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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

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

September 12, 2006

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 west dam design and intervener comments

Dear Mr. Missal:

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

i. **West Dam Design Report** – *Tahera Diamond Corporation - Jericho Project West Dam Design Report 1100060.004* (received: October 18, 2005)

After a review of the above listed correspondence it has been determined that additional information and clarity is needed.

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 of the West Dam Design. Within Dr. Arenson and Dr. Sego's review, the NWB has included highlighted (yellow) bold text giving TDC direction in formulating a response and the additional information TDC is to provide.

Comments from the Review of Dr. Arenson and Dr. Sego (U of A) provided to the NWB (Board)

a. **Foundation Conditions (Section 2.2)** According to the drawings it appears that the north, not the south abutment consists of a relatively steep bedrock slope.
The Board requests clarification to address any inconsistency with respect to the foundation conditions.

b. **Slope Stability Analysis (Section 4.2)** No graphical presentations of the slope stability analysis are provided. Information about the critical slip surfaces and instability mechanisms should be included. In addition, clarification of the two analytically methods described should be included, in particular the following statement "… **analyzed for both undrained thawed effective strength parameters** …". According to general engineering practice, slope stability analyses have to be carried out for the undrained (short term) condition as well as

the drained (long term) condition in the thawed state. These analyses are conducted as a total stress analysis for the first case and using an effective stress analysis for the second. It is not clear in the report how the analysis was conducted and what strength parameters were used.

The Board requests a detailed response to the reviewer's comments described above and should include graphical presentation of the slope stability analysis completed within an annex in the document.

c. **Creep (Section 5.0)** The reviewers agree with EBA's conclusion that low creep movements will occur under these circumstances. However, no detailed information about the ice content within the foundation is presented other than "… relatively low."

The Board request additional discussion regarding the foundation ice content to explain the comparison term "relatively low". What is this relative to? Additionally, further detail and discussion is requested to explain what site conditions exists and assumption have been made to justify the "risk of creep movement" to be "low"?

d. **Thermal Performance (Section 7.0)** Section 7 describes the thermal performance of the frozen core dam. The design report only refers to the SRK 2004 report, which was not available to the reviewers, and thermal boundary conditions used for the additional thermal analysis were not included in the report. More details and clarifications of the thermal analysis carried out to justify the predicted performance should be provided.

The Board requests detailed discussion on the points identified by the reviewers. If TDC believes this information has been submitted in another document, the NWB invites TDC to reference the appropriate section within the reference document to where the information can be found to address concerns. TDC should be reminded that the West Dam design is a stand alone document and therefore should include sufficient description of all analysis conducted. Finally, the Board requests the inclusion of thermal modeling results to be included within an annex in the document.

e. **Design of Thermosyphons (Section 7)** Construction drawings of horizontal pipes for thermosyphons are included in the report (Drawings WD-9 & WD-10), which will be activated in the future if required. However, no analysis or details about their design is included in the report.

The Board requests additional detail and discussion on the characteristics, components, and analysis of the thermosyphons. What criteria will be used to assess when activation of the thermosphons is to begin?

f. **Foundation Preparation (Section 10.4)** According to the design report Section 10.4 "**the key trench must be excavated into the permafrost so that the GCL liner system is keyed into permanently frozen ground**." This definition is vague, since permafrost is defined by temperature and not ice content. A more precise requirement such as a minimum depth and particular ground temperature that ensures a proper adfreezing of the GCL liner to the frozen foundation soils should be specified.

The Board requests further detail and discussion with respect to ground temperatures and the method of measurements that is required during construction of the key trench and liner system.

g. **Monitoring (Section 11.2)** Thermal monitoring is recommended via the use of horizontal as well as vertical ground temperature cables. More specific recommendations about the thermistor spacing and a recommended reading interval as well as the need for regular review of the temperature recordings to ensure the requirements of the design are being achieved throughout operational life of the structure.

The Board requests additional detail to address the reviewer's comments.

h. **Monitoring (Section 11.3)** The surveying for both the dam construction and for future monitoring of the deformation of the dam requires a stable and permanent reference point adjacent to the dam. In summary, the design report and construction specifications for the PKCA West Dam contain most of the necessary design requirements. However, some clarifications are required, in particular related to the slope stability analysis. The general design as well as the material parameters selected for the analysis are conservative. This design and the selected configuration for the dam are safe, i.e. the effective factors of safety are higher than the minimum standards. It is believed that frozen core will remain frozen for the lifetime of the PKCA West Dam, even under potential warming climatic conditions. The possibility of installing thermosyphons in the future adds to the safety of the dam design. The surveying and monitoring program recommended is crucial for a successful design and operation of the dam. It is therefore advised to further address these issues in the design report.
The Board request additional detail on how survey points will be anchored to avoid long-term movements or damage to the liner. Additional detail is requested to address how the monitoring program will be reviewed by a qualified geotechnical engineer and communicated to the NWB.

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

i. **Design Intent (Lake Level Projections - Section 2.3)** The Board requests additional detail and discussion on the amount of freeboard between the maximum allowable water level and top of liner. Has consideration been given to dam settlement and wave action? The NWB would like to remind TDC that the West Dam Design is a stand alone document.

j. **Settlement (Section 6.0)** TDC states that the water level in the PKCA will be maintained at a low level to minimize foundation thaw and settlement and that the a settlement should be less than 20 cm. The NWB request additional detail and discussion on what water elevation "low level" corresponds to and the analysis completed to assess the amount of expected settlement.

k. **Material Properties (Slope Protection – 9.1)** TDC proposes to use run-of-mine rock on the upstream dam shell. It is stated that this material should have a size larger than the minimum requirements of rip-rap for slope protection; however, this minimum size is not provided in the construction specifications. TDC should include this information in the West Dam construction specifications document.

l. TDC has included design drawings in the West Dam 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 vangulck@vgqconsulting.com.

Sincerely,

Original signed by:

Joe Murdock
Director Technical Services

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