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Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU
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Attention: Ms. Dionne Filiatrault, P.Eng.,
Manager of Technical Services

Dear Dionne:

Jericho Diamond Mine
Review of C1 Diversion Channel Design Report
NWB Water License NWB1JER0410

At the request of Nunavut Water Board (NWB), Acres International Limited (Acres) has conducted an independent review on the design report of the C1 Diversion Channel that was submitted by Tahera Diamond Corporation (Tahera), on behalf of Benachee Resources Inc. (BRI). BRI is a wholly-owned subsidiary of Tahera and is the registered holder of the Nunavut Water Board Water Licence No. NWB1JER0410 (Water Licence). The design report was prepared by EBA Engineering Consultants Ltd., dated August 30, 2005.

Background

Part D of the Water Licence describes the Conditions Applying to Construction. Item 2 of Part D refers to the design plan for the construction of dams, dykes or structures intended to contain, withhold, divert or retain water or waste. Item 16 of Part D specifically indicated that BRI shall submit to the NWB a detailed design plan and drawings, which outlines the construction of the C1 Diversion Channel structures at the Jericho site. Details of the design plan related to the diversion channel are stated in Schedule D, Item 16.

The open pit mining at Jericho will intercept the existing natural drainage flow from Lake C1 to Carat Lake. The C1 Diversion Channel is intended to direct the outflow from Lake C1, so that the inflow from Lake C1 will not enter the mining pit, but will be redirected and subsequently reconnected to the lower reaches of the natural stream C1 into the Carat Lake. The diversion channel will be set back at a minimum 30 m distance from the crest of the pit slope mine. The diversion channel must also be designed to satisfy the requirements from the Department of Fisheries and Oceans (DFO).

The design report for the C1 Diversion Channel included photographs taken from the recent 2005 site visit, background reports related to aquatic studies program carried out in 1999, subsurface information in the form of borehole logs drilled at the proposed diversion channel alignment and reported in the 2003 SRK Technical Memorandum A, as well as drawings of the C1 diversion channel from the 2004 SRK Technical Memorandum W.

Acres Review and Comments

Based on the review of the design report, as well as the accompanying construction specifications for the C1 diversion channel, Acres has the following comments:

1. **General**

   The design report, drawings and related construction specifications provided all of the requirements set up for the construction of the C1 Diversion Channel, as stipulated in the Part D Item 16 of the water license. The proposed C1 Diversion Channel provided in the design report has been modified to include requirements from the NWB license and the DFO. Consequently, the proposed design is different from the plan submitted in the 2003 SRK Technical Memorandum G.

   The design details and description of the proposed diversion channel, however, have not been clearly presented in Chapter 5 of the report. Some of the critical dimensions and elevations are not clearly shown on the drawings, and in some cases are difficult to obtain or extract from the design report. The following are examples of dimensions/elevations that need to be clarified:

   - Side slopes of channel in area adjacent to the fill pad (diversion structure).
   - Height of fill berms above the existing ground in Reach C (need to confirm that it will be 1 m, as per Section 6.1, Item 4, Page 12 of the design report).
   - Dimensions of "low flow" channel in Reach C, for channel in the fill or in the cut areas (need to confirm that it will be 0.6 m wide at the base, and 0.2 to 0.3 m deep, as per Section 5.3, Page 9 of the design report).
   - Extent of the channel adjacent to the diversion structure which will require a liner system (need to confirm whether this will be in sections of the channel which to be built on fill only)

2. **C1 Diversion Structure**

   Sections 3.5 (Page 6) and 5.2 (Page 8), do not provide an adequate and clear description of the structure to be built at the entrance of the channel diversion. The previous EIS document showed a diversion dam structure, but the design report shows only a "channel block" using zoned fills (it was referred to as a "fill pad" in Drawings 1100060006-01a and 02), connected to the adjacent and existing Carat Lake Road embankment.

   The design report needs to provide the following detail information:

   - Invert of channel (need to confirm approximately el 487 m at entrance as shown in Profile, Drawing 1100060006-02).
   - Side slopes of the channel.

3. **Hydraulic Design Parameters**

   No summary was provided for the hydraulic design assumptions that were made for the channel diversion. The design report only referred to the previous design work by SRK, without providing any reference report.

The design report identified that the channel design was based on discharging peak flows of 0.7 m^3/s to satisfy 1 in 200 year precipitation event. In comparison, SRK Report No. 1CT004.02, prepared in November 2000 (Mine Waste and Water Management at the Jericho Diamond Project) indicated that the channel would be sized to pass a 200 year flood, and estimated to be 3.7 m^3/s. In addition, SRK Technical Memorandum C, prepared in October 2003 (Supplemental Climate and Hydrology – Jericho Project, Nunavut) provided a flood peak estimate of 3.9 m^3/s for the Stream C1 diversion, with a 200 year return period, and using Rational Method (Table C11). Table C13 shows an adopted flood estimate of 1.9 m^3/s for the 200 year return period flood. What reference and how was the 0.7 m^3/s derived/used in the design report?

Further review on the SRK Technical Memorandum W, prepared in August 2004 (Site Water Management – Jericho Project, Nunavut) indicated a peak 200 year flow of 0.7 m^3/sec, which is similar to the value used in the design report. However, the assumed catchment area has been reduced from 150 ha in SRK Technical Memorandum C, to 105 ha. A summary of parameters used in the design, with brief comments and its references would be helpful.

Also, the design report lacks detailed discussions and a summary for the design water flow velocity, channel slopes and sizes to accommodate the peak flow during the 1:200 peak event. How high above the base channel would the typical water level be in the various Reaches A, B or C?

What is the size of the channel for the "low flow" conditions? The report mentioned a trapezoidal channel with 0.6 m wide at the base and 0.2 m to 0.3 m deep (Section 5.3, Page 9). What depth was used in the design? 0.2 m or 0.3 m?

For the channel designed in bedrock (Reach A), the depth of the rock excavation was determined from the 1% grade slope as shown in the profile drawing (Drawing 1100060006-02). The channel will be 2 m wide at the base and with a side slopes of 1H:1V. What is the estimated water depth in the channel in Reach A during the 1:200 year event?

4. **Permafrost Degradation, Berm Construction and Thermal Insulation Within Reach C**

The design report needs to further discuss the justification of the fill berm construction, as opposed to the channel excavation in overburden within the Reach C area. Some information regarding the following needs to be clarified:

- Was a model or study conducted to support the decision to have a wide channel for the peak flow during the 1:200 year event?
- What is the water level height contained within the two berms during the 1:200 year event?
- How was the minimum 5 m wide berm determined to ensure that the berm can preserve and aggrade the permafrost conditions? Was a geothermal modeling used for the sizing of the berms?

- Will there be potential for seepage through the berms, as they do not contain a geomembrane or an impervious barrier?
- The design report, Section 5.3, Page 10 discussed the construction of a 2 m cover of insulating sand and gravel/rock cover used in the zone between Reach C and the pit crest in areas containing high levels of ground ice. Where would this insulating layer be built, and was there any modeling or studies conducted to support the need of such structures?

5. Energy Dissipation /Fish Pool

- Drawing 1100060006-03 shows that the fish pool base will consist of 0.25 m thick Type 2 Granular fill, topped by boulders as directed by the Engineer. The Specifications (as provided in Drawing 1100060006-01a) indicates a Type 2 granular fill overlaid by Type 1 riprap. Do the boulders as indicated above refer to Type 1 riprap?
- No discussion was made in regards to the maintenance of the fish pool, i.e. removal of trapped silt and fines over time.
- The design report discussed pools in Reach B and the start of Reach A (Section 5.3, Page 11). Is there other specific sites within Reaches A and B where additional energy dissipation pools are located? Drawing 1100060006-01a only shows one pool location at the start of Reach C (Sta. 0+331.7).
- No detailed information or discussion was available for the riffles for fish enhancement as required by the DFO. Drawing 1100060006-01a only shows that riffles will be built within Reach C as directed by the Engineer.

6. Drawings and Construction Specifications

- Construction Specifications (Drawing 1100060006-01a) does not contain any discussion or directive on rock excavation within Reach A.
- Inlet profile of the diversion culvert drawing shows 0.2 m subbase (Drawing 1100060006-03). What type of material is referred to as subbase?
- Drawing 1100060006-03 also shows a layer of Type 1 riprap to be placed around the culvert at the inlet area. No thickness was shown on the drawing. No details were provided for the culvert outlet and the transition into the "low flow" channel in Reach B (a few metres distance downstream of Sta. 0+277.27).
- In Drawing 1100060006-02, Detail 4 (Reach B), a 5 m wide, 300 m thick Type 2 granular fill will be placed on both sides of the excavated channel. Should this layer cover the top of the Type 1 riprap, as shown in Section H, Drawing 1100060006-03 for a similar section? Which section is correct for the Reach B area? Section H was taken at a location near the end of Reach B.
- Section H, Drawing 1100060006-03 does not show the 0.2 m Type 2 granular fill or non-woven geotextile beneath the Type 1 riprap.

7. Other Minor Issues/Corrections

- Page 3 of the design report – The detailed design description related to the diversion channel is provided in Schedule D, Item 16 of the Water License, not Item 15 as shown in the report.

- Section 6.1 Construction, Page 12 – Reach B Energy Dissipation Pools. The content of this section is confusing. The energy dissipation pool as shown in the drawings is located at the start of Reach C, not in Reach B. It is understood that Reach B contains only a number of ditch stops, which presumably are designed to slow down the water flow as the channel gradient is relatively steep at this location (in the order of 8%, as shown in Drawing No. 110060006-02). This section also discussed about the culvert, which is located at the end of Reach A, not in Reach B.
- Appendix D of the design report refers to drawings taken from the 2003 SRK Technical Memorandum G – Water Management Facilities Design Criteria. This document does not contain such drawings. The two drawings shown in the design report appear to be from the 2004 SRK Technical Memorandum W – Site Water Management, as correctly stated at the beginning of Section 4.0, Page 7 of the design report.

In summary, there are a few details that need to be addressed, clarified or expanded in the Design Report and Specifications for the C1 Diversion Channel. Summary tables describing the design criteria, assumptions, as well as the selected design parameters would be useful to clarify and support the drawings and the construction specifications. Should you have any further questions or concerns regarding the above, please do not hesitate to contact me.

Yours very truly,

RAH:sep

R. A. Halim, P.Eng.
Senior Geotechnical Engineer

cc Mr. J. Murdock, NWB

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