Nuna BURNSIDE

Appendix A-2

Nuna Burnside Letter of January 26, 2007

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January 26, 2007

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FEC - 09754.240
Kug Lu
NWB Approval

Government of Nunavut
Project Management Division
Department of Community and Government Services
Kitikmeot Region
P.O. Bag 200
Cambridge Bay, Nunavut
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Attention: **Mr. Sudhir Kumar Jha, M.Eng. E.I.T.**
Project Officer
Community and Government Services – Kitikmeot Region

Re: **Nunavut Water Board Requests for Further Information**
Regarding the Amendment Application
Hamlet of Kugluktuk, Nunavut
File No. N-0 09755

Dear Mr. Kumar Jha,

1.0 Introduction

We have recently received a copy of the October 24, 2006 letter from the Nunavut Water Board (NWB) addressed to the Hamlet of Kugluktuk, regarding the Kugluktuk Water License Application – Amendment.

The letter provides questions and comments from the NWB regarding the recent submission by the Hamlet of an amendment application supported by the Nuna Burnside Engineering and Environmental Ltd. (Nuna Burnside) document entitled "*Detailed Design Report for the Improvement to the Sewage Lagoon and Solid Waste Disposal Facility, The Hamlet of Kugluktuk, Nunavut*".

The submission was supported by a copy of the Schematic Design Report and tender drawings, which were sent to the NWB and CGS, Government of Nunavut (GN) on CD in a letter dated August 15, 2006 and again on September 15, 2006.

The NWB reviewed the submission, and prepared an itemized list of comments, questions, and requests for additional detail and information in a letter dated October

24, 2006. It is our understanding that these items must be addressed in a manner satisfactory to the NWB before they will issue an amendment to the Water License.

We have followed the same numbering system and format in our responses that corresponds with those used in the October 24, 2006 NWB letter.

2.0 Responses to NWB October 24, 2006 Letter

Enclosed herein is our response to the October 24, 2006 letter on behalf of the Hamlet of Kugluktuk, regarding the amendment application for Water License NWB3KUG0308 as per Section 48, Item 2 of the Nunavut Water and Nunavut Surface Rights Tribunal Act (NWNSRTA). The geotechnical questions have been responded to by AMEC Earth & Environmental and are Attachment I..

It is our understanding that Section 57 of the NWNSRTA requires the applicant to satisfy the NWB, that the water produced for the appurtenant undertaking will be treated in a manner that the Board considerers acceptable. The Hamlet's past performance is also considered. Prior to the schematic design, Nuna Burnside evaluated the current operation and Hamlet's methodology. This was included in the Schematic Design Report. In addition, the Detailed Design of the sewage lagoon is based on meeting effluent quality standards significantly more stringent than currently required by the NWB.

Table 5 of the Schematic Design Report includes all available current and historical monitoring data, and the text includes an evaluation of these results. We suggest the NWB accept the Schematic Design Report as fulfilling the reporting requirements for 2005. It is our understanding that no sampling was conducted by INAC or the Hamlet in 2006.

Sewage Treatment and Solid Waste Disposal

I. Comments on Sewage Estimation

A. Different sources of data provided by the Nunavut Bureau of Statistics were used for the population estimates at different times during our study, which lead to inconsistencies initially. The numbers used are from the Nunavut Bureau of Statistics (2000 – 2020) (Attachment 1). These are the numbers which are used to determine the populations shown on Table 1/Schematic Design Report, and from which the sewage and solid waste volumes are projected. These same population numbers were subsequently used in the Detailed Design Report, June 2006.

Nuna Burnside had no involvement with the creation of the 2003 application, and recommends that the 2006 submission data be considered the most relevant.

B. We suggest that the 2003 NWB application be considered superseded by the June 2006 Design Report, as developed from the December 2005 Schematic Design Report.

Nuna Burnside was not involved in the 2003 application, and suggests that this no longer be referenced and be considered out of date.

In the same fashion, we suggest that estimated of sewage calculated in the Nuna Burnside 2005 and 2006 reports (as amended from Item A above) be considered the most up to date. Previous references in the 2004 Annual Monitoring Reports done by another party (not Nuna Burnside) be considered superseded.

C. Nuna Burnside did not work on the previous applications and reports. They were reviewed, however Nuna Burnside chose to generate its own calculations. The calculations are based on the Nunavut Bureau of Statistics data discussed in Item A. The Nuna generated population projections were compared to the historical data and found to be slightly higher values, which are more conservative then the population projections produced in the 2003 application.

D. The population data as discussed in Item A above, is based on Nunavut census information. The projection for sewage and solid waste is based on these numbers. This data is the best available and is sufficient for this design.

E. The assumptions shown in Table 5 of Detailed Design Report and Section 5.6 of the Schematic Design Report are values employed with wastewater treatment systems. It is accepted that the values are dependent on variables such as country location, climate conditions, temperature, water use, plant operating experience, etc., but a typical range of values is provided in reference 'Wastewater Engineering – Metcalf & Eddy – 4th Edition'- Table 3-12. The values used for our assumptions are justified as we have selected the conservative low-levels likely to be expected for northern climes such as the Northwest Territories and Nunavut.

F. A specific gravity of 1.0 is used to convert the sludge generation from dry mass to dry volume. This is based on typical ranges of published values (Metcalf and Eddy – 4th Edition – Table 14 – 7). The values shown on Table 4 of the Detailed Design Report, or projected and cumulative sludge volumes, are for dry sludge solids. A saturated sludge volume column representing the displaced volume in the bottom of the lagoon was not presented on the table. The saturated volume

was used to calculate the 0.3 m depth in the base of the lagoon or sludge retention. The lagoon has been designed with adequate volume for sludge retention for a 20 year life span.

In the later stages of lagoon life, capacity and efficiency could be improved by removing the sludge.

G. The decrease over time in the concentration of contaminants such as BOD, etc. was an assumption that was initially undertaken. In hindsight, this is not justified and we believe the contaminants will show no significant variability. This will be corrected in the revised version of the Detailed Design Report. It will not have a significant impact on the design or the expected discharge impact.

H. Water supply was not part of the Nuna Burnside work scope. It would be our assumption that the water supply system would be upgraded and a license amendment application made when needed. The supply source is the Coppermine River and volume of supply is not likely to be a concern.

The GN is in the process of preparing a Terms of Reference for engineering study to review options to increase in water plant and intake system capacity to meet the future needs of the community.

I. As discussed in each item above.

II. Comments and Effluent Quantity Projection

A. Actually, Column 3 is only used if the raw data results need to be amended for some reason (historic data trends etc.), which would result in the expected quality in 2006 to vary from the actual sample results. In this case, they are the same. Column 3 is redundant in this case and will be remove in the revised Detail Design Report.

B. These are reasonable removal rates for contaminants, particularly BOD and TSS, and acceptable levels for well-operated lagoon systems with annual discharging. The lagoon treatment efficiency is expected to be closer to the 70 percent reduction level, particularly during the period following the new lagoon commissioning. This is based on a shallow layer of wastewater being able to stand in the lagoon for approximately one year, during which time it can undergo a high rate of reduction. Later in the life of the lagoon the wastewater depth is greater, which reduces the overall efficiency. The low conservative 25 percent removal rate is stated as the worst case scenario. If the accumulated lagoon sludge is

removed on occasion throughout the life of the lagoon, the treatment efficiency could be significantly improved.

The efficiency values were based on using published values for Ontario climates (MOE Design Guidelines of Sewage Treatment, 1985), in-house experience with similar sized lagoons in northern and sub-arctic climates, and extrapolated conservative engineering estimates. The 25 percent removal rate in the later part of lagoon life is extremely low and is very conservative.

In addition, the wetlands treatment system is designed to meet effluent quality criteria significantly more stringent than the level currently require by the NWB.

C. The reference to a 60-day decanting period in Appendix G1 is a typo. We expect to employ the period of mid-June to mid-October (120 days) as the time window suitable for the decanting of the sewage lagoon. The selected time for decanting will depend on the local weather conditions at Kugluktuk, i.e. after the spring thaw and before the winter freeze-up. The required prior notice period of 10 days will be provided to an Inspector and the NWB.

The 70 percent reduction rate initially is based on a shallow layer of waste water in the lagoon, falling to a 25 percent reduction rate in the final years of lagoon life, when the water level is much deeper and there is less of a rate of reduction.

D. At this time, the design (based on an assessment of the current system) is in our opinion suitable. This is based on the field assessment of the current system and effluent discharge. The current treatment system is adequately treating the sewage based on the limited field sampling program to date. See Attachment II Table 5.0 and Figure 6.0 for the sampling results.

Table 5.0 in the Appendix E- Environmental Emergency Contingency Plan of the Detail Design Report summarizes sewage effluent sample data collected to date for the Kugluktuk Sewage Lagoon. A copy of the Table is attached to this response letter.

E. The proposed system is a significant improvement. Annual monitoring as required by the water license will provide ample forewarning should the wetland treatment system need to be enlarged or modified. In addition, the lagoon and wetland system is designed to meet much more stringent criteria than the current NWB limits. This provides a significant level of additional protection.

E. As outlined on page 22 in the Schematic Design Report, the "anticipated NWB limits" are based on what Nuna Burnside staff, including Mr. A. James (Jim) Wall who worked for the NWB for several years prior to joining Nuna Burnside, reasonably anticipate in the future. Mr. Wall indicated that some preliminary study and discussion had been undertaken by the NWB regarding future regulatory discharge criteria. A review of the criteria in other jurisdiction, and our policy of conservative engineering practice, prompted Nuna Burnside to use more conservative values than those that the NWB uses as guideline limits.

This provides a higher level of conservative engineering to the project. We trust the NWB will recognize the significant level of environmental protection, that is inherent when using, or a higher standard of compliance than what is currently the NWB minimum required.

III. Comments on Wetland Treatment

A. We suggest incorporating the content of the Schematic Design Report into the Detailed Design Report as support for the Detailed Design. Wetland treatment is discussed on Pages 18 through 24 in the Schematic Design Report and Appendix E.

Our original project mandate to our client (GN), was to submit the Schematic Design for approval then move on to Detailed Design, so all of the data in the Schematic Design was not included in the Detailed Design.

B. As discussed on page 22 of the Schematic Design Report, the Alberta Wetland model is not directly applicable to Nunavut, however (in our opinion) it is the best available basis to start from to develop a site specific model for Kugluktuk. As outlined in the Schematic Design Report, significant modification and alternations have been made.

This is also consistent to what other consultants/communities have done for other locations in Nunavut and the NWT.

1) The model is based on the effluent entering the lagoon being "primary" and after lagoon treatment the discharge is considered "secondary". The wetland system is designed to treat the lagoon discharge.

2) For the purposes of this site, the wetland area is considered to be a natural wetland that is gradually modified via the gradual annual increase in lagoon discharge to become an "engineered" wetland. Physical changes to flow paths

and other features will only be made (as proposed on page 16 of the Schematic Design Report), should the annual field monitoring indicate the need for further engineering.

3) As noted above, the wetland system for Kugluktuk has been designed based on the Alberta Wetland model with significant revisions and conservative estimates related to the active layer (.0.9 meters) and lower ambient temperatures then historically recorded.

4) We agree. It is outlined on page 22 in the Schematic Design Report how the Alberta Model has been modified and adapted. In addition, the system has been designed to meet discharge criteria significantly more stringent than current NWB discharge criteria. This includes the following:

Parameter	Current NWB License Requirements	Design Criteria
BOD (mg/L)	120	45
TSS (mg/L)	181	45
T-PO_4 (mg/L)	N/A	1
TKN (mg/L)	N/A	5
FC (CFU/dL)	1×10^4	2×10^2

5) The confidence in the model is based on several factors:

- Monitoring of the current lagoon system, which allows almost immediate discharge of sewage into the wetland through permeable lagoon walls, shows a well established wetland vegetation system and very little environmental impact. The purposed design greatly improves on this system of treatment and discharge.

- It is our understanding that the modified model has been used previously for communities in Nunavut that have received NWB approval based on that approach. The Hamlet communities are Coral Harbour and Arviat.

- The model is developed using significantly more stringent discharge criteria than that currently required by the NWB.

- Annual monitoring will provide confirmation of the model and allow ample opportunity to modify the system should future concerns be noted.

C. Onsite run-off and leachate impacted surface water will be retained in a pond and allowed to infiltrate/evaporate in place. The underlying sandy soil promotes infiltration during the summer when the permafrost thaws. Other times of the year everything is frozen. Diversion of overland flow around the waste area will limit the amount of impacted surface water.

Sampling of the groundwater immediately down gradient of the existing landfill berm showed no landfill impacts. Based on the size of the site, lack of current impacts, limited period of unthawed subsurface flow, no significant impacts to the wetland are anticipated. Migration of landfill contaminants in the subsurface (when thawed) acts as a natural attenuation zone prior to surface discharge in the wetland. As the landfill expands and permafrost moves into the waste the amount of waste generating leachate will be limited to the top approximately 1.0 m, which seasonally thaws.

D. The wetland will not be physically altered or engineered beyond what has been shown. Some minor changes to flow patterns to maximize the effectiveness may be made in the future if required. The wetland will simply develop in small increments each year, as the volume of lagoon discharge increases year to year. The small increase in discharge each year allow for a slow natural increase in vegetation and wetland capability.

E. This will be done in consultation with the community, based on the location of ATV and snowmobile trails to place the signs in the places most frequented by humans.

IV. Comments on Solid Waste Disposal Facility

A. The honey bag pit is contiguous with the outside berm of the active sewage lagoon. It cannot be decommissioned without damaging the existing lagoon, so it will remain and be decommissioned with the existing lagoon.

The existing lagoon (and honey bag pit) will be decommissioned by covering the sludge with a layer of clean soil after the new lagoon system has been functioning according to design. This will likely occour at least one year after the new lagoon is in operation.

There is a reference in the 2003 application to a 17,000 m^2 honey bag site. Efforts are being made to locate the honey bag site. Once the facility is located it will be decommissioned in a safe and approved manner.

B. References are included in Section 7.0. The site assumptions listed on page 26 of the Detailed Design Report were derived from the following sources:

1. Generation rate of 0.012 m^3/person/day. This was derived from several sources. In retrospect the best reference would be "Guidelines or the Planning, Design, Operational, and Maintenance of Modified Solid Waste Sites", Government of the Northwest Territories, April 2003.

   This document suggests a slightly higher water generation rate than the 0.014 m^3/person/day used in the Detailed Design. The calculations will be modified to 0.015 m^3/person/day. This will be reflected in the revised Detailed Design Repot submission.

2. Population growth of 1.5 percent from Nunavut Bureau of Statistics as discussed in Section I, Item A.
3. Field observations and in-house experience. This is also consistent with the NWT 2003 reference above.

4. The 40 percent volume reduction due to burning is based on field observations and in-house experience.

5. The 50 percent reduction due to compaction is based upon field observations, and in-house experience. The NWT, 2003 document suggests a 3:1 compaction rate. Field and in-house experience suggests 2:1 (50 percent) is more realistic and conservative given the limited machine time on site.

6. Field observations of conditions and proposed best practices based on in-house experience.

C. The retention area has been designed to accommodate a 30 mm storm event. Assuming the 30 mm falls all within the landfill and retention area footprint (26,986 m^2 for landfill and 1,318 m^2 for retention area). The total volume of run-off in the retention area would be 849.0 m^3. With a berm height of 1.0 m the retention area capacity is approximate 1,000 m^3. The storm event volume is approximately 85 percent of total retention capacity.

D. The storage capacity is based on adding up the area of the existing storage area of drums and materials by the existing lagoon and assuming that materials will be shipped out of the community when the area starts to reach capacity. Based on information provided by the community, back-hauls provided by the community be conducted out of the community will be conducted approximately once every

five years initially. The storage area is sized to allow an accumulation of an amount that makes a back-haul cost effective yet does not encourage a large stockpile.

E. Details and cross sections are presented in the tender drawings, which have been submitted to the NWB as part of the license application in August/2006..

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

A. The O&M manual title will be changed and O&M for the wetland areas will be added. The O&M will consist of the following:

- Inspection of the wetland as part of the monitoring program noting changes, taking pictures to document change over time
- Examine flow paths and document conditions during the sampling program
- Provide conclusions on how the system is reacting compared to design and historic inspections in the monitoring report
- Provide in the monitoring report recommendations for modifications to the wetland area and predications on future development.

This will be part of the annual monitoring report submitted with the sampling results.

B. The O&M plans are for the proposed facilities only. The existing lagoon and wetland system is not part of the application, as they will be out of service once the new system is constructed. The O&M plan will be clarified.

C. The monitoring stations (Four stations, WS1 to WS4) remain the same, as shown in Figure 6 of the Schematic Design Report. The new change of control for the effluent discharge from the new proposed sewage lagoon will be KUG-4A, as shown in the corrected Figure 3 of the Detailed Design Report. Both figures and a description are attached.

D. As previously addressed in Section II, Item C, the period of decanting will be between mid-June and mid-October (120 days) at a time to be selected during favorable weather conditions.

E. The O&M plan will be updated in the revised Detailed Design Report to include inspection check lists.

F. The June to October sampling period is recommended. The change to the water license is requested.

G. Page 7 of Appendix G1 Sewage Lagoon Section 3.5 Annual Reporting Procedures should include the following:

As required by the NWB license, an annual report will be prepared as submitted. The report will include all data from the current year of monitoring and inspections. The data will be compared to the NWB requirements and design parameter of the system. Current and historic data will be presented, and a trend analysis conducted to determine if the system will remain in compliance in the future. The report will include:

- Results
- Compliance
- Predictions
- Modifications made
- Conclusions recommendations.

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

A. An EMS based on ISO 14001 may be established in the future.

B. Section 5.4 of Appendix E, page 10 within Appendix G1 relates to sewage mitigative measures for the lagoon would be:

- Control sewage through the use of temporary berms
- Limit discharge to the environment
- Warn people of spill areas
- Assess spills into wetland and dilute with fresh water pumped from local streams
- Increase travel path lengths through berms and ditching to encourage retention time in the system to maximize treatment.

In the event of a catastrophic failure, the worst case scenario is the discharge of the entire lagoon contents into the wetland treatment system. Efforts should focus on retention and control followed by encouraging treatment in the system. Note, there is a long path (1.5 kilometers) to the ocean, and no human concerns along the path or at the shoreline. It is highly unlikely a system failure would impact the community.

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

A. As previously addressed in Section V, Item C.

B. This paragraph should be deleted and replaced with the following:

A CAEL certified laboratory should be contracted to conduct the laboratory analysis of the samples. The list of analysis required and NWB requirements should be sent to the lab, so they can prepare the appropriate bottle order handling instructions, preservatives, etc. Chain of custody and laboratory handling instructions followed. Field notes should be recorded on sampling location, conditions, observations, procedures, and field measurements. Field measurements such as flow, depth, temperature, visual, and olfactory notes will be recorded. Sample shipment will be planned to ensure they are received by the lab within the time allowed. Different labs have different procedures. Lab procedures should be followed carefully.

C. As long as the field sample logs record all the information and follows the procedures on page 8, 9, and 10 of Appendix F in Appendix G1, there will be sufficient data and proper data recording.

VIII. Comments on Solid Waste O&M Plans

A. The O&M plan will be updated and additional details provided.

B. As outlined in the Schematic Design Report, the batteries, waste oil materials are scheduled for removal and disposal as the first step in the project prior to construction. A contractor has already been selected to conduct this work.

As part of construction, the contaminated soil stockpile will be moved to the landfill site for use as cover materials. The top portion of the pile has been tested and found suitable for landfill cover. The bottom part of the pile will be tested when exposed and moved if acceptable. If it is not acceptable, it will be placed in the soil farm treatment area of the landfill when it is constructed – until then it will remain stockpiled.

The contaminated stockpiles are currently located in the proposed new lagoon location. The stockpile will have to be temporarily relocated out of the construction area until the soil farm area has been constructed.

IX. Editing Issues and Typing Errors

We appreciate the NWB pointing out these errors and inconsistencies. They will be addressed. A revised Detailed Design Report submission will be made with these revisions.

X. Geotechnical Considerations

To be addressed by AMEC.

XI. Strength of Native Soils

To be addressed by AMEC.

XII. Global Shear Failure

To be addressed by AMEC.

XIII. Geomembrane

To be addressed by AMEC.

C. The construction drawings were submitted to the Nunavut Water Board on August 15/06 and provide the details requested. Please refer to the submitted drawings.

E 1) See submitted construction drawings.

E 2) The construction drawings will be revised to show the geomembrane located in the middle of the berm as recommended by AMEC Option 2. See AMEC responses to NWB questions.

E 4) The construction drawing details will be revised to shown the new location of h liner in the middle f the berm.

E 5) The construction drawing details will be revised to shown the new location of the liner in the middle f the berm.

XIV. Bearing Capacity of the Foundation

To be addressed by AMEC.

XV. Hazardous Waste Suitable for Landfarming

A. Landfarming is only an option for soils that have been contaminated by materials that can be treated effectively by landfarming. In Nunavut, this is typically petroleum hydrocarbon impacted soil from fuel and oil spillage. The applicable guidance document is "Environmental Guideline for Industrial Waste Discharges", Government of Nunavut, 2002.

The landfill can accept only impacted soils that meet the CCME Industrial criteria or are below the leachate testing criteria as outlined in Section 3.2 of the above noted document.

The soil would be sampled and if it contains levels of petroleum hydrocarbons above the allowable limits for landfilling, it can be considered for landfarming. Since the landfarm is lined, impacted soil being landfarmed is isolated from the natural environment.

All "drainable" free products that can be drained from the soil via gravity while it sits on containment, will be collected and stored as hazardous waste. All petroleum impacted soils with no drainable free product can be considered suitable for landfarming. Soils stay in the lined landfarm area until contaminant levels are lowered until they met the criteria for landfilling. Remediated soil makes excellent landfill cover.

B. All materials not suitable for landfarming will be contained and stored in the hazardous waste area. This lined area is used to store and stage hazardous wastes for disposal. Procedures for the disposal of olefins includes shipping out of the community or processed through a portable incinerator or other approved equipment.

C. "Environmental Guideline for Industrial Waste Discharge", Government of Nunavut, 2002, and "Environmental Guideline for General Management of Hazardous Waste", Government of Nunavut, 2002.

XVI. Remediation of Contaminated Soils

A. At this time it is not known what volume of contaminated soil may require remediation. The land farm has been sized to accommodate the estimated volume of soil that the GN wants to remove from a local pipeline spill area that would not be suitable for immediate landfilling. It is conceivable that at some point in the future the volume of contaminated soil acquired from a spill will exceed the

capacity of the landfarm. In such a case, it will be stockpiled until it can be landfarmed or the landfarm can be expanded.

B. The details would be the same as for the landfarm. The stockpile or expanded landfarm area would only be constructed in an emergency situation when needed. It is nor sized, located, or planned for construction at this time. It is a future contingency plan.

C. The leachate in the lined stockpile will be controlled and collected in the same manner as the landfarm. Stockpile construction details including base liner, sump for leachate, and top cover will be a stockpile specific design.

XVII. HDPE Cover

A. This is a typo. It should be "mil".

B. The liner was upgraded to 40 mil instead of 30 mil.

XVIII. Landfarm Description

A. The landfarm size (20 m x 60 m) was estimated to handle an initial volume of approximately 600 m^3 of impacted soil when spread 0.5 m thick. This is based on the estimated volume that is over acceptable limits for landfilling from a GN pipe spill site in the community, and an allowance for a portion of the soil stockpile next to the sewage lagoon.

B. The soil balance estimates of 600 m^3 of soil can be accommodated by the current size of the landfarm when using a layer thickness of 0.5 m.

C. See landfarm details in the tender drawings submitted to the NWB as part of the license application in August/2006.

D. See design drawings submitted as part of the tender package submitted to the NWB as part of the license application in August/2006. Design and operation is based on "Code of Practice for Land Treatment of Soil Containing Hydrocarbons", Alberta Environment, 2005.

XIX. Landfarm Operations

A. The landfarm is designed to operate within the constraints of the existing climate. No accommodation has been made for monitoring water and nutrient content at this time.

B. No specific operational and monitoring program has been developed. This will be determined by the nature of the impacted soil, degree of contamination, the desired cost/benefit of the organization delivering the impacted soil to the landfarm/landfill site. Depending on variables such as quality of soil, contaminant type, and concentration, remaining capacity in the landfarm at the time, need for cover soil etc., negotiations between the Hamlet (site operator) and the owner of the impacted soil will determine what should be done. Operations will be consistent with "Code of Practice for Land Treatment of Soil Containing Hydrocarbons", Alberta Environment, 2005.

C. Timeline for remediation is dependent on the type, amount, and concentration of contamination. The site is currently set up to accept a specific volume for remediation via ambient conditions only.

D. This is a situation specific strategy (depends on material volumes being dealt with) that will be determined between the Hamlet (site operator) and deliverer of the impacted soils. Actions will be situation specific, but areas in the landfarm could be designate for current materials being remediated and another portion of the landfarm reserved for new contaminated material that maybe received in the future.

E. Samples tested for hydrocarbons:

   1. Four samples was the minimum to assess soil characteristics. In retrospect, a specific number of samples should not be specified as it will be situation dependent.

   2. This will be situation dependent.

F. Protection of the liner is important for multiple use of the landfarm. A specific placement and removal protocol has not been developed. The operation is dependent on equipment available, and the amount and nature of the material being laid down or removed. It is also dependent on the plan of the operator to supplement ambient conditions with activities to enhance the rate of remediation. This would require a situation specific cost/benefit analysis.

As part of the design a 200 mm sand layer will be placed over the liner to protect it from damage. Typically contaminated soils are end dumped into the landfarm and the material is then spread by a dozer. The dozer will travel over the end dump material to spread the contaminated soil. There will be an 600 to 800 mm layer of material that will be beneath the dozer that provides additional protection to the liner. This will limit the travel of machines over covered portions of the liner only.

At this time, there is no specific budget, plan or remediation timeline for the soils that have been identified that may enter the landfarm (GN spill area and potentially material in the base of the stockpile near the sewage lagoon). Until a request to move soil into the landfarm and the details about the soil is known, an operational plan with costs, timeline, and specific remediation action (i.e. adding water and treatments, and plowing frequency pre, during, and post treatment sampling etc.) cannot be determined. This cost and effort will be part of the remedial action soil treatment plan. At this time, our mandate has been to simply include the layout of the landfarm area within the landfill site.

XX. Water Retention Area

A. The storm event of 30 mm was selected based on Canadian climate data for the area. Appendix B of the Detailed Design Report provides the monthly rainfall from May to October. A review of the climate data indicates the maximum daily precipitation recorded to date was 53.7 mm. Over the area of the containment pond and the landfill, this would generate approximately 1,520 m^3, which exceeds the containment by approximately52 percent. However, the landfill area being very permeable is expected to allow infiltration of a significant potion of the rainfall, such that in an event of maximum historic daily rainfall event the containment will not be exceeded. August is the month of greatest average precipitation (41.01 mm). Over the landfill and containment area, the monthly volume would be approximately 12 % over the containment volume.

B. The probability is very low that a storm event would occur that will over fill the containment. The National Building Code (2005) Appendix C, Division B C-5, provides climate norms for Kuguluktuk (Coppermine), Nunavut. The rainfall amounts have been standardized to represent the one day rainfall amounts that have a 1 chance in 50 of being exceeded in any one year or the 1 in 50 year return value one day rainfalls. The one day rainfall amount for Kugluktuk is 55 mm.

C. The containment is sized to contain approximately 1,000 m^3. The storm event of 30 mm would generate (from the landfill and containment areas) approximately 840 m^3 of run-off, assuming no infiltration and subsequent evaporation. The storm effluent can be contained with approximately 75 percent of the containment capacity.

D. The climatic conditions are such that the area would only be drained if retained volume exceeded 30 percent of capacity so that another storm event would exceed capacity. Given the climate, permeable soils, evaporation and history with the existing site it is expected that it will only require drainage on very rare occasions.

E. As noted above, drainage is not expected to be needed, however if it does, sampling will be required to ensure water quality meets Nunavut Water Board discharge criteria. If it does not, remedial action will be required. The sampling and testing would include metals, hydrocarbons and general chemistry. The sampling and testing procedures will be included in the operation and maintenance manual.

F. As discussed, discharge is expected only rarely if ever. The containment can contain the entire average precipitation of the wettest month (August). When discharge is needed, the water will be tested for compliance with NWB requirements prior to discharge. Remedial action will be specific to the parameters that do not meet NWB discharge requirements.

XXI. Solid Waste Management Facility of the Detailed Design Report

A. Soil quality must meet CCME Industrial land use criteria.

B. This is situation specific and determined based on CCME protocols for sampling and analysis.

C. The available soil stockpile consists of the top portion of the contaminated soil stockpile next to the sewage lagoon. The top portion has been tested and found to meet CCME Industrial Criteria and is suitable for cover. Testing of the underlying portion is required to evaluate its suitability. The stockpile will be moved as part of lagoon construction in 2007 and/or 2008.

D. Most local soils are sandy with some silty/clayey areas and other areas with some gravel. These are all suitable as cover. The only restrictions on the cover material are that it be fine enough and manageable for operational application.

E. As noted above, given the climate, the local soils are suitable final cover materials. The final cover details are shown on the tender drawings. The cover must be clean soil, contoured to promote run-off, and sufficiently stable not to blow away.

XXII. Capping of the Landfill Perimeter

A. The blast rock would be granular gabbro obtained from the local quarry. Blast fragments are typically 10 mm to 30 mm angular fragments. Sorting or grading of the blast rock is not needed. The capping detail is shown on the construction drawings.

B. Approximately 0.3 m, which is essentially one complete layer of rock coverage with no exposed underlying soil.

C. Yes, same specifications as above.

XXIII. Figure 13

A. The detailed engineering drawing of the landfill berms was included in the tender document drawings submitted to the NWB as part of the license application in August/2006. There is no detail for the optional berm. It would be constructed similar to the existing berm on an as needed basis. Exact design would be dependent on the fill profile and site conditions at the time.

B. It will be designed if and when needed. Its design will be dependent on fill morphology and site conditions existing in year 20.

C. If it is needed it will be engineered appropriately.

D. Operational assessments and site conditions up to year 20 will evaluate the need. The need for the berm will be determined during year 15 to year 20.

E. The perimeter berm will be constructed similar to the existing berm, which was inspected and found to be in good stable condition. The berm design is based on in-house expertise. Waste density should not influence the perimeter berm as the waste is inside the berm. Should the optional berm be needed, necessary geotechnical evaluation of the base location will be undertaken as part of is design.

F. A 3:1 slope for the waste was designed based on the in-house expertise and not published data. With many landfills including those in permafrost conditions, as well as, examining the existing waste mass characteristics. A 3:1 slope is expected to be stable.

G. In-house experience and an evaluation of existing fill characteristics. A 3:1 slope for a relatively small landfill given the local climate conditions and operational methodology should be achievable and stable.

XXIV. Geomembrane Liner

A. A liner is not part of the landfill design. Limited seepage would be expected through and under the berm. An assessment of current conditions shows no impact downgradient of the landfill berm. Impacts can only occur in the unfrozen active layer of waste during the summer. There is a significant natural attenuation zone between the waste and the closest down gradient receptor, which is the small stream from the sewage lagoon area

   See the Figure 9 in the schematic design report for the location of soil and water sampling points downstream of the existing landfill. Appendix C-2 of the Schematic Design Report provides the soil and water anaylsis for MSW-1 and MSW-2 sampling. Based on the soil and water analysis negative impacts from the new landfill are not anticipated.

   See AMEC response for additional information.

B. *To be addressed by AMEC.*

C. *To be addressed by AMEC.*

XXV. Permafrost aggregation

Permafrost aggregation is not a relied upon mechanism to physically contain the waste. The berm will accomplish this with or without the permafrost, however it is expected that permafrost will invade the berm over time.

Permafrost aggregation will limit seepage. Some limited seepage is expected into the contaminant attenuation zone between the landfill and downgradient stream. The contaminant attenuation zone is roughly the size of the landfill footprint, which provides approximately 1:1 attenuation by dilution capability.

Wetland Treatment Model

- The application of a modified Alberta wetland model has been used in the NWT and Nunavut in the past, and has apparently been accepted as a method for determining wetland size and evaluating potential impacts. Many communities in Nunavut rely on such a system for sewage lagoon discharge treatment. Perhaps the NWB can provide an outline of their requirements of how the model should be applied and what types of field data is required to support a design based on such a model

- In the case of the modified Alberta wetland model, it is difficult to provide field data demonstrating how the model will work in 20 years with a much larger flow than is occurring today. The best that can be done is to extrapolate from current conditions and assume the slow incremental change to the amount of discharge will result in the slow incremental development of the wetland treatment system provided there is sufficient land area and flow path length

- Annual monitoring should provide ample warning of an impending failure of the system allowing for engineered action

- As discussed in previous sections, Nuna Burnside has used the modified Alberta wetland model as a basis for assessment, but also used significantly lower targets for impact assessment than those currently set by the NWB. These much more stringent criteria (anticipated future criteria) result in significant conservative estimation being built into the design.

Berm Construction

- Sewage lagoon, water reservoir, and landfill berms in Nunavut often rely on using local native materials for construction and the reaggragation of permafrost into the berm as part of its design. Perhaps the NWB can provide or "pre-approve" basic berm designs, and outline what site specific information is required for them to be approved by the NWB. If the proponent is aware of the needs of the NWB early on in the project, it would save all involved a lot of effort.

In summary, we appreciate the detail and effort the NWB has put into the review of the application and supporting documents. The end result of the review and the addressing of the issues will result in better infrastructure for the Hamlet of Kugluktuk, which is the goal of all parties concerned.

We hope to quickly and effectively address the issues raised by the NWB, so the application can be approved and work progress. As discussed, we would like to find a

more effective way to streamline the process, and save costs and time of the Consultant, Hamlet and GN. To achieve this consultants, Hamlet, and GN request, more detailed information from the NWB outlining what is required for a submission, including expected design details, wetland treatment system details, and perhaps examples of what the NWB has approved that meets their current expectations.

4.0 Recommended Next Step

We recommend a teleconference with the NWB, GN, and Nuna Burnside, to go over these points. Following the discussions, we recommend that the Detailed Design report be revised and resubmitted. This way, the NWB, GN, and Hamlet will have a single complete document that meets the needs of all parties.

Again, thank you for your comments and we look forward to resolving the outstanding issues on behalf of the Hamlet of Kugluktuk.

Yours truly,

Nuna Burnside Engineering and Environmental Ltd.

Gerry Popowich, P.Eng.
Project Manager

Any leachate seepage from the landfill in the seasonally active layer will be attenuated by natural processes in the soil, and by dilution from infiltration of precipitation in the contaminant attenuation zone downgradient of the landfill. This will ensure the leachate is attenuated well before it reaches a sensitive receptor, such as the stream draining the sewage lagoon area. No impacts were noted on the shallow groundwater downgradient of the landfill in 2005.

XXVI. Geomembrane to be Included in the Design

A. See detailed drawings from the tender document.

B. Liner details and requirements are shown on the construction drawings and described in the construction specifications that are included in the tender documents. The contractor is responsible for delivering the completed product to specification. Care must be taken during the operational life to protect the liner from damage.

XXVII. Lined Containment

A. The only lined containment areas on the site are:

- Hazardous waste area
- Landfarm area.

The sewage lagoon only has a liner on the inside of the berms.

B. With the exception of the two lined containments noted above, permafrost aggregation is only relied upon for partial containment. Limited seepage from the landfill is expected, as discussed in previous sections. The seepage will be attenuated in the area between the landfill and the stream discharging from the lagoon.

XXVIII See XX11 response

XXIX The detail design report will be reorganized into more easily readable format.

3.0 Summary

After a review of the NWB comments, we make the following comments:

NWB Review Policy

- It would be extremely helpful to all involved if there were detailed guidelines outlining the submission requirements, and examples of previous submissions the NWB found acceptable, posted on the NWB web site.

- It would be helpful to all concerned if the NWB had published guidelines and templates outlining their requirements, as to the detail of supporting studies and documents, especially when it relates to such common practices as:

  - Use of a modified Alberta wetland model for sewage discharge treatment
  - Engineered soil berms
  - Calculations of water requirements, sewage volume, and solid waste generation for Nunavut communities

- These are standard items that are conducted for most communities. It would be effective for all parties (GN, NWB, Hamlet, and consultants) if there was a standard method acceptable to the NWB that would be applied for all communities in Nunavut with only site specific alteration required

- Perhaps the NWB could review draft applications at the Schematic Design stage to avoid the costly and time consuming revisiting of issues, for more detail and resulting redesign that occurs when the review is conducted after detailed design

- Nuna Burnside would like clarification of their role of the NWB is taking on this project and future projects with the change to their license application process. It appears the NWB is no longer a regulatory body, which in most cases focuses on the result and impacts of the system, rather than the systems themselves. Perhaps the NWB can issue an outline of what items and to what degree its review will involve, so a proponent can submit documents better prepared to meet NWB requirements.

- We have based our work on good engineering practices and experience with previous projects approved in other jurisdictions. We have also had the benefit of the advice of Mr. Jim Wall, who worked for the NWB for several years previous to the start of this project in 2005. He indicates that previous submissions have not received this detail of engineering scrutiny.

Wetland Treatment Model

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