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Mr. Bill Dunn, P.Eng.
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Dear Mr. Dunn:

Re: Geotechnical Review of Grum Overburden Dump and Sulphide Pad Access Road

As requested, Piteau Associates Engineering Ltd. has completed a geotechnical assessment of the Grum Southeast Overburden Dump and the Sulphide Pad Access Road, both of which are under construction. Mr. A. Stewart visited the site on October 31 and November 1, 1992. During that time, inspections of both areas were made with Mr. M. Wasel, mine geologist. Subsequent to this, discussions were held with yourself and Mr. J. Hogg, General Manager.

GRUM SOUTHEAST OVERBURDEN DUMP

At the time of the site visit, the Southeast Overburden Dump was being developed in two main lifts. The lower lift, which was performing well, with no signs of instability, was comprised of two sub-lifts; an initial 6 to 8m thick layer of relatively dry overburden, overlain by a 2 to 3m thick layer of phyllite waste rock. The waste rock had been placed to provide a trafficable surface on which to operate the haul trucks. The lower lift appeared to have been constructed in general conformance with recommendations contained in our letter report of August 14, 1992.

The upper lift of the overburden dump appeared to be in the order of 15 to 18m high. During the site visit, very wet overburden was being placed in the dump, with haul trucks dumping short of the crest and dozers pushing the waste over the dump crest. The overburden waste was sufficiently loose and wet that it flowed down the face of the dump.

Based on the above, it is concluded that the upper dump lift is too high and that there is a significant possibility of failure of this lift. Thus, it is strongly recommended that the dumping recommendations contained in our August 14 report be followed. Specifically, it is recommended that individual lifts be limited to about 6m thick and that the overall slope angle be limited to 2.5 horizontal to 1 vertical (i.e. 22°). Furthermore, as much of the dump crest as possible should be utilized during dumping, and dump advance rates should be

limited to no more than 0.5m/day. As has already been done on the lower lift, a thin layer of phyllite on top of each overburden lift would help trafficability and would tend to improve the internal drainage capability of the dump. Further comments with regard to development of the Southeast Overburden Dump are contained in our report of August 14.

SULPHIDE PAD ACCESS ROAD

The access road to the proposed sulphide pad is in the area of the Main Waste Dump, southwest of the main access road to the Vangorda Pit and immediately downslope of a 30m high waste dump that has been in place for about two years. Based on an earlier inspection, the older 30m high dump appeared to be stable, with the only signs of instability being some settlement and cracking just behind the dump crest. However, the settlement and cracking of the old dump did not appear to be active and likely dated to the time of construction, when some activity of this nature would be expected.

During the site visit, it was observed that two areas of the sulphide pad access road had experienced failure. The active failure area was located at the leading edge of the road fill, about 200m southwest of the intersection with the Vangorda Access Road. In this area, the fill was only about 40 to 50m wide and 12 to 14m high. The face of the fill sloped at an angle of about 30°, with the overall angle from the crest to the furthest extent of the failed waste being about 25°. Within the previous 24 hours, since the dump surface had been graded, cracking had appeared up to about 14m behind the dump crest and a 1m high scarp was present about 6 to 8m behind the crest. Topography under the leading edge of the dump was flattening, reflecting the presence of a swale or draw between the old dump and a natural topographic high to the southwest of the access road. While the presence of snow made it difficult to observe surficial soils, the organic soils typically found in the area may be thicker than normal, and the underlying soils may be somewhat softer and wetter than those in the surrounding area. It is noteworthy that the results of a recent test pitting program indicate that the area of the topographic high is underlain by 0.2m of organics overlying a very stiff to hard clayey silt till to a depth of at least 5.9m.

The second failure occurred on the southeast side of the access road, about half way between the active face and the entrance to the access road. In this area, the waste appeared to be up to about 15m high. While considerable sloughing and movement had occurred on the 10° foundation slope, no cracking or other evidence of continuing movement was observed on the surface of the access road during the site visit. The crest to toe runout angle of the failed material was about 16°, and the natural ground surface had been disturbed for a distance of up to about 20m downslope of the toe of the waste rock. In this area, the trees were

tilting in various directions and the near surface soils had been sheared and pushed up in front of the dump toe. In one location, it was observed that up to 1m of peat was underlain by what appeared to be a soft, wet silty till that had become frozen since being disturbed. While there was no evidence of a wet silty sand under the failed area, such a water-bearing material was observed, and delineated as a discharge area, about 100 to 150m downslope of this area during a recent test pitting program. This area was also identified in our January 1991 report entitled "Grum Pit Review and Analysis of Hydrogeological Data and Design of Phase I Dewatering System" as being a groundwater discharge area.

Based on visual observation, it appears that both failures may have been the result of rapid dumping over too high a dump face onto a softened dump foundation. If appropriate operating precautions can be taken (i.e. such as dumping loads short and pushing waste over the crest, and having the dozer operator act as a spotter for the haul trucks), and instability can be tolerated in the short term, it is likely that the failures will cease as the road fill bridges the swale between the old waste dump and the topographic high. However, depending on the ultimate elevation and layout of the access road, the possibility of further failures cannot be ruled out, particularly if the road extends southeast or southwest of the topographic high. To prevent, or at least minimize, further failure, the best solution would probably be to reduce the lift of rock fill to about half the present height and construct the access road at a slower advance rate.

I hope the above is sufficient for your needs at this time. If you have any questions concerning the above, please do not hesitate to contact us.

Yours very truly,

PITEAU ASSOCIATES ENGINEERING LTD.

Alan F. Stewart, P.Eng.

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