September 12, 2006

Dillon Consulting Limited
P.O.Box 1409
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Attn: Mr. Gary Strong, P. Eng., Project Manager

Dear Sir:

Re: Examination of Drawings – Cape Dorset Sewage Lagoon

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC) was requested to provide comments on drawings issued for construction of the Cape Dorset sewage lagoon, dated September 7, 2006.

In light of the time constraints associated with the request from Dillon Consulting Limited, the content of this letter does not represent a formal or complete review of project drawings and specification. A review of the design in terms of Canadian Dam Safety regulations, or a "fatal-flaw" due-diligence examination also could not be completed due to the time constraint. The comments provided herein represent issues that have been identified from cursory examination of the drawings provided. It is noted that no project specifications were provided. All comments are restricted to Drawing 111 Lagoon Sections and Details.

It was stated in the geotechnical report for this project prepared by AMEC (dated OctoBer 13, 2005, page 9) that "the concept of a frozen core dyke to provide the primary containment of lagoon waters is considered to [be] technically tenuous at best...". AMEC discussed the installation a synthetic liner through the dyke and a cut-off curtain below the dyke. The bentonite liner shown on the drawings therefore represents a back-up primary containment system; it should be designed and installed to be fully competent during all stages of the project life.

The following comments are provided:

1. Section #1 shows the upstream and downstream faces of the dyke are at an angle of 1V:2.5V. The original design drawing provided to AMEC at the time of the preparation of the geotechnical report (October 2005) showed dyke slopes of 1V:2H. This revision represents conservative conditions from a slope stability perspective.
2. The bentonite liner shown in Section #1 represents a change from the synthetic liner (HDPE) represented in the original design details provided to AMEC in October 2005. AMEC is of the opinion that either liner system, of suitable design and properly installed within a stable dyke will achieve a similar level of containment.
3. Sections #1 and #2 show the crest anchoring detail for the liner. The liner is shown to wrap around the underside of a crushed rock section. The anchoring of the liner seems be

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required if the portion of the berm core downstream the liner will be construct in the first place, then the liner will be extend upwards the upstream slope (1V:1H) and, finally, the upstream portion of the berm core will be placed.

4. Sections #1 and #3 show the liner cut-off detail at the base of the dyke. The sections indicate that the cut-off trench should be backfill with the Type II granular material. The AMEC geotechnical report, dated October 13, 2006 (page 5) recommended that the excavated cut-off trench be backfilled with "compacted clayey material or grouted." The intent of this backfill is to limit seepage vertically down and under the liner within the cut-off trench.
5. Section #3 presents the base cut-off detail for the liner. It is noted that the minimum depth of embedment is 2 m. The drawings are silent on the competency of the material that the cut-off trench is excavated into. To provide direction to an engineer on the depth of embedment, it is AMEC's opinion that the cut-off liner should be placed within a zone of competent bedrock or ice-poor soil. The soil or bedrock should be such as to limit migration of water through the subgrade materials and under the base of the liner. AMEC would provide additional instructions to a field engineer/technologist on estimation of the required trench depth.
6. In Section #3 the short horizontal section of the bentonite liner is underlain and overlain by 100 mm of sand bedding. The remaining portions of the liner (that is, all vertical and sub-vertical sections) are surrounded by "berm core" material as shown on Section #1. The "berm core" material appears to be specified as Type II granular material. The current specification of Type II granular material has not been provided to AMEC for comment. With respect to placement adjacent to the liner, this material (immediately over the liner) should not contain large, irregular and sharp-edged particles that could induce deformation of the liner (into unsupported voids in the material) or puncture the liner during compaction. Better options would be: 1) placement a covering sand layer over the liner; 2) placement of a thick geotextile layer over the liner. In spite of some technical difficulties, placement of the sand layer over the liner is possible. AMEC can provide a detail specification to Dillon Consulting Limited on placement of the covering sand layer over the liner, if required.
7. It is unclear what the detail shown in Section #4 Liner Embedding Section is representing.
8. In Section #6, the design detail showing the installation of a "1.0 m long by 1000 mm diameter bentonite plug at the liner-pipe interface" actually points to a location about half way between the liner and the access manhole. AMEC suggests that the arrow should point directly to the liner. Further, the designers should satisfy themselves that a bentonite plug of 1000 mm in diameter (presumably centered on the outfall pipe centre) provides adequate protection against seepage along the path of the outfall pipe.
9. A crack in the outfall pipe represents one potential source of loss of integrity in the containment system. A crack in the outfall pipe could lead to thermal and physical erosion along the 300 mm sand bedding. In the extreme this could lead to greater loss of ground within the dyke core. It is considered that one vulnerable location, relative to cracking of the outfall pipe, is due to settlement of the access manholes. No details were provided that show how damage to the outfall pipe because of settlement of the access manhole could be reduced or mitigated. AMEC recommends the use of a flexible connection between the manhole and the outfall pipe that would withstand to potential of the manhole settlement. It would be prudent also to consider installation additional bentonite plugs, say, half way

between the liner and the manhole and half way between the manhole and the downstream slope of the berm.

10. In Section #8, the presence of a bentonite liner material underlying the emergency spillway is shown, but not labeled. The liner is labeled in Section #10. The crest anchoring detail of the bentonite liner under the emergency spillway is also shown in Section #8. It is shown to wrap under a coarse rock section. In the presently shown design, it is possible that in an emergency discharge condition, the coarse rock material could act as a conduit for water laterally (long the crest of the dyke), which could lead to other dyke integrity issues. AMEC suggests that consideration be given to eliminating the coarse rock section, as discussed in comment #3 above. The liner under the emergency spillway section could extend across the crest of the dyke, and overlap with the main vertical liner section towards the upstream side of the dyke.
11. Sections #9 and #10 presents a cross section of the emergency spillway. The sizing of the spillway has not been examined by AMEC. However, we note that the effective depth of the spillway is controlled by the height of the bentonite liner within the spillway. In this case the top of the liner is shown to be 300 mm below the top of the section; any discharge higher than this could seep laterally across the dyke face and would not be confined to the spillway.

We trust that this is sufficient for your present needs. If you have any questions, please do not hesitate to contact our office.

Yours truly,
AMEC Earth & Environmental

Sept. 12, 2006

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