



## **BHP EKATI DIAMOND MINE AQUATIC EFFECTS MONITORING PROGRAM, SCIENCE REVIEW**

### **Context**

The EKATI Diamond Mine, located approximately 300 kilometres northeast of Yellowknife, produces nearly four per cent of current world diamond production by weight and six per cent by value. Ekati officially opened on October 14, 1998.

Environmental stewardship of land and water at the EKATI Diamond Mine is governed by an operational environmental management plan, part of which includes effects-monitoring programs for wildlife and aquatics where traditional ecological and scientific knowledge complement each other. As a condition of BHP Billiton Diamond Inc.'s (BHP Billiton) Water License MV2003L2-0013, Part I, item 1, the EKATI Diamond Mine (EKATI) Aquatic Effects Monitoring Program (AEMP) requires re-evaluation every three years. The AEMP plan for 2007-2009 was prepared for submission to the Wek'eezhii Land and Water Board to fulfil conditions of Part I, items 1, 2, 3, 4 and 5 of Water License MV2003L2-0013.

Fish Habitat Management (FHM), Western Arctic Area has requested that Science review the documentation provided by the proponent to determine if the Aquatics Effects Monitoring plan adequately allows for the detection of any environmental impact of mine activity at an early enough stage to allow for corrective actions

### **Analysis and responses**

#### **General Comments**

Reviewers found it difficult to provide review and advice on an isolated part of a long-term process. The document, provided for review, did not clearly describe the plan. It required detailed knowledge of what the past work had been and what results were available from the previous work to understand the logical progression of the plan. From an outsider's perspective, the document does not provide a clear, complete, succinct nor well-organised description of the plan. This makes the review difficult and thus the ability to answer the primary question from FHM almost impossible. The real answer to that question might lie in the work which has been done to date and any analysis of that which might have been done. There is some of this implied in parts of this but those results are not presented here. Would some request to have such an analysis done by the proponents be a useful exercise? If so, would that provide FHM with their answer?

To observe an effect and attribute that to a specific cause, a properly designed experiment would include both a treatment group and a control group. This approach is not readily evident within the proposed protocol. However it would seem that there is (or should be) ample opportunity for it. The approach presented seems to be one of longitudinal (temporal) study in

which a shift in some parameter is taken as evidence of change. The problems with this approach are: a) picking the correct and appropriately sensitive parameter to observe the change early enough in the shift so as to allow for some response and b) attributing causation unequivocally to any change observed. What has been proposed can not do so in a way that will be particularly effective.

There is concern as to the limited sampling of responsive biota exposed to epilimnetic waters (assuming the lakes are stratified) under the proposed plan. Although impacts to deep waters are most likely (making determinations of profundal benthos community structure important), it is also possible that epilimnetic waters might be affected with lesser effects on the deep waters and sediments. The proponents are asking to drop inshore benthos sampling and have a weak sampling scheme for zooplankton and phytoplankton. Like zooplankton, chlorophyll a is temporally dynamic, but is being sampled only once in the summer. In addition, Chl a is not a particularly sensitive measure at the best of times. Perhaps the measures of water chemistry are sufficient, but links to biota with short times of response might be desirable. Hence, in answer to the question "*does the Aquatics Effects Monitoring plan submitted by BHP adequately allow for the detection of any environmental impact of mine activity at an early enough stage to allow for corrective actions*", the answer is both yes and no. The proposed protocol may suffice for impacts to profundal benthos, however, if there are any likely impacts that are limited to epilimnetic waters during stratification, the protocol is not adequate to detect change. Are these effects likely? Unfortunately, DFO Science personnel are not sufficiently aware of the potential effects of the mine on water chemistry to answer this question.

## Detailed Comments

### Pg. 2.1 Section 2-1, item 6

Are there enough background data with respect to what constitutes a 'normal' population/assemblage of nematodes in Arctic freshwater systems to be able to recommend to the proponent that this work be undertaken?

### Pg. 2.2 Section 2-1, item 9

If there is concern as to fish mortality and size/species selectivity through the use of either gillnets or by angling, the use of non-selective and/or non-destructive sampling methods/gear such as trap nets/hoop nets should be considered.

### Pg. 2.2 Section 2-1, item 13

What is the rationale for the inclusion of selected chlorinated organics and especially chlorinated phenols in the suite of analyses to be undertaken? Are these compounds used in the processing of the kimberlite and if so are they present in the waste streams from the processing operations? If so, then retain this requirement; but if not why is this requirement retained as part of the AEMP?

### Pg. 2.4 Section 2.2, item 18.

With respect to the introduction of multivariate analyses, from a strictly analytical point of view, the analyses could be productive if conducted every year, rather than every three years as proposed. A dramatic change could certainly be evident in that time especially if there is a departure from reference conditions. However, if it is certain that there will only be gradual trends over time, it is true that an annual examination will provide little new insight.

Pg. 2.4 Section 2.2, item 19

We are unfamiliar with the Temporal-Spatial Level by time design (Wiens and Parker, 1995) proposed and therefore cannot comment on whether it will improve the ability to detect gradually increasing trends over time.

Pg. 2.4 Section 2.3, item 24

We concur with this recommendation.

Pg. 3-2 Table 3-2

With respect to zooplankton, a sampling program undertaken once a summer in August will provide very low power for detecting mine-related effects. This is because zooplankton abundance, biomass, and species composition are typically variable seasonally and the pattern of seasonality may change among years and among lakes with changes in temperature, hydrology, etc. The proposed program will allow only for the detection of extremely large impacts

Concerning the inshore benthos, this is a judgement call to some degree. Even worse than zooplankton, inshore benthos are highly variable in both space and time, making them a comparatively poor candidate for the detection of biotic effects.

Pg. 3-5:

In *Table 3-4* it is stated that the annual frequency for monitoring of the fish component of the ecosystem is 'every 5 years'. In what year will the five-year periodic sampling regime occur in the three-year period covered by this document? If the intended sampling year falls outside of the 2007-2009 time frame for the AEMP, then the short answer, from a fish perspective, to the question posed by FHM "*does the Aquatics Effects Monitoring plan submitted by BHP adequately allow for the detection of any environmental impact of mine activity at an early enough stage to allow for corrective actions*" is 'no'.

Pg. 3-6, Table 3-6: Stomach contents of fish

It is not clear from this table how analysis of the stomach contents will answer the question posed by FHM. Regardless, taxonomy of content may not be the most relevant - why not also include/conduct some measure of stomach content frequency of occurrence, numbers, volume (all by taxon of course)? Over time this might provide some insight as to shifts in food base as a result of environmental change.

Pg. 3-6, Table 3-6:

Gross anatomy of organs and any observed deformities should also be included. Thus, since liver and gonad weights are to be taken, then a photograph of their gross anatomy in parallel to the DELT analysis would be useful. There is some literature on such effects for fishes in heavily industrially impacted northern Siberian lakes. Colour of the organs should be also be assessed (i.e., include a standard colour photocard in the photographs). If properly done and if properly baselined, such gross anatomy changes may in fact answer the question posed by FHM, however, whether this would be observable early enough to allow for corrective action remains to be seen. One issue with the DELT approach is that assigning cause might be a problem - but if such was done externally for large fish which were recaptured on a frequent basis it might work. Given the implied/real periodicity of fish sampling of every 5 years it is unlikely that timing would allow for 'early corrective action'.

Pg. 4-2 and 4-3, Tables 4-1 and 4-2:

The table indicates that in the lake, both fish and fish habitat will be sampled, but that in the streams only fish habitat will be sampled. This seems to suggest that no fish will actually be sampled in the streams. Is that so? If not, does this undermine the question posed by FHM or will lake sampling be enough?

## **Conclusions**

The Aquatic Effects Monitoring Program document provided for review depends on a knowledge of both what monitoring was done previously and what the results were, to understand the effectiveness of the overall monitoring plan. Without this full background picture, the current AEMP document provides insufficient information to determine if it would allow detection of any environmental impact of mine activity at an early enough stage to allow for corrective actions.

The approach described in the AEMP is to monitor temporal changes which will be affected by the choice of parameters and the frequency of sampling necessary to recognise change. In addition, determining the cause of any change observed would be difficult or impossible. A better approach may be to design an experiment which would include both a treatment group and a control group which would then allow an observed effect to be attributed to a specific cause.

There were also specific concerns with frequency of sampling and analyses which may be insufficient to detect environmental impact of mine activity.

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## **Sources of information**

EKATI Diamond Mine Aquatic Effects Monitoring Program Plan for 2007-2009. Dec. 2006.  
Rescan™ Environmental Services Ltd. Yellowknife

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