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Our Ref: 30165643

Subject: Draft Review of Relevant parts of the HHERA and Appendix V & VI-1
for the Final Closure and Reclamation Plan (FCRP)

Dear John,

Diavik Diamond Mines (2012) Inc. (DDMI) submitted its Final Closure and Reclamation Plan (FCRP) to the Wek'èezhii Land and Water Board (WLWB) in October 2022. There were numerous updates to the FCRP for various aspects of mine closure including new or updated engineering designs, changes to allow passive discharge of run-off to Lac De Gras, updated North Inlet designs, a Post-closure Quantitative Human Health and Ecological Risk Assessment and updated closure monitoring plans. In addition, DDMI has proposed updates to the SW1 and SW2 criteria.

Scope of Work

Arcadis Canada Inc. (Arcadis) has been asked to provide a high-level review of the Human Health and Ecological Risk Assessment (HHERA) report (Appendix X-25) as well as Section 9 of the FCRP (as well as relevant parts of Appendix V, Appendix VI-1, VI-2, and VI-3) as it pertains to potential effects on aquatic, terrestrial and human health. Arcadis will identify any significant concerns, deficiencies or uncertainties with a focus on potential effects of runoff quality on aquatic, terrestrial and human health.

In addition to the review Arcadis has also been asked to comment on the following:

- Are the criteria measurable and can results be verified independently?
- Will the proposed indicators be effective for measuring the outcomes defined by the associated closure objectives?
- Are there indicators that address all important facets of associated closure objectives?
- Are the thresholds defined by the criteria suitable for protection of values that form the basis for closure objectives?
- Will monitoring of performance with respect to closure criteria allow for timely response to failure to achieve closure objectives?

In addition, initial responses from DDMI to the comments pertaining to the water license amendment application, that are also relevant to the FCRP have been received and comments have been revised or removed based on DDMI's responses. Also, DDMI submitted proposed changes/options to the Surface Water Action Level Framework (SWALF) and provided some additional information in their responses to Requests for Information

(RFI) that resulted from the technical workshops held between March 6 and March 10, 2023. Comments pertaining to those, as it relates to the scope of work provided herein, have also been provided.

Background

DDMI is planning to undertake progressive reclamation at the Diavik Mine. The FCRP was submitted to WLWB on October 13, 2022. To complete closure as planned, an amendment to the current WL is required as the current license does not include the re-establishment of island pre-development runoff conditions through sequential decommissioning of the water management system (i.e., drainage control and collection system). Currently, the only authorized discharge is from the water treatment plant. DDMI intends to demonstrate in the WL application that: i) waste will not be released that will adversely affect the environment and that additional and/or revised Effluent Quality Criteria (EQC) are not required. Instead, DDMI has proposed a SWALF to demonstrate how closure criteria for the site wide SW1 and SW2 will be met. Although the WL application has not been approved, the proposed changes are also applicable to the FCRP.

DDMI commenced closure planning with the original mine design work in 1996 to 1998, and it has continually evolved with new information. DDMI is proposing progressive reclamation to reduce the duration of closure works.

As part of our review, EMAB asked us to also consider the following questions as they pertain to our reviews:

1. Are the criteria measurable and can results be verified independently?
2. Will the proposed indicators be effective for measuring the outcomes defined by the associated closure objectives?
3. Are there indicators that address all important facets of associated closure objectives?
4. Are the thresholds defined by the criteria suitable for protection of values that form the basis for closure objectives?
5. Will monitoring of performance with respect to closure criteria allow for timely response to failure to achieve closure objectives?

Arcadis' opinions with respect to each of the 5 questions are provided below.

1. Are the criteria measurable and can results be verified independently?

Arcadis reviewed the basis for the following closure criteria – SW1, SW2, SW3, M1, M2, W3 (W3-3), P1, and N12.

The risk-based closure criteria protective of human health and wildlife to seepage and run-off (SW-1) are based on numerical environmental quality guidelines and can be verified independently. The criteria are clear and measurable. There will be variability in the sampling, but in general it will be easy to verify compliance with the SW1 criteria. Arcadis has recommended that drinking water guidelines be added into the measurement of SW1 at the end of the (small – i.e., 100m) dilution zone to confirm potable water quality is maintained in Lac de Gras. This will be more difficult to be verified independently without knowledge of their in-lake sampling location and access to the sampling location. But as it is a numerical guideline, it is measurable and can be verified. These comments also apply to M2, P1 and N12.

The measurement endpoints for aquatic life in the SWALF are measurable and can be verified independently. However, there are numerous sources of variability associated with toxicity testing that could confound verification of the results. For example, different laboratories could produce different results, additional errors in experimental design, and conditions may not be suitable to obtain samples that won't be spatially or temporally variable. Laboratory variability in sample dilutions, mixing of samples etc. could confound the results as could if a different

laboratory was completing the toxicity testing. Having a numerical environmental quality guideline would be more easily verified than the toxicity endpoints that are proposed.

Once the action level to complete sampling at the ARC is triggered, it will be more difficult to verify compliance independently as access to the sampling location may be difficult and temporal variability will also be a factor.

The proposed amendments to the SWALF that were provided in the responses to Request for Information where DDMI are proposing to add 50% effect levels from reference conditions would not be able to be independently verified, and apart from not being protective of aquatic life, is very open to interpretation and sampling variability. It would make determining compliance very complicated and difficult, and it is strongly recommended that EMAB does not support the proposed changes to the SWALF by the addition of AEMP endpoint comparisons.

These comments also apply to closure objectives M1, W3 and NI2.

The closure criteria related to the closure objectives surrounding dust levels being safe for people, vegetation, aquatic life and wildlife (SW3) are based on numerical criteria and can be verified independently.

2. Will the proposed indicators be effective for measuring the outcomes defined by the associated closure objectives?

The proposed indicators for the protection of human health and wildlife are appropriate for measuring the closure objectives, with the exception of potable water. Drinking water guidelines should be added to the closure criteria and sampling that within Lac de Gras near shore and in the discharge areas should be added to the monitoring programs if exceedances or early warning triggers are identified.

The closure criteria surrounding the protection of aquatic life are not effective measures of evaluating that adverse effects are not occurring in Lac de Gras. Mixing zone sizes have not been defined, and DDMI is proposing that only an effect level above 50% be a trigger for mitigation. Based on the closure criteria proposed for the SW2, it does not appear that their closure objective of no adverse effects to aquatic life will be achieved.

In addition, the monitoring for the closure criteria is proposed to be at the breach of the pond. The distance of the pond to Lac de Gras can be more than 500 m. The change in water quality from the pond breach location to the discharge location is not known and additional impacts to water quality could occur in this distance. Water quality should be measured at the discharge point to Lac de Gras.

3. Are there indicators that address all important facets of associated closure objectives?

Run-off following drainage ditches will have associated suspended solids which will likely have metals absorbed to them. As these enter Lac de Gras, the likelihood for sedimentation in the shallow catchment areas with low flow and current is high. Sediment quality from sedimentation has not been considered in the protection of human health, wildlife or aquatic life within Lac de Gras. Potential impacts to fish and the aquatic food chain do not appear to have been considered for sediment quality. Consideration of maintaining sediment quality within Lac de Gras should be incorporated in the closure objectives.

Maintenance of water quality for the protection of potable water quality has also not been considered in the closure objectives.

4. Are the thresholds defined by the criteria suitable for protection of values that form the basis for closure objectives?

The only concern that Arcadis has is for the protection of aquatic life. Mixing zones appear to be far too large for the protection of aquatic life and a threshold of an IC50 at ARC1 is not acceptable. The threshold criteria of an IC25 for more than one species should be met at the end of the mixing zone. The mixing zone should be as small as practicable and shouldn't be larger than 100 m from shore. If toxicity at an IC25 is observed (not an IC50 as proposed), then discharge to Lac de Gras should be stopped immediately until such time that chronic toxicity is not present and water quality meets AEMP benchmarks.

5. Will monitoring of performance with respect to closure criteria allow for timely response to failure to achieve closure objectives?

The proposed SWALF will not allow a timely response to failure to achieve closure objectives. DDMI is proposing a trigger level to which adverse effects would be expected and then are proposing the completion of a risk assessment to evaluate whether these impacts could be real. The time from obtaining an exceedance to the completion of a risk assessment can be greater than 1 year.

In the responses to the information request, DDMI has proposed an early trigger level for human health and wildlife, and these are positive changes. An early trigger level for aquatic life should also be proposed. Risk assessments should be started as soon as the early trigger is exceeded.

Monitoring frequency also does not seem to be suitable to allow a timely response. Quarterly monitoring is not sufficient to understand temporal variabilities and to identify potential impacts.

Containment design of PAG rock relies on the waste being kept frozen. Climate change projections indicates this may not be the case. No prolonged monitoring is proposed to account for potential climate change impacts to the design or potential environmental impacts if the design does not stand up to climate change projections.

Effluent/Seepage as Waste

DDMI intended to demonstrate that the effluent and seepage water that they wish to discharge to Lac de Gras would not be considered a waste as it would not impair the use of Lac De Gras. Based on the presentation provided by the WLWB in the technical session on March 6, 2023, and on the definition of waste provided in Section 1 of the *Waters Act* and Section 51 of the Mackenzie Valley Resource Management Act (MVRMA), Arcadis is of the opinion that DDMI was **not** successful in claiming that the discharge would not be considered a waste. The definition of waste that would apply to the closure plan for mine is:

- a) *any substance that, if added to water, would degrade or alter or form part of a process of degradation or alteration of the quality of the water to an extent that is detrimental to its use by people or by any animal, fish or plant, or*
- b) *water that contains a substance in such a quantity or concentration, or that has been so treated, processed or changed, by heat or other means, that it would, if added to other water, degrade or alter or form part of a process of degradation or alteration of the quality of that water to the extent described in paragraph (a), ...*

It appears that DDMI is interpreting the "other water" to mean Lac de Gras as an entire waterbody or at an undefined distance, and not the water receiving the discharge (catchment areas). As per the GNWT-ENR

response to Information Request #4, they are unaware of any water license issued by the land and water boards of the Mackenzie Valley that has interpreted the “other water” in such a way.

Given that water quality within the discharge areas could be above the Aquatic Effects Monitoring Program (AEMP) benchmarks and is not expected to be safe for consumption, it suggests that the water quality could be altered for its safe use by people, wildlife and/or aquatic life. DDMI has indicated that there are zones where chronic effects to certain organisms could occur within the mixing zones.

Although much of the data used to support closure are based on predictions, the available information suggests that the discharge to Lac de Gras would be defined as a waste.

It is interesting to note that in DDMI’s response to Information Request #4 Attachment B it is stated that the SWALF approach may be more appropriate for the regulation of a non-wastewater discharge.

Appendix V Detailed Tabulation of Closure Objectives and Criteria.

Appendix V provides the detailed tabulation of closure objectives and criteria, as well as a history of revisions to those criteria. DDMI no longer relies on the site-specific risk-based closure criteria (SSRBCC) that were proposed in previous versions of the closure and reclamation plan (CRP V4.1).

DDMI has proposed significant revisions the FCRP (Version 1) for the closure criteria to measure surface water run-off and seepage water (SW1 and SW2 closure criteria). Instead of meeting the aquatic environmental monitoring program (AEMP) benchmarks, they have proposed the SWALF. Changes included in this SWALF include:

- DDMI has revised the chemical closure criteria for human health for surface runoff and seepage water quality. Previously the closure criteria were based on Health Canada drinking water guidelines, DDMI have now proposed using Recreational Use Guidelines which are the drinking water guidelines adjusted by a factor of 20 to account for incidental ingestion. It does not appear that the protection of potable water has been incorporated into the closure criteria. It is noted that drinking water of Lac De Gras water has been assessed in the Risk Assessment and in Appendix L. However, the protection of Lac de Gras water quality for the purposes of a potable water supply are currently not considered in the closure criteria.
- Numerical soil and sediment closure criteria has been reduced to only petroleum hydrocarbons. It is not clear why this has been done and why metals and other COCs have not been included in the closure criteria.
- DDMI has proposed a surface water criterion for TPH of 3 mg/L. This concentration would result in a sheen on water and would likely result in toxicity to aquatic life.
- DDMI has included a temporal component (as a guideline) that is meant to indicate the amount of time over which closure criteria are to be demonstrated as being achieved before the closure performance can be deemed successful. This timeframe is generally proposed to be five (5) years. There are concerns with this timeframe given the predictions of climate change and that some impacts may take more than five (5) years to be observed.
- Comments relating to the SWALF and SW-1 and SW-2 are provided below and will not be repeated here.

A spot check of Table 2 and Table 3 criteria was completed, and no discrepancies were identified.

Appendix VI-1 FCRP V1.0 Closure and Post-Closure Monitoring

DDMI has proposed two different types of monitoring as follows: i) performance monitoring which will monitor the performance of the mine site and each of the closure management areas against closure criteria and ii) Environmental Effects Monitoring, which will evaluate the combined environmental effects from all areas of the mine site on terrestrial and aquatic ecosystems.

Performance monitoring programs include monitoring for geotechnical stability, dust, hydrology, seepage, runoff and water quality, soil quality, vegetation, aesthetics and wildlife safety and use. The environmental effects monitoring programs include the Aquatic Effects Monitoring Program (AEMP), Wildlife Management and Monitoring Program (WMMP) and the Vegetation and Lichen Monitoring Program (VLMP).

Arcadis has reviewed and provided comments on only the closure criteria that could influence human health, aquatic life or terrestrial receptors (wildlife) with respect to the amendments to the WL and the FCRP. Specifically, the restoration of pre-mining drainage and the allowed discharge of untreated runoff and seepage water to Lac de Gras.

Surface Water Action Level Framework

DDMI has removed the use of AEMP benchmarks as the criteria to measure Closure Objectives that are related to keeping surface water safe for humans, wildlife and aquatic life and has instead proposed the Surface Water Action Level Framework (SWALF) to demonstrate compliance with the following Closure Objectives:

- SW1- Surface runoff and seepage water quality that is safe for humans and wildlife; and
- SW2- Surface runoff and seepage water quality that will not cause adverse effects on aquatic life or water uses in Lac de Gras or the Coppermine River.

Since the submission of the WL amendment application, technical workshops were held and requests for information were made. DDMI has, in a response to the request for information (IR #4), proposed potential amendments to the SWALF. The proposed changes to the SWALF will be referred to as the *proposed amended* SWALF to distinguish between the SWALF contained in the WL amendment application and the FCRP. In the proposed amended SWALF, DDMI has separated human health, wildlife and aquatic life into separate SWALFs. This separation adds some additional clarity to the process and should be encouraged to be incorporated in the final SWALF, if it is to proceed.

For SW1-1 (protection of human health) DDMI has removed the reliance on Health Canada (HC) Drinking Water Guidelines (DWG) and replaced them with Recreational Water Use Guidelines. Recreational use guidelines are drinking water guidelines adjusted by a factor of 20 to account for reduced level of exposure in recreational activities relative to consuming potable water. Comments pertaining to these have been provided under Appendix V. If an exceedance of the criteria is identified, then a risk assessment is triggered. If the risk assessment still identifies a potential for unacceptable risk, then mitigation measures are proposed. **The only concern with this approach is the potential timeline from when a risk assessment is triggered to where mitigation measures are implemented.** This process can take years to complete and implement, and in Arcadis' opinion, there should be interim mitigation measures proposed to reduce the potential risk until such time the risk assessment is completed, and mitigation measures are identified and implemented.

In the proposed amended SWALF, DDMI has proposed to include an early warning trigger, that when 80% of the SW1-1 criteria is reached, then the risk assessment would be triggered. These are positive proposed changes that should be included in the SWALF, if the SWALF is to proceed. Arcadis also suggests that the investigation of

cause should be triggered when 80% of the SW1-1 is reached and that monitoring for the AEMP benchmarks or drinking water guidelines within Lac de Gras should be added to the SW1-1.

Similar comments for the proposed amended SWALF for wildlife are made. The addition of an early warning trigger to the SW1-2 criteria and the commencement of a risk assessment at this early trigger are positive changes that addressed some of our concerns regarding the timeframe for action within the original SWALF proposed. The SWALF for wildlife indicates that if the SW1-2 criteria are exceeded at the monitoring location that water quality at the mixing zone boundary should be sampled to ensure compliance with the SW1-2. It is not clear why water quality in close proximity to the shoreline, where terrestrial wildlife would consume water, would also not be monitored.

Our greatest concerns pertain to the protection of aquatic life. For SW2 (protection of aquatic life), the previous version of the FCRP relied on the use of AEMP benchmarks and aquatic life benchmarks, together with the absence of acute toxicity to rainbow trout and to *Daphnia magna* as criteria to evaluate whether the SW2 Closure Objective was met. Significant changes to the approach to determine whether the SW2 Closure Objective is met have been proposed in this version. The SWALF is illustrated in Figure 3-3 of Appendix VI-1 and is described in Section 3.1.4.4 of the same appendix.

Different Action Levels (AL) have been defined based on the interpretation of monitoring and/or toxicity results that are collected during the various monitoring programs. Action Level 1 (AL1) is triggered if the water quality data for surface runoff and seepage water is equal to or greater than 10X AEMP benchmarks for aquatic life. In previous versions, the closure objectives were not met if the water quality data exceeded the AEMP. **The basis for 10X the AEMP was not provided in this section, but in the initial responses to comments, DDMI indicated it was based on the anticipated dilution within the catchment areas.**

If there is an exceedance of 10X AEMP then a sub-chronic toxicity test is completed. Essentially, surface water or seep water would be collected, and a standardized toxicity test (Environment Canada's EPS 1/RM/21) consisting of serially diluted samples will be completed for *C. dubia*. DDMI considers *C. dubia* to be sufficiently sensitive to predict whether chronic effects to aquatic life would occur. It appears that DDMI is applying the IC25 in the 12.5% dilution test unit as the threshold to determine whether toxicity would likely be present at the mixing zone boundary. The IC25 is defined as the concentration at which 25% of the test organisms will have a reduction in whatever endpoint is being measured. This is normally a reduction in growth or reproduction, but other endpoints are measured as well. In the case of test method EPS 1/RM/21, the endpoint is survival and reproduction.

According to DDMI's SWALF, if there is no toxicity at the 12.5% dilution, then no further action is required, and monitoring continues as scheduled. If there is toxicity, then this triggers the Action Response 2, where a sample will be collected at the mixing zone boundary and toxicity testing will be completed. **Section 3.1.4.4 does not indicate whether the toxicity testing methods and endpoints would be the same toxicity test completed at the first stage. Based on preliminary responses to comments DDMI is proposing the *C. dubia* standardized toxicity test method.** Typically, at the end of the regulated mixing zone, there should be no difference in water quality from the portions of the lake not influenced by mine activity. As such, chronic toxicity endpoints to various receptors should be assessed at full strength of lake water and there should be no chronic toxicity. It appears that DDMI intends to test one species with a high threshold effect concentration (EC₅₀) to trigger further action.

If there is no toxicity at the mixing zone boundary, then the SWALF indicates that the criteria should be revised as appropriate. It is unclear what this means or what the implications are. However, criteria should be set prior to

closure. If DDMI does not feel that the AEMP benchmarks are appropriate, then they should propose site-specific criteria that are, prior to site closure. If there is toxicity, then Action Level 3A is triggered. It should be noted that DDMI's threshold of toxicity has been set at this stage to a level where more than 50% of the organisms can be adversely impacted before it is considered a toxicity impairment. A 50% effect level will likely result in ecosystem impairment and the Closure Objective of no impairment to aquatic life will likely not be met. **It is Arcadis' opinion that this threshold should not be higher than an EC/IC 25 for chronic endpoints to more than one species (i.e., at least a fish and an invertebrate).**

If there is toxicity impairment (at the 50% effect level) and "practical" mitigation measures are not identified, then DDMI is suggesting an Environmental Trade Off Study be completed. It is not clear what this entails and whether consideration of factors other than economics (such as traditional use) will be considered.

With respect to the use of the Surface Water Action Level Framework to measure compliance with Closure Objective SW2, Arcadis offers the following opinions:

- The basis for the use of 10X AEMP as a criterion needs to be provided. Since dose response curves are not often linear, 10X AEMP could be lethal to organisms. It is not clear that 10X AEMP will provide adequate protection or triggers for aquatic life.
- Chronic toxicity tests should be used at the end of the mixing zone for multiple species.
- An IC50 to indicate toxicity impairment is not appropriate to trigger further action. Anything above an IC25 will need to have robust scientific rationale to support its use that population level effects will not result.
- It is not clear what considerations will go into the Environmental Trade off study and whose interests will be represented in this study. The Closure Goals that "land and water that is physically and chemically stable and safe for people, wildlife and aquatic life" and "land and water that allows for traditional use" may not be met if the Environmental Trade Off Study indicates that natural drainage is the path to be followed.

The proposed amendments to the SWALF do not address any of the concerns identified in the original proposal, but the inclusion of additional potential criteria does not, in our opinion, improve the SWALF. We offer the following high-level comments regarding the proposed amendments to the SWALF – Aquatic Life:

- An early warning trigger should be considered,
- Investigation of cause should be triggered earlier in the framework (i.e., as soon as the early warning trigger is exceeded),
- The trigger of having AEMP monitoring results in near field to be 1.5X or a difference of 50% from the reference conditions is not reasonable and there is no explanation why these critical effects are triggered at a difference from reference conditions that is so much higher than that what is required in the AEMP programs. For example, critical effects size in the AEMP program for fish are 10% to 25% difference depending on the endpoint.
- All proposed additions of AEMP measurements should be removed from the SWALF and the criteria of meeting AEMP benchmarks and the absence of chronic toxicity to more than one species should be added to the mixing zone boundary. Otherwise, failure to meet their closure objectives of no adverse effects to aquatic life could occur.

Appendix VI-2

Appendix VI-2 discusses the proposed changes to the Closure and Post-closure Aquatic Effects Monitoring Design Plan Version 1.0. Arcadis completed a review of this appendix as it relates to potential risks to aquatic life, human health and wildlife as opposed to a detailed review of the proposed changes for an effects monitoring program. We note the following from this appendix:

- DDMI indicates that the AEMP and other environmental effects monitoring programs will NOT be used to evaluate compliance with closure criteria. If the environmental effects monitoring program results indicate that closure criteria are not being met, then the results should be used to inform the closure plan and potential impacts.
- DDMI indicates that there are a number of parameters that are expected to increase in concentration in Lac de Gras for 6 to 10 years post closure. They attribute these to “natural tributaries” and Lac du Sauvage. DDMI’s closure criteria do not account for cumulative effects from Diavik and from Ekati, which could inhibit them from achieving their closure objectives. Their closure criteria for the protection of aquatic life, and human and wildlife use should consider contributions from other sources that could result in adverse impacts to the use and safety of Lac de Gras.
- It is indicated that the predicted concentrations of parameters will remain well below the AEMP effects benchmarks OUTSIDE the mixing zone. DDMI has not defined the extent of the mixing zones and indicated in the Workshop that water quality at ARC1 would not be similar to Lac de Gras and that impacts would still be expected. The mixing zone needs to be defined and needs to be as small as practicable. It does not appear that DDMI has addressed the mixing zone concerns that were raised in the CRP V4.1.

Appendix VI-3

Appendix VI-3 summarizes the Tier 2 Closure and Post-Closure Wildlife Management and Monitoring Plan. The wildlife management and monitoring plan is not relevant for the evaluation of risk-based closure criteria.

Closure objectives related to potential wildlife health effects from contaminants will be evaluated using chemical monitoring and not wildlife monitoring. Arcadis has no comments from this appendix with respect to the protection of wildlife health.

Appendix X-25 Human and Ecological Risk Assessment

The HHERA assessed the potential for risk to receptors considering post-closure conditions (relying on predicted concentrations 10 years post-closure). Reference conditions (representing “natural” regional concentrations not influenced by the mine) were used to understand the portion of the risk estimate derived from mine activities. Based on the information provided, it is not clear whether these reference locations are unimpacted areas. Arcadis briefly reviewed the reference locations used for surface water in the risk assessment. Based on a preliminary comparison of reference concentrations to pre-mining surface water quality data, it is not clear that the reference data is representative of unimpacted water quality. Concerns remain regarding the suitability of relying on the reference conditions data. Since DDMI uses the reference location to interpret the potential contribution of mining activities to exposure and to risk (and likely to justify whether mitigation measures are required) the selection of suitable reference locations is extremely important.

The human health risk assessment (HHRA) assessed risks to Indigenous populations and recreational users of the site (such as hikers and hunters). The HHRA considered the use of the land for camping, hunting and

gathering food and the use of water for canoeing and fishing, as a source of drinking water and for bathing/swimming.

The HHRA concluded that the risks to people from post-closure mine contributions are negligible, except for the risks posed by exposure to arsenic and uranium in sediment located along the rocky shoreline. However, DDMI concluded that if people were wearing shoes, then the risk to uranium would be negligible and that the concentrations of arsenic are within natural variation at the Site and in the wider region. Therefore, it was concluded that the risk contribution from the mine was negligible.

Interpretation of toxicity appears to be based on LC50 which would be concentrations by which 50 percent of organisms are adversely affected, i.e., 50 % of organisms are killed. This does not provide adequate protection to aquatic life to meet their closure objectives of no adverse effect to aquatic life.

Based on our review of the information with respect to the WL amendment application, we offer the following comments:

- For a number of the parameters, the measured concentrations at the reference locations were higher than the predicted concentrations at various discharge points 10 years after post closure. Arcadis has not reviewed the predictive models and have not reviewed the reference location rationale or sampling. However, one would not expect to have concentrations of parameters lower than unimpacted reference locations for the following reasons:
 - Some movement of impacts would have been expected over the life of the mine, therefore a baseline of impacts similar to reference conditions or higher would be expected.
 - Redirecting surface water run-off from areas of the mine that have been impacted would be expected to have some impacts identified in the run-off. At the very least, we would expect the concentrations to be similar to reference locations, if not a little bit higher. Some of the concentrations were significantly lower. This could be the case but could also represent concerns with the predictive modeling or concerns with the selection of reference locations.
 - Concern remains with reference locations some of which appear to be impacted by mining activities. In addition, some of the reference locations reportedly have excessive dust depositions making these reference locations questionable. DDMI should provide comparison of water quality from current reference locations relied upon in the RA to pre-mining water quality to identify whether the reference locations relied upon in the RA are representative of unimpacted conditions.
 - Furthermore, Arcadis does not agree on the approach taken with regards to risk from reference locations. It is not appropriate to deduct risk from reference locations from risk from mine locations to determine risk. An unacceptable risk should not be identified only if the difference in the risk from the mine is greater than the acceptable risk threshold. This would not be representative of the potential risks to human and ecological receptors. It is not clear if the predictive modelling accounted for cumulative loading of metals to the environment. All metals that enter the receiving waters will either partition to sediment, remain in surface water or be taken up and accumulated in biota.
- DDMI has evaluated human health risks using a tiered approach considering exposure based on post-closure predicted concentrations and reference concentrations. It appears that DDMI is only considering a risk unacceptable if the risk from the predicted post-closure concentrations minus the risk from the reference concentration is greater than the risk threshold of an HQ 0.2 or an ILCR 1×10^{-6} . This approach requires further justification. If an unacceptable risk is predicted based on post-closure

concentrations, then the risk is unacceptable and requires consideration or management. In areas where reference concentrations are naturally elevated then it is common to manage risks to background/reference levels. But the incremental risk from the site does not need to exceed the risk threshold of 0.2 of 1×10^{-6} which is suggested. As a result, unacceptable risks are predicted for some parameters, in addition to uranium and arsenic which was indicated by DDMI.

- DDMI has reduced the consideration of sediment impacts to PHC F3 in the closure criteria. However, the HHRA identifies potential risks to human health from sediment impacts of uranium and arsenic. Sediment monitoring, especially in future discharge areas should be added to the closure plan as closure criteria to meet Closure Objectives.
- There are general concerns with the mixing zones and the mixing under low flow/low currents as well as ice cover. As this may affect deposition into sediments, Arcadis is of the opinion that sediment impacts should be monitored.
- In addition, the interpretation of risk by DDMI for HQs above 1 is flawed as it appears the assumption was made that risk from HQ increases in linear fashion when in fact the magnitude of risk associated with HQs is dependent on concentration - response relationships. This could potentially greatly underestimate risk.
- It is acknowledged by DDMI that uncertainty remains with the BLM and Windward models in that predicted concentrations e.g., of copper are lower than concentration in natural conditions of Lac de Gras which seems unrealistic. Arcadis did not review the models; however, this seems to underestimate the input and end concentrations in Lac de Gras which potentially underestimates risk.

Conclusions

Arcadis' review of the FCRP, Appendix V, Appendix VI-1, VI-2, VI-3 and Appendix X-25 identified a number of major concerns with the protection of aquatic life and human health. Arcadis is of the opinion that the approval of various components within the FCRP is not appropriate at this time until concerns noted above are addressed. Primarily our concerns lie with the protection of aquatic life in Lac de Gras.

Sincerely,
Arcadis Canada Inc.

DRAFT

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DRAFT

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Enclosures:

Tables: Excel Template