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Technical Review Memorandum

TO Richard Dwyer
Licensing Administrator, Nunavut Water Board
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FROM David Abernethy
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Nunavut Regional Office

SUBJECT Water License #3BM-ARC0810, Hamlet of Arctic Bay, Qikiqtani
Region, Amendment Application

DESCRIPTION

The Government of Nunavut's Department of Community and Government Services (GB-CGS) submitted an amendment application for the above-mentioned water license to the Nunavut Water Board (NWB) on April 30, 2008. This application is for the construction of a new sewage lagoon and the decommissioning of the existing sewage lagoon in the Hamlet of Arctic Bay. The application, including supporting documentation, was subsequently distributed by the NWB to interested parties for review on July 30, 2008.

Trow Associates Inc. (Trow) was retained by the GN-CGS to undertake an Engineering Study to support the decommissioning of a sewage lagoon cell and complete a detailed planning design for the construction of a new sewage treatment facility. Naviq Consulting Inc. (NCI) was retained by Trow to provide permafrost engineering and geothermal analysis with respect to the design of the new sewage lagoon.

COMMENTS / RECOMMENDATIONS

The following comments / recommendations are provided to the NWB for consideration in the approval of the submitted license amendment application.

1. Proposed Sewage Treatment Facility

A new sewage treatment facility that includes the construction of a lagoon and utilization of a natural wetland has been proposed by the GN-CGS. The predicted effluent quality from this treatment facility, including the sewage lagoon and treatment wetland, is estimated to have a BOD₅ of 18 mg/L, a TSS of 22 mg/L, and faecal coliforms of less than 100,000. The new sewage

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lagoon will be constructed in a valley approximately three (3) kilometers northeast of the community and will require the construction of a new gravel access road from the existing sewage lagoon.

The new sewage lagoon will have a twenty year design life and hold sewage for 335 days (approximately 11 months). Page 18 of Trow's April 2008 *Design Brief for the New Sewage Lagoon for the Hamlet of Arctic Bay* states that the total storage requirement for sewage is 51,360 m³. This lagoon will have a surface area of 31,500 m² and will include two lined berms to the north and south. The lagoon has been designed to accommodate 11,700 m³ of direct precipitation as well as runoff from the surrounding land that drains into the lagoon. Therefore the total capacity required for the lagoon is 63,060 m³.

It is proposed that the treated sewage effluent be decanted into a natural treatment wetland that drains into Victor Bay. The decant will occur over a 30 day period from between mid to late August to mid to late September. This natural wetland comprises a total area of 11.2 hectares. Victor Bay is a marine environment located approximately 700 m away from the proposed lagoon.

a. New Sewage Lagoon

- **Effluent Discharge Criteria**

- Page 25 of the Design Brief provides effluent quality predictions from the proposed lagoon. Effluent from the lagoon is predicted to achieve:
 - BOD₅: 97 mg/L;
 - Total suspended solids: 116*-172** mg/L (* Based solely on reductions from sedimentation, ** Includes removal of colloidal fraction of TSS through bio-chemical oxidation); and,
 - Faecal coliforms: 1 x 10⁶ / 100 ml.

Part D, Item 3 of the existing water license provides effluent discharge requirements for the "final discharge point." These are,

- BOD₅: 100 mg/L;
- Total suspended solids: 120 mg/L;
- Faecal coliforms: 1 x 10⁶ CFU / 100 mL;
- Oil and grease: no visible sheen; and,
- pH: between 6 and 9.

According to page 8 of the license, the final discharge point is defined as "in respect of an effluent means an identifiable discharge

point of a facility beyond which the operator of a facility no longer exercises control over the quality of the effluent." The proponent and the NWB should definitively state where the final discharge point is located. The reason for this is to determine compliance with the monitoring and final discharge requirements. For instance, is it the location of decant or after wetland treatment prior to entering the receiving environment? At any rate, the proponent should be required to monitor both locations. This would allow the operator to monitor the effectiveness of the wetland treatment as well as compliance with effluent criteria.

It is noted that the predicted effluent quality exceeds the TSS criteria presently stated in the existing license. Thus, another reason to definitively state the final discharge point. INAC would not recommend approval of any amendment where the predicted criteria exceed the stated license requirements.

- **Installation of Liner in the Lagoon's Berms and Valley Sides**
 - Page 16 of the Design Brief states that the northwest and southwest berms will be constructed with liners on their upstream slopes and that liners will be installed along each side of the valley forming the lagoon. These liners will be keyed into permafrost or sound rock. The GN-CGS should provide greater detail on the installation of these impermeable liners. The type of liner (e.g., HDPE material) should be stated as well as how the liners will be incorporated into the cell to prevent seepage. In addition, a discussion on what quality assurance / quality control measures that will be applied during their installation should be provided. Furthermore, design drawings and as-built plans and drawings required under Part E, Items 2 and 3 should be submitted to the NWB and INAC Field Operations upon completion of the project.
- **Effluent Monitoring**
 - Page 26 of the Design Brief proposes that the quality of effluent released from the lagoon be sampled once at the beginning of decant and once at the end of decant. It is recommended that an additional sample be taken mid-way through decant at all effluent locations (decant, wetland discharge to receiving environment, etc.) to ensure the effluent meets license requirements and to monitor the lagoon's treatment performance more effectively.

- **Spillway Design**

- Page 26 of the Design Brief makes reference to two (2) spillways in the lagoon berms however these are not noted in the submitted drawings. The GN-CGS should explain why spillway will not be constructed as a geotechnical/geothermal protection measure.

b. Natural Treatment Wetland Area

- **Retention Time**

- The retention time for treated sewage effluent released into the natural treatment wetland area cannot be determined from Trow's April 2008 *Vegetated Filter Strip Wetland Assessment, Hamlet of Arctic Bay, Nunavut*. This information should be made known. According to the Alberta Environment March 2000 *Guidelines for the Approval and Design of Natural and Constructed Treatment Wetlands for Water Quality Improvements*, referenced in this report, the minimum hydraulic retention time in a natural wetland is 14-20 days (refer to page 6-2).

c. Operations and Maintenance Manual

- **Submission of an Operations and Maintenance Manual**

- Page 5 of water license #3BM-ARC0810 (issued March 17, 2008) requires the Licensee to submit an updated *Operations and Maintenance Manual* in its license amendment application prior to constructing a new sewage lagoon. A copy of this manual could not be found in the submitted application. Therefore, INAC recommends that the GN-CGS provide an updated *Operations and Maintenance Manual* in accordance with the water license requirements.

- **Monitoring Program Station Numbers**

- A diagram that references Monitoring Program Station Numbers provided in Part H, Item 1 of the existing license must be included in an updated *Operations and Maintenance Manual*. And should be appended to the license.

- **Monitoring of Berm Thermal and Seepage Performance**

- The updated *Operations and Maintenance Manual* should describe the use and location (drawing) of thermistor cables and vertical slotted standpipes within the lagoon berms for monitoring temperature and effluent seepage. The use of these monitoring methods is discussed in NCI's April 2008 *Geothermal Analysis of Proposed Sewage Lagoon, Arctic Bay*, Trow's April 2008 *Design Brief for the New Sewage Lagoon for the Hamlet of Arctic Bay*, and Trow's January 15, 2008 Design Drawing No. OTCD00019154A-L1.

- **Acute Toxicity Testing Requirements at the Natural Treatment Wetland Area's Final Discharge Point**

- These sampling requirements referenced in Part D, Item 6 in the water license should be stated in the updated *Operations and Maintenance Manual*. The Licensee is required to demonstrate that effluent discharged from the natural treatment wetland area's final discharge point is not acutely toxic. Reference to this license requirement could not be located in the submitted application.

- **Sludge monitoring and removal procedures**

- Sludge monitoring and removal procedures should also be described in the updated *Operations and Maintenance Manual*. Page 20 of the Design Brief states that effluent quality will guide when the sludge management program is implemented and that sludge will be disposed of in a separate cell constructed at the landfill site when removed from the lagoon. Additional sludge monitoring should include measuring the depth of sludge at least on a yearly basis to monitor lagoon capacity as it relates to treatment capability. This information should be provided in the annual report.
- The GN-CGS should ensure that its updated *Operations and Maintenance Manual* describes, at a minimum, the effluent quality/sludge depth that will determine when sludge removal is required, sludge sampling/analysis procedures, predicted drying time, and the sludge will be transported to the landfill site.

2. Decommissioning of Existing Sewage Lagoon

a. As-built Plans and Drawings

- The GN-CGS should provide an applicable plan, complete with drawings (final) for the decommissioning of the existing sewage lagoon as required by Part E, Item 3 of the license.

Should you have any questions regarding the comments / recommendation provided, please contact me at (867) 975-4555 or AbernethyD@inac-ainc.gc.ca.

Regards,
David W. Abernethy

Cc. Kevin Buck, Manager of Water Resources
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