INDEPENDENT ENVIRONMENTAL MONITORING AGENCY
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September 15, 2016

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

Dear Ms. Camsell-Blondin,

Re: Dominion Diamond Ekati Corporation's 2015 Aquatic Effect Monitoring Program Re-evaluation Report

The Independent Environmental Monitoring Agency (Agency) has reviewed Dominion Diamond Ekati Corporation's (DDEC) 2015 Aquatic Effect Monitoring Program (AEMP) Re-evaluation Report. The Agency submits the following comments for your consideration.

Overall, the Agency supports most of DDEC's recommendations which are well thought out improvements to the AEMP's ability to better describe the aquatic ecosystem and detect aquatic environmental changes that may be detrimental to aquatic biota living downstream of the mine.

The Agency acquired the services of Dr. Michael Paterson of IISD-Experimental Lakes Area Inc. to assist in our review of the AEMP Re-evaluation. Mr. Paterson has 35 years of experience in the field of Aquatic Ecology and he was also involved in the original Environmental Assessment for the Ekati Mine. His report helped inform the Agencies comments. A copy of his report has also been submitted to the Board.

General

In light of the detailed and complex nature of some of the topics being discussed, the Agency feels that some of these topics are best addressed in person and do not lend themselves well to written comment/response style reviews. In addition, a meeting to discuss the topics will enable a general discussion of each topic which will allow everyone to hear and understand the view point of all stakeholders and not just the group who raised the issue. The Agency attended a meeting that DDEC organized in advance of the AEMP Re-evaluation being distributed, however because the meeting was held before reviewers had a chance to read the document there was limited opportunity for discussion of the technical content.

Recommendation: The WLWB schedule a discussion meeting to allow for open discussion of the concerns raised during this review. Following the meeting reviewers should be given the

opportunity to adjust their comments based on the discussion and DDEC time to respond before a Board decision is made.

Aquatic Effects Synthesis

The Agency agrees with the AEMP Re-evaluation report that "An emphasis should be placed on establishing correlations between nutrient increases, plankton community changes, and possible cascading effects [up the food chain to fish]." To that end, DDEC has not, as yet, developed a complete picture of how energy flows through AEMP lake ecosystem food webs. This is important as we need to know what changes to certain communities (phytoplankton, crustacean zooplankton, rotifer zooplankton, benthic invertebrates) and trophic levels (phytoplankton, invertebrate herbivores, invertebrate omnivores, invertebrate predators, fish herbivores, fish planktivores, fish piscivores) will affect fish the most through the food chain. Also this may give us a better idea of contaminant pathways through food chains.

Despite DDEC's claims to the contrary (p. 5-90), the Agency believes it may be possible to determine this partially through stable isotopes analysis. While stomach analysis is an important means of determining what taxonomic groups a fish species eats, the AEMP Re-evaluation report (p. 3-5) is correct in stating that these analyses only provide a snapshot in time for fish diet (also see 2015 AEMP section 3.3.5.3.10 for sculpin; 2012 AEMP section 3.7.3.12 for large bodied fish). Without multiple snapshots throughout a season and taken yearly, it is difficult to know how fish diet may change with prey species phenology (natural community change through a season). Through stable isotope analysis, which may only be needed once or twice over the course of a decade, a longer term picture can come into focus of which sectors of biotic communities (i.e. periphyton, benthos, crustacean zooplankton, non-crustaean zooplankton) are most utilized by a fish species in AEMP lakes. Ultimately, this would help determine if a fish species is more likely to be impacted by changes in benthos or in plankton.

Recommendation: Stable isotope analysis should be reconsidered by DDEC with a view to achieving a better understanding of energy flow through the aquatic biota food web, particularly as to how energy inputs to fish may be impacted by changes in lower trophic levels.

Reporting

Methodology Reporting

It would be beneficial to have all methods (sampling, statistical analysis, etc) for all sections of the AEMP (water quality, sediment quality, phyto- and zooplankton, benthos, fish) contained in one report. Currently most methods are contained in the Evaluation Report, but some (fish, for instance) are found in the Data Report. It is thus a time-consuming task for readers interested in how AEMP monitoring samples are collected and analyzed to find all the relevant methodological information. It may be necessary to develop a methods manual that would contain all methods under one cover.

Recommendation: DDEC develop a methods manual that would contain all methods for all sections of the AEMP under one cover.

Zooplankton Sampling

Frequency of Open Water Sampling

Frequency of open water sampling for phyto- and zooplankton is an issue and is dependent on what is the objective in monitoring plankton communities. If plankton are being sampled primarily as an early-warning indicator of significant whole-community effects based on their shorter generation times, once-a-year sampling at a time of least variability (August-early September in the case of Ekati lakes) as is currently done may be sufficient. If on the other hand, plankton are being sampled to better detect and predict changes affecting the primary Valued Ecosystem Components in Ekati lakes higher up the food chain, such as fish, it is the belief of the Agency that more frequent sampling is required during the open water season.

Recommendation: It is the Agency's view that for the purpose of the Aquatic Effects Synthesis, sampling the plankton more than once per open-water season is warranted. A rationale for continued once-per-season plankton sampling should be presented by DDEC.

Mesh Size

Zooplankton sampling methods are inadequate for collecting and assessing rotifer populations (more than 60% of samples contained fewer than 3 species). Zooplankton monitoring uses a 118-µm mesh nets (2014 AEMP Data Report). It is likely that this mesh size greatly underestimates rotifer biomass and density, possibly by as much as 1 to 2 orders of magnitude (Likens and Gilbert 1970; Chick et al. 2010). The consensus among zooplankton researchers is that a 20 to 35 µm mesh is needed to quantitatively sample rotifers. Because nets with such small mesh sizes often clog, different nets are likely needed to effectively collect both rotifers and crustaceans. It is reasonable to assume that both nets could be deployed simultaneously in each tow (one on either side of the boat, for example) so it should not add to zooplankton sampling time of current AEMP methods. The Agency is interested to know how this missing element of zooplankton populations would affect Simpson and Shannon diversity indices.

Recommendation: DDEC should consider incorporating the use of 20 to 35 µm mesh nets in its annual zooplankton sampling regime. DDEC should explain how under-representing the rotifer community may affect Simpson and Shannon diversity indices.

Community Composition

Although the Agency appreciates that the addition of more detailed community composition analyses for plankton will be beneficial to greater understanding of changes in plankton communities, it may be necessary to retain measurement of diversity indices. This is particularly true if it becomes necessary to determine long temporal trends in these metrics or to compare reference vs impacted lake conditions. Generating these indices is not a complicated or time consuming process.

Recommendation: DDEC should consider retaining Shannon and Simpson diversity indices for phytoplankton and zooplankton monitoring.

Water Quality Sampling

AEMP reports have shown that the Ekati mine has affected water chemistry in the Koala and King-Cujo watersheds, mostly expressed in changes in concentrations of several ions and nutrients. In turn, these changes may have affected thermal stratification as well as biota. Multivariate analysis is a welcome tool that the company is using to determine how multiple water quality variables could be affecting biota. It is extremely difficult if not impossible to ascribe a single causative factor such as nutrification as responsible for variation in plankton community composition.

Volume-weighted chemical concentrations

Lake stratification caused by variations in water density affects lake water chemistry and biology. Currently, water quality sampling is based on samples collected from the upper and mid-water depths. The AEMP Re-evaluation now proposes to sample deep-water strata as well. While the Agency welcomes this addition, we are concerned that the addition of deep-water samples alone may be insufficient to fully understand mine effects in stratifying lakes. The AEMP's current practice of aggregating measurements from multiple depth strata for water quality may not be advisable. Water quality analysis in multiple depths should be kept distinct to describe the full range of potential chemical exposure to biota.

Lake bathymetry, including depth of thermocline and water column stability, have been factored into the Aquatic Effect Synthesis assessment of relative importance of various factors driving functional change in biota (p. 4-33), but bathymetry also needs to be taken into account when considering abiotic factors that affect the chemical regimes at different depths. If the goal of the AEMP is to assess chemical concentrations relative to Aquatic Response Framework (ARF) action levels, then the current water sampling program is likely meeting that goal. However, to fully appreciate the effects of the mine on water chemistry (even on one date), it would be ideal to collect samples from a depth profile in each stratified lake and to then use bathymetric maps to obtain a volume-weighted chemical concentration of each depth layer. While the Agency acknowledges this would mean more work and cost for DDEC (sampling at more than 3 depths in each lake), it would help to account for among-lake differences in bathymetry that may influence among-year changes in water chemistry. Not all chemical parameters need to be analyzed for all samples from all depths on all days and duplicate and triplicate analyses are also probably not always required. In some cases, samples can be collected and archived and only analyzed if initial samples from a limited suite of depths (such as the ones currently used) provide an indication of potential problems. Within-depth variation can also be determined from a sub-set of collections.

Recommendation: Volume-weighted chemical concentrations of each depth strata in all AEMP lakes should be calculated.

Passive Continuous Monitoring

Considering that streams are sampled more frequently than lakes for water quality (in 3 open-water months for streams, in one month for lakes) and the stream data are not being linked to lake water quality results, established methods for increasing lake open-water sampling may be warranted. To that end, we would suggest that this could be achieved with a continuous-monitoring probe for each AEMP lake. Related to this, a concern the Agency has raised previously during the EA for the Jay project is whether dust could impact lake ecosystems at Ekati. A continuous turbidity monitoring probe could be positioned in lake sites where a dustfall zone intersects a lake. This would give real-time monitoring of dust-caused turbidity to more accurately assess impacts of periods of heavy dustfall on lake water quality.

Recommendation: DDEC should investigate the incorporation of passive continuous monitoring probes to collect more frequent water quality data during the open-water season. As well, the introduction into sampling design for water quality of passive continuous monitoring probes for turbidity should be considered to monitor effects of dustfall on lake water quality in lakes intersected by dustfall zones.

Table 5.3.3

Table 5.3.3 incorrectly states that Total Kjeldahl Nitrogen (TKN) is "…evaluated indirectly as total ammonia-N, nitrite N, and nitrate-N". TKN does not include nitrate or nitrite and is substantially comprised of Nitrogen species not included in the listed parameters (most notably organic N).

Recommendation: The statement in Table 5.3.3 about the Nitrogen constituents of TKN should be corrected.

<u>Sediment Sampling Methods</u>

The AEMP is designed to identify significant environmental changes brought about by the Ekati mine. Given this objective, it is worrisome that DDEC wants to stop using the K-B corer that has been proven to more effectively identify changes in sediment quality over time than the Ekman grab. A DDEC study found that the top 1 cm of corer samples had higher concentrations of most variables than the Ekman dredge samples. It was determined that the 2 cm layer of sediment from Ekman samples was diluting the higher concentrations of variables found in the most recently deposited sediments (i.e. top 1 cm) that could only be sampled with the corer. So the corer is more sensitive to monitoring temporal changes in sediment quality than the Ekman dredge. (p. 5-56 of AEMP Re-Evaluation Report).

"The 2014 AEMP Evaluation of Effects [using Ekman data] concluded that no mine effects were detected with respect to selenium sediment concentrations in any monitored lake of the Koala or King-Cujo watersheds" (ERM 2015b). However, statistical and graphical analyses using core data [to replace the dredge data in 2011 and 2014] suggest that selenium concentrations have increased through time in Leslie, Moose, and Nema lakes in the Koala Watershed." (p. 5-57 of AEMP Re-Evaluation Report) This result is of great significance to fish monitoring as the 2015 AEMP identifies selenium in tissues as an emerging issue for slimy sculpin, a lake bottom-

dwelling species, in those same Koala watershed lakes. Sculpin selenium results were also consistent with 2012 results for trout and whitefish — increasing concentrations — in the same downstream lakes.

If we accept the Re-Evaluation Report's argument that Ekman dredge sampling protocol should continue to be used for the Koala & King-Cujo watersheds due to the need to maintain monitoring of historical trends, then the same consideration need not be made for new mining projects in different watersheds at Ekati. Jay and Sable are just beginning their AEMP sampling history. The corer-vs-dredge study's results suggest that before/after comparisons of sediment quality for these 2 new mine developments may be better served using the more conservative results of the corer. The study also "suggested that replacing the current AEMP sediment sampling protocol with a coring protocol could improve the sensitivity of the program, resulting in a higher probability of detecting a mine effect" (section 5.4.1.1 -p. 5-50 of AEMP Re-evaluation Report)

Recommendation: The K-B corer continue to be used with the Ekman dredge for the King and Cujo watersheds and certainly be used in control lakes and all AEMP lakes attached to the Sable and Jay projects.

Slimy Sculpin

Non-lethal Sampling

Slimy sculpins are likely a good surrogate species to gauge impacts on large-bodied species. However, the Agency, as we have stated in the past, believes that non-lethal means of monitoring large-bodied species, particularly lake trout and round whitefish, should be conducted. Assuring Aboriginal communities that fish health and safety for human consumption is not compromised by the mine is best addressed more frequently than once every 6 years. The Agency is aware of recent advances in non-lethal sampling techniques for determining body condition and contaminant loading, some of which have been used successfully in the past at Ekati and some which could be investigated further.

Recommendation: The AEMP should incorporate non-lethal sampling of large-bodied fish species that could be undertaken at a greater frequency than the current once-every-6-years schedule.

Lack of Sculpin Baseline Data

The lack of sculpin baseline data at Ekati is problematic for determining whether changes in contaminant loads in sculpin are attributable to mine effects. One method that may help generate baseline data for contaminants is the use of otoliths. The literature shows a number of studies have used chemical concentrations in otolith annual layers to gauge chemical uptake in fish over time. In Ekati lakes otoliths from the oldest sculpin (10 years) could be utilized to determine relative body burdens in fish sample populations up to 10 years ago. The Agency does not know if whole-sculpin samples or ageing structures (i.e. otoliths) from earlier mine-development years were archived but if so, those could be utilized to flesh out chemical uptake at even earlier time periods.

Recommendation: DDEC should investigate the use of sculpin otoliths to establish a longer temporal trend in sculpin chemical body burdens.

Section 5.7.2

Section 5.7.2 seems to suggest that changes in body burdens of some metals in sculpin (selenium in 2012, molybdenum in 2012 & 2015) are unrelated to mine activity. The Precautionary Principle would dictate that in the absence of scientific certainty due to lack of baseline, we should err on the side of caution so that these changes should be considered possibly, if not likely, caused by the mine, rather than "not deemed ... mine-related" which suggests a natural cause. (Table 5.7-1 & 2)

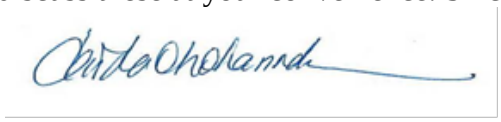
Recommendation: Given the lack of sculpin baseline data, the wording in Section 5.7.2 should be changed to reflect the uncertainty as to whether increases in molybdenum and selenium concentrations in sculpin are caused by the mine.

Graphical presentations

The Venn diagrams (Fig 4.2-6 to 4.2-8) displaying the relative contributions of water quality, lake morphology and biota to influencing various plankton communities are very clear in the information they convey. This is an effective way to convey information in visual format. Even a casual reader should understand the information presented there. On the other hand, graphs of water quality in lakes over time have become visually muddy. It is hard to follow the temporal trends for each lake.

Recommendation: Water quality graphs for each variable should be revised to make the information more visually distinguishable.

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



Jaida Ohokannoak
Chairperson

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Tlicho Government - Sjoerd van der Wielen
Yellowknife Dene First Nation – Alex Power
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North Slave Metis Alliance – Shin Shiga
Kitikmeot Inuit Association – Jared Ottenhof
Government of the Northwest Territories – Laurie McGregor
Indigenous and Northern Affairs Canada – Jennifer O'Neil

References

Chick, J. H., et al. (2010). Underestimation of rotifer abundance a much greater problem than previously appreciated. Limnology and Oceanography: Methods 8: 79-87.

Likens, G. E. and J. J. Gilbert (1970) Notes on quantitative sampling of natural populations of planktonic rotifers. Limnology and Oceanography 15: 816-820.