WORKING WITH THE PEOPLE FOR THE ENVIRONMENT

August 1, 2019

Mark Cliffe-Phillips
Executive Director
Mackenzie Valley Environmental Impact Review Board
P.O. Box 938
Yellowknife, NT X1A 2N7

Re: EMAB Intervention – PKMW

Dear Mr. Cliffe-Phillips

The Environmental Monitoring Advisory Board (EMAB) is pleased to submit an intervention for MVEIRB File DDMI EA1819-01 for Diavik Diamond Mines Processed Kimberlite in Pits and Underground Environmental Assessment. We have provided a link to a Dropbox file since the files are large and there are many of them

Please contact John McCullum at the EMAB office if you need more information.

Sincerely,

Charlie Catholique
Vice-Chair

Cc Board Members and Alternates (by email)
Parties to the Environmental Agreement (by email)
Catherine Fairbairn, MVEIRB (by email)
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Environmental Monitoring Advisory Board

Intervention to the Mackenzie Valley Environmental Impact Review Board

on

DDMI Diamond Mines' EA1819-01

Processed Kimberlite in Pits and Underground Environmental Assessment

August 1, 2019

Contents

Introductory Comments

A note on attachments: attachment cover pages are included at the end of this document. All attachment documents are included in the attachments folder with the attachment number in the file heading. Citations are labelled with either the MVEIRB public registry (PR) number or EMAB attachment number, where applicable.

EMAB's Mandate

The Environmental Monitoring Advisory Board (EMAB) serves as a public watchdog for the environmental regulation at Diavik Diamond Mine (DDMI). The formation of EMAB came as a result of the Environmental Agreement (see EMAB Attachment #5), which came into effect in the year 2000. The Agreement was signed by five Aboriginal Parties (Kitikmeot Inuit Association, Lutsel K'e Dene First Nation, North Slave Metis Alliance, Tlicho Government and Yellowknives Dene First Nation), the Federal and Territorial Governments, and DDMI Diamond Mine. EMAB operates independently of these Parties to the Agreement to review environmental reports and regulatory data related to DDMI, and to make recommendations to the Parties based on our reviews. Providing advice and direction to DDMI, and verifying the effectiveness of DDMI's environmental programs are also a part of EMAB's scope of work. Additionally, EMAB facilitates the exchange of information between DDMI and affected communities, working as closely as possible with Aboriginal communities to ensure that their input, concerns, and Traditional Knowledge (TK) are considered by DDMI. EMAB's mandate also includes participating as an intervenor in regulatory processes which involve DDMI.

EMAB does not speak for any of the Parties and must make clear that this submission should not be taken as representing any of their individual views.

EMAB's intervention addresses issues related to potentially significant adverse impacts of DDMI's proposal to place processed kimberlite (PK) in the pits and underground at the minesite. Our intent is to identify issues, provide constructive comments and make recommendations that will mitigate any potential adverse environmental impacts of the project.

EMAB wishes to acknowledge that DDMI has largely implemented its commitments to monitor the impacts of the mine on the environment in the area including Lac de Gras (LDG) and surroundings. Impacts are within predictions made during the original Comprehensive Study Report (CSR) completed in 1999. The mine is generally well-managed and DDMI is generally responsive to direction from regulators.

Plain Language Summary of Intervention

- The number of rounds of Information Requests, and the many responses in many locations, have made it very difficult to keep track of all the information provided during this proceeding.

MVEIRB should look carefully at this and decided if the information is clear enough for reviewers, and whether there are lessons for future reviews.

- EMAB supports the concept of placing PK into the pits. However, it must be done in a way that protects the environmental health of the pit lake area and surroundings.
- EMAB is especially supportive of the idea to move the extra-fine PK (EFPK), also known as slimes, from the Processed Kimberlite Containment (PKC) Facility into the pit, if it can be done in a way that protects the environmental health of the minesite and LDG.
- EMAB notes that the definitions of significance should be carefully considered. Particularly, as they apply to the post-environmental assessment (EA) regulatory processes.
- Once this project starts any PK put into the pits will be very difficult to take out of the pits.
- EMAB needs to be confident that predicted results are accurate. We need to know that the proposed project will not result in significant adverse impacts on the environment.
- Water quality modelling provides the backbone for this assessment. DDMI has said the model they are using is simplified and it will run better models after the project is approved. There have been many questions about the modelling. DDMI has provided updated and corrected versions of the results. However, there are still questions about the way the modelling was done and how reliable the results are. This is particularly true for the predictions for the unanticipated mixing of the pit water. EMAB will raise a number of questions about the modelling in our intervention. For example:
    - The models should be re-run with new data DDMI is in the process of collecting. This should be done before final approval of the project and any PK is deposited to any pit.
    - Before a dike is opened, data from monitoring the pit lake should be compared with the results of modelling. The model should be re-run using the real data to confirm the original predictions. The real data should also be used to model the long-term effects of reconnecting with LDG.
- EMAB does not believe that A21 should be considered as a location for PK or EFPK disposal.
- DDMI has proposed not opening the dikes if water quality is not good. The decision to open them will be an important one. DDMI should provide a description of how the dikes could be re-closed after opening them in the event that it is required.
- There are questions remaining about fish and aquatic health. In particular, the assumption that fish and other aquatic life will not go below 40 m.
- Aboriginal harvesters need to be sure that if this project goes ahead the fish in the pit lake, and in LDG are safe to eat.
- There are possible impacts to wildlife from the project and DDMI needs to provide plans to fix them.
- It is important to follow a comprehensive monitoring plan to assess the predictions made by DDMI. The program should extend from the start of the project through to the post-breach period. It should include water quality, stability of the pit lakes, aquatic health, fish use of the lake, and wildlife health. Data from this monitoring should be used to verify the predictions about water quality before final approvals are given and dikes are opened.
- Contingency plans, such as re-closing the dikes, need to be described in more detail

- Current closure objectives do not address pit lakes containing PK. Closure objectives and criteria should be updated to consider this project.
- There are questions about how well the cumulative effects assessment has been done.
- EMAB wants DDMI to do the study on removing slimes from the tailings pond (Processed Kimberlite Containment facility, or PKC) as soon as possible.
- There are problems with leaving the slimes in the PKC if they cannot be moved to the pits. The PKC pond will drain within a year, and the pond covering the slimes in the PKC is crucial. The pond covers the slimes, which are like quicksand and could be a danger to wildlife and humans.
- It is EMAB's view that, with mitigation, the proposal will not result in significant adverse environmental impacts.

Comments and Recommendations on the Review Process

- The review process has been confusing and difficult to keep track of and this may have impeded the ability of reviewers to provide the best possible review. The confusion stems back to DDMI's original application to the Wek'eezhii Land and Water Board (WLWB) being completely inadequate with respect to assessment of potential significant adverse environmental effects ie. all DDMI provided was a half-page table.
- Much of the information since the initial application has been provided through Information Requests (IRs) and Party comments, followed by DDMI responses, followed by further IRs and further comments and responses through the WLWB and the Mackenzie Valley Impact Review Board (MVEIRB) online review systems (ORS). Many of the IR responses are substantive, such as results of application of water quality models, sensitivity analyses of the model, or a research proposal. :
    - 106 Party comments on the initial application, with responses from DDMI (Aug'19)
    - WLWB IR's (Aug 31'18) following up Party comments on the application and responses – 5 IR's with 17 sub-IR's
    - 77 Party comments on DDMI responses to WLWB IR's, with responses from DDMI
        - Additional Information provided by DDMI with its responses to Party comments (provided Jan 8'19)
    - WLWB Technical session Jan 16-17 with follow up IR's (15 plus 4 model scenarios to run)
    - MVEIRB IR's to DDMI (24 plus requirement for Summary Impact Statement) in April '19. Not for comment by Parties
        - DDMI also provided supplementary information with its responses (16 attachments)
    - Party IR's to DDMI (156 plus 10 after deadline) - June 20'19 with responses from DDMI
    - MVEIRB IR's on July 26'19 (5 including 10 sub-IR's)
- The ORS system works reasonably well for a single set of Party comments on a document, followed by responses from the proponent. A second round of comments and responses can become cumbersome. By the time there are seven rounds of review/comment/proponent response it is beyond the ability of most reviewers to keep track of all the information presented

and to determine which information continues to be valid and which has been replaced by more recent responses.

- The Summary Impact Statement (SIS - Rio Tinto, May 2019b) was intended to tie all the information to date together in a single comprehensive report; however, it did not include information the company provided as IR responses the week prior to issuance of the SIS.
- EMAB observes that the number of IR's, and particularly the number of rounds of IR's, indicates that the proponent has not been providing sufficiently adequate or clear information. This problem extends right back to the initial water licence amendment application.
- The information management component of the review process for this proposal has been confusing and sub-optimal and this may have inhibited the ability of organizations with limited resources, such as EMAB, or Affected Communities, from participating fully and effectively.

Recommendations:

1. The MVEIRB carefully consider whether DDMI has provided sufficient information about its proposal, in a sufficiently understandable form, that Parties to the review are able to understand the potential adverse impacts and proposed mitigations, and provide informed comments and recommendations about it.

2. The MVEIRB, and the WLWB, evaluate the information provided by the proponent in this assessment, and the form it has been provided, and determine whether there are lessons to be learned for future assessments in terms of information management.

Comment and Recommendation on Participant Funding

EMAB was pleased that funding was made available to participants in this environmental assessment, particularly Affected Communities, through the recently rolled out Northern Participant Funding Program. EMAB supports the need for participant funding in the review process and encourages the provision of participant funding at both the environmental assessment and regulatory review stages.

Recommendation:

1. That MVEIRB recommend that permanent, adequately resourced, participant funding programs be established to allow Affected Communities and other organizations to fully participate in environmental assessment and water licence proceedings.

Comments and Recommendations on PKMW Proposal

1.0. Definition of Significance

1.1. Overview

The Canadian Environmental Assessment Agency's (CEAA) CSR for the DDMI Diamonds Project defined 'significant adverse effects' as an impact having "a high probability of a permanent or long-term effect of high magnitude, within the regional study area." These definitions have been applied to Valued Components (VCs): water quality, surface water quantity, fish and fish habitat and wildlife and wildlife habitat (Slater Environmental (SEC), July 2019) (see EMAB Attachment #9). This raises concerns for EMAB, particularly with respect to water quality:

- A high magnitude effect for water quality is the concentration of a contaminant exceeding the drinking water and/or the aquatic guideline by more than 20 percent.
- The local study area for water and fish is "East Island and surrounding water, within 1 km of the East Island shoreline". The Regional Study Area is defined as "the drainage basin of LDG."

With this assessment threshold, water quality changes – no matter how large – within 1 km of East Island (which represents more than 25 square kilometers, almost 5% of the total area of LDG) would never constitute a significant effect. Similarly, any change less than 20% above Aquatic Effects Monitoring (AEMP) benchmarks would not be significant.

By definition, significant adverse impacts cannot be mitigated (CSR 1999). Most of DDMI's proposed definitions and thresholds of significance for the PK to mine workings project are similar to those outlined in the CSR (SEC, June 2019).

DDMI has used the CSR definitions of significance to argue in its Interim Closure and Reclamation Plan (ICRP) that it should not have to meet AEMP benchmarks plus 20% for water quality and aquatic health inside a 1km ring around East Island because these would not be considered significant impacts under the CSR definition.

DDMI developed an updated definition of significance for Cultural Use to reflect the complexity of assessing effects on cultural use and meet the requirements of the *Mackenzie Valley Resource Management Act* (MVRMA). While the significance thresholds and definitions for Cultural Use are not drawn from the 1999 CEAA Comprehensive Study Report, they apply similar methods and set thresholds of similar magnitude. Based on the definition of significance developed to evaluate effects on Cultural Use, effects will only be considered significant if the residual effects extend beyond decommissioning and abandonment and cause critical reduction or elimination of Cultural Use within the Regional Assessment Area (RAA). The RAA is a 13,865 km^2 area, shown in Figure 8-1 in the SIS (Rio Tinto, May 2019b). DDMI does not provide a definition for critical reduction of Cultural Use.

1.2. Impact Predictions

Water Quality:

- Under DDMI's current definitions and thresholds of significance, models would have to predict contaminant concentrations that exceed AEMP benchmarks by 20% for over 30 years at more than 1km from East Island before an effect would be considered significant (SEC, June 2019).

Cultural Use:

- Under DDMI's current definitions and thresholds of significance, effects to cultural use would only be considered to be significant if residual effects extend beyond abandonment of the mine site and cause 'critical reduction' or elimination of cultural use (SEC, June 2019).
- DDMI does not provide a definition for 'critical reduction of cultural use' (SEC, June 2019).

1.3. Developer's Conclusion

DDMI prefers using previously developed significance thresholds and definitions because it maintains consistency with the CSR.

1.4. EMAB's Conclusion

It is EMAB's view that in the past DDMI has misused the CSR definitions of significance to provide justification for proposing unacceptably high water quality parameter concentrations within 1 km of East Island, and may make the same argument with respect to monitoring effects of pit lake water on LDG.

In response to EMAB's review comment #4, DDMI outlined that the environmental assessment method used to develop the SIS are consistent with current practices. While the methods for conducting environmental assessments remain similar to those used under CEAA in 1999, this does not mean that the specific thresholds for significance are still applicable and appropriate. DDMI's response does not provide up-to-date rationale for the applying the threshold and significance definitions developed during the initial mine assessment.

The recalibration of the assessment that arises from updated definitions and thresholds could lead to identification of important effects that are not currently considered in the assessment. For example, the current assessment for wildlife and wildlife habitat focuses on changes in wildlife health due to water quality effects during the closure and post-closure periods. Revisions of thresholds for wildlife may mean that other potential effects become relevant.

1.5. Rationale

EMAB is concerned that decisions based on DDMI's definition of significance will be used by the company during regulatory proceedings to rationalize the use of a 1km mixing zone around the pit

lakes, and that DDMI will propose water quality benchmarks at that distance. DDMI has already made this argument to justify proposing a 1 km mixing zone around East Island for runoff and seepage from its waste rock storage area and processed kimberlite containment area.

It is EMAB's view that DDMI's rationale of using the definition of significance from the CSR as a basis for proposing a very large area around East Island as a mixing zone within which environmental standards do not have to be met is incorrect. Ehrlich and Ross (2015) have addressed the general issue of the relationship between significance determination and regulation in their article "The significance spectrum and EIA (environmental impact assessment) significance determinations" (see EMAB Attachment #1) in which they observe that "One reason for this is because regulations are primarily designed to deal with impacts that are not significant. The regulators who issue authorizations such as water licenses are primarily legally able to do so for projects that do not have significant impacts. These authorizations typically define specific limits. The range of these, on the significance spectrum, would appear as an area within the 'no significant impact' range. Regulators are able to choose the final limits of their authorizations only if the EIA significance determiner first decides that the residual impacts are acceptable (i.e. not significant)."

EMAB notes that definitions used in the CSR do not consider changes that have occurred since 1999 (SEC, June 2019). Significance thresholds have likely changed as the environmental conditions and context at DDMI have changed. This issue needs to be addressed and significance thresholds should be revisited for all valued components (VC's) (SEC, June 2019). DDMI's argument to maintain using CSR thresholds and definitions is not supported by rationale as to why they are still relevant or applicable for present-day use (SEC, June 2019).

For example, DDMI maintains using the outdated AEMP benchmark of 30µg/L for zinc for consistency with the CSR, even though the context has changed, and the Canadian Water Quality Guideline for the Protection of Aquatic Life has reduced appropriate zinc levels to 7µg/L (SEC, June 2019). It would be more appropriate for DDMI to use the updated Canadian Water Quality Guidelines.

Under DDMI's proposed definitions and thresholds of significance, models would have to predict contaminant concentrations that exceed AEMP benchmarks by over 20% for over 30 years at more than 1km from East Island before an effect would be considered significant (SEC, June 2019).

The decision to rely on significance thresholds and definitions from the 1999 CEAA CSR does not adequately consider the changes in conditions and context that have occurred since that assessment was conducted. Environmental conditions and contexts have changed and need to be considered. The issue needs to be addressed for all VCs, but most notably, the conditions and context for the Bathurst caribou herd have changed dramatically and the significance threshold has likely also changed. When the CSR was completed the Bathurst caribou herd had a population over 42 times the current population. The significance thresholds developed at that time may have provided sufficient protection for the herd in that context. In the April 2019 "*Scope of the Environmental*

Assessment and Reasons for Decision" document, the Review Board emphasizes the precarious state of the Bathurst caribou herd and states that any potential impact of the proposed activities on the herd should be carefully considered and mitigated. This careful consideration should extend to the thresholds for significance and the definitions used to characterize effects.

The cultural and legislative/policy context has also changed since the completion of the CSR. The CEAA no longer applies and has since been replaced with the MVRMA (SEC June 2019). People's understanding of mining and its effects has also changed. Governments and citizens have much more experience with diamond mining. Reconciliation with Indigenous groups has become an important Canadian policy initiative. Although these changes have led to an adjustment in the definition of significance for Cultural Use from the CSR, the SIS does not address how perspectives and values have been considered in establishing the definitions and thresholds for significance for all VCs. This should be reflected in DDMI's definitions for significant effects to cultural use. Significance thresholds appear to rely on technical characteristics of the effects. There is minimal consideration of the values of the Aboriginal people who are likely to be affected by the project. These people who are most affected use the area for life-sustaining activities, such as fishing (SEC, June 2019). Societal values, and particularly those of the Aboriginal people of the area, should have a key role in determining significance (SEC, June 2019).

1.6. Recommendations

1. DDMI should update their proposed definitions and thresholds for significance to reflect the current conditions and context for the Environmental Assessment. The updated definitions and thresholds should be supported by rationale that includes information about how the perspectives and values of people who will be affected most have been considered.

2. When conducting its assessment, the MVEIRB should give careful consideration to the definitions and thresholds for significance. It should rely on definitions and thresholds that reflect the current conditions and context for the environmental assessment and incorporate the perspectives and values of the people who will be most affected.

3. The Review Board should clarify how it would expect the definitions of significance in the environmental assessment to be operationalized during the regulatory phase, and whether a finding that an impact is not significant during an environmental impact assessment has any effect on the application of benchmarks, standards, guidelines etc. by regulators.

Reliability of Predictions

2.1. Overview

DDMI's assessment of the potential impacts of this project is largely based on the results of preliminary water quality modelling that uses simplifying assumptions. The assumptions, along with decisions regarding inputs and methods create uncertainty about the model predictions. There is potential for the model to under-predict effects for the project. It is important to examine all aspects of the modelling.

2.2. Impact Predictions

If the model is not accurately calibrated or uses the wrong input terms, then impact predictions may be incorrect and there may be potential for adverse environmental impacts.

2.3. Developers Conclusions

DDMI concludes that there will be no significant adverse impacts based on predictions using its water quality modelling results. DDMI tested the sensitivity of the model using a number of different scenarios and generally found that the model was not strongly affected.

2.4. EMAB's Conclusions

EMAB has raised a number of issues about the basis for DDMI's water quality modeling including: loading sources to pits, PK density and consolidation rates, porewater chemistry, model calibration, porewater release rates and the approach used in the sensitivity analyses.

2.5. Rationale

There are a number of questions about the accuracy of the water quality modelling predictions based on the various inputs DDMI has used. These include:

- Calibration is not based on the immediate environment at DDMI. Instead it relies on previous model calibrations for other mines in the region including the Ekati mine and Gahcho Kue Mine. DDMI has confirmed that most components of the model have not been calibrated (Rio Tinto, May 2019b (SIS) Section 4.4.1 and Rio Tinto July 2019b (July 4'19 response to EMAB IR# 14)), in SEC, July 2019). For example, the model relies on temperature data from the Snap Lake mine (SEC, July 2019). The user manual for CE-QUAL-W2 Model (Cole and Scott 2015 cited by Knapp, Feb 2019) (see EMAB Attachment #6) states "Results will be suspect at best and will not withstand scrutiny at worst if the model is applied with insufficient and/or inadequate calibration data."

- Inputs/loading, i.e. groundwater and porewater/pit wall contaminants were not included in the model and not adequately addressed in the sensitivity analyses (SEC, July 2019). DDMI did not provide information on the methods used to estimate water quality of the supernatant water pool, including how groundwater is incorporated into the estimate (SEC, July 2019).
- PK porewater quality source term may not be correct (SEC, July 2019; North-South Consultants (NSC), June 2019). DDMI has used different contaminant concentrations over the period since the application was first submitted and has acknowledged that the current use of a very small sample of fresh PK may underestimate contaminant concentrations (SEC, July 2019)
  Note that DDMI has commissioned research on porewater chemistry and PK consolidation from the University of Alberta (U of A) and has said it plans to re-run the model once the results are available.
- Densities and consolidation rates may not be correct, especially for EFPK (SEC, July 2019).
- The sensitivity analyses took a fragmented approach, i.e. the sensitivity analyses looked at a number of different scenarios as separate events, whereas in real life it is more likely the scenarios would be combined (SEC, July 2019).
- EFPK component of model likely does not represent actual behaviour of EFPK and there is potential that EFPK may take a long time to settle and affect water quality in the pit, especially if unanticipated mixing occurs (SEC, July 2019). DDMI's 2012 ICRP progress report includes Appendix II-6, Geotechnical Site Investigation Factual Report by AMEC Environment and Infrastructure dated Dec 5, 2011 (see EMAB Attachment #2). The report includes settling tests that show a thin layer of EFPK forming on the surface on top of the PK. As noted, this layer may behave differently than the PK and require less energy to disturb.

EMAB also notes that results from U of A research will not be available before the conclusion of the EA.

2.6. Recommendations

1. In conducting its assessment of potential effects on water quality, the MVEIRB should acknowledge the preliminary nature of the current modelling. To address the uncertainty about model results, the MVEIRB should require completion of more detailed, site-specific modelling to confirm the accuracy of predictions. This refined modelling should be provided for review/approval prior to final approvals and deposition of PK into pits.
    a. DDMI should be required to re-run the water quality model once U of A results are available.
    b. DDMI should also be required to re-run the model once it can be calibrated using information specific to the pit lake, i.e. before breaching the dike.
    c. MVEIRB should engage an independent 3rd party expert to review the water quality model and results.

2. Should the predictions change significantly after additional data becomes available DDMI should be required to re-assess the potential for significant adverse environmental impacts from the project.

3.0. Assessment of Effects on Water Quality

3.1. Overview

Following from its proposed definitions of significance DDMI has proposed that effects on water quality are negligible if they are less than 5% above AEMP benchmarks (Rio Tinto, May 2019b (SIS), Table 4-2). AEMP benchmarks are set based on protection of aquatic life. In many cases AEMP benchmarks can be much higher than natural or baseline conditions so a change that reaches an AEMP benchmark may be a large change in the concentration of that contaminant. Assessment of change in water quality of LDG should be done by a comparison with baseline conditions. In general, EMAB believes that water quality in LDG should remain as close as possible to what it was before the DDMI mine was developed.

Please also refer to EMAB comments on DDMI's proposed definitions of significance in section 1 of this intervention.

3.2. Rationale

The use of AEMP Benchmarks to define negligible magnitude relies on an underlying assumption that water quality has value only in the context of protecting some specific water use, in this case primarily for protection of the aquatic ecosystem. This assumption is appropriate when considering how water quality may affect aquatic ecosystem VCs, for example fish and fish habitat. However, the identification of water quality as a VC assigns an inherent value to water quality. An assessment of effects on water quality as a VC should consider the extent of change from baseline conditions, not just the extent of excursion above use-protection based guidelines or benchmarks. When developing definitions of magnitude of change, it is likely appropriate to assign lower ratings to changes that fall within use-protection guidelines or benchmarks, but these changes should not be considered negligible.

3.3. Recommendation

1. When developing definitions and thresholds for significance for water quality, the MVEIRB should consider the magnitude of change from baseline conditions. For water quality, negligible magnitude should be consistent with changes from baseline that are not

detectable with a reasonable monitoring program. Changes that are within use-protection guidelines or benchmarks may be appropriate for defining other categories of magnitude.

4.0. Benchmarks for Unanticipated Mixing Scenarios

4.1. Overview

DDMI has proposed that Ecological Thresholds for Water Quality be set at 20% above AEMP benchmarks. DDMI bases this on the definition of significance they have proposed for magnitude of effect. It is EMAB's view that it is incorrect to propose ecological thresholds above the levels considered to be protective of aquatic life i.e. AEMP benchmarks; this leaves potential that the thresholds may not be protective of aquatic life that is exposed to these concentrations for chronic periods. Additional comments on DDMI's proposed significance thresholds can be found under item 1 of this intervention.

4.2. Impact Predictions

EMAB's view is that AEMP benchmarks are protective of aquatic life, and that exposure to concentrations of contaminants above AEMP benchmarks may result in adverse impacts.

4.3. Developer's Conclusions

DDMI predicts the impacts from aquatic life being exposed to its proposed "revised ecological thresholds for water quality" (Rio Tinto, May 2019b (SIS), Table 4-3) will be insignificant.

4.4. EMAB's Conclusions

EMAB disagrees with DDMI's revised ecological thresholds for water quality because they may not be protective of aquatic health.

4.5. Rationale

Ecological thresholds should not be set above those protective of aquatic life.

EMAB notes that approved closure objective M1 states that water quality in the flooded pit and dike area should be similar to LDG or at a minimum protective of aquatic life (DDMI 2011, ICRP Ver 3.2) (see EMAB Attachment #4).

4.6. Recommendations

1. Ecological thresholds for water quality should not be higher, or lower as appropriate, than those established for the protection of aquatic life.

2. See Recommendation 3 under section 1.6 above.

5.0. Inclusion of A21

5.1. Overview

DDMI's modelling confirms that the A21 pit is the least suitable of the three pits for PK disposal. Diffusion of porewater into LDG is predicted to happen at a faster pace than in the other two pits, and meromixis is predicted to break down within 50 years, much less than the 100 years plus predicted for A418, or even A154.

5.2. Impact Predictions

Modelling predicts a more rapid deterioration of stratification in A21 than in A418 or A154, increasing the rate of contaminants entering LDG compared to the other pits. Destratification of the pits increases risks and could result in impacts to water quality and aquatic life. Compared to A418 and A154, there is increased risk associated with PK disposal in the A21 pit.

5.3. Developer's Conclusions

DDMI has included the assessment of A21 under the scope of this review in order to evaluate all available options (Rio Tinto, July 2019b; DDMI response to GNWT IR# 17). The need for additional storage beyond the capacity of A418 and A154 is not anticipated, however the option to dispose of PK in the A21 pit may be preferred in the event that A21 becomes available for disposal before A418 or A154 (Rio Tinto, July 2019b; DDMI response to GNWT IR# 17).

5.4. EMAB's Conclusions

EMAB does not think that A21 should be approved for PK disposal. Modelling has predicted that it would be less stable than the other pits. A418 and A154 have massive storage capacity, so that is not an issue. Inclusion of A21 is not necessary considering that modelling has shown that there are better options available that reduce potential risk.

5.5. Rationale

A21 modelling predicts a more rapid deterioration of stratification. Destratification would occur after approximately 50 years (SEC, June 2019). In comparison, destratification of A418 is predicted to occur much more slowly, with the onset of destratification estimated to occur beyond 100 years. This suggests that A418 is likely the preferred pit for disposal (SEC, June 2019).

Modelling results for all scenarios in A21 show that the stability of the meromictic gradient is not high (NSC, June 2019). Even if destratification occurs as predicted, and results in minimal exceedances of AEMP benchmarks, breakdown of the gradient allows for mobilization of contaminants from the PK porewater, possibly allowing for further increased concentrations of contaminants (NSC, June 2019).
Sensitivity analyses were not completed for pit A21. Therefore, there is less confidence in DDMI's predictions about A21 than for A418.

Scenario 3a for modelling A21 predicts an exceedance of nitrite, nitrate, and molybdenum below 40m depth (Rio Tinto, May 2019b (SIS), 2019). Scenario 4a for modelling A21 predicts that nitrite concentrations will exceed AEMP benchmarks in the upper 40m of the water column (Rio Tinto, May 2019b (SIS), 2019), this would have implications if the assumption that fish will not go below 40m is incorrect. Only for scenario 2a at A21 are all parameters predicted to be below AEMP benchmarks. From EMAB's perspective, AEMP benchmarks should be met for all scenarios to provide confidence in the decision to include A21 as a PK disposal option.

Limiting the amount of PK allowed for disposal or increasing the minimum water cap depth could decrease risk associated with PK disposal in A21. Including these limitations, with justification that they would improve stability of A21, could improve DDMI's rationale to include disposal to A21 in the scope of this assessment. Additionally, sensitivity analysis was only conducted for pit A418. They used results from A418 sensitivity analyses to make assumptions about A154 and A21. Conducting sensitivity analysis for A21 could provide more confidence in DDMI's assumptions.

5.6. Recommendations

1. The A21 pit should not be considered for PK disposal.

2. If MVEIRB decides to allow A21 for PK disposal, they should include pit-specific limits on the amount of PK allowed for disposal, increase the size of the water cap, and direct DDMI to conduct separate sensitivity analyses.

6.0. Decision to reconnect to LDG

6.1. Overview

Once PK has been deposited into a pit and the water cap has been pumped over top, DDMI will apply various criteria for deciding when, or if, the pit should be reconnected with LDG. DDMI proposes to use water quality as the sole criterion for making this decision, and has proposed limited monitoring of the pit lake to support the assessment of whether water quality is adequate to reconnect. EMAB's view is that there are a number of other criteria that should also be considered in the decision.

DDMI has indicated that, as a contingency, they may not reconnect the pit lake with LDG. There are a number of other factors that EMAB believes should be taken into consideration in this decision. These are addressed in section 10 of this intervention, on contingency plans.

6.2. Developer's Conclusions

If monitoring shows that water quality in the pit lake meets criteria then there will be no significant adverse impacts of reconnection with LDG.

6.3. EMAB's Conclusions

There are a number of criteria that should be taken into account in making the decision to reconnect the pit lakes to LDG:

- Water quality in the pit lake and potential effects on LDG and on aquatic life in the pit lake; DDMI has stated that it will use the AEMP benchmarks in the top 40 m of the pit as the criteria.
- Sediment quality in areas potentially used by fish and other aquatic life (SEC, July 2019);
- Physical stability of pit walls in relation to safety of humans and wildlife who may use the pit lake area post-closure, as well as in relation to potential for a collapse that could result in mixing of contaminated porewater with the rest of the water in the pit lake (SEC, July 2019); and
- Traditional Knowledge criteria, which are yet to be developed.

It will be important to ensure adequate characterization of the water and sediment quality in the pits, and trends over time, through a comprehensive monitoring program, prior to making the decision to reconnect (see item 9. Monitoring). A methodology to assess stability of the pit walls is also required.

Finally, TK should be applied to the decision to reconnect; this will require the development of TK criteria.

6.4. Recommendations

1. Water and sediment quality in the pit lake should be monitored comprehensively throughout the pit lake and over a sufficient time period to identify trends to ensure conditions are protective of aquatic ecosystem health prior to reconnecting with LDG.

2. MVEIRB should recognize sediment quality as an important indicator for the fish and fish habitat VC, and require DDMI to define appropriate sediment quality criteria that it will apply before reconnecting pit lakes with LDG. These criteria should be developed to support licensing for the PK to Mine Workings (PKMW) Project and should be protective of the aquatic ecosystem. The application of the criteria should be limited to areas that may affect fish, i.e., where fish are likely to be present.

3. To address potential effects on public safety, MVEIRB should require establishment of criteria for defining acceptable pit wall stability (e.g., return periods, factors of safety, etc.) before reconnection of pit lakes with LDG. These criteria should be developed to support licensing for the PKMW Project. They should be consistent with the expected post-closure land use, specifically increased recreational and subsistence use of the pit lake areas.

4. To recognize the value of Traditional Knowledge in making the decision to reconnect the pit lake with LDG, MVEIRB should require establishment of Traditional Knowledge criteria to consider in the decision.

7.0. Effects to Fish and Fish Habitat

7.1. Overview

Uncertainties about water quality and meromictic pit lake stability pose risks to aquatic life. Additionally, assumptions that fish will only reside in the upper 40m of the water column may not be correct. If this assumption is wrong, there is potential for fish to be exposed to water quality parameters that could have adverse impacts on the health of fish and other aquatic life.

Other than through water quality monitoring, DDMI has not proposed to monitor effects on fish. EMAB addresses this inadequacy in the section below. Inadequacies include monitoring fish (including other aquatic components such as benthic invertebrates), use of the pit lake (particularly at or below 40m), fish habitat monitoring plans and monitoring for contamination of fish tissue.

7.2. Impact Predictions

DDMI's modelling has shown that the upper 40m of LDG will be within benchmarks and safe for aquatic organisms. They have also identified that below the chemocline low dissolved oxygen (DO) conditions are probable and certain parameters may not be within benchmarks, however in the absence of a destratification event, it is unlikely that these exceedances would extend into the upper 40m. EMAB accepts that DDMI's DO predictions seem reasonable based on the modelling provided, and predicted DO levels in surface waters are likely not a concern. EMAB also accepts that DDMI's assumption that fish would not actively go to those depths below the chemocline or to areas with low or depleted DO is reasonable based on the information provided, but it must be verified. Furthermore, ability for fish, specifically less mobile fish with small home ranges (i.e. slimy sculpin), to egress an area if water quality parameters suddenly become hazardous is not certain. DDMI also acknowledged that slimy sculpin would be unlikely to move away from contamination (Rio Tinto, May 2019b (SIS), 2019). EMAB has reason to believe that there is potential for fish to be impacted by this project, in particular, less mobile fish with small home ranges.

The assumption that fish will not go below 40m is critical. If fish are found to go below 40m, impact predictions could be affected. EMAB believes this assumption presents risk, and has potential to cause adverse effects, if the assumption remains unverified.

It is important that subsistence harvesters, who rely on fish in LDG, have reassurance that it is safe to consume fish from LDG. Monitoring and reporting the levels of metal contaminants, specifically mercury, could provide some reassurance to harvesters who want to fish near the reclaimed DDMI site. As LDG is a traditional and cultural area, it is important that the affected peoples have confidence that the area is safe to use for subsistence activities. EMAB's view is that if tissue metal concentrations are not confirmed and people do not have assurance that the fish are safe to eat, then people may choose to avoid returning to the LDG area for subsistence harvesting

7.3. Developer's Conclusions

DDMI has concluded that the PKMW project will not have a significant impact to fish because water quality parameters in fish habitat are expected to be within the limits recommended to support aquatic life. They have determined that the top 40m of water in LDG will be suitable for aquatic life. Paired with the assumption that fish will not go below 40m, DDMI has determined that there will not be significant impacts to aquatic organisms.

7.4. EMAB's Conclusions

EMAB believes that there is potential for the PKMW project to interact with fish and other aquatic life and cause adverse impacts. We do not think that DDMI has provided sufficient evidence to support their assumptions, nor have they proposed a sufficient monitoring plan for monitoring fish and fish habitat after breaching the dikes.

7.5. Rationale

7.5.1. Dissolved Oxygen

Overall, EMAB is satisfied with DDMI's DO predictions based on the modelling provided. The responses provided by DDMI indicate that DO levels during an unanticipated mixing event will remain within a safe range for survival of aquatic life, even under ice. Effects on DO could be different than those predicted if DDMI's modelling inputs are inaccurate.

Mass-balance models were not run for A154 or A21. The mass-balance model ran conducted for DO in A418 under destratification may overestimate DO (NSC, July 2019) (see EMAB Attachment #8).

7.5.2. Assumptions

DDMI's assumed lower boundary for water that will be used by fish is 40m. DDMI claims this assumption is supported by Traditional Knowledge, which says that fish in LDG typically reside between 6-7m depth for most of the year, and between 15-20m during the summer months (Rio Tinto, May 2019b (SIS), 2019). However, at the DDMI Traditional Knowledge Panel Session #11, it was suggested that fish can go down to around 100m. It is unclear how the max depth suggested by TK, relates to DDMI's chosen boundary of 40m. DDMI's February 2019 literature review in response to WLWB IR# 9 (Rio Tinto, February 2019) also provides some context for why the boundary of 40m chosen, but EMAB does not feel like a clear answer has been provided as to why the 40m boundary was specifically chosen.

Additionally, fish assumptions stated in DDMI's February 2019 literature review in response to WLWB IR# 9 (Rio Tinto, February 2019) are related to mobile, large-bodied fish, and do not address implications for smaller, less mobile fish like slimy sculpin. Slimy sculpin have small home ranges and would be unlikely to move away from contaminants (Rio Tinto, May 2019b (SIS), 2019). They would be exposed to direct and indirect effects that would occur due to a worst-case-scenario event (Rio Tinto, May 2019b (SIS), 2019).

7.5.3. Fish Habitat Monitoring

DDMI has noted that they will be conducting aerial drone surveys to monitor constructed fish habitat starting one year prior to filling the pits and continuing for 5 years (Appendix VI-1, DDMI Responses to MVEIRB IR's). DDMI has also planned for geotechnical inspections of constructed fish habitat and shoreline stability before and during infilling. Geotechnical surveys would cease once the pits are infilled (Appendix VI-1, DDMI Responses to MVEIRB IR's). However, post-closure fish and fish habitat monitoring are not described. As the intention of reconnecting the pits is to restore enhanced fish habitat, how fish are using the area after breaching the dikes should be confirmed through monitoring.

7.5.4. Fish Tissue Chemistry

DDMI no longer has a scientific monitoring plan for sampling large bodied fish tissue chemistry, even though concern about mercury levels in fish in LDG has continued to be raised by Affected

Communities since as far back as the CSR. This concern continues, including with respect to the potential effects of the PKMW project. Reinstating a large-bodied fish tissue chemistry monitoring plan would provide information on the safety of consuming fish in LDG for subsistence users. This information would be very valuable for those wanting to use the area for subsistence harvesting.

While DDMI does some analysis of fish tissues collected at TK camps, the data is not collected scientifically, making it difficult to use for analysis and comparisons. The SIS states that mercury levels recorded in large bodied fish at the 2018 TK camp were higher than the levels observed in 1997 (Rio Tinto, May 2019b (SIS), 2019). Though this information was not collected via a scientific method, there is indication that mercury levels in some fish have been above guidelines for subsistence users. The PKMW project has the potential to increase public concern about metal contaminants, including mercury, in fish tissue, and it is something that should be monitored moving forward.

7.6. Recommendations

1. It is recommended that monitoring of fish use of the pelagic zone of the pit lake be required, at least initially after breaching the dikes, to confirm that fish are only using the upper 40 m portion of the water column. Methods could include non-lethal techniques such as acoustic monitoring, trap nets, minnow traps, and fish tagging.

2. Monitoring of fish use of the enhanced habitats required by the Fisheries Authorizations should also be required.

3. DDMI should also address the predicted effects on DO in the other two pit lakes using a mass-balance model, notably for pit A21 which is characterized by a notably different shape, volume, and depth, and a shallower water cap.

4. A dissolved oxygen survey should also be completed at additional sites, including shallow sites over substrate, to confirm the predictions that dissolved oxygen concentrations will be high above the chemocline in all seasons.

5. Monitoring the top 40m of the water column before breaching should be considered a minimum, given that the actual depth of the mixolimnion is not known. The depth of the mixolimnion should be confirmed before breaching the dikes to confirm to which depth the water quality is safe for aquatic life.

6. It is recommended that a metals (including mercury) in fish tissue survey be undertaken on large bodied fish that are harvested in the study area (e.g. lake trout), following breaching of the dikes. The survey would measure metal concentrations in the tissues that are consumed. It is further recommended that DDMI fund a study to collate and inventory all years of LDG lake trout tissue data it has collected, review the data set and conduct

appropriate analyses to determine levels of metals in lake trout over time, compare these to existing guidelines and make recommendations for possible future studies of metals in lake trout.

7. Prior to breaching of the dikes, sampling of biota (fish and benthic invertebrates) that may have been introduced when water from LDG was pumped in to form the closure cap should be conducted. These biota would have been exposed to higher concentrations of contaminants in water prior to the formation of a stable chemocline. If significant numbers of organisms are present, the need to assess them for concentrations of metals and mercury to avoid potential risk to fish that will be introduced after breaching of the dikes should be considered.

8.0. Effects to Wildlife

8.1. Overview

During operations, using the pits for PK disposal will create large open water areas. The expelled porewater immediately above the PK will likely not be within AEMP benchmarks before the end of mine operations. This is likely to happen while operations are still occurring at the minesite, while PK disposal to the pits is ongoing (SEC, July 2019).

8.2. Impact Predictions

Concentrations of parameters in the water overlying the PK in the pits during operations may exceed levels that are safe for wildlife and birds. Additionally, the pit lakes contain much less water than LDG, and it is anticipated that open water will occur in the pit lakes earlier in the season than in LDG, potentially attracting waterfowl and/or other birds and wildlife. During operations this open water may have unsafe levels of contaminants. This has potential to affect wildlife health, most concerningly the health of waterfowl, during operations.

8.3. Developer's Conclusions

DDMI's Table 7-4 in the SIS (Rio Tinto, May 2019b), indicates that disposing of PK to the pits and decanting of porewater from mine workings during operations has no potential to interact with wildlife.

8.4. EMAB's Conclusions

EMAB believes that there is potential for the PKMW project to interact with wildlife during operations, before the pit lakes have become stratified. DDMI has predicted the ice in the pits will melt earlier than the rest of LDG (Rio Tinto, July 2019b; DDMI July 4 Response to EMAB IR# 14) creating an open water area that may attract wildlife. This surface water is not anticipated to be within AEMP benchmarks at that time, and could affect wildlife health.

8.5. Rationale

The SIS indicated that the PKMW project would not interact with wildlife or wildlife habitat during mine operations. However, this does not address the potential for open water conditions in the PK pits to attract waterfowl or other wildlife (SEC, July 2019). DDMI should acknowledge that there is potential for the project to interact with wildlife.

In response to EMAB IR#5, DDMI outlined the existing wildlife monitoring and management procedures proposed to mitigate wildlife use of the pits:

1. Monitoring/tracking of wildlife presence and/or proximity to the mine workings.
2. Training all site personnel to record and/or report incidental sightings of wildlife, including birds, in the general area of the mine workings during operations.
3. Use of wildlife deterrence techniques such as truck horns, bear bangers, 12Ga cracker shells, 12Ga bean bags, scarecrows, decoy foxes and falcons, noise makers (Wetland Wailer Mk IV), and hanging screens down the high walls of the pits (Rio Tinto, July 2019b; IR Responses).

EMAB notes that DDMI has committed to update the Wildlife Monitoring Program to specifically address the effects of PKMW (Rio Tinto, July 2019b; DDMI July 4 2019 response to ECCC IR#6), including possible interaction with waterfowl. A number of these procedures will likely address concerns related to the pits and the PKMW project (SEC, July 2019); however, details are required on the ways that wildlife may interact with the project and how existing and new procedures will mitigate them.

8.6. Recommendations

1. When conducting the environmental assessment, MVEIRB should acknowledge the potential for the PK disposal to affect wildlife habitat and health during the operational period, and consider these effects in the assessment. To mitigate potential effects, MVEIRB should require development/refinement of management plans to incorporate specific requirements for wildlife monitoring and response protocol related to waterfowl and wildlife use of pits during the operational period.

9.0. Monitoring (Pre and Post Dike Breach)

9.1. Overview

Effectively monitoring water quality is an important factor in establishing conditions and trends in the pit lake, in considering when the pit lakes should be reconnected to LDG and in monitoring post-breach effects in the pit lake and on LDG. It is crucial that monitoring plans can adequately assess water quality, both before and after reconnection. DDMI's water monitoring plan for the PKMW Project has been improved and updated since the onset of this EA process. However, In EMAB's view there are further improvements that could be made, specifically regarding sampling locations and sampling frequency.

For information on EMAB's views on DDMI's proposed fish and fish habitat monitoring, refer to section 7.0.

9.2. Impact Predictions

If DDMI's water quality monitoring plan is not adequate (e.g. unable to appropriately determine if water quality parameters are consistently within benchmarks and safe for aquatic life and wildlife), then adverse impacts could occur.

9.3. Developer's Conclusions

DDMI has developed a water quality monitoring plan. In response to EMAB IR# 21 (Rio Tinto July 2019b; IR Responses) they conclude that the level of detail provided is appropriate at this stage of the Environmental Assessment.

9.4. EMAB's Conclusions

EMAB notes that Appendix 1 attached to DDMI's May 9, 2019 responses to MVEIRB IR's on Post Closure Monitoring and Reporting (Rio Tinto, May 2019a) will need to be updated to reflect the final monitoring plan for the PKMW proposal.

EMAB's view is that DDMI's current water quality monitoring plan is not adequate and needs some improvement to provide the information required to mitigate potential risks associated with water and sediment quality upon breaching the dikes. This includes increased sampling over space and time to provide a clear understanding of the behaviour of the supernatant water, pit lake water and sediment quality prior to breaching, and post breach effects

9.5. Rationale

DDMI proposes to primarily rely on a single sampling location with sampling in the pit to characterize conditions. The plan includes sampling at various depths and frequencies at this location. Section 4.4 of the May 9 Response to IRs also describes a single sampling event with multiple locations that would occur before the pits are reconnected to LDG (SEC, July 2019).

DDMI does not propose to sample the water stored in the pit while PK is being deposited, although it does propose to sample decant water. The decant water likely will not be representative of the water stored in the pit due to aging of the process water and the influence of other sources like groundwater, porewater release and local runoff. The quality of the supernatant water is a key component of the model and monitoring should be conducted to verify model assumptions (SEC, July 2019).

Porewater quality is an important input for modelling predictions. The monitoring program should include a program to collect porewater quality from the PK placed in pits, to verify assumptions in the modelling. A program to monitor PK consolidation would also provide valuable input for model verification (SEC, July 2019).

The modelling currently relies on temperature data from Snap Lake. Temperature monitoring in LDG should be initiated to support model updates.

The monitoring program should include monitoring of quantity and quality of groundwater inflows into the pits where possible.

The primary reliance on a single station to characterize water quality in each pit after the pits are full may not provide a representative characterization of water quality conditions. Water quality may be variable due to influences from pit walls, local runoff, winds, or internal pit currents. Similarly, a single sampling event with one transect prior to pit reconnection may not accurately characterize variability in pit water quality over time. A more comprehensive monitoring program is needed to confirm the model predictions and the suitability of water quality for reconnection with LDG. The program should aim to understand spatial (in three dimensions) and temporal variability of water quality conditions to support validation of modelling and decision-making about pit lake reconnection. Pit lake reconnection should only occur once monitoring confirms that water quality is suitable in all relevant locations in the pit, and through all seasons (SEC, July 2019).

Section 4.4 of the May 9 Response to IRs proposes quarterly sampling of water quality at 2m below surface, 2m above the chemocline, 2m below the chemocline and 2m above the bottom. This approach will require a good understanding of the location of the chemocline – which is not possible without profiles that extend throughout the depth of the pit. Sampling should occur throughout the water column at least until the chemocline is established and at a consistent depth (SEC, July 2019).

After a stable gradient has formed and until such time as water quality has improved to the point that dikes may be breached, monitoring should be conducted at a station in the centre of the lake in late winter, after the spring turnover, during late summer and after the fall turnover. The intent would be to obtain information when stratification in the epilimnion and hypolimnion (both above the chemocline) has been established for much of the season and after the water column above the chemocline has been mixed (NSC, July 2019).

During each sampling episode, a sample for analysis of laboratory parameters should be collected from near the bottom. Water quality from below the chemocline could be used to support risk assessments to address the effect of unanticipated mixing (NSC, July 2019).

The monitoring program should include monitoring of sediment quality in areas that may be accessible to fish once the pit lakes are reconnected to LDG. Monitoring should be conducted to support decision-making about reconnection, and also after reconnection to confirm continuation of suitable conditions.

DDMI proposes that monitoring in the pits can be reduced to two times per year once the dikes are breached. This reduced frequency may be appropriate once monitoring confirms temporal variability (e.g., seasonal) of conditions after reconnection. More frequent sampling should continue for a period of at least two years after breaching to confirm temporal variability.

9.6. Recommendations

1. DDMI should develop a comprehensive water and sediment quality monitoring program to confirm the model predictions and the suitability of water quality for reconnection with LDG. The program should aim to understand spatial (in three dimensions) and temporal variability of water quality conditions to support validation of modelling and decision-making about pit lake reconnection. Pit lake reconnection should only occur once monitoring confirms that water quality is suitable in all relevant locations in the pit, and through all seasons (suggest late winter, after spring turnover, late summer and after fall turnover). Monitoring should be conducted to support decision-making about reconnection and continue after reconnection to confirm continuation of suitable conditions.

2. DDMI should develop a sampling plan to verify model calibration, inputs and assumptions. This should include sampling the supernatant water above the PK, porewater quality of the PK placed into the pit, groundwater (as possible) and LDG temperatures.

Prior to Breaching Dike:

3. Initial sampling should extend throughout the water column, to determine when meromixis is established and monitor development of a chemocline. Sampling frequency should be

based on the anticipated rate of gradient formation. Initial conditions should be recorded for the suite of AEMP parameters.

4. When water quality at the sampling location in the centre of the pit lake is considered suitable for breaching of the dikes, an expanded water quality sampling program should be conducted to address potential spatial and temporal variability. It is recommended that sampling be conducted for two years to ensure that there are not seasonal or interannual variations in conditions that result in adverse effects to water quality in the pit lakes above the chemocline.

5. Prior to considering breaching of the dikes, water quality should be sampled at additional stations for a two year period to determine whether there is marked spatial variation in water quality between the open pelagic area of the lake and shallow areas, in particular where fish habitat has been constructed.

6. The criteria for breaching of the dikes should consider sampling over the two years, in different areas of the lake. If there is marked temporal or spatial heterogeneity, then the criteria should be adjusted accordingly.

7. The monitoring program should include monitoring of sediment quality in areas that may be accessible to fish once the pit lakes are reconnected to LDG.

8. The monitoring program should be adaptive.

After Breaching Dike:

9. Monitoring of the pit lake for the first year(s) after breaching of the dikes should confirm that the meromictic gradient remains stable.

10. Sampling in the pit lake should include vertical profiles of pH, dissolved oxygen, temperature and conductivity above and immediately below the chemocline. Sampling should be conducted in late winter, after the spring turnover, in late summer and after the fall turnover. Parameters sampled for laboratory analysis should include those monitored in the AEMP, and comparisons would be to both the AEMP benchmarks and water quality in LDG.

11. Initial monitoring after breaching of the dikes should include various locations in the pit lake, including at the dike breaches, to determine which areas are more affected by direct water exchange with LDG and which are more affected by water quality within the pit lake. If spatial heterogeneity is observed then the locations of sample collection should be adjusted.

12. The frequency of water quality sampling in the pit lake can be reduced if conditions are observed to be stable. An assessment of the risk of an unanticipated mixing event would need to be completed to determine what frequency of sampling is required to support implementation of the contingency plan (i.e., closing the breaches in the dike). Monitoring data available at the time will assist in informing this assessment.

13. If water quality in the pit lakes is markedly different from that in LDG, then initial sampling of conductivity, or some other parameter suitable for tracing the plumes from mixing with the pit lakes, should be conducted to determine the spatial extent of effects in LDG. It is anticipated that sampling at multiple times during the open water season would be required to address seasonal variation in mixing as well as stabilization after initial breaching of the dikes.

14. After the spatial extent of the effect of the pit lakes has been established, sampling sites should be located close to and further from the breaches to determine the extent to which water quality in LDG is affected by the pit lakes.

15. Parameters should include those included in the AEMP, and compared to AEMP benchmarks and background conditions in the LDG.

16. Sediment quality sampling should continue after breaching in areas used by fish.

17. DDMI should describe how they will monitor for unacceptable water quality in the pit in relation to the contingency plan to close the breaches.

18. See the proposed monitoring plans included in NSC, July 2019 and SEC, July 2019 for further detail.

19. Please refer to the fish section (Section 7.0) of this document for recommendations for fish and fish habitat monitoring.

10.0. Descriptions of Contingency Plans

10.1. Overview

DDMI has proposed a number of contingencies to respond to unacceptable water quality in the pit lake:

- To not reconnect the pit lake with LDG
- To close the breaches in the dike to disconnect the pit lake from LDG

- To allow contamination resulting from an unanticipated mixing of the pit lake to be diluted by mixing with uncontaminated LDG water while increasing loadings to LDG.

DDMI proposes to provide details of these contingency plans following approval of the PKMW proposal by MVEIRB and the WLWB.

It is EMAB's view that DDMI should describe each of the contingency plans in sufficient detail that the feasibility of the plan to mitigate impacts can be evaluated and any potential adverse impacts associated with the plan can be assessed.

10.2. Impact Predictions

Each of the contingency plans could potentially cause adverse impacts.

10.3. Developer's Conclusions

DDMI has provided its assessment of the impacts associated with not reconnecting the pit with LDG, or disconnecting them, in its July 4 response to MVEIRB IR# 55 (Rio Tinto, July 2019a). It has also provided a very short (less than a paragraph) description of how it would investigate in situ treatment if water quality became unacceptable in the pit lake, with the backup plan of filling the breaches to isolate the pit lake from LDG (e.g. Rio Tinto, July 2019b, July 4 Response to EMAB IR# 20, July 4 Response to LKDFN IR# 14).

10.4. EMAB's Conclusions and Rationale

EMAB recognizes that DDMI has provided some information on the impacts of not reconnecting the pit lake with LDG, and how it would respond if pit lake water quality became unacceptable after breaching the dikes.

EMAB's view is that one sentence is not sufficient to describe DDMI's plan to investigate in situ treatment in the pit lake, or to close the breaches in the dike. DDMI should provide more detail on both these contingencies. In the case of the plan to close the breaches DDMI should indicate how it would monitor for unacceptable water quality to provide for detection as soon as possible. It should also describe the longest period unacceptable water quality could go undetected, and the period of time that would elapse between detection and completion of closing of the dikes, both if equipment is available onsite, or if it would need to be mobilized from the south. Clarity on the response time will allow a better idea of the potential impacts that might occur.

EMAB is also not convinced that DDMI's description and assessment of the impacts of not reconnecting the pit lake with LDG, or disconnecting it later, is adequate, especially in the case of

cultural impacts. EMAB notes that DDMI has used the significance definitions it has proposed to deem the impacts negligible.

10.5. Recommendations

1. DDMI should develop a description of the contingency plan to re-close the dike after breaching. This description should be sufficiently detailed to allow assessment of the feasibility of DDMI being able to execute the plan and should provide the worst-case time period between unacceptable water quality occurring, detection, and finalizing closing the breaches.

2. DDMI should provide more information on the potential impacts associated with the contingency plans, and on how it has incorporated the views and desires of Affected Communities and Aboriginal Peoples in describing these impacts. The assessment of impacts should be based on updated definitions of significance (see recommendations in Section 1: Definition of Significance), particularly with respect to impacts on cultural use.

3. DDMI should describe the impact on LDG of loadings associated with unanticipated mixing of the pit lakes.

11.0. Revised Closure Objectives

11.1. Overview

The current closure objectives and draft criteria included in DDMI's Interim Closure and Reclamation Plan (ICRP) Version 3.2 approved in 2011 (this is the most recently approved ICRP although these statements apply to ICRP Ver 4 that is still under review) do not describe closure measures for pit lakes containing PK and do not consider associated effects (SEC, July 2019). They also do not consider the effects of PKMW on the Processed Kimberlite Containment facility (PKC), notably that the pond covering the EFPK in the PKC is expected to drain within a year of PK being redirected to the pit (Response by Sean Sinclair from DDMI to question from John McCullum from EMAB at January 2019 Technical Session).

In addition to existing site-wide objectives that water should be safe for humans, wildlife and aquatic life, objectives for the pits are that water quality should be similar to LDG or at a minimum, protective of aquatic life, that the pits

11.2. EMAB's Conclusions and Rationale

The current closure plan for the PKC Facility relies on careful placement of PK beaches to establish a surface that will support placement of rock cover over most areas, and establishment of a small, permanent closure pond over the slimes. The closure plan relies on the pond to address concerns about the safety of PK slimes. At the January 2019 WLWB technical session, DDMI estimated that discontinuing placement of PK in the PKC Facility would cause the current pond to drain within one year. As a result, the decision to place PK in pits may affect achievement of closure objectives for the PKC Facility. The draining of the pond would also offer an opportunity for DDMI to explore closure options for PK slimes, including potential measures for covering these materials (SEC, July 2019).

As mine plans change, closure planning and the associated objectives and criteria need to be refined to ensure that closure plans are always relevant to the actual site conditions and activities. The closure plan is a key mitigation measure for addressing long-term effects of mining activities, and the closure objectives and criteria define the expected outcomes that the closure plan should produce. As a result, a positive conclusion for an environmental assessment relies on the assumption that an effective closure plan will be implemented once mining activities are completed. Because DDMI is now proposing that those mining activities will include the storage of PK in pits and discontinuation of PK placement in the PKC Facility, these need to be incorporated in closure planning, including objectives and criteria that address potential effects of the revised PK management on VCs (SEC, July 2019).

For example, the ICRP would benefit from objectives that address potential for resuspension of PK material (both during pit filling and for post-closure conditions) and interaction of PK material with the aquatic ecosystem. Criteria will be required to define acceptable outcomes for these objectives. These may include criteria that prescribe minimum depth of closure water cap and depth of water needed to avoid potential direct contact of fish with PK. Criteria related to stratification of the closure pit lakes may also be relevant because stratification is likely to remain important for maintaining suitable water quality at the pit lake surface where it interacts with LDG.

Establishing criteria related to interaction of PK with the aquatic environment will likely need to consider the perspectives of the TK Panel including the following:

> "*One panel member said that they have set nets 12–14 metres deep on an extremely hot day. One suggestion was to make sure PK was at least 30 metres below the surface of the water, as this is deep enough and fish will not go that deep without a food source to attract them. However, the Inuit contingent suggested that fish can go much deeper, up to roughly 100 metres, which may be a regional difference*." (Thorpe Consulting Services, May 2018; DDMI Traditional Knowledge Panel Session #11, Options for Processed Kimberlite, Section 2)

There would also be benefit from the development and implementation of a reclamation research plan focused on addressing slimes in the PKC Facility. DDMI is proposing further feasibility research

related to relocating EFPK to the pits, which offers a potential long-term solution for storage of these materials. Research scope should be expanded to take advantage of the expected draining of the pond and include investigation of other closure methods, for example covering in place. Methods used for covering of mature fine tailings at oil sands facilities may provide examples.

11.3. Recommendations

1. MVEIRB should identify an effective closure and reclamation plan as a key mitigation measure for addressing long-term effects of the PKMW Project. To ensure that this mitigation will be effective, the MVEIRB should establish requirements for timely updating of the closure and reclamation plan to incorporate the PKMW Project. Updated closure planning should include updates of closure objectives and criteria to address potential interactions between VCs and PK stored in pits, as well as changes in conditions at the PKC Facility. MVEIRB should also require a comprehensive reclamation research project to investigate methods for closure and reclamation of PK slimes (see section 13 for EMAB's views on the slimes in relation to this project proposal).

12.0. Cumulative Effects on Water Quality

12.1. Overview

The SIS (Rio Tinto, May 2019b, section 4.5) and DDMI's responses to EMAB IR# 10 (Rio Tinto, July 2019b; IR Responses) describe a cumulative effects assessment for water quality. In the assessment DDMI considers existing DDMI operations and operations at Ekati Mine, including the Jay Project.

12.2. Impact Predictions

There could be significant adverse effects to water quality if cumulative effects on water quality are not carefully considered.

12.3. EMAB's Conclusions

EMAB does not feel that DDMI's assessment of cumulative effects to water quality are adequate.

Overall, DDMI has not provided enough information to understand the basis for the cumulative effects to water quality assessment.

12.4. Rationale

Appendix B of the SIS shows different results between tables B7 through B9 and B10 through B12 (SEC, July 2019). Although the tables appear to confirm the use of modelling predictions, details on how the modelling was conducted are not described. This makes it difficult to understand how the existing effects at DDMI, and effects from Ekati mine were incorporated into the model (SEC, July 2019).

Section 4.5.2.3 of the SIS does not provide a direct explanation of how effects from DDMI's and Ekati's operations are considered in combination with the proposed PK to Pits project (SEC, July 2019).

DDMI discusses cumulative effects for water quality parameters in section 4.6.2.1 of the SIS. They state that modelling was completed for nitrate, cadmium and molybdenum in the pit lakes. However, they do not provide any rationale for the selection of considered parameters. They also do not provide any information as to why other parameters were not considered (SEC, July 2019).

12.5. Recommendations

1. To support its assessment of cumulative effects, the MVEIRB should seek additional clarification about the methods used to predict cumulative effects to water quality.

13.0. PK Slimes

13.1. Overview

It is EMAB's view that relocation of the slimes from the PKC facility to the mine workings should be addressed in this assessment. In April 2019 MVEIRB determined that removal of the slimes from the PKC facility for deposit in the mine workings will not be addressed under the scope of this EA. EMAB does not support this decision. Relocation of the slimes from the PKC facility to the mine workings should be considered. It is our view that this was the main advantage of the original PK to Mine Workings proposal. Placing all PK, including slimes, in the pits would provide a long-term storage location with minimal long-term stability risks (SEC, June 2019). It would require less maintenance and monitoring than keeping the slimes in the PKC Facility, as well as reduce the risks associated with long-term containment of the slimes in the PKC facility (SEC, June 2019). EMAB's consultants and DDMI's TK Panel have also recommended that the slimes be relocated to the mine workings along with the rest of the PK material to be deposited.

Maintaining the PKC facility under the currently approved PKC closure plans presents more risk than would be presented if the slimes were relocated to the pits. Uncertainties regarding the PKC facility closure include maintaining the dams and the PKC pond. Due to seepage, it is unknown if maintaining the pond will be feasible at closure. The dam will be a permanent physical structure on the landscape that will need to be sufficiently monitored for the foreseeable future. Disposing of the slimes in the pits would eliminate these issues.

13.2. Developer's Conclusion

DDMI removed the proposal to re-mine the PKC facility and deposit EFPK/slimes in the mine workings from the scope of this project. However, DDMI has discussed their intention to evaluate the option of moving the slimes to the pits. In the original project timetable DDMI proposed to undertake a feasibility study for re-mining EFPK in the second half of 2020. They have now pushed this study back to the second half of 2021 (Rio Tinto, July 2019a; DDMI responses to MVEIRB IR# 17, table 6).

13.3. EMAB's Conclusions

EMAB believes that DDMI should re-consider their decision to remove re-mining the slimes from the PKC facility from the scope of the Environmental Assessment. Relocation of the slimes to the mine workings should be considered as an opportunity to improve this project proposal. It would greatly reduce closure and post-closure risks related to the PKC facility and would provide a safer and more stable place to store the slimes long-term.

EMAB is concerned that DDMI has proposed to delay the feasibility study from the originally proposed schedule in the latter half of 2020 to the latter half of 2021. In EMAB's view the study should begin at the earliest possible time.

13.4. Rationale

EMAB's consultants, Slater Environmental (SEC) and Randy Knapp, reviewed DDMI's Water Licence Amendment Application. SEC also reviewed the SIS, and associated Information Requests. SEC and Knapp both agree with EMAB's view that the ability to move the slimes to the pits would be the primary advantage to this project proposal if it were still in the scope of assessment. Included below is justification for SEC and Knapp's individual views:

SEC:

- Depositing PK (including the slimes) to the pits would be a major advantage. It would provide permanent storage in a location with minimal risk (SEC, June 2019).

- Most of the long-term stability risks associated with the PKC facility are due to the presence of the slimes, and the associated need to maintain the dam and pond that contain the slimes. These risks are inherent to the current closure plan of the PKC facility (SEC, June 2019).
- Depositing PK, not including the slimes, to the mine working addresses DDMI's need for more PK storage. However, it does not reduce closure and post-closure risks at the PKC facility unless re-mining, and disposal of the slimes in the mine workings, is included (SEC, June 2019)

Randy Knapp

- Relocation of the slimes would be a benefit to the PKMW Project and it should be considered (Knapp, Feb 2019).
- Relocation of the slimes would give DDMI the option to consider a dry closure plan for the PKC facility. This would eliminate the need for long term maintenance of the PKC pond and spillway that is currently proposed (Knapp, Feb 2019).
- DDMI completed modelling which included placement of 5Mm^3 of PK slimes in the pits. The predicted surface water qualities were below AEMP benchmarks for all parameters at the surface and at 40m depth. This suggests that slimes could be included in the PK to pits disposal without a notable change to water quality predictions (Knapp, Feb 2019).

Uncertainties about the currently approved PKC closure plan also provide rationale for the consideration to move the slimes to the mine workings. Slimes in the PKC facility will require long-term containment via permanent dams. The dams will need to be maintained and monitored long-term and will create challenges during closure and post-closure. Conversely, the pits are a physically stable storage location that would require much less long-term monitoring (SEC, June 2019).

It is unknown if it is feasible to maintain the proposed wet cover over the PKC (i.e. the pond covering the slimes, which would help prevent wildlife from accessing and getting caught in the slimes). Stability of the pond is uncertain as the measured seepage rates from the pond would not allow for formation of a permanent pond (Knapp, 2017, Review of ICRP 4.0, Appendix 1) (see EMAB Attachment #7). Current seepage estimates predict that the PKC pond would be drained within a year (Sinclair, Sean, January 2019; Response by Sean Sinclair from DDMI to question from John McCullum from EMAB at January 2019 Technical Session). Without a stable PKC pond, the slimes would be exposed and present a hazard to wildlife and humans (Knapp, Review of ICRP 4.0, Appendix 1). Depositing the slimes to the pits would allow DDMI to develop a dry closure concept for the PKC facility. This would eliminate the need for long-term monitoring of the dam, PKC pond and spillway (Knapp, Feb 2019).

Additionally, the TK Panel has identified that they have concerns with the current plan to leave the slimes in the PKC facility. They have recommended that they want the slimes removed from the PKC facility because of concern about risks to wildlife (DDMI, October 2018; TK Recommendations Table/Oct 2018) (see EMAB Attachment #3). Furthermore, the TK panel recommended that if the PK to pits proposal is approved, and DDMI moves forward with putting PK into the pits, that the slimes

should also be put in the pits (Thorpe Consulting Services, May 2018; DDMI Traditional Knowledge Panel Session 11, Attachment 12).

EMAB also notes that draining of the PKC pond within a year of PK being redirected to the pit will provide an opportunity for DDMI to investigate options for covering the EFPK other than maintaining a pond over it.

13.5. Recommendations

1. We recommend that DDMI be required to evaluate feasibility of relocation of the slimes to the pits as a condition of any project approval and provide justification as to why re-mining of the slimes for pit disposal should not be undertaken.

2. It should be a condition of any approval of the PKMW project that DDMI should proceed with the Feasibility Assessment at the earliest possible opportunity to get a clear understanding of timing requirements as well as the potential effects and benefits of re-mining. The timing of the assessment should be brought forward, not pushed back to 2021 as currently proposed by DDMI.

List of Acronyms

AEMP: Aquatic Effects Monitoring Program

CCME: Canadian Council of Ministers of the Environment

CEAA: Canadian Environmental Assessment Agency

CSR: Comprehensive Study Report

DDMI: DDMI Diamond Mines Inc.

DO: Dissolved oxygen

EA: Environmental assessment

EIA: Environmental impact assessment

EFPK: Extra fine processed kimberlite

EMAB: Environmental Monitoring Advisory Board

FPK: Fine processed kimberlite

ICRP: Interim Closure and Reclamation Plan

IR: Information request

LDG: Lac de Gras

LDS: Lac du Sauvage

MVEIRB: Mackenzie Valley Environmental Impact Review Board

MVRMA: Mackenzie Valley Resource Management Act

NSC: North-South Consultants

ORS: Online Review System

PK: processed kimberlite

PKC: Processed Kimberlite Containment

PKMW: Processed Kimberlite to Mine Workings

PR: Public registry

RAA: Regional Assessment Area

SEC: Slater Environmental

SIS: Summary Impact Statement

TDS: Total dissolved solids

TK: Traditional Knowledge

UofA: University of Alberta

VC: Valued component

WLWB: Wek'èezhìi Land and Water Board

Citations

Alan Ehrlich & William Ross (2015): The significance spectrum and EIA significance determinations, Impact Assessment and Project Appraisal, DOI: 10.1080/14615517.2014.981023. *(EMAB Attachment #1)*

AMEC (2011): Diavik Diamond Mine PKC Facility 2010 Geotechnical Site Investigation Factual Report in Appendix II-6 of Diavik Diamond Mines (2012) Annual ICRP Progress Report *(EMAB Attachment #2)*

Canada (1999): CEAA Comprehensive Study Report: DDMI Diamonds Project. *(PR #29)*

Diavik Diamond Mines (Oct 2018): Diavik TK Panel Recommendation Tracking Table V10 Diavik Responses. *(EMAB Attachment #3)*

Diavik Diamond Mines (July 2011): Interim Closure and Reclamation Plan Version 3.2. *(EMAB Attachment #4)*

Environmental Agreement (March 2000): Environmental Agreement – Diavik Diamond Project. *(EMAB Attachment #5)*

Knapp, Randy (Feb 2019): Review of DDMI's Water Licence Amendment. Diavik Responses to WLWB Information Request re: Water License W2015L2-0001 Amendment Request. *(EMAB Attachment #6)*

Knapp, Randy (August 2017): Review of Diavik Version 4 Closure and Reclamation Plan: Final report to the Environmental Monitoring Advisory Board *(EMAB Attachment #7)*

Mackenzie Valley Environmental Impact Review Board (April 2019): Scope of the Environmental Assessment and Reasons for Decision: Depositing Processed Kimberlite in Pits and Underground. *(PR #40)*

North-South Consultants (July 2019): Diavik Diamond Mines Inc. EA1819-01 Processed Kimberlite in Pits and Underground Environmental Assessment: Support to EMAB for MVEIRB Hearing Presentation. *(EMAB Attachment #8)*

North-South Consultants (June 2019): Review of Diavik's Summary Impact Statement for the Processed Kimberlite to Mine Workings Project (MVEIRB File No.: EA1819-01) Technical Memorandum 367-19-03. *(PR #84)*

Rio Tinto (July 2019a): Diavik Response to MVEIRB Information Requests for the Environmental Assessment pf the Processed Kimberlite to Mine Workings Proposal (MVEIRB File No.: EA1819-01). *(PR #86)*

Rio Tinto (July 2019b): Diavik Response to Party Information Requests for the Environmental Assessment pf the Processed Kimberlite to Mine Workings Proposal (MVEIRB File No.: EA1819-01). *(PR #83)*

Rio Tinto (May 2019a): Diavik Response to MVEIRB Information Requests for the Environmental Assessment pf the Processed Kimberlite to Mine Workings Proposal (MVEIRB File No.: EA1819-01). *(PR #84)*

Rio Tinto (May 2019b): Summary Impact Statement: Processed Kimberlite to Mine Workings Project. *(PR #53)*

Rio Tinto (February 2019): Diavik Responses to WLWB IRs re: Water Licence W2015L2-0001 Amendment Request for the Deposition of Processed Kimberlite to Mine Workings. *(PR #16)*

Rio Tinto (June 2018): DDMI Water License W2015L2-0001 Amendment Request for the Deposition of Processed Kimberlite to Mine Workings*. (PR #5)*

Sinclair, Sean (January 2019). Pers. Comm. Response from DDMI to question from John McCullum from EMAB at January 2019 WLWB Technical Session.

Slater Environmental (July 2019): Memo Re: Diavik Diamond Mine – Processed Kimberlite to Mine Workings Project. *(EMAB Attachment #9)*

Slater Environmental (June 2019): Memo Re: Diavik Diamond Mine – Processed Kimberlite to Mine Workings Project Summary Impact Statement. *(PR #84)*

Thorpe Consulting Services (May 2018): Diavik Traditional Knowledge Panel Session #11. Options for Processed Kimberlite: Diavik Diamond Mines. *(PR #85)*

Attachments

EMAB Attachment #1

Alan Ehrlich & William Ross (2015): The significance spectrum and EIA significance determinations, Impact Assessment and Project Appraisal

EMAB Attachment #2

AMEC (2011): Diavik Diamond Mine PKC Facility 2010 Geotechnical Site Investigation Factual Report in Appendix II-6 of Diavik Diamond Mines (2012): Annual ICRP Progress Report

EMAB Attachment #3

Diavik Diamond Mines (October 2018): Diavik TK Panel Recommendation Tracking V10 - Diavik Responses

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EMAB Attachment #9

Slater Environmental (July 2019): Memo Re: Diavik Diamond Mine – Processed Kimberlite to Mine Workings Project

EMAB Attachment #10

CV's for EMAB Consultants