Review Comment Table

Board:	WLWB
Review Item:	Ekati - 2018 Aquatic Effects Monitoring Program (AEMP) Annual Report (W2012L2-0001)
File(s):	W2012L2-0001
Proponent:	Diavik Diamond Mines (2012) Inc.
Document(s):	Summary Report 4.6 MB Part 1 - Evaluation of Effects (1 of 2) 17 MB Part 1 - Evaluation of Effects (2 of 2) 13 MB Part 2 - Data Report (1 of 4) 19 MB Part 2 - Data Report (2 of 4) 20 MB Part 2 - Data Report (3 of 4) 18 MB Part 2 - Data Report (4 of 4) 21 MB Part 3 - Statistical Report 23 MB Data Files (excel) 2 MB
Item For Review Distributed On:	May 16 at 15:25 Distribution List
Reviewer Comments Due By:	July 8, 2019
Proponent Responses Due By:	Sep 6, 2019
Item Description:	On March 29, 2019, Dominion Diamond Mine ULC (Dominion) submitted its 2018 Aquatic Effects Monitoring Program (AEMP) Annual Report (the Report) to the Wek'éezhii Land and Water Board for approval, in accordance with Part J, Condition 7 of Water Licence W2012L2-0001. The Report consists of several parts: Summary Report, Evaluation of Effects (Part 1), Data Report (Part 2), and Statistical Report (Part 3). Additionally, Dominion has provided tabular data in excel format, in response to the Board's January 25, 2018 Direction. Please note that on March 27, 2019, Dominion provided notification that the approved Medium Action Level for total phosphorus had been exceeded in Cujo Lake during the 2018 open-water season. Part J, Condition 8(a) requires Dominion notify the Board within 60 days of when the exceedance is detected. The Notification states that this exceedance was determined during the preparation of the 2018 AEMP Report and has outlined its planned next steps.

	Reviewers are invited to submit comments and recommendations using the Online Review System (ORS) by the review comment deadline specified below. If reviewers seek clarification on the submission, they are encouraged to correspond directly with the proponent prior to submitting comments and recommendations. If reviewers do, however, submit questions or are seeking clarification, they are asked to provide specific recommendations on how the Board should consider the proponent's response in their decision. Reviewers may also wish to consider providing an overarching recommendation regarding whether the Board should approve the submission, to provide context for the comments and recommendations and assist the Board with its decision. All documents that have been uploaded to this review are also available on our public Registry. If you have any questions or comments about the ORS or this review, please contact Board staff identified below. ***Please note that on June 10, 2019 the review deadlines were extended (Review Deadline: Extended from June 27 to July 4; Proponent Deadline: Extended from to July 11 to July 18) to ensure all Parties have an opportunity to consider the notification of biological action level exceedances and associated rationale.*** ***On July 15, 2019, Dominion submitted a request to extend the proponent response deadline. On July 18, 2019, the proponent response deadline was extended to September 6, 2019.***
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Comment Summary

Environment and Climate Change Canada: Russell Wykes			
ID	**Topic**	**Reviewer Comment/Recommendation**	**Proponent Response**
4	General File	**Comment** ECCC Cover Letter **Recommendation**	
1	2018 Summary Report Overall	**Comment** The results of selenium concentrations in multiple variables (water quality, sediment quality, and fish tissue) support the potential for a mine-related effect on the environment from the discharge of effluent from the Long Lake Containment Facility (LLCF). While these impacts are discussed individually, there is no synthesis or analysis completed on the potential implications of these results collectively. ECCC acknowledges that in response to Decision #3 of the Board's Reasons for Decision on the 2017 AEMP Annual Report regarding selenium analysis that the Proponent has deferred additional investigation to the AEMP Re-evaluation process due in December 2019. ECCC agrees that an integrative analysis of the selenium in all monitoring components is necessary to fully assess potential impacts from selenium to the receiving environment. **Recommendation** N/A	**Sep 5:** N/A
2	2018 Summary Report Selenium in fish tissues	**Comment** The report indicates that mine-related impacts on fish tissue selenium concentrations have been found within the Koala Watershed and that these impacts are attributed to the LLCF. Mine-related changes include, "increase in selenium concentration in Lake Trout muscle, Round Whitefish muscle, and Slimy Sculpin wholebody tissues in lakes downstream of the LLCF as far as Nema Lake,	**Sep 5:** The US EPA provides guidelines for selenium in both muscle (8.5 mg/kg dwt) and egg/ovary (11.3 mg/kg dwt) elements. While the egg/ovary element supersedes the muscle element when egg/ovary concentrations are available, both elements are considered protective against chronic selenium effects. The current AEMP sampling design (20 individuals total, including mature males and females, and

		increase in selenium concentration in Round Whitefish liver tissue in lakes downstream of the LLCF as far as Slipper Lake,and with increasing influence ofthe LLCF in all fish tissues." Based on these results it may be warranted to include collection of egg-ovary tissue samples in future sampling to further understand potential selenium toxicity in the receiving environment. Since selenium is transferred to the eggs during vitellogenesis and is often higher in concentration than muscle tissue, this method of sampling and analysis provides the most accurate data to assess the potential selenium hazard to reproduction and toxicity to offspring. **Recommendation** ECCC recommends the Proponent provide a discussion on the potential applicability/usefulness of collection of egg-ovary tissue samples during future fish sampling years to further inform potential selenium toxicity to fish in the receiving environment.	immature fish) does not allow for a representative measure of selenium concentrations in ovaries of the mature female proportion of the population in each lake. Monitoring concentrations in Round Whitefish female ovaries would likely require increased sample sizes in order for ovary selenium concentrations to be representative of the population in each lake. Increasing the number of samples is not desired or planned in order to maintain minimal impacts on Round Whitefish populations (see response to WLWB comment #4) and because the muscle element guideline is already protective against chronic selenium effects.
3	2018 Summary Report - Section 4 Part 1 - Evaluation of Effects - Sections 3.3.5.3	**Comment** The summary report identifies several potential mine-related changes that were identified for four biological fish variables, inluding: 1) decrease in Slimy Sculpin catch per unit effort (CPUE) in Leslie, Moose, and Slipper lakes and with increasing influence of the LLCF 2)decrease in Lake Trout condition with increasing influence of the LLCF 3) decrease in Round Whitefish egg count with proximity to mine infrastructure 4) increase in Round Whitefish internal parasites in Slipper Lake and in Round Whitefish external parasites in Nema and Slipper lakes. While ECCC acknowledges that these are not confirmed mine-related effects and that future sampling will further inform these trends, no	**Sep 5:** A potential mine-related effect is concluded when there appears to be a trend in the data or there is a significant statistical result but when the evidence is insufficient or when there is contradicting evidence that prevents the conclusion of a mine-related effect. A lack of baseline data, natural variation among lakes, and/or naturally high variability in the variable of interest are the largest contributors where there is this type of uncertainty in the conclusions. Allowing for the conclusion of a potential mine-related effect in such cases is a conservative approach, and should be viewed as a way to consider variables in the context of a previously observed potential mine-related effect in future AEMP monitoring and results. However, a

		analysis is provided on what other factors may contribute to the results, nor is there any interpretation on the potential implications of these results when taken together. **Recommendation** ECCC recommends the Proponent provide a discussion on potential factors that could contribute to the observed results in biological fish variables. This should include a discussion/analysis of the linkages between the different biological effects.	potential mine-related effect is not equivalent to a mine-related effect, and is also not equivalent to a negative effect with ecological significance. For variables where a mine-related effect is concluded, the low Action Level is exceeded and a Response Plan is developed under the Aquatic Response Framework. The Response Plan addresses questions such as the likely causes of mine-related effects and the ecological significance of these effects. Until a mine-related effect is concluded based on the evidence provided by the AEMP data, it is not necessary to speculate on these topics. When only potential mine-related effects are concluded for biological variables, rationale is given to explain why such a conclusion was reached in the respective sections of the 2018 AEMP Evaluation of Effects Report. Specifically, for the above-mentioned biological effects: Slimy Sculpin CPUE: “Nanuq Lake (reference lake) showed a general increase in Slimy Sculpin electrofishing CPUE from 2007 to 2018, while reference lakes Counts and Vulture and monitored lakes Leslie, Moose, and Slipper showed a general decrease (Table 3.3-20; Figure 3.3-35).” Thus, the temporal trend in monitored lakes Leslie, Moose and Slipper did not differ from reference lakes Counts and Vulture. “No baseline electrofishing CPUE data for Slimy Sculpin are available, so it is unclear whether the spatial trend observed is related to mining activities or is the result of natural variation. Graphical analysis suggests that this spatial trend was not present in 2007 [i.e., the first year of Slimy Sculpin sampling], was first detected in 2012, and persisted in 2015 and 2018 (Figure 3.3-35).” Lake Trout condition: “While spatial trends were not significant, graphical assessment suggests a potential emerging trend of decreasing

			condition with increasing influence of the LLCF in 2012 and 2018. While results suggest a potential mine-related effect on Lake Trout condition in lakes downstream of the LLCF, high within-lake variability makes any influence from mine-related activities unclear." Round Whitefish egg counts: "Spatial trend analyses indicate that there was no significant correlation between mean Round Whitefish egg count and the influence of the LLCF, but a significant correlation was found with general distance to mine infrastructure (Table 3.3-38; Figure 3.3-72) where mean egg count showed a decrease with proximity to mine infrastructure. No baseline data for Round Whitefish egg count are available. Without baseline data, it is difficult to determine if this spatial trend was present before mining operations started, and thus to determine if it reflects natural variation among lakes. It is therefore unclear if the statistically detected decrease of mean Round Whitefish egg count with proximity to mine infrastructure is related to mine activities." Round Whitefish parasites: "No baseline data for internal parasite [or external] infection in Round Whitefish are available and it is unclear if reference lakes have always had lower rates of internal parasitism compared to lakes in the Koala Watershed. It is therefore also unclear if the difference in variability in the proportion of Round Whitefish infected by internal parasites between reference and monitored lakes is related to mine activity or natural variation among lakes. Other variables that can influence the prevalence and/or intensity of infection in a fish host population, depending on the species and life cycle of specific parasites, include fish population density, bird population density, the presence or absence of

			alternate hosts, the presence or absence of bird attractors other than fish, the age and size structure of the fish population, the susceptibility of fish to infection, and environmental factors that may influence fish susceptibility to infection.”
Fisheries and Oceans Canada: Dan Coombs			
ID	**Topic**	**Reviewer Comment/Recommendation**	**Proponent Response**
1	Summary Report Page 4-7: Potential mine-related changes were identified for four biological fish variables and two fish tissue metals in 2018: ? decrease in Slimy Sculpin catch per unit effort (CPUE) in Leslie, Moose, and Slipper lakes and with increasing influence of the LLCF; ? decrease in Lake Tr	**Comment** Dominion has reported several 'potential mine related changes' that may be negatively impacting fish and fish productivity related to the Long Lake Containment Facility (LLCF)(page 4-7). DFO notes in particular, Dominions reported trends of lower CPUE of slimy sculpin, decrease of lake trout condition and round whitefish egg count(s), which may result in/ be considered unauthorized serious harm to fish. DFO further notes that high levels of selenium has the potential to affect egg development and the reproductive potential of fishes (Lemly AD. 1997. A teratogenic deformity index for evaluating impacts of selenium on fish populations. Ecotoxicol Environ Saf 37:259–266.). As such, DFO will work with other federal regulators and the proponent to fully assess the potential levels of impact(s) as a result of the LLCF to the Koala and Lac de Gras watershed. **Recommendation** DFO recommends that the Proponent provide further information / assessment respecting the potential scale of effects/ impacts to fish (productivity/ populations?) on the downstream environment as as result of the LLCF. Information should further explain the spatial disturbution of effects the Koala and Lac de Gras watershed, and	**Sep 5:** The evaluation of all fish variables to determine whether a change is significant and if a change is mine-related is based in concert on statistical results, graphical analysis, and best professional judgement. The three hypotheses progressively tested to support the conclusion of mine-related effects are: 1. Do individual lakes show evidence of change over time (i.e., is there a temporal trend within lakes)? 2. Do temporal trends differ among lakes (i.e., are monitored lakes different from reference lakes)? 3. Is there a spatial relationship to differences among lakes (i.e., is the distance to mining activity associated with any variation in fish variables)? Concluding a mine-related effect for a particular variable is not equivalent to concluding a negative effect with ecological significance, and does not mean that serious harm (“the death of fish or any permanent alteration to, or destruction of, fish habitat”) has occurred. There is a difference between a mine-related trend and an effect with ecological significance. When a change in a fish variable is concluded to be mine-related, Action Levels are triggered within the Aquatic Response Framework, such that significant adverse impacts (i.e., serious harm to fish) do not occur. A potential mine-related effect is concluded when there appears to be a trend in the

		define statements such as "proximity to mine infrastructre".	data or there is a significant statistical result but when the evidence is insufficient or when there is contradicting evidence that prevents the conclusion of a mine-related effect. A lack of baseline data, natural variation among lakes, and/or naturally high variability in the variable of interest are the largest contributors where there is this type of uncertainty in the conclusions. Allowing for the conclusion of a potential mine-related effect in such cases is a conservative approach, and should be viewed as a way to consider variables in the context of a previously observed potential mine-related effect in future AEMP monitoring and results. Therefore, a potential mine-related effect is not equivalent to a mine-related effect on the biological variables associated with DFO's comment, and therefore also not equivalent to serious harm. Selenium was identified as a mine-related effect and as such, Action Levels were triggered through the Aquatic Response Framework. A Fish Response Plan is being revised to address this issue and actions will be developed to protect against adverse effects on fish and fish populations. Spatial relationships (hypothesis 3 above), are assessed based on three measures: concentration factors, the general distance to the mine, and the distance to an active haul road (for EROD only). The statement "proximity to mine infrastructure" relates to the general distance to the mine and is defined as follows (2018 AEMP Statistical Report, Section 1.1.1.2): "General distance to the mine is based on ranking the measured linear distance between each lake and the nearest major mine infrastructure including pits, Waste Rock Storage Areas (WRSAs), camps, processing facilities, and the LLCF (Table 1.2-4). Higher ranked sites are considered closer

			to the mine. The rank order for general distance to the mine site was (from nearest to furthest): Kodiak Lake, Nema Lake, Leslie Lake, Moose Lake, Vulture Lake, Slipper Lake, Counts Lake, and Nanuq Lake. By ranking lakes by general distance to the mine, all potential mine-mediated effects (e.g., aerial, ground water seepage, and general site impact) are integrated and can be considered in the spatial analysis."
GNWT - ENR: Central Email GNWT			
ID	**Topic**	**Reviewer Comment/Recommendation**	**Proponent Response**
3	General File	**Comment** ENR Letter with Comments and Recommendations **Recommendation**	
1	Topic 1: Phosphorus Benchmark Exceedances	**Comment** As noted in the Summary Report, and in Section 4.2.3.11 of the Evaluation of Effects, Dominion has committed to the collection of monthly samples in the open water season of 2019 according to the Response Plan for Total Phosphorus (Version 1.3) methods to confirm benchmark exceedances for total phosphorus (low action level). Regarding low action level exceedances, Dominion has stated in the Total Phosphorus Response Plan that: "Dominion Diamond will collect water samples approximately monthly during the open-water season (mid-late June through early October) at the AEMP sampling location using the same frequency and replication employed for the August (AEMP) sampling (2 replicates per depth x 2 or 3 depths - depending on the lake). Dominion Diamond will conduct this sampling four to five times throughout the open-water season to meet the sample size recommended by Clark and Hutchinson (1992) and Clark et al.	**Sep 5:** In 2019, Dominion is conducting monthly sampling for total phosphorus in Cujo Lake only during the open-water season. The purpose of the additional sampling is to confirm a medium Action Level exceedance in Cujo Lake, not to assess mine-related effects. Environment Canada (2004) states: "In view of the variability in [total phosphorus] concentration, it is important that an appropriate number of samples be collected to accurately reflect [total phosphorus] concentrations in a system." As one option, Environment Canada (2004) recommends obtaining a mean of several samples collected during the open-water season. Clark and Hutchinson (1992) and Clark et al. (2010) recommend a sample size of four to five (i.e., monthly samples) to obtain the open-water mean. As outlined in the approved Total Phosphorus Response Plan Version 1.3, Dominion has followed this guidance. Monthly sampling will not be conducted in Nanuq Lake (reference lake) or Lac du Sauvage because Action

		(2010)“ (Section 3.3 of the Ekati - AEMP - Phosphorus Response Plan - Version 1.3). While ENR supports this response to address low action level exceedances, ENR is seeking clarity on how the intensive sampling for all open water months in 2019 will be used to confirm or reject benchmark exceedances. Specifically, how will Dominion report means and final phosphorus concentrations based on the samples collected in 2019 (i.e., will samples be recorded and analyzed monthly, or will all be averaged for a 2019 open water value?). Furthermore, will Dominion only apply the intensive phosphorus sampling program in Cujo Lake and Nanuq Lake where the exceedances were recorded, or will the sampling frequency be applied to all sites within the King-Cujo Watershed and Lac du Sauvage? To ensure that any potential conclusion regarding mine effects is correct, ENR is of the opinion that the sampling program should be applied to all sites within the King-Cujo Watershed and Lac du Sauvage for the confirmation sampling program of the 2019 open water season. **Recommendation** 1) ENR recommends that during the open water season for 2019 that Dominion collect monthly total phosphorus samples for all sampling locations in the King-Cujo Watershed and Lac du Sauvage. Sampling methods and analysis should follow the methods outlined in the Response Plan for Total Phosphorus, Version 1.3 and reported in the 2019 AEMP Report.	Levels were not exceeded in these lakes. The potential for changes in total phosphorus concentrations in these lakes, and all other AEMP lakes, are monitored via sampling conducted in April and August of each year as part of the AEMP. No change in total phosphorus concentrations have been observed in these lakes over the course of the AEMP. Because no change to Total Phosphorus has been seen in any of the other lakes in the King-Cujo watershed, no changes to the Total Phosphorus Response Plan are warranted. Additionally, Dominion would like to remind ENR that changes to the AEMP Design Plan should only be made during the AEMP Re-evaluation, unless warranted by legitimate concerns for impacts to the Receiving Environment. Even then, the Aquatic Response Framework and its associated Response Plans are intended to investigate and describe the ecological significance of changes in the Receiving Environment. Whereas the AEMP is designed and intended to identify changes in the Receiving Environment. Clark, B., N.J. Hutchinson. 1992. Measuring the trophic status of lakes: Sampling protocols. Ontario Ministry of Environment and Energy. ISBN 0-7778-0387-9, 36 p. Clark B.J., A. M. Paterson , A. Jeziorski, S. Kelsey. 2010. Assessing variability in total phosphorus measurements in Ontario lakes. Lake and Reservoir Management. 26:1. 63-72. DOI: 10.1080/07438141003712139. Environment Canada. 2004. Canadian Guidance Framework for the Management of Phosphorus in Freshwater Systems. Ecosystem Health: Science-based Solutions Report No. 1–8. National Guidelines and Standards Office, Water Policy and Coordination Directorate, Environment Canada.

2	None	**Comment** None **Recommendation** 2) ENR recommends Dominion clarify how means and final phosphorus concentrations based on the samples collected in 2019 will be analyzed and reported in the 2019 AEMP Report to confirm benchmark exceedances.	**Sep 5:** Samples collected during 2019 will be analyzed by the same methods and approved analytical detection limits used for the AEMP. The mean total phosphorus concentration of all samples collected in Cujo Lake during the 2019 open-water season will be compared to the medium Action Level as indicated in the approved Total Phosphorus Response Plan, Version 1.3. If a medium Action Level exceedance is confirmed, the exceedance will be reported to the Board within 60 days of detection as required by Dominion's Water Licence (W2012L2-0001). The analysis will not be reported as part of the AEMP.
Independent Environmental Monitoring Agency: Marc Casas			
ID	**Topic**	**Reviewer Comment/Recommendation**	**Proponent Response**
1	General File	**Comment** IEMA comments on 2018 AEMP Annual Report **Recommendation**	
2	Metals in fish - Mercury	**Comment** In Kodiak Lake trout muscle, mean mercury levels have exceeded Health Canada guideline for human consumption. Seven fish of 20 sampled exceeded the guideline in Kodiak Lake, up from one fish in 30 sampled between 2002 and 2012 (a 30 yr-old in 2007). This represents the first time that an impacted lake (Kodiak) has been reported to have trout mean mercury levels (0.518 mg/kg) above Health Canada guideline for human consumption (0.500 mg/kg). Of note, the high mercury body burdens were not confined to older trout as is usually the case, since mercury levels accumulate in the body overtime. Five younger fish aged 6 to 8 years old were found to be at or above Health Canada guidelines. In lakes with non-toxic levels of mercury,	**Sep 5:** The analysis of mercury concentrations in fish tissues in the 2018 AEMP concluded a mine-related effect for Round Whitefish muscle and liver, resulting in a low Action Level (LAL) exceedance under the Aquatic Response Framework (ARF) and triggering the inclusion of fish tissue mercury in the Fish Response Plan (FRP). Further investigation of mercury, including the potential source of mercury contamination in fish in Kodiak Lake, will be undertaken through the ARF process rather than as part of the AEMP. An updated FRP, that includes assessment of mercury in fish tissues, likely cause of Action Level exceedance, and ecological implications of Action Level exceedance will be submitted to the Board in October 2019. Although mercury concentrations in fish tissues that exceeded

		juvenile and young adult fish normally haven't lived long enough to accumulate the amount of mercury necessary to push their mercury levels above the levels considered hazardous to human health (MacCrimmon et al 1983, Gantner et al. 2010). In Ekati lakes, historically this has been seen in lake trout of a minimum 12 years old. Mercury concentrations above safe consumption guideline levels in Kodiak Lake trout are a concern for the Agency. This will likely also be of concern to our Aboriginal Society members who have a great stake in ensuring fish from Ekati lakes are safe to eat once the mine closes. It should be noted that Kodiak Lake is not downstream of the Long Lake Containment Facility (LLCF) where processed kimberlite is discharged. It is located beside the airstrip and downstream of Bearclaw Lake and the Panda Diversion Channel. Therefore, the source of mercury in these fish is unknown. **Recommendation** Recommendation: Dominion investigate the source of mercury contamination in the Kodiak Lake trout population including why higher levels of mercury might be appearing in younger fish.	the LAL in 2018 will be investigated through the ARF process, it is important to note that increased mercury concentrations in younger fish in certain Ekati AEMP lakes may not necessarily be the result of increased source concentrations within the lakes. Further, a positive correlation between fish age and mercury concentration is not necessarily based on the duration of exposure as incorrectly stated in the comment above, "juvenile and young adult fish normally haven't lived long enough to accumulate the amount of mercury necessary to push their mercury levels above the levels considered hazardous to human health". Mercury dynamics in aquatic systems are complex and a positive correlation between fish age and/or length and mercury concentration may be related to multiple factors including source concentrations, food chain length (Ganter et al. 2010), growth rate, and shifts in diet such as a switch to piscivory (MacCrimmon et al. 1983). Therefore, changes in the concentration of mercury observed in monitored lakes in the 2018 AEMP may be the result of multiple factors, some that may be mine-related and others that may be related to natural changes in these aquatic ecosystems. All possible factors will be considered in the updated FRP. Ganter, N., M. Power, D. Iqaluk, M. Meili, H. Borg, M. Sundbom, K. R. Soloman, G. Lawson, and D. C. Muir. 2010. Mercury concentrations in landlocked Arctic char (Salvelinus alpinus) from the Canadian Arctic. Part I: Insights from trophic relationships in 18 lakes. Environmental Toxicology and Chemistry. 29(3): 621-32. DOI: 10.1002/etc.95 MacCrimmon, H. R., C. D. Wren, and B. L. Gots. 1983. Mercury uptake by lake trout, Salvelinus namaycush, relative to age, growth, and diet in Tadenac Lake with comparative data form

			other PreCambrian shield lakes. Canadian Journal of Fisheries and Aquatic Sciences. 40(2): 114-120. DOI:10.1139/f83-020.
3	Metals in Fish- Selenium in Slimy Sculpin	**Comment** Toxic levels of selenium have been found to adversely affect fish larval development (Lemly 1993, Chapman et al. 2010). In Slimy Sculpin (sculpin) mean whole-body selenium exceeded USEPA whole-body guideline (8.5 mg/kg dry wt) in Leslie Lake, the first lake downstream of the LLCF. The majority of sampled sculpin (20 of 29 individuals) had selenium levels above guideline. This is a significant increase from 2015, the last year of sculpin sampling, when only two of 26 sculpin sampled were above the guideline. Dominion reports that selenium increases in sculpin and whitefish of Leslie Lake are an effect from LLCF discharge. The source of exposure to high levels of selenium in Leslie Lake is likely the sediments because: a steadily increasing temporal trend in sediment selenium concentrations has been identified in all Koala watershed lakes (see 2017 AEMP); a highly significant relationship between fish tissue and sediment concentrations was determined in 2012; and concentrations in the water are well below the benchmark in all lakes. Last year, the 2017 AEMP report concluded that sediment selenium concentration in Leslie Lake had reached a level at which “there may be a potential for adverse effects to aquatic life” (2017 Ekati AEMP report p. 3-166). In its Fish Response Plan Version 1.2, Dominion has not proposed action levels for selenium in slimy sculpin. However, selenium in sculpin has reached a level that would trigger at least a Medium Action level if Dominion’s proposed Medium Action Level for large-	**Sep 5:** The 2017 AEMP concluded an increasing trend in selenium in sediment in Leslie and Moose lakes only, and not in all Koala Watershed lakes as indicated in IEMA’s comment. Additionally, the highly significant relationship between fish tissue and sediment concentrations that was presented in the 2012 AEMP did not include data from Leslie Lake as they were determined to be outliers where fish tissue concentrations were higher relative to corresponding lake sediment concentrations than in other lakes. Therefore, while AEMP data suggest that the source of exposure for fish to high concentrations of selenium in Leslie Lake is potentially the sediments, this has not been confirmed. Further investigation of the relationships between selenium concentrations in water, sediment, and fish tissues is being undertaken as part of the 2019 Re-Evaluation (submission to the Board in December 2019). This is part of a commitment made in response to Decision #3 of the Board's Reasons for Decision on the 2017 AEMP Annual Report regarding selenium analysis (see also ECCC comment #1). Finally, Dominion would like to note that IEMA’s use of the term “significantly high” to describe elevated concentrations of selenium in Slimy Sculpin is misleading in this context as it suggests that they have resulted in effects with biological or ecological significance, which have not been concluded based on results for Slimy Sculpin biological variables in the 2018 AEMP. The Fish Response Plan (FRP) V1.2 did not include Action Levels for selenium in Slimy Sculpin

		bodied fish species were applied to slimy sculpin (i.e., mean body concentrations greater than EPA guideline). The Agency is concerned at Dominion's lack of response to the significantly high levels of selenium in sculpin. In previous AEMP reviews, Dominion has argued that sculpin are a fish species that can act as an early warning system for potential future effects on large bodied fish. As such Dominion should note these early warning signs and take a proactive approach to address the elevated levels of selenium in sculpin, such as the development of selenium action levels for slimy sculpin in the Fish Response Plan. **Recommendation** Recommendation: Slimy sculpin should be included in the development of selenium action levels in the Fish Response Plan.	because Slimy Sculpin variables are not part of the Aquatic Response Framework (ARF). Therefore, in the FRP V1.2, Action Levels were proposed for large-bodied fish. The inclusion of Slimy Sculpin in the ARF is being considered as part of the 2019 AEMP Re-Evaluation (submission to the Board will be in December 2019). Thus, any further discussion and recommendations on this topic will be considered as part of the re-evaluation process. Although Slimy Sculpin variables are not currently part of the ARF, Dominion is responding appropriately to elevated selenium concentrations in fish tissues through the existing FRP (currently being revised). Response actions associated with selenium in large-bodied fish are intended to address potential selenium concerns in all fish species despite Action Levels being defined for specific species monitored as part of the AEMP (Round Whitefish and Lake Trout). The extensive investment in the FRP and associated work does not constitute a "lack of response" as incorrectly indicated by IEMA.
4	Metals in Fish - Selenium in Whitefish	**Comment** Selenium is showing signs of increasing to levels of concern not only in sculpin but also round whitefish in Leslie Lake. Low Action Levels were exceeded in whitefish muscle in lakes downstream of the LLCF (Leslie, Moose and Nema lakes). Monitoring of selenium (in round whitefish at minimum) should be expanded to measure selenium concentrations in female ovarian tissue of harvestable fish species since toxic levels of selenium is most harmful to developing eggs. Therefore, monitoring selenium levels in the ovaries would provide better understanding of potential impacts to fish development. Also, selenium in some round whitefish livers were measured at	**Sep 5:** The US EPA provides guidelines for selenium in both muscle (8.5 mg/kg dwt) and egg/ovary (11.3 mg/kg dwt) elements. While the egg/ovary element supersedes the muscle element when egg/ovary concentrations are available, both elements are considered protective against chronic selenium effects. The current AEMP sampling design (20 individuals total, including mature males and females, and immature fish) does not allow for a representative measure of selenium concentrations in ovaries of the mature female proportion of the population in each lake. Monitoring concentrations in Round Whitefish female ovaries would likely require increased sample

		levels that the BC Ministry of Environment guideline for safe fish consumption considers harmful to human consumers of edible fish tissues (14 mg/kg for moderate frequency of fish consumption). This guideline was not applied since whitefish livers are not being consumed by Aboriginal people of directly affected communities. However, these elevated levels of selenium in whitefish liver are cause for concern since other species present in Ekati lakes, such as burbot (Lota lota), can have their livers consumed by people. **Recommendation** Recommendation: Dominion should monitor selenium concentrations in female ovaries of round whitefish. Recommendation: Dominion should investigate burbot in future AEMP fish monitoring for selenium concentrations in liver and muscle to determine their safety for human consumption.	sizes in order for ovary selenium concentrations to be representative of the population in each lake. Increasing the number of samples is not desired or planned in order to maintain minimal impacts on Round Whitefish populations (see response to WLWB comment #4) and because the muscle element guideline is already protective against chronic selenium effects. Including Burbot as part of the large-body fish species sampled in the AEMP is not an appropriate monitoring option. There is no baseline information for Burbot in AEMP lakes, making mine-related effects difficult to determine. Additionally, a lack of baseline information means that there is no indication of whether populations could withstand fishing pressure resulting from monitoring. Finally, the AEMP method for capturing large-bodied fish (gillnetting), has not been effective at capturing Burbot (i.e., no to low captures during AEMP monitoring), while other standardized methods such as long-lining have shown low capture rates in the Ekati area. Changes are not required to the current AEMP Design Plan for monitoring selenium in fish tissues. The Fish Response Plan V1.3 (under revision) addresses potential selenium concerns in all fish species despite Action Levels being defined for specific species monitored as part of the AEMP (Round Whitefish and Lake Trout). Action Levels for selenium in the Fish Response Plan include a criterion associated with selenium concentrations that are safe for consumption. In future, tissue concentrations will be compared with this Action Level, which is planned to be based on the BC MOE (2017)/Health Canada (2010a, 2010b) methods for calculating safe consumption and a site-specific consumption rate. BC MOE. 2017. Approved Water

			Quality Guidelines. British Columbia Ministry of Environment: Victoria, BC. Health Canada. 2010a. Federal contaminated site risk assessment in Canada Part II: Health Canada toxicological reference values (TRVs) and chemical-specific factors. Contaminated Sites Division: Ottawa, ON. Health Canada. 2010b. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0. Contaminated Sites Division: Ottawa, ON.
5	Zooplankton Sampling Methodology	**Comment** The Agency believes that zooplankton diversity and density in AEMP lakes may be underestimated due to the mesh size of collecting nets being large enough to allow the tiniest species to pass through. To address this the Jay AEMP proposes to use a finer mesh (80 µm) plankton net to collect zooplankton samples in Lac du Sauvage, instead of the 118 µm mesh plankton net currently used for the existing Ekati AEMP. It is likely this would increase the number of species, especially rotifers, collected. The 118 µm net is still being used in Ekati-wide AEMP as seen in 2018. The Agency would encourage the use of a finer meshed sampling net be used in the entire site-wide AEMP. **Recommendation** Recommendation: Dominion use finer mesh size (80 µm) for AEMP plankton sampling across all Ekati monitoring.	**Sep 5:** The Jay AEMP has been designed to effectively determine whether mine-related effects have occurred in the Receiving Environment specific to the Jay Project (i.e., Lac du Sauvage). The Ekati AEMP is designed to determine effects in a completely different Receiving Environment, beginning with Leslie Lake. Sampling methods and approaches included in each AEMP Design Plan are appropriate to the Receiving Environment and objectives of determining mine-related effects. While it is true that a smaller mesh size would likely result in higher densities of small zooplankton being captured; this change would not result in an improvement to the existing Ekati Mine AEMP. A 118 µm mesh size has been used consistently for the existing AEMP since baseline sampling began over 20 years ago. Changing the mesh size at this point would negate comparability of all future data to data collected from baseline through 2018. This change would significantly impede Dominion's ability to conclude whether mine-related effects are evident, effectively preventing Dominion from meeting the key objective of the AEMP. Dominion strongly recommends that IEMA carefully consider the potential impacts of

			recommending changes to AEMP sampling protocols prior to suggesting them. Any change to AEMP sampling protocols must above all other objectives, increase the ability to detect changes in the Receiving Environment. Any recommended change that impacts the AEMP's ability to detect change over time, has the potential to undermine the entire purpose of the program. No change to the zooplankton sampling protocol in the AEMP is recommended or required.
6	Aquatic Response Framework	**Comment** The Agency supports the actions planned to address exceedances of action levels for Dissolved Oxygen, Potassium, Chloride and Phosphorus. The Agency would like to commend Dominion for its updates to Aquatic Response Framework response plans water quality and plankton which are improving with each new version submitted to the WLWB. **Recommendation** None	**Sep 5:** Dominion thanks the Agency for their support.
7	Study Design	**Comment** There seems to be a slight study design error in the spatial analysis for EROD activity in fish. Distance to active haul road or airstrip was used to define proximity of affected lakes to mining activity. Moose Lake is 780 m from the airstrip, while portions of the shoreline of both Leslie and Nema lakes abut the haul road for Fox. So in spatial analysis for EROD, Leslie and Nema lakes should be considered closer to sources of contaminants (i.e., petroleum products) inducing EROD activity than Moose Lake. But the current analysis is categorizing Moose Lake as closer than the other two. This may be valid for slimy sculpin since the haul road was no longer used after 2014/2015 when the Fox pit ended production, but for the longer-lived species like round whitefish, older individuals sampled in 2018 would have been alive	**Sep 5:** As described in Part 3 of the 2018 AEMP – Statistical Report: "Distance to an active haul road is based on the measured linear distance between each lake and the nearest active haul road or the airstrip (Table 1.2-4). Haul roads were considered active if mine activities in 2017 to 2018 required use for transport of rock or ore." The Fox Haul road was not considered an active haul road for the 2018 analysis therefore the order used in the spatial analysis is correct. As an enzyme-based biomarker, EROD is a sensitive indicator only of recent exposure to hydrocarbons because parent compounds that result in induction are readily metabolized. Although some of the sampled Round Whitefish may have been alive when the Fox Haul road was active, the nature of the EROD biomarker is that it is reflecting only recent

		when the haul road was actively used. **Recommendation** Recommendation: For whitefish and trout EROD analysis, the spatial analysis should be redone with the scale of increasing distance from haul roads being sequenced as Leslie, Nema and Moose lakes. This will allow us to see if this gives a clearer picture of the influence of proximity to haul roads/airstrip on EROD induction in whitefish.	exposure to compounds that induce EROD. This characteristic of the EROD biomarker was considered in the determination of which haul roads would be considered active in the spatial analysis. For these reasons, EROD spatial analysis is not required to be redone in the 2018 AEMP, as it would not accurately represent effects associated with mine activity and likely sources of hydrocarbons. Additionally, the results of the 2018 AEMP clearly show no mine-related effect on EROD induction in Round Whitefish and Slimy Sculpin, and no exposure to PAHs (polycyclic aromatic hydrocarbons) and/or other contaminants. Very low EROD induction values were found for all fish (all induction values were less than one) in the lakes monitored in 2018 as part of the AEMP. These low EROD induction values suggest a low signal-to-noise ratio indicating that EROD induction in all fish in all lakes was very similar and that no exposure to PAH and/or other contaminants occurred.
WLWB: Anneli Jokela			
ID	**Topic**	**Reviewer Comment/Recommendation**	**Proponent Response**
1	Evaluation of Effect (Part 1 of 2): Percentage of Values Below Detection Limit (DL) for Tobit Regression Analysis	**Comment** Section 2.2.4.1 of the Evaluation of Effects describes that Tobit regression was used for analysis of metals, where between 1% and 60% of the data fell below the DL for at least one lake. Meanwhile, section 1.2.1.1 of the Statistical Report describes that Tobit regression was used for analysis of metals, where between 1% and 50% of the data fell below the DL for at least one lake. It is not clear which method was used. **Recommendation** Please explain the apparent discrepancy, clarify which number is correct, and	**Sep 5:** In the past regression models were attempted to be fit to variables with 60% or fewer values below analytical detection limits (DLs). However, it was found that regression fits for variables with between 50% and 60% of values less than DL tend to be unstable and/or do not converge. Therefore, regression results were not reported. Due to the consistent lack of fit for variables with 50% to 60% of values below DL, the cutoff was updated to 50%. The update was reflected in the Part 3 of the 2018 AEMP - Statistical Report methodology but not in Part 1 – Evaluation of Effects. In 2018, there were five site/variable combinations

		indicate any implications this may have on the conclusions of the report.	with 50% to 60% of values below DL: (1) total ammonia-N: Counts Lake under-ice, (2) total boron: Counts Lake under-ice, (3) total boron: S3 open-water, (4) nitrate-N: Nanuq Outflow open-water, and (5) total phosphorus: S5 under-ice. No regression results were reported for these site/variable combinations, instead conclusions were drawn based on graphical analysis. No implications to the AEMP conclusions are anticipated as all AEMP conclusions are influenced by graphical analysis regardless of whether statistical analyses are completed. The final 2017 and 2018 AEMP conclusions regarding the extent of mine-related effects for these variables in the relevant watersheds were in agreement.
2	Evaluation of Effects (Part 1 of 2) - Section 3.3.2.3, Figure 3.3-14b - Moose Lake; Figure 3.3.14c; and Figure 3.3.14d	**Comment** In the noted figures, the years for the corresponding data are presented along the x-axis. There appears to be an extra column of data between 2000 and 2001, and only one column of data where 2002 and 2003 should be prior to 2004. **Recommendation** (1) Please clarify if the title below the 2001 data is meant to read 2002 for Figure 3.3-14b - Moose Lake; Figure 3.3.14c; and Figure 3.3.14d. (2) If so, can Dominion clarify whether the data columns as presented are correct and that only an adjustment to the x-axis labels are needed? (3) If any other changes are needed to the figures, please explain how they have changed and whether these changes influence any of the conclusions made in the report	**Sep 5:** Yes, there is an error on the x axes of these figures where 2001 should read 2002. The data themselves are presented in the correct annual order and are correct. The error on the axis did not influence any conclusions made in the 2018 AEMP Report. No update to the report is required.
3	Evaluation of Effects – Section 3.3.5.3: LSI and GSI	**Comment** Dominion has grouped infected and uninfected fish during analysis in the 2018 Annual Report both when significant effects of parasitism have been noted and when they have not. For	**Sep 5:** Infected and non-infected Slimy Sculpin are grouped for GSI and LSI analyses to allow for sufficient sample sizes to perform statistical and/or graphical analyses. The effect of parasitism on GSI and LSI is

		example, Dominion states in the 2018 Annual Report: "Because there was generally no significant effect of parasitism on total length, all fish were pooled regardless of infection status for all subsequent length analyses."; and, "Despite the relationship between parasitism and GSI, all Slimy Sculpin (infected and uninfected) were pooled to maintain sample sizes and biological variability in the dataset for further statistical testing of GSI."; and, "The effect of parasitism on LSI in Slimy Sculpin, assessed using an LME, was consistent across lakes where infected fish generally had lower LSI than uninfected fish (Table 3.3-65 and Part 3 – Statistical Report, Section 2.6.15.2). Despite the relationship between parasitism and LSI, all Slimy Sculpin (infected and uninfected) were pooled to maintain sample sizes and biological variability in the dataset for subsequent temporal and spatial analyses involving GSI." **Recommendation** Given the significant relationship between parasitism, and GSI and LSI, please discuss the potential ramifications of grouping infected and non-infected fish on the ability of the AEMP to detect project-related effects in LSI and GSI indices.	consistent across all lakes (infected Slimy Sculpin have lower GSI and LSI values than un-infected ones), including reference and monitored lakes, and there were no mine-related effects concluded for parasitism in Slimy Sculpin. Based on these findings, it was considered of more value to perform statistical and/or graphical analyses on the full dataset than to forgo the GSI and LSI analyses. Additional graphical interpretations of the GSI and LSI data with parasitism, when possible with the limited dataset, were considered when analyzing the data. Some trends were found, for example, an increase in LSI and female and male GSI in Kodiak Lake over time which co-occurred with a decrease in parasitism. Although these kinds of correlations are present and can be described, they were not presented as they do not appear to be mine-related and therefore do not change the overall conclusions of the 2018 AEMP Report. Dominion recognizes that the Board's comment is valid and analyses of GSI and LSI in Slimy Sculpin will continue to consider parasitism in the interpretation of results even if only graphical analyses are possible due to data limitations. The inclusion of parasitism as a co-variable for LSI and GSI Slimy Sculpin statistical analyses will continue to be considered as additional data become available through additional AEMP sampling years.
4	Evaluation of Effects – Section 3.3.5.3 Parameters: CPUE – Slimy Sculpin Condition – Lake Trout; Round Whitefish – Molybdenum	**Comment** There appears to be difficulty with parsing the effects of natural variation in fish metrics from potential mine related effects in all fish species being sampled. Some examples include the following: In 2018's assessment of Lake Trout Condition, Dominion states: "Although graphical analysis suggests a potential emerging trend of lower condition in Leslie	**Sep 5:** Dominion does not recommend increasing the frequency of sampling for any fish species for multiple reasons, explained below. Where there is uncertainty in the AEMP conclusions for fish variables, the most important contributing factors include a lack of baseline data, natural variation among lakes, and/or naturally high variability in the variables of interest.

	concentrations.; and Slimy Sculpin – GSI and LSI	Lake, due to high within-lake variability it is unclear if it is related to mine activities or natural variability." In 2018's assessment of molybdenum concentrations in Round Whitefish, Dominion states: "A significant trend of increasing Round Whitefish liver molybdenum with increasing influence of the LLCF was observed but because no baseline data was consistently available for the analysis, it is unclear whether this spatial trend is related to mine activities or the result of natural variation." In 2018's assessment of Slimy Sculpin CPUE, Dominion states: "A significant trend of decreasing Slimy Sculpin electrofishing CPUE with increasing influence of the LLCF was observed, however no baseline data were available thus it is unclear whether this spatial trend is related to mine influences or natural variation" In 2018's assessment of Slimy Sculpin GSI and LSI, Dominion states: "Given a lack of baseline data and the annual variability in GSI in the spatial correlation, it is unclear whether the spatial trend observed is related to mining activities or is the result of natural variation." "A significant spatial trend of increasing Slimy Sculpin LSI with increasing influence of the LLCF was observed but it is unclear whether this spatial trend is related to mine influences or natural variation." **Recommendation** Can Dominion comment on the feasibility of increasing the frequency of non-lethal sampling of large-bodied fish and/or increasing the frequency of Slimy Sculpin sampling to improve the ability of the AEMP design to distinguish potential project-related effects from natural variation?	Increased sampling frequency is not anticipated to address the data issues identified in the comments. Specifically, increased sampling frequency will not overcome the lack of baseline data for large-bodied fish, where some lakes were not part of the sampling design in all baseline years. Slimy Sculpin were added as a monitoring component of the AEMP in 2012 (after mining started) and the lack of baseline data is a factor that is considered in the interpretation of all variables for this species. When differences in data between reference and monitored lakes are already present in the first year of sampling (i.e., after the initiation of mining), long-term monitoring (and not increased sampling frequency) is the only way to differentiate between a potential mine-related effect and natural variation within and among lakes. High variability is expected and natural for fish population variables. While increasing sampling frequency (and sample sizes) is a potential approach to better differentiate between a mine-related effect and natural variability, this not feasible without unacceptable impact on the Ekati's fish populations. Previous AEMP analyses have demonstrated that frequent sampling of large-bodied fish was having a negative effect on CPUE, which is used as a measure of the fish population in each lake. While CPUE seems to have since recovered, it would be ill-advised to knowingly exacerbate this issue and may hamper Dominion's ability to draw conclusions with respect to fish in future AEMPs. Although it is unclear what sampling frequency may result in a decrease in CPUE for Slimy Sculpin, the three-year sampling frequency is currently judged acceptable. Although Lake Trout are non-lethally sampled as part of the AEMP, there is still some risk to fish survival associated

			with any fish capture method. Moreover, switching to sampling Round Whitefish non-lethally is not expected to be feasible as Round Whitefish tend to have low survival rates in gillnets and/or following handling, despite the short net sets used for the Ekati AEMP. It is also not possible to capture Lake Trout only (avoid capture of Round Whitefish) using AEMP gillnetting methods.
5	Evaluation of Effects – Section 3.3.5.3: Lake Trout Mercury; Mercury Figures 3.3-117 and 3.3-119	**Comment** The 2018 AEMP Annual Report identifies several instances of elevated mercury concentrations in fish tissue. For example, Dominion states: "Results suggest a potential mine-related effect on Lake Trout muscle mercury concentration in Leslie, Moose, Slipper, and Kodiak lakes."; and "Results suggest a mine-related effect on Round Whitefish muscle concentration in Kodiak, Leslie, Moose, Nema, and Slipper lakes, and a mine-related effect on liver mercury concentration in Kodiak, Moose and Nema lakes."; and "A significant spatial correlation of increasing mercury concentrations with increasing influence of the LLCF was detected, but was confounded by overall differences between monitored and reference lakes." ; and "A significant spatial pattern in Lake Trout mercury concentration with respect to the LLCF was detected but appears to reflect differences between monitored and reference lakes that have existed since baseline years rather than a true spatial relationship." Mean mercury concentrations in monitored lakes in Lake trout (Figure 3.3-119) appear to have all undergone marked increases since 2007. Despite higher initial concentrations, the magnitude of these increases appears greater than the relatively small increases	**Sep 5:** The current analysis approach uses statistical and graphical methods for comparisons among reference and monitored lakes to determine mine-related effects. Differences in mercury concentrations between monitored and reference lakes, including the magnitude of changes, are noted multiple times in the description of results in the 2018 AEMP Report. Examples include the following: • "Overall, Lake Trout muscle mercury concentrations were higher and had greater variability in monitored lakes than reference lakes, including in baseline and early monitoring years." • "Graphical analysis suggests that temporal variation in Lake Trout muscle mercury concentration was similar among monitored lakes but differed from reference lakes, particularly with respect to increases in mercury concentration observed from 2012 to 2018." • "No consistent significant differences in temporal trends were observed between monitored and reference lakes but graphical analysis suggests that temporal variation in monitored lakes differed from reference lakes with respect to the magnitude of change, particularly the increase from 2012 to 2018." • "A significant spatial pattern in Lake Trout mercury concentration with respect to the LLCF was detected but appears to reflect differences between monitored

		observed in the reference lakes. This suggests that the analysis framework may not adequately consider the magnitude of changes in parameter concentrations between monitored and reference lakes. **Recommendation** Please discuss the ability of the current analysis approach to distinguish differences in the magnitude of changes in mercury concentrations when making comparisons between monitored and reference lakes over time.	and reference lakes that have existed since baseline years rather than a true spatial relationship." Although in recent years for Lake Trout, the magnitude of increase in mercury concentrations has been greater in monitored lakes compared to reference lakes, the analysis also considers that there was a similar difference in the magnitude of the decrease in mercury concentrations between monitored and reference lakes in baseline/early monitoring years. Therefore, differences in mercury dynamics in the monitored lakes appear to have differed from the reference lakes since the baseline period and the magnitude of changes has been adequately considered in the current analysis approach. Furthermore, a mine-related effect was concluded in the 2018 AEMP Report in Round Whitefish muscle and liver based on the magnitude of mercury increase in recent years demonstrating that the magnitude of changes was considered in the current analysis approach.
6	Evaluation of Effects – Section 3.3.5.3: Slimy Sculpin Strontium	**Comment** Dominion noted that a mine related effect was detected in water quality Total Strontium concentrations in 2018 (Figure 4.1a, Summary Report). Dominion further notes that there are potential mine related effects in strontium in Slimy Sculpin in the 2018 AEMP's Evaluation of Effects. Specifically, Dominion states: "Results suggest a mine-related effect on Slimy Sculpin strontium concentration downstream of the LLCF as far as Slipper Lake." Within the 2015 AEMP Re-evaluation, it was recommended that Slimy Sculpin variables be included within the Response Framework following the 2018 AEMP reporting. In the Board's Reasons for Decision, dated February 27, 2017, the Board	**Sep 5:** Given the proximity of the Re-evaluation and the time until the next fish sampling event, Dominion believes that this comment is best addressed as part of the 2019 AEMP Re-evaluation to be submitted to the Board in December 2019.

		approved the recommendation that Slimy Sculpin continue to be monitored every three years for use as an early indicator of change, and that the inclusion of Slimy Sculpin into the Response Framework wait until 2018. Therefore, Slimy Sculpin are not currently part of the Response Framework but are to be incorporated into the Response Framework following the 2018 AEMP Annual Report. **Recommendation** How does Dominion propose including Slimy Sculpin into the Response Framework now that these additional data have been collected?	
7	Evaluation of Effects (Part 2 of 2) - Section 3.4: Summary (pg. 68)	**Comment** Section 3.4 states: "Six potential mine-related changes in plankton variables were also identified: increase in total phytoplankton density in Kodiak Lake; increase in edible phytoplankton density in Kodiak Lake; increase in non-edible phytoplankton density in Kodiak Lake; decrease in non-edible phytoplankton densities in Nema Lake; altered taxonomic composition of the phytoplankton community in Kodiak Lake; and decrease in rotifer densities in Leslie Lake." Dominion then indicates that these changes will continue to be monitored as part of the annual AEMP to assess whether they may be mine-related. **Recommendation** How many years of additional monitoring data would likely be required in order to assess whether these changes in plankton variables are mine related?	**Sep 5:** Plankton communities are inherently variable. Dominion cannot ascertain the number of additional years required to confirm if the observed changes in plankton variability are mine-related. Changes in plankton communities will continue to be assessed annually in the AEMP and are also being analyzed as part of the 2019 AEMP Re-evaluation that is to be submitted to the Board in December of this year.
8	Evaluation of Effects (Part 2 of 2) - Section 4.4: Summary (pg. 462)	**Comment** Section 4.4 states, "Results of the most recent sediment quality analyses in the King-Cujo Watershed and Lac du Sauvage (i.e., in 2017, ERM 2018f) suggest that concentrations of four evaluated sediment quality variables have increased in Cujo	**Sep 5:** Appendix E of the 2017 AEMP Report, Part 1 - Evaluation of Effects provides the results of the literature review, including references, for evaluated sediment quality variables that have increased in Cujo Lake. This information was also summarized in the

		Lake: molybdenum and uranium as a result of Discharge from the KPSF, and selenium and strontium possibly as a result of natural variability." Dominion then states that based on available literature, it was concluded to be unlikely that adverse effects to aquatic life would occur because of the observed increases in sediment concentrations of these four sediment quality variables in Cujo Lake. **Recommendation** Please summarize and provide references for the literature that was used in determining that it is unlikely that adverse effects to aquatic life in Cujo Lake would occur.	Evaluation of Effects section for each of these individual metals in the King-Cujo Watershed and Lac du Sauvage (see 2017 AEMP Evaluation of Effects, Sections 4.3.4.8 and 4.3.4.11 to 4.3.4.13). The 2018 AEMP Report appropriately referred to the 2017 AEMP Report rather than repeating the detailed results of the literature review because sediment quality was evaluated in 2017, not in 2018. A summary of the information presented in Sections 4.3.4.8 and 4.3.4.11 to 4.3.4.13 of the 2017 AEMP Report, Part 1 - Evaluation of Effects is included below: Section 4.3.4.8: A CCME guideline for molybdenum in sediments does not exist; therefore, a literature search was conducted to determine the likelihood of toxicity to aquatic life from the observed sediment molybdenum concentrations downstream of the KPSF in Cujo Lake (Appendix E). In 2017, the observed concentration of molybdenum in sediments of the Cujo Lake was 37 mg/kg. This concentration is well below the recommended literature chronic toxicity thresholds for whole sediment (e.g., the lowest threshold is a NOEC of 3,589 mg/kg in C. dilutus; Tables E-1 and 2 of Appendix E). Therefore, based on the available toxicity data, it is unlikely that the observed increase in sediment molybdenum concentrations in Cujo Lake would result in adverse effects to aquatic life. Section 4.3.4.11: A CCME guideline for selenium in sediments does not exist; therefore, a literature search was conducted to determine the likelihood of toxicity to aquatic life from the observed sediment selenium concentrations in Cujo Lake (Appendix E). In 2017, the observed concentration of selenium in the sediments of Cujo Lake was 0.97 mg/kg. There is a general lack of freshwater sediment toxicity data for selenium, but the

			BC MOE (2014) provides an alert concentration of 2.0 mg/kg, which is also the US EPA (2006) sediment screening benchmark for selenium. Because the observed selenium concentrations in Cujo Lake was less than 2.0 mg/kg the potential for adverse effects to aquatic life in Cujo Lake is low. Additionally, the Aquatic Response Plan for Selenium is intended to be protective of the most sensitive aquatic receptor (fish) to selenium toxicity, regardless of sediment concentrations (ERM 2016d). Section 4.3.4.12: A CCME guideline for strontium in sediments does not exist; therefore, a literature search was conducted to determine the likelihood of toxicity to aquatic life from the observed sediment strontium concentrations in Cujo Lake (Appendix E). The literature search found no appropriate strontium sediment toxicity test results. In the absence of toxicity information, it is useful to place the sediment strontium results from AEMP lakes in the context of observed strontium concentrations in sediments from a wide variety of locations. In a survey of 2,737 freshwater sediment samples collected across the United States, Irwin et al. (1997) reported 50th percentile and arithmetic mean concentrations of 425 and 575 mg/kg, respectively. In 2017, the mean sediment strontium concentration in Cujo Lake was 38 mg/kg, 15-fold lower than the mean reported by Irwin et al. (1997). Therefore, it is unlikely that observed increases of sediment strontium concentrations in Cujo Lake would result in adverse effects to aquatic life. Section 4.3.4.13: A CCME guideline for uranium in sediments does not exist; therefore, a literature search was conducted to determine the likelihood of toxicity to aquatic life from the observed sediment strontium concentrations in Cujo Lake (Appendix E). In 2017, the

			observed sediment uranium concentration in Cujo Lake was 18.3 mg/kg. The lowest toxicity thresholds reported in the literature were reported by Dias et al. (2009), but the coarse artificial sediment used by the authors (i.e., 88% silica sand with particle sizes no smaller than 150 µm) is not representative of the predominantly silty sediment (i.e., particle size between 4 and 63 µm) in all AEMP monitored lakes (see Section 3.5 of Part 2 – Data Report). Based on empirical evidence, uranium bioavailability to benthic macroinvertebrates is significantly reduced as the composition of fine particles (i.e., particles less than 50 µm) in sediment increases (Crawford and Liber 2015, 2016) therefore, the low toxicity thresholds reported by Dias et al. (2009) for C. riparius are likely overly conservative for silty sediments. Furthermore, the average concentrations of uranium in sediments from the three reference lakes (Nanuq, Counts, and Vulture Lakes) in 2017 exceeded the lowest threshold of 2.49 mg/kg published by Dias et al (2009). Based on an assessment of the available literature on sediment uranium toxicity, the spiked-sediment toxicity thresholds published by Lagauzère et al. (2017e) and Liber et al. (2011) are more appropriate for (1) natural sediments composed of sand, silt, and clay (as well as organic matter), and (2) sediments with naturally elevated uranium concentrations. Thus, the lowest toxicity threshold from Lagauzère et al. (2017) and Liber et al. (2011) of 740 mg/kg (a 10-day NOEC for growth in C. dilutus) is considered an appropriate threshold for sediment uranium in the AEMP monitored lakes. Therefore, it is unlikely that the observed increase in sediment uranium concentrations

			in Cujo Lake would result in adverse effects to aquatic life.
9	Statistical Report – Section 1.2.1.2: EROD Induction as a tracer for PAH exposure	**Comment** Dominion has used EROD induction as part of their analysis of fish in the 2018 AEMP annual report. The relationship between EROD induction and fish size (Age) has been explored at Ekati however literature on EROD induction suggests that reproductive status is also an important modifying factor in EROD induction and no mention of the impact of reproductive status on EROD induction results and analyses is made by Dominion. An example from the literature is from White (2000): "EROD induction in fish is well characterized, the most important modifying factors being fish species, reproductive status and age, all of which can be controlled through proper study design."(Reference: Whyte JJ, Jung RE, Schmitt CJ, Tillitt DE. (2000). Ethoxyresorufin-O-deethylase (EROD) activity in fish as a biomarker of chemical exposure. Crit Rev Toxicol. 2000 Jul;30(4):347-570.) **Recommendation** Has reproductive status been accounted for when assessing EROD induction data? If so, how? If not, what are the potential ramifications of reproductive status on the EROD induction results presented?	**Sep 5:** EROD activity has been shown to be influenced by reproductive status, more specifically by the reproductive status of females, where EROD activity decreases in spawning females (Wunderlich et al, 2015). While reproductive status was not accounted for when assessing EROD data in the 2018 AEMP, there is unlikely to be sufficient data to incorporate the influence of reproductive status on EROD induction in Round Whitefish statistical analyses (i.e., with only 20 total fish, the number of fish in each of the 5 reproductive status categories for each sex in each lake is limited). Even with variables such as length and weight, where sufficient data are available and where significant relationships with EROD induction were demonstrated, difficulty in incorporating and interpreting three-way interactions biologically, made modelling EROD induction incorporating these relationships unfeasible. Despite the potential of mature females in general to show lower EROD activity values than immature females and males, the results of the 2018 AEMP clearly show no mine-related effect on EROD induction in Round Whitefish, and no exposure to PAHs (polycyclic aromatic hydrocarbons) and/or other contaminants. Very low EROD induction values were found for all fish (all induction values were less than one, for both sexes and all maturity stages) in the lakes monitored in 2018 as part of the AEMP. These low EROD induction values suggest a low signal-to-noise ratio indicating that EROD induction in all fish in all lakes was very similar and that no exposure to PAH and/or other contaminants occurred.

Distribution List

Ekati - 2018 Aquatic Effects Monitoring Program (AEMP) Annual Report (W2012L2-0001)

File(s): W2012L2-0001
Proponent: Dominion Diamond Mines ULC
Reviewer Comments Due By: June 27, 2019
Proponent Comments Due By: July 11, 2019

Document(s)

Summary Report
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Part 1 - Evaluation of Effects (2 of 2)
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Part 2 - Data Report (3 of 4)
Part 2 - Data Report (4 of 4)
Part 3 - Statistical Report
Data Files (excel)

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ECCC File: 5100 000 012/008
WLWB File: W2012L2-0001

July 8, 2019

via online review system

Anneli Jokela
Regulatory Manager
Wek'èezhìi Land and Water Board
1-4905 48th Street
Yellowknife, NT X1A 3S3

Dear Anneli Jokela:

RE: W2012L2-0001 – Dominion Diamond Mines Inc. – Ekati – 2018 AEMP Annual Report

Environment and Climate Change Canada (ECCC) has reviewed the information submitted to the Wek'èezhìi Land and Water Board (WLWB) regarding the above-mentioned annual report and is submitting comments via the online review system. ECCC's specialist advice is provided based on our mandate, in the context of the *Canadian Environmental Protection Act*, the pollution prevention provisions of the *Fisheries Act*, the *Migratory Birds Convention Act,* and the *Species at Risk Act*.

Please contact Russell Wykes at (867) 669-4743 or Russell.Wykes@Canada.ca should you require more information.

Sincerely,

[original signed by]

Russell Wykes
A/ Senior Environmental Assessment Coordinator

Attachment(s): ECCC Comments Excel Sheet

cc: Georgina Williston, Head, Environmental Assessment North (NT and NU)

July 8, 2019

Joseph Mackenzie
Chair
Wekeezhii Land and Water Board
#1-4905 48th Street
Yellowknife, NT
X1A 3S3

Dear Mr. Mackenzie,

Re: **Dominion Diamond Ekati ULC (Dominion)**
Water Licence – W2012L2-0001
2018 AEMP Annual Report
Request for Comment

The Department of Environment and Natural Resources (ENR), Government of the Northwest Territories has reviewed the report at reference based on its mandated responsibilities under the Environmental Protection Act, the Forest Management Act, the Forest Protection Act, the Species at Risk (NWT) Act, the Waters Act and the Wildlife Act and provides the following comments and recommendations for the consideration of the Board.

Topic 1: Phosphorus Benchmark Exceedances

Comment(s):

As noted in the Summary Report, and in Section 4.2.3.11 of the Evaluation of Effects, Dominion has committed to the collection of monthly samples in the open water season of 2019 according to the Response Plan for Total Phosphorus (Version 1.3) methods to confirm benchmark exceedances for total phosphorus (low action level). Regarding low action level exceedances, Dominion has stated in the Total Phosphorus Response Plan that:

> "Dominion Diamond will collect water samples approximately monthly during the open-water season (mid-late June through early October) at the AEMP sampling location using the same frequency and replication employed for the August (AEMP) sampling (2 replicates per depth x 2 or 3 depths -

depending on the lake). Dominion Diamond will conduct this sampling four to five times throughout the open-water season to meet the sample size recommended by Clark and Hutchinson (1992) and Clark et al. (2010)" (Section 3.3 of the Ekati - AEMP - Phosphorus Response Plan - Version 1.3).

While ENR supports this response to address low action level exceedances, ENR is seeking clarity on how the intensive sampling for all open water months in 2019 will be used to confirm or reject benchmark exceedances. Specifically, how will Dominion report means and final phosphorus concentrations based on the samples collected in 2019 (i.e., will samples be recorded and analyzed monthly, or will all be averaged for a 2019 open water value?). Furthermore, will Dominion only apply the intensive phosphorus sampling program in Cujo Lake and Nanuq Lake where the exceedances were recorded, or will the sampling frequency be applied to all sites within the King-Cujo Watershed and Lac du Sauvage? To ensure that any potential conclusion regarding mine effects is correct, ENR is of the opinion that the sampling program should be applied to all sites within the King-Cujo Watershed and Lac du Sauvage for the confirmation sampling program of the 2019 open water season.

Recommendation(s):

1) ENR recommends that during the open water season for 2019 that Dominion collect monthly total phosphorus samples for all sampling locations in the King-Cujo Watershed and Lac du Sauvage. Sampling methods and analysis should follow the methods outlined in the Response Plan for Total Phosphorus, Version 1.3 and reported in the 2019 AEMP Report.

2) ENR recommends Dominion clarify how means and final phosphorus concentrations based on the samples collected in 2019 will be analyzed and reported in the 2019 AEMP Report to confirm benchmark exceedances.

Comments and recommendations were provided by ENR technical experts in the Water Management and Monitoring Division and the North Slave Region and were coordinated and collated by the Environmental Assessment and Monitoring Section (EAM), Environmental Stewardship and Climate Change Division.

Should you have any questions or concerns, please do not hesitate to contact Patrick Clancy, Environmental Regulatory Analyst at (867) 767-9233 Ext: 53096 or email patrick_clancy@gov.nt.ca.

Sincerely,

Patrick Clancy
Environmental Regulatory Analyst
Environmental Assessment and Monitoring Section
Environmental Stewardship and Climate Change Division
Department of Environment and Natural Resources
Government of the Northwest Territories

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July 3, 2019

Joseph Mackenzie
Chair, Wek'eezhii Land and Water Board
#1-4905 48th St, Yellowknife, NT
X1A 3S3

Re: 2018 Ekati Aquatic Effects Monitoring Plan Annual Report

Dear Mr. Mackenzie,

The Independent Environmental Monitoring Agency (Agency) has reviewed Dominion Diamond Mines ULC's (Dominion) 2018 Ekati Aquatic Effects Monitoring Plan (AEMP) Annual Report. As we have come to expect over the years, it is a high-quality report that efficiently covers all aspects of aquatic environmental impacts downstream of the Ekati mine.

After completing our review, the Agency has comments regarding the Annual Report, the most important being results of fish contaminant monitoring.

Metals in Fish

Mercury

In Kodiak Lake trout muscle, mean mercury levels have exceeded Health Canada guideline for human consumption. Seven fish of 20 sampled exceeded the guideline in Kodiak Lake, up from one fish in 30 sampled between 2002 and 2012 (a 30 yr-old in 2007). This represents the first time that an impacted lake (Kodiak) has been reported to have trout mean mercury levels (0.518 mg/kg) above Health Canada guideline for human consumption (0.500 mg/kg). Of note, the high mercury body burdens were not confined to older trout as is usually the case, since mercury levels accumulate in the body overtime. Five younger fish aged 6 to 8 years old were found to be at or above Health Canada guidelines. In lakes with non-toxic levels of mercury, juvenile and young adult fish normally haven't lived long enough to accumulate the amount of mercury necessary to push their mercury levels above the levels considered

hazardous to human health (MacCrimmon et al 1983, Gantner et al. 2010[1]). In Ekati lakes, historically this has been seen in lake trout of a minimum 12 years old.

Mercury concentrations above safe consumption guideline levels in Kodiak Lake trout are a concern for the Agency. This will likely also be of concern to our Aboriginal Society members who have a great stake in ensuring fish from Ekati lakes are safe to eat once the mine closes. It should be noted that Kodiak Lake is not downstream of the Long Lake Containment Facility (LLCF) where processed kimberlite is discharged. It is located beside the airstrip and downstream of Bearclaw Lake and the Panda Diversion Channel. Therefore, the source of mercury in these fish is unknown.

Recommendation: Dominion investigate the source of mercury contamination in the Kodiak Lake trout population including why higher levels of mercury might be appearing in younger fish.

Selenium in Slimy Sculpin

Toxic levels of selenium have been found to adversely affect fish larval development (Lemly 1993, Chapman et al. 2010 [2]). In Slimy Sculpin (sculpin) mean whole-body selenium exceeded USEPA whole-body guideline (8.5 mg/kg dry wt) in Leslie Lake, the first lake downstream of the LLCF. The majority of sampled sculpin (20 of 29 individuals) had selenium levels above guideline. This is a significant increase from 2015, the last year of sculpin sampling, when only two of 26 sculpin sampled were above the guideline. Dominion reports that selenium increases in sculpin and whitefish of Leslie Lake are an effect from LLCF discharge. The source of exposure to high levels of selenium in Leslie Lake is likely the sediments because: a steadily increasing temporal trend in sediment selenium concentrations has been identified in all Koala watershed lakes (see 2017 AEMP); a highly significant relationship between fish tissue and sediment concentrations was determined in 2012; and concentrations in the water are well below the benchmark in all lakes.

Last year, the 2017 AEMP report concluded that sediment selenium concentration in Leslie Lake had reached a level at which "*there may be a potential for adverse effects to aquatic life"* (2017 Ekati AEMP report p. 3-166). In its Fish Response Plan Version 1.2, Dominion has not proposed action levels for selenium in slimy sculpin. However, selenium in sculpin has reached a level that would trigger at least a Medium Action level if Dominion's proposed Medium Action Level for large-bodied fish species were applied to slimy sculpin (i.e., mean body concentrations greater than EPA guideline).

The Agency is concerned at Dominion's lack of response to the significantly high levels of selenium in sculpin. In previous AEMP reviews, Dominion has argued that sculpin are a fish species that can act as an early warning system for potential future effects on large bodied fish. As such Dominion should note

[1] MacCrimmon P.N.., R., C. D. Wren and B. L. Gots**.** 1983. Mercury uptake by lake trout, *Salvelinus namaycush*, relative to age, growth, and diet in Tadenac Lake with comparative data from other PreCambrian Shield lakes. Can. J**.** Fish. Aquat. Sci. 48: 114-120.

Gantner, N., Muir,D.C. Power, M. et al. 2010. Mercury concentrations in landlocked arctic char (Salvelinus alpinus) from the canadian arctic. part ii: influence of lake biotic and abiotic characteristics on geographic trends in 27 populations. Environmental Toxicology and Chemistry, Vol. 29, No. 3, pp. 633–643

[2] Lemly, A.D. 1993. Teratogenic effects of selenium in natural populations of freshwater fish. Ecotoloxic. Environm. Safety. 26:181-204.

Chapman, P., Adams, W.J, et al. 2010. Ecological Assessment of Selenium in the Aquatic Environment. 141 p. CRC Press.

these early warning signs and take a proactive approach to address the elevated levels of selenium in sculpin, such as the development of selenium action levels for slimy sculpin in the Fish Response Plan.

Recommendation: Slimy sculpin should be included in the development of selenium action levels in the Fish Response Plan.

Selenium in Whitefish

Selenium is showing signs of increasing to levels of concern not only in sculpin but also round whitefish in Leslie Lake. Low Action Levels were exceeded in whitefish muscle in lakes downstream of the LLCF (Leslie, Moose and Nema lakes). Monitoring of selenium (in round whitefish at minimum) should be expanded to measure selenium concentrations in female ovarian tissue of harvestable fish species since toxic levels of selenium is most harmful to developing eggs. Therefore, monitoring selenium levels in the ovaries would provide better understanding of potential impacts to fish development. Also, selenium in some round whitefish livers were measured at levels that the BC Ministry of Environment guideline for safe fish consumption considers harmful to human consumers of edible fish tissues (14 mg/kg for moderate frequency of fish consumption). This guideline was not applied since whitefish livers are not being consumed by Aboriginal people of directly affected communities. However, these elevated levels of selenium in whitefish liver are cause for concern since other species present in Ekati lakes, such as burbot (*Lota lota*), can have their livers consumed by people.

Recommendation: Dominion should monitor selenium concentrations in female ovaries of round whitefish.

Recommendation: Dominion should investigate burbot in future AEMP fish monitoring for selenium concentrations in liver and muscle to determine their safety for human consumption.

Zooplankton Sampling Methodology

The Agency believes that zooplankton diversity and density in AEMP lakes may be underestimated due to the mesh size of collecting nets being large enough to allow the tiniest species to pass through. To address this the Jay AEMP proposes to use a finer mesh (80 µm) plankton net to collect zooplankton samples in Lac du Sauvage, instead of the 118 µm mesh plankton net currently used for the existing Ekati AEMP. It is likely this would increase the number of species, especially rotifers, collected. The 118 µm net is still being used in Ekati-wide AEMP as seen in 2018. The Agency would encourage the use of a finer meshed sampling net be used in the entire site-wide AEMP.

Recommendation: Dominion use finer mesh size (80 µm) for AEMP plankton sampling across all Ekati monitoring.

Aquatic Response Framework

The Agency supports the actions planned to address exceedances of action levels for Dissolved Oxygen, Potassium, Chloride and Phosphorus. The Agency would like to commend Dominion for its updates to Aquatic Response Framework response plans water quality and plankton which are improving with each new version submitted to the WLWB.

Study Design

There seems to be a slight study design error in the spatial analysis for EROD activity in fish. Distance to active haul road or airstrip was used to define proximity of affected lakes to mining activity. Moose Lake is 780 m from the airstrip, while portions of the shoreline of both Leslie and Nema lakes abut the haul road for Fox. So in spatial analysis for EROD, Leslie and Nema lakes should be considered closer to sources of contaminants (i.e., petroleum products) inducing EROD activity than Moose Lake. But the current analysis is categorizing Moose Lake as closer than the other two. This may be valid for slimy sculpin since the haul road was no longer used after 2014/2015 when the Fox pit ended production, but for the longer-lived species like round whitefish, older individuals sampled in 2018 would have been alive when the haul road was actively used.

Recommendation: For whitefish and trout EROD analysis, the spatial analysis should be redone with the scale of increasing distance from haul roads being sequenced as Leslie, Nema and Moose lakes. This will allow us to see if this gives a clearer picture of the influence of proximity to haul roads/airstrip on EROD induction in whitefish.

Should you have any questions concerning these comments, the Agency is pleased to discuss these at your convenience.

Sincerely,

Emery Paquin
Vice Chairperson

Cc: Dominion Diamond– Harry O'Keefe, Lynn Boettger
Tłı̨chǫ Government – Violet Camsell-Blondin
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