BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
1605, 840 – 7 Avenue S.W. , Calgary, Alberta, Canada. T2P 3G2
Phone (403) 250-5185 Fax (403) 250-5330

PROJECT MEMORANDUM

To:	**Department of Indian and Northern Affairs**	**Fax No.:**	**Via-e-mail**
Attention:	**Mr. Carl McLean, Manager Lands Administration, Nunavut Region**	**CC:**	**Patrick Duxbury, NWB**
From:	**Holger Hartmaier (Ext. 113)**	**Date:**	**January 27, 2004**
Subject:	**Polaris Mine Closure- Response to Teck Cominco regarding storage of metals contaminated soils in LRD Quarry.**		
No. of Pages (including this page):4 Pages		**Project No:**	**0131-013-01**

Further to your e-mail of January 27, 2004 and the letter from Teck Cominco (TC) dated January 26, 2004 providing their response to BGC's comments of December 30 2004 regarding the storage of metals contaminated soils in the Little Red Dog (LRD) Quarry, I wish to respond with the following points of clarification:

Responses are numbered according to the TC letter dated January 26, 2004, from Bruce Donald, Reclamation Manager.

Item 2.2 Disposal of Metals Contaminated Soils in LRDQL

I had a look at the original report that was prepared by BGC Engineering Inc. for Gartner Lee Limited (GLL) that assessed the underground thermal regime (BGC, 2001) in order to get more background on the -4^{o} C criterion.

BGC modelled current conditions in the underground mine to predict the location of the cryopeg. The cryopeg is the boundary between frozen and unfrozen ground. In the case of Polaris, a marine cryopeg exists due to the salinity of the pore water. The salinity results in a depression of the freezing point due to the presence of dissolved solids in the water. BGC indicated that the cryopeg at Polaris was somewhere between -3.0^{o} C and -4.5^{o} C. They recommended using -3.0^{o} C as a conservative value for abandonment planning.

BGC also carried out an assessment of the long-term sensitivity of the cryopeg to global warming. The modelling indicated that there were minimal changes in the location of the -3^{o} C cryopeg due to global warming.

Based on the modelling that was done by BGC, the underground workings used for the disposal of the contaminated soils were predicted to be entirely within the -4^{o} C isotherm. The geothermal modelling of the underground mine conditions was based on in-situ measurements provided by TC. BGC (2001) recommended that…"Before final abandonment decisions are made regarding the deep permafrost regime… the 2-D analytical model… should be verified with new in-situ instruments."

The original closure plan was approved on the basis that all metals and hydrocarbon contaminated soils would be placed into selected areas of the mine so that they would be within the -4^{o} C isotherm, as outlined in the BGC Engineering Report. It is recommended that TC be requested to provide updated results of their underground temperature measurements in order to assess the validity of the geothermal model and the present thermal regime around the underground disposal areas.

I have recommended that the metals contaminated soils be placed into the LRD Quarry so that a minimum temperature of -4^{o} C is maintained to be equivalent to the disposal conditions in the approved underground disposal areas. Since the LRD Quarry was not originally intended for use as a disposal site for contaminated soils, I recommend adopting this criterion to ensure that the contaminated soils in both locations are being encapsulated under similar conditions. This rationale also makes sense from a regulatory perspective as it would be inappropriate to place contaminated soils into a surface location using criteria that are less stringent than deep underground disposal in permafrost for the same materials.

Note that TC intends on using the LRD Quarry as a contingency disposal area for hydrocarbon contaminated soils in the event that there is insufficient space underground. Therefore similar conditions must apply in setting the upper limits of disposal within the LRD Quarry.

Item 2.3 Landfill Cover Design Comments

TC should consider the use of frost gauges in addition to thermistors to monitor the aggradation of permafrost in the landfill cover. Frost tubes consist of a relatively short plastic casing that is installed into the cover to a depth below the anticipated active zone. An inner, removable tube contains and indicator solution (methylene blue), which changes colour upon freezing. This device is easily installed, easy to read and accurate to within a few centimetres. The advantage of this system is that it can precisely locate the depth below which frozen ground occurs, but doesn't provide any actual temperature measurements. TC can use the existing thermistors to provide the temperature data, but rather than decreasing the spacing of thermistors to determine the active layer thickness, TC should consider the use of frost tubes.

TC have misinterpreted my comments with regard to the cover requirements. Placing the contaminated soils below the -4^{o} C isotherm does not prevent placing additional waste above this level. The upper limit of placement of contaminated soils will restrict the volume available within the LRD Quarry for these materials, however the cover design thickness is not affected. There is nothing to prevent TC from placing inert demolition debris above this level, then covering with the designed cover as per the BGC landfill closure report (BGC, 2001).

By placing the contaminated soils into the deepest part of the LRD Quarry, I believe that all of the above requirements can be satisfied.

TC have indicated that the criterion for disposal in LRD should be based on keeping the contaminated soils at or below 0^{o} C and that the -4^{o} C criterion should not apply. This would not be consistent with the ambient conditions at the approved underground disposal site. The LRD Quarry will provide ambient conditions similar to the underground disposal site, if the recommended disposal protocols are followed.

TC have indicated in their January 20, 2004 letter that there is ample room in LRD Quarry for disposal of the remaining metals contaminated soils, as well as the contingency case for hydrocarbon contaminated soils. We therefore do not anticipate that there will be a requirement for placing contaminated soils at a depth shallower than 5 m in LRD Quarry.

Closure

Thank you for providing BGC the opportunity to respond to TC's comments regarding disposal of metals contaminated soils in LRD Quarry. I trust that our comments will satisfy your requirements at this time. If you have any questions or require additional information, please do not hesitate to contact me.

Yours truly,
Per
BGC Engineering Inc.

Original Signed by Holger Hartmaier

Holger Hartmaier, M.Eng., P.Eng.
Senior Geotechnical Engineer

References

BGC Engineering Inc. (2001), Polaris Landfill Closure Report, Project Memorandum to Gartner Lee Limited, February 9, 2001.

BGC Engineering Inc. (2001), Polaris Mine Geothermal Regime- U/G Mine and Garrow Lake, Project Memorandum to Polaris Mine Operations, Cominco, February 9 2001.

Gartner Lee Limited (2001), Polaris Mine Decommissioning and Reclamation Plan, prepared for Cominco Ltd., March 2001.

Teck Cominco (2004), Polaris Mine Request to Place Contaminated Soils in LRDQ, Letter from Bruce Donald to Patrick Duxbury, Nunavut Water Board, January 20, 2004.