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March 12, 2019

Joseph Mackenzie, Chair
Wek'èezhìi Land and Water Board
#1, 4905 – 48th Street
Yellowknife, NT, X1A 3S3

Dear Mr. Mackenzie:

Re: Potassium Response Plan Version 2.1

Dominion Diamond Mines ULC (Dominion) is pleased to provide the Wek'èezhìi Land and Water Board (the Board) with Version 2.1 of the Potassium Response Plan (the Plan). Version 2.1 of the Plan is provided in accordance with requirements of Part J, Item 13, of Water Licence W2012L2-0001, and the Board's Decision on Version 2.0 of the Plan. A summary of concordance is provided in Table 1-3 of the Plan. Furthermore, Version 2.1 of the Plan fulfills items (a) to (d) of the Board's Directive and Reasons for Decision on Version 2.0 (January 24th, 2019):

a) Remove the following sentence from section 3.2.1: "*The identification of sodium as potentially having an ameliorating effect on potassium toxicity was also questioned by the GNWT-ENR during the Water Licence Amendment process*";
b) Include the amphipod *Hyalella azteca* as a fourth test species, using the Environment and Climate Change Canada (ECCC) protocol (ECCC, 2017), in the sodium-potassium investigation in section 3.2.1 of the Potassium Response Plan;
c) Revise section 3.2.2.1 of the Potassium Response Plan to align with Dominion's response to Board staff comment 4; and,
d) Provide the results of the sodium-potassium investigation and discuss the implications for potassium management, with the submission of the 2019 AEMP Annual Report.

Dominion trusts that you will find the information to be clear and informative. Should you have any questions, please contact Giovanna Diaz, Environment Specialist – Fisheries and Aquatics, at Giovanna.Diaz@ddcorp.ca or 403-910-1933 ext. 2405 or the undersigned at Harry.O'Keefe@ddcorp.ca or 867-445-3185.

Sincerely,

Original signed by Harry O'Keefe

Harry O'Keefe
Team Lead – Environment Projects

Record #:HSE RCD ENV 1149;
Document Owner: Environment Department;
Date: 7-Mar-2019
Template # EKA TEM 1852.13

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References:

Environment and Climate Change Canada (ECCC). 2017. Biological test method: test for survival, growth and reproduction in sediment and water using the freshwater amphipod *Hyalella azteca*. Third Edition. EPS1/RM/33. September 2017.

Ekati Diamond Mine

Response Plan for Potassium
Version 2.1

Dominion Diamond Mines

Dominion Diamond Mines ULC

EKATI DIAMOND MINE

Response Plan for Potassium

Version 2.1

March 2019

Project #0444160-0017

Citation:
ERM. 2019. *Ekati Diamond Mine: Response Plan for Potassium*. Version 2.1. Prepared for Dominion Diamond Mines ULC by ERM Consultants Canada Ltd.: Yellowknife, Northwest Territories.

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EXECUTIVE SUMMARY

This report presents Dominion Diamond Mines ULC's (Dominion Diamond's) *Response Plan for Potassium*, Version 2.1. This plan is written to address the Wek'èezhìi Land and Water Board Directive and Reasons for Decision on Water Licence Amendment – Potassium Effluent Quality Criteria and the Directives from Reasons and Decision on Version 2.0 in accordance with the requirements in Dominion Diamond's Water Licence (W2012L2-0001) and the *Aquatic Response Framework*, Version 3.0.

Low action level exceedances have been identified for Leslie and Moose lakes in previous versions of this plan and a medium action level exceedance was previously identified for Leslie Lake in 2017. During the under-ice season of 2018, a high action level exceedance was identified for Leslie Lake, a medium action level exceedance was identified for Moose Lake, and a low action level exceedance was identified for Cujo Lake. Potassium concentrations observed in all monitored lakes remain below the water quality benchmarks for potassium (i.e., 64 mg/L for lakes in the Koala Watershed and 41 mg/L for lakes in other monitored watersheds) and continue to represent a low risk to aquatic life and drinking water quality. Actions in response to the action level exceedance have been completed (e.g., proposed alignment of effluent quality criteria and water quality benchmarks) and a number of actions identified in previous versions of this plan are ongoing. Mitigation for the high action level exceedance observed in April 2018 has already been initiated through the delay of the Long Lake Containment Facility (LLCF) Discharge during the 2018 open-water season. Proposed response actions include the potassium toxicity testing (as defined though the Water Licence Amendment process) and monthly under-ice water quality sampling through the 2018/2019 winter period in lakes downstream of the LLCF.

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GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

Action Level	A predetermined change, to a monitored variable or other qualitative or quantitative measure that requires the Licensee to take appropriate actions that may include, but that are not limited to: further investigations, changes to operations, or enhanced mitigation measures.
AEMP	Aquatic Effects Monitoring Program
AES	Aquatic Ecology Synthesis
ARF	Aquatic Response Framework
ATPase	Adenosine Triphosphatase
CCME	Canadian Council of Ministers of the Environment
Discharge	The direct or indirect release of any water or Waste to the Receiving Environment as defined in W2012L2-0001
Dominion Diamond	Dominion Diamond Mines ULC
ECCC	Environment and Climate Change Canada
ENR	Environment and Natural Resources
EQC	Effluent Quality Criteria
ERM	ERM Consultants Canada Ltd.
ETMFs	Exposure and toxicity modifying factors
GNWT	Government of Northwest Territories
IC_{xx}	Inhibition Concentration estimated to cause an xx% inhibitory effect on the sublethal endpoint being measured (e.g., on growth or reproduction)
K^+	Potassium cation
KPSF	King Pond Settling Facility
LLCF	Long Lake Containment Facility
MAC	Maximum allowable concentration
Na^+	Sodium cation

OWMM	Operational Water Management Model
Plan, the	The *Response Plan for Potassium*
Response Framework	A systematic approach to responding when the results of a monitoring program indicate that an Action Level has been reached.
Response Plan	A part of the Response Framework that describes the specific actions to be taken by the Licensee in response to reaching or exceeding an Action Level.
SNP	Surveillance Network Program
SSWQO	Site Specific Water Quality Objective
WHO	World Health Organization
the Board	Wek’èezhìi Land and Water Board

1. INTRODUCTION

This report presents Dominion Diamond Mines ULC's (Dominion Diamond's) *Response Plan for Potassium* (the Plan), Version 2.1. The Plan is written in accordance with the requirements in Water Licence W2012L2-0001 (Table 1-1), commitments made in Dominion Diamond's *Aquatic Response Framework* (ARF), Version 3.0 (ERM 2018a), and the Wek'èezhìi Land and Water Board (the Board) Directive and Reasons for Decision on Water Licence Amendment - Potassium Effluent Quality Criteria (EQC; Table 1-2), and Directives from Reasons and Decision on Version 2.0 (Table 1-3). This Plan, in combination with other response plans, provides a tool for the protection of the uses of the aquatic receiving environment at the Ekati Diamond Mine by triggering management actions to provide environmental protection such that significant adverse effects do not occur. The Ekati Diamond Mine response plans function in an interconnected manner and allow for hierarchical response as effects are observed from abiotic to biotic variables through the food web.

Table 1-1. *Response Plan for Potassium*, Version 2.1 Concordance with Water Licence W2012L2-0001 Criteria

Water Licence W2012L2-0001 Criterion	Water Licence Section	Report Section
A description of the parameter, its relation to Significance Thresholds, and the ecological implication of the Action Level exceedance.	Schedule 8, Part J, Item 4(a)	2.1, 2.4
A summary of how the Action Level exceedance was determined and confirmed.	Schedule 8, Part J, Item 4(b)	2.2
A description of likely causes of the Action Level Exceedance and potential mitigation options if appropriate.	Schedule 8, Part J, Item 4(c)	2.3
A description of the actions to be taken by the Licensee in response to the Action Level exceedance including:		
• a justification of the selected action which may include a cost/benefit analysis;	Schedule 8, Part J, Item 4(d)(i)	3
• a description of timelines to implement the proposed actions;	Schedule 8, Part J, Item 4(d)(ii)	4
• a projection of the environmental response to the planned actions, if appropriate;	Schedule 8, Part J, Item 4(d)(iii)	NA
• a monitoring plan for tracking the responses to the actions, if appropriate;	Schedule 8, Part J, Item 4(d)(iv)	3.1.3
• a schedule to report on the effectiveness of actions and to revise the AEMP Response Plan as required; and	Schedule 8, Part J, Item 4(d)(v)	4
For hydrology-related parameters at the Narrows, a description of how the Action Levels proposed will ensure water levels at the Narrows are maintained such that the Jay Development does not adversely affect fish passage and the continuation of traditional use of the area as an open water source.	Schedule 8, Part J, Item 4(e)	NA
Any other information that is necessary to assess the response to an Action Level exceedance or that has been requested by the Board.	Schedule 8, Part J, Item 4(f)	NA

Note: "NA" represents criteria not applicable to the Response Plan for Potassium, Version 2.1

Table 1-2. *Response Plan for Potassium*, Version 2.1 Concordance with the Board Directives on Water Licence Amendment Application to Amend the Potassium Effluent Quality Criteria

The Board Directive, June 15, 2018*	Report Section
Within 90 days of the effective date of Amendment #5, Dominion is to submit, in accordance with Schedule 6, Condition 4, a Response Plan Version 2.0 to reflect the concerns raised through this Proceeding, including but not limited to:	
a. Update to discussion of management/mitigation options available to the Company;	3.1 and 3.2
b. Update to potential actions that could be taken in response to Medium and High Action Levels;	3.2
c. Description of investigation to explore the effect of sodium on potassium toxicity;	3.2.1
d. Discussion of how results of toxicity study (Part H, Condition 37) and sodium potassium ratio investigation will be incorporated into response planning; and	3.2.1
e. Include commitment to update water quality modelling with Water Licence Renewal.	3.1.4

Table 1-3. *Response Plan for Potassium*, Version 2.1 Concordance with the Board Directives on *Response Plan for Potassium*, Version 2.0

The Board Directive, February 11, 2019*	Report Section(s)
The Response Plan for Potassium Version 2.0 was approved with additional direction for Version 2.1. Dominion Diamond is to submit Version 2.1 to incorporate Revisions C through E within 30 days of communicating its decision:	
Revision C: Dominion Diamond is to remove the following sentence from section 3.2.1: "The identification of sodium as potentially having an ameliorating effect on potassium toxicity was also questioned by the GNWT-ENR during the Water Licence Amendment process.	3.2.1
Revision D: Dominion Diamond is to include the amphipod *Hyalella azteca* as a fourth test species, using the Environment and Climate Change Canada (ECCC) protocol (ECCC, 2017), in the sodium-potassium investigation in section 3.2.1 of the Potassium Response Plan.	3.2.1
Revision E: Dominion Diamond is to revise section 3.2.2.1 of the Potassium Response Plan to align with Dominion's response to WLWB staff comment 4.	3.2.2.1
Decision 7: Dominion Diamond is to provide the results of the sodium-potassium investigation and discuss the implications for potassium management, with the submission of the 2019 AEMP Annual Report.	4.0

**See http://registry.mvlwb.ca/Documents/W2012L2-0001/W2012L2-0001%20-%20Ekati%20-%20AEMP%20-%20Potassium%20Toxicity%20Study%20Design%20and%20Response%20Plan%20V2%20-%20Reasons%20for%20Decision%20-%20Feb%2011_19.pdf*

1.1 PLAN HISTORY

The initial development of the Plan was a requirement specified in the Board Directive and Reasons for Decision on the Ekati Diamond Mine 2013 Aquatic Effects Monitoring Program (AEMP) report (ERM Rescan 2014). The ARF was still under review by the Board at the time; therefore, there was no formal system in place to require the development of a Response Plan. Version 1.0 was submitted to the Board on March 31, 2015 (ERM 2015a). Version 1.0 identified two response actions required to develop improved understanding of the risks associated with potassium in the receiving environment downstream of the Long Lake Containment Facility (LLCF): (1) an updated water quality prediction and (2) a review of the potassium site-specific water quality objective (SSWQO). The Board reviewed Version 1.0 and provided its Directive and Reasons for Decision on June 29, 2015. Although the Board supported the proposed actions, the Board directed the submission of Version 1.1. The subsequent version was to address the concerns outlined in the Board Directive and Reasons for Decision relative to non-compliance with Water Licence criteria (i.e., some criteria could not be met because the ARF had not yet been approved). An updated potassium SSWQO report (Action 1 of Version 1.0) and a memorandum presenting updated water quality predictions for potassium (Action 2 of Version 1.0) were provided to the Board on July 31, 2015 (ERM 2015b, 2015c). During the public review it was identified that the SSWQO calculation should be revised from 70 mg/L to 64 mg/L (due to a rounding error), and the Board accepted the proposed SSWQO of 64 mg/L for lakes downstream of the LLCF. The Board also required that the modelled potassium predictions be revisited because peak under-ice concentrations were under-predicted by the model. The Board required submission of an updated revised SSWQO for potassium and updated water quality predictions as appendices to Version 1.1 by June 30, 2016.

The Plan, Version 1.1 including the revised SSWQO and updated water quality predictions was submitted in July 2016 following a request for an extended deadline. Version 1.2 was submitted a few months later, in October 2016, to address low action level exceedances identified for Leslie and Moose lakes during the open-water season of 2016. Version 1.1 was not posted by the Board for stakeholder comment before Version 1.2 was submitted; therefore, only Version 1.2 was made available for stakeholder review (ERM 2016d). Both versions 1.1 and 1.2 included proposed medium and high action levels, and recommended two additional actions to address the low action level exceedances: (1) continued monitoring and evaluation of potassium under the AEMP, and (2) the comparison of observed 2016 and winter 2017 potassium concentrations to predictions in the refined Koala Watershed water quality model to evaluate how predictions compare to actual observations. Version 1.2 concluded that both the observed and model-predicted future potassium concentrations in lakes downstream of the LLCF were less than the water quality benchmark of 64 mg/L and did not present a potential ecological risk to aquatic organisms or a concern for drinking water for humans or wildlife (ERM 2016d). The Board provided their Directive and Reasons for Decision on Version 1.2 on January 17, 2017. The Board indicated support for the actions proposed to investigate the low action level exceedances and supported the proposed medium and high action levels but again did not approve the Plan. Instead, the Board required Version 1.3 to be submitted by June 30, 2017 and indicated that it should include mitigation options for potassium if measured concentrations of potassium in 2016 and 2017 (under-ice) exceeded the predicted range of concentrations downstream of the LLCF.

On May 19, 2017 Dominion Diamond notified the Board of a medium action level exceedance in Leslie Lake during April 2017 and requested an extension to the deadline for Version 1.3 to provide sufficient time to address both the Directive and Reasons for Decision on Version 1.2 and the newly identified medium action level exceedance. The Board approved a submission deadline for Version 1.3 of August 9, 2017. Version 1.3 addressed the Directive on Version 1.2 and medium action level exceedance. Version 1.3 included a number of ongoing and proposed actions to address the observed exceedances and proposed modification of the high action level (ERM 2016e). The Board provided their Directive and Reasons for Decision on Version 1.3 on January 25, 2018. The Board approved Version 1.3 but required that a Version 1.4 be submitted for conformity check that included the approved high action level at 90% of the water quality benchmark. Version 1.4 was submitted May 1, 2018 (ERM 2018b) and was approved by the Board in their Directive on Version 1.4 on June 18, 2018. In addition, to fulfill a commitment made in Version 1.3, Dominion Diamond provided a report detailing the progress made with respect to the management and mitigation of potassium in water downstream of the LLCF on April 30, 2018 (ERM 2018c).

Version 2.0 was submitted to the Board on October 3, 2018 (ERM 2018d) in accordance with the Board's Decision on Version 1.4 of the Plan. Version 2.0 of the Plan incorporated the following Board Directives:

- update to discussion of management/mitigation options available to the Company;
- update to potential actions that could be taken in response to Medium and High Action Levels;
- description of investigation to explore the effect of sodium on potassium toxicity;
- discussion of how toxicity study (Part H, Condition 37) and sodium potassium ratio investigation will be incorporated into response planning; and,
- include the commitment to update water quality modelling with Water Licence Renewal.

The Board provided their Directive and Reasons for Decision on Version 2.0 of the Plan on February 11, 2019. The Board approved Version 2.0 but required that a Version 2.1 be submitted with the required revisions by March 13, 2019.

1.2 REPORT STRUCTURE

This report is divided into the following four sections:

- Section 1: Provides the concordance of the *Response Plan for Potassium*, Version 2.1 with Water Licence (W2012L2-0001) criteria (Table 1-1), provides the Plan history, and presents a summary of changes from Version 1.4 (Table 1.2-1).
- Section 2: Provides background information including a description of potassium, the determination and confirmation of the action level exceedance, the likely cause of the action level exceedance, the ecological significance of the action level exceedance, and the relation of the action level exceedance to significance thresholds.
- Section 3: Outlines the completed, ongoing, and proposed response actions recommended to address the observed action level exceedances.
- Section 4: Provides a schedule and recommended next steps.

Table 1.2-1. Summary of Changes from Version 1.4

Report Section	Description of Change
1. Introduction	• Updated to reflect objective of Version 2.0 • Updated to reflect objective of Version 2.1
1.1. Plan History	• Updated plan history
1.2. Report Structure	• Updated to include summary of changes from Version 1.4
2. Background	
2.1. Description of Variable	• No material changes
2.2. Determination and Confirmation of Action Level Exceedance	• Updated to include description of current action level exceedances
2.3. Likely Cause of Action Level Exceedance	• Updated to include cause of current action level exceedances
2.4. Ecological Implications of Action Level Exceedance and Relation to Significance Thresholds	• Updated to describe implications of the high action level exceedance in Leslie Lake, medium action level exceedance in Moose Lake, and low action level exceedance in Cujo Lake
3. Response Actions	
3.1. Completed and Ongoing Actions	• Updated ongoing actions
3.2. Proposed Actions	• Updated actions to address exceedance of high action level in Leslie Lake and incorporation of potassium toxicity laboratory testing • Removed the sentence related to the identification of sodium as potentially having ameliorating effect on potassium toxicity • Updated actions to incorporate *Hyalella azteca* as a fourth test species in the sodium-potassium investigation • Updated actions to include that the potential mitigation option of using an alternative water source is retained as contingency, and it is not expected to be required
4. Schedule and Recommended Next Steps	• Updated to reflect current recommendations • Updated to include the timeline to submit the sodium-potassium investigation results and implications for potassium management

2. BACKGROUND

2.1 DESCRIPTION OF VARIABLE

Potassium exists naturally in both rock and water. Potassium exists in freshwater predominantly as a cation, K+, which is highly soluble and stable in aquatic environments. It does not degrade or volatilize and is relatively non-reactive. However, potassium can also be released from rock to water through weathering. Dynamics within aquatic systems are generally driven by dilution, concentration by evaporation, and uptake into aquatic life (Rescan 2012).

Potassium is required by all animal cells and is used in a variety of critical metabolic functions, including homeostasis and nerve function. It is closely regulated and transported across membranes using the Na+/K+ ATPase (sodium-potassium adenosine triphosphatase) pump, as well as through potassium-selective ion channels. These processes concentrate potassium on the inside of cells relative to the extracellular environment and maintain an electrochemical gradient across cell membranes. Plants accumulate potassium in their tissues, where it is critical for photosynthesis, transport, and protein synthesis. Despite the fact that potassium is essential for all organisms, this cation may exhibit toxicity to aquatic organisms at elevated concentrations. The mechanism of potassium toxicity to aquatic organisms likely relates to disruption of cellular processes that rely on maintenance of a potassium gradient across the cellular membrane (e.g., osmoregulation and cellular depolarization associated with nerve innervation and muscle contraction). These processes concentrate potassium on the inside of cells relative to extracellular fluids and maintain an electrochemical gradient across cell membranes. Elevated concentrations of potassium have been shown to affect contractions of heart muscles and nerve cells by altering depolarization of the cells, which occurs in part as a result of ion flux of potassium and sodium across the biological membrane (Appendix A of ERM 2016d). For the purpose of the Plan, the term potassium refers to total potassium (includes dissolved and particulate potassium).

Short- and long-term SSWQOs were first developed for potassium at the Ekati Diamond Mine in 2012 (Rescan 2012). These SSWQOs were developed to assess the level of environmental risk associated with increasing potassium concentrations observed downstream of the mine in the absence of generic water quality guidelines. More recently (2015), available literature on potassium toxicity was assessed and additional toxicity testing was conducted using site-collected water. Testing with site water was conducted to provide a more realistic determination of site-specific potassium toxicity than testing using laboratory water as it considers exposure and toxicity modifying factors (ETMFs) as recommended by the Canadian Council of Ministers of the Environment (CCME 2007). Site water tests were conducted on the four most sensitive species included in the 2012 long-term SSWQO. The updated SSWQOs were calculated to be 103 mg/L for short-term exposures and 64 mg/L for long-term exposures (Appendix A of ERM 2016d).

The long-term SSWQO of 64 mg/L was adopted as the water quality benchmark for lakes downstream of the LLCF for the protection of aquatic life for potassium. The long-term SSWQO of 41 mg/L is the water quality benchmark for all other lakes monitored at the Ekati Diamond Mine. The water quality benchmark is considered safe for all aquatic organisms for indefinite exposure in the applicable receiving environment (i.e., downstream of the LLCF or all other monitored lakes) making it useful for long-term monitoring activities that may result in sustained exposure (see Appendix A of ERM 2016d and Rescan 2012).

Chronic effects are not anticipated when potassium concentrations in monitored lakes are less than the applicable water quality benchmark. However, chronic effects may or may not occur when potassium concentrations are greater than the applicable potassium benchmark because of the conservative approach in developing the SSWQO used to establish the benchmark (i.e., all of the species mean data utilized in deriving the SSWQOs exceeded the SSWQO values; Rescan 2012, ERM 2016d). There are no health-related Canadian drinking water guidelines (i.e., maximum allowable concentrations, MAC) or guidelines for potassium in drinking water for livestock (often used as a surrogate for wildlife guidelines) or wildlife. Risks to aquatic life, humans, and wildlife from potassium exposure are discussed further in Section 2.4.

2.2 DETERMINATION AND CONFIRMATION OF ACTION LEVEL EXCEEDANCE

Low, medium, and high action levels for potassium have been defined and approved as outlined in Table 2.2-1.

Table 2.2-1. Potassium Action Levels

Action Level	Condition #	Condition
Low[1]	L1	The average measured monthly concentration of potassium at any near-field AEMP sampling location is greater than 50% of the water quality benchmark (i.e., 50% of the SSWQO of 64 mg/L = 32 mg/L for lakes downstream of the LLCF or 50% of the SSWQO of 41 mg/L = 20.5 mg/L for other lakes); and
	L2	The variable shows an increasing trend relative to historical observations in the same month for which Condition (1) is met.
Medium[2]	M1	The average measured concentration of potassium at any near-field AEMP sampling location is greater than 70% of the water quality benchmark (i.e., 70% of the SSWQO of 64 mg/L = 44.8 mg/L for lakes downstream of the LLCF or 70% of the SSWQO of 41 mg/L = 28.7 mg/L for other lakes).
High[2]	H1	The average measured concentration of potassium at any near-field AEMP sampling location is greater than 90% of the water quality benchmark (i.e., 90% of the SSWQO of 64 mg/L = 57.6 mg/L for lakes downstream of the LLCF or 90% of the SSWQO of 41 mg/L = 36.9 mg/L for other lakes).

Notes:
[1] *As defined in the ARF, Version 3.0 (ERM 2018a).*
[2] *As defined in the Response Plan for Potassium, Version 1.4 (ERM 2018b).*

A general increase in potassium concentrations has been observed downstream of the LLCF since 2001, shortly after operations began at the Ekati Diamond Mine (Figures 2.2-1 and 2.2-2; ERM 2018e). Low action level exceedances have been identified for Leslie and Moose lakes and a medium action level exceedance has been identified for Leslie Lake in previous versions of this Plan (ERM 2015a, 2016c, 2016d, 2016e, 2018b). The observed average potassium concentration in Leslie Lake during the 2018 under-ice season was also greater than 90% of the water quality benchmark for lakes downstream of the LLCF, thus exceeding the high action level (Figure 2.2-1). The observed concentration in Moose Lake during the 2018 under-ice season was greater than 70% of the benchmark, thus exceeding the medium action level (Figure 2.2-1).

Figure 2.2-1

Under-ice Season Observed Potassium Concentrations in AEMP Lakes, 1994 to 2018

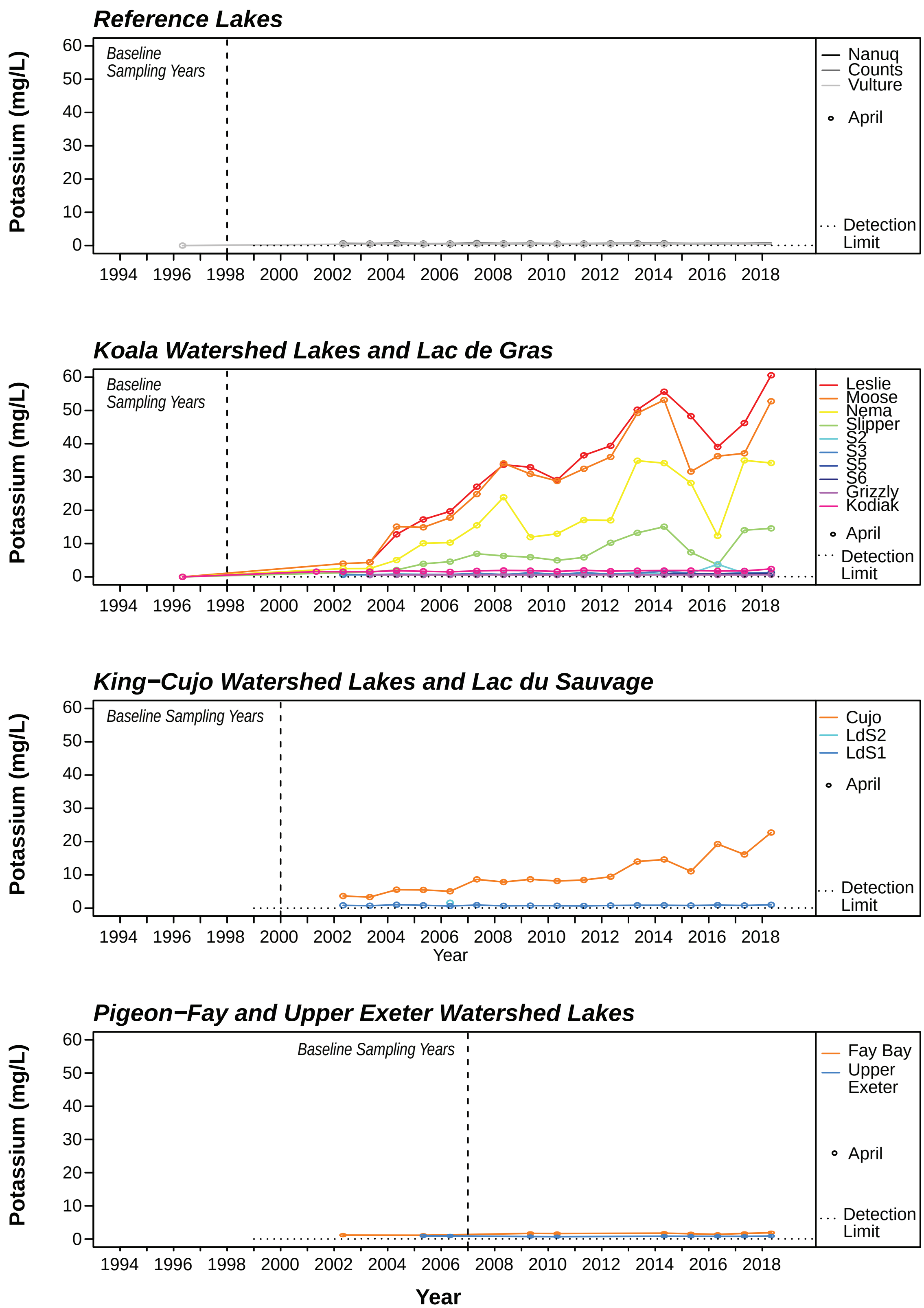
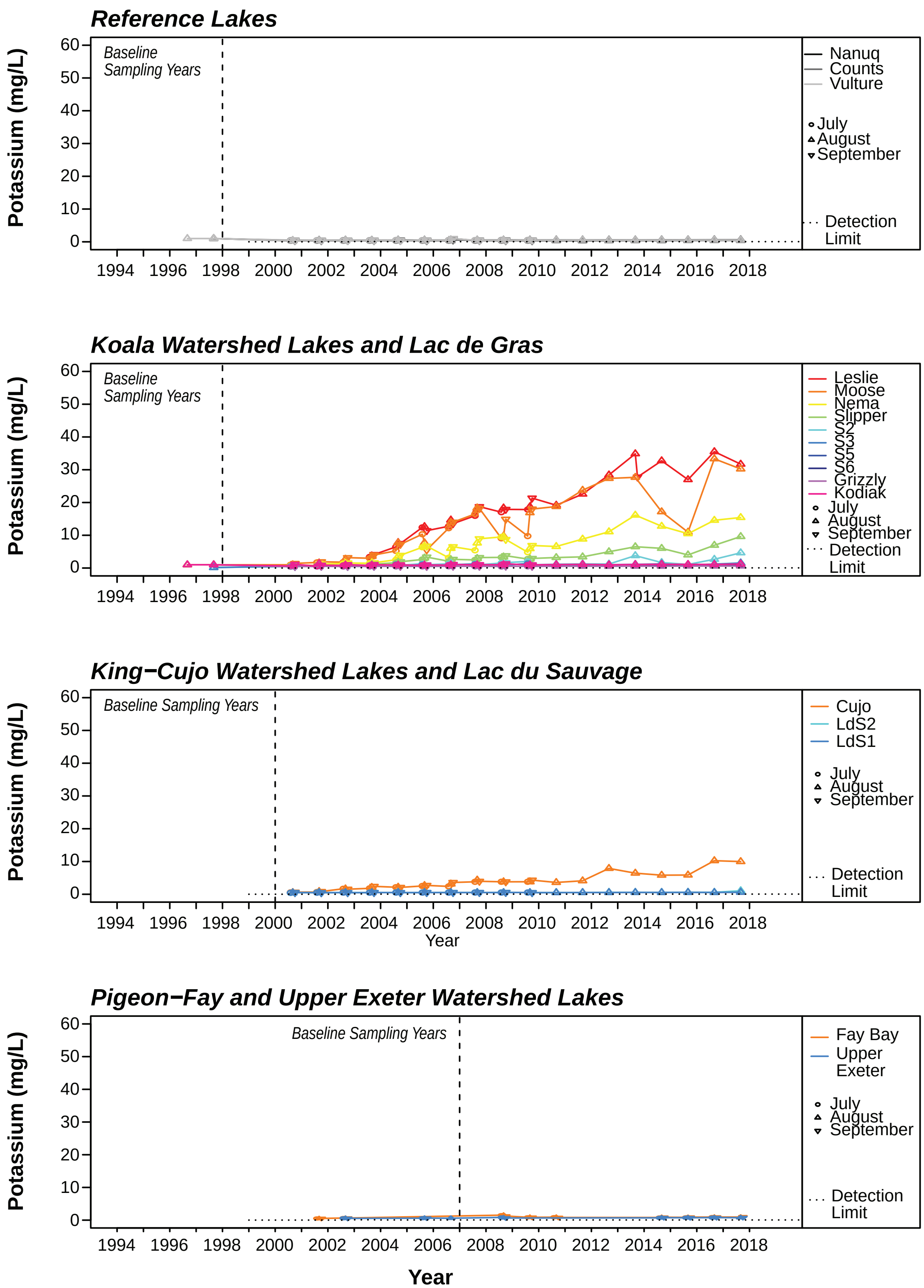


Figure 2.2-2

Open-water Season Observed Potassium Concentrations in AEMP Lakes, 1994 to 2017



A general increase in potassium concentrations has also been observed in Cujo Lake since 2001 (Figures 2.2-1 and 2.2-2; ERM 2018e). The observed average potassium concentration in Cujo Lake during the 2018 under-ice season was, 22.7 mg/L; thus exceeding the low action level (50% of the water quality benchmark of 41 mg/L for lakes not downstream of the LLCF). The 2018 under-ice season is the first year that a low action level exceedance has occurred for Cujo Lake.

2.3 LIKELY CAUSE OF ACTION LEVEL EXCEEDANCE

Discharge from the LLCF to the receiving environment has been identified as the primary cause for elevated potassium concentrations observed in lakes downstream of the LLCF (e.g., Leslie and Moose lakes). The Koala Watershed water quality model indicates that the largest source of potassium to the LLCF both historically and in future is from water released from the Process Plant (ERM 2017). There are also historical and future potassium loadings to the LLCF as water is decanted from Beartooth Pit to manage water levels in the pit. From 2016 to present, there has been a steady increase of potassium in water released from the Process Plant (ERM 2017). Potassium concentrations in water released from the Process Plant approached 200 mg/L in late 2016 and were often greater than 200 mg/L in late 2017 (the average concentration of potassium in water released from the Process Plant in 2017 was 182 mg/L; ERM 2018c). Elevated potassium concentrations were not predicted by historical water quality modelling or apparent following evaluation of historical Process Plant water quality pumped to the LLCF (see also Section 3.1.4). Thus, it was determined that the recent increases could not be identified by a simple mass balance approach. An in-depth investigation of cause was initiated to determine both the source and mechanism of the elevated potassium in the Process Plant. The main objective of the investigation was to examine the historical Process Plant ore and water sources that may have contributed to the elevated potassium concentrations in Process Plant water (ERM 2018c). In addition, the investigation explored how progression in mine development including changes in ore geochemistry (and their relative proportions) over time may contribute to the probable mechanism(s) for the recently observed elevated potassium (see Section 3.1.6).

The likely cause of the elevated potassium concentrations in the Cujo Lake is Discharge from the King Pond Settling Facility (KPSF). The KPSF stores water pumped from the Waste Rock Dam Pond, Desperation Pond, Misery Pit, and Lynx Pit. Average potassium concentrations observed in the KPSF (at Surveillance Network Program station 1616-43) tend to be greater in 2015 to 2017 when compared to historical concentrations (Figure 2.3-1). A similar relationship has also been observed for Cujo Lake, with increases in potassium beginning in 2001 (Figures 2.2-1 and 2.2-2; ERM 2018e). Greater annual Discharge volumes (e.g., 2015) from the KPSF to Cujo Lake also tend to result in elevated potassium concentrations the following April (Figure 2.3-1; monthly Discharge volumes from KPSF include those to Cujo Lake and a small portion used for road watering). The volume of water Discharged from the KPSF in 2017 (399,075 m^3) was greater than average annual Discharge (256,392 m^3 between 2003 and 2017; Figure 2.3-1), which likely resulted in the observed exceedance of the low action level in Cujo Lake during the under-ice period of 2018.

2.4 ECOLOGICAL IMPLICATIONS OF ACTION LEVEL EXCEEDANCE AND RELATION TO SIGNIFICANCE THRESHOLDS

The overarching objective of the ARF (ERM 2018a) for the Ekati Diamond Mine is to provide a tool that will protect the uses of the aquatic receiving environment at the Ekati Diamond Mine. Uses of the aquatic receiving environment include use by people and wildlife for drinking water and fishing, and use by fish and other aquatic life in the receiving waterbodies (ERM 2018a). Significance thresholds were defined in the ARF to protect these identified uses of the aquatic receiving environment (see ERM 2018a). The significance thresholds are considered to be levels of environmental change which, if reached, could result in significant adverse effects.

The significance threshold for water quality is based on an assessment of whether the water is 'unsafe to drink for wildlife and/or humans' (Table 3.3-1 in ERM 2018a). The significance threshold for plankton and benthos, and for fish are relevant to this Plan because elevated potassium concentrations have the potential to alter plankton and/or benthos communities in such a way that 'sufficient food for fish is no longer available' or to result in conditions in which a fish species may become 'unable to survive, grow, or reproduce'. A discussion of the anticipated ecological effects of the identified action level exceedances and their relation to the significance thresholds is provided below for both drinking water quality and aquatic life (plankton, benthos, and fish).

2.4.1 Drinking Water Quality

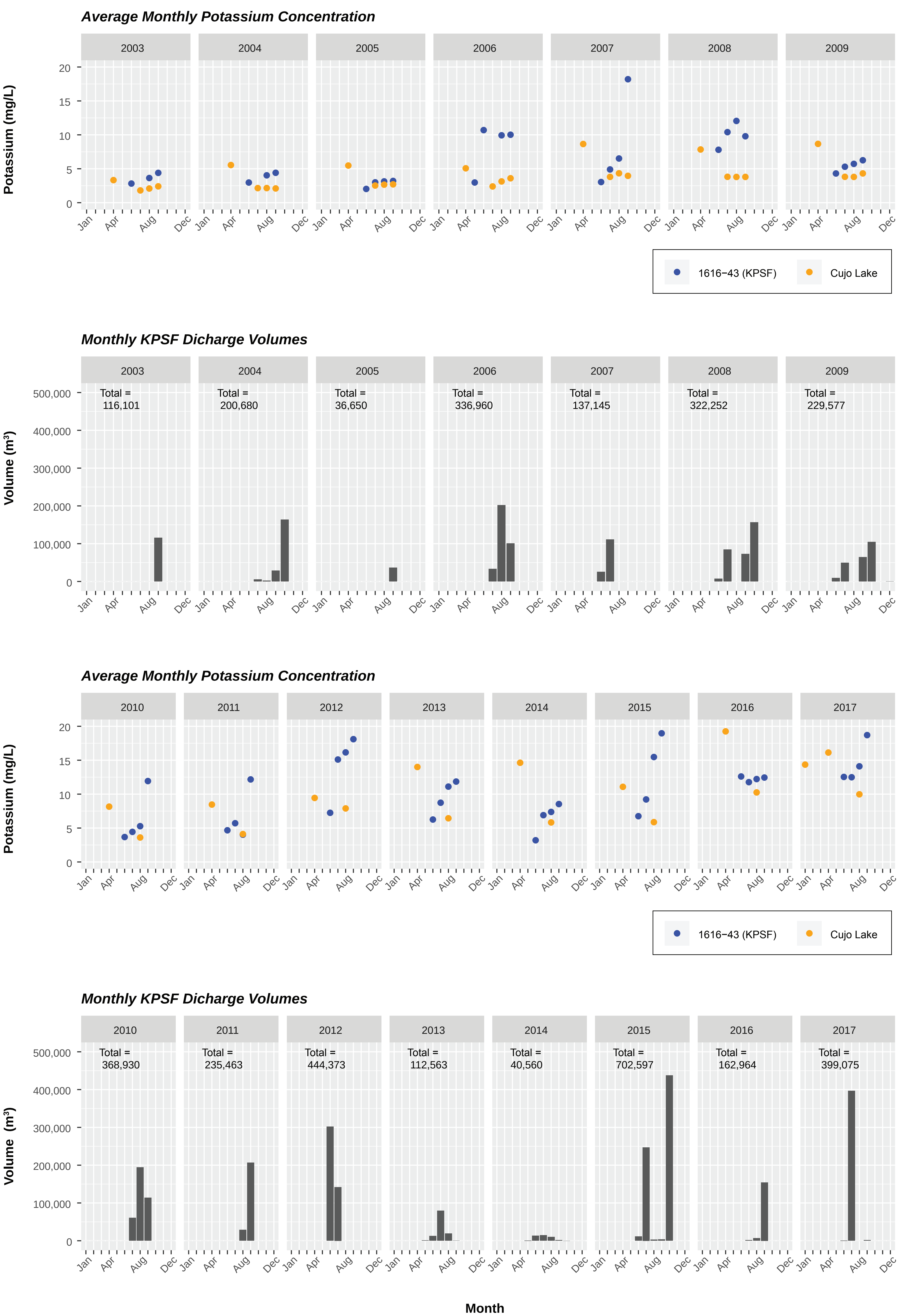
The ARF states that the safety of drinking water for humans is evaluated though comparison to health‑related Canadian drinking water guidelines (i.e., MAC), and the safety of drinking water for wildlife would be evaluated through comparison to CCME guidelines for livestock watering as a surrogate benchmark in the absence of any drinking water guidelines for wildlife (ERM 2017). However, Health Canada has not defined a MAC for potassium in drinking water (Health Canada 2008). There is also no CCME potassium guideline for livestock watering and literature reviews indicated there are no surrogate guidelines for potassium in drinking water for wildlife.

Humans, plants, and animals have an essential requirement for potassium. The recommended daily intake of potassium for adult humans is 4.7 g/day (WHO 2009). Adverse health effects resulting from high levels of potassium intake are rare in healthy humans with normal kidney function because excess potassium is rapidly excreted or would induce vomiting (WHO 2009). Hyperkalemia, defined as potassium concentrations in plasma exceeding 5 mmol/L, can result from acute ingestion of large amounts of potassium but typically only affects persons with impaired kidney function or other medical conditions. In rare cases, hyperkalemia can result in cardiac arrest and death. In adults with normal kidney function, an acute exposure of 78 mg of potassium per kg of body weight (i.e., 5.5 g for a 70 kg adult) could precipitate hyperkalemia (Health Canada 2008).

Assuming that Leslie Lake, the monitored lake with the greatest potassium concentrations, was being used for drinking water during the under-ice season of 2018 when the high action level was exceeded, 91 L of water would have to be ingested at one time to reach this acute exposure limit. Therefore, potassium concentrations in Leslie, Moose, and Cujo lakes are considered to be well below levels at which adverse effects from human consumption may be anticipated.

Figure 2.3-1

Average Monthly Potassium Concentration in the KPSF and Cujo Lake and Monthly Discharge Volumes from KPSF to Cujo Lake, 2003 to 2017



Note: Total volumes reported as Discharges from the KPSF (as reported in the Ekati Diamond Mine Annual Report) and may include Discharges to Cujo Lake and for road watering.

2.4.2 Aquatic Life

Average concentrations of potassium observed during both the under-ice and open-water season have remained below the long-term water quality benchmark of 64 mg/L in all lakes downstream of the LLCF through time. This is also true for the results of each sample collected, including samples collected from deep-depth in Leslie and Moose lakes where concentrations of some water quality variables can be elevated compared to concentrations in the upper portions of the water column. Potassium concentrations equal to or less than 64 mg/L in lakes downstream of the LLCF are not anticipated to result in chronic effects to aquatic life; therefore, no toxicity to aquatic life is anticipated to result from the under-ice potassium concentrations observed in the aquatic receiving environment downstream of the LLCF. The August 2018 average potassium concentration was marginally above the 50% benchmark in Leslie Lake at 32.4 mg/L and less than the 50% benchmark in Moose Lake at 24.9 mg/L (ERM unpublished). Observed potassium concentrations also remain below the most sensitive endpoint included in the derivation of the SSWQO used to establish the water quality benchmark, further supporting this conclusion. The most sensitive endpoint was observed with the amphipod, *Hyalella azteca*, which produced an IC_{10} (concentration estimated to cause a 10% inhibitory effect in the measured sublethal endpoint) of 91 mg/L in site collected water (Appendix A of ERM 2016d).

The potassium water quality benchmark is 41 mg/L for Cujo Lake (and all other monitored lakes not downstream of the LLCF; Rescan 2012). Potassium concentrations in Cujo Lake have remained below the benchmark through time. In addition, the average August 2018 observed potassium concentration in Cujo Lake was less than the 50% benchmark at 9.65 mg/L (ERM unpublished). Thus, the observed potassium concentrations in Cujo Lake, including the observed concentration during the 2018 under-ice season, are not anticipated to result in chronic effects to aquatic life. Observed potassium concentrations also remain below the most sensitive endpoint included in the derivation of the SSWQO for lakes not downstream of the LLCF (Rescan 2012), further supporting this conclusion. The most sensitive endpoint was observed with the water flea, *Daphnia magna*, which produced an IC_{16} (concentration estimated to cause a 16% inhibitory effect in the measured sublethal endpoint) of 53 mg/L (Rescan 2012).

Elevated potassium concentrations also have the potential to affect the composition of phytoplankton, zooplankton, and benthic invertebrate communities if taxa that are more tolerant to elevated potassium levels have a competitive advantage over more sensitive groups. Mine-related changes in the composition of the phytoplankton and zooplankton communities have been observed in Leslie Lake and Moose lakes as well as in other lakes downstream of the LLCF as far as site S2 in Lac de Gras (ERM 2016a, 2018e). To gain a greater understanding of phytoplankton dynamics downstream of the LLCF, the Aquatic Ecology Synthesis (AES) study was conducted as a part of the 2015 AEMP Re-evaluation (ERM 2016b). The AES study identified a pattern in phytoplankton functional composition in lakes downstream of the LLCF. Historical phytoplankton communities were dominated by mixotrophic (may obtain energy via autotrophy and/or heterotrophy depending on surrounding conditions), colonial, and motile (e.g., presence of flagella) taxa. The AES study identified that changes in nutrient availability downstream of the LLCF likely caused the historical phytoplankton community to shift toward a community that was edible (for zooplankton), had a high silica demand, and were non-motile. In recent years the phytoplankton community has begun shifting back toward the functional and community compositions observed historically. For example, in 2016, lakes downstream of the LLCF had high densities of phytoplankton from the class Coccolithophyceae, which were composed of a single mixotrophic and motile species, *Chrysochromulina parva,* while many of the unidentified algae observed were described as "small flagellates", which are often mixotrophic and motile. Further, in 2016 there was a resurgence of Myxophyceae taxa, which are often colonial, and *Ochromonas* spp., which are mixotrophic, motile, and sometimes colonial. In 2017, the relative densities of phytoplankton groups even more closely resembled baseline or early monitoring years (ERM 2018a). Thus, the shift towards historical community and functional composition in lakes downstream of the LLCF is unlikely to be indicative of a negative mine-related effect associated with exposure to potassium.

There have been no mine related changes in phytoplankton densities or community composition observed in Cujo Lake (ERM 2018e). The elevated phytoplankton densities observed in reference and monitored lakes in 2016 did not persist in 2017 (ERM 2018e).

Zooplankton community composition has also demonstrated some changes in lakes downstream from the LLCF, as far as Nema Lake (ERM 2018e). In these lakes, cladocerans (particularly *Holopedium gibberum*) and rotifers (particularly *Conochilus* sp. and *Kellicottia longispina*) have been replaced, to an extent, by copepods. Similar to phytoplankton communities, overall shifts in zooplankton communities are thought to be related to changes in the relative availability of macronutrients because relative densities of consumers with high somatic nitrogen:phosphorus ratios increasing through time and with spatial proximity to the LLCF (e.g., calanoid and cyclopoid copepods; Dobberfuhl and Elser 2000; McCarthy, Donohue, and Irvine 2006).

Zooplankton biomass, density, diversity, and overall community composition have remained relatively stable through time in Cujo Lake. Though no mine effects were detected with respect to zooplankton diversity or community composition, a close examination of zooplankton species compositions suggests that the rotifer *Conochilus* sp. and the cladoceran *H. gibberum*, have been largely absent from Cujo Lake since 2002. A similar trend was observed in lakes downstream of the LLCF. The absence of *H. gibberum* from lakes immediately downstream of the LLCF and KPSF is thought to be related to the observed increase in pH and calcium levels given the species is indicative of low pH and calcium environments (ERM 2018e; Hamilton 1958).

No mine-related changes in benthic invertebrate communities in lakes downstream of the LLCF were observed during the 2017 AEMP (ERM 2018e). However, lake benthos density has increased through time in Cujo Lake, but appears to have remained stable, though elevated, since around 2003. Results of the most recent fish monitoring (large-bodied and small-bodied) programs did not conclude any direct effects to fish that are likely driven by the observed changes in biological community compositions or result of water quality toxicity from exposure to potassium (Rescan 2013, ERM 2016a).

In summary, the potassium concentrations that have been observed downstream of the LLCF and KPSF to date are unlikely to have resulted in negative effects to aquatic life because:

- concentrations remain below the applicable benchmarks and sensitive toxicity thresholds;
- changes in plankton community compositions are most likely related to nutrient availability, pH, and calcium concentrations;

- no mine-related changes in benthic invertebrate communities are observed downstream of the LLCF and increases in benthic invertebrate density in Cujo Lake have been stable since around 2003; and
- the results of the most recent fish monitoring programs also did not conclude any mine-related changes likely to be associated with direct effects to fish from exposure to potassium.

3. RESPONSE ACTIONS

The Plan has been in place since 2015. Previous versions of the Plan have proposed actions to address the low and medium action level exceedances observed prior to 2017. Thus, a number of actions are currently ongoing or have already been completed. Completed and ongoing actions are described in Section 3.1. Section 3.2 describes new actions for the high action level exceedance observed during the winter of 2018 and actions that may be that initiated in response to potential future medium and high action level exceedances.

3.1 COMPLETED AND ONGOING ACTIONS

3.1.1 SSWQO Development – Completed

The short-term and long-term potassium SSWQOs that were originally developed in 2012 were updated in 2015/2016 to provide improved understanding of risks to the aquatic environment stemming from observed and predicted potassium concentrations in the receiving environment downstream of the LLCF (see Appendix A of ERM 2016d). The updated SSWQOs incorporated newly published data and toxicity test results obtained using site-collected water collected from Cell E and Leslie Lake. The updated short- and long-term SSWQOs were calculated at 103 and 64 mg/L, respectively. These updated SSWQOs underwent extensive stakeholder review and the long-term SSWQO of 64 mg/L was accepted by the Board in 2016 as an appropriate water quality benchmark for the protection of aquatic life downstream of the LLCF at the Ekati Diamond Mine (WLWB 2016).

3.1.2 Align Effluent Quality Criteria with Water Quality Benchmark – Completed

In 2018, through the Water Licence Amendment process, Dominion Diamond requested that the maximum average concentration EQC for potassium be amended to directly reflect the 2016 long-term potassium SSWQO (and benchmark for lakes downstream of the LLCF) of 64 mg/L. The EQC for potassium at the time was 41 mg/L, which was the previous water quality benchmark (i.e., established using the previous SSWQO) (Rescan 2012). Dominion Diamond's request was consistent with the Boards' *Water and Effluent Quality Management Policy*, which describes the direct link between receiving environment guidelines/objectives and EQC. The alignment of the EQC with the water quality benchmark for lakes downstream of the LLCF was intended to facilitate clear and consistent interpretation and application of Water Licence requirements and to provide consistency between regulatory requirements, in this instance the Water Licence and this Plan. The alignment would also enable Dominion Diamond to continue its development of potential potassium management approaches with a reasonable level of confidence in the regulatory limits to be achieved. In addition, aligning the benchmark and EQC would allow the operational flexibility for Dominion Diamond to Discharge compliant water to lakes downstream of the LLCF.

On July 11, 2018 the Water Licence W2012L2-0001 was amended to indicate that the Surveillance Network Program (SNP) 1616-30 maximum average concentration EQC for potassium is 53 mg/L and the maximum potassium concentration of any grab sample is 103 mg/L. The value 53 mg/L represents the maximum 95th percentile open-water concentration of potassium resulting from the stochastic modelling from 2018 to 2020 (see http://registry.mvlwb.ca/Documents/W2012L2-0001/W2012L2-0001%20-%20Ekati%20-%20WL%20Amendment%20-%20Potassium%20EQC%20-%20Dominion%20Response%20to%20WLWB%20Information%20Request%20-%20Apr%2023_18.pdf).

The Board determined that there was no need to change the potassium EQC at SNP stations 1616-43 (KPSF) or 1616-27 (Desperation Pond).

3.1.3 Water Quality Monitoring and Reporting – Ongoing

Dominion Diamond regularly monitors potassium concentrations in water at potential point sources to the LLCF and KPSF including the Process Plant, Beartooth Pit, Desperation Sump, and pit sumps. A regular water quality monitoring program is also ongoing within the LLCF and KPSF and their Discharge, both as part of the SNP and as part of Dominion Diamond's internal monitoring processes. Discharge data are screened against EQC and submitted to the Inspector for approval prior to Discharge of water into the receiving environment. During Discharge, water quality is sampled weekly to verify that EQCs defined in the Water Licence are met (water that does not meet the criteria is not Discharged). SNP data are reported and made publicly available on the Board public registry on a monthly basis. A summary of water Discharged to the receiving environment is also reported following each pumping season.

Potassium concentrations are also regularly monitored in the downstream receiving environment. The annual AEMP includes the sampling of downstream lake sites during both the under-ice and open-water seasons and sampling of streams on a monthly basis during the open-water season. The AEMP also monitors aquatic biological communities (plankton, benthos, and fish). An AEMP report is completed and submitted to the Board on March 31 of each year. The report includes an evaluation of potential mine-related changes in potassium concentrations as well as an evaluation of potential changes in biological communities that may be attributed to changes in water chemistry. The AEMP data are then analyzed and presented in a variety of ways on a three-year basis, as part of the AEMP Re-evaluation, to confirm that the AEMP is functioning as intended and that mine effects are being appropriately identified. The next AEMP Re-evaluation report is due to the Board on December 15, 2019. Both the annual AEMP and three-year AEMP re-evaluation reports are reported publicly and circulated for comment and review. The AEMP data are also screened against action levels set in the ARF and exceedances are reported to the Board within 60 days of detection and a Plan is developed and submitted within 90 days of detection. The action levels have been set to allow management actions to be initiated within an adequate timeframe to ensure that a significant adverse environmental effect does not occur.

3.1.4 Water Quality Modelling – Ongoing

The Koala Watershed water quality model was refined in 2015 and 2016 to address low action level exceedances observed for potassium downstream of the LLCF. The model has since been refined, on more than one occasion, to include recent changes to the mine plan, updated model input parameters, and model calibration with recent observed data. The most recent model results were presented in ERM (2017). The ERM (2017) model predictions fit well to the observed potassium data (Figures 3.1-1 and 3.1-2). The model predicts that potassium concentrations downstream of the LLCF will peak in 2019 to 2020 and decline through the remainder of operations. The water quality prediction model for the Koala

Watershed lakes downstream of the LLCF predicts minor short-duration exceedances (e.g., 2019; 64.8 mg/L for three months and 2020; 67.5 mg/L for three months in Leslie Lake) of the benchmark of 64 mg/L for potassium during the under-ice periods of 2019 to 2020 in Leslie Lake (Figure 3.1-1). Potassium predictions for Moose Lake indicate exceedance of the benchmark during the under-ice period of 2020 (Figure 3.1-1). The short-duration predicted exceedances are not anticipated to result in adverse effects (see Section 2.4.2 and see Section 3.2.1). Based on the results of this modelling work, potential adverse effects to aquatic life, humans, and wildlife as a result of future (after 2020) potassium concentrations in the receiving environment are not anticipated.

Potassium concentrations observed in April 2018 in lakes downstream of the LLCF tended to be greater than predicted for the under-ice season of 2018 but remained below the peak predicted concentrations (see Figure 3.1-1 for predicted concentrations). Water quality model predictions inherently contain some level of uncertainty, particularly for future years where model inputs are estimated rather than being based on observed data. Key uncertainties in the Koala Watershed model are discussed in detail in ERM (2017), these include input loads to the LLCF (in particular, Process Plant water quality), chemical reactions or ion exchanges within the LLCF, mixing processes in the LLCF, inter-annual variability in hydrology (e.g., see also Dominion Diamond 2018), and the mine plan. In addition, there is variation in observed ice thickness and Discharge volumes from year to year that can lead to differences between observed and predicted concentrations. In the case of the April 2018 data, the difference between the predicted (see ERM 2017 and Figure 3.1-1) and observed Discharge volumes was likely the largest contributor to the difference between observed and predicted potassium concentrations in Leslie and Moose lakes.

The Koala Watershed water quality model will continue to be refined and used as a tool to improve the understanding of future risks to aquatic environment stemming from observed and predicted potassium concentrations within and upstream of the LLCF and to predict future potassium concentrations within the LLCF to inform Discharge strategies and to assess and evaluate potential mitigation options.

A water quality model update will be completed as part of Dominion Diamond's Water Licence renewal in 2021. Ongoing investigations into potassium at the Ekati Diamond Mine completed as part of this Plan (and future versions) will be included in the model update.

3.1.5 Operational Water Management – Ongoing

In 2017 Dominion Diamond initiated a pumping optimization program aimed at identifying the optimal manner to manage water within the cells of the LLCF and the best Discharge scenario for Discharge of water from the LLCF to Leslie Lake. The program includes development of an operational water management model (OWMM), coupled with a monitoring program. The OWMM complements the use of the Koala Watershed model long-term predictions and uses basic inputs of current climate, water levels, ice, pumping estimates, cell geometries, and water quality to provide estimates of water levels and quality in the LLCF as a daily time step (rather than monthly). A Discharge strategy for 2017 was implemented following the evaluation of the pros and cons to the various options identified. The strategy was designed to maximize Discharge during the freshet period and balance water storage capacity within the LLCF while maintaining compliance with Water Licence W2012L2-0001.

Figure 3.1-1

Observed Potassium and Model Predictions for Lakes Downstream of the LLCF

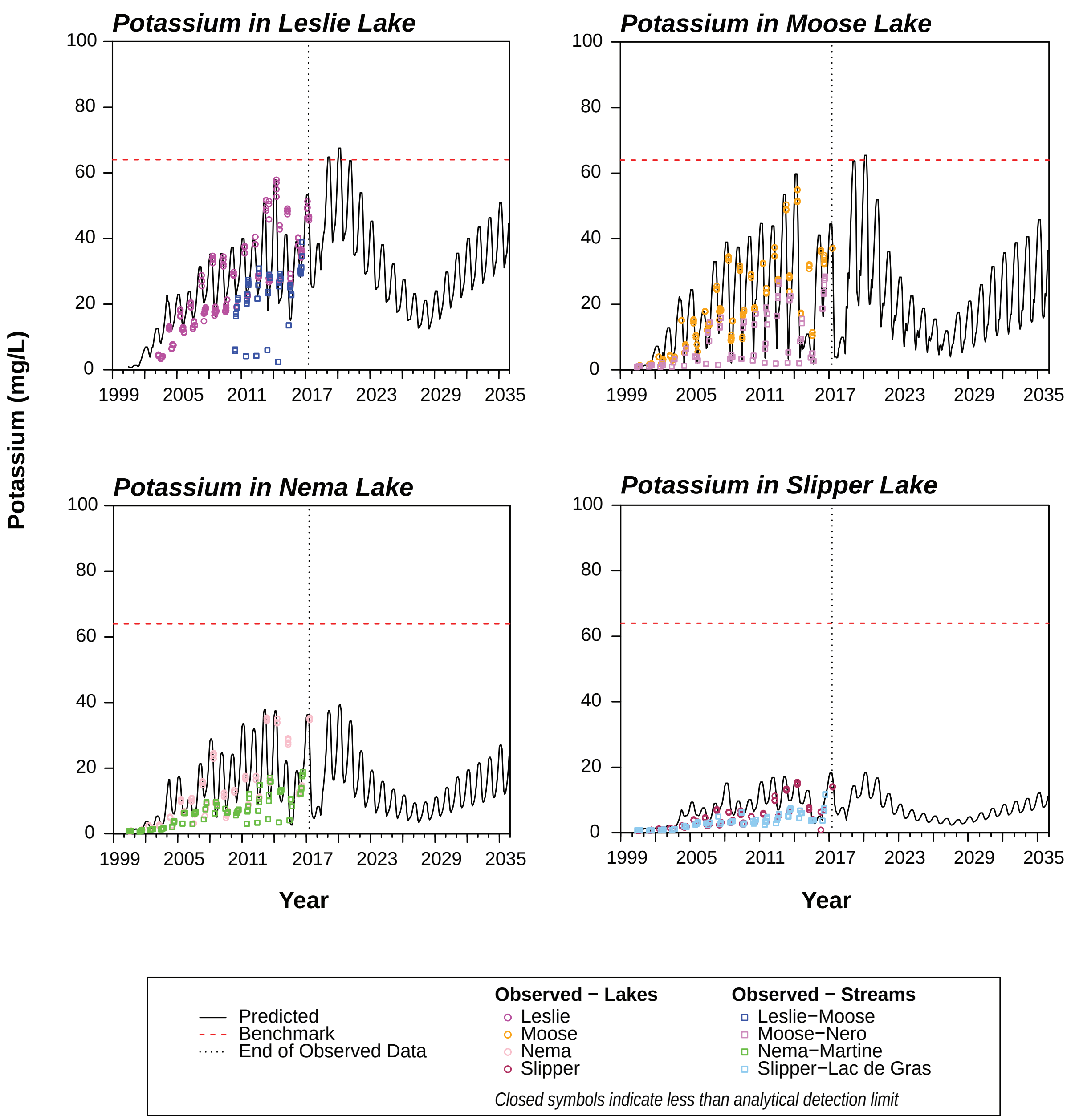
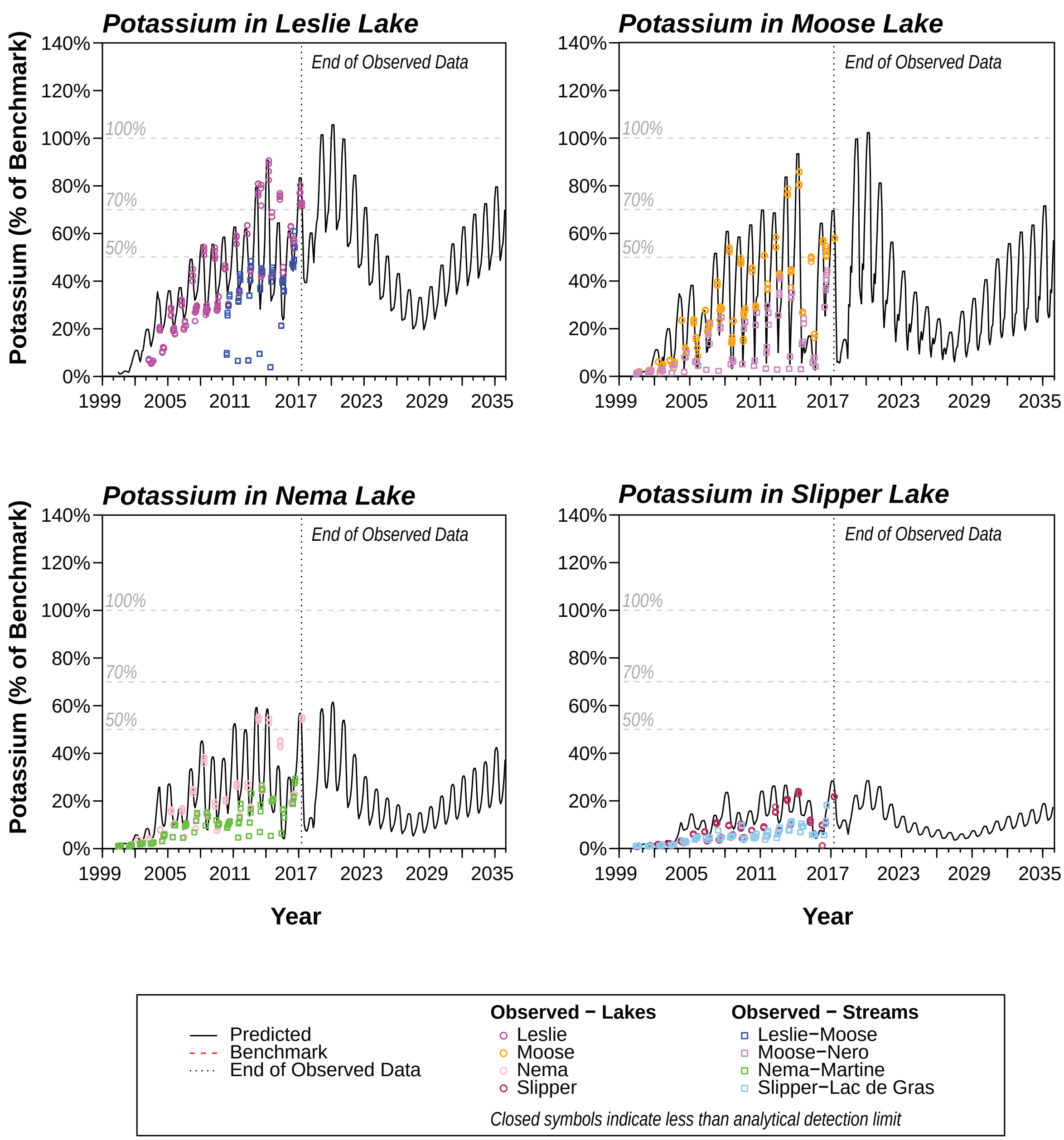


Figure 3.1-2

Observed Potassium and Model Predictions as a Percentage of the Benchmark for Lakes Downstream of the LLCF



With the implementation of the strategy, water quality in the LLCF (cells D and E) and downstream was frequently monitored to track observed concentrations compared to those predicted by the OWMM. The frequent monitoring allowed model calibration and real-time management of the LLCF water levels and volumes Discharged to the downstream environment.

Operational water management was again implemented, beginning in freshet 2018, to optimize the rate and timing of Discharge and mitigate potential effects of potassium release to the receiving environment. The OWMM calibration was refined and the model was updated to produce potential Discharge scenarios while also managing Beartooth Pit water levels (through pumping pit water to Cell C of the LLCF). Based on the results of the potential Discharge scenarios, Dominion Diamond did not Discharge water from the LLCF during the 2018 open-water season. With no water Discharged from the LLCF, the average potassium concentration in Leslie Lake on August 7, 2018 was 32.4 mg/L (average of duplicate bottom, mid-depth, and surface water samples collected as part of the AEMP), which is marginally greater than the 50% benchmark.

3.1.6 Investigation of Cause – Ongoing

The Potassium Mitigation Progress Report (ERM 2018c) provides an overview of the ongoing investigation of the cause of the elevated potassium concentrations in the LLCF and downstream lakes. A preliminary investigation of the ore processed and the corresponding potassium concentrations in process water released from the Process Plant was completed. The results indicated that potassium concentrations observed in water released from the Process Plant in 2016/2017 could not be predicted based on a simple mass balance approach. Thus, a geochemistry program was commissioned to better understand the mechanism for the elevated potassium concentrations in water released from the Process Plant (and LLCF). The initial results of the geochemistry program indicated that cation exchange occurred with the release of potassium ions from the clay minerals in the ore in exchange for calcium ions (ERM 2018c). With the improved understanding of the mechanism(s) resulting in increased potassium concentration in water released from the Process Plant, the source terms for the water quality model were updated to better predict future potassium concentrations in the receiving environment (see ERM 2017). The results of the geochemistry testing also indicated that the source of the observed increased potassium concentrations in water released from the Process Plant is likely associated with the Misery ore mill feed (ERM 2018c).

Beginning in 2018 the ore mix was dominated by Misery ore (with the cessation of underground mining at Koala underground), however, beginning in 2019 it is anticipated that there will be a mixture of Pigeon, Misery, and Sable ores. During this time there is the potential that potassium concentrations could continue to be elevated. After 2020 the Process Plant feed will begin to be dominated by the Sable and Jay kimberlite with smaller proportions of the Misery underground ore. Thus, additional geochemistry testing has been initiated focusing on the Sable, Misery underground, and Jay ores. It is anticipated that the results will advance the understanding of the cation exchange process that is influencing potassium concentrations in water released from the Process Plant and the results will provide a more refined source term for the water quality model update expected as part of Dominion Diamond's Water Licence renewal in 2021.

3.2 PROPOSED RESPONSE ACTIONS

The proposed response actions include two potassium toxicity laboratory studies in addition to monthly under-ice water quality monitoring. As identified in Section 3.1.5 (Operational Water Management) mitigation for the high action level exceedance observed in April 2018 has already been initiated through no LLCF Discharge during the 2018 open-water season. The results of the August 2018 AEMP sampling indicate that average potassium concentration was marginally greater than the 50% benchmark in Leslie Lake (32.4 mg/L) and less than the 50% benchmark in Moose Lake (24.9 mg/L) and in Cujo Lake (9.65 mg/L; ERM unpublished). Dominion Diamond has also identified potential mitigation options and contingency measures (Section 3.2.2) that have been previously detailed in the Potassium Mitigation Progress Report (ERM 2018c).

3.2.1 Potassium Toxicity Laboratory Testing and Under-Ice Water Quality Monitoring

The following proposed actions have or will be initiated in response to the observed concentrations in Leslie and Moose lakes:

Potassium Toxicity Study Design: During the Water Licence Amendment process for the potassium EQC, the Government of Northwest Territories (GNWT)-Environment and Natural Resources (ENR) recommended additional toxicity testing. The results of the additional toxicity testing would provide stakeholders with additional confidence that adverse effects would not be expected if exceedances of the potassium benchmark (64 mg/L) were to occur in the aquatic receiving environment downstream of the LLCF. In response, the Board required that a Potassium Toxicity Study Design report be submitted providing the design of the laboratory testing '*to evaluate the toxicity responses of sensitive species using site water spiked with potassium concentrations at minimum 64 mg/L, 80 mg/L, and 100 mg/L*' (W2012L2-0001 Part H, Condition 37(a)). The Potassium Toxicity Study Design has been submitted as a separate report for review at the same time as this Plan.

Monthly Under-ice Water Quality Sampling: Water quality sampling in Leslie and Moose lakes during the 2018/2019 under-ice season will be completed on a more regular basis than the current AEMP monitoring (i.e., monthly versus April only) to gain a better understanding of the duration of under-ice elevated potassium concentrations.

Sodium-Potassium Investigation: The 2017 Koala Watershed model predictions indicate that while potassium concentrations are expected to increase and stabilize through to 2021 in lakes downstream of the LLCF, the predicted sodium concentrations are expected to decline (ERM 2017). Thus, there was concern that reduced sodium/potassium ratios in lakes downstream of the LLCF may result in less amelioration of potassium toxicity. To address the potential scenario of an observed decrease in sodium concentrations with corresponding increase in potassium, an investigation to evaluate toxicity modifying factors for potassium is proposed. The investigation will examine toxicity of potassium under different sodium concentrations and water hardness (also shown to modify the toxicity of other major ions, such as chloride and sulphate) that occur spatially and are predicted to occur through to the end of mine operations at the Ekati Diamond Mine. Separate toxicity tests would be conducted using two invertebrates (*Ceriodaphnia dubia, Hyalella azteca)*, fish (*Pimephales promelas*), and green alga (*Pseudokirchneriella subcapitata*). The test waters would be prepared in the laboratory by reconstitution of salts in order to achieve an ionic balance that is comparable to that observed in the Ekati Diamond Mine aquatic receiving environments. Once the base water is prepared, the target concentrations of sodium or water hardness, and potassium will be prepared for testing each of the study species. Tests will each be conducted according to standard Environment Canada (2007a, 2007b, 2011) and ECCC (2017) methods.

The results of the additional toxicity testing in combination with results of under-ice potassium concentrations may be used in the discussion of potential ecological implications of action level exceedance in future plans. In addition, the results may inform future operational water management to optimize water Discharged from the LLCF while minimizing potential effects to sensitive species in downstream lakes. It is anticipated that the results of the sodium-potassium investigation will inform future versions of the Plan in discussion of the ecological implications of action level exceedance. A review of the both the SSWQO (41 mg/L) and updated SSWQO for lakes downstream of the LLCF (64 mg/L) may be warranted dependent on the results of the sodium-potassium testing.

3.2.2 Potassium Mitigation Options and Contingency Measures

3.2.2.1 Alternate Water Source

Geochemical studies have shown that ion-exchange processes occurring in the Process Plant result in elevated potassium concentrations, with calcium (and magnesium) ions in the Process Plant water exchanging with potassium ions on the fine processed kimberlite solids. At present, reclaim water for the Process Plant is sourced from Cell D of the LLCF. The use of an alternate, freshwater source for the Process Plant with the goal of either reducing the ion-exchange in the Process Plant or diluting the resultant potassium concentrations was considered. However, as identified in ERM (2018c) there are a number of technical aspects that suggest an alternate water source would not provide any reduction in potassium concentrations in the LLCF or the downstream receiving environment.

This option would also likely have negative environmental effects to both the freshwater source and the downstream aquatic receiving environment. The Process Plant requires a substantial volume of water (approximately 2.4 Mm^3/year). Currently, a large proportion of the water required by the Process Plant is reclaimed from the LLCF. Thus, switching to a freshwater source would require a substantial increase in the amount of freshwater withdrawn from the area surrounding the Ekati Diamond Mine (likely Upper Exeter Lake) as well as a substantial increase in Discharge from the LLCF.

In addition, the water demand (2.4 Mm^3/year) is 12 times greater than current Water Licence freshwater use limits for Grizzly Lake. Consequently, the implementation of using a new freshwater source for the Process Plant would require a Water Licence Amendment to include a new freshwater source and associated freshwater use limits.

Use of an alternate water source for the Process Plant will not be used as a potential mitigation option but will continue to be included as a potential contingency option. However, this contingency option is not expected to be required because the option for operational water management, with use of Panda and Koala pits for additional water storage, will be effective in controlling future potassium concentrations.

3.2.2.2 Additional Water Storage

Koala Watershed minewater is currently stored in the LLCF and in Beartooth Pit. At the time of the Plan, Version 1.4 development, Dominion Diamond indicated their plans to investigate the capacity for additional water storage in the LLCF through examination and optimization of the current process kimberlite deposition plan. The Wastewater and Processed Kimberlite Management Plan (Version 7.0; Dominion Diamond 2017) now outlines the currently approved site-wide management plan for minewater and processed kimberlite. The current minewater management plan, which incorporates the Jay project and the use of Panda and Koala pits as storage for fine processed kimberlite and minewater beginning in 2020, is also reflected in the most recent Koala Watershed water quality model (ERM 2017). Once fine processed kimberlite and Process Plant water is deposited in Panda and Koala pits, potassium concentrations in the LLCF are predicted to decline with minimal amounts of further minewater loadings to the facility (e.g., sump water) and water quality is able to improve through dilution with natural runoff.

Given that the water quality predictions indicate that the exceedance of the benchmark will likely occur in the downstream environment in the short-term (i.e., 2019 and 2020), additional water storage options (outside of the LLCF such as the use of mined out pits) have not been the focus for mitigation options. However, this mitigation option may be investigated fully should the need for additional water storage be required in the future.

3.2.2.3 Water Treatment

Water treatment provides a high level of certainty with respect to constituent removal from minewater. Technologies for the Ekati Diamond Mine have been reviewed as part of the Potassium Mitigation Progress Report (ERM 2018c). However, these treatment technologies require substantial power (electricity) for operation and they also could create new environmental risks and liabilities at the mine (e.g., one of the by-products of water treatment is a highly saline brine solution that would require management and safe disposal; and the substantial power for operation of a treatment facility requires haulage, handling, and burning of diesel fuel on site). From a regulatory perspective, the introduction of a water treatment system on site would likely receive strong regulatory support in concept. However, there would likely be an amendment process required under the Water Licence and possibly a surface lease amendment and/or Land Use Permit required to facilitate site changes to accommodate the associated management issues that would be part of such a system. Information provided through the Water Licence Amendment process indicated that Discharge can occur without being treated and remain appropriately protective of the receiving environment. Therefore, on this basis alone, water treatment is not currently considered a reasonable option but a continued contingency option.

4. SCHEDULE AND RECOMMENDED NEXT STEPS

It is recommended that the ongoing actions described in Section 3.1 be continued and actions proposed in Section 3.2.1 proceed (following regulator review in the case of the Potassium Toxicity Study Design). The mitigation and contingency measures identified as proposed actions in Section 3.2.2 will be again evaluated should a medium or high action level be triggered or the results of potassium toxicity testing and investigation of cause alter the understanding of the source(s) and mechanism(s) of change in potassium concentrations or potassium toxicity within and downstream of the LLCF.

The need for future updates to the Plan will be considered on a case-by-case basis, if an action level is exceeded in future AEMP monitoring periods. The results of the sodium-potassium investigation and the implications for potassium management will be submitted with the 2019 AEMP Annual Report. Exceedance of approved action levels will continue to be reported to the Board within 60 days of detection, as described in the ARF, Version 3.0 (ERM 2018a).

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