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October 24, 2006

Paul Waye
Senior Administrative Officer
Hamlet of Kugluktuk
P. O. Box 271
Kugluktuk, Nunavut X0B 0E0

Subject: Kugluktuk Water License Application - Amendment

Dear Mr. Waye,

The **Nunavut Water Board** (NWB) requests further information pertaining to the amendment application for water license **NWB3KUG0308** as per ***Section 48 Item 2*** of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA).

The **NWB** would like to remind the Hamlet that as per ***Section 57*** of the NWNSRTA, *the Board may not issue a license unless the applicants 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 Hamlet'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** understands that the Hamlet did not submit Annual Reports from 1995 to 2002 (**Part A, Item 3 of N7L4-1526**), and in 2005 (**Part B, Item 1 of NWB3KUG0308**) despite number reminders from the **NWB** and INAC Water Resources to do so. Annual Reports act as a reporting mechanism to the Board on water and waste matters through the duration of a license period. The **NWB** has reviewed the 2004 Annual Report and Water Sampling Results, and has requested that the Hamlet immediately submit the 2005 Annual Report and Water Sampling Results to the Board in the **NWB** letters to the Hamlet dated October 16, 2006.

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

Sewage Treatment and Solid Waste Disposal

I. Comments on Sewage Estimation

A. There are different versions about the population in Kugluktuk. In the detailed design report (June 2006), current population is 1585 in the body text but 1362 in Appendix G1 Operation and Maintenance Plans for Sewage Lagoon. In the schematic design report (December 2005), current population is 1362 "as per RFP" in page 4 but 1556 (2005) in the population projection (Table 1). The 2001 Census showed a population of 1212 in Kugluktuk, but in the population projection (Table 1) of detailed design report, 2001 population is 1422. Therefore, the population projection for Kugluktuk is questionable, and then it also makes questionable the following projections for sewage and solid waste. These inconsistencies in the application require further clarity.

B. The following are the comparison of actual data and projected data for population, water intake, and sewage. There are 18%, 28%, and 17% difference between the projected and actual data for population in 2006, water intake in 2004, and sewage in 2004, respectively. Does the Hamlet believe that the differences are significant and may play a role in determining appropriate volume capacity for the facility?

Table 1 Difference between Projected Data and Actual Data

Data source	Projected data	Item and difference	Actual data	Data source
2003 application	1340 in 2006	Population (18%)	1585 in 2006	2006 application
2003 application	54809 m^3 in 2004	Water intake (28%)	39,500 m^3 in 2004	2004 annual report
2003 application	54809 m^3 in 2004 (equal to annual water use)	Sewage (17%)	45,424 m^3 in 2004 (calculated by adding 15% of water intake)	2004 annual report

C. Projection comparison of 2003 and 2006 applications is as follows. For the year 2012, two projections also have big difference. Both projections seem not to calibrate their projection equation with historical data.

Table 2 Difference between Two Applications

2003 application	Item and difference	2006 application
2002 1237	Starting year Population	2006 1585
2.03%	Projected population growth rate	1.5%
5-10 (2003-2012)	Projection period	20 (2007-2026)
1512 in 2012	**Population**	**1793 in 2012**
90lpcd*(1+0.00023*population)	Equation for water use projection	100lpcd*(1+0.00023*population)
66,934 m^3 in 2012	**Water use and sewage**	**92,433 m^3 in 2012**
0.014 m^3pcd*(1+0.01)* population (1990 reference used)	Equation for solid waste projection	0.012 m^3pcd* population (no proper referencing)
8619 m^3 in 2012	**Solid waste**	**7853.3 m^3 in 2012** **3128.8 m^3 for compacted waste and cover materials (volume reduction by burning and compaction considered)**

D. Based on the previous discussion about projection and design, what kind of confidence does the Hamlet have for the projection for the population, sewage and solid waste? The NWB requests additional information.

E. Table 5 in the application provides the assumptions for the calculation of effluent concentrations, but without any references (or proper referencing). What are the justifications for the assumptions?

F. In Table 5 of the application the sludge generation rate is 50 grams per person per day, and the unit of cumulative sludge volume is m^3. What is used to calculate the volume from the mass? What assumptions have been made?

G. In Table 4 of the application the designed concentrations of contaminants decrease over time, e.g. 329.8 mg/l BOD_5 in 2006 vs. 295.6 mg/l BOD_5 in

2026. Is it justifiable? The NWB requests detailed discussion into this assumption.

H. The projected sewage volume (126,113 m^3 in 2026) exceeds the current water intake capacity (64,000 m^3 in the water license) nearly by 100%. What plans are in place for the water supply system in the future?

I. The NWB requests that the Hamlet provide justifications for all the assumptions and clarify the above concerns.

II. Comments on Effluent Quality Projection

A. Why are the values in column 2 and 3 of Table 6 (page 16) the same? What does the title of column 3 mean?

B. Two contaminant reduction rates are assigned without proper references (or referencing) to two scenarios, i.e. 70% in the beginning and 25% at the end of the design period. There is little explanation. The NWB requests further clarity including the role of the lagoon and wetland, justifications of contaminant reduction rates and proper references.

C. The treatment process has been described (lagoon plus wetland system), but the system operation appears to be vague. The discharge pattern for the proposed lagoon is not clear. The detailed design report seems to apply two patterns, i.e. 70% reduction rate assumption of the lagoon plus wetland polishing for the year 1 with the discharge pattern of short-term decanting, and 25% reduction rate assumption of the lagoon as primary treatment plus wetland secondary treatment for the year 20 with the 120-day discharge pattern. Does this prediction methodology seem reasonable? In addition, Appendix F uses 120-day discharge pattern in the wetland treatment predictive model, but Appendix G1 for lagoon O&M sets up a 60-day decanting period. Why is there a conflict between them?

D. The information presented about the natural wetland (15ha) is inadequate to conclude that it can treat lagoon effluent as much as described in Table 8. Does the Hamlet agree that more data are required to conclude this?

E. For the first scenario, except Table 6, no further discussion is made for the “anticipated NWB limits”, like Table 8 for the second scenario. The NWB requests further discussion on “anticipated NWB limits”.

III. Comments on Wetland Treatment

A. The schematic design report provides some thoughts and analysis (page 19 to 23) for the wetland treatment, which is not available in the detailed design report. The NWB requests detailed discussion about wetland treatment in Kugluktuk.

B. Alberta wetland guidelines (Guidelines for the Approval and Design of Natural and Constructed Treatment Wetlands for Water Quality Improvement) is referenced for polishing of treated municipal wastewater (normally secondary effluents) or water quality improvement. The design

for Kugluktuk sewage treatment system only references the spreadsheet for determining the wetland area required for wastewater polishing with the conceptual model of subsurface (SSF) flow system, but does not follow the whole process, i.e. questionnaire, preliminary feasibility, evaluation guideline, and design guideline of Alberta wetland guidelines. The use of that spreadsheet is questionable as:

1) The proposed lagoon effluent is primary effluent, while the wetland system is used to polish secondary effluent;
2) The proposed wetland is a natural wetland area, but the spreadsheet seems suitable for constructed wetland system;
3) The data provided in the schematic design report might not demonstrate that the proposed wetland is a SSF system, for which the spreadsheet is designed;
4) Kugluktuk is typical Arctic marine climate, tundra vegetation, which is significantly different from that in Alberta.
5) The concepts in the Alberta model have not been calibrated through an evaluation of parameters with known values. Furthermore, the model has not been calibrated through the collection of field data and an assessment of model outputs. What level of confidence does the Hamlet have with the Alberta model outputs and its comparison to actuality?

C. The water retention area of proposed landfill site will facilitate temporary storage of runoff (page 28) and possible leachate from the landfill. How does the Hamlet estimate the quantity and quality of leachate? There is an outlet to the wetland. How are the hydraulic and contaminant loadings added into the wetland treatment? The NWB requests that the Hamlet clarify them.

D. Both the schematic design report and detailed design report do not detail how the proposed wetland will be engineered, and engineering drawings have not been presented. The NWB requests that the Hamlet clarify the above concerns and provide detailed information for the wetland engineering. Site specifics are needed.

E. Warning signs will be posted along the perimeter of the proposed wetland area. What are the appropriately spaced intervals (page 22)? The NWB requests the Hamlet identify all the locations for warning signs for sewage lagoon, wetland, and solid waste facility in a figure or drawing.

IV. Comments on Solid Waste Disposal Facility

A. In Figure 5 of 2006 application there is one former honey bag pit located near the lagoon. Is there an abandonment and restoration plan in place for the former honey bag pit? The NWB requests that the Hamlet provide information about how the Hamlet deals with the abandoned honey bag

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pit. The NWB would like to point the Hamlet to page 8 of 2003 application, in which one honey bag pit is described as "17,000 m² total, located at a site between the airstrip and Coronation Gulf, approximately 5 km from the community". Are they the same? The NWB requests that the Hamlet clarify the number and locations of honey bag pit(s).

B. There are 6 assumptions for the proposed landfill site without proper referencing. The NWB requests that the Hamlet provide proper references for all the assumptions made for this section and also other sections.

C. From page 26 to 28 (4.1.2 Recommended Design Improvements) details on the calculation for the landfill site and water retention area are omitted. The NWB requests that the Hamlet provide details in this section.

D. What is the assumed storage capacity for hazardous waste (page 31) and how is it predicted? The NWB requests that the Hamlet present the projection.

E. The details and drawings for the proposed landfarm and hazardous waste storage are not provided. The NWB requests that the details and appropriately qualified drawings be presented to the Board.

V. Comments on Operation and Manual (O&M) Plans for Sewage Lagoon (Appendix G1)

A. The NWB recommends that the Hamlet change the title to O&M plans for Sewage Lagoon and Wetland and provide specific contents for the O&M of the proposed and existing wetland areas.

B. It is stated that the O&M plans are based on proposed improvements in page 2, and the existing lagoon cell and wetland area are introduced but proposed ones are not introduced. The amendment application seems to address both current and future O&M, thus the O&M plans should be prepared for both. The NWB requests that the Hamlet clarify this point.

C. The amendment application formally incorporates the wetland treatment into the sewage treatment system, and it also means the change of the point of control (KUG-4) from the outlet of lagoon to final discharge point into the Coronation Gulf. This is stated in page 3. However, the Hamlet formally applied for the change in the amendment application and presented the locations of new sampling points in a different way (Figure 6 of Schematic Design, Figure 3 of QA/QC Plans and Figure 3 of Sewage O&M Plans in Detailed Design). For the points of control, there are different descriptions and figures in different parts of the Detailed Design Report. The NWB requests that the Hamlet clarify the final point of control (lagoon outlet or wetland outlet), demonstrate the change through study, and provide consistent descriptions and figures for all points of control (monitoring stations).

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D. It is stated that 365-day sewage holding lagoon is used with an annual mid-August discharge in page 3, but in page 5 the lagoon is decanted over a 60-day period between June 15 and October 1 (please refer to Part II, item C). The NWB requests the Hamlet clarify the inconsistence.

E. It is good to present the operation log, but it is only for the sewage quantity record. Are weekly and monthly maintenance practices presented in page 5 to 6 considered? Such as inspections for ditches and drainage channels, site warning signage, discharge spillways, and sludge depth? Does the Hamlet agree that checklists or logs for those inspections are required? Appendix C (Site Forms) of Appendix G2 (Solid Waste Facility O&M Plans) presents a good example of inspection checklist.

F. In page 6 in is stated that samples will be taken during the months of June to October inclusive, which is not in accordance with the water license (May to August, inclusive). The NWB requests that the Hamlet clarify it and formally apply for the changes if applicable.

G. The NWB requests that the Hamlet clarify the annual report submission schedule (page 7).

VI. Comments on Environmental Emergency Contingency Plan (Appendix E of Appendix G1)

A. The NWB is very pleased to know that the Hamlet has its own environmental policy in place (page 2 to 3). The amendment application package already includes the documents about environmental policy, improvements program, procedures for operation and emergency response, and monitoring. If more components such as “Environmental Management System (EMS) Audit” and “Management Review” are introduced, a simplified but effective EMS may be established. If properly implemented, the EMS of the Hamlet may reduce the non-compliances and improve the community’s environmental performance. The NWB encourages the Hamlet to establish and implement an EMS, following the principles of ISO 14001 (international environmental management standard).

B. In Section 5.4 there are no mitigative measures mentioned for emergencies occurred in the lagoon and wetland sewage treatment system. The NWB requests that the Hamlet clarify the above concern.

VII. Comments on Monitoring Program Quality Assurance/Quality Control Plan (Appendix F of Appendix G1)

A. The description about the sampling location and frequency in page 4 to 5 is inconsistent with that in O&M Plans for Sewage lagoon. The NWB requests that the Hamlet clarify it and make it consistent.

B. The first paragraph of page 7 does not provide clear information about the sizes and types of buffers. The NWB requests that the Hamlet clarify it

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and provide clear instructions for sampling bottles, sizes and types based on all parameters required.

C. Field sampling log is stated in page 8 and sample identification in page 10. Does the Hamlet agree that separate forms for each in an appendix are required?

VIII. Comments on Solid Waste Facility O&M Plans

A. The description for the landfill operation and maintenance (page 4 to 6) needs additional detail. The NWB requests that the Hamlet provide detailed instruction for it, combining with the explanation of Figure 3 to 7.

B. The proposed lagoon may occupy part of all the current area for contaminated soil, waste oil and battery storage. What procedures and measures will be taken to deal with this area and those hazardous wastes? The NWB requests that the Hamlet clarify the above concern.

IX. Editing Issues and Typing Errors

A. The estimation of sewage volume in the detailed design uses the rate of 90 lpcd for calculation (page 12), and it might be wrong because it can not match the projected annual sewage quantity (101,578 m^3 in 2016 and 126,113 m^3 in 2026). The projected number is consistent with the description in schematic design (100 lpcd reflecting the changing life styles).

B. From page 17 to 18, there are 3 paragraphs mentioning Appendix E, one from Schematic Design Report (Page 17) and two from Detailed Design Report (Page18). It may confuse people. In fact, the Appendix E of Schematic Design Report is the same as the Appendix F of Detailed Design Report. The NWB requests clarification.

C. “Truck discharge flume 300mm smooth walled culvert, cut in half” in Figure 6 is inconsistent with the description in page 21 (3000mm culvert). The NWB requests clarification.

D. The parameter area rate constant for BOD and TSS appears to have been wrongly switched over in Appendix F.

E. The license requirements about O&M should be Part F rather than Part G (page 2 of Appendix G1).

Geotechnical Considerations

X. Within Appendix D- Geotechnical Investigation of the Detailed Design Report, Standard Proctor compaction tests were completed on a small number of soil samples to obtain maximum dry density of construction

materials. The angle of internal friction was estimated using "published correlation data for angle of internal friction and density" to be about 30°.

A. What is the reference for the "published correlation"?

B. Is the correlation used appropriate for a uniform sand soil encountered at this site? If yes, why?

C. Why wasn't direct shear testing completed to obtain a measured value of angle of internal friction?

D. How confident is the Hamlet in the selection of a 30° angle of internal friction?

XI. Within Appendix D- Geotechnical Investigation of the Detailed Design Report, it was stated that "the shear strength of the native soils will be characterized by a 28 to 30° friction angle."

A. What is the basis for the selection of this value?

B. If this value was based on the standard Proctor test results and density correlation with angle of internal friction, what was the basis for selection of the in-situ density?

C. Is the in-situ density of the native soils known? If so, what is the value and how was it determined?

XII. Within Appendix D- Geotechnical Investigation of the Detailed Design Report, the factor of safety of the berm with respect to global shear failure "is expected to be greater than 1.5 on the basis that the berm is unsaturated".

A. What method of analysis was completed to obtain the factor of safety?

B. What structure does this factor of safety of 1.5 correspond to?

C. In addition to the assumption of unsaturated berm conditions and angle of friction angle for the berm and native soils, what other assumptions are inherent in the stability analysis?

D. The landfill and bulky materials disposal areas do not contain a geomembrane in the berm design. Unsaturated conditions have been assumed because of a liner covering the berm. What assumptions were used in the analysis of stability for these structures?

E. The berms for each containment structure (i.e., landfill, lagoon, etc.) will have a unique loading condition applied to the inside slope of the berm and different berm geometry. What were the applied loadings applied to the berms for each containment structure assumed in the stability analysis?

F. The factor of safety was specified to be greater than 1.5. What was the actual value from the stability analysis for each structure?

G. How sensitive are the stability analysis to the assumed conditions of:

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1) Angle of internal friction

2) Unsaturated conditions

H. Additional detail and description into the quality control and quality assurance (i.e., quality assurance program) of, but not limited to, soil type, material characteristics, moisture content, and density, used in constructing each structure is requested.

I. A detailed monitoring plan, which includes, but not limited to, soil property testing methods (e.g., sieve, density, moisture content, etc) and frequency of testing during construction is requested.

J. Detail and description into soil and material specifications acceptable for construction, as well as, specifications for as-placed conditions like moisture content, density, lift thickness, grain size distribution, and standard proctor are also requested.

K. Will construction, quality assurance, and quality control monitoring be overseen by a qualified geotechnical engineer? If not, why not?

XIII. Within Appendix D- Geotechnical Investigation of the Detailed Design Report, it was stated that if the geomembrane "extend[s] over the entire inner face of the berm from the crest to the toe and…laid horizontally within the sewage treatment lagoon for a sufficient horizontal width… piping and internal erosion will not occur in the foundation soil for the berm."

A. How has piping and internal erosion 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? If so, what are the results? If not, why not?

C. Figure 6- Proposed Sewage Lagoon Plan of the Detailed Design Report provides a top view drawing of the lagoon. Cross-sections A-A' and B-B', which contain details of the berm configuration, are provided in Figure 7. The text and drawing in Figure #7 is too small to identify any details. A properly formatted drawing is requested.

D. What, if any, site/foundation prep work is required before berm development occurs? Will the same practices be completed for the other containment structures?

E. Figure #7 Section B-B' does provide a more clear depiction of the lagoon berm compared to section A-A'. The drawing provides no detail regarding geomembrane layout and positioning. The text in the Detailed Design Report provides minimal discussion on geomembrane configuration in the berm.

1) Why are the engineering drawings not reflective of that described in the Detailed Design Report?

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2) If a geomembrane is used in the berm design, the engineering drawings must reflect this and be corrected throughout the submission documents.

3) Additional detail and discussion is requested into how geomembrane layout and extent will be of "sufficient horizontal width" so that "piping and internal erosion will not occur in the foundation soil for the berm".

4) Will the geomembrane be keyed into the foundation? If so, what are the design details?

5) Will the geomembrane be anchored within the berm? If so, what are the design details and engineering analysis?

XIV. There are no details or discussion on the bearing capacity of the foundation soils under potentially thawing conditions or the expected amount of settlement for the berms. The geotechnical investigation did not establish the ground ice content in the foundation soils which could lead to differential settlements and foundation instability.

A. Does the Hamlet agree that bearing capacity and settlement are important geotechnical considerations in the design, stability, and containment of these structures? If not, why not?

B. Have any thermistors been installed to provide site specific temperature date for design purposes?

XV. Within Section 4.3.2 of the Detailed Design Report, it was stated that if "hazardous waste… is suitable for landfarming (i.e., if a spill occurs that generates hydrocarbon contaminated soils), then this waste may be incorporated in the landfarm".

A. What quantifiable measures (i.e., material concentrations and contaminant type) will be used to establish what hazardous waste is "suitable" for landfarming?

B. If a material is not suitable for landfarming, what is the disposal method if the soil is characterized as hazardous waste?

C. What standards/guidelines will be utilized to establish if a material is hazardous waste?

XVI. Within Section 4.3.2 of the Detailed Design Report, it was stated that "soils may be temporary stored… in lined stockpile within the landfill site until there is space within the landfarm to facilitate placement".

A. Is the landfarm not of sufficient size to direct contaminated soils directly to the landfarm facility?

B. What are the engineering details and specifications of the liner proposed for the stockpile?

C. How will leachate from the lined stockpile be controlled and collected?

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XVII. Within Section 4.4.1 of the Detailed Design Report, it was stated that “30 ml HDPE” and “20 ml HDPE cover” was used in the existing landfarm area. Commonly geomembrane liners are reported have a thickness in mm or mil.

A. Clarification is requested to address why volume units have been provided for the geomembrane?

B. A 40 mil HDPE geomembrane is specified in Appendix 1- Cost Estimates Table. This is not consistent with the text of the Detailed Design Report. Clarification is requested to address inconstancy.

XVIII. General description of the landfarm dimensions and characteristics was provided in Section 4.4.2 of the Detailed Design Report. No engineering drawings or construction specifications were provided for this design.

A. Was a soil volume balance completed to determine landfarm size requirements?

B. What are the results of the soil volume balance?

C. What are the detailed engineering characteristics and construction specifications of the landfarm? For example, there are no specifications for berm geometry, liner details, liner protection, surface preparation, leachate containment within the landfarm, sump design, surface grading to diver waters from entering the facility, stability analysis, construction material properties, QA/QC, etc.

D. Detailed engineering drawings are requested.

XIX. Landfarm operations are briefly described in Section 4.4.3 of the Detailed Design Report. There lacks sufficient detail into the operations of the landfarm to effectively remediate contaminated soils, as well as, control the mechanisms and rates of remediation. In addition to the stated soil aeration, water content, nutrient availability, and temperature are some of the critical parameters for microbial activity to effectively remediate contaminated soils.

A. What are the desired water content and nutrient characteristics for the contaminated soils in the landfarm?

B. How will the water content and nutrients be added/controlled, as well as, temporally and spatially monitored within the landfarm?

C. How long will it take to remediate the contaminated soils to levels that would permit removal from the landfarm?

D. Will there be separation of freshly contaminated soils entering the landfarm from the existing (i.e. partially remediated) soils? If so, what are the details of this operation strategy? If not, why not?

E. It is further stated that once per year, four samples will be tested for hydrocarbons.

1) How was it determined that four soil samples sufficient to characterize soil concentrations within the entire landfarm?

2) What are the spatial details (i.e., soil depth and horizontal extent) regarding soil sampling within the landfarm?

F. How will soils be placed and removed from the landfarm without damage to the liner?

XX. (Section 4.1.2 of the Detailed Design Report) The water retention area for the landfill was "sized to contain a 30 mm storm event or equivalent quantity of snow runoff".

A. What is the engineering basis of selection of this storm event?

B. What is the probability of a 30 mm storm event?

C. What is the potential for the retention area to overtop with fluid?

D. How often will the fluid be drained from the water retention area?

E. Will monitoring of the fluid from the water retention area will be completed prior to drainage? If so, additional details are requested. If no, why not?

F. How will water from the water retention area be disposed and managed?

XXI. Within page 5 of Appendix G2 –Solid Waste Management Facility of the Detailed Design Report, it is stated that cover material for the landfill will consist of contaminated soil that is stockpiled on site or material from a locally available source.

A. What concentration limits must the stockpiled contaminated soil pass if it is to be used for cover material?

B. What are the details of the monitoring, including spatial and temporal frequency, of testing the stockpiled contaminated soil?

C. How much stockpiled soil is available and how long will this be available for use as a cover material?

D. If other material is to be obtained from a local source, what characteristics of the soil are acceptable for use as cover?

E. What are the geotechnical engineering design and details, function, and characteristics of the final cover?

XXII. Capping of the landfill perimeter berm with blast rock from the quarry will be practiced.

A. What are the specifications and characteristics of the blast rock that would be acceptable for use as capping material?

B. What thickness of blast rock will be used on the perimeter berms?

C. Will capping of perimeter berms for the other containment structure be completed? If so, what are the details? If not, why not?

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XXIII. Figure 13- Solid Waste Disposal Facility Landfill Development Year 20 of the Detailed Design Report provides a cross section schematic of the landfill at year 20. A caption was provided that states “optional additional berm constructed on waste to assist with vertical development”.

A. A detailed engineering drawing of the perimeter berm and optional berm was not provided in the Detailed Design Report and are requested.

B. What are the dimensions and engineering characteristics of the perimeter and optional additional berm?

C. Is the optional berm stable from slope and sliding failure under the applied loads?

D. What quantifiable characteristics will be used to benchmark if this optional berm is required?

E. What method of analysis, assumptions, as well as, what soil and waste strength and density values with justification on their selection, were used to assess the stability of the perimeter berm and optional additional berm?

F. What is the level of confidence does the Hamlet have that a 3:1 slope for the refuse will be stable?

G. What evidence or justification is there to suggest that a refuse slope of this angle will be stable?

XXIV. The landfill does not contain a geomembrane liner.

A. Does the Hamlet agree that the landfill, which does not contain a liner, could have seepage through and under the berm?

B. If permafrost aggregation is relied upon in the design of the landfill berm to limit seepage, does the Hamlet have an understanding of the thermal regime with time and what are these details?

C. If the berms are not lined nor have permafrost aggregation, how will seepage be prevented through the active zone?

XXV. Is permafrost aggregation relied upon for long term containment of waste from the landfill? If so, what design details will promote this containment practice?

XXVI. The lagoon, hazardous waste depot, and landfarm specify a geomembrane to be included in the design.

A. What provisions have been made in the design to protect the liner integrity from construction, operation, and environmental damage?

B. There was no description or detail regarding construction specification, installation, construction and long-term monitoring, quality control, or quality assurance for the installation of the liner. Additional detail and discussion is requested to address each of these issues to ensure that the

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liner will not be damaged during construction and will perform as designed for the service life of the facility.

XXVII. The Hamlet is requested to provide additional detail and description to address each of the points provided below.

A. Which, if any, of these containment structures use a liner on the base of the facility?

B. If a liner is not included on the base of a facility, is permafrost aggregation relied upon for containment? If so, additional detail and description is requested to justify this practice and demonstrate containment.

XXVIII. Section 4.4 Erosion of the Detailed Design Report, provides a brief on contingency measures for erosion prone areas. As part of the repair, blast rock is to cover the repaired area. What are the characteristics of the blast rock that will limit future erosion, and what thickness of blast rock will be required?

XXIX. Non-specific comments: The Detailed Design Report has been arranged in a convoluted format that repeats texts and figures within the main body and in various appendices. Many engineering drawings, specifications, and details have not been provided. In many cases, the details for construction, quality control, quality assurance, and geotechnical analysis were minimal or not provided. Detailed responses to the above questions are requested to avoid the potential for an additional full review of the Detailed Design Report at a later date.

In closing the **NWB** requests a detailed response to the bulleted items in this letter. The **NWB** would like to remind the Hamlet 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 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 considerations (Part X to XXIX) 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,

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Original signed by:

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

cc. Mayor Derrick Power (Fax)
Sudhir Kumar Jha (GN-CGS)
Xavier Fernades (Nuna Burnside)