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Building Nunavut Together
Nunavuliuqatigiingniq
Bâtir le Nunavut ensemble

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Department of Community and Government Services
Nunalingni Kavamatkunnilu Pivikhaqautikkut
Ministère des Services Communautaires et gouvernementaux

Kugaaruk Water Licence: 3BM-PEL 0712 — Annual Report 2010

May 08, 2014

Nunavut Water Board, P.O. Box 119
Gjoa Haven, NU X0B 1L0

Attention: Phyllis Beaulieu, Manager of Licensing

RE: Annual Report 2010: Hamlet of Kugaaruk Water Licence: 3BM-PEL-0712

Dear Ms. Phyllis,

The Hamlet of Kugaaruk is pleased to submit to Nunavut Water Board this attached file containing Annual Report 2010 of water uses and waste disposal as requested and directed under the compliance of Water Licence 3BM-PEL 0712.

We realize that this report is submitting currently in a later date from original obligation, however, it is in compliance with outstanding items as notified by the Board and regulatory agencies. We summarize those conditions and requirements outlined in Part B through Part H in Water Licence as below:

- ✓ Tabular form of water consumption and sewage disposal are filled up from Hamlet Fluid Manager recorded from daily water distribution and sewage disposal.
- ✓ No device Meter available for volume measurement, however, truck-fill measurement shows precise and close to accurate in measuring quantities.
- ✓ All water obtained from the Kugajuk River as the approved source.
- ✓ All sewage and solid waste disposal carried into the Sewage Lagoon and Solid Waste facilities.
- ✓ O&M manuals of Sewage and Solid waste are active, however, new O&M manual for Water System will be updated once the new Intake pump house and Treatment Plant starts operation.

We hope that Nunavut Water Board will find this report valuable in consideration of the Amendment Application submitted to the Board in Dec 2013.

Sincerely,

Shah Alam, P. Eng.
Municipal Planning Engineer,
Community and Government Services, Cambridge Bay, Nu
Phone: 867-983-4156, fax: 867-983-4124
salam@gov.nu.ca<mailto:salam@gov.nu.ca>

ANNUAL REPORT

YEAR BEING REPORTED: 2010

The following information is compiled pursuant to the requirements of Part B, Item 1 of Water Licence 3BM-PEL-0712 issued to the Hamlet of Kugaaruk.

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i) - iii) tabular summaries of all data generated under the "Monitoring Program"; monthly and annual quantities in cubic metres of freshwater obtained from all sources; monthly and annual quantities in cubic metres of each and all wastes discharged;

Attached are quantities of water used as reported in our On Tap Water Delivery System and the estimated discharge of sewage waste based on quantities used.

Month Reported	Quantity of Water Obtained from all sources (Litres)	Quantity of Sewage Waste Discharged
January	2,185,420.50	Same
February	2,125,386.60	Same
March	2,285,365.60	Same
April	2,265,246.70	Same
May	2,287,432.30	Same
June	2,188,617.80	Same
July	2,302,856.50	Same
August	2,425,856.80	Same
September	2,378,682.60	Same
October	2,324,742.40	Same
November	2,312,415.60	Same
December	2,134,265.40	Same
ANNUAL TOTAL	**27,216,288.80**	

iv. a summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and facilities;

- *New Generator set for water intake, and changes in water intake point at river bed for reduction of turbidity and salt amount in intake. Installation of new Gen set ensured the operation in full load (10-24 hours/day) and reduced additional maintenance cost.*
- *Improved sewage lagoon in place of existing lagoon with control decanting into a secondary cell for remediation of contamination. Raw sewage collects from house tank through vacuum truck and dispose to sewage lagoon using two discharge chutes. Capacity of rectangular new lagoon about 46,000 m3.*
- *Soil remediation Land Farm facility splash pad for pumping water to agitated soil with HC contamination and sampling water from Monitoring Wells.*

v. a list of unauthorized discharges and summary of follow-up action taken;

- *No unauthorized discharge carried anytime during this period*

vi. a summary of any **abandonment and restoration** work completed during the year and an outline of any work anticipated for the next year;

- *Not an actual abandonment but restoration of existing lagoon and its access road improvement completed to the new lagoon with earthen-granular berm and control discharge to the secondary cell when necessary.*

- *Plan for change of intake screen and place at least 1.5m above river bed and adjust the location for a clearance of 3.5 m from regular water surface; thus help in control of salt and turbidity intake.*

vii. a summary of any studies requested by the Board that relate to waste disposal, water use or reclamation, and a brief description of any future studies planned;

- *A follow up Geotechnical Safety review for the sewage lagoon dam conducted by AMEC and reported on Nov 24, 2010. This follow up review on the previously completed Geotechnical Investigations for the Sewage Lagoon carried in 2005 also by AMEC. As suggested by the investigation, plan for future to keep dyke temperature ranging -1^{0}C to -5^{0}C during the operation period.*
- *Method of sludge sampling and sludge management from sewage lagoon requested (NWB letter Feb 22, 2010) by the Board is under the future plan.*

viii. any other details on water use or waste disposal requested by the Board by November 1st of the year being reported; and

- *Spill Contingency Plan was approved by the Board on January 22, 2010, but requested addendum for some items such as: Potential Impacts of spills (antifreeze), procedure for restoring affected areas, effluent discharge frequency & lagoon's capacity and containment.*

ix updates or revisions to the approved Operation and Maintenance Plans.

- *Operation and maintenance plan for solid waste and sewage facility approved by the Board (Feb 22-23, 2010) with an addendum request.*
- *QA/QC plan for water, sewage and solid waste submitted and approved*

The Licensee noted that those approved O&M plans remains functional and addendum clarification was updated with the Board.

ADDITIONAL INFORMATION THAT THE LICENSEE DEEMS USEFUL:

- Semi engineered wetland for sewage effluent remediation working effectively.
- No evidence or sign of leak or crack across lagoon berm, dam or approach road. Request for geotechnical inspection follow up as per recommendation by the consultant (AMEC) and sludge blanket thickness measurement in 5-years from starts operation.
- There is no mechanical or digital system for water supply measurement, but truck-fill supply from Fluid Manger Data ensures the quantity of distribution.

FOLLOW-UP REGARDING INSPECTION/COMPLIANCE CONCERNS:

- New Intake pump house and Water Treatment System are in Capital Plan. The new Intake pump house and Treatment Plant will include a 3-phase power line and Gen set as back-up.
- A secondary source of water supply in plan in the case of emergency situation and temporary when salt intrusion to river water.
- TetraTech (consultant) collected soil samples from monitoring location LF1 through LF6 and tested for BTEX values in compliance with CCME Guidelines 2004 and 2006 revised. Observation noted reduction values in F1 through F4 Petroleum HC concentration with some exceptional fraction, suggested for continue the agitation, water wash and sample tests as designed for.

24 November 2010
YX00828

Dillon Consulting Limited
P.O. Box 1409,
4920 47th Street
Yellowknife, NT X1A 2P1

Attention: Mr. Gary Strong, P.Eng., Partner

Dear Mr. Strong:

Re: Dam Safety Review for the Kugaaruk Sewage Lagoon, Kugaaruk, NU

At the request of Mr. Gary Strong, on behalf of Dillon Consulting Limited (DCL), AMEC Earth and Environmental (AMEC), a division of AMEC Americas Limited conducted a geotechnical safety review for the sewage lagoon dam located in community of Kugaaruk, NU. Geotechnical investigations for the sewage lagoon were carried out by AMEC in 2005, the lagoon and dam design was completed by DCL in 2006, and construction of the sewage lagoon commenced in 2007 and was completed in 2008.

Authorization to proceed with the dam safety investigation was provided via a signed Dillon Short Form Agreement for Sub-Consultant Service, dated August 9, 2010 for the above noted project.

1.0 SCOPE OF WORK

In accordance with AMEC's proposal, dated July 30, 2009 and subsequent discussions with DCL, the scope of work outlined for the project is as follows:

- Conduct a review of design drawings and relevant normative documents.
- Perform the site reconnaissance and interview dam operating personnel,
- Review operational plans and operational records.
- Prepare a geotechnical report which presents results of the reviews and field reconnaissance.

2.0 EXISTING INFORMATION

The following is a review of the AMEC geotechnical report, DCL's design record drawings, AMEC construction monitoring report which pertains to lagoon dam design and construction and the Nunavut Water Board (NWB) Licence document. The AMEC reports can be found in

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Appendix A, the DCL record drawings are included in Appendix B and the NWB licence document is in Appendix C.

Report Titled "Geotechnical Investigation for Sewage Lagoon, Kugaaruk, NU" dated October 31, 2005, submitted to DCL by AMEC.

The original scope for the geotechnical investigation included a field reconnaissance visit, a drilling program consisting of 6 to 10 boreholes, interpretation of aerial photographs, and numerical modeling of the dam operational temperatures throughout the life cycle of the facility. Following the site reconnaissance visit and discussions with DCL, the drilling program and aerial photograph interpretation phases of the project were not undertaken due to sufficient information being obtained from the site reconnaissance and geothermal modeling.

Based on the site reconnaissance, it was concluded that the lagoon site is covered with an organic mat, 50 mm to 100 mm thick. Poorly drained, saturated, fine grained marine deposits, consisting of sand and silt with gravel and inclusions of cobbles and boulders, were found below the organic mat. It was calculated that the mean annual permafrost temperature at the site could be in a range of -10 ^{o}C to -11 ^{o}C at a depth of about 15 m below the ground surface. The thickness of the active layer was assessed to be in the order 0.7 m to 1.0 m.

Three design approaches for dam construction were discussed in the report. The first approach considered construction of the dam with a liner, whereby a suitable synthetic liner would be installed in a near vertical position to an assumed elevation of 98.5 m (1.5 m below the existing ground surface), in a cut-off trench near the upstream slope. The cut-off trench with liner was recommended to be backfilled with either compacted clayey soil or with grout. The liner curtain above the cut-off trench then extended vertically to the top of the dam, or alternatively followed the upstream slope of the dam.

The second potential approach considered construction of a frozen core dam with a 50 mm thick insulation layer placed at a shallow depth over the crest of the dam. The intent of the insulation was to reduce seasonal thawing at the dam crest, which could potentially lead to percolation of effluent through the dam. Geothermal analyses were carried out for the first and second approaches to confirm that the considered design options were suitable to provide low permafrost temperatures within the dam, and shallow thaw depths within the lagoon impoundment area.

The third approach considered repairing of the existing dam. It was recommended to re-design the dam with a frozen core. The report recommended removal of any loose material and backfilling of any erosion features, the dam would then have been raised to the design elevation in 250 mm (compacted) lifts. Similar to the second approach, placement of a 50 mm thick insulation layer was recommended along the dam crest.

The first design approach, with cut-off trench and liner, was adopted for the dam. The geometry for the cut-off trench and liner was modified somewhat from that outlined in the geotechnical

report. Also, since clayey backfill was not available at the site, geothermal calculations were undertaken to assess the potential to use sand backfill to install the liner. The geothermal calculations demonstrated that if sand backfill was used to install the liner, it would freeze subsequent to being compacted in place, and would remain in a frozen condition given the expected subsurface soil and thermal conditions with the lagoon in operation. Accordingly, sand backfill compacted and then frozen in place was adopted in the liner design to replace compacted clayey soil backfill in the cut-off trench.

Drawings Titled "Sewage & Solid Waste Sites – Record Drawings, Kugaaruk, NU" dated December, 2009, submitted to the Government of Nunavut by DCL.

Seven record drawings were reviewed as part of the geotechnical dam safety review. The drawings show as-built design details of the lagoon dam, manhole, spillway, drainage pipe, and other details associated with the facility.

Drawings No. 100 and 101, Titled "Lagoon Site" and "Design Lagoon Site View:"
The drawings display plan and profile views of the constructed lagoon with elevation contours. The lagoon impoundment is generally shaped like a bowl with the unloading area on the southeast slope of the lagoon, and the drainage outfall located in the northwest lagoon berm. The dam generally slopes at 2.5H:1V along the interior and exterior slopes. The drawing shows the unloading half-culverts, emergency overflow weir, lagoon drainage outfall, and manhole. The profiles show ground elevations starting from the ocean shore and ending at the truck turnaround pad.

Drawing No. 102, Titled "Lagoon Sections":
The Drawing displays a series of topographic profiles, provides data on invert elevations of the lagoon along various cross sections and presents a large scale profile of the turnaround pad. The topographic profiles for the lagoon are spaced approximately at 10 m intervals.

Drawing No. 103, Titled "Wetland Sections":
The drawing displays a plan view with drainage paths for the wetland area north from the lower pond. A series of the topographic profiles shows ground elevations across the wetland area at 20 m intervals extending from the lower pond.

Drawing No. 200, Titled "Discharge and Overflow Flume and Landfill Fence Details":
The first through fourth sections on the drawing show design details for the discharge flume. A profile view of the discharge flume indicates two flumes, made from high density polyethylene (HDPE) pipe shells, directed across the slope from the crest of the truck turnaround pad to nearly the bottom of the lagoon. The third and fourth sections show design details for pressure treated timbers used to support the discharge flume on the slope, and security bollards along the truck turnaround pad. The fifth through eighth sections show design details for the emergency overflow weir. It was understood that location of the liner near the emergency overflow weir follows the exterior slope of the dam down to the exterior slope toe.

Drawing No. 201, Titled "Berm Sections and Details":
The drawing displays details of the dam design for various soil conditions, including the portion of the dam encompassing the existing dam and the dam abutment to the native rock outcrop. Two sections on the drawing (fourth and fifth) show design details for placement of the liner for typical sections of the dam. The last two sections on the drawing provide design details for the lagoon drainage outfall pipe. It was understood that the liner in the vicinity of the lagoon drainage outfall pipe was placed over the internal slope of the dam.

Drawing No. 202, Titled "Manhole Derail":
The drawing illustrates manhole details, including water supply plan, hatch and lid framing, and access section.

Report Titled "Sewage Lagoon Cut-off Trench Construction Monitoring, Kugaaruk, NU" dated October 31, 2007, submitted to DCL by AMEC.

The Construction monitoring program included inspection of the cut-off trench excavation and monitoring backfilling/compaction activities during construction. The scope of work consisted primarily of the following duties:

- confirm that the cut-off trench was not less than 2 m deep;
- confirm that the cut-off trench was constructed in hard frozen soil/bedrock with a practical absence of visible ice;
- compile a record of soil composition and the ice content of the excavated soil along the cut-off trench.
- inspect engineered fill quality, including such fill parameters as gradation, moisture content, frozen/unfrozen state and inclusions of cobbles or boulders.
- review the compatibility of the lift thickness to the capacity of available compaction equipment, where necessary;
- test the compaction for each lift, using a nuclear dosimeter or other appropriate tests, and;
- record all geotechnical activities on the site, and direct that remedial measures be implemented where these activities are not in compliance with to the earth work specifications.

With the exception of the toe of the sewage lagoon berm, practically the entire cut-off trench is situated atop granite gneiss that is weathered, jointed, and foliated extensively. The lines of intersection of these discontinuities have created numerous large rock wedges that have been dislodged to some extent by repeated freeze-thaw cycles. The individual intact pieces of granite gneiss appeared to be extremely strong with little to no visible weathering observed.

Excavation of the cut-off trench was performed by Kudlik Construction Ltd. (Kudlik) by means of drilling and blasting with dynamite, which was necessary to excavate into the competent granite in which most of the cut-off trench was constructed. The drilling was done using an air rotary track mounted drill rig and diesel compressor.

The base of the excavated cut-off trench was at least 1 m wide, as specified in the design, throughout all of the excavated segments. After the cut-off trench was excavated and cleared of debris, approximately 200 mm to 300 mm of sand fill was placed along the trench bottom and side slopes to prevent the liner from tearing on the sharp faces/edges of the blasted bedrock. The side slopes were packed and smoothed by the bucket of the back-hoe and the trench bottom was packed with a plate tamper. The liner was lowered into place, and the trench was then backfilled with a sand and gravel fill in approximate 250 mm to 300 mm thick lifts compacted to minimum 95 percent of the standard Proctor maximum dry density (SPMDD).

The liner used during construction was a Bentofix Thermal Lock Geosynthetic Clay Liner. The compaction equipment used on site consisted of a Hatz Supra diesel plate tamper and CAT CS553 vibratory smooth drum roller (packer).

The on-site geotechnical activities that were not compliant with either the earth work specifications or the original design for the sewage lagoon are as follows:

- The manhole access and joining pipeline were relocated approximately 19 m to the east of the original location because the proposed top of the manhole access would have been significantly lower than the proposed top of the berm at the original location. It is understood that this decision to move the manhole was made between Kudlik and DCL personnel during construction.
- On September 7th, 2007, a hydraulic hose in the packer broke and the smooth drum was not able to vibrate for the duration of the construction for the year. In response to this, backfilling was done in thinner lifts, and packed with the packer, the diesel plate tamper, and also by trucks and bulldozers on occasion. Visual inspection as well as densometer testing confirmed that the compacted material met the 95% SPMDD requirement.
- In the summer of 2007, only a portion of the cut-off trench had been completed. The north segment of the cut-off trench had been successfully excavated, lined, and backfilled with sand fill to between approximately 23.6 m and 28 m, geodetic. The west segment of the cut-off trench was excavated to approximately Sta 0+100, but backfilling had only been completed approximately to Sta 0+005, to an approximate elevation of 24 m, geodetic. The remainder of the trench segment had been left exposed, to be completed the following spring. The east segment of cut-off trench had been completely excavated, but only backfilled and compacted to approximately Sta 0+020, with the remaining portion of the east segment left to be completed in the spring of 2008.

Based on the monitoring results, AMEC concluded that the cut-off trench was excavated into the hard frozen soils to depths specified in DCL design drawings. It is anticipated that the trenches will perform as designed, provided that the soils surrounding cut-off trench remain in a frozen state.

Report Titled "Licence Number: 3BM – PEL0712, Kugaaruk, NU" dated signed September 7, 2007, submitted to the Hamlet of Kugaaruk by Nunavut Water Board.

The licence document provides comprehensive information in regards to the potable water distribution system and sewage water facilities, including any required modifications, construction and/or repair, abandonment/remediation and a monitoring program. It was understood that the hamlet should submit to the Nunavut Water Board the following documents related to the potable water system and sewage water facilities.

- Water Distribution Facility Operation and Maintenance Plan;
- Sewage Treatment Facility Operation and Maintenance Plan;
- Solid Waste Facility Operation and Maintenance Plan;
- Environmental Emergency Contingency Plan for Water, Sewage and Solid Waste Operations in the Hamlet of Kugaaruk, Nunavut; and
- Monitoring Program Quality Assurance/Quality Control Plan

3.0 FIELD RECONNAISSANCE

The field inspection of the dam was carried out by Dr. Alexandre Tchekhovski, P. Eng. with AMEC, from September 13th through to September 16th, 2010. During the inspection, detailed visual observations were completed related to the dam slope stability, seepage, integrity of the discharge flume, integrity of the lagoon drainage outfall pipe, manhole, and emergency overflow weir. Two meetings were also held with the community public works foreman.

During the inspection, detailed visual observations were performed on the dam slopes to assess the dam stability and seepage. Other observations were also made in regards to the integrity of the discharge flume, lagoon drainage outfall pipe, manhole and emergency overflow weir.

The lagoon dimensions from berm crest to berm crest are approximately 130 m by 110 m. The long axis of the lagoon is oriented in a SE-NW direction. A general view of the lagoon and berms is shown at Photograph 1, Appendix C. The effluent level in the lagoon during the site visit was approximately 3.5 m below the dam crest. However, it can be seen in Photograph 2, Appendix C, that in the past the effluent level has been considerably higher – extending to approximately 2 m below the dam crest.

3.1 Seepage and Slope Stability

During the first day of the site visit (September 13, 2010), the exterior slopes of the dam were inspected for signs of seepage. All of the exterior slopes were found to be dry with no indications of any current seepage. Also there was no evidence of seepage that may have occurred in the past, when the effluent level in the lagoon was considerably higher.

The southeast slope of the lagoon consists of an undisturbed bedrock outcrop (Photograph 3, Appendix C) with a riprap blanket constructed to support the discharge flume culverts. The slope of the riprap blanket is about 2.5H:1V, and the length of the slope is approximately 9 m. The riprap blanket consists of (blast) rock fragments ranging in size from about 200 mm to 400 mm. There was no indication of problems within the natural slope, such as erosion features, slumps, or rock falls within the riprap blanket.

The effluent level along the northeast, northwest and southwest slopes of the dam was about 3.5 m below the dam crest. A general view of the internal slopes is provided in Photograph 2 and Photograph 4 through to Photograph 7, Appendix C. The internal slopes were found to be stable, consisting of rock fragments, up to 500 mm in size. The angle of the internal slopes was approximately 2.5H:1V, i.e. in a close agreement with the record drawings (Appendix B).

Depending on the topography of the surrounding natural terrain, the external slopes of the dam varied in height from about 1 m (central portion of the southwest slope, Photograph 8, appendix C), to about 10 m (central portion of the northwest slope, Photograph 9, Appendix C). Construction of the external slope was not required along the majority of the northeast slope, where the dam abuts with a relatively steep native rock outcrop (Photograph 10, Appendix C). Similar to the internal slopes, the external slopes were found to be stable with no indications of any erosion, moisture, slumps or rock falls. The angle of the external slopes was also about 2.5H:1V, i.e. in a close agreement with the record drawings (Appendix B).

The crest of the dam was about 4.5 m to 5 m wide, and was surfaced with fine crushed gravel and sand. No depressions, which would have indicated possible settlement or erosion, were observed on the dam crest surface (Photograph 11, Appendix C).

3.2 Drainage Fume Culvert

The fume culvert, consisting of two high density polyethylene half-pipe shells, was placed directly on the surface of the riprap blanket (internal southeast slope of the lagoon). The culvert extends from the truck turnaround pad down to an elevation approximately 0.5 m above the effluent level (Photograph 3, Appendix C). The culvert was found to be in good working condition with no visible cracks or holes along the shell invert (sliding surface).

3.3 Lagoon Drainage Outfall

The lagoon drainage outfall structure consists of a 300 mm diameter high density polyethylene (HDPE) pipe extending from the lagoon interior to a manhole which contains valves and heat tracing and finally a second section of 300 mm diameter HDPE pipe leading from the manhole to exit at the toe of the exterior slope. Short 4 m long sections of corrugated, galvanized steel culvert inserted over the upstream and downstream ends of the HDPE outfall pipe provide protection to the pipe ends. The corrugated pipe slopes down at approximately a 2 percent grade, effluent was being drained from the lagoon during the site visit (Photograph 12, Appendix C). The HDPE pipe and corrugated steel end protectors were found to be in proper working

conditions with no settlement of the slope immediately below the location where the effluent was discharging onto native ground.

The control valve manhole, located in the northwest berm external slope, was also inspected. The manhole lid had no hasp for a padlock (Photograph 13, Appendix C), and the community public works foremen noted that that the hasp was broken by unidentified persons in the spring of 2010. The manhole shaft was plumb, and no damage was observed either outside or inside of the manhole.

3.4 Emergency Overflow Weir

The emergency overflow weir is located at the crest of the northwest berm. The overflow weir consists of a ditch, approximately 0.3 m deep and 1 m wide, excavated across the crest of the northwest berm and along the external slope. The invert and slopes of the ditch are covered with riprap to reduce erosion potential (Photograph 14, Appendix C). The overflow weir was found to be dry during the site visit. It was also understood that the overflow weir has never been wet, meaning that there was no prior overflow of the lagoon to the date of the site visit. No settlement depressions or erosion features were observed along the overflow weir, meaning that the overflow weir has not impacted the overall stability of the northwest berm.

3.5 Lower or Secondary Effluent Pond

Effluent is being drained from the lagoon into the lower pond located immediately downslope from the northwest berm external slope toe. The lower pond is approximately 40 m by 30 m, and the height of the berm forming the lower lagoon is in a range from 2 m to 3 m (Photograph 15 and 16, Appendix C). DCL's record drawings do not provide design details for the lower pond, such as material used for berm construction and any liner application. Field observations have indicated that effluent is seeping under the lower pond berm from the lower pond toward the Arctic Ocean (Photograph 17, Appendix C). It appears likely that the lower pond berm has no cut-off trench, or embedded liner extending to the crest of the berm. Two posts with abbreviated signs were present on the lower pond berm. The purpose of the posts and meaning of the signs is not known (Photograph 18, Appendix C).

3.6 Meetings with Community Foreman

Two meetings were held with the community public works foreman. During the first meeting (September 14, 2010), Dr. Tchekhovski told to the foreman about the purpose of the dam safety inspection, and asked the foreman to provide the dam operation manual and operational records. The following information was obtained from the meeting:

- the community public works office does not have a copy of the lagoon operation manual;

- the senior administrative officer does not require lagoon operation records such as date used, volume and temperature of unloaded effluent, date for drainage commencing and completion and effluent levels on dates of drainage commencing and completion;

A second meeting took place on September 15, 2010, and Dr. Tchekhovski recommended that the community should obtain a copy of the sewage lagoon operation manual and maintain the records of operation activities as specified in the operation manual. A copy of the "Electrical Operation and Maintenance Manual for Heat Trace of Drainage Pipe" was the only document relating to operation of the sewage lagoon that could be found in the public works office.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The dam berms were found in very good operating condition during the site visit. No effluent seepage was identified along the three constructed sewage lagoon berms: northeast, northwest, and southwest. However, the effluent level was very low during the site visit. AMEC recommends that the next site visit by a geotechnical/permafrost engineer be undertaken in about 2 years at a time when there is a maximum effluent level in the lagoon (likely early summer). Based on the experience from the first site visit, a detail program for geotechnical inspection of the dam could be prepared by AMEC.

The hasp for the manhole lid should be replaced and the manhole lid should be kept locked. The community public works office should be provided with the sewage lagoon operation manual, including templates for records of the operation activities.

5.0 CLOSURE

This report has been prepared for the exclusive use of Dillon Consulting Limited, the Hamlet of Kugaaruk and its agents for the specific application described in this report. The use of this report by third parties is done so at the sole risk of those parties. It has been prepared in accordance with generally accepted permafrost and foundation engineering practices. No other warranty, expressed or implied, is made.

We trust this information meet your current needs. Should you have any questions, please feel free to contact the undersigned.

Respectfully submitted,

AMEC Earth & Environmental,
a division of AMEC Americas Limited

REGISTERED PROFESSIONAL ENGINEER
Nov. 24/10
D. DUMSKY
LICENSEE
NWT/NU

Dmitry Dumsky, P.Eng.
Geotechnical and Permafrost Engineer

Nov. 24, 2010

Alexandre Tchekhovski, Ph.D., P. Eng.
Associate Geotechnical and Permafrost Engineer

PERMIT TO PRACTICE
AMEC Earth & Environmental, a
Division of AMEC Americas Limited
Signature
Date November 24, 2010
PERMIT NUMBER: P 047
The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU

Reviewed by:
Kevin Spencer, M. Eng., P. Eng.,
Associate Geotechnical Engineer