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Nov. 14, 2006

Navjit Sidhu
Project Officer
Community & Government Services
Bag 200, 2nd Floor
Cambridge Bay,
NU, X0B 0C0

Subject: Kugaaruk Water License Application

Dear Mr. Sidhu,

The **Nunavut Water Board** (NWB) understood, through correspondence with Janice Lee of Dillon Consulting Limited, that only Tender Specifications, Tender Drawings and Phase 2 Pre-Design Report in the above application package would be considered, and all other documents would only be considered if they are references in the three documents. After the review of the three documents, the **NWB** requests further information pertaining to the application for a water license as per ***Section 48 Item 2*** of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA).

The **NWB** would like to remind the Proponent that as per ***Section 57*** of the NWNSRTA, *the Board may not issue a license unless the Proponents satisfies the Board that any waste produced by the appurtenant undertaking will be treated and disposed of in a manner that is appropriate for the maintenance of the water quality standards and effluent standards that the Board considers acceptable*. The Proponent's past performance will also be considered to ensure the completion of the appurtenant undertaking is adequate and such measures as may be required in mitigation of any adverse impacts are properly accounted for.

With all of these in mind, the **NWB** would like to point the Proponent to the previous water license **NWB3PEL9803**, which was expired on October 31, 2003. The Proponent has been operating its water use and waste disposal facilities without a water license for three years. Annual Reports act as a reporting mechanism to the Board on water and waste matters through the duration of a

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license period. However, the Proponent did not submit Annual Reports from 1998 through 2005 (**Part B, Item 1**) despite number reminders from the **NWB** and INAC Water Resources to do so.

The **NWB** would like to acknowledge the recent efforts the Hamlet has taken to begin to license the municipal facilities. Through the communication between Mr. Gary Strong and Mr. Jim Rogers (INAC), as advised by Mr. Joe Murdock (NWB), INAC is aware that this application does not embody all municipal facilities but rather just the sewage lagoon. Mr. Elwood Johnson (Hamlet of Kugaaruk) has advised the NWB that he will be the primary contact with the NWB on all other unlicensed facilities (not including the sewage lagoon). The NWB, through Mr. Elwood Johnson's request, will work toward licensing these other facilities.

Sufficient detail and an avoidance of ambiguity and inconsistency should be followed in submitting response materials to the following comments:

Sewage Treatment

1. General Comments on the Application

   a. The information about reconstruction of the existing lagoon is scattered in the questionnaire, tender specifications and drawings, Phase II Pre-design Report, and there is no cross-referencing between theses documents. The NWB requests proper referencing between these documents.

   b. The application materials submitted are insufficient. There exist information gaps between the tender documents and the pre-design.

      i. Phase II Pre-design Report could not support the tender specifications and drawings. The recommended option in Phase II Pre-design Report is "Blasting to expand capacity of existing sewage lagoon", but without detailed introduction to the option. Furthermore, the cost estimation for the recommended option in the pre-design report does not consider the cost of an alternative solution (package sewage treatment plant) during the reconstruction period. The NWB requests further details about the recommended option.

      ii. The design presented in the tender drawings is different from the Phase II Pre-design. For example, the emergency overflow weir section in Drawing 200 and the typical berm section in Drawing 201 of tender drawings are different from those in Drawing 201 of Appendix A of Phase II Pre-design Report. The NWB requests clarity about which to be considered.

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iii. The AMEC Geotechnical Investigation of tender specifications could not support the tender drawings either. The slope, rip rap material thickness, overburden depth, key location, and shape of the berm in the tender drawings are completely different than that used in the thermal modelling in the AMEC report (refer to bullets 5 to 7 of Geotechnical Considerations). The NWB requests consistency in the application with regard to the thermal modelling. The Proponent is to make the necessary revision.

iv. No effluent criteria and effluent projection are clearly presented and discussed in the pre-design report. The NWB requests that the Proponent provide full details on how the sewage lagoon behaves. Engineering judgement should be used to determine design functions, design retention time, effluent quality, sludge generation and management.

v. The tender specifications submitted in electronic form are inconsistent with the hardcopy specifications. The hardcopy one includes the work of Package Sewage Treatment Plant in Section 01110, but the electronic one does not. The Proponent is to clarify the inconsistence.

vi. The alternative solution shall be required for the re-construction period of the existing lagoon. However, no detailed specifications are provided for the package sewage treatment system in the tender documents and any other application documents. The Proponent is to demonstrate through appropriate qualifiers that the package plant will ensure minimal impact to freshwater.

2. Comments on Supplementary Questionnaire

a. (VI Inspection and Monitoring, page 12) As per *VI Inspection and Monitoring*, the Proponent states that a spills reporting system and spill contingency plan are not in place. The NWB understands that spills have occurred over the past five years. The Proponent states in Phase II Pre-design Report that *a full Spill Contingency Plan will be included in the Operations and Maintenance Manual once the new site is complete.* The NWB requests an outline of the operations and maintenance manual and spill contingency plan to be submitted.

b. (VI Inspection and Monitoring, page 12 & 13) As per *VI Monitoring* Program, The Proponent states that there is no monitoring program in place for wastewater and leachate and no plan for any change in the monitoring program. Does the Proponent believe monitoring is not required? If so, why?

3. Comments on Phase II Pre-Design Report

a. (Section 3.1.1, page 6) it is stated that package wastewater treatment plant is not allowed to operate without being housed in a heated building in the

arctic region. In the tender document (hardcopy), package treatment plant is part of the project. The NWB requests detailed information on the plant to be used.

b. (Section 3.3, page 10) The Proponent states that 3 locations are identified for the new lagoon, but only the site map for one location is provided. For the preferred location, Drawing 101 of Appendix A presents 3 options of lagoon layout, but the volume calculation for each lagoon layout is not provided. The berm slope is 3:1 in page 10, but 2.5:1 in Drawing 201 of Appendix A. The Proponent is to clarify these inconsistencies and provide further detail into the lagoon design process.

c. (Section 3.6, page 11) There is not information presented for the effluent criteria and effluent projection. The NWB requests further detail on the effluent projection.

d. (Section 3.6, page 11) The proponent states that the lagoon will be annually discharged by pumping the effluent into the receiving environment over a period of two weeks, the discharge pattern of which is inconsistent with the tender Drawing 201. The proponent is to clarify the inconsistency and provide sufficient detail for annual discharge in the case of the tender Drawing 201.

e. (Section 8.2, page 35) The introduction to option 1 “Package sewage treatment plant” and option 4 “S4 - Blasting to expand capacity of existing sewage lagoon” is insufficient. The NWB requests that the Proponent provide further detail and engineering discussion for these two options.

f. (Section 8.2, page 35-36) Table 8.2 summarizes the criteria weight and scores of four options. How the community and GN/CGS officers are consulted for the weights of the seven “want criteria”? How are the four options assigned to the scores in Table 8.2? Quantitatively or qualitatively? The NWB requests further detail about each criterion and each option, as per ***Section 48 Item 3*** of the NWNSRTA.

    i. What are the annual operating costs and lifecycle costs for all four options, and capital costs for Option 1 and 4;

    ii. What is the difference of operator maintenance among option 2&3 and 4?

    iii. What is the impact of Option 1 on the golf course?

    iv. What is the difference among the four options for the criteria of Environmental Impact and Canadian Waste Effluent Standards?

    v. Why does Option 4 have a highest score in the criterion of Environmental Impact but a lowest one in that of Canadian Waste Effluent Standards? How other 3 options are assigned the scores for the two criteria?

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g. (Section 8.3, page 37) The drawings in Appendix A of the Phase II Pre-design Report are not for the recommended option "Blasting to expand capacity of existing sewage lagoon". No detailed design is provided for the recommended option. The NWB requests that the Proponent fill up the information gap from the pre-design report to the tender specifications and tender drawings.

Geotechnical Considerations

4. Within the Specifications report, the construction of the berms specifies a standard Proctor density. With respect to placement density of soils, additional detail and discussion is requested to address each of the points below.

    a. The optimum water content for maximum dry density for each soil type used in constructing the berm was not provided in the submitted reports.

        i. Given that the standard Proctor maximum dry density is specified for placement of soil material in the berm, does the Proponent agree that soil testing for optimum water content and maximum dry density are important geotechnical parameters for construction of the berms?

        ii. Was the optimum water content and maximum dry density for critical soils used in construction tested? If yes, what are the results? If not, why not?

        iii. Will density measurements be completed during construction? If so, how will this be measured and at what frequency? If not, why not?

    b. Within Section 01110 of the Specifications report, it was stated that construction for Phase 2 will be completed prior to November 2007. Will construction of the berm take place during potentially freezing conditions? If so, will there be any adjustments to the placement of the soils and as-placed water content compared to above freezing conditions and what are the details of this practice?

    c. The Specification report provides acceptable range of grain size distributions for the construction soils. The sieve analysis provided in Appendix C was completed on sandy gravel. No other sieve analyses were provided. Are there sufficient quantity and quality of materials meeting these specifications available on site? If so, what are the results of the sieve analysis?

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5. Additional detail and discussion is requested to address the following issues with respect to berm configuration and descriptions used in the thermal analysis by AMEC (Appendix C- AMEC Geotechnical Investigation) that are depicted in the engineering drawings.

    a. Thermal analysis was completed for a 5 m height berm. The actual height of the berm varies and is dependent on the natural topography of the site. Is the berm height used in the thermal analysis the critical case for analysis?

    b. The thermal analysis used a berm configuration with a 2:1 inside and outside slope. The berm inside and outside slope in the engineering drawings is specified as 3:1.

        i. Why is there a difference in berm height between the thermal analysis and that specified in the engineering drawings?

        ii. Are the results of the thermal analysis for a different berm configuration than that specified in the engineering drawings valid? If yes, justify this decision. If no, should additional thermal analysis be completed using the specified berm configuration?

    c. The key location in Figure 3 of Appendix C is located near the mid point of the inside slope. The engineering drawings show the location of the key to be placed at the mid point of the berm crest. Therefore, the location of the key is different between the thermal analysis and the engineering drawings. How does this discrepancy impact the predicted thermal regime and performance of the berm, as well as, the seepage through and under the berm?

    d. Section 5.1 of Appendix C stated that the liner “should extend into a 1.5 m deep cut-off trench below the base of the dyke”. The engineering drawings show a 2.0 m deep trench.

        i. What impact does this difference between the thermal analysis and the engineering drawings have on design and performance of the berm, as well as, the predicted thermal regime?

        ii. Section 1.0 of Appendix C stated that drilling of 6 to 10 boreholes were to be completed as part of the geotechnical investigation, but was not undertaken.

            a. Does the Proponent agree that the depth of the active zone, thickness of overburden, and depth to bedrock are important geotechnical characteristics to understand to minimize the potential for seepage below the berm?

b. What confidence does the Proponent have that a key trench of 2.0 depth will be below the active layer and acceptable for this design?

e. A clear understanding of the subsurface stratigraphy was not provided in Appendix C.

i. Will inspection of the trench be completed during construction to ensure that depth of liner installation is sufficient? If so, what are the details of the inspection program? If not, why not?

ii. Is there a need to prepare the foundation before berm construction? If so, what are the details? If not, why not?

f. Section 5.1 of Appendix C stated that the upper layer of the berm can contain a 0.5 m thick cobble layer with size up to 200 mm for slope protection against water erosion.

i. The thickness of rip rap layer specified in the engineering drawings is a minimum of 300 mm. Will the differences in rip rap thickness between the thermal analysis and that specified in the engineering drawings impact the applicability of the thermal analysis and how will this impact the design? If not, why not?

ii. The rip rap in the specifications reports a larger grain size than 200 mm. Clarification is requested to address the impact of this inconsistency on the design.

iii. How was the required size of rip rap material determined?

g. Section 5.1 of Appendix C stated that the “cut-off trench should be backfilled with compacted clayey material or grouted”. The engineering drawings have hatching within the cut-off trench that is the same style as the hatching in the berm core, suggesting that Type II granular material will be placed in the trench.

i. Do the engineering drawings show a Type II granular material to be placed in the key trench? If no, what is the material and its specifications backfilled in the key trench?

ii. If yes to i. above, does the Proponent agree that Type II granular material will be more permeable than a clayey material or grouted soil and will assist in sealing the GCL?

iii. Clay or grout material was used as the backfill material in the thermal analysis, not Type II granular material as specified in the engineering drawings. What impact does this difference between the thermal analysis and the engineering drawings

have on the design and performance of the berm, as well as, the predicted thermal regime?

6. Within Section 5.6 of Appendix C (AMEC Geotechnical Investigation) there are specific recommendations with regards to monitoring and contingency planning. Appendix C stated that a minimum of two thermistors cables should be installed along the dyke crest to provide information on temperatures within the dyke and foundation. The thermistors should be monitored at a prescribed rate. Further to contingency planning, it was stated that installation of thermosyphons could be installed to mitigate warming. The Proponent is requested to provide additional detail and discussion to address each of the points that follow.

    a. Does the Proponent agree that thermal monitoring is important to mitigate potential seepage and thawing?

    b. The engineering drawings do not provide details as to the location of the thermistor locations. The Pre-Design report did not discuss details for thermal monitoring. Where will thermistors be installed?

    c. The specifications report did not provide any details with regards to temperature monitoring, with the exception of the AMEC Geotechnical Investigation report (which is identical to that provided in Appendix C of the Pre-Design report). Will the frequency for monitoring piezometers be identical to what is recommended in Appendix C by AMEC? If not, why not and what will be done?

    d. Discussion on the potential use of thermosyphons was not provided in the Pre-Design or Specifications report. Additional detail and discussion is requested to respond on the use of thermosyphons as a contingency in this design.

    e. What mitigating measures are in place to limit an increase in ground temperatures that could impact containment performance?

7. Within Section 5.4.1 of Appendix C- AMEC Geotechnical Investigation, it was stated that “no allowance for climate warming was made to the air temperatures over the period of the simulation”. Additional detail and discussion is requested to justify/support this decision?

8. Within the Executive Summary of the Pre-Design, Phase 2 report, it was stated that a lagoon may include the “installation of a Granular Clay Liner (GCL)”. Does the Proponent mean Geosynthetic Clay Liner not Granular Clay Liner? If not, what is a Granular Clay Liner?

9. With regards to the engineering drawings, additional detail and discussion is requested for each of the following.

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a. Detail # 3 within Drawing #201 provides a typical berm section. The location of this detail is not provided in Drawing #101. Clarification is requested to address where in the structure this cross-section applicable?

b. In Drawing #201, the Benotmat (ST) liner caption states "see specification". What does this caption refer to and what information does the specification provide that isn't provided in the engineering drawing?

c. With respect to Drawing #201, what is the thickness of Type II granular material between the GCL and the rip rap, as well as, the GCL and the foundation soils? Additional detail into liner installation and fill placement is requested.

d. Within Section #4 of Drawing #201, a "crushed rock" material is specified in the anchor trench. The specifications for this material were not provided in the specifications report.

    i. What are the size and gradation specifications for this material?

    ii. The drawing depicts crushed rock within the anchor trench but there are no dimensions on the location of placement. Where within the anchor trench is the crushed rock to be located?

e. Within Section #8 of Drawing #201, a 300 mm thick sand layer is to be placed around the HDPE intake pipe. What are the specifications for this material?

f. Within Section #8 of Drawing #201, "rip rap field" material is to be used on the outside slope of the lagoon at the discharge outfall. Is this material the same as the rip rap material specified on the inside slopes of the berms? If not, what are the specifications for this material?

10. A Bentomat ST GCL was specified in the engineering drawings for use as a berm liner. From the engineering analysis of the berm structure, what engineering design requirements of a GCL (i.e., permeability, strength characteristics, etc.) were obtained, and how do these requirements compare to the specifications for the selected GCL? Additional detail and discussion is requested to address this issue.

11. The lagoon contains a perimeter berm in the design with an applied loading on the inside slope. There is not a clear understanding of the stability of the perimeter berm from slope failure under the applied loads. Additional detail and discussion on the stability of the berms from slope failure are requested that provide a full description of:

    a. Method of analysis

b. Any limitations in the method of analysis

c. What loading conditions were considered in the stability analysis?

d. Values of assumed or known soil strength and density (for the berm and foundation soils) used in the analysis with justification for their use.

e. What is the factor of safety against global slope failure of the berms?

f. The ground ice content of the foundation soils was not provided. Is there concern for settlement or foundation instability? If so, what measures are in place to prevent these occurrences? If not, why not?

g. How confident is the Proponent that the GCL is stable within the berm from sliding and pullout from the anchor?

h. What analysis and the details of the analysis were completed to assess sliding potential and pullout from the anchor?

12. Additional detail and description is requested to address each of the following items.

    a. How has piping and internal erosion (particularly the foundation soils) been accounted for in the design of the berm for the lagoon?

    b. Has a seepage analysis been completed to assess piping potential of the soils (particularly the foundation soils)? If so, what are the results? If not, why not?

    c. Was a seepage analysis conducted to assess required key trench depth?

13. The lagoon berm contains a GCL that lines the inner side slope, keyed at the base, and anchored near the trench. Will construction of the berm, foundation preparation, trench, etc, as well as quality assurance, and quality control monitoring be supervised by a qualified geotechnical engineer? If not, why not?

14. What provisions have been made to diver surface water around the lagoon so that erosion of the outside berm slopes is minimized? Additional detail and discussion is requested to address this issue.

In closing the NWB requests a detailed response to the bulleted items in this letter. The **NWB** would like to remind the Proponent that **Section 70 Item 1** of the NWNSRTA allows the Board to install license conditions that it considers appropriate, including conditions relating to the quantity, concentration and types of waste that may be deposited and the manner of depositing waste, and the

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studies to be undertaken, works to be constructed, plans, including contingency plans, to be submitted, and monitoring programs to be undertaken.

If you require assistance regarding geotechnical issues please feel free to contact Dr. Jamie Van Gulck, P.Eng. at (519) 577-4129 or vangulck@vgqconsulting.com. Please do not hesitate to contact the undersigned with any other questions or comments with regards to the foregoing at (867) 360-6338ext.27 or tech4@nunavutwaterboard.org.

Sincerely,

Original signed by:

Zhong Liu (M.Sc., MBA, M.A.Sc.)

Technical Advisor

cc. Elwood Johnston (Senior Administrative Officer of Kugaaruk)