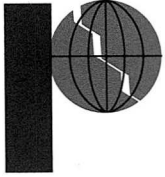


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PITEAU ASSOCIATES
GEOTECHNICAL AND
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November 9, 1991

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Mr. Bill Dunn, P.Eng.
Chief Engineer
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P.O. Box 1000
Faro, Y.T.
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Dear Mr. Dunn:

Re: Geotechnical Review of Faro and Vangorda Pits

INTRODUCTION

As requested, Piteau Associates Engineering Ltd. has completed a review of geotechnical concerns in the Faro and Vangorda Pits. This review and letter report follow similar reviews conducted in the past. The most recent letter report is dated July 18, 1991.

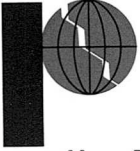
Mr. A. Stewart visited the site on October 16 to 18 and November 4 and 5, 1991. During that time, geologic mapping was reviewed, inspections of the pit walls were made, and results of ongoing pit monitoring were reviewed. Discussions were held with mine personnel regarding these matters.

The following summarizes the results of the geotechnical review. Some general aspects which have already been covered in previous letter reports will not be repeated herein.

FARO PIT

General

At the time of the October 16 to 18 and November 4 and 5 site visits, mining on the east wall was almost completed on the 3510 and 3490 ft levels, respectively. An impact berm had been established along the toe of the east wall to catch rockfalls and ravelling material. This impact berm, which created a 4 to 6m deep catchment ditch, appears to be adequate to catch falling rubble. However, the portion of the ditch under the south slump area recently had to be cleaned after it had become filled with debris, and some rockfalls had rolled over the impact berm and onto the haulroad. Thus, continued maintenance and cleaning of the ditch on an as-required basis is recommended. Notwithstanding this, it is understood from mine personnel that rockfall activity has steadily decreased with time, as winter conditions have set in. While this reduction in rockfalls is expected, the possibility of further rockfall activity cannot be completely ruled out.



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Faro Creek Diversion

At the present time, the water in the Faro Creek Diversion is impounded upstream of the pit and piped around the pit in a 20 inch diameter pipeline. It is understood that because of low flows in the creek (typical of winter conditions), it is planned that the 20 inch pipeline be replaced by an 8 inch pipeline. This smaller pipeline would be able to handle the reduced flow at a higher velocity, thus reducing the potential for freezing during the winter. The pipe would be laid such that if the pump fails for any reason, the pipe would be able to drain without freezing. The main problem with this scheme would be the potential for freezing of the pump during a power failure, if power cannot be quickly restored.

While the pumping scheme described above is favoured to carry Faro Creek, it is also understood that this system would only be used as a backup. The proposed scheme for Faro Creek would be to breach the existing diversion channel and direct the flow down the Faro Valley, over the north wall of the pit in an existing seepage channel, and into the main sump at the toe of the north wall alongside the haulroad. From this point, it would be pumped to the tailings pond. The main problems with this scheme are the effects that the surface discharge may have on the pit wall and the main sump. Depending on the depth of frost penetration in the pit wall, and on the temperature of the water (expected to be near freezing), some erosion of Faro Valley sediments may occur. This erosion may result in a significant volume of sediment being deposited in the main sump, possibly leading to sump operating problems. While major slope stability problems on the north wall, due to raising of the phreatic surface within the slope, are not anticipated, the possibility of such an occurrence cannot be completely ruled out.

Based on the above, it is concluded that both schemes should work, given appropriate weather and operating conditions. However, the pipeline option is favoured, as it would appear to present fewer potential problems. The ditch breaching option would be a backup to the pipeline option.

Geologic Mapping and Interpretation

Since our last visit of August 5 to 8 (for which no letter report was issued), very little rock has been exposed in the area of greatest interest. Thus, very little relevant lithologic and structural mapping has been completed. However, based on recent mining progress, a considerable amount of relevant geologic information should become available in the next one to two months as the east wall is mined to the 3470 and 3450 levels. Thus, to continue the ongoing



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Chief Engineer
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geologic interpretation of lithology and "major structures" in the east wall, it is recommended that Mitch Wasel continue to map bench faces as they are exposed. All data should be plotted on plan and in section. As discussed during the most recent site visit, two or three additional cross-sections, drawn perpendicular to the slope rather than along the mine grid, should also be developed. The proposed ultimate pit slope should be included on these sections.

Following preparation of the plans and sections, a reassessment of the potential for additional large scale instability should be conducted and compared with previous assessments. As has been done in the past, all combinations of "major structures" should be evaluated to determine if any of the potential failure modes identified in earlier letter reports appear to be likely, and if any new stability concerns (based on lithology or geologic structure) are present.

Faro Pit Slope Monitoring

Slope movement on the east wall, as determined by prism monitoring, has slowed dramatically since our last letter report of July 18, 1991. In the north slump area, where as many as seven prisms are being monitored, peak movement rates of 30 to 65mm/day recorded in mid-July have decelerated to between about 15 and 30mm/day. Occasional movement rate increases have been recorded in local areas for a few days. These increases, which are likely related to mining at the toe of the slope and/or the influence of water in the slope, appear to subside after a few days. As has been observed in the past, Prisms 1 and 2, located in the vicinity of the pit crest, have not experienced any movement.

In the south slump area, where between nine and fourteen prisms have been monitored at any one time in the last few months, maximum movement rates of various prisms have ranged from <10mm/day to as much as about 3000mm/day. Since the last week of July, however, all prisms have slowed dramatically, with three prisms (i.e. Prisms 22, 25 and 26) having stopped moving. The remaining prisms are all moving <100mm/day, with all but two or three having slowed to <70mm/day. Continued slow deceleration is anticipated throughout the winter; however, as in the north slump area, short term acceleration could occur in response to external factors such as mining at the toe of the slope.

As for the north and south slump areas, movement of the calc-silicate area has slowed considerably since the latter part of July. While peak movement rates of up to about 500mm/day were recorded in July, these have all decreased, with only one prism indicating a movement rate of above 5 to 10mm/day (i.e. Prism 19A is moving at about 30 to 40mm/day). It is noteworthy that only six prisms exist in



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this area at the present time; at least four others have been lost due to rockfalls, etc.

Based on the prism monitoring results, the frequency of monitoring may be reduced to about twice a week. Notwithstanding this, and as discussed with Gerrit Vos, the actual monitoring frequency for the prisms may vary and should be adjusted, depending on which prisms are indicating the most movement, and where active mining is occurring at any particular time.

As the stability of the calc-silicate portion of the east wall is anticipated to be most critical in the latter stages of mining, and as there are no remaining prisms on the lower portion of this area of the wall, it is recommended that additional prisms be installed in this area. Potential locations (i.e. probably on about the 3550 and 3450 safety berms) were discussed with Mitch Wasel. Actual locations will depend on ease of access and safety at the time of installation.

VANGORDA PIT

General

At the time of the site visit, mining in the southern half of the pit was largely completed, and mining in the northern portion of the pit was at the 1116 to 1146m elevation. It is understood that about 15 months of mining life remain in the pit.

Cross Fault on West Side of Pit

What has been identified as the "Cross Fault" has been located on the west and east pit walls on about the 1116m level at about Section 12. Based on a very limited amount of data, the fault appears to dip between 40° and 62° toward 348°; however, it is likely that it is wavy in nature with an orientation that varies to some degree. It is also likely that the fault is not a discrete fault plane, but a wide fault zone. It is noteworthy that the apparent orientation of the fault is unlike most other faults that have been identified in the pit, in that it dips northward as opposed to westward.

Based on a preliminary structural geologic assessment of the Cross Fault, it would appear that it could adversely affect the stability of the west wall of the pit in the immediate area of the proposed main haulroad, at about Section 8 to 10. However, there is insufficient data to absolutely determine that this is the case. Thus, it is recommended that ongoing mapping be carried out on each



Mr. Bill Dunn, P.Eng.
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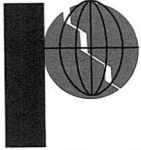
bench in this area to better define the orientation and location of this fault. Drillhole logs from this area of the pit should be reviewed to assist in the interpretation. The structural and stability assessment should be ongoing, until the fault can be adequately defined, and its influence on stability of the haulroad determined.

Northwest Fault

It is understood that a major structure, referred to as the Northwest Fault, has been interpreted to cut off the Vangorda orebody at the north end of the pit. However, the precise orientation and location of this fault, and its impact on the overall stability of the pit walls, has not been determined. Based on very limited data contained on cross-sections that were reviewed on November 4 and 5, it appears that the fault dips about 55° to 60° toward about 103° . To confirm this, it is recommended that additional data contained on other cross-sections be compiled and assessed. In addition, existing diamond drillhole intersection data should be used to develop a structural contour plan of the fault. All of the above data should be compared and assessed to determine the average orientation of the fault, its likely waviness, its location in space, and the locations at which it intersects the proposed ultimate pit wall. Following this, an assessment of how this fault could affect stability of the pit slopes should be carried out. Details as to how to carry out the evaluation of the orientation of the fault were discussed with Peter Ledwidge during the site visit.

Bedrock Failure on East Side of Pit Along Flume

On November 2, a lightly loaded blast was detonated between the 1152 and 1146m levels at about Section 2 on the east wall. The blast was in an area where free digging was being carried out, and where a hard toe had been encountered. Following the blast, located about 30 to 35m from the flume on the 1152 bench, cracking was observed in the rock near the crest of the flume excavation and in the snow adjacent to the flume itself. The affected area appeared to be between 15 and 30m wide (i.e. along the bench). Inspection of the cracks indicated that they occurred along a pre-existing surface subparallel to foliation. The dip direction/dip of the fracture was estimated at $184^\circ/10^\circ$, which is approximately the same as the regional orientation of the S2 foliation. It is noteworthy that the theoretical dip of a plane extending from the base of the blast pattern to the cracks along the flume is calculated at 10° to 15° (i.e. subparallel to the regional S2 foliation and the actual crack created by the blast). It is also noteworthy that the blast was reported to be choked, thus directing excessive energy and gas back into the slope.



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Chief Engineer
Curragh Resources Ltd.

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As it is apparent that some movement has taken place along the cracks in the area in question, and as further movement along these or other failure planes subparallel to foliation could jeopardize the integrity of the flume, it is recommended that remedial measures be taken to artificially support the bench on which the flume is located. Toward this end, it is recommended that the most practical method of artificially supporting the bench would be to concrete lengths of steel into vertical boreholes along the crest of the bench, such that they act as reinforcing dowels. It is understood that the mine can obtain 12m lengths of used "95 lb" railroad rails, and is able to concrete these rails into 10-5/8 inch diameter drillholes drilled by the blasthole drill. This drill rig is able to drill 15m deep holes.

For purposes of determining the lateral spacing of the dowels, it has been assumed that a failure plane could extend upward at a dip of 10° from the toe of the 12m bench below the flume (see Fig. 1). It is also assumed that a vertical crack could form the back scarp of the failure, and that this crack and the failure plane could be subject to water pressure due to leakage from the flume, and/or general groundwater seepage. Based on a lower bound estimate of shear strength equivalent to the dip of the failure plane, it is conservatively estimated that the lower bound factor of safety could be about 0.75. To increase the factor of safety to 1.5, additional shearing resistance equivalent to about 70 kips/ft of slope would be required.

While the specifications for the "95 lb" rails are unknown, it is assumed that the rails may have an ultimate shearing strength of about 80 kips/in² and a cross-sectional area of about 9 in². Assuming the concrete does not provide any shearing resistance, each dowel would have an ultimate capacity of about 720 kips of shearing resistance. Thus, the recommended lateral spacing between vertical rail dowels would be about 10 ft (i.e. 720 kips/70 kips per ft = 10.3 ft). Before beginning installation of the dowels, it is very important that the actual shearing strength and cross-sectional area of the dowels be determined. If they are different than the parameters assumed above, a revised dowel spacing must be calculated.

It has been assumed in the above design that improved blasting practices, such as those used in other areas along final walls, would be implemented along this portion of the east wall. It is critical that every effort be made to minimize blast damage, such as that which caused the cracking discussed above.

The need for dowels on the bench below the flume (i.e. between the 1140m and 1128m levels) cannot be ruled out entirely. However, assuming that blasting can be carried out without directing excessive energy and gas into the wall, dowels



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are not likely to be required on this bench. It is recommended that, before mining below the 1140m level, an inspection of the slope and flume area be made to better assess if any further dowelling is required. It would also be advisable to install and monitor a few prisms in the area of the flume/access road on the 1152m level.

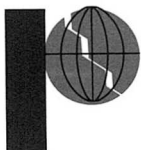
With regard to installation of the row of dowels, it is recommended that they be installed within 2m of the crest of the slope. If possible, the bars should be approximately centred in the holes (possibly by spot welding two or three spacers on each end of the bar) before the concrete is poured into the hole. The dowels should be installed prior to blasting and excavating the rock from the bench below.

Overburden on North Wall

In the area of the north wall of the pit, significant thicknesses of overburden have been encountered in the vicinity of the flume. While the flume itself is founded on bedrock east of about 10,000E, it is founded on overburden to the west of this point. The access road alongside the flume appears to be constructed primarily on overburden along virtually all of the north wall.

The thickness of the overburden ranges up to at least 20m, with the thickness generally increasing to the west and south. West of about 10,000E, overburden thickness is still to be determined by mine geology staff. The overburden appears to be comprised of at least two or three distinct types of material. The upper unit is described as a relatively dense glacial till similar to that previously encountered on the east wall of the pit, and at the crest of the Faro Pit. This material is underlain by a lodgement till that appears to be comprised of at least 50% broken phyllite. While phyllite bedrock typically underlies the lodgement till, the near surface portion of the rock in many areas is extremely weathered, with a competency similar to that of moderately dense/compact soil, and thus has been considered to behave as overburden.

The original pit slope design for the north wall assumed that the flume and access road would be founded entirely on competent bedrock. Furthermore, the north wall interramp slope angle below the flume was designed at 45°, generally being comprised of 24m high double benches. Based on the subsurface conditions summarized above, it is concluded that there is a significant risk that such a slope would experience one or more failures that would jeopardize the flume and/or access road. As failure of the flume is understood to be unacceptable, remedial measures to prevent such an occurrence are recommended.



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Chief Engineer
Curragh Resources Ltd.

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A number of remedial measures have been discussed with respect to minimizing the risk of instability to the flume and access road, including:

- moving the crest of the pit northward such that the flume and access road are founded entirely in bedrock;
- pumping the creek around the pit;
- steepening the grade of the flume and removing most, if not all, of the overburden;
- excavating the overburden at a flatter angle (i.e. approximately 34°) and risk losing ore, unless the lower slopes in bedrock can be steepened;
- artificially reinforcing or buttressing the slope such that the original slope design could be implemented.

Piteau Associates was requested to conceptually evaluate the artificial support option, and recommend which type of support might be suitable for allowing the pit slope to be established in its originally designed location.

Of the various methods that are available for artificially supporting the overburden, it is concluded that a tieback system is the most practical, and the safest to install. A crib or bin wall type system would run the risk of being unstable, particularly during construction, and is not recommended. While it must be emphasized that a detailed design would be required before construction could begin on a tieback support system, it is conceptually envisaged that such a support system would include rows of grouted tensioned tiebacks installed in a 45° to 65° sloping cut in overburden. As discussed with you on November 8, mesh, rigid tie bars and strapping would also form a part of the tieback system. Also, as such work is highly specialized, it should be contracted to an experienced shoring contractor.

If any portion of the north wall is to be excavated in unsupported overburden, it is recommended that it be excavated at a slope of 34° (i.e. 1.5 horizontal to 1 vertical), with a single 6 to 7m wide berm at the overburden/bedrock contact. Such a slope would be more stable than a benched slope excavated at the same interramp slope angle.

With regard to the potential for steepening the portion of the north wall that is in bedrock, it is recognized that such steepening may be possible if the geologic structure in the bedrock is as anticipated, and the rock is



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sufficiently competent. However, it is recommended that such steepening could only be considered and evaluated after at least one or two benches in competent bedrock have been excavated and documented, and the geologic structure assessed for potential failure modes.

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,

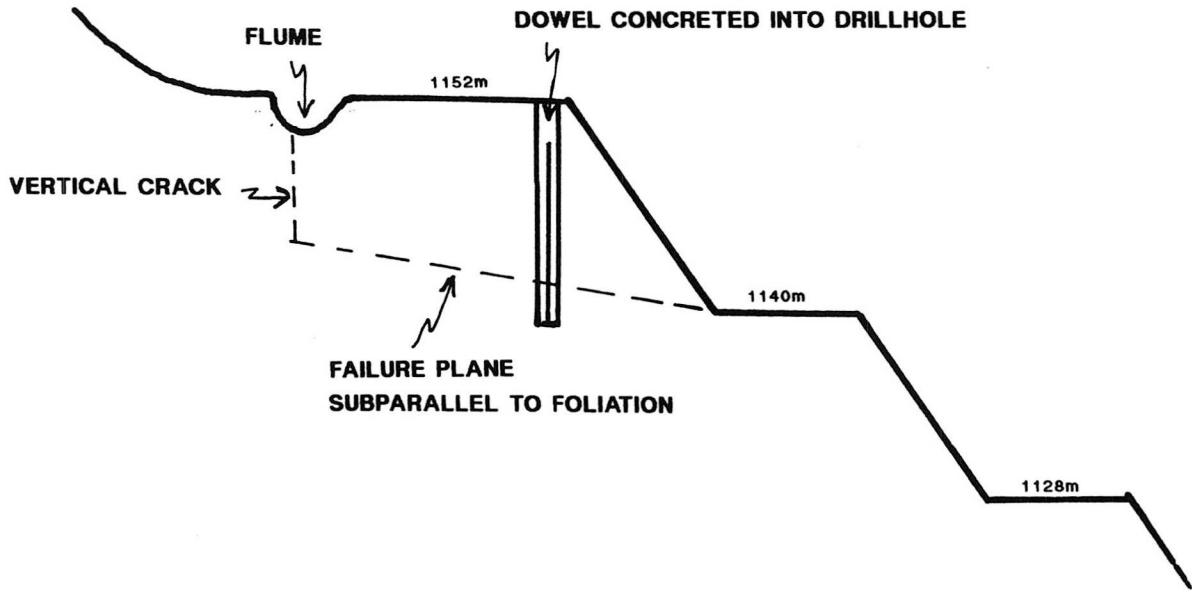
PITEAU ASSOCIATES ENGINEERING LTD.

Alan F. Stewart, P.Eng.



AFS/ef

Att.



APPROX. SCALE IS 1:500

FIG. 1

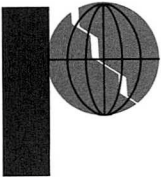
CURRAGH RESOURCES
VANGORDA PIT



PITEAU ASSOCIATES
GEOTECHNICAL CONSULTANTS
VANCOUVER CALGARY

TYPICAL SECTION ILLUSTRATING VERTICAL DOWELS

BY: <i>AFS</i>	DATE: <i>9/11/91</i>
APPROVED:	DWG:



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Our file: 85-804B

July 5, 1992

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

Re: Geotechnical Review of Faro and Vangorda Pits

INTRODUCTION

As requested, Piteau Associates Engineering Ltd. has completed a review of geotechnical concerns in the Faro and Vangorda Pits. This review and letter report follow similar reviews conducted in the past; the most recent letter report is dated May 11, 1992.

Mr. A. Stewart visited the site on June 15 and 16, 1992. During that time, geologic mapping was reviewed, inspections of the pit walls were made, and results of ongoing pit monitoring were reviewed. Discussions were held with mine personnel regarding these matters.

The following summarizes the results of the geotechnical review. Some general aspects which have already been covered in previous letter reports will not be repeated herein.

FARO PIT

General

At the time of the site visit, mining had been completed in the Faro Pit and some flooding of the pit bottom was occurring. The only activity in the pit was that related to servicing the underground operation. In the two or three weeks prior to the site visit, temperatures had risen from below freezing to well above freezing, and the spring thaw was well underway. Very little snow or ice remained in or around the pit and the local streams were in flood. Flow in Faro Creek was sufficiently high such that four pumps pumping into one 20-inch diameter pipe and one 10-inch diameter pipe were unable to prevent overflow into the Faro Creek diversion channel.



Mr. Bill Dunn, P.Eng.
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Slope Monitoring

Slope movement rates on the east wall, as determined by prism monitoring, have increased or remained essentially constant since our May 11 report. In the north slump area, where seven prisms have been monitored, five prisms are moving at a relatively constant rate of about 5 to 15mm/day, with the remaining two prisms, located at the crest of the pit, showing no movement. These movement rates are essentially the same or less than those indicated during last fall and winter.

Twelve prisms have been monitored in the south slump area. Monitoring results indicate that the central portion of the area (i.e. in the vicinity of Prisms 14, 27, 30, 32 and 33) typically is moving at a rate of 40 to 100mm/day, with rates for individual prisms often fluctuating erratically. The remaining prisms in this area are experiencing little or no movement. In general, movement rates do not appear to have risen appreciably since our last report. However, it is anticipated that significant rate increases could occur in the month of July.

Of the six prisms that are being monitored in the calc-silicate area, only Prism 19A is experiencing more than 5mm/day movement. This prism has accelerated from about 35mm/day to about 45mm/day since early to mid-June. None of the four additional prisms installed in the calc-silicate area between the 3500 and 3550 ft levels appear to be moving.

Notwithstanding the general lack of prism movement in many areas of the east wall, a significant amount of rockfall and raveling activity has occurred. Much of the catchment area that had been created on the lower safety berms has become filled in recent weeks, with the result that it is likely that some rockfalls will not be retained on the slope, but will reach the pit bottom. As long as no mining activity is scheduled for the toe of the east wall, the rockfall activity is not expected to cause any concerns.

Based on the monitoring results, and on the lack of mining under the east wall, it is recommended that monitoring frequency be reduced to once or twice a week. However, if any mining activity is to take place under this wall in the future, it should not resume until the results of more frequent prism monitoring have been reviewed in detail by qualified personnel, until appropriate monitoring frequencies have been established, and until the slope has been visually inspected and it has been determined that rockfall activity no longer poses a danger to men and equipment.



Mr. Bill Dunn, P.Eng.
Chief Engineer
Curragh Resources Inc.

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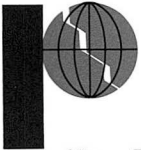
"AY" and "M" Targets

As discussed with Mitch Wasel, two potential high grade targets exist in the northwest corner of the pit; namely the "AY" and "M" zones. The "AY" target is located immediately above the sump at the north end of the pit and may contain in the order of 250,000 tonnes of ore. The ore zone is estimated to be about 120 ft high and to extend 75 to 80 ft into the wall. The rock mass behind the ore is phyllite, in which the S2 foliation appears to strike subparallel to the slope and dip near vertical to gently out of the wall in the upper and lower reaches of the slope, respectively. The present interramp slope angle in the area is about 40°, with locally steeper and flatter areas. The slope above this area has existed for a number of years in an apparently stable state.

The "M" target, located slightly west and upslope of the "AY" target, is estimated to contain in the order of 55,000 tonnes of ore. This zone also extends about 80 ft into the wall over a slope height of about 100 ft. However, the footwall side of the ore zone is bounded by a blocky intrusive dyke.

It is understood that mining of the two ore zones would likely be carried out as rapidly as possible in late summer or fall. Due to the shape and location of the targets, and the available access, it would almost certainly be necessary to use small mining equipment. It is likely that the plan would be to excavate at least a 50° to 60° interramp slope over the 100 to 120 ft high ore zones. The number of blasts would be minimized and all muck would be dozed to the toe of the slope before being loaded out.

While no specific geotechnical assessments of the two mining targets have been carried out, it is likely that the areas in question can be mined, providing mining is carried out over a short time span and providing appropriate precautions are taken and preparations are made. In this regard, the slopes above the target areas are of particular concern from a stability standpoint. While these slopes have stood for a number of years apparently without any recent stability problems, it is anticipated that steepening of the slopes and renewed blasting in the area may result in some instability, with the potential for rockfalls being the greatest concern at this time. Thus, it is recommended that the slopes above the target areas be scaled prior to mining. Inspection of the upper and newly excavated slopes should be carried out after each blast to determine if any additional scaling or other remedial work is required to stabilize the slopes.



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July 5, 1992

VANGORDA PIT

General

At the time of the site visit, mining in the northern half of the pit was progressing on the 1092 to 1104m levels. Overburden mining was essentially complete other than some flattening of oversteepened overburden in the northwest corner of the pit. The Vangorda Creek diversion flume was flowing nearly full and some seepage was observed under the flume, particularly in the vicinity of the Northwest Fault. Considerable seepage was also being intercepted by ditches and sumps along the western side of the pit bottom, and the pipeline that was being used to pump the water from the pit had been extended such that water was being discharged through a culvert to the western side of the main haulroad, rather than just behind the pit crest. Detailed geologic mapping of the pit walls was being carried out by Mr. Dennis Brown, a Ph.D. student completing field study requirements for his doctoral research.

Cross Fault

As discussed in our November 9, 1991, March 25 and May 11, 1992 reports, the Cross Fault has been mapped in the pit in the vicinity of Section 12. Previous mapping has indicated that this fault is likely at least a 50 to 60m wide, broken and permeable fault zone with an average dip of about 60° toward a dip direction of about 345°. There have also been some indications that the trend of the fault could change to the north, tending to follow the trend of the west wall of the pit.

The most recent geologic interpretation of the Cross Fault indicates that its average orientation is similar to that noted above. However, it would also appear that the trend of the fault zone does not curve to the north and that the width of the fault zone may not be as great as originally thought. Thus, it would seem that only that portion of the west pit wall between about Sections 8 and 12 could be adversely effected by the fault zone. As discussed in our May 11 report, because the fault zone appears to dip more steeply than the interramp slope angle, and to be at least about 30° oblique to the trend of the slope in this area, it will not likely be completely undercut during mining. However, the numerous shear planes within the fault zone, and the generally broken nature of the rock within this zone, will likely cause instability in the vicinity of the haulroad in this area of the pit. In this regard, it is anticipated that bench scale plane and wedge failures will occur along with general degradation of the rock mass. While this could result in there being considerable difficulty in maintaining the haulroad at full design width in this area, it is



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likely that such problems could be overcome by backfilling and buttressing the area of the haulroad in question. Specifically, once mining has reached the 1062m level, it is recommended that sufficient waste rock backfill be dumped into the mined out "slot" south of Section 8 to adequately buttress the haulroad on the west side of the pit.

Northwest Fault

Since our last letter report of May 11, 1992, the Northwest Fault has been exposed on the pit wall in the northwest portion of the pit. Based on the recent site inspection and discussions with Dennis Brown, it would appear that the fault strikes approximately north/south and dips subvertically to the east. While the fault is characterized as a highly broken fault zone that is estimated to be an average of 50m wide, it is likely that the fault pinches and swells, both down dip and along strike.

The fault intersects the bench on which the Vangorda Creek flume is located at the point where the relocated portion of the flume joins the original flume alignment. On the west wall of the pit, the fault was observed in the bedrock just below the overburden/bedrock contact in the vicinity of Section 2E. In this area, it can be seen that downward movement of the eastern fault block has dragged and folded the phyllite such that the S2 foliation now dips up to 30 to 35° eastward (i.e. out of the west wall) rather than about 20 to 30° westward as is typical of the regional S2 foliation dip. Within and northwest of the fault zone, the rock appears to be highly broken, with the orientation of the S2 foliation generally following the regional trend but locally being very erratic and contorted. This area of the pit also appears to be very wet. It is noteworthy that mining will expose a considerable amount of ultimate pit wall in the northwest corner of the pit in the near future. As discussed with Dennis Brown, these new exposures should provide a significant amount of information concerning the lithology and geologic structure in this corner of the pit, and will be an important part of future assessments of pit wall stability in this area.

Based on the information available to date, it would appear that the Northwest Fault will trend essentially north/south and intersect the northwest corner of the pit from about elevation 1074m to about elevation 1060m on the main haulroad. In terms of the fault's influence on pit wall stability in this corner of the pit, it is likely that the portion of the slope below the haulroad will deteriorate rapidly, possibly resulting in some breakback of the haulroad. However, as this portion of the pit slope is only in the order of 30 to 40m high and will not be developed until the late stages of mining, the consequences of instability are felt to be manageable. For example, it may be necessary to



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allow only single lane traffic in the northwest corner for a short period of time, or to slow mine development in that corner of the pit until the ground freezes in winter. Above the haulroad, the benched rock slope is not anticipated to be excessively high, and the overburden slope in the northwest corner is being dozed to a relatively gentle angle. While instability in this area and in the north wall underneath the creek flume does not appear to be a significant problem to date, most of the final slope in these areas has not been exposed. Thus, continued mapping of these portions of the pit slope is recommended.

The potential for the Northwest and Cross Faults to intersect and form a large scale wedge failure does not appear to be great, as it would appear that such a wedge would have a dip direction of about 345 to 360° and a plunge of about 60°, which is steeper than the interramp slope angle of the west wall of the pit. In addition, the line of intersection of the potential wedge would likely be well behind the west wall.

West Wall Overburden Slope North of Section 8

As discussed in our May 11 report, the overburden/bedrock contact on the west wall of the pit, north of about Section 8, is between about the 1104 and 1110m elevations, resulting in a benched overburden slope up to about 30 to 35m high. The overburden appears to be comprised primarily of glacial till that is similar to that exposed at the pit crest in most other areas of the pit. While this till often stands very steeply over limited slope heights equivalent to that of a typical mining bench, at least two slope failures have occurred in this material, and bench faces have been oversteepened to the point where the bench crests are overhanging in some locations. Underlying the till in some places is an oxidized bouldery sand and gravel.

As previously discussed, the northernmost portion of the west wall overburden is being dozed to a relatively flat angle and should not pose any stability problems. However, the west wall in the area between about Sections 2E and 7E has not been flattened and remains oversteepened and susceptible to slope failures in the overburden, particularly where the underlying phyllite has been folded by the Northwest Fault and the S2 foliation dips into the pit at 30 to 35°. In addition, no effective safety berms have been established between the pit crest and the present pit bottom, which is just above the main haulroad that will be in use throughout the remaining life of the pit. To provide an increased level of safety in this area, it is recommended that one of two measures be taken. That is, either a full width safety berm (possibly with a windrow of waste near the outside edge for extra catchment capacity) should be established at the next planned bench elevation (i.e. the 1092m level), or the



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overburden slope should be flattened. If the slope is flattened, however, it may be necessary to move the haulroad at the crest of the pit slightly westward. At least visual monitoring of the overburden benches is recommended if the slopes are not flattened.

East Wall

The east wall of the Vangorda Pit appears much the same as that observed during our previous site visit. While a portion of the slope seems somewhat ragged, and berm widths are limited in some areas, it also appears that good control blasting techniques have been used on the wall. The steeper than average S2 foliation that is present on some of the benches (i.e. up to about 50° dip), and to which some of the bench faces are breaking back to, appears to be flattening at the present pit bottom. This will likely improve the ability to maintain wider safety berms and steeper bench face angles throughout the east wall. Notwithstanding the generally acceptable appearance of the east wall, there are a number of loose boulders on the slope that, if disturbed, would likely roll to the pit bottom. As discussed during the site visit, these boulders should be scaled from the slope.

Vangorda Creek Diversion Bench

The bench on which the Vangorda Creek diversion flume is located generally appears to be in good condition. The only area on this bench where there are signs that movement may be occurring is where the Northwest Fault intersects the bench. In this area, where sideboards have been welded to the flume, the grade on the flume is almost flat, possibly as a result of settlement. Minor cracks in the access road fill were also observed at this location. However, these may have been the result of thawing of fill placed on the access road during last winter's relocation of the flume. While minor breakback is occurring at a few locations along the crest of the flume bench, it is not of sufficient extent to jeopardize the integrity of either the flume or the access road at this time.

Slope Monitoring

As discussed in our May 11 report, it is recommended that prisms be installed along the bench on which the Vangorda Creek flume is located. One of these prisms should be installed beside the flume in the area where the Northwest Fault intersects the flume bench, and where the grade on the flume is flat. Visual inspections of this bench should be carried out on a regular basis and after any blasts in the area. Depending on what measures are taken on the western side of the pit, where there are oversteepened overburden benches, it may be prudent to install two or three prisms in this area of the pit as well.



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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.

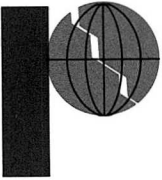
Yours very truly,

PITEAU ASSOCIATES ENGINEERING LTD.

Alan F. Stewart, P.Eng.



AFS/ef



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August 17, 1992

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

Re: Geotechnical Review of Faro and Vangorda Pits

INTRODUCTION

As requested, Piteau Associates Engineering Ltd. has completed a review of geotechnical concerns in the Faro and Vangorda Pits. This review and letter report follow similar reviews conducted in the past; the most recent letter report is dated July 5, 1992.

Mr. A. Stewart visited the mine site on July 30 and 31, 1992. During that time, geologic mapping was reviewed, inspections of the pit walls were made, and results of ongoing pit monitoring were reviewed. Discussions were held with mine personnel regarding these matters.

The following summarizes the results of the geotechnical review. Some general aspects which have already been covered in previous letter reports will not be repeated herein.

FARO PIT

General

At the time of the site visit, mining had been completed in the Faro Pit and some flooding of the pit bottom was occurring. The only activity in the pit was that related to servicing the underground mining, which is due to cease operations at the end of August 1992. Preparations were being made to commence depositing tailings into the mined out pit. Since the previous site visit, spring runoff had reached its peak and flows had receded considerably.

Slope Monitoring

Since our July 1992 report, only five prisms have been monitored on a regular basis. In this regard, one prism in the calc-silicate area and four prisms in the south slump area have been monitored every two or three days on average.



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Results of monitoring in the south slump area indicate that Prisms 27, 30, 32, 33 and 35 experienced peak movement rates of about 75 to 125mm/day in the last week of June. Since that time, movement rates have decelerated to between about 30 and 75mm/day. It is understood that the frequency of rockfalls has also decreased noticeably in the last few weeks. In the calc-silicate area, movement of Prism 19A has gradually slowed from a maximum of about 50mm/day to about 30 to 35mm/day since late June.

Based on the monitoring results, and on the lack of mining in the pit, it is recommended that the monitoring frequency be reduced even further. A frequency of about every seven to ten days for a few key prisms is probably adequate to maintain a general record of slope movement on the east wall.

"AY" and "M" Targets

Other than the apparent likelihood that it will not be economically feasible to mine the "M" target, no new information regarding these two target areas was obtained. The comments and recommendations contained in our report of July 5 are still valid.

VANGORDA PIT

General

At the time of the site visit, mining in the Vangorda Pit had been completed to the 1092m elevation and was progressing on the 1086m level. Overburden mining was complete. While flow in the Vangorda Creek diversion flume had decreased markedly since the last site visit in mid-June, some leakage was observed from the flume. Considerable seepage was being intercepted by sumps along the western side of the pit bottom. Mr. Dennis Brown was continuing detailed geologic mapping of the pit walls. However, as it is understood that he will only be at the mine until the end of August, it is recommended that another geologist be assigned geologic mapping duties.

With regard to the pit design, it is understood that a minor change has been made to the safety berms. Rather than tapering the benches where elevation changes were to be incorporated, the benches have now been altered such that full bench widths are maintained at any given bench level. The north and east walls of the pit will have a continuous safety berm at the 1086m level. It is also understood that the pit completion date has been revised to the middle of February 1993.



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Cross Fault

No additional information beyond that discussed in our July 5 report is available for the Cross Fault. Thus, the comments and recommendations contained in the previous report are still considered to be valid.

Northwest Fault

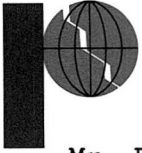
Since our last letter report of July 5, additional mapping in the area of the Northwest Fault has determined that two separate faults actually exist. Based on the recent site inspection and discussions with Dennis Brown, it would appear that the originally defined fault is a strike slip fault that strikes approximately north/south and dips subvertically to the east. While the fault is characterized as a highly broken fault zone that is estimated to be an average of 50m wide, it is likely that the fault pinches and swells, both down dip and along strike. As previously determined, this fault intersects the bench on which the Vangorda Creek flume is located at the point where the relocated portion of the flume joins the original flume alignment. However, the fault now appears to intersect the west wall of the pit 50 to 100m further south than originally thought. As previously observed on the west wall, downward movement of the eastern fault block has dragged and folded the phyllite such that the S2 foliation now dips up to 30 to 35° eastward (i.e. out of the west wall) rather than about 20 to 30° westward as is typical of the regional S2 foliation dip.

The second fault in the area appears to strike subparallel to the north wall of the pit and dip about 60° into the pit, having an estimated dip direction/dip of about 125/60. This fault, which to date has only been seen to cause breakback of a few bench faces on the north wall, is thought to be the dip slip fault that truncates the Vangorda orebody at the north end of the pit. The width of the fault is estimated to be about 20m; however, as for the other fault, it likely pinches and swells along strike and down dip. Field observations indicate that this fault is older than the subvertical strike slip fault.

Within and northwest of the two fault zones, the rock appears to be relatively broken, with the orientation of the S2 foliation being erratic and contorted. Two dominant orientations are a 30° to 40° dip into the pit and a 15° to 40° northeast dip along the north wall. This area of the pit also appears to be very wet.

Although there are two faults in the north wall of the pit, rather than just one as originally anticipated, the influence that these faults could have on the stability of the pit slopes does not appear to be significantly different than that discussed in our last report. That is, one or both of these faults is

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expected to intersect the north and northwest portions of the main haulroad from about elevation 1074m to about elevation 1060m. In terms of pit wall stability in this area of the pit, it is likely that the portion of the slope below the haulroad will deteriorate rapidly, possibly resulting in some breakback of the haulroad. However, as this portion of the pit slope is only in the order of 30 to 40m high and will not be developed until the late stages of mining, the consequences of instability are felt to be manageable. For example, it may be necessary to restrict traffic to single lane in the northwest corner for a short period of time, or to slow mine development in that corner of the pit until the ground freezes in winter. Above the haulroad in the northwest corner of the pit, the overburden slope has been dozed to a relatively gentle angle. While instability in this area and in the north wall underneath the creek flume does not appear to have been a significant problem to date, about 30 to 35m of slope height is still to be exposed before the haulroad is established. As the rock mass in this area is expected to be highly fractured, possibly with adverse S2 orientations, continued mapping of this portion of the pit slope is recommended. To minimize instability in this area, it will be most important to use careful control blasting and excavation techniques and to avoid overdigging the bench faces. Every effort should be made to establish a full width safety berm at the 1086m elevation, as this berm will be the last catchment above the main haulroad. ✱

The potential for either of the two Northwest Faults and the Cross Fault to intersect and form a large scale wedge failure appears low.

West Wall Overburden Slope

As previously discussed, the glacial till overburden/bedrock contact on the west wall of the pit is between about the 1104 and 1110m elevations, resulting in a benched overburden slope up to about 30 to 35m high. The northernmost portion of the west wall overburden has been dozed to a relatively flat angle and should not pose any stability problems. However, the west wall in the area between about Sections 2E and 7E has not been flattened and remains oversteepened and susceptible to slope failures in the overburden, particularly where the phyllite has been folded by the Northwest Fault and the S2 foliation dips into the pit at 30 to 35°.

North of Section 4E, a berm has been established at the 1110m level, while south of Section 8E, there is a safety berm at the 1104m elevation. Between Sections 4E and 8E, no effective safety berms have been established between the pit crest and the 1092m level, and it appears that the slope has been steepened slightly since the last site visit. However, a 12m wide safety berm is to be left along the west wall at the 1092m elevation, which is about 10 to 20m above the main haulroad that will be in use throughout the remaining life of the pit. Some e



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cracks and settlement were observed in the overburden along the west wall, although most did not appear to be fresh.

The provision of a safety berm at the 1092m level should provide reasonable catchment for small failures from the overburden, particularly after freeze up. However, the potential for a failure large enough to spill over the safety berm onto the haulroad cannot be discounted. Thus, it is recommended that visual monitoring of the overburden slopes be conducted on a regular basis. In this regard, the survey base station at the crest of the west wall should be a suitable location to conduct such monitoring. Depending on the results of the visual monitoring, and access to the slope, the use of prisms could also be considered.

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East Wall

The east wall of the Vangorda Pit appears much the same as that observed during previous site visits. While a portion of the slope seems somewhat ragged, and berm widths are limited in some areas, it also appears that the recently established 1104m safety berm is performing well. The steeper than average S2 foliation that is present on some of the benches (i.e. up to about 50° dip), and to which some of the bench faces are breaking back to, appears to be continuing, rather than flattening as anticipated during our last site visit. Some blasting difficulties, in the form of hard toes, have been experienced; however, blasting damage to the east wall appears to have been kept to a minimum.

Since the last site visit, the loose boulders that were observed near the pit crest have been scaled from the slope. The only potential bench scale failure that was noted is a 20 to 30m long wedge between about the 1110 and 1120m levels. This feature appears to have an apparent plunge of about 45° to 50°, and would likely fail as a number of small blocks, starting at the southern end of the wedge. While it is anticipated that most, if not all, of the debris from this wedge would be retained on the 1104m safety berm, it is possible that some rubble would spill to the pit bottom. Thus, it is recommended that the wedge be monitored. If possible, Prism 5, that is presently positioned upslope of the wedge, should be relocated to the top of the wedge near its southern end. Visual monitoring of this block should also be conducted on a regular basis, particularly following blasts in the area and if access is not sufficient to allow Prism 5 to be relocated.

JS

Vangorda Creek Diversion Bench

As discussed in our letter report of July 5, the bench on which the Vangorda Creek diversion flume is located generally appears to be in good condition. No specific stability concerns are apparent at this time.



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Slope Monitoring

Five prisms were installed between the 1130 and 1152m elevations on the north and east walls of the pit in early July. While initial monitoring results indicate that no slope movement is occurring, very little data has been collected on which to base this preliminary conclusion. As previously discussed, visual inspections of the pit walls, particularly of the flume bench and of the west overburden slope, should be carried out on a regular basis and after any blasts. The need for additional prisms should be evaluated on an ongoing basis.

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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