Memorandum

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Project:	Jericho Diamond Project Environmental Assessment	**File No.:**	03005
From:	Rick Pattenden	**Date:**	3 October, 2003
To:	Greg Missal, Tahera Corporation	**Page:**	1 of 6
cc:			
Re:	Response to NIRB Reviewers Deficiency Statements – Aquatic Biota		

Mainstream Aquatics Ltd. has reviewed the deficiency statements by the NIRB reviewers that pertain to aquatic biological issues. The following provides our response.

A. Department of Fisheries and Oceans - Letter dated May 2003

No specific fisheries concerns were identified. The letter stated that the EIA contained insufficient information for a review by DFO and that technical meetings would likely be required to address outstanding concerns pertaining to fish habitat and navigation.

Without knowing the specific concerns of DFO we are unable to provide a response. It should be noted; however, that Tahera Corporation has initiated discussions with representatives of DFO to establish a fish habitat compensation plan based on information presented in Attachment 4.1 of B.3.1. Environmental Management Plan.

B. Department of Indian and Northern Affairs - Information request dated 25 April

1. *Carat Lake water circulation (p.4) - the proponent should provide a consideration of the impact of the causeway on lake circulation.*

An assessment of causeway effects on lake water circulation is presented in the document titled "Upwelling generated by Causeway" (Greisman 2003). The following provides an evaluation specific to the potential impacts on fish populations.

The causeway will result in a measurable change in water circulation in Carat Lake by modifying along-shore currents and by causing upwelling of water from the deepest part of the lake. Both have the potential to affect aquatic biota in Carat Lake.

Modification of along-shore currents has the potential to impact fish by altering the velocity characteristics of spawning sites within the zone of causeway affect. Potential spawning sites are located 210 m east and 180 m west of the causeway (Figure 3.4 in B.2.3 Aquatic Impacts Assessment November 2000). A general rule of thumb indicates that the zone of influence is equal to the length of the structure (Paul Greisman, pers. comm.). The causeway is 90 m in length; therefore, both potential spawning sites are located at least two times the distance of the expected zone of influence. As such, the potential adverse effects caused by modification of along-shore currents by the causeway on potential fish spawning areas are expected to be negligible.

Upwelling of water from the deepest part of the lake can influence aquatic biota by altering the vertical temperature and nutrient regime within the lake. Existing lake conditions presently enable light winds to drive upwelling from 10 to 20 m depth (Greisman 2003). Because frequent upwelling presently occurs under natural conditions the Carat Lake biological community is pre-adapted to the effect. As such, upwelling caused by the causeway is expected to have negligible effects on aquatic biota in Carat Lake.

2. *Primary Access Road Options (p.7) - EIA should consider assessment of all three options.*

An assessment of the Contwoyto Lake road option is presented in Section in B.2.3 Aquatic Impacts Assessment December 2002 Amendment.

3. *Borrow Pits and Quarry Sites (p.7) - EIA missed this component.*

Project activities and the Project footprint will not infringe on streams of lakes (A.1 Project Description). Based on this information these Project components should have no effect on aquatic biota.

4. *Ammonia Modelling (p.17) - Worse case scenario nitrogen model and impact on Lake C3.*

See Section G of this document

5. *Accidents and malfunctions (p.19) - Failure of PKCA North Dam*

The PKCA will be constructed in the Long Lake basin and will consist of two cells and one polishing pond. PKCA discharge will be to the west via Stream C3, which drains into Lake C3. Lake C3 drains directly into Carat Lake (A.1 Project Description). The north dam will be used to separate the PKCA from a small watershed that drains into Carat Lake via Lake C1, Stream C1, Lake C2, and Stream C19. Baseline inventories have identified fish and fish habitats only in Lake C1 and Stream C1 (RL&L 2000).

Structural failure of the north dam resulting in an uncontrolled release of untreated PKCA fines has the potential to adversely affect the aquatic environment in this watershed. The PKCA fines (sediment and water) would contain levels of suspended sediments, metals, and ammonia that would exceed CCME guidelines (SRK Technical Memoranda F under separate cover) and would be acutely toxic to fish. If this material reached the aquatic environment, the resulting potential effects would be loss of habitat, direct mortality, and reduced water quality.

For the purposes of this evaluation, it is assumed that mitigation measures will not prevent entry of an uncontrolled spill into the aquatic system and the spill would likely occur in June when the potential volume of the spill would be at its highest.

The magnitude is considered to be high for each adverse effect (loss of habitat, direct mortality of fish, and reduced water quality) because the result would be mortality of a large component or all of the aquatic biological community in each affected waterbody. The downstream extent of the detrimental effects on fish of an uncontrolled spill would vary depending on the volume of the material released, as well as dilution effects and holding times in each basin. An assessment of water quality effects suggests that a spill would affect the entire drainage including Carat Lake (AMEC Water Quality Memoranda under separate cover).

The adverse effects of an uncontrolled spill from the PKCA will be significant. Immediate consequences would include direct mortality of fish due to acute toxicity of contaminants. Long-term consequences would involve degradation of habitat due to sedimentation and reduced water quality. The ecological context of an uncontrolled spill is high and it is unlikely that the effect would be reversible during the life of the project. Due to low productivity characteristic of subarctic lakes, fish populations would require several generations to return to pre-impact densities. In addition, barriers to fish passage on Stream C1 would hamper re-establishment of a fish community in Lake C1. The geographic extent of the spill would be moderate because only waterbodies within the Jericho Site would be affected. The level of confidence in this rating is low, as is the certainty (qualitative and quantitative) in the evaluation. At the present time, there is insufficient information to accurately predict the duration of the effects.

C. Yellowknife Dene First Nations dated 12 May

1. *Risk assessment of vehicle traffic.*

There will be a network of roads in the Jericho Site (permanent and winter) that will be used to transport materials. The tonnage transported, frequency, and location of the traffic will vary depending on the project phase. Highest activities and tonnage transported would occur during construction phase, which would require use of the existing winter road that extends 29 km from the Lupin Site. In total, 441 truck loads would be required during the construction phase (A.1 Project Description).

The B.2.3 Aquatic Impact Assessment December 2002 Amendment erroneously stated 361 truck loads would be required during the construction phase. The following provides a re-evaluation using 441 truck loads.

A number of hazardous materials would be transported during winter. If an accidental spill occurred, Tahera Corporation would implement an established emergency response procedure to minimize the potential impact. All spills that are accessible would be properly collected and disposed. It is possible that some material would remain after clean up and could potentially affect fish depending on the location and timing of the spill.

Data for the period 1994 to 1998, presented in Diavik (1998), indicate a spill rate of 9.0×10^{-7} per loaded truck kilometre of travel on the existing route from Yellowknife. Using this information, the estimated number of return trips and the distance traveled within the Jericho Site (3.5 km), the number of potential spill incidents would be 2.8×10^{-3}. Even if the total number of predicted trips were used (932), the number of incidents during the entire life of the project would not exceed 5.9×10^{-3}.

This information suggests that the likelihood of a spill occurring during the life of the project is extremely low. It should also be noted that not all truck loads contain materials that are hazardous to the aquatic environment.

2. *Magnitude of impact based on size of a petroleum spill.*

For the purposes of this assessment, it is assumed that a 'worst case spill' of up to 15,000 L from a petroleum tanker truck may occur in the Jericho Site; mitigation measures would not remove the entire spill and the spill would enter the aquatic system. Based on these assumptions, there could be adverse effects associated with a spill on the winter road within the Jericho Site (i.e., Lynne Lake) or on Contwoyto Lake.

Assuming a fixed spill volume of 15,000 L, the effect of a spill on aquatic biota would depend on the volume of the waterbody affected. For this evaluation, the magnitude of the effect would be high for both large and small waterbodies. Spills are short duration events; however, the effects of a spill on aquatic life

could be much longer. As such, the duration of a spill event has a single rating of moderate (several years). It is assumed that no more than one spill will occur during life of the project.

The ecological context of a spill is high in a small waterbody (e.g., Lynne Lake) and is not reversible during the life of the Project. In contrast, the impacted area of a large waterbody (e.g., Contwoyto Lake) could be recolonized by fish originating from populations not affected by the spill; therefore, it is reversible. In Lynne Lake, the geographic extent of the spill would be high because the entire waterbody is affected, while in Contwoyto Lake it would be low because only a portion of the lake would be impacted.

Adverse effects associated with an accidental spill on the winter road in the Jericho Site may be high, but they would be restricted to the sub-local or local level. Based on this information, the rating for a 'worst case spill' is significant for Lynne Lake and not significant for Contwoyto Lake. The level of confidence in this rating is low, as is the certainty (qualitative and quantitative) in the evaluation. At the present time, there is insufficient information to accurately predict the magnitude of the effect on fish.

D. Environment Canada Technical Review dated 1 May 2003

1. *Issue 22 - Benthic invertebrate data have not been assessed.*

An assessment of baseline benthic invertebrate data is presented in the Jericho Diamond Project Pilot Aquatic Effects Monitoring Program Report (RL&L 2001) presented under separate cover.

2. *Issues 23 to 25 – Monitoring program should be adjusted.*

Tahera Corporation will follow recommendations related to Issues 23 to 25.

E. Kitikmeot Inuit Association (KIA) Technical Review dated April 2003

The KIA technical review identified low, moderate, and high significance issues associated with the aquatic environmental assessment. Low and moderate significance issues pertaining to aquatic resources will not be dealt in this document. Most of these concerns have been addressed by information presented in existing EIA documents. Tahera Corporation has agreed to address other low and moderate significance issues to the satisfaction of the KIA (e.g., Issue 70 – sample fish communities downstream of Carat Lake).

No high significance issues deal directly with aquatic biota concerns; however, there are indirect concerns related to changes in water quality. This issue was raised by a number of reviewers and is addressed in Section G of this document.

F. Health Canada dated 12 May 2003

1. *No information provided on metals concentrations in fish (other than mercury and aluminum)*

Information is presented in Jericho Diamond Project Aquatic Studies Program Report-1996 (RL&L 1997)

G. Various Reviewers - Changes to Water Quality and Effects on Aquatic Biota

Various reviewers requested additional modelling of mine discharge constituents and a re-evaluation of potential effects on water quality and aquatic biota downstream of mine discharge in (e.g., Carat Lake and Lake C3). The following provides a revised environmental assessment for aquatic biota using the same approach described in the B.2.3 Aquatic Impacts Assessment November 2000. Specifically, exceedence

of CCME water quality guidelines for the protection of aquatic life is used as the threshold of impact. The AMEC Water Quality Memoranda submitted under separate cover has been used as the supporting document for this assessment.

Discharge releases from the mine and waste rock areas, treated sewage from the housing facility, and the PKCA have the potential to introduce contaminants into the aquatic environment in the form of metals, nutrients, and suspended sediments, and dissolved solids. These contaminants may reduce water quality to the level where it could adversely affect aquatic biota. Potential effects on fish include increased contaminant loads, lowered reproductive capacity, and loss of habitat. A change in water quality can affect fish indirectly by altering the productive capacity of the aquatic ecosystem. Nutrient loading may increase the production of invertebrates, thereby providing more food for fish. Conversely, elevated suspended sediment loads could reduce primary production of phytoplankton by reducing light penetration.

Mine Operation

During mine operation it is assumed that all mine related discharge will be directed to the PKCA (Tahera Corporation, pers. comm.). Effluent from this source will discharge to Lake C3 via Stream C3. Assuming a 'worst case scenario' of extreme low flows and maximum PK discharge concentrations, three constituents will exceed CCME guidelines for the protection of aquatic life in Lake C3 at the outlet of Stream C3 (Table 1). These are aluminum, ammonia, and cadmium.

Table 1 Mine discharge constituents that have the potential to exceed CCME water quality guidelines for the protection of aquatic life.

Constituent	CCME Guidelines	Operation[a]		Post-Closure	
		Pre-Mitigation Conc. (mg/L)	Post-Mitigation Conc. (mg/L)	Pre-Mitigation Conc. (mg/L)	Post-Mitigation Conc. (mg/L)
Aluminum - Al	0.005 – 0.100	**0.130**	<0.005	**0.6597**	0.018
Ammonia - N	0.019	**0.363**	<0.019	-[b]	-
Cadmium - Cd	0.000017	**0.00013**	<0.000017	**0.0010**	**0.00003**
Copper – Cu	0.002 – 0.004	0.002	<0.002	**0.0273**	0.00076
Iron – Fe	0.3	0.127	<0.3	**0.7919**	0.02200
Molybdenum - Mo	0.073	0.016	<0.073	**0.0937**	0.0026
Total Dissolved Solids	na	195	na	1254	35
Uranium – U	na	0.085	na	0.1763	0.0049

[a] Assumes worst case scenario.

[b] After 20 years ammonia is expected to be at background in the pit.

The discharge generated by the mine site would meet regulatory guidelines (Tahera Corporation, pers. comm.). Mitigation would involve spray irrigation or water treatment. Assuming that the treatment is successful and that discharge meets CCME water quality guidelines for protection of aquatic life, the no adverse effects on aquatic biota are expected in Lake C3.

Mine Post-closure

On closure, it is assumed that the PKCA will be reclaimed to dry land and no discharge will be released to Lake C3 (Tahera Corporation, pers. comm.). All other contaminant sources will be directed towards and drain to the mine pit. The pit will require approximately 20 years to fill at which time overflow water would be directed to Pond A and exfiltrated to the tundra or discharged through a buried pipe to a diffuser. Carat Lake would be the receiving waterbody for all mine discharge post-closure.

The predicted concentrations of a number of constituents will exceed CCME water quality guidelines for the protection of aquatic life (Table 1). They include aluminum, cadmium, copper, iron, and molybdenum.

If overland flow is deemed insufficient, a pipe and diffuser system would be employed. The discharge pipe would be situated offshore in Carat Lake near the lake bottom to reduce concentrations to an acceptable level. The outfall pipe would be equipped with a diffuser to facilitate rapid dilution of the effluent. The diffuser would achieve 36:1 dilution within 7 m of the diffuser discharge assuming a 9.5 m depth and diffuser placement 420 m offshore. Assuming effective operation of the diffuser, most constituent concentrations would fall below CCME water quality guidelines for protection of aquatic life.

The magnitude of effect within the 7 m dilution zone is assumed to be high due to exceedence of the CCME guidelines. This impact zone is small relative to the size of Carat Lake, so the geographic extent is considered low. The duration of the effect is high as well as the frequency, because it would occur for an undetermined length of time following mine closure. The ecological context of the effect is also deemed to be low because of the restricted zone of impact (154m^2 or 770 m^3 within 5 m of lake bottom) and the absence of habitat that is critical to the viability of the fish community or other biota in Carat Lake. Based on this information, it is expected that concentrations of most mine discharge constituents released to Carat Lake will not have a significant adverse effect on the fish community or other aquatic biota populations.

Following dilution, the cadmium concentration of the mine discharge would still exceed CCME guidelines at a distance 7 m from the diffuser (0.00003 mg/L versus 0.000017mg/L, respectively). Additional dilution would occur within Carat Lake at an unknown distance from the diffuser. An evaluation of the significance of elevated cadmium concentrations based on CCME guidelines is problematic given the very low threshold concentration. Information from the literature suggests that a safe cadmium concentration (i.e., one that does not cause a measurable effect in test subjects) approximates 0.0004 mg/L rather than 0.000017 mg/L (AMEC Aquatic Toxicology Report submitted under separate cover). If this alternate value is used, the threshold for effect would not be exceeded 7 m from the diffuser, and the results of the impact assessment for cadmium would be similar to that for the other constituents: no significant adverse effect.

However, based on a conservative approach using the CCME guideline for cadmium, the impact zone could theoretically increase to include all of Carat Lake. Using this approach, elevated cadmium concentrations could have a significant adverse effect on the fish community and other aquatic biota in Carat Lake. The confidence and certainty in the effects assessment for cadmium is low due to uncertainty regarding the concentration that actually would impact aquatic biota and the extent of the effect within Carat Lake. At the present time, there is insufficient empirical data to accurately predict the effects.

Literature Cited

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