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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

File: 2AM-JER0410/D7

August 1st, 2006

By Fax: 1-416-777-1898

Greg Missal
Vice-President Nunavut Affairs
Tahera Diamond Corporation
Suite 803, Richmond Street West
Toronto, Ontario M5H 2K1

Subject: NWB review of the submitted TDC Landfarm and Contaminated Snow Containment Facility (LCSCF) Design

Dear Mr. Missal:

The Nunavut Water Board (NWB) requests further clarity on issues related to the Jericho Diamond Mine *Landfarm and Contaminated Snow Containment Facility (LCSCF)* (**Part D, Item 7**). The following documents were consulted in reviewing the LCSCF Design:

i. **TDC LCSCF Design Plan** – *Tahera Diamond Corporation Landfarm and Contaminated Snow Containment Facility Design Summary Report* December 2005 (received: January 27th, 2006)

ii. **TDC Preliminary Landfarm Management Plan –** Landfarm Management Plan Jericho Diamond Mine Nunavut AMEC August 2004

Supplemental documents were also consulted in the review. The documents referenced in this review include the following:

i. **Jericho Water Licence Public Hearing Transcripts** – *Nunavut Water Board Benachee Resources Inc. Water Licence Application* (Dicta Court Reporting December 2004)

ii. **INAC Public Hearing Intervention Statement** – *INAC Intervention, Tahera Diamond Corporation Limited Water Licence Application* (received: November 30th, 2004)

iii. **Environment Canada Intervention Statement** – *NWB1JER0410 - Tahera Diamond Corporation, Jericho Diamond Mine – Submission of Landfarm and Contaminated Snow Containment Facility – Design Report, Construction Specifications, Operating Manual* (received: March 16th, 2005)

The NWB has retained the external expertise of Dr. Jamie Van Gulck of VGQ Consulting Inc. to evaluate technical aspects of the presented design and evaluate any potential impact where waste may enter freshwater. After a review of the above correspondence it has been determined that further clarity is needed. Please find below Dr. Van Gulck's review of the LCSCF Design. Within Dr. Van Gulck's review the NWB has included highlighted bold text giving TDC direction in formulating a response and indicating additional information TDC is to provide.

Comments from the Review of Dr. Jamie Van Gulck (VGQ) provided to the NWB

Review and Comments

The design report and construction specifications include a summary of the landfarm and contaminated snow containment facility (LCSCF), design information such as construction materials, and a summary construction drawing. The following review and comments are based on the design summary report and accompanying construction specifications. Where appropriate, the review is arranged according to items a) to i) specified in Schedule D, Item 7 of the Water Licence that require further consideration.

a) Detailed Implementation Schedule

1. A schedule of activities and timeline has not been provided in the report. **The NWB requests a response from TDC that will provide sufficient detail into scheduling and the timelines associated with this facility.**

b) Site baseline information

1. A topographic map was provided in the report that depicts building locations, surface water features, and elevations. However, roadways, and services that may be used in the construction and operation, or may interfere with, the facility that may have been assessed during previously collected and reported documents are required. Additionally, site drainage patterns must be provided. **The NWB requests detailed discussion on the points identified by Dr. Van Gulck under this bullet. If TDC believes this information has been submitted in another document the NWB invites TDC to appropriately reference the referenced document and the appropriate section within the referenced document where the information can be found to address concerns. TDC should be reminded that the LCSCF design is a stand alone document.**

2. What is the pre-construction water quality in nearby surface water, nearby facility drainage course(s), and in the depth to active layer below the proposed facility location? **The NWB requests detailed discussion on the points identified under this bullet.**

c) Comprehensive design details including the dimensions, materials of construction and installation/construction procedures of all landfarm facility components are required such as: retaining structures, liner properties, monitoring equipment)

1. *Section 2.2.* The exact location of the facility has not been determined on site and must be located. However, consideration must be given to ensure short and long term global stability of the facility on the waste rock pile. What are the detailed cross-section(s) and loadings used to assess global stability of the facility? What are the results of the global stability analysis? **The NWB requests a detailed response to the above and requests TDC to build on reasoning behind facility location with respect to anticipated foundation conditions, site logistics, and surface drainage. It is noted that in the submitted construction specifications for the LCSCF that a "*geotechnical investigation has not been completed and foundation conditions are therefore unknown…Results from the investigation may be used to reduce the waste rock pad thickness*". The NWB requests detailed discussion on how this information is to be presented to the NWB and other regulatory bodies before construction.**

2. *Section 2.2.* The facility will be located on a "substantial thickness of waste rock" and the foundation material. What is the expected settlement of the foundation and how will this impact the final elevations of the facility berms? **The NWB requests a detailed response to Dr. Van Gulck's concern and also requests the term "substantial" be quantified.**

3. *Section 2.3.2.* What historical or measured data is there to support the estimated contaminated snow volume of 400 m^3? **The NWB requests a detailed response on how the assumption was formulated.**

4. *Section 2.3.2.* What provisions have been made if estimates of contaminated snow volume were incorrect, or if excess contaminated or drifted snow exceeds the capacity of the facility? How much buffer volume is available for excess rainwater or snow above the design value? **The NWB expects TDC to address the concerns listed above in this bullet. Furthermore the NWB requests details on how the anticipated water quantities were determined. What design rationale was used (Please provide calculations)? Has consideration been given to recycled waters in the landfarm facility? What confidence does TDC have in the calculated contaminated snow expected? Why was the average annual snowfall value used in lieu of the maximum snowfall value over the 10-year design period? TDC states that the sump area has been designed with sufficient capacity to contain design runoff volume without flooding the upgradient contaminated soil yet the details in defining the facilities capacity have not been included. In Section 3.4 TDC states that design estimates used in sump capacity may be exceeded. As stated by TDC "*In the event that the freeboard storage is mobilized, a portion of the landfarm area would be temporarily flooded*". The NWB requests further clarity and detailed discussion on the capacity of sump and the possibility of flooding the upgradient contaminated soil.**

5. *Section 3.1.* Table 1 should specify zone A and zone B material to be consistent with construction drawing. Additionally, zone A and zone B material must not be acid generating. The construction specifications provide gradation size criterion for zone A and zone B material. **The NWB requests TDC to make the noted revisions suggested under this bullet in a revised LCSCF Design.**

6. *Section 3.1.* Table 1 specifies a total geomembrane area that does not distinguish between the two thicknesses of geomembranes specified in the construction drawing. In fact, throughout the design report and specifications document, there is no mention of two different thickness geomembranes. Clarification is required if in fact two geomembrane thicknesses will be used in the construction of the facility. **The NWB requests TDC to address the concerns stated under this bullet.**

7. *Section 3.2.* What analysis and applied loadings were considered to assess the "worst case" scenario for the design of the foundation of the facility? What is the expected long-term settlement of the facility, and has this been considered in final elevations of the facility berms? **The NWB requests TDC to fully address the concerns stated under this bullet.**

8. *Section 3.3.* The facility comprises the use of several material types to construct the berms and slide slopes. What analysis has been completed, and what are the details of the analysis and loadings considered, to ensure stability of the berms and slopes? **The NWB requests TDC to fully address the concerns stated under this bullet.**

9. *Section 3.3.* The facility utilizes a multi-layer liner system design comprising of granular material, geotextiles, and a geomembrane. Internal stability of the liner system

components from sliding and integrity of the geosynthetics may be critical to ensure overall liner integrity. What analysis has been completed, and what are the details of the analysis and loadings considered, to ensure liner internal stability from sliding and integrity of the geosynthetic components (e.g. are the specification strengths of the geosynthetics appropriate)? The geomembrane is keyed into the berm. What analyses and what applied loadings have been completed for the key, and what is the key designed to accomplish? The placement of the geomembrane and geosynthetics should be conducted under the supervision and to the satisfaction of the Engineer. **The NWB requests a full detailed response to the contents under this bullet. As stated by TDC, "*containment within the facility is contingent upon the liner integrity. As such, care should be taken during construction and operation to not damage the liner*". Does TDC believe that a 4 tire ATV vehicle operating directly on the geosynthetic layer will not alter integrity and the containment function? Would the geosynthetic run the risk of damage or puncture when subjected to wheel loading?**

10. *Section 3.3.* Table 2 provides details on equipment that can operate on the liner as a function of backfill thickness. Are construction and operating equipment available on site that could accommodate these requirements? **The NWB requests TDC to fully address the concerns stated under this bullet.**

11. *Section 3.3.* How is the integrity of the liner system checked after it is covered? **The NWB requests detailed discussion into how the integrity of the liner is evaluated after it is covered.**

12. *Section 3.3.* The liner components are partially comprised on materials that degrade with time, due in part, from the applied loadings and environment.

    i. Provisions should be made to cover geosynthetic materials during storage and shortly after placement to avoid solar degradation.
    ii. What provisions have been provided to ensure the geosynthetic products are compatible with the expected contaminant?
    iii. Since the liner components will deteriorate with time, what is the service life of the facility?

    The NWB requests TDC to fully address the concerns stated under this bullet. The NWB also understands that a ten (10) year design life has been given to the facility. How was this design life determined? Has other arrangements been made that account for the possibility of contaminated soil materials remaining (and not remediated) in the LCSCF facility after the ten (10) year design life?

13. *Section 3.3.* The function of the liner should be to minimize migration of contaminant from leaving the facility. Contaminant transport can occur due to a combination of mechanisms, including advection and diffusion. What specific contaminant is the liner expected to contain? What contaminant transport analyses have been completed to ensure that a single geomembrane is an acceptable liner to contain the contaminants over the short and long term? How have holes and wrinkles in the geomembrane, a result of construction and long term punctures, been considered in the contaminant transport analysis? What hydraulic and contaminant transport properties where applied for each soil type in the analysis? What is the expected hydraulic head for fluid inside and outside of the facility? If contaminants break the liner due to liner degradation or liner failure, where will they likely be transported to? **The NWB requests TDC to fully address the concerns stated under this bullet.**

14. *Section 3.4.* A containment volume of 740 m^3 is specified in section 3.4, and a containment volume of 750 m^3 is specified in section 2.3.2. Clarification is required to address this discrepancy. **The NWB requests clarification from TDC.**

15. *Section 3.4.* What are the design specifications for the drain located within the sump? **TDC is to provide these details to the NWB as suggested by Dr. Van Gulck.**

16. *Section 4.0.* Acknowledgement has been provided to limit turning within the facility to long turns. If long turns cannot be accommodated with existing haul trucks, it is suggested that contaminated material be dumped near facility entrance and mobilized into the facility with smaller pieces of equipment.

    i. Are there smaller pieces of equipment available on site in the event of this practice? Is there equipment available to remove remediate contaminated soil?
    ii. How will the contaminated soil and leachate from this material be controlled while temporarily stored outside the facility?
    iii. How long will material be stored outside of the facility?
    iv. Consideration should be given to provide a turning zone, with an appropriately design foundation to protect the liner, within the facility to avoid many of these operation issues.

    TDC is to provide detailed discussion to the listed bullets above and the commentary introducing the listed bullets (Bullets under c.16).

17. *Section 4.0.* A minimum 2 m offset for placement of soil from the toe of the berm has been specified. Was this offset considered in the volume calculations for facility soil and water capacity? **The NWB requests that TDC addresses Dr. Van Gulck's question. Under section 2.3.1 of the LCSCF Design Report TDC adopts the concept of adaptable design as acceptable. Contingency measures (facility expansion, remediation in stages, construction of a second landfarm) need to be discussed in significant detail. As this is the case the NWB requests the following:**

    i. How was the sizing quantity determined (please provide any calculations)?
    ii. How was the amount of soil admitted calculated?
    iii. What degree of confidence does TDC have in its sizing calculations?
    iv. Are there any limitations to the sizing calculations? If so what limitations exist?

d) Measure for runoff, leachate or seepage control

1. *Section 2.3.2.* Runoff occurring from freshet outside of the facility, which could accumulate in the downgradient portion of the facility, should not be permitted. The site should be located away from flood prone areas and/or water should be diverted around the facility (e.g. via a ditch if required) so as to not enter into the facility. **The NWB requests comment on the above. TDC should provide evidence of the measures in place to ensure none of the above is occurring.**

2. Monitoring wells to assess groundwater quality around the facility should be considered to assess the impact of the facility on the subsurface environment. **Environment Canada also recommends that groundwater monitoring wells be included in the design of the facility. The NWB recommends that wells be located both upgradient and downgradient of the facility to monitor potential groundwater contamination.**

3. Consideration should be given to install leak detection system to assess performance of the liner. **The NWB requests detailed discussion on the leak detection system TDC has installed to assess liner performance. If a system has not been installed, the NWB requests detailed reasoning into the rationale used in making this decision. What degree of engineering confidence does TDC have in its assessment of liner performance as a function of time?**

e) Environmental monitoring equipment

1. What equipment is required to monitor the quality of groundwater and surface water outside the facility? Is this equipment available at the facility location? **TDC is to provide clarity to the concerns listed under this bullet.**

f) Overview of Operation and Maintenance needs

1. *Section 2.3.1.* The contaminated soil will be placed in the facility to be remediated in stages. What are the details regarding the remediation process (or stages)? What provisions and activities have been made to promote remediation? What is the expected time needed to remediate the soil? After the soil is remediated, it could be removed from the facility to accommodate additional material. How will the liner be protected during removal of remediated soil? **TDC is to provide detailed discussion to all questions listed under this bullet.**

2. What equipment and resources are required to operate and maintain the facility? Is this equipment available on site for this purpose? **TDC is to list the equipment and resources on site to operate and maintain the LCSCF and confirm if the listed equipment is on site.**

g) Operational monitoring to assess treatment efficiency

1. *Section 4.0.* What volume of liquid is expected to be pumped out the facility on a yearly basis? Where will the drained fluid be discharged and what provisions have been made to dispose of the discharge in an environmentally sound manner? What is the expected quality of water to be collected and what will be the final quality of water to be discharged? If treatment of the water is required, what are the design and operation details of the treatment? **The NWB requests clear defined responses to the above concerns listed under this bullet. Furthermore the NWB understands that TDC will pump dry the LCSCF at the end of the summer to provide maximum storage capacity for snowfall and contaminated snow placement. What provisions are in place for this activity? Where will this water be directed? Will this water be tested and how will this be completed using best engineering practices?**

2. *Section 4.0.* The report states that the “details pertaining to the operation of the [facility] and monitoring of the contaminated soils will be submitted in a separate report”. The licence requires this information to be contained in the current report, not separately. Among other things, a description of the soil and water monitoring program and schedule that will be used to assess treatment of contaminated soil and water is required. **The NWB requests TDC to appropriately reference where Schedule D7 (g) (Operational Monitoring to Assess Treatment Efficiency) has been met or provide this information in a revised LCSCF Design. If TDC has submitted this information in another document the NWB invites TDC to appropriately reference the referenced document and the appropriate section within the referenced document where the information can be found to address concerns. TDC should be reminded that the LCSCF design is a stand alone document. The NWB would like to remind TDC that during the Public Hearing INAC supported the idea of using a**

landfarm to remediate fuel contaminated soils, but as stated by INAC the landfarm should be maintained and monitor that it is performing as intended (Jericho Water Licence Public Hearing Transcript- Page 251 Lines 11-15)

h) Proposed soil quality remedial objective to be achieved

1. What criteria will be used, and to what level of quality will the contaminated soil be remediated? **TDC's August 2004 Landfarm Management Plan states that the landfarm will be operated until the soil meets CCME criteria. The NWB requests that TDC provides remediation treatment levels in its revised LCSCF design.**

i) Closure and reclamation summary

1. A closure plan, time to closure, and reclamation of the facility location has not been included in the report and is required. **The NWB requests clarity from TDC on why this has not been included in the submitted report and requests that this information be included in the LCSCF revision.**

Further to Dr. Van Gulck's comments listed above the NWB requests clarity on the following points:

i. TDC has included design drawings in the Design Summary Report. The NWB requests signed and stamped design drawings from TDC.

ii. TDC has identified that the waste rock pile will host site to the LCSCF yet there are elements of the waste rock management plan not understood. The Waste Rock Management Plan (WRMP) has not been approved by the NWB. Details of the LCSCF have not been provided in the WRMP. The NWB requests TDC to clearly outline, in detail, how the LCSCF and the waste rock pile will interact with one another with respect to potential impact to freshwaters. Can waters managed in the LCSCF potentially impact the waste rock pile the LCSCF is built upon? How will waters from the LCSCF impact the WRMP? How will waters from the LCSCF impact the SWMP? The NWB also requests the disclosure of any limitations attached to the responses provided to address the concerns listed under this bullet.

iii. Section 3.1. How will information on berm resizing be communicated to the NWB?

iv. The NWB requests detailed discussion on how contaminated rock and heavy oil contaminated soil will be treated. **TDC's August 2004 Landfarm Management Plan** sets a temporary storage area for heavy oil contaminated soil. This area was bounded by berms within the landfarm footprint. The NWB requests detailed discussion on why this element was altered and removed from the current design. How will contaminated rock be treated and where will it be stored? There is no discussion on dealings with contaminated rock in the current design.

v. **TDC's August 2004 Landfarm Management Plan** states that runoff or seepage will be directed to Pond B or the Open Pit and pumped to the PKCA as part of the mine water management plan. The Site Water Management Plan (SWMP) and Waste Rock Management (WRMP) do not contain any information related to the LCSCF. **TDC is to incorporate all engineering elements of the LCSCF that could potentially influence the WRMP and SWMP into revised versions of the WRMP, SWMP, and LCSCF no later than thirty (30) days following issuance of this letter**. The NWB notes that Pond B is currently considered as "contingency" structure (as per the SWMP) that may not necessarily be constructed. The decision to construct Pond B is dependent on

monitoring data that has not been set out clear in the SWMP. NWB reviews of the SWMP and WRMP have been enclosed with this letter correspondence.

vi. As per Environment Canada's Intervention Statement, measures should be in place to ensure that freeboard is not utilized, as this would result in the landfarm area becoming temporarily flooded. Environment Canada also recommends that TDC treats and discharges water within the sump if conditions indicate that the freeboard is being encroached upon. The NWB request detailed discussing addressing EC's concerns and ensuring that these concerns have been met.

In summary the Board requests a formal response to each of the above stated points. 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 the undersigned at (867) 360-6338 or tech1@nwb.nunavut.ca .

Sincerely,

Original signed by:

Joe Murdock
Coordinator of Technical Services

cc. Carl McLean (INAC)
Jim Rogers (INAC)
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Geoff Clark (KIA)
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