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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

September 12, 2006

File: 2AM-JER0410/D2
By Fax: 1-416-777-1898

Greg Missal
Vice-President Nunavut Affairs
Tahera Diamond Corporation
130 Adelaide Street West, Suite 1900
Toronto, Ontario M5H 3P5

Subject: NWB review of submitted TDC responses to divider dyke design and intervener comments

Dear Mr. Missal:

The Nunavut Water Board (NWB) requests further clarity on issues related to the Jericho Diamond Mine Long Lake Divider Dyke Design Report (**Part D, Item 2**). The following documents were consulted in reviewing the Divider Dyke Design Report:

- i. **Divider Dyke Design Report** – *Tahera Diamond Corporation - Jericho Project Long Lake Divider Dyke Design Report 1100060.004* (received: July 14, 2005)
- ii. **Kitikmeot Inuit Association Intervention Comments** – *NWB1JER0410 – Tahera Diamond Corporation – Jericho Project Long Lake Divider Dyke Construction Specifications and Design Report* (received: October 18, 2005)
- iii. **Indian and Northern Affairs Canada (INAC) Intervention Comments** – *NWB1JER0410 – Tahera Diamond Corporation – Jericho Project Long Lake Divider Dyke A Construction Specifications* (received: October 21, 2005)
- iv. **Acres International Limited Intervention Statement** – *NWB1JER0410 – Tahera Diamond Corporation – Jericho Project Long Lake Divider Dyke A* (received: October 20, 2005)
- v. **EBA response letter to INAC Intervention Comments** – *NWB1JER0410 – Tahera Diamond Corporation – Jericho Project Long Lake Divider Dyke A* (received: November 23, 2005)
- vi. **EBA response letter to Acres International Limited Intervention Statement** – *NWB1JER0410 – Tahera Diamond Corporation – Jericho Project Long Lake Divider Dyke A* (received: November 23, 2005).

The NWB has retained the external expertise of Dr. Lukas Arenson and Dr. David Sego of University of Alberta (U of A) to evaluate technical aspects of the presented design and evaluate any potential impact on freshwater. After a review of the above correspondence, it has been determined that further clarity is needed. Please find below Dr. Arenson and Dr. Sego's review and within the reviews the NWB has included highlighted (yellow) bold text giving TDC direction in formulating a response and the additional information TDC is to provide.

1. **(Riprap Materials Item 6.2)** Figure 1 of the design report and Tables 3.1 to 3.3 indicate the grain size distributions for the different materials. According to the U.S. Army Corps of Engineers (1955) and the U.S. Army et al. (1971), which use the filter criteria suggested by Terzaghi, the following criteria have to be met:

$$\frac{15\% \text{ size of material A}}{85\% \text{ size of material B}} \leq 5$$

and

$$\frac{50\% \text{ size of material C}}{50\% \text{ size of material D}} \leq 25$$

The grain size distributions presented fulfill criterion 1, but for the second criterion a value of 115 was calculated. Please explain why the second criterion was not met.

The Board requests additional detail and description to address why one of the filter criteria (as noted in the U of A review) was not considered in the design. The Board requests additional detail with regards to filter criterion requirements and comparisons to 1) material gradations provided in Figure 1 and 2) particle size distributions provided in the construction specifications, to clearly demonstrate that filtration criteria for all material interfaces within the dyke have been adequately considered in design and construction specifications.

Figure 1 provides material gradation for various divider dyke components. Gradation curves are provided for many of the materials with reference to “bottom size” and “top size” in the figure legend. It is unknown what these terms are referring to and the Board request further clarification to address this issue.

2. **(Long-term Monitoring Item 8.0)** The effectiveness of the LLDD assumes that the dyke does not freeze during winter, which currently is not controlled. In addition to the proposed monitoring of the water quality and the dyke movements, it is recommended to measure dyke temperatures. However, since a frozen dyke only affects the performance of the dam with respect to filtering and not the stability, this is only a recommendation, that does not have to be addressed.

The Board requests a response to the review’s comments provided above.

Further to the reviewer’s comments listed above, the Board requests clarity on the following points:

3. **(Design Intent Item 2.0)** TDC stated that a low sill or overflow channel may be required to allow water to overflow the dyke. Within reference document vi., EBA stated that the “overflow could consist of pipes, or siphons or a low sill (emergency spillway). Details of a low sill emergency spillway structure will be presented in the PKCA management plan”. TDC should be reminded that the Divider Dyke design is a stand alone document and therefore should include sufficient description of all design details (i.e., location type of materials, size, etc.) and under what criteria or conditions are required for construction. If TDC has provided this detail through another stand alone document, the NWB invites TDC to appropriately reference where this information can be found (document title, document section, page numbers where detail can be found).
4. **(Stability Analysis Item 4.0)** Within reference document iv., it was stated “*results of stability analysis were presented graphically in Appendix A. Figures A4, A5 and A6 showed stability analysis for the downstream slope. The phreatic water surfaces generated in these figures do not appear to be representative for long term or static conditions.*” The Board requests further detail and discussion on how water levels on upstream and downstream of the dyke, as well as, the phreatic surface of the water within the dyke were determined to complete the stability analysis. Were the conditions analysed for water flow through the dyke and

foundation representative of freezing conditions, filter blinding conditions, or otherwise? Clarification is also requested to address why Figures A1 to A3 have a phreatic line on the upstream and downstream face of the dyke to be at a similar level, while Figures A4 to A6 show a phreatic line that drops dramatically within the dyke between the upstream and downstream face. Was this not considered because it was not a critical structure?

5. **(Riprap Materials Item 6.2)** Within reference document vi., TDC acknowledges that the recommended gradation for riprap is smaller than that required for full wave heights (as was stated in reference document iv). The riprap gradation curve provided in Figure 1 of the design report, specifies a d_{50} of about 130 mm ("top size"), which is less than the required 155 mm. Additionally, Table 3.3 from the construction specifications stated that the percent passing of 25 to 55% is to have a particle size of 50 mm, which is also less than the required 155 mm. The Board requests additional detail outlining why is there inconsistency between the specified grain size in the construction specification (Table 3.3) for the riprap material and that provided in the design report (Figure 1). To partially address this issues described above, EBA responded, "the specified size is less than the required size, such that the riprap meets the filter criteria between the underlying 20 mm minus material and the rip-rap". Further to this point, EBA's response stated "it [riprap layer] is expected to perform adequately as rip-rap material; however additional run of mine material will be placed if degradation is observed". Is there a monitoring program implemented to assess riprap layer performance and quantitative criteria established to benchmark when riprap repair should be implemented? If so, does TDC plan to include information for this monitoring in the annual geotechnical report **(Part G, Item 2 (g))**?
6. **(Design Intent Item 2.0)** TDC stated that particles passing the dyke will combine and settle in the deposition cell following flocculation. Will a flocculent or chemical be used to aid in this process? If so, what are the characteristics of the flocculent/chemical and method of application or does TDC anticipate settling due to gravity?
7. **(Design Intent Item 2.0)** TDC stated that divider dyke B will be constructed during future mine operations or as required for water quality. What criteria and measures will be used when future operations require an additional dyke? Additionally, what criteria will be used if an additional dyke is required for water quality reasons?
8. **(Design Intent Item 2.2 - Foundation Conditions)** TDC stated that additional site characterization will be carried out during the open water season to further evaluate lake bottom and foundation conditions. The Board requests that this information be included in the final construction and engineering records? Will this information be presented in the construction records as per **Part D, Item 19**?
9. **(Design Cross-Sections Item 3.0)** TDC stated that a key trench will be required along shore abutment portion where existing terrain is covered by boulder fields. No details of the key trench have been provided in the design report. The Board request additional detail and discussion on a typical design and construction specifications of the key trench, information on how it will be constructed (location, type of materials, size, etc.), and under what criteria or conditions are required for construction.
10. **(Stability Analysis Item 4.0)** In addition to the dyke retaining some of the PK materials, it will be used as a haul road for the construction of the west dam. The Board request further discussion and detail on how the stability analysis completed accounts for these expected traffic loads. Additionally, TDC stated that the dyke "can be classified in a very low consequence category" since the "dykes are internal to the tailings disposal facility and failure of the dykes would cause no loss of life and would generally limit economic, social and environmental losses to the Owner's property. The Board requests additional detail and discussion on what provisions are in place to monitor dyke performance during temporary

use as a haul road since personnel will be using the road and therefore failure may lead to loss of life.

11. **(Stability Analysis Item 4.0)** TDC stated that the stability analyses were completed on the deepest dyke cross section without tailings upstream of the dyke and with no tailings at the downstream toe. Since the dyke's primary function is to retain tailings, is it not expected that the upstream face of the dyke could be subjected to an applied loading due to the accumulation of saturated tailings in the upstream reservoir? Was tailings loading considered in the stability analysis and global stability of the dyke?
12. **(Settlement Item 5.0)** TDC stated that if excessive movements of the dyke occurred, design or operation modifications can be made to limit thaw settlements. The Board requests additional detail and discussion of what design and operation modifications would be acceptable and how these modifications may impact the design of the dyke as presented in the design report.
13. **(Material Properties Item 6.1 – Filter)** TDC recommended that the effectiveness of the filter be tested with fine PK or supernatant. The Board requests additional detail and discussion on why TDC recommends filter testing. Is TDC confident in the design of the filter from a stability point perspective, or is the recommended testing only to assess the efficiency of the filter to retain fine PK? When should the recommended testing be completed? How would the results from the recommended testing impact the design and stability of the dyke? Will this information be presented in the construction records as per **Part D, Item 19**?
14. **(Construction Item 7.4 – Material Placement)** TDC stated that materials placed in open water will assume its natural angle of repose and that materials placed above open water will be compacted to a specified density. Thus, the construction procedure may result in different density materials spatially within the dyke, and therefore, potentially different material strengths spatially within the dyke. How has this issue been addressed in the stability analysis? Will this information be presented in the construction records as per Part D, Item 19?
15. **(Long-Term Monitoring Item 8.1 – Purpose)** TDC stated that a program should be developed to “satisfy regulatory requirements for dyke performance”. The Board requests additional information into what specific “regulatory requirements” this statement refers to with reference to the document outlining these requirements.
16. TDC has included design drawings in the Divider Dyke Design Report. The NWB requests signed and stamped design drawings from TDC.

The NWB is pleased with TDC's recent commitment to resolve the technical concerns addressed in this letter. The NWB is looking forward to meeting TDC face-to-face in the near future to discuss. In summary the Board requests a formal response to each of the above stated provisions. Sufficient detail and an avoidance of ambiguity should be followed in submitting response materials to the listed provisions. If you require assistance whatsoever please feel free to contact Dr. Jamie Van Gulck, P.Eng. at (204) 792-4129 or yangulck@vgqconsulting.com.

Sincerely,

Original signed by:

Joe Murdock
Director Technical Services

cc. Bruce Ott (AMEC)
Carl McLean (INAC)
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