November 17, 2005 EBA File: 1100060.004

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Attention: Dan Johnson

Subject: Jericho Diamond Mine
Processed Kimberlite Containment Area
Divider Dyke A

The following addresses the technical questions raised in the letter from INAC dated October 21, 2005 from Robert Eno of Indian and Northern Affairs Canada, Nunavut Regional Office, regarding the Jericho Divider Dyke Design Report. The points are addressed in the order as presented in Mr. Eno's letter.

1. The design of the dyke assumed that partial dyke construction (to elevation 521 m) would occur during the summer and fall of 2005. The current status is that the dyke rockfill and filter has been placed to approximate elevation of 518 m. The filter material has had to be placed during freezing conditions; therefore, densities have been lower than specified. The lower densities are not anticipated to result in stability concerns; however, some settlement may occur when the material thaws. The filter performance of the dyke will need to be monitored to determine its effectiveness and determine if any modifications are required.

2. The EBA divider dyke design report shows two dykes, Divider Dyke A and Divider Dyke B. Divider Dyke A is currently being constructed as described in the project plans. Divider Dyke B is for future considerations and may be required if the ore quantities exceed those originally considered.

3. The original lake bathymetry indicated the approximate water depth was about 2 m and 4 m at Divider Dykes A and B, respectively. Probe holes at the Divider Dyke B location confirmed the lakebed elevations at Divider Dyke B. Observations during construction of Divider Dyke A confirmed the lakebed elevations at Divider Dyke A. Observations during construction also determined that there was no or minimal soft sediment along the Divider Dyke A alignment.

4. The stability analysis evaluated the downstream stability with full supply level of tailings against the dyke, and the upstream stability with no tailings. These are the worst case conditions for dyke stability.

5. A copy of the NRCAN seismic study is included. A conservative seismic value was chosen for the design; however, this did not drive the design configuration.

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We trust this addresses the questions posed. Please contact the undersigned if you have any questions.

Yours truly,
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Comments from NRCan on Seismicity
(Extracted from Jericho Final EIS Review, dated 12 May 2003)

The project is in a region of very low seismicity, but two magnitude 4+ earthquake recently happened in a similar part of the shield (Magnitude 4.5 and 4.2; November 28th 2001; 64.95N 113.5W; about 140 km SW of the site). These demonstrate that all the seismic hazard does not come from distant earthquakes. Indeed events exceeding magnitude 6.5 are thought possible anywhere in the Canadian Shield, albeit rarely.

The seismic hazard calculation from PGC used to conclude that the overall impact is negligible is what the GSC calculates as being equivalent to the 1995 (and 1985) National Building Code of Canada and is based on GSC's 1982 seismic source zones. It indicates less than 2% g and 0.05 m/s for the 1/1000 year event, from Attachment 3.3. However these results are rather inappropriate (see below). A specific point is that the seismic sources used in 1982 totally neglect all earthquakes within about 400 km of the Jericho site, and so the seismic hazard is computed only from distant sources in Boothia-Ungava and the Nahanni and Mackenzie mountains. Furthermore, the Nahanni earthquakes - earthquakes far larger than any considered by the 1982 model that are relevant to the site - were not included since they happened after the calculations were finalized.

Our "4th generation" seismic hazard calculations for the 2005 edition of the National Building Code of Canada (details available on the WWW at www.seismo.nrcan.gc.ca) uses two probabilistic models that include the consequences of the Nahanni earthquakes and updates other seismicity parameters. NRCan ran a computation for the site at the 0.0001 p.a. probability level and found the hazard from these two models to be negligible.

A better representation of seismic hazard at the site considers instead the occurrence of large earthquakes in the Canadian Shield as a whole, and in worldwide shields of similar age. NRCan has concluded that:

- the maximum earthquake credible would have magnitude 6 3/4;
- current knowledge does not permit the screening out of shield areas that could have earthquakes of this size, so they should be considered as low probability events anywhere on the Canadian Shield;
- a reasonable design earthquake for the shield would be magnitude 6.0; and
- the rate of magnitude 6.0 or greater is estimated to be 0.004 p.a. per 1,000,000 square kilometres.

For the probability level of 0.001 p.a., the M6 earthquake could be expected to occur within an area of 250,000 km*km, equivalent to a circle of radius 280 km about the site. For the probability level of 0.0001 p.a., the earthquake could be expected to occur within an area of 25,000 km*km, equivalent to a circle of radius 90 km about the site. Thus by this analysis, the mine should cope with a magnitude 6 earthquake at a distance of 280 km (estimated Peak Ground Acceleration of about 1% g and PGV of 0.004 m/s, on a rock site) or possibly 90 km (Peak Ground Acceleration of about 5% g and PGV of 0.01 m/s, on a rock site). For comparison, NRCan computed the largest Nahanni earthquake (M6.9 at about 600 km distance) might have produced a little less than 0.3% g.

NRCan has incorporated a comparable probabilistic analysis into our NBCC 2005 work as a third model representing the shield earthquakes. The probabilistic hazard values for NBCC will be 6% g for a probability of 0.000404 per annum (2% in 50 years).

NRCan concludes that a safety check against the shaking from these rare large shield earthquakes which may occur close to the site would be prudent.

Seismic Hazard Analysis for Contwoyto Lake, Nunavut

prepared by Alison Bird, Seismologist

What follows is a detailed hazard assessment of the site near Contwoyto Lake, Nunavut (65.997°N, 111.475°W). The approach for this site is somewhat different to that of sites addressed in the past as it does not lie in the vicinity of any large active faults for which a maximum possible earthquake could be determined. This site instead lies within the 'stable craton' of central Canada, with a 'floor' level of potential seismic activity.

It should be noted that neither site conditions nor structural engineering are considered in this analysis.

Recorded Earthquakes

All seismicity which has been located in the region since 1898 (when the first seismographs were installed in western North America) is shown on the map in Figure 1. The Contwoyto Lake site is indicated with a red triangle. Note that although the level of recording in this region has, until recent years, been minimal, any earthquake which could be expected to cause damage would have been recorded during the past century. There have been few events, all less than magnitude 5; seismic activity in this region is generally thought to be caused by post-glacial rebound:

Date yyyy mm dd	Time hhmm ss.s	Lat	Lon	Depth km	Mag
1963 06 05	0131 37.0	66.500	-110.000		3.10
1966 01 10	0428 20.0	66.250	-111.830		4.60
1966 01 19	0710 20.0	67.830	-107.670		3.70
1966 04 19	0520 59.0	66.750	-111.000		2.50
1976 10 21	1750 56.0	68.060	-109.930	18.00F	2.90
1983 03 23	1147 23.0	65.690	-111.560	18.00F	3.30
2001 11 28	0411 14.2	64.914	-113.666	20.00F	3.90
2001 11 28	0418 39.6	64.957	-113.660	20.00F	4.50

Probabilistic Analysis

The current standard probabilistic analysis of the Contwoyto Lake site was sent to Mr. Robertson on September 3^{rd}. The results are also presented below:

Return Period (years)	100	200	475	1,000
Probability of Exceedence per annum	0.010	0.005	0.0021	0.001
Probability of Exceedence in 50 years	40%	22%	10%	5%
Peak Horizontal Ground Acceleration (g)	0.009	0.011	0.013	0.016
Peak Horizontal Ground Velocity (m/s)	0.027	0.032	0.040	0.047

The zoning for this site, using the 1990 NBCC/CNBC, is Acceleration Zone 0, corresponding to 0.00-0.04 g; Velocity Zone 0, corresponding to 0.00-0.04 m/s. These figures are for a probablility level of 10% in 50 years.

Extrapolated Values

If the above data is presented in a log-log plot, it can be extrapolated to determine a peak ground acceleration (PGA) of 0.030 g and peak ground velocity (PGV) of 0.090 m/s, for a return period of 10,000 years (Figure 2). It should be noted that extrapolation to this return period is outside the realm of the NBCC and should be taken only as a rough approximation.

Proposed values for new National Building Code

As mentioned above, the site near Contwoyto Lake lies within the 'stable craton' of central North America, which has too few earthquakes to define reliable source zones. Previous hazard maps (as used in the current probabilistic analysis presented above) considered only ground motions generated from distant sources. Understanding of seismicity in the stable shield or core regions of continents, using global examples, has lead to revised values and the development of a 'floor' level of seismic hazard which has been incorporated into proposed models which will form the basis of the 2005 edition of the National Building Code of Canada (Adams *et al.* 2003). This assumes large earthquakes could occur anywhere in Canada.

What follows are the proposed NBCC 2005 median values for Site Class C (firm ground) 2%/50 year (equivalent to 1/2475 years or 0.000404 per annum probability) values for your region of interest. Peak acceleration (PGA) and 5% damped spectral acceleration values are expressed in terms of g.

Location	Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
Contwoyto Lake, NU	0.12	0.056	0.023	0.006	0.059

For rock site values, the amplification factor of 1.39 should be divided into values for firm soil (Adams *et al.* 1999).

This code is not yet published; these values are therefore unofficial, but the differences should be noted. Newer peak ground acceleration values for this region are somewhat higher in order to consider not simply earthquakes which have occurred in the site area, but also those which *could* occur, according to activity recorded in other regions of the Canadian Shield.

In developing the floor level, the following conclusions are have been reached:

i) the maximum earthquake credible would have a magnitude of 7.0.
ii) current knowledge does not permit the exclusion of shield areas which could not have earthquakes up to this size, so they should be considered as low probability events anywhere on the Canadian Shield.
iii) a reasonable design earthquake for the shield would be magnitude (Ms, or surface wave magnitude) 6.0, but larger, much more rare earthquakes can occur.
iv) the rate of Ms 6.0 or greater is estimated to be a 0.004 p.a. per 1,000,000 km^2.

The new National Building Code of Canada, due out January 2005, is available on-line at: www.seismo.nrcan.gc.ca/hazards/OF4459/index_e.php.

Deterministic Analysis

Mapped faults within several hundred kilometers of the Contwoyto Lake site have been reviewed. There are only a few minor faults in the GSC catalogue, none of which is associated with recorded earthquakes nor is known by the GSC to be active (Figure 3). It is suggested you confer with a geotechnical consultant to determine the status of these faults.

The nearest major faults are the Tintina, Denali and Fairweather Faults in Yukon and Alaska which are 1200 km, 1440 km and 1545 km from the site, respectively. The distances suggest the site would receive only minor ground motions from their maximum expected magnitudes of 7.3, 7.3 and 8.7 respectively.

The above work has been discussed with both Garry Rogers and John Adams; they both agree that the probabilistic results, particularly those of the 2005 NBCC, are likely to yield the most reliable results for your purpose. A deterministic approach, when there are no known active faults in the region, does not provide a representative measure of PGA.

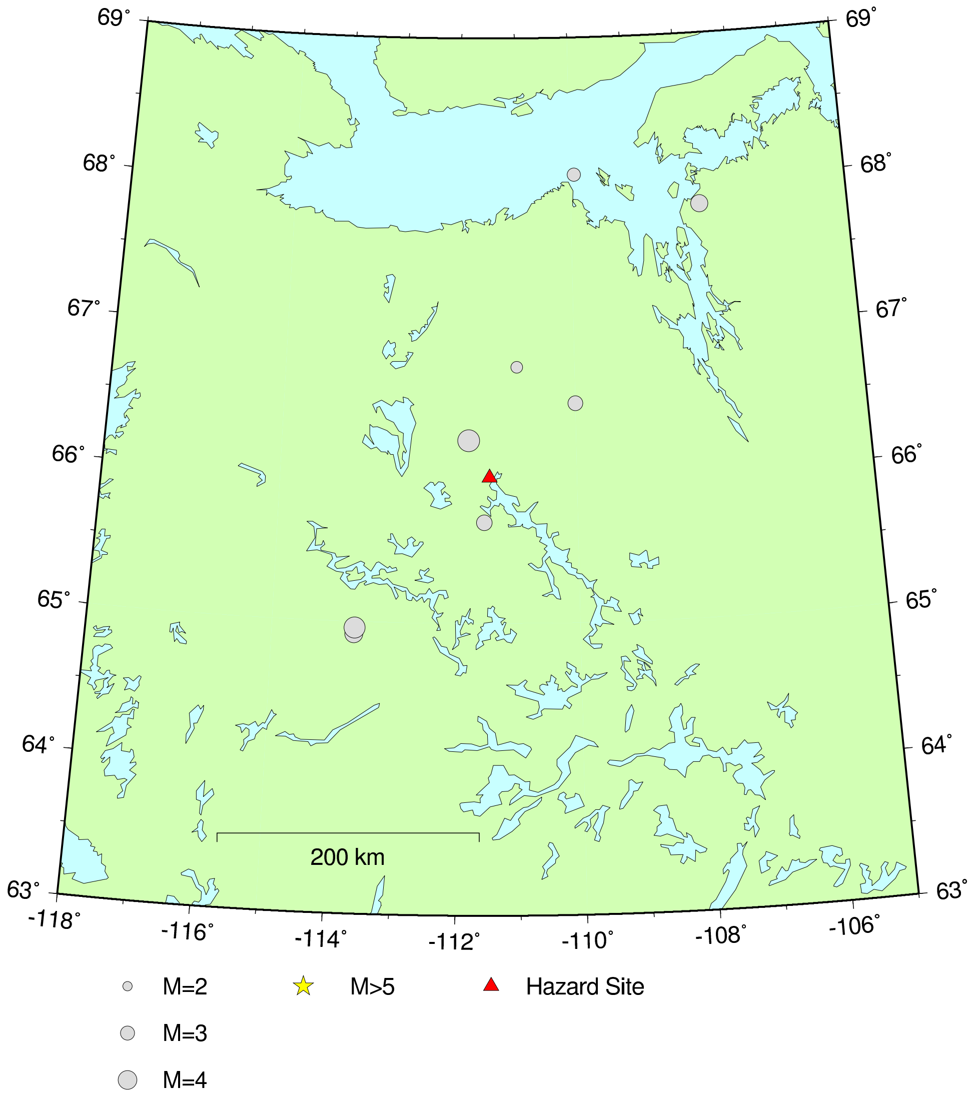

Figure 1: Area of study, showing all seismic activity for the period 1898 to 2003. Contwoyto Lake site is denoted by a red triangle.

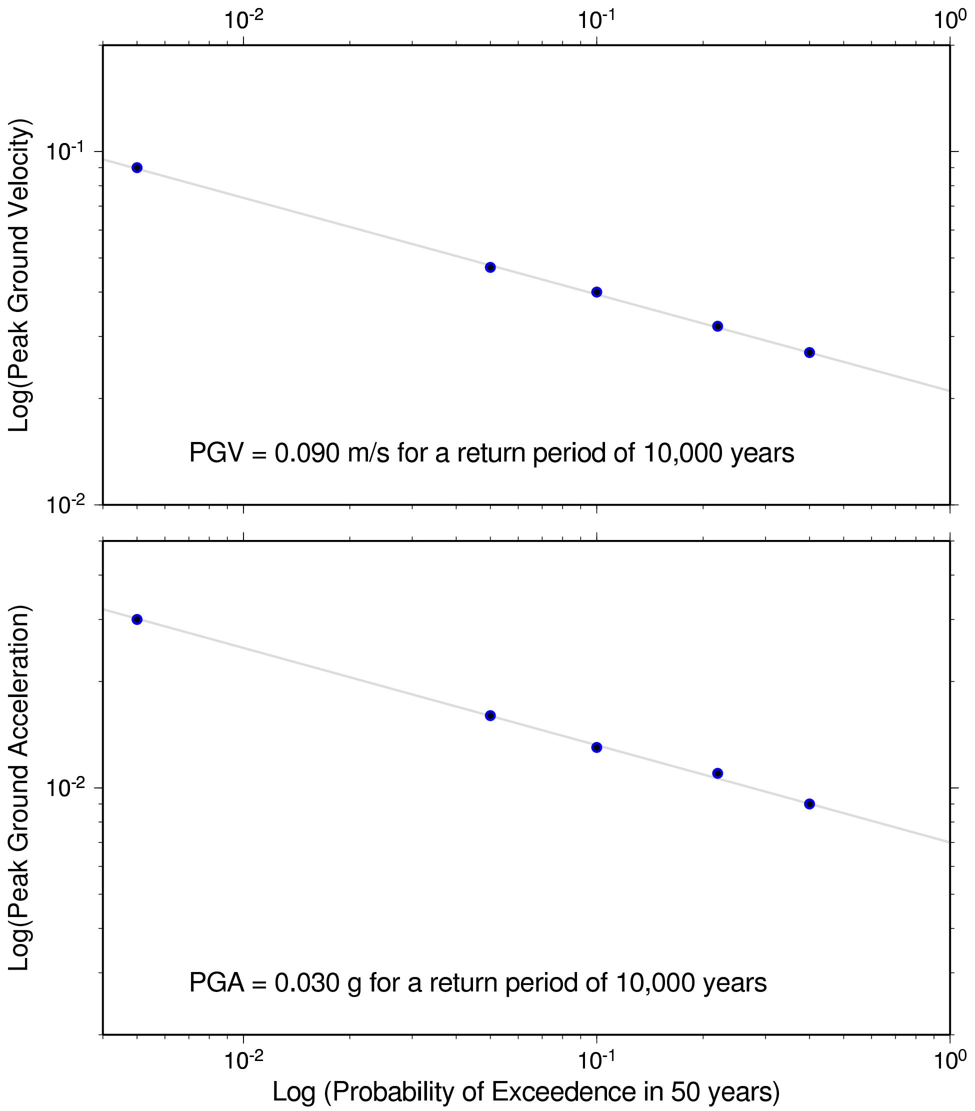

Figure 2: Log-log plots of Peak Ground Velocity and Peak Ground Acceleration versus Probablility of Exceedence.

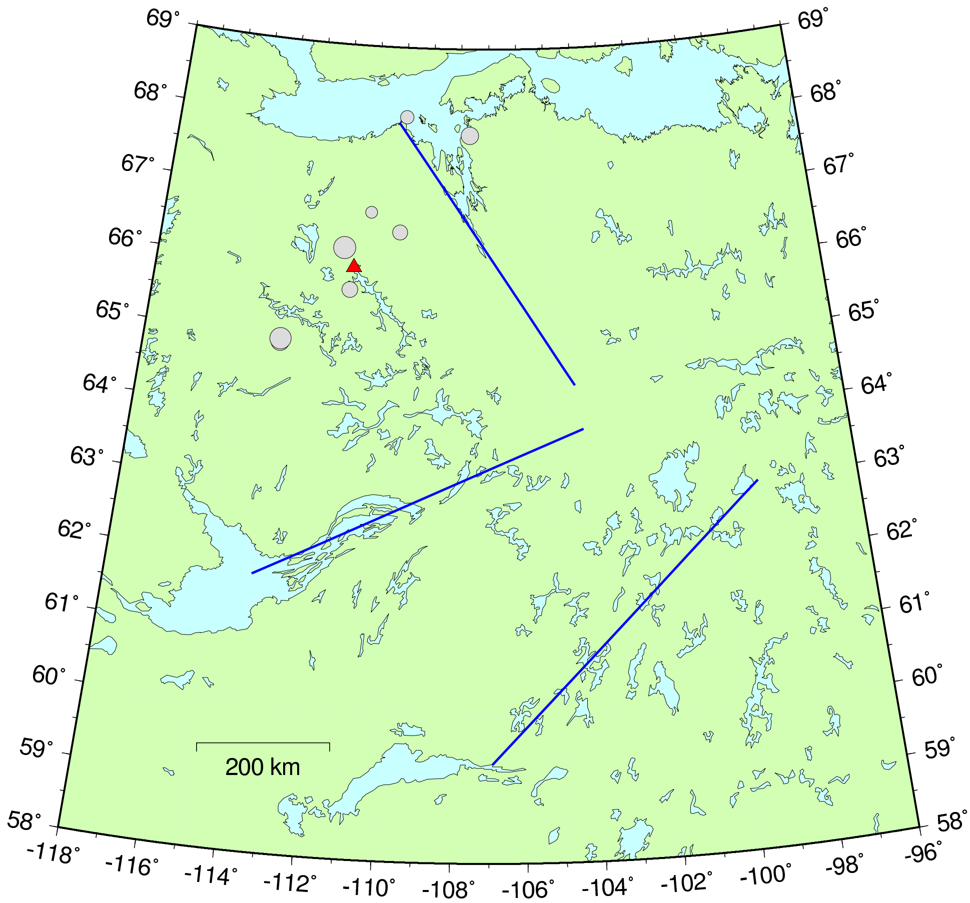

Figure 3: Approximate traces of mapped faults in the Contwoyto Lake area; none are known to be active.

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