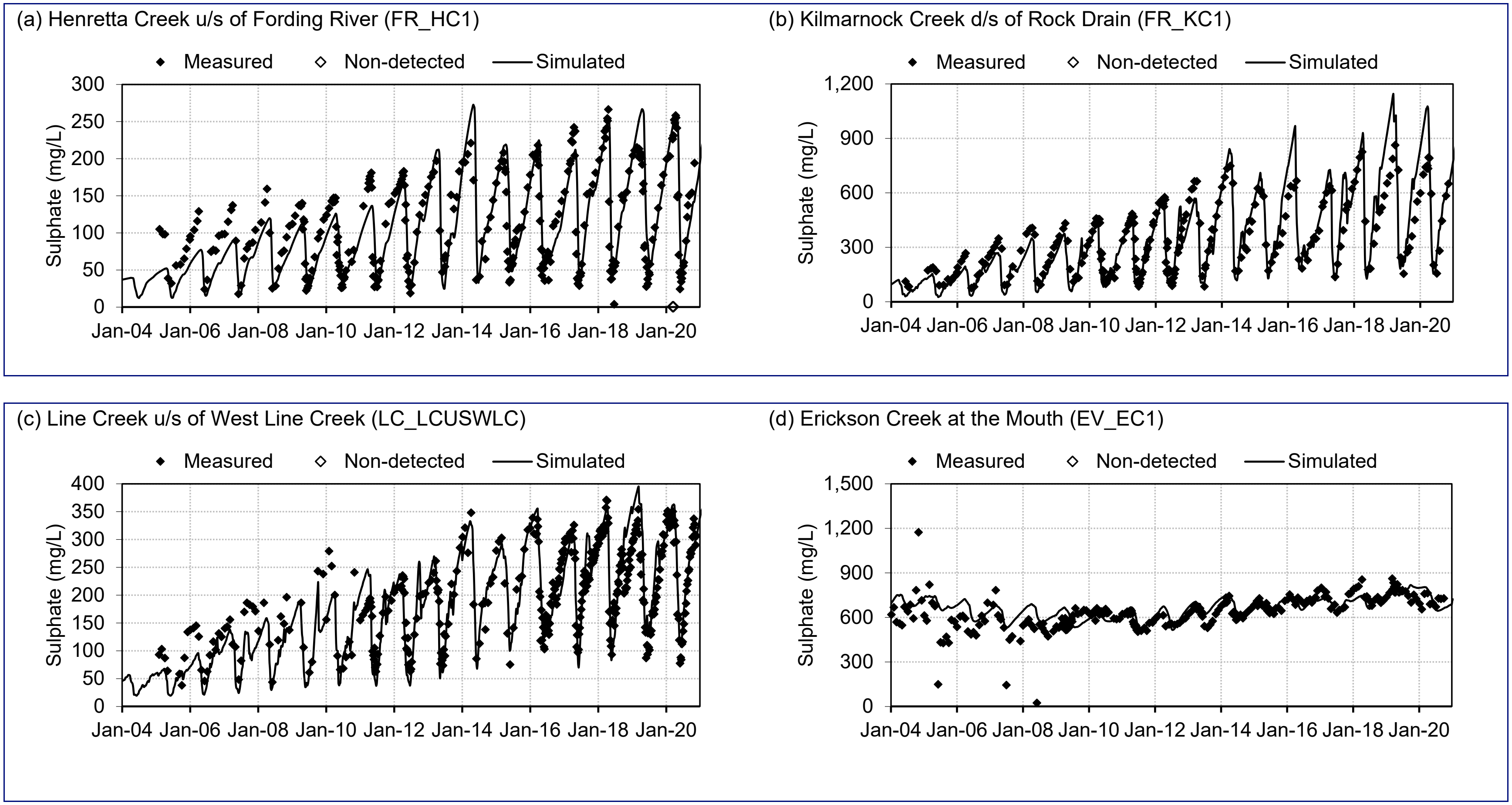
2.1.3.3.1 Tributaries

Simulated sulphate concentrations in tributaries to the Fording River and Elk River, after calibration, matched reasonably well with measured data in terms of replicating the range of measured concentrations and matching seasonal, yearly, and longer-term trends (see Figure 2.1-15 and additional plots in Appendix B). The 2020 model updates have resulted in improved performance in tributaries relative to that of the 2017 RWQM, as illustrated in the plots included in Appendix B.

In several tributaries, including in Leask Creek and Wolfram Creek, simulated trends did not always follow the observed trends (Figure 2.1-16). A similar pattern was noted for selenium and nitrate and is likely a result of uncertainty in the simulated flows and/or pumping records available from mine site water management activities. These differences did not detrimentally affect the ability of the model to accurately simulate measured concentrations in the Fording River and Elk River, and the performance of the 2020 RWQM in these tributaries is better than that of the 2017 RWQM (see Appendix B).

Relative bias in the sulphate calibration is typically between 0.8 and 1.2, with error ranging from 10 to 40% (Table 2.1-9). These values indicate that the WQC is better able to replicate seasonal and longer-term patterns than individual measured data points. As previously noted, some of the model error stems from the fact that the model outputs are weekly average concentrations, whereas the measured data were collected by grab sampling, which represents an instantaneous concentration at the time of collection.

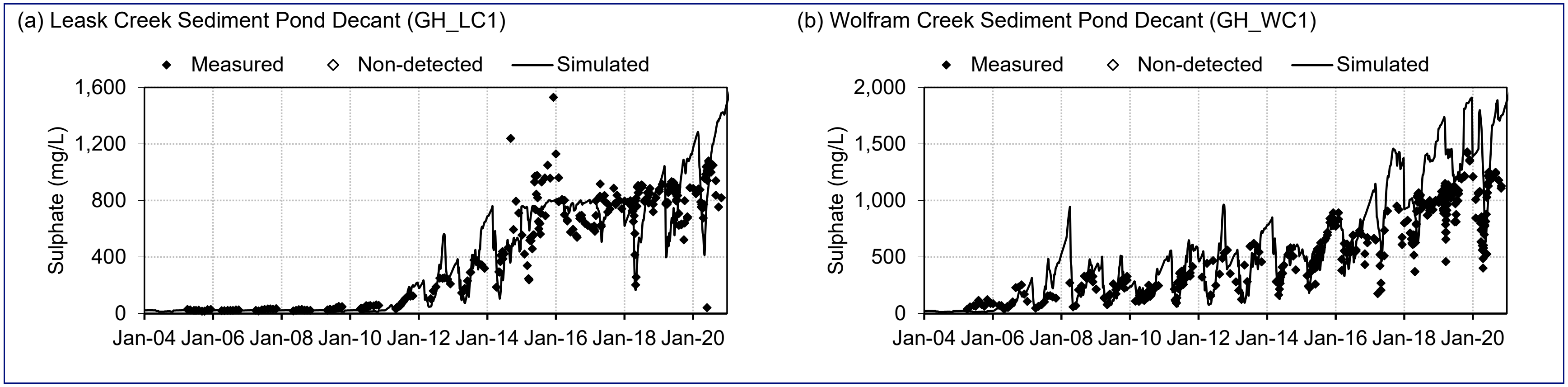
Sulphate calibration factors applied to the waste rock are provided in Table 2.1-10. In general, the calibrated rates fall within or just outside the confidence intervals developed around the average values that were used to initiate the calibration process. Where exceptions occur, they are likely due to differences in the flow data used to generate the geochemical source terms and those used as input in the WQC (output from the FC; Annex B).



Note:

When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-15 Sulphate Concentrations in Henretta Creek, Kilmarnock Creek, Line Creek and Erickson Creek, 2004-2020



Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-16 Sulphate Concentrations in Leask Creek and Wolfram Creek, 2004-2020

Table 2.1-9 Error and Bias Results for Sulphate Calibration, 2004-2018

Operation / General Location	Node ID	Node Description	Bias[(a)] (mg/L)	Relative Bias[(b)]	Error[(c)] (mg/L)	Percent Error[(d)]
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	1.6	1.0	30	28%
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	20	1.1	91	34%
	FR_LMP1	Lake Mountain Pond	-5.5	0.94	32	32%
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	-14	0.96	61	19%
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	254	1.2	287	27%
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	170	1.1	210	15%
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	43	1.1	84	22%
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	21	1.0	96	21%
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	-36	0.91	117	28%
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	53	1.1	157	36%
	GH_TC1	Thompson Creek at LRP Road (E102714)	11	1.0	93	21%
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	-5.9	0.78	11	40%
	LC_DCDS	Dry Creek d/s of Sedimentation Ponds	-5.5	0.8	10	37%
	LC_DC1	Dry Creek near mouth (at bridge) (E288270)	-0.71	0.94	3.3	28%
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	-3.7	0.98	31	16%
	LC_WLC	West Line Creek (E261958)	-81	0.91	158	17%
	LC_LC3	Line Creek d/s of West Line Creek (0200337)	-34	0.87	47	18%
	LC_LCDSSLCC	LCO Compliance Point (Line Creek d/s of South Line Creek confluence) (E297110)	-17	0.92	35	17%
	LC_LC4	Line Creek u/s of Process Plant (0200044)	-11	0.93	24	16%
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	33	1.1	62	10%
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	28	1.0	175	25%
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	38	1.1	198	30%
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	77	1.1	118	18%
	EV_HC1	EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (E102682)	2.0	1.0	41	25%
Fording River	FR_FR1	Fording River d/s of Henretta Creek (0200251)	-0.76	0.99	19	25%
	FR_FR2	Fording River u/s Kilmarnock Creek (0200201)	-8.2	0.95	27	17%
	FR_FR4	Fording River between Swift and Cataract Creeks (0200311)	7.8	1.0	37	22%
	FR_FRCP1[(e)]	Fording River, 525 m d/s of Cataract Creek (E300071)	-158	0.65	202	45%

Table 2.1-9 Error and Bias Results for Sulphate Calibration, 2004-2018

Operation / General Location	Node ID	Node Description	Bias[(a)] (mg/L)	Relative Bias[(b)]	Error[(c)] (mg/L)	Percent Error[(d)]
Fording River	GH_PC2	Fording River d/s of Porter Creek (E287431)	7.6	1.0	39	15%
	FR_FRABCH	FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (E223753)	15	1.1	37	14%
	LC_FRDSDC	Fording River d/s of Dry Creek (E288272)	18	1.1	26	17%
	<u>GH_FR1</u>	GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (0200378)	-8.8	0.95	22	13%
	<u>LC_LC5</u>	Fording River d/s of Line Creek (0200028)	-5.8	0.96	18	13%
Michel Creek	**CM_MC2**	CMO Compliance Point (Michel Creek d/s of CMO near Andy Goode Creek junction) (E258937)	49	1.2	72	31%
	EV_MC3	Michel Creek u/s of Erickson Creek (0200203)	15	1.4	18	51%
	EV_MC2	EVO Michel Creek Compliance Point (E300091)	-7.7	0.94	30	24%
	EV_MC1	Michel Creek u/s of Highway 43 Bridge (0200425)	26	1.4	28	44%
Elk River	**GH_ERC**	GHO Elk River Compliance Point - Elk River, 220 m d/s of Thompson Creek (E300090)	11	1.4	11	38%
	<u>GH_ER1</u>	Elk River u/s of Boivin Creek (u/s of Fording River; E206661)	4.6	1.2	5.8	24%
	<u>EV_ER4</u>	Elk River u/s of Grave Creek (from Fording River to Michel Creek) (0200389)	-0.9	0.99	13	19%
	EV_ER2	Elk River u/s of Michel Creek (0200111)	2.8	1.0	13	22%
	<u>EV_ER1</u>	Elk River d/s of Michel Creek (0200393)	11	1.2	16	26%
	<u>RG_ELKORES</u>	Elk River at Elko Reservoir (E294312)	6.8	1.1	8.7	16%
	RG_ELKMOUTH	Elk River at Highway 93 near Elko; ECCC station BC08NK0003	5.5	1.1	7.7	19%
Koocanusa Reservoir	**<u>RG_DSELK</u>**[(f)]	Koocanusa Reservoir - South of the Elk River (E300230)	7.6	1.3	8.0	33%

[(a)] Bias represents the average difference between simulated and measured concentrations. A positive bias indicates that modelled concentrations are greater, on average, than measured concentrations, whereas a negative bias indicates the reverse.

[(b)] A relative bias greater than one indicates that modelled concentrations are greater, on average, than measured concentrations, whereas a negative bias indicates the reverse.

[(c)] The error represents the average absolute difference between simulated and measured concentrations.

[(d)] The percent error represents the ratio of the error to the average measured concentration.

[(e)] Simulated concentrations at FR_FRCP1 reflect fully mixed conditions, whereas measured data collected during low flow periods reflect primarily the quality of Cataract Creek water; hence, the difference between simulated concentrations and measured data during low flow periods.

[(f)] The comparison of simulated to measured data considers measured data at the four stations located downstream of the Elk River: RG_DSELK, RG_GRASMERE, RG_USGOLD and RG_BORDER.

ID = Identification; CMO = Coal Mountain Operations; d/s = downstream; ECCC = Environment and Climate Change Canada; u/s = upstream; m = metre; mg/L = milligrams per litre.

Note: Sites in **bold** font correspond to Order Stations and Compliance Points listed in EMA Permit 107517; Order Stations are indicated by <u>underlined</u> font.

Table 2.1-10 Loading Rates and Calibration Factors for Sulphate, 2004-2018

Operation / General Location	Node ID	Node Description	Average Loading Rate (g/BCM/yr)	Confidence Interval (g/BCM/yr)[(a)]	Calibration Factor	Calibrated Loading Rate (g/BCM/yr)
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	27	19 to 45	0.5	14
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	5.3	3.9 to 7.9	0.8	4.2
	FR_LMP1	Lake Mountain Pond	19	10 to 37	0.3	5.7
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	10	8.4 to 14	1.2	13
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	13	8.4 to 21	1.1	15
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	14	10 to 18	0.75	10
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	19	10 to 37	0.5	9.5
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	22	17 to 28	0.6	13
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	14	2.4 to 34	0.8	11
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	39	14 to 88	0.3	12
	GH_TC1	Thompson Creek at LRP Road (E102714)	33	15 to 98	0.7	23
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	19	10 to 37	0.5	9.5
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	17	12 to 43	0.3, 0.5, 0.6, 0.8, 1.0[(b)]	5.0, 8.3, 10, 13, 17
	LC_WLC	West Line Creek (E261958)	14	11 to 22	0.7	10
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	8.9	8.1 to 9.6	1.1	10
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	23	0 to 72	1.4	33
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	23	0 to 72	0.5	12
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	15	12 to 18	0.6	8.8

u/s = upstream; d/s = downstream; ID = identification; g/BCM/yr = grams per bank cubic metre per year.

(a) Confidence interval represents the lower and upper confidence limits for average release rates.

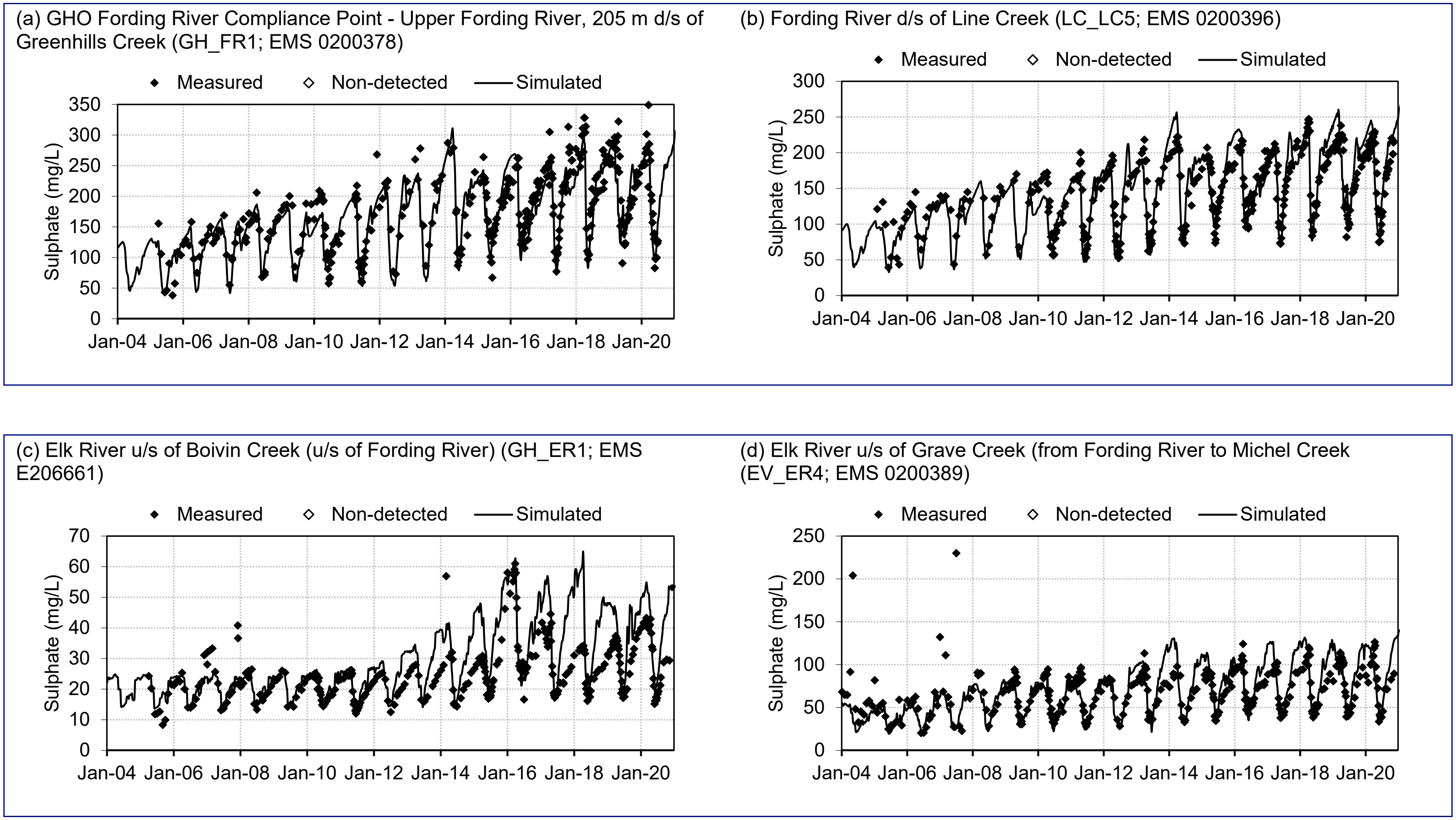
(b) A calibration factor of 0.3 was applied to the Upper Line Creek 1 sub-catchment, 0.5 was applied to the Upper Line Creek 2 and Horseshoe Ridge Pit sub-catchments, 0.6 was applied to the No Name Creek Access Road Spoils sub-catchment, 0.8 was applied to the Mine Services Area West, North Line Creek, and Centre Line Creek sub-catchments, and 1.0 was applied to the Horseshoe Creek sub-catchments.

2.1.3.3.2 Fording River and Elk River

As with nitrate and selenium, simulated sulphate concentrations in the Fording River and Elk River matched reasonably well with measured data in terms of replicating the range of measured concentrations and matching seasonal, yearly, and longer-term trends (Figure 2.1-17 and Appendix B).

Throughout most of the Fording River and Elk River, a positive bias was maintained, with relative bias values ranging from 0.9 to 1.4. Model error in the Fording River ranged from 13 to 25%. In the Elk River, it ranged from 16% to 38% (Table 2.1-9), with some over-prediction of concentrations in winter. Overall, the performance of the 2020 RWQM is better that that of the 2017 RWQM, as illustrated in the plots included in Appendix B.

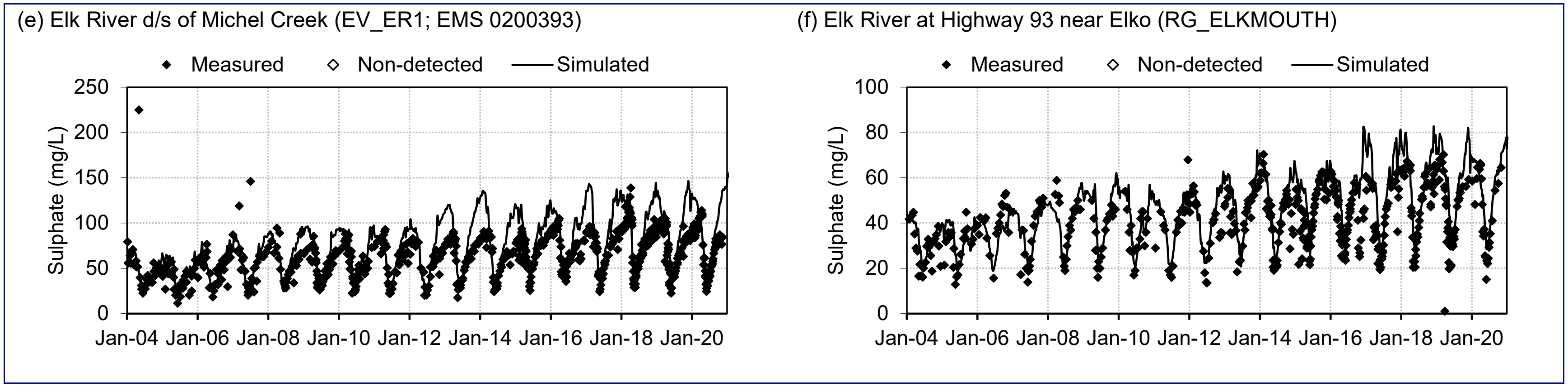
Monthly relative bias for locations in the Fording River and Elk River are shown in Figure 2.1-18. These results indicate that the model typically over-predicts sulphate concentrations, to some extent, between August and March and under-predicts between April and July in some reaches.



Note:

When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-17 Sulphate Concentrations in the Fording River and Elk River, 2004-2020



Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-17 Sulphate Concentrations in the Fording River and Elk River, 2004-2020

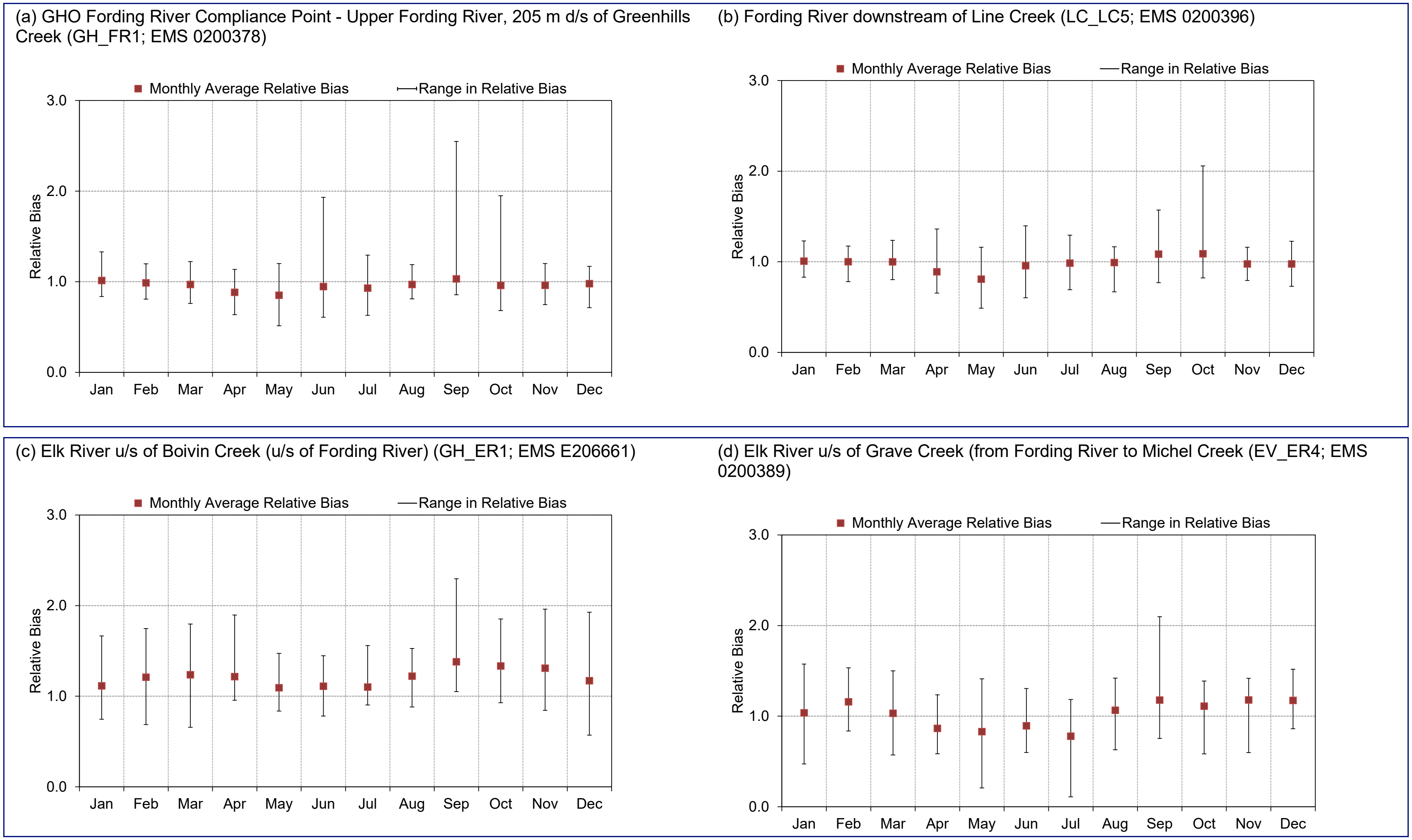


Figure 2.1-18 Sulphate Bias Values in the Fording River and Elk River, 2004-2018

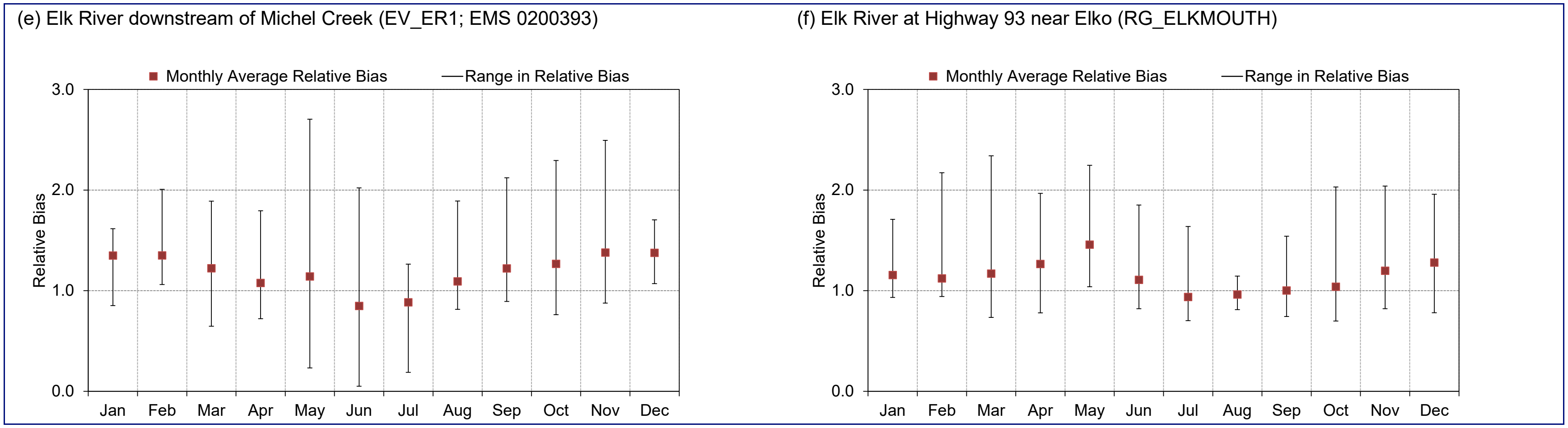


Figure 2.1-18 Sulphate Bias Values in the Fording River and Elk River, 2004-2018

2.1.3.4 Cadmium

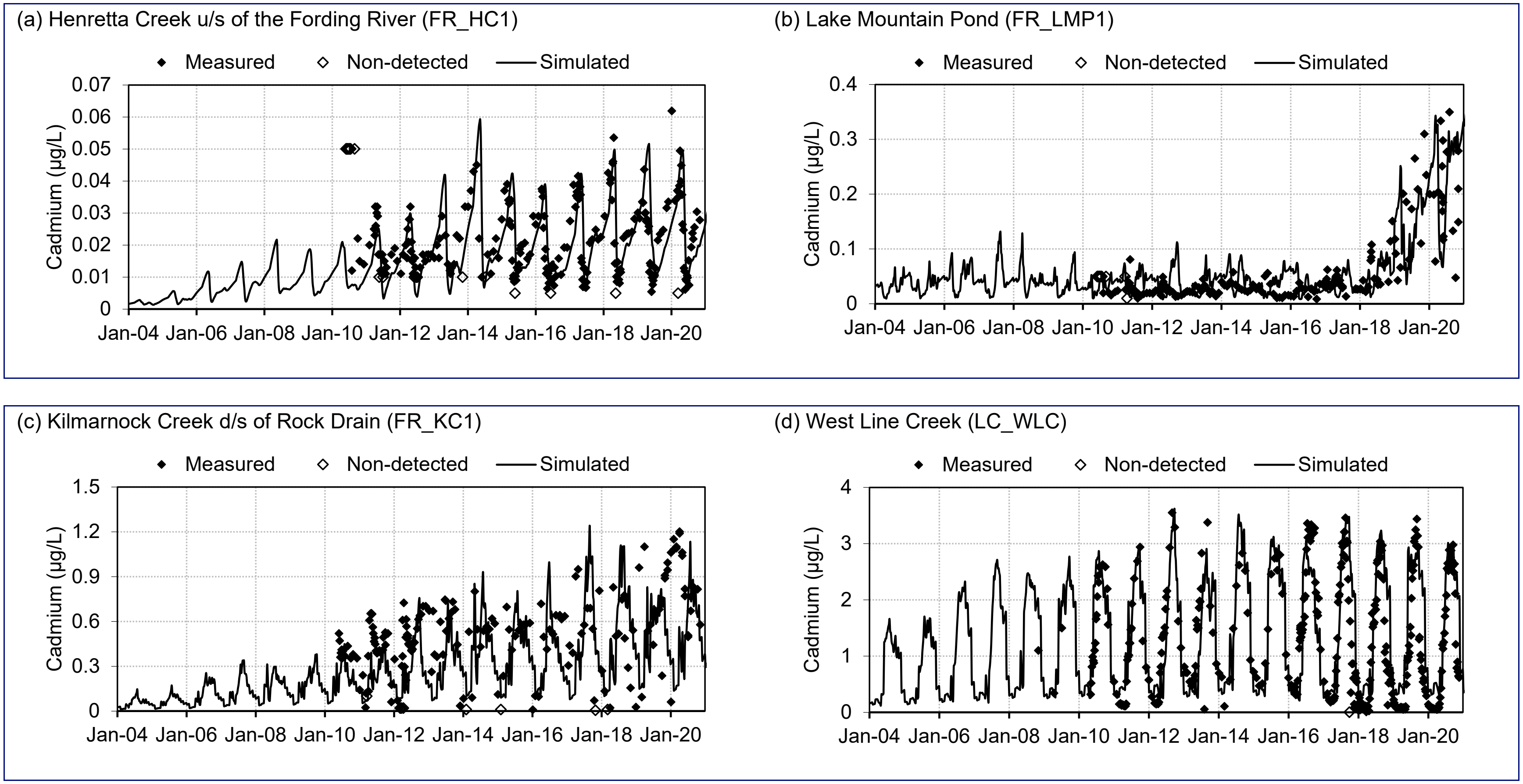
2.1.3.4.1 Tributaries

Model performance for cadmium is mixed. In some mine-affected tributaries, simulated concentrations mirrored the measured range and followed seasonal patterns (Figure 2.1-19, with additional figures in Appendix B). In other tributaries, such as Clode Creek and Leask Creek, model performance was poor (Figure 2.1-20), indicating that further refinement of the model for cadmium in specific drainages may be warranted. Nevertheless, the 2020 model updates have resulted in better performance in tributaries relative to that of the 2017 RWQM, as illustrated in the plots in Appendix B.

Cadmium calibration factors applied to the attenuation that occurs between spoils (i.e., the point of release) and the first downstream modelling nodes are provided in Appendix C. In general, the calibrated attenuation factors were within +/- 20% of the average values that were used to initiate the calibration process (Annex A). Where exceptions occur, they are likely due to differences in the flow data used to initially estimate the attenuation factors (monitored information) and those used as input in the WQC (output from the FC of the 2020 RWQM; Annex B).

Cadmium attenuation is also occurring as water and mass move downstream between monitoring points in mine-affected tributaries (where more than one monitoring point is present) and in the mainstems of Line Creek and the Fording River. The values assigned as load reduction factors to account for this process are shown in Appendix D. The load reduction factors apply year-round.

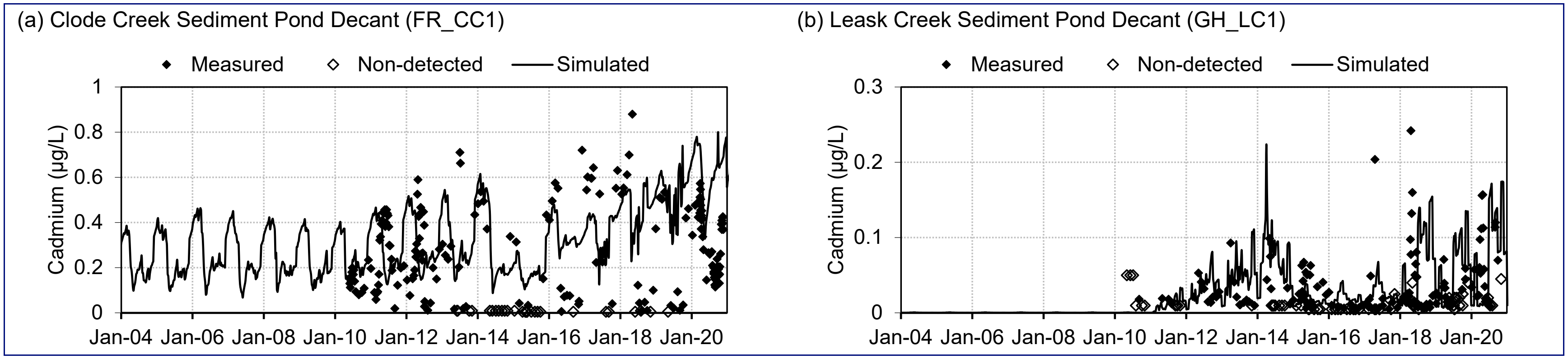
Relative bias in the cadmium calibration is typically between 0.3 and 1.7, with error ranging from 28 to 134% (Table 2.1-11). These values indicate that the WQC is better able to replicate seasonal and longer-term patterns than individual measured data points.



Note:

When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-19 Cadmium Concentrations in Henretta Creek, Lake Mountain Pond, Kilmarnock Creek and West Line Creek, 2004-2020



Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-20 Cadmium Concentrations in Clode Creek and Leask Creek, 2004-2020

Table 2.1-11 Error and Bias Results for Cadmium Calibration, 2004-2018

Operation / General Location	Node ID	Node Description	Bias[a] (µg/L)	Relative Bias[b]	Error[c] (µg/L)	Percent Error[d]
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	-0.00048	0.98	0.0094	44%
	FR_CC1	Clode Creek Sediment Pond Decant (E102481)	0.066	1.3	0.19	82%
	FR_LMP1	Lake Mountain Pond	-0.004	0.9	0.027	72%
	FR_KC1	Kilmarnock Creek d/s of Rock Drain (0200252)	-0.11	0.75	0.23	52%
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	0.03	1.1	0.25	60%
	GH_CC1	Cataract Creek Sediment Pond Decant (0200384)	-0.057	0.76	0.16	65%
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	-0.0069	0.77	0.014	47%
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	0.029	1.7	0.052	133%
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	0.0079	1.3	0.038	134%
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	-0.015	0.69	0.052	106%
	GH_TC1	Thompson Creek at LRP Road (E102714)	-0.012	0.51	0.017	66%
Line Creek Operations (LCO)	LC_DC3	Dry Creek u/s of East Tributary (E288273)	-0.028	0.55	0.034	54%
	LC_DCDS	Dry Creek d/s of Sedimentation Ponds	-0.0021	0.95	0.026	64%
	LC_DC1	Dry Creek near mouth (at bridge) (E288270)	-0.01	0.68	0.013	39%
	LC_LCUSWLC	Line Creek u/s of West Line Creek (E293369)	-0.024	0.93	0.097	28%
	LC_WLC	West Line Creek (E261958)	0.095	1.1	0.55	41%
	LC_LC3	Line Creek d/s of West Line Creek (0200337)	-0.0028	0.99	0.16	42%
	LC_LCDSSLCC	LCO Compliance Point (Line Creek d/s of South Line Creek confluence) (E297110)	-0.014	0.92	0.061	36%
	LC_LC4	Line Creek u/s of Process Plant (0200044)	0.0092	1.2	0.051	100%
Elkview Operations (EVO)	EV_EC1	Erickson Creek at the Mouth (0200097)	-0.009	0.44	0.0094	58%
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	-0.023	0.85	0.099	66%
	EV_BC1	Bodie Creek Sedimentation Pond Decant (E102685)	-0.014	0.78	0.065	98%
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	0.018	1.4	0.04	91%
	EV_HC1	EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (E102682)	-0.003	0.84	0.0071	37%
Fording River	FR_FR1	Fording River d/s of Henretta Creek (0200251)	-0.0031	0.81	0.007	42%
	FR_FR2	Fording River u/s Kilmarnock Creek (0200201)	-0.0053	0.9	0.019	36%
	FR_FR4	Fording River between Swift and Cataract Creeks (0200311)	-0.022	0.59	0.03	56%

Table 2.1-11 Error and Bias Results for Cadmium Calibration, 2004-2018

Operation / General Location	Node ID	Node Description	Bias[a] (µg/L)	Relative Bias[b]	Error[c] (µg/L)	Percent Error[d]
Fording River	FR_FRCP1[e]	Fording River, 525 m d/s of Cataract Creek (E300071)	0.013	1.4	0.025	69%
	GH_PC2	Fording River d/s of Porter Creek (E287431)	-0.015	0.63	0.017	41%
	FR_FRABCH	**FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (E223753)**	-0.007	0.81	0.012	34%
	LC_FRDSDC	Fording River d/s of Dry Creek (E288272)	-0.0011	0.95	0.0081	37%
	GH_FR1	GHO Fording River Compliance Point - Upper Fording River, 205 m d/s of Greenhills Creek (0200378)	-0.0029	0.88	0.013	52%
	LC_LC5	Fording River d/s of Line Creek (0200028)	0.0064	1.3	0.017	72%
Michel Creek	**CM_MC2**	CMO Compliance Point (Michel Creek d/s of CMO near Andy Goode Creek junction) (E258937)	0.046	2.4	0.053	164%
	EV_MC3	Michel Creek u/s of Erickson Creek (0200203)	0.00084	1.0	0.0067	36%
	EV_MC2	EVO Michel Creek Compliance Point (E300091)	-0.0091	0.71	0.011	35%
	EV_MC1	Michel Creek u/s of Highway 43 Bridge (0200425)	-0.00063	0.97	0.0087	39%
Elk River	**GH_ERC**	GHO Elk River Compliance Point - Elk River, 220 m d/s of Thompson Creek (E300090)	-0.00078	0.9	0.0018	25%
	GH_ER1	Elk River u/s of Boivin Creek (u/s of Fording River; E206661)	-0.0071	0.48	0.0078	57%
	EV_ER4	Elk River u/s of Grave Creek (from Fording River to Michel Creek) (0200389)	-0.00034	0.98	0.0078	53%
	EV_ER2	Elk River u/s of Michel Creek (0200111)	-0.0013	0.91	0.0085	57%
	EV_ER1	Elk River d/s of Michel Creek (0200393)	0.000084	1.0	0.0056	37%
	RG_ELKORES	Elk River at Elko Reservoir (E294312)	-0.001	0.93	0.0044	31%
	RG_ELKMOUTH	Elk River at Highway 93 near Elko; ECCC station BC08NK0003	0.001	1.1	0.0031	32%
Koocanusa Reservoir	**RG_DSELK**[f]	Koocanusa Reservoir - South of the Elk River (E300230)	-0.00016	0.97	0.0021	36%

[a] Bias represents the average difference between simulated and measured concentrations. A positive bias indicates that modelled concentrations are greater, on average, than measured concentrations, whereas a negative bias indicates the reverse.

[b] A relative bias greater than one indicates that modelled concentrations are greater, on average, than measured concentrations, whereas a negative bias indicates the reverse.

[c] The error represents the average absolute difference between simulated and measured concentrations.

[d] The percent error represents the ratio of the error to the average measured concentration.

[e] Simulated concentrations at FR_FRCP1 reflect fully mixed conditions, whereas measured data collected during low flow periods reflect primarily the quality of Cataract Creek water; hence, the difference between simulated concentrations and measured data during low flow periods.

[f] The comparison of simulated to measured data considers measured data at the four stations located downstream of the Elk River: RG_DSELK, RG_GRASMERE, RG_USGOLD and RG_BORDER.

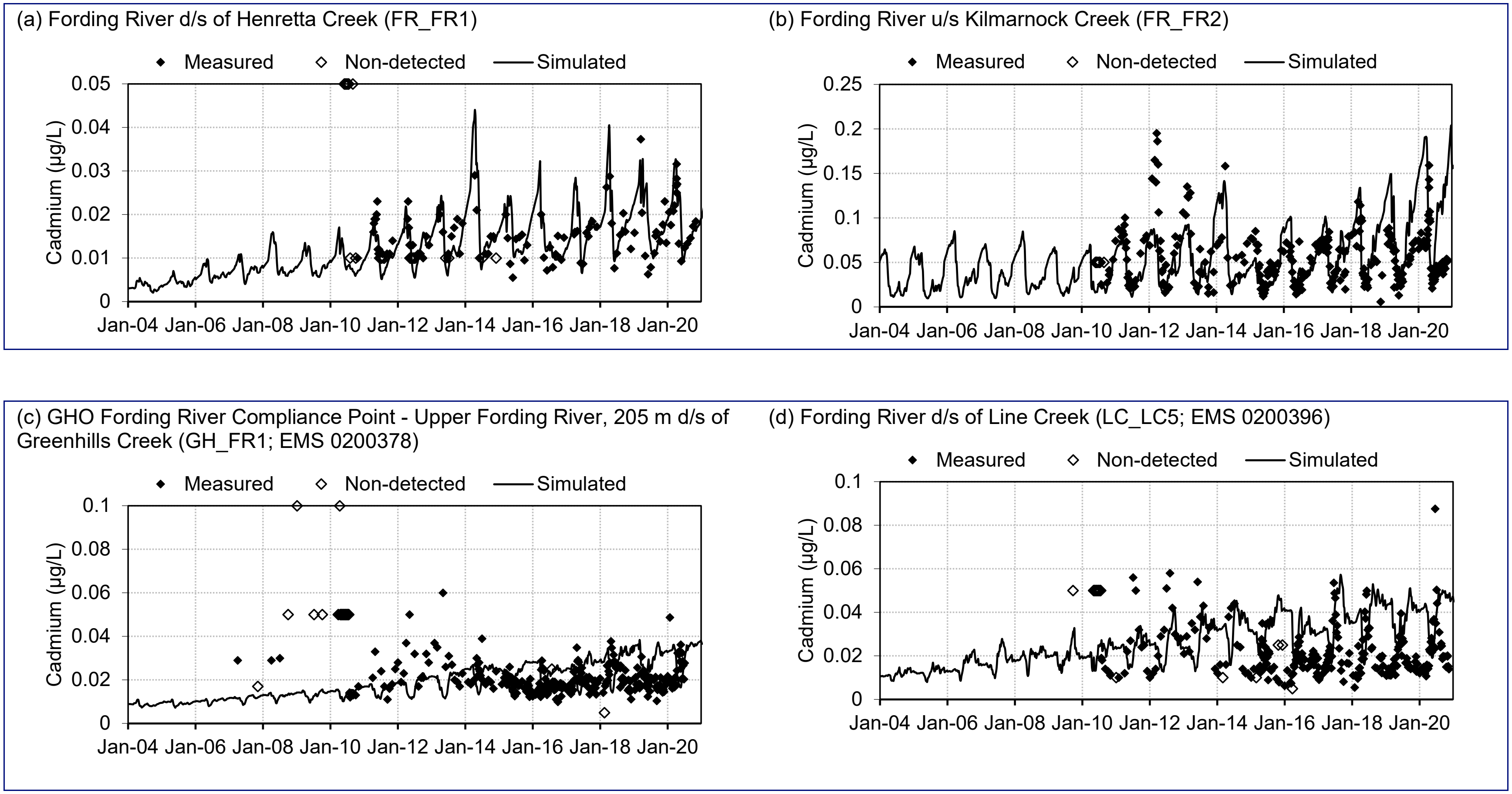
ID = Identification; CMO = Coal Mountain Operations; d/s = downstream; u/s = upstream; m = metre; mg/L = milligrams per litre.

Note: Sites in **bold** font correspond to Order Stations and Compliance Points listed in EMA Permit 107517; Order Stations are indicated by underlined font.

2.1.3.4.2 Fording River and Elk River

Simulated cadmium concentrations matched reasonably well with measured data in terms of replicating the range of measured concentrations and matching seasonal and yearly trends in the Fording River downstream of Henretta Creek (FR_FR1), upstream of Kilmarnock Creek (FR_FR2) and between Swift Creek and Cataract Creek (FR_FR4; Figure 2.1-21 and Appendix B). Farther downstream, at the GHO Fording River Compliance Point (GH_FR1) and Fording River downstream of Line Creek (LC_LC5), and in the Elk River upstream of Grave Creek (EV_ER4), there is a longer-term, increasing trend in simulated cadmium concentrations that is not evident in the measured data (Figure 2.1-21). The longer-term, increasing trend is due to the correlation between cadmium and sulphate release from waste rock (Section 1.4.2).

Relative bias ranged from 0.6 to 1.3 and model error ranged from 34 to 72% in the Fording River (Table 2.1-11). In the Elk River, relative bias ranged from 0.5 to 1.1, and model error ranged from 25 to 57%. The relative bias statistics indicate that the model tends to under-estimate measured concentrations in the Fording River during freshet and in the Elk River throughout most of the year (Figure 2.1-22). However, because simulated cadmium concentrations showed a longer-term, increasing trend that was not evident in the measured data, the goal of the calibration process was to not over-predict in the latter half of the calibration period. That said, the performance of the 2020 RWQM has improved compared to the 2017 RWQM, as illustrated in the plots included in Appendix B.

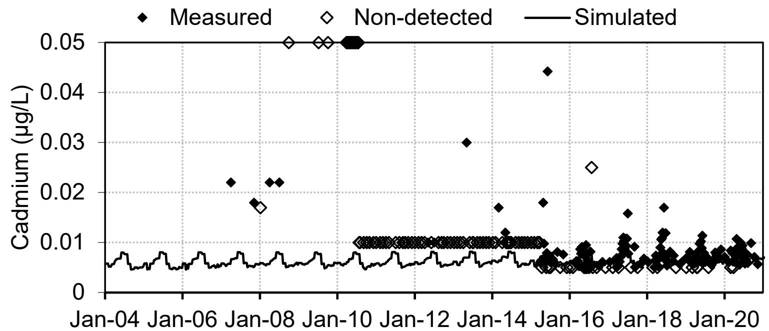


Note:

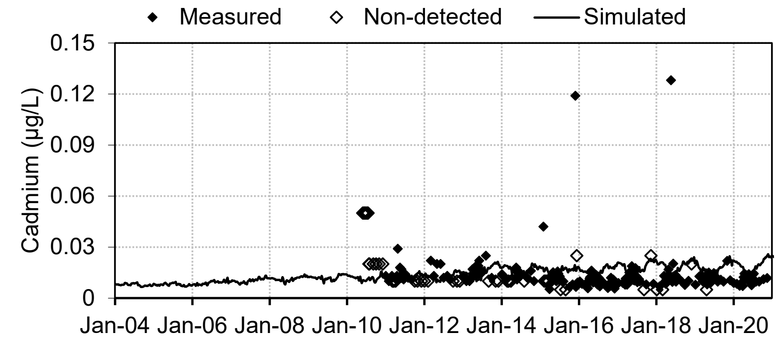
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-21 Cadmium Concentrations in the Fording River and Elk River, 2004-2020

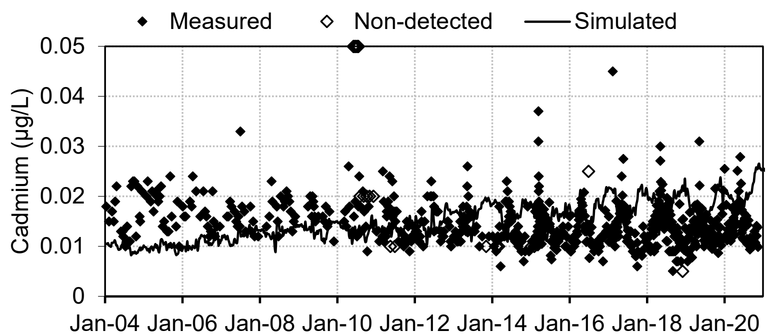
(e) Elk River u/s of Boivin Creek (u/s of Fording River) (GH_ER1; EMS E206661)



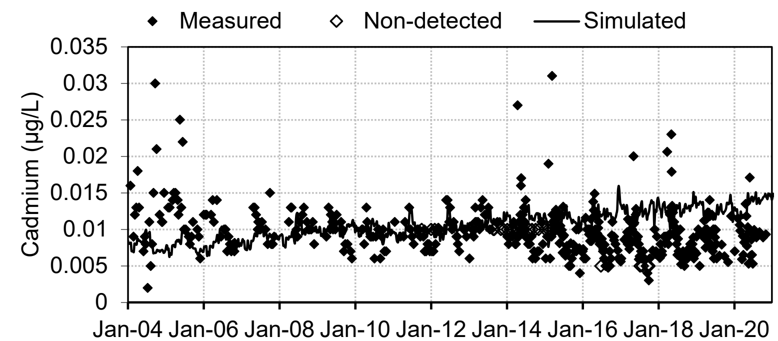
(f) Elk River u/s of Grave Creek (from Fording River to Michel Creek (EV_ER4; EMS 0200389)



(g) Elk River d/s of Michel Creek (EV_ER1; EMS 0200393)



(h) Elk River at Highway 93 near Elko (RG_ELKMOUTH)



Note:
When simulating historical conditions, the WQC uses the weekly flow estimates output by the FC for the corresponding historical period (i.e., 2004 to 2019). When projecting into the future, the WQC uses twenty sets of weekly flows generated by the FC. In these figures, projected median weekly concentrations are shown.

Figure 2.1-21 Cadmium Concentrations in the Fording River and Elk River, 2004-2020

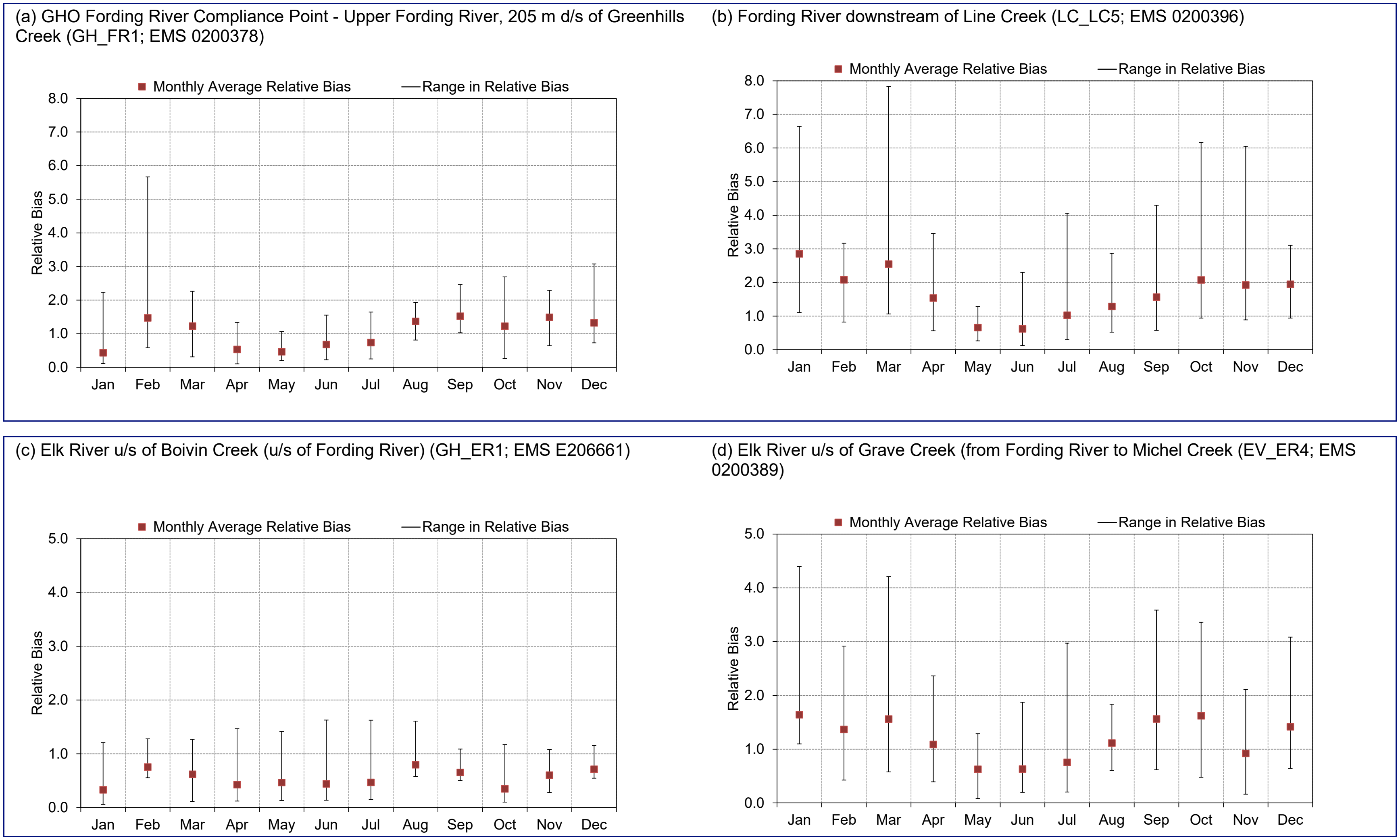


Figure 2.1-22 Cadmium Bias Values in the Fording River and Elk River, 2004-2018

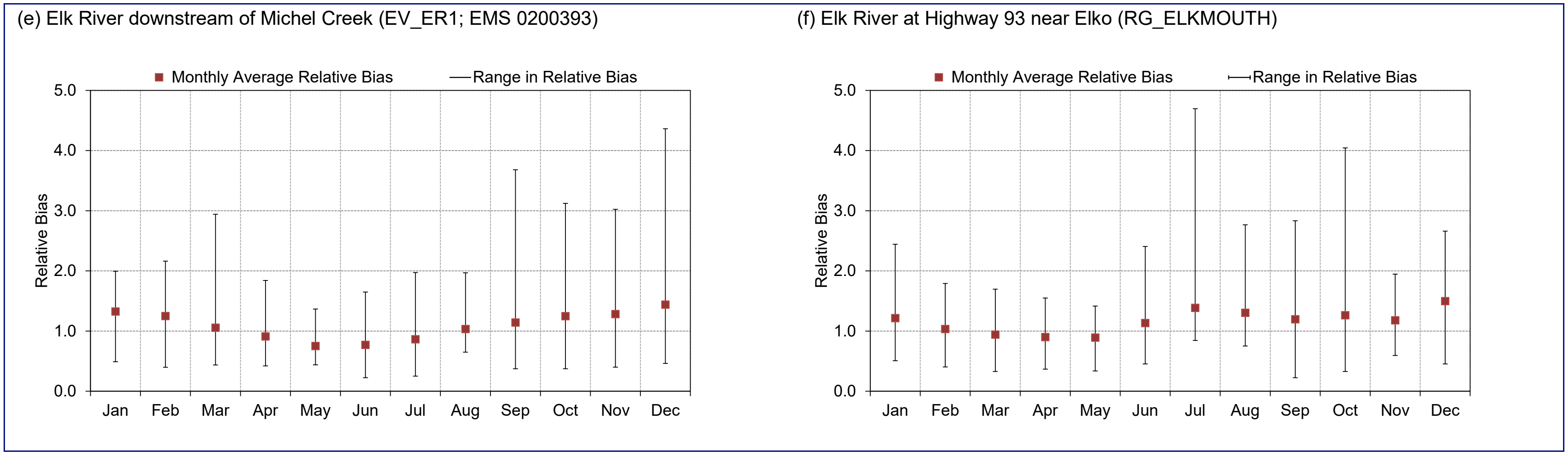


Figure 2.1-22 Cadmium Bias Values in the Fording River and Elk River, 2004-2018

2.2 Model Use and Limitations

The 2020 RWQM is a planning and assessment tool. It has been constructed to replicate and forecast how constituent concentrations in the Elk Valley may change due to mining and associated management activities, at a spatial and temporal scale suitable to support regional planning initiatives, local mitigation design and project assessments. It is not intended to be used to design small-scale infrastructure (e.g., sediment ponds or culverts) or to accurately predict daily concentrations. Rather, it is designed to simulate changes in constituent concentrations in individual tributaries in response to mining and associated management activities, based on the current understanding of the geochemical and hydrological processes that occur within waste rock spoils and other mine features.

For selenium, nitrate and sulphate, model calibration was performed to maintain a neutral to slight positive bias. Accordingly, the error and bias included in the calibrated model should not result in grossly over-estimated management systems to reach a given target concentration in the Fording River or Elk River.

The model is less accurate in its projections of cadmium. However, cadmium concentrations remain below levels of potential concern, and the 2020 RWQM provides a reasonable means by which to develop projections of potential future cadmium concentrations for screening and assessment purposes. That said, refinement of the model would be required before it is used to support the detailed design of management measures targeting this constituent.

3 References

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Appendix A

Constituent Concentrations assigned to Drainage from Non-Mine Areas

Table A-1: Alkalinity Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[(a)]	Undisturbed Areas Flowing into the Fording River[(a)]	Undisturbed Areas Flowing into LCO Dry Creek[(a)]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[(a)]	Undisturbed Areas Flowing into the Elk River[(a)]	Areas Flowing into Koocanusa Reservoir[(a)]
January	mg $CaCO_3$/L	153	138	152	153	148	123
February	mg $CaCO_3$/L	151	139	148	151	152	125
March	mg $CaCO_3$/L	146	143	147	146	149	120
April	mg $CaCO_3$/L	143	140	151	143	155	105
May	mg $CaCO_3$/L	119	112	125	119	143	85
June	mg $CaCO_3$/L	109	106	96	109	128	81
July	mg $CaCO_3$/L	123	121	115	123	128	87
August	mg $CaCO_3$/L	140	126	133	140	135	98
September	mg $CaCO_3$/L	147	151	143	147	139	109
October	mg $CaCO_3$/L	144	143	141	144	144	109
November	mg $CaCO_3$/L	143	144	140	143	146	111
December	mg $CaCO_3$/L	147	143	147	147	150	119

[(a)] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg $CaCO_3$/L = milligrams of calcium carbonate per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-2: Calcium Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[a]	Undisturbed Areas Flowing into the Fording River [a]	Undisturbed Areas Flowing into LCO Dry Creek[a]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[a]	Undisturbed Areas Flowing into the Elk River[a]	Areas Flowing into Koocanusa Reservoir[a]
January	mg/L	47	51	40	41	48	43
February	mg/L	47	53	37	41	49	43
March	mg/L	49	55	37	42	50	41
April	mg/L	45	47	39	42	50	36
May	mg/L	37	37	32	39	46	28
June	mg/L	33	33	25	37	42	25
July	mg/L	38	40	30	38	42	28
August	mg/L	44	40	35	39	44	34
September	mg/L	46	53	37	39	44	37
October	mg/L	46	51	37	39	46	38
November	mg/L	47	51	36	40	48	38
December	mg/L	47	53	38	40	49	42

[a] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-3: Cadmium Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[a]	Undisturbed Areas Flowing into the Fording River [a]	Undisturbed Areas Flowing into LCO Dry Creek[a]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[a]	Undisturbed Areas Flowing into the Elk River[a]	Areas Flowing into Koocanusa Reservoir[a]
January	mg/L	0.000012	0.000005	0.000034	0.0000040	0.0000057	0.0000039
February	mg/L	0.000011	0.000005	0.000034	0.0000051	0.0000034	0.0000044
March	mg/L	0.0000091	0.000005	0.000032	0.0000051	0.0000058	0.0000045
April	mg/L	0.00001	0.000006	0.000034	0.0000031	0.000007	0.0000046
May	mg/L	0.0000087	0.0000082	0.000033	0.0000031	0.0000069	0.0000035
June	mg/L	0.000011	0.0000093	0.000033	0.0000035	0.0000081	0.000003
July	mg/L	0.000011	0.000011	0.000035	0.0000030	0.0000078	0.0000027
August	mg/L	0.0000093	0.0000075	0.000035	0.0000053	0.0000056	0.0000033
September	mg/L	0.000011	0.000005	0.000035	0.0000050	0.0000043	0.0000038
October	mg/L	0.00001	0.0000074	0.000033	0.0000030	0.0000046	0.0000036
November	mg/L	0.0000098	0.000005	0.000033	0.0000044	0.0000043	0.0000045
December	mg/L	0.000011	0.0000065	0.000032	0.0000031	0.0000044	0.0000043

[a] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-4: Chloride Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[(a)]	Undisturbed Areas Flowing into the Fording River [(a)]	Undisturbed Areas Flowing into LCO Dry Creek[(a)]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[(a)]	Undisturbed Areas Flowing into the Elk River[(a)]	Areas Flowing into Koocanusa Reservoir[(a)]
January	mg/L	0.30	0.20	0.32	0.63	0.30	9.0
February	mg/L	0.43	0.38	0.46	0.50	0.35	9.6
March	mg/L	0.33	0.25	0.33	0.50	0.32	8.7
April	mg/L	0.38	0.42	0.4	0.38	0.33	6.1
May	mg/L	0.33	0.36	0.39	0.34	0.49	2.8
June	mg/L	0.37	0.35	0.57	0.41	0.42	1.9
July	mg/L	0.36	0.36	0.4	0.29	0.31	2.6
August	mg/L	0.27	0.23	0.34	0.30	0.33	4.3
September	mg/L	0.37	0.4	0.47	0.30	0.41	5.4
October	mg/L	0.39	0.58	0.49	0.35	0.42	5.6
November	mg/L	0.35	0.23	0.44	0.50	0.37	6.4
December	mg/L	0.33	0.33	0.33	0.40	0.34	7.9

[(a)] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-5: Hardness Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[(a)]	Undisturbed Areas Flowing into the Fording River[(a)]	Undisturbed Areas Flowing into LCO Dry Creek[(a)]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[(a)]	Undisturbed Areas Flowing into the Elk River[(a)]	Areas Flowing into Koocanusa Reservoir[(a)]
January	mg $CaCO_3$/L	182	187	160	145	170	164
February	mg $CaCO_3$/L	181	190	150	147	171	163
March	mg $CaCO_3$/L	181	186	151	148	172	159
April	mg $CaCO_3$/L	168	174	157	145	174	137
May	mg $CaCO_3$/L	135	129	126	127	160	101
June	mg $CaCO_3$/L	121	116	102	125	144	91
July	mg $CaCO_3$/L	140	140	122	131	143	103
August	mg $CaCO_3$/L	164	153	139	138	152	124
September	mg $CaCO_3$/L	173	188	148	138	153	141
October	mg $CaCO_3$/L	174	185	148	143	160	144
November	mg $CaCO_3$/L	177	189	146	142	167	147
December	mg $CaCO_3$/L	181	199	154	140	169	157

[(a)] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg $CaCO_3$/L = milligrams of calcium carbonate per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-6: Magnesium Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[(a)]	Undisturbed Areas Flowing into the Fording River[(a)]	Undisturbed Areas Flowing into LCO Dry Creek[(a)]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[(a)]	Undisturbed Areas Flowing into the Elk River[(a)]	Areas Flowing into Koocanusa Reservoir[(a)]
January	mg/L	15	14	15	11	12	14
February	mg/L	15	14	14	11	11	14
March	mg/L	15	16	14	11	12	13
April	mg/L	14	13	14	9	12	11
May	mg/L	10	9.7	11	7	11	7.7
June	mg/L	9.3	8.7	9.4	8	9.4	6.7
July	mg/L	11	10	11	9	9.3	7.9
August	mg/L	13	12	13	10	10	9.8
September	mg/L	14	14	14	10	10	11
October	mg/L	14	14	14	11	11	12
November	mg/L	15	14	13	10	11	12
December	mg/L	15	14	14	10	11	13

[(a)] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-7: Nitrate Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[a]	Undisturbed Areas Flowing into the Fording River[a]	Undisturbed Areas Flowing into LCO Dry Creek[a]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[a]	Undisturbed Areas Flowing into the Elk River[a]	Areas Flowing into Koocanusa Reservoir[a]
January	mg N/L	0.095	0.059	0.12	0.14	0.09	0.16
February	mg N/L	0.1	0.066	0.14	0.12	0.1	0.15
March	mg N/L	0.1	0.049	0.15	0.12	0.078	0.13
April	mg N/L	0.086	0.037	0.16	0.12	0.085	0.10
May	mg N/L	0.054	0.016	0.12	0.12	0.072	0.15
June	mg N/L	0.043	0.0098	0.055	0.11	0.057	0.092
July	mg N/L	0.029	0.0072	0.021	0.11	0.023	0.058
August	mg N/L	0.026	0.0093	0.016	0.10	0.022	0.058
September	mg N/L	0.03	0.01	0.02	0.11	0.025	0.06
October	mg N/L	0.031	0.010	0.024	0.12	0.035	0.067
November	mg N/L	0.059	0.02	0.052	0.13	0.054	0.1
December	mg N/L	0.091	0.046	0.099	0.15	0.074	0.14

[a] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg N/L = milligrams of nitrogen per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-8: Potassium Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[a]	Undisturbed Areas Flowing into the Fording River[a]	Undisturbed Areas Flowing into LCO Dry Creek[a]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[a]	Undisturbed Areas Flowing into the Elk River[a]	Areas Flowing into Koocanusa Reservoir[a]
January	mg/L	0.58	0.35	1.0	0.24	0.33	0.73
February	mg/L	0.6	0.44	1.0	0.23	0.33	0.75
March	mg/L	0.52	0.84	1.0	0.27	0.33	0.81
April	mg/L	0.49	0.38	1.0	0.23	0.35	0.75
May	mg/L	0.4	0.44	0.84	0.20	0.36	0.52
June	mg/L	0.42	0.44	0.79	0.21	0.33	0.41
July	mg/L	0.47	0.44	0.89	0.22	0.33	0.41
August	mg/L	0.51	0.44	0.94	0.22	0.36	0.49
September	mg/L	0.54	0.44	1.0	0.23	0.36	0.58
October	mg/L	0.5	0.49	0.99	0.25	0.35	0.66
November	mg/L	0.5	0.44	1.0	0.24	0.34	0.65
December	mg/L	0.58	0.44	1.0	0.25	0.34	0.69

[a] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-9: Selenium Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[(a)]	Undisturbed Areas Flowing into the Fording River[(a)]	Undisturbed Areas Flowing into LCO Dry Creek[(a)]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[(a)]	Undisturbed Areas Flowing into the Elk River[(a)]	Areas Flowing into Koocanusa Reservoir[(a)]
January	mg/L	0.0011	0.00057	0.0014	0.00072	0.00094	0.00012
February	mg/L	0.0012	0.00079	0.0014	0.00075	0.0011	0.00015
March	mg/L	0.001	0.00068	0.0014	0.00073	0.001	0.00012
April	mg/L	0.0011	0.00076	0.0015	0.00056	0.001	0.00011
May	mg/L	0.0009	0.00062	0.0014	0.00037	0.00085	0.000093
June	mg/L	0.00091	0.00042	0.0019	0.00041	0.0007	0.000081
July	mg/L	0.00097	0.0004	0.0013	0.00054	0.00059	0.000074
August	mg/L	0.0011	0.00052	0.0014	0.00063	0.00065	0.000087
September	mg/L	0.0013	0.00053	0.0016	0.00066	0.00074	0.00012
October	mg/L	0.0013	0.00063	0.0015	0.00071	0.00082	0.0001
November	mg/L	0.0012	0.00062	0.0013	0.00070	0.00089	0.00011
December	mg/L	0.0014	0.00083	0.0014	0.00073	0.001	0.00011

[(a)] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-10: Sodium Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[(a)]	Undisturbed Areas Flowing into the Fording River[(a)]	Undisturbed Areas Flowing into LCO Dry Creek[(a)]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[(a)]	Undisturbed Areas Flowing into the Elk River[(a)]	Areas Flowing into Koocanusa Reservoir[(a)]
January	mg/L	1.6	0.67	2.7	0.50	0.69	10
February	mg/L	1.7	0.64	2.8	0.52	0.71	10
March	mg/L	1.3	1.3	2.9	0.52	0.73	9.7
April	mg/L	1.4	0.7	2.9	0.42	0.72	7.0
May	mg/L	1.1	0.64	2.4	0.26	0.71	3.2
June	mg/L	1.0	0.64	1.7	0.28	0.56	2.1
July	mg/L	1.3	0.64	2.3	0.37	0.55	3.0
August	mg/L	1.3	0.64	2.4	0.43	0.63	4.7
September	mg/L	1.6	0.64	2.6	0.46	0.64	5.7
October	mg/L	1.4	0.62	2.0	0.48	0.67	6.4
November	mg/L	1.4	0.68	2.1	0.48	0.68	7.2
December	mg/L	1.6	0.64	2.3	0.50	0.69	8.8

[(a)] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-11: Sulphate Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[(a)]	Undisturbed Areas Flowing into the Fording River[(a)]	Undisturbed Areas Flowing into LCO Dry Creek[(a)]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[(a)]	Undisturbed Areas Flowing into the Elk River[(a)]	Areas Flowing into Koocanusa Reservoir[(a)]
January	mg/L	22	41	7.7	17	22	47
February	mg/L	26	41	7.4	17	23	49
March	mg/L	30	40	7.3	17	23	50
April	mg/L	24	33	7.4	12	22	39
May	mg/L	14	14	6.1	5.3	18	19
June	mg/L	12	9.1	6.3	6.1	13	15
July	mg/L	16	16	7.7	10	13	19
August	mg/L	23	28	8.1	14	15	27
September	mg/L	24	34	8.1	15	16	34
October	mg/L	25	35	8.0	16	13	35
November	mg/L	28	36	8.5	16	21	40
December	mg/L	24	43	7.8	17	22	44

[(a)] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Table A-12: Total Dissolved Solids Concentrations in Drainage from Undisturbed Areas

Month	Units	Undisturbed Areas Flowing into Line Creek and Michel Creek[a]	Undisturbed Areas Flowing into the Fording River[a]	Undisturbed Areas Flowing into LCO Dry Creek[a]	Undisturbed Areas Flowing into EVO Dry, Harmer and Grave[a]	Undisturbed Areas Flowing into the Elk River[a]	Areas Flowing into Koocanusa Reservoir[a]
January	mg/L	194	203	162		176	209
February	mg/L	191	207	150		190	219
March	mg/L	199	201	157		189	216
April	mg/L	182	192	158		181	182
May	mg/L	144	134	132		171	122
June	mg/L	128	120	105		153	117
July	mg/L	151	147	128		148	135
August	mg/L	182	173	144		165	153
September	mg/L	194	211	156		166	174
October	mg/L	191	196	155		173	182
November	mg/L	190	203	147		179	177
December	mg/L	191	198	153		176	198

[a] Values presented are geometric mean concentrations.
EVO = Elkview Operations; LCO = Line Creek Operations; mg/L = milligrams per litre.
Source: Teck 2020a and Environment Canada 2020.

Appendix B

Model Calibration Results for Nitrate, Selenium, Sulphate and Cadmium

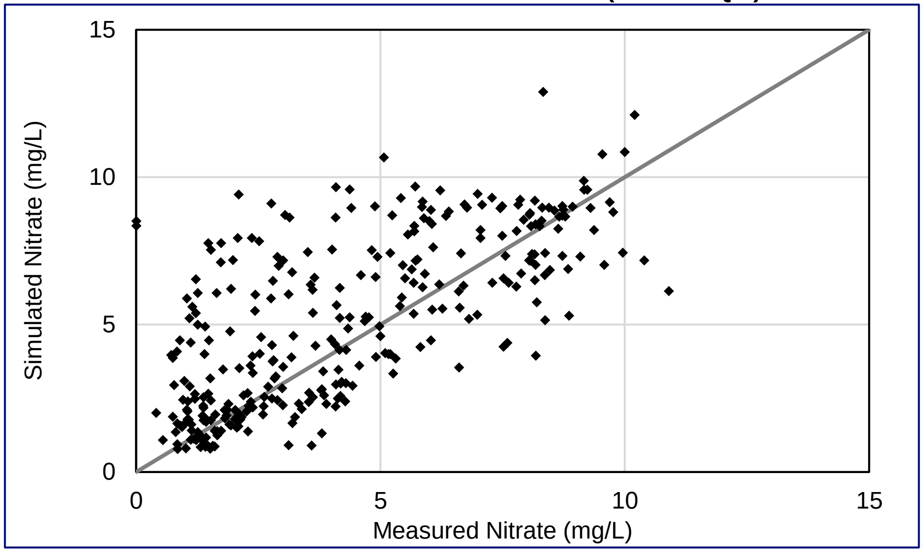
B1-1: Nitrate Calibration Information for Node FR_HC1 - Henretta Creek u/s of Fording River (EMS E216778)

Measured and Simulated Nitrate Data and Calibration Statistics

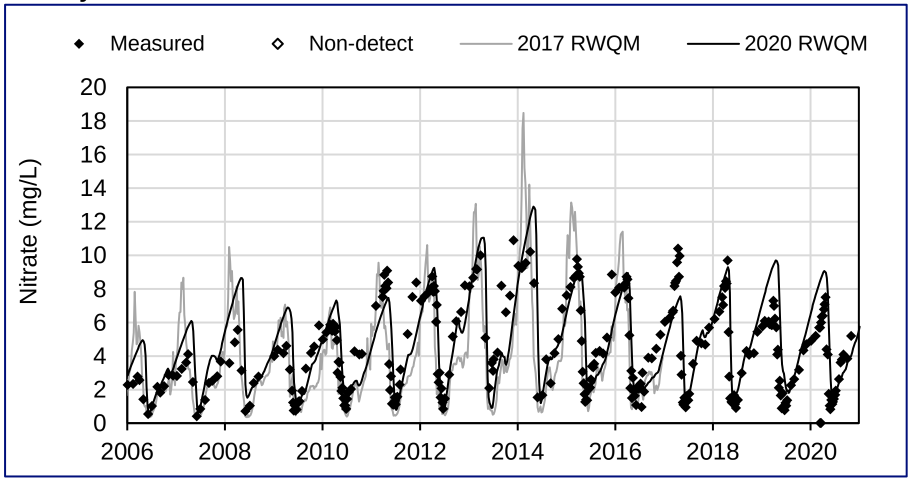
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	209	260
Non-Detect Count	0	0
Measured Mean (mg/L)	4.3	4.4
Simulated Mean (mg/L)	3.7	4.9
Bias (mg/L)	-0.6	0.55
Relative Bias	0.86	1.1
Error (mg/L)	1.4	1.5
Percent Error	32%	34%

(a) As adjusted for the 2019 IPA.

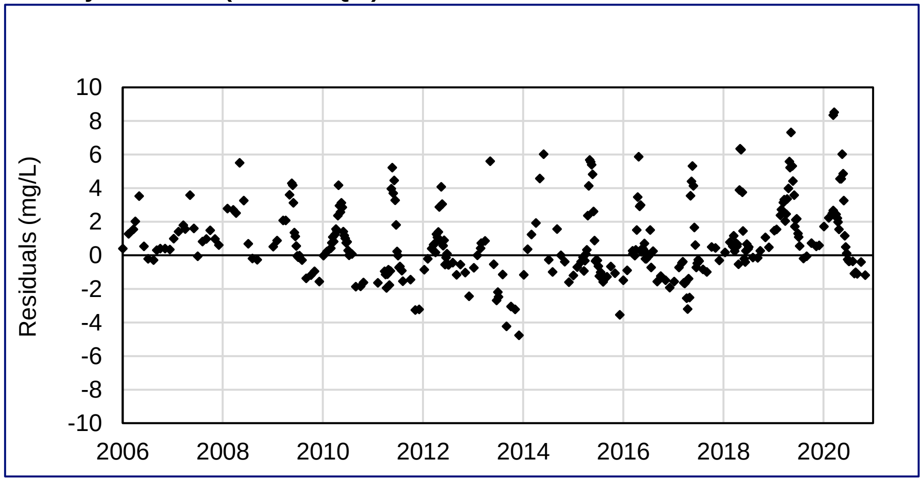
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

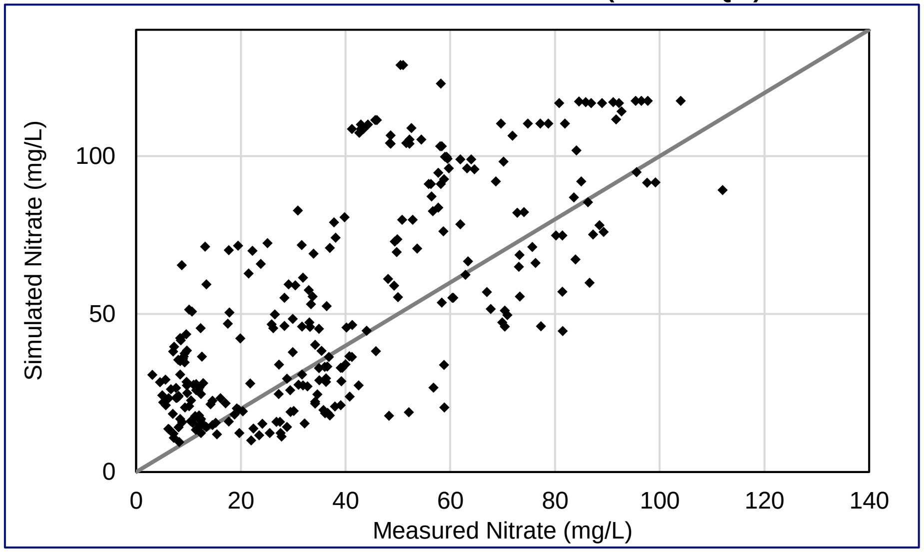
B1-2: Nitrate Calibration Information for Node FR_CC1 - Clode Creek Sediment Pond Decant (EMS E102481)

Measured and Simulated Nitrate Data and Calibration Statistics

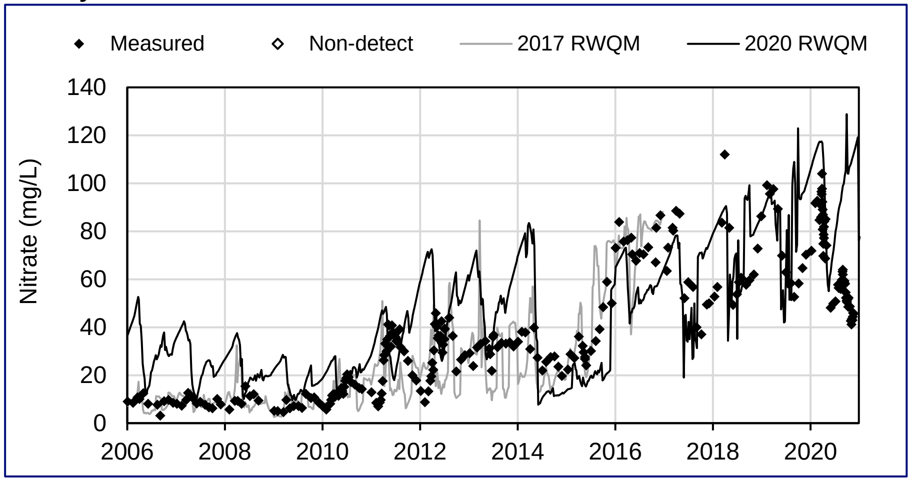
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/7/2016	12/5/2018
Data Points Available for Comparison, n	180	207
Non-Detect Count	0	0
Measured Mean (mg/L)	26	31
Simulated Mean (mg/L)	24	39
Bias (mg/L)	-1.9	7.8
Relative Bias	0.93	1.3
Error (mg/L)	9.6	17
Percent Error	37%	54%

[a] As adjusted for the 2019 IPA.

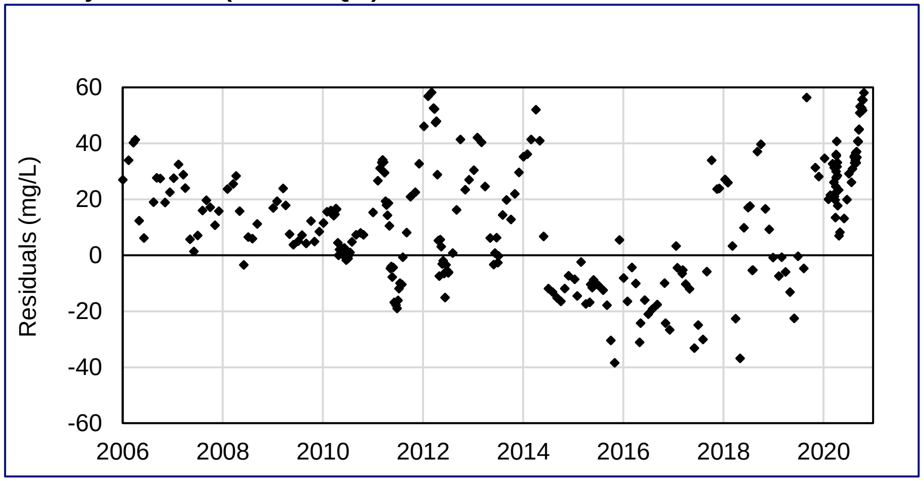
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

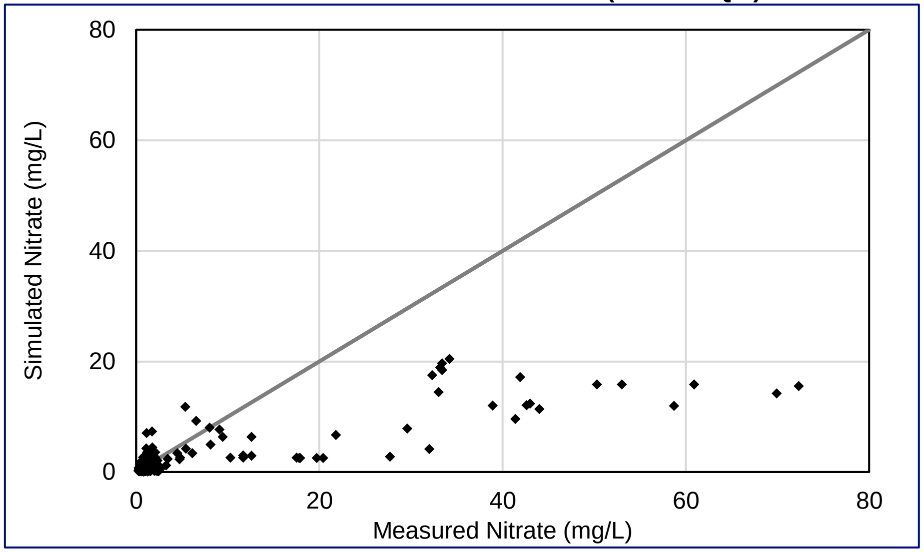
B1-3: Nitrate Calibration Information for Node FR_LMP1 - Lake Mountain Pond

Measured and Simulated Nitrate Data and Calibration Statistics

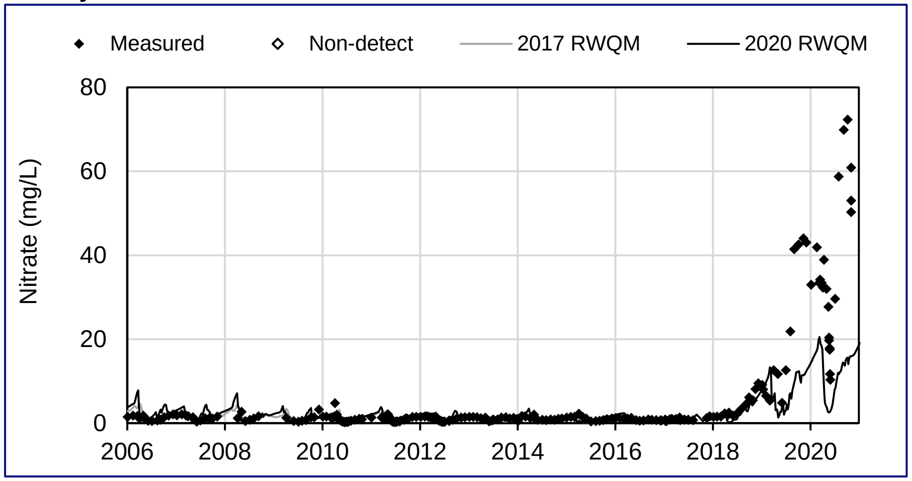
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/14/2016	12/10/2018
Data Points Available for Comparison, n	162	214
Non-Detect Count	0	0
Measured Mean (mg/L)	1.1	1.2
Simulated Mean (mg/L)	1.1	1.2
Bias (mg/L)	0.07	-0.0072
Relative Bias	1.1	0.99
Error (mg/L)	0.53	0.77
Percent Error	49%	62%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



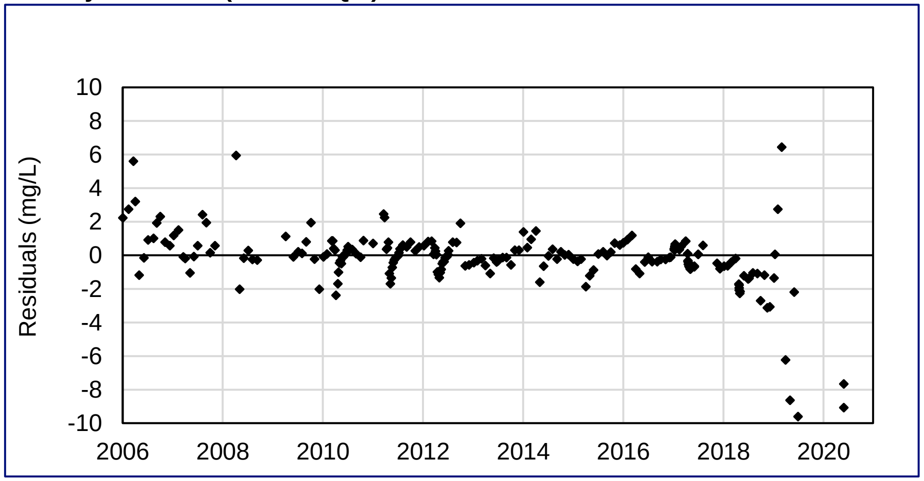
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

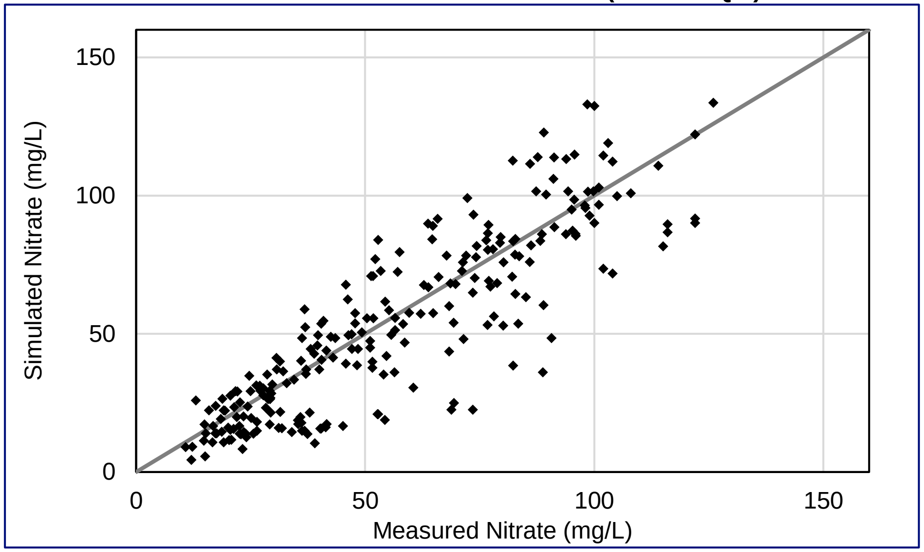
B1-4: Nitrate Calibration Information for Node FR_KC1 - Kilmarnock Creek d/s of Rock Drain (EMS 0200252)

Measured and Simulated Nitrate Data and Calibration Statistics

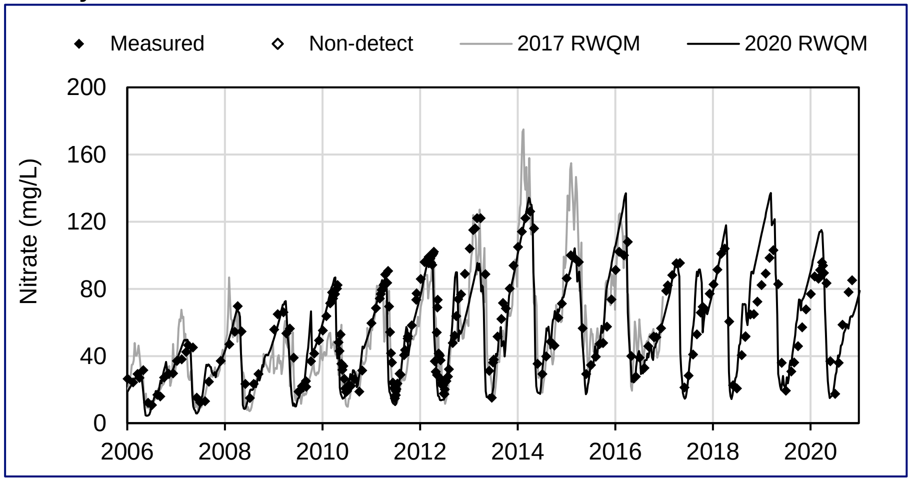
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/12/2016	12/3/2018
Data Points Available for Comparison, n	191	217
Non-Detect Count	0	0
Measured Mean (mg/L)	53	55
Simulated Mean (mg/L)	48	50
Bias (mg/L)	-5.2	-4.3
Relative Bias	0.9	0.92
Error (mg/L)	13	11
Percent Error	24%	20%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)

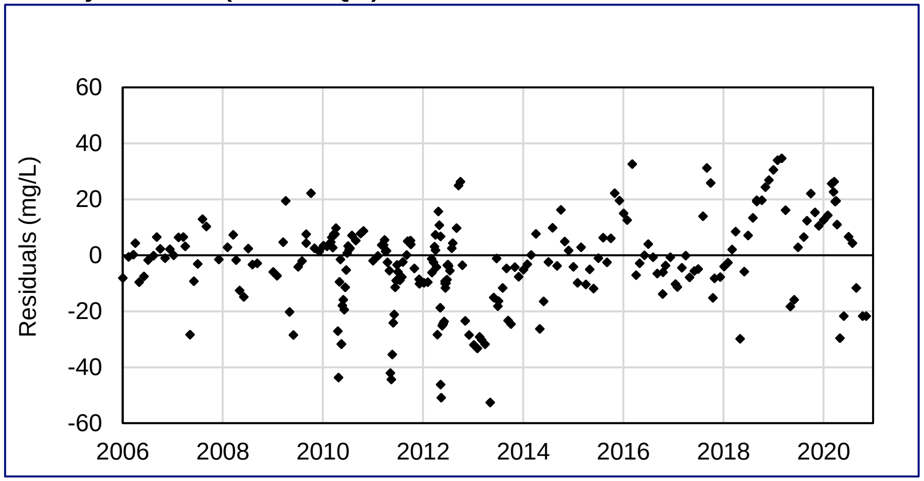


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

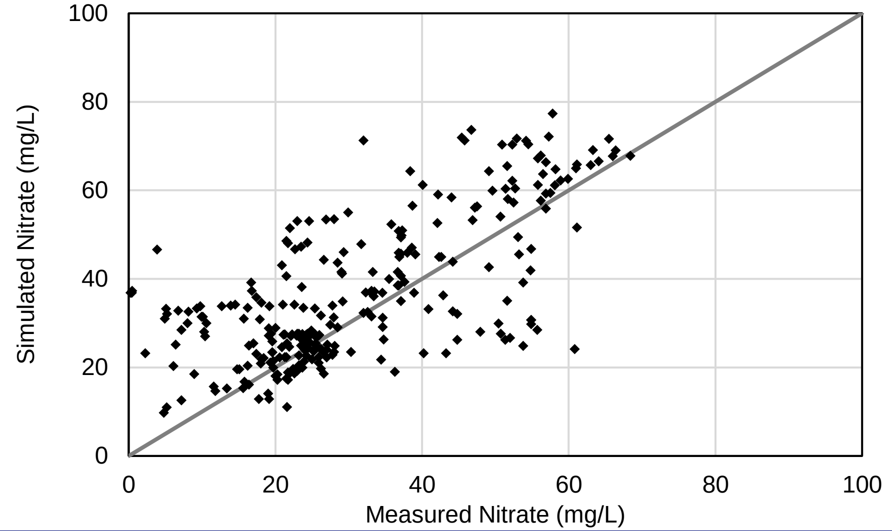
B1-5: Nitrate Calibration Information for Node GH_SC1 - Swift Creek Sediment Pond Decant (EMS E221329)

Measured and Simulated Nitrate Data and Calibration Statistics

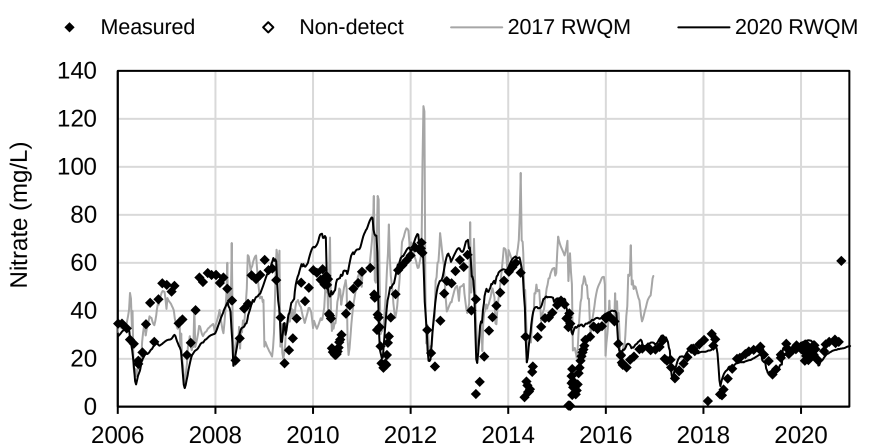
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/5/2016	12/10/2018
Data Points Available for Comparison, n	199	230
Non-Detect Count	0	0
Measured Mean (mg/L)	35	33
Simulated Mean (mg/L)	44	39
Bias (mg/L)	9.2	6.7
Relative Bias	1.3	1.2
Error (mg/L)	17	12
Percent Error	48%	35%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



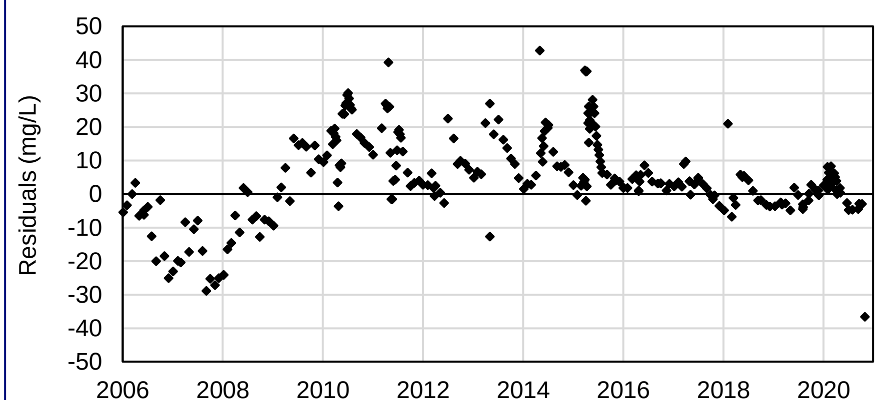
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

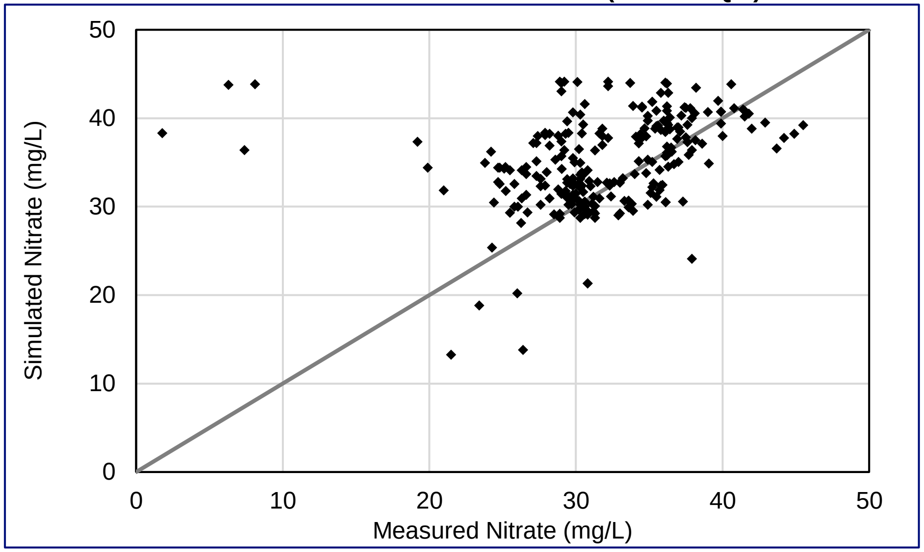
B1-6: Nitrate Calibration Information for Node GH_CC1 - Cataract Creek Sediment Pond Decant (EMS 0200384)

Measured and Simulated Nitrate Data and Calibration Statistics

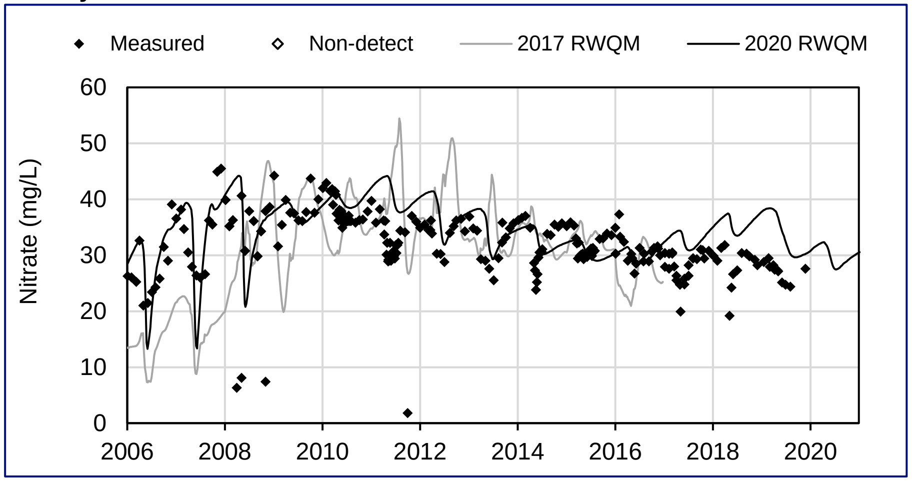
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	201	237
Non-Detect Count	0	0
Measured Mean (mg/L)	33	32
Simulated Mean (mg/L)	32	35
Bias (mg/L)	-0.62	2.9
Relative Bias	0.98	1.1
Error (mg/L)	7.4	4.7
Percent Error	22%	15%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



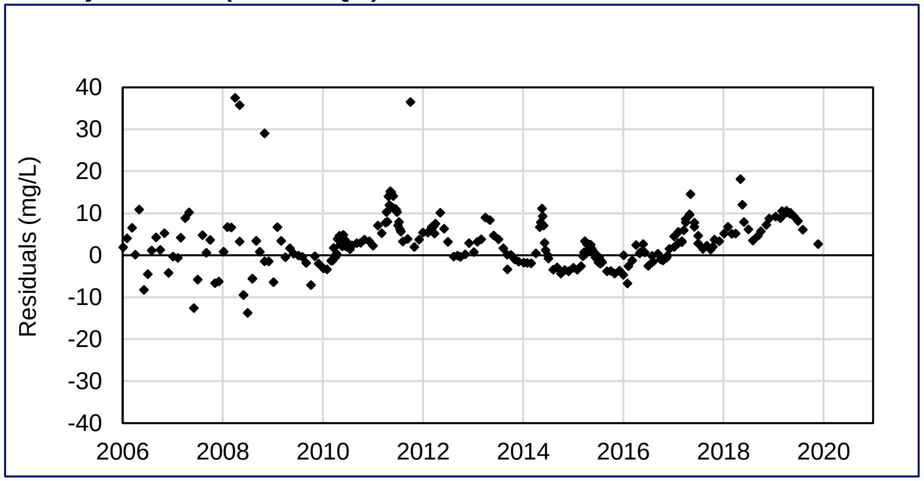
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

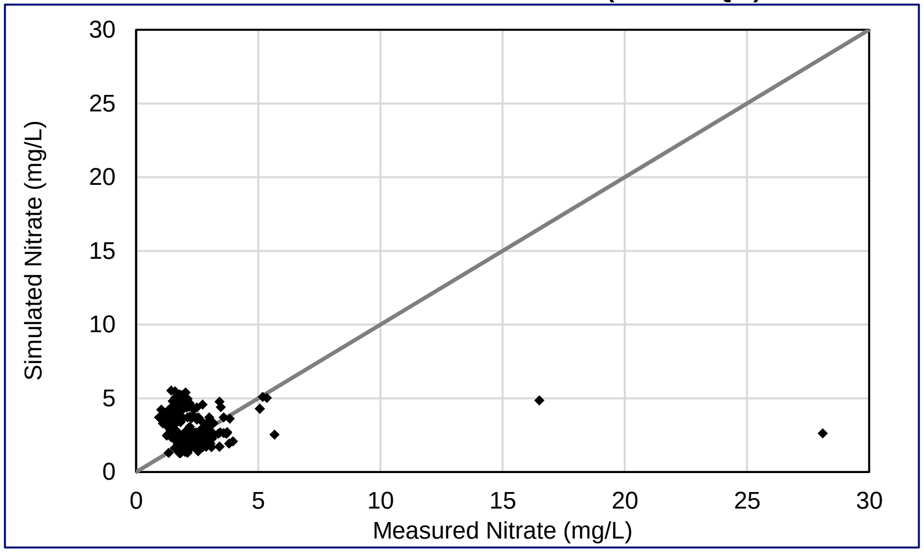
B1-7: Nitrate Calibration Information for Node GH_PC1 - Porter Creek Sediment Pond Decant (EMS 0200385)

Measured and Simulated Nitrate Data and Calibration Statistics

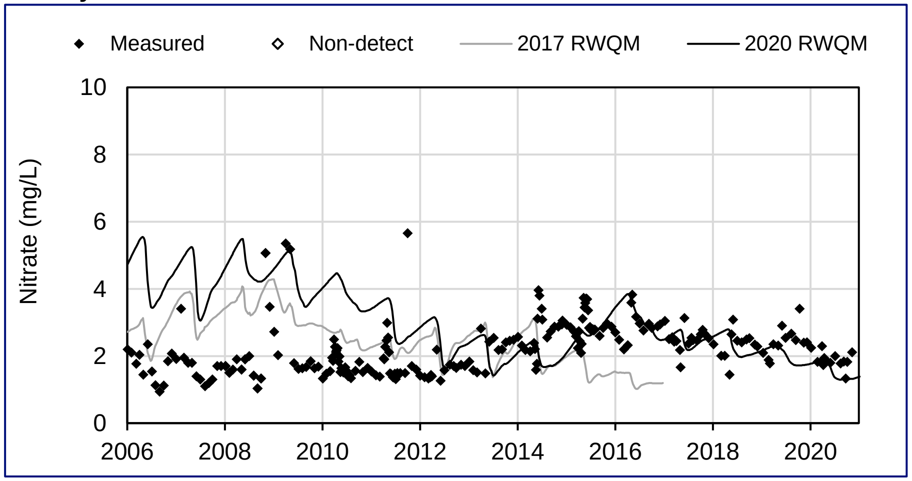
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	194	223
Non-Detect Count	0	0
Measured Mean (mg/L)	2.2	2.4
Simulated Mean (mg/L)	2.5	3.2
Bias (mg/L)	0.22	0.86
Relative Bias	1.1	1.4
Error (mg/L)	1.2	1.5
Percent Error	53%	64%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



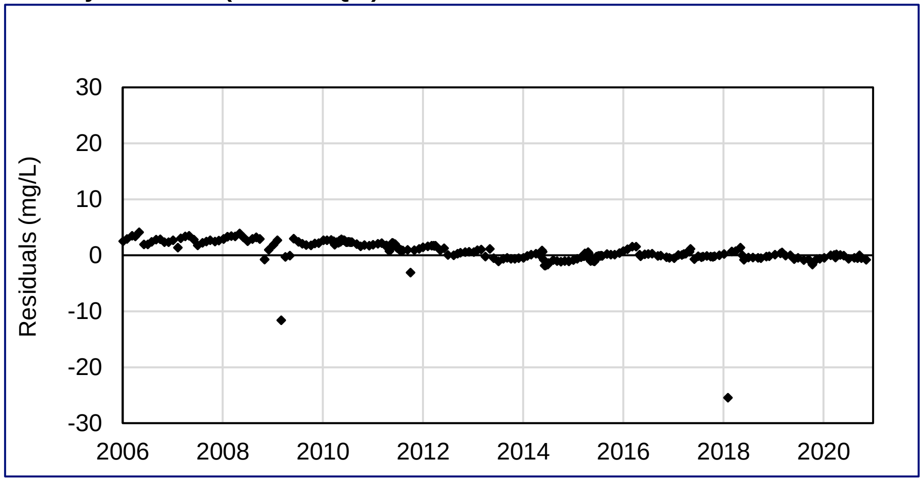
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

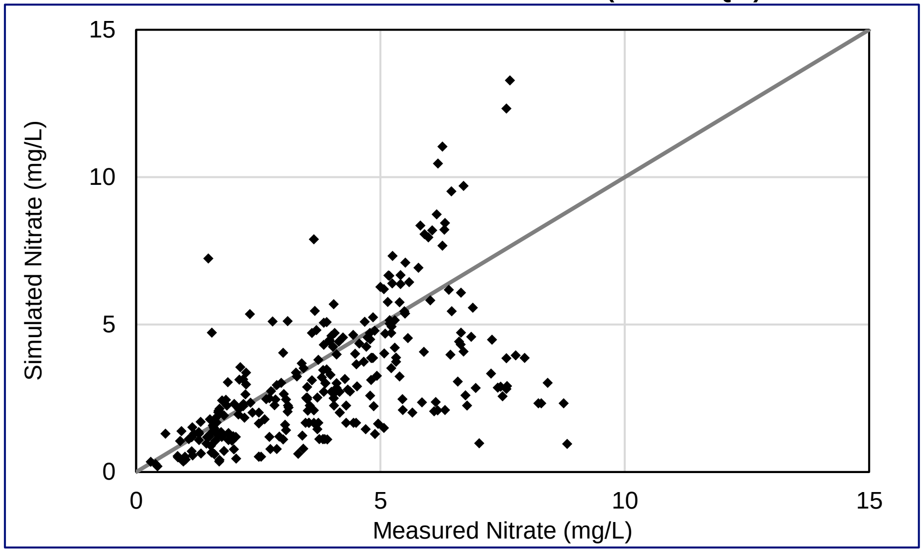
B1-8: Nitrate Calibration Information for Node GH_GH1 - Greenhills Creek Sediment Pond Decant (EMS E102709)

Measured and Simulated Nitrate Data and Calibration Statistics

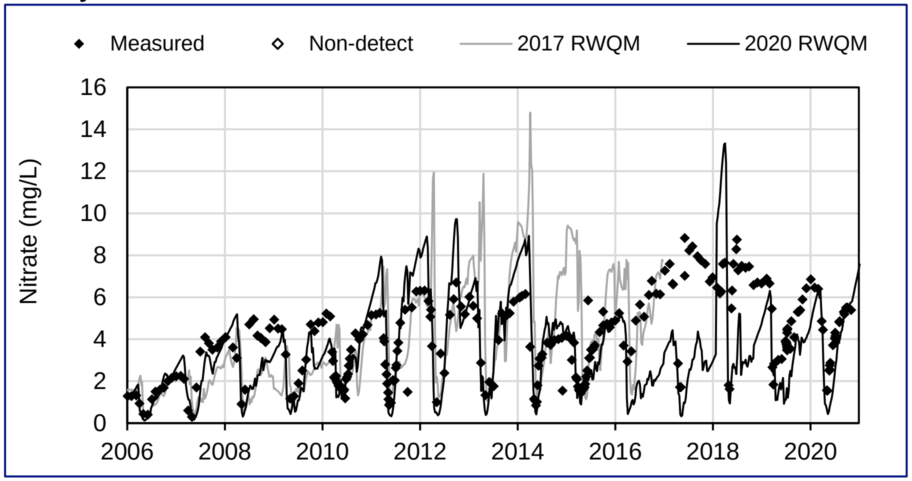
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	196	230
Non-Detect Count	0	0
Measured Mean (mg/L)	3.3	3.8
Simulated Mean (mg/L)	3.8	3.2
Bias (mg/L)	0.52	-0.55
Relative Bias	1.2	0.85
Error (mg/L)	1.7	1.4
Percent Error	51%	38%

[(a)] As adjusted for the 2019 IPA.

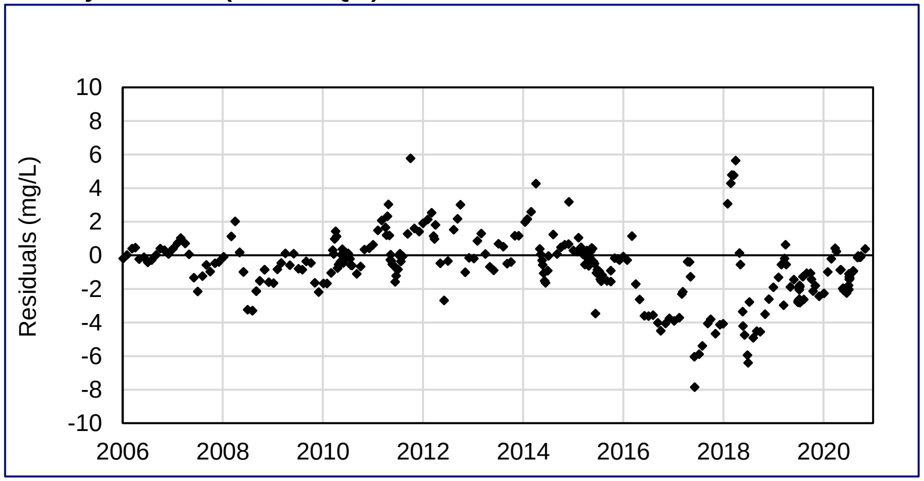
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

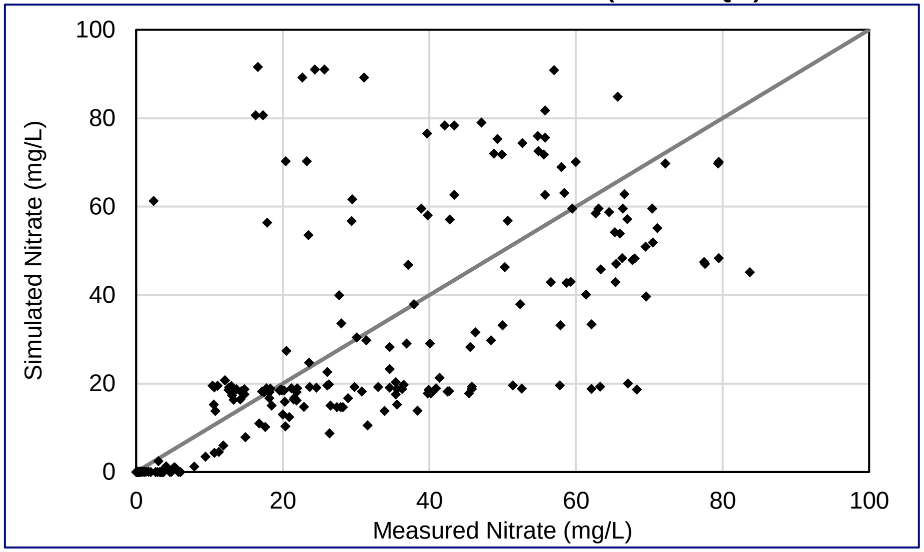
B1-9: Nitrate Calibration Information for Node GH_LC1 - Leask Creek Sediment Pond Decant (EMS E257796)

Measured and Simulated Nitrate Data and Calibration Statistics

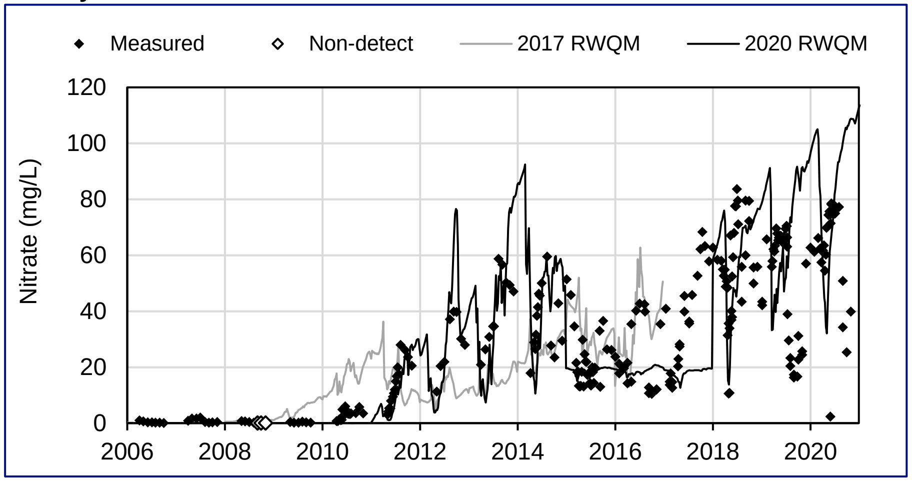
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	4/3/2006	4/3/2006
Last Measured Sample	12/7/2016	12/4/2018
Data Points Available for Comparison, n	144	199
Non-Detect Count	3	3
Measured Mean (mg/L)	18	26
Simulated Mean (mg/L)	19	22
Bias (mg/L)	1.7	-4.2
Relative Bias	1.1	0.84
Error (mg/L)	12	10
Percent Error	66%	39%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



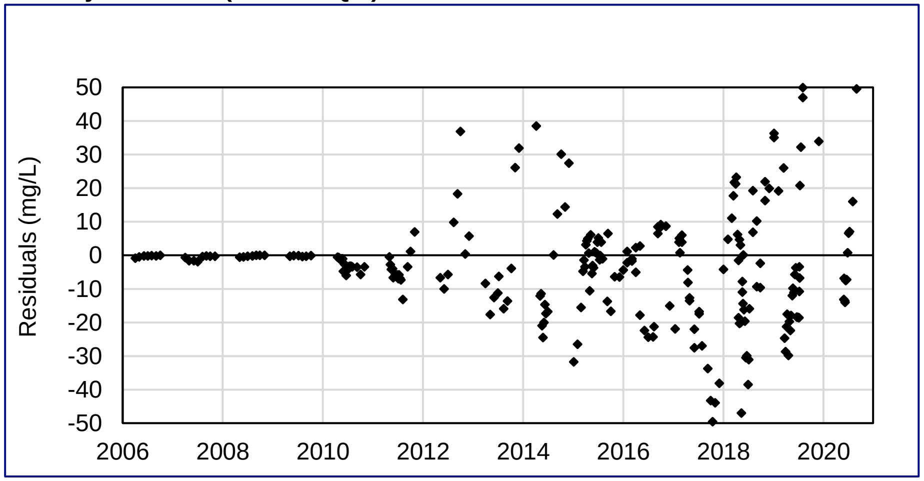
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

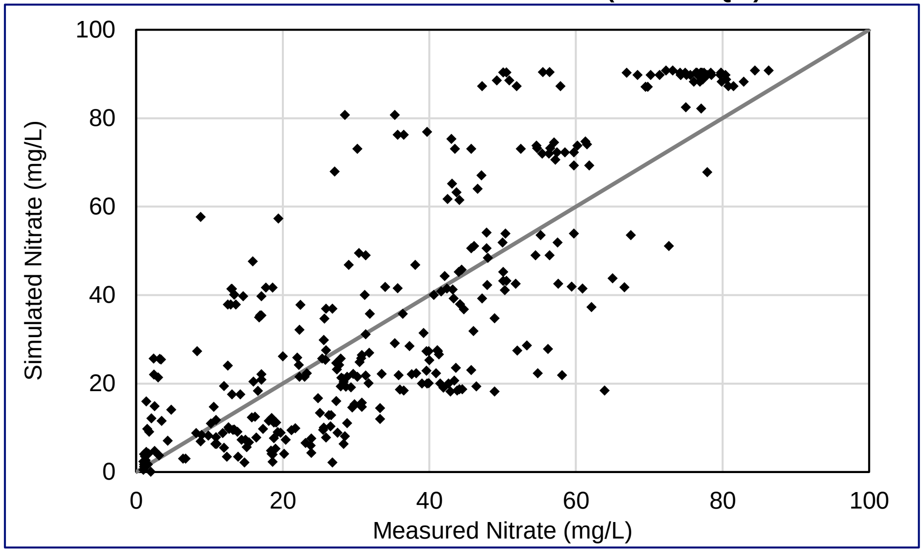
B1-10: Nitrate Calibration Information for Node GH_WC1 - Wolfram Creek Sediment Pond Decant (EMS E257795)

Measured and Simulated Nitrate Data and Calibration Statistics

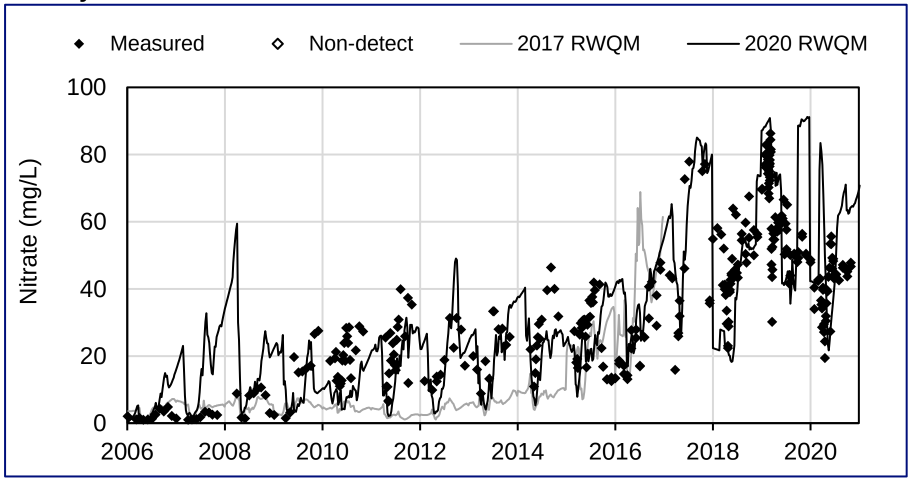
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/7/2016	12/4/2018
Data Points Available for Comparison, n	170	226
Non-Detect Count	0	0
Measured Mean (mg/L)	20	26
Simulated Mean (mg/L)	12	23
Bias (mg/L)	-7.3	-2.9
Relative Bias	0.62	0.89
Error (mg/L)	13	12
Percent Error	65%	46%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)

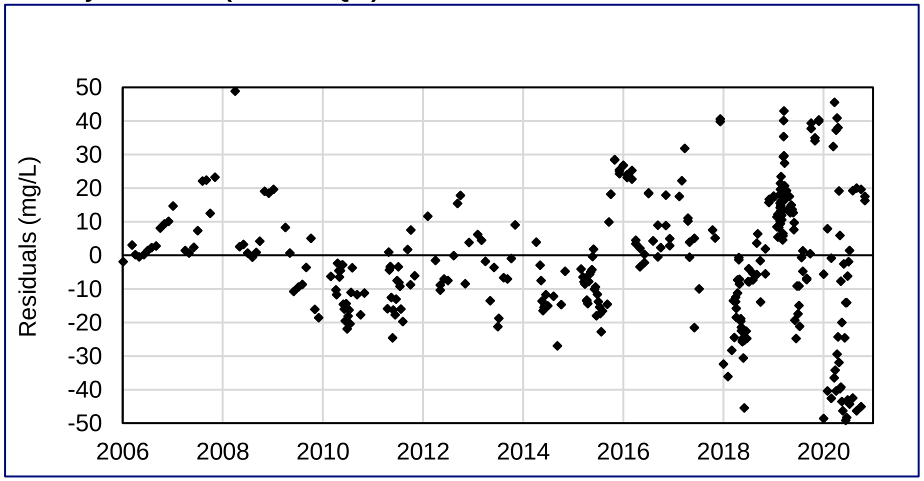


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

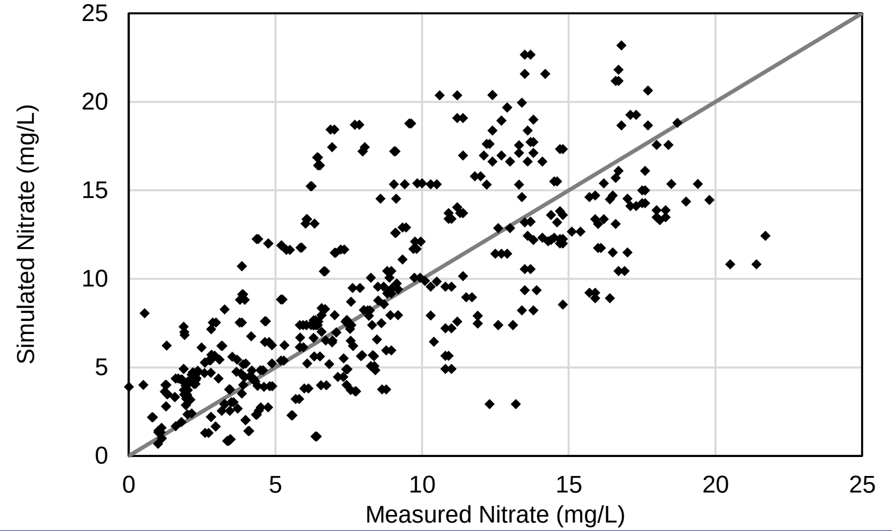
B1-11: Nitrate Calibration Information for Node GH_TC1 - Thompson Creek at LRP Road (EMS E102714)

Measured and Simulated Nitrate Data and Calibration Statistics

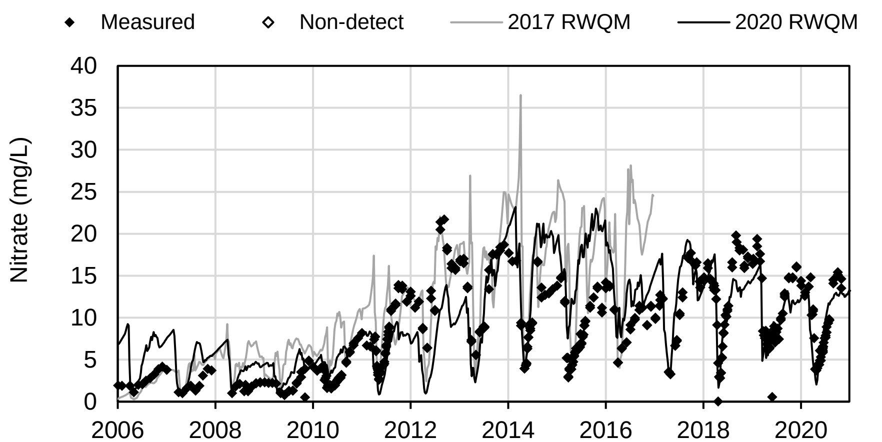
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	304	375
Non-Detect Count	0	0
Measured Mean (mg/L)	7.2	8.0
Simulated Mean (mg/L)	11	9.3
Bias (mg/L)	4.2	1.3
Relative Bias	1.6	1.2
Error (mg/L)	4.9	3.4
Percent Error	68%	43%

(a) As adjusted for the 2019 IPA.

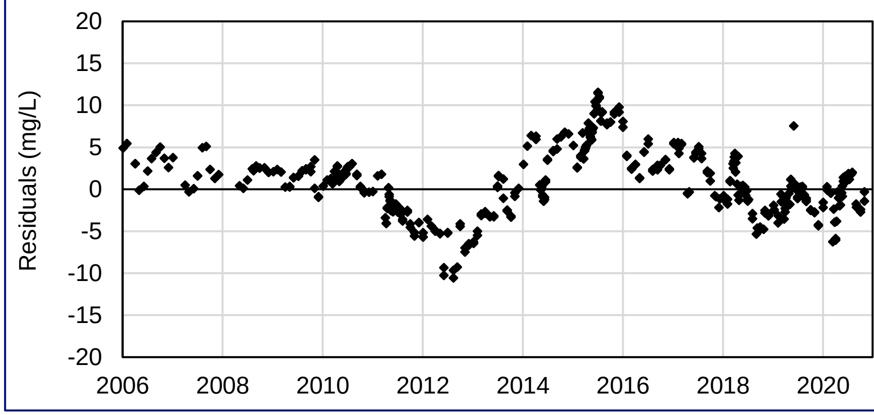
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-12: Nitrate Calibration Information for Node LC_DC3 - Dry Creek u/s of East Tributary (EMS E288273)

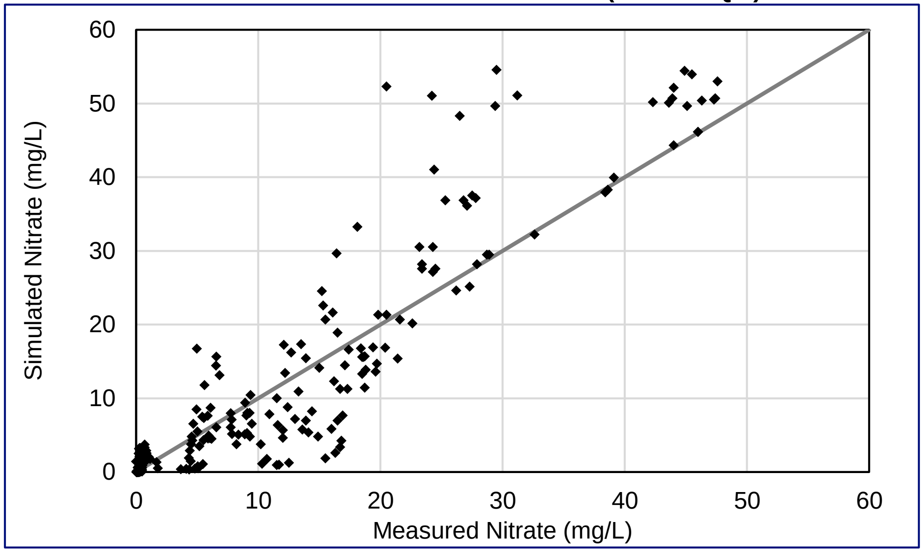
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	4/6/2011	4/6/2011
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	103	177
Non-Detect Count	1	1
Measured Mean (mg/L)	-	3.7
Simulated Mean (mg/L)	-	3.0
Bias (mg/L)	-	-0.74
Relative Bias	-	0.8
Error (mg/L)	-	2.1
Percent Error	-	55%

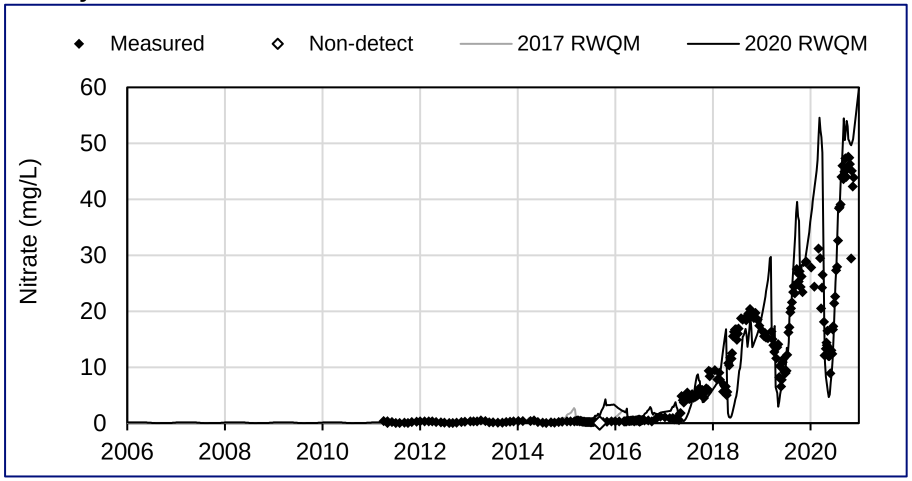
(a) As adjusted for the 2019 IPA.

(b) Location was not presented in the 2017 RWQM.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



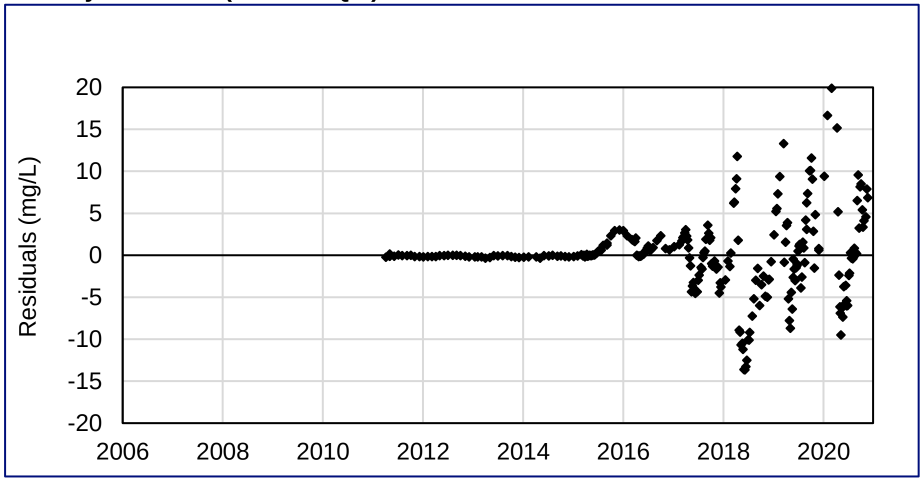
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-13: Nitrate Calibration Information for Node LC_DCDS - Dry Creek d/s of Sedimentation Ponds (EMS E295210)

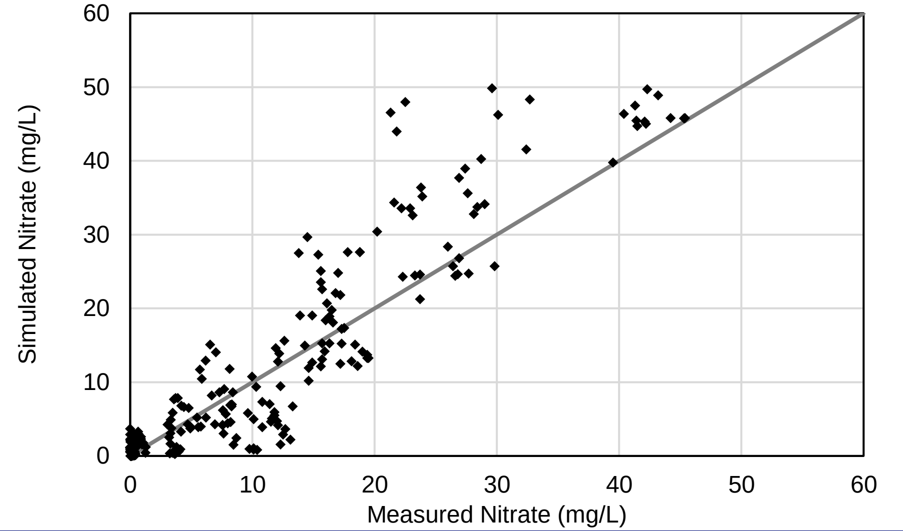
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	11/6/2013	11/6/2013
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	84	162
Non-Detect Count	8	8
Measured Mean (mg/L)	-	3.8
Simulated Mean (mg/L)	-	3.2
Bias (mg/L)	-	-0.59
Relative Bias	-	0.84
Error (mg/L)	-	2.1
Percent Error	-	55%

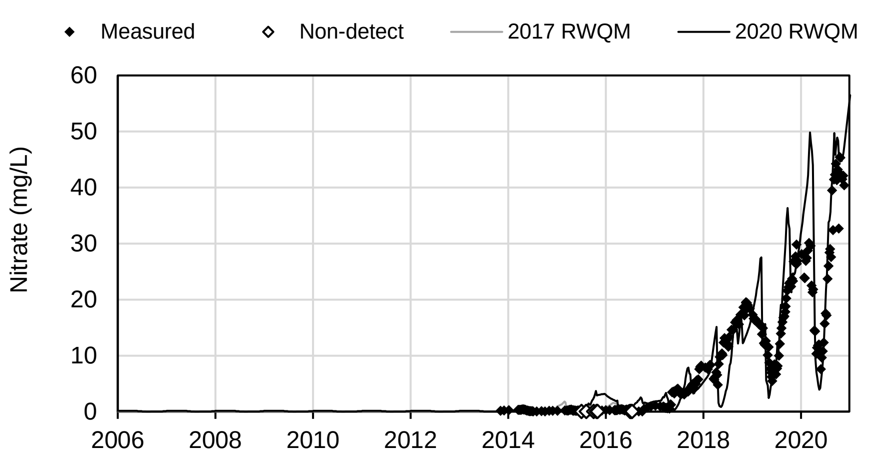
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

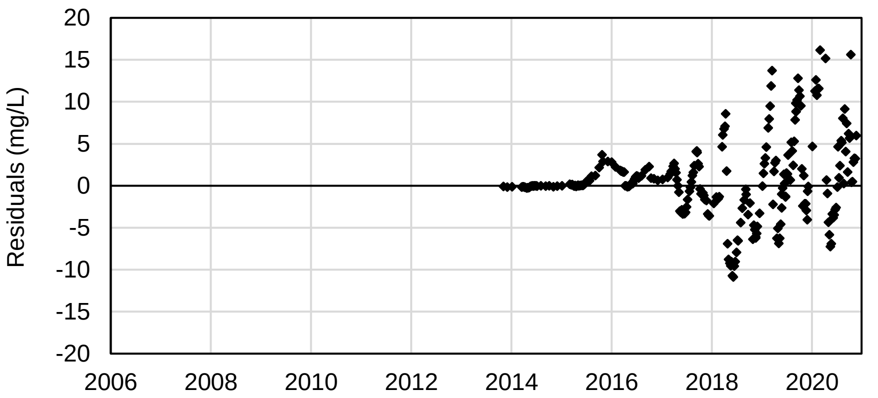
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

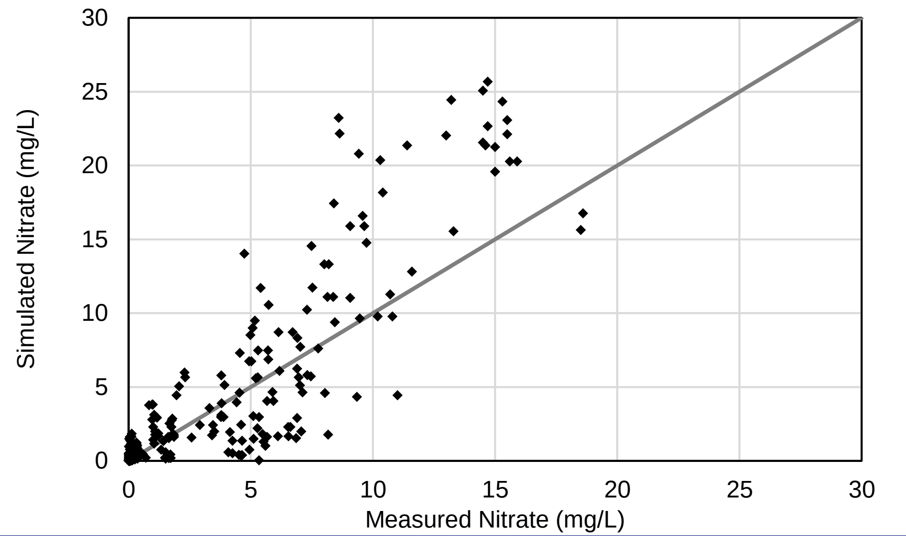
B1-14: Nitrate Calibration Information for Node LC_DC1 - Dry Creek near mouth (at bridge) (EMS E288270)

Measured and Simulated Nitrate Data and Calibration Statistics

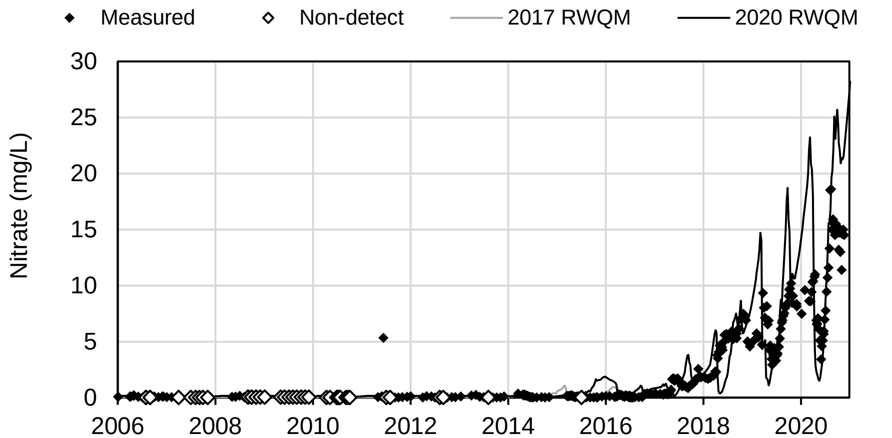
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	175	251
Non-Detect Count	42	42
Measured Mean (mg/L)	0.11	0.89
Simulated Mean (mg/L)	0.11	0.93
Bias (mg/L)	0.0071	0.039
Relative Bias	1.1	1.0
Error (mg/L)	0.12	0.57
Percent Error	111%	64%

[a] As adjusted for the 2019 IPA.

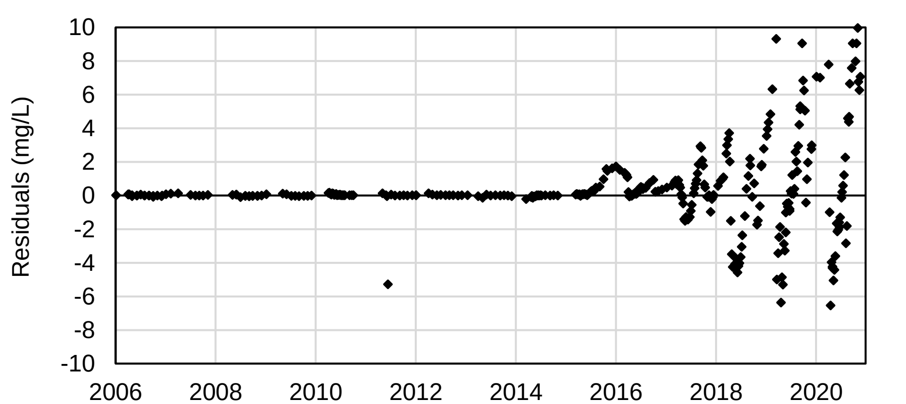
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

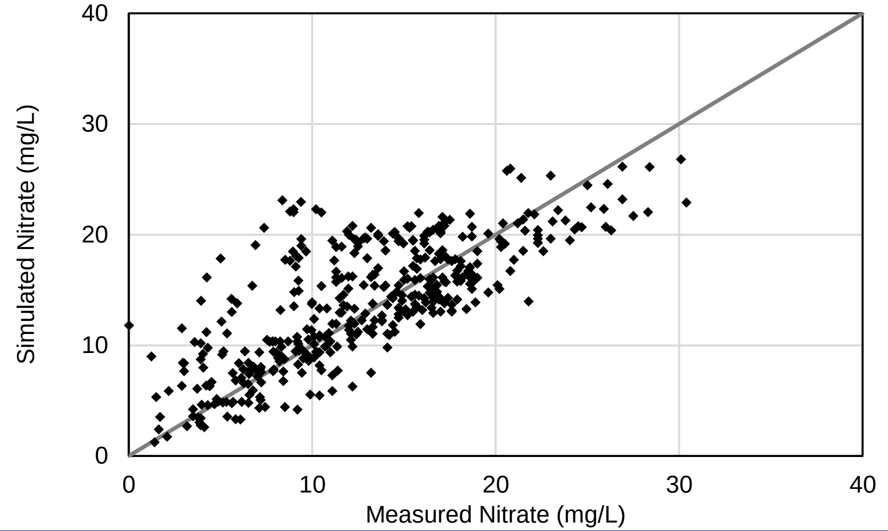
B1-15: Nitrate Calibration Information for Node LC_LCUSWLC - Line Creek u/s of West Line Creek (EMS E293369)

Measured and Simulated Nitrate Data and Calibration Statistics

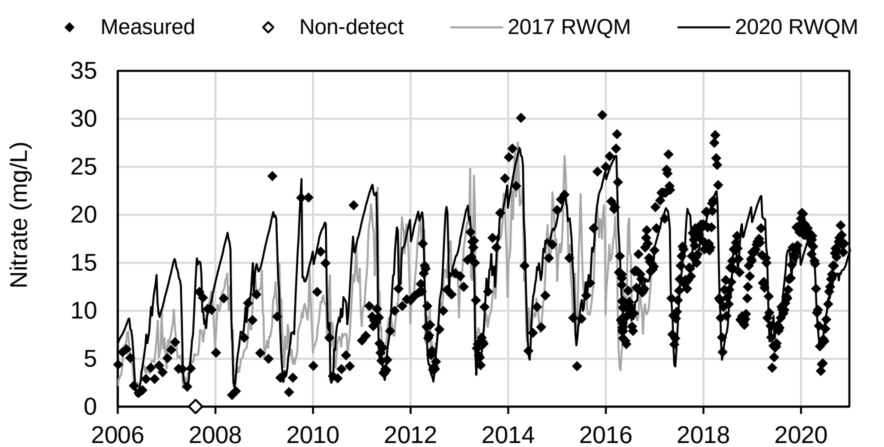
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/28/2016	12/27/2018
Data Points Available for Comparison, n	207	310
Non-Detect Count	1	1
Measured Mean (mg/L)	11	13
Simulated Mean (mg/L)	11	14
Bias (mg/L)	-0.21	1.3
Relative Bias	0.98	1.1
Error (mg/L)	3.8	3.3
Percent Error	35%	27%

(a) As adjusted for the 2019 IPA.

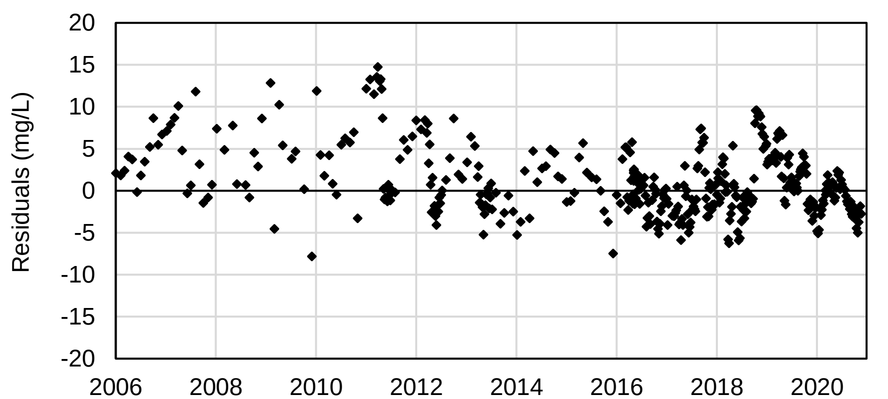
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

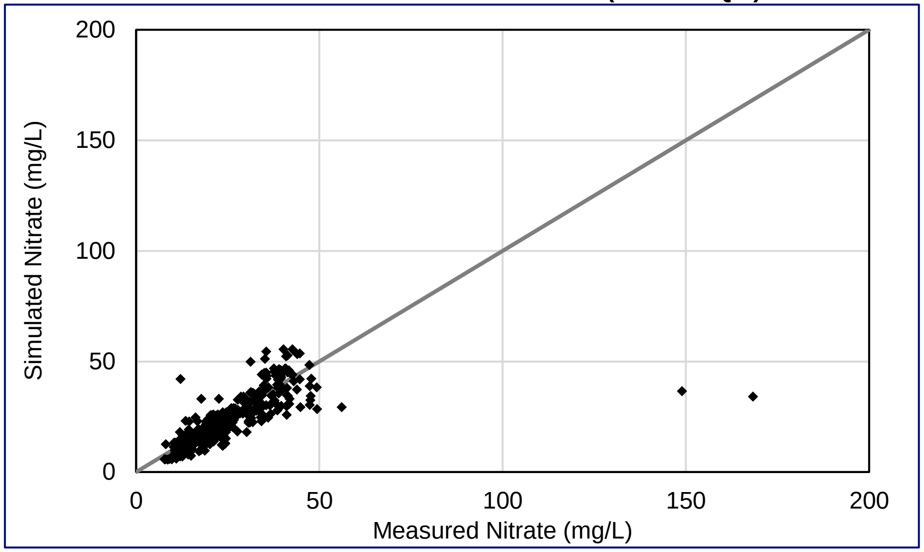
B1-16: Nitrate Calibration Information for Node LC_WLC - West Line Creek (EMS E261958)

Measured and Simulated Nitrate Data and Calibration Statistics

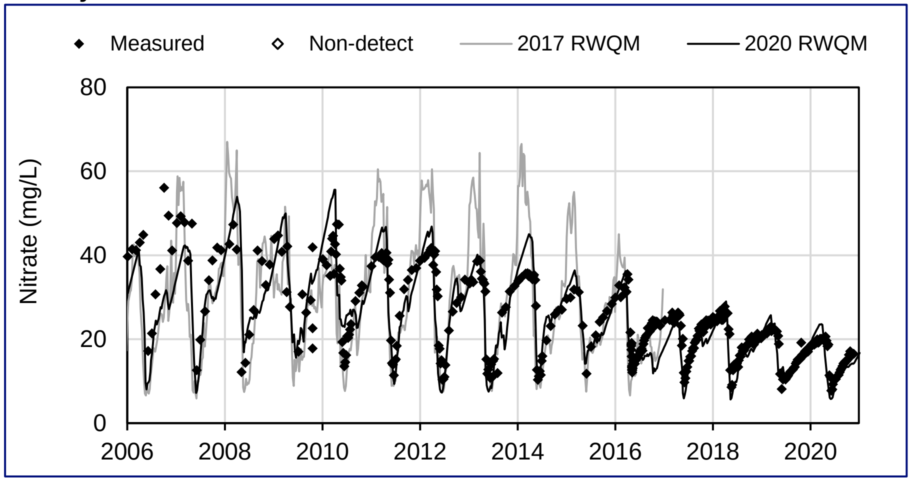
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/5/2016	12/27/2018
Data Points Available for Comparison, n	244	343
Non-Detect Count	0	0
Measured Mean (mg/L)	29	27
Simulated Mean (mg/L)	27	25
Bias (mg/L)	-2.3	-1.9
Relative Bias	0.92	0.93
Error (mg/L)	8.8	5.2
Percent Error	30%	20%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



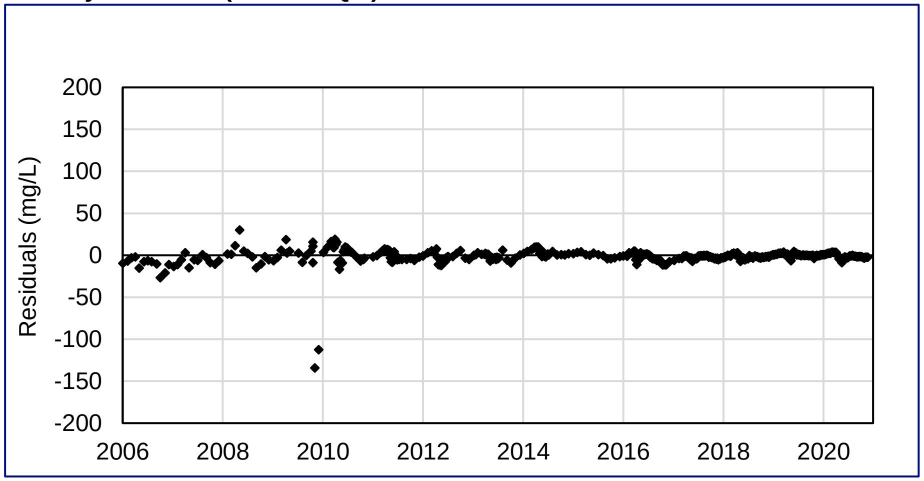
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

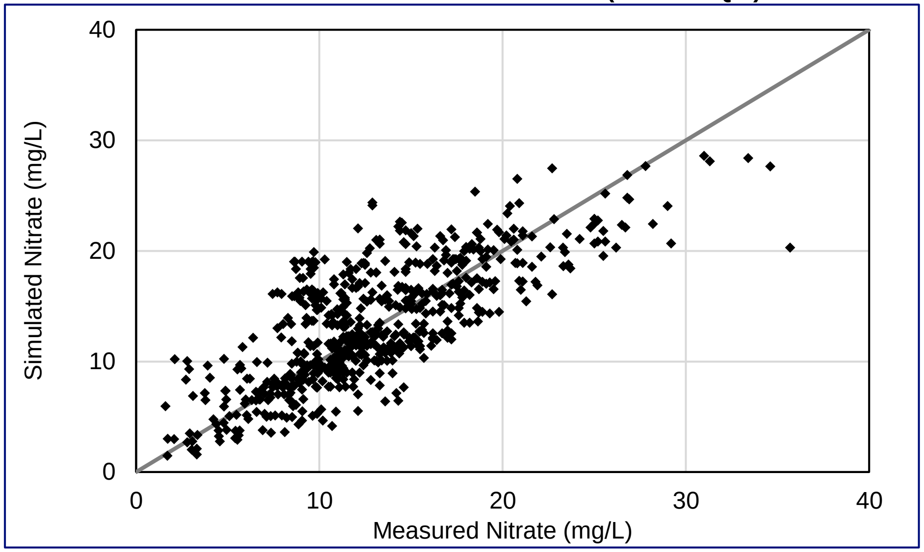
B1-17: Nitrate Calibration Information for Node LC_LC3 - Line Creek d/s of West Line Creek (EMS 0200337)

Measured and Simulated Nitrate Data and Calibration Statistics

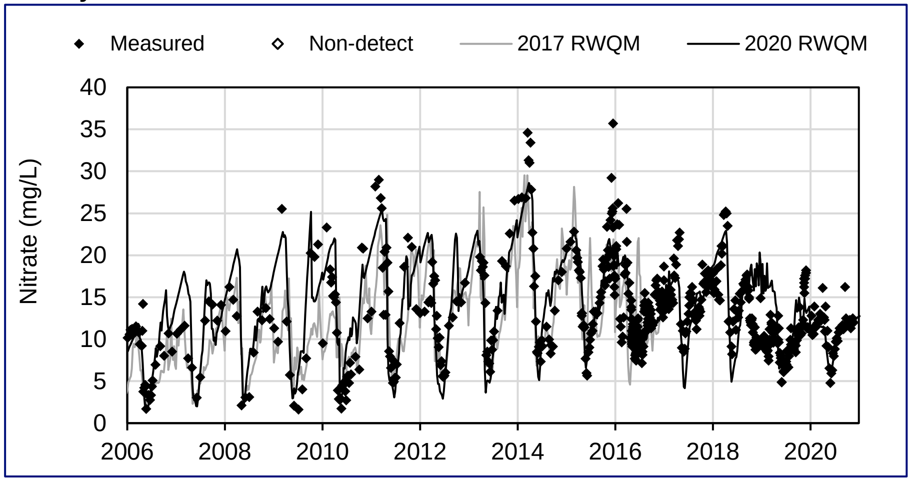
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/27/2016	12/31/2018
Data Points Available for Comparison, n	369	505
Non-Detect Count	0	0
Measured Mean (mg/L)	-	14
Simulated Mean (mg/L)	-	14
Bias (mg/L)	-	0.24
Relative Bias	-	1.0
Error (mg/L)	-	2.9
Percent Error	-	21%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



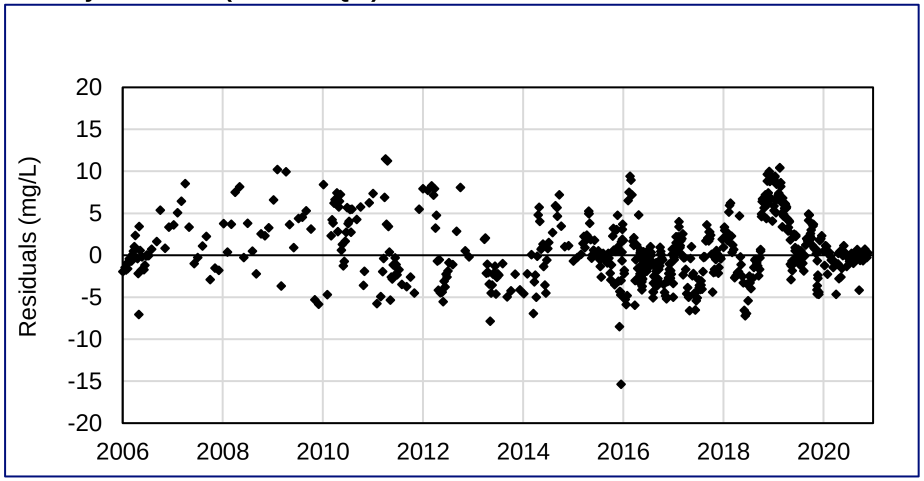
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-18: Nitrate Calibration Information for Node LC_LCDSSLCC - LCO Compliance Point - Line Creek d/s of South Line Creek Confluence (EMS E297110)

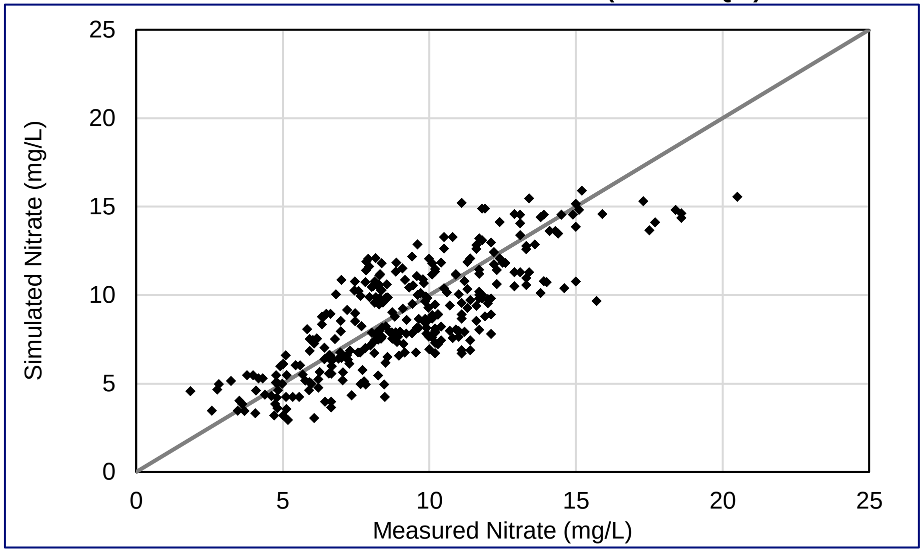
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	6/4/2014	6/4/2014
Last Measured Sample	12/28/2016	12/27/2018
Data Points Available for Comparison, n	108	218
Non-Detect Count	0	0
Measured Mean (mg/L)	-	9.9
Simulated Mean (mg/L)	-	9.4
Bias (mg/L)	-	-0.46
Relative Bias	-	0.95
Error (mg/L)	-	1.7
Percent Error	-	18%

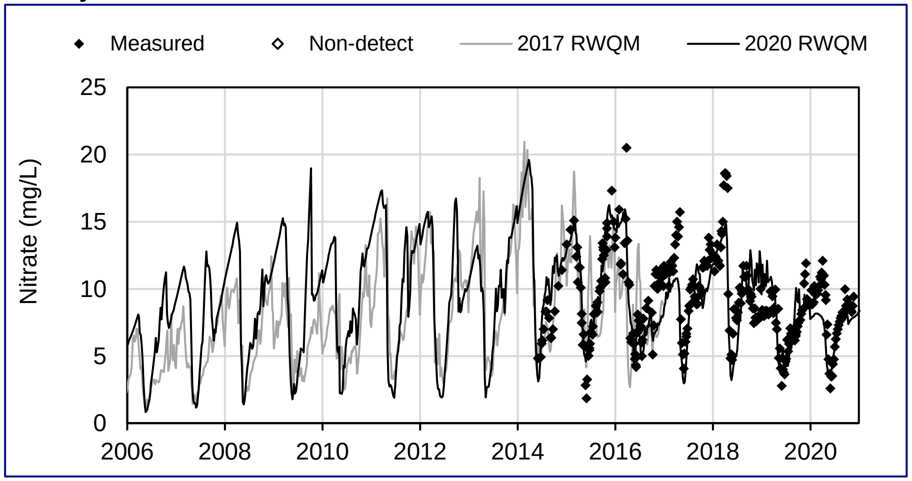
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



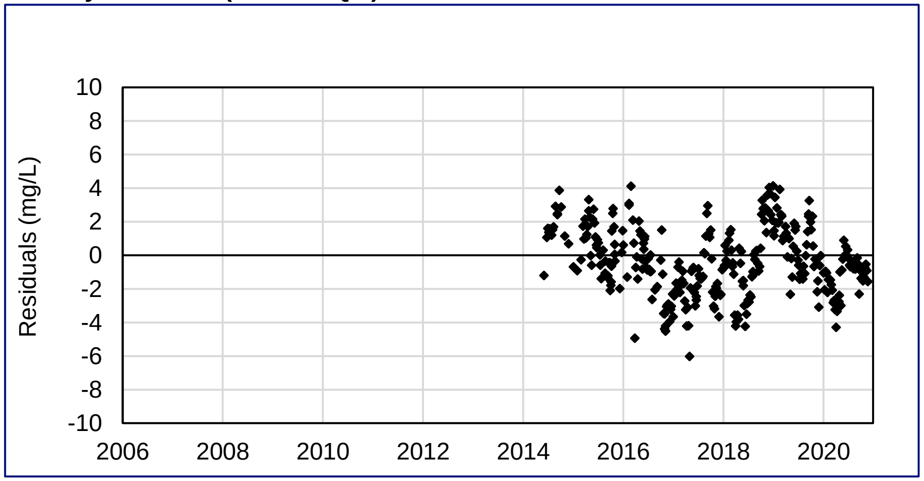
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

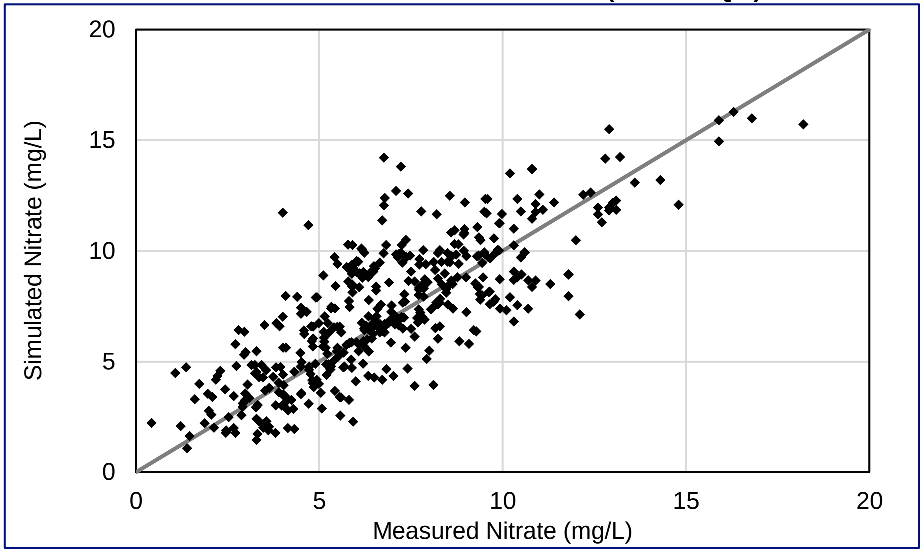
B1-19: Nitrate Calibration Information for Node LC_LC4 - Line Creek u/s of Process Plant (EMS 0200044)

Measured and Simulated Nitrate Data and Calibration Statistics

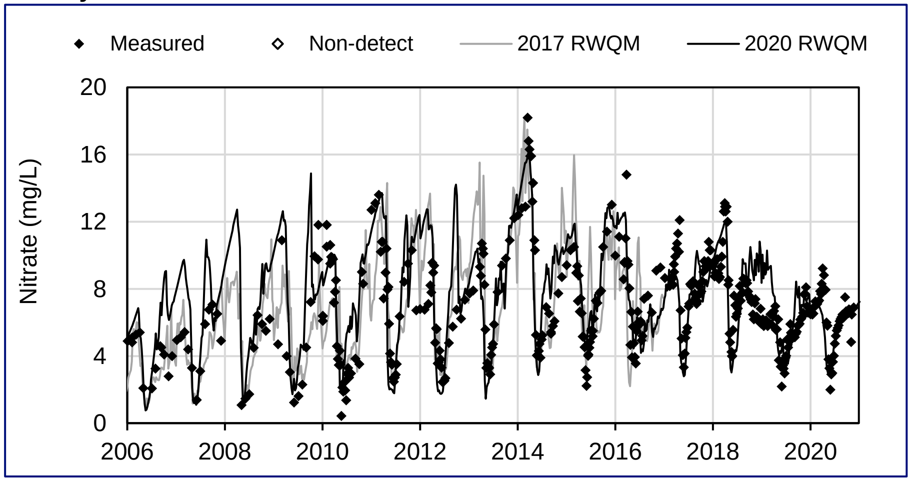
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/7/2016	12/27/2018
Data Points Available for Comparison, n	241	346
Non-Detect Count	0	0
Measured Mean (mg/L)	6.6	7.1
Simulated Mean (mg/L)	6.7	7.6
Bias (mg/L)	0.074	0.52
Relative Bias	1.0	1.1
Error (mg/L)	1.9	1.6
Percent Error	28%	23%

(a) As adjusted for the 2019 IPA.

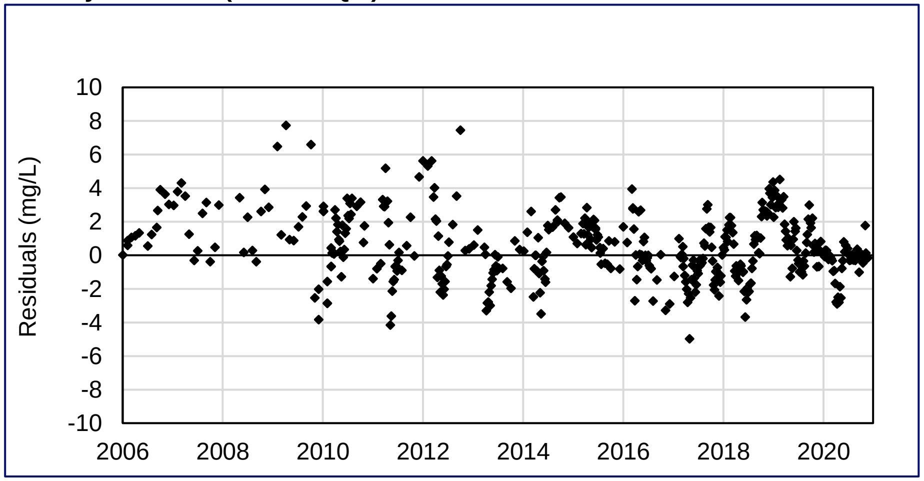
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

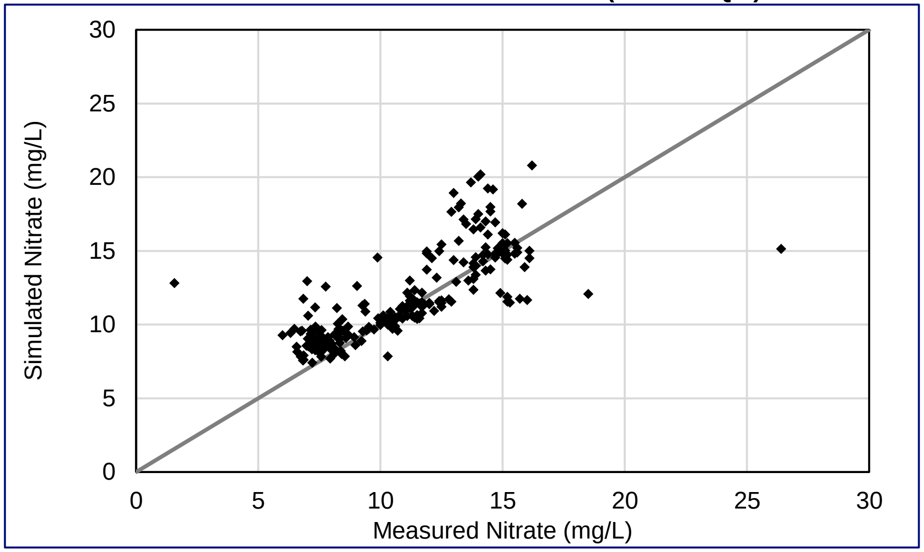
B1-20: Nitrate Calibration Information for Node EV_EC1 - Erickson Creek at Mouth (EMS 0200097)

Measured and Simulated Nitrate Data and Calibration Statistics

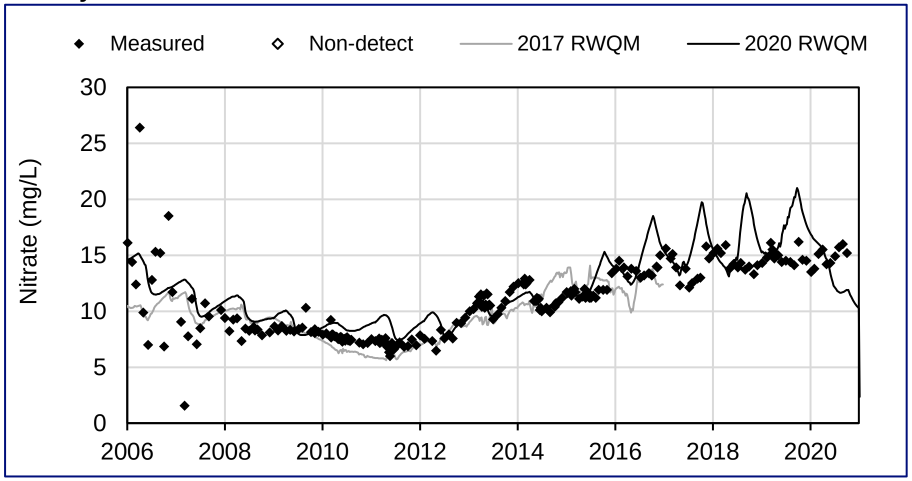
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	191	215
Non-Detect Count	0	0
Measured Mean (mg/L)	9.8	10
Simulated Mean (mg/L)	9.3	11
Bias (mg/L)	-0.53	0.83
Relative Bias	0.95	1.1
Error (mg/L)	1.4	1.4
Percent Error	15%	14%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)

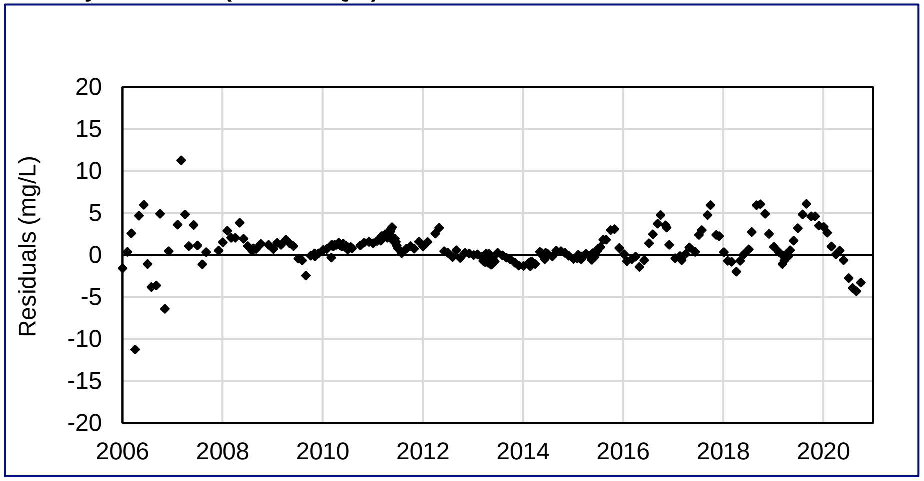


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

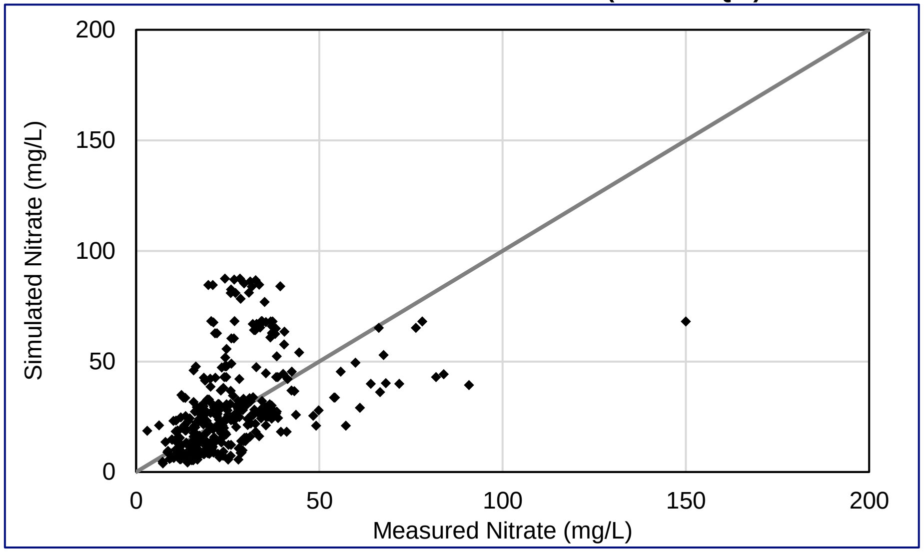
B1-21: Nitrate Calibration Information for Node EV_GT1 - Gate Creek Sediment Pond Decant (EMS E206231)

Measured and Simulated Nitrate Data and Calibration Statistics

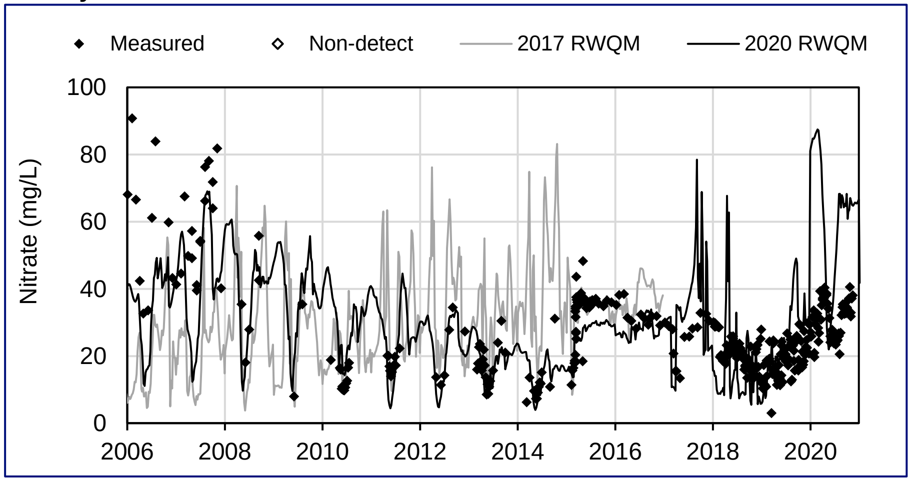
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/5/2016	12/31/2018
Data Points Available for Comparison, n	151	232
Non-Detect Count	0	0
Measured Mean (mg/L)	31	28
Simulated Mean (mg/L)	29	22
Bias (mg/L)	-1.8	-5.4
Relative Bias	0.94	0.81
Error (mg/L)	16	10
Percent Error	51%	38%

(a) As adjusted for the 2019 IPA.

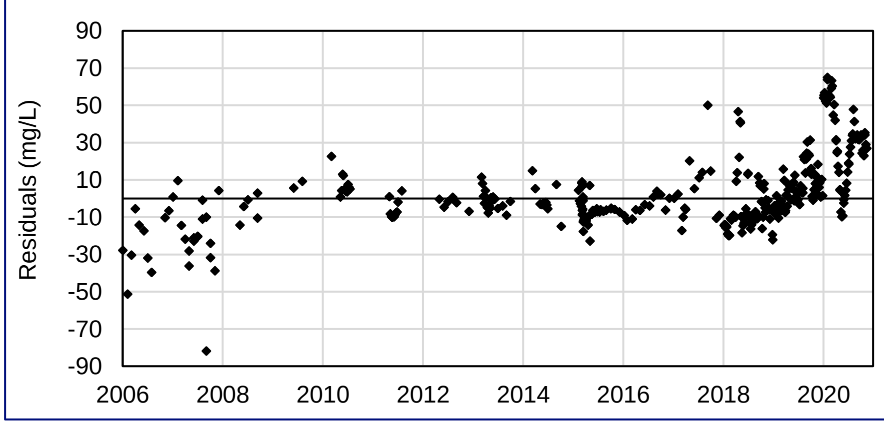
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

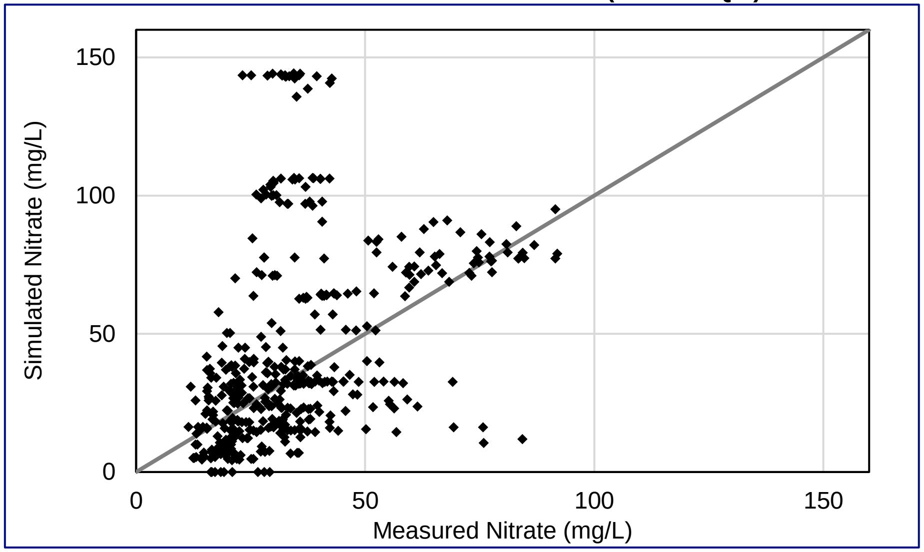
B1-22: Nitrate Calibration Information for Node EV_BC1 - Bodie Creek Sediment Pond Decant (EMS E102685)

Measured and Simulated Nitrate Data and Calibration Statistics

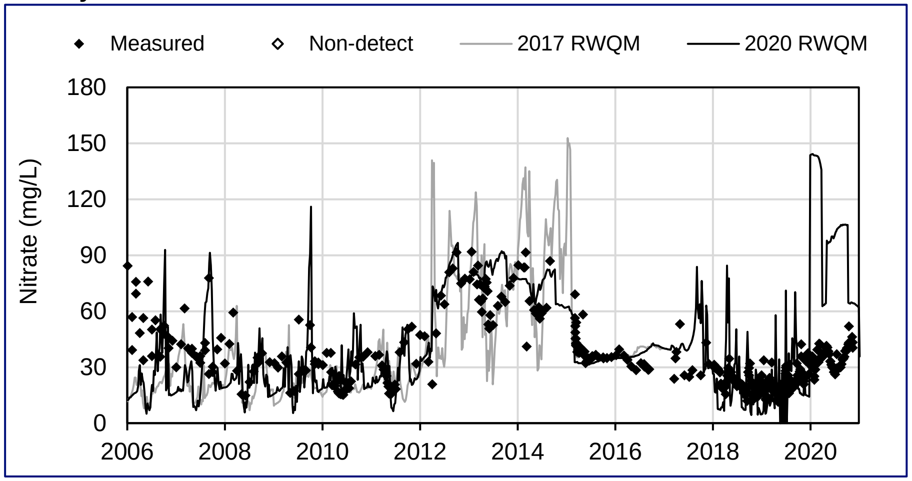
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	9/14/2016	12/31/2018
Data Points Available for Comparison, n	219	305
Non-Detect Count	0	0
Measured Mean (mg/L)	43	37
Simulated Mean (mg/L)	37	36
Bias (mg/L)	-5.2	-1.6
Relative Bias	0.88	0.96
Error (mg/L)	15	13
Percent Error	35%	34%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



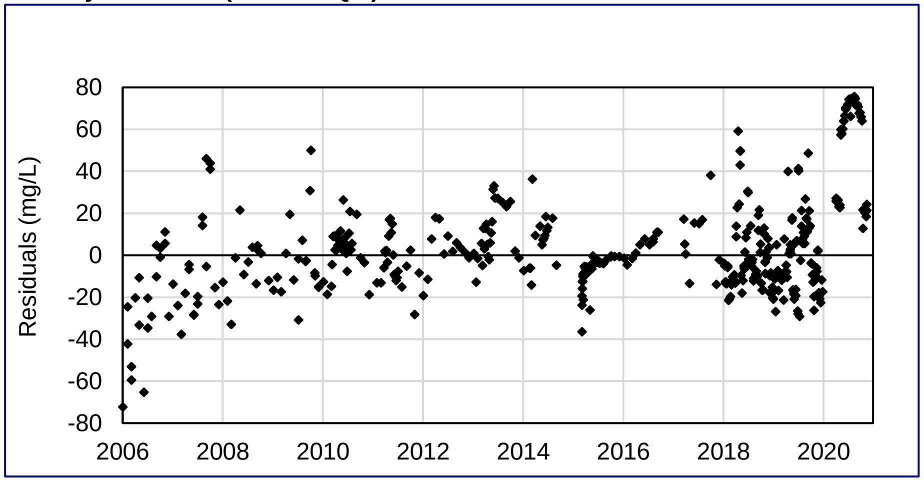
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

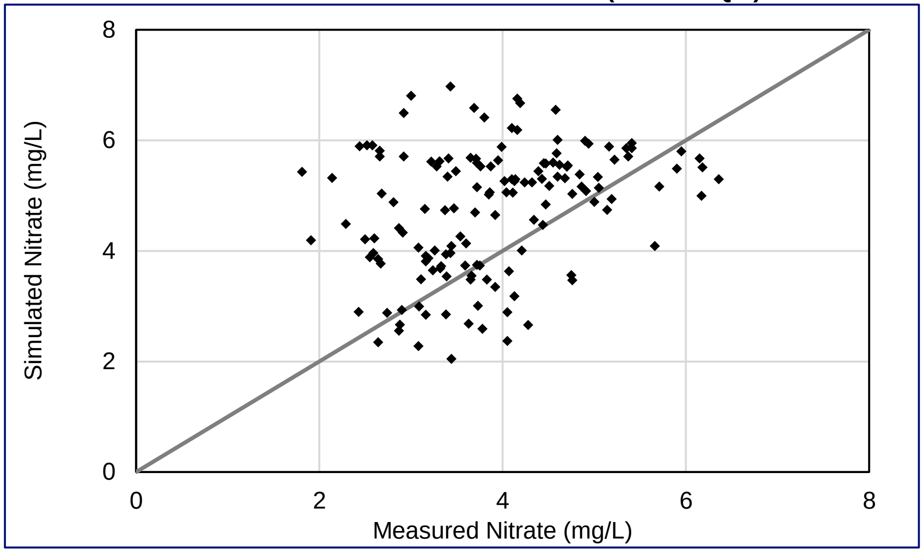
B1-23: Nitrate Calibration Information for Node EV_DC1 - EVO Dry Creek Sediment Pond Decant (EMS E298590)

Measured and Simulated Nitrate Data and Calibration Statistics

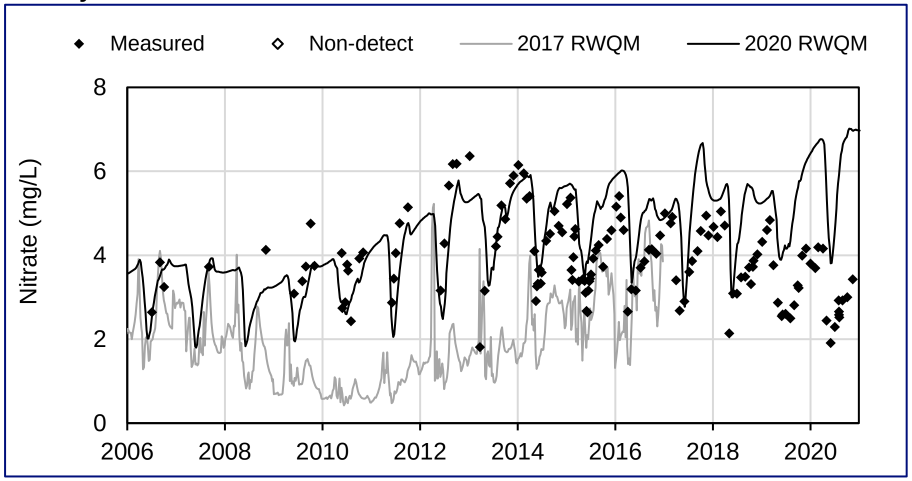
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	7/4/2006	7/4/2006
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	90	116
Non-Detect Count	0	0
Measured Mean (mg/L)	4.1	4.0
Simulated Mean (mg/L)	2.1	4.6
Bias (mg/L)	-1.9	0.52
Relative Bias	0.53	1.1
Error (mg/L)	2.0	0.92
Percent Error	49%	23%

[(a)] As adjusted for the 2019 IPA.

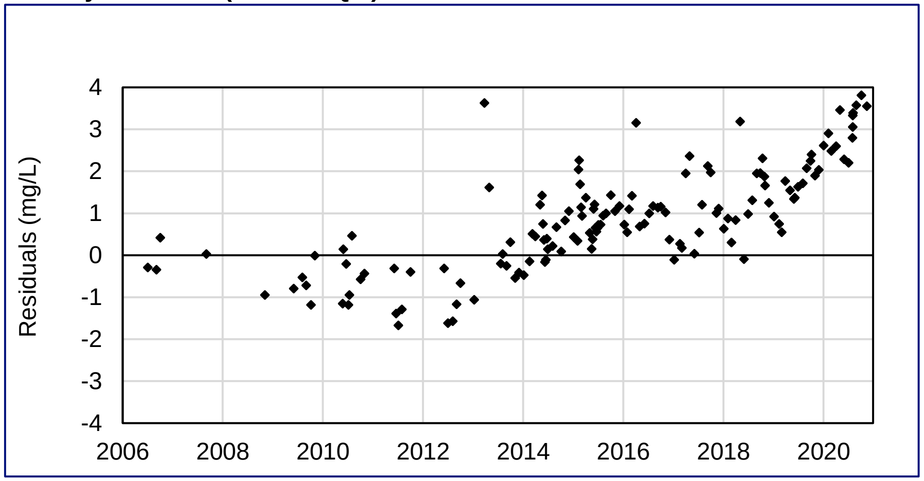
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

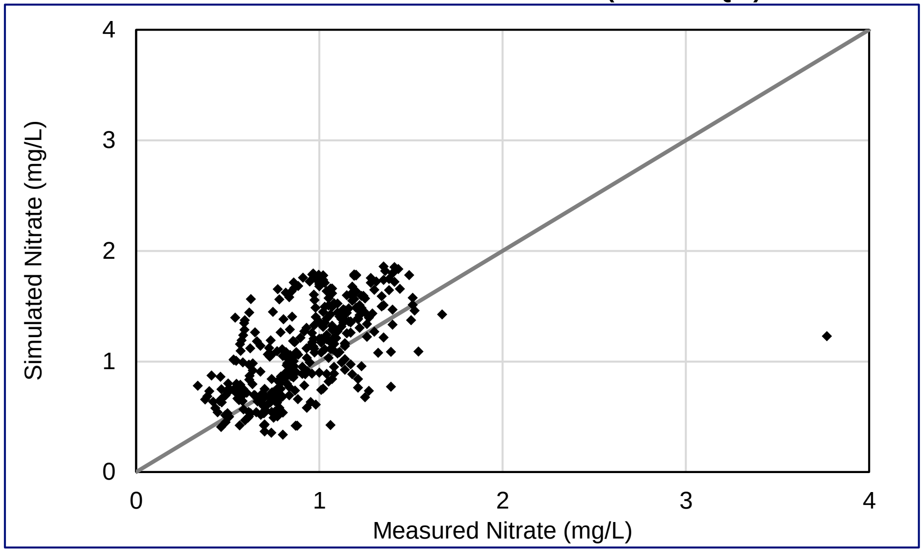
B1-24: Nitrate Calibration Information for Node EV_HC1 - EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (EMS E102682)

Measured and Simulated Nitrate Data and Calibration Statistics

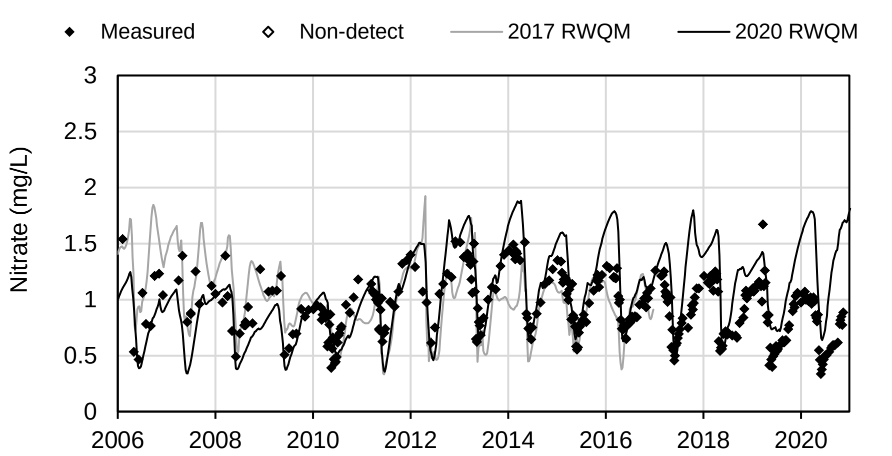
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	2/7/2006	2/7/2006
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	213	277
Non-Detect Count	0	0
Measured Mean (mg/L)	0.98	0.96
Simulated Mean (mg/L)	0.93	1.1
Bias (mg/L)	-0.043	0.11
Relative Bias	0.96	1.1
Error (mg/L)	0.21	0.25
Percent Error	22%	26%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



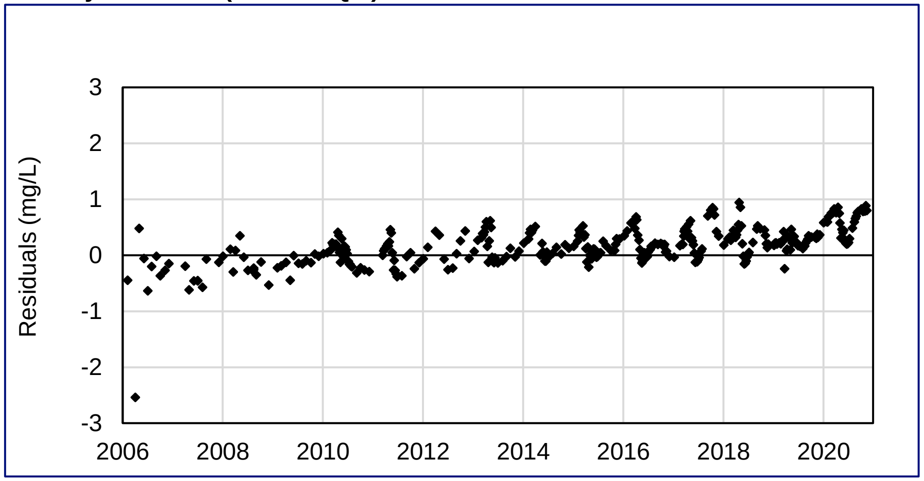
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

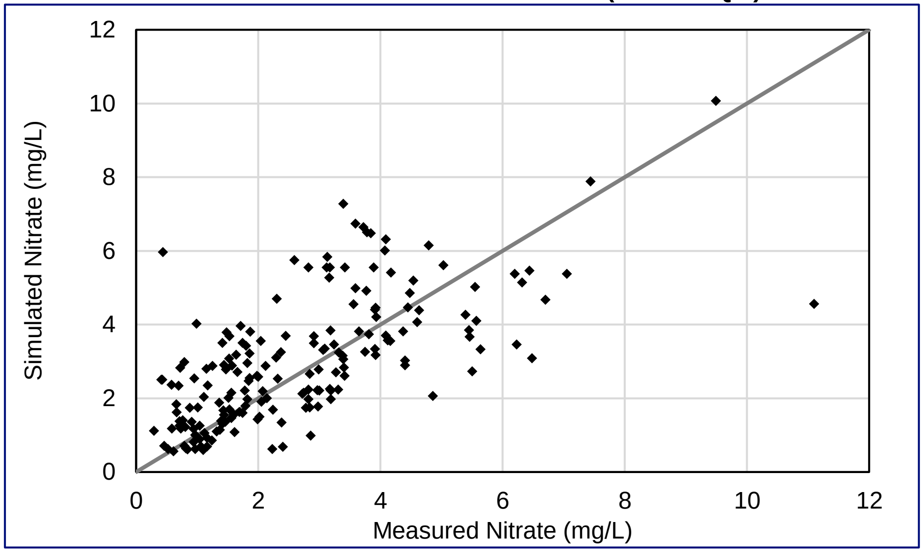
B1-25: Nitrate Calibration Information for Node FR_FR1 - Fording River d/s of Henretta Creek (EMS 0200251)

Measured and Simulated Nitrate Data and Calibration Statistics

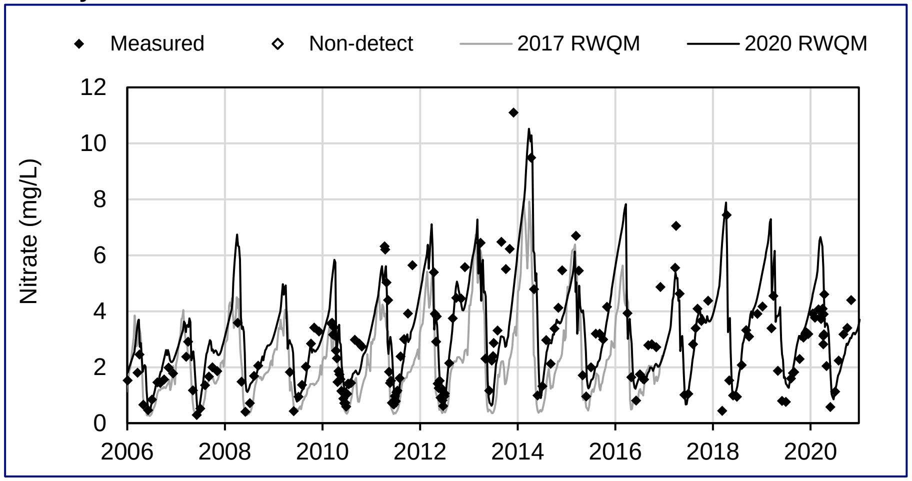
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	133	152
Non-Detect Count	0	0
Measured Mean (mg/L)	2.5	2.6
Simulated Mean (mg/L)	1.6	2.8
Bias (mg/L)	-0.96	0.15
Relative Bias	0.62	1.1
Error (mg/L)	1.1	1.0
Percent Error	42%	38%

(a) As adjusted for the 2019 IPA.

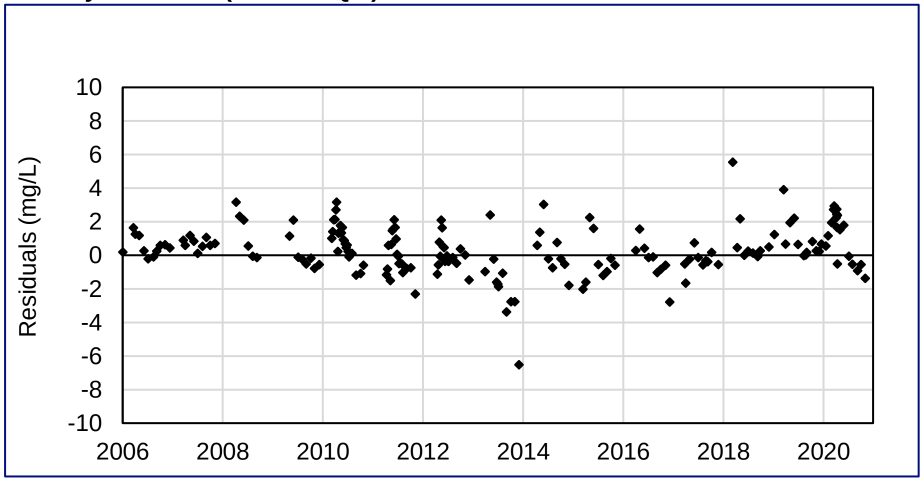
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

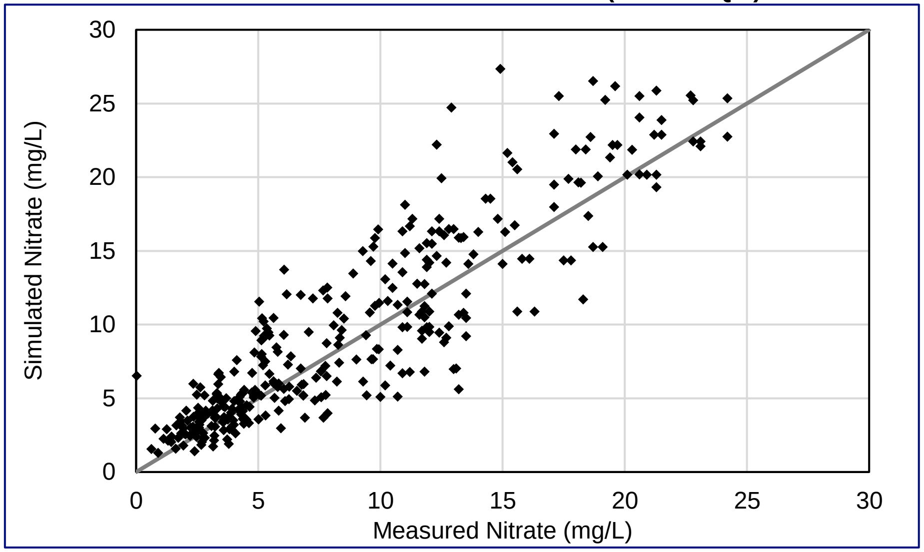
B1-26: Nitrate Calibration Information for Node FR_FR2 - Fording River u/s of Kilmarnock Creek (EMS 0200201)

Measured and Simulated Nitrate Data and Calibration Statistics

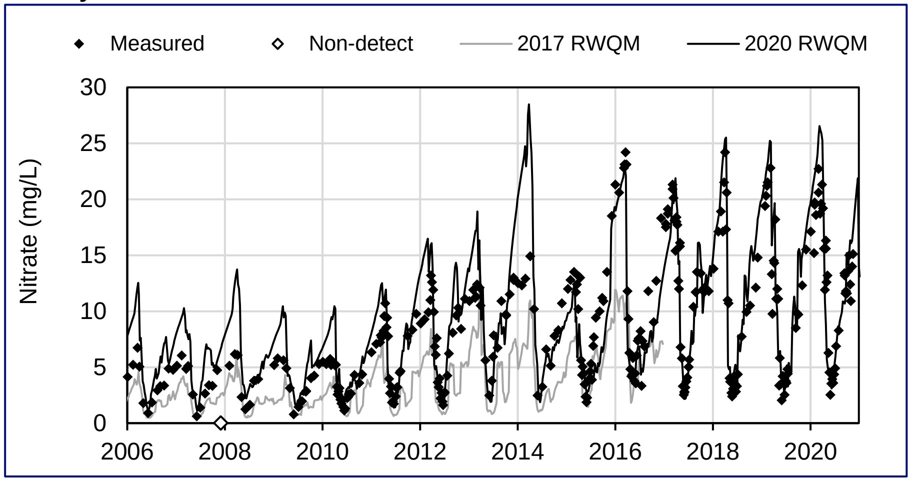
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/12/2016	12/5/2018
Data Points Available for Comparison, n	213	275
Non-Detect Count	1	1
Measured Mean (mg/L)	6.7	7.7
Simulated Mean (mg/L)	3.9	8.6
Bias (mg/L)	-2.9	0.83
Relative Bias	0.57	1.1
Error (mg/L)	3.0	2.2
Percent Error	45%	28%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)

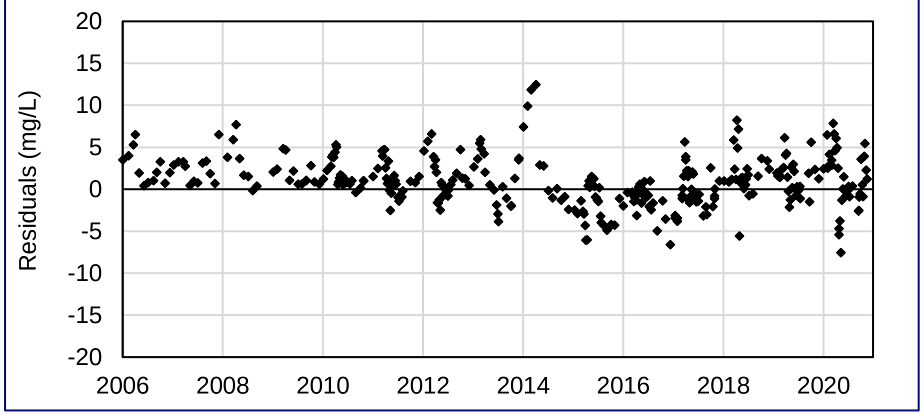


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

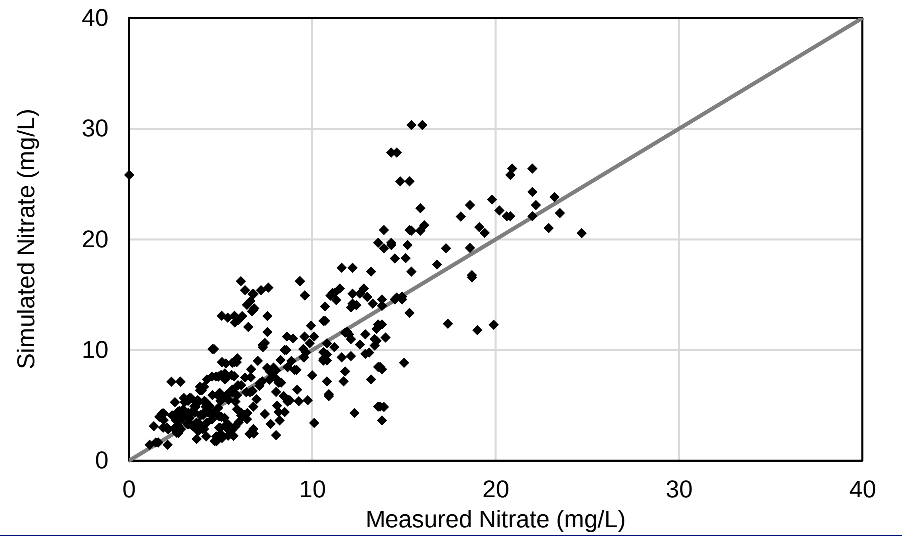
B1-27: Nitrate Calibration Information for Node FR_FR4 - Fording River between Swift and Cataract Creeks (EMS 0200311)

Measured and Simulated Nitrate Data and Calibration Statistics

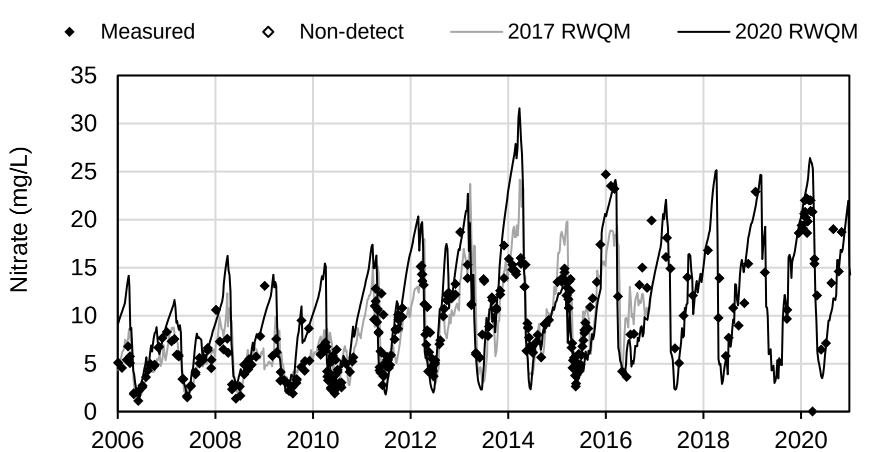
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/12/2016	12/5/2018
Data Points Available for Comparison, n	318	335
Non-Detect Count	0	0
Measured Mean (mg/L)	7.4	7.6
Simulated Mean (mg/L)	7.7	8.4
Bias (mg/L)	0.29	0.79
Relative Bias	1.0	1.1
Error (mg/L)	2.3	2.7
Percent Error	31%	35%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



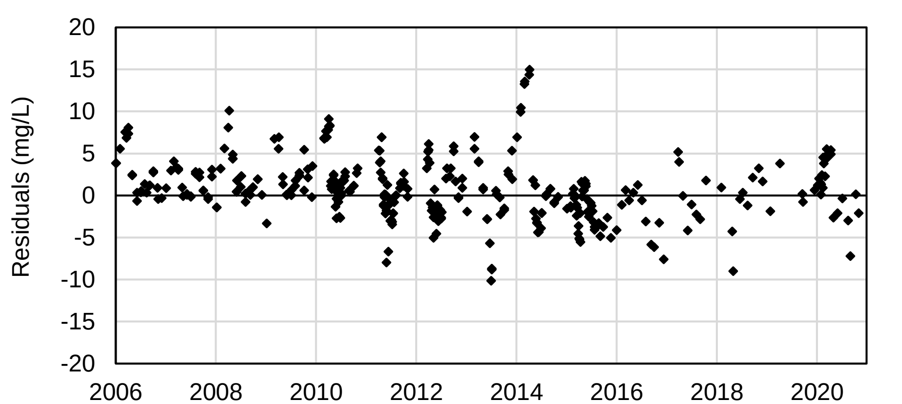
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-28: Nitrate Calibration Information for Node FR_FRCP1 - Fording River, 525 m d/s of Cataract Creek (EMS E300071)

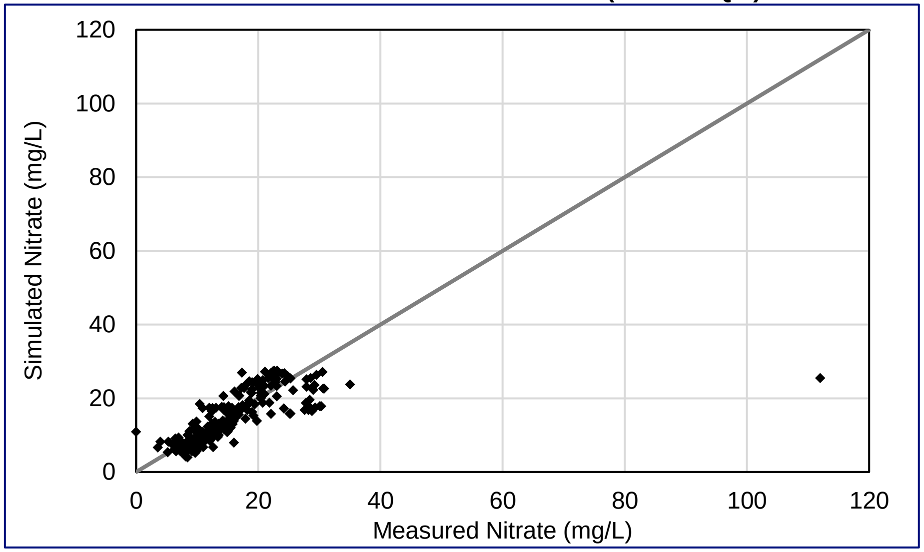
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	2/3/2015	2/3/2015
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	82	155
Non-Detect Count	0	0
Measured Mean (mg/L)	-	15
Simulated Mean (mg/L)	-	13
Bias (mg/L)	-	-1.4
Relative Bias	-	0.9
Error (mg/L)	-	2.9
Percent Error	-	20%

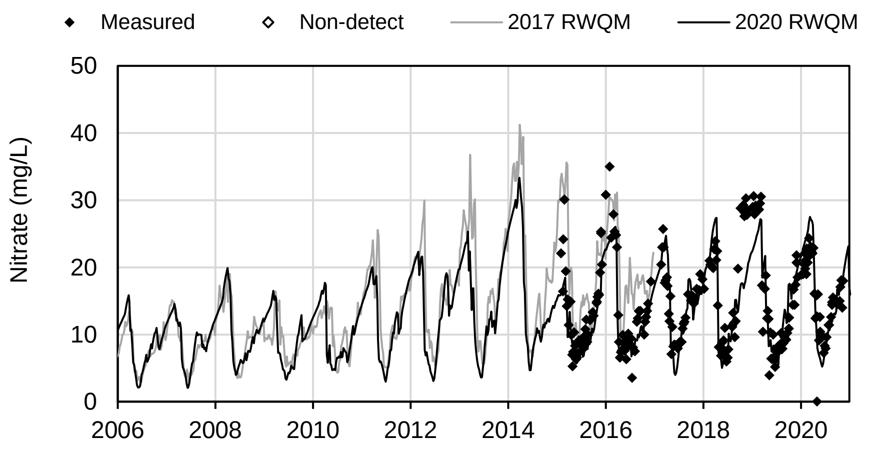
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



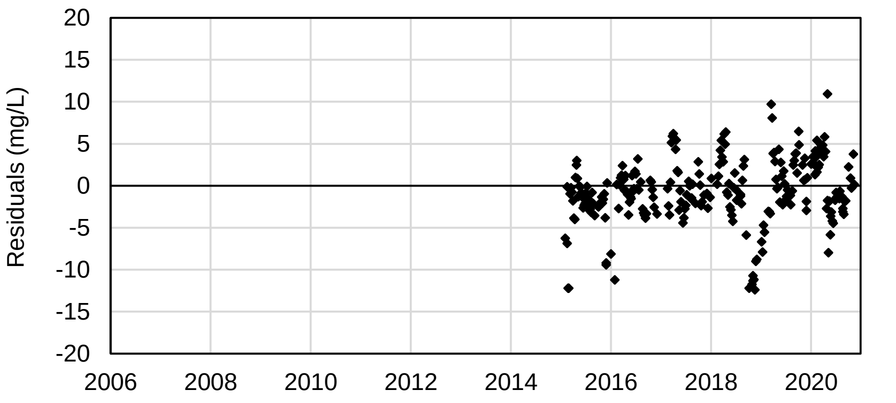
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

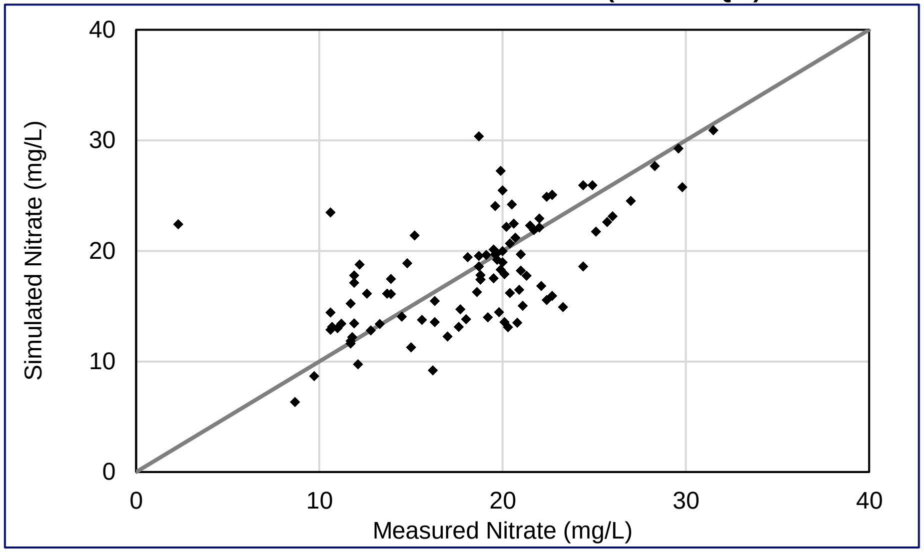
B1-29: Nitrate Calibration Information for Node GH_PC2 - Fording River d/s of Porter Creek (EMS E287431)

Measured and Simulated Nitrate Data and Calibration Statistics

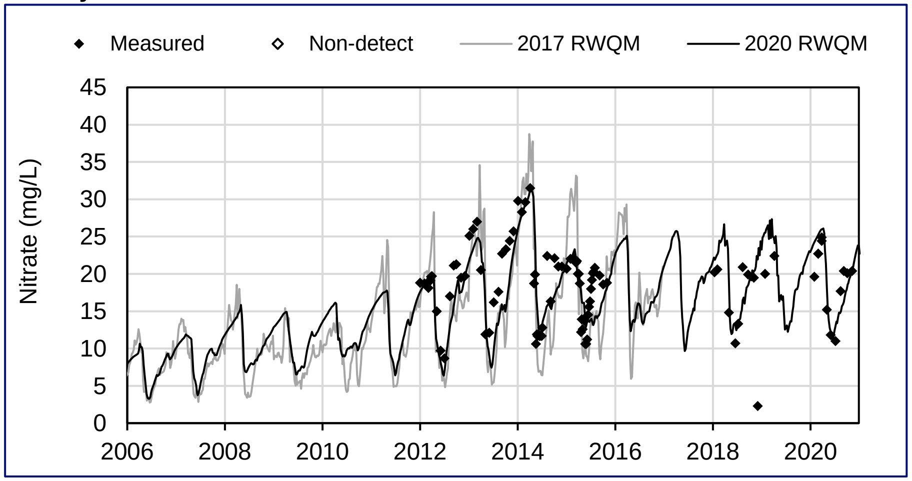
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2012	1/3/2012
Last Measured Sample	11/2/2015	12/5/2018
Data Points Available for Comparison, n	72	81
Non-Detect Count	0	0
Measured Mean (mg/L)	18	18
Simulated Mean (mg/L)	17	18
Bias (mg/L)	-1.8	-0.38
Relative Bias	0.9	0.98
Error (mg/L)	4.8	3.2
Percent Error	26%	18%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



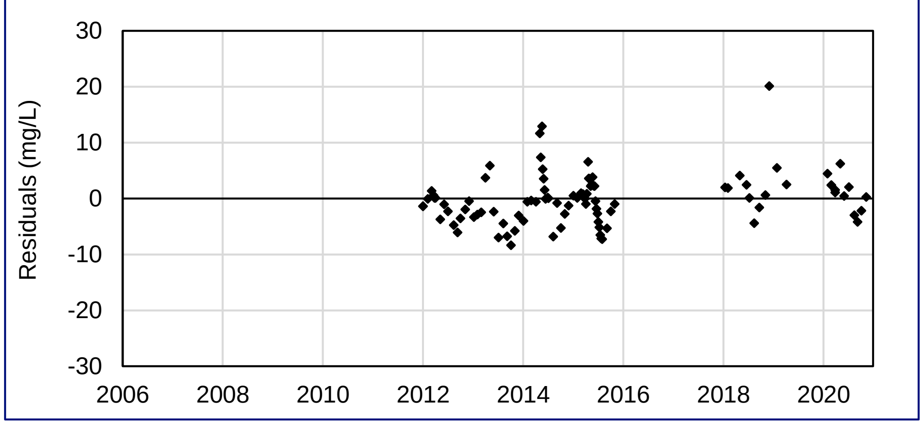
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-30: Nitrate Calibration Information for Node FR_FRABCH - FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (EMS E223753)

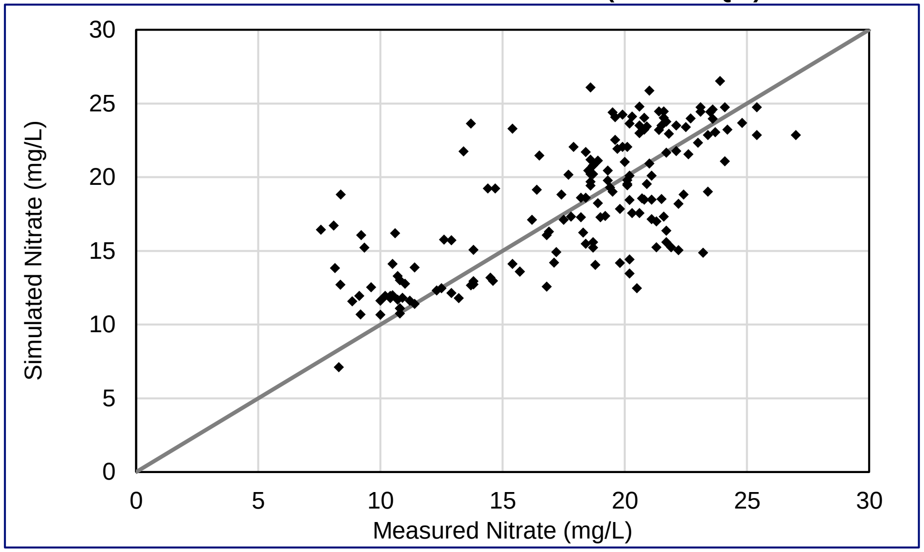
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	6/24/2013	6/24/2013
Last Measured Sample	12/8/2016	12/6/2018
Data Points Available for Comparison, n	24	71
Non-Detect Count	0	0
Measured Mean (mg/L)	-	18
Simulated Mean (mg/L)	-	18
Bias (mg/L)	-	-0.19
Relative Bias	-	0.99
Error (mg/L)	-	2.5
Percent Error	-	14%

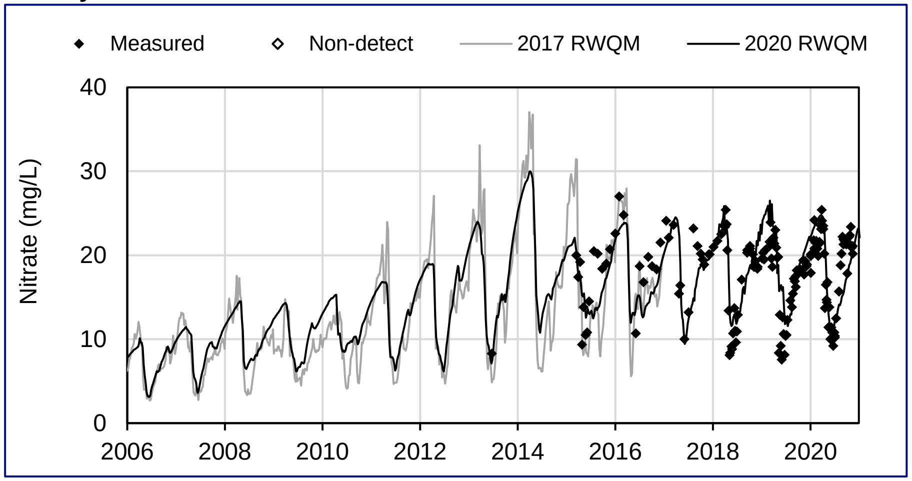
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



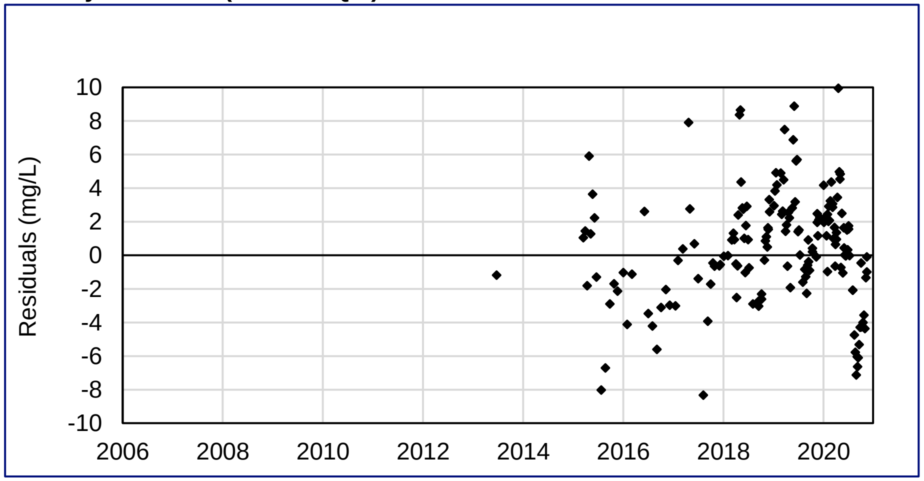
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-31: Nitrate Calibration Information for Node LC_FRDSDC - Fording River d/s of Dry Creek (EMS E288272)

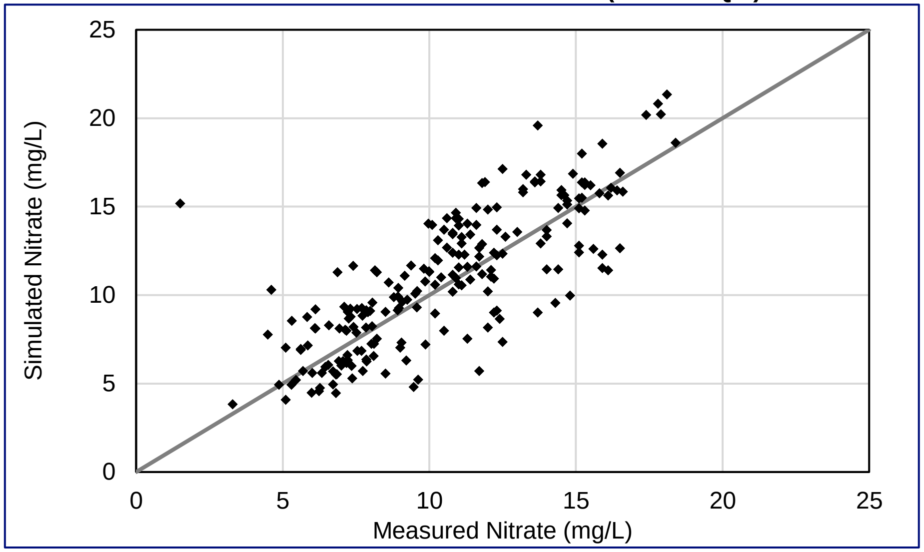
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	12/7/2011	12/7/2011
Last Measured Sample	12/6/2016	12/5/2018
Data Points Available for Comparison, n	108	160
Non-Detect Count	0	0
Measured Mean (mg/L)	-	10
Simulated Mean (mg/L)	-	11
Bias (mg/L)	-	0.49
Relative Bias	-	1.0
Error (mg/L)	-	1.6
Percent Error	-	15%

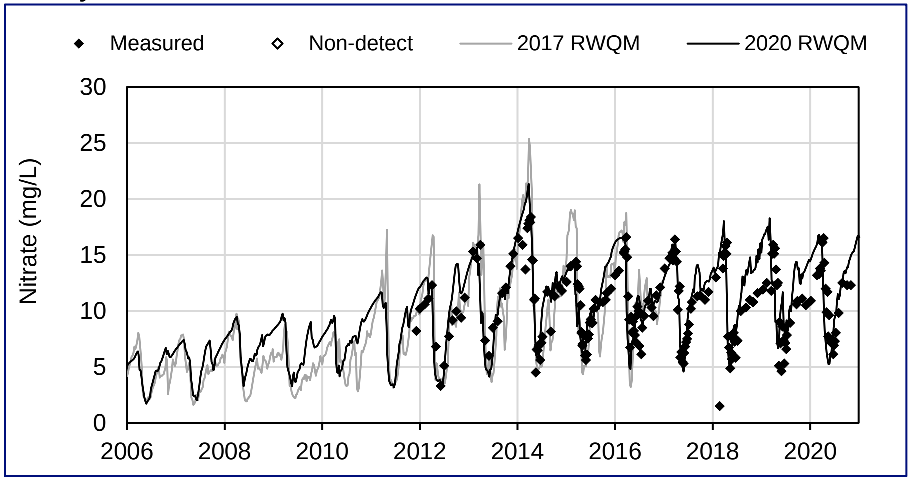
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



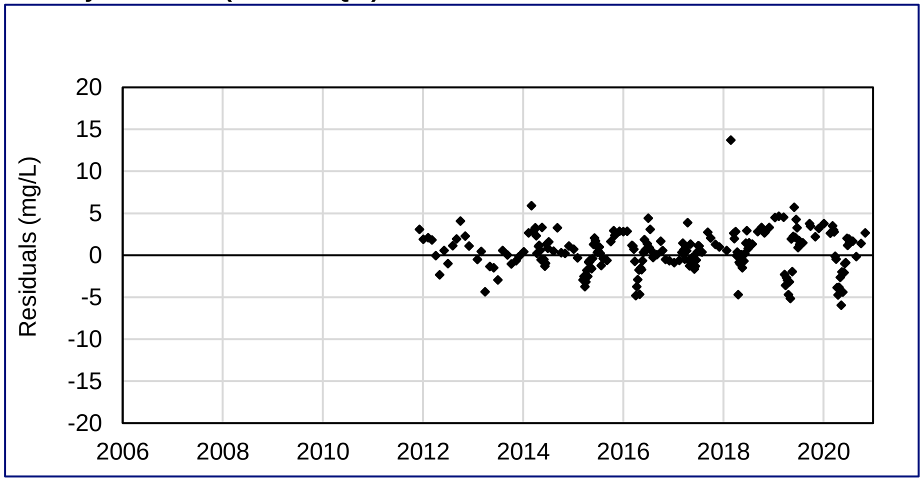
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

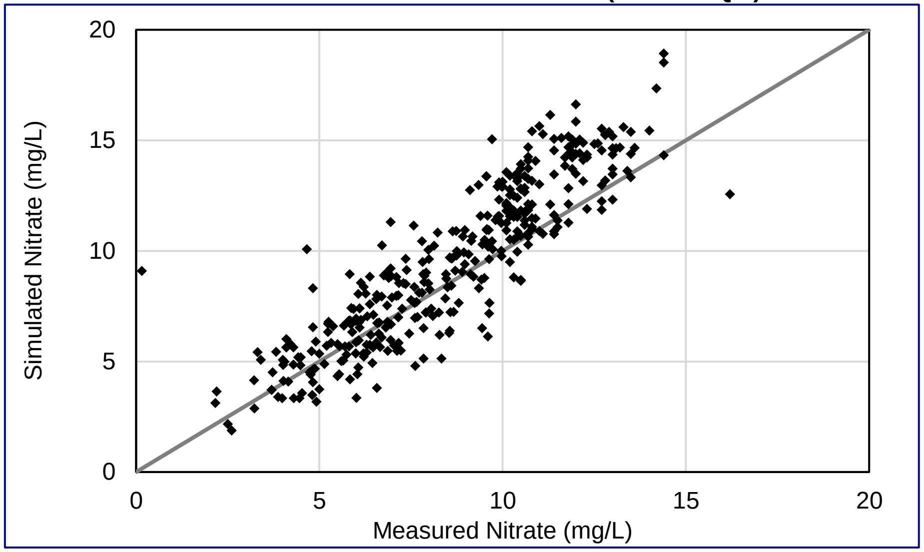
B1-32: Nitrate Calibration Information for Node GH_FR1 - GHO Fording River Compliance Point (EMS 0200378)

Measured and Simulated Nitrate Data and Calibration Statistics

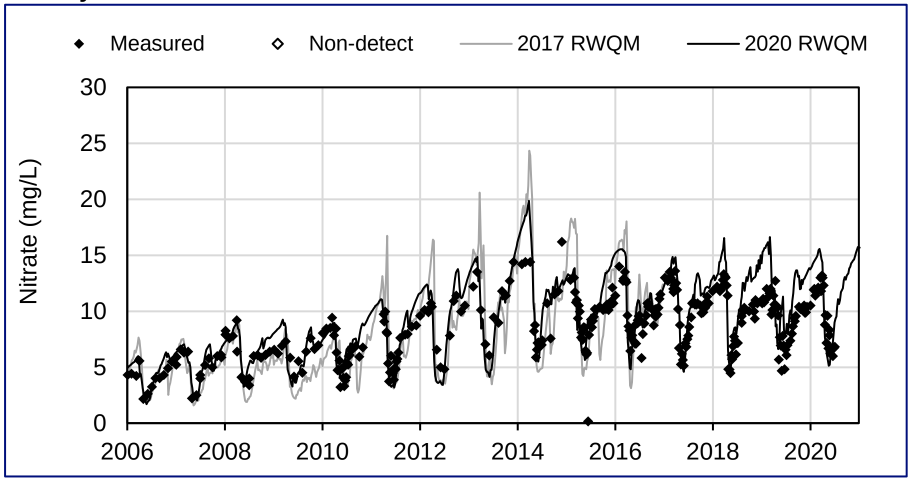
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	229	308
Non-Detect Count	0	0
Measured Mean (mg/L)	7.8	8.3
Simulated Mean (mg/L)	7.9	9.1
Bias (mg/L)	0.11	0.75
Relative Bias	1.0	1.1
Error (mg/L)	1.9	1.3
Percent Error	24%	15%

(a) As adjusted for the 2019 IPA.

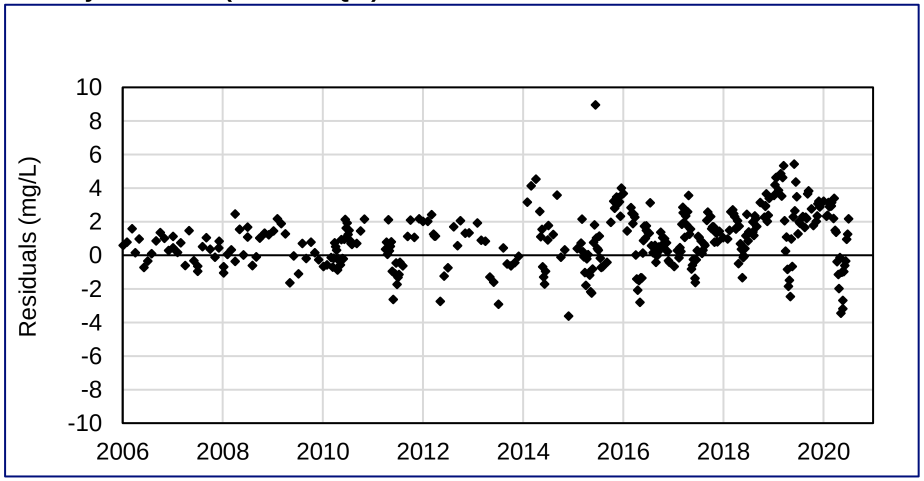
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

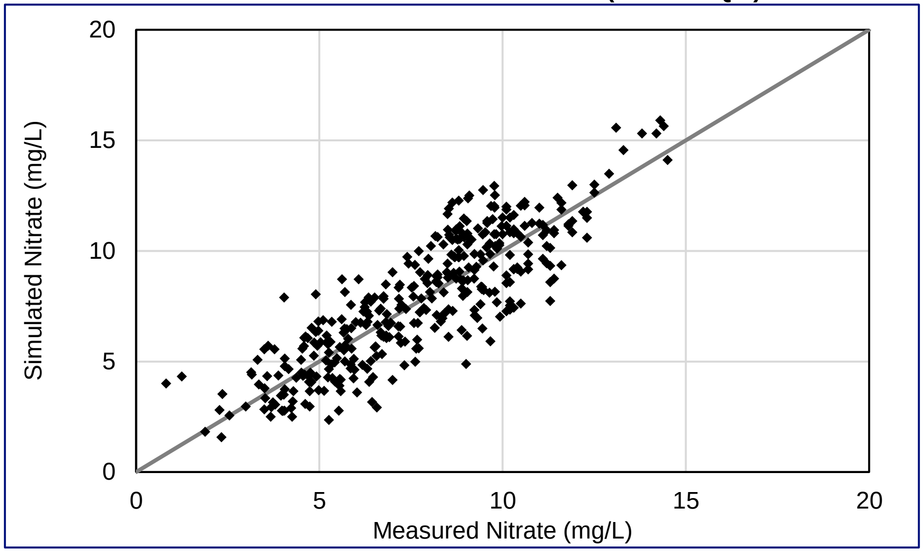
B1-33: Nitrate Calibration Information for Node LC_LC5 - Fording River d/s of Line Creek (EMS 0200028)

Measured and Simulated Nitrate Data and Calibration Statistics

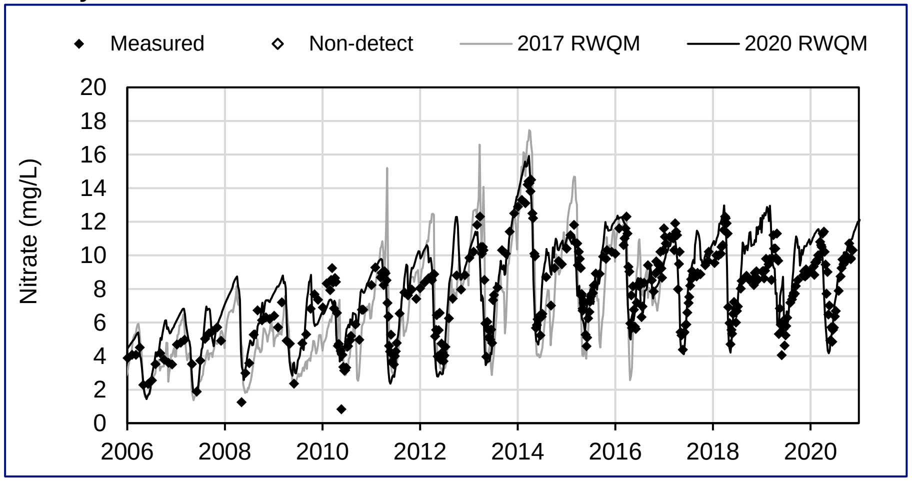
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/28/2016	12/4/2018
Data Points Available for Comparison, n	237	303
Non-Detect Count	0	0
Measured Mean (mg/L)	7.2	7.6
Simulated Mean (mg/L)	6.9	7.5
Bias (mg/L)	-0.32	-0.027
Relative Bias	0.96	1.0
Error (mg/L)	1.6	1.1
Percent Error	22%	15%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



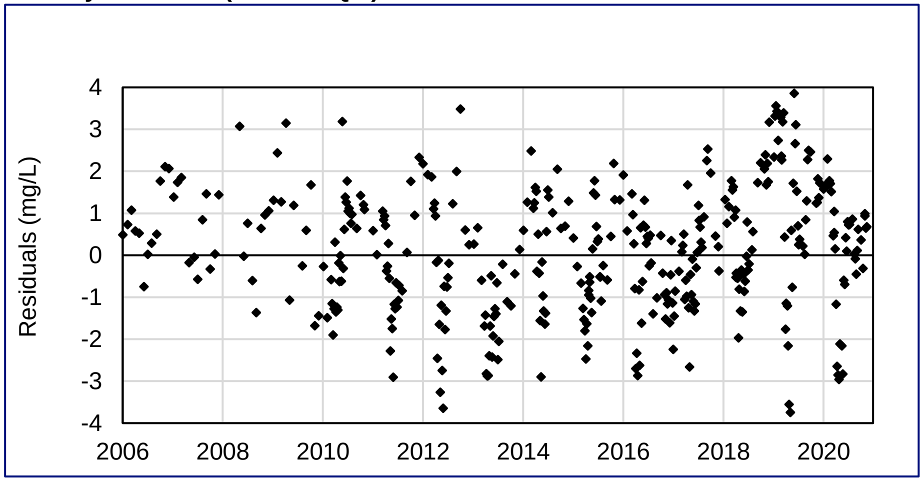
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

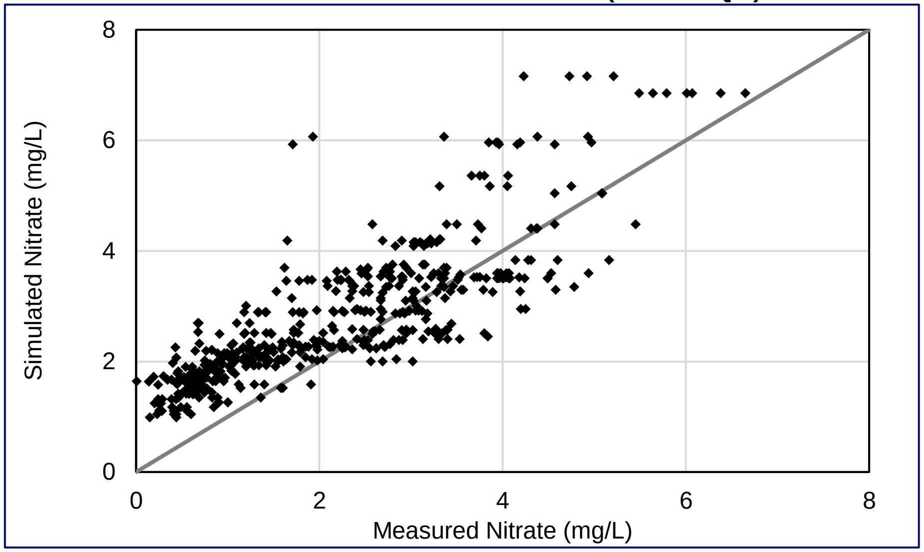
B1-34: Nitrate Calibration Information for Node CM_MC2 - CMO Compliance Point (EMS E258937)

Measured and Simulated Nitrate Data and Calibration Statistics

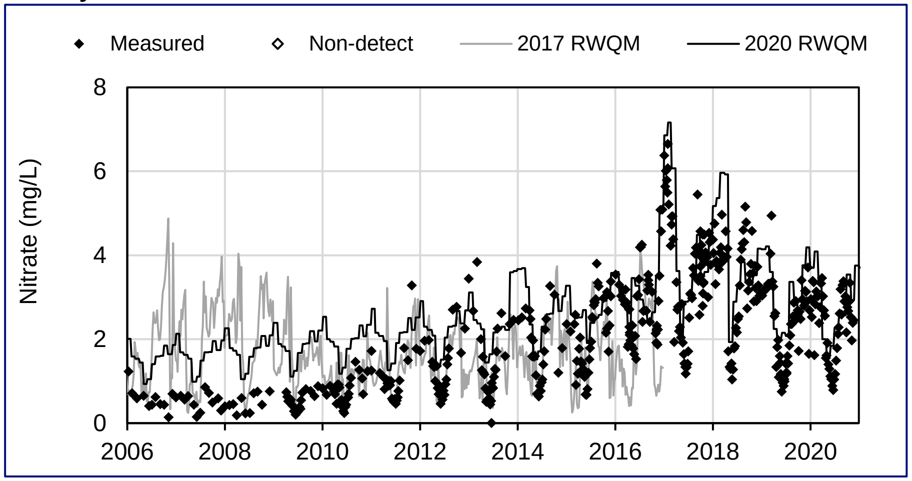
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/11/2006	1/11/2006
Last Measured Sample	12/21/2016	12/28/2018
Data Points Available for Comparison, n	280	398
Non-Detect Count	0	0
Measured Mean (mg/L)	1.5	2.1
Simulated Mean (mg/L)	1.5	2.8
Bias (mg/L)	-0.054	0.65
Relative Bias	0.96	1.3
Error (mg/L)	0.86	0.85
Percent Error	56%	40%

[a] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



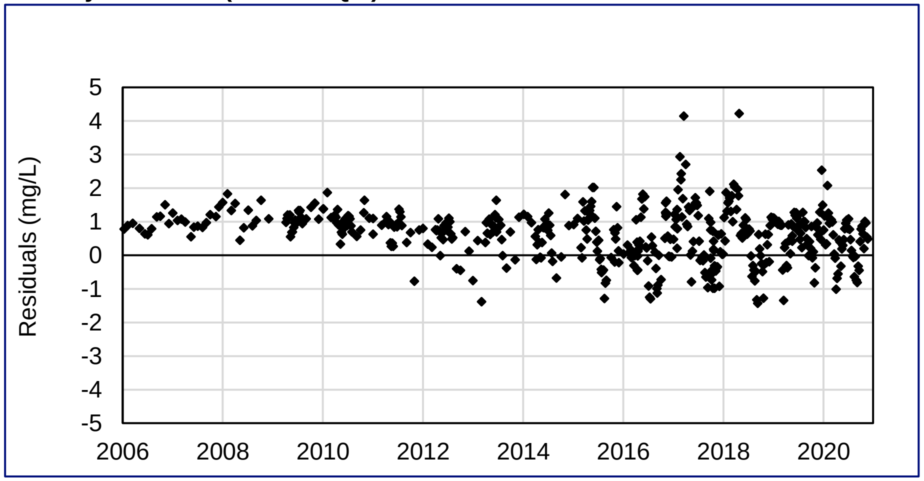
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

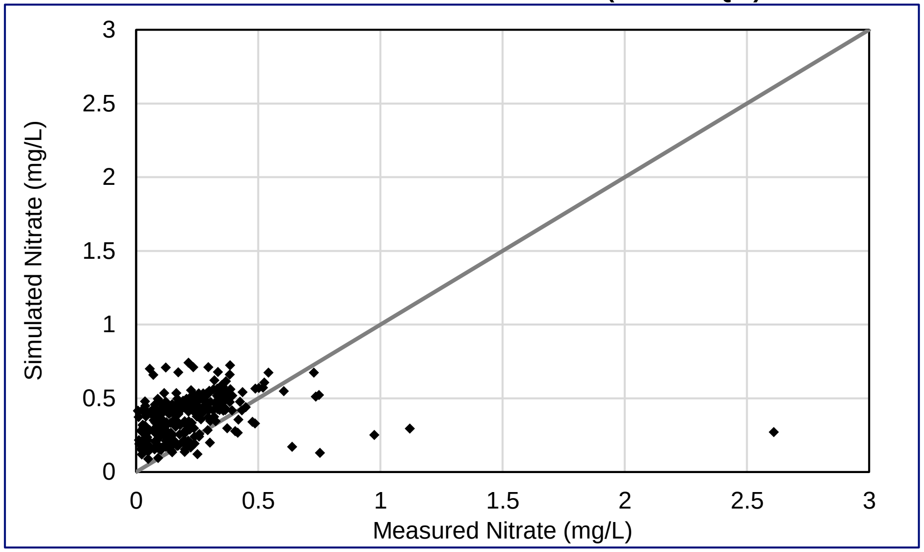
B1-35: Nitrate Calibration Information for Node EV_MC3 - Michel Creek u/s of Erickson Creek (EMS 0200203)

Measured and Simulated Nitrate Data and Calibration Statistics

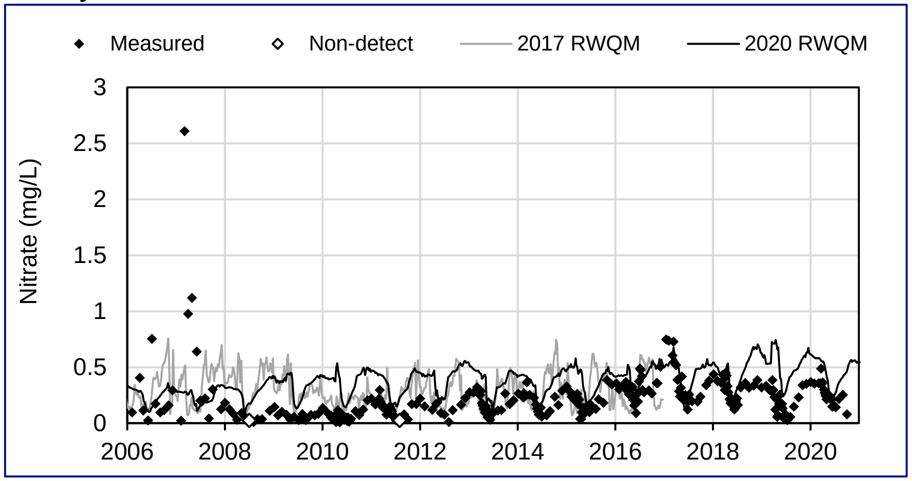
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	2/7/2006	2/7/2006
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	210	261
Non-Detect Count	2	2
Measured Mean (mg/L)	0.19	0.21
Simulated Mean (mg/L)	0.26	0.36
Bias (mg/L)	0.071	0.14
Relative Bias	1.4	1.7
Error (mg/L)	0.17	0.019
Percent Error	91%	9%

[(a)] As adjusted for the 2019 IPA.

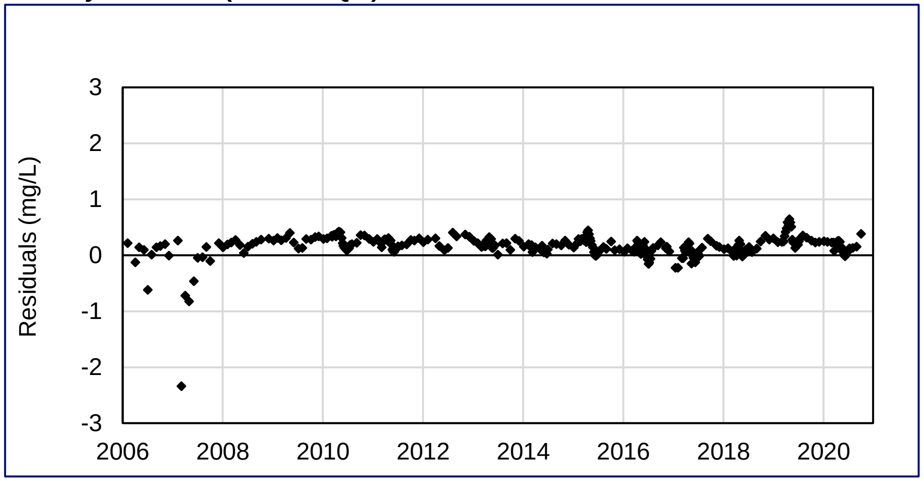
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-36: Nitrate Calibration Information for Node EV_MC2 - EVO Michel Creek Compliance Point (EMS E300091)

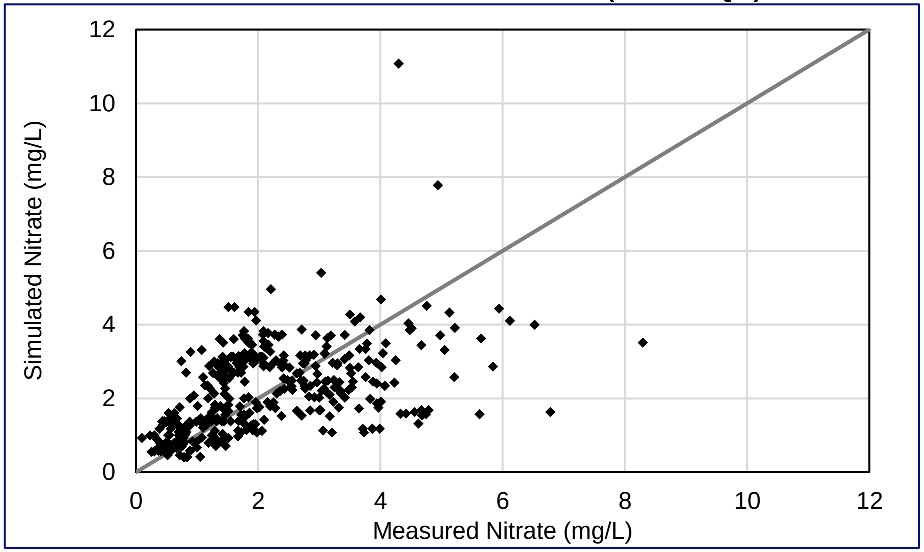
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	12/3/2014	12/3/2014
Last Measured Sample	12/5/2016	12/31/2018
Data Points Available for Comparison, n	89	212
Non-Detect Count	0	0
Measured Mean (mg/L)	-	2.6
Simulated Mean (mg/L)	-	2.1
Bias (mg/L)	-	-0.5
Relative Bias	-	0.81
Error (mg/L)	-	0.99
Percent Error	-	37%

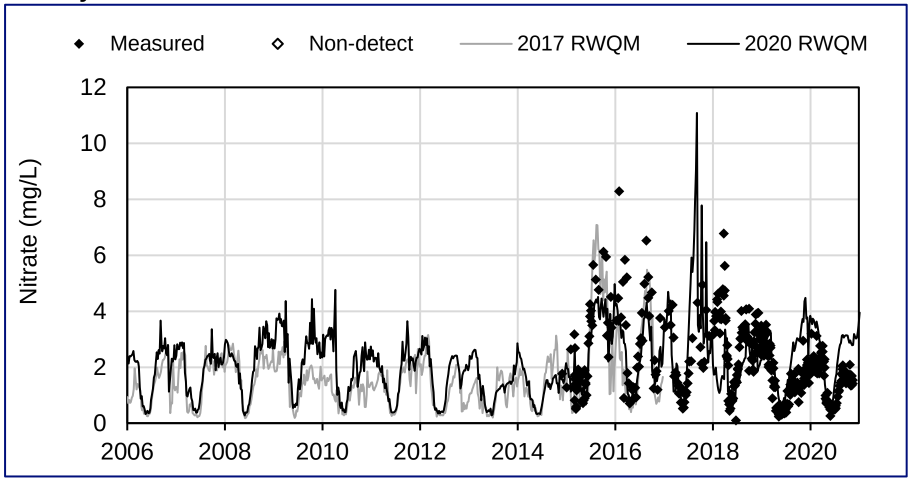
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



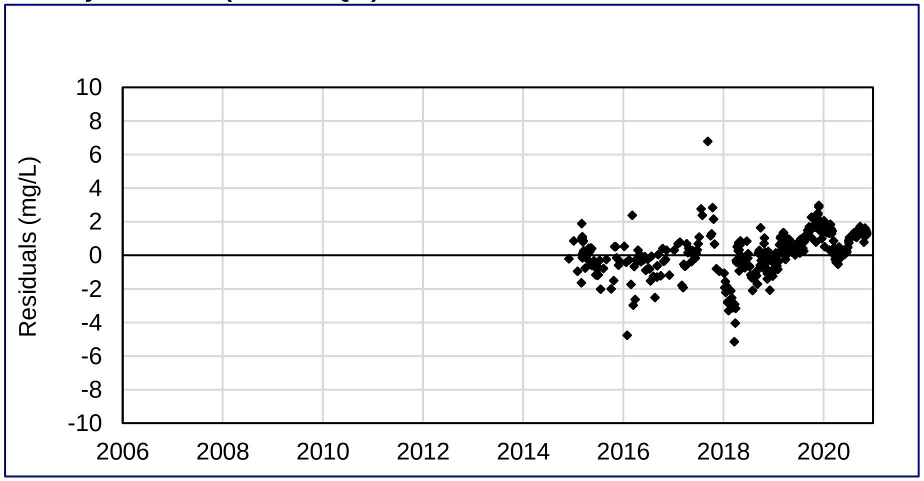
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

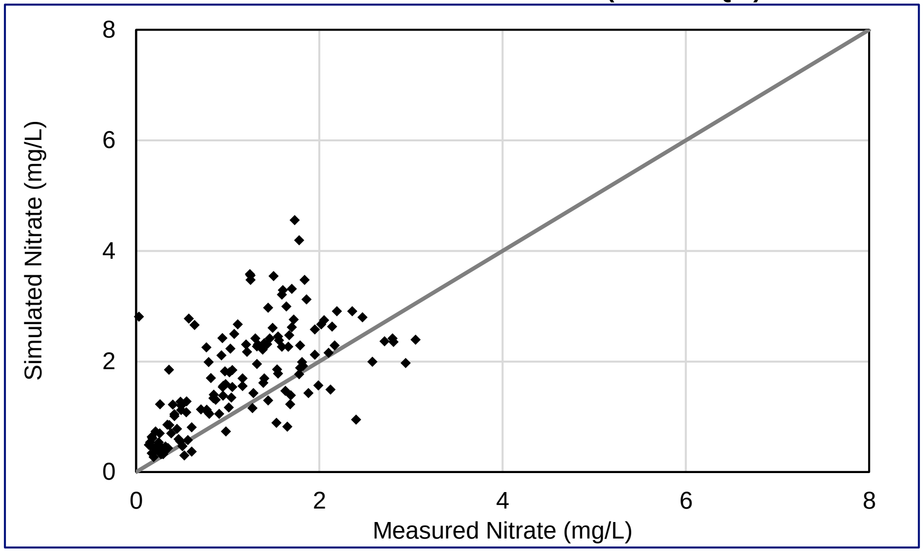
B1-37: Nitrate Calibration Information for Node EV_MC1 - Michel Creek u/s of Highway 43 Bridge (EMS 0200425)

Measured and Simulated Nitrate Data and Calibration Statistics

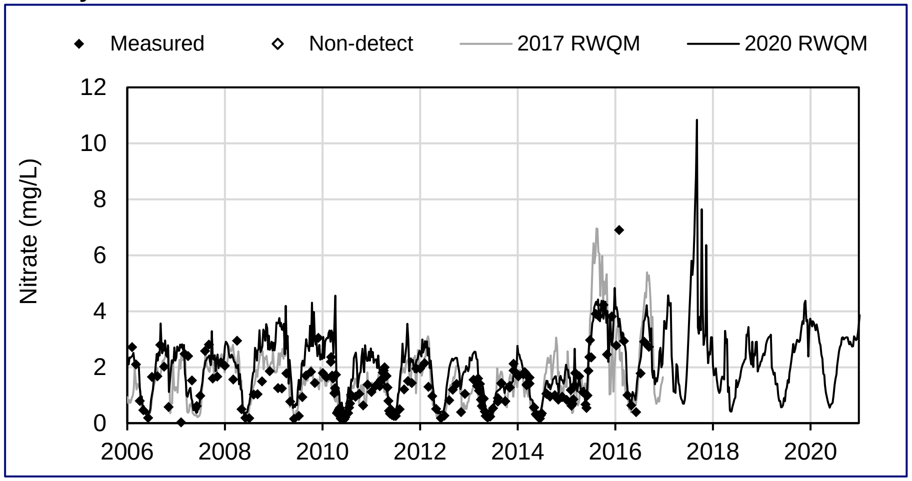
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	2/7/2006	2/7/2006
Last Measured Sample	9/13/2016	9/13/2016
Data Points Available for Comparison, n	208	208
Non-Detect Count	0	0
Measured Mean (mg/L)	1.2	1.2
Simulated Mean (mg/L)	1.2	1.7
Bias (mg/L)	0.075	0.45
Relative Bias	1.1	1.4
Error (mg/L)	0.45	0.6
Percent Error	41%	49%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



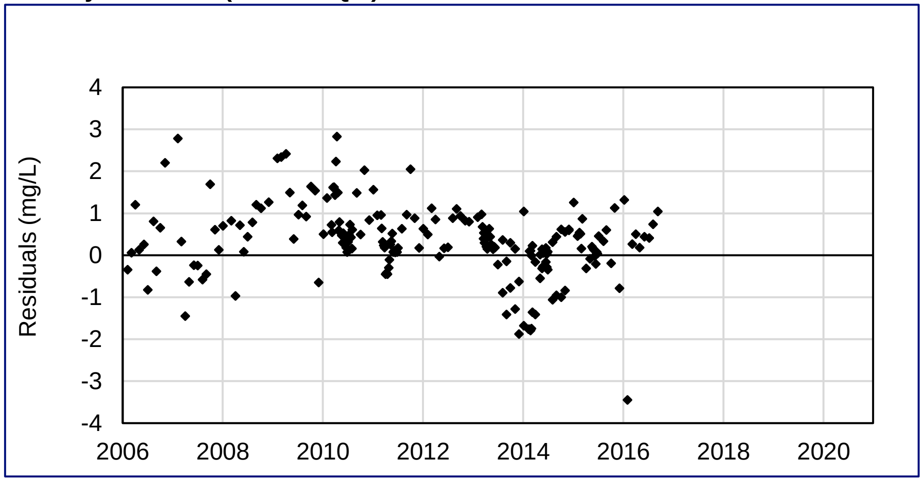
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-38: Nitrate Calibration Information for Node GH_ERC - GHO Elk River Compliance Point (EMS E300090)

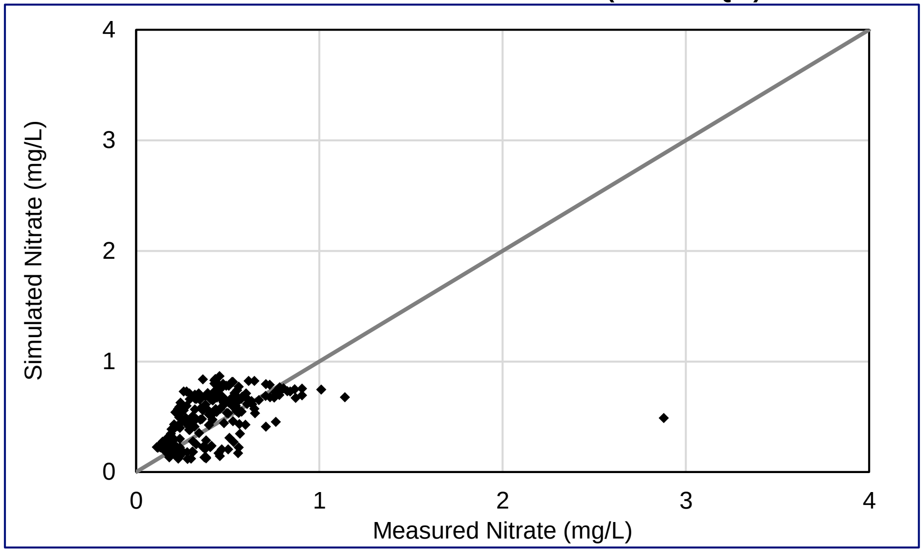
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	12/4/2014	12/4/2014
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	68	135
Non-Detect Count	0	0
Measured Mean (mg/L)	-	0.36
Simulated Mean (mg/L)	-	0.45
Bias (mg/L)	-	0.086
Relative Bias	-	1.2
Error (mg/L)	-	0.16
Percent Error	-	45%

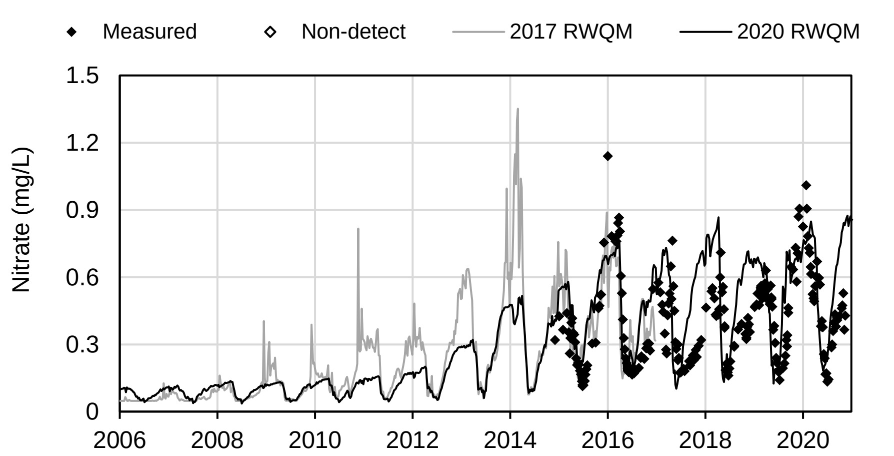
[a] As adjusted for the 2019 IPA.

[b] Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



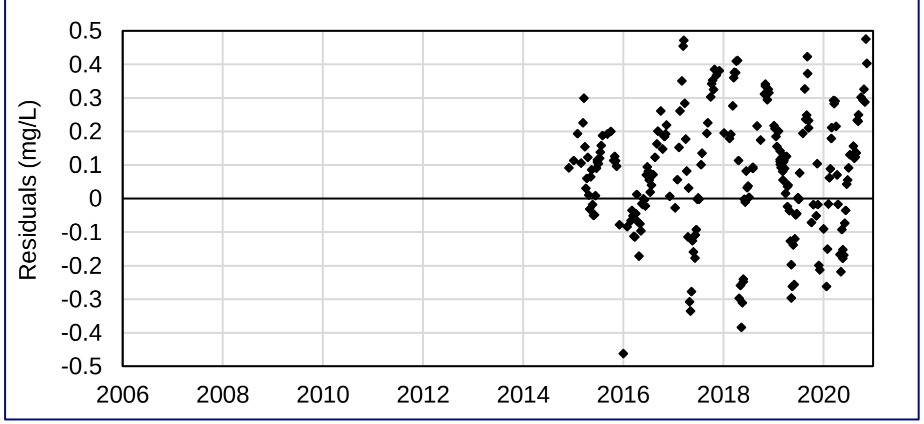
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

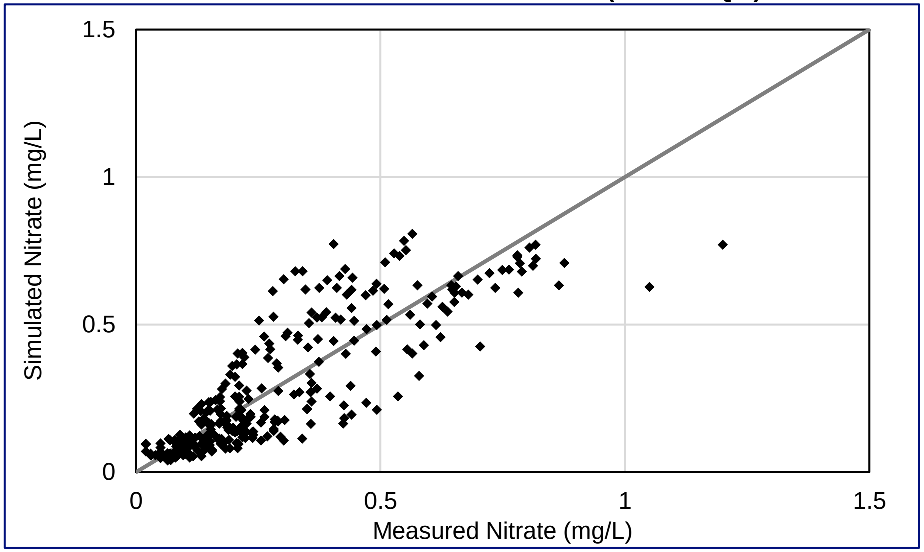
B1-39: Nitrate Calibration Information for Node GH_ER1 - Elk River u/s of Boivin Creek (u/s of Fording River) (EMS E206661)

Measured and Simulated Nitrate Data and Calibration Statistics

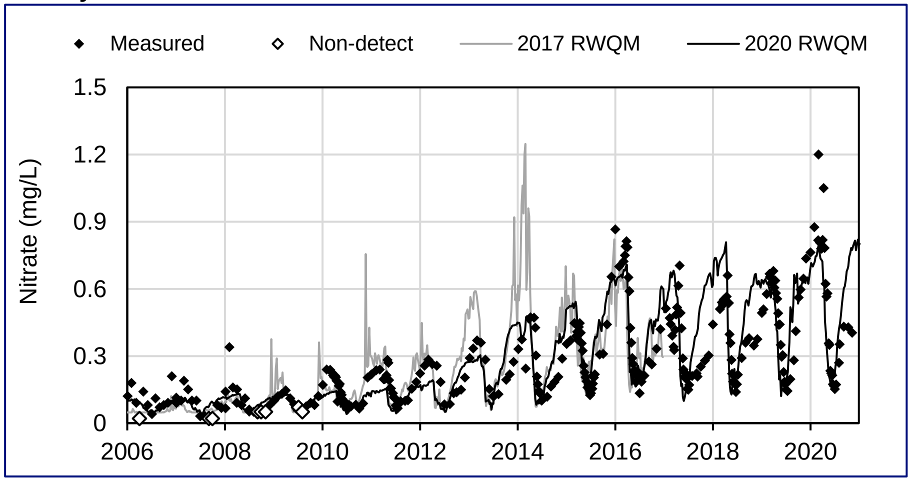
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/4/2006	1/4/2006
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	204	256
Non-Detect Count	8	8
Measured Mean (mg/L)	0.21	0.24
Simulated Mean (mg/L)	0.21	0.24
Bias (mg/L)	0.0026	0.0043
Relative Bias	1.0	1.0
Error (mg/L)	0.087	0.081
Percent Error	42%	34%

[(a)] As adjusted for the 2019 IPA.

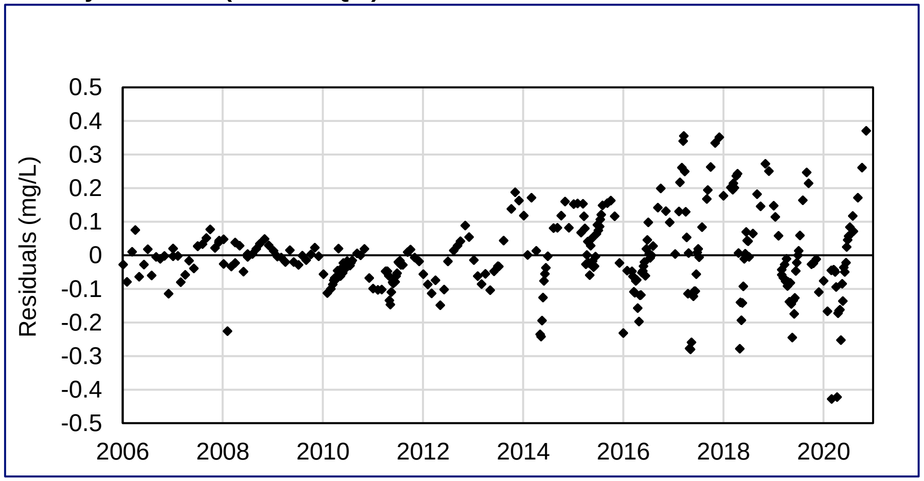
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

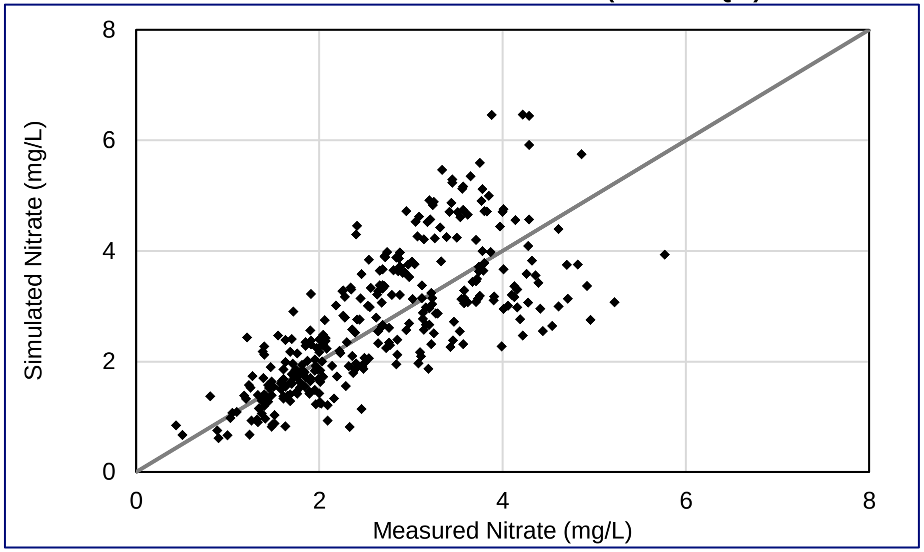
B1-40: Nitrate Calibration Information for Node EV_ER4 - Elk River u/s of Grave Creek (EMS 0200027)

Measured and Simulated Nitrate Data and Calibration Statistics

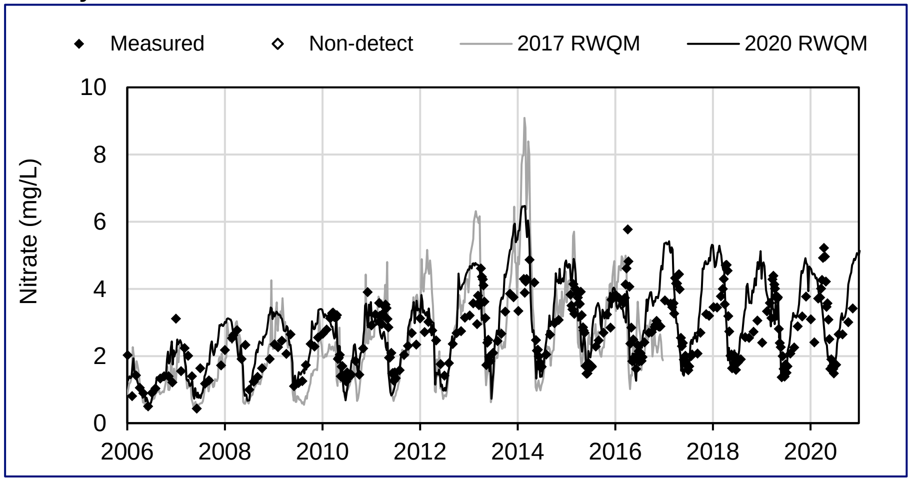
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/6/2016	12/3/2018
Data Points Available for Comparison, n	217	269
Non-Detect Count	0	0
Measured Mean (mg/L)	2.5	2.6
Simulated Mean (mg/L)	2.5	2.7
Bias (mg/L)	-0.048	0.1
Relative Bias	0.98	1.0
Error (mg/L)	0.76	0.64
Percent Error	30%	24%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)

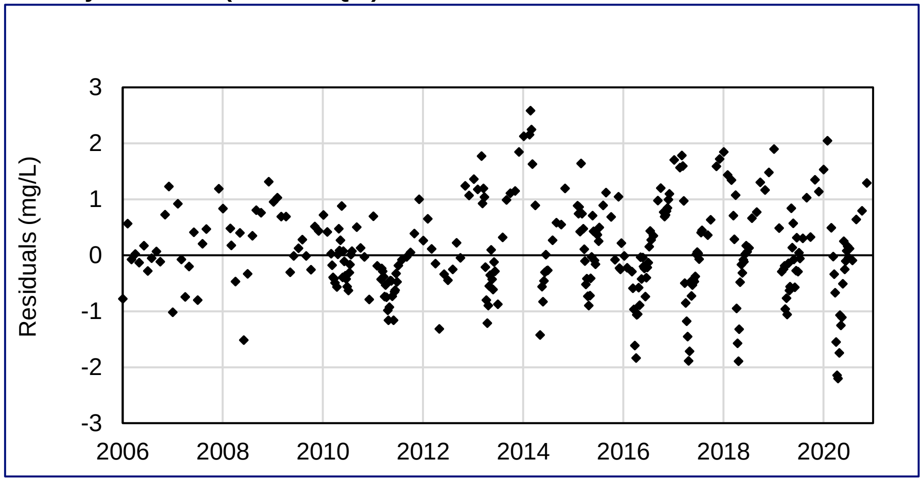


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-41: Nitrate Calibration Information for Node EV_ER2 - Elk River u/s of Michel Creek (EMS 0200111)

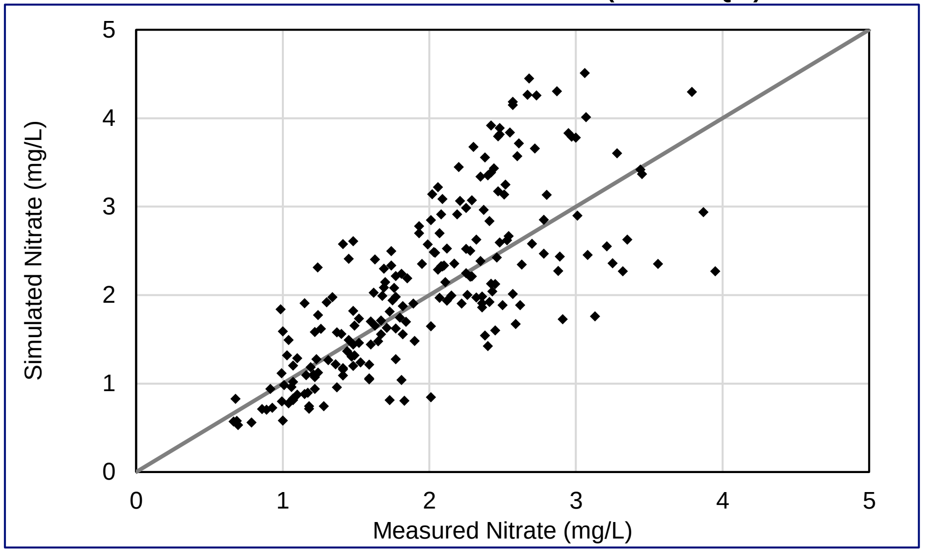
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/6/2016	12/3/2018
Data Points Available for Comparison, n	163	188
Non-Detect Count	0	0
Measured Mean (mg/L)	-	1.9
Simulated Mean (mg/L)	-	2.1
Bias (mg/L)	-	0.14
Relative Bias	-	1.1
Error (mg/L)	-	0.5
Percent Error	-	26%

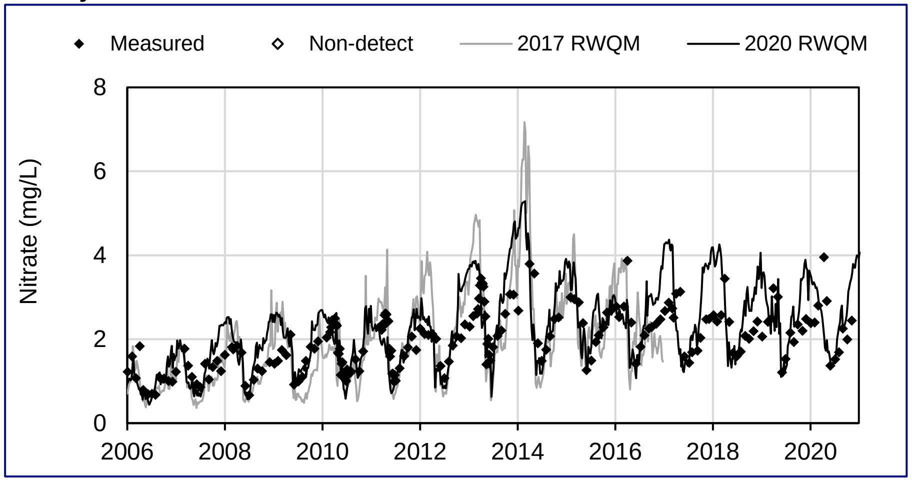
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



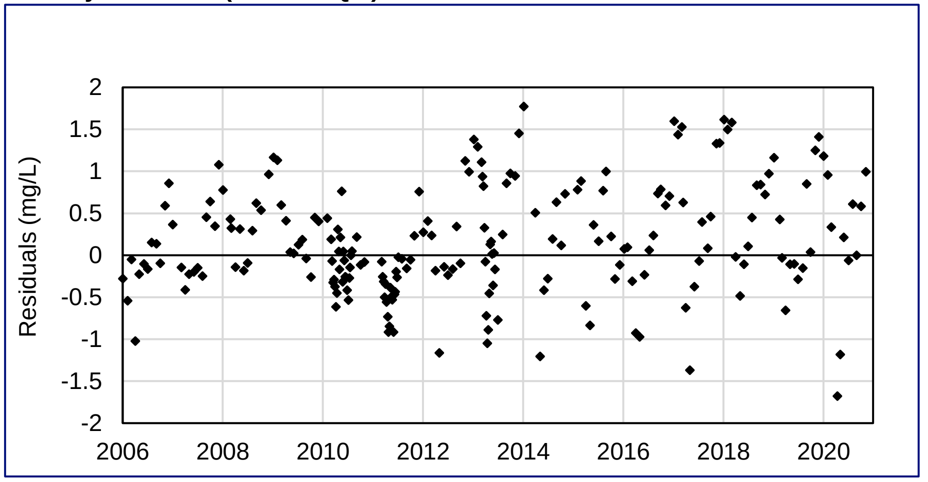
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

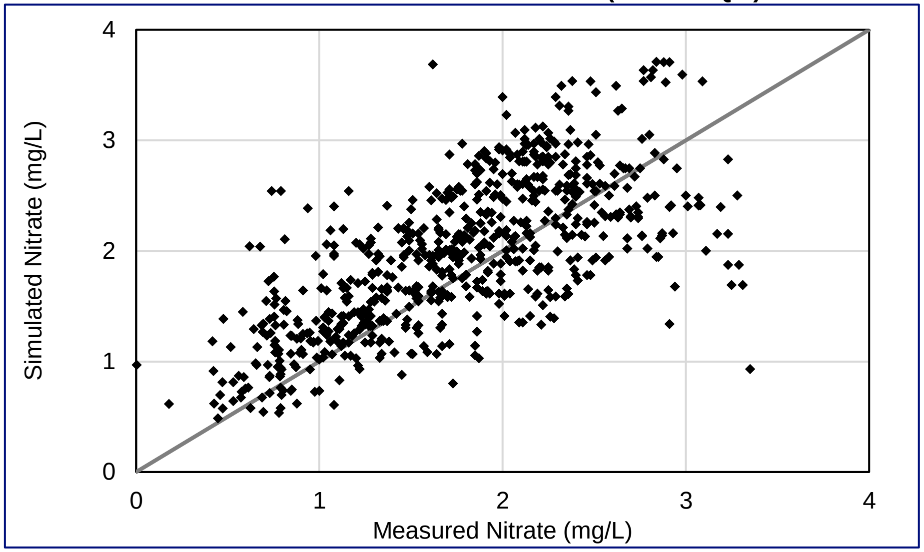
B1-42: Nitrate Calibration Information for Node EV_ER1 - Elk River d/s of Michel Creek (EMS 0200393)

Measured and Simulated Nitrate Data and Calibration Statistics

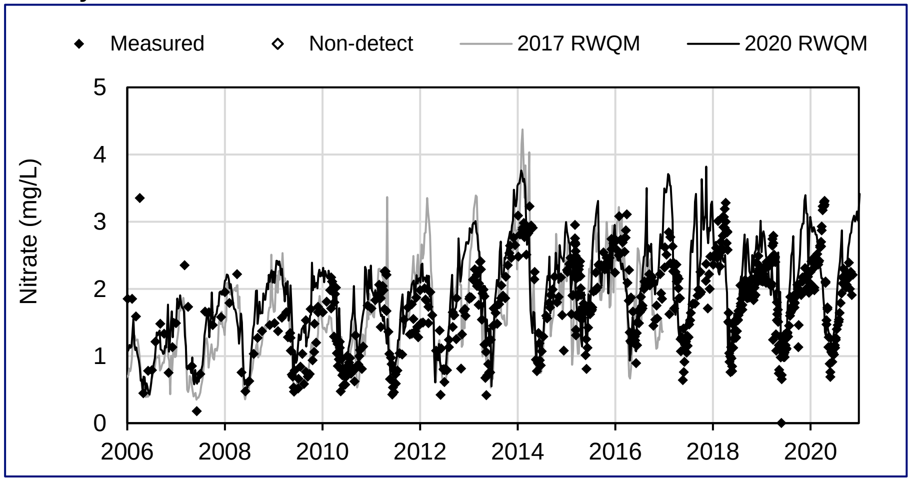
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	1/3/2006	1/3/2006
Last Measured Sample	12/18/2016	12/31/2018
Data Points Available for Comparison, n	388	535
Non-Detect Count	0	0
Measured Mean (mg/L)	1.6	1.7
Simulated Mean (mg/L)	1.7	1.9
Bias (mg/L)	0.017	0.19
Relative Bias	1.0	1.1
Error (mg/L)	0.43	0.42
Percent Error	26%	24%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



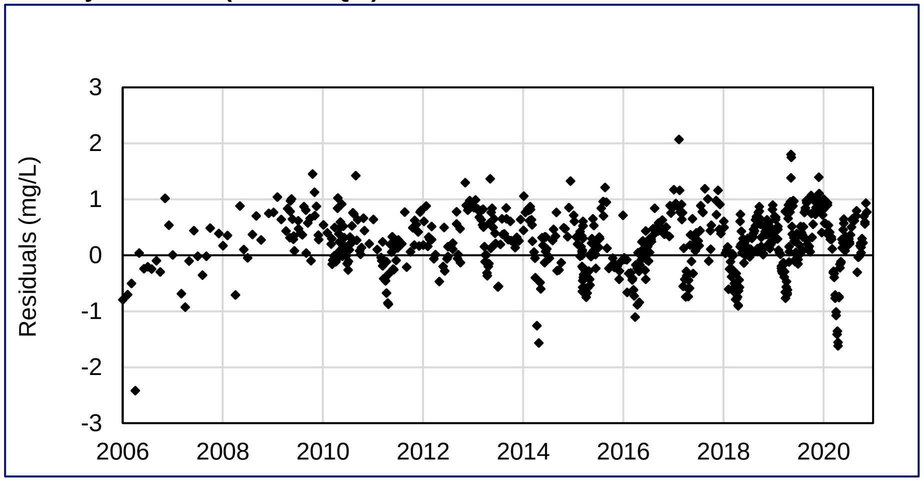
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B1-43: Nitrate Calibration Information for Node RG_ELKORES - Elk River at Elko Reservoir (EMS E294312)

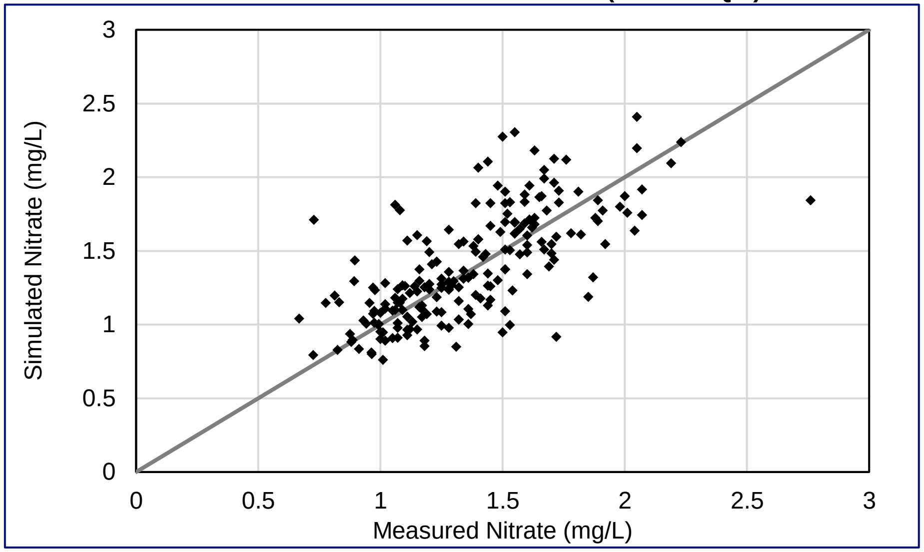
Measured and Simulated Nitrate Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	9/6/2011	9/6/2011
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	101	154
Non-Detect Count	0	0
Measured Mean (mg/L)	-	1.4
Simulated Mean (mg/L)	-	1.4
Bias (mg/L)	-	0.0075
Relative Bias	-	1.0
Error (mg/L)	-	0.19
Percent Error	-	14%

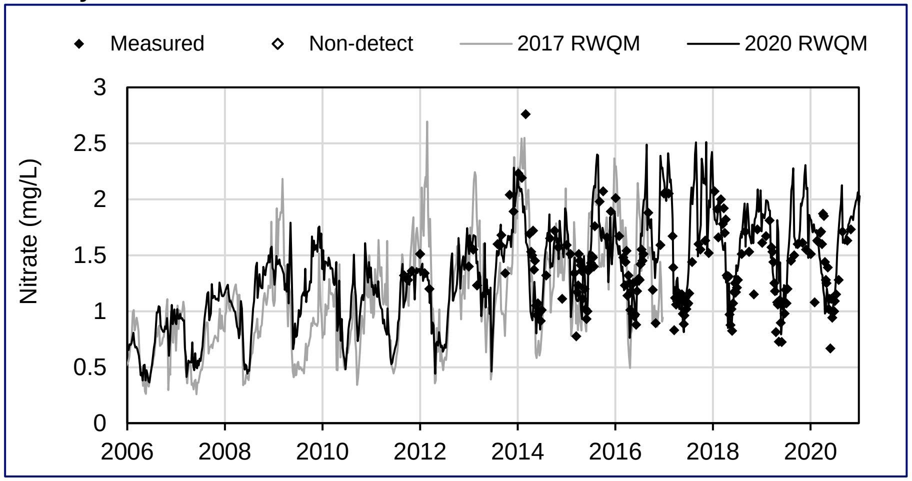
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)



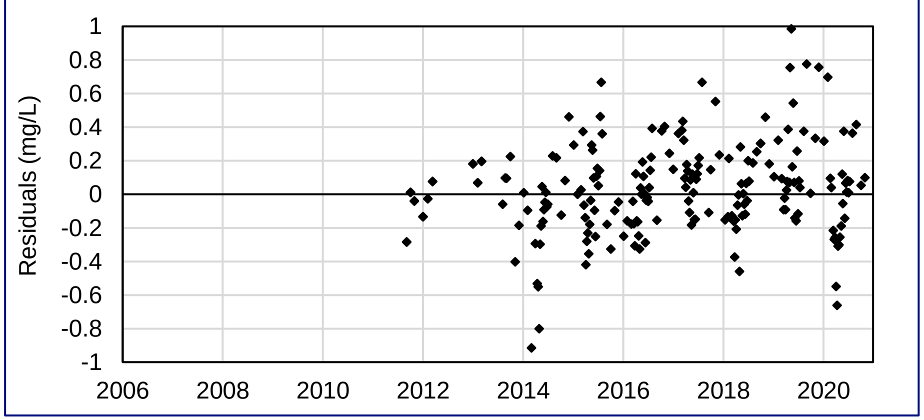
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

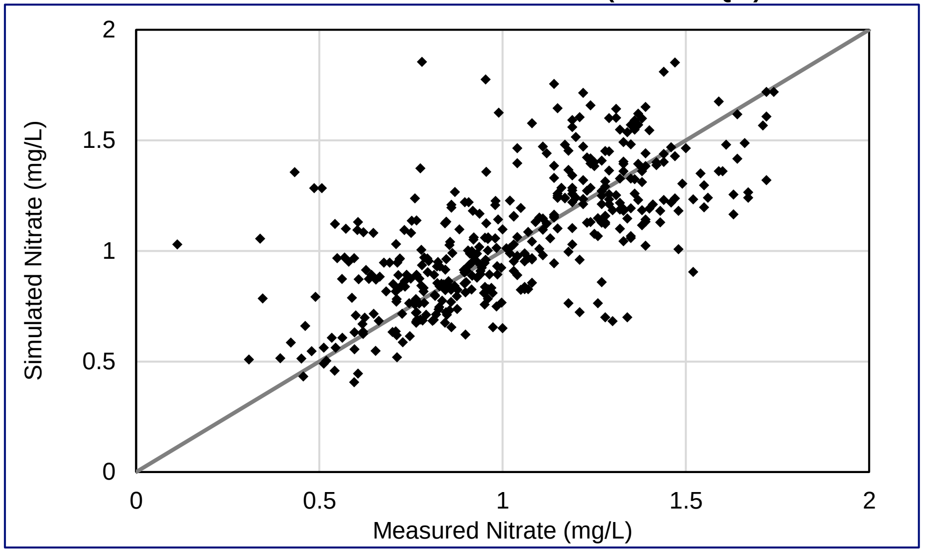
B1-44:Nitrate Calibration Information for Node RG_ELKMOUTH - Elk River at Highway 93 near Elko

Measured and Simulated Nitrate Data and Calibration Statistics

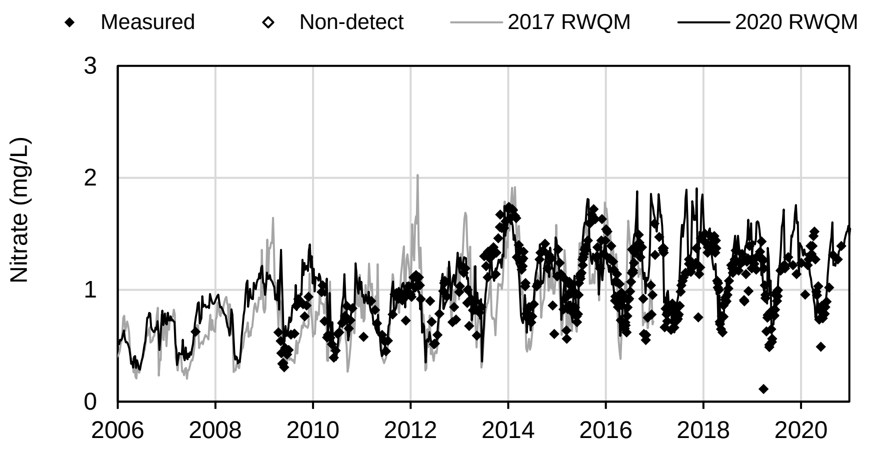
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	8/6/2007	8/6/2007
Last Measured Sample	12/18/2016	12/16/2018
Data Points Available for Comparison, n	252	346
Non-Detect Count	0	0
Measured Mean (mg/L)	0.97	1.0
Simulated Mean (mg/L)	0.94	1.1
Bias (mg/L)	-0.031	0.033
Relative Bias	0.97	1.0
Error (mg/L)	0.22	0.17
Percent Error	23%	16%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Nitrate Concentrations (2020 RWQM)

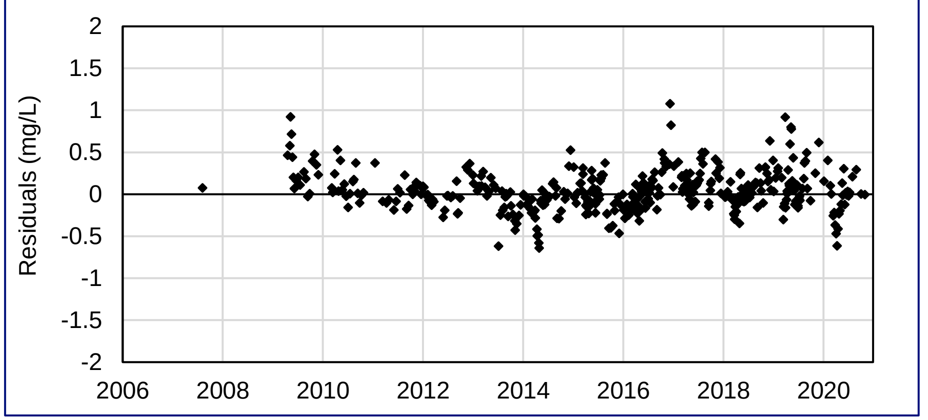


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

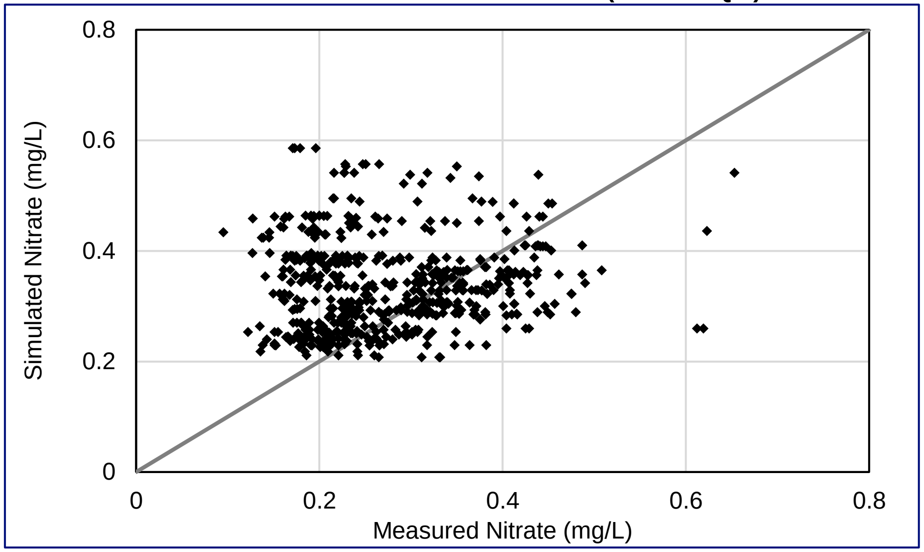
B1-45: Nitrate Calibration Information for Node RG_DSELK - Koocanusa Reservoir - South of the Elk River (EMS E300230)

Measured and Simulated Nitrate Data and Calibration Statistics

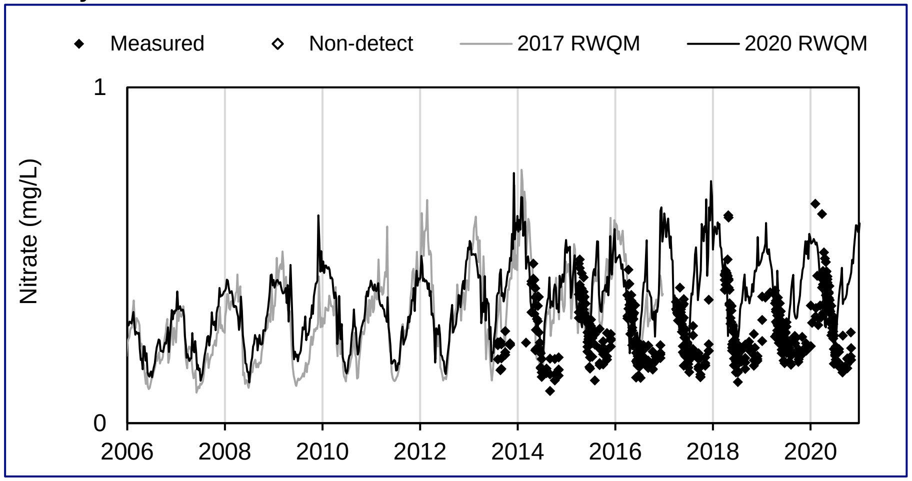
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2006 to 2016	2006 to 2018
First Measured Sample	8/7/2013	8/7/2013
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	216	377
Non-Detect Count	0	0
Measured Mean (mg/L)	0.26	0.27
Simulated Mean (mg/L)	0.32	0.34
Bias (mg/L)	0.052	0.066
Relative Bias	1.2	1.2
Error (mg/L)	0.094	0.1
Percent Error	35%	37%

[(a)] As adjusted for the 2019 IPA.

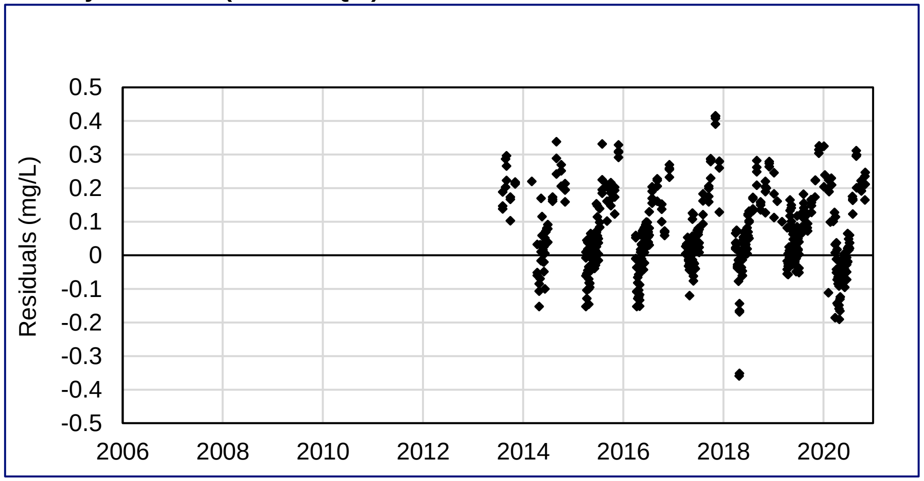
Simulated versus Measured Nitrate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

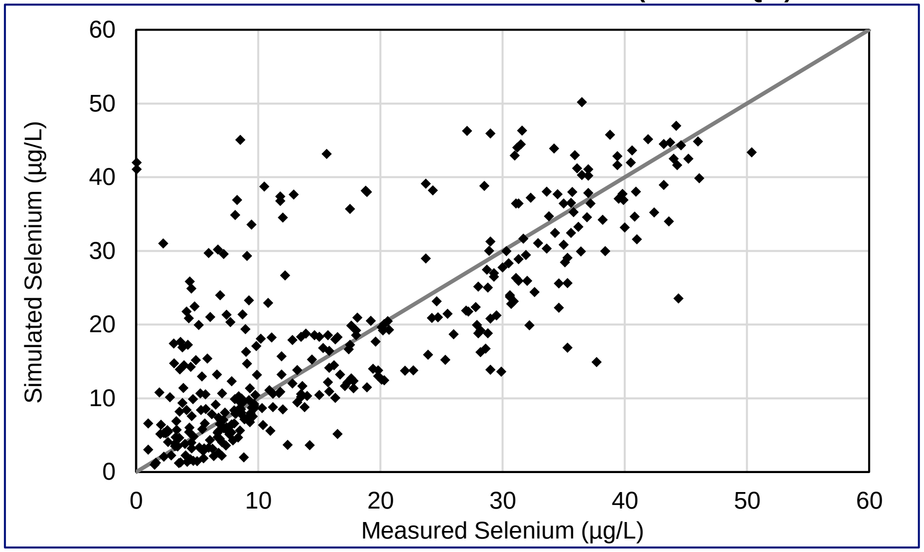
B2-1: Selenium Calibration Information for Node FR_HC1 - Henretta Creek u/s of Fording River (EMS E216778)

Measured and Simulated Selenium Data and Calibration Statistics

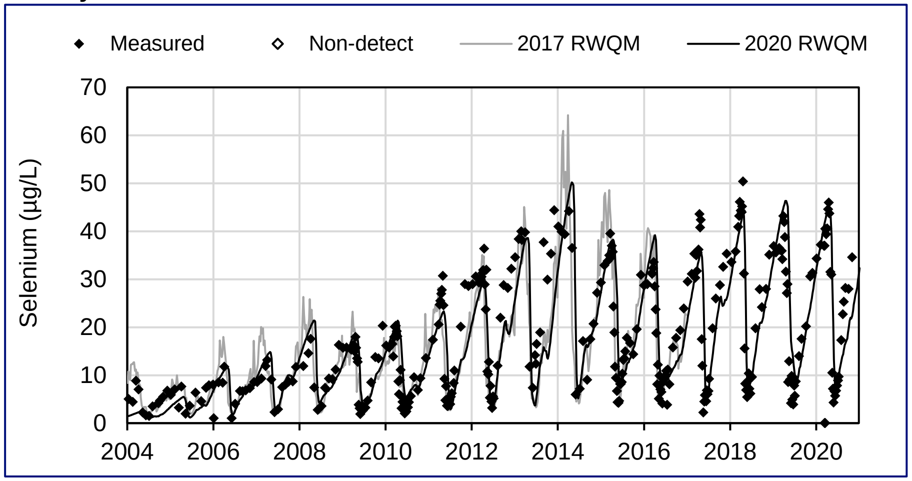
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/12/2004	1/12/2004
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	239	290
Non-Detect Count	0	0
Measured Mean (µg/L)	15	16
Simulated Mean (µg/L)	14	17
Bias (µg/L)	-0.24	0.81
Relative Bias	0.98	1.0
Error (µg/L)	4.0	5.5
Percent Error	27%	34%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

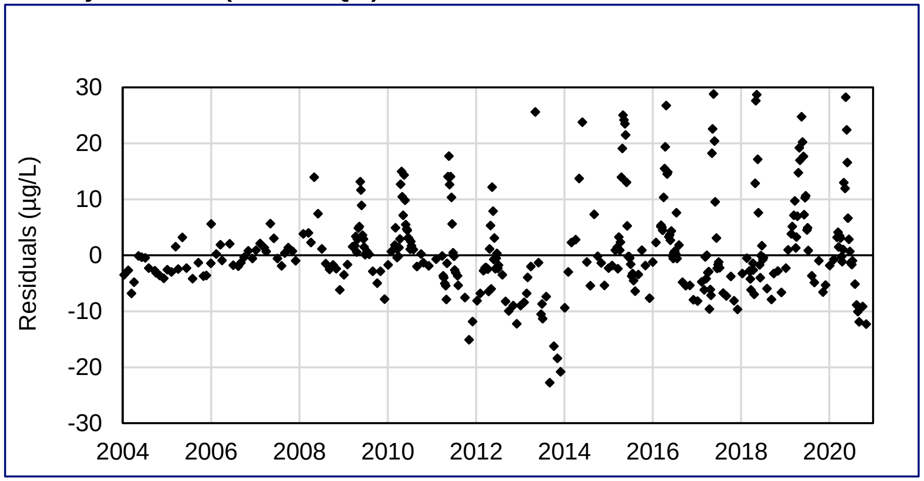


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

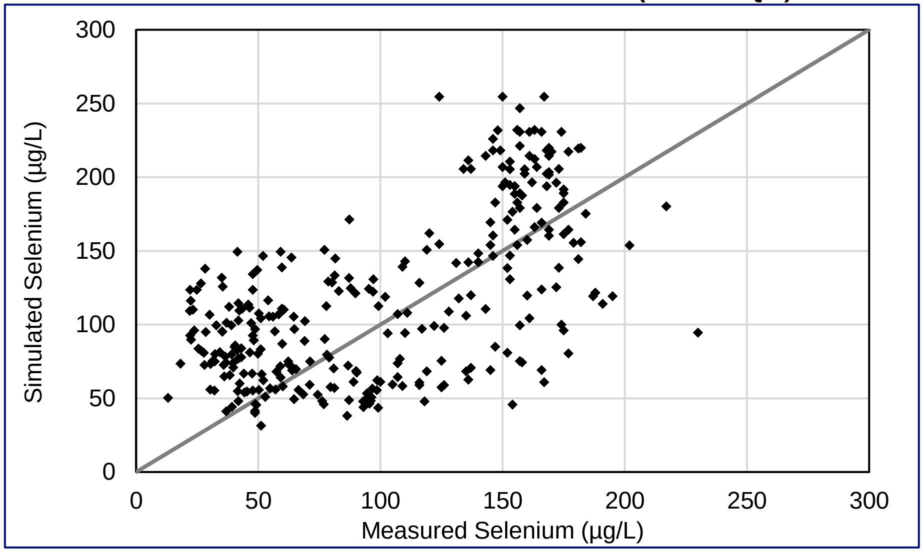
B2-2: Selenium Calibration Information for Node FR_CC1 - Clode Creek Sediment Pond Decant (EMS E102481)

Measured and Simulated Selenium Data and Calibration Statistics

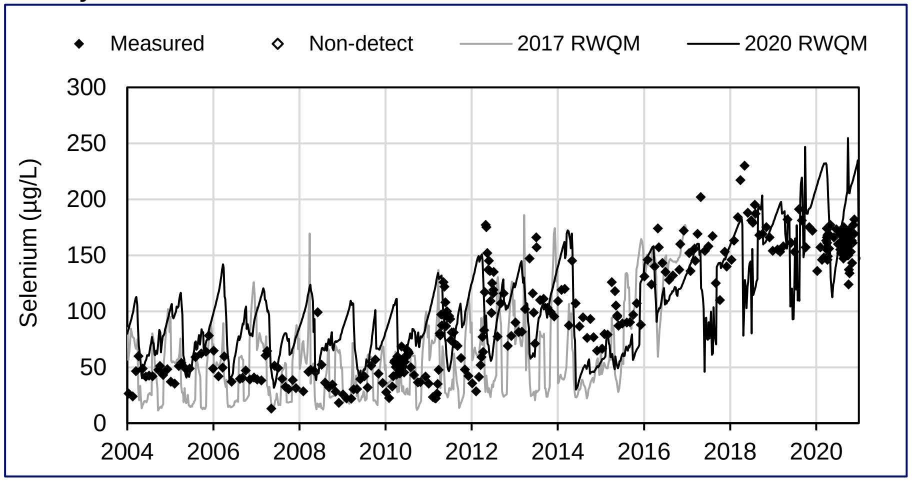
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/12/2004	1/12/2004
Last Measured Sample	12/7/2016	12/5/2018
Data Points Available for Comparison, n	207	234
Non-Detect Count	0	0
Measured Mean (µg/L)	73	84
Simulated Mean (µg/L)	56	94
Bias (µg/L)	-17	9.9
Relative Bias	0.77	1.1
Error (µg/L)	39	41
Percent Error	54%	49%

[a] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



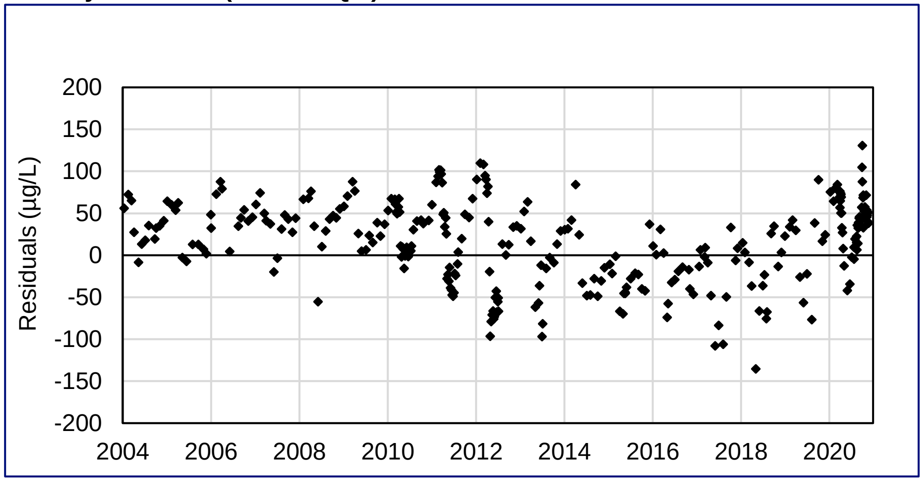
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

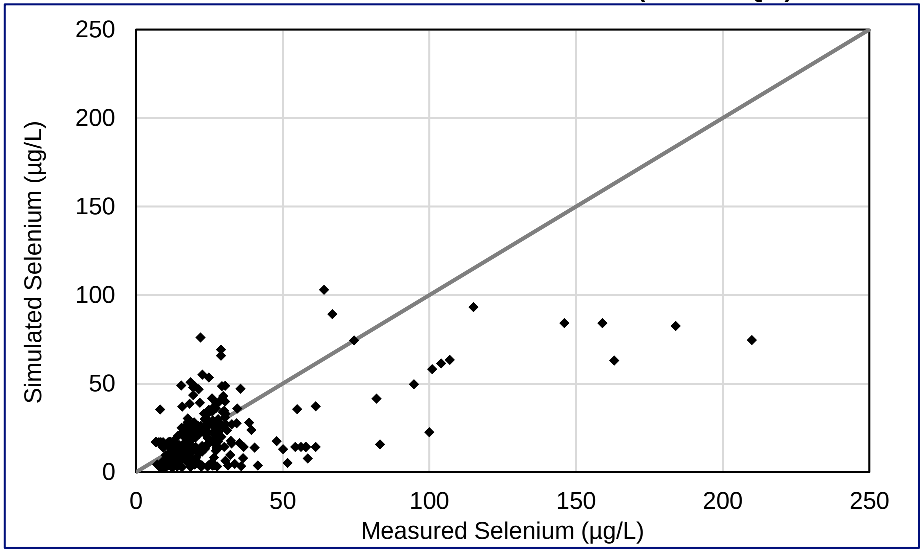
B2-3: Selenium Calibration Information for Node FR_LMP1 - Lake Mountain Pond

Measured and Simulated Selenium Data and Calibration Statistics

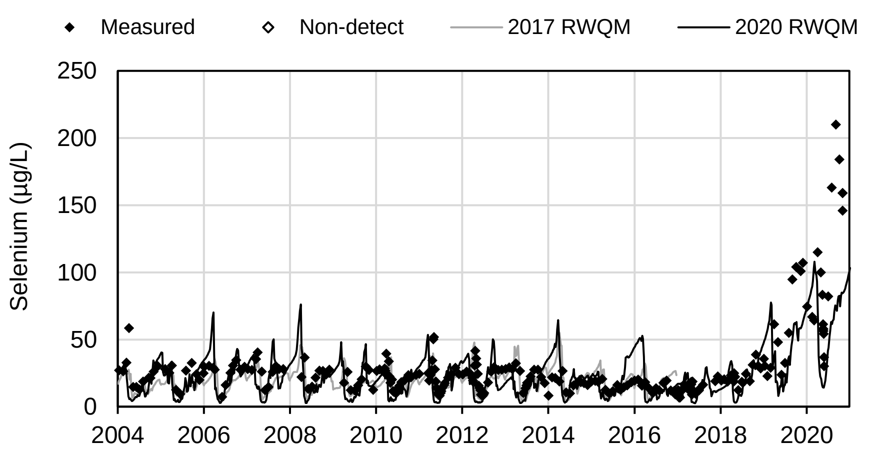
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/12/2004	1/12/2004
Last Measured Sample	12/14/2016	12/10/2018
Data Points Available for Comparison, n	188	240
Non-Detect Count	0	0
Measured Mean (µg/L)	21	20
Simulated Mean (µg/L)	18	17
Bias (µg/L)	-3.1	-2.8
Relative Bias	0.86	0.86
Error (µg/L)	7.2	9.5
Percent Error	34%	47%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

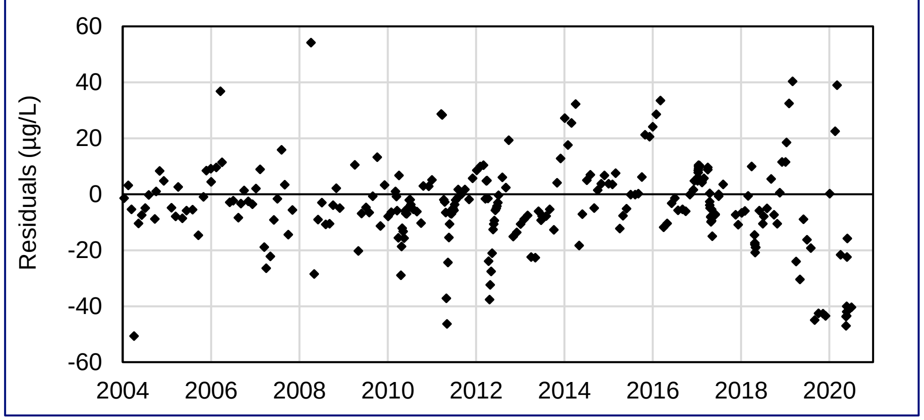


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

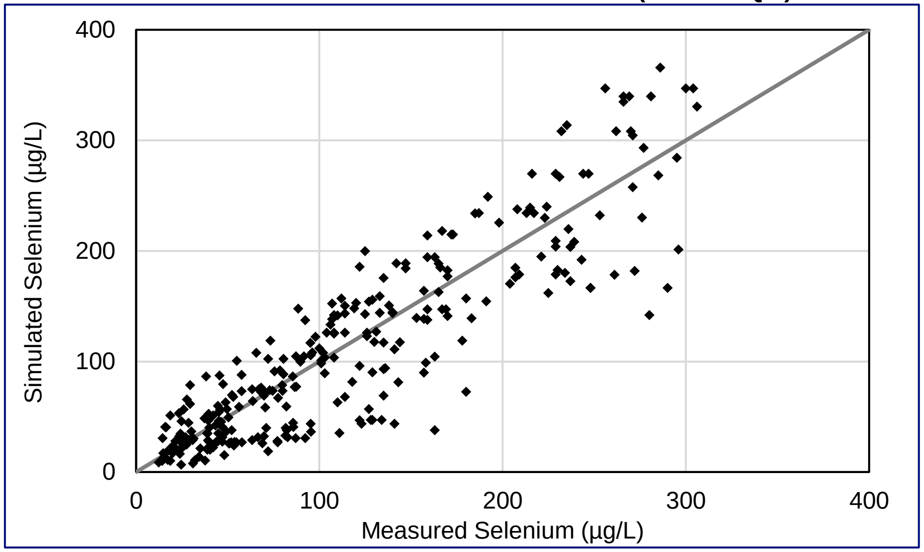
B2-4: Selenium Calibration Information for Node FR_KC1 - Kilmarnock Creek d/s of Rock Drain (EMS 0200252)

Measured and Simulated Selenium Data and Calibration Statistics

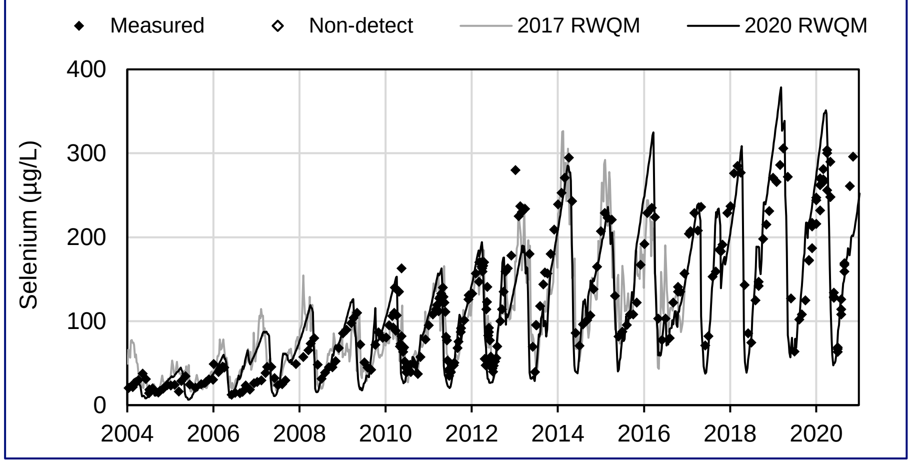
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/12/2004	1/12/2004
Last Measured Sample	12/12/2016	12/3/2018
Data Points Available for Comparison, n	218	244
Non-Detect Count	0	0
Measured Mean (µg/L)	92	102
Simulated Mean (µg/L)	91	96
Bias (µg/L)	-1.6	-5.7
Relative Bias	0.98	0.94
Error (µg/L)	23	26
Percent Error	25%	26%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



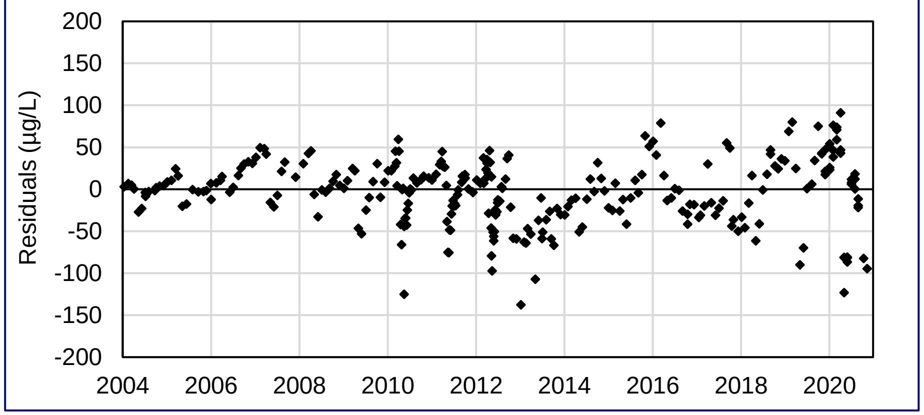
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

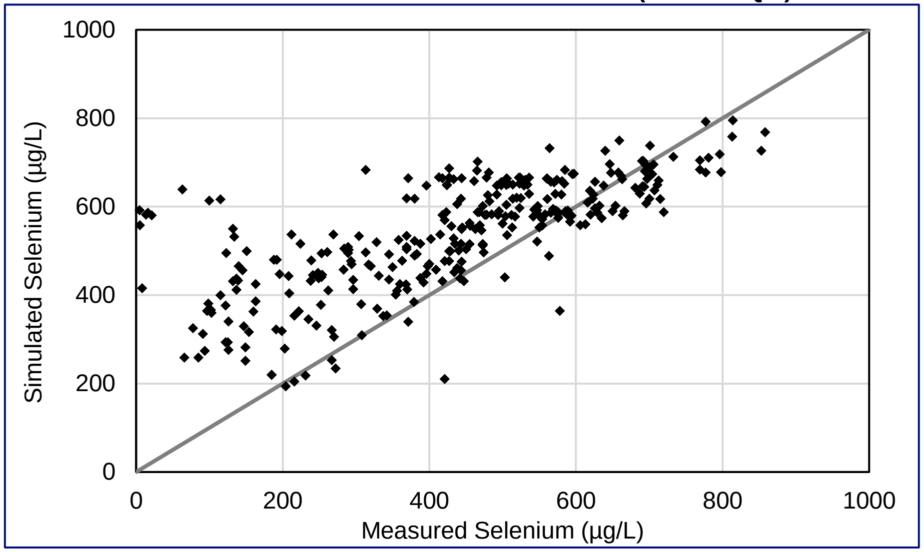
B2-5: Selenium Calibration Information for Node GH_SC1 - Swift Creek Sediment Pond Decant (EMS E221329)

Measured and Simulated Selenium Data and Calibration Statistics

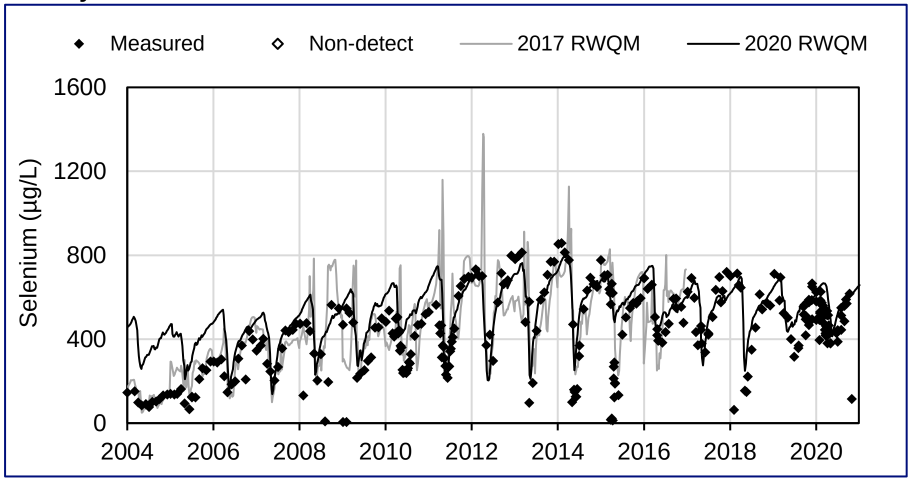
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/2/2004	1/2/2004
Last Measured Sample	12/5/2016	12/10/2018
Data Points Available for Comparison, n	211	242
Non-Detect Count	0	0
Measured Mean (µg/L)	388	407
Simulated Mean (µg/L)	460	516
Bias (µg/L)	72	110
Relative Bias	1.2	1.3
Error (µg/L)	137	133
Percent Error	35%	33%

(a) As adjusted for the 2019 IPA.

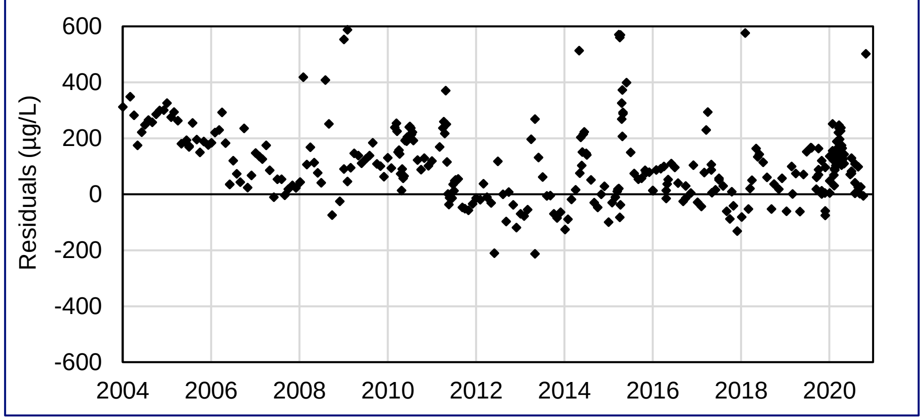
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

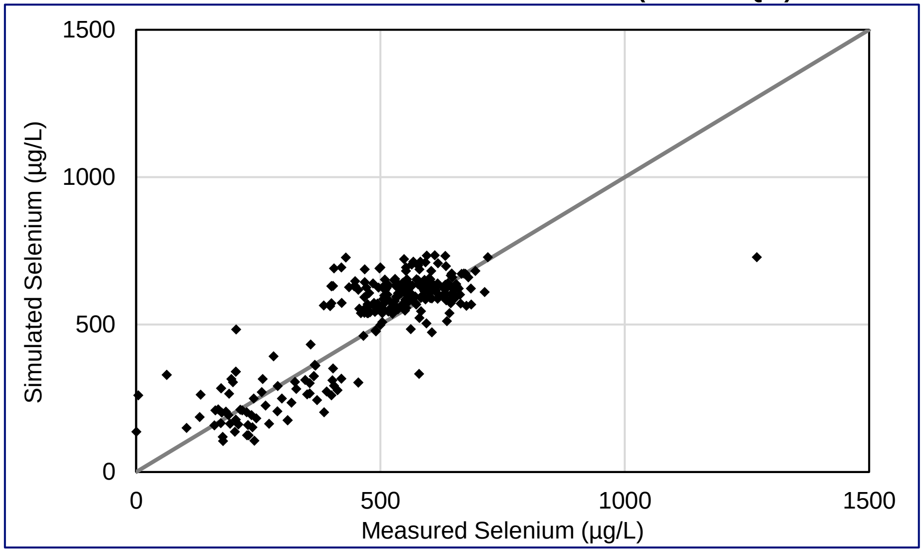
B2-6: Selenium Calibration Information for Node GH_CC1 - Cataract Creek Sediment Pond Decant (EMS 0200384)

Measured and Simulated Selenium Data and Calibration Statistics

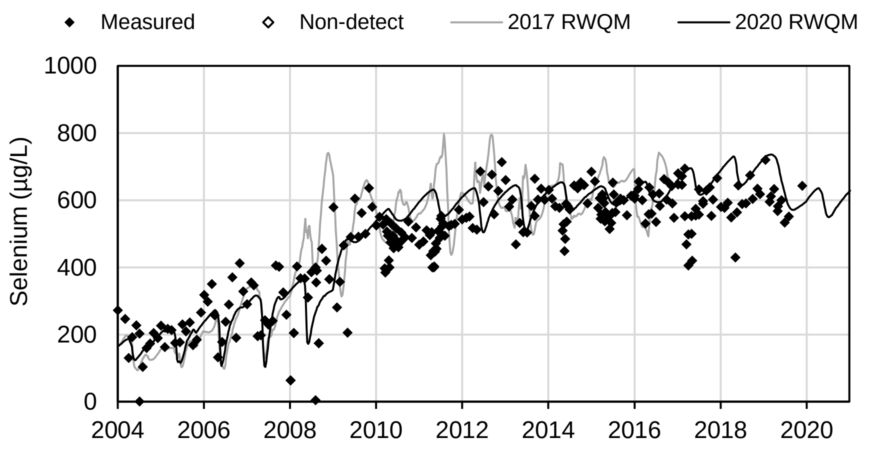
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/2/2004	1/2/2004
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	221	257
Non-Detect Count	0	0
Measured Mean (µg/L)	453	471
Simulated Mean (µg/L)	506	504
Bias (µg/L)	53	34
Relative Bias	1.1	1.1
Error (µg/L)	99	76
Percent Error	22%	16%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



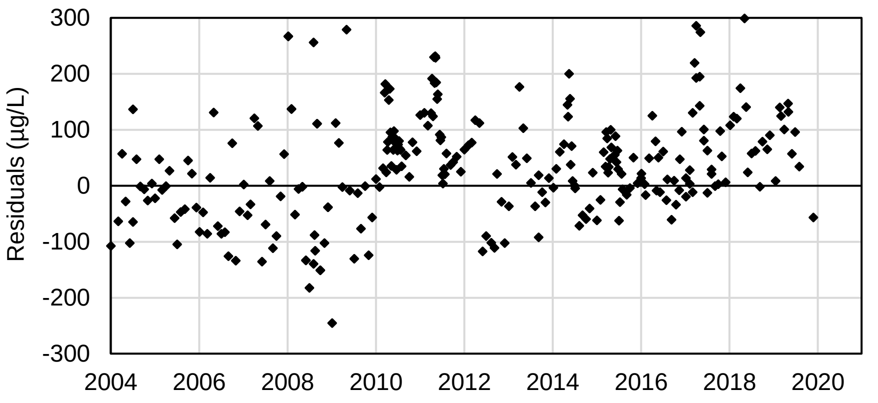
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

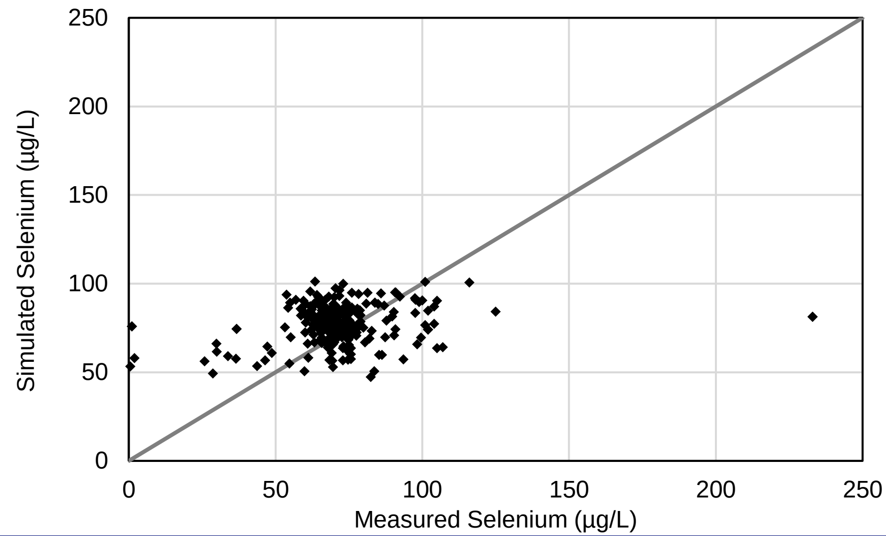
B2-7: Selenium Calibration Information for Node GH_PC1 - Porter Creek Sediment Pond Decant (EMS 0200385)

Measured and Simulated Selenium Data and Calibration Statistics

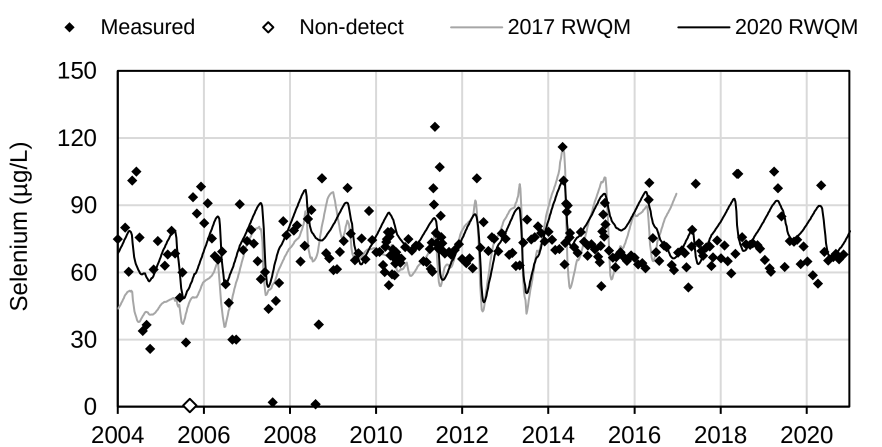
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/2/2004	1/2/2004
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	205	234
Non-Detect Count	1	1
Measured Mean (µg/L)	72	72
Simulated Mean (µg/L)	70	77
Bias (µg/L)	-1.6	5.2
Relative Bias	0.98	1.1
Error (µg/L)	17	16
Percent Error	24%	22%

[(a)] As adjusted for the 2019 IPA.

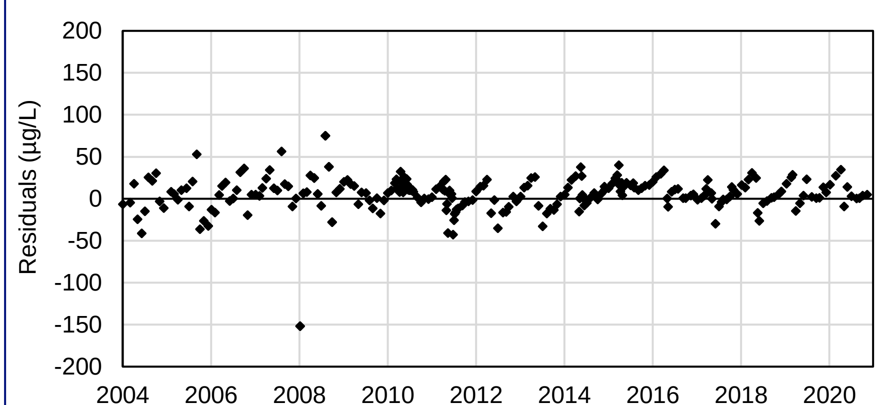
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

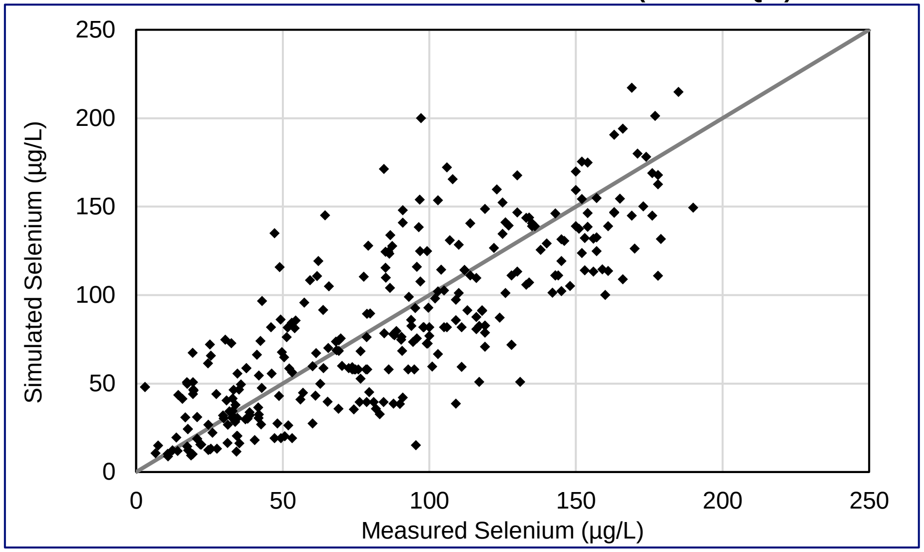
B2-8: Selenium Calibration Information for Node GH_GH1 - Greenhills Creek Sediment Pond Decant (EMS E102709)

Measured and Simulated Selenium Data and Calibration Statistics

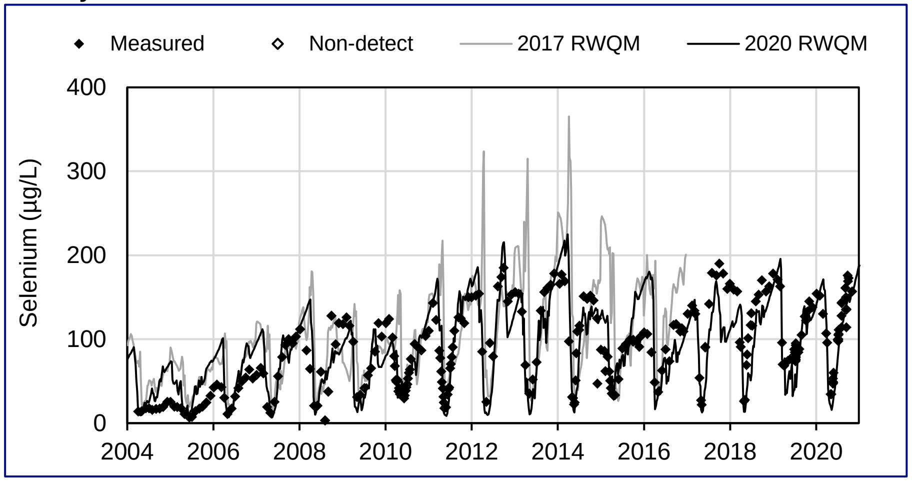
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/4/2004	4/4/2004
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	207	240
Non-Detect Count	0	0
Measured Mean (µg/L)	73	80
Simulated Mean (µg/L)	105	81
Bias (µg/L)	31	1.6
Relative Bias	1.4	1.0
Error (µg/L)	46	25
Percent Error	62%	31%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



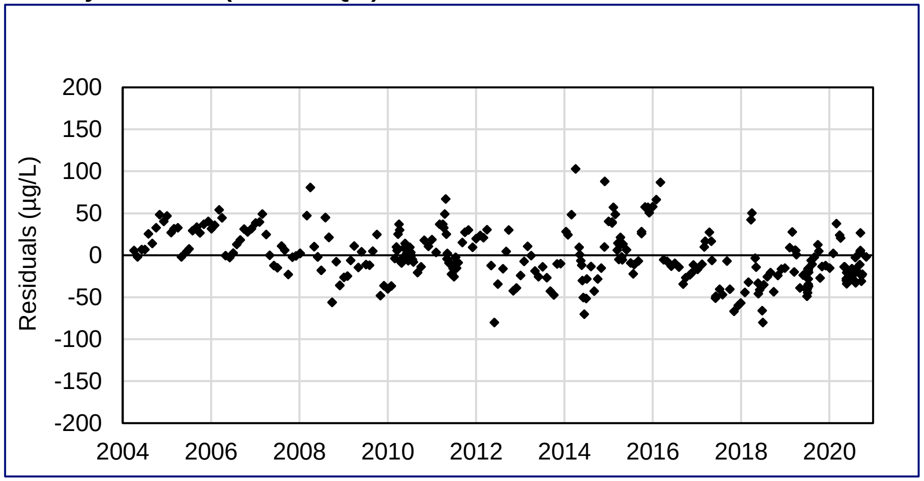
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

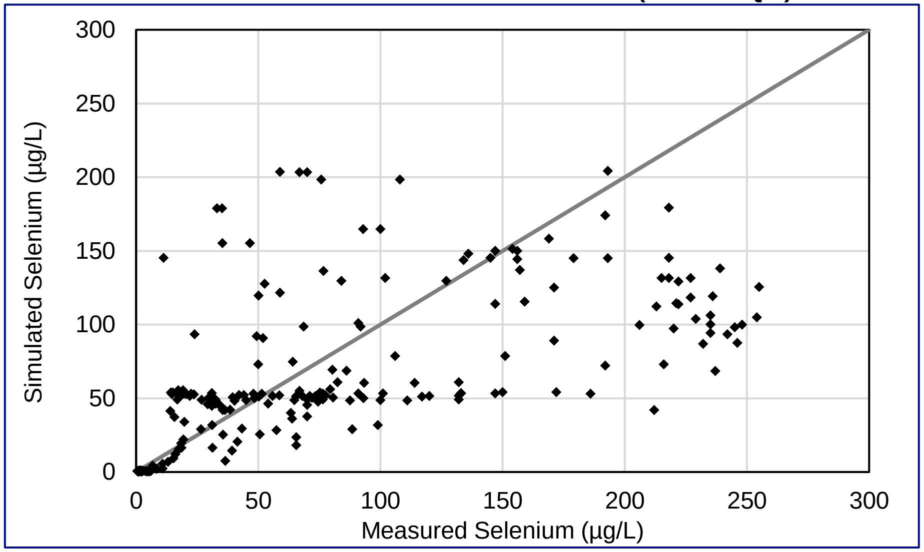
B2-9: Selenium Calibration Information for Node GH_LC1 - Leask Creek Sediment Pond Decant (EMS E257796)

Measured and Simulated Selenium Data and Calibration Statistics

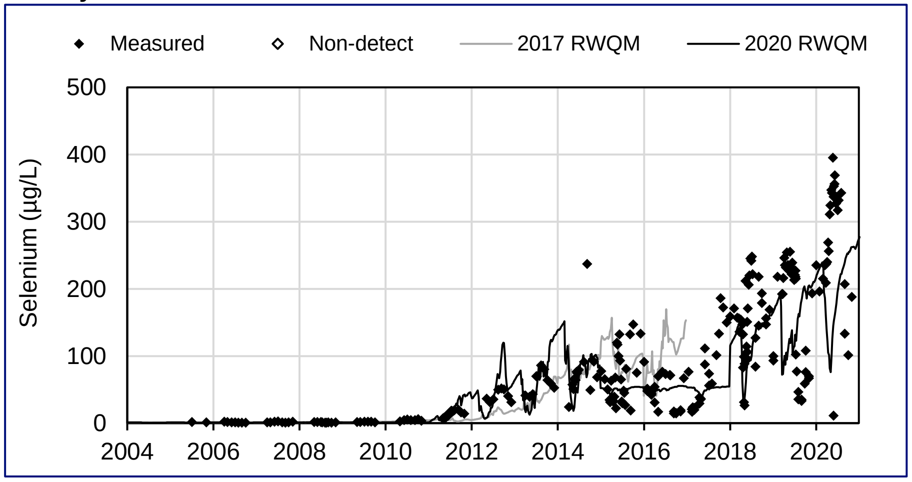
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	7/3/2005	7/3/2005
Last Measured Sample	12/7/2016	12/4/2018
Data Points Available for Comparison, n	136	191
Non-Detect Count	0	0
Measured Mean (µg/L)	38	63
Simulated Mean (µg/L)	48	49
Bias (µg/L)	9.7	-14
Relative Bias	1.3	0.78
Error (µg/L)	27	28
Percent Error	71%	44%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



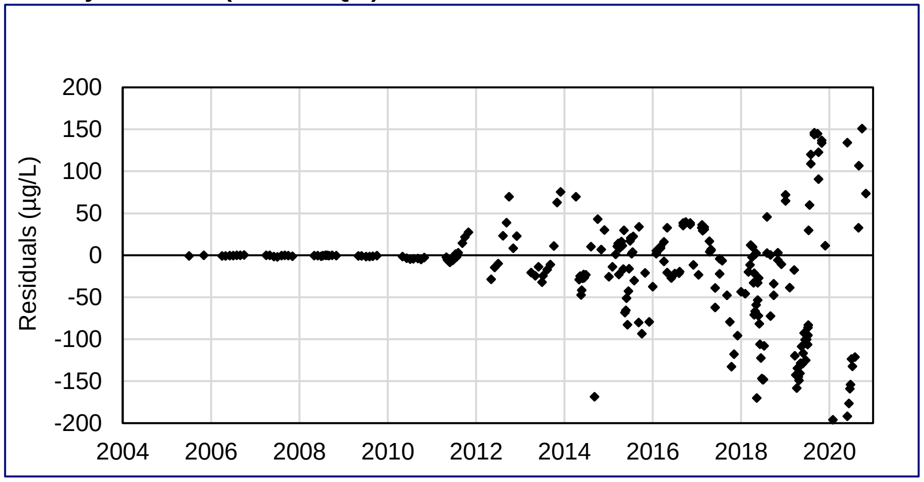
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

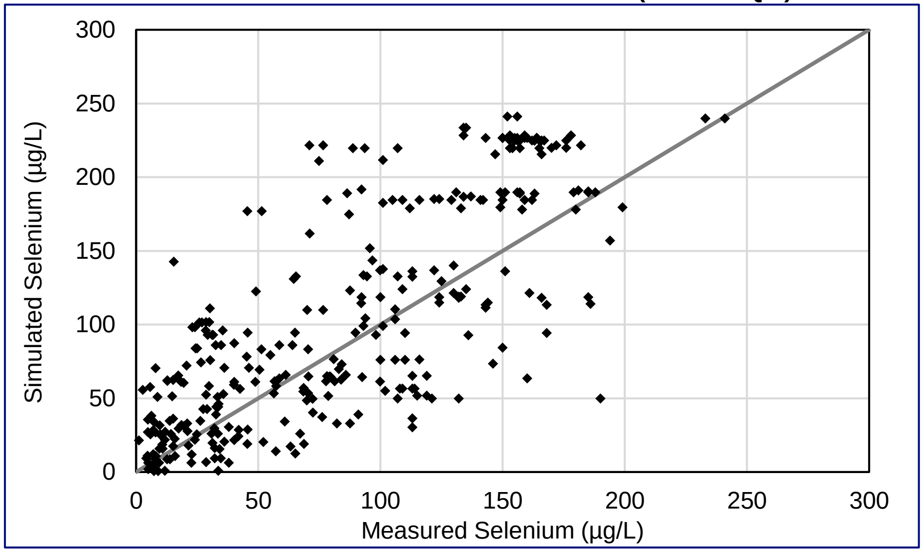
B2-10: Selenium Calibration Information for Node GH_WC1 - Wolfram Creek Sediment Pond Decant (EMS E257795)

Measured and Simulated Selenium Data and Calibration Statistics

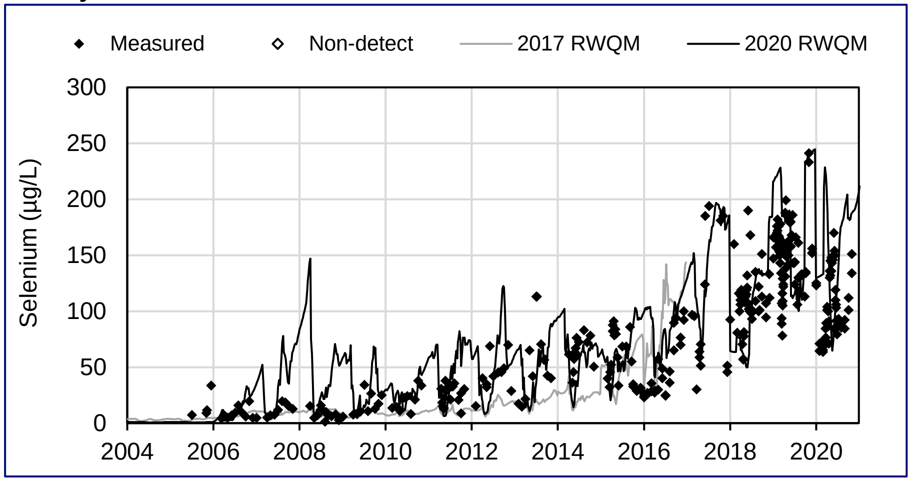
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	7/3/2005	7/3/2005
Last Measured Sample	12/7/2016	12/4/2018
Data Points Available for Comparison, n	155	211
Non-Detect Count	0	0
Measured Mean (µg/L)	35	55
Simulated Mean (µg/L)	28	60
Bias (µg/L)	-7.5	5.3
Relative Bias	0.79	1.1
Error (µg/L)	23	31
Percent Error	65%	56%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

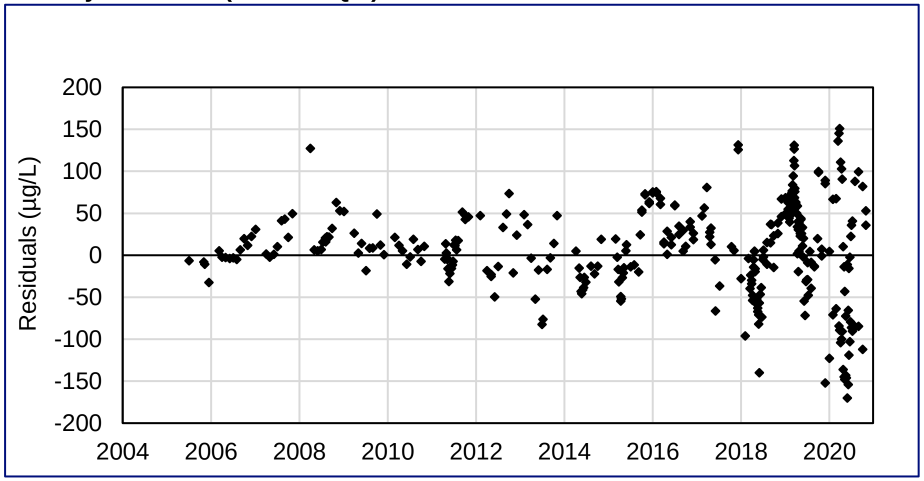


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

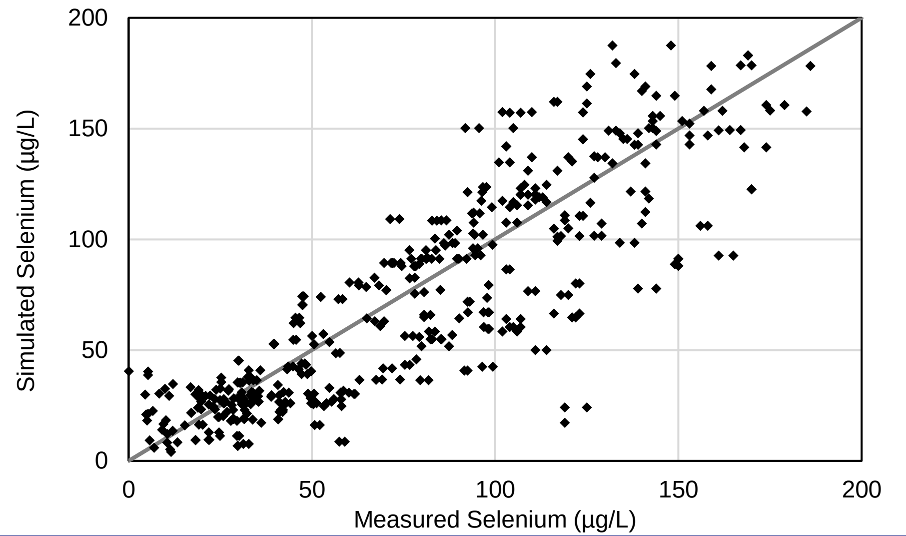
B2-11: Selenium Calibration Information for Node GH_TC1 - Thompson Creek at LRP Road (EMS E102714)

Measured and Simulated Selenium Data and Calibration Statistics

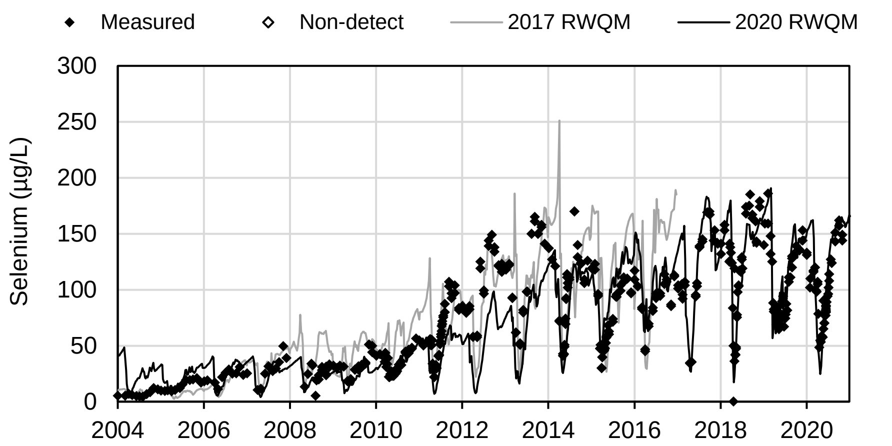
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/2/2004	1/2/2004
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	302	371
Non-Detect Count	0	0
Measured Mean (µg/L)	63	73
Simulated Mean (µg/L)	73	65
Bias (µg/L)	11	-7.7
Relative Bias	1.2	0.89
Error (µg/L)	24	20
Percent Error	39%	28%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



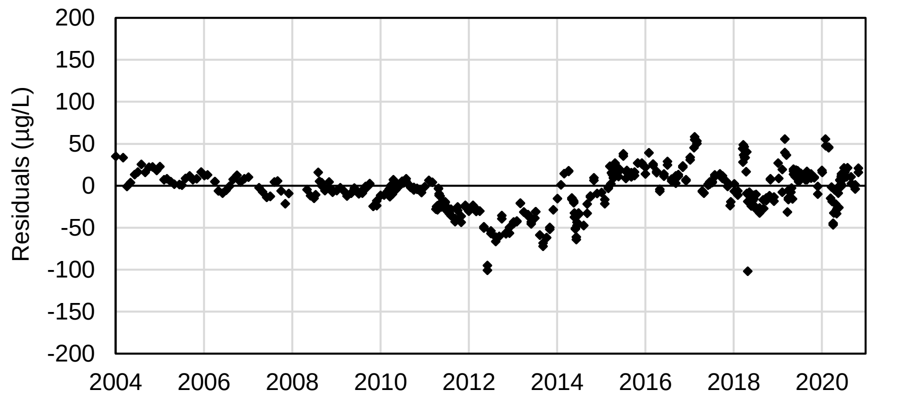
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-12: Selenium Calibration Information for Node LC_DC3 - Dry Creek u/s of East Tributary (EMS E288273)

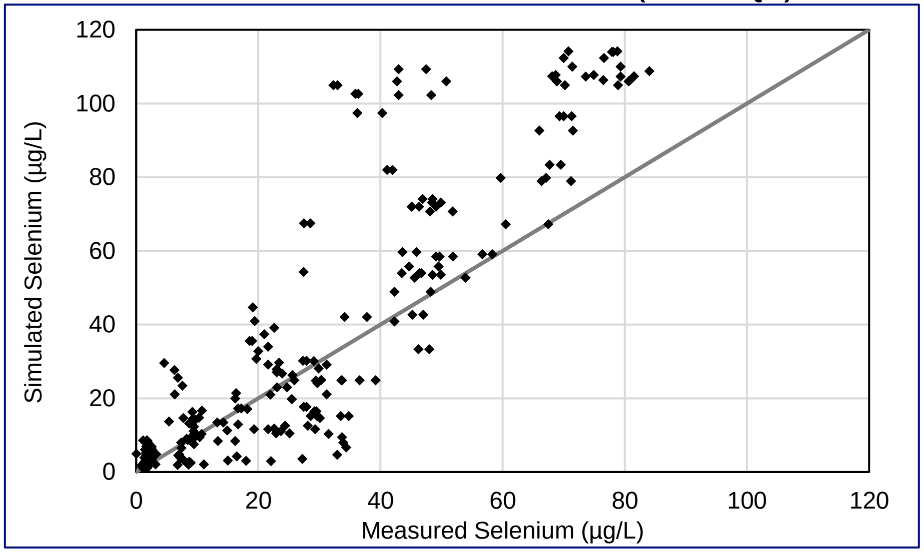
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	10/21/2010	10/21/2010
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	104	178
Non-Detect Count	1	1
Measured Mean (µg/L)	-	6.6
Simulated Mean (µg/L)	-	6.6
Bias (µg/L)	-	0.091
Relative Bias	-	1.0
Error (µg/L)	-	3.7
Percent Error	-	56%

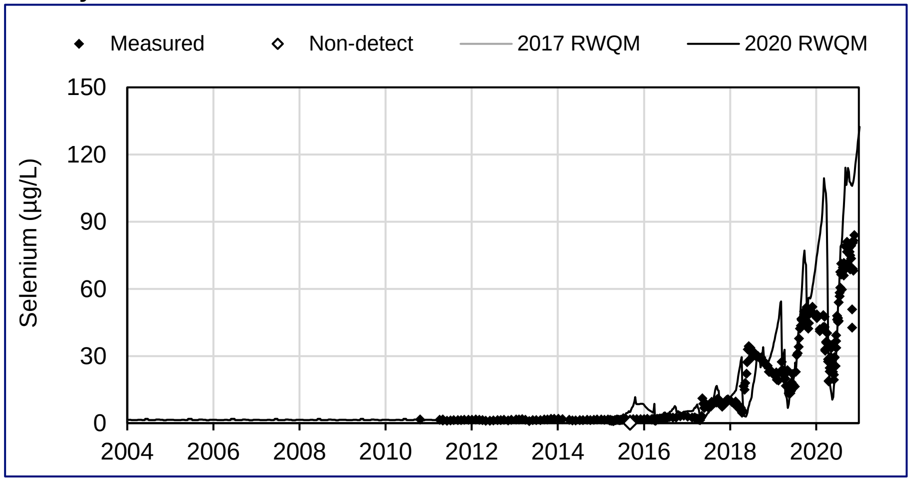
[(a)] As adjusted for the 2019 IPA.

[(b)] Location was not presented in the 2017 RWQM.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



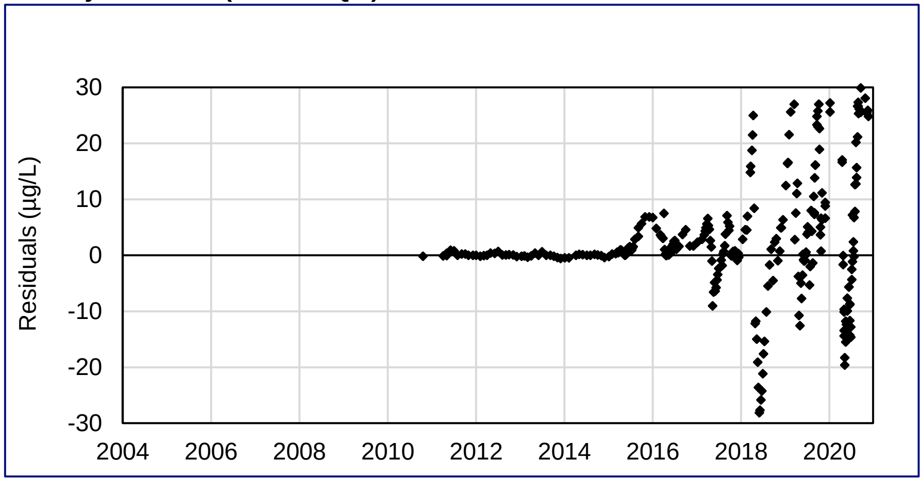
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-13: Selenium Calibration Information for Node LC_DCDS - Dry Creek d/s of Sedimentation Ponds (EMS E295210)

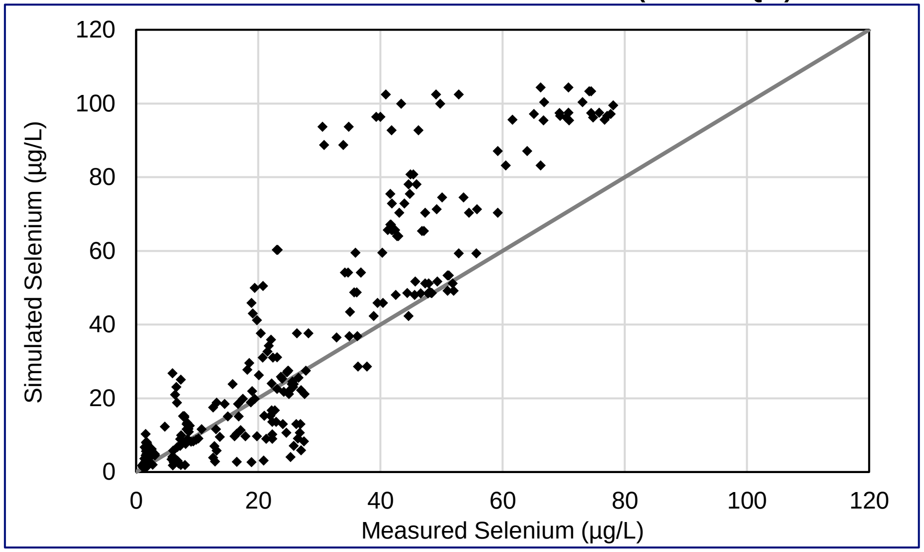
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	11/6/2013	11/6/2013
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	84	162
Non-Detect Count	0	0
Measured Mean (µg/L)	-	6.7
Simulated Mean (µg/L)	-	7.1
Bias (µg/L)	-	0.39
Relative Bias	-	1.1
Error (µg/L)	-	3.4
Percent Error	-	51%

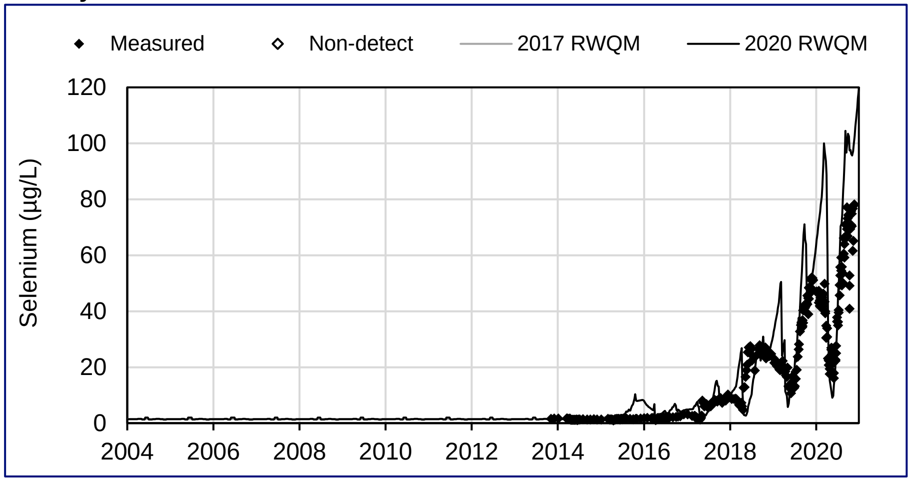
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



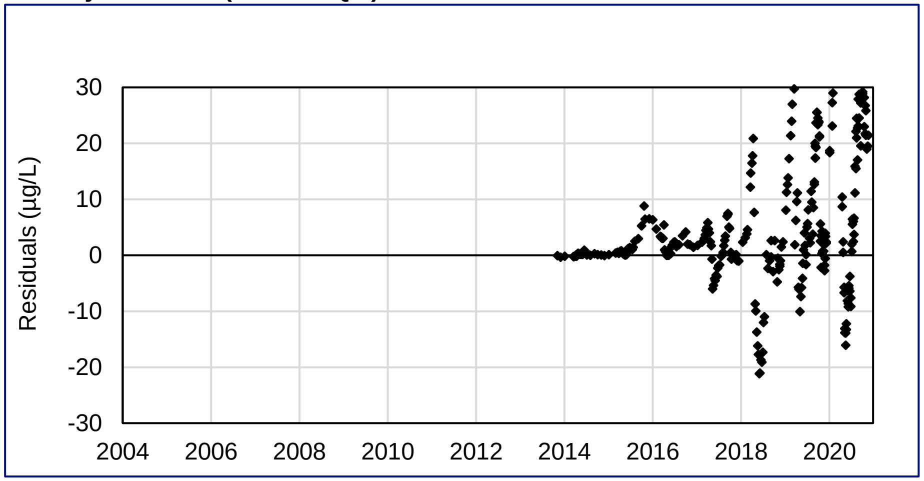
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-14: Selenium Calibration Information for Node LC_DC1 - Dry Creek near mouth (at bridge) (EMS E288270)

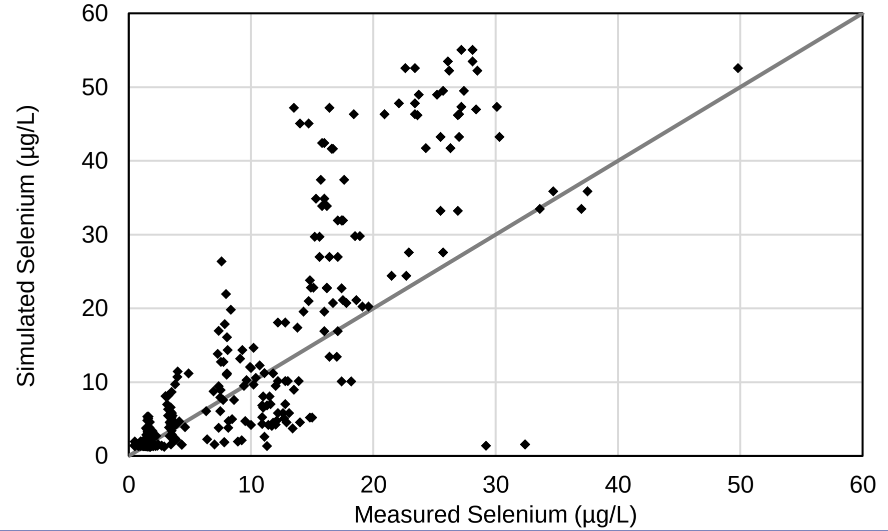
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/4/2004	4/4/2004
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	182	258
Non-Detect Count	6	6
Measured Mean (µg/L)	2.1	3.0
Simulated Mean (µg/L)	1.6	3.0
Bias (µg/L)	-0.55	-0.056
Relative Bias	0.74	0.98
Error (µg/L)	0.85	1.7
Percent Error	41%	56%

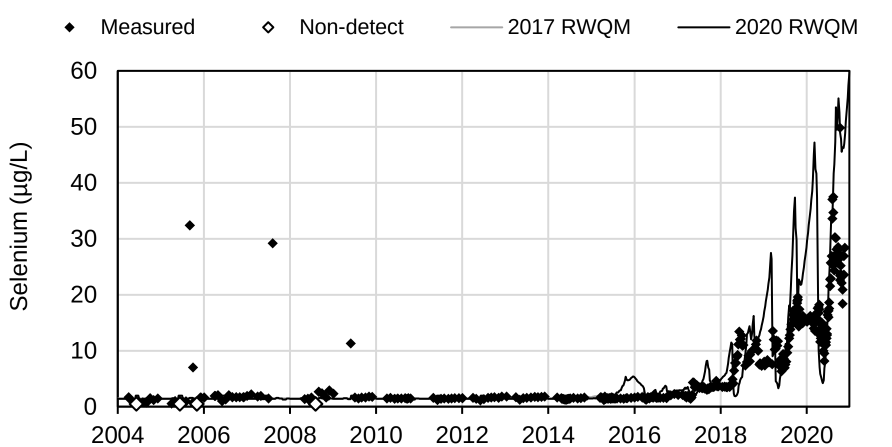
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



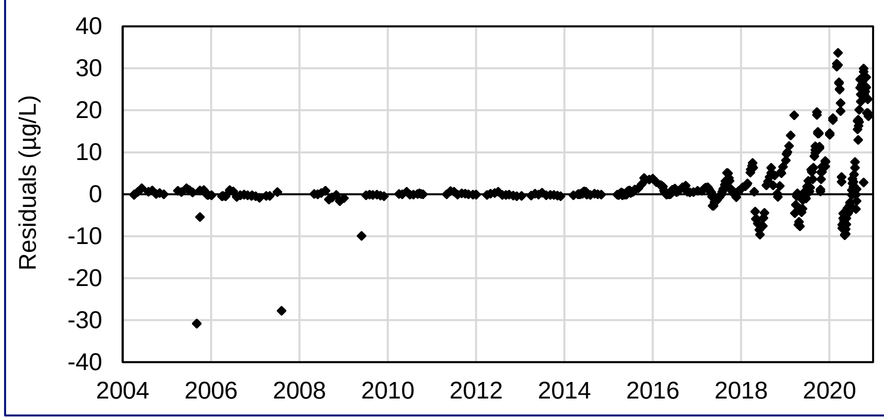
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

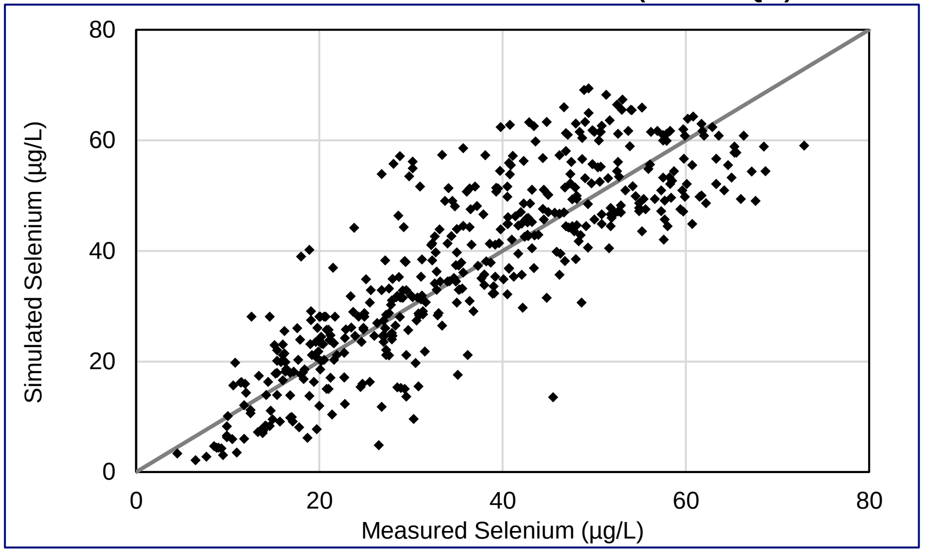
B2-15: Selenium Calibration Information for Node LC_LCUSWLC - Line Creek u/s of West Line Creek (EMS E293369)

Measured and Simulated Selenium Data and Calibration Statistics

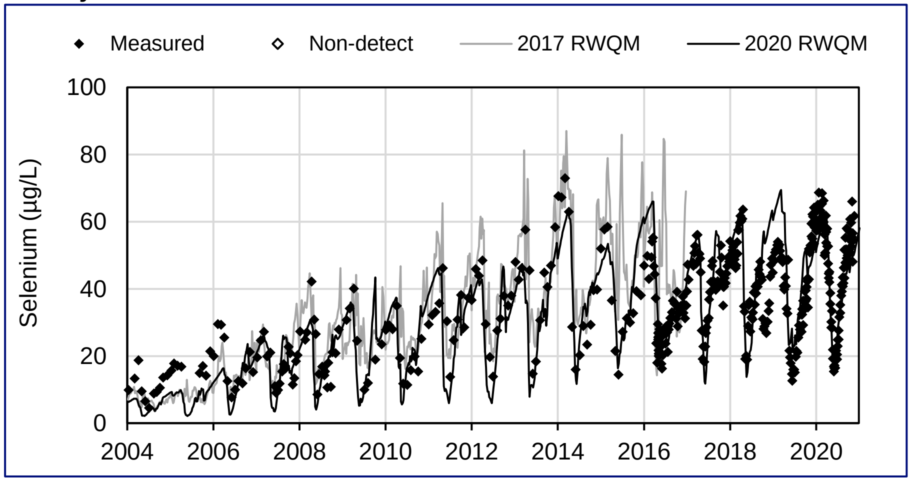
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/13/2004	1/13/2004
Last Measured Sample	12/28/2016	12/27/2018
Data Points Available for Comparison, n	203	306
Non-Detect Count	0	0
Measured Mean (µg/L)	27	32
Simulated Mean (µg/L)	32	33
Bias (µg/L)	4.9	1.1
Relative Bias	1.2	1.0
Error (µg/L)	9.5	6.5
Percent Error	34%	20%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

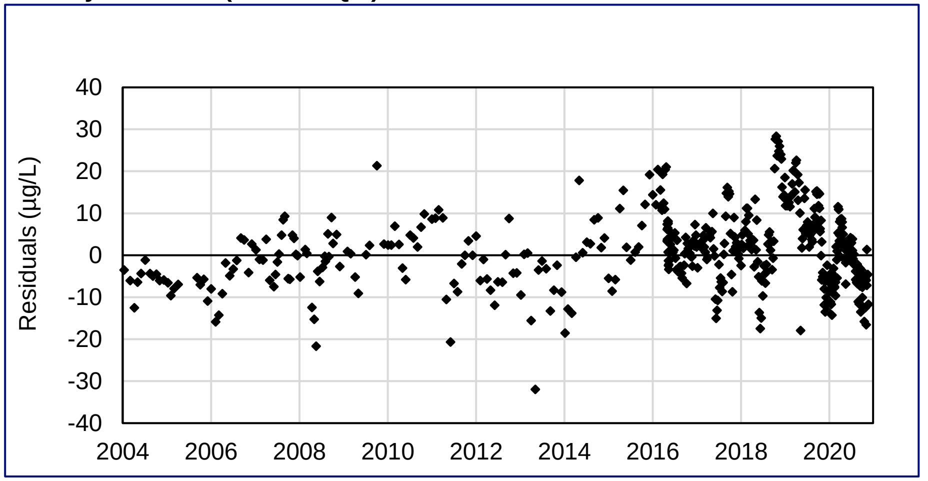


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

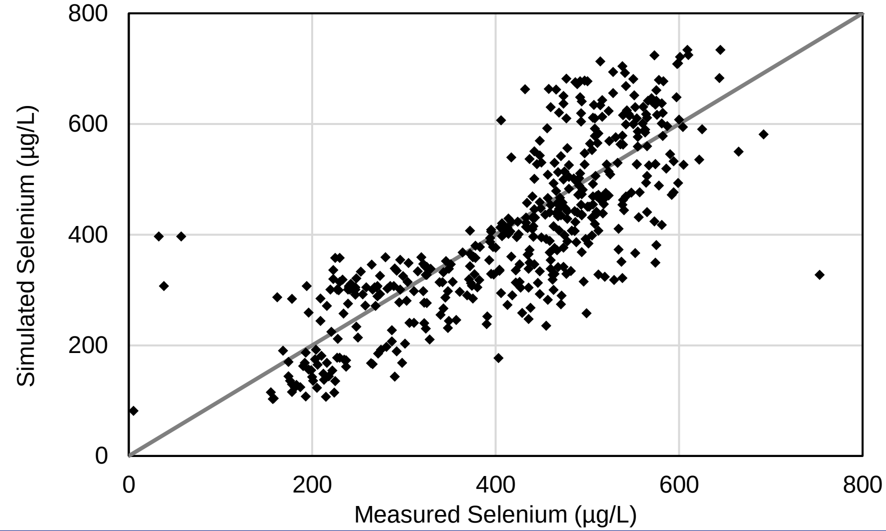
B2-16: Selenium Calibration Information for Node LC_WLC - West Line Creek (EMS E261958)

Measured and Simulated Selenium Data and Calibration Statistics

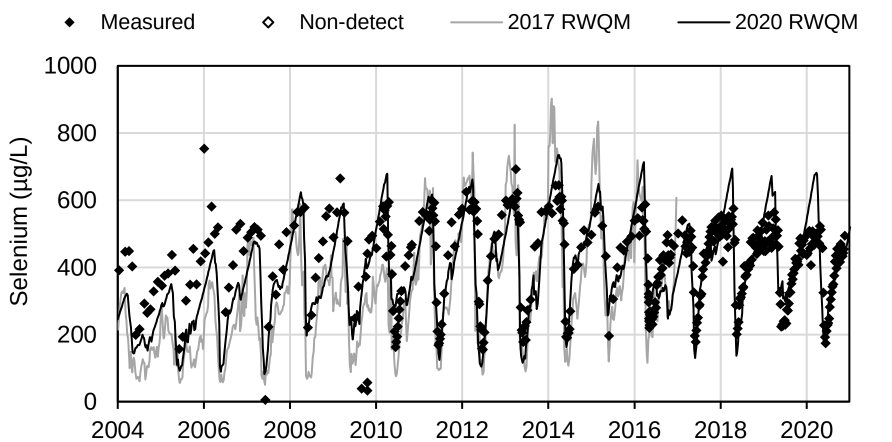
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/13/2004	1/13/2004
Last Measured Sample	12/5/2016	12/27/2018
Data Points Available for Comparison, n	265	364
Non-Detect Count	0	0
Measured Mean (µg/L)	412	419
Simulated Mean (µg/L)	319	395
Bias (µg/L)	-94	-24
Relative Bias	0.77	0.94
Error (µg/L)	129	75
Percent Error	31%	18%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



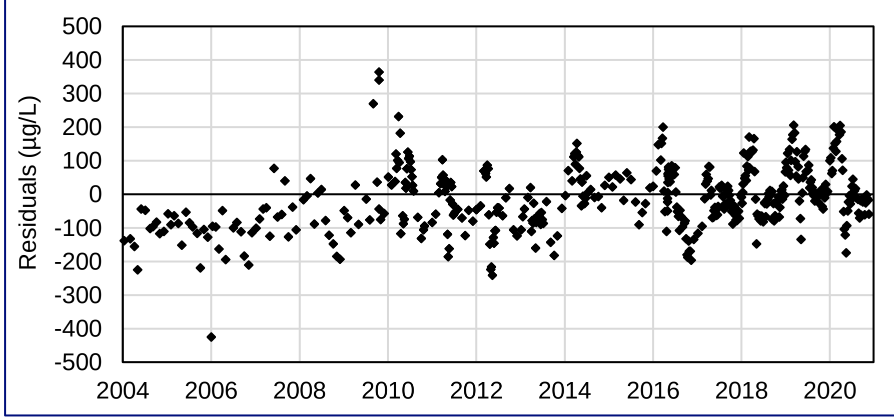
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-17: Selenium Calibration Information for Node LC_LC3 - Line Creek d/s of West Line Creek (EMS 0200337)

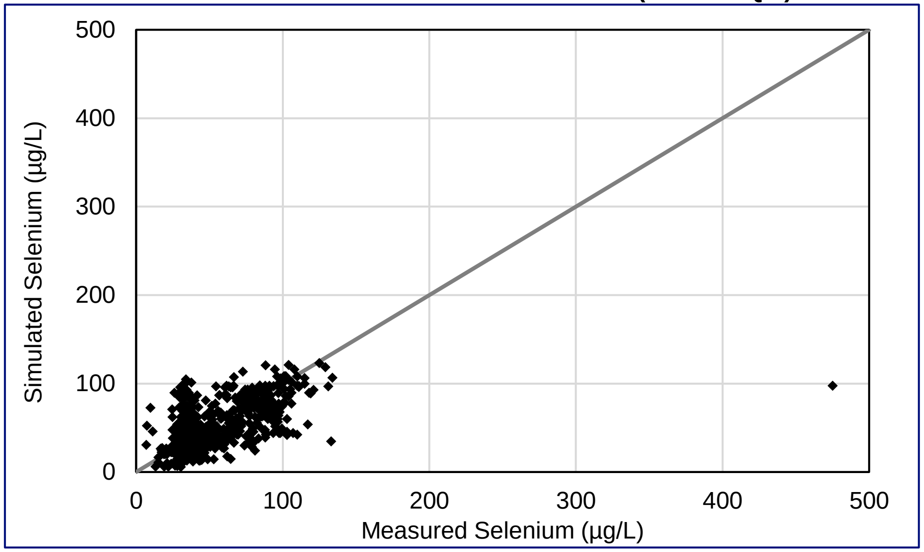
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/13/2004	1/13/2004
Last Measured Sample	12/27/2016	12/31/2018
Data Points Available for Comparison, n	324	567
Non-Detect Count	0	0
Measured Mean (µg/L)	-	59
Simulated Mean (µg/L)	-	54
Bias (µg/L)	-	-4.7
Relative Bias	-	0.92
Error (µg/L)	-	16
Percent Error	-	28%

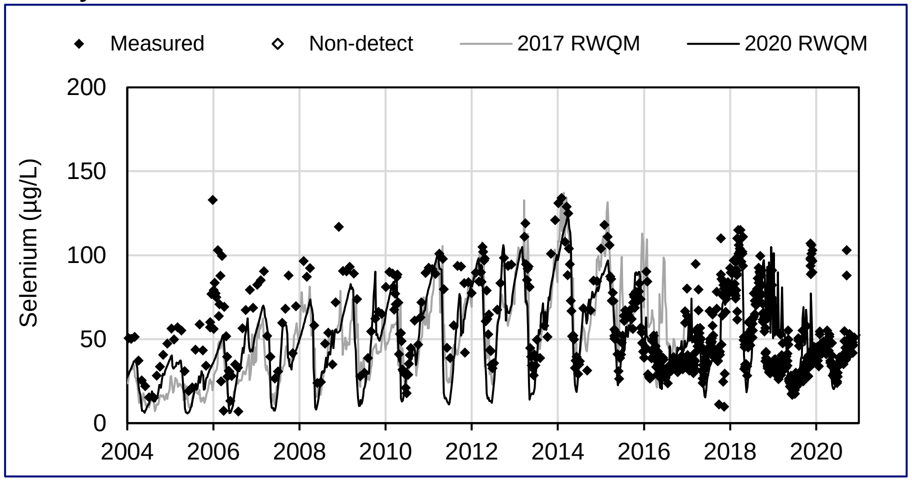
(a) As adjusted for the 2019 IPA.

(b) Location was not presented in the 2017 RWQM.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



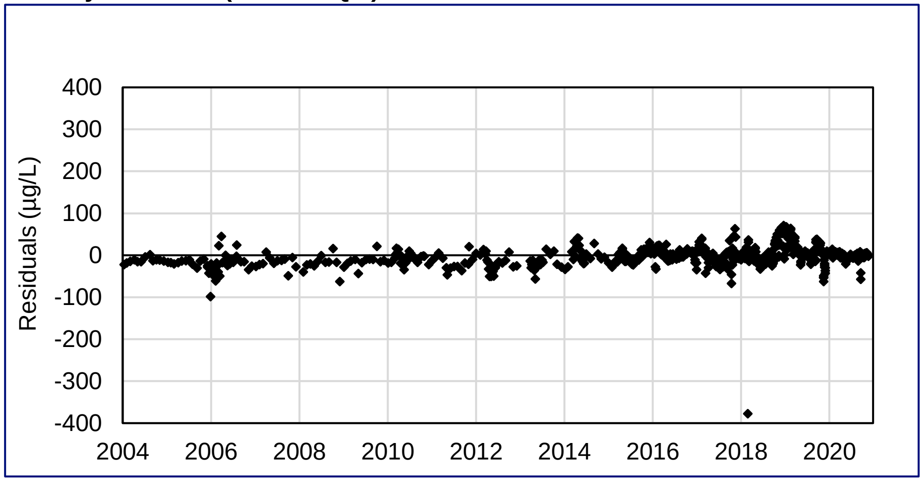
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-18: Selenium Calibration Information for Node LC_LCDSSLCC - LCO Compliance Point - Line Creek d/s of South Line Creek Confluence (EMS E297110)

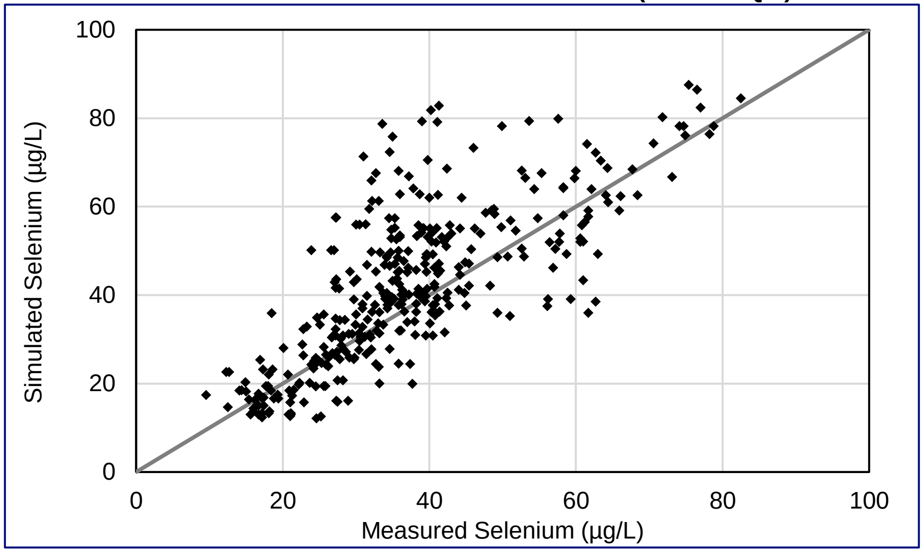
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/4/2014	6/4/2014
Last Measured Sample	12/28/2016	12/27/2018
Data Points Available for Comparison, n	87	198
Non-Detect Count	0	0
Measured Mean (µg/L)	-	41
Simulated Mean (µg/L)	-	45
Bias (µg/L)	-	3.8
Relative Bias	-	1.1
Error (µg/L)	-	8.7
Percent Error	-	21%

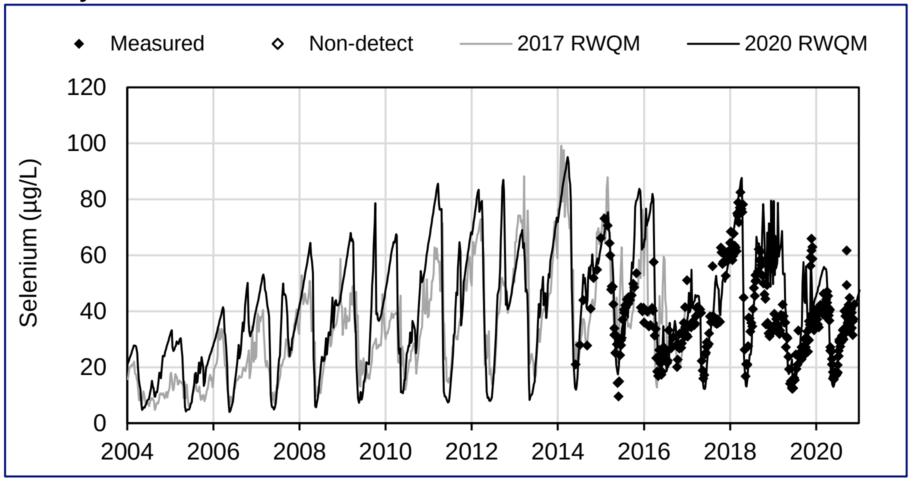
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

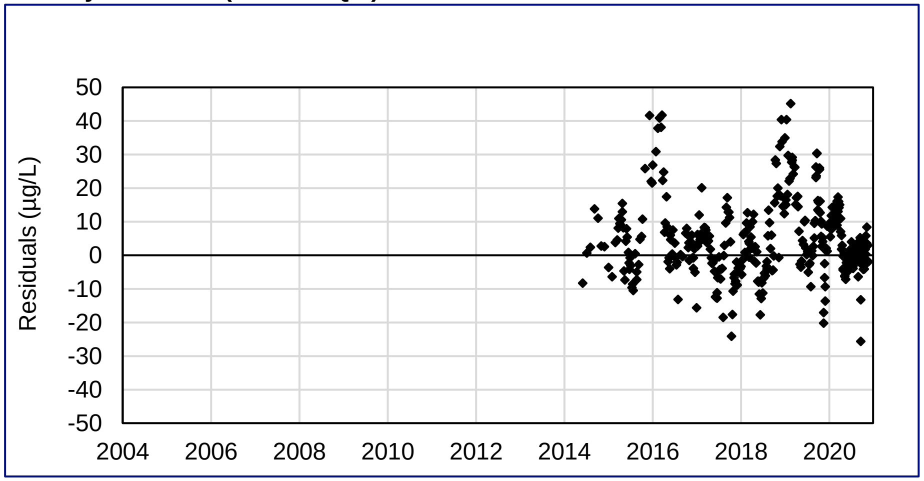
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

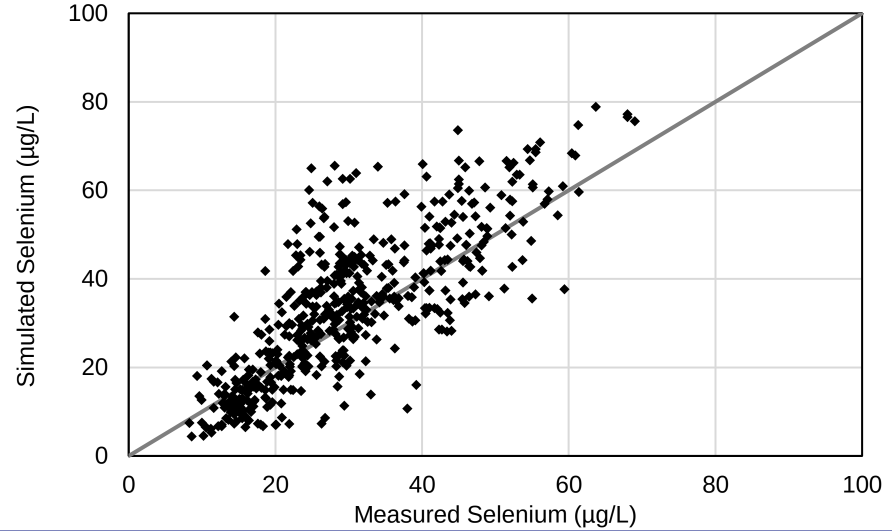
B2-19: Selenium Calibration Information for Node LC_LC4 - Line Creek u/s of Process Plant (EMS 0200044)

Measured and Simulated Selenium Data and Calibration Statistics

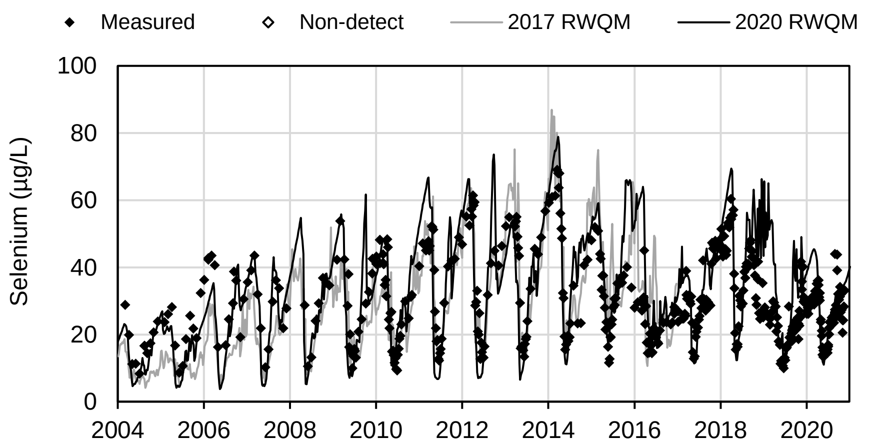
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/4/2004	3/4/2004
Last Measured Sample	12/7/2016	12/27/2018
Data Points Available for Comparison, n	270	376
Non-Detect Count	0	0
Measured Mean (µg/L)	30	32
Simulated Mean (µg/L)	29	34
Bias (µg/L)	-1.2	2.0
Relative Bias	0.96	1.1
Error (µg/L)	7.7	7.6
Percent Error	25%	24%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



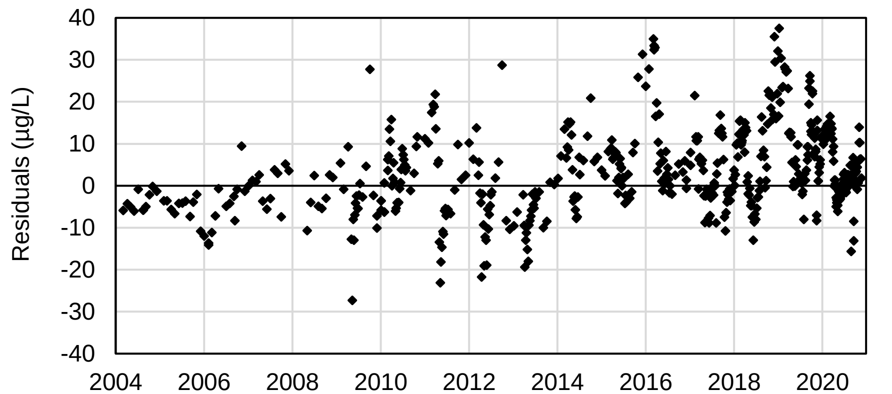
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

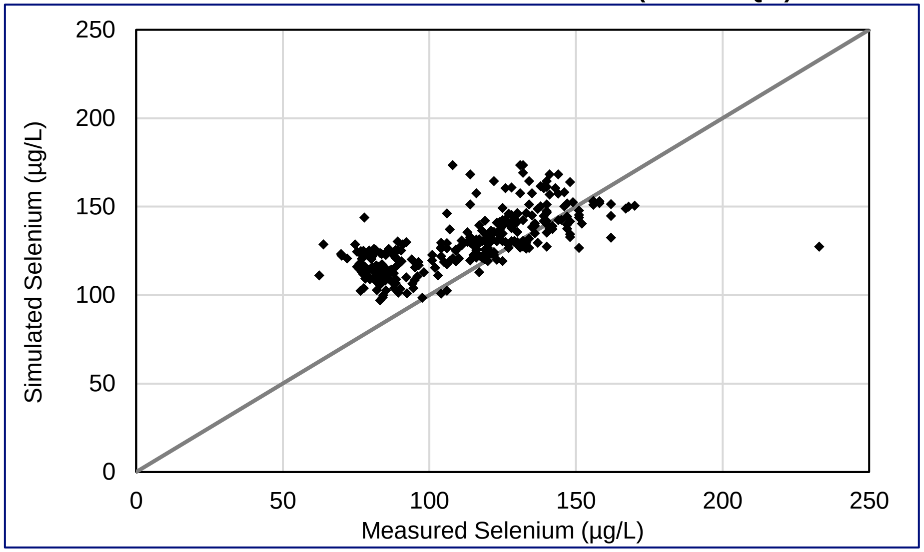
B2-20: Selenium Calibration Information for Node EV_EC1 - Erickson Creek at Mouth (EMS 0200097)

Measured and Simulated Selenium Data and Calibration Statistics

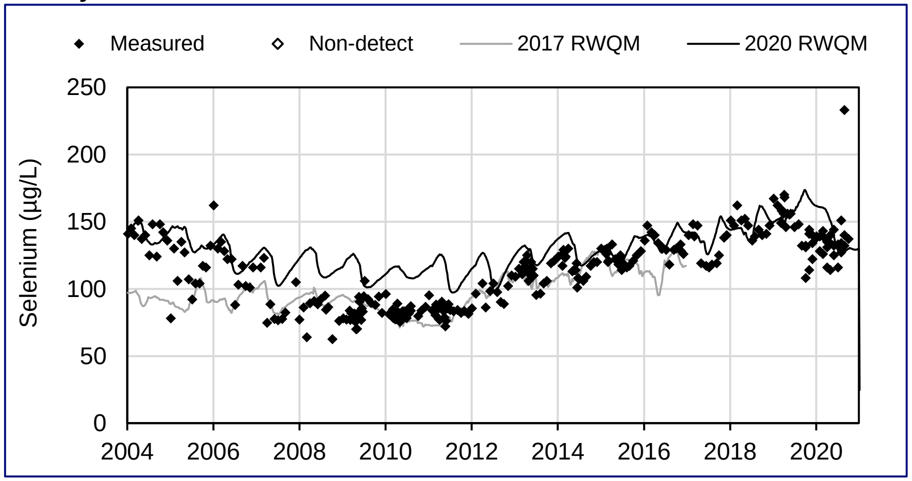
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	227	251
Non-Detect Count	0	0
Measured Mean (µg/L)	103	107
Simulated Mean (µg/L)	96	125
Bias (µg/L)	-7.4	18
Relative Bias	0.93	1.2
Error (µg/L)	13	20
Percent Error	12%	19%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

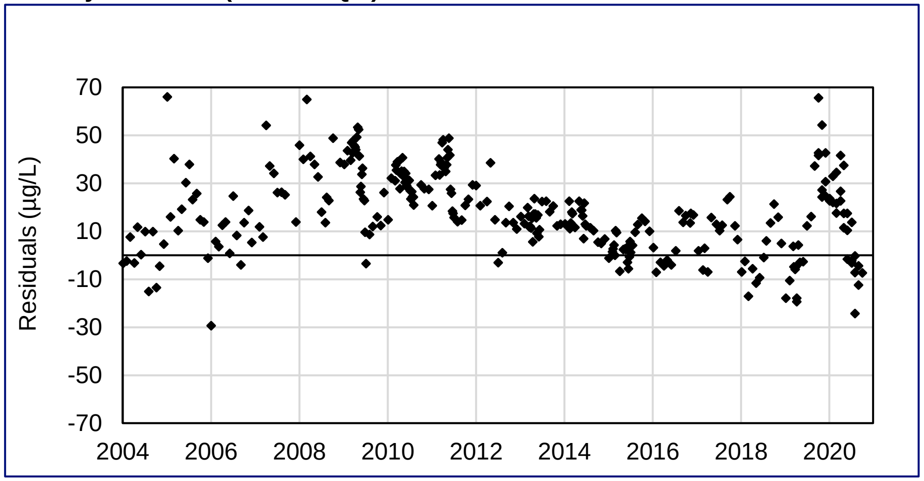


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

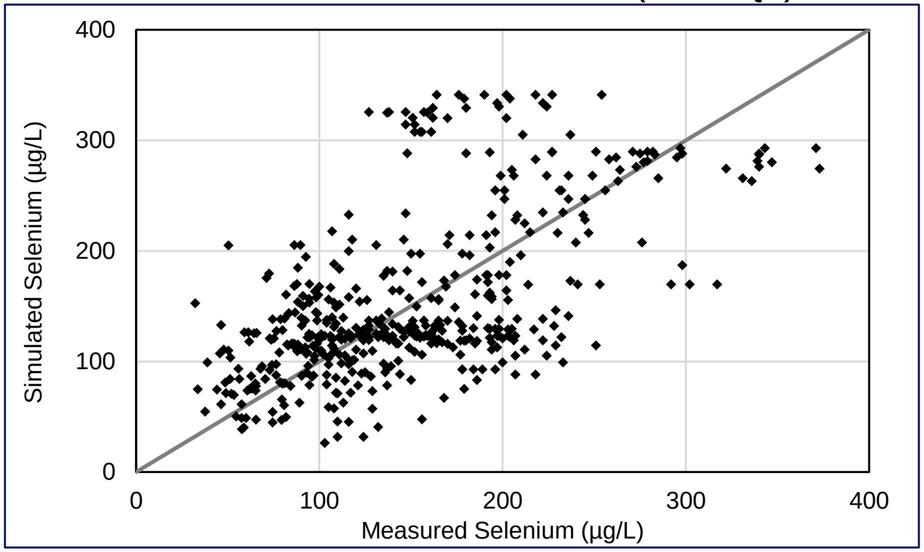
B2-21: Selenium Calibration Information for Node EV_GT1 - Gate Creek Sediment Pond Decant (EMS E206231)

Measured and Simulated Selenium Data and Calibration Statistics

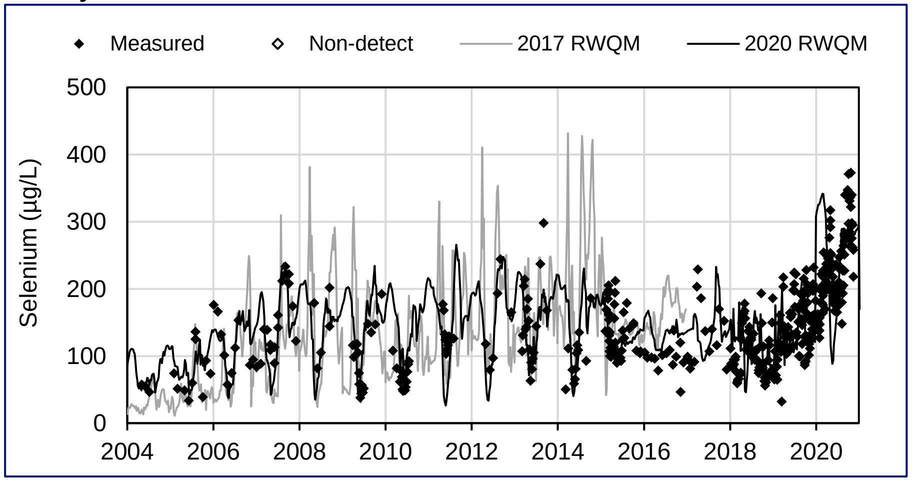
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/4/2004	5/4/2004
Last Measured Sample	12/5/2016	12/31/2018
Data Points Available for Comparison, n	185	266
Non-Detect Count	0	0
Measured Mean (µg/L)	120	117
Simulated Mean (µg/L)	128	119
Bias (µg/L)	8.4	2.4
Relative Bias	1.1	1.0
Error (µg/L)	50	37
Percent Error	42%	32%

[(a)] As adjusted for the 2019 IPA.

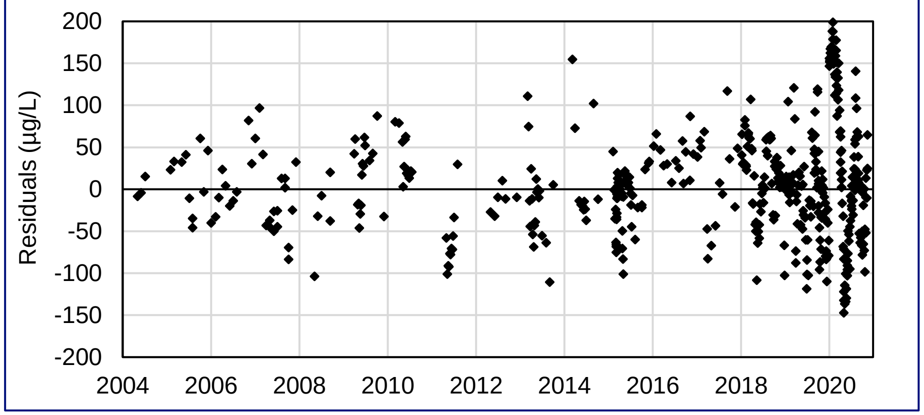
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

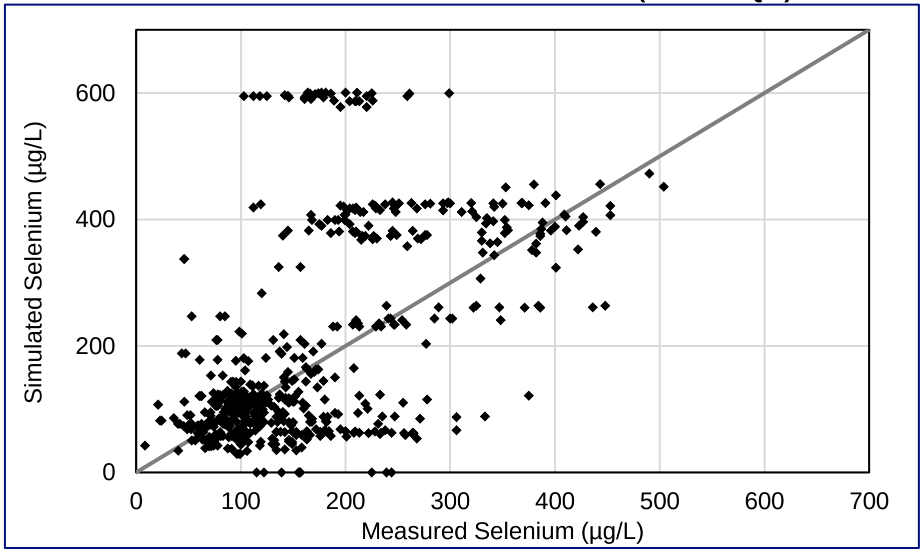
B2-22: Selenium Calibration Information for Node EV_BC1 - Bodie Creek Sediment Pond Decant (EMS E102685)

Measured and Simulated Selenium Data and Calibration Statistics

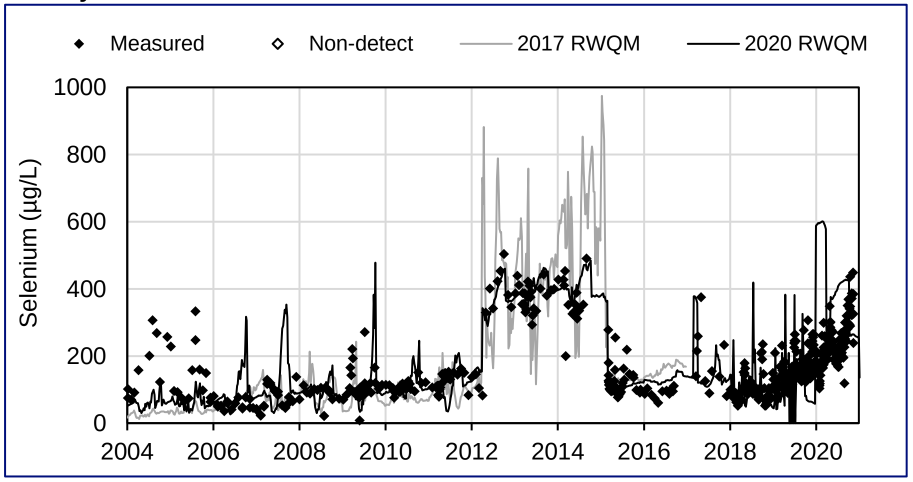
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	9/14/2016	12/31/2018
Data Points Available for Comparison, n	267	353
Non-Detect Count	0	0
Measured Mean (µg/L)	156	144
Simulated Mean (µg/L)	158	145
Bias (µg/L)	1.9	0.9
Relative Bias	1.0	1.0
Error (µg/L)	65	45
Percent Error	42%	31%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



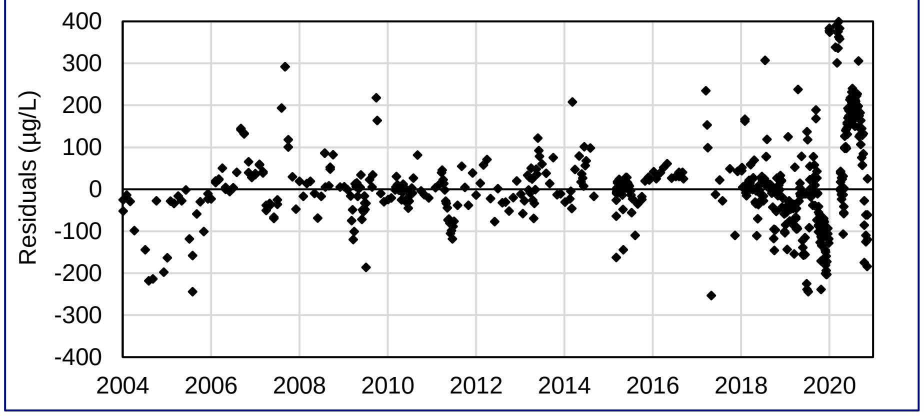
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

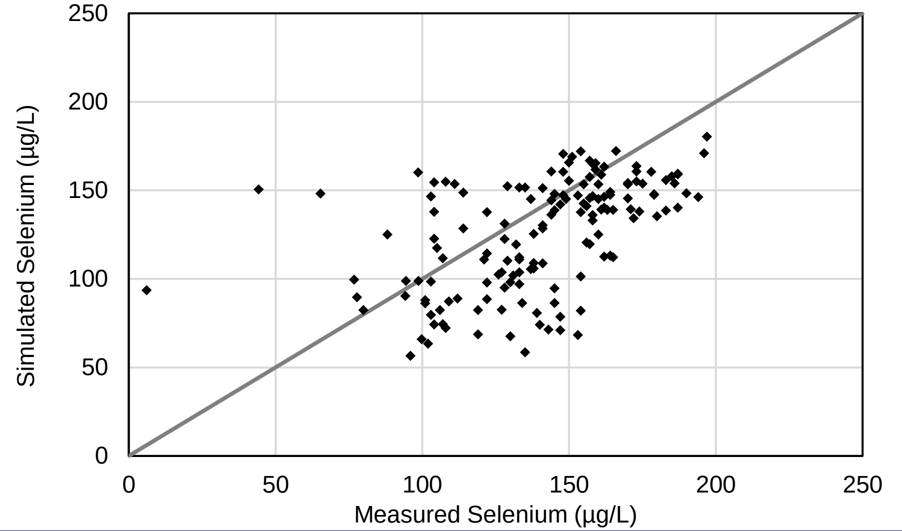
B2-23: Selenium Calibration Information for Node EV_DC1 - EVO Dry Creek Sediment Pond Decant (EMS E298590)

Measured and Simulated Selenium Data and Calibration Statistics

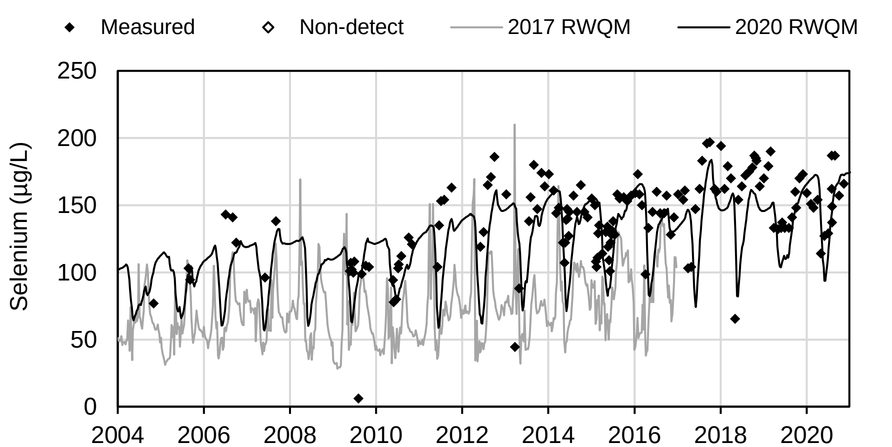
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	11/2/2004	11/2/2004
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	97	123
Non-Detect Count	0	0
Measured Mean (µg/L)	130	137
Simulated Mean (µg/L)	77	122
Bias (µg/L)	-54	-15
Relative Bias	0.59	0.89
Error (µg/L)	58	29
Percent Error	45%	21%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



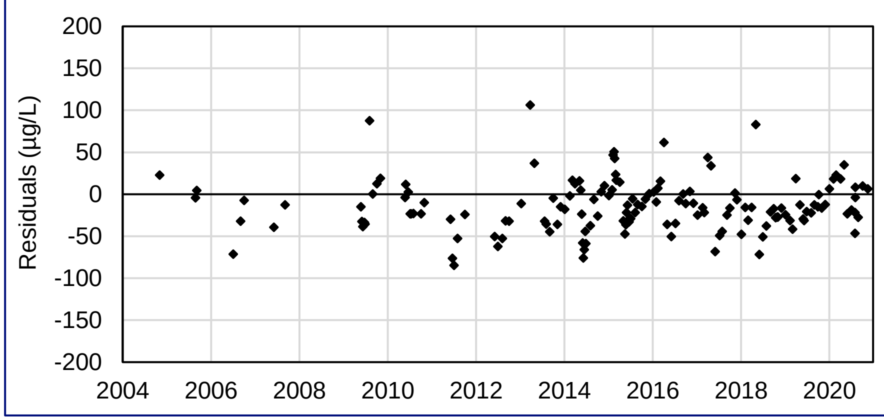
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

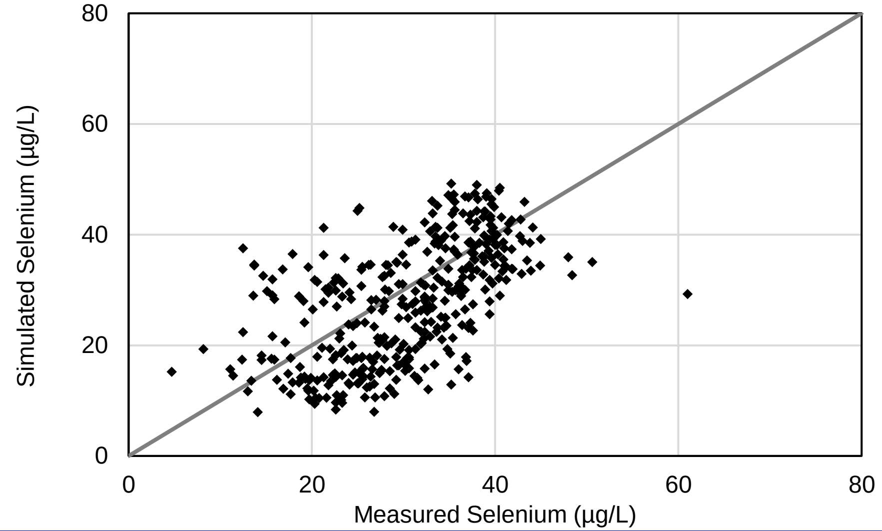
B2-24: Selenium Calibration Information for Node EV_HC1 - EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (EMS E102682)

Measured and Simulated Selenium Data and Calibration Statistics

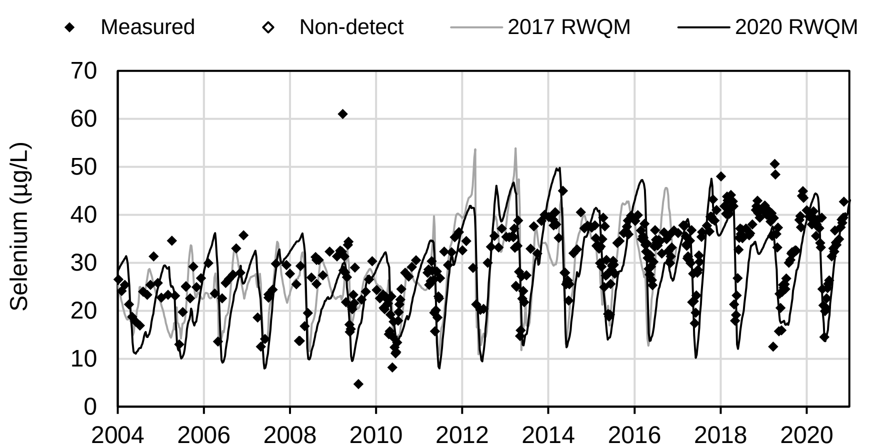
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	252	316
Non-Detect Count	0	0
Measured Mean (µg/L)	28	29
Simulated Mean (µg/L)	27	27
Bias (µg/L)	-1.3	-2.3
Relative Bias	0.95	0.92
Error (µg/L)	6.4	8.2
Percent Error	23%	28%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



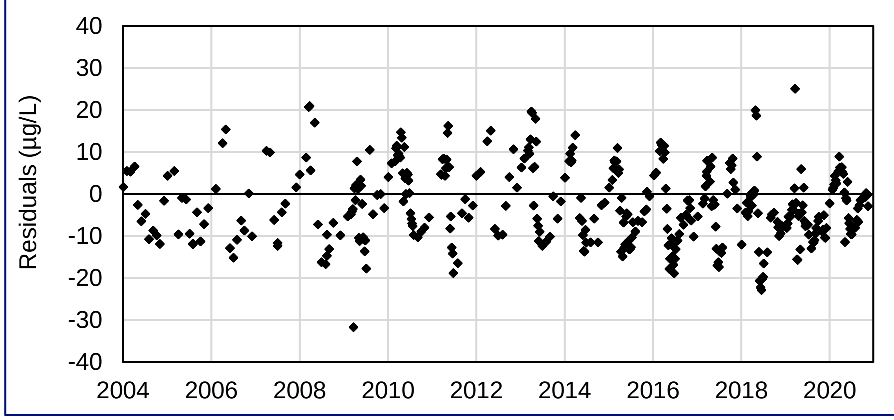
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

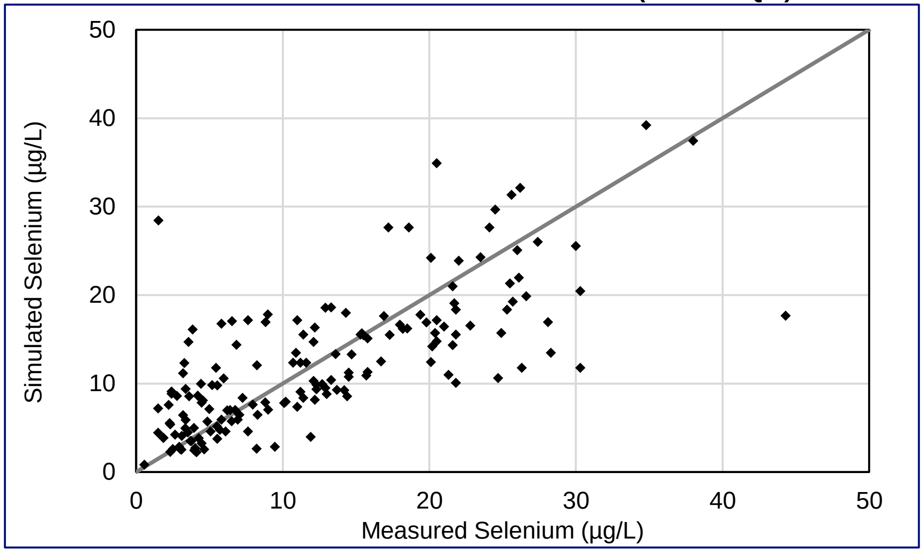
B2-25: Selenium Calibration Information for Node FR_FR1 - Fording River d/s of Henretta Creek (EMS 0200251)

Measured and Simulated Selenium Data and Calibration Statistics

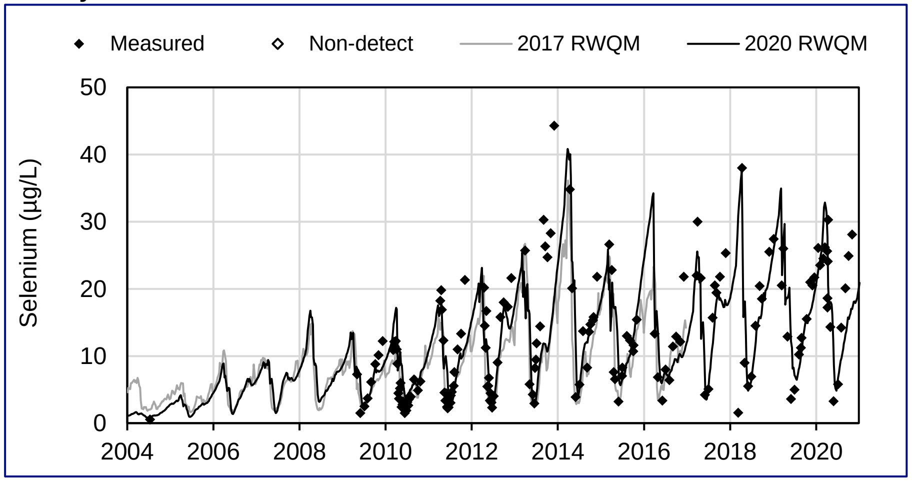
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	7/13/2004	7/13/2004
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	115	134
Non-Detect Count	0	0
Measured Mean (µg/L)	10	11
Simulated Mean (µg/L)	7.9	11
Bias (µg/L)	-2.3	-0.34
Relative Bias	0.77	0.97
Error (µg/L)	3.5	4.1
Percent Error	35%	37%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



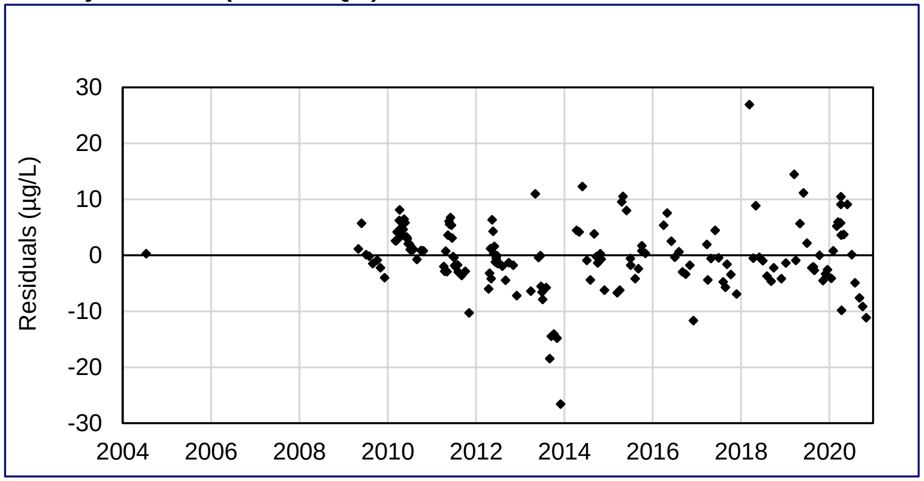
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

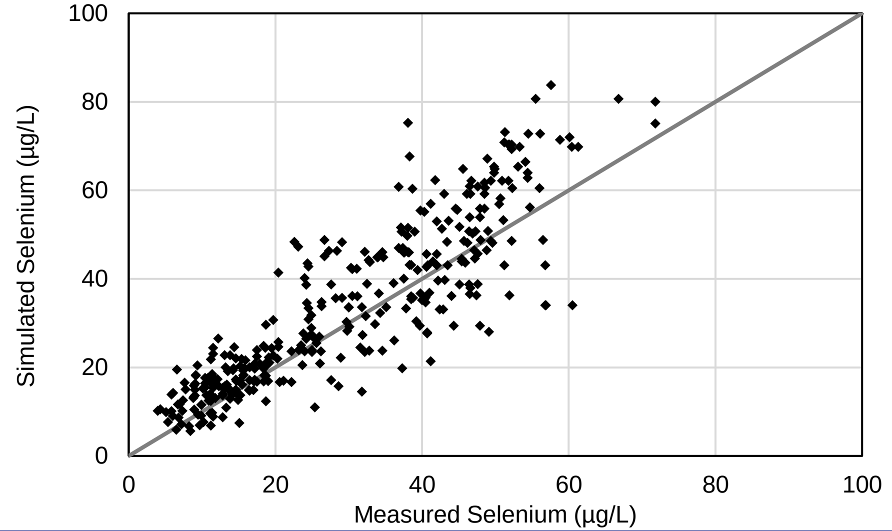
B2-26: Selenium Calibration Information for Node FR_FR2 - Fording River u/s of Kilmarnock Creek (EMS 0200201)

Measured and Simulated Selenium Data and Calibration Statistics

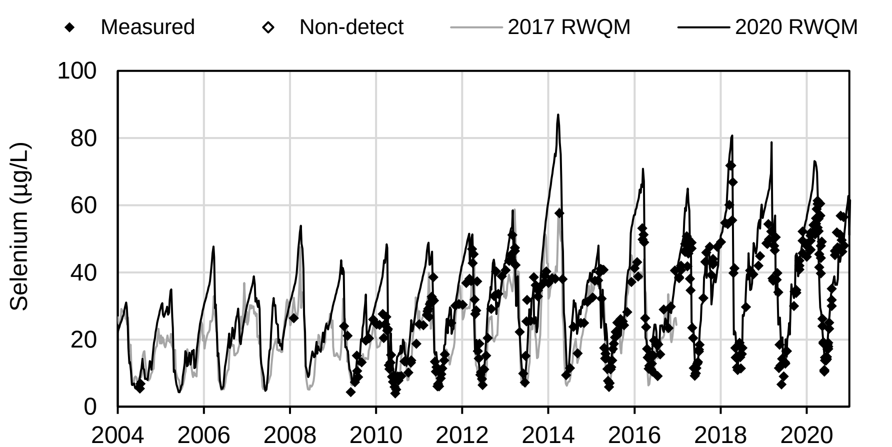
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	7/7/2004	7/7/2004
Last Measured Sample	12/12/2016	12/5/2018
Data Points Available for Comparison, n	188	250
Non-Detect Count	0	0
Measured Mean (µg/L)	24	27
Simulated Mean (µg/L)	22	31
Bias (µg/L)	-2.0	4.5
Relative Bias	0.92	1.2
Error (µg/L)	5.4	7.3
Percent Error	23%	27%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



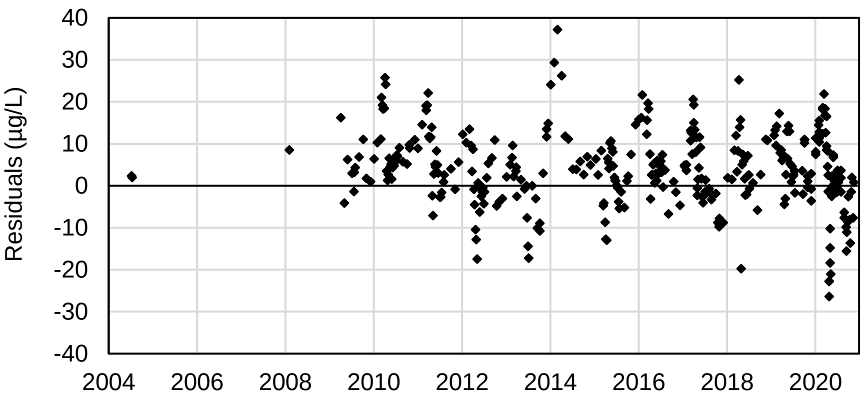
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

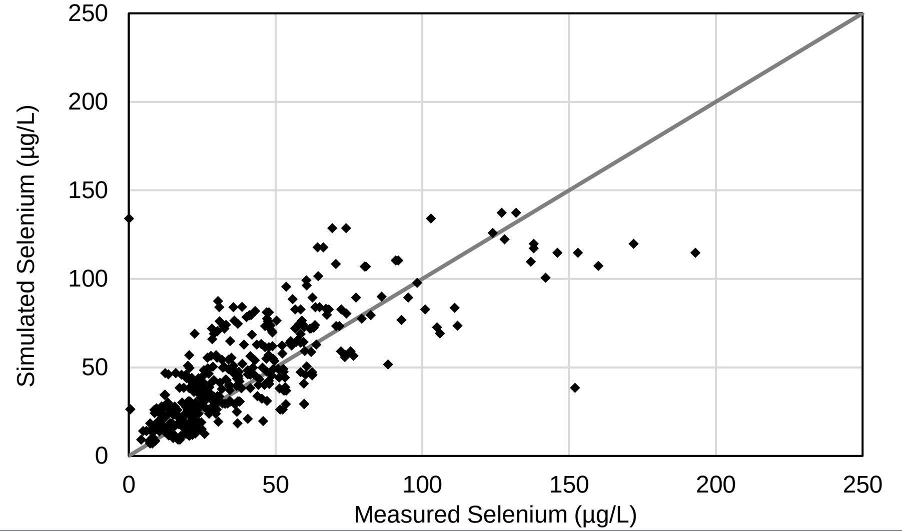
B2-27: Selenium Calibration Information for Node FR_FR4 - Fording River between Swift and Cataract Creeks (EMS 0200311)

Measured and Simulated Selenium Data and Calibration Statistics

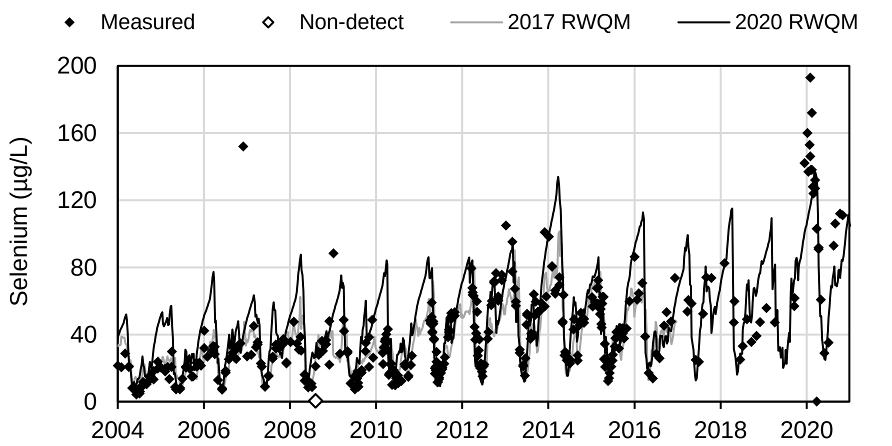
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/2/2004	1/2/2004
Last Measured Sample	12/12/2016	12/5/2018
Data Points Available for Comparison, n	355	372
Non-Detect Count	2	2
Measured Mean (µg/L)	34	35
Simulated Mean (µg/L)	34	43
Bias (µg/L)	0.14	8.4
Relative Bias	1.0	1.2
Error (µg/L)	9.9	14
Percent Error	29%	40%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



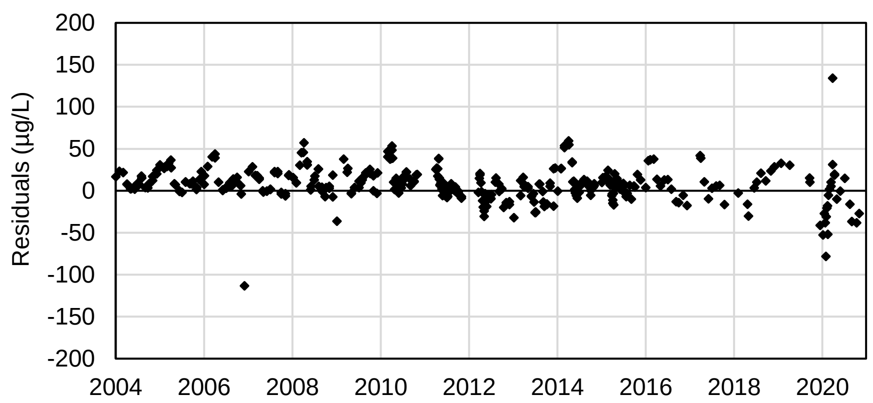
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-28: Selenium Calibration Information for Node FR_FRCP1 - Fording River, 525 m d/s of Cataract Creek (EMS E300071)

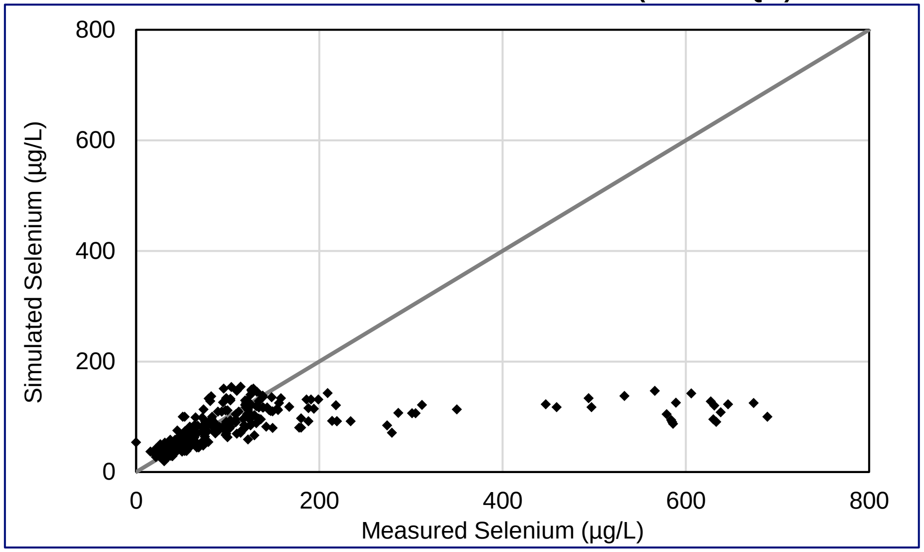
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/3/2015	2/3/2015
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	82	155
Non-Detect Count	0	0
Measured Mean (µg/L)	-	125
Simulated Mean (µg/L)	-	76
Bias (µg/L)	-	-49
Relative Bias	-	0.61
Error (µg/L)	-	63
Percent Error	-	51%

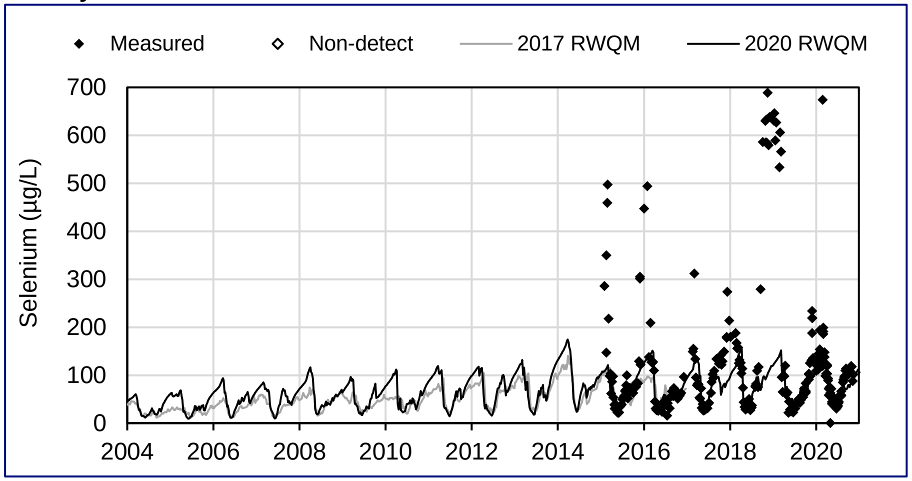
[a] As adjusted for the 2019 IPA.

[b] Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



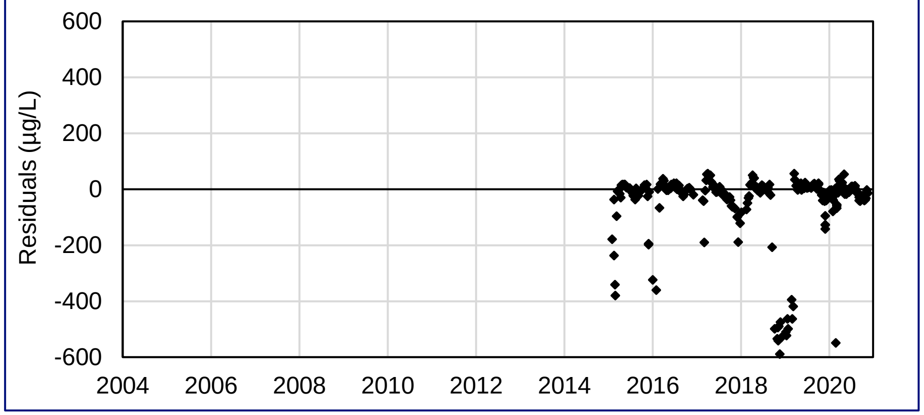
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

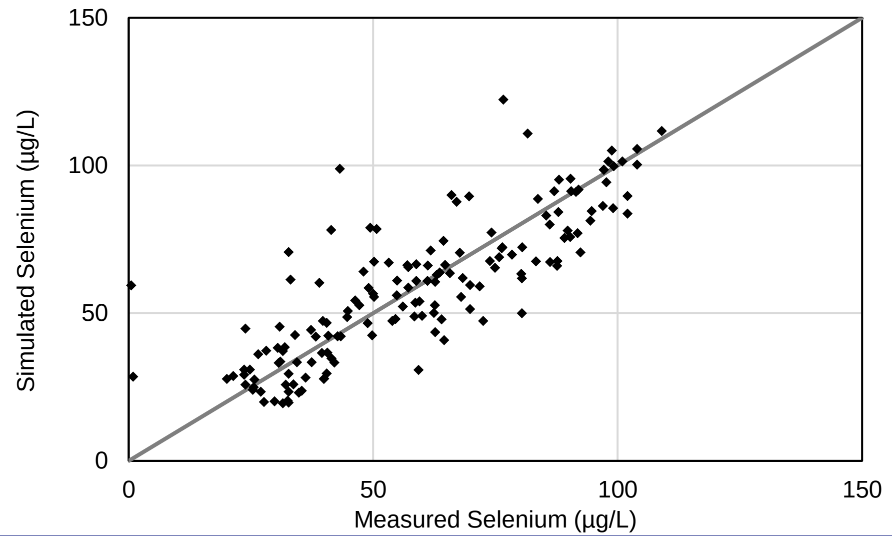
B2-29: Selenium Calibration Information for Node GH_PC2 - Fording River d/s of Porter Creek (EMS E287431)

Measured and Simulated Selenium Data and Calibration Statistics

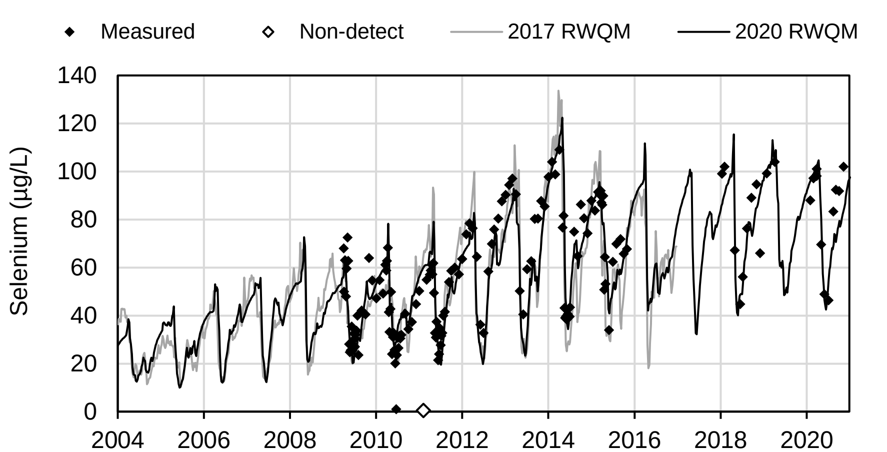
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/1/2009	4/1/2009
Last Measured Sample	11/2/2015	12/5/2018
Data Points Available for Comparison, n	134	143
Non-Detect Count	1	1
Measured Mean (µg/L)	55	56
Simulated Mean (µg/L)	53	56
Bias (µg/L)	-1.5	0.33
Relative Bias	0.97	1.0
Error (µg/L)	12	11
Percent Error	21%	19%

[(a)] As adjusted for the 2019 IPA.

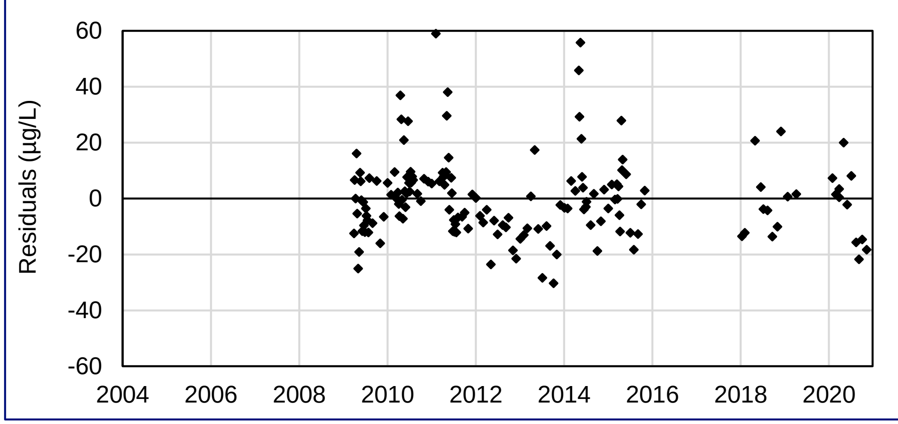
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-30: Selenium Calibration Information for Node FR_FRABCH - FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (EMS E223753)

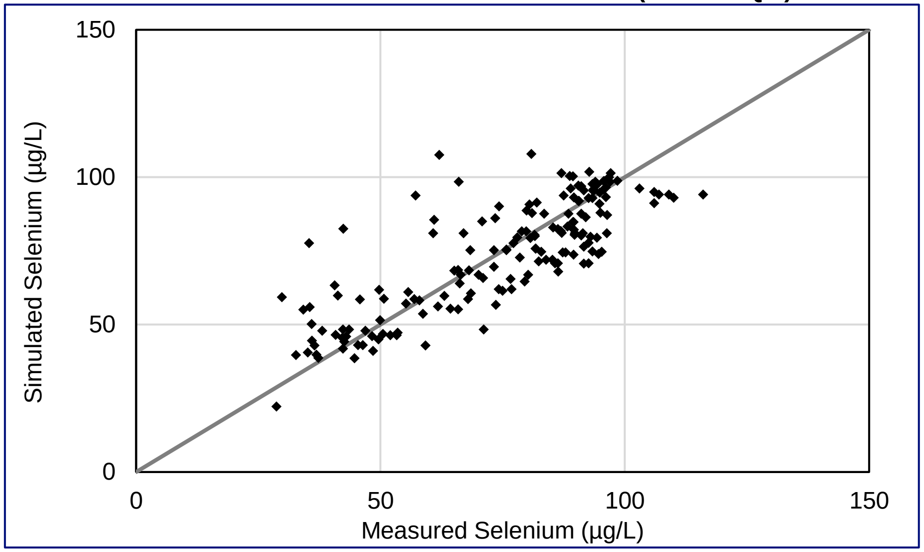
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/24/2013	6/24/2013
Last Measured Sample	12/8/2016	12/6/2018
Data Points Available for Comparison, n	24	72
Non-Detect Count	0	0
Measured Mean (µg/L)	-	72
Simulated Mean (µg/L)	-	70
Bias (µg/L)	-	-1.5
Relative Bias	-	0.98
Error (µg/L)	-	11
Percent Error	-	15%

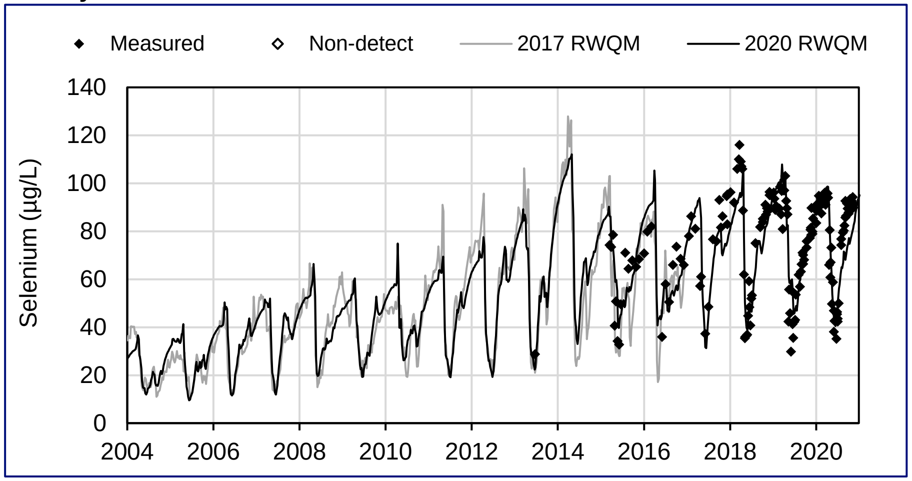
[a] As adjusted for the 2019 IPA.

[b] Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



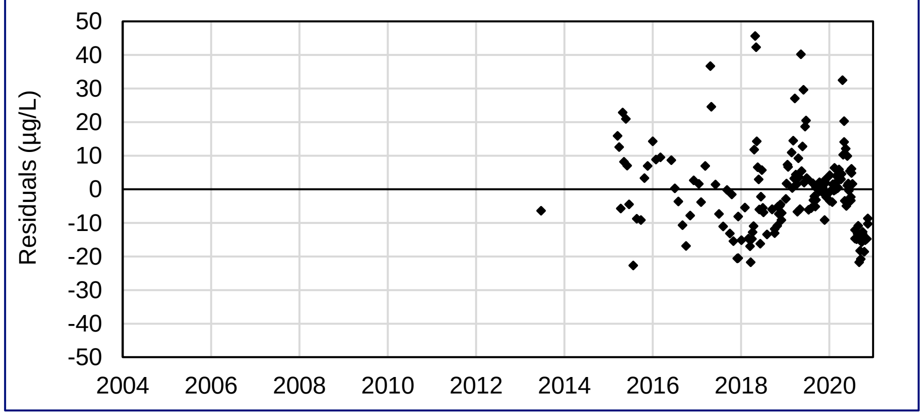
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-31: Selenium Calibration Information for Node LC_FRDSDC - Fording River d/s of Dry Creek (EMS E288272)

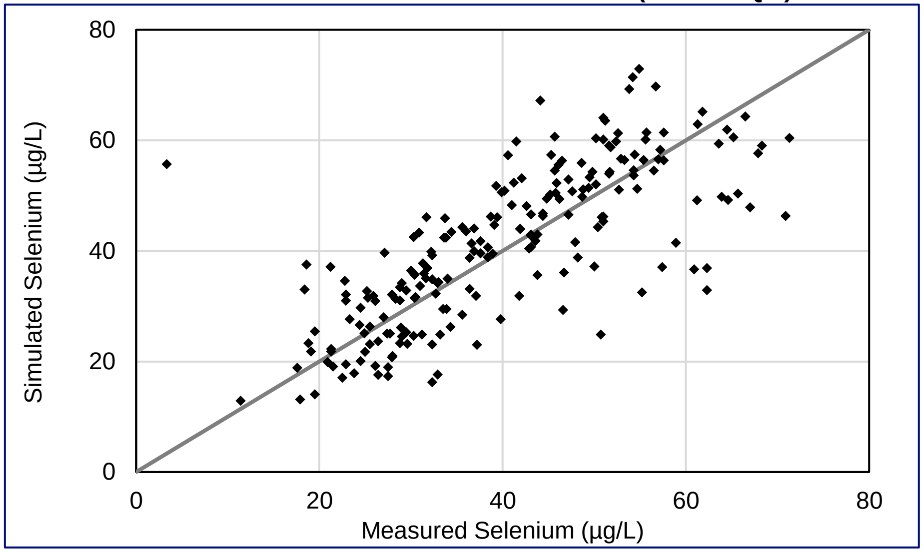
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/7/2011	12/7/2011
Last Measured Sample	12/6/2016	12/5/2018
Data Points Available for Comparison, n	108	160
Non-Detect Count	0	0
Measured Mean (µg/L)	-	38
Simulated Mean (µg/L)	-	40
Bias (µg/L)	-	2.1
Relative Bias	-	1.1
Error (µg/L)	-	6.4
Percent Error	-	17%

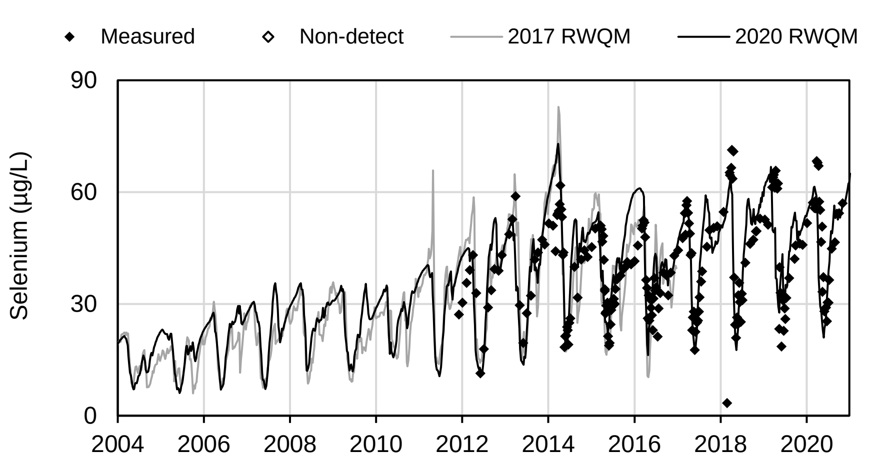
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

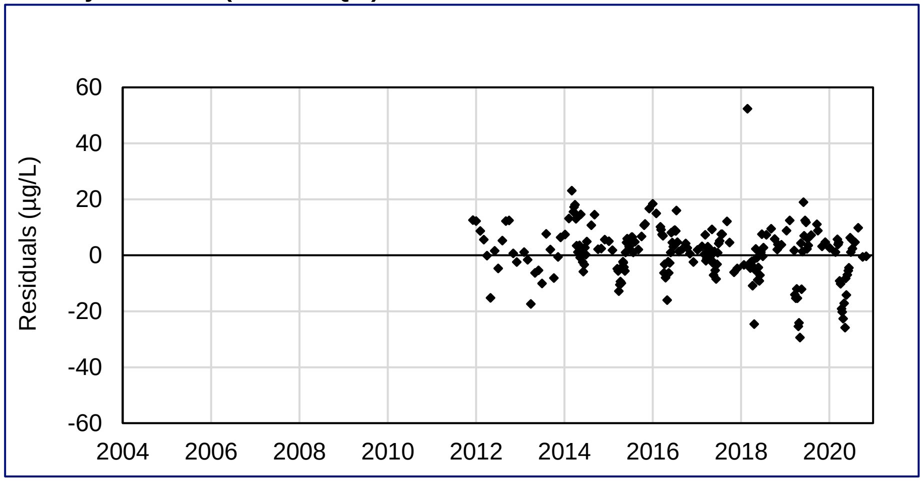
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

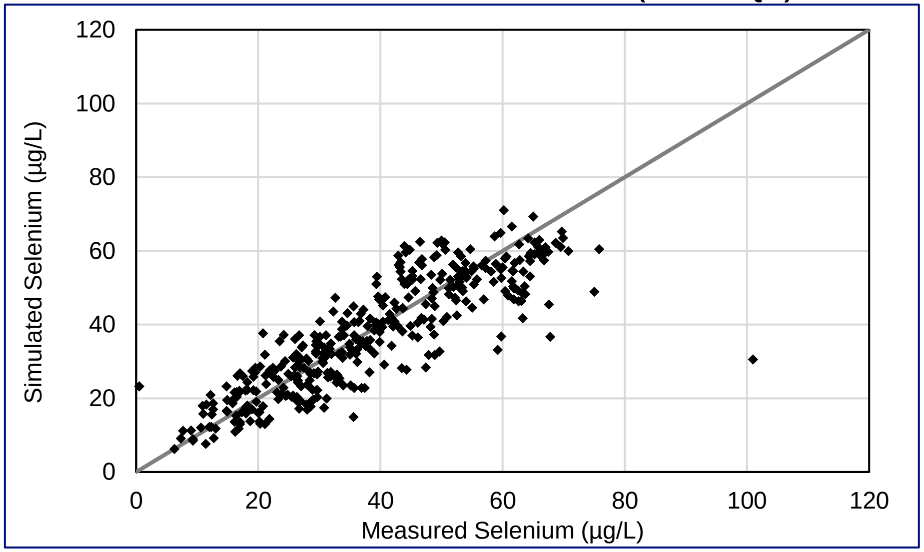
B2-32: Selenium Calibration Information for Node GH_FR1 - GHO Fording River Compliance Point (EMS 0200378)

Measured and Simulated Selenium Data and Calibration Statistics

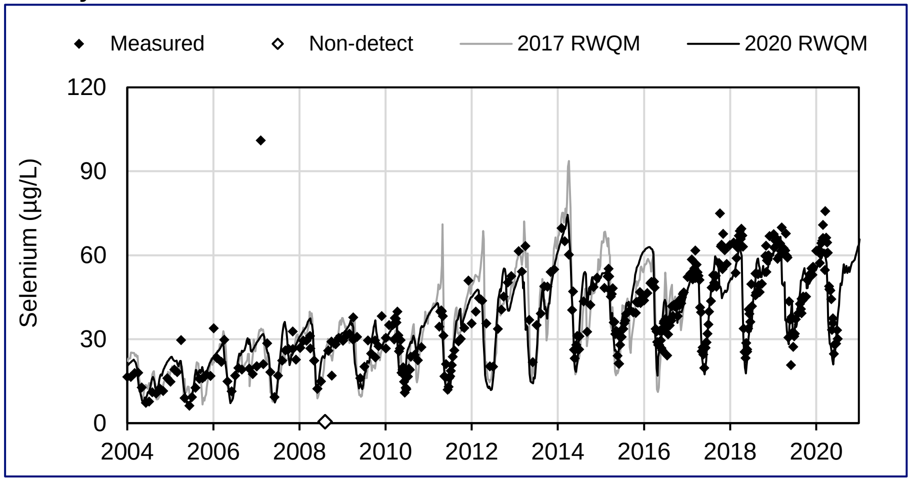
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/2/2004	1/2/2004
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	253	333
Non-Detect Count	2	2
Measured Mean (µg/L)	31	35
Simulated Mean (µg/L)	32	35
Bias (µg/L)	0.96	-0.23
Relative Bias	1.0	0.99
Error (µg/L)	6.4	5.9
Percent Error	21%	17%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



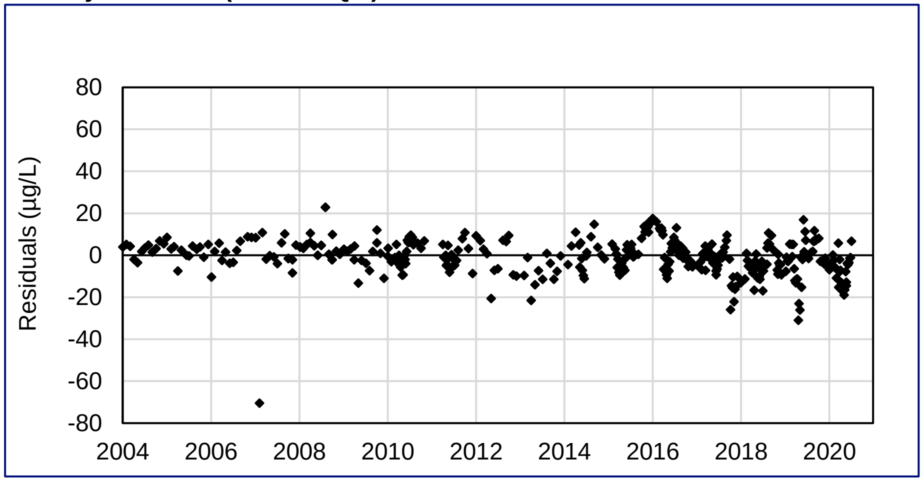
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

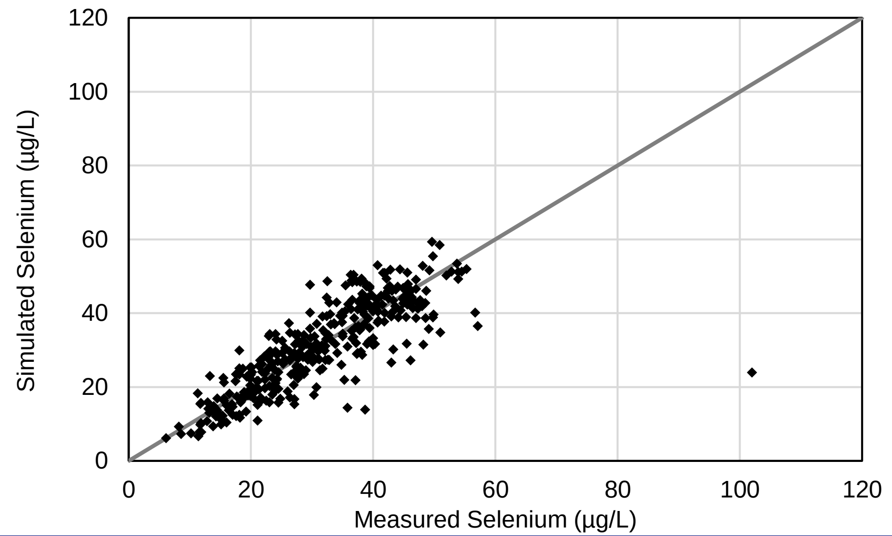
B2-33: Selenium Calibration Information for Node LC_LC5 - Fording River d/s of Line Creek (EMS 0200028)

Measured and Simulated Selenium Data and Calibration Statistics

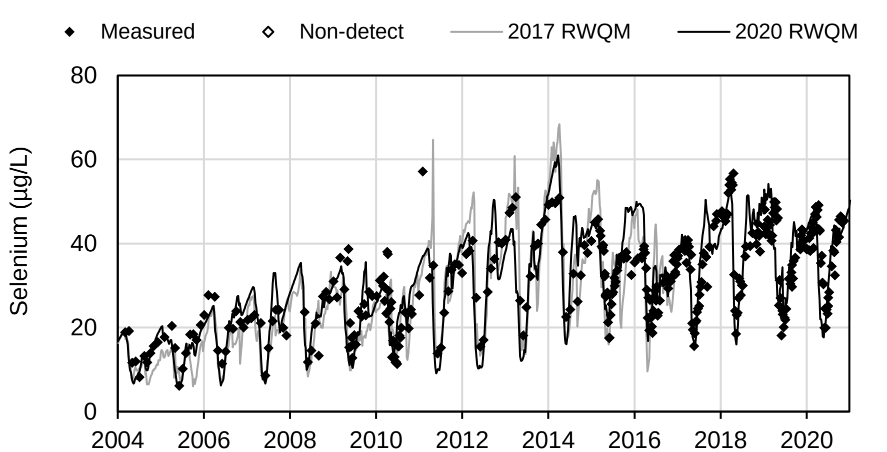
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/4/2004	3/4/2004
Last Measured Sample	12/28/2016	12/4/2018
Data Points Available for Comparison, n	214	281
Non-Detect Count	0	0
Measured Mean (µg/L)	27	30
Simulated Mean (µg/L)	26	29
Bias (µg/L)	-1.4	-0.31
Relative Bias	0.95	0.99
Error (µg/L)	6.1	4.8
Percent Error	22%	16%

[(a)] As adjusted for the 2019 IPA.

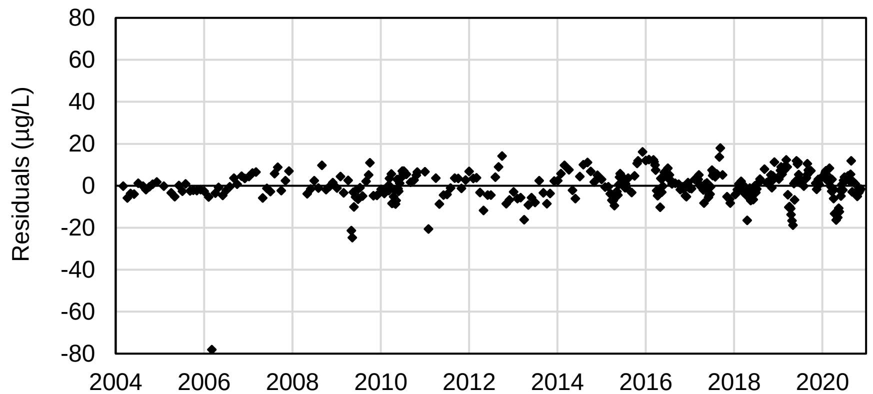
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

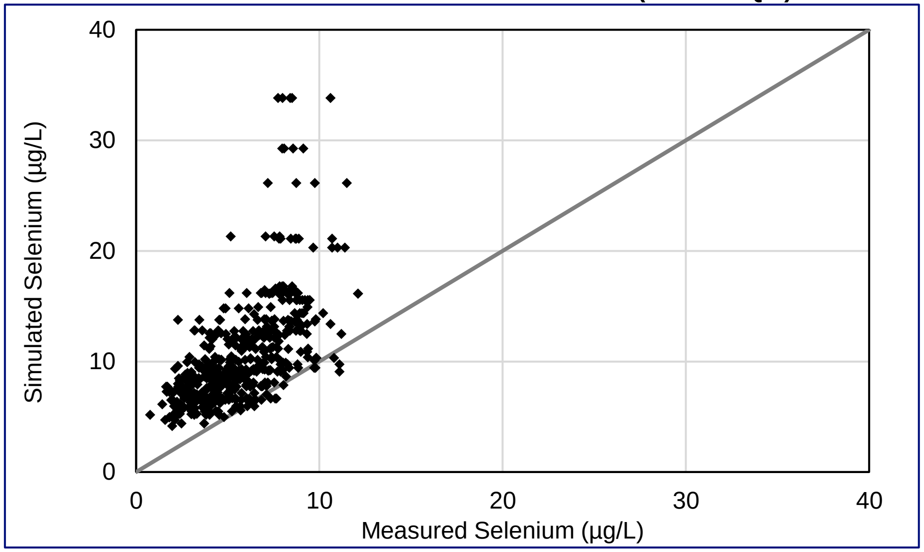
B2-34: Selenium Calibration Information for Node CM_MC2 - CMO Compliance Point (EMS E258937)

Measured and Simulated Selenium Data and Calibration Statistics

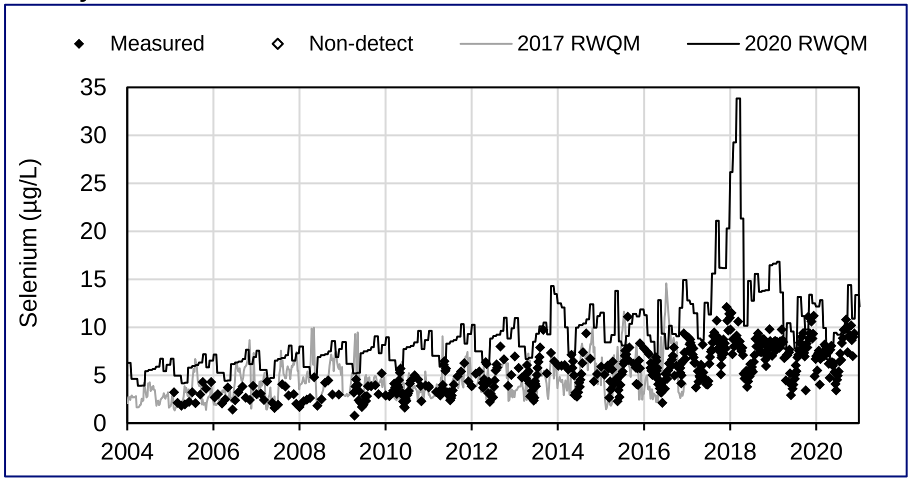
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/2/2005	2/2/2005
Last Measured Sample	12/21/2016	12/28/2018
Data Points Available for Comparison, n	288	408
Non-Detect Count	0	0
Measured Mean (µg/L)	4.4	5.3
Simulated Mean (µg/L)	4.7	11
Bias (µg/L)	0.26	5.3
Relative Bias	1.1	2.0
Error (µg/L)	1.9	5.3
Percent Error	43%	100%

[(a)] As adjusted for the 2019 IPA.

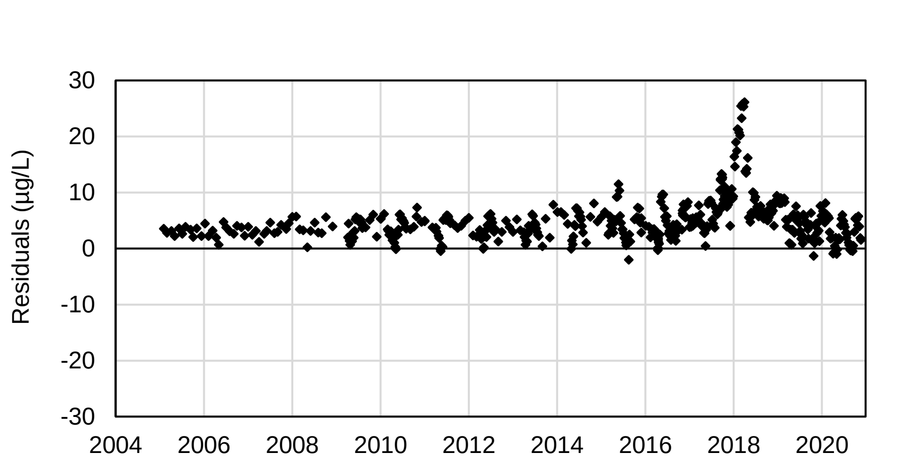
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

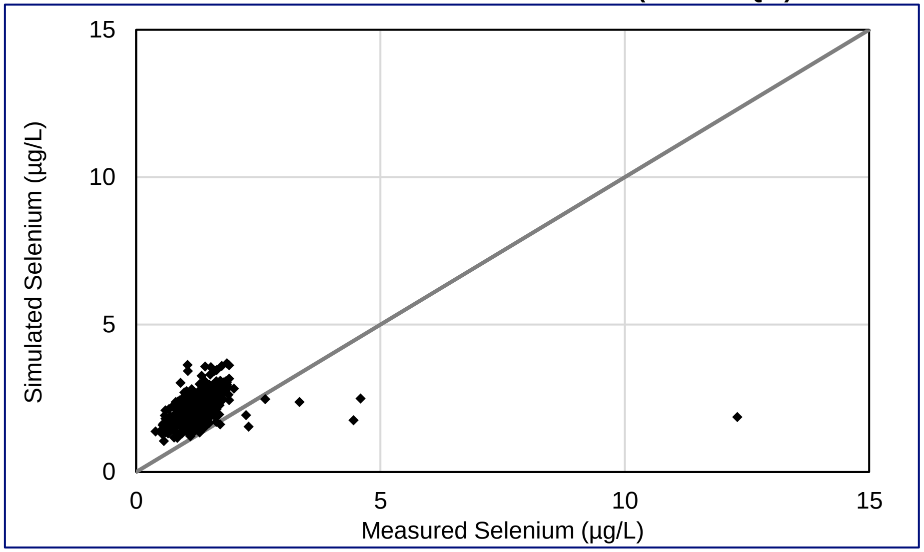
B2-35: Selenium Calibration Information for Node EV_MC3 - Michel Creek u/s of Erickson Creek (EMS 0200203)

Measured and Simulated Selenium Data and Calibration Statistics

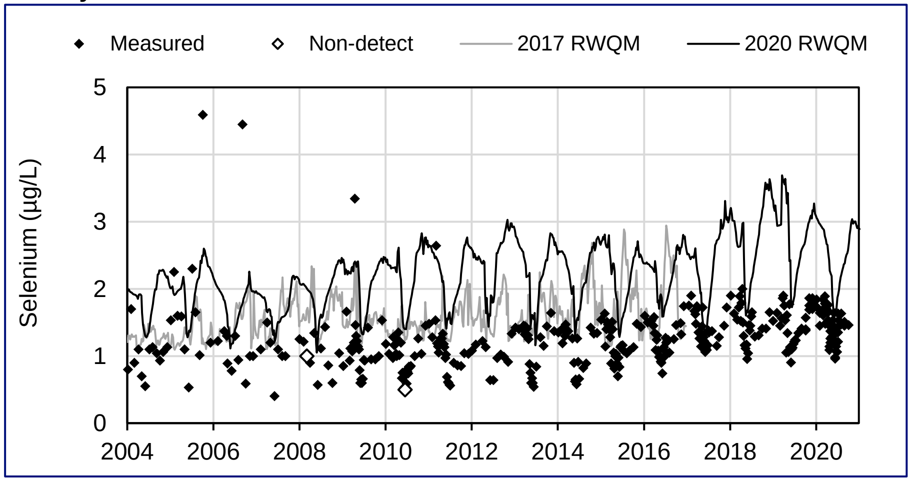
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	244	295
Non-Detect Count	2	2
Measured Mean (µg/L)	1.2	1.2
Simulated Mean (µg/L)	1.6	2.1
Bias (µg/L)	0.35	0.87
Relative Bias	1.3	1.7
Error (µg/L)	0.59	0.99
Percent Error	49%	79%

[a] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



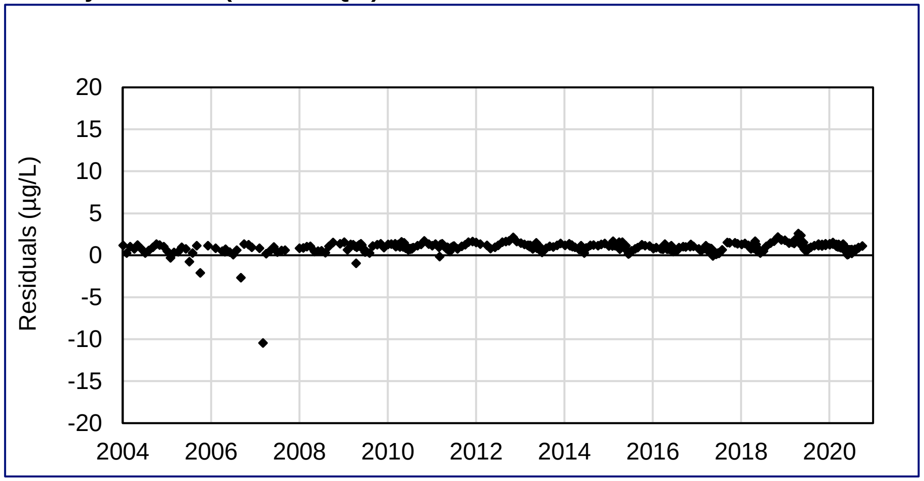
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-36: Selenium Calibration Information for Node EV_MC2 - EVO Michel Creek Compliance Point (EMS E300091)

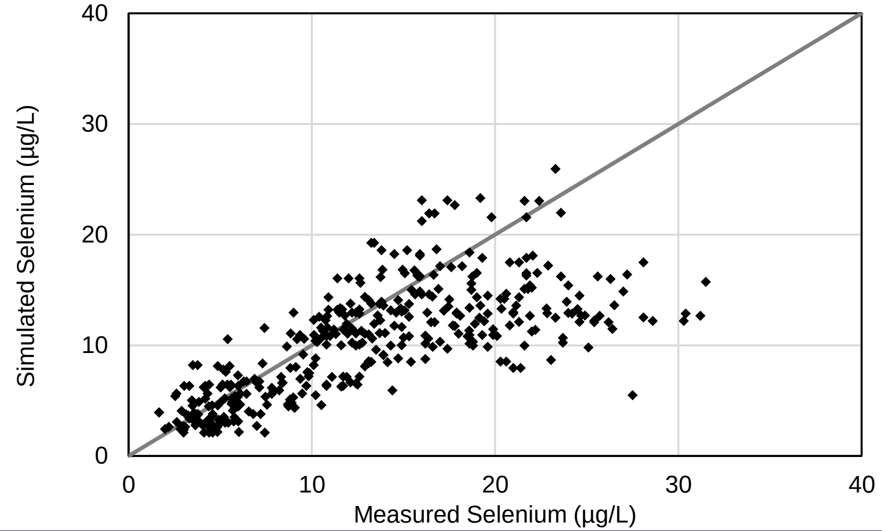
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/3/2014	12/3/2014
Last Measured Sample	12/19/2016	12/31/2018
Data Points Available for Comparison, n	101	217
Non-Detect Count	0	0
Measured Mean (µg/L)	-	14
Simulated Mean (µg/L)	-	9.4
Bias (µg/L)	-	-4.9
Relative Bias	-	0.66
Error (µg/L)	-	5.3
Percent Error	-	37%

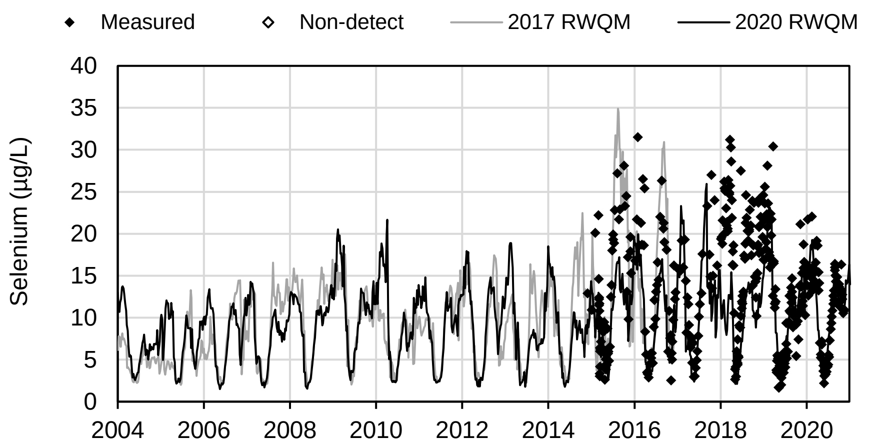
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



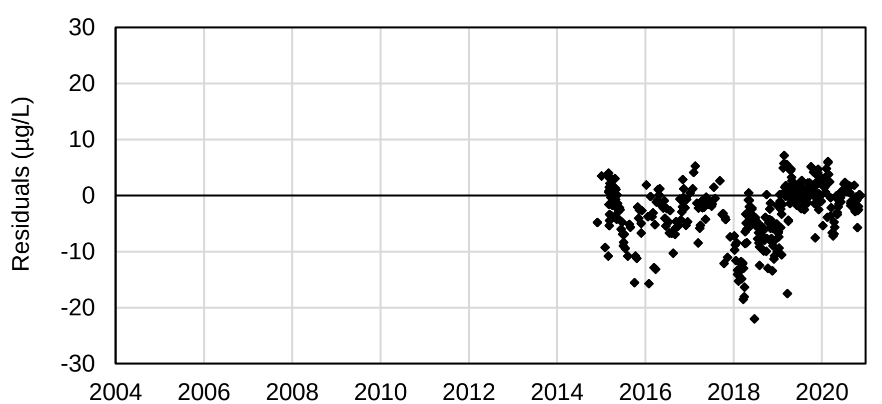
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

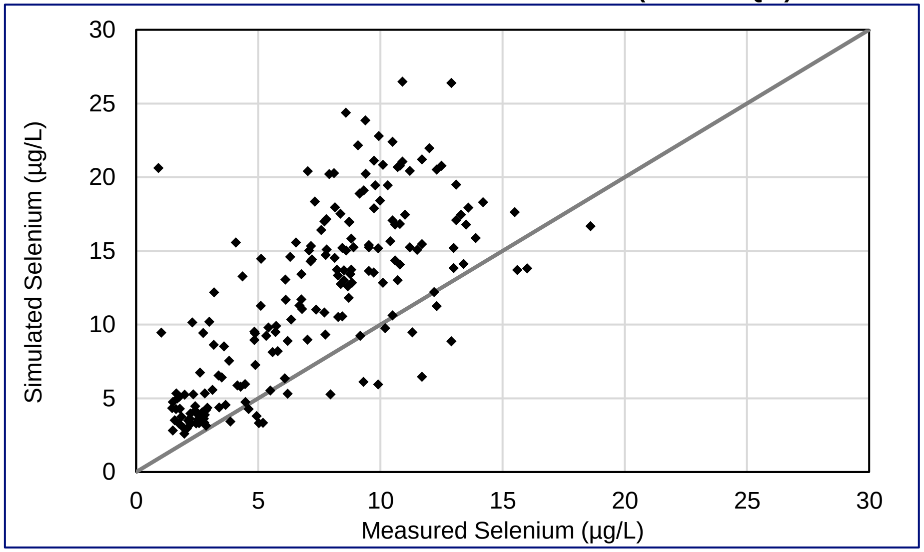
B2-37: Selenium Calibration Information for Node EV_MC1 - Michel Creek u/s of Highway 43 Bridge (EMS 0200425)

Measured and Simulated Selenium Data and Calibration Statistics

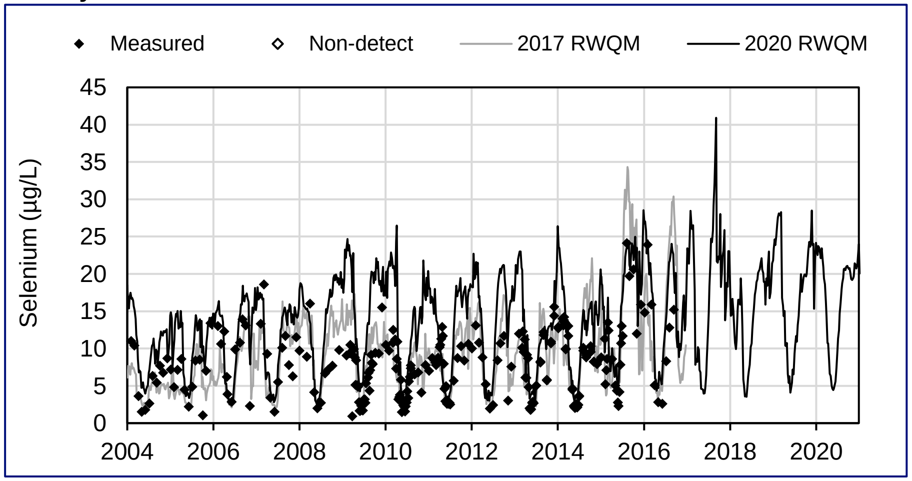
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/3/2004	2/3/2004
Last Measured Sample	9/13/2016	9/13/2016
Data Points Available for Comparison, n	251	251
Non-Detect Count	0	0
Measured Mean (µg/L)	7.7	7.7
Simulated Mean (µg/L)	7.7	12
Bias (µg/L)	0.66	4.3
Relative Bias	1.1	1.6
Error (µg/L)	2.7	4.6
Percent Error	38%	60%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



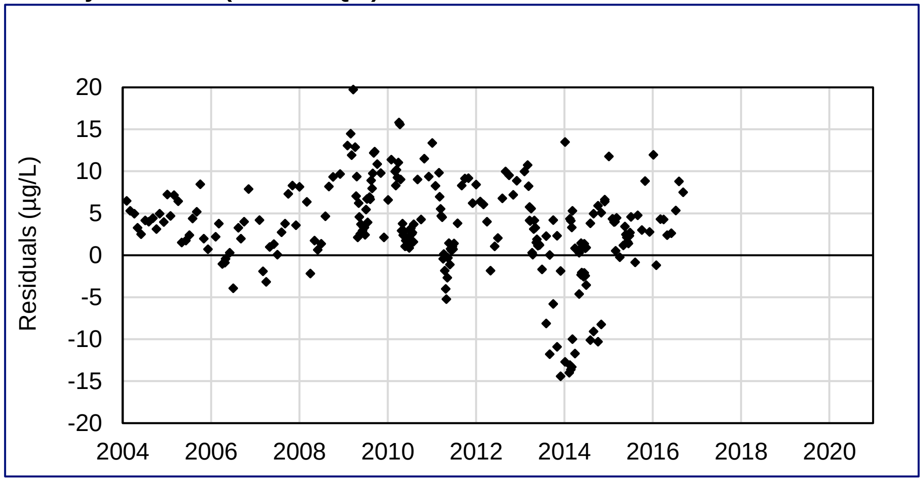
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-38: Selenium Calibration Information for Node GH_ERC - GHO Elk River Compliance Point (EMS E300090)

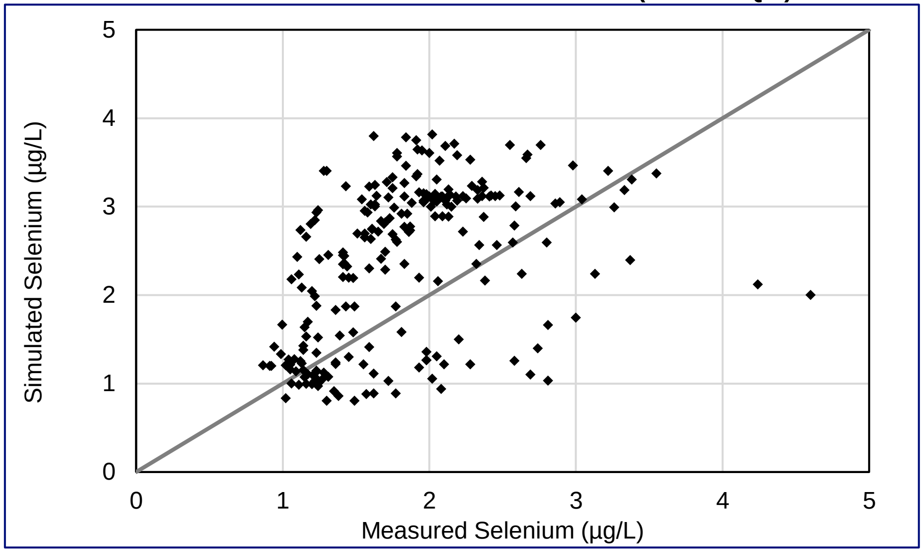
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/4/2014	12/4/2014
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	68	136
Non-Detect Count	0	0
Measured Mean (µg/L)	-	1.6
Simulated Mean (µg/L)	-	2.2
Bias (µg/L)	-	0.56
Relative Bias	-	1.3
Error (µg/L)	-	0.85
Percent Error	-	52%

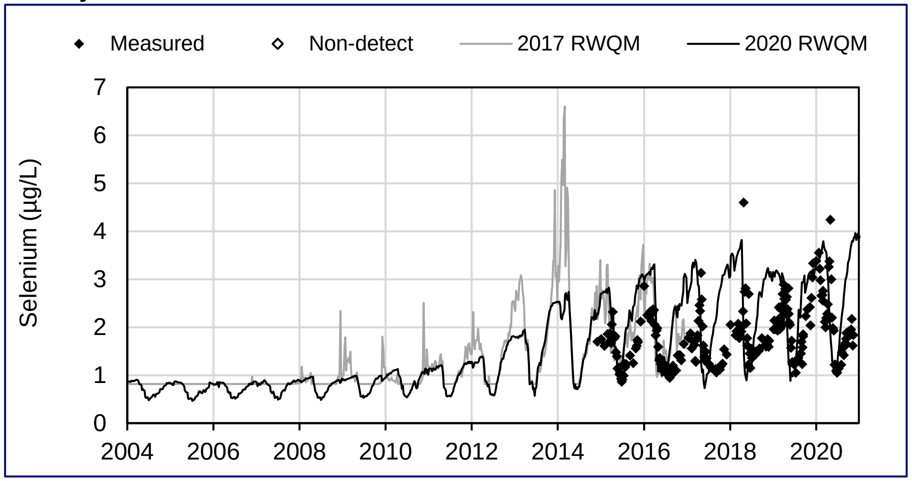
[a] As adjusted for the 2019 IPA.

[b] Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

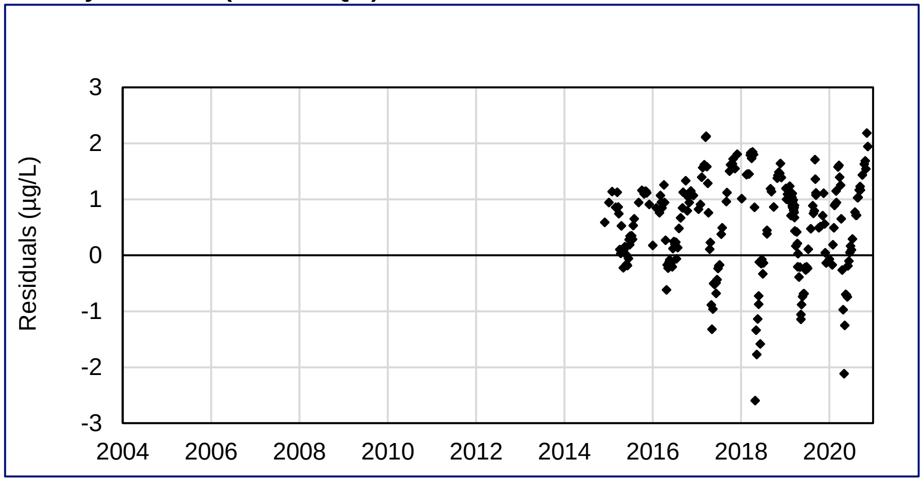


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

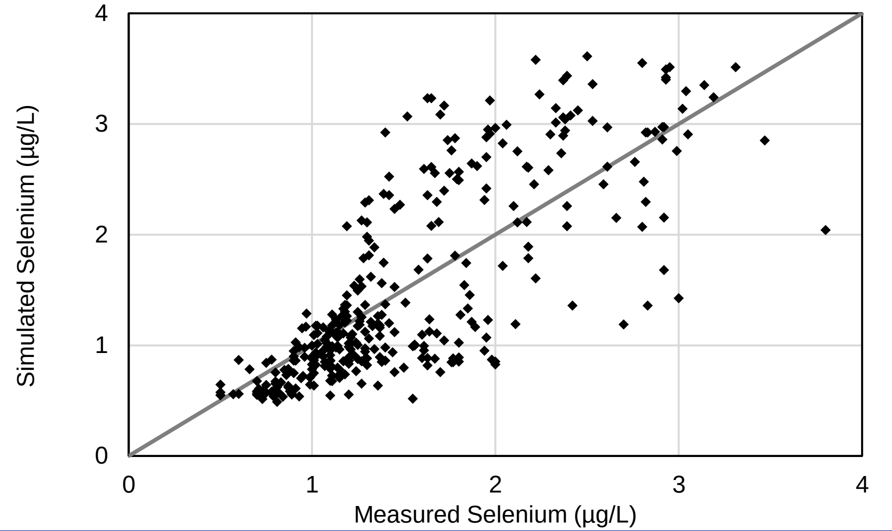
B2-39: Selenium Calibration Information for Node GH_ER1 - Elk River u/s of Boivin Creek (u/s of Fording River) (EMS E206661)

Measured and Simulated Selenium Data and Calibration Statistics

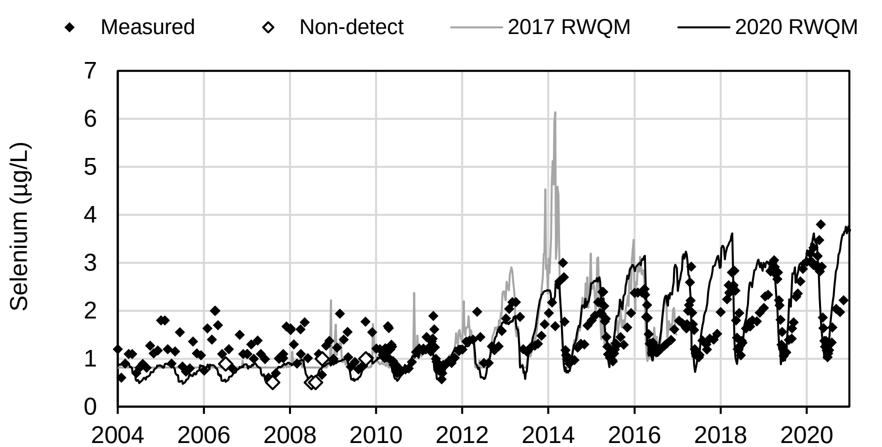
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/2/2004	1/2/2004
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	233	285
Non-Detect Count	7	7
Measured Mean (µg/L)	1.3	1.4
Simulated Mean (µg/L)	1.2	1.3
Bias (µg/L)	-0.08	-0.031
Relative Bias	0.94	0.98
Error (µg/L)	0.37	0.42
Percent Error	29%	30%

(a) As adjusted for the 2019 IPA.

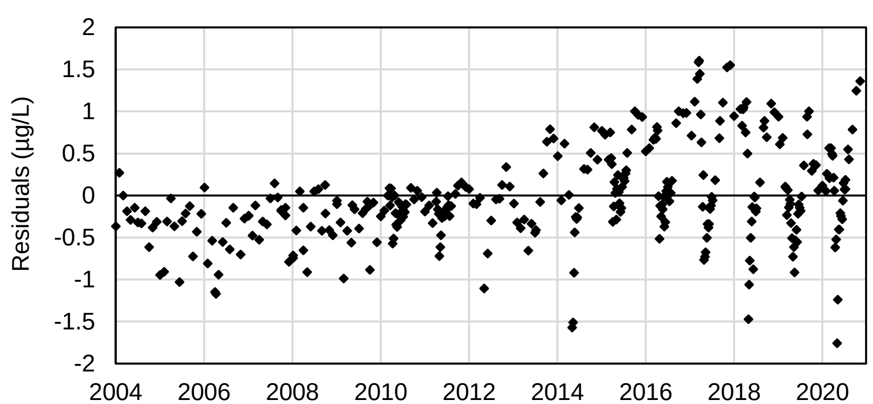
Simulated versus Measured Selenium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

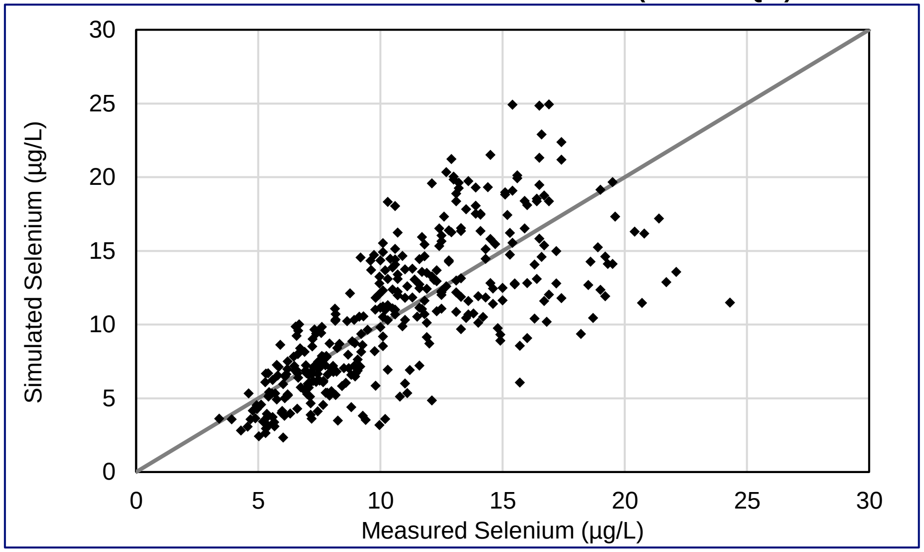
B2-40: Selenium Calibration Information for Node EV_ER4 - Elk River u/s of Grave Creek (EMS 0200027)

Measured and Simulated Selenium Data and Calibration Statistics

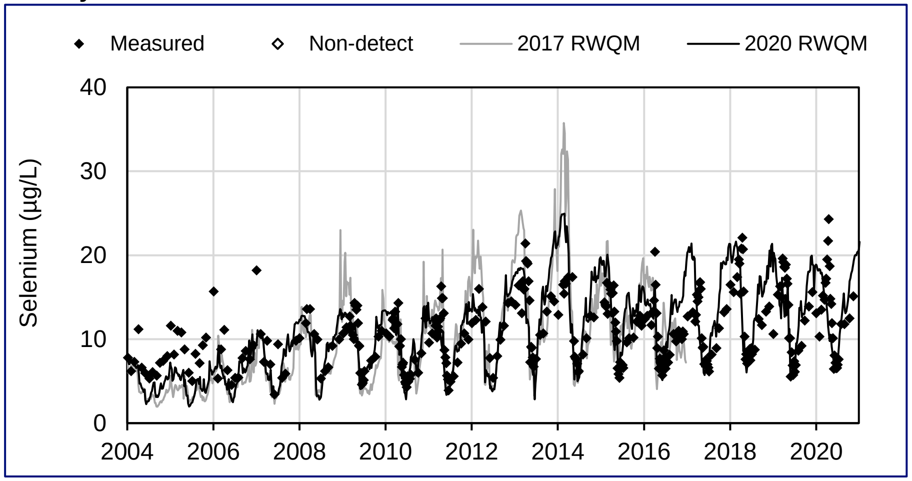
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/6/2016	12/3/2018
Data Points Available for Comparison, n	252	304
Non-Detect Count	0	0
Measured Mean (µg/L)	10	10
Simulated Mean (µg/L)	9.9	10
Bias (µg/L)	-0.24	-0.017
Relative Bias	0.98	1.0
Error (µg/L)	3.2	2.5
Percent Error	31%	24%

[a] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

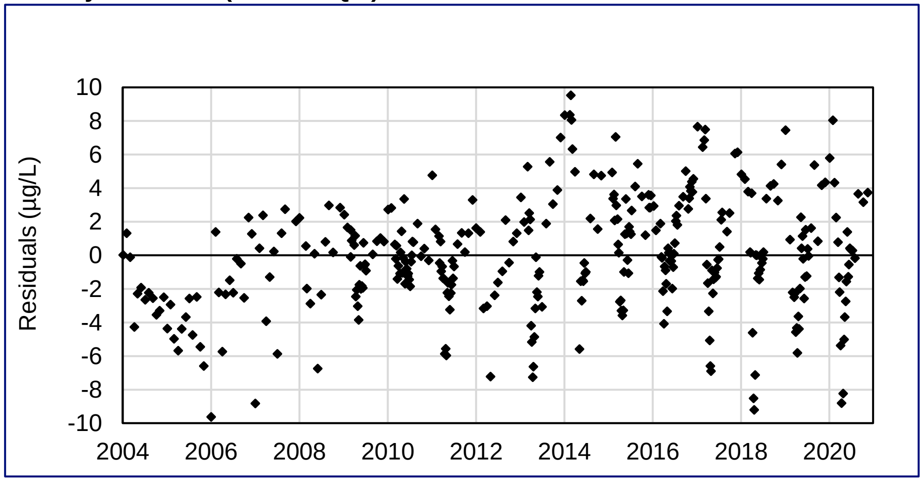


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-41: Selenium Calibration Information for Node EV_ER2 - Elk River u/s of Michel Creek (EMS 0200111)

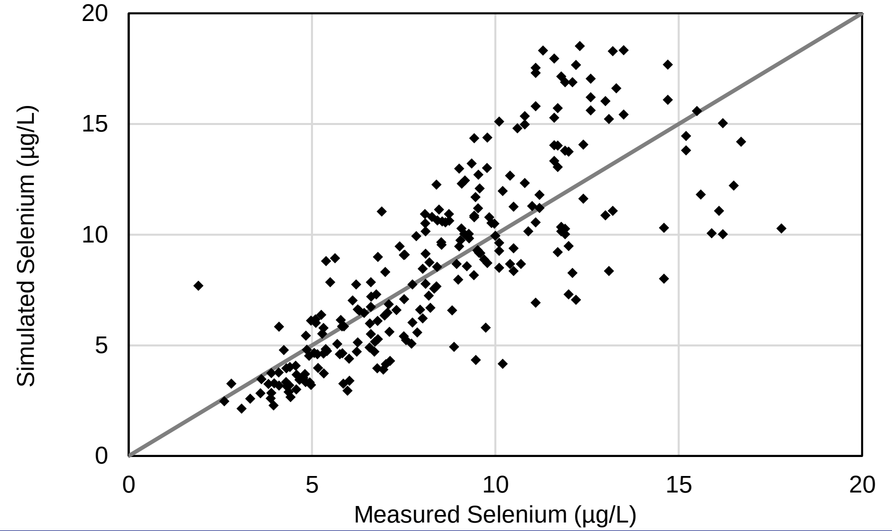
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/2/2004	3/2/2004
Last Measured Sample	12/6/2016	12/3/2018
Data Points Available for Comparison, n	196	220
Non-Detect Count	0	0
Measured Mean (µg/L)	-	8.4
Simulated Mean (µg/L)	-	8.5
Bias (µg/L)	-	0.11
Relative Bias	-	1.0
Error (µg/L)	-	1.9
Percent Error	-	23%

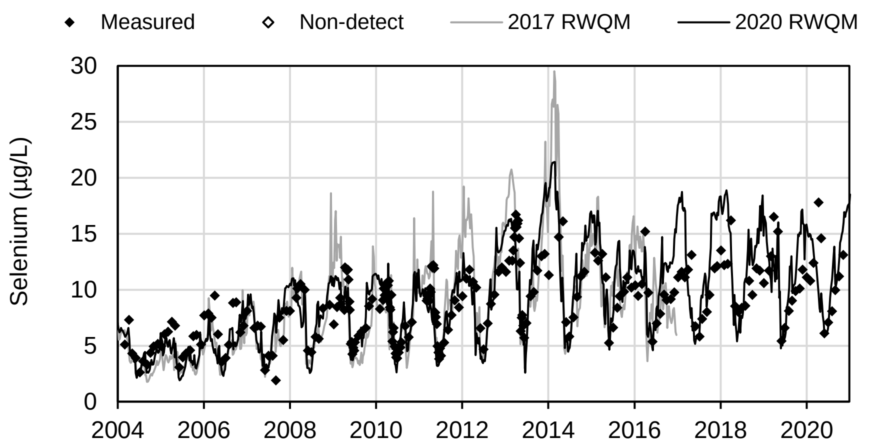
[(a)] As adjusted for the 2019 IPA.

[(b)] Location was not presented in the 2017 RWQM.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

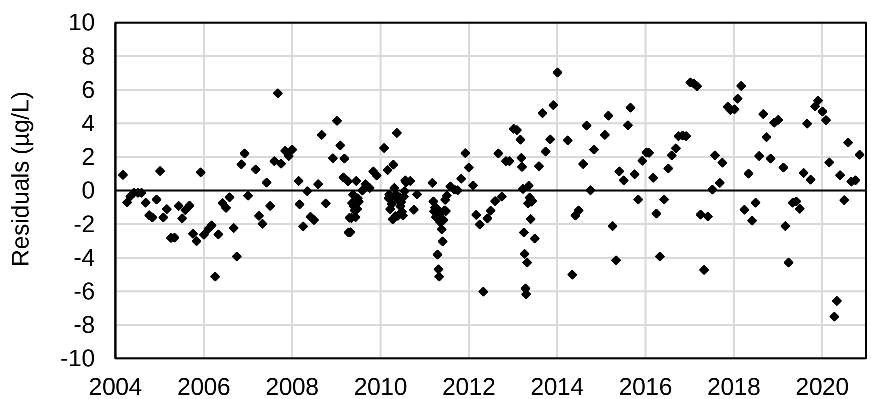


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

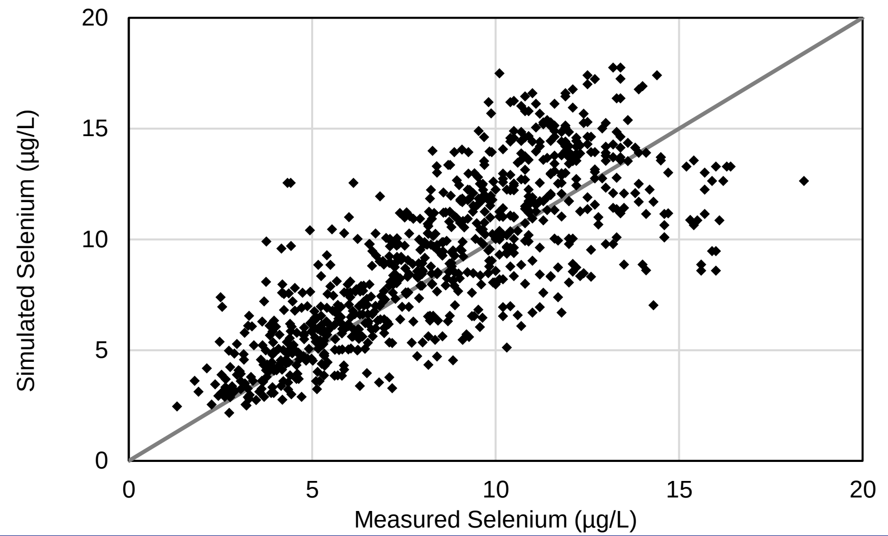
B2-42: Selenium Calibration Information for Node EV_ER1 - Elk River d/s of Michel Creek (EMS 0200393)

Measured and Simulated Selenium Data and Calibration Statistics

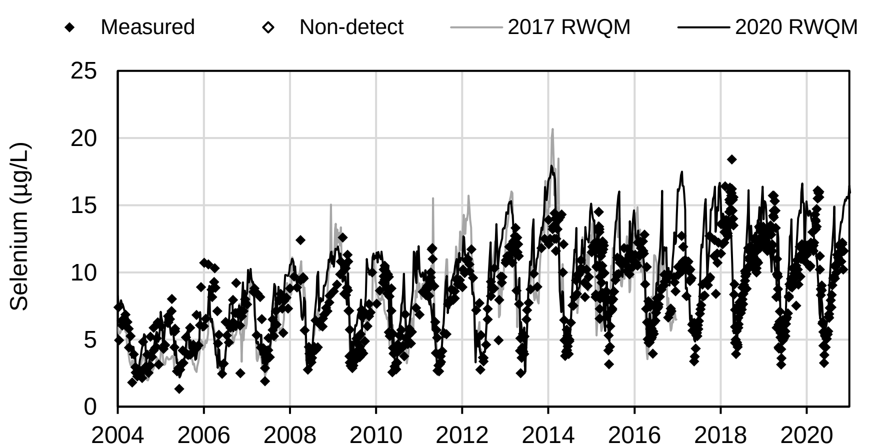
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/18/2016	12/31/2018
Data Points Available for Comparison, n	526	672
Non-Detect Count	0	0
Measured Mean (µg/L)	7.5	8.1
Simulated Mean (µg/L)	7.4	8.7
Bias (µg/L)	-0.096	0.63
Relative Bias	0.99	1.1
Error (µg/L)	1.7	1.7
Percent Error	23%	21%

[a] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



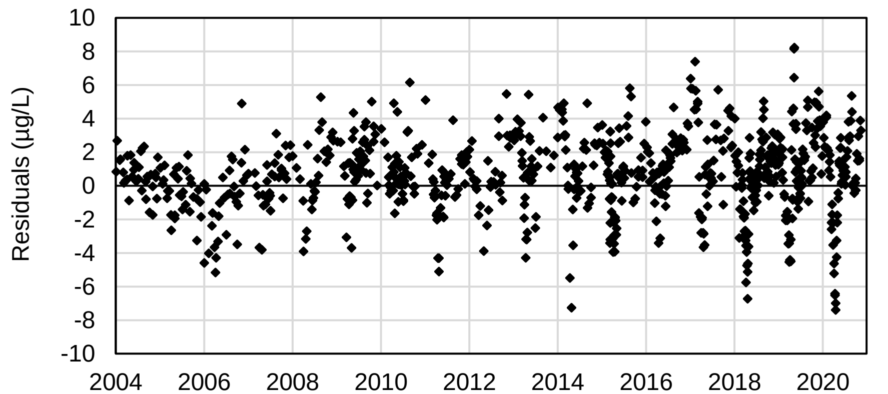
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B2-43: Selenium Calibration Information for Node RG_ELKORES - Elk River at Elko Reservoir (EMS E294312)

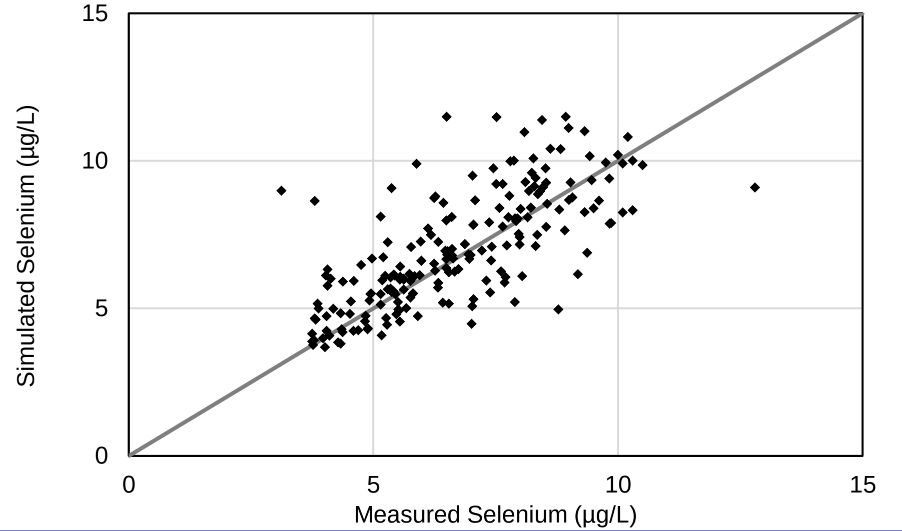
Measured and Simulated Selenium Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	9/23/2009	9/23/2009
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	102	155
Non-Detect Count	0	0
Measured Mean (µg/L)	-	6.6
Simulated Mean (µg/L)	-	6.9
Bias (µg/L)	-	0.29
Relative Bias	-	1.0
Error (µg/L)	-	0.92
Percent Error	-	14%

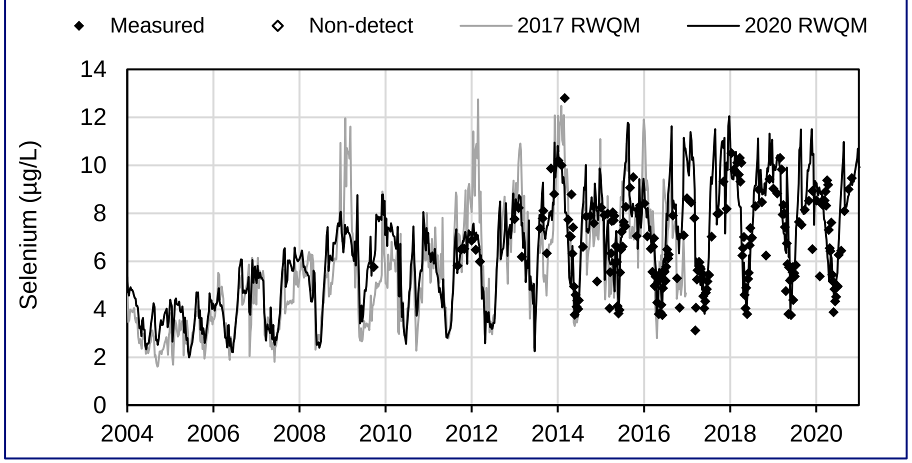
[a] As adjusted for the 2019 IPA.

[b] Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



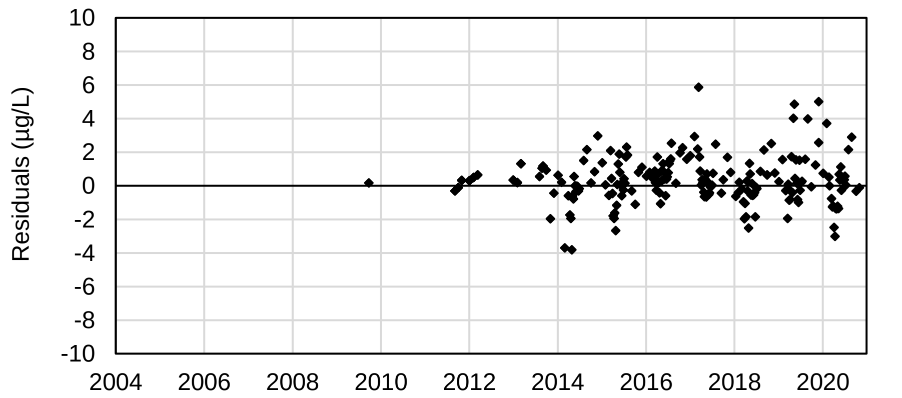
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

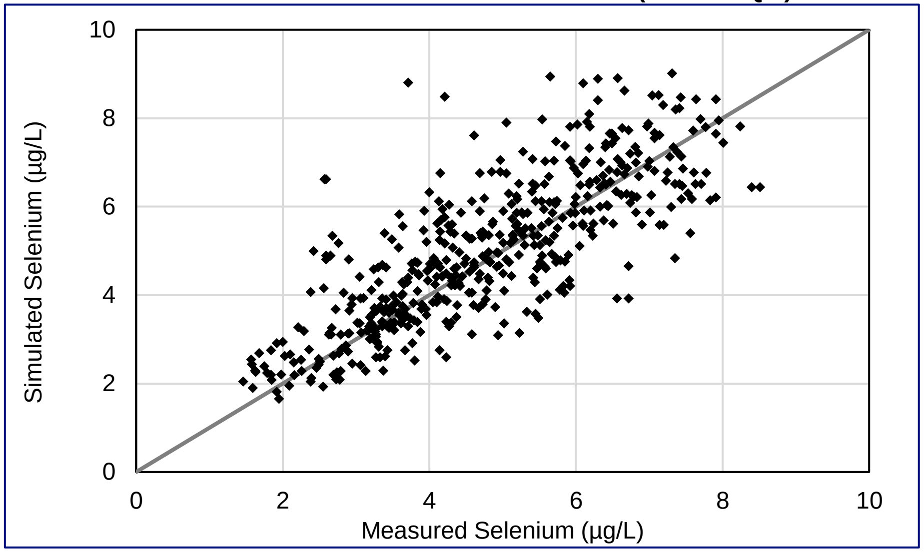
B2-44:Selenium Calibration Information for Node RG_ELKMOUTH - Elk River at Highway 93 near Elko

Measured and Simulated Selenium Data and Calibration Statistics

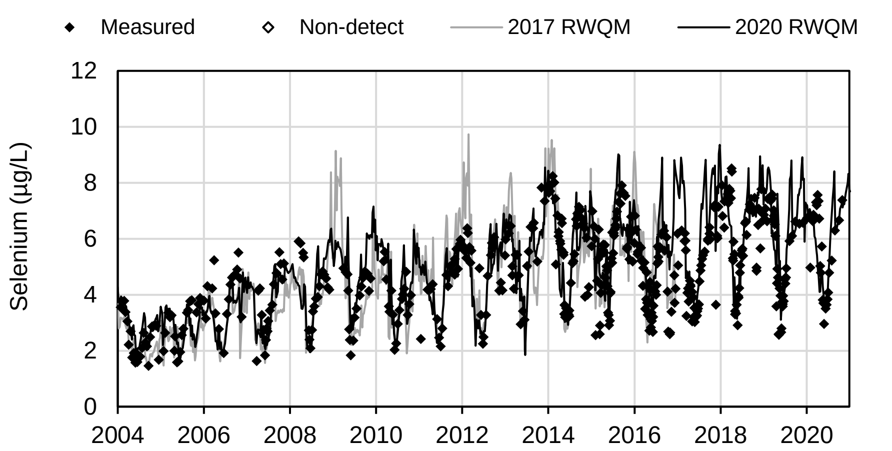
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/26/2004	1/26/2004
Last Measured Sample	12/18/2016	12/16/2018
Data Points Available for Comparison, n	341	433
Non-Detect Count	0	0
Measured Mean (µg/L)	4.3	4.7
Simulated Mean (µg/L)	4.2	4.9
Bias (µg/L)	-0.058	0.23
Relative Bias	0.99	1.0
Error (µg/L)	0.8	0.76
Percent Error	19%	16%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)



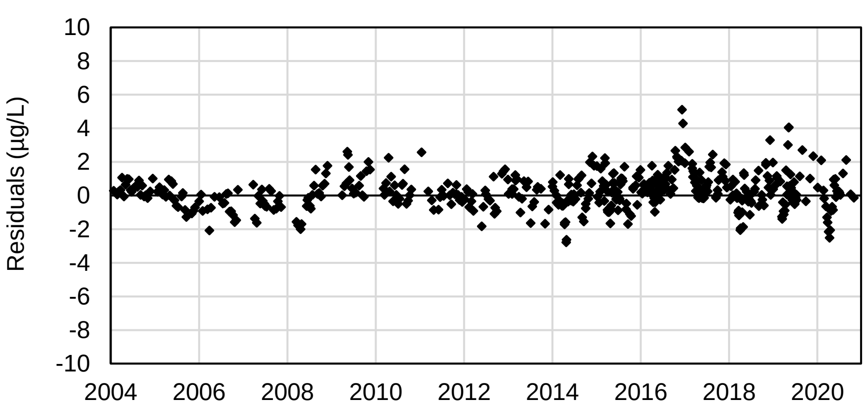
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

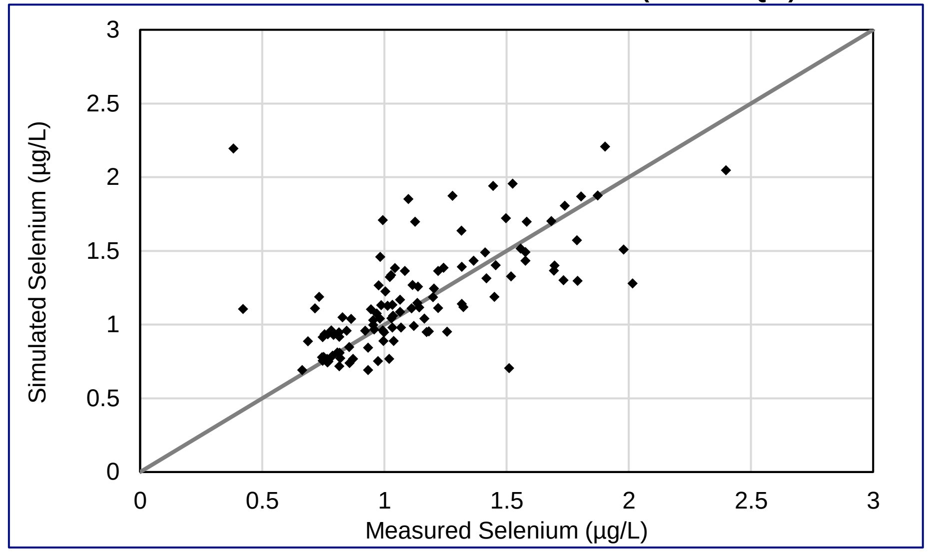
B2-45: Selenium Calibration Information for Node RG_DSELK - Koocanusa Reservoir - South of the Elk River (EMS E300230)

Measured and Simulated Selenium Data and Calibration Statistics

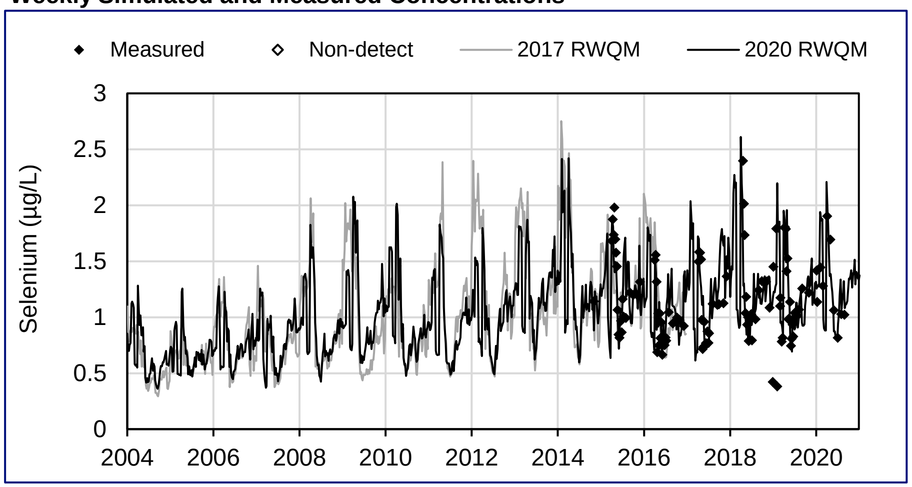
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	11/5/2014	11/5/2014
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	41	77
Non-Detect Count	0	0
Measured Mean (µg/L)	1.1	1.1
Simulated Mean (µg/L)	1.1	1.1
Bias (µg/L)	0.019	0.012
Relative Bias	1.0	1.0
Error (µg/L)	0.26	0.16
Percent Error	23%	14%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Selenium Concentrations (2020 RWQM)

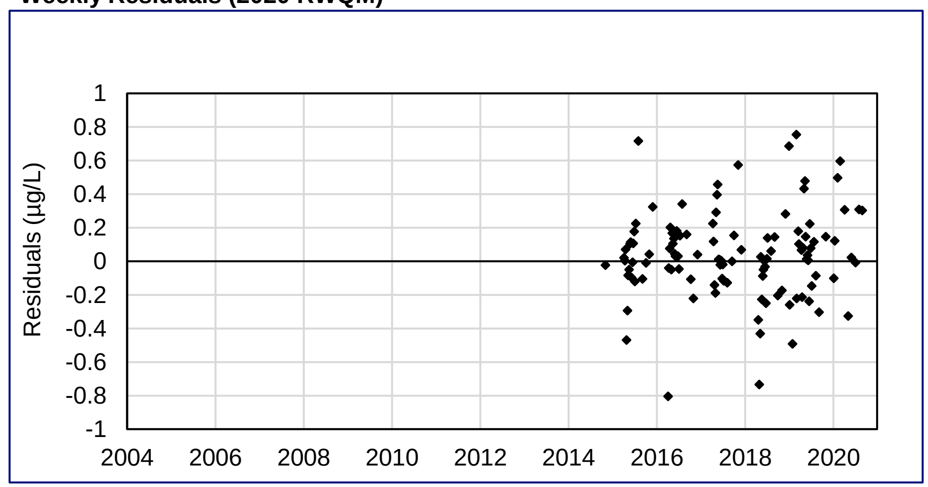


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

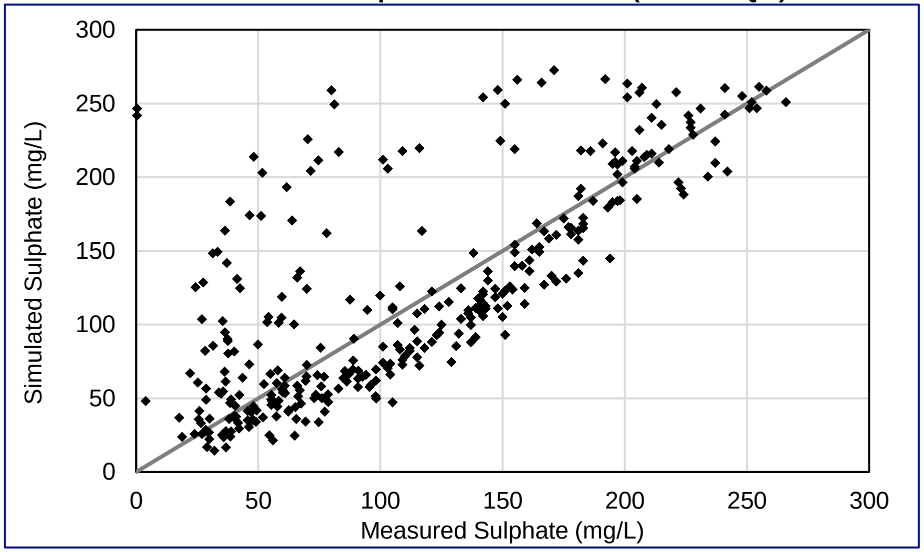
B3-1: Sulphate Calibration Information for Node FR_HC1 - Henretta Creek u/s of Fording River (EMS E216778)

Measured and Simulated Sulphate Data and Calibration Statistics

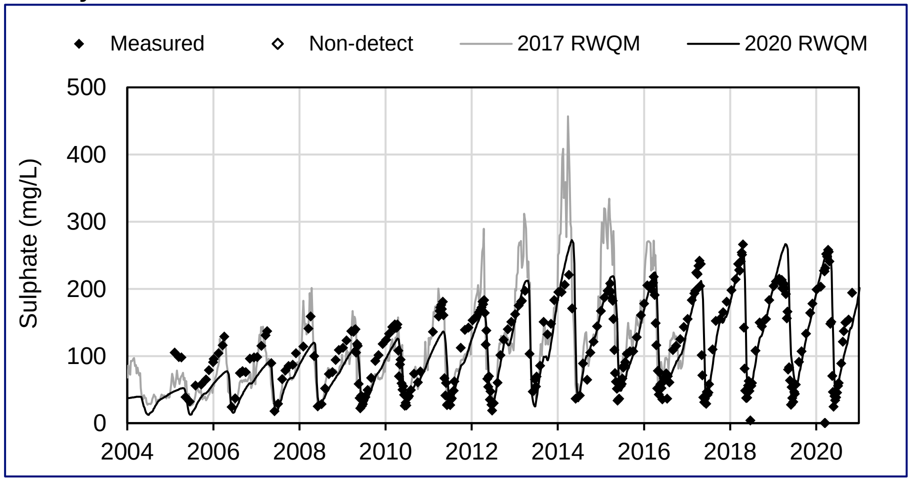
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/7/2005	2/7/2005
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	225	276
Non-Detect Count	0	0
Measured Mean (mg/L)	100	107
Simulated Mean (mg/L)	115	109
Bias (mg/L)	15	1.6
Relative Bias	1.1	1.0
Error (mg/L)	30	30
Percent Error	30%	28%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)

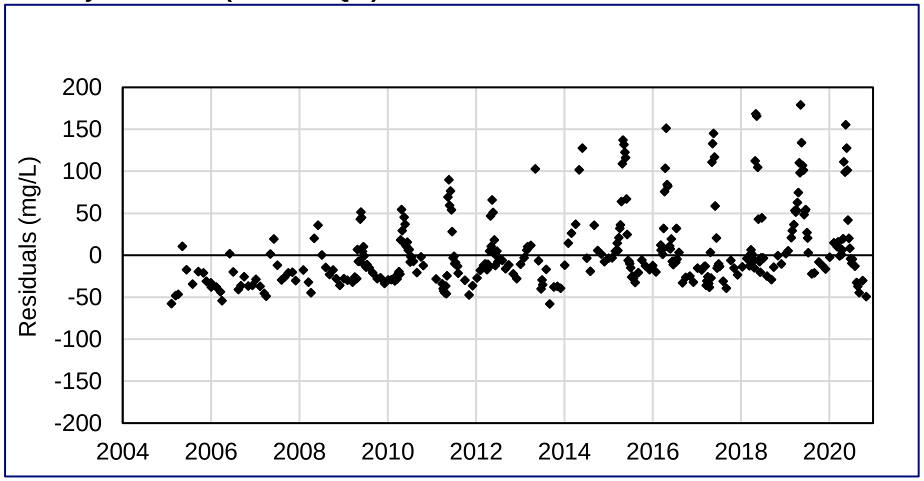


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

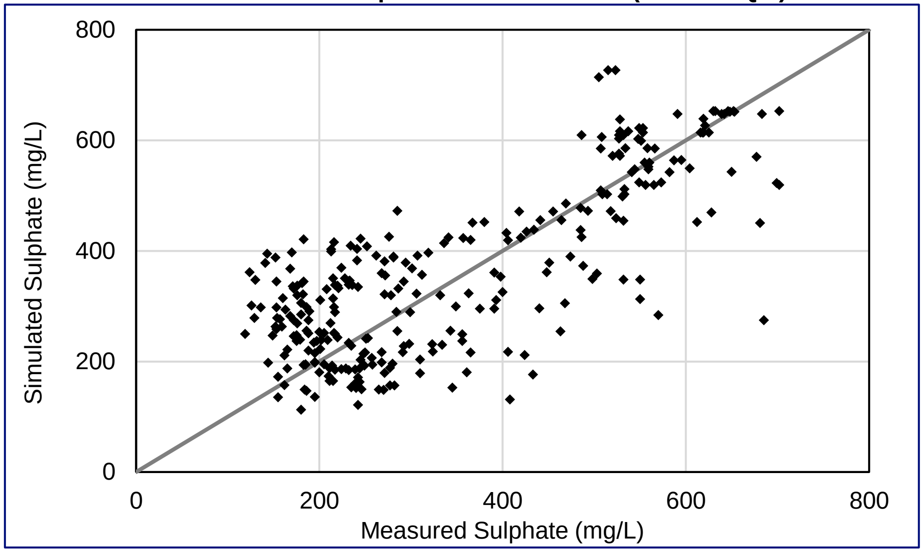
B3-2: Sulphate Calibration Information for Node FR_CC1 - Clode Creek Sediment Pond Decant (EMS E102481)

Measured and Simulated Sulphate Data and Calibration Statistics

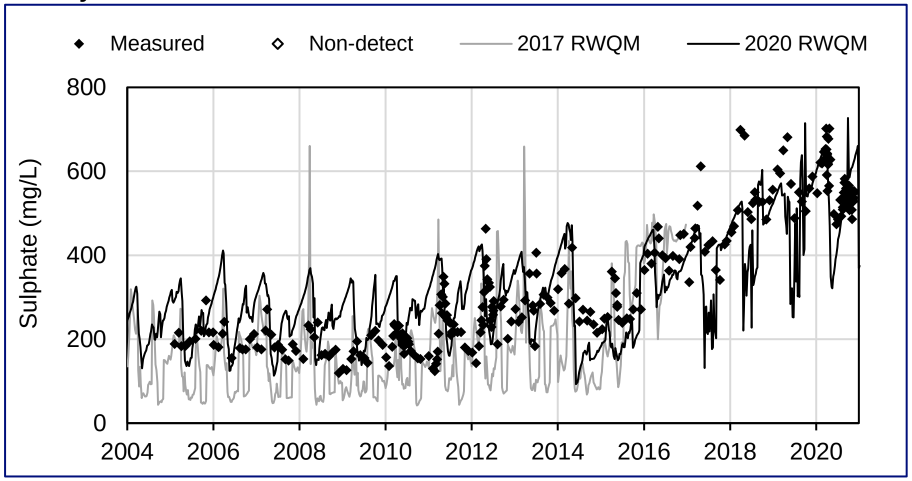
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/7/2005	2/7/2005
Last Measured Sample	12/7/2016	12/5/2018
Data Points Available for Comparison, n	192	219
Non-Detect Count	0	0
Measured Mean (mg/L)	243	273
Simulated Mean (mg/L)	177	293
Bias (mg/L)	-66	20
Relative Bias	0.73	1.1
Error (mg/L)	102	91
Percent Error	42%	34%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



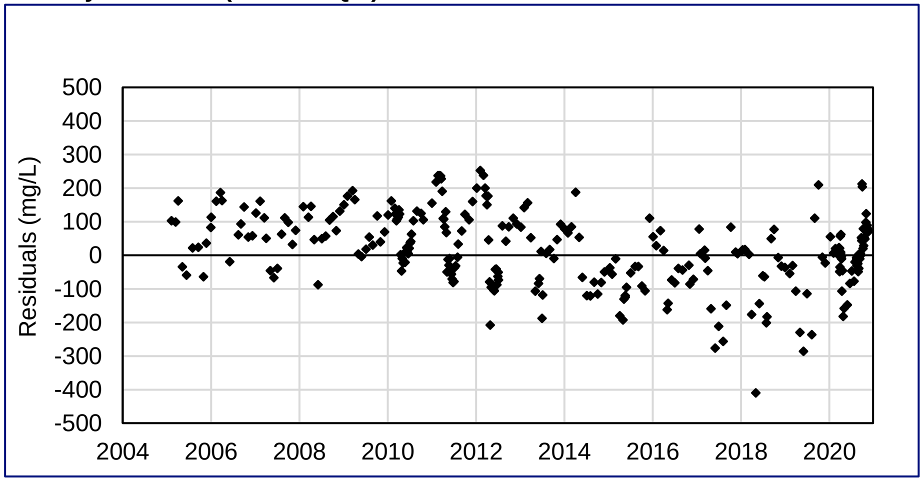
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

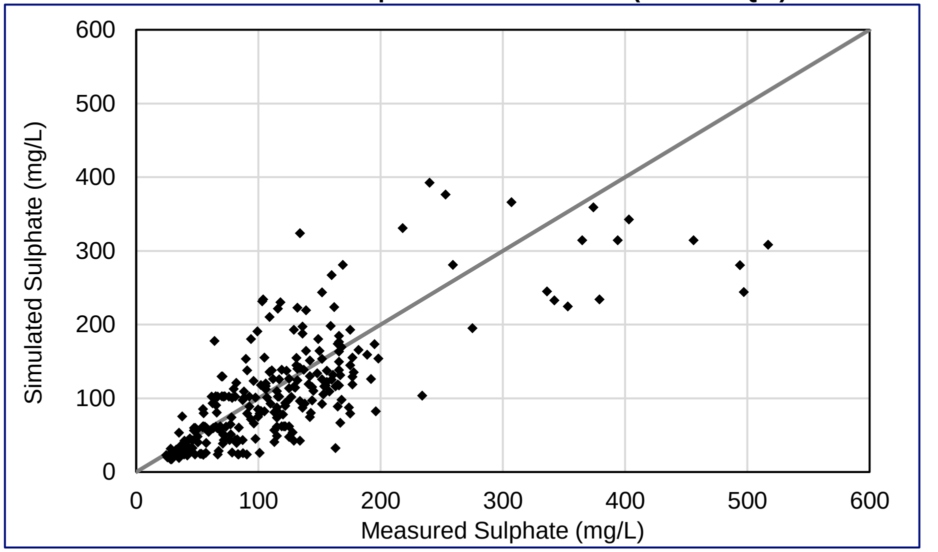
B3-3: Sulphate Calibration Information for Node FR_LMP1 - Lake Mountain Pond

Measured and Simulated Sulphate Data and Calibration Statistics

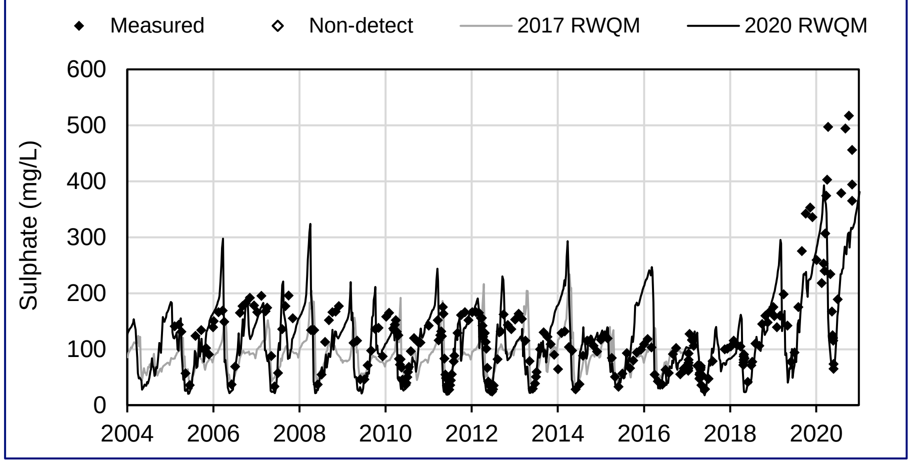
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/7/2005	2/7/2005
Last Measured Sample	12/14/2016	12/10/2018
Data Points Available for Comparison, n	175	227
Non-Detect Count	0	0
Measured Mean (mg/L)	103	98
Simulated Mean (mg/L)	89	92
Bias (mg/L)	-14	-5.5
Relative Bias	0.87	0.94
Error (mg/L)	32	32
Percent Error	31%	32%

[(a)] As adjusted for the 2019 IPA.

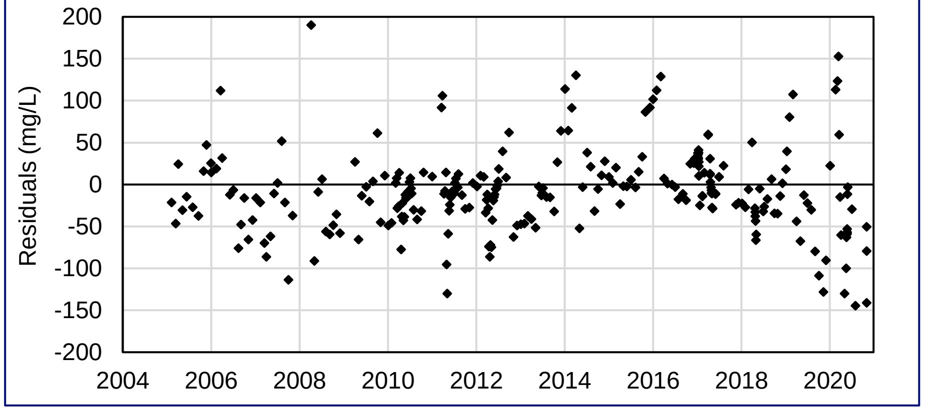
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

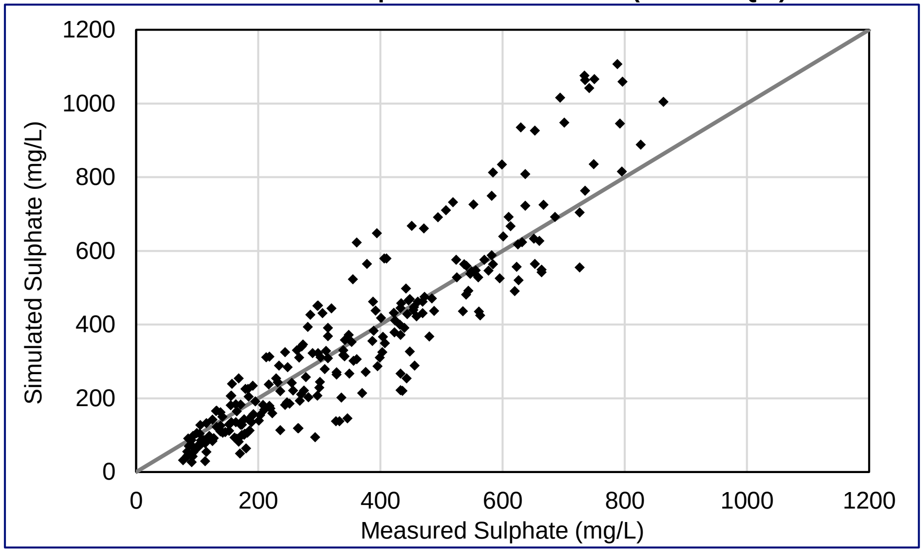
B3-4: Sulphate Calibration Information for Node FR_KC1 - Kilmarnock Creek d/s of Rock Drain (EMS 0200252)

Measured and Simulated Sulphate Data and Calibration Statistics

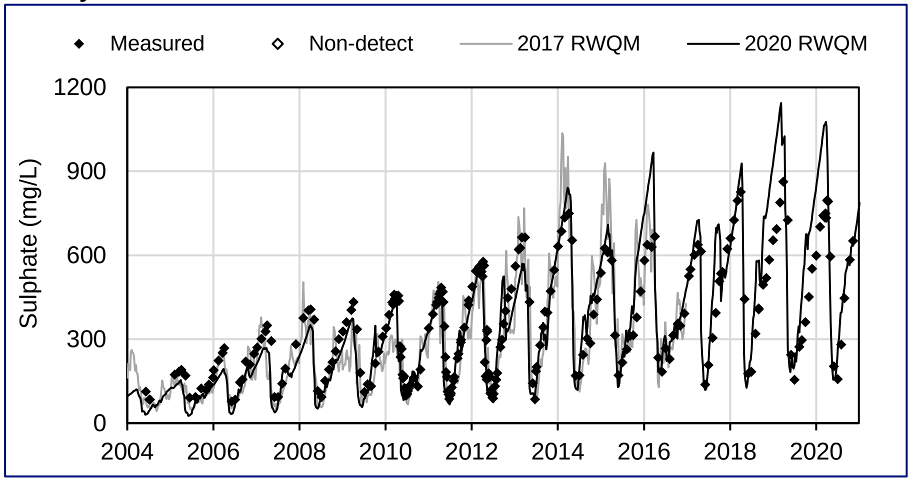
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/7/2004	6/7/2004
Last Measured Sample	12/12/2016	12/3/2018
Data Points Available for Comparison, n	205	231
Non-Detect Count	0	0
Measured Mean (mg/L)	301	322
Simulated Mean (mg/L)	275	308
Bias (mg/L)	-26	-14
Relative Bias	0.91	0.96
Error (mg/L)	70	61
Percent Error	23%	19%

[a] As adjusted for the 2019 IPA.

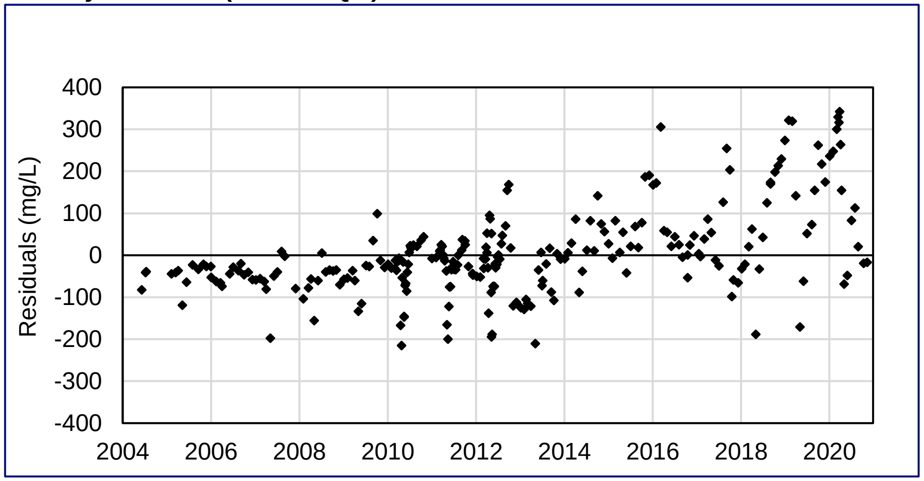
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

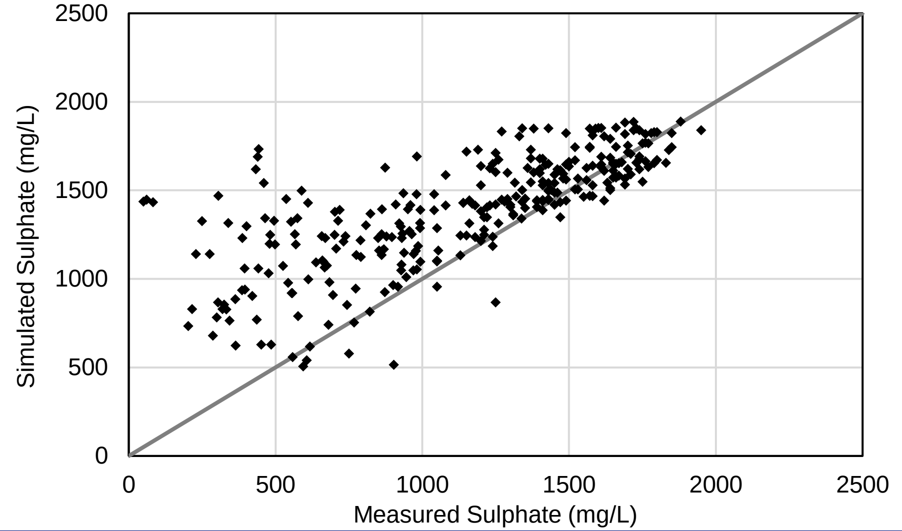
B3-5: Sulphate Calibration Information for Node GH_SC1 - Swift Creek Sediment Pond Decant (EMS E221329)

Measured and Simulated Sulphate Data and Calibration Statistics

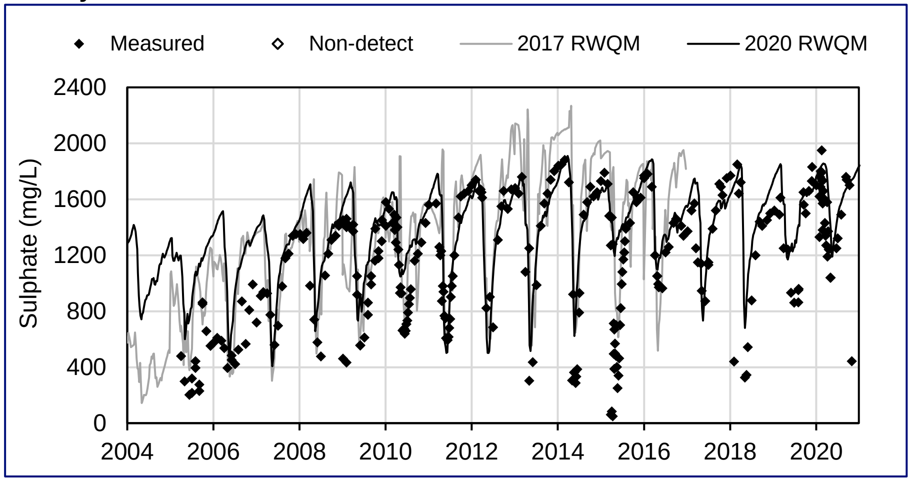
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/5/2016	12/10/2018
Data Points Available for Comparison, n	227	258
Non-Detect Count	0	0
Measured Mean (mg/L)	1045	1083
Simulated Mean (mg/L)	1290	1337
Bias (mg/L)	245	254
Relative Bias	1.2	1.2
Error (mg/L)	321	287
Percent Error	31%	27%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)

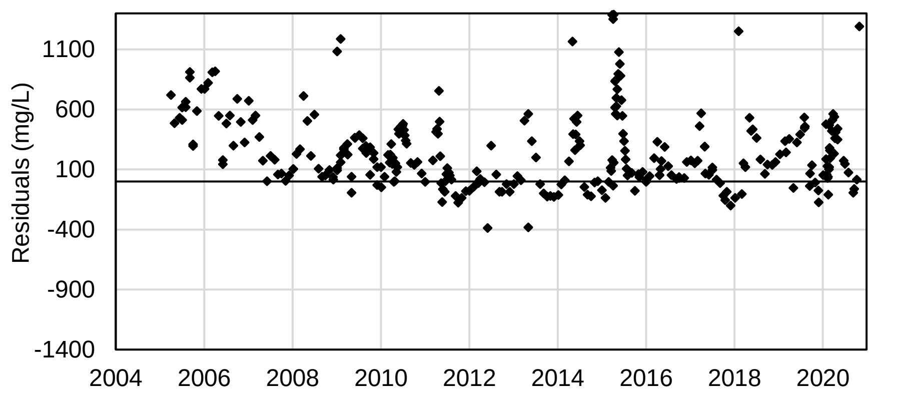


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

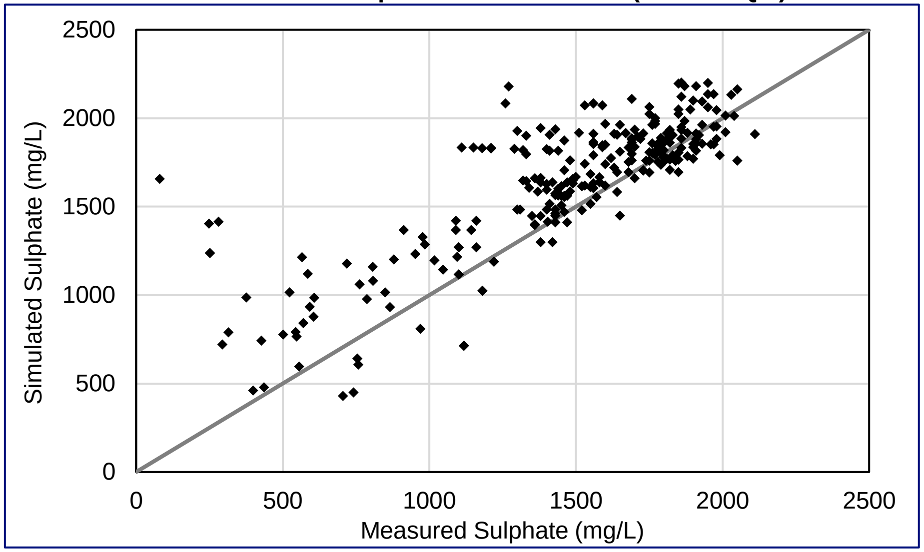
B3-6: Sulphate Calibration Information for Node GH_CC1 - Cataract Creek Sediment Pond Decant (EMS 0200384)

Measured and Simulated Sulphate Data and Calibration Statistics

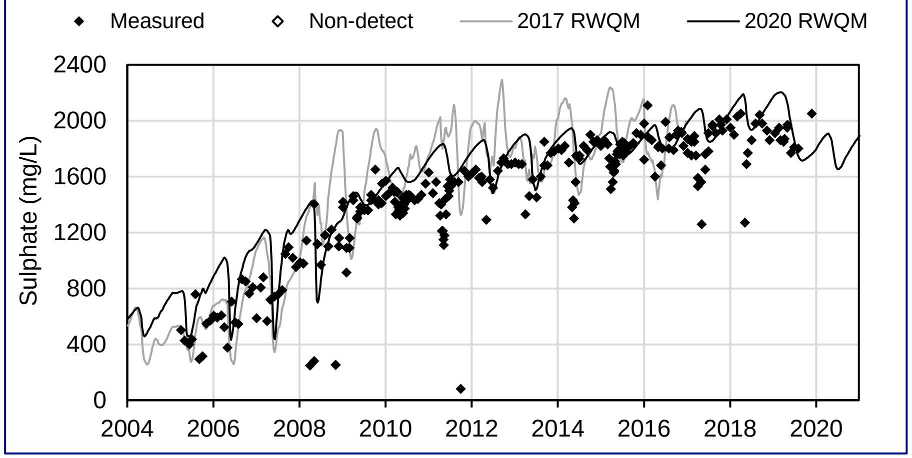
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	224	260
Non-Detect Count	0	0
Measured Mean (mg/L)	1380	1440
Simulated Mean (mg/L)	1580	1611
Bias (mg/L)	200	170
Relative Bias	1.1	1.1
Error (mg/L)	274	210
Percent Error	20%	15%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



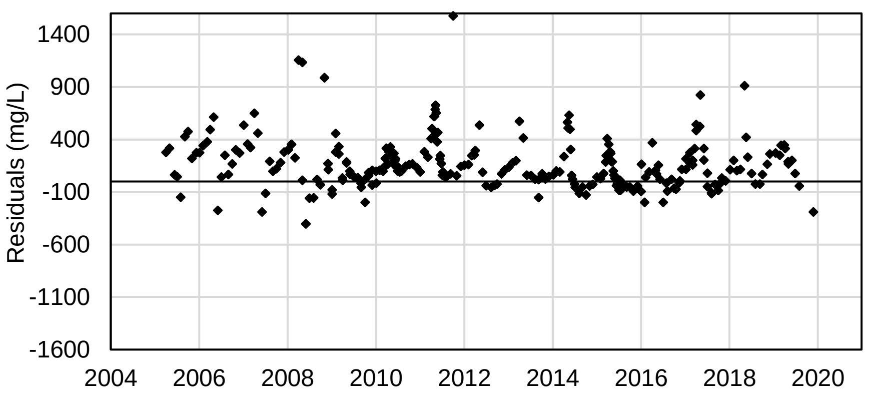
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

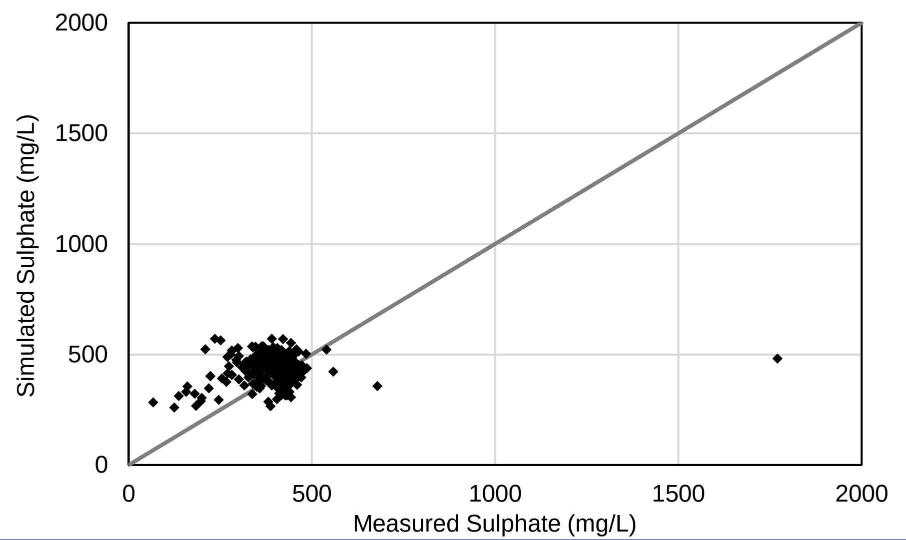
B3-7: Sulphate Calibration Information for Node GH_PC1 - Porter Creek Sediment Pond Decant (EMS 0200385)

Measured and Simulated Sulphate Data and Calibration Statistics

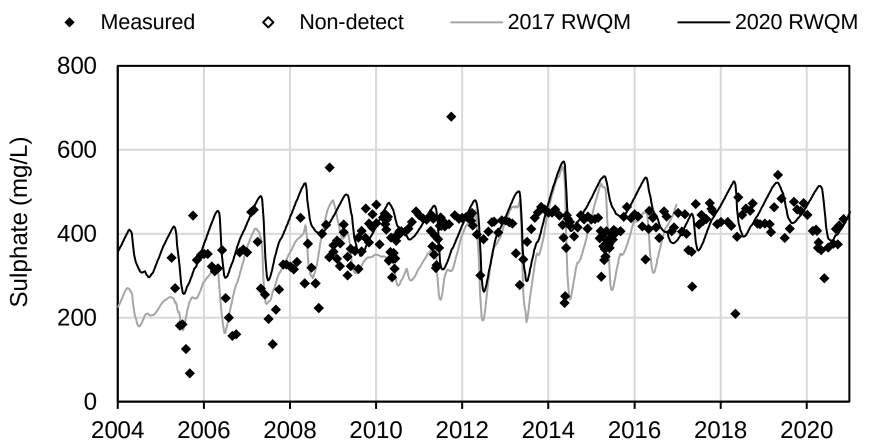
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	217	246
Non-Detect Count	0	0
Measured Mean (mg/L)	378	389
Simulated Mean (mg/L)	356	432
Bias (mg/L)	-23	43
Relative Bias	0.94	1.1
Error (mg/L)	78	84
Percent Error	21%	22%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



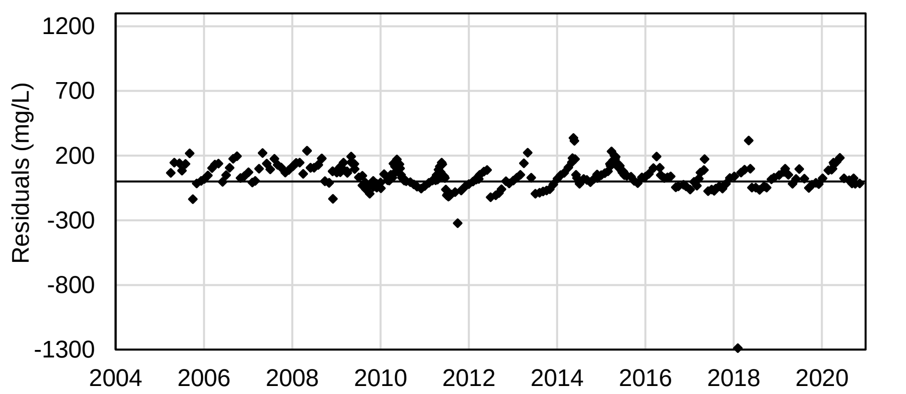
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

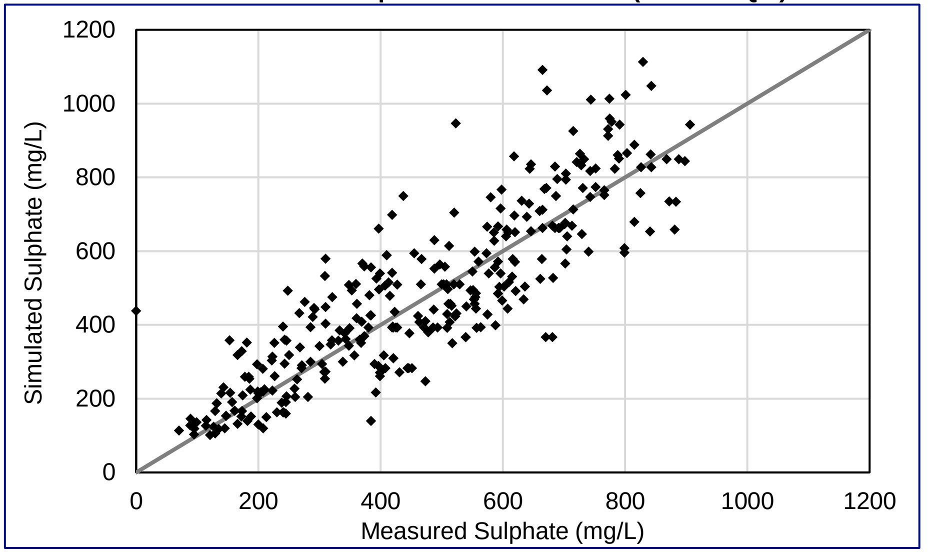
B3-8: Sulphate Calibration Information for Node GH_GH1 - Greenhills Creek Sediment Pond Decant (EMS E102709)

Measured and Simulated Sulphate Data and Calibration Statistics

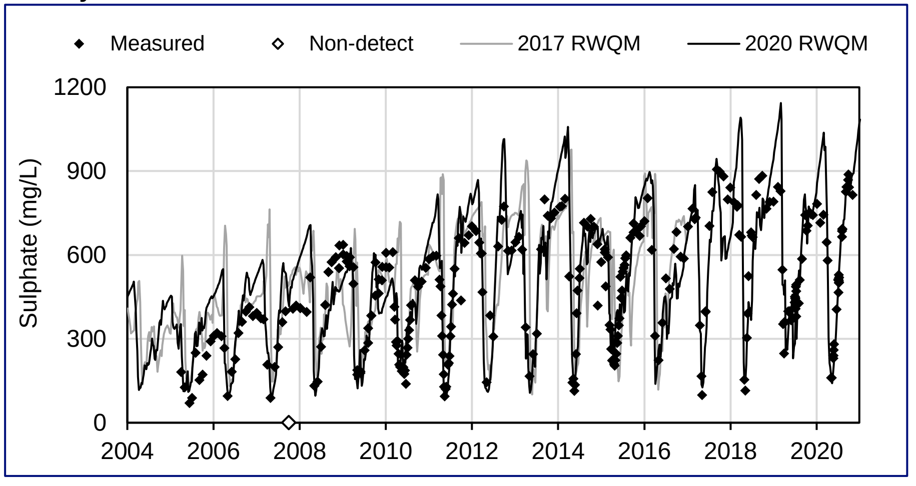
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	219	253
Non-Detect Count	1	1
Measured Mean (mg/L)	421	449
Simulated Mean (mg/L)	484	470
Bias (mg/L)	64	21
Relative Bias	1.2	1.0
Error (mg/L)	155	96
Percent Error	37%	21%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



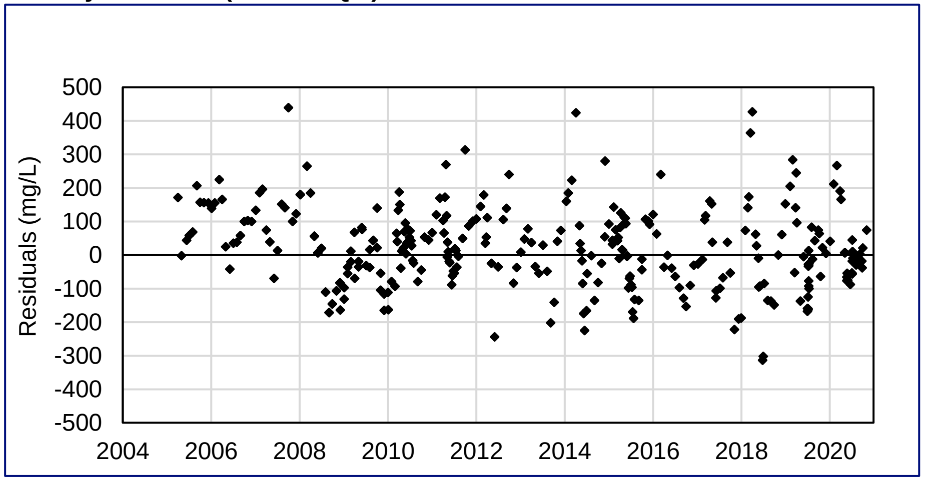
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

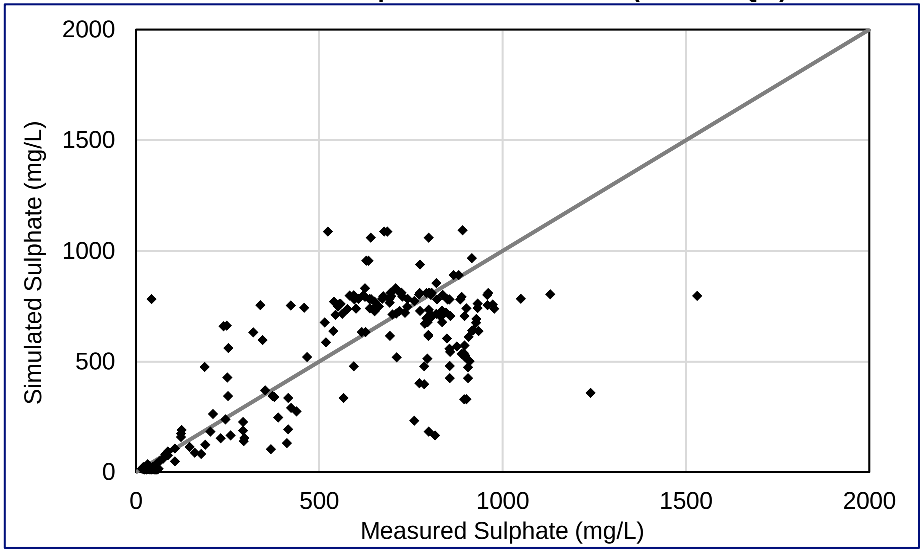
B3-9: Sulphate Calibration Information for Node GH_LC1 - Leask Creek Sediment Pond Decant (EMS E257796)

Measured and Simulated Sulphate Data and Calibration Statistics

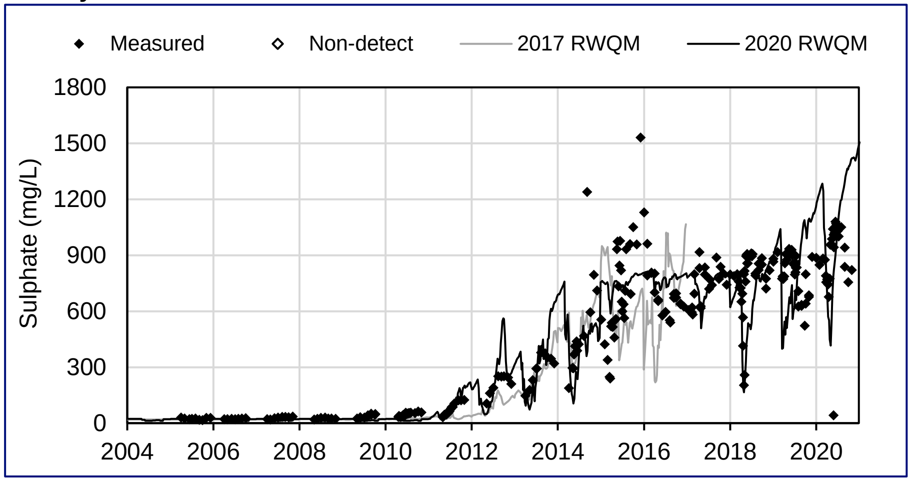
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/7/2016	12/4/2018
Data Points Available for Comparison, n	158	213
Non-Detect Count	0	0
Measured Mean (mg/L)	311	426
Simulated Mean (mg/L)	261	390
Bias (mg/L)	-49	-36
Relative Bias	0.84	0.91
Error (mg/L)	120	117
Percent Error	39%	28%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



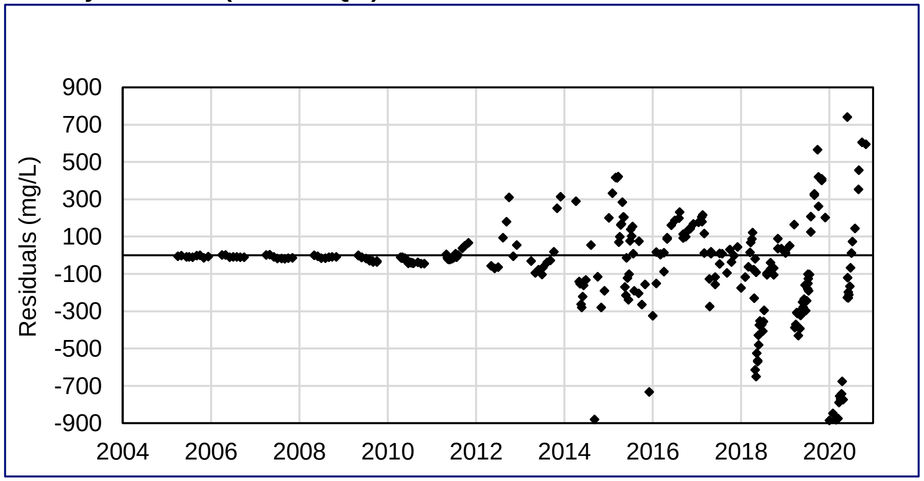
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

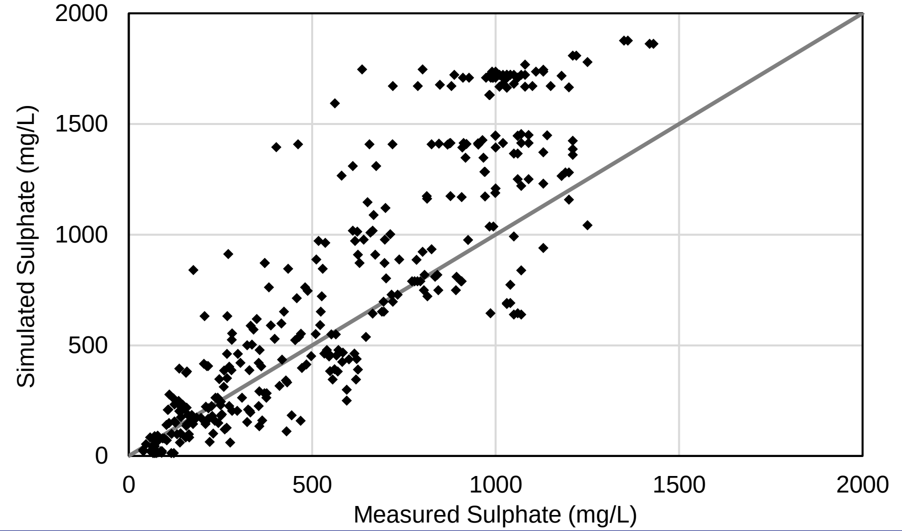
B3-10: Sulphate Calibration Information for Node GH_WC1 - Wolfram Creek Sediment Pond Decant (EMS E257795)

Measured and Simulated Sulphate Data and Calibration Statistics

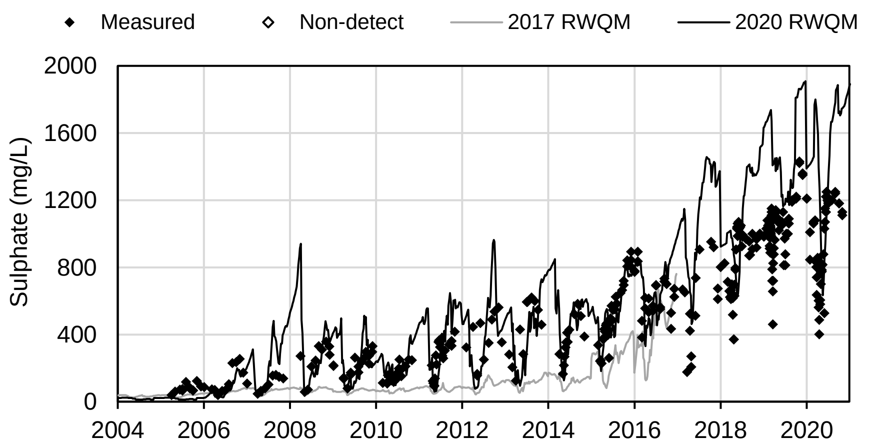
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/7/2016	12/4/2018
Data Points Available for Comparison, n	192	248
Non-Detect Count	0	0
Measured Mean (mg/L)	329	431
Simulated Mean (mg/L)	137	484
Bias (mg/L)	-192	53
Relative Bias	0.42	1.1
Error (mg/L)	195	157
Percent Error	59%	36%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



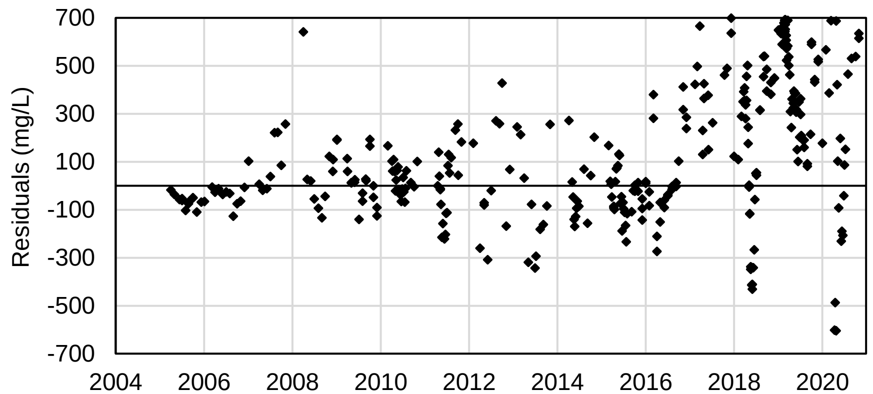
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

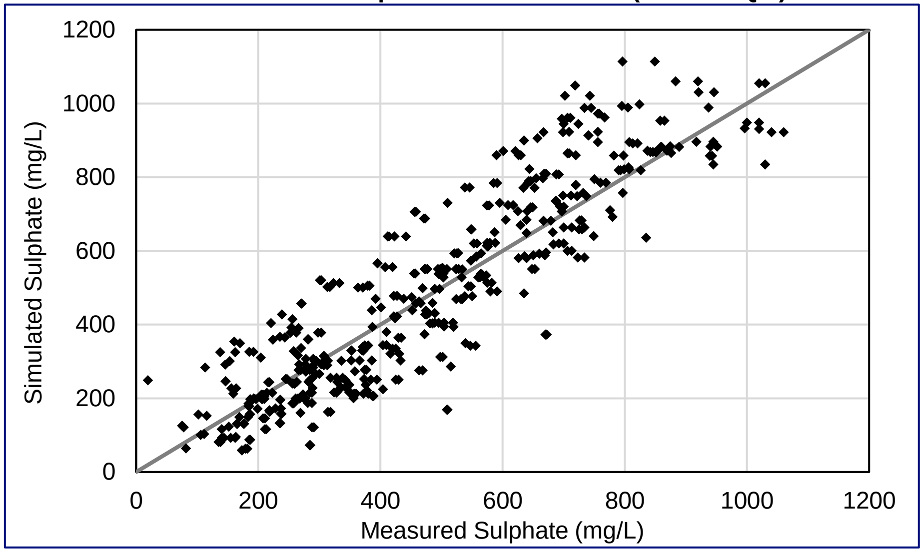
B3-11: Sulphate Calibration Information for Node GH_TC1 - Thompson Creek at LRP Road (EMS E102714)

Measured and Simulated Sulphate Data and Calibration Statistics

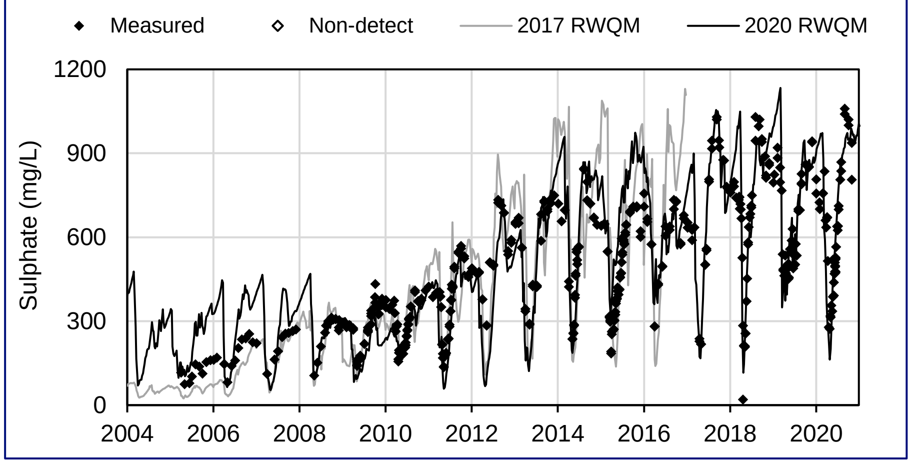
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	333	404
Non-Detect Count	0	0
Measured Mean (mg/L)	392	438
Simulated Mean (mg/L)	409	450
Bias (mg/L)	17	11
Relative Bias	1.0	1.0
Error (mg/L)	111	93
Percent Error	28%	21%

(a) As adjusted for the 2019 IPA.

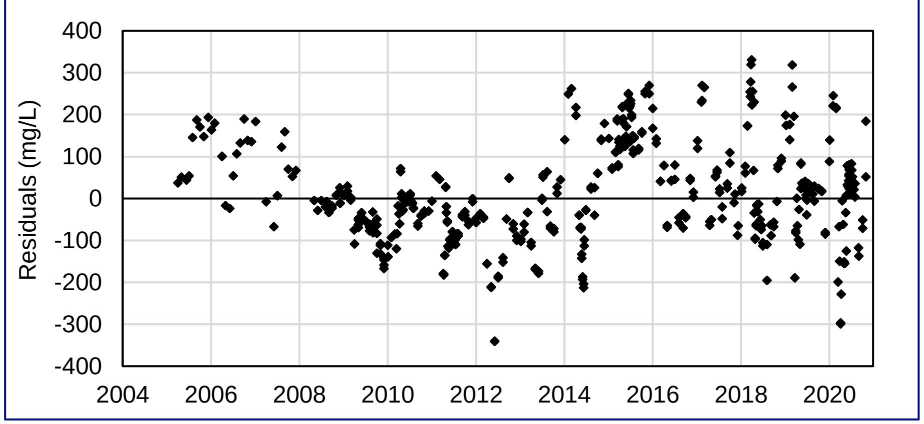
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-12: Sulphate Calibration Information for Node LC_DC3 - Dry Creek u/s of East Tributary (EMS E288273)

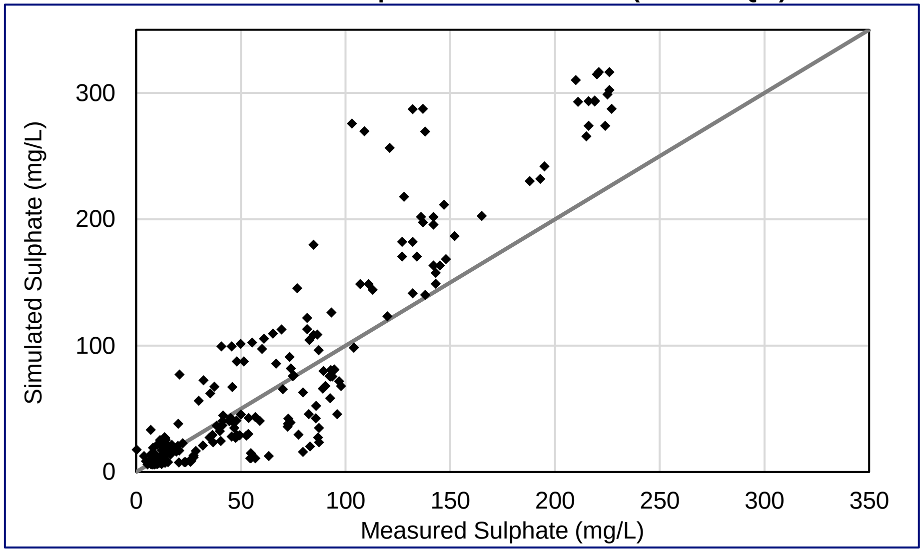
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	10/21/2010	10/21/2010
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	104	178
Non-Detect Count	1	1
Measured Mean (mg/L)	-	27
Simulated Mean (mg/L)	-	21
Bias (mg/L)	-	-5.9
Relative Bias	-	0.78
Error (mg/L)	-	11
Percent Error	-	40%

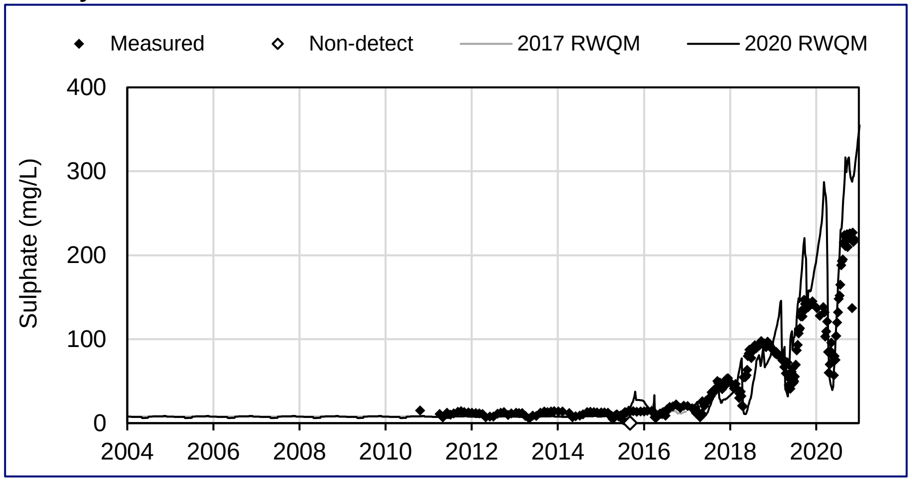
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



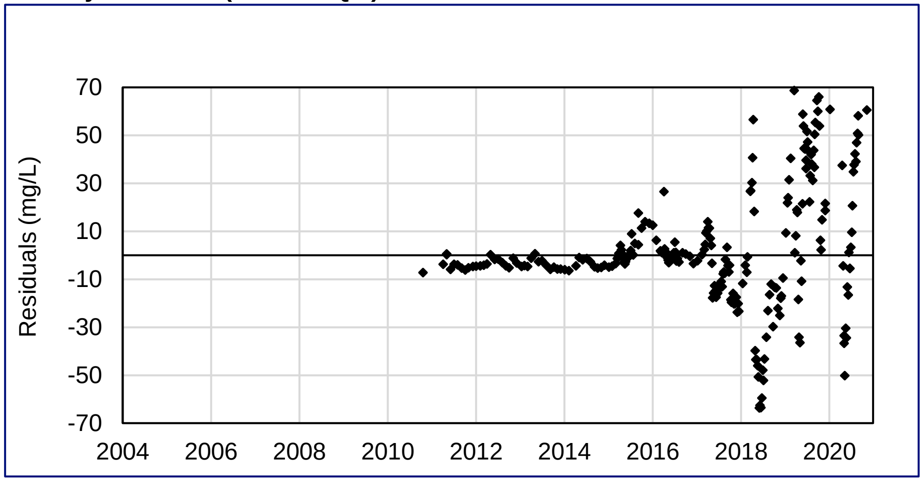
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-13: Sulphate Calibration Information for Node LC_DCDS - Dry Creek d/s of Sedimentation Ponds (EMS E295210)

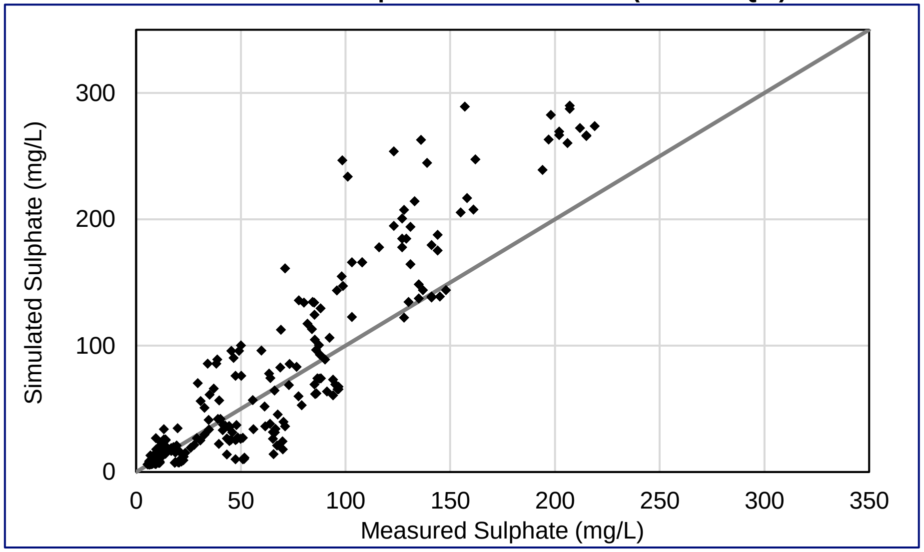
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	11/6/2013	11/6/2013
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	84	162
Non-Detect Count	0	0
Measured Mean (mg/L)	-	27
Simulated Mean (mg/L)	-	22
Bias (mg/L)	-	-5.5
Relative Bias	-	0.8
Error (mg/L)	-	10
Percent Error	-	37%

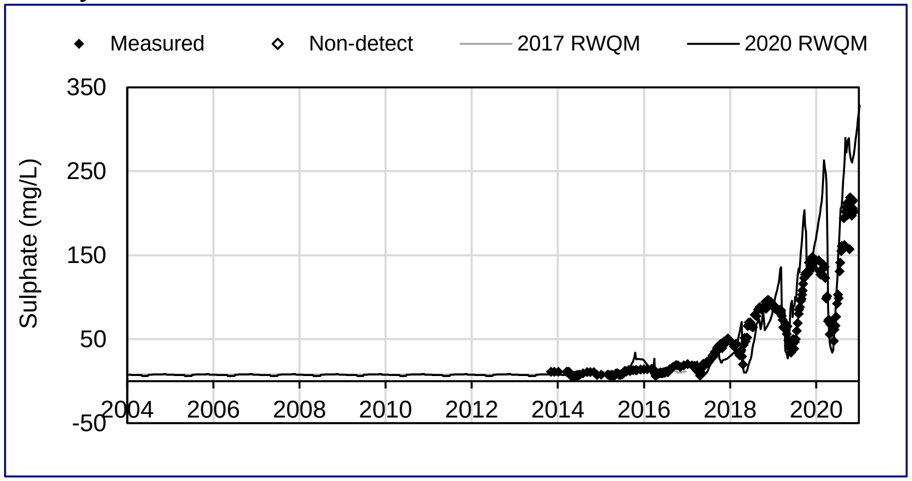
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

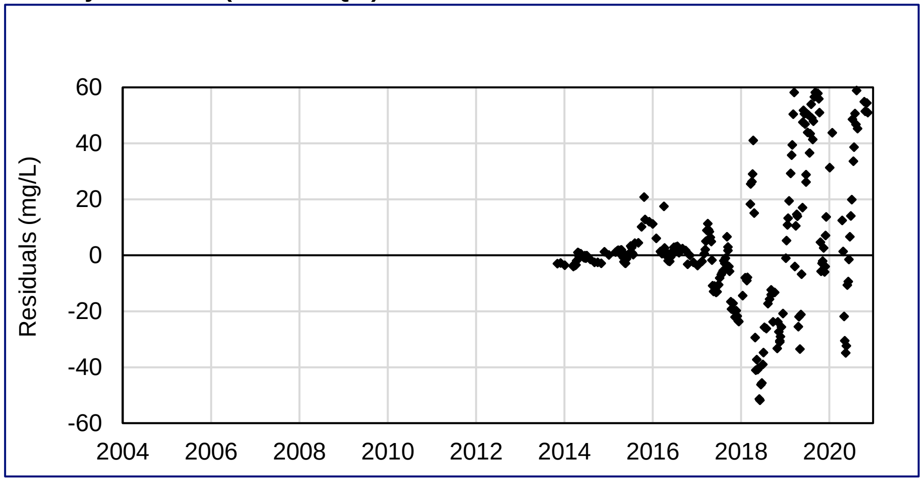
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

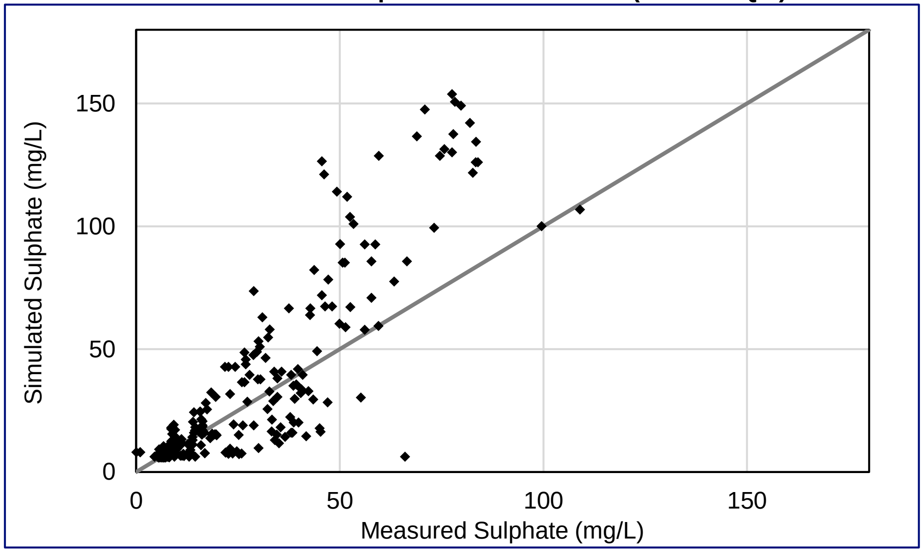
B3-14: Sulphate Calibration Information for Node LC_DC1 - Dry Creek near mouth (at bridge) (EMS E288270)

Measured and Simulated Sulphate Data and Calibration Statistics

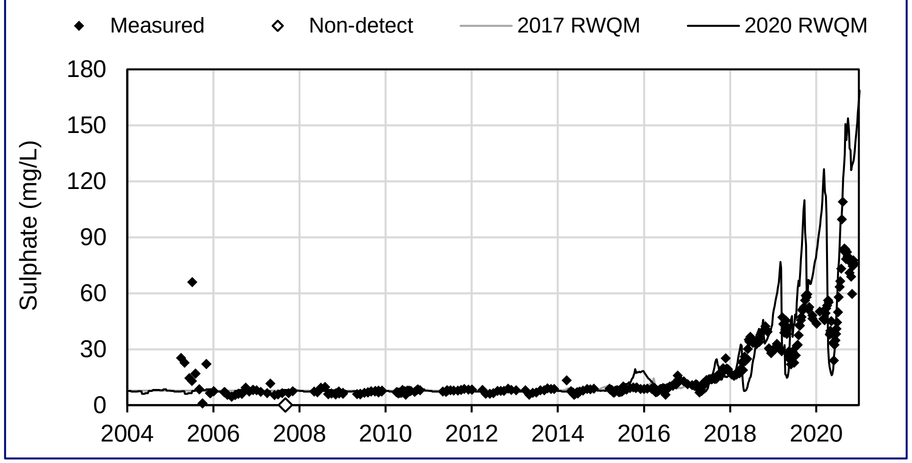
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	202	278
Non-Detect Count	1	1
Measured Mean (mg/L)	8.3	12
Simulated Mean (mg/L)	8.1	11
Bias (mg/L)	-0.14	-0.71
Relative Bias	0.98	0.94
Error (mg/L)	1.8	3.3
Percent Error	22%	28%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



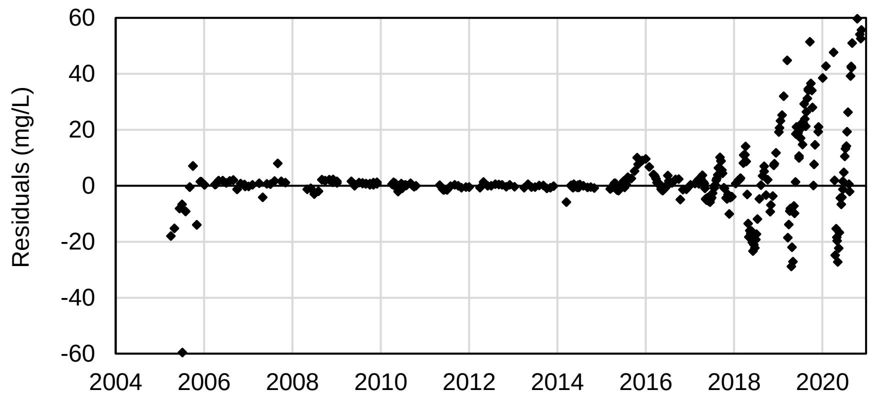
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

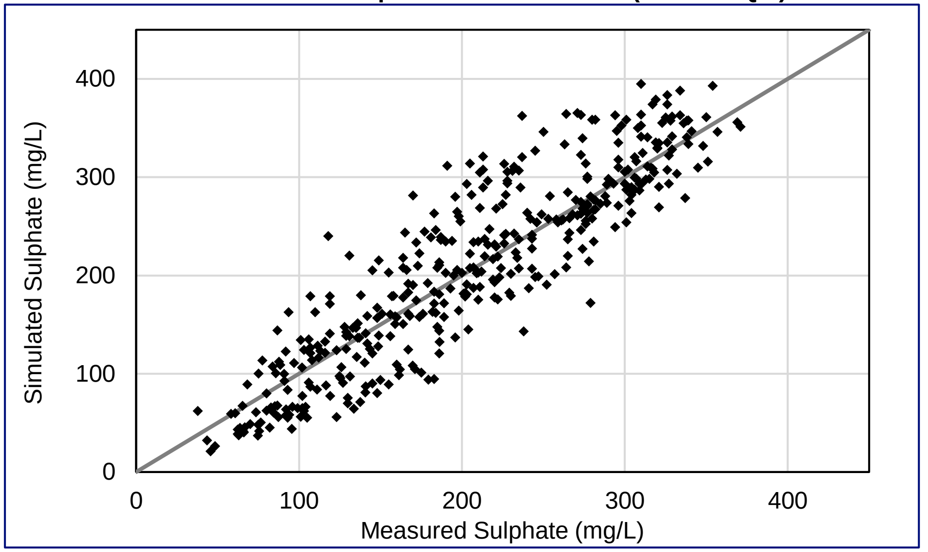
B3-15: Sulphate Calibration Information for Node LC_LCUSWLC - Line Creek u/s of West Line Creek (EMS E293369)

Measured and Simulated Sulphate Data and Calibration Statistics

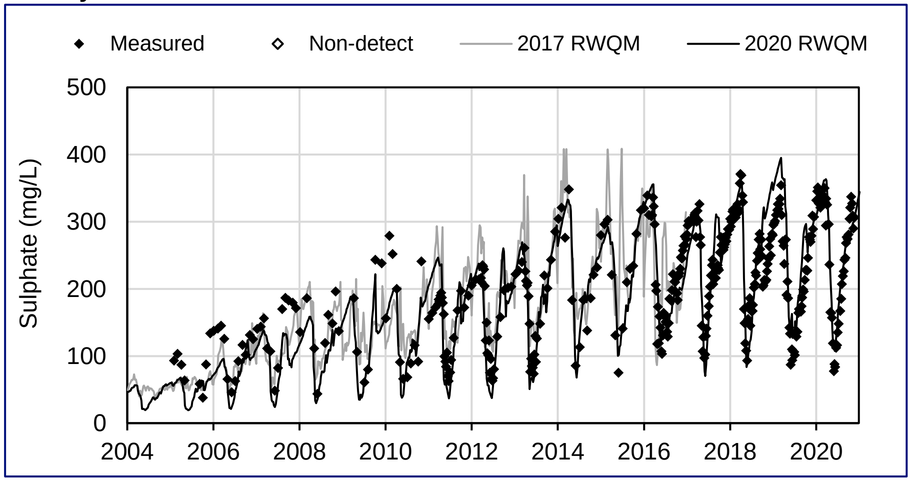
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/2/2005	2/2/2005
Last Measured Sample	12/28/2016	12/27/2018
Data Points Available for Comparison, n	201	304
Non-Detect Count	0	0
Measured Mean (mg/L)	168	194
Simulated Mean (mg/L)	180	190
Bias (mg/L)	12	-3.7
Relative Bias	1.1	0.98
Error (mg/L)	43	31
Percent Error	26%	16%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



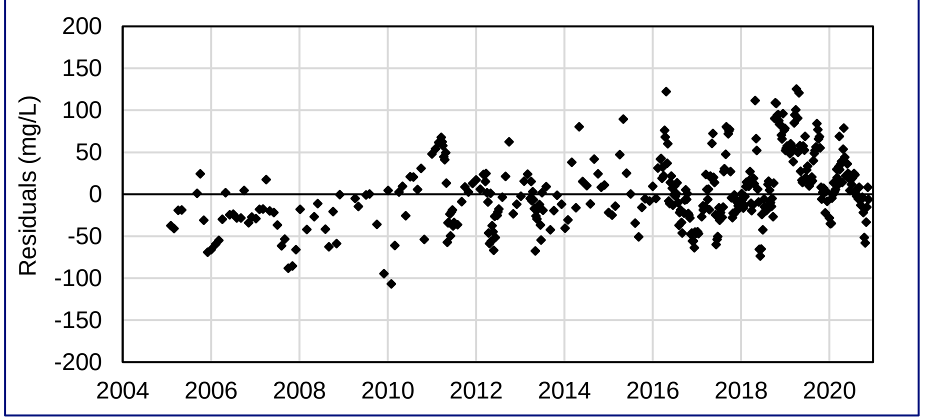
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

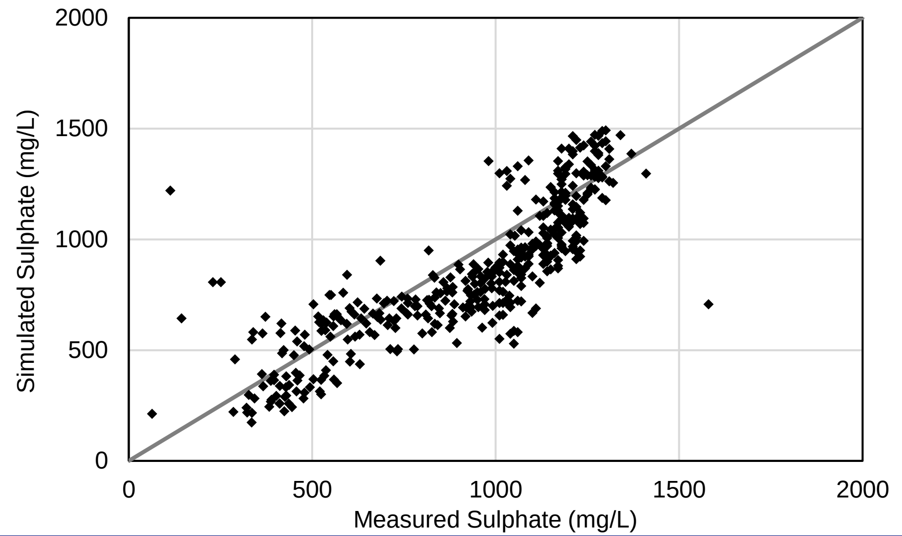
B3-16: Sulphate Calibration Information for Node LC_WLC - West Line Creek (EMS E261958)

Measured and Simulated Sulphate Data and Calibration Statistics

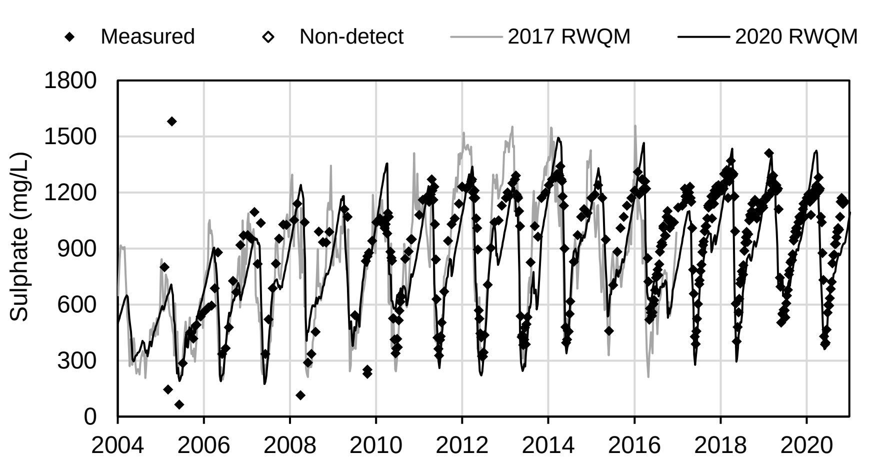
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/2/2005	2/2/2005
Last Measured Sample	12/5/2016	12/27/2018
Data Points Available for Comparison, n	235	333
Non-Detect Count	0	0
Measured Mean (mg/L)	865	914
Simulated Mean (mg/L)	760	833
Bias (mg/L)	-104	-81
Relative Bias	0.88	0.91
Error (mg/L)	181	158
Percent Error	21%	17%

[(a)] As adjusted for the 2019 IPA.

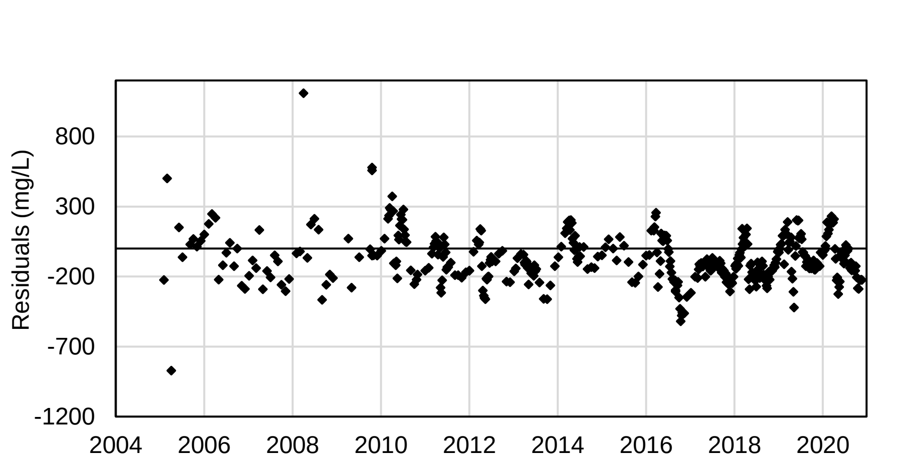
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-17: Sulphate Calibration Information for Node LC_LC3 - Line Creek d/s of West Line Creek (EMS 0200337)

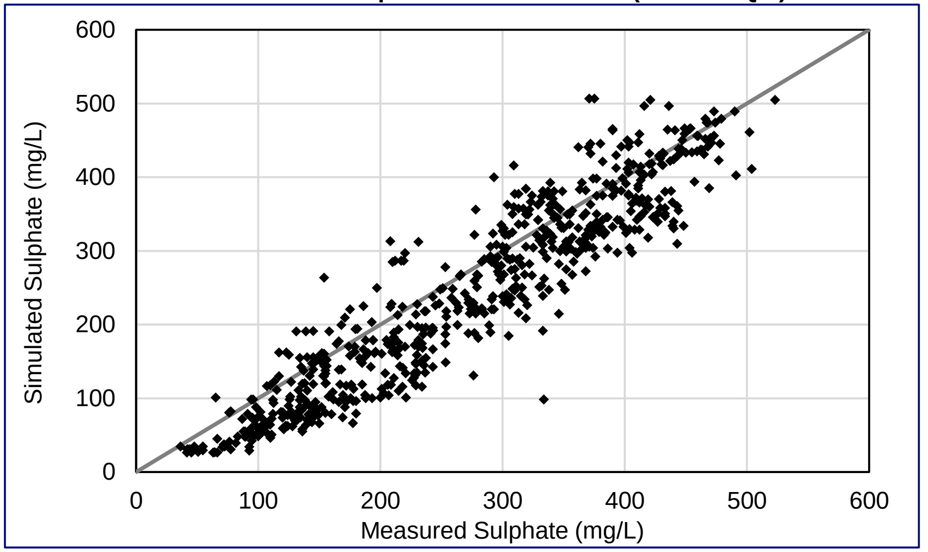
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/2/2005	2/2/2005
Last Measured Sample	12/27/2016	12/31/2018
Data Points Available for Comparison, n	368	495
Non-Detect Count	0	0
Measured Mean (mg/L)	-	253
Simulated Mean (mg/L)	-	219
Bias (mg/L)	-	-34
Relative Bias	-	0.87
Error (mg/L)	-	47
Percent Error	-	18%

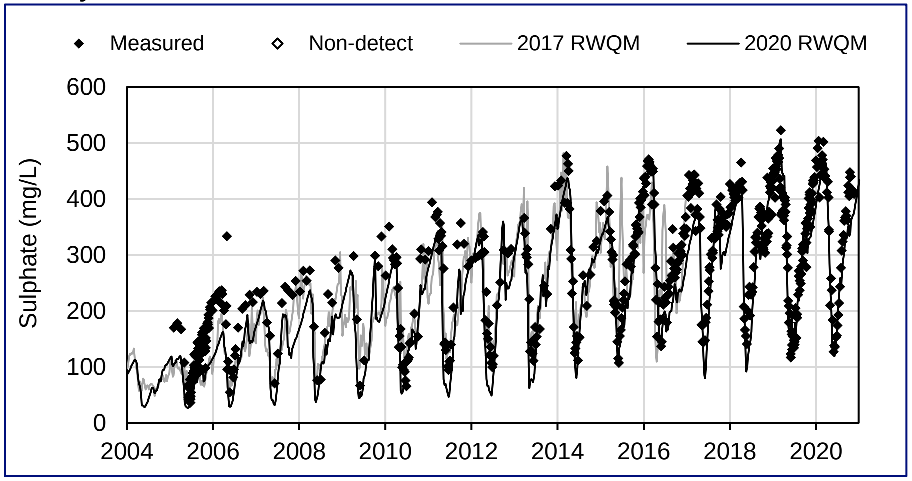
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



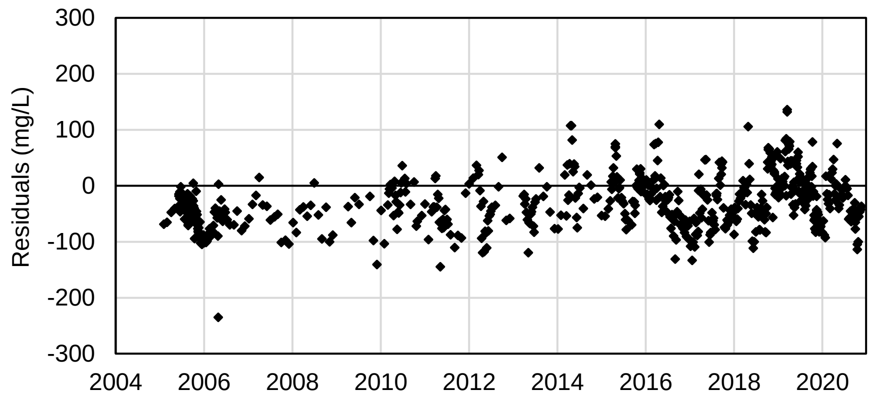
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-18: Sulphate Calibration Information for Node LC_LCDSSLCC - LCO Compliance Point - Line Creek d/s of South Line Creek Confluence (EMS E297110)

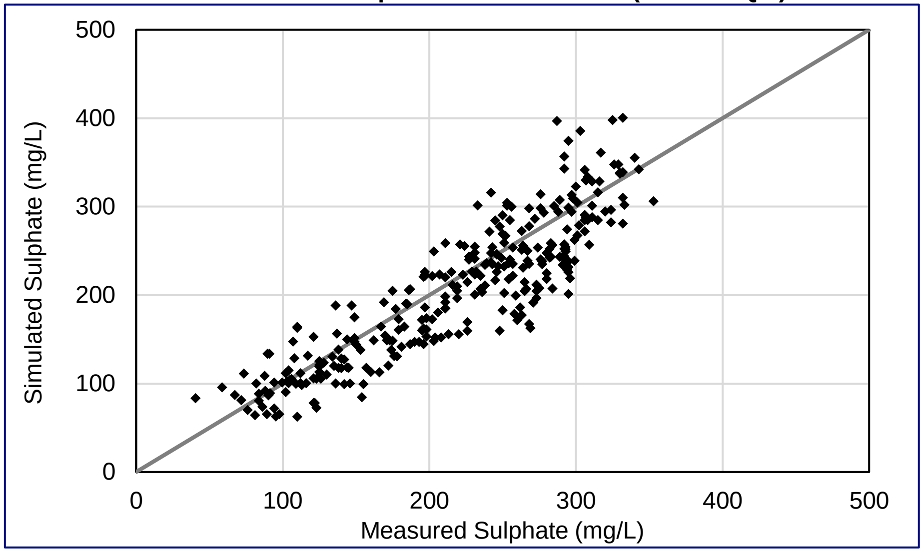
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/4/2014	6/4/2014
Last Measured Sample	12/28/2016	12/27/2018
Data Points Available for Comparison, n	86	196
Non-Detect Count	0	0
Measured Mean (mg/L)	-	212
Simulated Mean (mg/L)	-	195
Bias (mg/L)	-	-17
Relative Bias	-	0.92
Error (mg/L)	-	35
Percent Error	-	17%

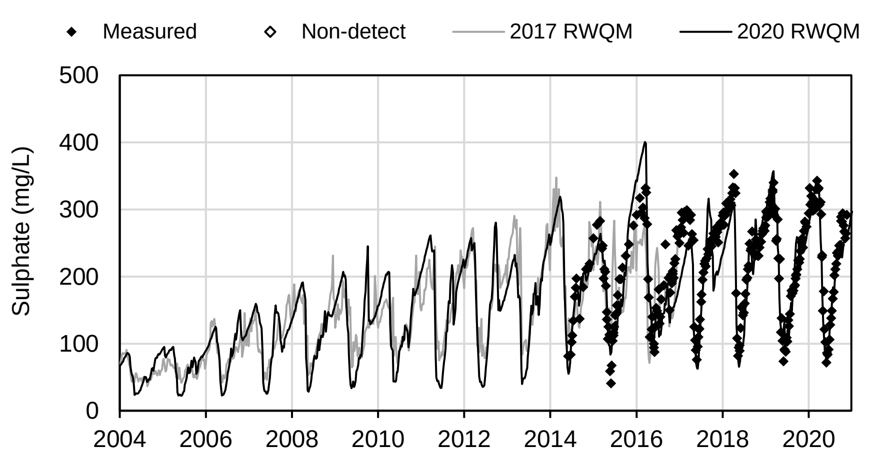
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



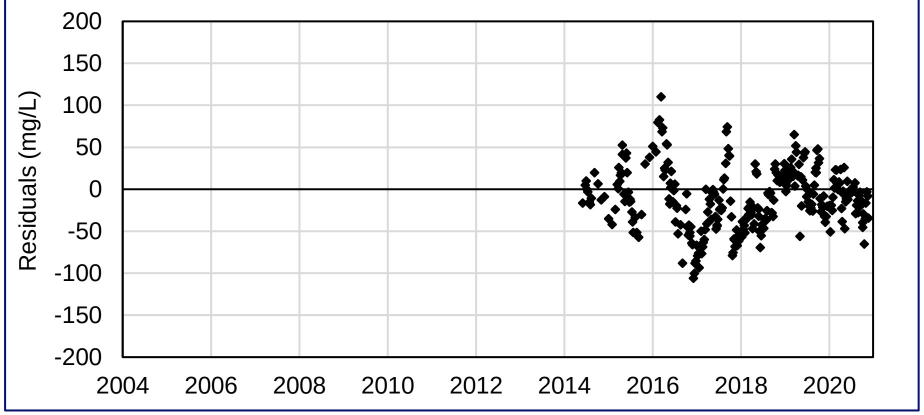
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

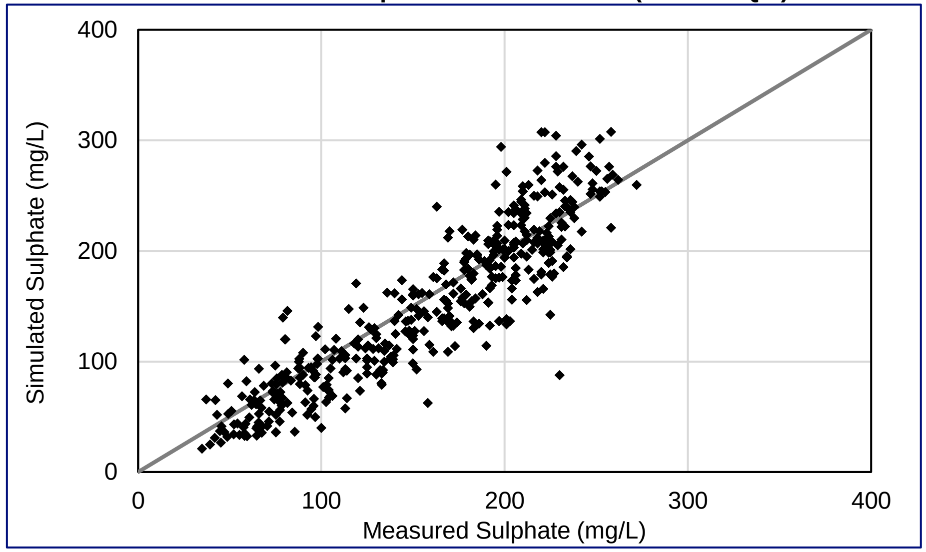
B3-19: Sulphate Calibration Information for Node LC_LC4 - Line Creek u/s of Process Plant (EMS 0200044)

Measured and Simulated Sulphate Data and Calibration Statistics

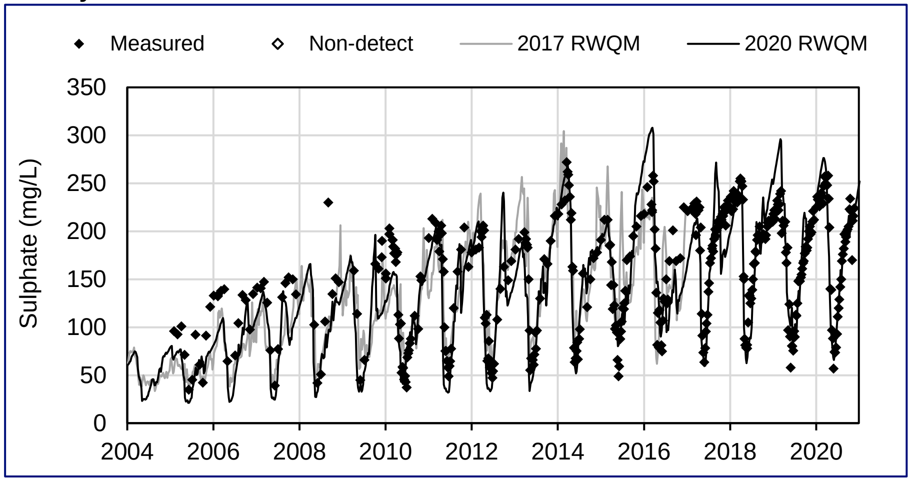
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/2/2005	2/2/2005
Last Measured Sample	12/7/2016	12/27/2018
Data Points Available for Comparison, n	242	347
Non-Detect Count	0	0
Measured Mean (mg/L)	135	151
Simulated Mean (mg/L)	130	140
Bias (mg/L)	-4.7	-11
Relative Bias	0.97	0.93
Error (mg/L)	29	24
Percent Error	22%	16%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



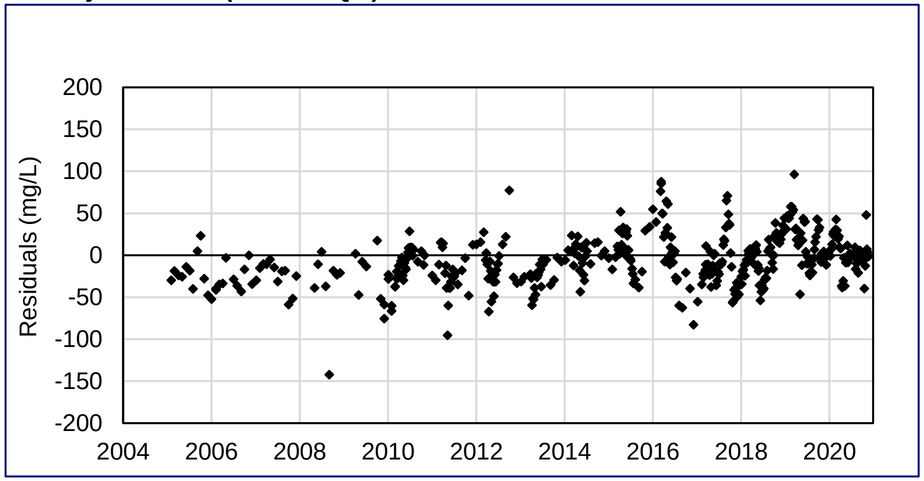
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

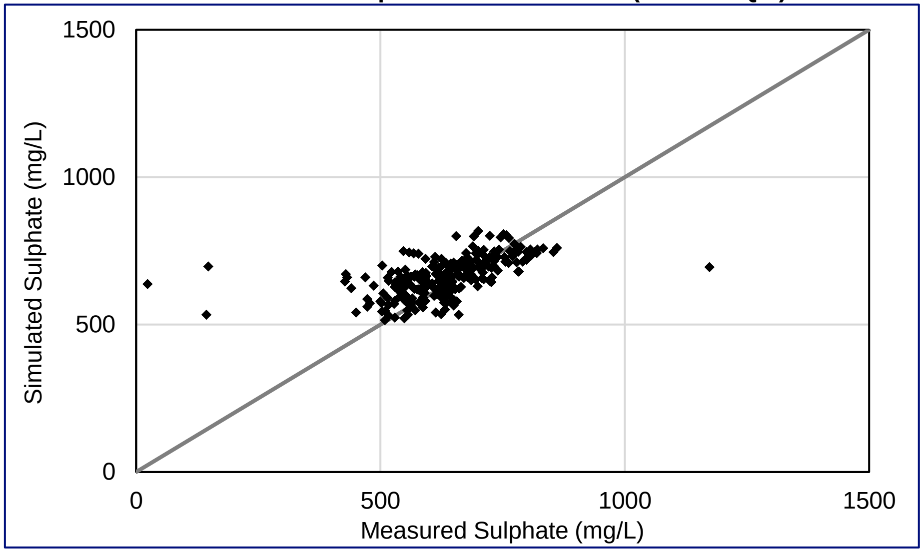
B3-20: Sulphate Calibration Information for Node EV_EC1 - Erickson Creek at Mouth (EMS 0200097)

Measured and Simulated Sulphate Data and Calibration Statistics

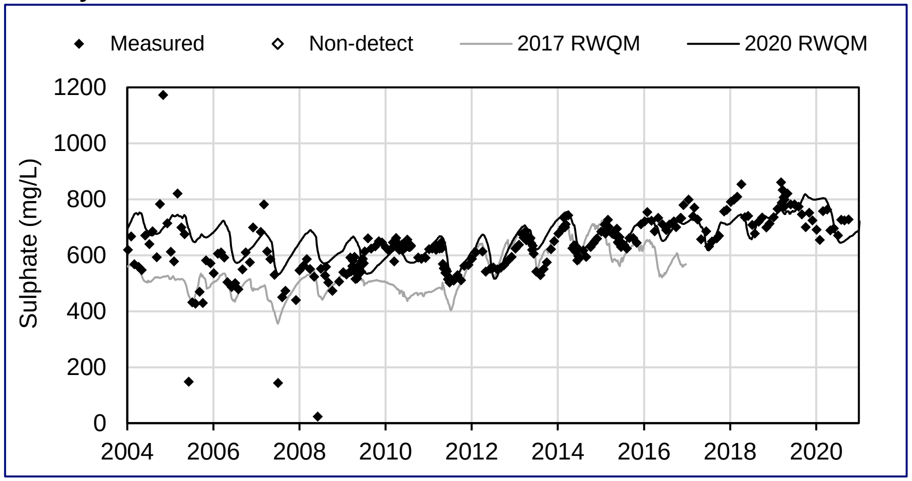
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	228	252
Non-Detect Count	0	0
Measured Mean (mg/L)	609	620
Simulated Mean (mg/L)	547	653
Bias (mg/L)	-62	33
Relative Bias	0.9	1.1
Error (mg/L)	85	62
Percent Error	14%	10%

[a] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)

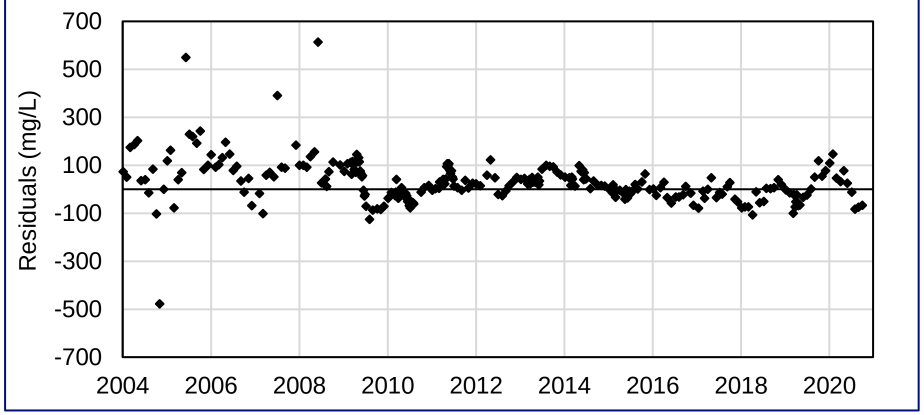


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

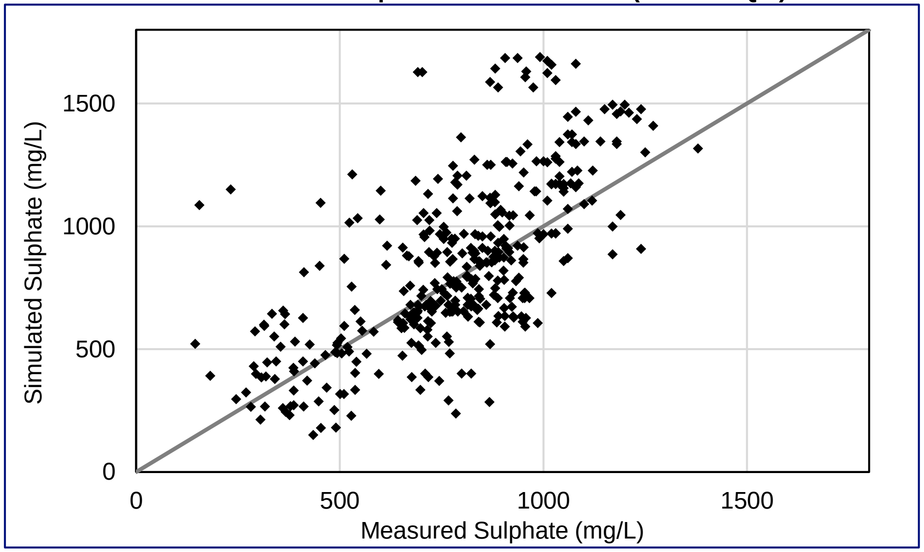
B3-21: Sulphate Calibration Information for Node EV_GT1 - Gate Creek Sediment Pond Decant (EMS E206231)

Measured and Simulated Sulphate Data and Calibration Statistics

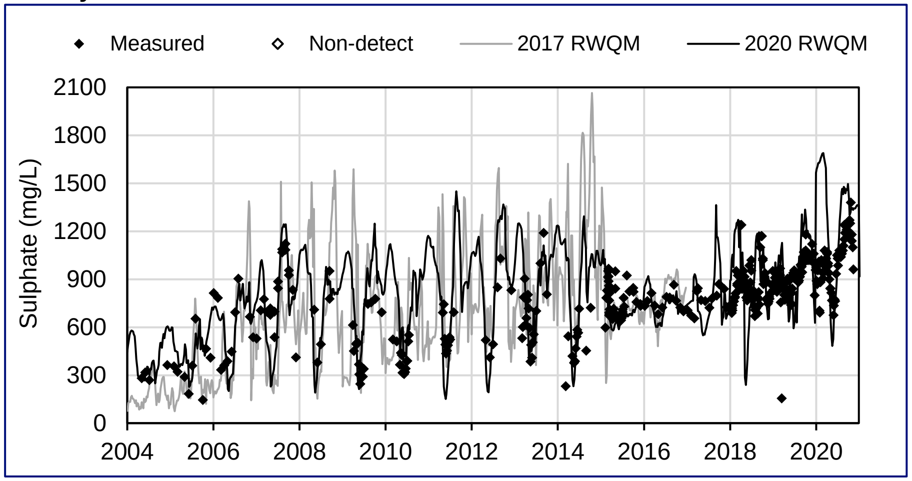
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/4/2004	5/4/2004
Last Measured Sample	12/5/2016	12/31/2018
Data Points Available for Comparison, n	179	259
Non-Detect Count	0	0
Measured Mean (mg/L)	630	695
Simulated Mean (mg/L)	665	723
Bias (mg/L)	34	28
Relative Bias	1.1	1.0
Error (mg/L)	229	175
Percent Error	36%	25%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



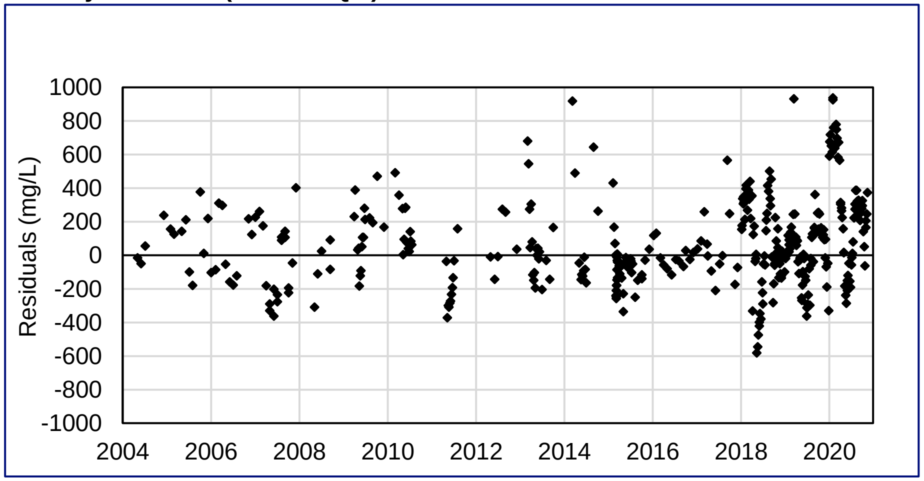
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

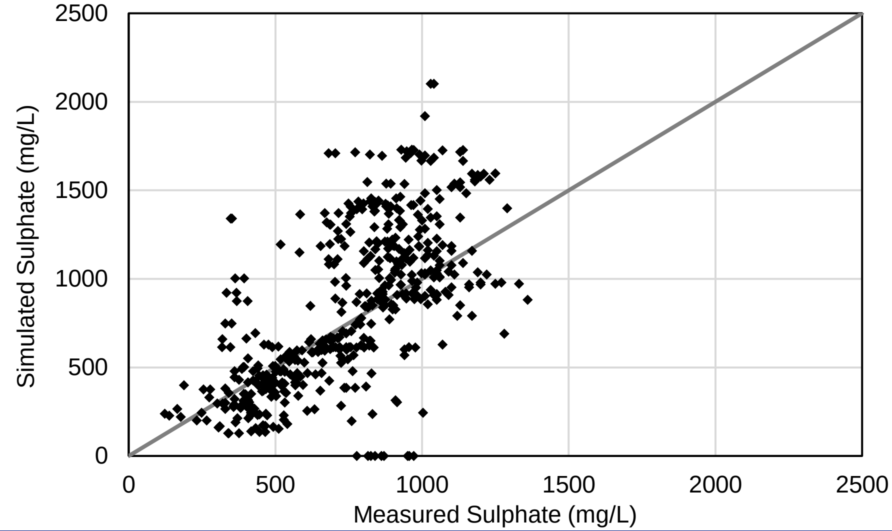
B3-22: Sulphate Calibration Information for Node EV_BC1 - Bodie Creek Sediment Pond Decant (EMS E102685)

Measured and Simulated Sulphate Data and Calibration Statistics

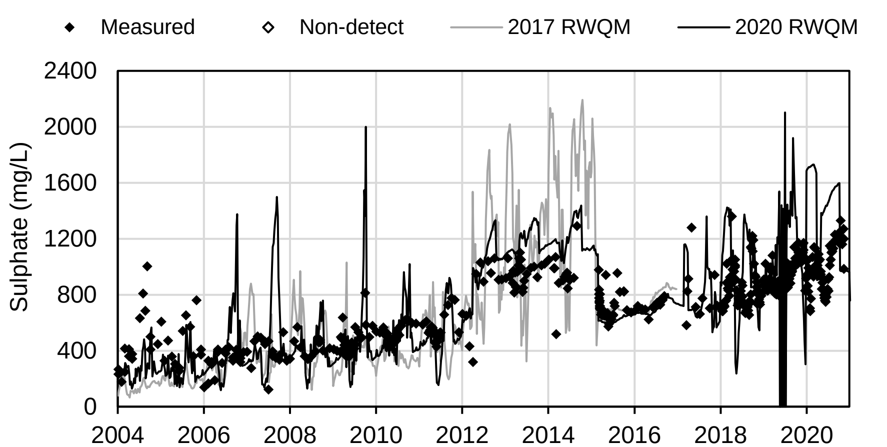
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	9/14/2016	12/31/2018
Data Points Available for Comparison, n	261	347
Non-Detect Count	0	0
Measured Mean (mg/L)	599	658
Simulated Mean (mg/L)	585	696
Bias (mg/L)	-13	38
Relative Bias	0.98	1.1
Error (mg/L)	204	198
Percent Error	34%	30%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



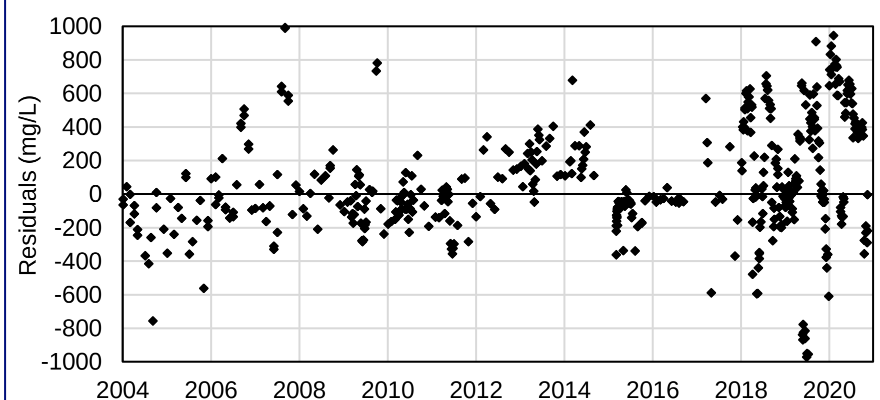
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

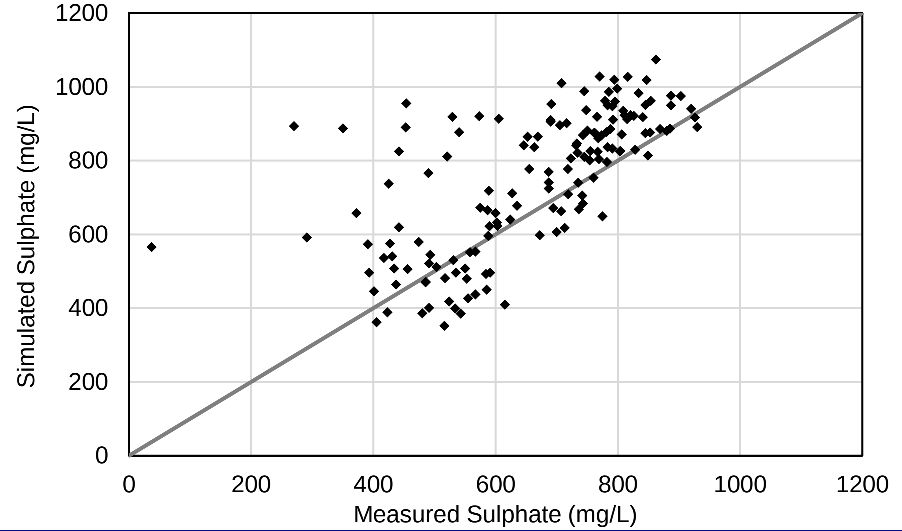
B3-23: Sulphate Calibration Information for Node EV_DC1 - EVO Dry Creek Sediment Pond Decant (EMS E298590)

Measured and Simulated Sulphate Data and Calibration Statistics

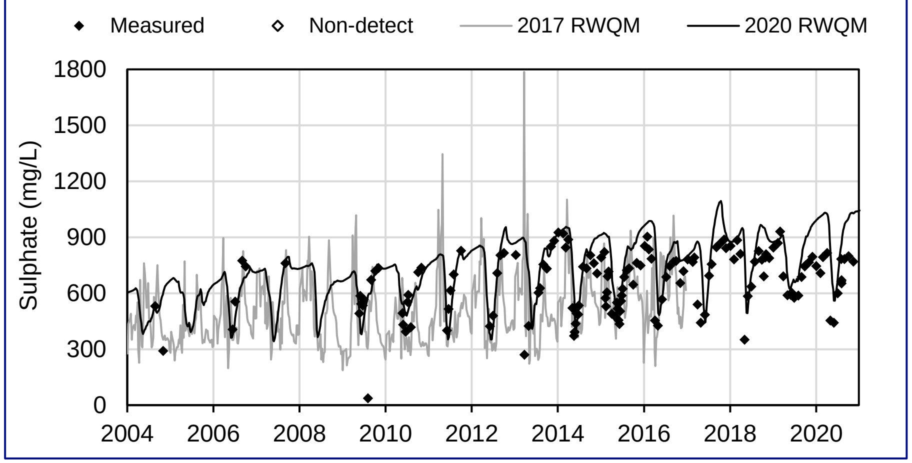
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	8/26/2004	8/26/2004
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	96	122
Non-Detect Count	0	0
Measured Mean (mg/L)	625	648
Simulated Mean (mg/L)	534	725
Bias (mg/L)	-91	77
Relative Bias	0.85	1.1
Error (mg/L)	170	118
Percent Error	27%	18%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



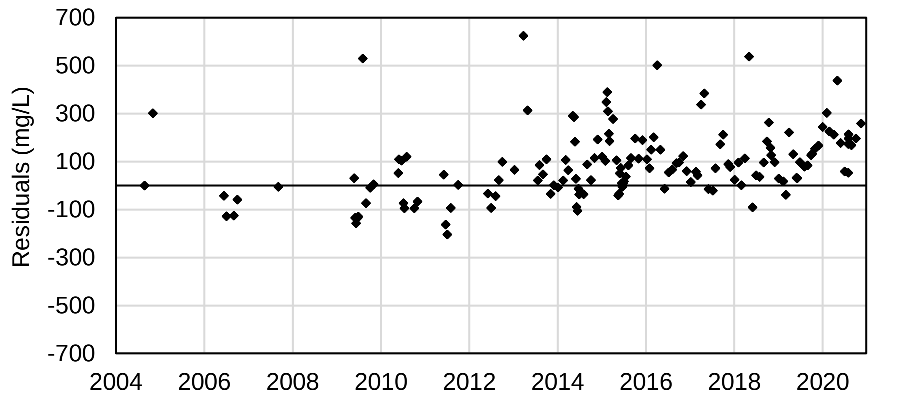
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

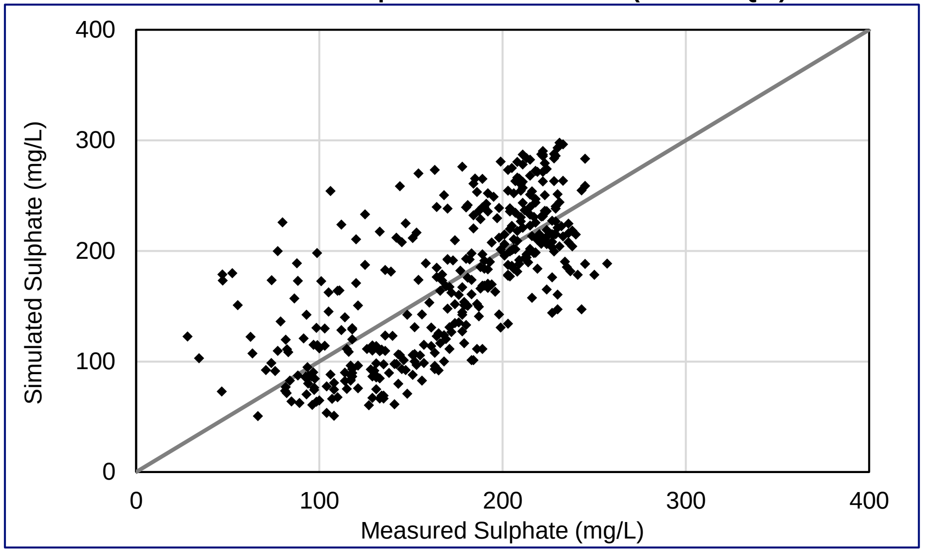
B3-24: Sulphate Calibration Information for Node EV_HC1 - EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (EMS E102682)

Measured and Simulated Sulphate Data and Calibration Statistics

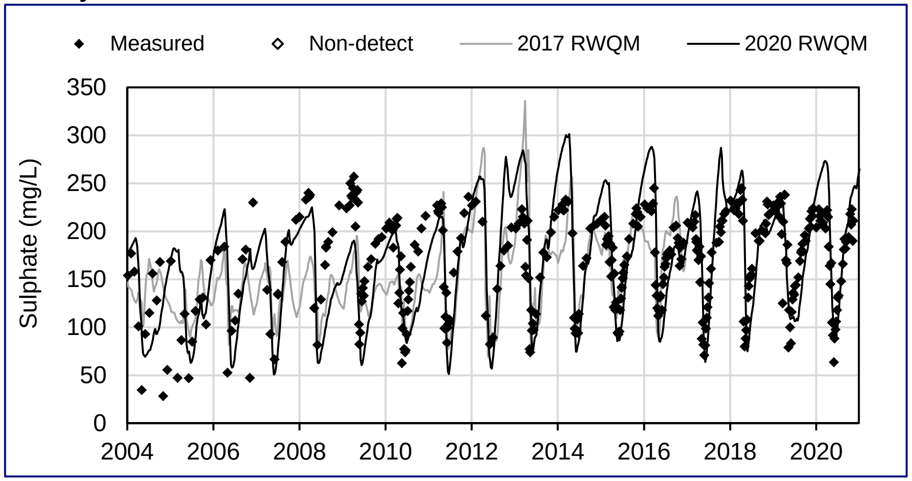
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	251	315
Non-Detect Count	0	0
Measured Mean (mg/L)	163	166
Simulated Mean (mg/L)	157	168
Bias (mg/L)	-6.0	2.0
Relative Bias	0.96	1.0
Error (mg/L)	39	41
Percent Error	24%	25%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



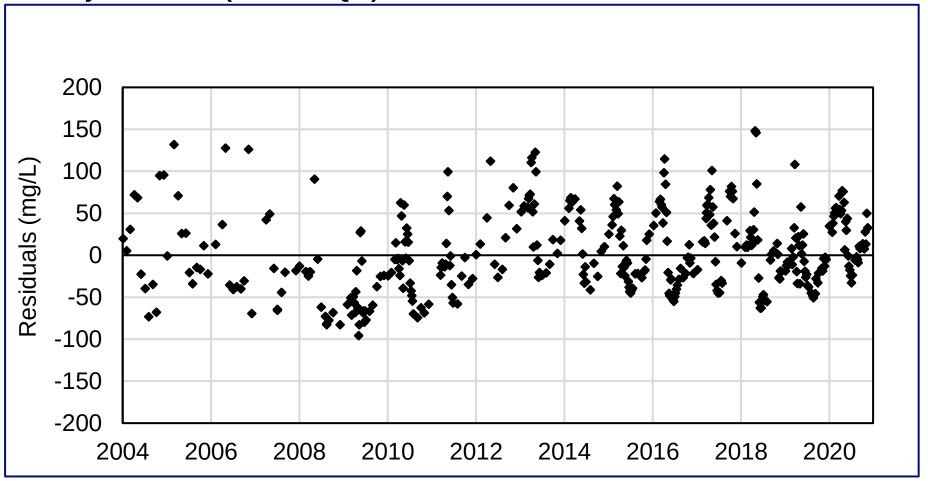
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

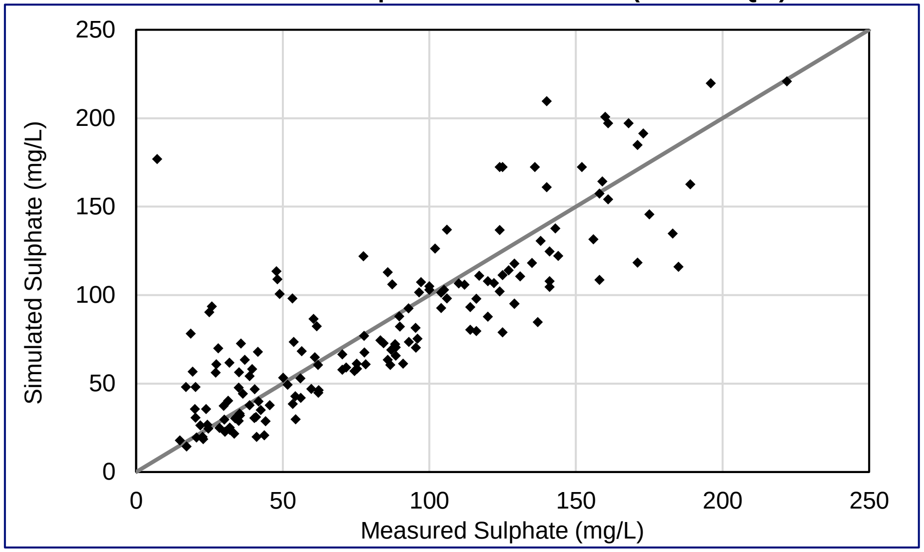
B3-25: Sulphate Calibration Information for Node FR_FR1 - Fording River d/s of Henretta Creek (EMS 0200251)

Measured and Simulated Sulphate Data and Calibration Statistics

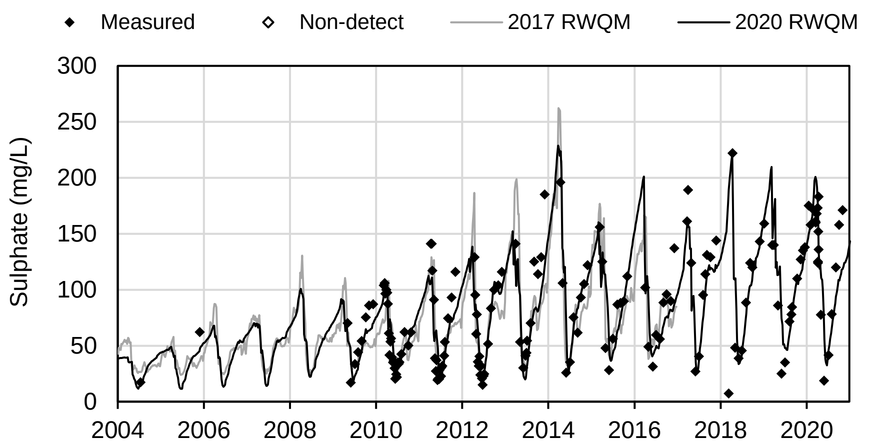
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	7/13/2004	7/13/2004
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	109	128
Non-Detect Count	0	0
Measured Mean (mg/L)	68	73
Simulated Mean (mg/L)	67	73
Bias (mg/L)	-1.3	-0.76
Relative Bias	0.98	0.99
Error (mg/L)	18	19
Percent Error	27%	25%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



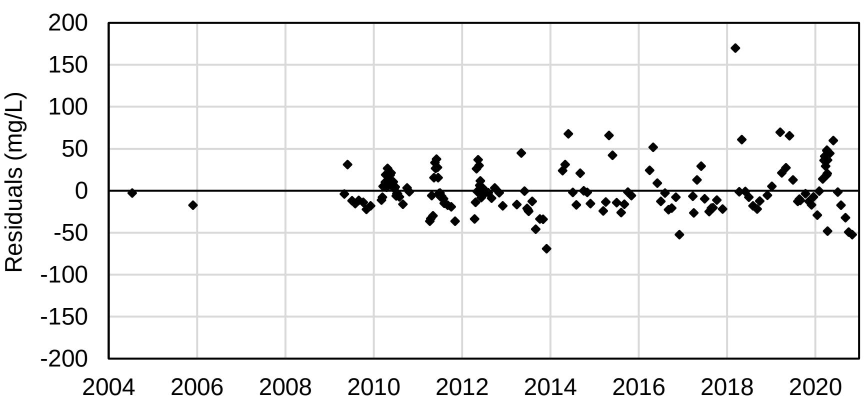
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

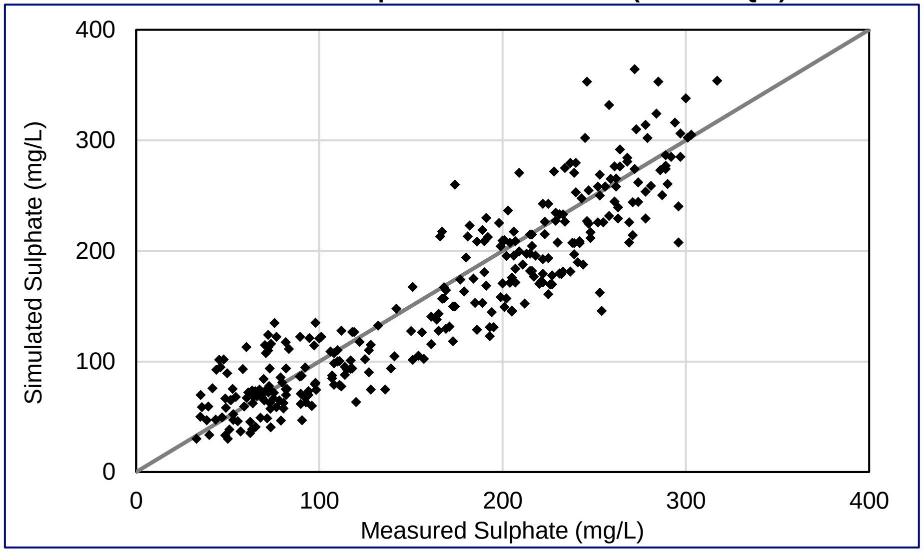
B3-26: Sulphate Calibration Information for Node FR_FR2 - Fording River u/s of Kilmarnock Creek (EMS 0200201)

Measured and Simulated Sulphate Data and Calibration Statistics

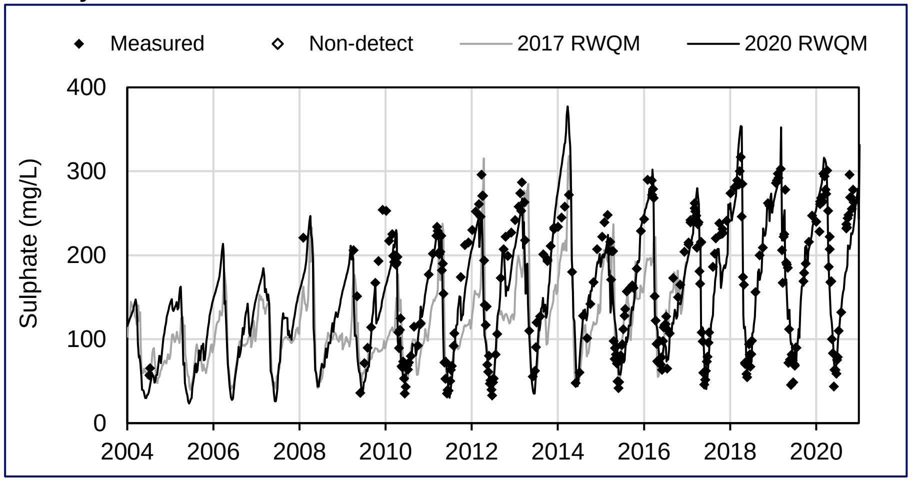
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	7/7/2004	7/7/2004
Last Measured Sample	12/12/2016	12/5/2018
Data Points Available for Comparison, n	180	242
Non-Detect Count	0	0
Measured Mean (mg/L)	148	155
Simulated Mean (mg/L)	125	147
Bias (mg/L)	-23	-8.2
Relative Bias	0.85	0.95
Error (mg/L)	42	27
Percent Error	29%	17%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)

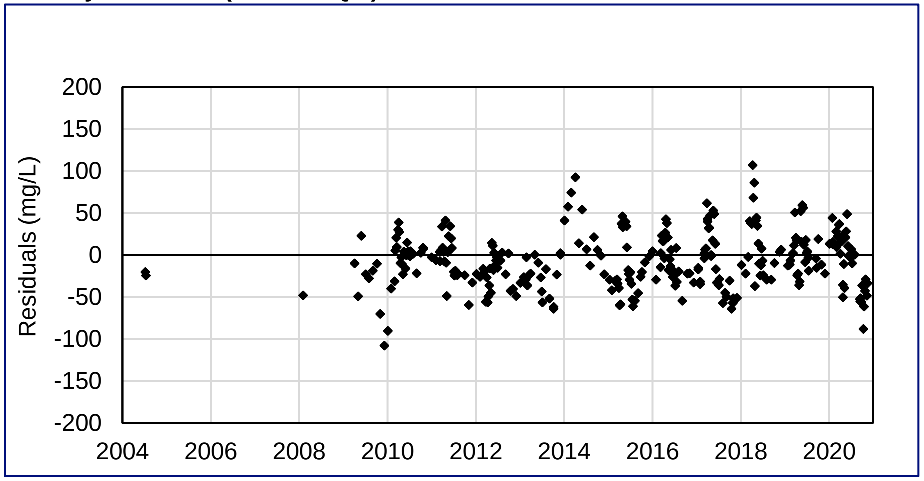


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

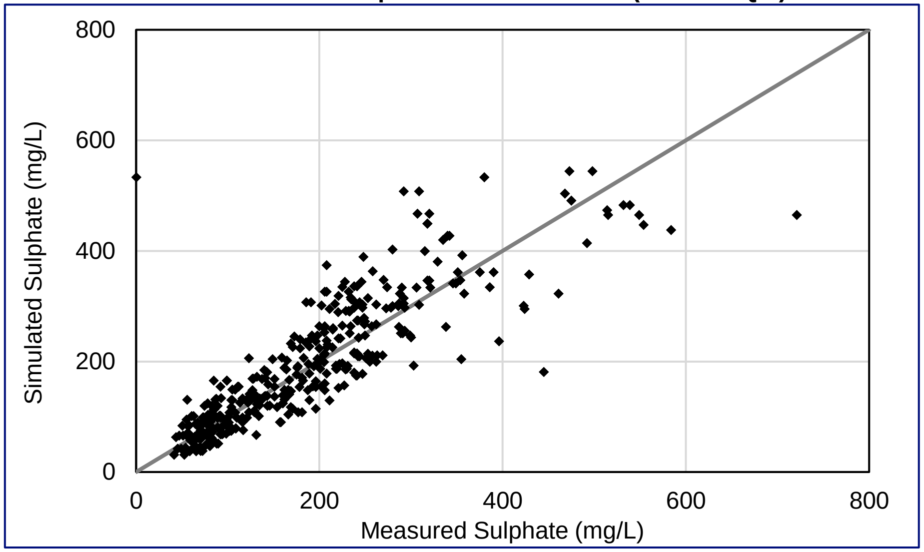
B3-27: Sulphate Calibration Information for Node FR_FR4 - Fording River between Swift and Cataract Creeks (EMS 0200311)

Measured and Simulated Sulphate Data and Calibration Statistics

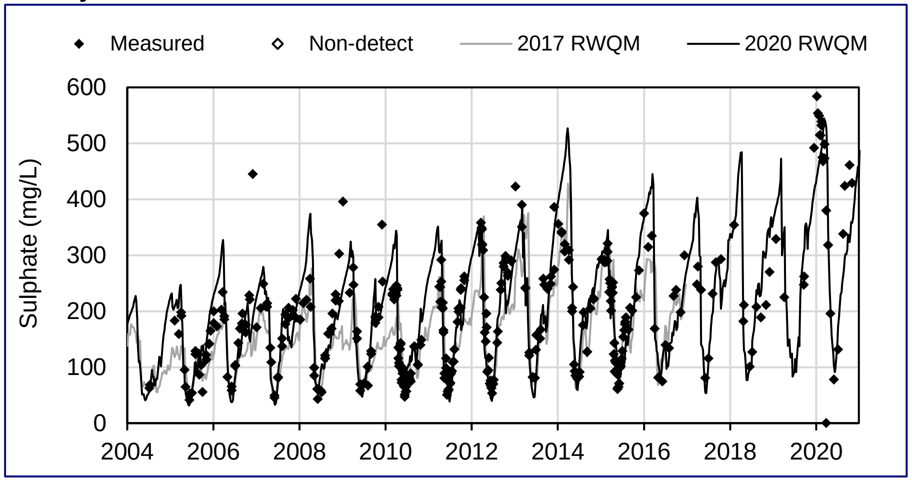
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	7/7/2004	7/7/2004
Last Measured Sample	12/12/2016	12/5/2018
Data Points Available for Comparison, n	339	356
Non-Detect Count	0	0
Measured Mean (mg/L)	168	170
Simulated Mean (mg/L)	153	178
Bias (mg/L)	-15	7.8
Relative Bias	0.91	1.0
Error (mg/L)	42	37
Percent Error	25%	22%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



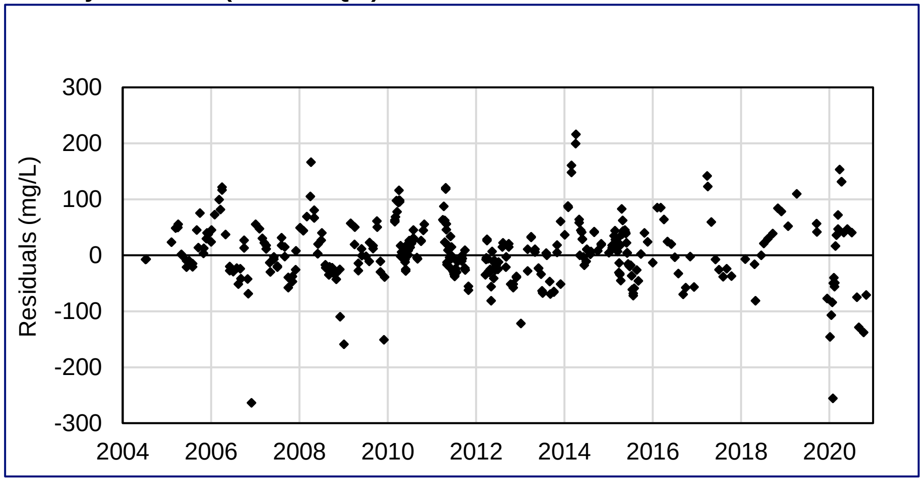
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-28: Sulphate Calibration Information for Node FR_FRCP1 - Fording River, 525 m d/s of Cataract Creek (EMS E300071)

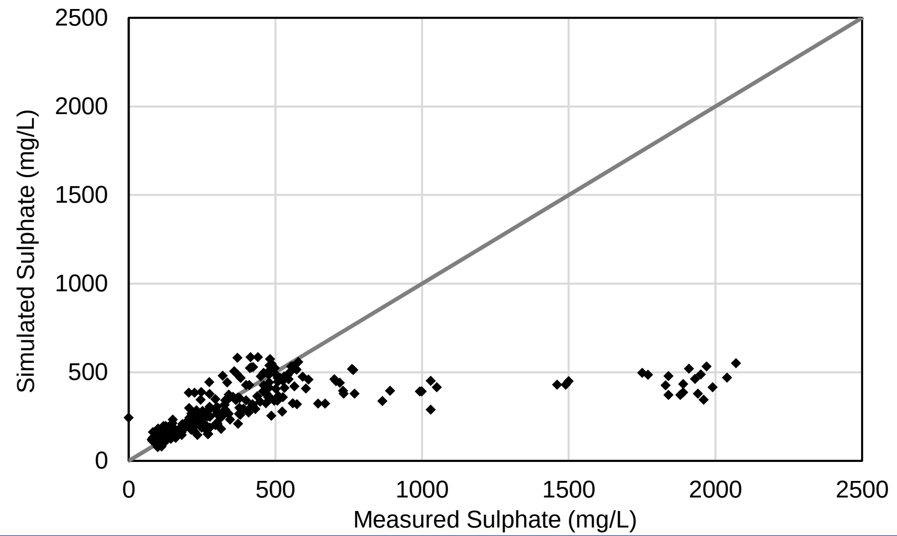
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/3/2015	2/3/2015
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	82	155
Non-Detect Count	0	0
Measured Mean (mg/L)	-	446
Simulated Mean (mg/L)	-	288
Bias (mg/L)	-	-158
Relative Bias	-	0.65
Error (mg/L)	-	202
Percent Error	-	45%

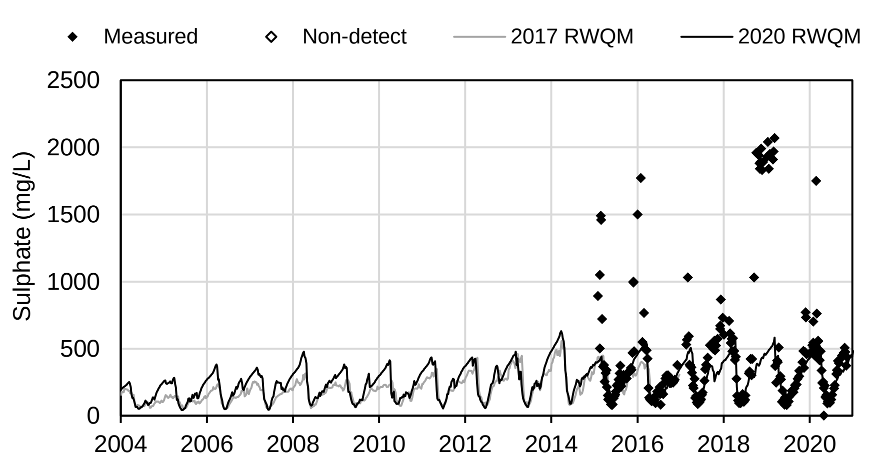
[a] As adjusted for the 2019 IPA.

[b] Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)

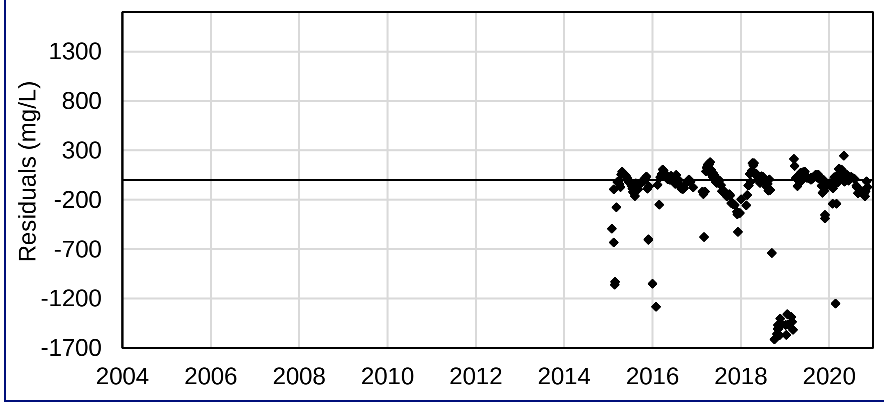


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

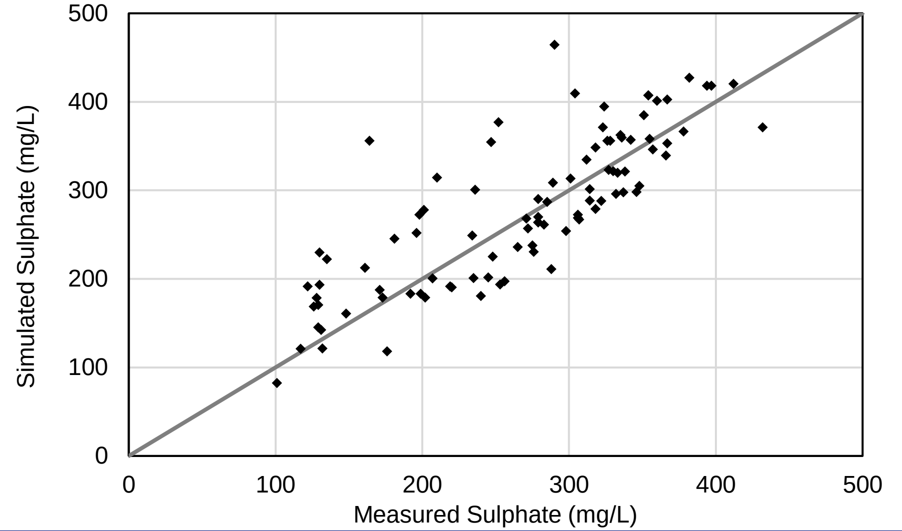
B3-29: Sulphate Calibration Information for Node GH_PC2 - Fording River d/s of Porter Creek (EMS E287431)

Measured and Simulated Sulphate Data and Calibration Statistics

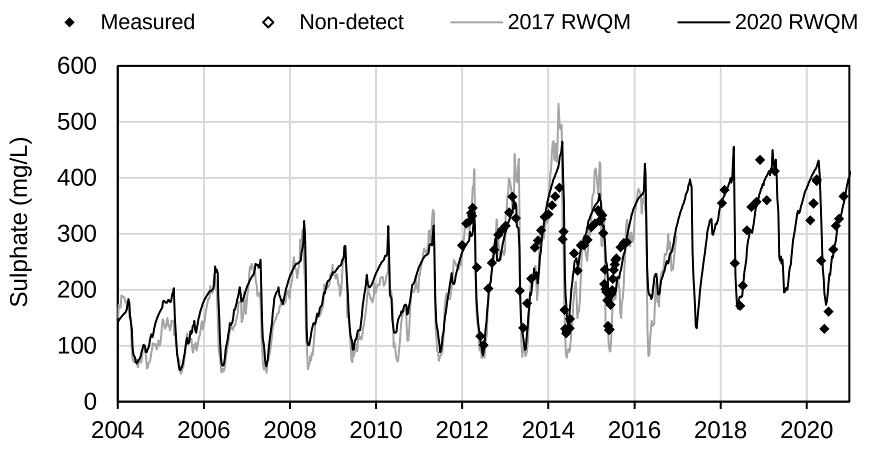
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/3/2012	1/3/2012
Last Measured Sample	11/2/2015	12/5/2018
Data Points Available for Comparison, n	72	81
Non-Detect Count	0	0
Measured Mean (mg/L)	253	259
Simulated Mean (mg/L)	241	267
Bias (mg/L)	-12	7.6
Relative Bias	0.95	1.0
Error (mg/L)	47	39
Percent Error	18%	15%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



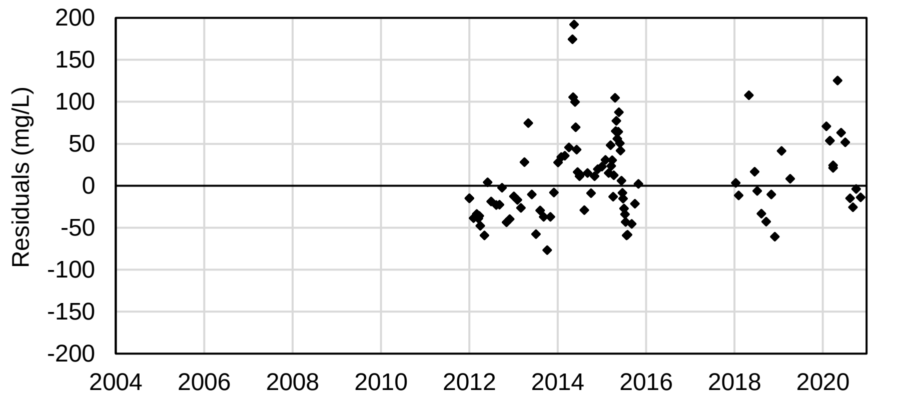
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-30: Sulphate Calibration Information for Node FR_FRABCH - FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (EMS E223753)

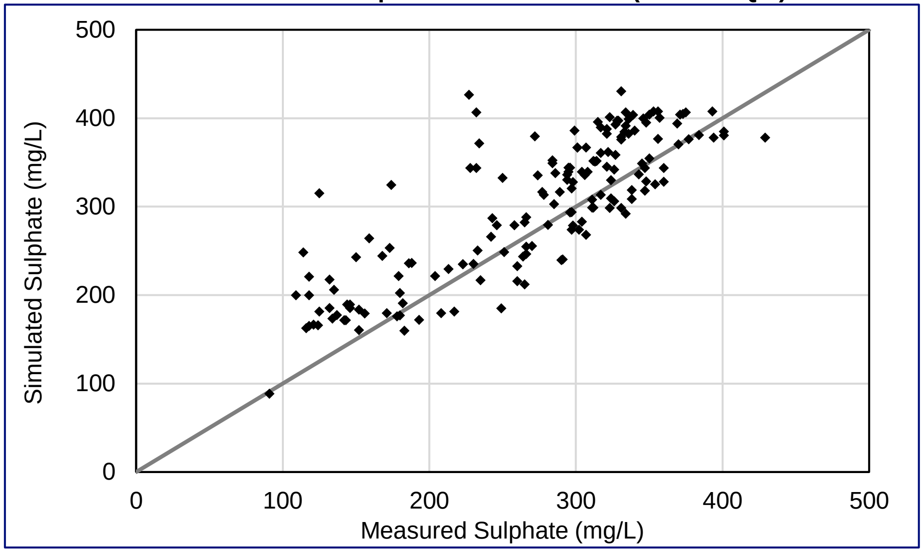
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/24/2013	6/24/2013
Last Measured Sample	12/8/2016	12/6/2018
Data Points Available for Comparison, n	24	71
Non-Detect Count	0	0
Measured Mean (mg/L)	-	266
Simulated Mean (mg/L)	-	281
Bias (mg/L)	-	15
Relative Bias	-	1.1
Error (mg/L)	-	37
Percent Error	-	14%

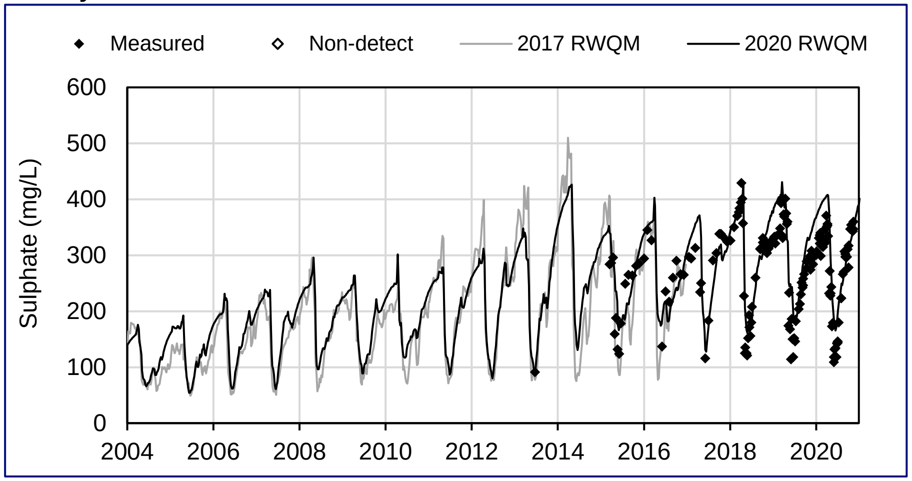
[a] As adjusted for the 2019 IPA.

[b] Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



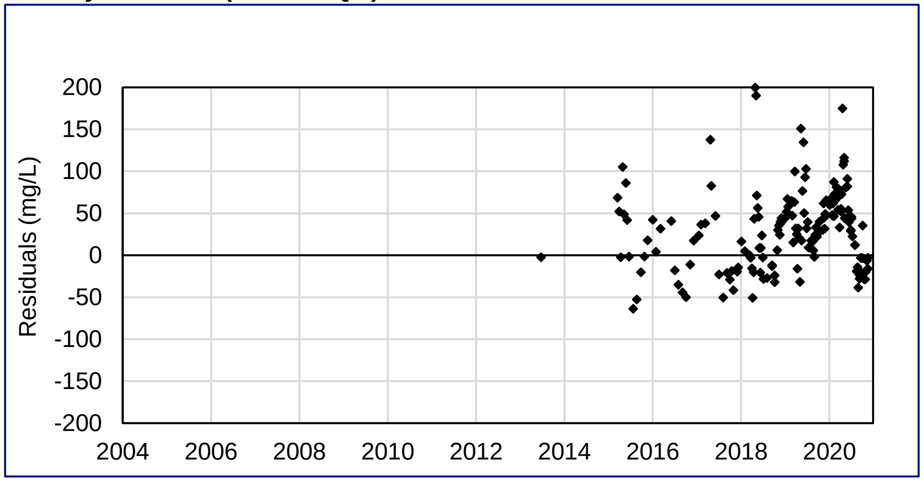
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-31: Sulphate Calibration Information for Node LC_FRDSDC - Fording River d/s of Dry Creek (EMS E288272)

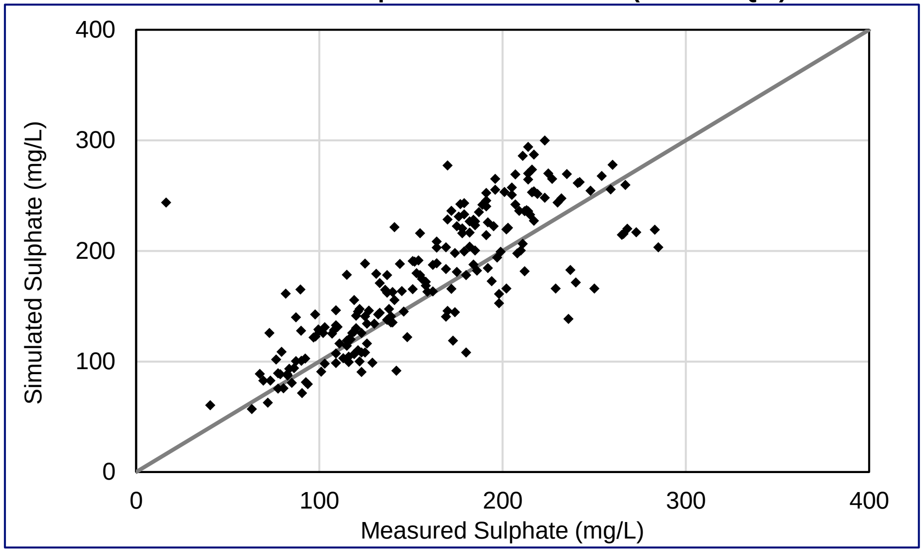
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/7/2011	12/7/2011
Last Measured Sample	12/6/2016	12/5/2018
Data Points Available for Comparison, n	108	160
Non-Detect Count	0	0
Measured Mean (mg/L)	-	154
Simulated Mean (mg/L)	-	171
Bias (mg/L)	-	18
Relative Bias	-	1.1
Error (mg/L)	-	26
Percent Error	-	17%

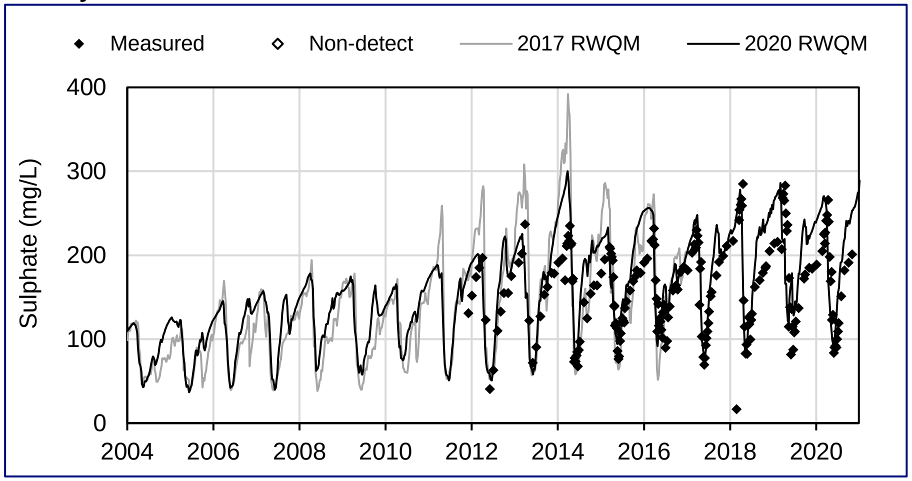
[(a)] As adjusted for the 2019 IPA.

[(b)] Location was not presented in the 2017 RWQM.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



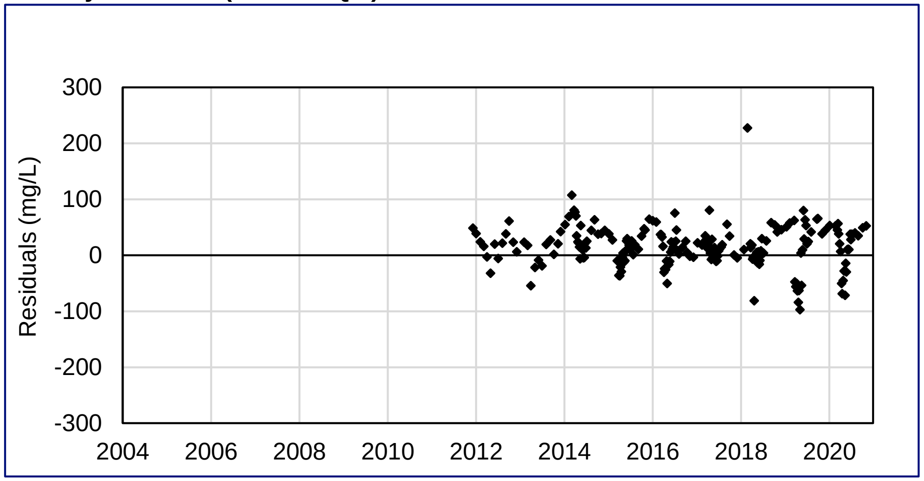
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

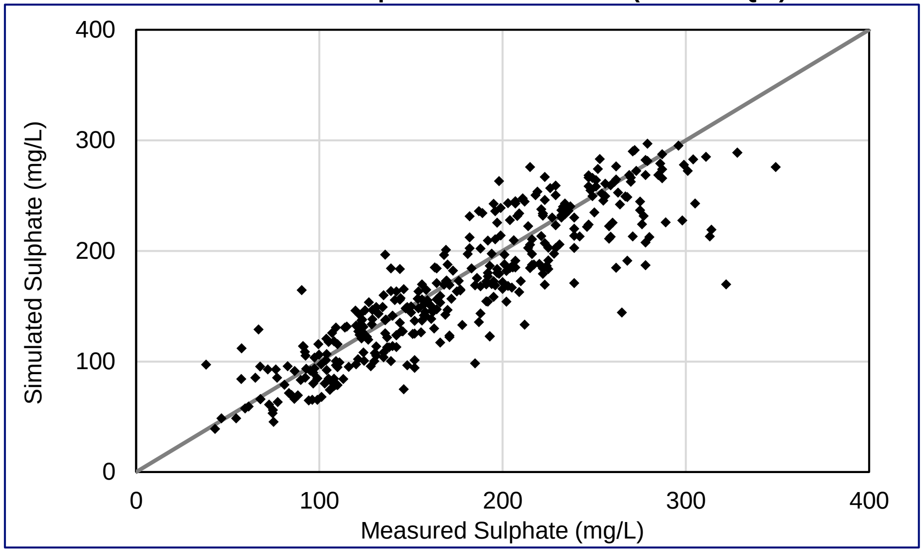
B3-32: Sulphate Calibration Information for Node GH_FR1 - GHO Fording River Compliance Point (EMS 0200378)

Measured and Simulated Sulphate Data and Calibration Statistics

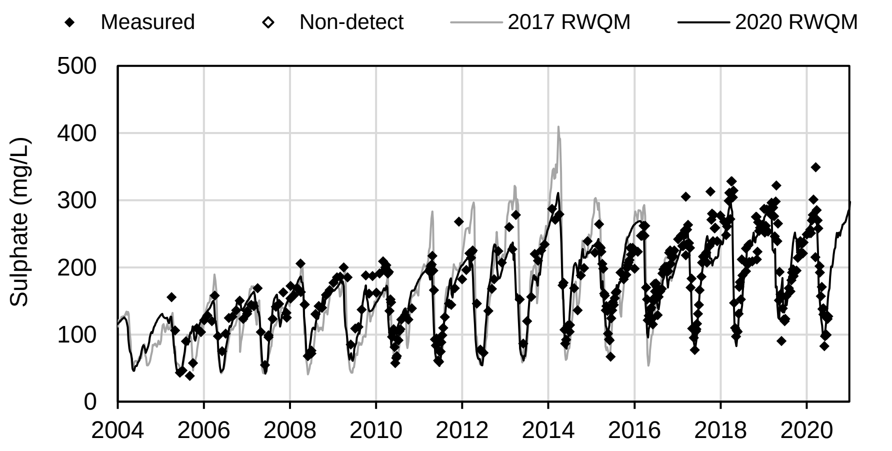
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	238	316
Non-Detect Count	0	0
Measured Mean (mg/L)	157	171
Simulated Mean (mg/L)	150	162
Bias (mg/L)	-6.8	-8.8
Relative Bias	0.96	0.95
Error (mg/L)	27	22
Percent Error	17%	13%

[a] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



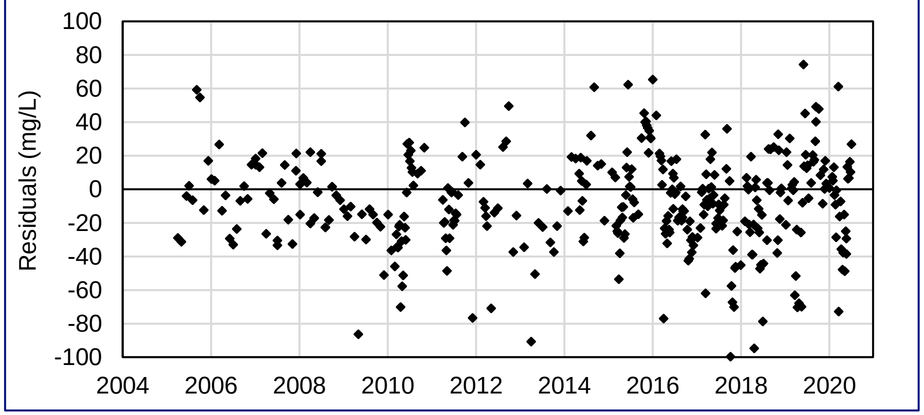
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

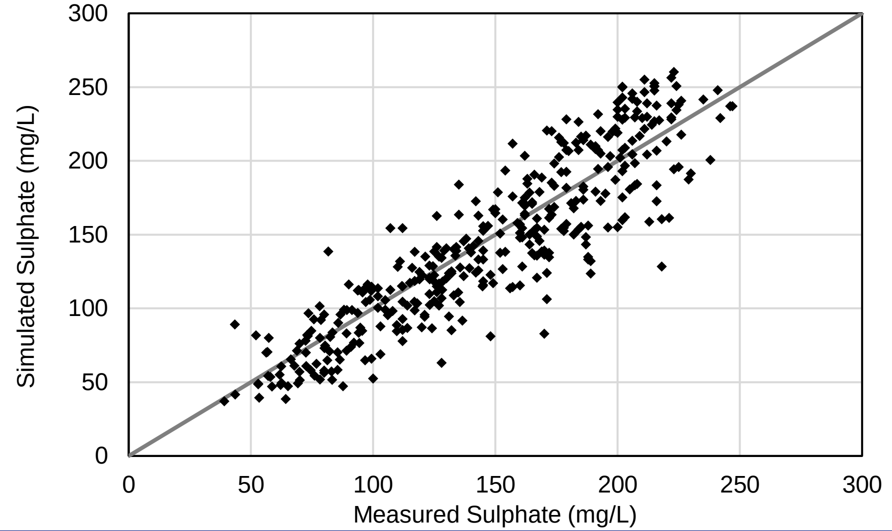
B3-33: Sulphate Calibration Information for Node LC_LC5 - Fording River d/s of Line Creek (EMS 0200028)

Measured and Simulated Sulphate Data and Calibration Statistics

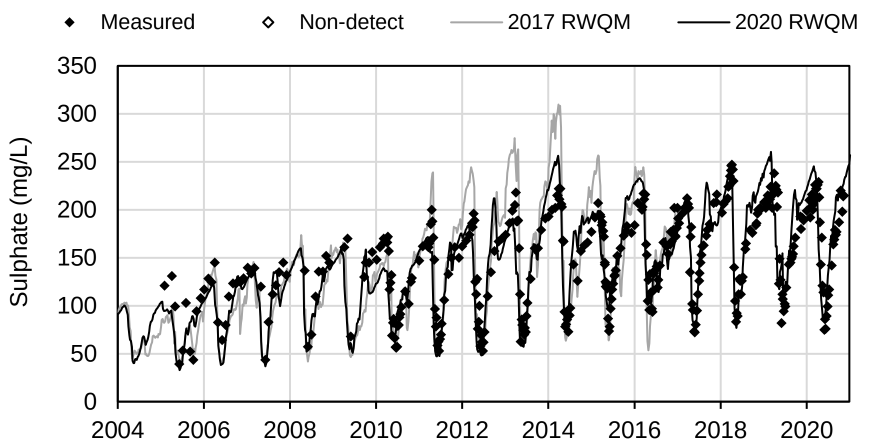
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/2/2005	2/2/2005
Last Measured Sample	12/28/2016	12/4/2018
Data Points Available for Comparison, n	243	309
Non-Detect Count	0	0
Measured Mean (mg/L)	134	141
Simulated Mean (mg/L)	136	136
Bias (mg/L)	2.2	-5.8
Relative Bias	1.0	0.96
Error (mg/L)	25	18
Percent Error	18%	13%

(a) As adjusted for the 2019 IPA.

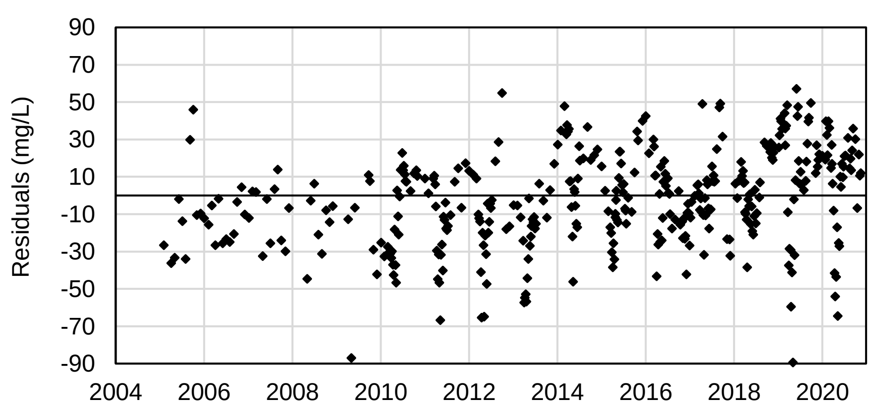
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

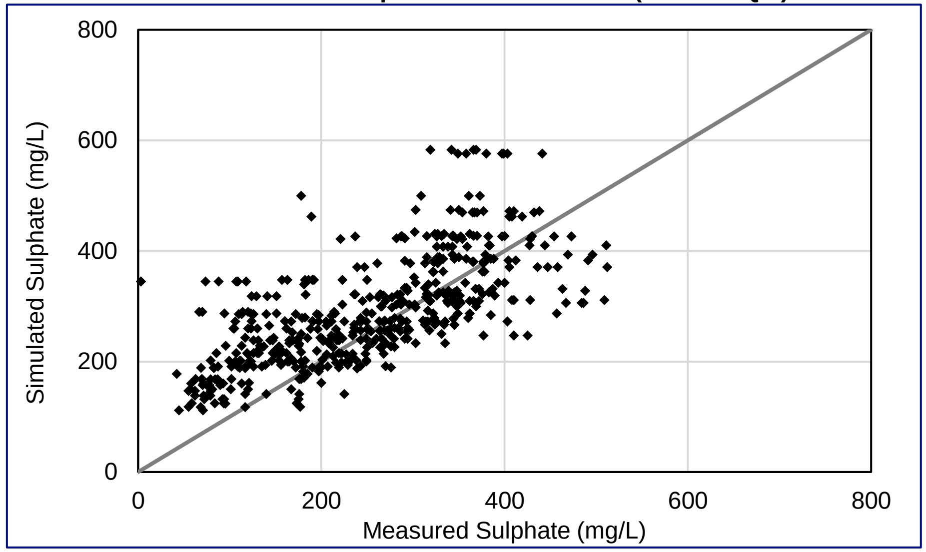
B3-34: Sulphate Calibration Information for Node CM_MC2 - CMO Compliance Point (EMS E258937)

Measured and Simulated Sulphate Data and Calibration Statistics

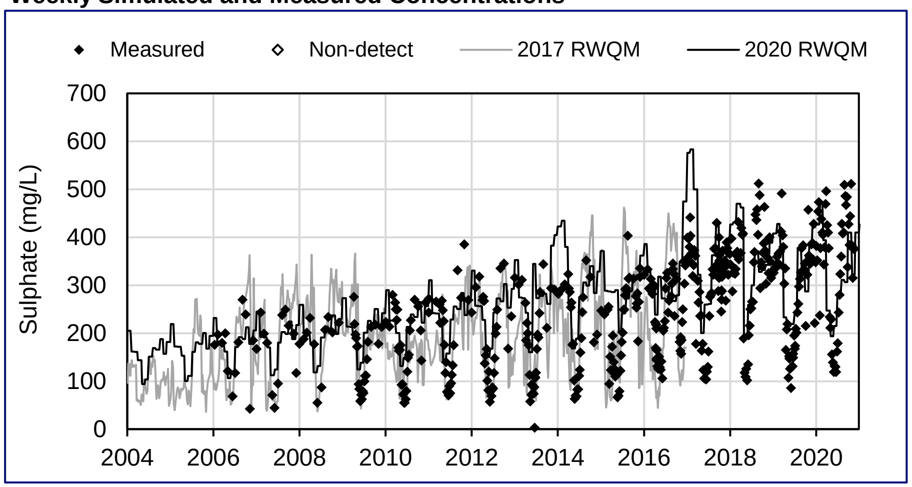
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/11/2006	1/11/2006
Last Measured Sample	12/21/2016	12/28/2018
Data Points Available for Comparison, n	281	399
Non-Detect Count	0	0
Measured Mean (mg/L)	195	230
Simulated Mean (mg/L)	181	279
Bias (mg/L)	-14	49
Relative Bias	0.93	1.2
Error (mg/L)	70	72
Percent Error	36%	31%

(a) As adjusted for the 2019 IPA.

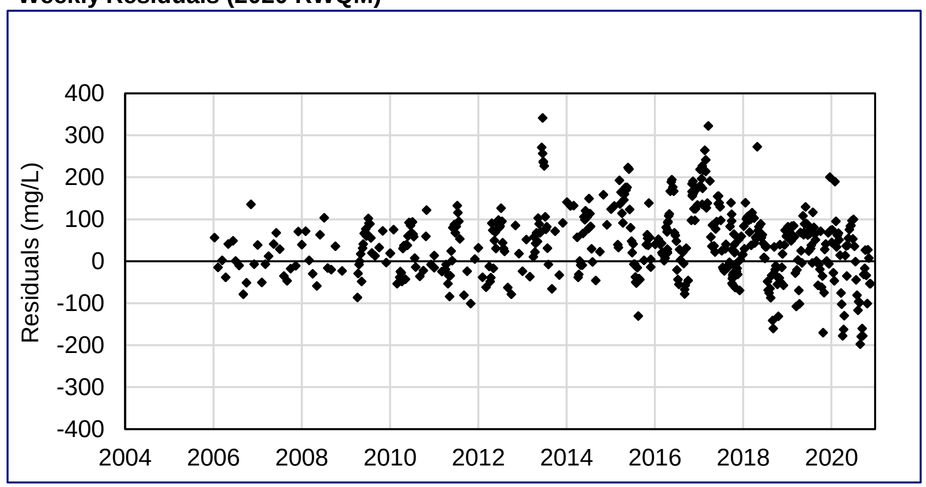
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

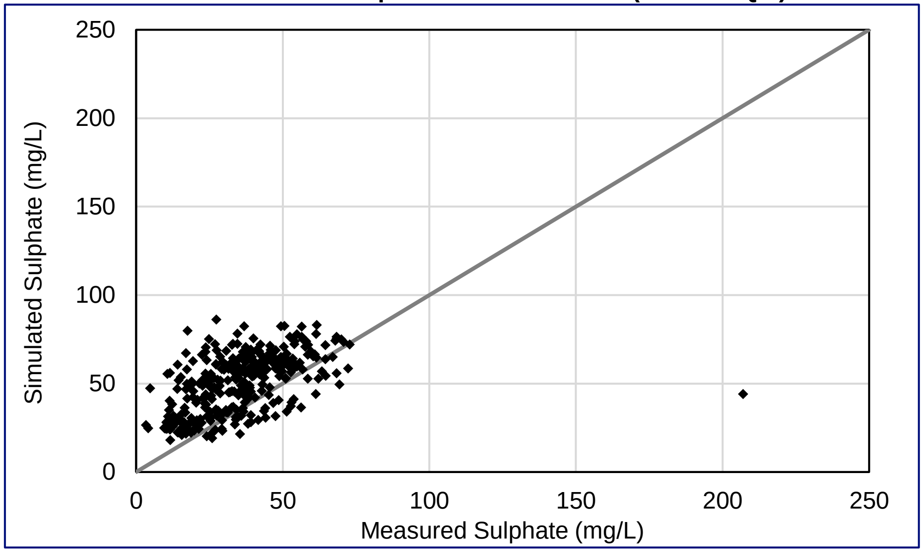
B3-35: Sulphate Calibration Information for Node EV_MC3 - Michel Creek u/s of Erickson Creek (EMS 0200203)

Measured and Simulated Sulphate Data and Calibration Statistics

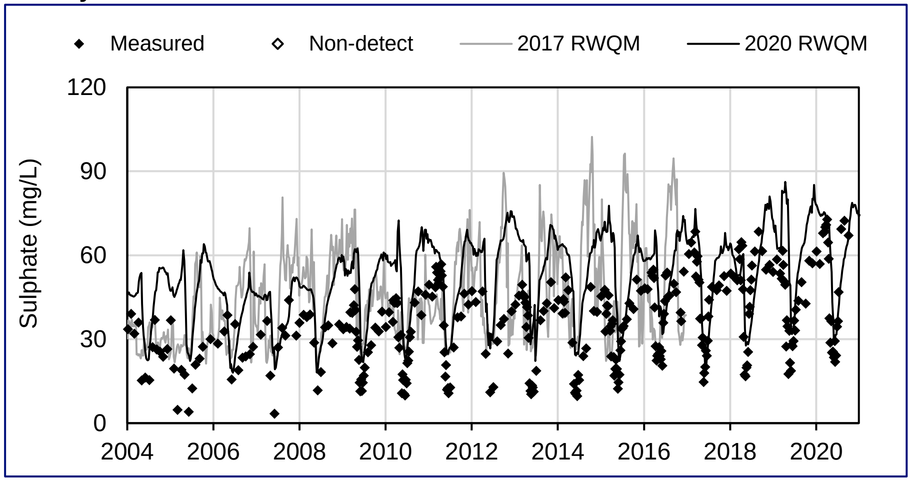
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	247	298
Non-Detect Count	0	0
Measured Mean (mg/L)	33	35
Simulated Mean (mg/L)	42	49
Bias (mg/L)	9.7	15
Relative Bias	1.3	1.4
Error (mg/L)	15	18
Percent Error	47%	51%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)

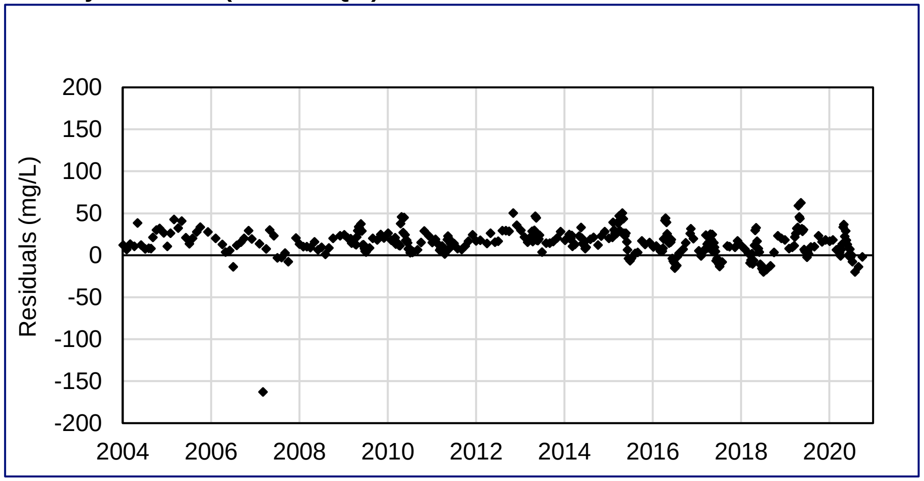


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-36: Sulphate Calibration Information for Node EV_MC2 - EVO Michel Creek Compliance Point (EMS E300091)

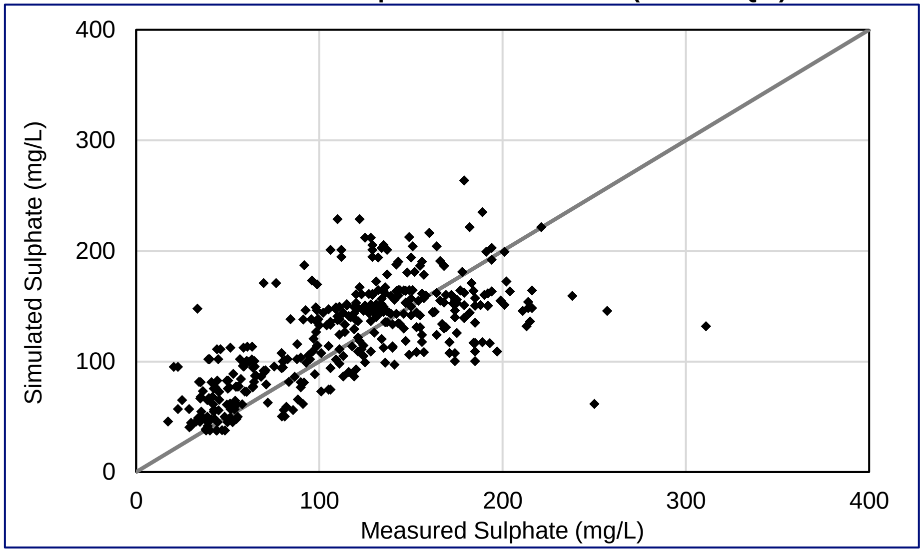
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/3/2014	12/3/2014
Last Measured Sample	12/5/2016	12/31/2018
Data Points Available for Comparison, n	87	210
Non-Detect Count	0	0
Measured Mean (mg/L)	-	122
Simulated Mean (mg/L)	-	114
Bias (mg/L)	-	-7.7
Relative Bias	-	0.94
Error (mg/L)	-	30
Percent Error	-	24%

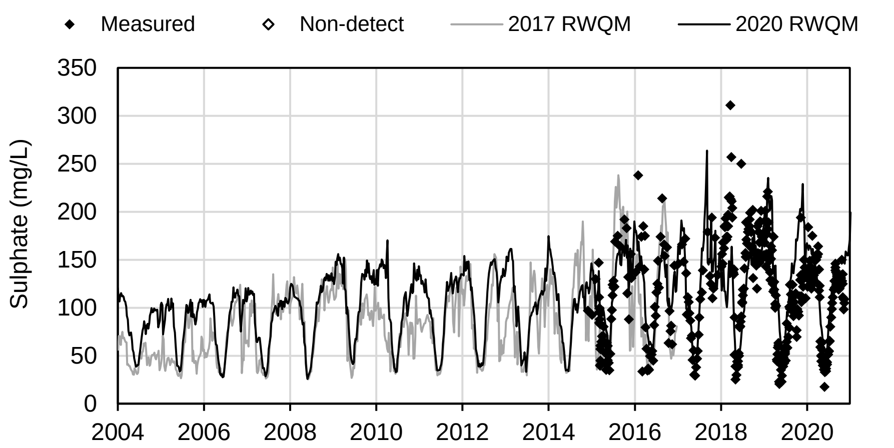
[a] As adjusted for the 2019 IPA.

[b] Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



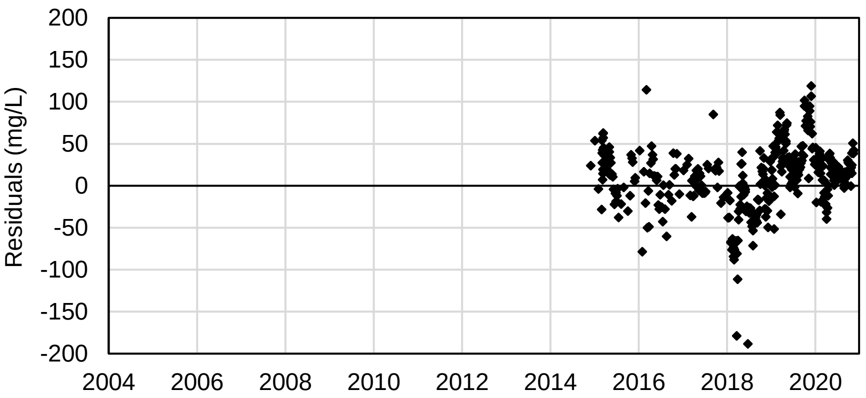
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

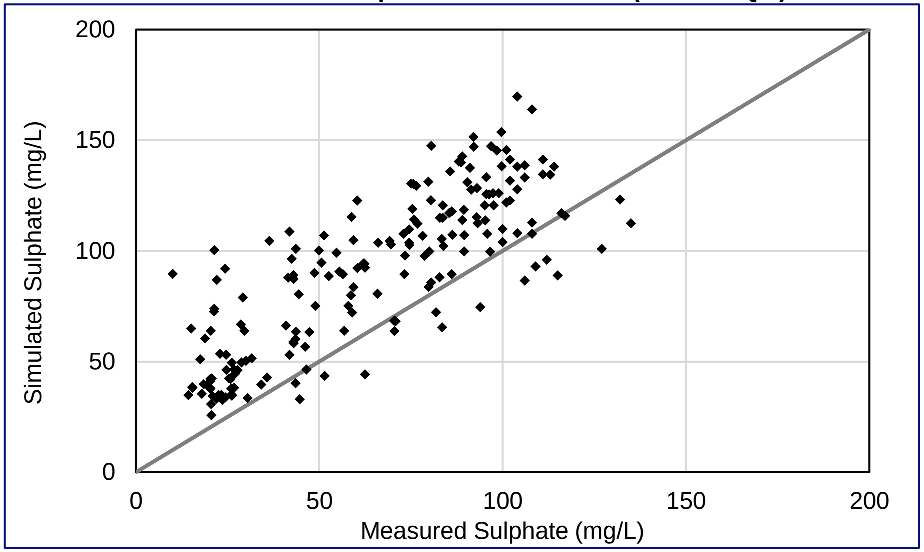
B3-37: Sulphate Calibration Information for Node EV_MC1 - Michel Creek u/s of Highway 43 Bridge (EMS 0200425)

Measured and Simulated Sulphate Data and Calibration Statistics

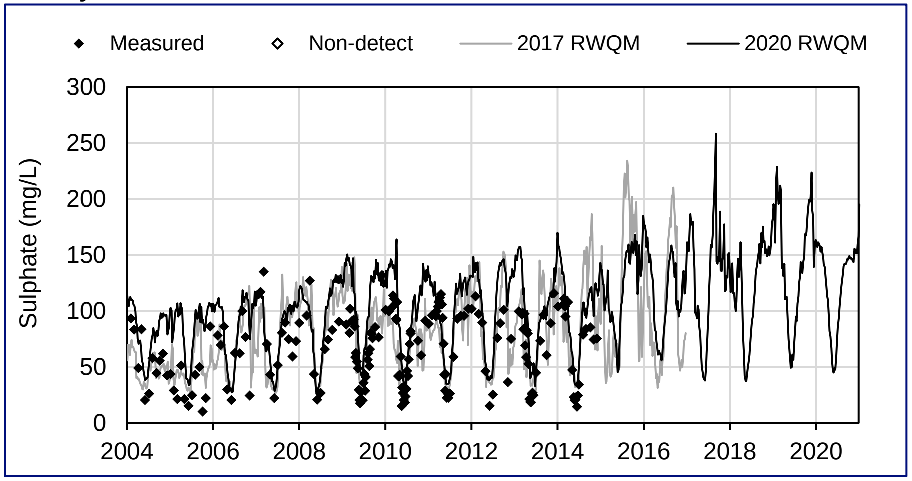
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/3/2004	2/3/2004
Last Measured Sample	12/3/2014	12/3/2014
Data Points Available for Comparison, n	193	193
Non-Detect Count	0	0
Measured Mean (mg/L)	65	65
Simulated Mean (mg/L)	72	90
Bias (mg/L)	7.7	26
Relative Bias	1.1	1.4
Error (mg/L)	22	28
Percent Error	34%	44%

[a] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



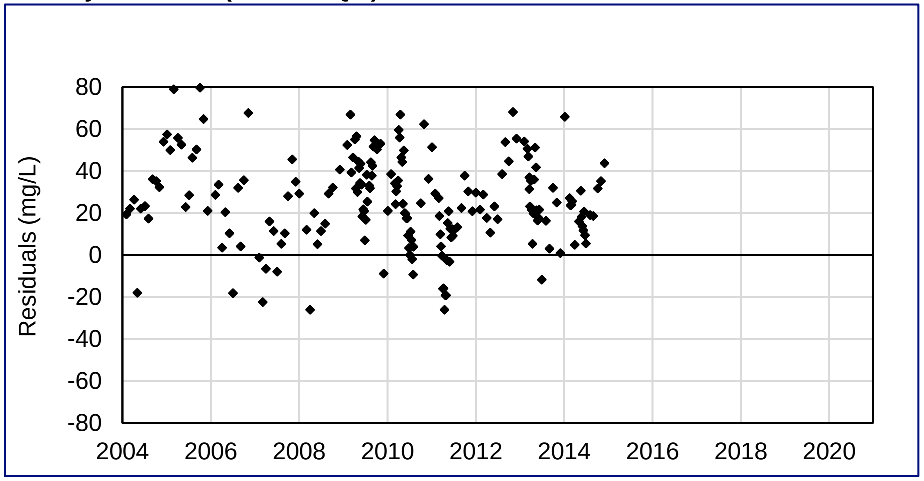
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-38: Sulphate Calibration Information for Node GH_ERC - GHO Elk River Compliance Point (EMS E300090)

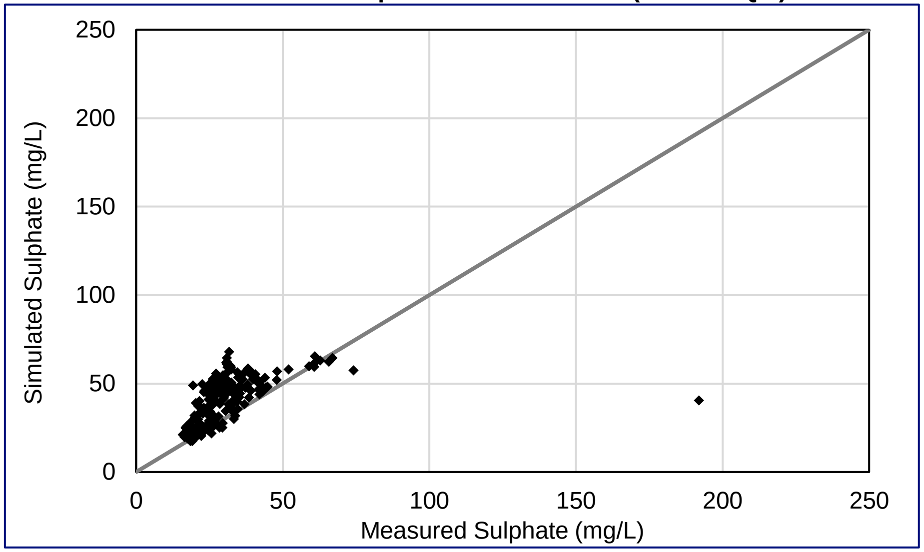
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[(a,b)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/4/2014	12/4/2014
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	68	135
Non-Detect Count	0	0
Measured Mean (mg/L)	-	30
Simulated Mean (mg/L)	-	41
Bias (mg/L)	-	11
Relative Bias	-	1.4
Error (mg/L)	-	11
Percent Error	-	38%

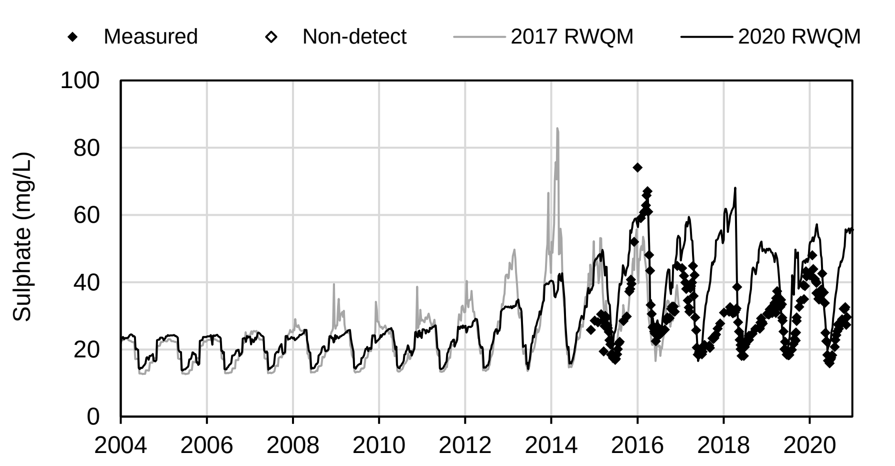
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



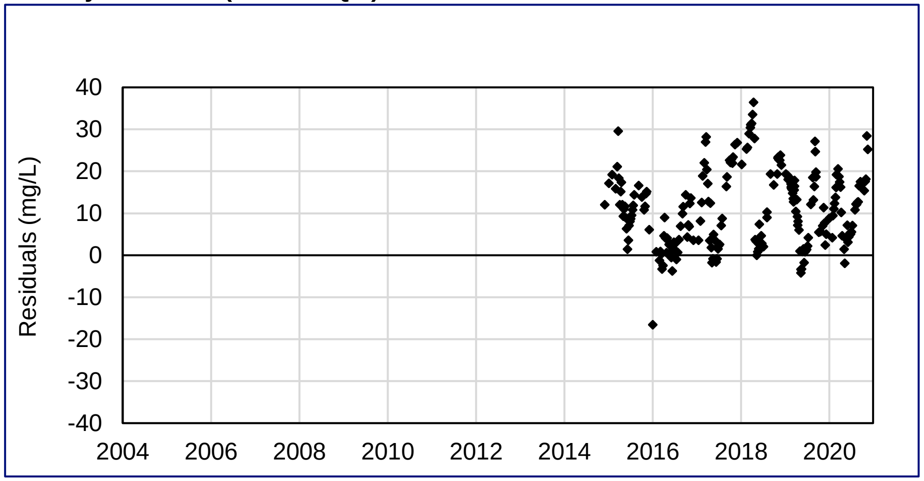
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

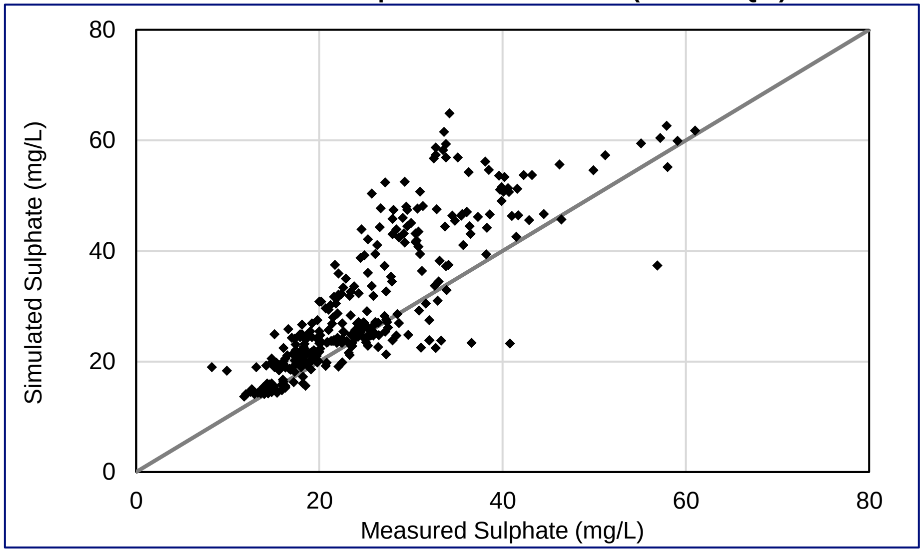
B3-39: Sulphate Calibration Information for Node GH_ER1 - Elk River u/s of Boivin Creek (u/s of Fording River) (EMS E206661)

Measured and Simulated Sulphate Data and Calibration Statistics

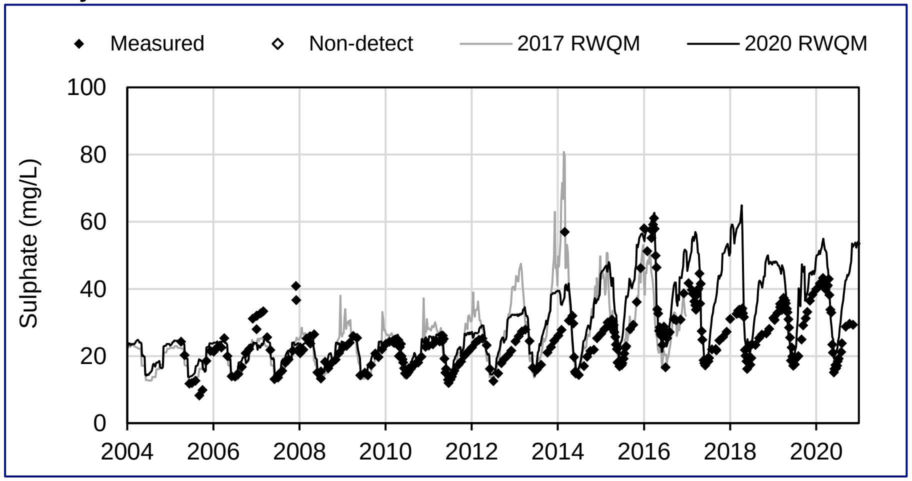
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/3/2005	4/3/2005
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	213	265
Non-Detect Count	0	0
Measured Mean (mg/L)	23	24
Simulated Mean (mg/L)	24	29
Bias (mg/L)	0.49	4.6
Relative Bias	1.0	1.2
Error (mg/L)	4.8	5.8
Percent Error	20%	24%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



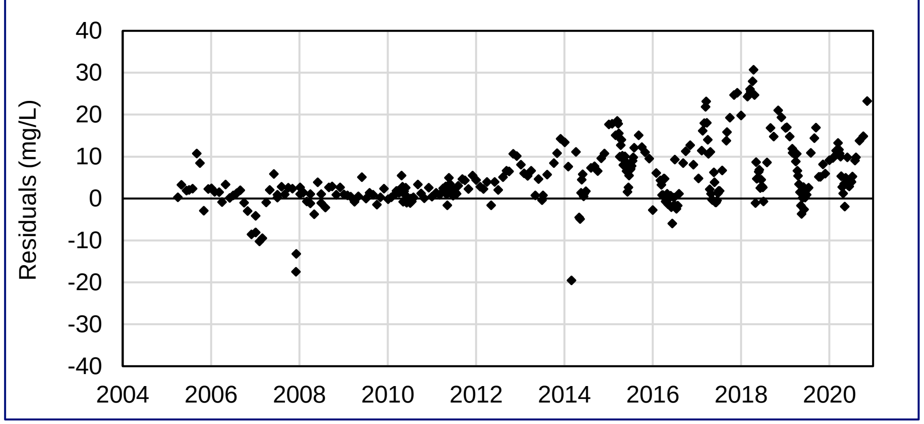
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

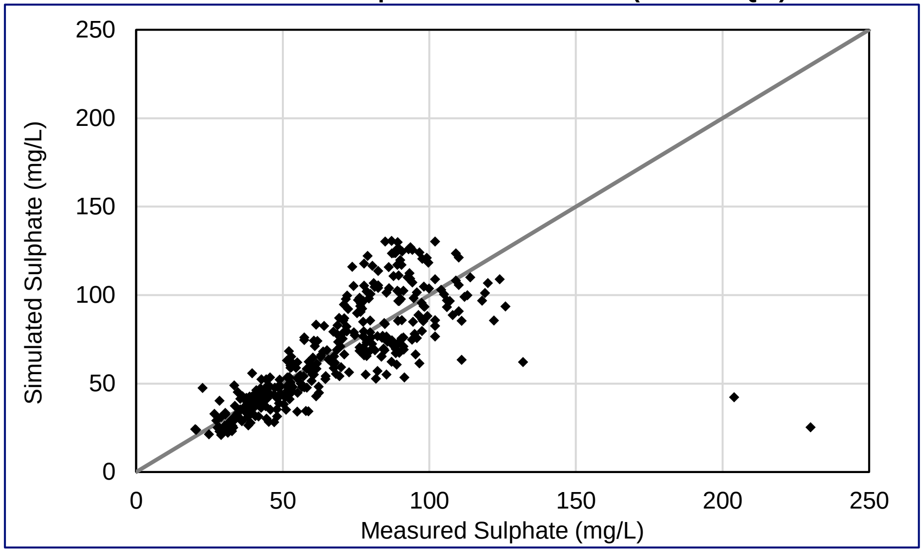
B3-40: Sulphate Calibration Information for Node EV_ER4 - Elk River u/s of Grave Creek (EMS 0200027)

Measured and Simulated Sulphate Data and Calibration Statistics

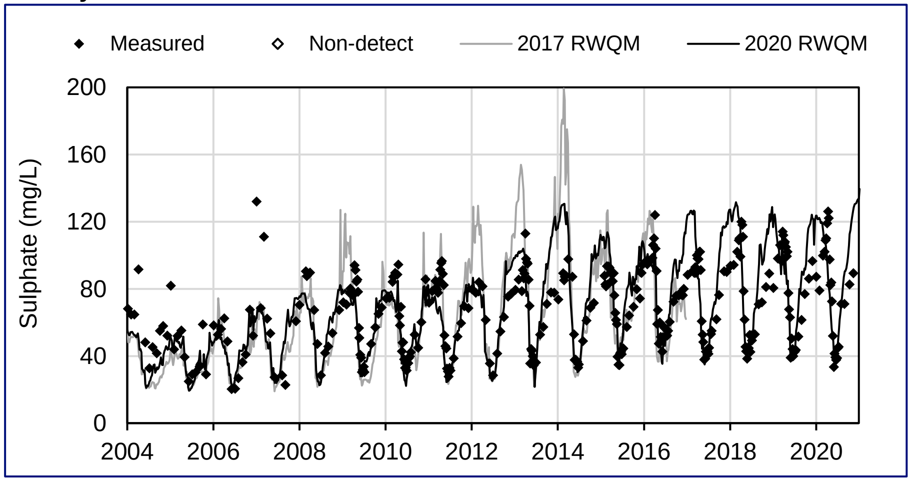
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/6/2016	12/3/2018
Data Points Available for Comparison, n	251	303
Non-Detect Count	0	0
Measured Mean (mg/L)	65	66
Simulated Mean (mg/L)	62	66
Bias (mg/L)	-3.0	-0.9
Relative Bias	0.95	0.99
Error (mg/L)	16	13
Percent Error	25%	19%

(a) As adjusted for the 2019 IPA.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



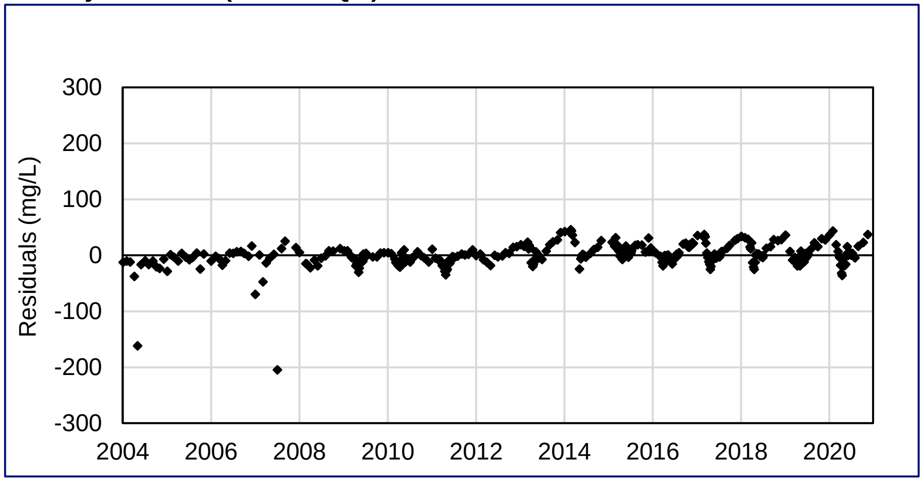
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-41: Sulphate Calibration Information for Node EV_ER2 - Elk River u/s of Michel Creek (EMS 0200111)

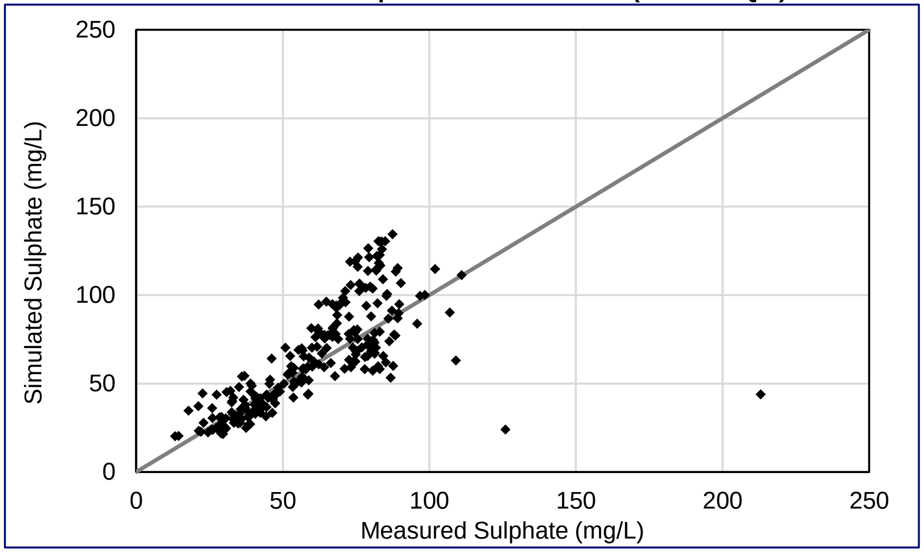
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/2/2004	3/2/2004
Last Measured Sample	12/6/2016	12/3/2018
Data Points Available for Comparison, n	196	221
Non-Detect Count	0	0
Measured Mean (mg/L)	-	59
Simulated Mean (mg/L)	-	62
Bias (mg/L)	-	2.8
Relative Bias	-	1.0
Error (mg/L)	-	13
Percent Error	-	22%

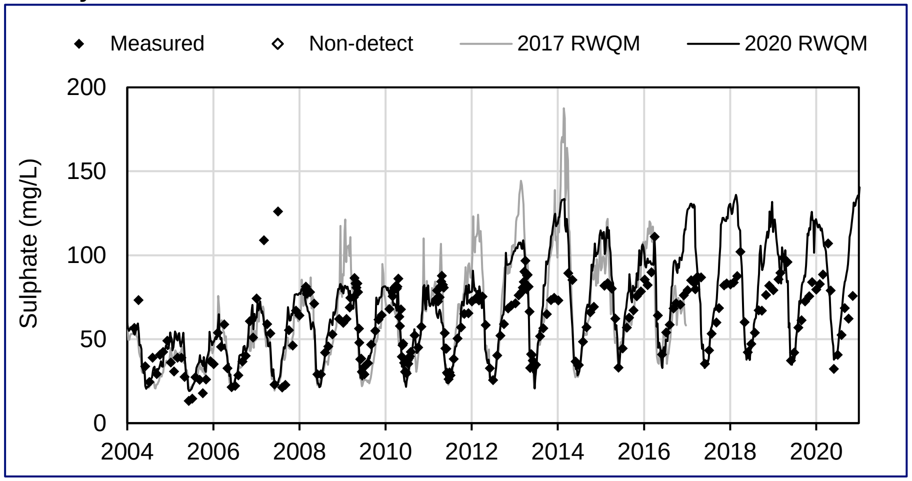
[a] As adjusted for the 2019 IPA.

[b] Location was not presented in the 2017 RWQM.

Simulated versus Measured Sulphate Concentrations (2020 RWQM)



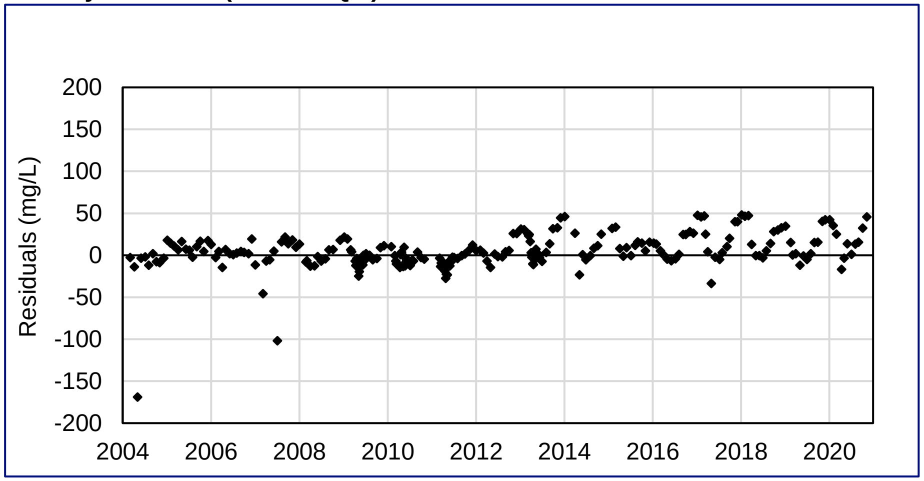
Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

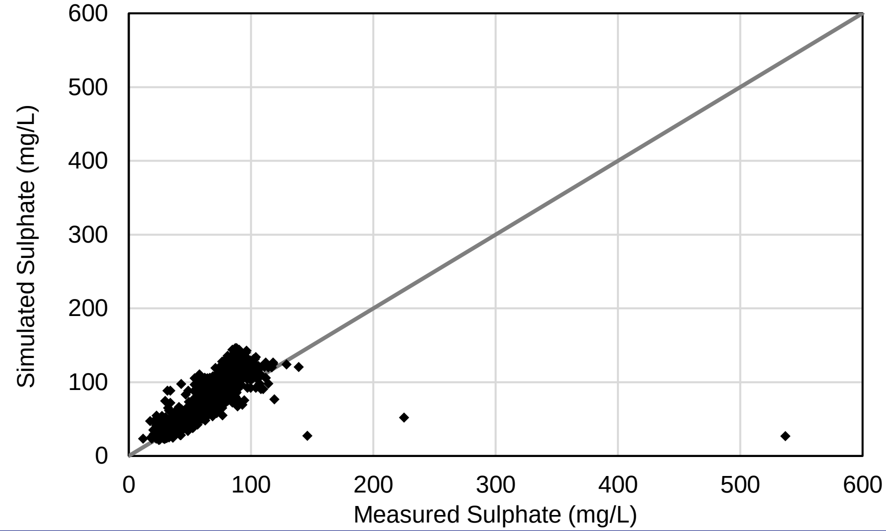
B3-42: Sulphate Calibration Information for Node EV_ER1 - Elk River d/s of Michel Creek (EMS 0200393)

Measured and Simulated Sulphate Data and Calibration Statistics

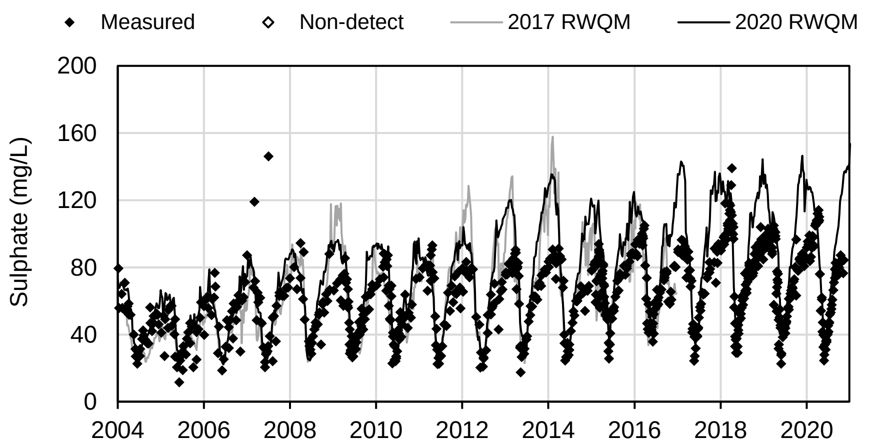
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/6/2004	1/6/2004
Last Measured Sample	12/18/2016	12/31/2018
Data Points Available for Comparison, n	539	686
Non-Detect Count	0	0
Measured Mean (mg/L)	59	63
Simulated Mean (mg/L)	60	74
Bias (mg/L)	1.4	11
Relative Bias	1.0	1.2
Error (mg/L)	13	16
Percent Error	23%	26%

[(a)] As adjusted for the 2019 IPA.

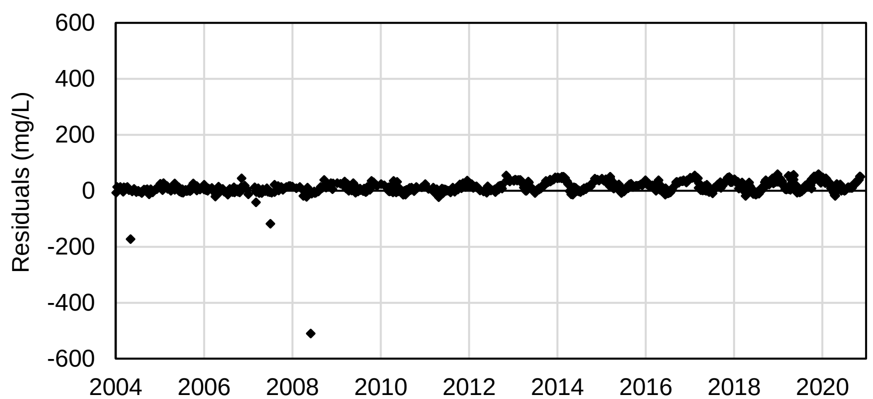
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

B3-43: Sulphate Calibration Information for Node RG_ELKORES - Elk River at Elko Reservoir (EMS E294312)

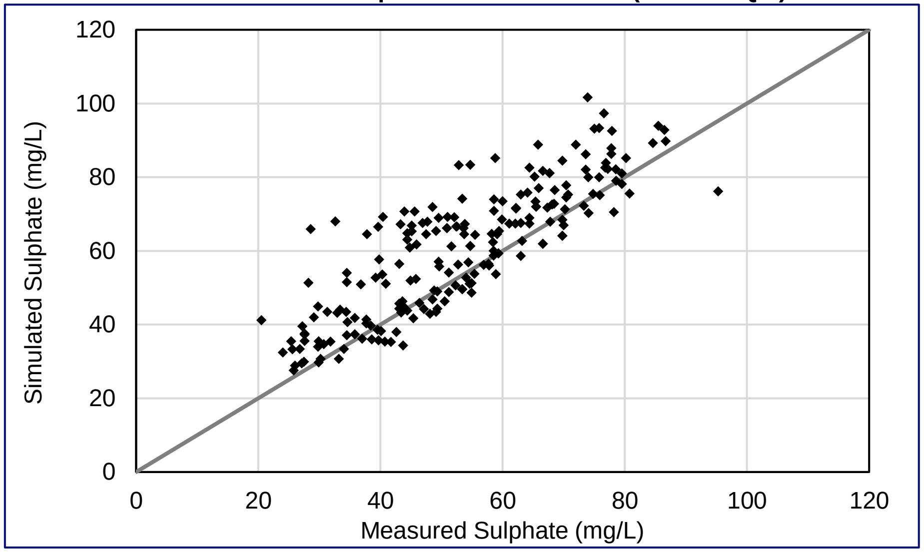
Measured and Simulated Sulphate Data and Calibration Statistics

Statistic	2017 RWQM[a,b]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	9/23/2009	9/23/2009
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	102	155
Non-Detect Count	0	0
Measured Mean (mg/L)	-	53
Simulated Mean (mg/L)	-	60
Bias (mg/L)	-	6.8
Relative Bias	-	1.1
Error (mg/L)	-	8.7
Percent Error	-	16%

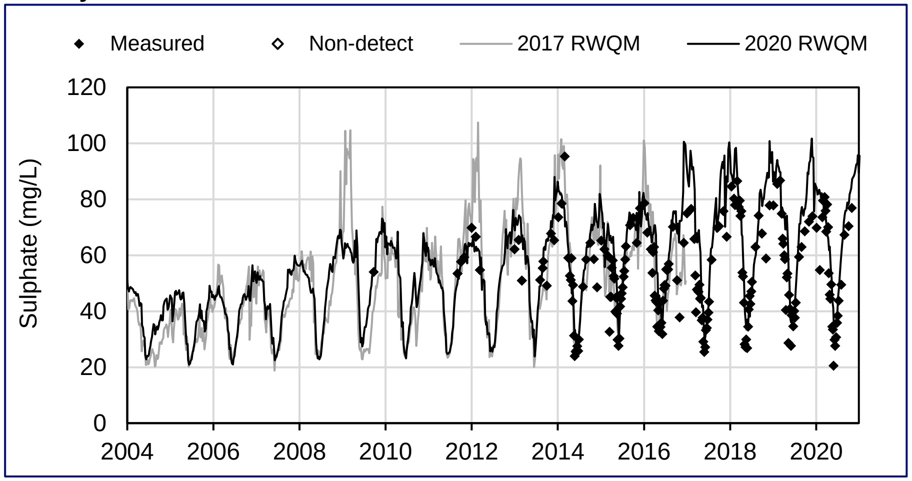
(a) As adjusted for the 2019 IPA.

(b) Calibration statistics were not provided for the 2017 RWQM, because of the limited amount of monitoring data available.

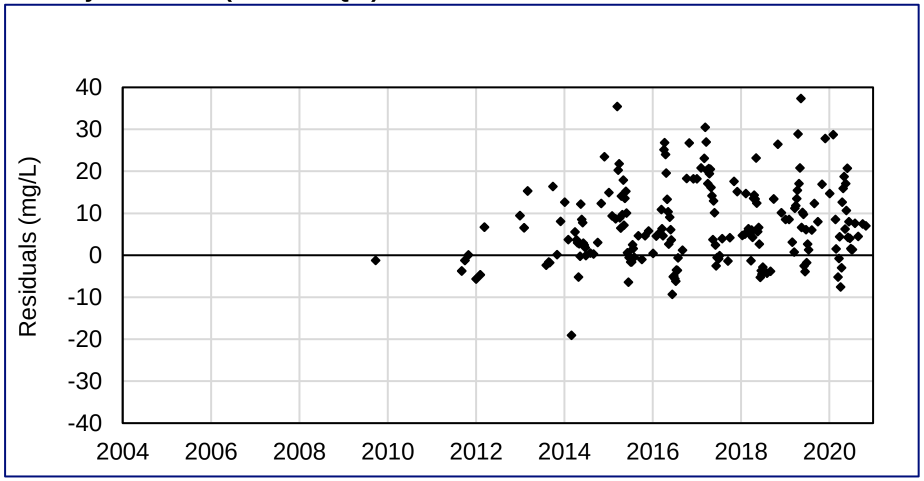
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

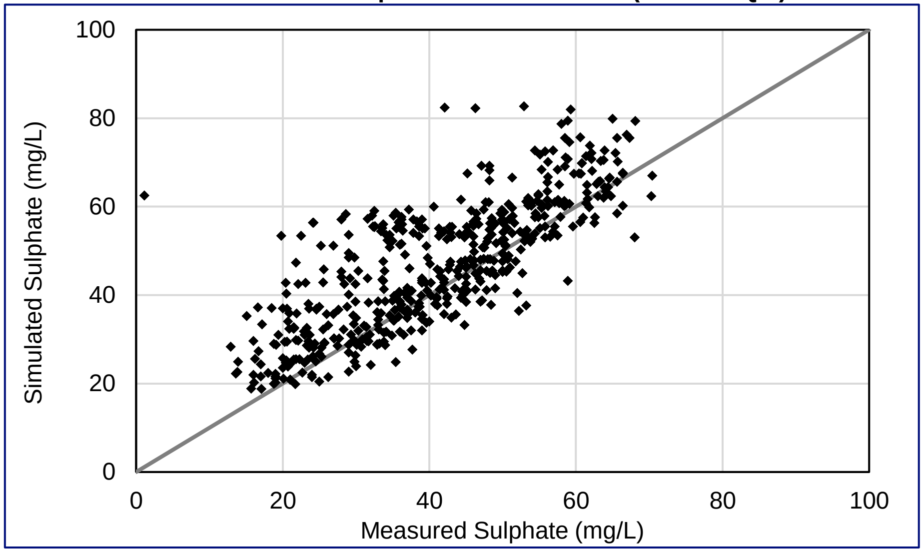
B3-44: Sulphate Calibration Information for Node RG_ELKMOUTH - Elk River at Highway 93 near Elko

Measured and Simulated Sulphate Data and Calibration Statistics

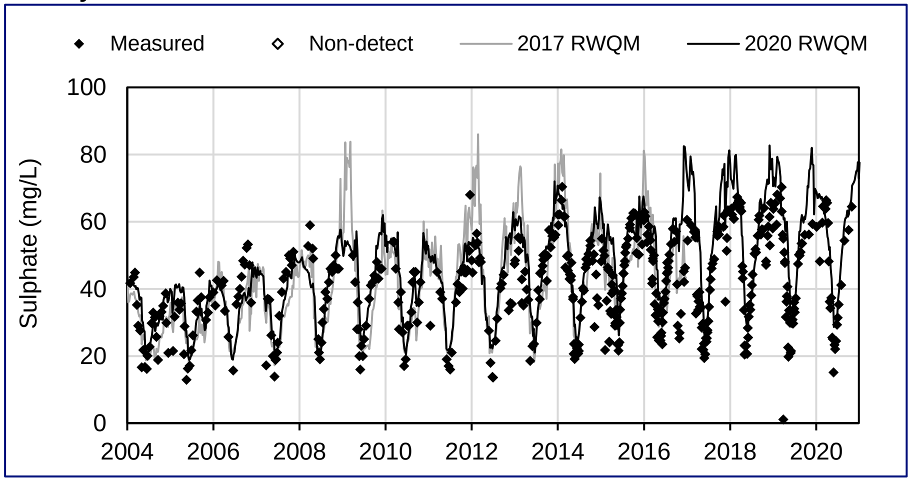
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/26/2004	1/26/2004
Last Measured Sample	12/18/2016	12/16/2018
Data Points Available for Comparison, n	355	449
Non-Detect Count	0	0
Measured Mean (mg/L)	38	40
Simulated Mean (mg/L)	40	46
Bias (mg/L)	1.7	5.5
Relative Bias	1.0	1.1
Error (mg/L)	7.2	7.7
Percent Error	19%	19%

[(a)] As adjusted for the 2019 IPA.

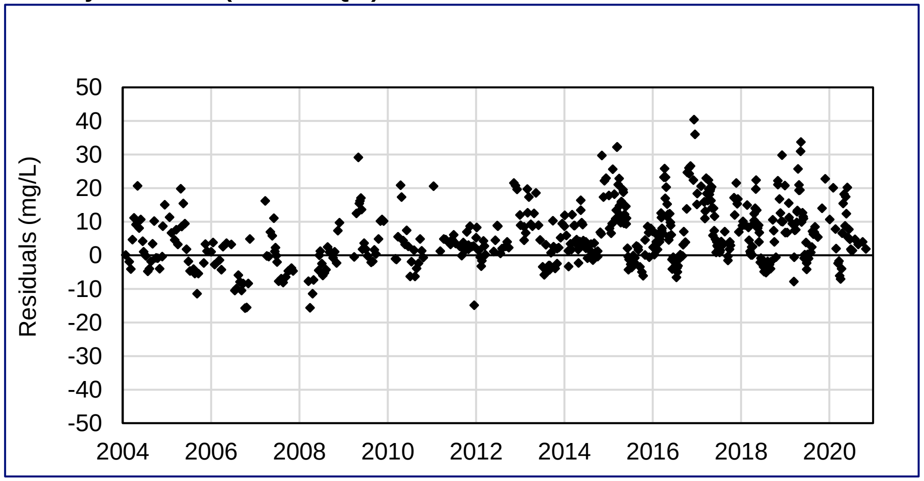
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

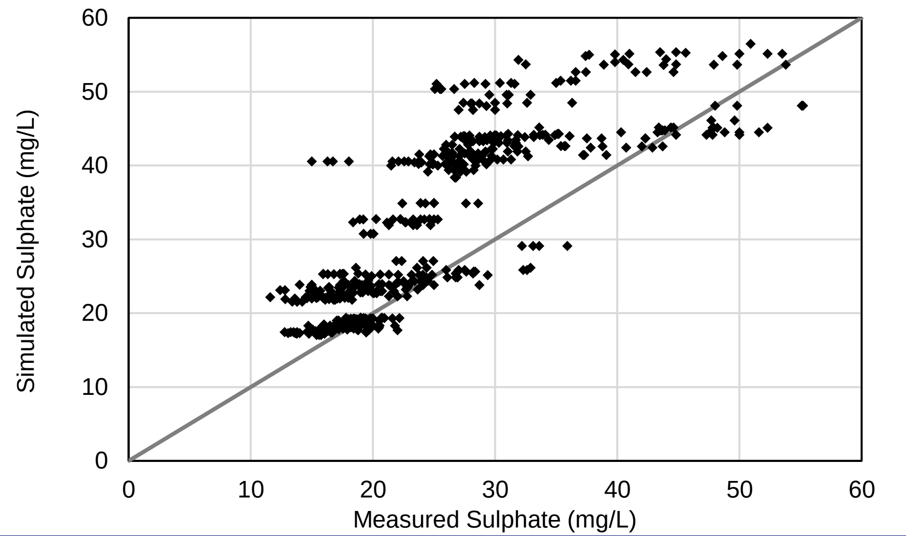
B3-45: Sulphate Calibration Information for Node RG_DSELK - Koocanusa Reservoir - South of the Elk River (EMS E300230)

Measured and Simulated Sulphate Data and Calibration Statistics

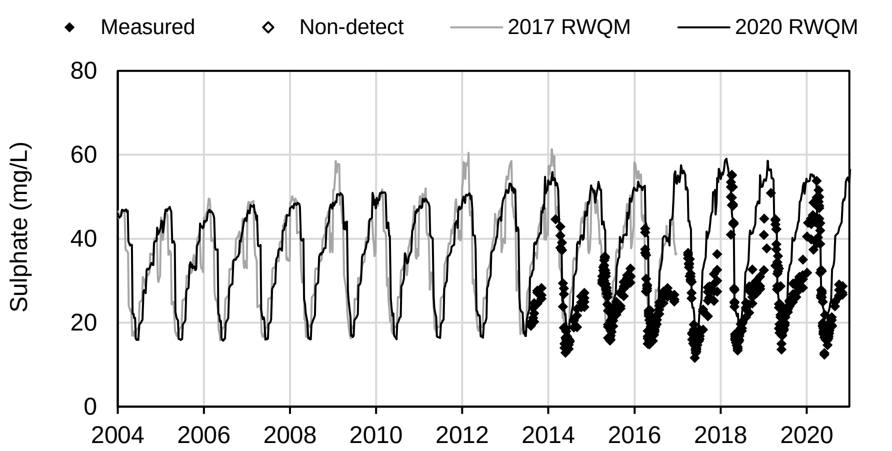
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	8/7/2013	8/7/2013
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	216	377
Non-Detect Count	0	0
Measured Mean (mg/L)	24	24
Simulated Mean (mg/L)	29	32
Bias (mg/L)	4.7	7.6
Relative Bias	1.2	1.3
Error (mg/L)	7.7	8.0
Percent Error	32%	33%

[(a)] As adjusted for the 2019 IPA.

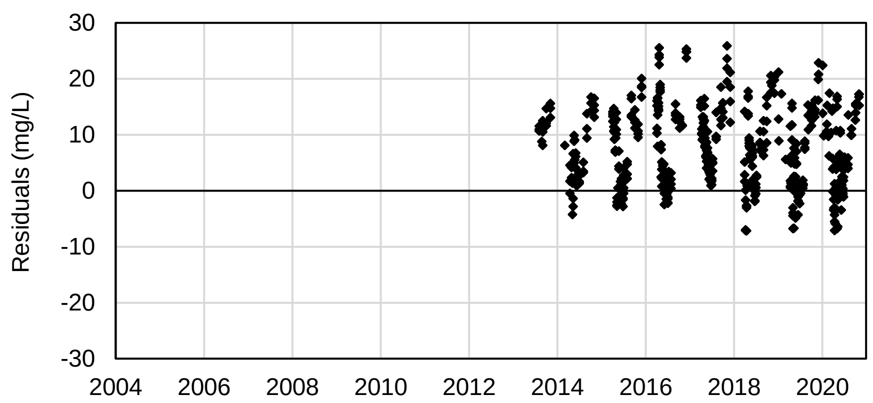
Simulated versus Measured Sulphate Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

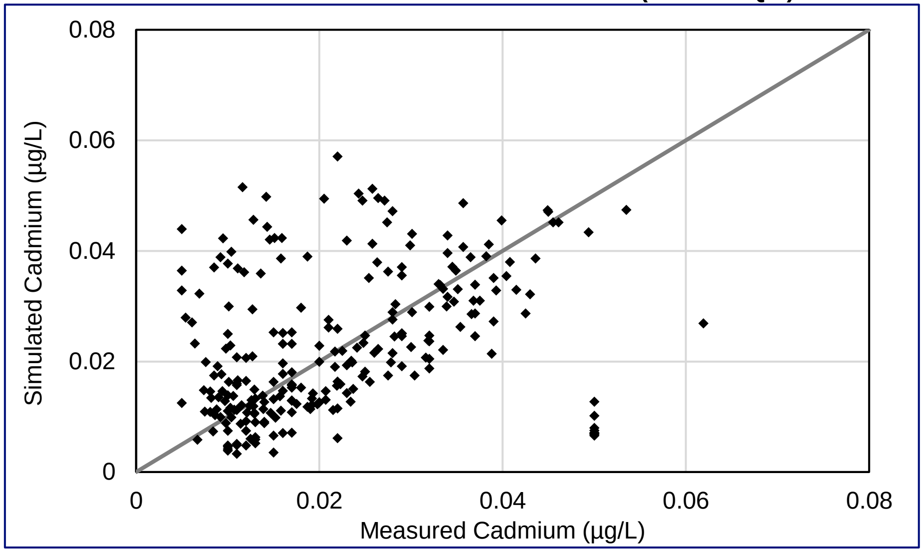
B4-1: Cadmium Calibration Information for Node FR_HC1 - Henretta Creek u/s of Fording River (EMS E216778)

Measured and Simulated Cadmium Data and Calibration Statistics

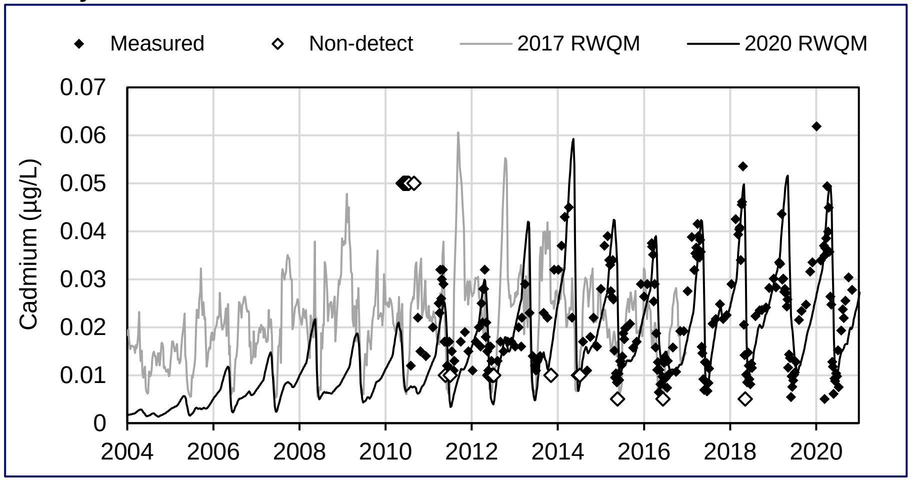
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/31/2010	5/31/2010
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	144	195
Non-Detect Count	18	19
Measured Mean (µg/L)	-	0.021
Simulated Mean (µg/L)	-	0.021
Bias (µg/L)	-	-0.00048
Relative Bias	-	0.98
Error (µg/L)	-	0.0094
Percent Error	-	44%

(a) As adjusted for the 2019 IPA.

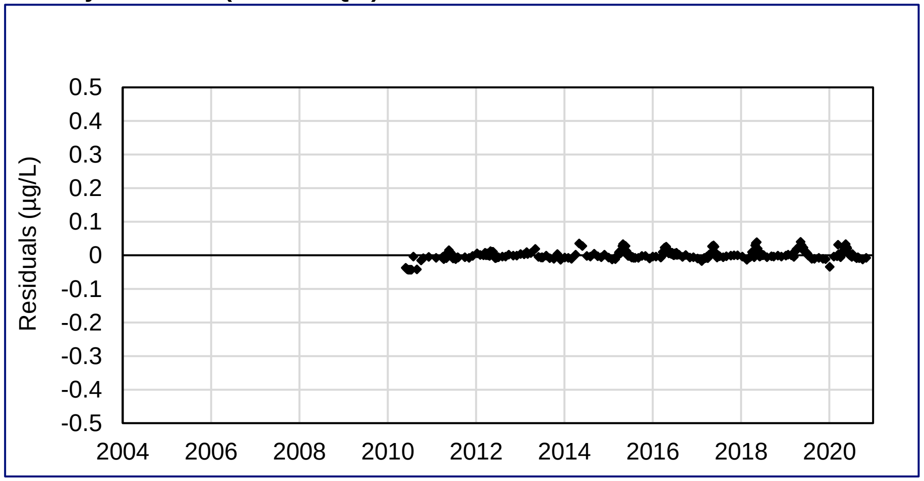
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

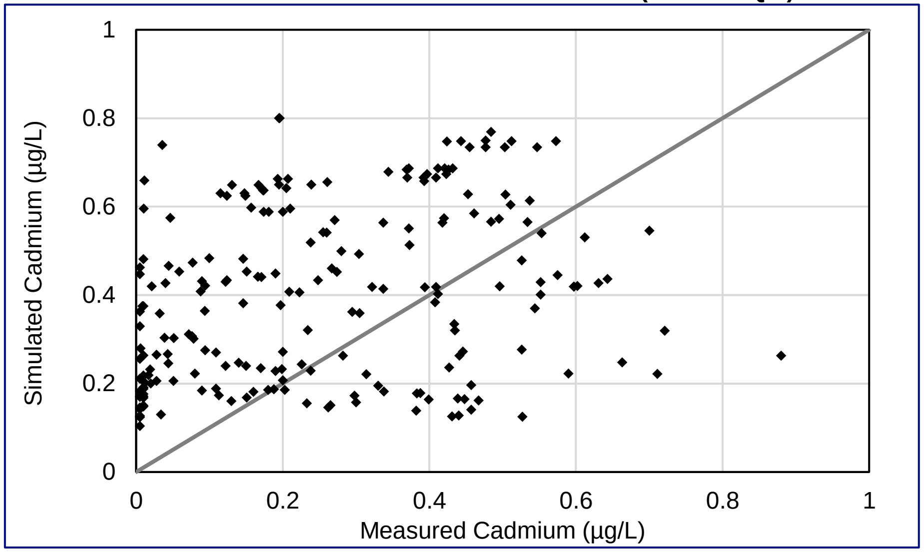
B4-2: Cadmium Calibration Information for Node FR_CC1 - Clode Creek Sediment Pond Decant (EMS E102481)

Measured and Simulated Cadmium Data and Calibration Statistics

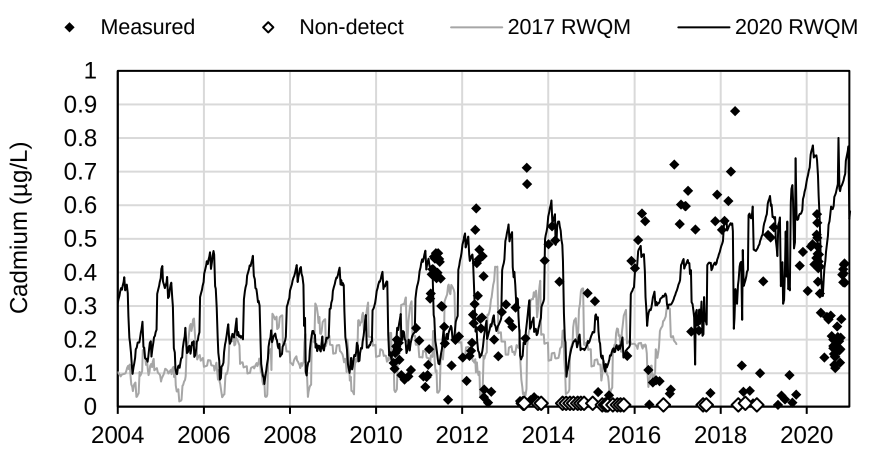
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/31/2010	5/31/2010
Last Measured Sample	12/7/2016	12/5/2018
Data Points Available for Comparison, n	123	150
Non-Detect Count	22	27
Measured Mean (µg/L)	-	0.23
Simulated Mean (µg/L)	-	0.3
Bias (µg/L)	-	0.066
Relative Bias	-	1.3
Error (µg/L)	-	0.19
Percent Error	-	82%

[(a)] As adjusted for the 2019 IPA.

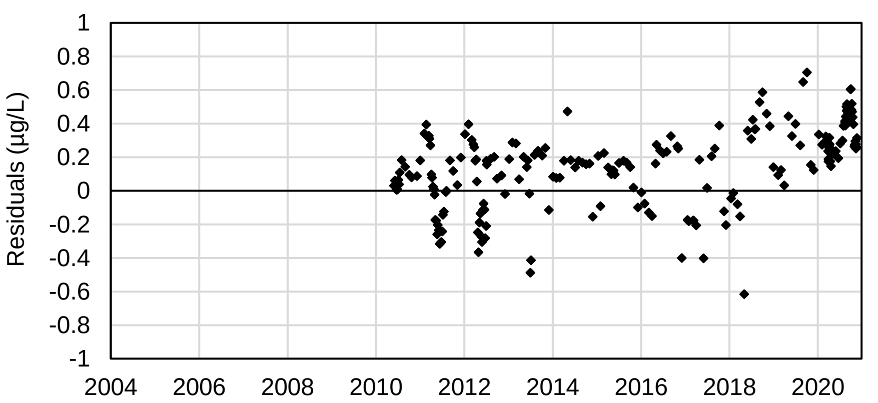
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

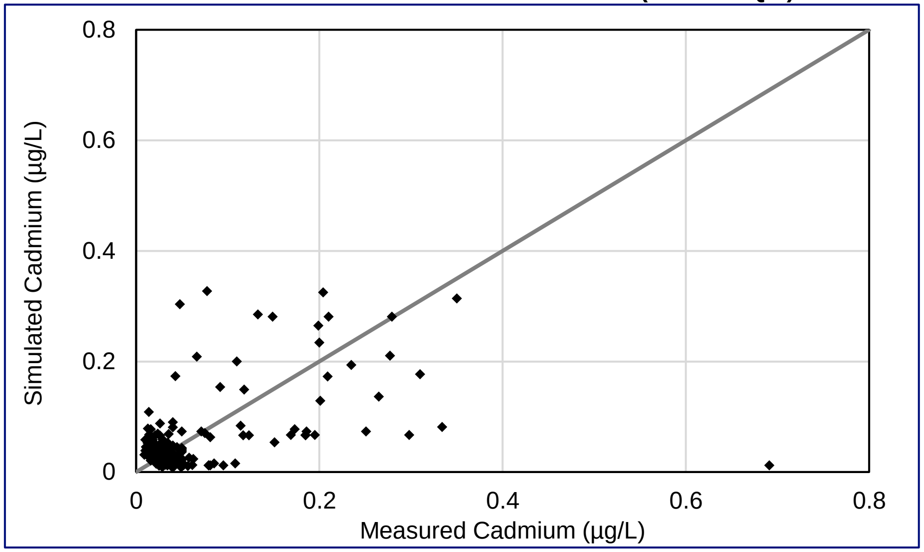
B4-3: Cadmium Calibration Information for Node FR_LMP1 - Lake Mountain Pond

Measured and Simulated Cadmium Data and Calibration Statistics

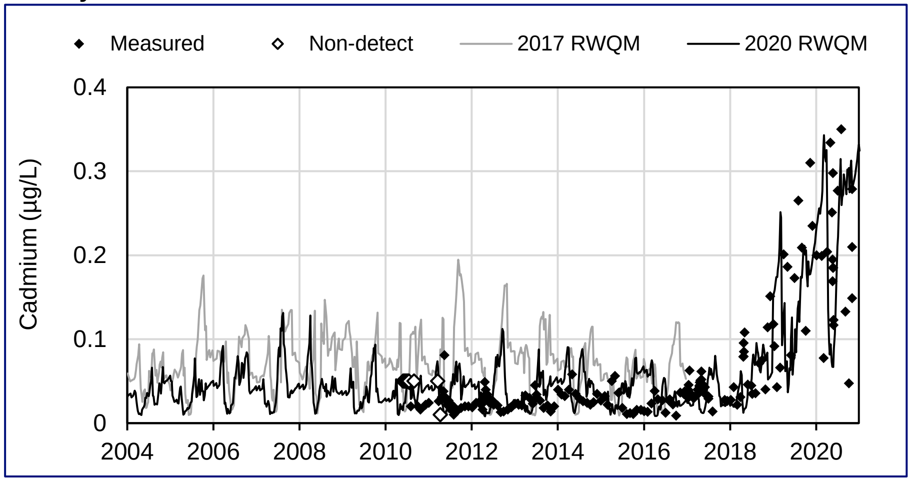
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/14/2016	12/10/2018
Data Points Available for Comparison, n	113	164
Non-Detect Count	11	11
Measured Mean (µg/L)	-	0.038
Simulated Mean (µg/L)	-	0.034
Bias (µg/L)	-	-0.004
Relative Bias	-	0.9
Error (µg/L)	-	0.027
Percent Error	-	72%

(a) As adjusted for the 2019 IPA.

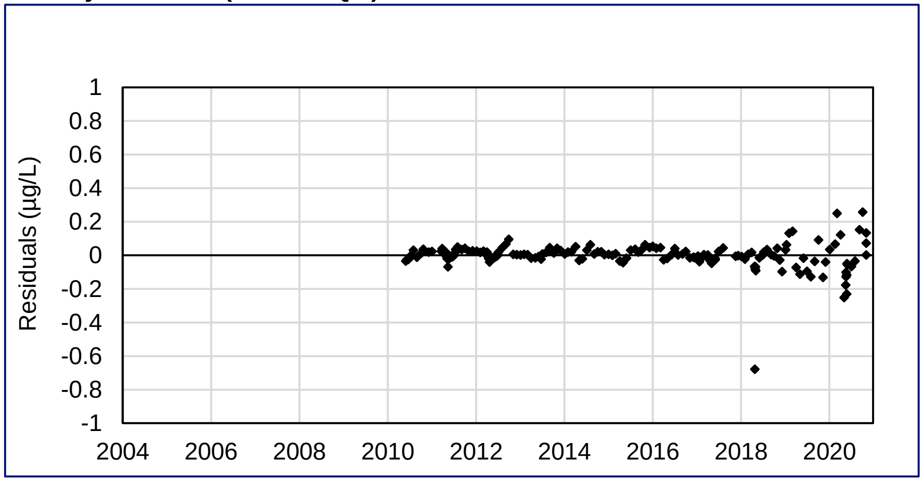
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

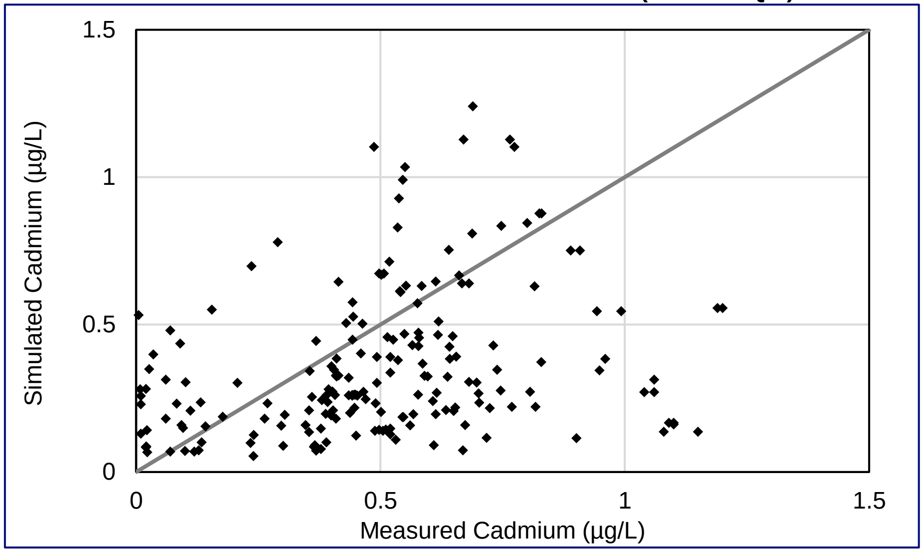
B4-4: Cadmium Calibration Information for Node FR_KC1 - Kilmarnock Creek d/s of Rock Drain (EMS 0200252)

Measured and Simulated Cadmium Data and Calibration Statistics

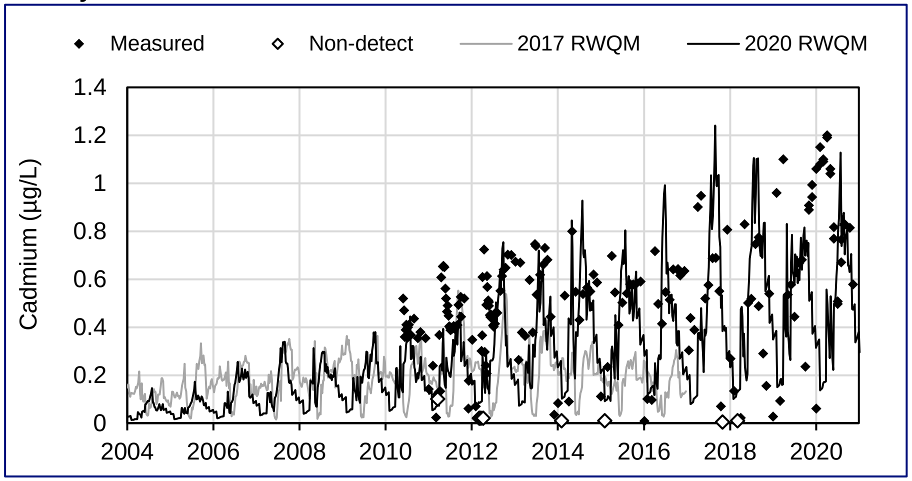
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/31/2010	5/31/2010
Last Measured Sample	12/12/2016	12/3/2018
Data Points Available for Comparison, n	134	160
Non-Detect Count	6	8
Measured Mean (µg/L)	-	0.44
Simulated Mean (µg/L)	-	0.33
Bias (µg/L)	-	-0.11
Relative Bias	-	0.75
Error (µg/L)	-	0.23
Percent Error	-	52%

[(a)] As adjusted for the 2019 IPA.

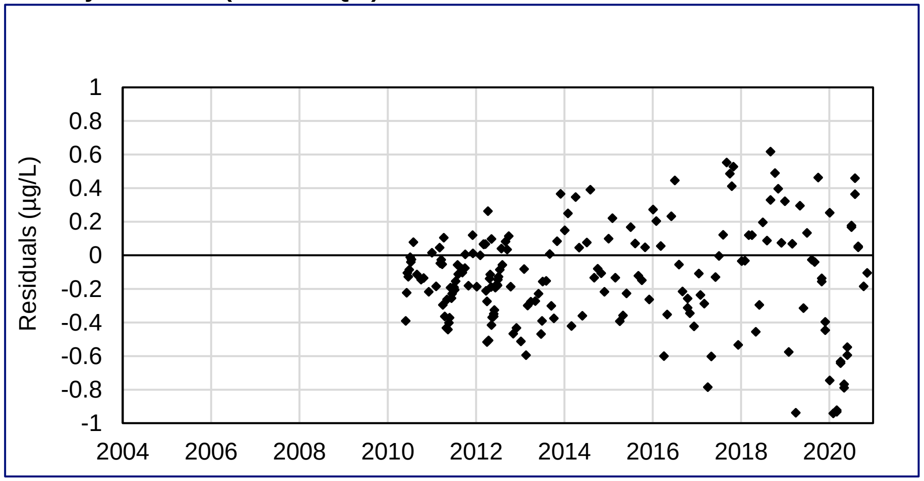
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

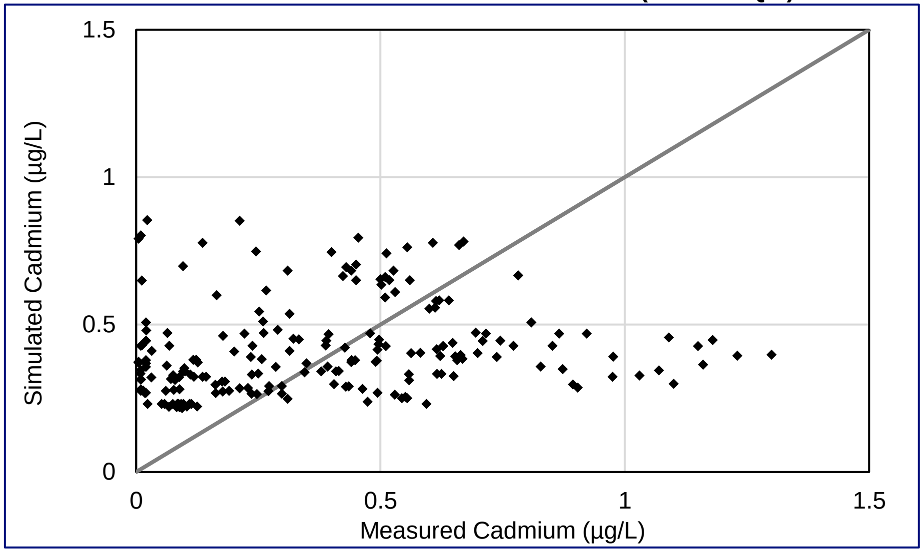
B4-5: Cadmium Calibration Information for Node GH_SC1 - Swift Creek Sediment Pond Decant (EMS E221329)

Measured and Simulated Cadmium Data and Calibration Statistics

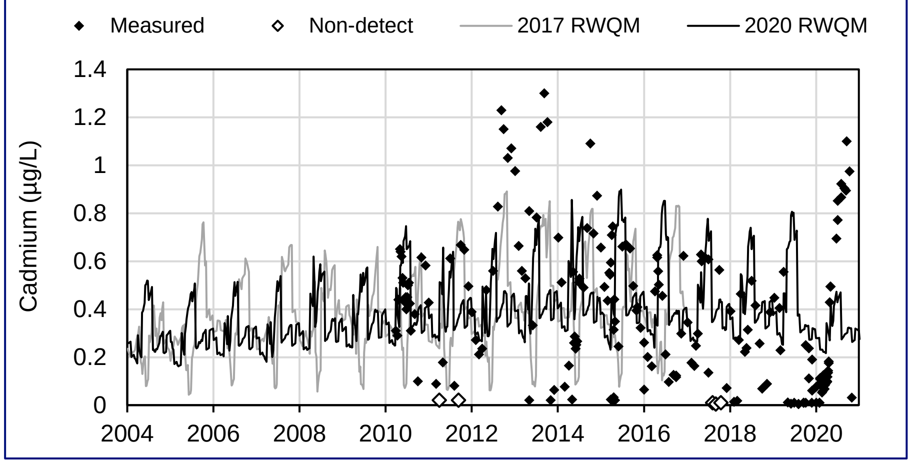
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/29/2010	3/29/2010
Last Measured Sample	12/5/2016	12/10/2018
Data Points Available for Comparison, n	115	146
Non-Detect Count	2	5
Measured Mean (µg/L)	-	0.42
Simulated Mean (µg/L)	-	0.45
Bias (µg/L)	-	0.03
Relative Bias	-	1.1
Error (µg/L)	-	0.25
Percent Error	-	60%

[(a)] As adjusted for the 2019 IPA.

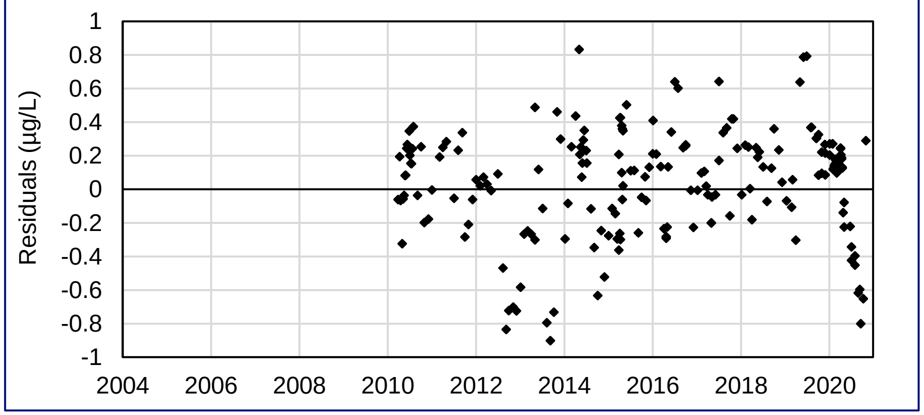
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

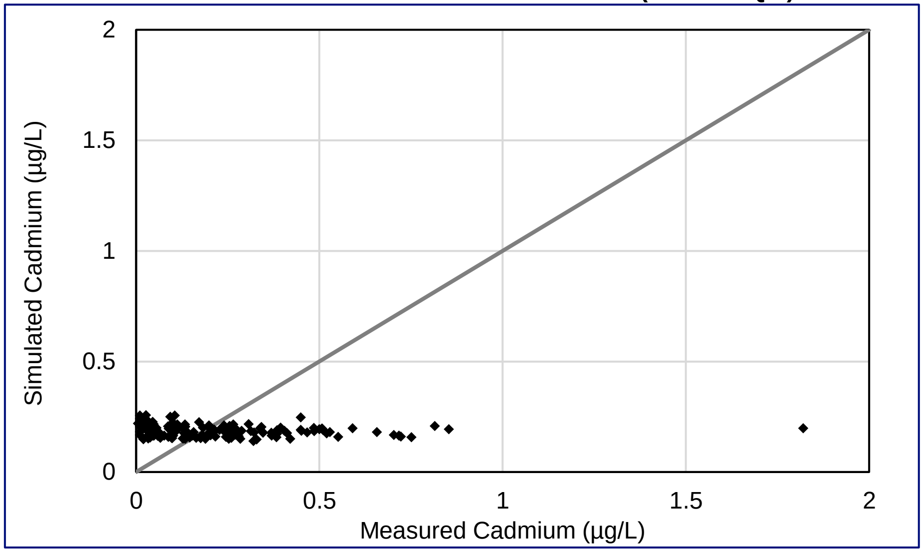
B4-6: Cadmium Calibration Information for Node GH_CC1 - Cataract Creek Sediment Pond Decant (EMS 0200384)

Measured and Simulated Cadmium Data and Calibration Statistics

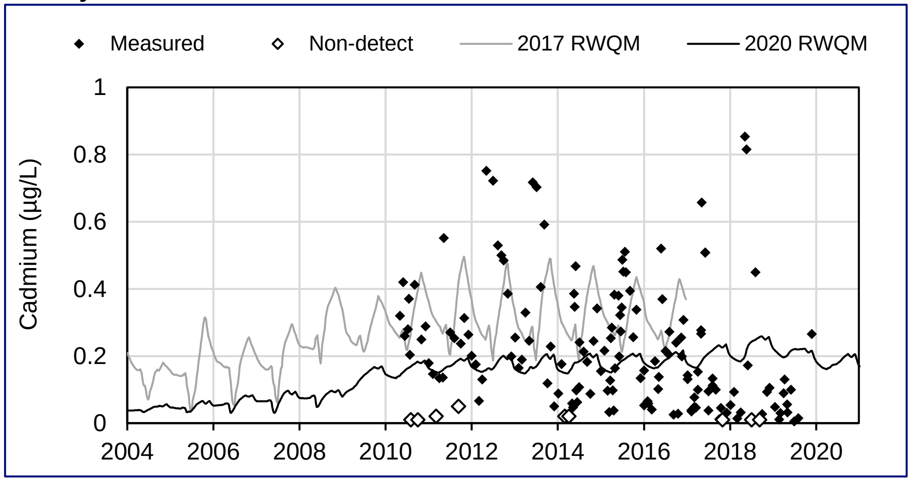
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/3/2010	5/3/2010
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	108	144
Non-Detect Count	6	9
Measured Mean (µg/L)	-	0.24
Simulated Mean (µg/L)	-	0.18
Bias (µg/L)	-	-0.057
Relative Bias	-	0.76
Error (µg/L)	-	0.16
Percent Error	-	65%

[a] As adjusted for the 2019 IPA.

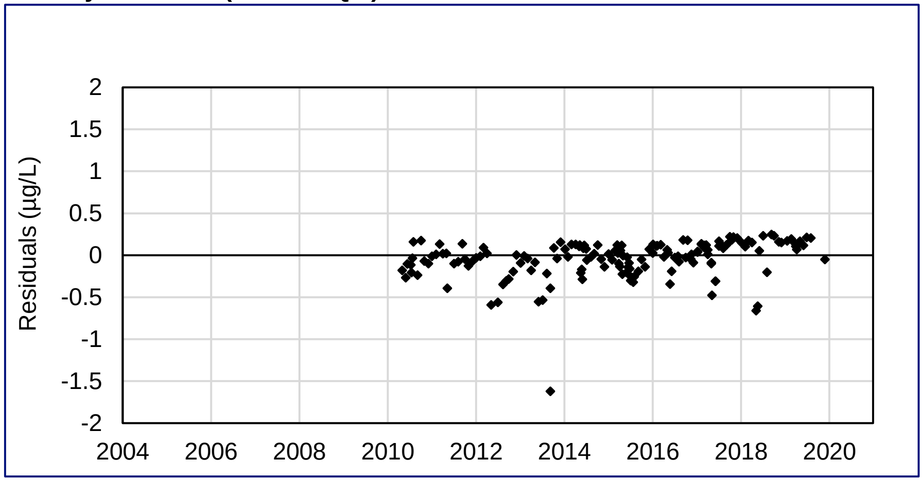
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

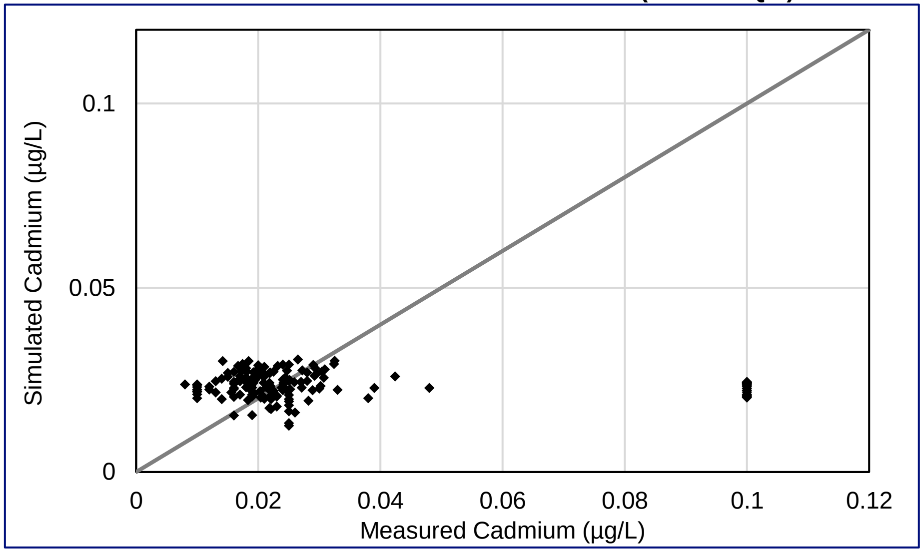
B4-7: Cadmium Calibration Information for Node GH_PC1 - Porter Creek Sediment Pond Decant (EMS 0200385)

Measured and Simulated Cadmium Data and Calibration Statistics

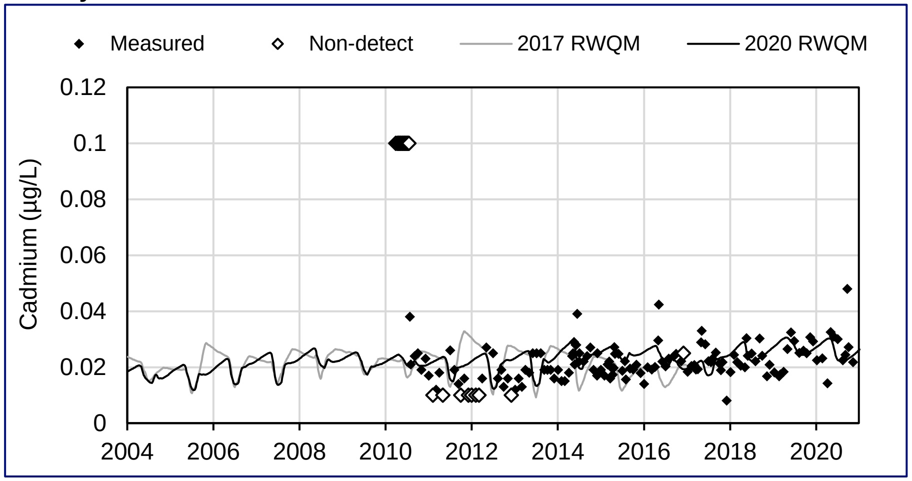
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/29/2010	3/29/2010
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	107	136
Non-Detect Count	25	25
Measured Mean (µg/L)	-	0.03
Simulated Mean (µg/L)	-	0.023
Bias (µg/L)	-	-0.0069
Relative Bias	-	0.77
Error (µg/L)	-	0.014
Percent Error	-	47%

[(a)] As adjusted for the 2019 IPA.

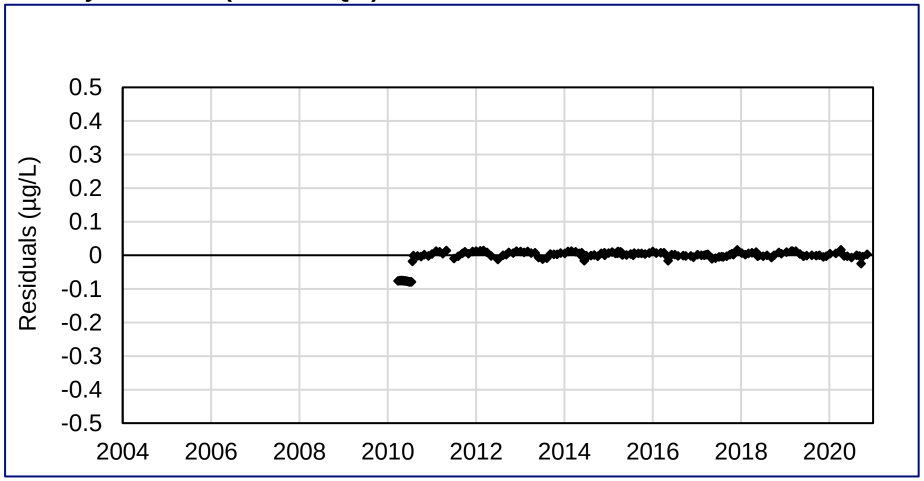
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

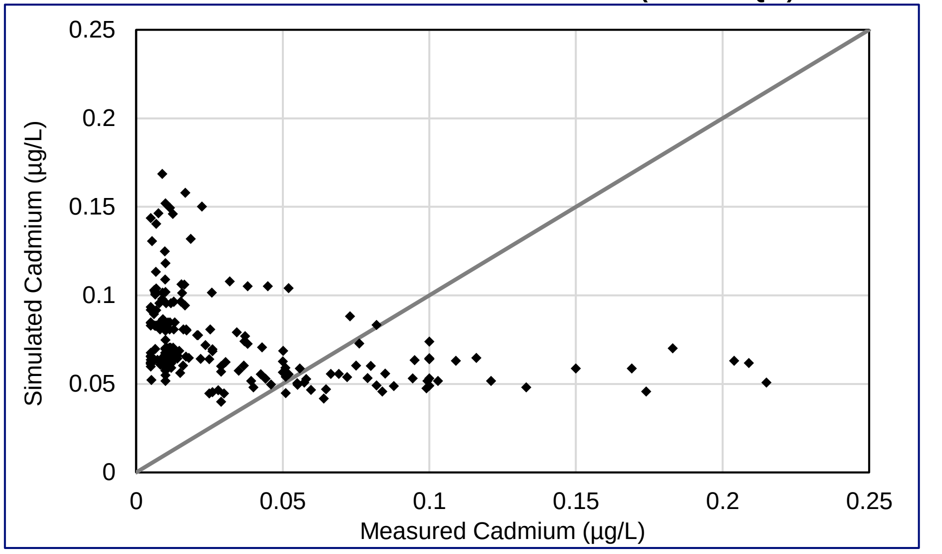
B4-8: Cadmium Calibration Information for Node GH_GH1 - Greenhills Creek Sediment Pond Decant (EMS E102709)

Measured and Simulated Cadmium Data and Calibration Statistics

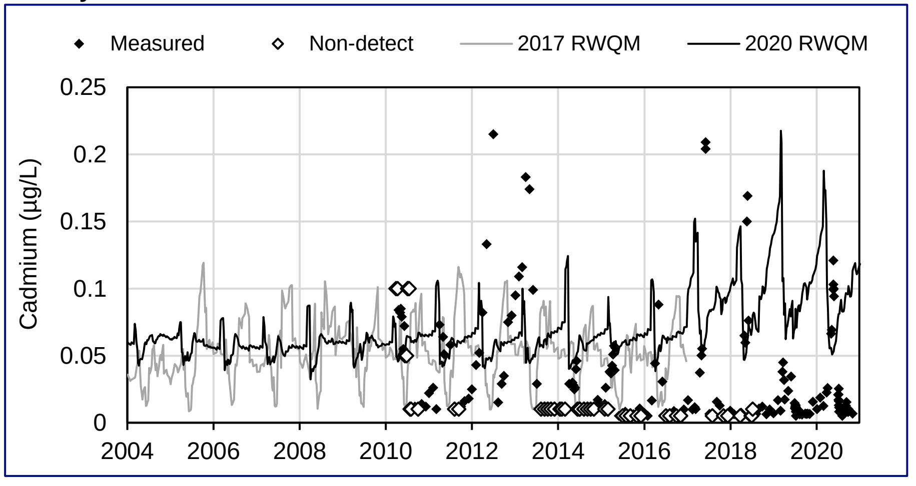
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/29/2010	3/29/2010
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	110	143
Non-Detect Count	38	45
Measured Mean (µg/L)	-	0.039
Simulated Mean (µg/L)	-	0.068
Bias (µg/L)	-	0.029
Relative Bias	-	1.7
Error (µg/L)	-	0.052
Percent Error	-	133%

[(a)] As adjusted for the 2019 IPA.

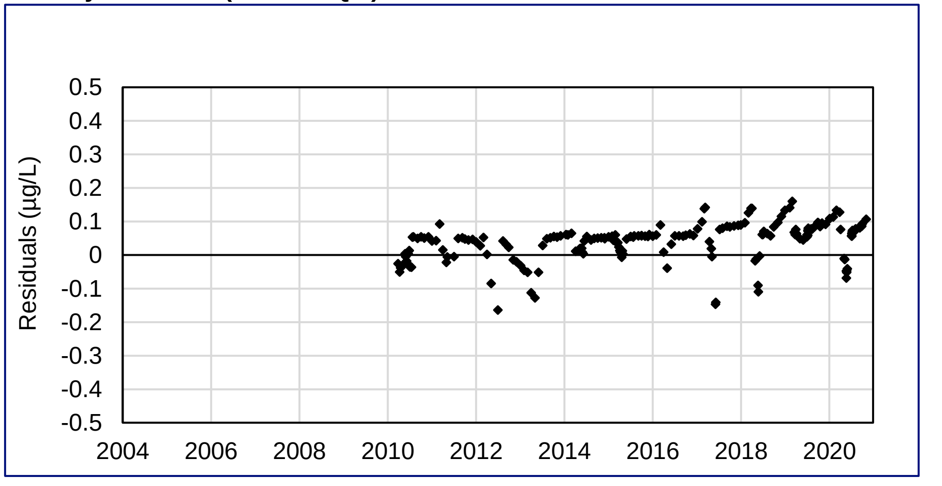
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

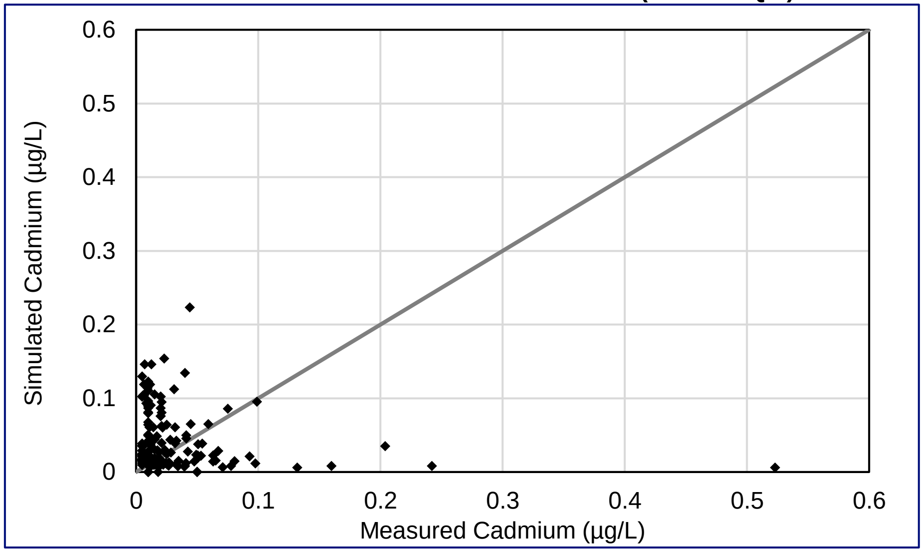
B4-9: Cadmium Calibration Information for Node GH_LC1 - Leask Creek Sediment Pond Decant (EMS E257796)

Measured and Simulated Cadmium Data and Calibration Statistics

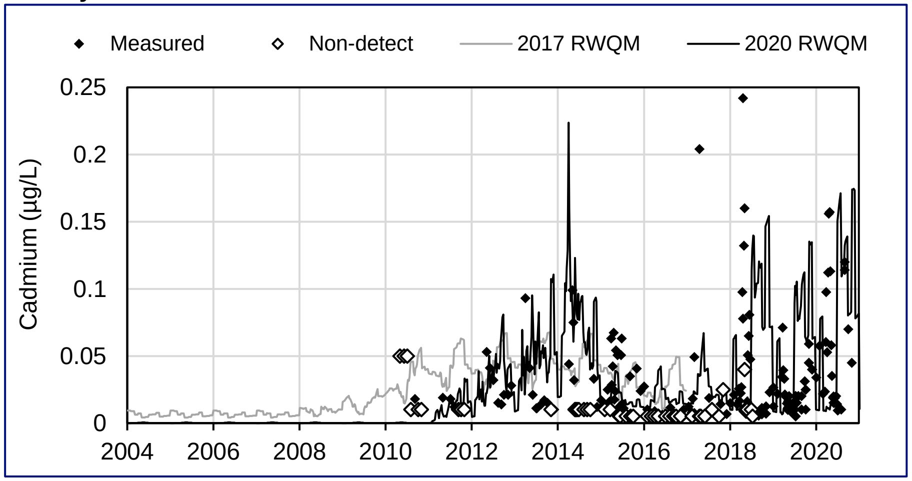
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/4/2010	5/4/2010
Last Measured Sample	12/7/2016	12/4/2018
Data Points Available for Comparison, n	94	149
Non-Detect Count	38	52
Measured Mean (µg/L)	-	0.028
Simulated Mean (µg/L)	-	0.036
Bias (µg/L)	-	0.0079
Relative Bias	-	1.3
Error (µg/L)	-	0.038
Percent Error	-	134%

[(a)] As adjusted for the 2019 IPA.

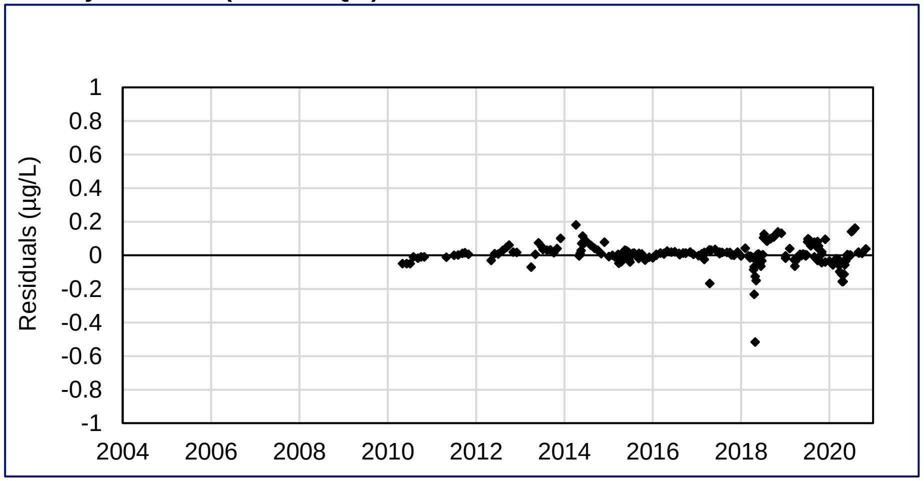
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

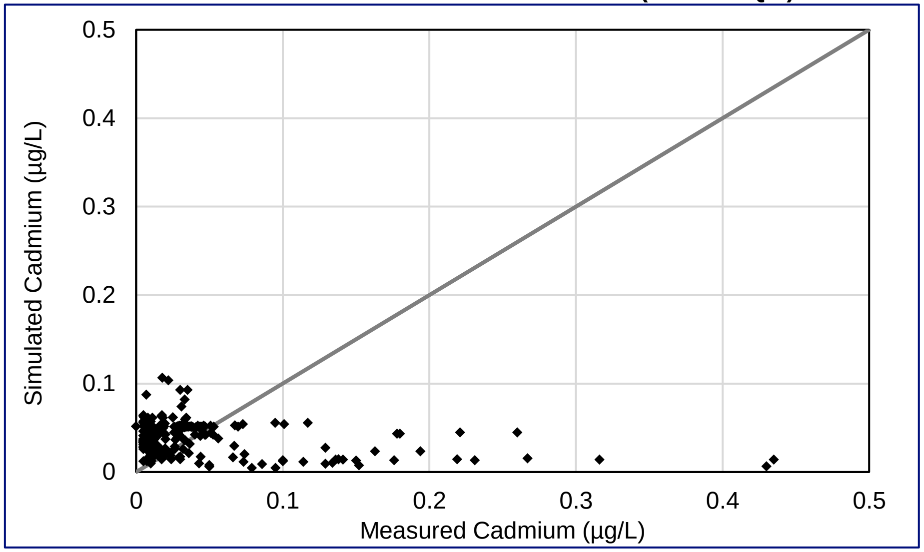
B4-10: Cadmium Calibration Information for Node GH_WC1 - Wolfram Creek Sediment Pond Decant (EMS E257795)

Measured and Simulated Cadmium Data and Calibration Statistics

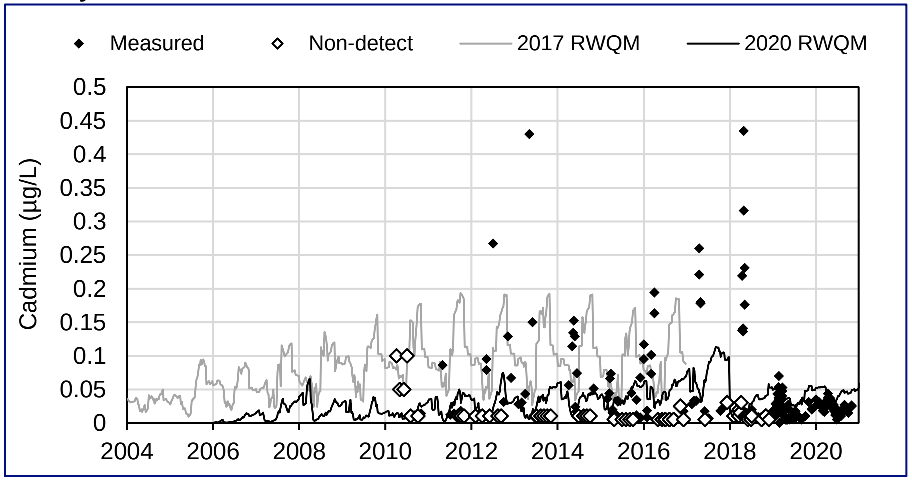
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/6/2010	4/6/2010
Last Measured Sample	12/7/2016	12/4/2018
Data Points Available for Comparison, n	96	152
Non-Detect Count	43	65
Measured Mean (µg/L)	-	0.049
Simulated Mean (µg/L)	-	0.034
Bias (µg/L)	-	-0.015
Relative Bias	-	0.69
Error (µg/L)	-	0.052
Percent Error	-	106%

[a] As adjusted for the 2019 IPA.

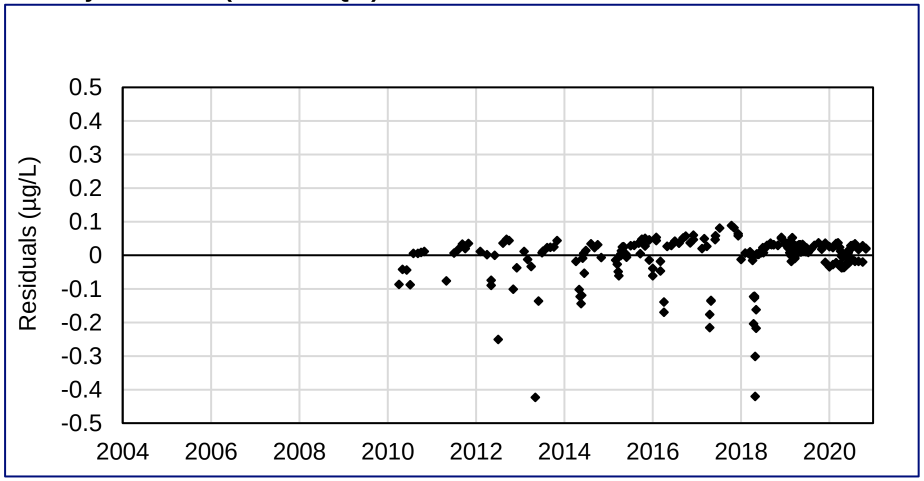
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

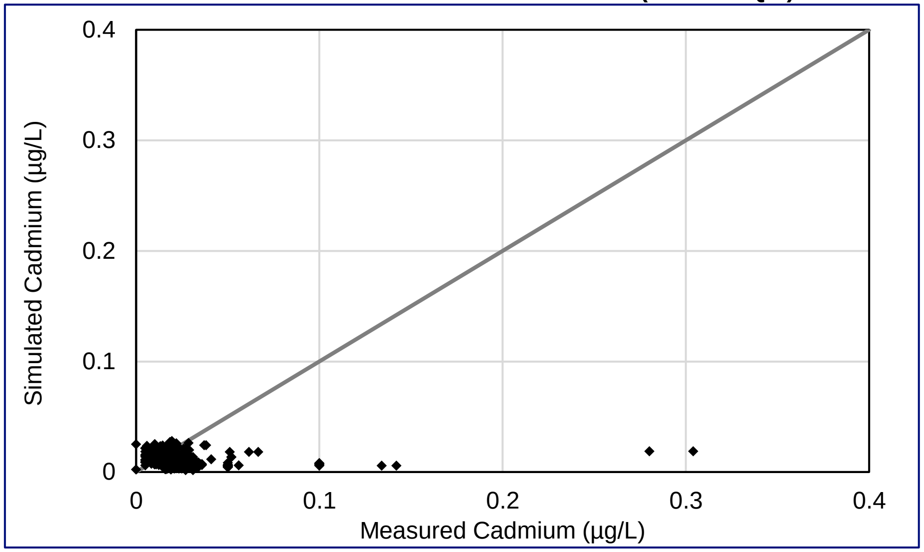
B4-11: Cadmium Calibration Information for Node GH_TC1 - Thompson Creek at LRP Road (EMS E102714)

Measured and Simulated Cadmium Data and Calibration Statistics

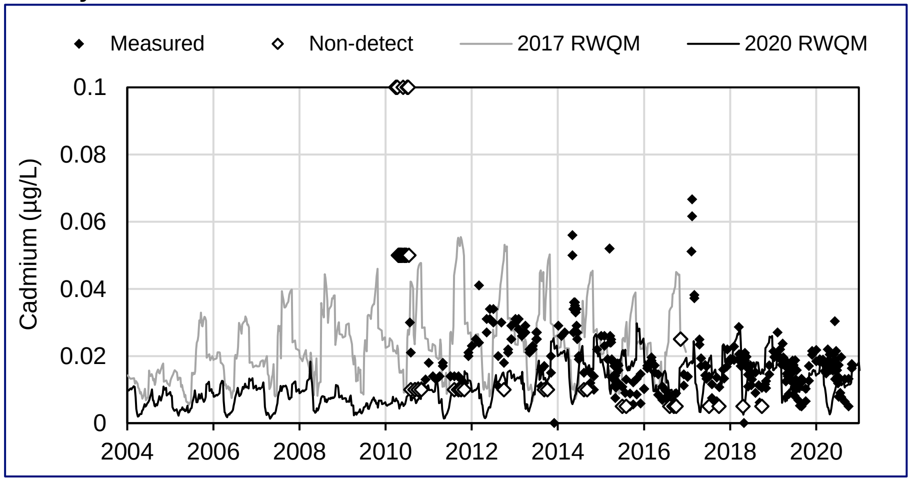
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/29/2010	3/29/2010
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	189	258
Non-Detect Count	41	45
Measured Mean (µg/L)	-	0.025
Simulated Mean (µg/L)	-	0.013
Bias (µg/L)	-	-0.012
Relative Bias	-	0.51
Error (µg/L)	-	0.017
Percent Error	-	66%

(a) As adjusted for the 2019 IPA.

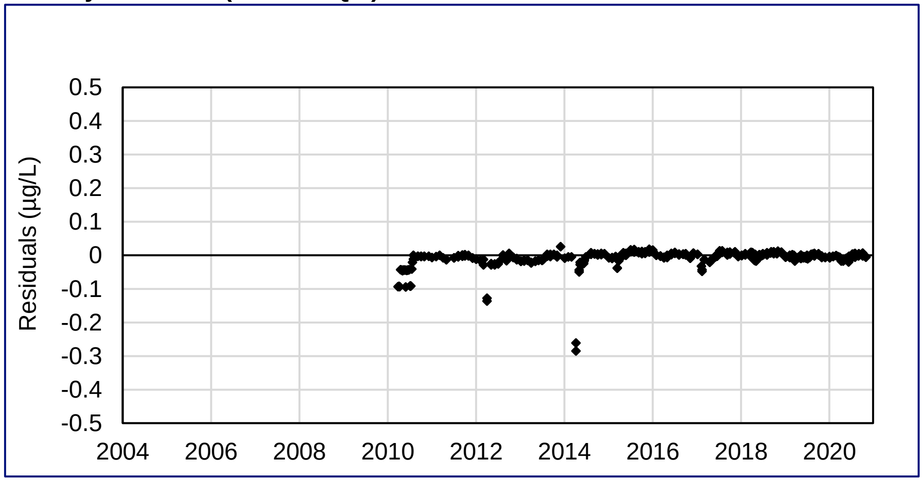
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

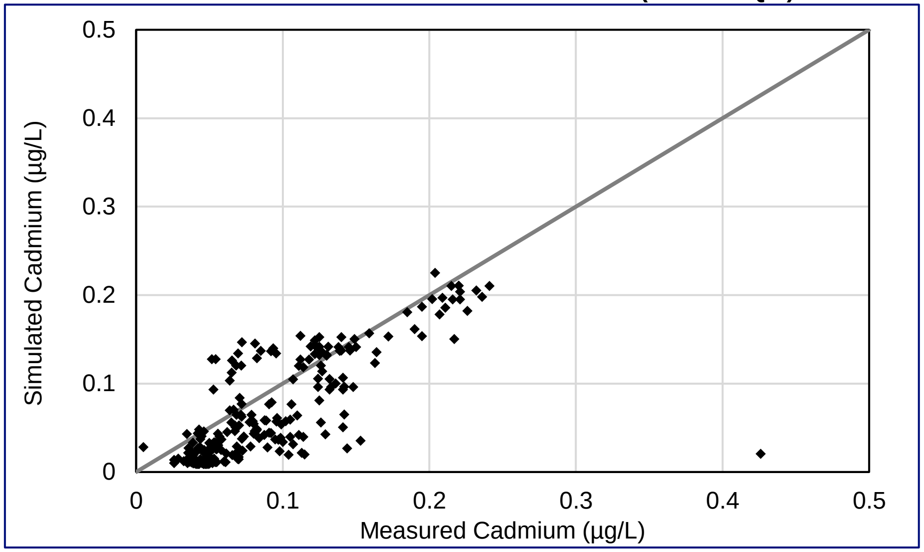
B4-12: Cadmium Calibration Information for Node LC_DC3 - Dry Creek u/s of East Tributary (EMS E288273)

Measured and Simulated Cadmium Data and Calibration Statistics

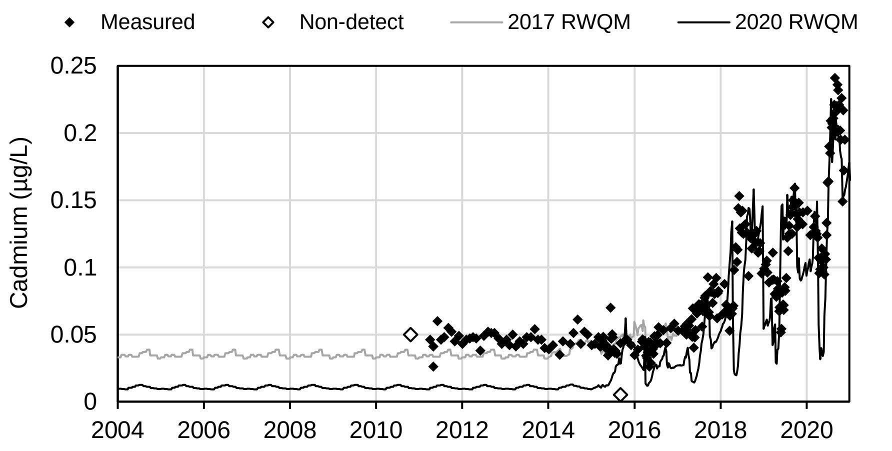
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	10/21/2010	10/21/2010
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	103	177
Non-Detect Count	2	2
Measured Mean (µg/L)	-	0.063
Simulated Mean (µg/L)	-	0.034
Bias (µg/L)	-	-0.028
Relative Bias	-	0.55
Error (µg/L)	-	0.034
Percent Error	-	54%

[a] As adjusted for the 2019 IPA.

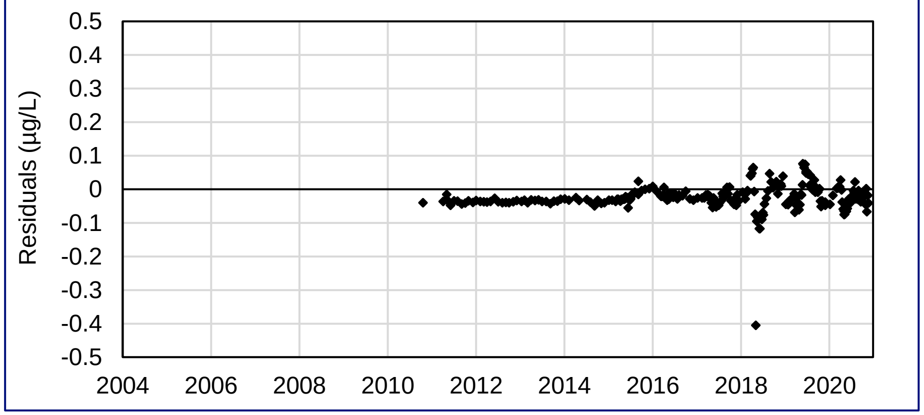
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

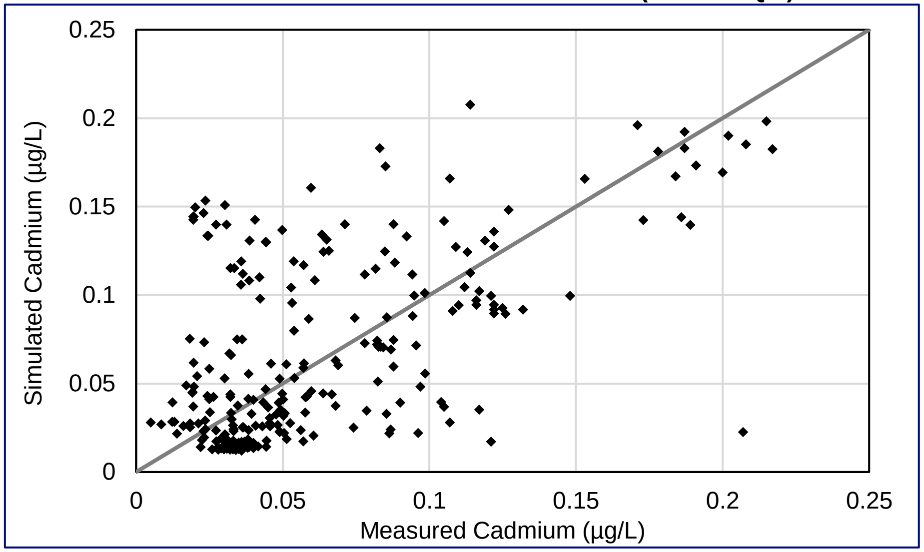
B4-13: Cadmium Calibration Information for Node LC_DCDS - Dry Creek d/s of Sedimentation Ponds (EMS E295210)

Measured and Simulated Cadmium Data and Calibration Statistics

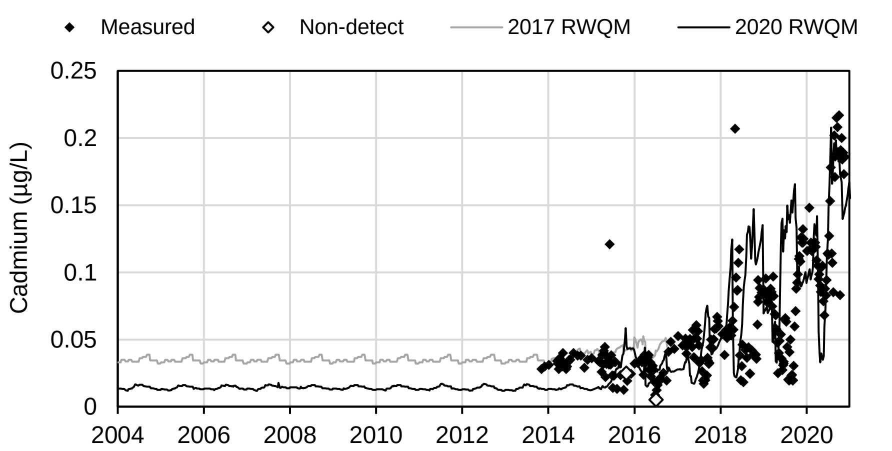
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	11/6/2013	11/6/2013
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	84	162
Non-Detect Count	2	2
Measured Mean (µg/L)	-	0.041
Simulated Mean (µg/L)	-	0.039
Bias (µg/L)	-	-0.0021
Relative Bias	-	0.95
Error (µg/L)	-	0.026
Percent Error	-	64%

[a] As adjusted for the 2019 IPA.

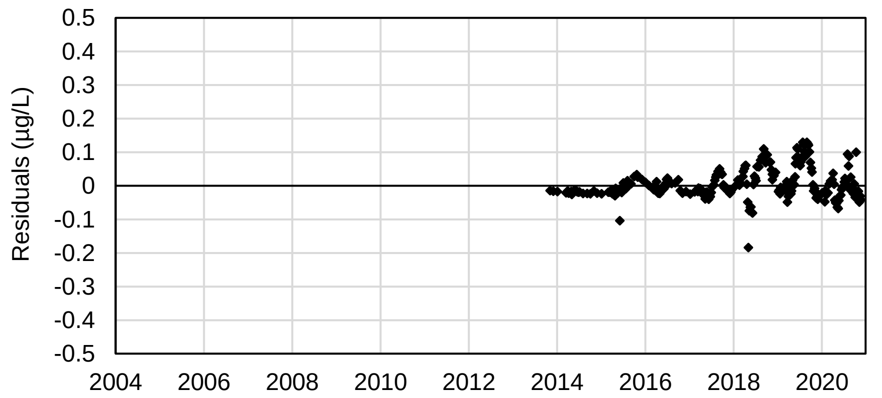
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

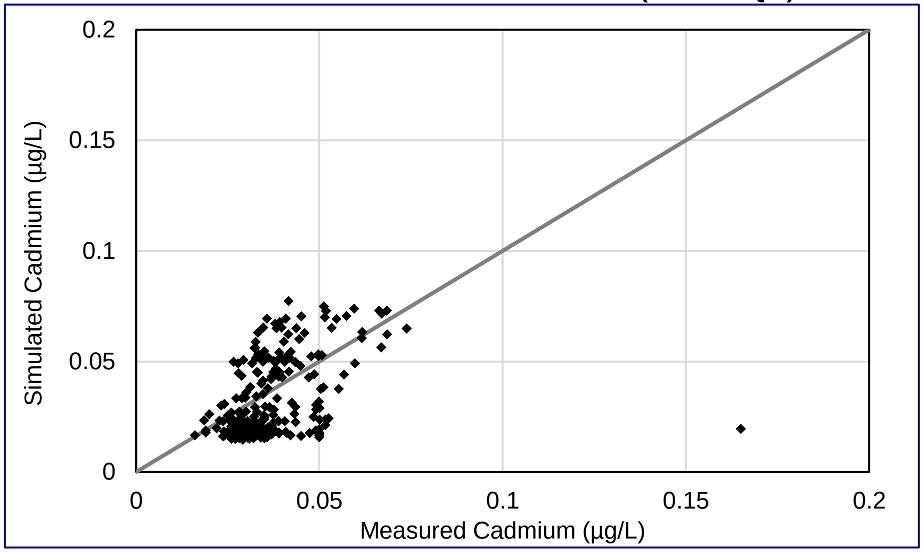
B4-14: Cadmium Calibration Information for Node LC_DC1 - Dry Creek near mouth (at bridge) (EMS E288270)

Measured and Simulated Cadmium Data and Calibration Statistics

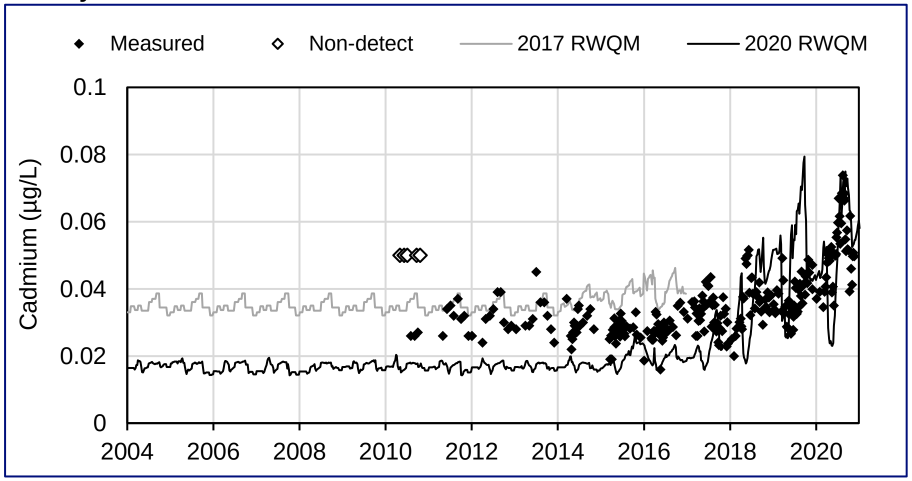
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/3/2010	5/3/2010
Last Measured Sample	12/6/2016	12/18/2018
Data Points Available for Comparison, n	111	187
Non-Detect Count	5	5
Measured Mean (µg/L)	-	0.032
Simulated Mean (µg/L)	-	0.022
Bias (µg/L)	-	-0.01
Relative Bias	-	0.68
Error (µg/L)	-	0.013
Percent Error	-	39%

[(a)] As adjusted for the 2019 IPA.

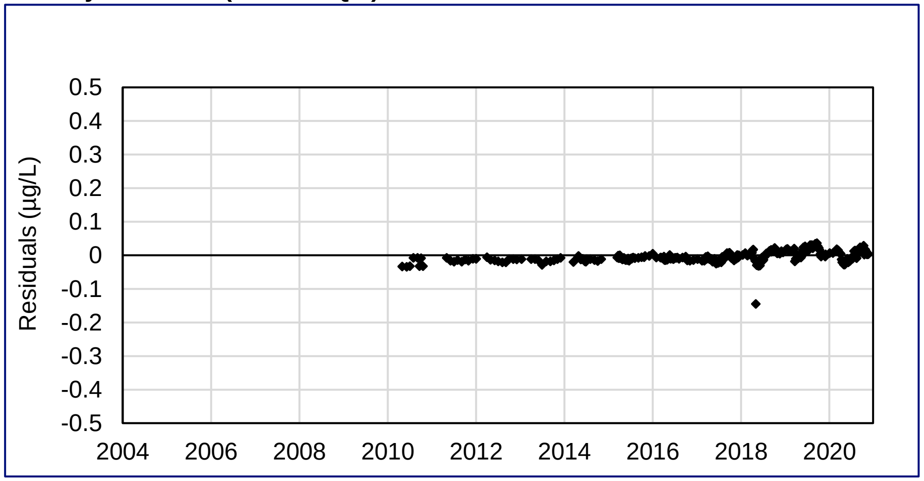
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

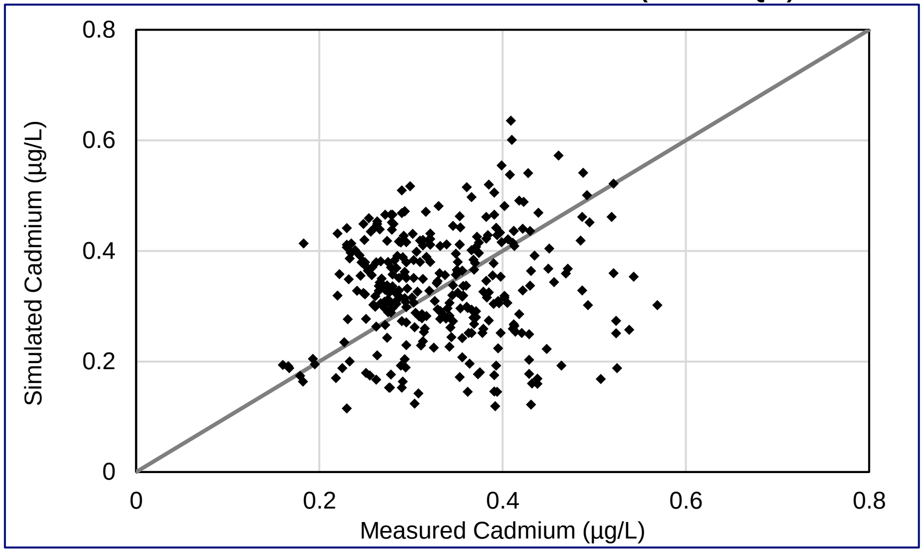
B4-15: Cadmium Calibration Information for Node LC_LCUSWLC - Line Creek u/s of West Line Creek (EMS E293369)

Measured and Simulated Cadmium Data and Calibration Statistics

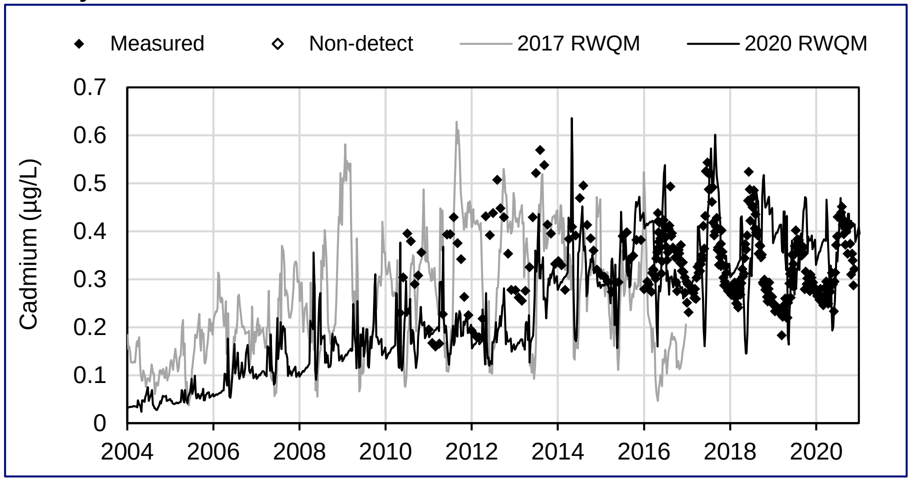
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/4/2010	5/4/2010
Last Measured Sample	12/28/2016	12/27/2018
Data Points Available for Comparison, n	116	219
Non-Detect Count	0	0
Measured Mean (µg/L)	-	0.35
Simulated Mean (µg/L)	-	0.32
Bias (µg/L)	-	-0.024
Relative Bias	-	0.93
Error (µg/L)	-	0.097
Percent Error	-	28%

[(a)] As adjusted for the 2019 IPA.

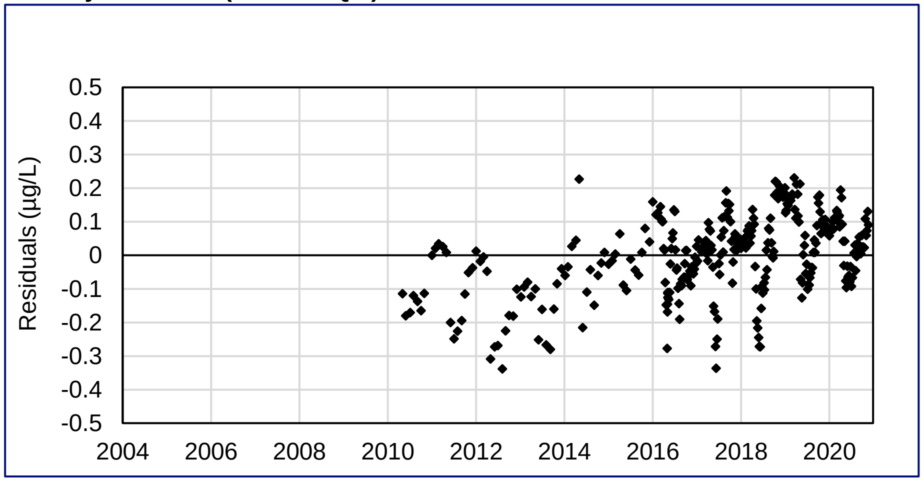
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

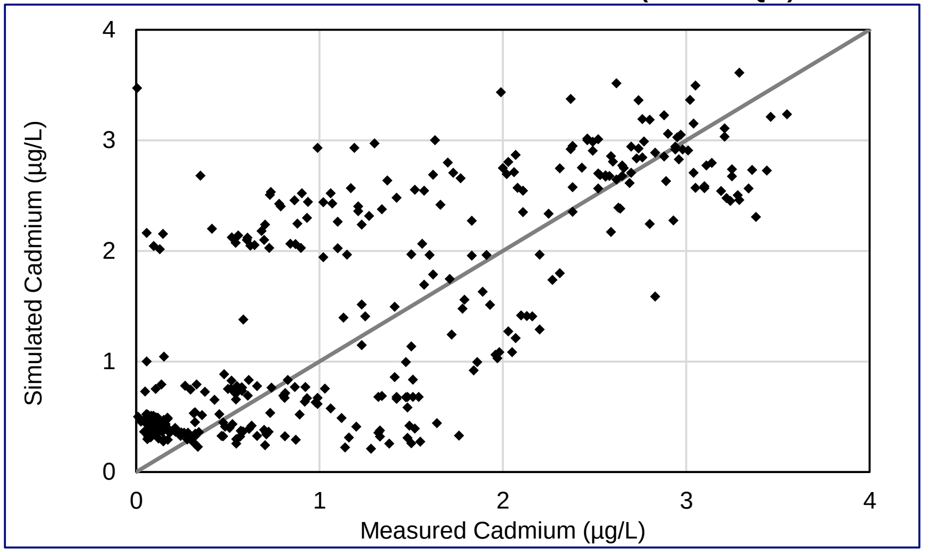
B4-16: Cadmium Calibration Information for Node LC_WLC - West Line Creek (EMS E261958)

Measured and Simulated Cadmium Data and Calibration Statistics

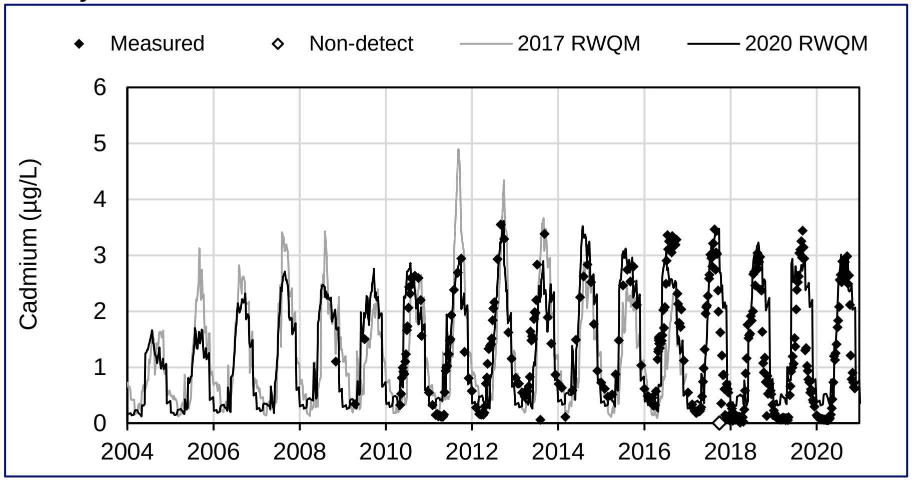
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	11/4/2008	11/4/2008
Last Measured Sample	12/5/2016	12/27/2018
Data Points Available for Comparison, n	164	263
Non-Detect Count	0	1
Measured Mean (µg/L)	-	1.3
Simulated Mean (µg/L)	-	1.4
Bias (µg/L)	-	0.095
Relative Bias	-	1.1
Error (µg/L)	-	0.55
Percent Error	-	41%

[a] As adjusted for the 2019 IPA.

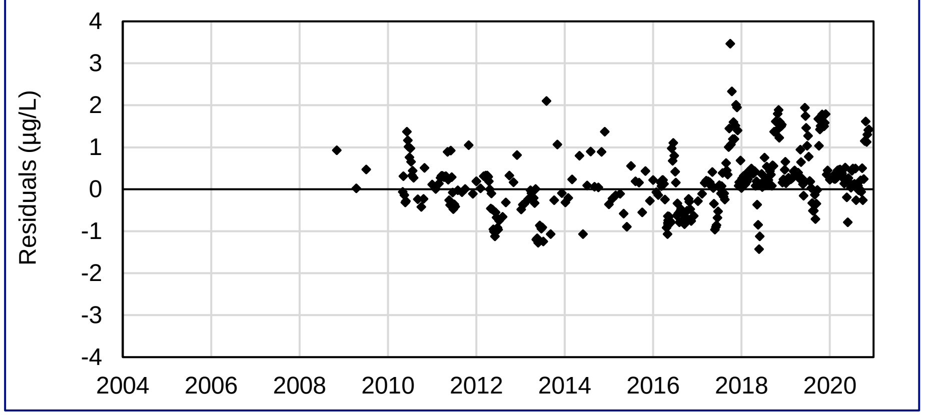
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

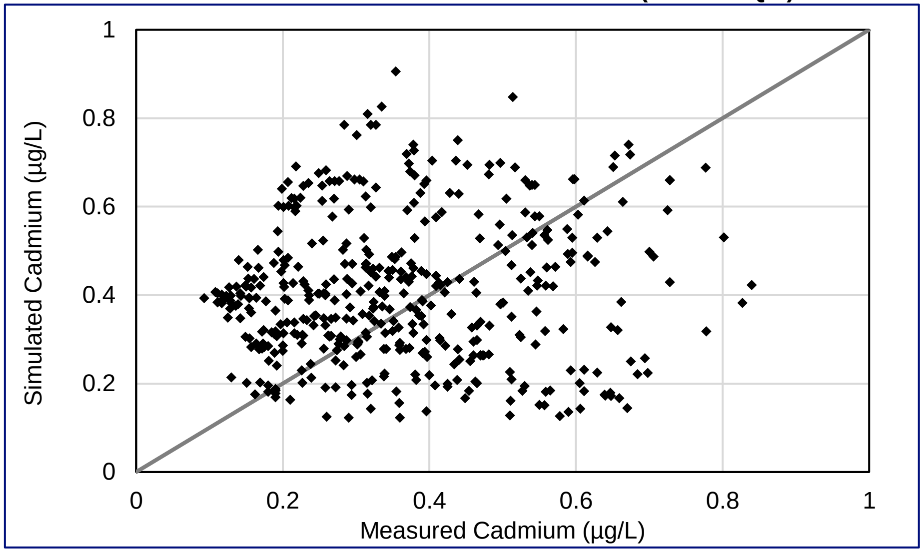
B4-17: Cadmium Calibration Information for Node LC_LC3 - Line Creek d/s of West Line Creek (EMS 0200337)

Measured and Simulated Cadmium Data and Calibration Statistics

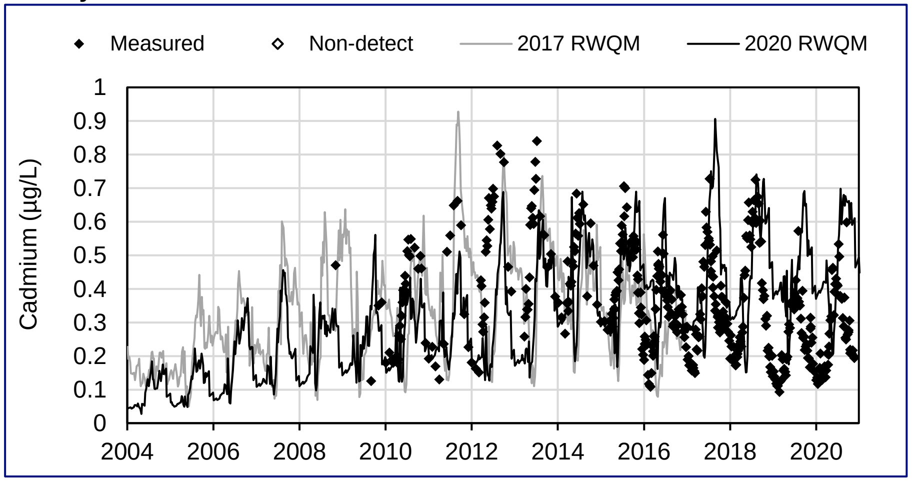
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	11/4/2008	11/4/2008
Last Measured Sample	12/27/2016	12/27/2018
Data Points Available for Comparison, n	222	336
Non-Detect Count	0	0
Measured Mean (µg/L)	-	0.39
Simulated Mean (µg/L)	-	0.39
Bias (µg/L)	-	-0.0028
Relative Bias	-	0.99
Error (µg/L)	-	0.16
Percent Error	-	42%

[(a)] As adjusted for the 2019 IPA.

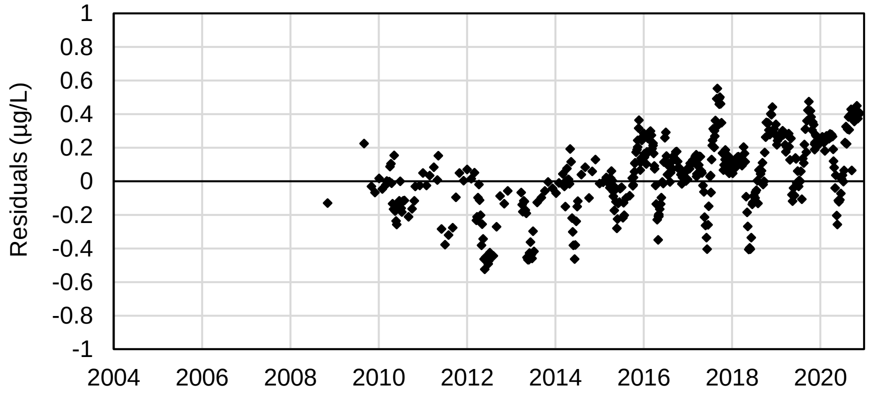
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

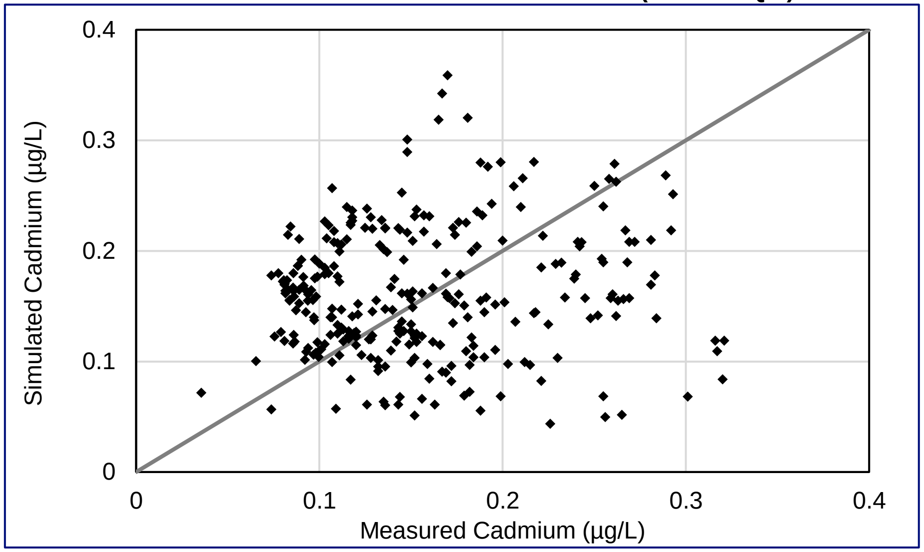
B4-18: Cadmium Calibration Information for Node LC_LCDSSLCC - LCO Compliance Point - Line Creek d/s of South Line Creek Confluence (EMS E297110)

Measured and Simulated Cadmium Data and Calibration Statistics

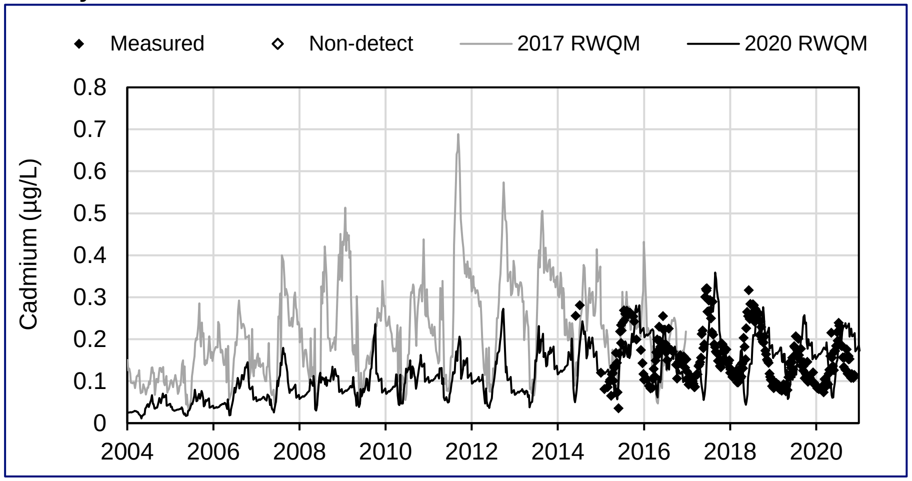
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/4/2014	6/4/2014
Last Measured Sample	12/28/2016	12/27/2018
Data Points Available for Comparison, n	79	188
Non-Detect Count	0	0
Measured Mean (µg/L)	-	0.17
Simulated Mean (µg/L)	-	0.16
Bias (µg/L)	-	-0.014
Relative Bias	-	0.92
Error (µg/L)	-	0.061
Percent Error	-	36%

(a) As adjusted for the 2019 IPA.

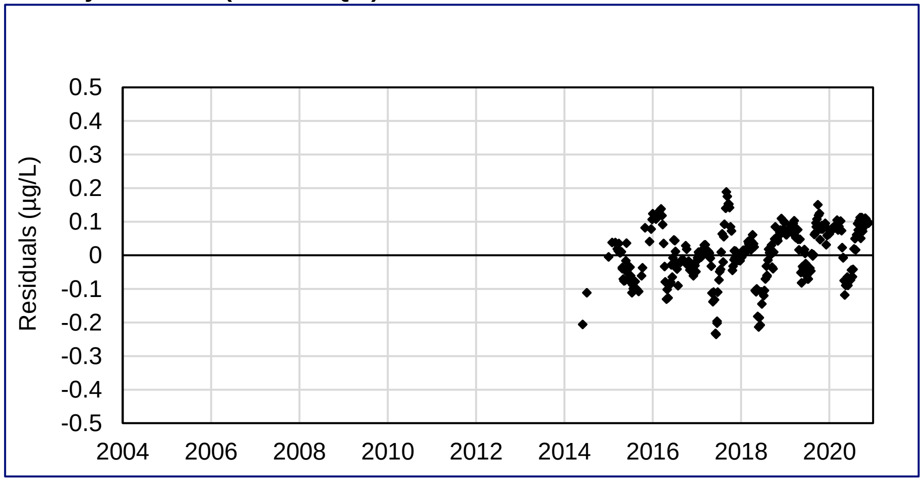
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

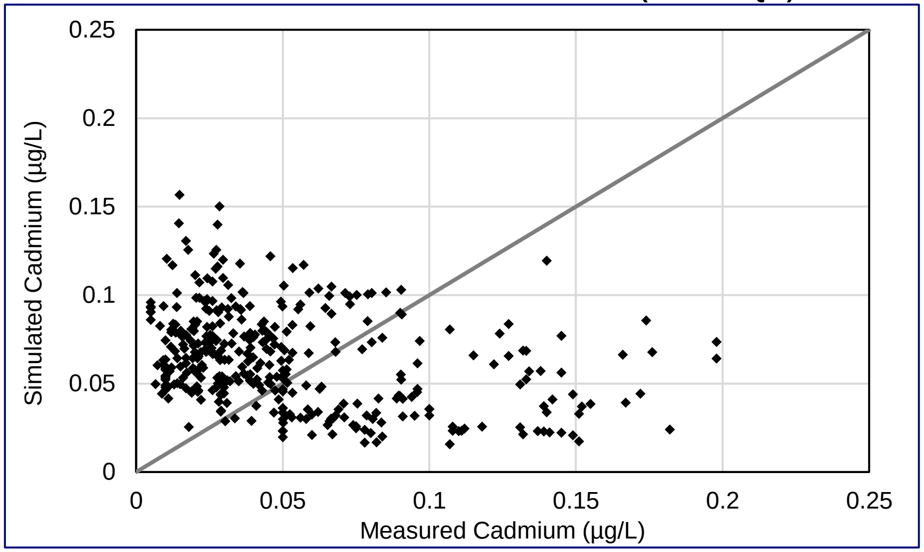
B4-19: Cadmium Calibration Information for Node LC_LC4 - Line Creek u/s of Process Plant (EMS 0200044)

Measured and Simulated Cadmium Data and Calibration Statistics

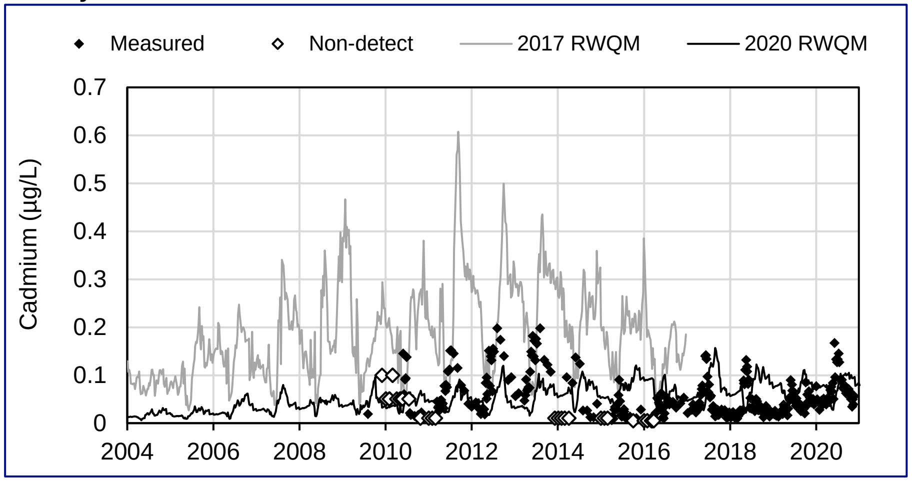
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	8/4/2009	8/4/2009
Last Measured Sample	12/7/2016	12/27/2018
Data Points Available for Comparison, n	171	276
Non-Detect Count	32	32
Measured Mean (µg/L)	-	0.051
Simulated Mean (µg/L)	-	0.061
Bias (µg/L)	-	0.0092
Relative Bias	-	1.2
Error (µg/L)	-	0.051
Percent Error	-	100%

(a) As adjusted for the 2019 IPA.

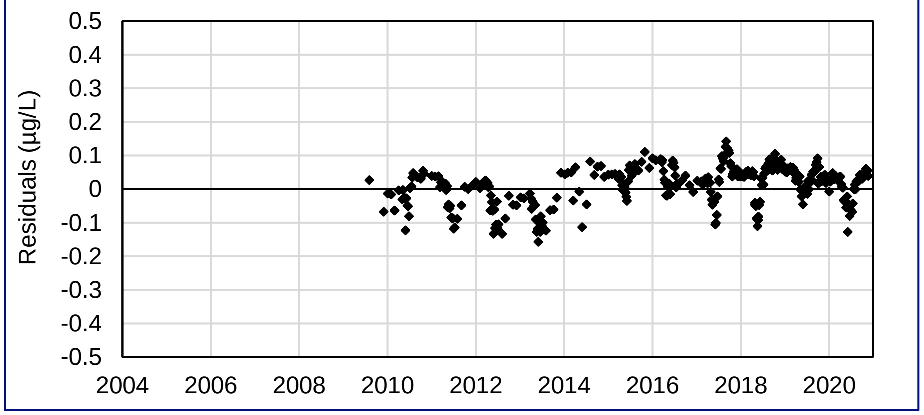
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

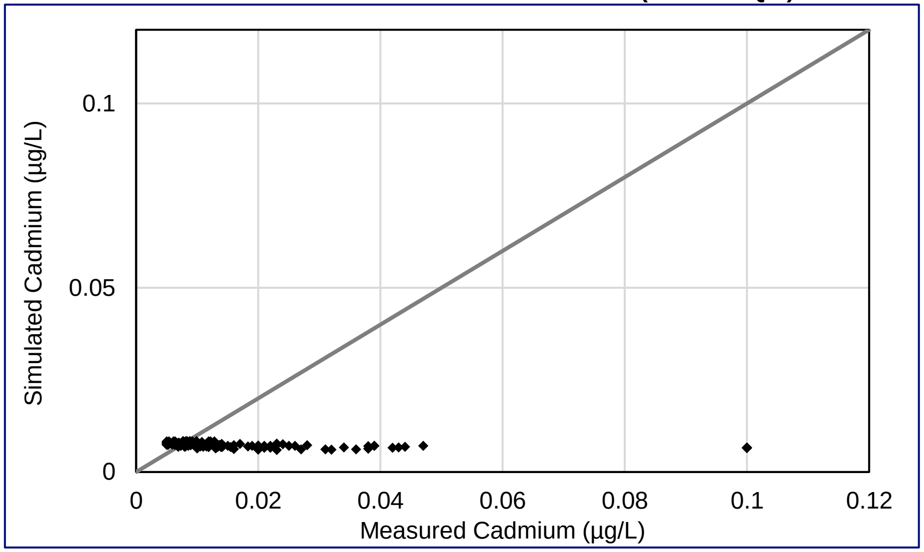
B4-20: Cadmium Calibration Information for Node EV_EC1 - Erickson Creek at Mouth (EMS 0200097)

Measured and Simulated Cadmium Data and Calibration Statistics

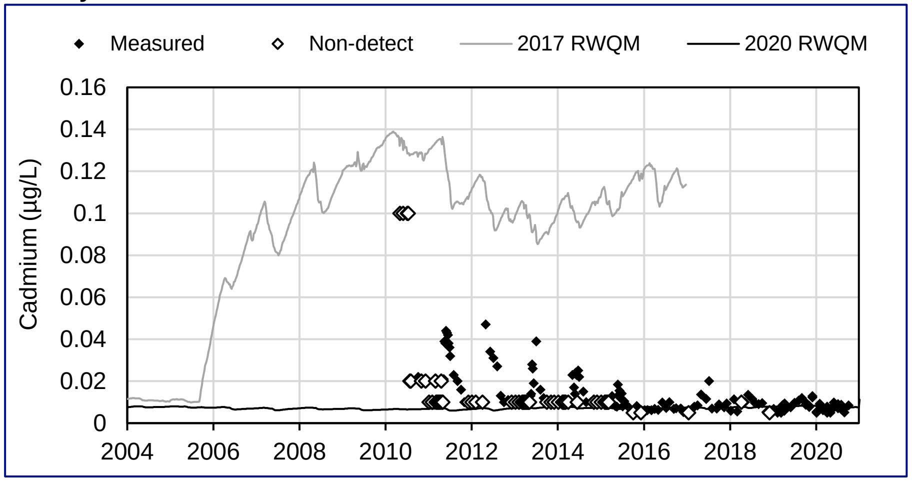
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/4/2010	5/4/2010
Last Measured Sample	12/5/2016	12/4/2018
Data Points Available for Comparison, n	127	151
Non-Detect Count	60	63
Measured Mean (µg/L)	-	0.016
Simulated Mean (µg/L)	-	0.0072
Bias (µg/L)	-	-0.009
Relative Bias	-	0.44
Error (µg/L)	-	0.0094
Percent Error	-	58%

[(a)] As adjusted for the 2019 IPA.

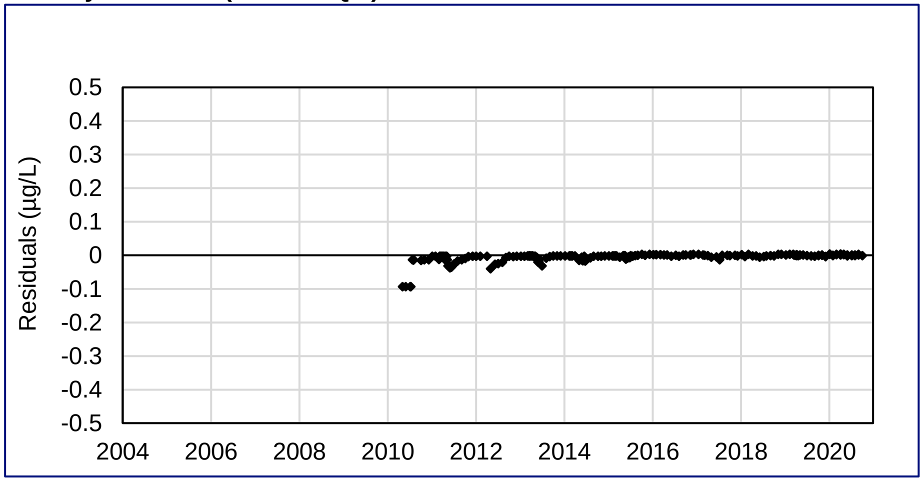
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

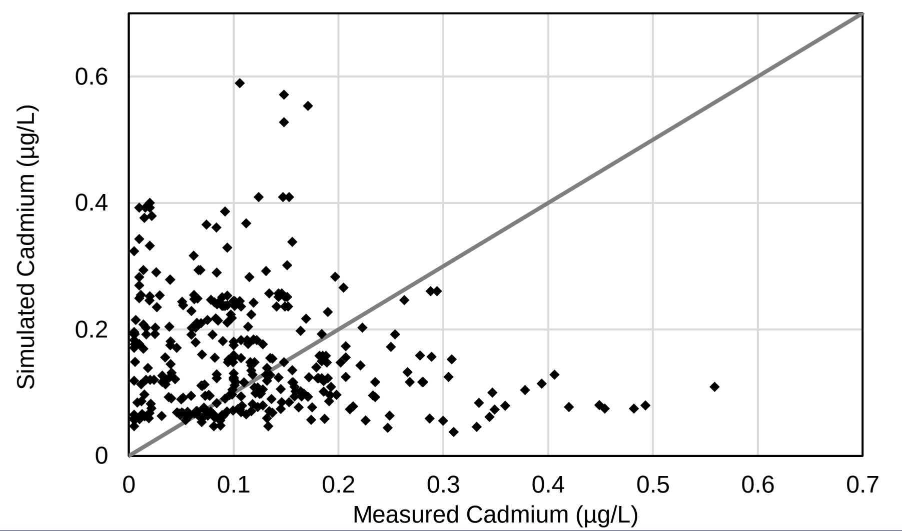
B4-21: Cadmium Calibration Information for Node EV_GT1 - Gate Creek Sediment Pond Decant (EMS E206231)

Measured and Simulated Cadmium Data and Calibration Statistics

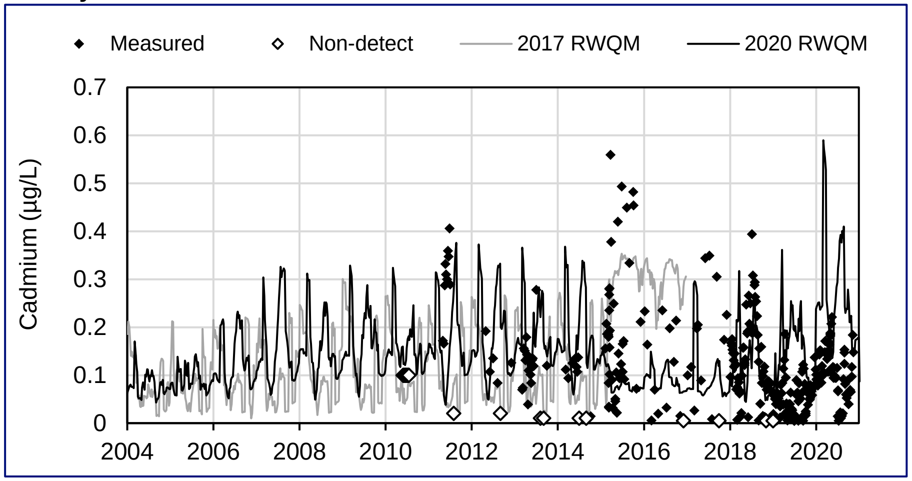
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/5/2016	12/31/2018
Data Points Available for Comparison, n	111	191
Non-Detect Count	15	17
Measured Mean (µg/L)	-	0.15
Simulated Mean (µg/L)	-	0.13
Bias (µg/L)	-	-0.023
Relative Bias	-	0.85
Error (µg/L)	-	0.099
Percent Error	-	66%

(a) As adjusted for the 2019 IPA.

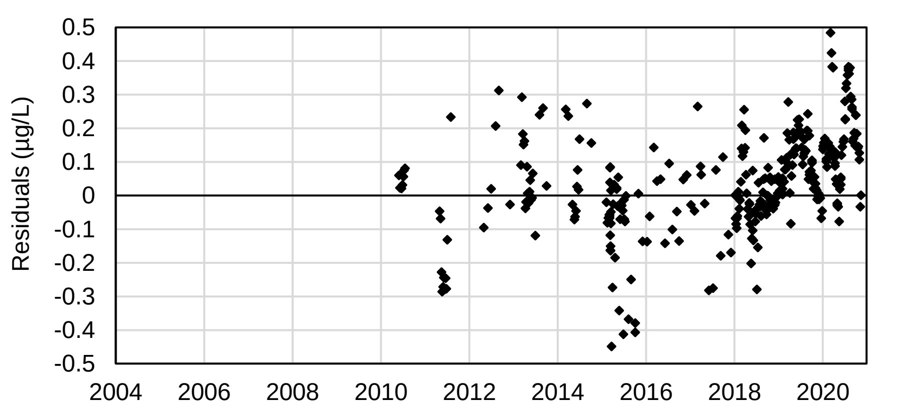
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

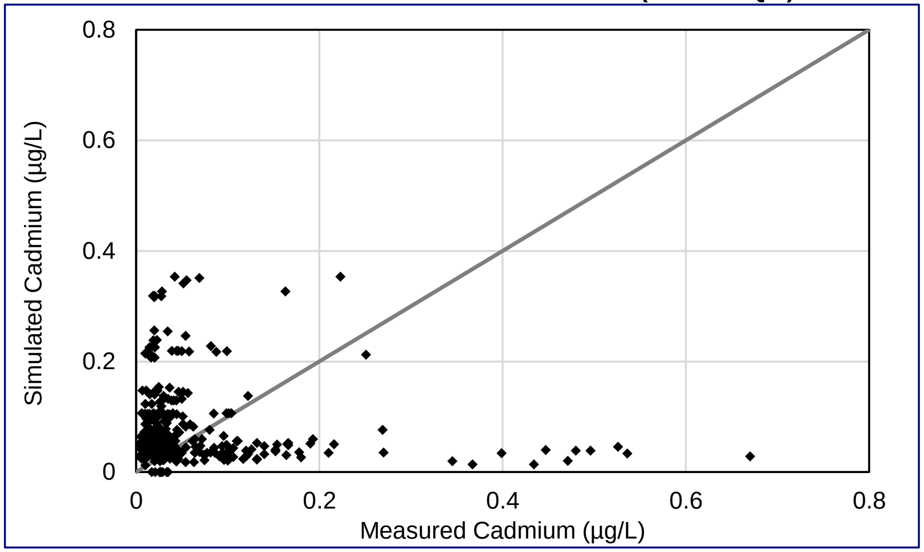
B4-22: Cadmium Calibration Information for Node EV_BC1 - Bodie Creek Sediment Pond Decant (EMS E102685)

Measured and Simulated Cadmium Data and Calibration Statistics

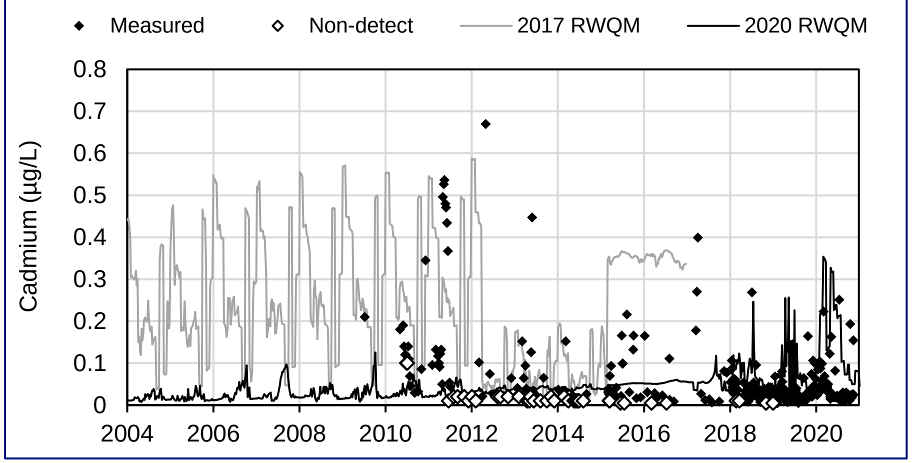
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	7/8/2009	7/8/2009
Last Measured Sample	9/14/2016	12/31/2018
Data Points Available for Comparison, n	138	224
Non-Detect Count	39	42
Measured Mean (µg/L)	-	0.066
Simulated Mean (µg/L)	-	0.052
Bias (µg/L)	-	-0.014
Relative Bias	-	0.78
Error (µg/L)	-	0.065
Percent Error	-	98%

(a) As adjusted for the 2019 IPA.

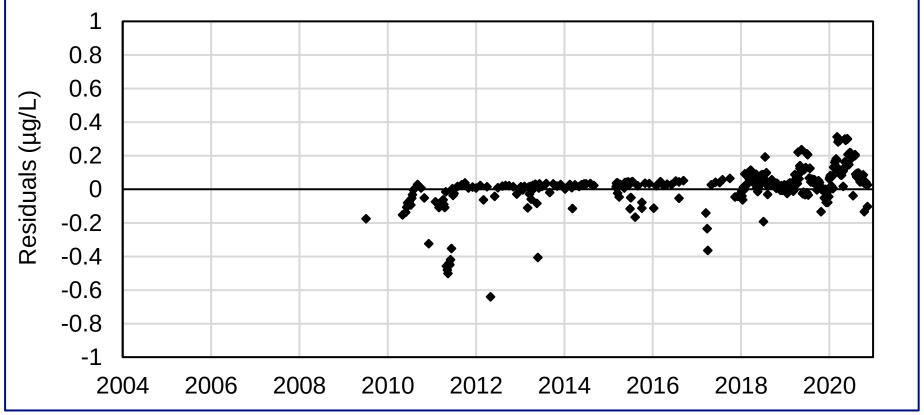
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

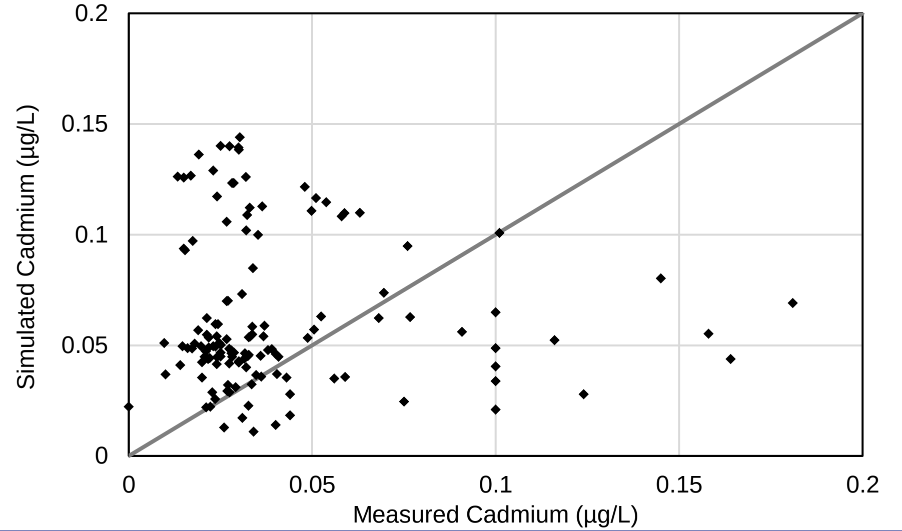
B4-23: Cadmium Calibration Information for Node EV_DC1 - EVO Dry Creek Sediment Pond Decant (EMS E298590)

Measured and Simulated Cadmium Data and Calibration Statistics

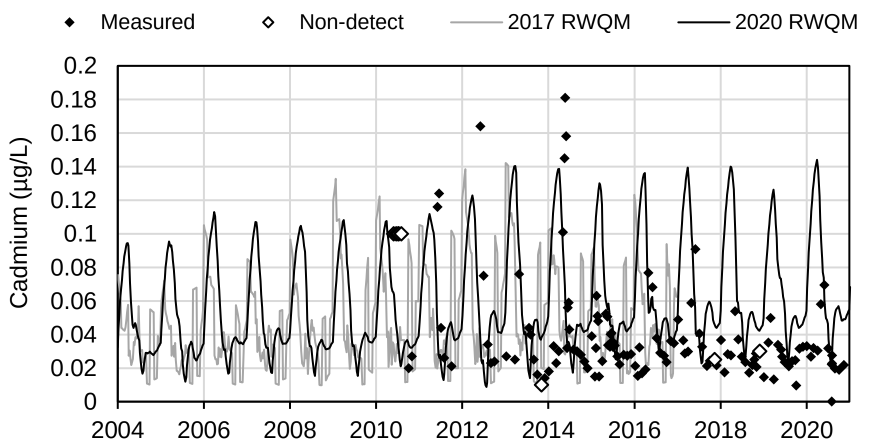
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	79	105
Non-Detect Count	6	8
Measured Mean (µg/L)	-	0.044
Simulated Mean (µg/L)	-	0.062
Bias (µg/L)	-	0.018
Relative Bias	-	1.4
Error (µg/L)	-	0.04
Percent Error	-	91%

[(a)] As adjusted for the 2019 IPA.

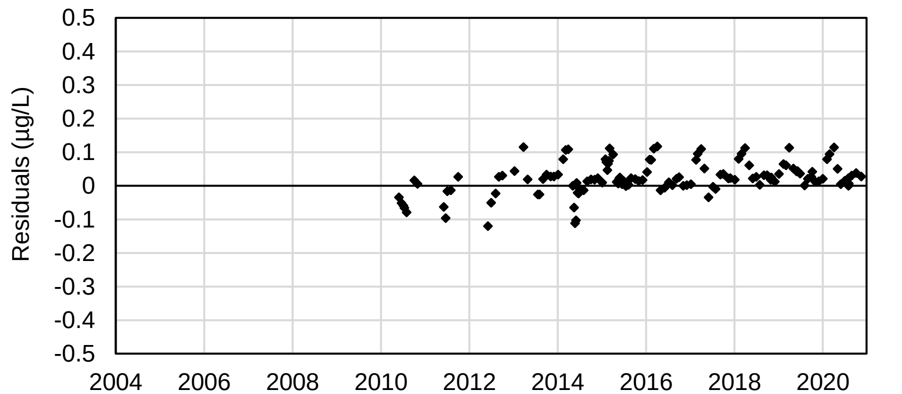
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

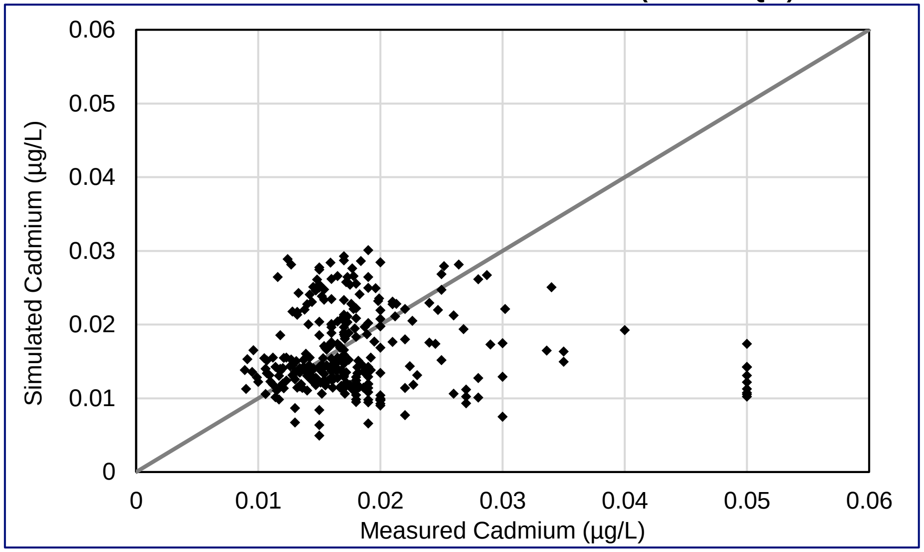
B4-24: Cadmium Calibration Information for Node EV_HC1 - EVO Harmer Compliance Point (Harmer Creek Dam Spillway) (EMS E102682)

Measured and Simulated Cadmium Data and Calibration Statistics

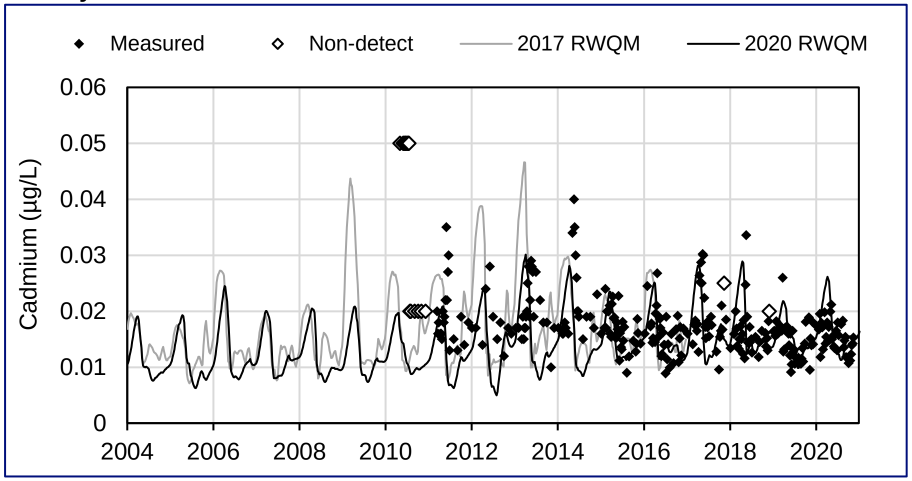
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/4/2010	5/4/2010
Last Measured Sample	12/5/2016	12/3/2018
Data Points Available for Comparison, n	157	221
Non-Detect Count	15	17
Measured Mean (µg/L)	-	0.019
Simulated Mean (µg/L)	-	0.016
Bias (µg/L)	-	-0.003
Relative Bias	-	0.84
Error (µg/L)	-	0.0071
Percent Error	-	37%

[a] As adjusted for the 2019 IPA.

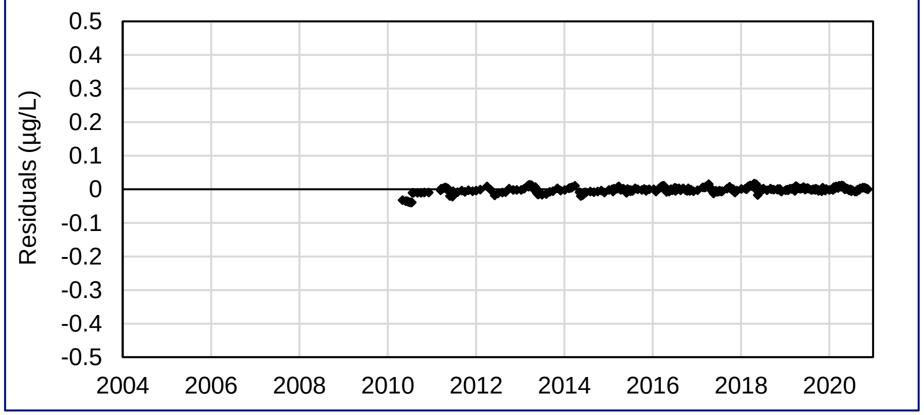
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.

In 2020, projected median weekly concentrations are presented.

Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

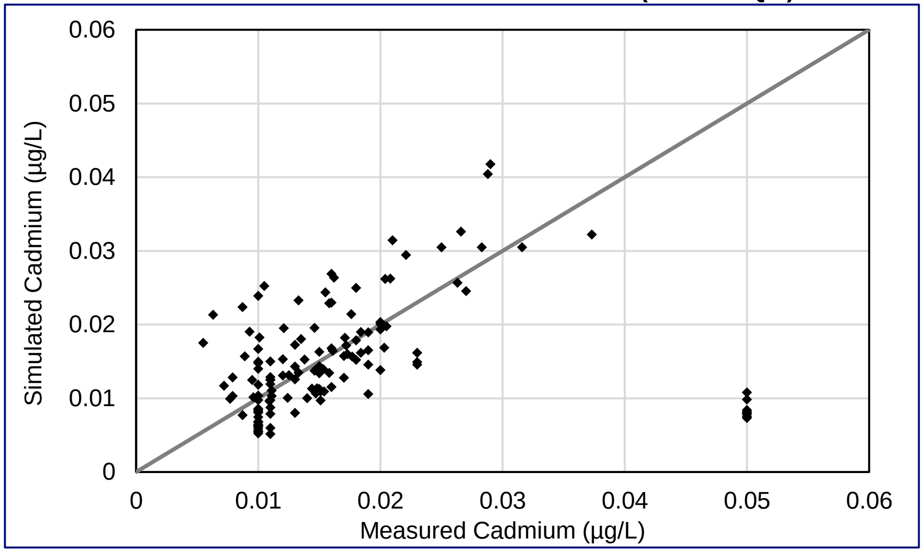
B4-25: Cadmium Calibration Information for Node FR_FR1 - Fording River d/s of Henretta Creek (EMS 0200251)

Measured and Simulated Cadmium Data and Calibration Statistics

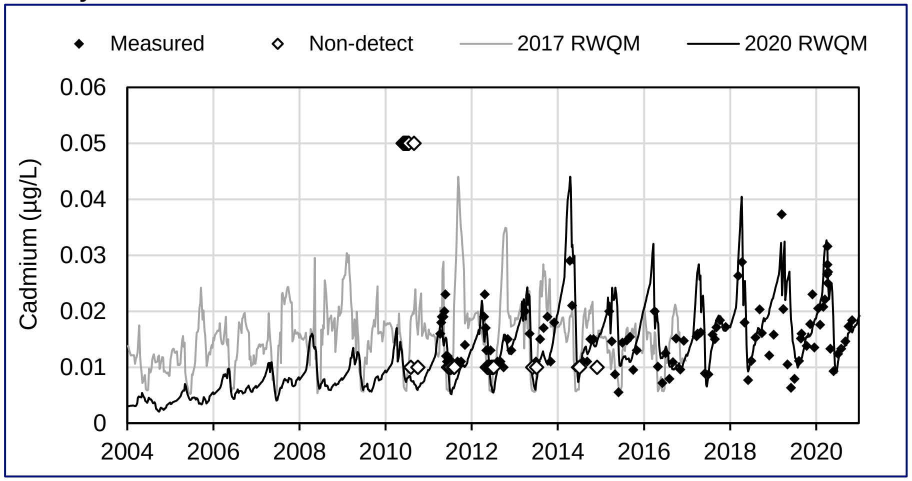
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	87	106
Non-Detect Count	29	29
Measured Mean (µg/L)	-	0.017
Simulated Mean (µg/L)	-	0.014
Bias (µg/L)	-	-0.0031
Relative Bias	-	0.81
Error (µg/L)	-	0.007
Percent Error	-	42%

[a] As adjusted for the 2019 IPA.

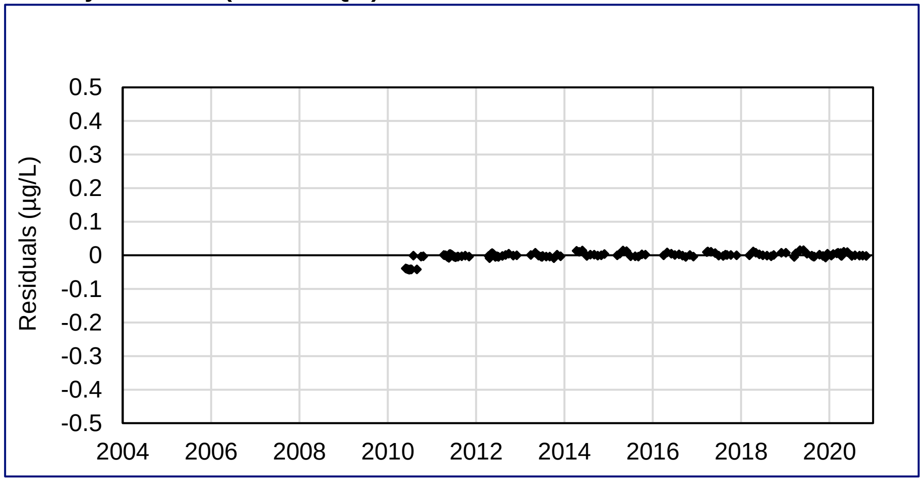
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

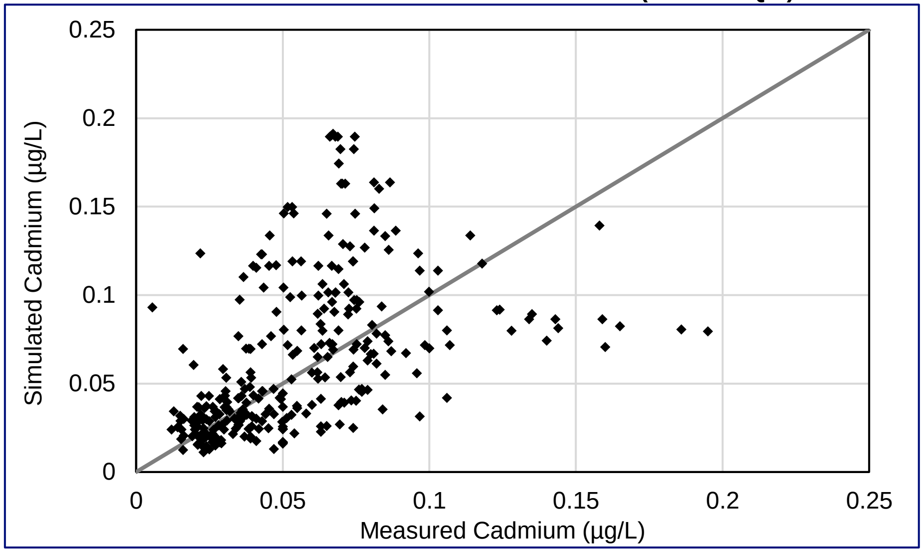
B4-26: Cadmium Calibration Information for Node FR_FR2 - Fording River u/s of Kilmarnock Creek (EMS 0200201)

Measured and Simulated Cadmium Data and Calibration Statistics

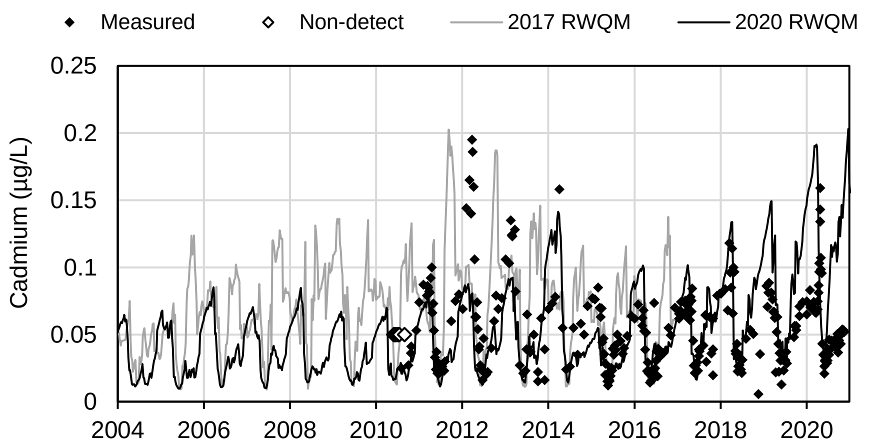
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/12/2016	12/5/2018
Data Points Available for Comparison, n	154	216
Non-Detect Count	8	8
Measured Mean (µg/L)	-	0.054
Simulated Mean (µg/L)	-	0.049
Bias (µg/L)	-	-0.0053
Relative Bias	-	0.9
Error (µg/L)	-	0.019
Percent Error	-	36%

[a] As adjusted for the 2019 IPA.

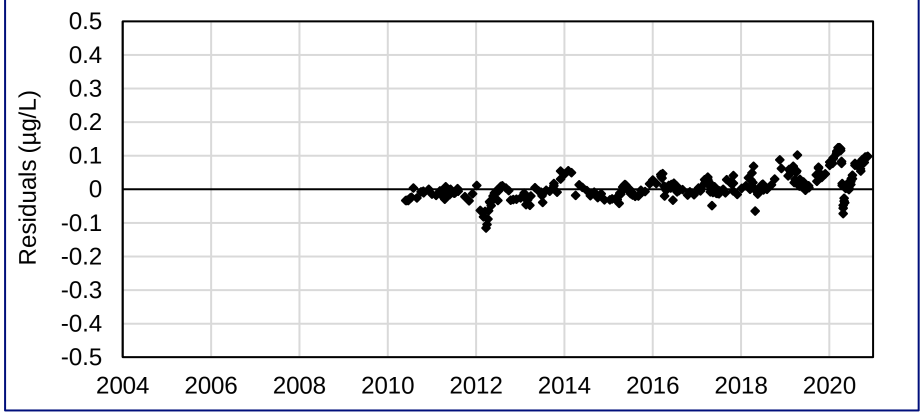
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

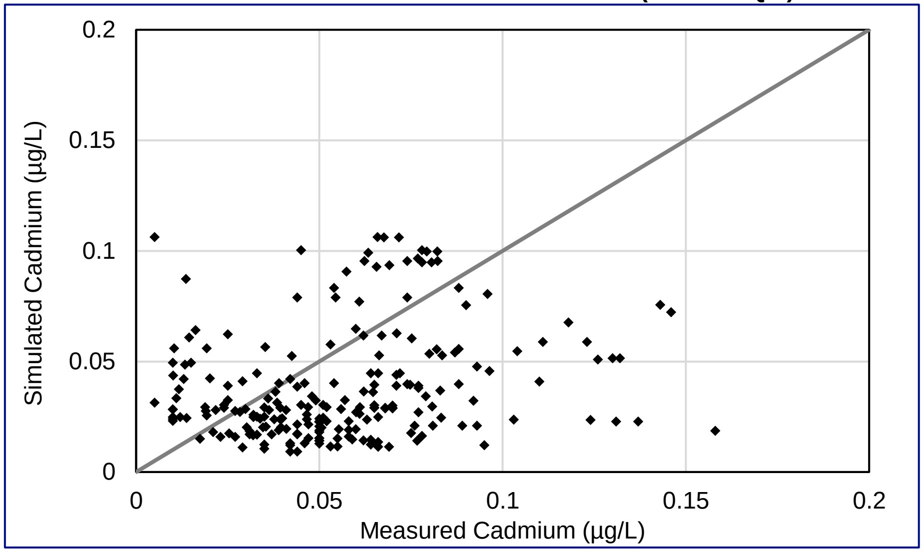
B4-27: Cadmium Calibration Information for Node FR_FR4 - Fording River between Swift and Cataract Creeks (EMS 0200311)

Measured and Simulated Cadmium Data and Calibration Statistics

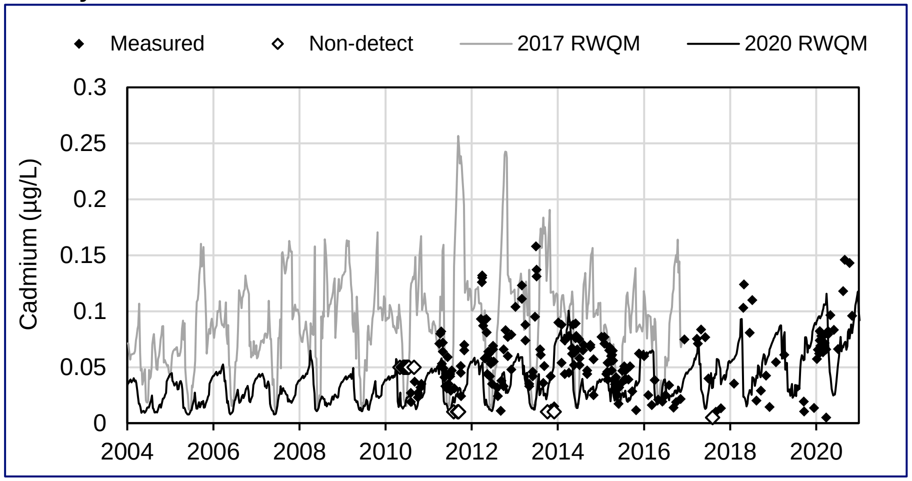
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	5/3/2010	5/3/2010
Last Measured Sample	12/12/2016	12/5/2018
Data Points Available for Comparison, n	177	194
Non-Detect Count	18	19
Measured Mean (µg/L)	-	0.053
Simulated Mean (µg/L)	-	0.032
Bias (µg/L)	-	-0.022
Relative Bias	-	0.59
Error (µg/L)	-	0.03
Percent Error	-	56%

[(a)] As adjusted for the 2019 IPA.

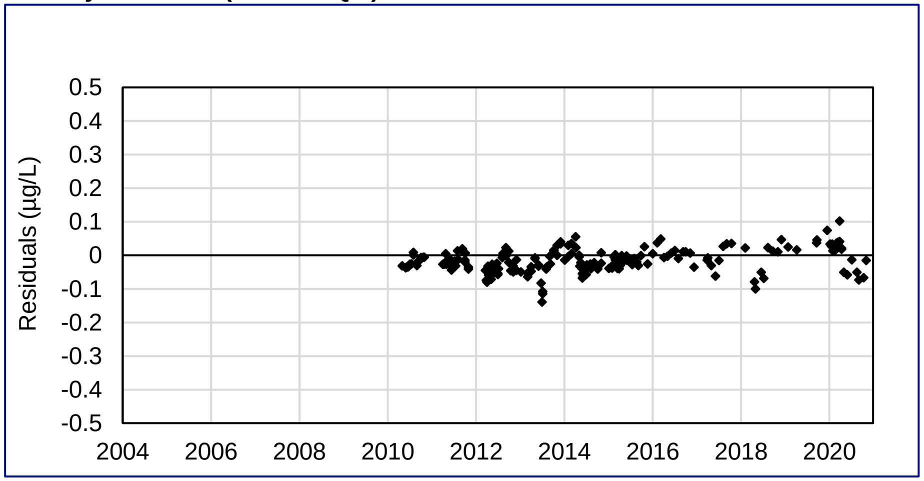
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

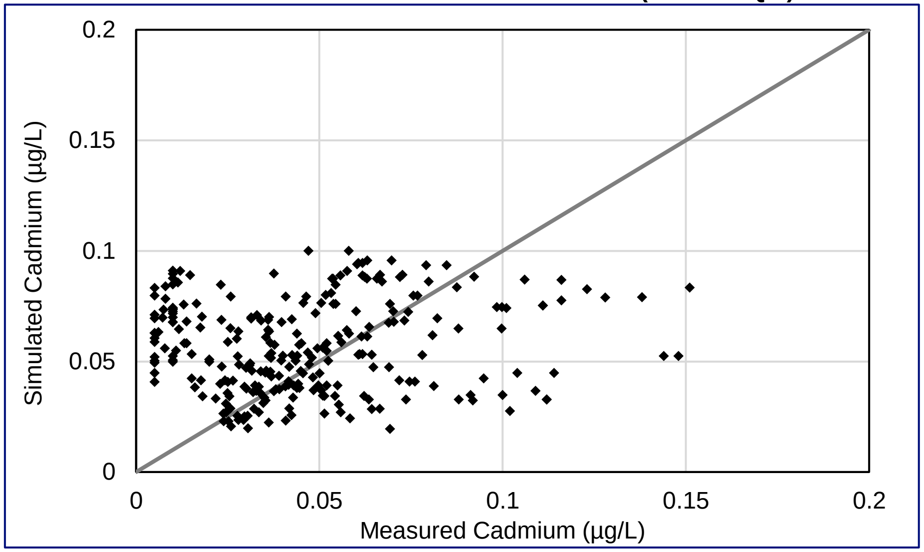
B4-28: Cadmium Calibration Information for Node FR_FRCP1 - Fording River, 525 m d/s of Cataract Creek (EMS E300071)

Measured and Simulated Cadmium Data and Calibration Statistics

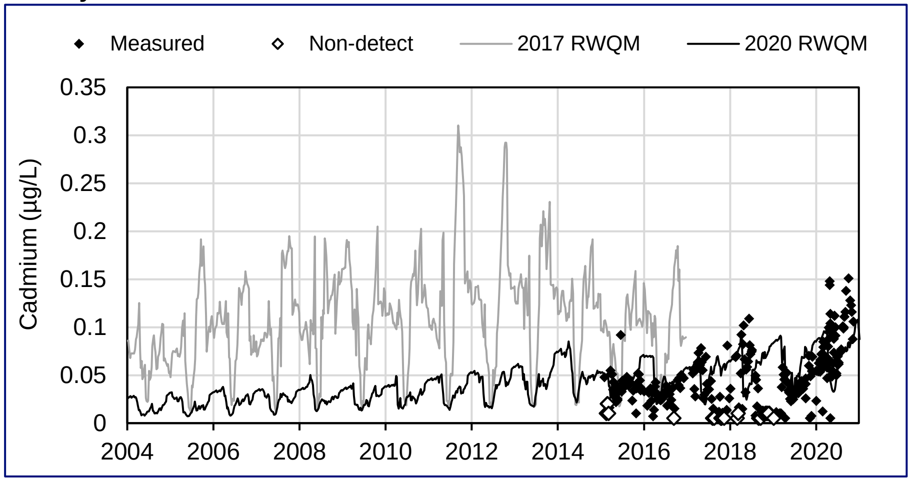
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	2/3/2015	2/3/2015
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	82	155
Non-Detect Count	5	21
Measured Mean (µg/L)	-	0.036
Simulated Mean (µg/L)	-	0.049
Bias (µg/L)	-	0.013
Relative Bias	-	1.4
Error (µg/L)	-	0.025
Percent Error	-	69%

(a) As adjusted for the 2019 IPA.

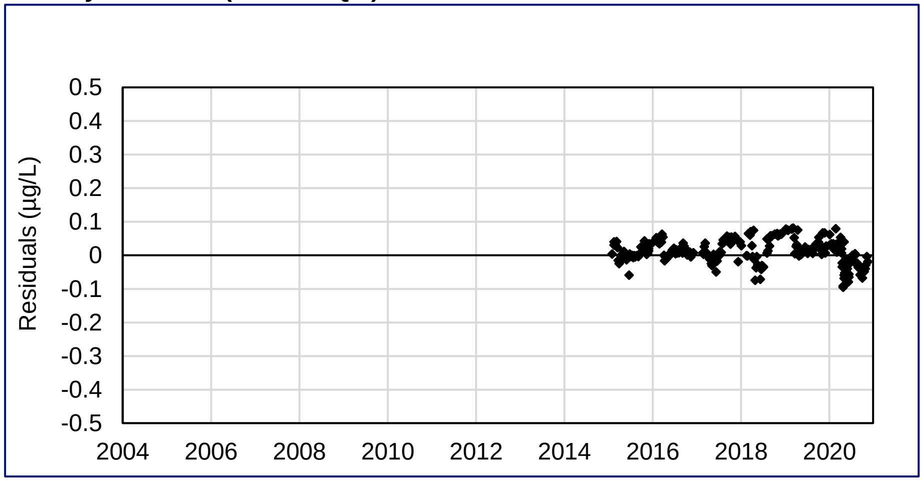
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

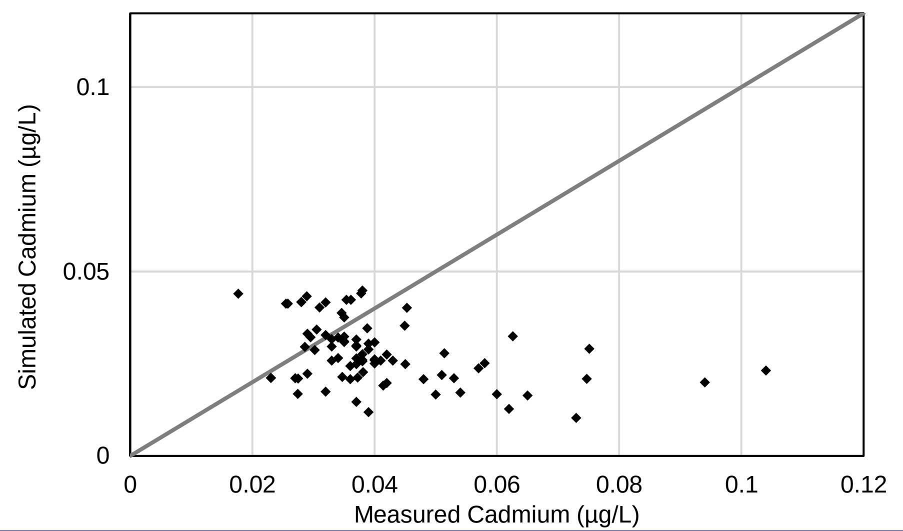
B4-29: Cadmium Calibration Information for Node GH_PC2 - Fording River d/s of Porter Creek (EMS E287431)

Measured and Simulated Cadmium Data and Calibration Statistics

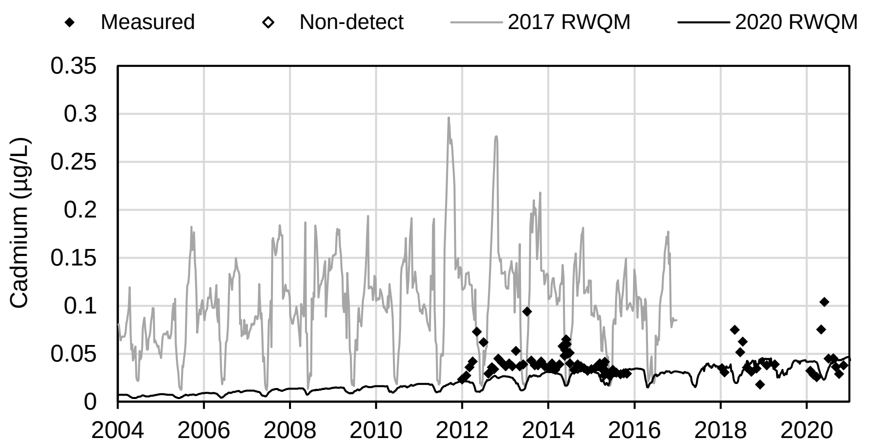
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/3/2012	1/3/2012
Last Measured Sample	11/2/2015	12/5/2018
Data Points Available for Comparison, n	59	68
Non-Detect Count	0	0
Measured Mean (µg/L)	-	0.041
Simulated Mean (µg/L)	-	0.026
Bias (µg/L)	-	-0.015
Relative Bias	-	0.63
Error (µg/L)	-	0.017
Percent Error	-	41%

(a) As adjusted for the 2019 IPA.

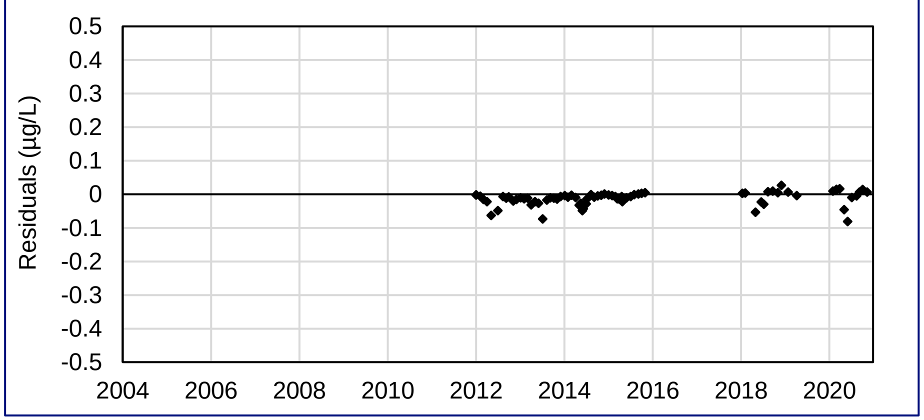
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

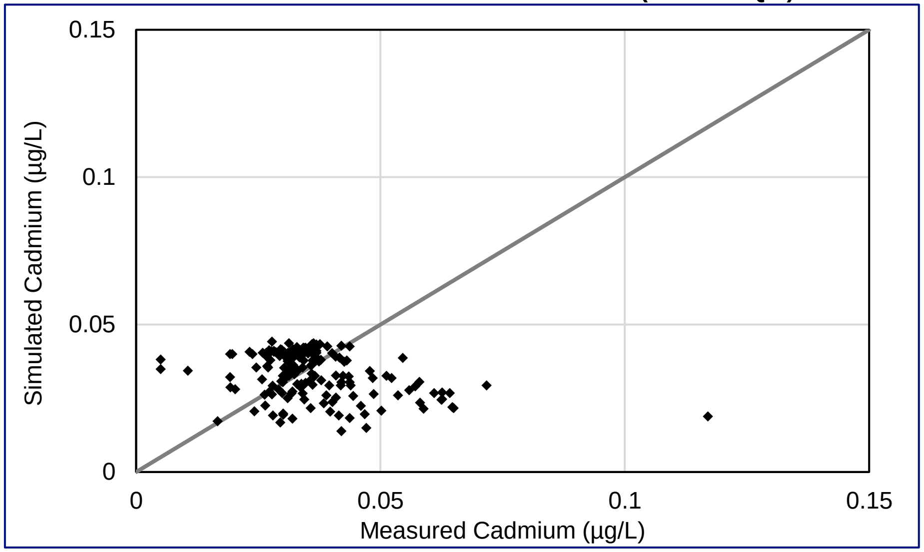
B4-30: Cadmium Calibration Information for Node FR_FRABCH - FRO Compliance Point (Fording River, 100 m u/s of Chauncey Creek) (EMS E223753)

Measured and Simulated Cadmium Data and Calibration Statistics

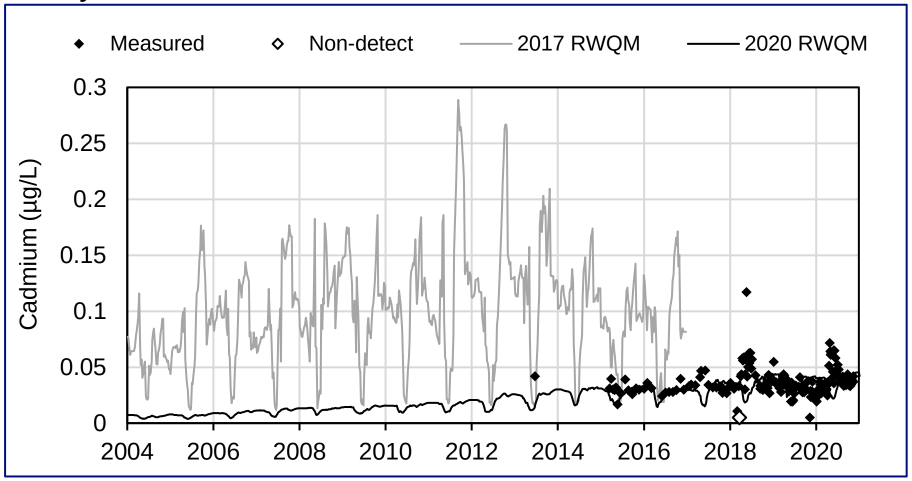
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/24/2013	6/24/2013
Last Measured Sample	12/8/2016	12/6/2018
Data Points Available for Comparison, n	24	71
Non-Detect Count	0	1
Measured Mean (µg/L)	-	0.037
Simulated Mean (µg/L)	-	0.03
Bias (µg/L)	-	-0.007
Relative Bias	-	0.81
Error (µg/L)	-	0.012
Percent Error	-	34%

(a) As adjusted for the 2019 IPA.

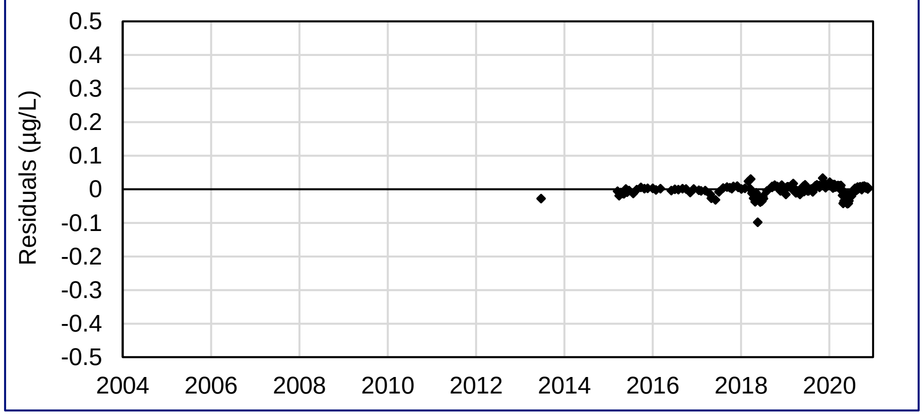
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

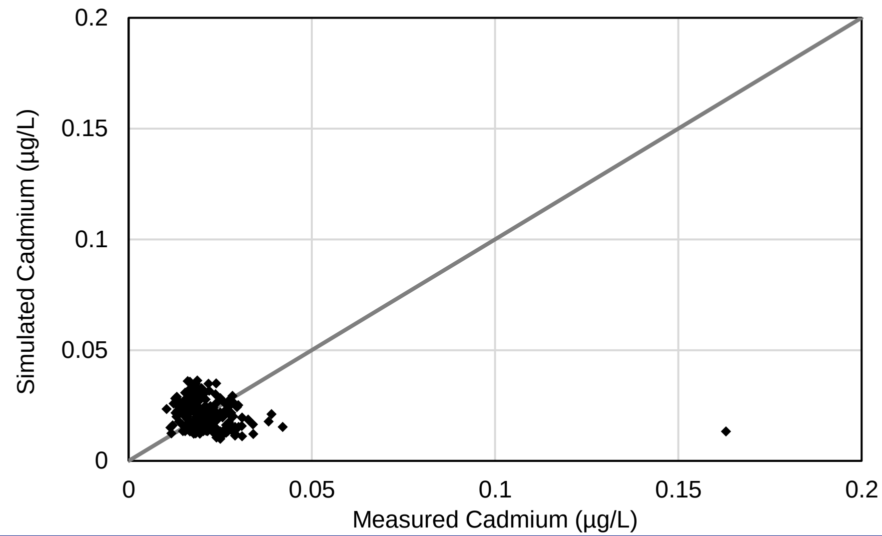
B4-31: Cadmium Calibration Information for Node LC_FRDSDC - Fording River d/s of Dry Creek (EMS E288272)

Measured and Simulated Cadmium Data and Calibration Statistics

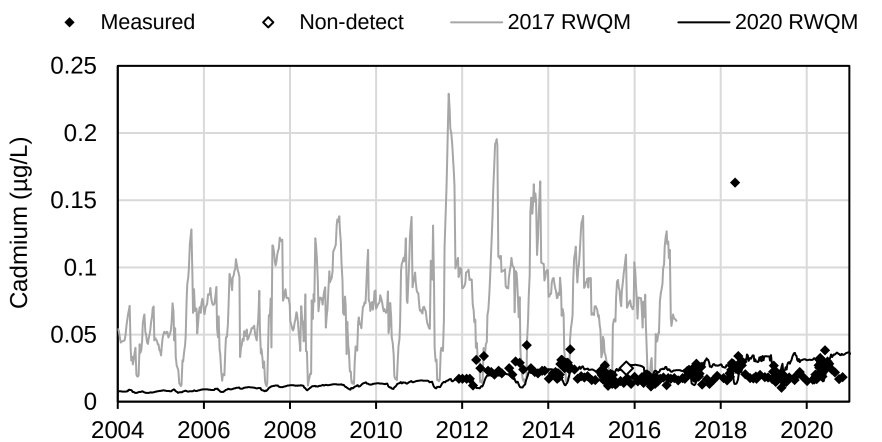
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/7/2011	12/7/2011
Last Measured Sample	12/6/2016	12/5/2018
Data Points Available for Comparison, n	108	160
Non-Detect Count	1	1
Measured Mean (µg/L)	-	0.022
Simulated Mean (µg/L)	-	0.021
Bias (µg/L)	-	-0.0011
Relative Bias	-	0.95
Error (µg/L)	-	0.0081
Percent Error	-	37%

[(a)] As adjusted for the 2019 IPA.

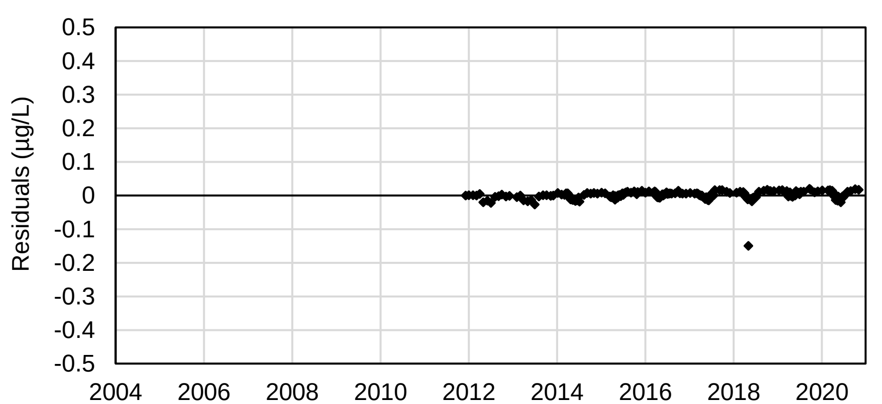
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

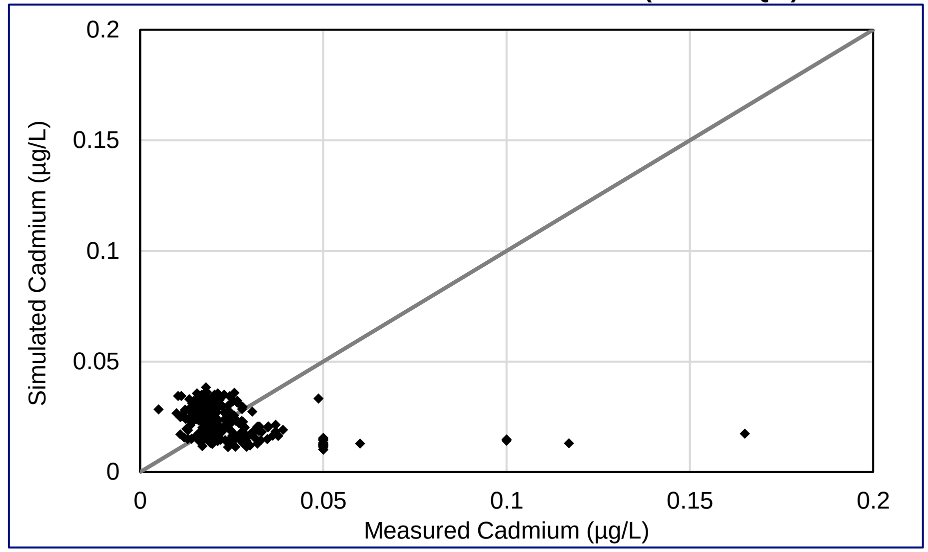
B4-32: Cadmium Calibration Information for Node GH_FR1 - GHO Fording River Compliance Point (EMS 0200378)

Measured and Simulated Cadmium Data and Calibration Statistics

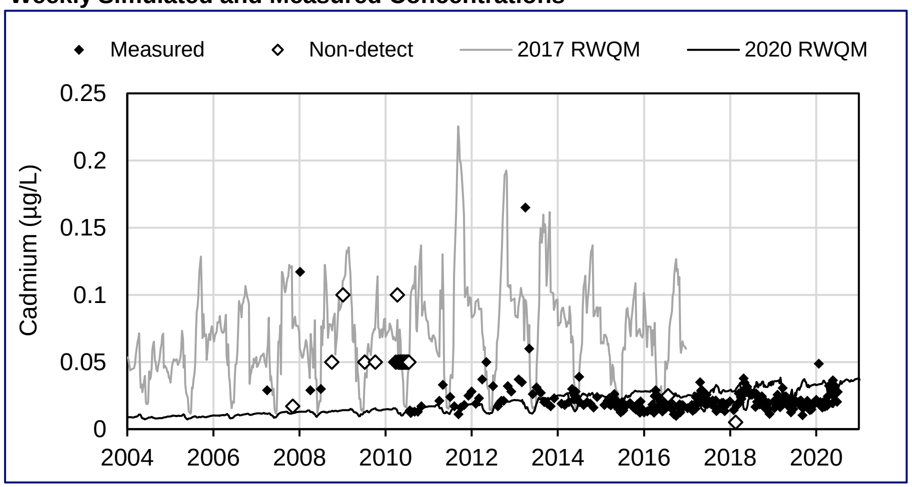
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/2/2007	4/2/2007
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	153	232
Non-Detect Count	22	23
Measured Mean (µg/L)	-	0.025
Simulated Mean (µg/L)	-	0.022
Bias (µg/L)	-	-0.0029
Relative Bias	-	0.88
Error (µg/L)	-	0.013
Percent Error	-	52%

[(a)] As adjusted for the 2019 IPA.

Simulated versus Measured Cadmium Concentrations (2020 RWQM)

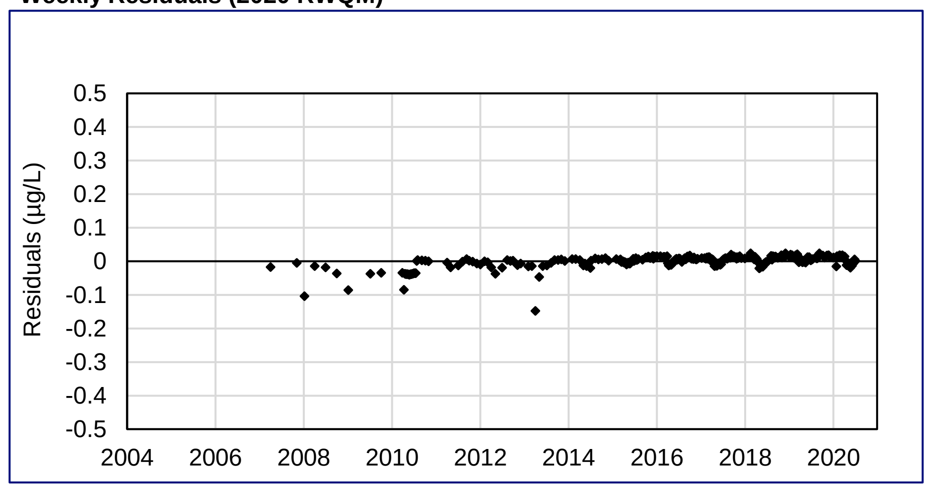


Weekly Simulated and Measured Concentrations



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Weekly Residuals (2020 RWQM)



Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

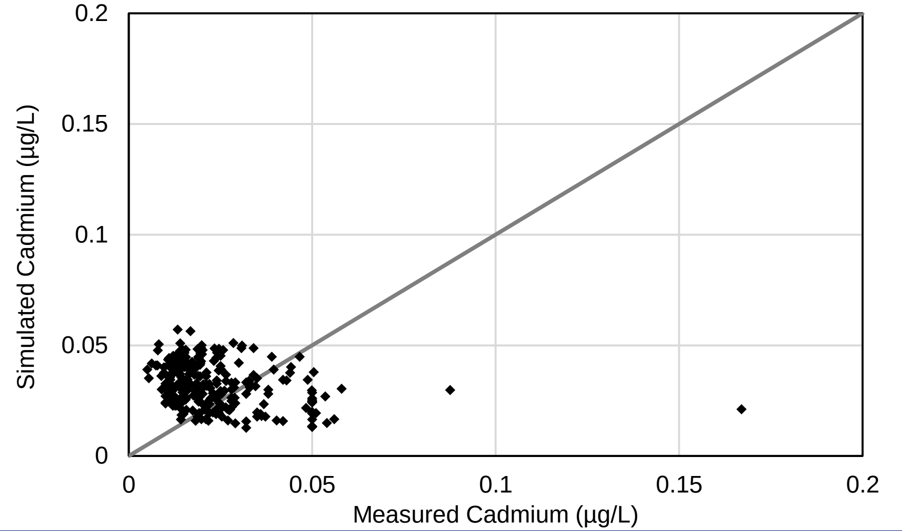
B4-33: Cadmium Calibration Information for Node LC_LC5 - Fording River d/s of Line Creek (EMS 0200028)

Measured and Simulated Cadmium Data and Calibration Statistics

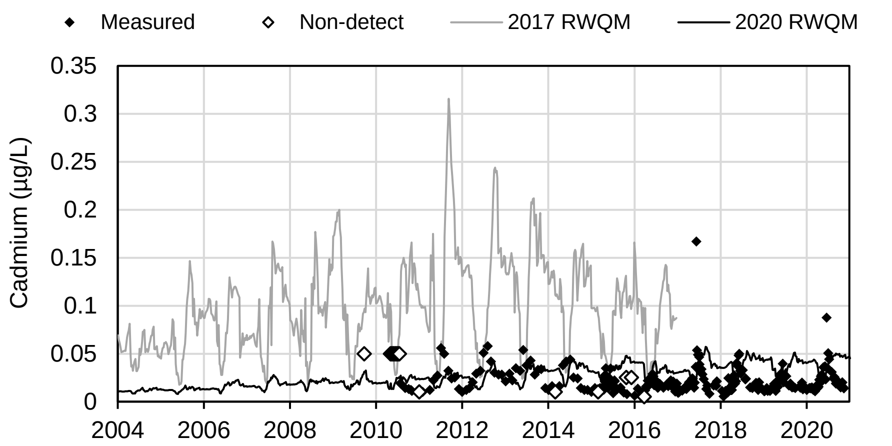
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	9/23/2009	9/23/2009
Last Measured Sample	12/28/2016	12/4/2018
Data Points Available for Comparison, n	133	199
Non-Detect Count	19	19
Measured Mean (µg/L)	-	0.024
Simulated Mean (µg/L)	-	0.03
Bias (µg/L)	-	0.0064
Relative Bias	-	1.3
Error (µg/L)	-	0.017
Percent Error	-	72%

(a) As adjusted for the 2019 IPA.

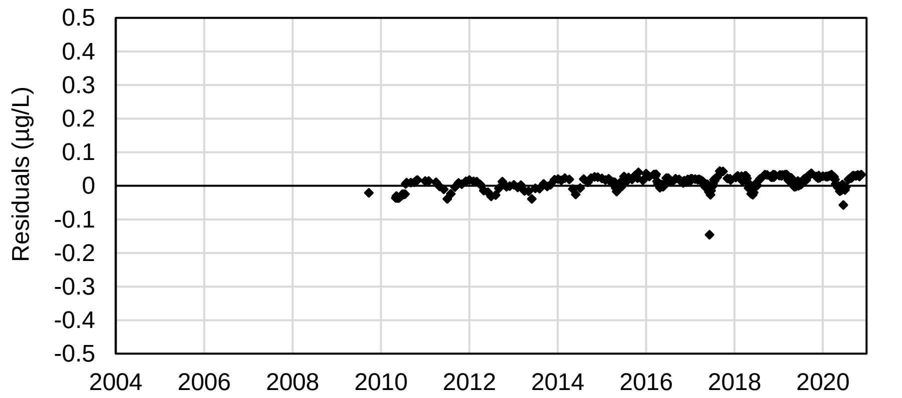
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

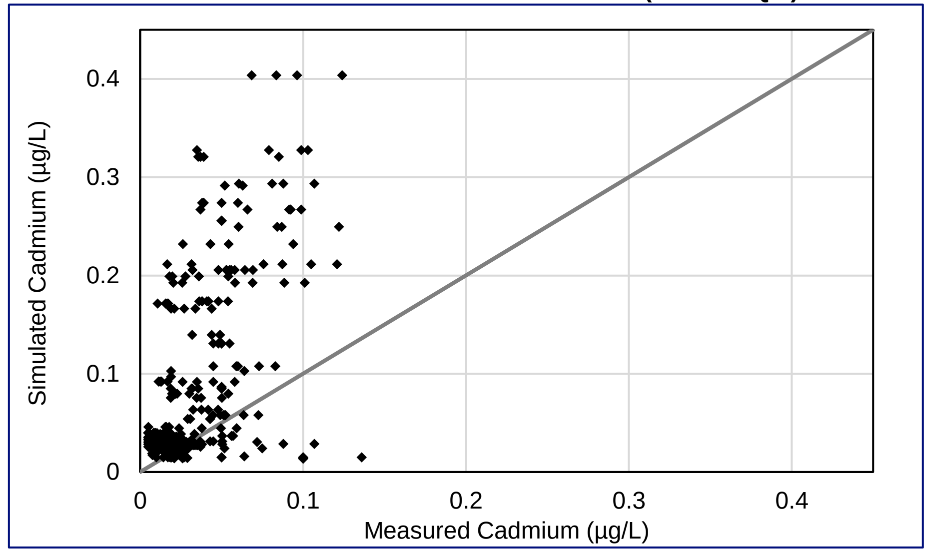
B4-34: Cadmium Calibration Information for Node CM_MC2 - CMO Compliance Point (EMS E258937)

Measured and Simulated Cadmium Data and Calibration Statistics

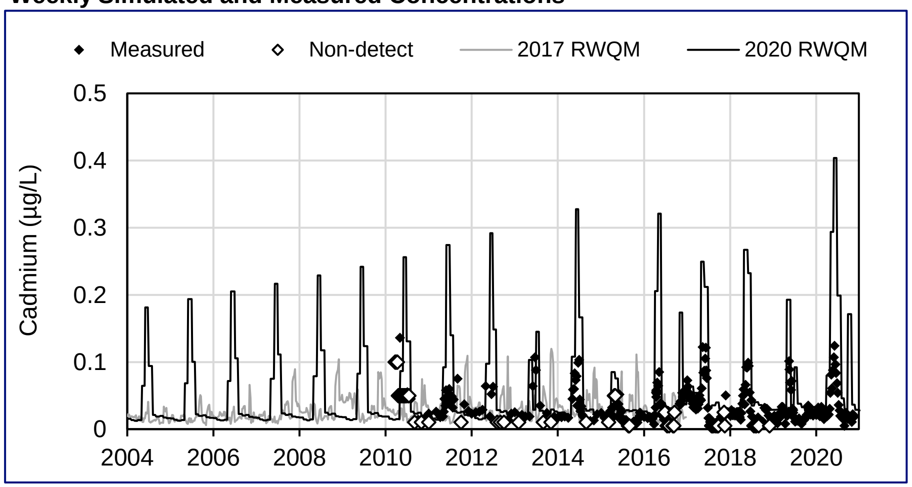
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	3/23/2010	3/23/2010
Last Measured Sample	12/21/2016	12/28/2018
Data Points Available for Comparison, n	187	305
Non-Detect Count	38	52
Measured Mean (µg/L)	-	0.032
Simulated Mean (µg/L)	-	0.079
Bias (µg/L)	-	0.046
Relative Bias	-	2.4
Error (µg/L)	-	0.053
Percent Error	-	164%

(a) As adjusted for the 2019 IPA.

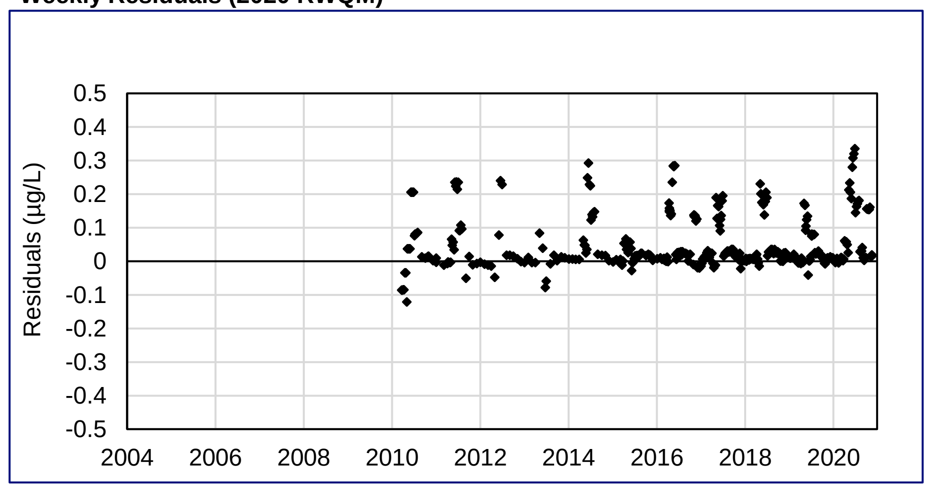
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

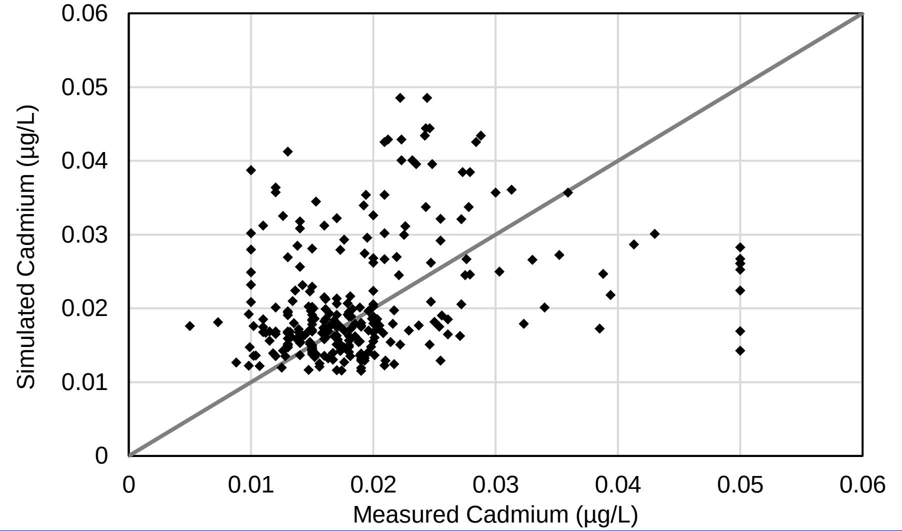
B4-35: Cadmium Calibration Information for Node EV_MC3 - Michel Creek u/s of Erickson Creek (EMS 0200203)

Measured and Simulated Cadmium Data and Calibration Statistics

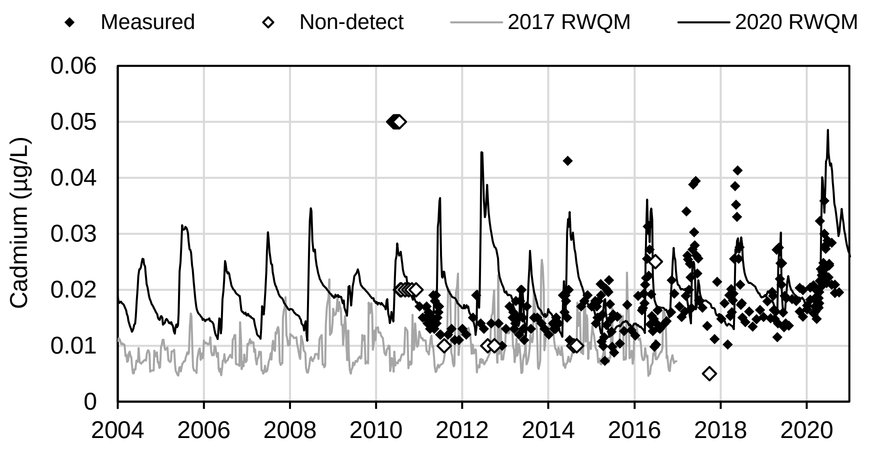
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	154	205
Non-Detect Count	20	21
Measured Mean (µg/L)	-	0.019
Simulated Mean (µg/L)	-	0.019
Bias (µg/L)	-	0.00084
Relative Bias	-	1.0
Error (µg/L)	-	0.0067
Percent Error	-	36%

[(a)] As adjusted for the 2019 IPA.

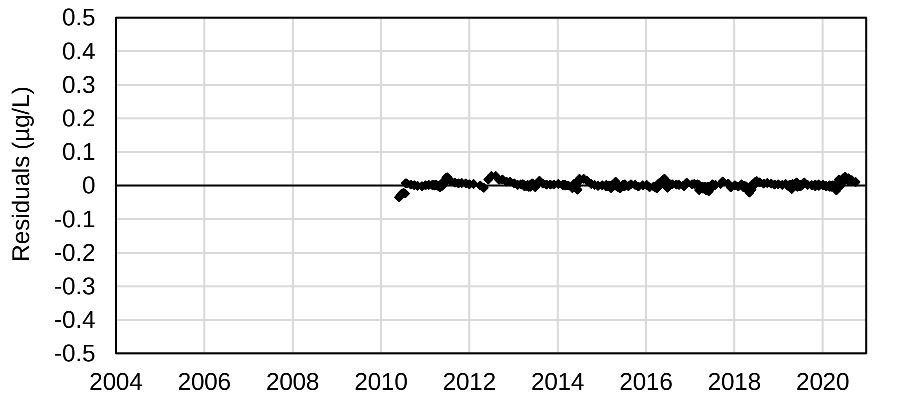
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

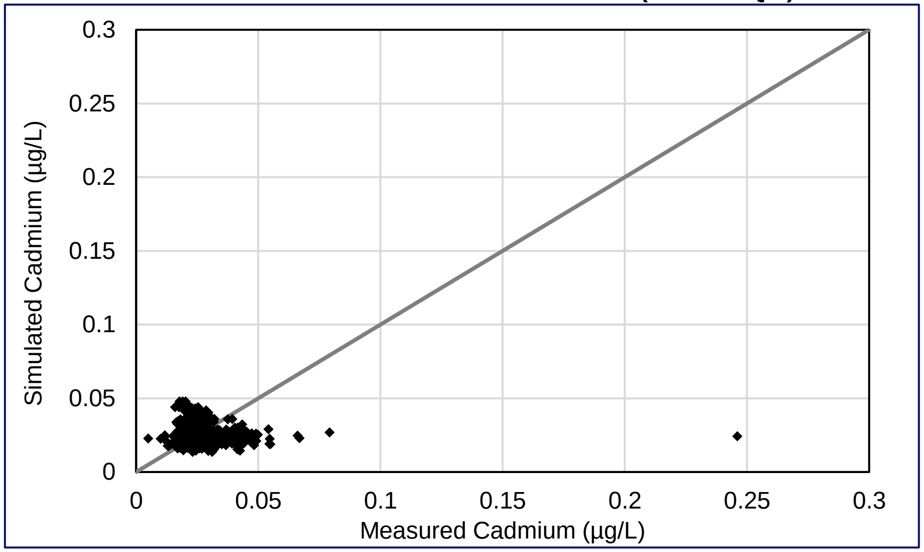
B4-36: Cadmium Calibration Information for Node EV_MC2 - EVO Michel Creek Compliance Point (EMS E300091)

Measured and Simulated Cadmium Data and Calibration Statistics

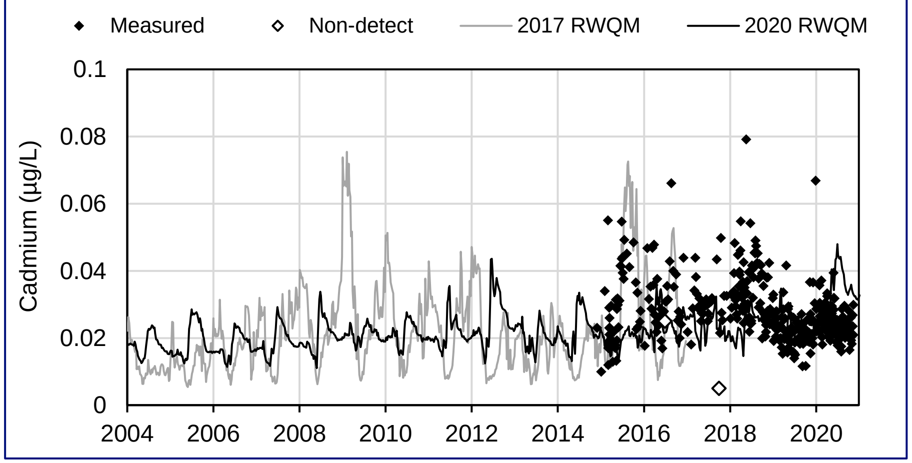
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/3/2014	12/3/2014
Last Measured Sample	12/5/2016	12/31/2018
Data Points Available for Comparison, n	87	203
Non-Detect Count	1	2
Measured Mean (µg/L)	-	0.032
Simulated Mean (µg/L)	-	0.022
Bias (µg/L)	-	-0.0091
Relative Bias	-	0.71
Error (µg/L)	-	0.011
Percent Error	-	35%

[(a)] As adjusted for the 2019 IPA.

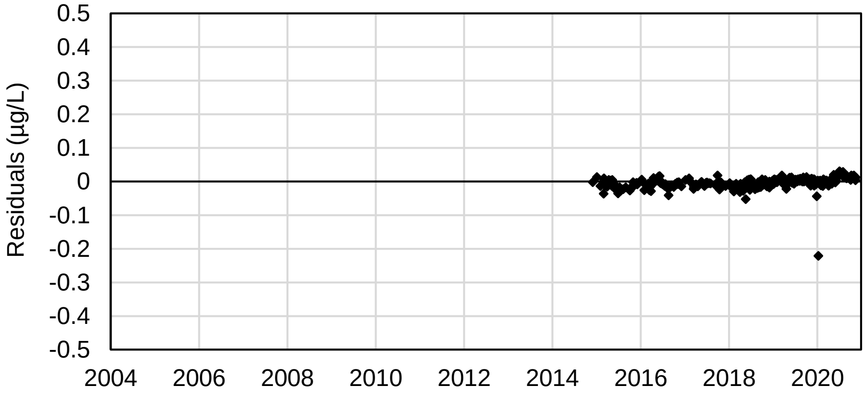
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

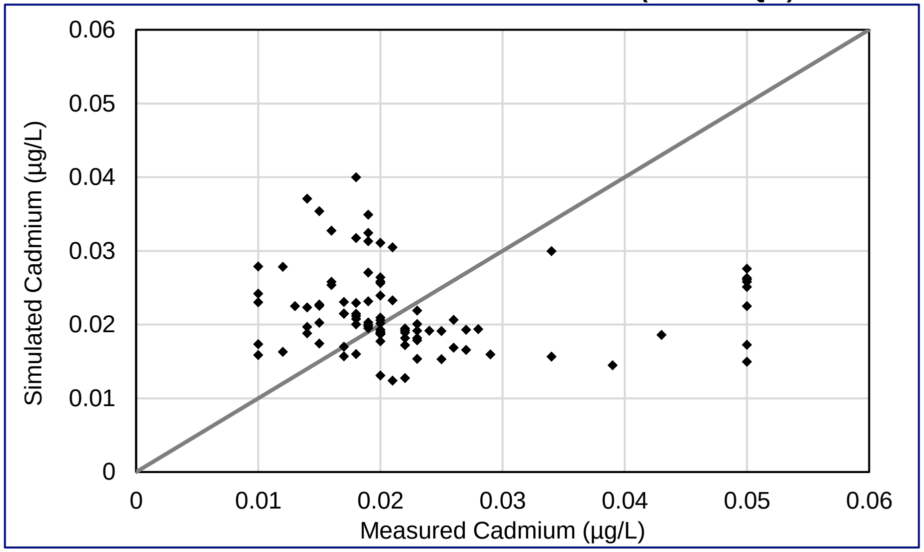
B4-37: Cadmium Calibration Information for Node EV_MC1 - Michel Creek u/s of Highway 43 Bridge (EMS 0200425)

Measured and Simulated Cadmium Data and Calibration Statistics

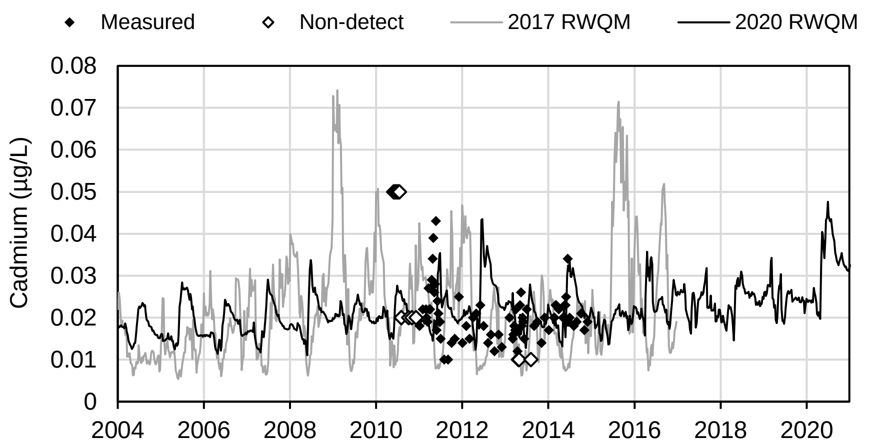
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/3/2014	12/3/2014
Data Points Available for Comparison, n	94	94
Non-Detect Count	16	16
Measured Mean (µg/L)	-	0.022
Simulated Mean (µg/L)	-	0.022
Bias (µg/L)	-	-0.00063
Relative Bias	-	0.97
Error (µg/L)	-	0.0087
Percent Error	-	39%

[(a)] As adjusted for the 2019 IPA.

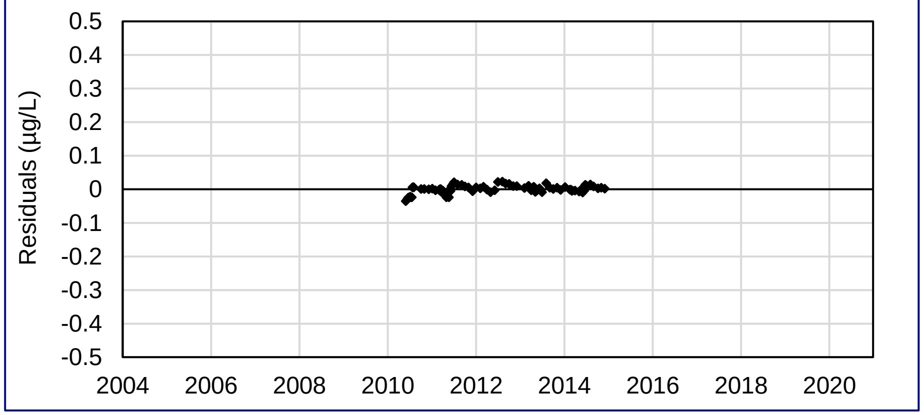
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

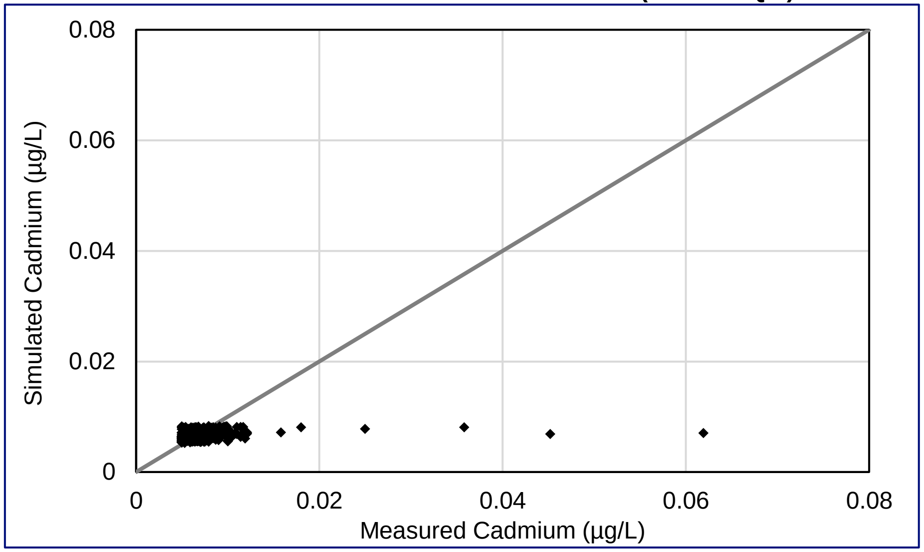
B4-38: Cadmium Calibration Information for Node GH_ERC - GHO Elk River Compliance Point (EMS E300090)

Measured and Simulated Cadmium Data and Calibration Statistics

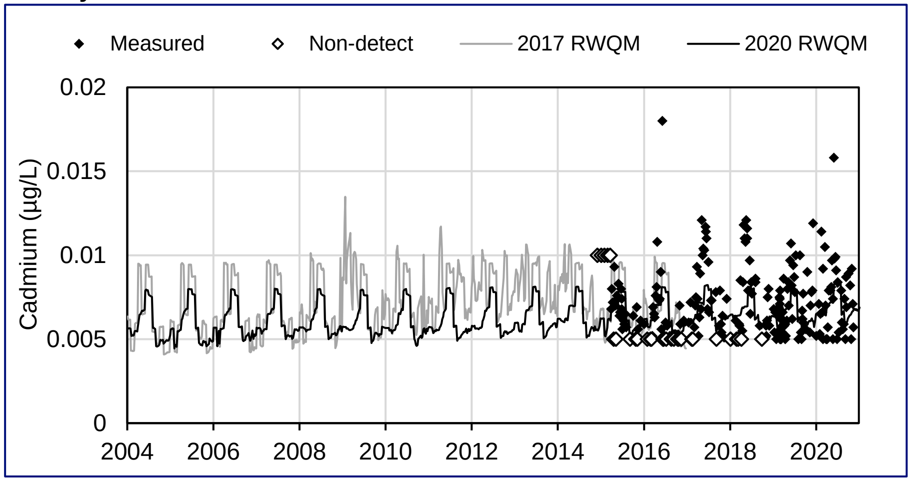
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	12/4/2014	12/4/2014
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	68	136
Non-Detect Count	22	30
Measured Mean (µg/L)	-	0.0075
Simulated Mean (µg/L)	-	0.0067
Bias (µg/L)	-	-0.00078
Relative Bias	-	0.9
Error (µg/L)	-	0.0018
Percent Error	-	25%

(a) As adjusted for the 2019 IPA.

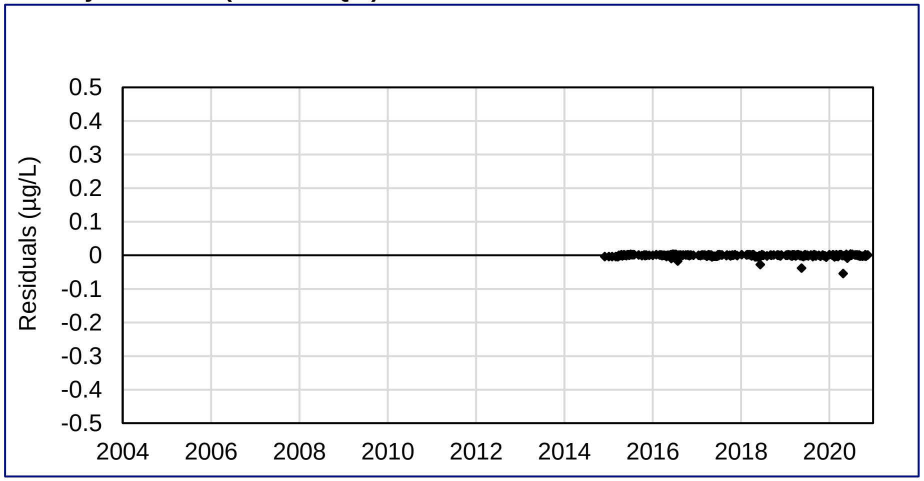
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

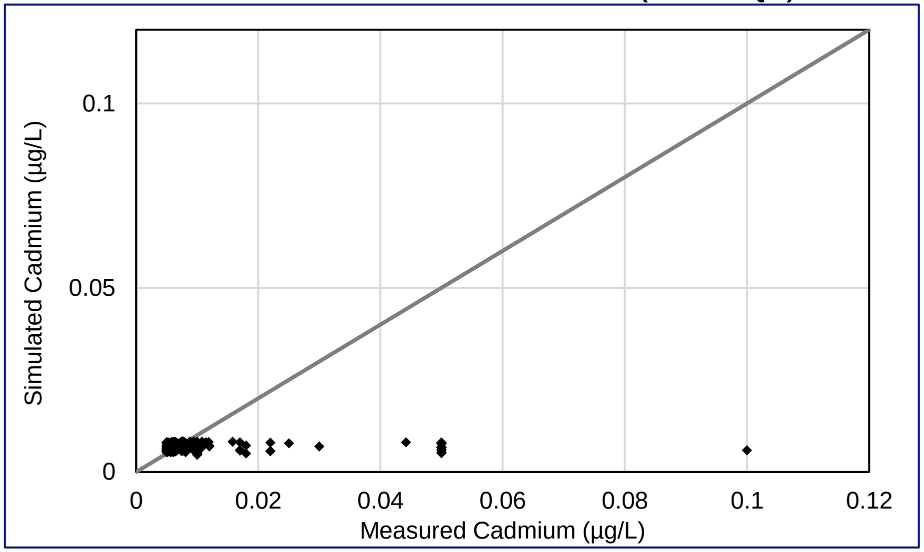
B4-39: Cadmium Calibration Information for Node GH_ER1 - Elk River u/s of Boivin Creek (u/s of Fording River) (EMS E206661)

Measured and Simulated Cadmium Data and Calibration Statistics

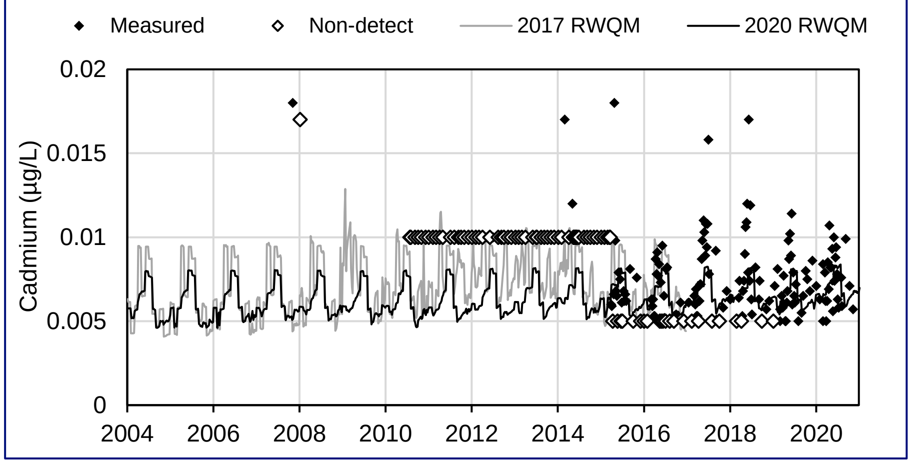
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	4/2/2007	4/2/2007
Last Measured Sample	12/7/2016	12/3/2018
Data Points Available for Comparison, n	141	193
Non-Detect Count	97	104
Measured Mean (µg/L)	-	0.014
Simulated Mean (µg/L)	-	0.0067
Bias (µg/L)	-	-0.0071
Relative Bias	-	0.48
Error (µg/L)	-	0.0078
Percent Error	-	57%

[(a)] As adjusted for the 2019 IPA.

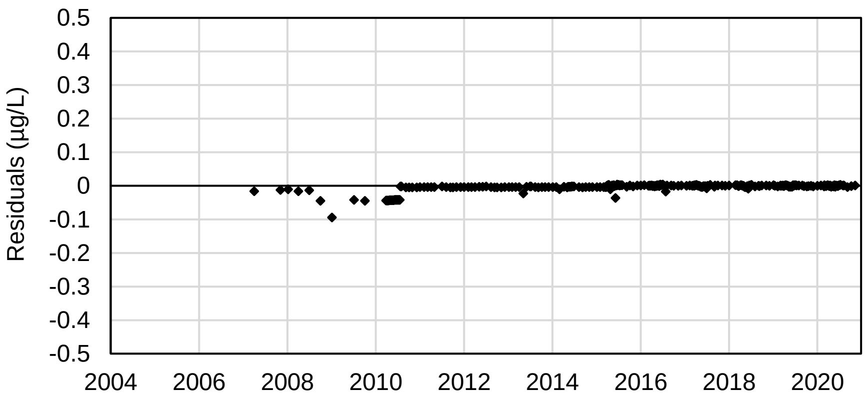
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

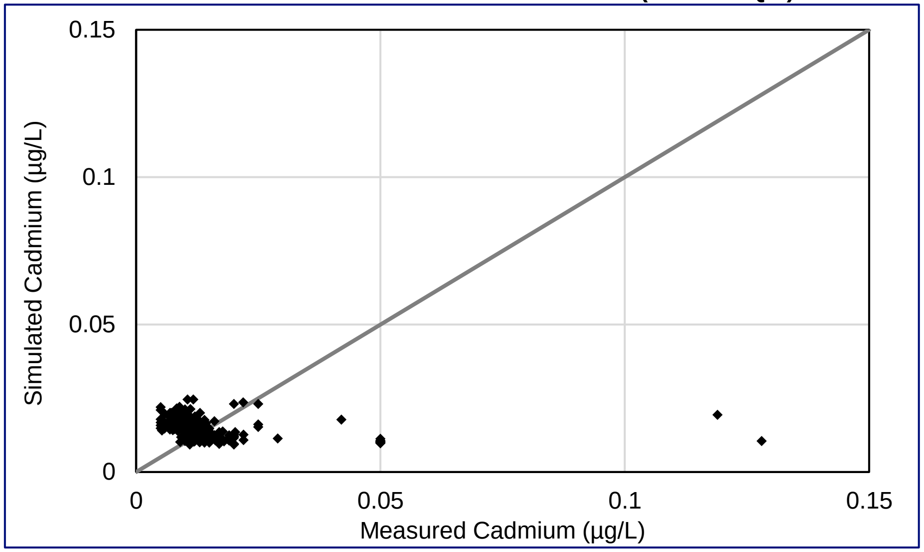
B4-40: Cadmium Calibration Information for Node EV_ER4 - Elk River u/s of Grave Creek (EMS 0200027)

Measured and Simulated Cadmium Data and Calibration Statistics

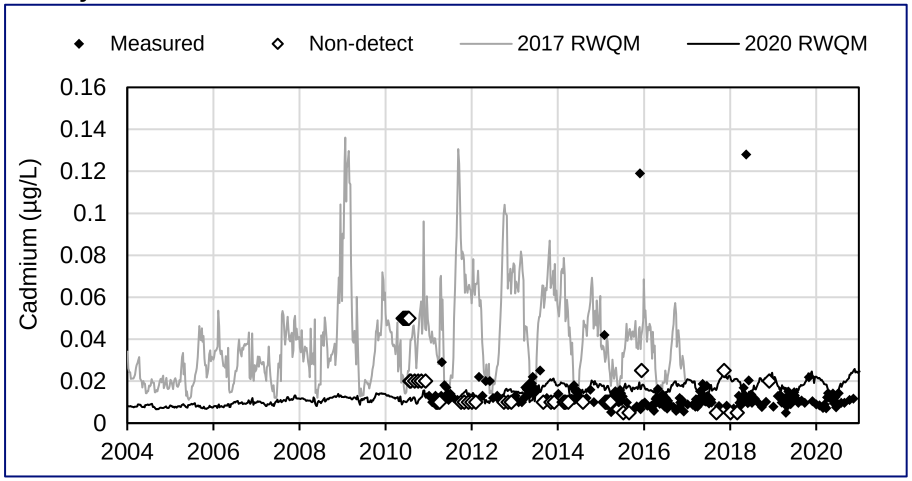
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/6/2016	12/3/2018
Data Points Available for Comparison, n	158	210
Non-Detect Count	44	49
Measured Mean (µg/L)	-	0.015
Simulated Mean (µg/L)	-	0.014
Bias (µg/L)	-	-0.00034
Relative Bias	-	0.98
Error (µg/L)	-	0.0078
Percent Error	-	53%

[(a)] As adjusted for the 2019 IPA.

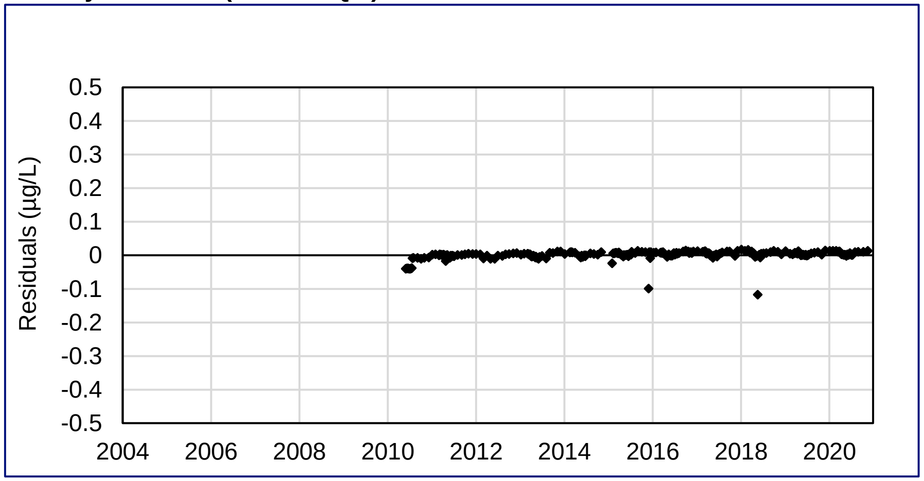
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

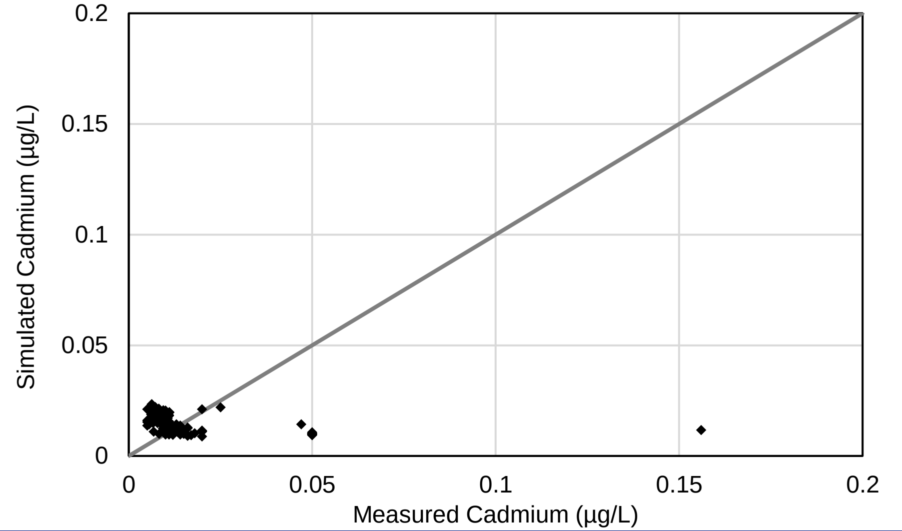
B4-41: Cadmium Calibration Information for Node EV_ER2 - Elk River u/s of Michel Creek (EMS 0200111)

Measured and Simulated Cadmium Data and Calibration Statistics

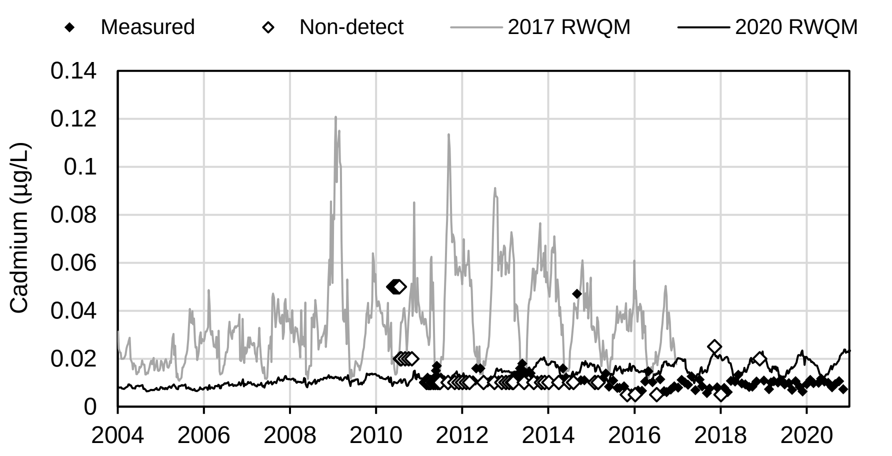
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	6/1/2010	6/1/2010
Last Measured Sample	12/6/2016	12/3/2018
Data Points Available for Comparison, n	103	127
Non-Detect Count	49	52
Measured Mean (µg/L)	-	0.015
Simulated Mean (µg/L)	-	0.014
Bias (µg/L)	-	-0.0013
Relative Bias	-	0.91
Error (µg/L)	-	0.0085
Percent Error	-	57%

[(a)] As adjusted for the 2019 IPA.

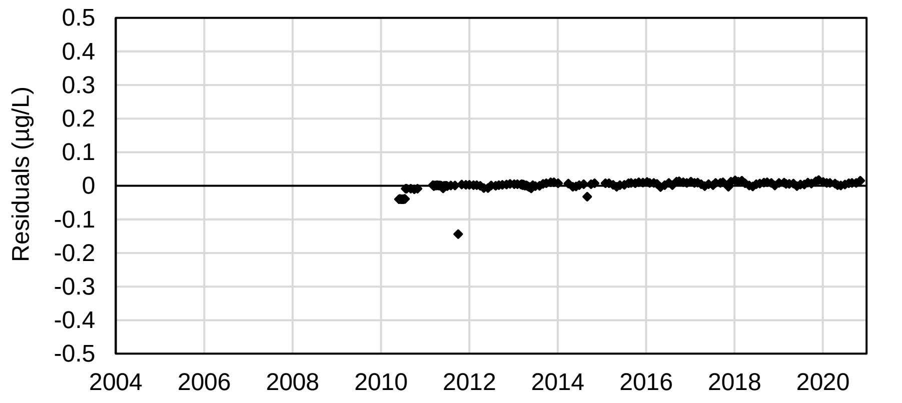
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

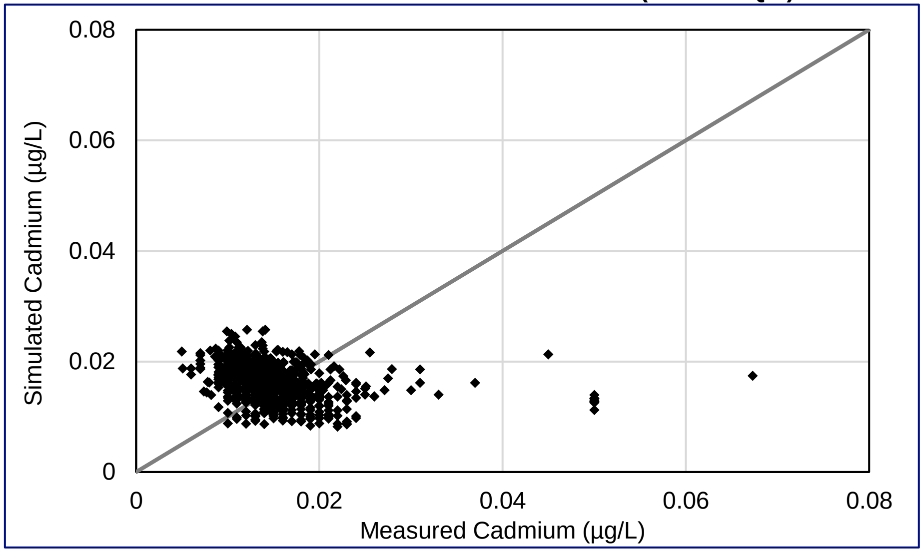
B4-42: Cadmium Calibration Information for Node EV_ER1 - Elk River d/s of Michel Creek (EMS 0200393)

Measured and Simulated Cadmium Data and Calibration Statistics

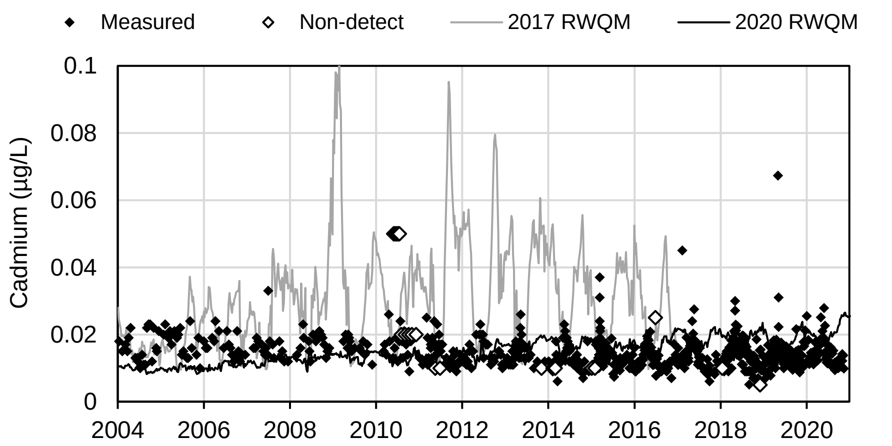
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/12/2004	1/12/2004
Last Measured Sample	12/18/2016	12/31/2018
Data Points Available for Comparison, n	418	565
Non-Detect Count	21	23
Measured Mean (µg/L)	-	0.015
Simulated Mean (µg/L)	-	0.015
Bias (µg/L)	-	0.000084
Relative Bias	-	1.0
Error (µg/L)	-	0.0056
Percent Error	-	37%

(a) As adjusted for the 2019 IPA.

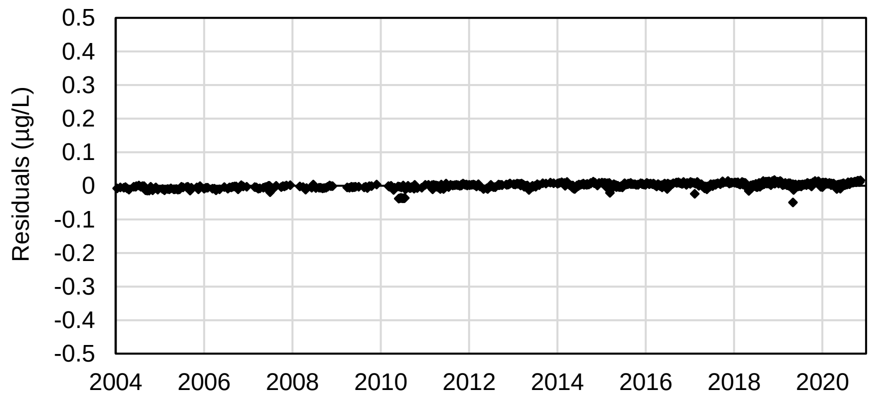
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

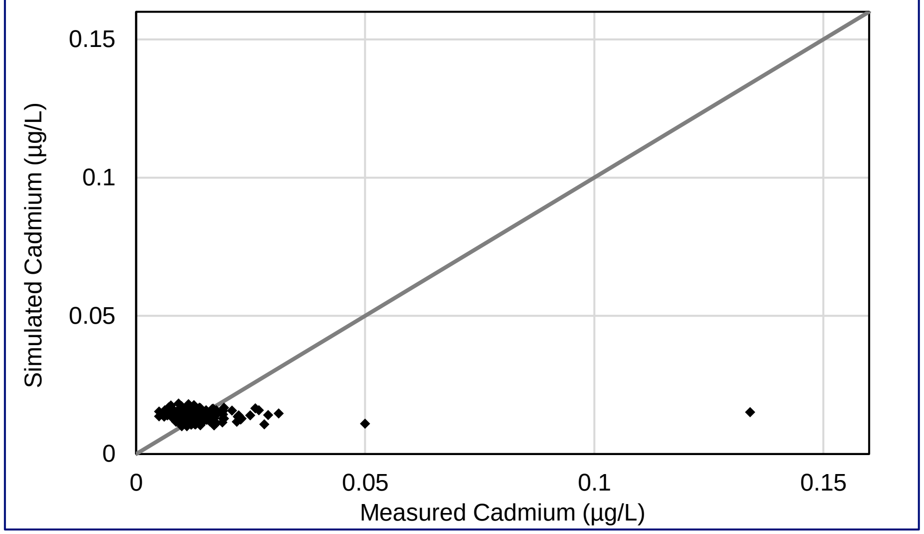
B4-43: Cadmium Calibration Information for Node RG_ELKORES - Elk River at Elko Reservoir (EMS E294312)

Measured and Simulated Cadmium Data and Calibration Statistics

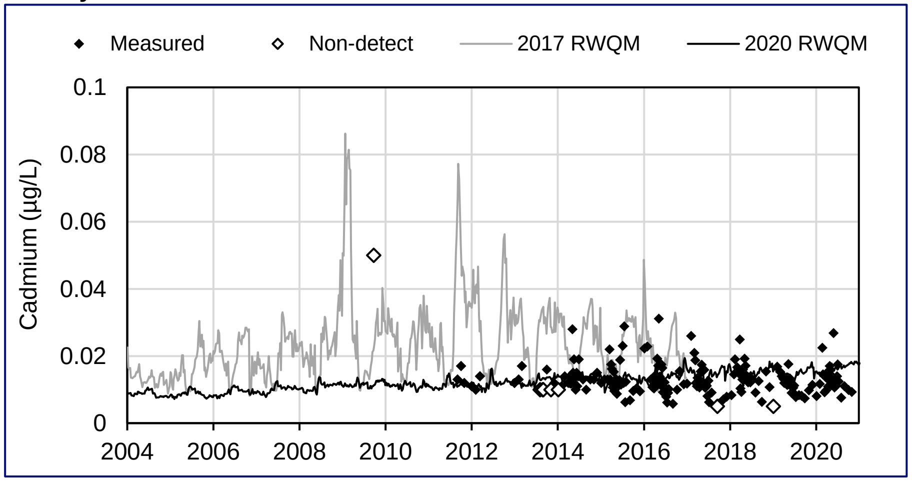
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	9/23/2009	9/23/2009
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	102	154
Non-Detect Count	6	7
Measured Mean (µg/L)	-	0.014
Simulated Mean (µg/L)	-	0.013
Bias (µg/L)	-	-0.001
Relative Bias	-	0.93
Error (µg/L)	-	0.0044
Percent Error	-	31%

[a] As adjusted for the 2019 IPA.

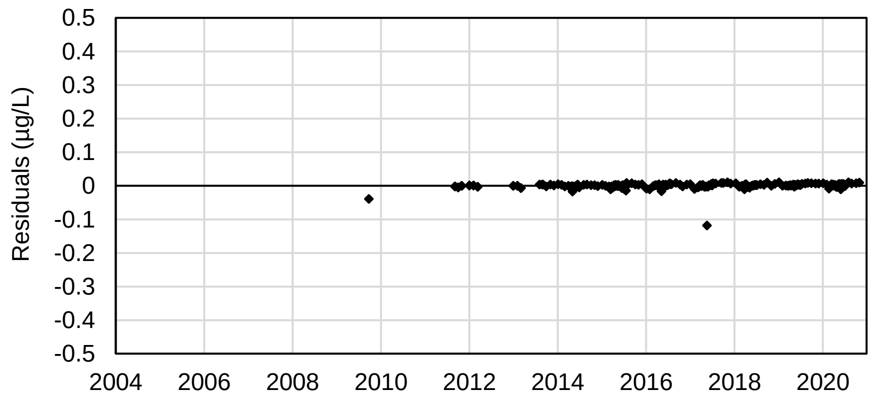
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

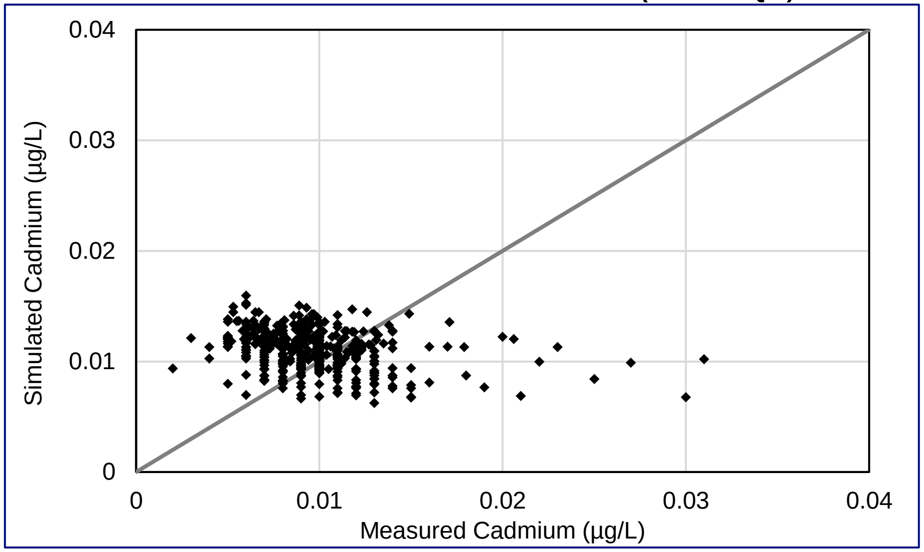
B4-44: Cadmium Calibration Information for Node RG_ELKMOUTH - Elk River at Highway 93 near Elko

Measured and Simulated Cadmium Data and Calibration Statistics

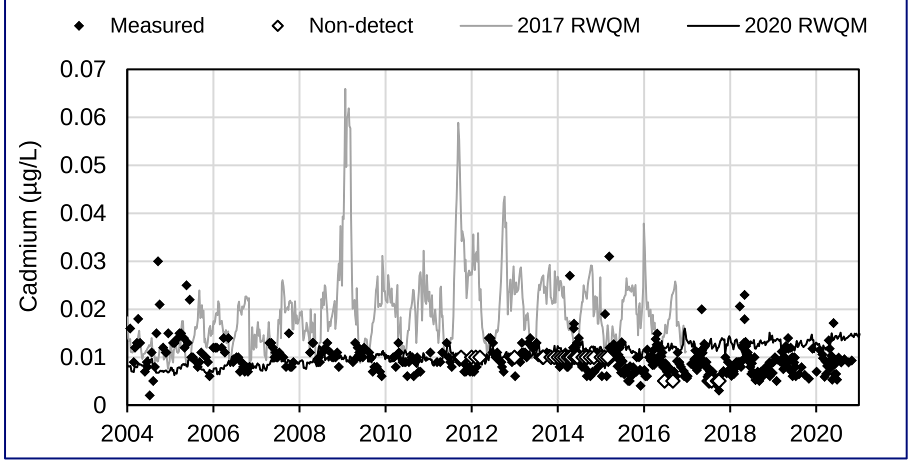
Statistic	2017 RWQM[a]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	1/26/2004	1/26/2004
Last Measured Sample	12/18/2016	12/16/2018
Data Points Available for Comparison, n	330	424
Non-Detect Count	25	29
Measured Mean (µg/L)	-	0.0097
Simulated Mean (µg/L)	-	0.011
Bias (µg/L)	-	0.001
Relative Bias	-	1.1
Error (µg/L)	-	0.0031
Percent Error	-	32%

[a] As adjusted for the 2019 IPA.

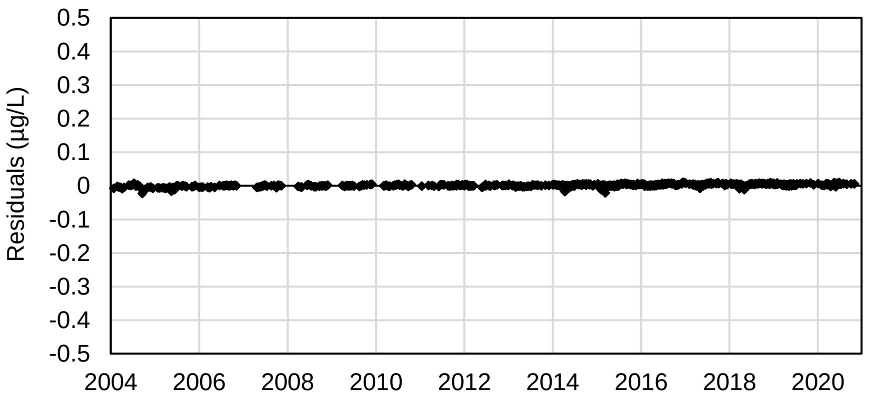
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

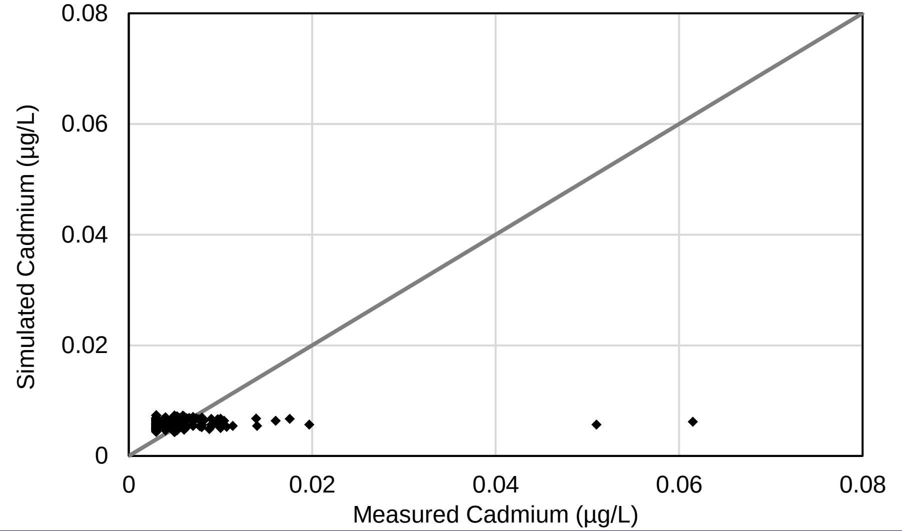
B4-45: Cadmium Calibration Information for Node RG_DSELK - Koocanusa Reservoir - South of the Elk River (EMS E300230)

Measured and Simulated Cadmium Data and Calibration Statistics

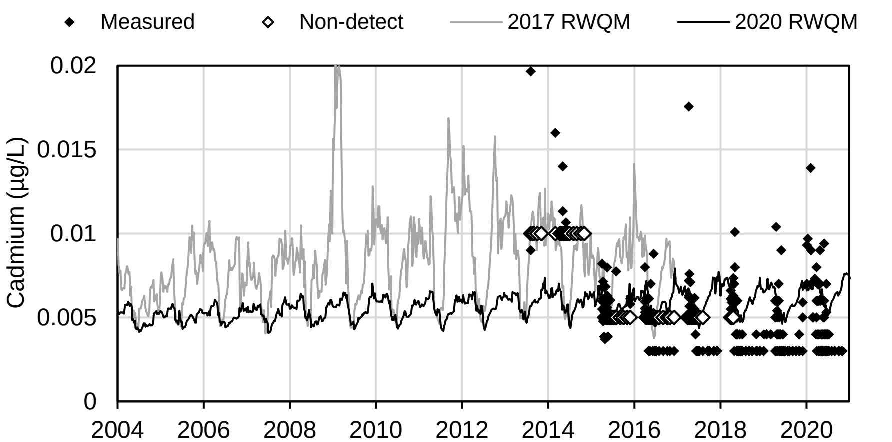
Statistic	2017 RWQM[(a)]	2020 RWQM
Model Averaging Period	Weekly	Weekly
Calibration Period	2004 to 2016	2004 to 2018
First Measured Sample	8/7/2013	8/7/2013
Last Measured Sample	12/6/2016	12/4/2018
Data Points Available for Comparison, n	217	378
Non-Detect Count	152	202
Measured Mean (µg/L)	-	0.0059
Simulated Mean (µg/L)	-	0.0058
Bias (µg/L)	-	-0.00016
Relative Bias	-	0.97
Error (µg/L)	-	0.0021
Percent Error	-	36%

(a) As adjusted for the 2019 IPA.

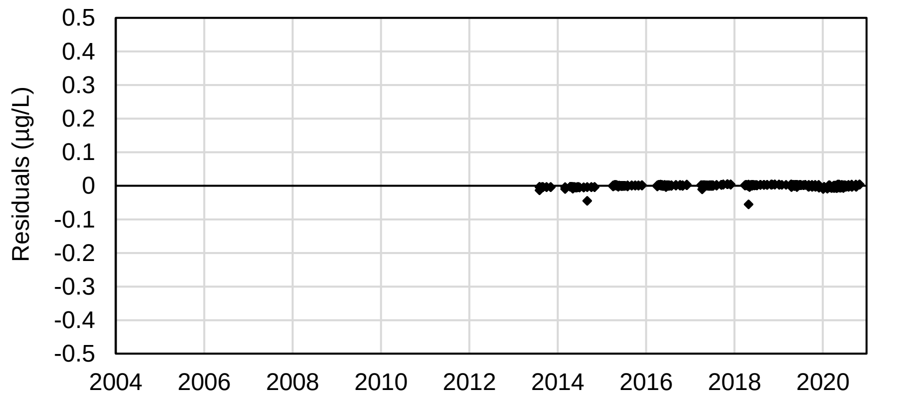
Simulated versus Measured Cadmium Concentrations (2020 RWQM)



Weekly Simulated and Measured Concentrations



Weekly Residuals (2020 RWQM)



Notes: Measured data are individual sample results.
In 2020, projected median weekly concentrations are presented.
Calibration statistics were not generated for the 2017 RWQM, because the objective of the calibration was to determine if the model produced a consistent over or under-estimation of measured concentrations and to what extent that may affect the ability of the model to be used as a screening tool for cadmium.

Note: Weekly Residual = Weekly Simulated Value - Instantaneous Measured Value.

Appendix C

Regional Load Balance Calculations from 2016 to 2019 Monitoring Data

Teck

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Water Quality Management
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Memorandum

Date: **September 1, 2020**

Subject: **Regional Load Balance Calculations from 2016 to 2019 Monitoring Data**

Purpose

A regional load balance was produced for selenium, sulphate and nitrate using surface flow and water chemistry monitoring data collected in 2016 through the end of 2019 at the discharge monitoring locations, Compliance Points, and Order Stations in the Elk Valley. The assessment of the regional surface water load balance was completed to determine if a mass balance can be achieved in the system on a seasonal and annual basis and to understand if and how the mass balance may vary across the three constituents and the four years.

This assessment is focused on the mass balance between surface water monitoring stations in the Elk Valley. Groundwater bypass of the monitoring locations has not been considered in this assessment however, groundwater contributions and travel times are expected to influence the mass balance of constituents of interest in the Elk Valley. The extent of this influence is currently being explored under the Mass Balance investigation project and is discussed as an uncertainty in Teck's Water Quality Adaptive Management Plan annual report for 2019 (Teck, 2020).

Methods

Overview

Teck has an extensive network of water monitoring locations regionally and at mining operations in the Elk Valley. Flow and water chemistry data are collected monthly or weekly at discharge and receiving environment locations. Loading of water quality constituents is calculated as the product of flow and the concentration of that constituent at each monitoring location. Instantaneous loading rates are calculated where concurrent flow and water quality measurements are available. Loadings are then averaged over each month to generate monthly average loading rates for each monitoring location. In many cases, particularly through the winter months, this monthly average is based on a single instantaneous flow and water quality measurement.

Data Infilling

Where a concurrent flow and water quality measurement is not available for a given month, a load is calculated using historical trends in monitoring data from previous years. First, the average percent change in loading at a monitoring location from month to month is calculated for the entire data record for that location. Then the loading for the missing month is interpolated based on measurements from the previous month using the historical average percent change for that period. For example, if there are sufficient data available to calculate loading for April 2019 but insufficient data to complete the calculation for May 2019, the average percent change from April to May is calculated based on the available data for previous years and this relationship is used to estimate loading for May 2019.

Tributary Load Calculation

Loadings of selenium, nitrate and sulphate were calculated using surface water monitoring data collected in each tributary using the methodology described above. The drainages that were considered in the assessment are shown in Table 1 with the mainstem location at which the mass balance has been assessed indicated in the left column (organized from upstream to downstream).

Table 1. Contributing monitoring locations considered in the load balance

	Monitoring Station ID	Name	Downstream Assessment Location
Fording River Drainages	FR_FR2	Upper Fording River	LC_LC5
	FR_KC1	Kilmarnock Creek	LC_LC5
	GH_SC1/SC2	Swift Creek	LC_LC5
	GH_CC1	Cataract Creek	LC_LC5
	GH_PC1	Porter Creek	LC_LC5
	GH_GH1	Greenhills Creek	LC_LC5
	LC_DC1	LCO Dry Creek	LC_LC5
	LC_LC4	Line Creek	LC_LC5
Elk River Drainages	GH_WILLOW	Willow Creek	GH_ERC
	GH_WADE	Wade Creek	GH_ERC
	GH_COUGAR	Cougar Creek	GH_ERC
	GH_MC1	Michelson Creek	GH_ERC
	GH_LC2	Leask Creek	GH_ERC
	GH_WC2	Wolfram Creek	GH_ERC
	GH_TC2	Thompson Creek	GH_ERC
	EV_DC1	EVO Dry Creek	EV_ER1
	EV_OC1	Otto Creek	EV_ER1
	EV_SM1	Six Mile Creek	EV_ER1
	EV_GC2	Goddard Creek	EV_ER1
Michel Creek Drainages	CM_MC2	Michel Creek downstream of CMO	EV_MC2
	EV_EC1	Erickson Creek	EV_MC2
	EV_SP1	South Pit Creek	EV_MC2
	EV_MG1	Milligan Creek	EV_MC2
	EV_GT1	Gate Creek	EV_MC2
	EV_BC1	Bodie Creek	EV_MC2
	EV_AQ6	Aqueduct Creek	EV_MC2

LCO - Line Creek Operations
CMO - Coal Mountain Operations

Mainstem Load Calculation

Monthly average loads were calculated at the Compliance Points and Order Stations listed in Table 1. The mainstem monitoring locations where flows are measured are Fording River at the mouth (Environment Canada monitoring station 08NK018; LC_LC5), Line Creek at the mouth (Environment Canada monitoring station 08NK022), Elk River downstream of Fording River (Environment Canada monitoring station 08NK016; EV_ER4) and Michel Creek at Highway 3 bridge (Teck monitoring station EV_MC2). Measured flows were used in load calculations where available. In locations without regular flow monitoring, flows were scaled from the closest monitoring location using watershed area ratios consistent with methodologies included in the Regional Surface Flow Monitoring Plan (Teck 2017). The mainstem locations that were included in the assessment as well as the flow estimation methodology are listed in Table 2.

Table 2. Mainstem monitoring locations considered in the load balance

EQuIs Code	Name	Flow estimation methodology
LC_LC5	Fording River at the Mouth	Measured (08NK018)
GH_ERC	GHO Elk River Compliance Point	Scaled from 08NK016 (Elk River downstream of Fording River) and 08NK018 (Fording River at the mouth)
EV_ER4	Elk River Downstream of the Fording River	Measured (08NK016)
EV_MC2	Michel Creek at Hwy 3 bridge	Measured (EV_MC2)
EV_ER1	Elk River downstream of Michel Creek	Scaled from 08NK016 (Elk River downstream of Fording River) and EV_MC2 (Michel Creek at Highway 3 bridge)

Estimated Natural Area Load Calculation

In addition to loading from mine discharge, natural areas contribute load to Compliance Points and Order Stations. Concentrations of selenium, nitrate and sulphate in these drainages are typically low but they make up a high proportion of the flow regionally. Consequently the load contribution from natural areas can be relatively high at some mainstem locations. To account for this, an estimate of the loading from natural and background areas to the Compliance Points and Order Stations was included in the mass balance calculations.

Monthly flows from natural areas were calculated as the difference between the summed tributary flows and the flows measured or calculated at each mainstem location. Measured concentrations were used from the locations shown in Table 3. These locations are upstream of mining influence and should be representative of background concentrations in the Elk Valley. A list of natural area monitoring stations used in the assessment and which natural areas each data set was applied to are shown in Table 3.

Table 3. Natural area monitoring locations used in the load balance

Monitoring Station ID	Name	Data Applied to
FR_UFR1	Fording River above of FRO	Natural areas draining to the Fording River
GH_ER2	Elk River above GHO	Natural areas draining to the Elk River
CM_MC1	Michel Creek above CMO	Natural areas draining to Michel Creek

Results and Interpretation

The results of these load balance calculations are provided in graphical format and are attached to this memorandum. In each figure the stacked, solid coloured bars represent the average monthly load calculated based on measured data at surface from each contributing mine-impacted tributary and the hatched bar represents the estimated load from natural areas; the total calculated load at the mainstem location is represented by the cumulative load from each of these source. The dotted line is the load calculated based on the monitoring data collected at each mainstem location.

Loading based on measured data at the mainstem location is less than upstream cumulative loading when the dotted line is lower than the stacked bars and greater when the dotted line is above the stacked bars.

Sulphate is understood to be conservative within the system relative to selenium and nitrate. Selenium and nitrate are sensitive to redox conditions and other instream processes (Teck, 2020). Because of this, sulphate load is used as a tracer to support the interpretation of mass balance results. Closing out the mass balance for sulphate has been a focus for the 2019/2020 Mass Balance Investigation to support a more accurate representation of selenium and nitrate load loss in the RWQM. Hydrological influences are interpreted to be the dominant influence on loading when patterns in sulphate loads match those for selenium and nitrate. Where selenium and nitrate patterns are different than sulphate, flows are not expected to be the root cause and load reduction or attenuation of selenium and nitrate may be occurring.

The general observation based on data presented in the attached figures is that the sum of loads from surface water in contributing drainages is higher than the load calculated at mainstem locations through the winter months (December to March) and in some cases through the entire year. This trend is more evident in the selenium and nitrate results than the sulphate results and is relatively consistent across the four years reviewed. Sulphate is expected to behave conservatively and so the difference in the selenium and nitrate results compared to the sulphate results indicate that the discrepancy is not likely due to uncertainty in the flow estimates alone.

The summed loads from contributing drainages during higher flow months (April to August) are lower than the load calculated based on monitoring data at the main stem locations. These times of year are typically more dynamic, with flows fluctuating from day to day. Flow and water quality measurements taken on different days in different tributaries may account for some of the discrepancies observed during this period. The estimated natural loads add additional uncertainty.

The difference between the summed tributary loads (including estimated natural area contributions) and load calculated from measured data at mainstem monitoring locations was calculated for each monitoring station in Table 2 for each month. These differences were then averaged over the winter months (December to March) and the full year (January to December). They are presented below for the Fording River, the Upper Elk River, Michel Creek and the Lower Elk River for each year and as an average over the four year period in Table 4 and discussed below. Percent differences are calculated using the following equation:

$$\%Difference = \frac{Load_{MS-}(\sum Load_T + Load_N)}{Load_{MS}}$$

Where: Load $_T$ = calculated load from the upstream tributaries

Load $_N$= estimated load from natural areas

Load $_{MS}$ = Load calculated from monitoring data collected at mainstem locations

Table 4. Summary of percent differences for the winter (W) and full year (F) from 2016-2019

		In the Fording River (LC_LC5)			In the Upper Elk (GH_ERC)			In Michel Creek (EV_MC2)			In the Lower Elk (EV_ER1)		
		NO3	Se	SO4	NO3	Se	SO4	NO3	Se	SO4	NO3	Se	SO4
2016	W	-37%	-37%	-23%	-39%	-52%	-27%	28%	32%	16%	-63%	-49%	-46%
	F	-7%	-10%	0%	-20%	-34%	-7%	43%	42%	27%	-33%	-27%	-22%
2017	W	-19%	-24%	-13%	-74%	-84%	-33%	43%	53%	44%	-59%	-60%	-30%
	F	-2%	-8%	0%	-51%	-71%	-55%	35%	35%	20%	-56%	-51%	-30%
2018	W	-39%	-30%	-15%	-68%	-52%	-5%	N/A	N/A	N/A	N/A	N/A	N/A
	F	-4%	-6%	5%	-19%	-28%	-8%	40%	42%	32%	-26%	-28%	-15%
2019	W	-37%	-30%	-30%	-39%	-53%	-25%	N/A	N/A	N/A	-83%	-55%	-43%
	F	-12%	-6%	-2%	-15%	-37%	-21%	24%	18%	23%	-48%	-33%	-24%
Average	**W**	**-33%**	**-30%**	**-20%**	**-55%**	**-60%**	**-22%**	**36%**	**43%**	**30%**	**-68%**	**-55%**	**-39%**
	F	**-6%**	**-8%**	**1%**	**-27%**	**-42%**	**-23%**	**36%**	**34%**	**26%**	**-41%**	**-35%**	**-23%**

Negative percentages indicate summed tributary loads are greater than load calculated at the mainstem.
N/A – indicates periods where there is insufficient data to calculate a percent difference

In the Fording River, tributary selenium loads over the winter months are on average 30% greater then selenium loads calculated at LC_LC5 (Fording river downstream of Line Creek) . Summed nitrate loads over the winter months are an average of 33% greater then the loads calculated at LC_LC5 compared to the summed sulphate loads which are an average of 20% greater then the loads calculated at LC_LC5. The average discrepancy for the full year (January to December) for selenium and nitrate respectively is 8%, 6% a greater than mainstem while sulphate is 1% smaller. This pattern is consistent across all four years.

In the Upper Elk, there is a higher amount of uncertainty in the data due to a larger proportion of contributions from ungauged natural areas. Summed tributary selenium loads over the winter months are on average 60% greater then selenium loads calculated at GH_ERC (GHO Elk River

Compliance Point). Summed nitrate loads over the winter months are an average of 55% greater then the loads calculated at GH_ERC compared to the summed sulphate loads which are an average of 22% greater then the loads calculated at GH_ERC. The average discrepancy for the full year (January to December) for selenium, nitrate and sulphate respectively is 42%, 27% and 23% greater than mainstem respectively.

In Michel Creek, a different pattern is observed compared to the other locations. Settling ponds from these Elkview tributaries are located on permeable colluvium in the valley bottom and have been observed to infiltrate water resulting in load bypass of the surface monitoring stations through the shallow subsurface. Flow data is unavailable at EV_MC2 during some winter months in 2018 and 2019 which confounds interpretation of the mass balance. These periods are not included in the averages shown in Table 4. The average across the two years of load balances show summed tributary selenium loads over the winter months are on average 43% smaller than selenium loads calculated at EV_MC2. Summed nitrate loads over the winter months are an average of 36% smaller than the loads calculated at EV_MC2 compared to the summed sulphate loads which are an average of 30% smaller than the loads calculated at EV_MC2. The average discrepancy for the full year (January to December) for selenium, nitrate and sulphate respectively is 34%, 36% and 26% smaller than mainstem respectively.

In the Lower Elk, summed tributary selenium loads over the winter months are on average 55% greater than selenium loads calculated at EV_ER1 (Elk River downstream of Michel Creek). Summed nitrate loads over the winter months are an average of 68% greater than the loads calculated at EV_ER1 compared to the summed sulphate loads which are an average of 39% greater than the loads calculated at EV_ER1. The average discrepancy for the full (January to December) for selenium, nitrate and sulphate respectively is 35%, 41% and 23% greater than mainstem respectively.

Summary

The assessment supports the hypothesis that there is a discrepancy between the mass balance of sulphate and selenium and nitrate between tributary and mainstem monitoring locations in the Elk Valley and that this mass imbalance is particularly prominent in the winter. Closing out the mass balance for sulphate has been a focus for the 2019/2020 Mass Balance Investigation to have a more accurate representation of potential selenium and nitrate load loss in the system. The emphasis of these ongoing investigations is on the effect of groundwater travel time and storage on the mass balance of sulphate as well as on selenium and nitrate, and on biogeochemical removal mechanisms for nitrate and selenium in shallow and deeper suboxic zones.

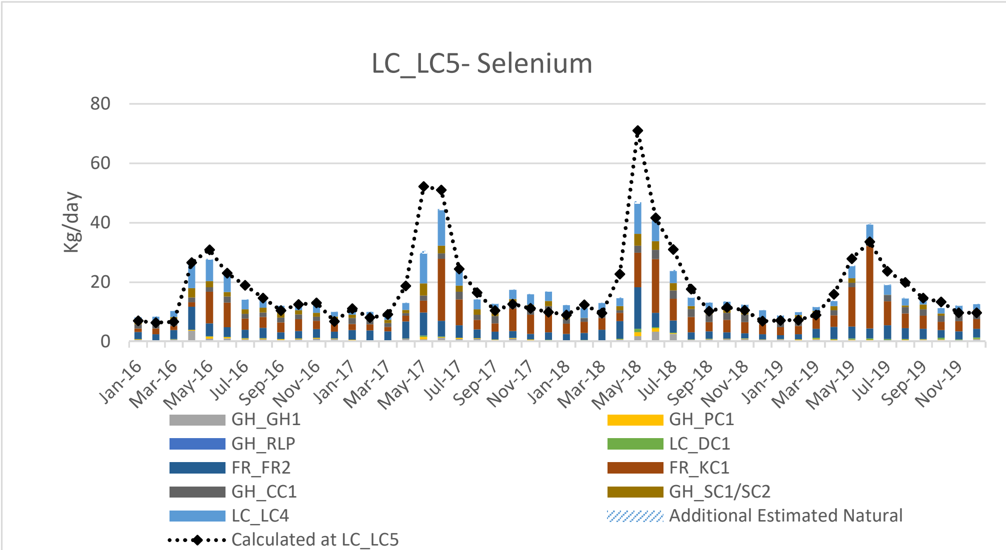
Limitations

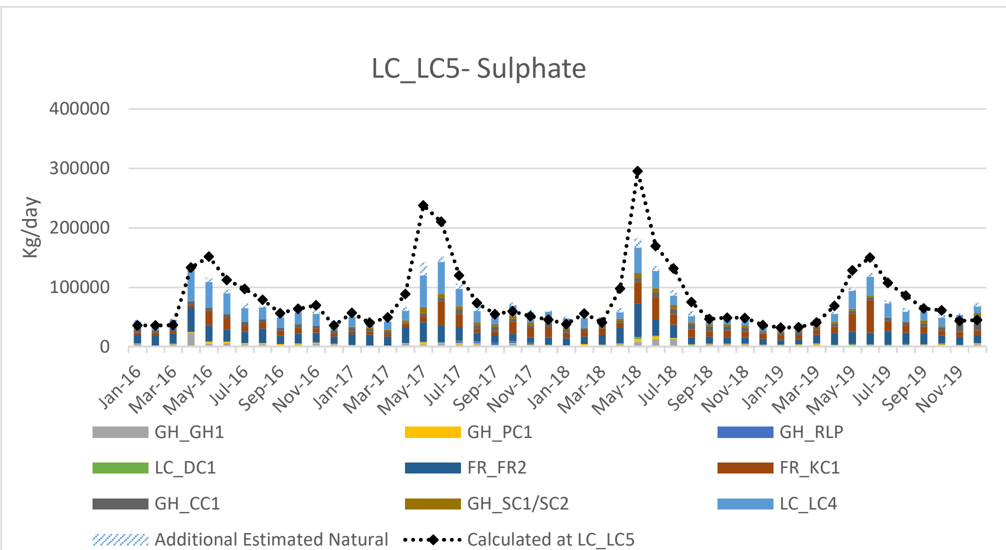
Flow monitoring data collection in the Elk Valley varies in level of accuracy across monitoring points based on ground conditions and the targets set through the Regional Surface Flow Monitoring Plan. Where flow monitoring data accuracy is lower, or where data has been gap filled there is more uncertainty associated with the mass balance calculations.

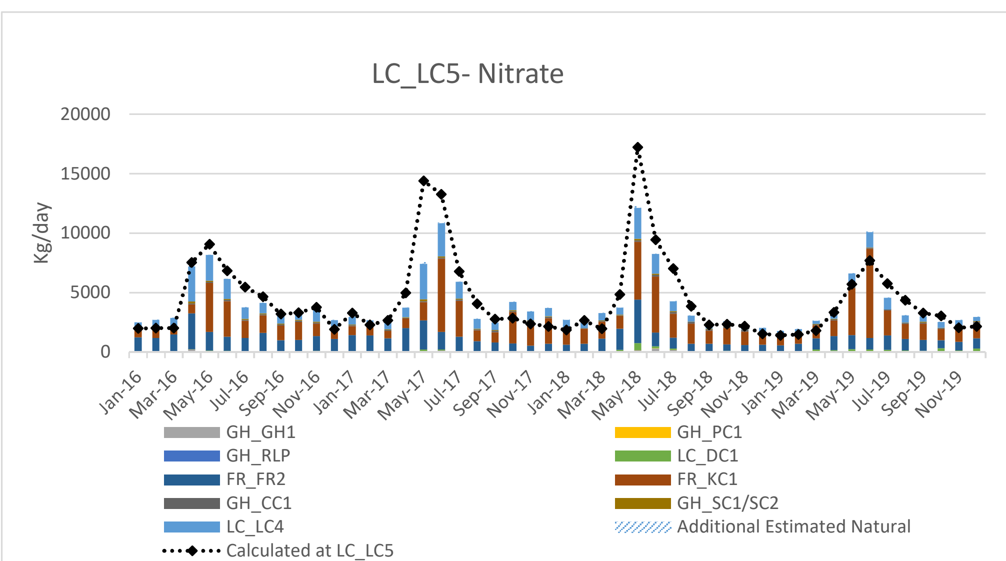
As discussed above, all load calculations have been completed on surface water monitoring data. There is known load bypass through the ground at several of the locations included in the assessment and this has not been considered in the results

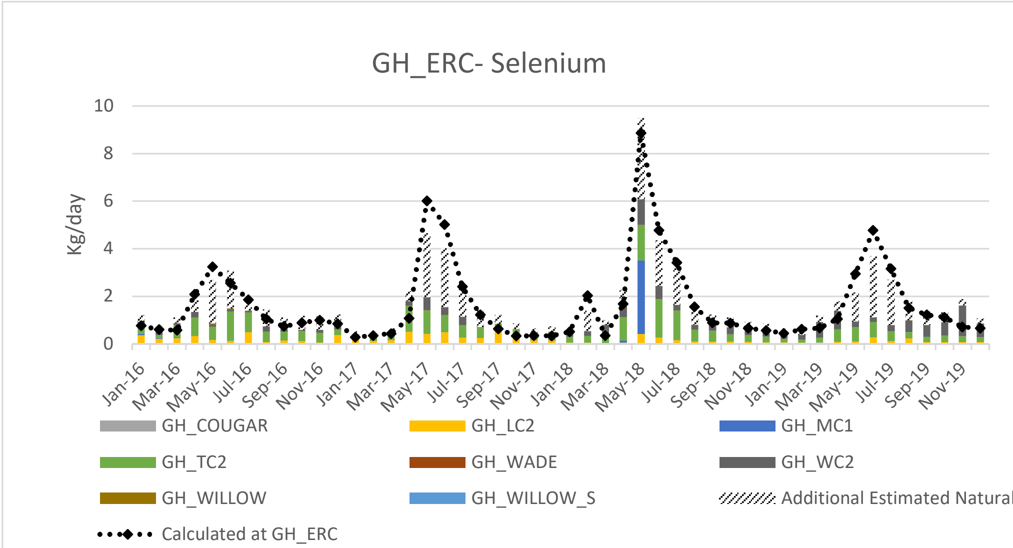
References

Teck. 2020. *Water Quality Adaptive Management Plan for Teck Coal Operations in the Elk Valley-2019 Annual Report*. Submitted to Ministry of Environment and Climate Change Strategy. Submitted by Teck Coal Limited, Sparwood, BC. July 2020.

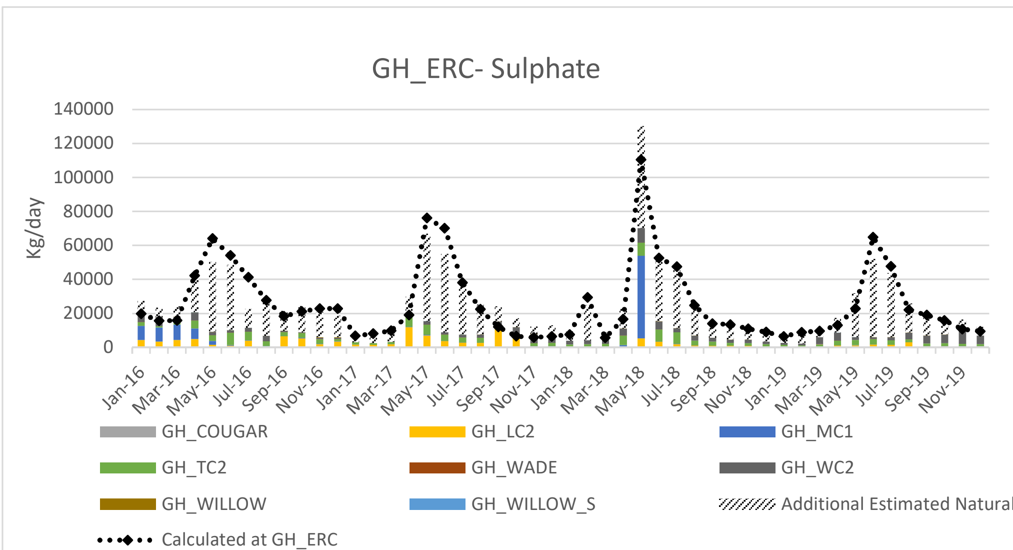

LC_LC5- Selenium
Kg/day
80
60
40
20
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
GH_GH1
GH_PC1
GH_RLP
LC_DC1
FR_FR2
FR_KC1
GH_CC1
GH_SC1/SC2
LC_LC4
Additional Estimated Natural
Calculated at LC_LC5


LC_LC5- Sulphate
Kg/day
400000
300000
200000
100000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
GH_GH1
GH_PC1
GH_RLP
LC_DC1
FR_FR2
FR_KC1
GH_CC1
GH_SC1/SC2
LC_LC4
Additional Estimated Natural
Calculated at LC_LC5

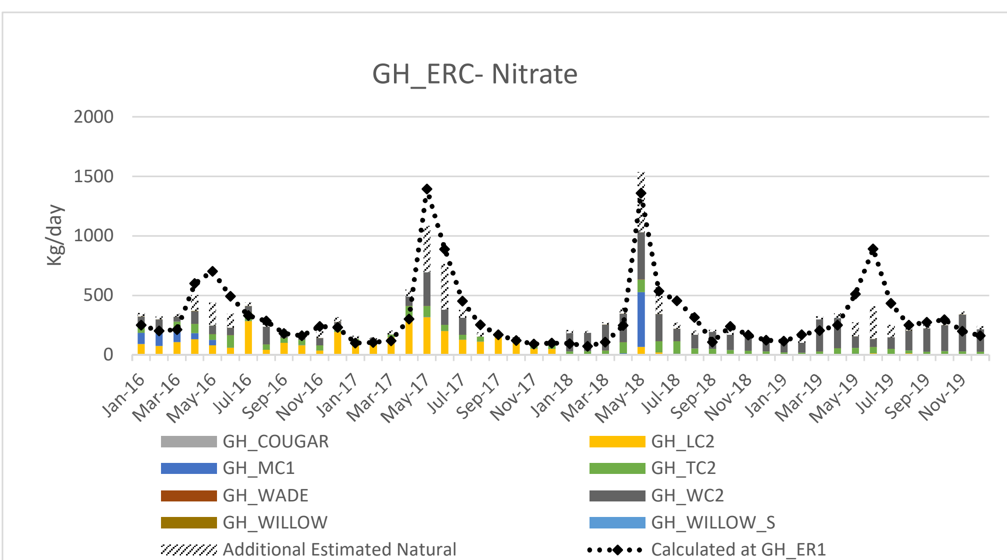

LC_LC5- Nitrate
Kg/day
20000
15000
10000
5000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
GH_GH1
GH_PC1
GH_RLP
LC_DC1
FR_FR2
FR_KC1
GH_CC1
GH_SC1/SC2
LC_LC4
Additional Estimated Natural
Calculated at LC_LC5



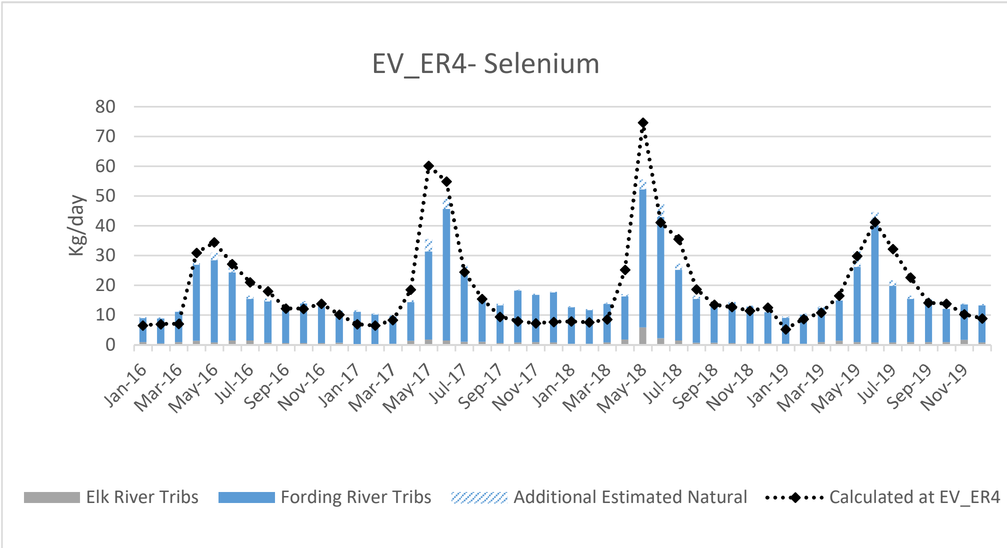
GH_ERC- Selenium
Kg/day
10
8
6
4
2
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
GH_COUGAR
GH_LC2
GH_MC1
GH_TC2
GH_WADE
GH_WC2
GH_WILLOW
GH_WILLOW_S
Additional Estimated Natural
Calculated at GH_ERC



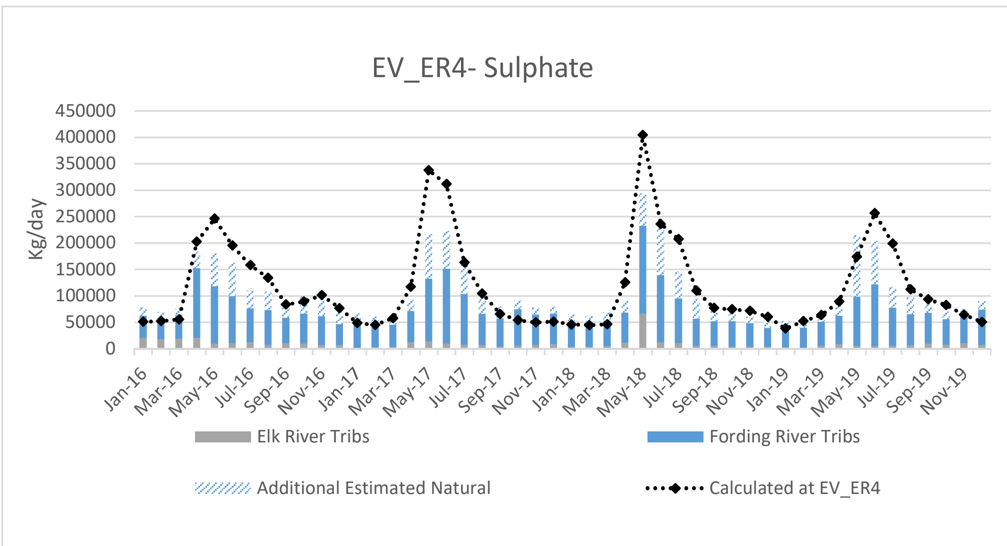
GH_ERC- Sulphate
Kg/day
140000
120000
100000
80000
60000
40000
20000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
GH_COUGAR
GH_LC2
GH_MC1
GH_TC2
GH_WADE
GH_WC2
GH_WILLOW
GH_WILLOW_S
Additional Estimated Natural
Calculated at GH_ERC



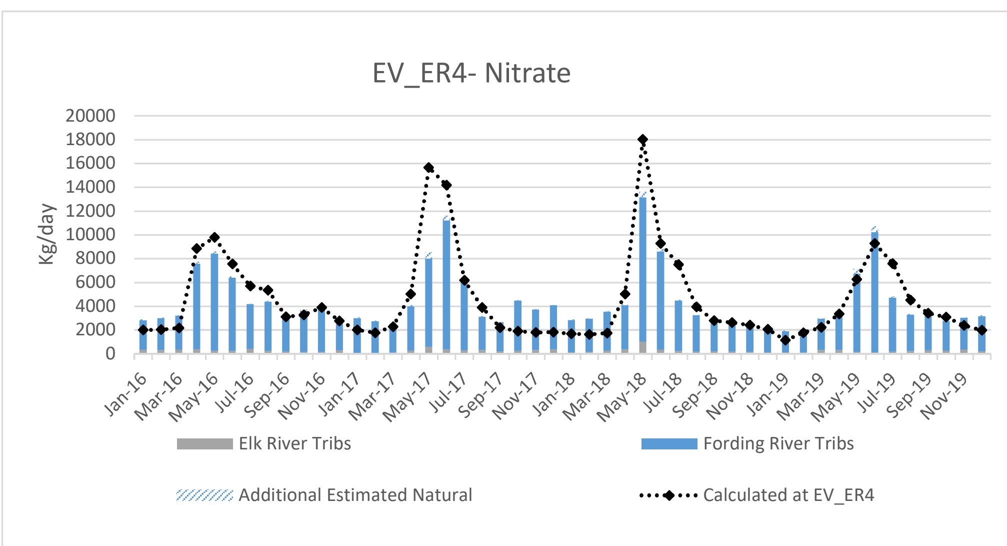
GH_ERC- Nitrate
Kg/day
2000
1500
1000
500
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
GH_COUGAR
GH_LC2
GH_MC1
GH_TC2
GH_WADE
GH_WC2
GH_WILLOW
GH_WILLOW_S
Additional Estimated Natural
Calculated at GH_ER1



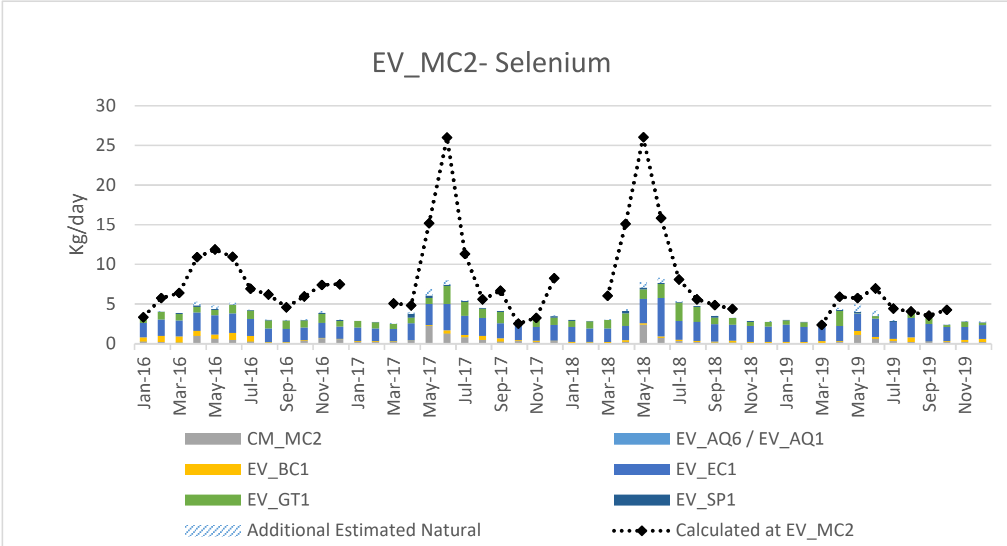
EV_ER4- Selenium
Kg/day
80
70
60
50
40
30
20
10
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Elk River Tribs
Fording River Tribs
Additional Estimated Natural
Calculated at EV_ER4

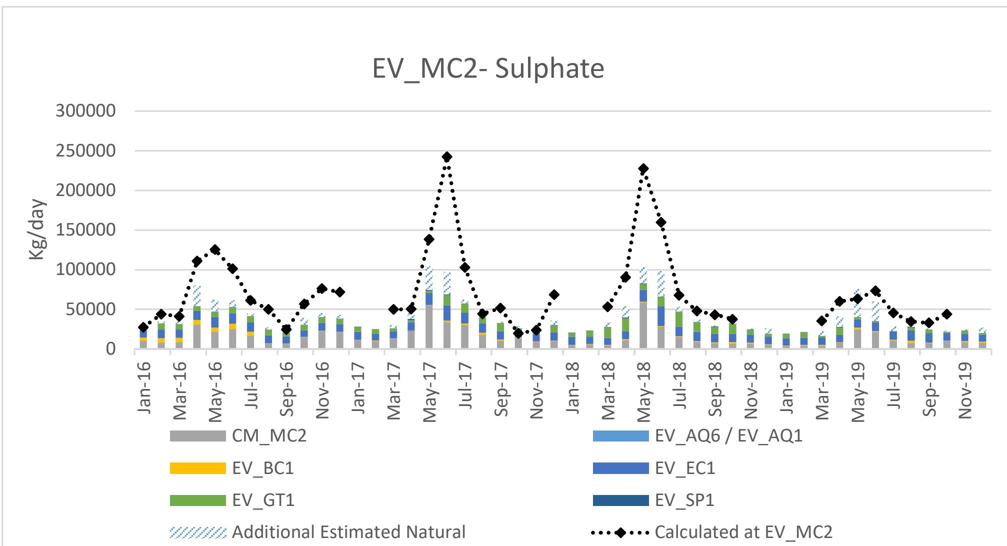


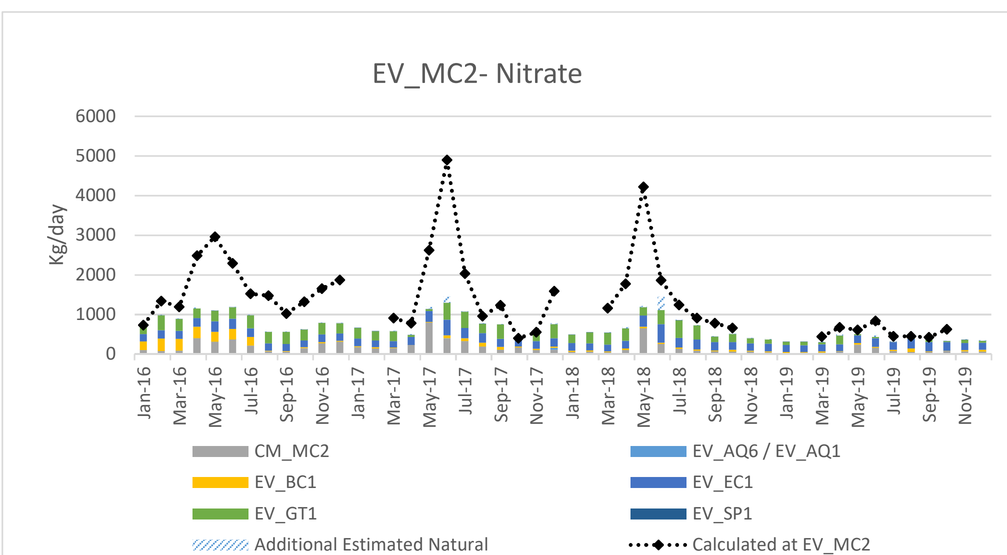
EV_ER4- Sulphate
Kg/day
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Elk River Tribs
Fording River Tribs
Additional Estimated Natural
Calculated at EV_ER4

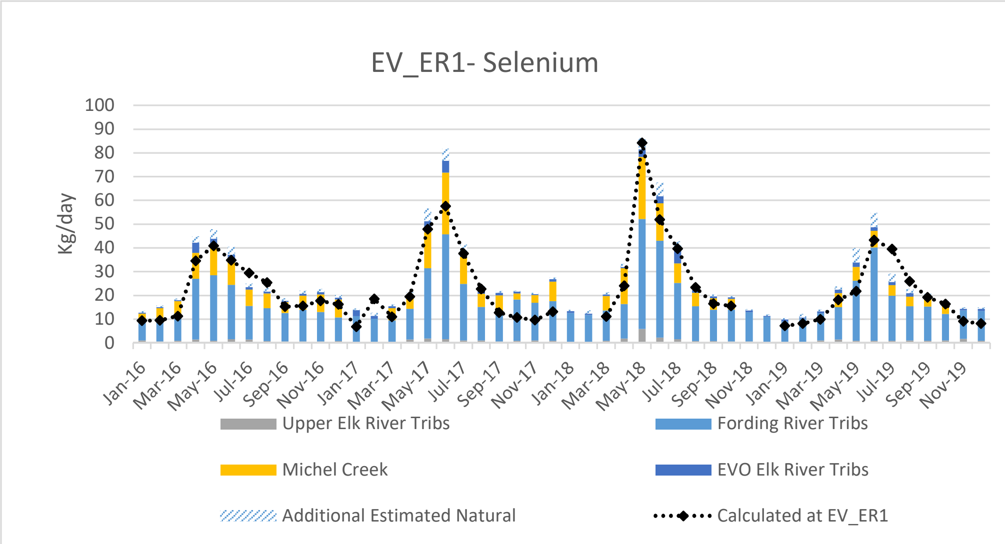


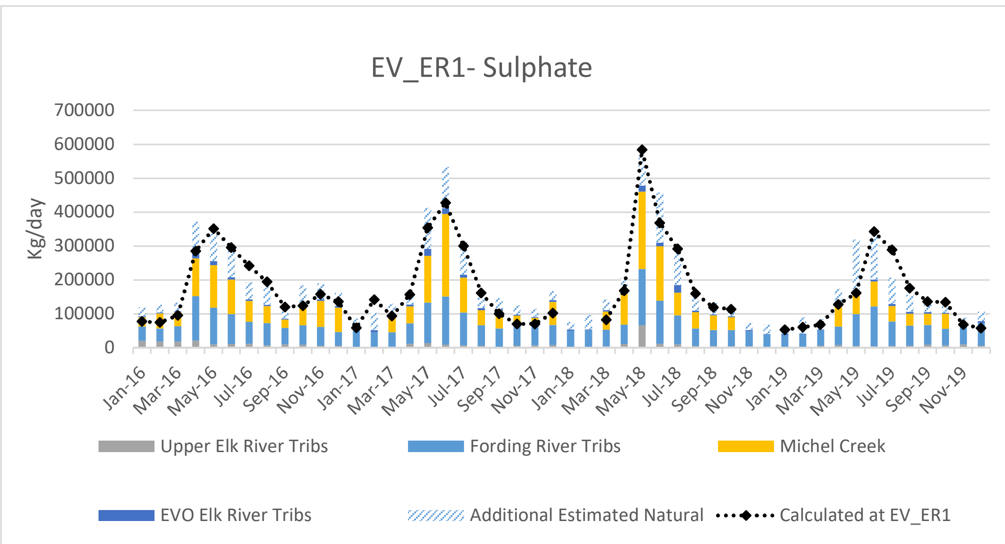
EV_ER4- Nitrate
Kg/day
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Elk River Tribs
Fording River Tribs
Additional Estimated Natural
Calculated at EV_ER4

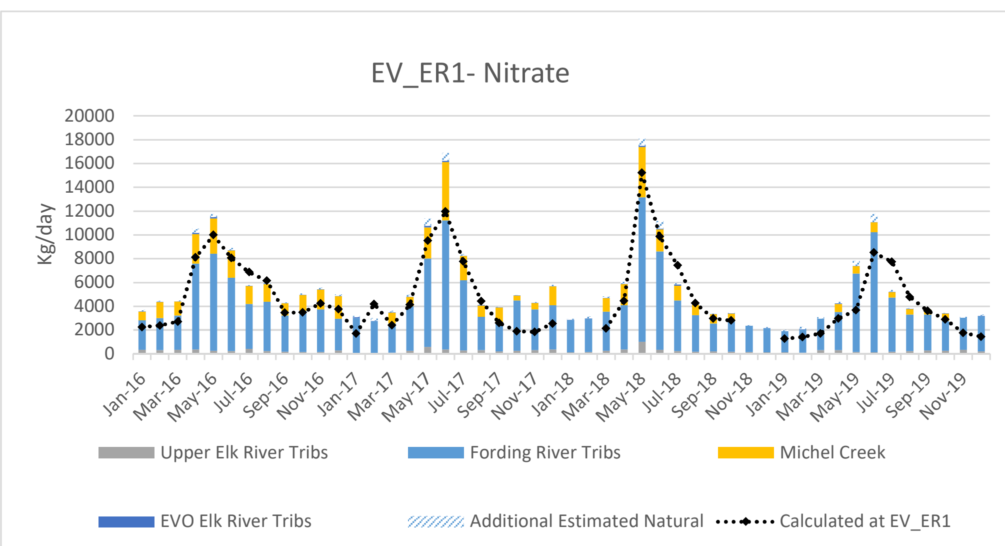

EV_MC2- Selenium
Kg/day
30
25
20
15
10
5
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
CM_MC2
EV_AQ6 / EV_AQ1
EV_BC1
EV_EC1
EV_GT1
EV_SP1
Additional Estimated Natural
Calculated at EV_MC2


EV_MC2- Sulphate
Kg/day
300000
250000
200000
150000
100000
50000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
CM_MC2
EV_AQ6 / EV_AQ1
EV_BC1
EV_EC1
EV_GT1
EV_SP1
Additional Estimated Natural
Calculated at EV_MC2


EV_MC2- Nitrate
Kg/day
6000
5000
4000
3000
2000
1000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
CM_MC2
EV_AQ6 / EV_AQ1
EV_BC1
EV_EC1
EV_GT1
EV_SP1
Additional Estimated Natural
Calculated at EV_MC2


EV_ER1- Selenium
Kg/day
100
90
80
70
60
50
40
30
20
10
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Upper Elk River Tribs
Fording River Tribs
Michel Creek
EVO Elk River Tribs
Additional Estimated Natural
Calculated at EV_ER1


EV_ER1- Sulphate
Kg/day
700000
600000
500000
400000
300000
200000
100000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Upper Elk River Tribs
Fording River Tribs
Michel Creek
EVO Elk River Tribs
Additional Estimated Natural
Calculated at EV_ER1


EV_ER1- Nitrate
Kg/day
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Upper Elk River Tribs
Fording River Tribs
Michel Creek
EVO Elk River Tribs
Additional Estimated Natural
Calculated at EV_ER1

Appendix D

Cadmium Calibration Factors

2020 Elk Valley Regional Water Quality Model Update – Appendix D of Annex C

Cadmium Calibration Factors

Rev0

March 2021

Teck

Table D-1. Pre-PAG Calibration Factors for Cadmium

Operation / General Location	Node ID	Node Description	January	February	March	April	May	June	July	August	September	October	November	December
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	0.9	0.9	0.75	0.75	0.75	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	FR_CC1[(a)]	Clode Creek Sediment Pond Decant (E102481)	1.0, 1.2, 1.2, 1.2 and 0.9	1.0, 1.0, 1.0, 1.0 and 0.9	1.0, 1.1, 1.1, 1.1 and 0.93	1.0, 1.2, 1.2, 1.2 and 0.93	1.0, 1.1, 1.1, 1.1 and 0.93	1.0, 1.2, 1.2, 1.2 and 0.93	1.0, 1.2, 1.2, 1.2 and 0.93	1.0, 1.1, 1.1, 1.1 and 0.93	1.0, 1.0, 1.0, 1.0 and 0.93	1.0, 1.1, 1.1, 1.1 and 0.93	1.0, 1.1, 1.1, 1.1 and 0.93	1.0, 1.2, 1.2, 1.2 and 0.9
	FR_LMP1[(b)]	Lake Mountain Pond	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1	0.3, 1, 1 and 1
	FR_KC1[(c)]	Kilmarnock Creek d/s of Rock Drain (0200252)	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	GH_CC1[(d)]	Cataract Creek Sediment Pond Decant (0200384)	1.0	1.0	1.0	1 and 1.1	1 and 1.1	1 and 1.2	1 and 1.2	1 and 1.1	1 and 1.1	1.2 and 1.1	1 and 1.1	1.0
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.1	1.1	1.1	1.1	1.1
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	1.0	1.0	1.0	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	GH_TC1[(e)]	Thompson Creek at LRP Road (E102714)	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1
Line Creek Operations (LCO)	LC_DC3[(f)]	Dry Creek upstream of East Tributary (E288273)	0.75, 1, 1 and 1	0.75, 1, 1 and 1	0.75, 1, 1 and 1	0.75, 1, 1 and 1	0.75, 1.1, 1 and 1	0.75, 1.1, 1 and 1	0.75, 1.1, 1 and 1	0.75, 1.1, 1 and 1	0.75, 1.1, 1 and 1	0.75, 1, 1 and 1	0.75, 1, 1 and 1	0.75, 1, 1 and 1
	LC_LCUSWLC[(g)]	Line Creek u/s of West Line Creek (E293369)	1.1, 1.1, 1.0, 1.0, 1.0, 1.0, 1.0, and 1.0	1.1, 1.1, 1.0, 1.0, 1.0, 1.0, 1.0, and 1.0	1.1, 1.1, 1.0, 1.0, 1.0, 1.0, 1.0, and 1.0	1.2, 1.2, 0.9, 0.9, 0.9, 0.9, 0.9, and 0.9	1.5, 1.5, 0.2, 0.2, 0.2, 0.2, 0.2, and 0.2	1.9, 1.9, 0.15, 0.15, 0.15, 0.15, 0.15, and 0.15	1.9, 1.8, 1.0, 1.0, 1.0, 1.0, 1.0, and 1.0	1.5, 1.4, 1.1, 1.1, 1.1, 1.1, 1.1, and 1.1	1.3, 1.3, 1.1, 1.1, 1.1, 1.1, 1.1, and 1.1	1.3, 1.3, 1.0, 1.0, 1.0, 1.0, 1.0, and 1.0	1.3, 1.2, 1.0, 1.0, 1.0, 1.0, 1.0, and 1.0	1.2, 1.1, 1, 1, 1, 1, 1, and 1
	LC_WLC	West Line Creek (E261958)	1.1	1.1	1.1	1.1	1.1	0.75	0.75	0.75	0.75	0.75	0.75	1.1
Elkview Operations (EVO)	EV_EC1[(h)]	Erickson Creek at the Mouth (0200097)	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	EV_BC1[(i)]	Bodie Creek Sedimentation Pond Decant (E102685)	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1.1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	0.98	0.98	0.98	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Notes:
(a) Calibration factors are presented in the following order: Turnbull South Pit, Clode Creek Lower, Eagle 6 Pit (Includes Eagle 6 Pit North and Eagle 6 West), and Eagle 4 Pit.
(b) Calibration factors are presented in the following order: North East Tributary, John Creek and Lake Pit and Lake Mountain Pit.
(c) Calibration factors are presented in the following order: Eagle 6 Pit South and Kilmarnock Lower
(d) Calibration factors are presented in the following order: Cataract Creek and Cougar Pit Phase 6 (Cougar Pit Phase 6 discharges to Cataract Creek until the end of 2007).
(e) Calibration factors are presented in the following order: Cougar Pit Phase 3 and Thompson Creek.
(f) Calibration factors are presented in the following order: Upper Dry Creek and Mount Michael Pits 1, 2, and 3.
(g) Calibration factors are presented in the following order: Upper Line Creek, Horseshoe Creek, Horseshoe Ridge Pit, North Line Extension Pit, No Name Creek Access Road Spoils, Mine Services Area West, North Line Creek and Center Line Creek.
(h) Calibration factors are presented in the following order: Adit Pit, Upper Erickson Creek, Lower Erickson Creek and F2 Pit.
(i) Calibration factors are presented in the following order: Natal Pits (include Natal Pit North, Natal Pit West and Natal Pit 2) and Bodie Creek.
ID = Identification; d/s = downstream; u/s = upstream.

Table D-2. Post-PAG Calibration Factors for Cadmium

Operation / General Location	Node ID	Node Description	January	February	March	April	May	June	July	August	September	October	November	December
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	0.9	0.9	0.75	0.75	0.75	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	FR_CC1[a]	Clode Creek Sediment Pond Decant (E102481)	1, 1.2, 1.2, 1.2 and 0.9	1, 1, 1, 1 and 0.9	1, 1.1, 1.1, 1.1 and 0.93	1, 1.2, 1.2, 1.2 and 0.93	1, 1.1, 1.1, 1.1 and 0.93	1, 1.2, 1.2, 1.2 and 0.93	1, 1.2, 1.2, 1.2 and 0.93	1, 1.1, 1.1, 1.1 and 0.93	1, 1, 1, 1 and 0.93	1, 1.1, 1.1, 1.1 and 0.93	1, 1.1, 1.1, 1.1 and 0.93	1, 1.2, 1.2, 1.2 and 0.9
	FR_LMP1[b]	Lake Mountain Pond	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9	0.3, 0.9, 0.9 and 0.9
	FR_KC1[c]	Kilmarnock Creek d/s of Rock Drain (0200252)	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2	1.1 and 1.2
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	GH_CC1[d]	Cataract Creek Sediment Pond Decant (0200384)	1 and 1.1	1.0	1 and 1.1	1 and 1.1	1 and 1.1	1 and 1.2	1 and 1.2	1 and 1.1	1 and 1.1	1.2 and 1.1	1 and 1.1	1 and 1.1
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	1.1	1.0	1.1	1.1	1.1	1.2	1.2	1.1	1.1	1.1	1.1	1.1
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	1.0	1.0	1.0	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	1.0	1.0	1.0	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	1.0	1.0	1.0	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.1	1.0
	GH_TC1[e]	Thompson Creek at LRP Road (E102714)	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1	0.95 and 1
Line Creek Operations (LCO)	LC_DC3[f]	Dry Creek upstream of East Tributary (E288273)	0.98, 1, 1 and 1	0.98, 1, 1 and 1	0.98, 1, 1 and 1	0.98, 1, 1 and 1	0.98, 1.1, 1 and 1	0.98, 1.1, 1 and 1	0.98, 1.1, 1 and 1	0.98, 1.1, 1 and 1	0.98, 1.1, 1 and 1	0.98, 1, 1 and 1	0.98, 1, 1 and 1	0.98, 1, 1 and 1
	LC_LCUSWLC[g]	Line Creek u/s of West Line Creek (E293369)	1.2, 1.2, 1, 1, 1, 1, 1, and 1	1.2, 1.1, 1, 1, 1, 1, 1, and 1	1.2, 1.1, 1, 1, 1, 1, 1, and 1	1.2, 1.2, 0.9, 0.9, 0.9, 0.9, 0.9, and 0.9	1.8, 1.7, 0.5, 0.2, 0.2, 0.2, 0.2, and 0.2	2.6, 2.5, 0.15, 0.15, 0.15, 0.15, 0.15, and 0.15	2.2, 2.2, 1, 1, 1, 1, 1, and 1	1.7, 1.7, 1.1, 1.1, 1.1, 1.1, 1.1, and 1.1	1.5, 1.4, 1.1, 1.1, 1.1, 1.1, 1.1, and 1.1	1.4, 1.4, 1, 1, 1, 1, 1, and 1	1.4, 1.3, 1, 1, 1, 1, 1, and 1	1.2, 1.2, 1, 1, 1, 1, 1, and 1
	LC_WLC	West Line Creek (E261958)	1.1	1.1	1.1	1.1	1.1	0.75	0.75	0.75	0.75	0.75	0.75	1.1
Elkview Operations (EVO)	EV_EC1[h]	Erickson Creek at the Mouth (0200097)	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1	1, 0.99, 1 and 1
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	EV_BC1[i]	Bodie Creek Sedimentation Pond Decant (E102685)	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1	0.9, 0.9, 0.9 and 1
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	0.98	0.98	0.98	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Notes:
(a) Calibration factors are presented in the following order: Turnbull South Pit, Clode Creek Lower, Eagle 6 Pit (Includes Eagle 6 Pit North and Eagle 6 West), and Eagle 4 Pit.
(b) Calibration factors are presented in the following order: North East Tributary, John Creek and Lake Pit and Lake Mountain Pit.
(c) Calibration factors are presented in the following order: Eagle 6 Pit South and Kilmarnock Lower
(d) Calibration factors are presented in the following order: Cataract Creek and Cougar Pit Phase 6 (Cougar Pit Phase 6 discharges to Cataract Creek until the end of 2007).
(e) Calibration factors are presented in the following order: Cougar Pit Phase 3 and Thompson Creek.
(f) Calibration factors are presented in the following order: Upper Dry Creek and Mount Michael Pits 1, 2, and 3.
(g) Calibration factors are presented in the following order: Upper Line Creek, Horseshoe Creek, Horseshoe Ridge Pit, North Line Extension Pit, No Name Creek Access Road Spoils, Mine Services Area West, North Line Creek and Center Line Creek.
(h) Calibration factors are presented in the following order: Adit Pit, Upper Erickson Creek, Lower Erickson Creek and F2 Pit.
(i) Calibration factors are presented in the following order: Natal Pits (include Natal Pit North, Natal Pit West and Natal Pit 2) and Bodie Creek.
ID = Identification; d/s = downstream; u/s = upstream.

Table D-3. Pre-PAG Calibrated Attenuation Factors for Cadmium

Operation / General Location	Node ID	Node Description	January	February	March	April	May	June	July	August	September	October	November	December
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	0.87	0.87	0.72	0.71	0.71	0.79	0.83	0.85	0.86	0.87	0.87	0.87
	FR_CC1[(a)]	Clode Creek Sediment Pond Decant (E102481)	0.95, 0.98, 0.99, 0.99 and 0.71	0.96, 0.9, 0.91, 0.91 and 0.79	0.95, 0.98, 0.99, 0.99 and 0.8	0.93, 1, 1, 1 and 0.79	0.89, 1, 1, 1 and 0.82	0.85, 1, 1, 1 and 0.79	0.86, 1, 1, 1 and 0.78	0.89, 1, 1, 1 and 0.87	0.91, 1, 1, 1 and 0.89	0.92, 1, 1, 1 and 0.87	0.94, 1, 1, 1 and 0.85	0.94, 0.99, 1, 1 and 0.73
	FR_LMP1[(b)]	Lake Mountain Pond	0.28, 0.95, 0.95 and 0.95	0.29, 0.96, 0.96 and 0.96	0.28, 0.95, 0.95 and 0.95	0.28, 0.93, 0.93 and 0.93	0.27, 0.89, 0.89 and 0.89	0.25, 0.85, 0.85 and 0.85	0.26, 0.86, 0.86 and 0.86	0.27, 0.89, 0.89 and 0.89	0.27, 0.91, 0.91 and 0.91	0.28, 0.92, 0.92 and 0.92	0.28, 0.94, 0.94 and 0.94	0.28, 0.94, 0.94 and 0.94
	FR_KC1[(c)]	Kilmarnock Creek d/s of Rock Drain (0200252)	0.93	0.97 and 0.98	0.96 and 0.97	0.9 and 0.91	0.74	0.44 and 0.45	0.49 and 0.5	0.66 and 0.67	0.74	0.8	0.86 and 0.87	0.91
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	0.97	0.97	0.98	0.95	0.91	0.9	0.92	0.96	0.96	0.96	0.97	0.96
	GH_CC1[(d)]	Cataract Creek Sediment Pond Decant (0200384)	0.99	0.99	0.99	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.99
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.99	0.99	0.99	0.99
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	0.99	0.99	0.98	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.99	0.99
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	1.0	0.99	0.97	0.94	0.92	0.96	0.98	0.98	0.98	0.99	0.98	0.99
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
	GH_TC1[(e)]	Thompson Creek at LRP Road (E102714)	0.94 and 1	0.94 and 1	0.93 and 1	0.9 and 1	0.88 and 1	0.92 and 1	0.91 and 1	0.93 and 1	0.93 and 1	0.93 and 1	0.9 and 1	0.93 and 1
Line Creek Operations (LCO)	LC_DC3[(f)]	Dry Creek upstream of East Tributary (E288273)	0.71, 0.96, 0.95 and 0.95	0.72, 0.96, 0.96 and 0.96	0.71, 0.96, 0.95 and 0.95	0.7, 0.96, 0.93 and 0.93	0.67, 0.96, 0.89 and 0.89	0.64, 0.97, 0.85 and 0.85	0.64, 0.96, 0.86 and 0.86	0.67, 0.96, 0.89 and 0.89	0.68, 0.96, 0.91 and 0.91	0.69, 0.96, 0.92 and 0.92	0.7, 0.96, 0.94 and 0.94	0.71, 0.96, 0.94 and 0.94
	LC_LCUSWLC[(g)]	Line Creek u/s of West Line Creek (E293369)	1, 0.97, 0.87, 0.87, 0.87, 0.87, 0.87, and 0.87	1, 0.97, 0.88, 0.88, 0.88, 0.88, 0.88, and 0.88	1, 0.97, 0.88, 0.88, 0.88, 0.88, 0.88, and 0.88	1, 0.97, 0.76, 0.76, 0.76, 0.76, 0.76, and 0.76	1, 0.97, 0.13, 0.13, 0.13, 0.13, 0.13, and 0.13	1, 0.97, 0.077, 0.077, 0.077, 0.077, 0.077, and 0.077	1, 0.97, 0.54, 0.54, 0.54, 0.54, 0.54, and 0.54	1, 0.97, 0.74, 0.74, 0.74, 0.74, 0.74, and 0.74	1, 0.97, 0.82, 0.82, 0.82, 0.82, 0.82, and 0.82	1, 0.97, 0.77, 0.77, 0.77, 0.77, 0.77, and 0.77	1, 0.97, 0.79, 0.79, 0.79, 0.79, 0.79, and 0.79	1, 0.97, 0.85, 0.85, 0.85, 0.85, 0.85, and 0.85
	LC_WLC	West Line Creek (E261958)	0.94	0.96	0.94	0.94	0.81	0.32	0.27	0.34	0.38	0.52	0.61	0.88
Elkview Operations (EVO)	EV_EC1[(h)]	Erickson Creek at the Mouth (0200097)	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	0.98	0.98	0.95	0.97	0.95	0.94	0.95	0.96	0.97	0.97	0.98	0.98
	EV_BC1[(i)]	Bodie Creek Sedimentation Pond Decant (E102685)	0.85, 0.85, 0.85 and 0.99	0.86, 0.86, 0.86 and 0.99	0.85, 0.85, 0.85 and 0.99	0.84, 0.84, 0.84 and 0.99	0.8, 0.8, 0.8 and 0.99	0.76, 0.76, 0.76 and 0.99	0.77, 0.77, 0.77 and 0.99	0.8, 0.8, 0.8 and 0.99	0.82, 0.82, 0.82 and 0.99	0.83, 0.83, 0.83 and 0.99	0.84, 0.84, 0.84 and 0.99	0.85, 0.85, 0.85 and 0.99
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	0.97	0.97	0.97	0.99	0.98	0.99	1.0	0.99	0.99	0.99	0.99	0.99

Notes:
(a) Attenuation factors are presented in the following order: Turnbull South Pit, Clode Creek Lower, Eagle 6 Pit (Includes Eagle 6 Pit North and Eagle 6 West), and Eagle 4 Pit.
(b) Attenuation factors are presented in the following order: North East Tributary, John Creek and Lake Pit and Lake Mountain Pit.
(c) Attenuation factors are presented in the following order: Eagle 6 Pit South and Kilmarnock Lower
(d) Attenuation factors are presented in the following order: Cataract Creek and Cougar Pit Phase 6 (Cougar Pit Phase 6 discharges to Cataract Creek until the end of 2007).
(e) Attenuation factors are presented in the following order: Cougar Pit Phase 3 and Thompson Creek.
(f) Attenuation factors are presented in the following order: Upper Dry Creek and Mount Michael Pits 1, 2, and 3.
(g) Attenuation factors are presented in the following order: Upper Line Creek, Horseshoe Creek, Horseshoe Ridge Pit, North Line Extension Pit, No Name Creek Access Road Spoils, Mine Services Area West, North Line Creek and Center Line Creek.
(h) Attenuation factors are presented in the following order: Adit Pit, Upper Erickson Creek, Lower Erickson Creek and F2 Pit.
(i) Attenuation factors are presented in the following order: Natal Pits (include Natal Pit North, Natal Pit West and Natal Pit 2) and Bodie Creek.
ID = Identification; d/s = downstream; u/s = upstream.

Table D-4. Post-PAG Calibrated Attenuation Factors for Cadmium

Operation / General Location	Node ID	Node Description	January	February	March	April	May	June	July	August	September	October	November	December
Fording River Operations (FRO)	FR_HC1	Henretta Creek u/s of the Fording River (E216778)	0.87	0.87	0.72	0.71	0.71	0.79	0.83	0.85	0.86	0.87	0.87	0.87
	FR_CC1(a)	Clode Creek Sediment Pond Decant (E102481)	0.94, 0.92, 0.93, 0.93 and 0.67	0.95, 0.87, 0.88, 0.88 and 0.76	0.94, 0.94, 0.95, 0.95 and 0.77	0.92, 0.96, 0.96, 0.96 and 0.76	0.88, 0.97, 0.97, 0.97 and 0.8	0.84, 0.95, 0.95, 0.95 and 0.75	0.85, 0.95, 0.95, 0.95 and 0.75	0.89, 0.98, 0.98, 0.98 and 0.85	0.91, 0.99, 0.99, 0.99 and 0.88	0.91, 0.98, 0.98, 0.98 and 0.86	0.93, 0.98, 0.98, 0.98 and 0.83	0.93, 0.93, 0.94, 0.94 and 0.68
	FR_LMP1(b)	Lake Mountain Pond	0.28, 0.85, 0.85 and 0.85	0.29, 0.86, 0.86 and 0.86	0.28, 0.85, 0.85 and 0.85	0.28, 0.83, 0.83 and 0.83	0.26, 0.79, 0.79 and 0.79	0.25, 0.75, 0.75 and 0.75	0.25, 0.76, 0.76 and 0.76	0.27, 0.8, 0.8 and 0.8	0.27, 0.82, 0.82 and 0.82	0.27, 0.82, 0.82 and 0.82	0.28, 0.84, 0.84 and 0.84	0.28, 0.84, 0.84 and 0.84
	FR_KC1(c)	Kilmarnock Creek d/s of Rock Drain (0200252)	0.93	0.97 and 0.98	0.96 and 0.97	0.9 and 0.91	0.74	0.44 and 0.45	0.49 and 0.5	0.66 and 0.67	0.74	0.8	0.86 and 0.87	0.91
	GH_SC1	Swift Creek Settling Pond Discharge (E221329/E105061)	0.97	0.97	0.98	0.95	0.91	0.9	0.92	0.96	0.96	0.96	0.97	0.96
	GH_CC1(d)	Cataract Creek Sediment Pond Decant (0200384)	0.99	0.99	0.99	0.98 and 0.99	0.98 and 0.99	0.98	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.98 and 0.99	0.99
Greenhills Operations (GHO)	GH_PC1	Porter Creek Sediment Pond Decant (0200385)	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
	GH_GH1	Greenhills Creek Sediment Pond Decant (E102709)	0.99	0.99	0.98	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.99	0.99
	GH_LC1	Leask Creek Sediment Pond Decant (E257796)	1.0	0.99	1.0	1.0	1.0	1.0	0.98	0.98	0.98	0.99	0.98	0.99
	GH_WC1	Wolfram Creek Sediment Pond Decant (E257795)	0.99	0.99	0.99	1.0	1.0	1.0	1.0	0.99	1.0	1.0	0.99	1.0
	GH_TC1(e)	Thompson Creek at LRP Road (E102714)	0.94 and 1	0.94 and 1	0.92 and 1	0.88 and 1	0.87 and 1	0.91 and 1	0.9 and 1	0.93 and 1	0.92 and 1	0.93 and 1	0.89 and 1	0.92 and 1
Line Creek Operations (LCO)	LC_DC3(f)	Dry Creek upstream of East Tributary (E288273)	0.92, 0.95, 0.94 and 0.94	0.93, 0.96, 0.95 and 0.95	0.92, 0.96, 0.94 and 0.94	0.9, 0.95, 0.92 and 0.92	0.86, 0.95, 0.88 and 0.88	0.81, 0.95, 0.84 and 0.84	0.83, 0.95, 0.85 and 0.85	0.86, 0.96, 0.89 and 0.89	0.88, 0.96, 0.91 and 0.91	0.89, 0.96, 0.91 and 0.91	0.91, 0.96, 0.93 and 0.93	0.91, 0.95, 0.93 and 0.93
	LC_LCUSWLC(g)	Line Creek u/s of West Line Creek (E293369)	1, 0.97, 0.84, 0.84, 0.84, 0.84, 0.84, and 0.84	1, 0.97, 0.85, 0.85, 0.85, 0.85, 0.85, and 0.85	1, 0.97, 0.85, 0.85, 0.85, 0.85, 0.85, and 0.85	1, 0.97, 0.72, 0.72, 0.72, 0.72, 0.72, and 0.72	1, 0.97, 0.28, 0.11, 0.11, 0.11, 0.11, and 0.11	1, 0.97, 0.058, 0.058, 0.058, 0.058, 0.058, and 0.058	1, 0.97, 0.44, 0.44, 0.44, 0.44, 0.44, and 0.44	1, 0.97, 0.65, 0.65, 0.65, 0.65, 0.65, and 0.65	1, 0.97, 0.75, 0.75, 0.75, 0.75, 0.75, and 0.75	1, 0.97, 0.71, 0.71, 0.71, 0.71, 0.71, and 0.71	1, 0.97, 0.74, 0.74, 0.74, 0.74, 0.74, and 0.74	1, 0.97, 0.81, 0.81, 0.81, 0.81, 0.81, and 0.81
	LC_WLC	West Line Creek (E261958)	0.94	0.96	0.94	0.94	0.81	0.32	0.27	0.34	0.38	0.52	0.61	0.88
Elkview Operations (EVO)	EV_EC1(h)	Erickson Creek at the Mouth (0200097)	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1	1, 0.98, 1 and 1
	EV_GT1	Gate Creek Sedimentation Pond Decant (E206231)	0.98	0.98	0.95	0.97	0.95	0.94	0.95	0.96	0.97	0.97	0.98	0.98
	EV_BC1(i)	Bodie Creek Sedimentation Pond Decant (E102685)	0.85, 0.85, 0.85 and 0.99	0.86, 0.86, 0.86 and 0.98	0.85, 0.85, 0.85 and 0.97	0.83, 0.83, 0.83 and 0.96	0.79, 0.79, 0.79 and 0.94	0.75, 0.75, 0.75 and 0.96	0.76, 0.76, 0.76 and 0.97	0.8, 0.8, 0.8 and 0.99	0.82, 0.82, 0.82 and 1	0.82, 0.82, 0.82 and 0.99	0.84, 0.84, 0.84 and 0.99	0.84, 0.84, 0.84 and 0.98
	EV_DC1	EVO Dry Creek Sediment Pond Decant (E298590)	0.97	0.97	0.97	0.99	0.98	0.99	1.0	0.99	0.99	0.99	0.99	0.99

Notes:
(a) Attenuation factors are presented in the following order: Turnbull South Pit, Clode Creek Lower, Eagle 6 Pit (Includes Eagle 6 Pit North and Eagle 6 West), and Eagle 4 Pit.
(b) Attenuation factors are presented in the following order: North East Tributary, John Creek and Lake Pit and Lake Mountain Pit.
(c) Attenuation factors are presented in the following order: Eagle 6 Pit South and Kilmarnock Lower
(d) Attenuation factors are presented in the following order: Cataract Creek and Cougar Pit Phase 6 (Cougar Pit Phase 6 discharges to Cataract Creek until the end of 2007).
(e) Attenuation factors are presented in the following order: Cougar Pit Phase 3 and Thompson Creek.
(f) Attenuation factors are presented in the following order: Upper Dry Creek and Mount Michael Pits 1, 2, and 3.
(g) Attenuation factors are presented in the following order: Upper Line Creek, Horseshoe Creek, Horseshoe Ridge Pit, North Line Extension Pit, No Name Creek Access Road Spoils, Mine Services Area West, North Line Creek and Center Line Creek.
(h) Attenuation factors are presented in the following order: Adit Pit, Upper Erickson Creek, Lower Erickson Creek and F2 Pit.
(i) Attenuation factors are presented in the following order: Natal Pits (include Natal Pit North, Natal Pit West and Natal Pit 2) and Bodie Creek.
ID = Identification; d/s = downstream; u/s = upstream.

Table D-5. Cadmium Attenuation Factors that Apply Downstream of Initial Monitoring Points

Node ID	Description	Cadmium Load Reduction Factor (%)
FR_HC1 to FR_FR1	Henretta Creek to Henretta Creek u/s of the Fording River	80%
FR_FR4	Fording River between Swift and Cataract Creeks (0200311)	45%
CSP_Ph_6 to GH_CC1	Cougar South Pit Phase 6 to Cataract Creek Sediment Pond Decant	90%
FR_FRCP1	Fording River, 525 m d/s of Cataract Creek (E300071)	30%
GH_PC2	Fording River d/s of Porter Creek (E287431)	80%
LC_DC4	Dry Creek below East Tributary Subsurface Flow	42%
CSP_Ph_3 to GH_GH1	Cougar South Pit Phase 3 to Greenhills Creek Sediment Pond Decant	90%
LC_LCDSSLCC	LCO Compliance Point (Line Creek d/s of South Line Creek confluence) (E297110)	50%
LC_LC4	Line Creek u/s of Process Plant (0200044)	48%
CSP_Ph_6 to GH_MC1	Cougar South Pit Phase 6 to Mickelson Creek	90%
CSP_Ph_6 to GH_LC1	Cougar South Pit Phase 6 to Leask Creek	90%
CSP_Ph_6 to GH_WC1	Cougar South Pit Phase 6 to Wolfram Creek	90%
CSP_Ph_3 to GH_WC1	Cougar South Pit Phase 3 to Wolfram Creek	90%
CSP_Ph_3 to GH_TC1	Cougar South Pit Phase 3 to Thompson Creek	95%
F2_Pit to EV_BC1	F2 Pit to Bodie Creek Control Pond	95%
Natal_Pits to EV_BC1	Natal Pits to Bodie Creek Control Pond	92%
Natal_Pits to EV_GT1	Natal Pits to Gate Creek	90%
EV_EC1	Erickson Creek at the Mouth (0200097)	90%

d/s = downstream; LCO = Line Creek Operations; u/s = upstream.