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Dear Michelle

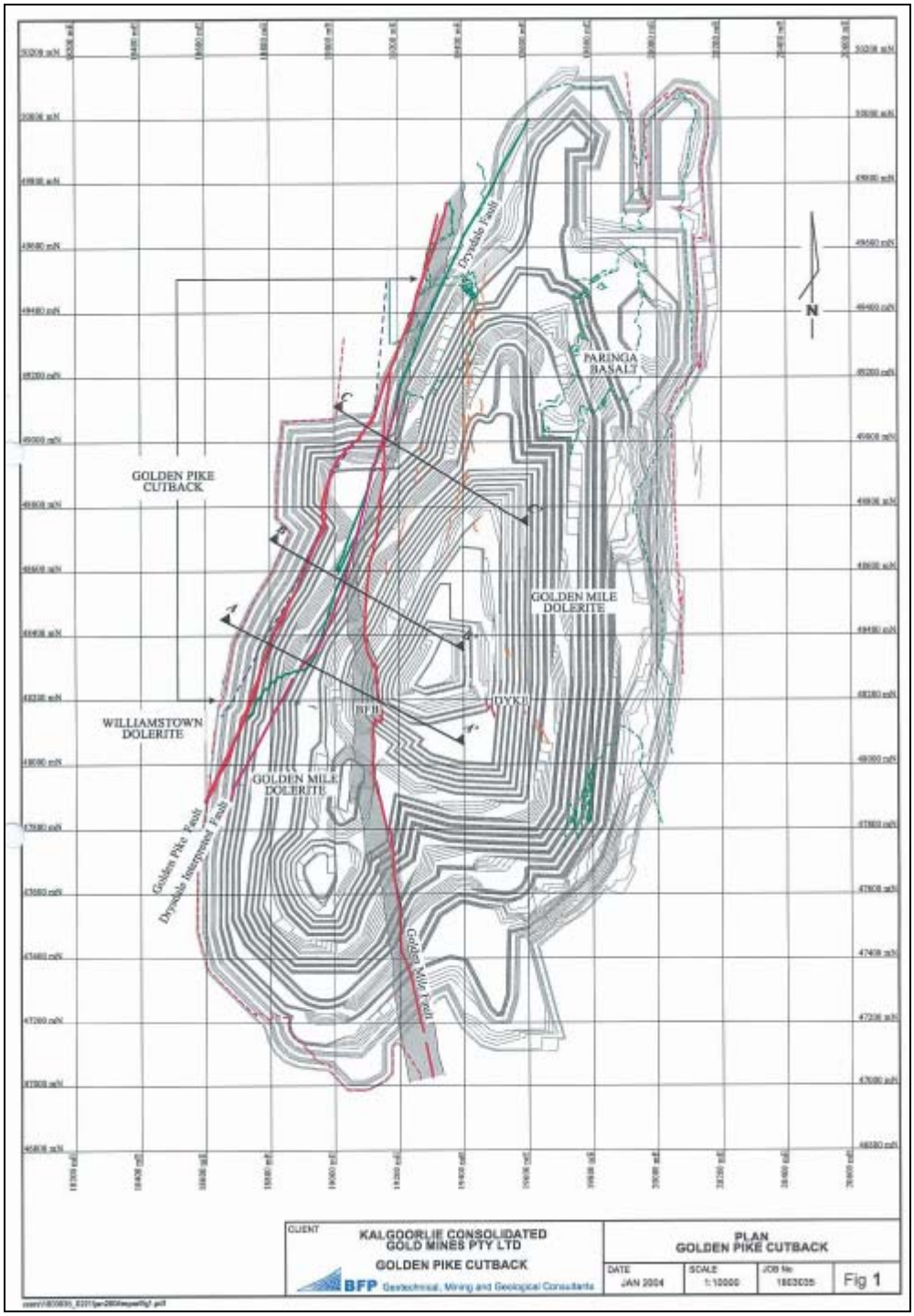
RE INDEPENDENT REVIEW OF GOLDEN PIKE CUTBACK GEOTECHNICAL DESIGN

Please find the following review as per your request dated 14 February 2007.

1 INTRODUCTION

Will Sarunic (Principal Geotechnical Consultant) of Snowden Mining Industry Consultants (Snowden) has been requested by Kalgoorlie Consolidated Gold Mines (KCGM) to undertake an independent review of the geotechnical assessment process for the proposed Golden Pike Cutback of the Super Pit, and provide responses to public submissions associated with this cutback. The cutback is located on the west side of the current Super Pit (Figure 1) and is approximately 1,300 m in length at the crest.

Figure 1 Proposed Golden Pike Cutback location



INFORMATION PROVIDED BY KCGM

KCGM provided the following request to Snowden with respect to the scope of work and information sources to undertake this work.

As discussed KCGM has been asked by Government to get an Independent Review on the studies undertaken regarding Pit Wall Stability for the proposed Golden Pike Cutback. This forms part of the Public Environmental Review for the Fimiston Operations Extension

1.1 SCOPE OF SERVICES

The scope as provided by KCGM is as follows

The review of the attached documents will be in two parts outlined below:

1 To review the attached reports and conclusions by BFP and report based on the following criteria:

1.1 Comment on the validity of the outcomes and conclusions reached as applicable to the Golden Pike Cutback; and

1.2 Comment on the level of confidence in the conclusions drawn.

2 To consider issues directly relating to pit wall stability raised during the public comment period for the Public Environmental Review:

2.1 Review public comments for relevance.

2.2 Provide to KCGM written responses to public comments where appropriate.

1.2 LINKS TO REPORTS

BFP Report - Geotechnical Assessment of the Golden Pike Cutback

- http://www.superpit.com.au/uploaded/publications/App%20H1%20-%20Geotechnical%20Assessment%20Golden%20Pike%20Cutback%20Feb%202004%20(3,550%20KB)_408.pdf

BFP Report - Requirements for Pit Abandonment for the Golden Pike Cutback

- http://www.superpit.com.au/uploaded/publications/App%20H1%20-%20Requirements%20of%20Pit%20Abandonment%20and%20Design%20for%20Golden%20Pike%20Cutback%20July%202005%20(4,260%20KB)_410.pdf

Additional to this KCGM also provided a link to the Public Environmental Review for the Fimiston Operations Extension which forms the parent document for this extension request.

- http://www.superpit.com.au/uploaded/publications/KCGM%20Fimiston%20Open%20Pit%20Extension%20PER%20Main%20Report%20Sept%2006%20(4,790%20KB)_388.pdf

1.3 PUBLIC SUBMISSIONS – PIT STABILITY

The following presents a summary of the public submission queries related to pit wall stability. Full details of each of the submissions related to pit wall stability were supplied by KCGM.

Depth Increase

There is concern that there is an increase in the potential of pit wall failure as the open pit gets deeper.

Submissions Reference

This issue was raised in submissions 10, 11, 13, 15 17, 18, 21, 27, 30 and 33.

Abandonment

The DoIR Guidelines for Pit Abandonment should be adhered to.

Submissions Reference

This issue was raised in submissions 11, 17 and 21.

Pit Water

There is concern that water in the pit will impact on stability especially the old workings.

Submissions Reference

This issue was raised in submissions 10, 11, 18 and 21.

Old Workings

There is concern that old underground workings will impact on stability of the open pit.

Submissions Reference

This issue was raised in submissions 10, 15, 18 and 21.

2 SNOWDEN REVIEW

The Snowden review, as per the scope, was carried out in two stages:

- Firstly, a review of the supplied BFP documentation as to the validity of the outcomes and conclusions reached by BFP and comment on the level of confidence attached to these.
- Secondly and at a later date, review the public submissions for relevance and provision of draft responses to these.

It should also be noted that Snowden has used information gained from a recent site visit to the Super Pit to assess the performance of current slopes and the general operating practices, and assuming these continue, the likely impact of design implementation upon the performance of the proposed Golden Pike Cutback.

2.1 BACKGROUND INFORMATION RELEVANT TO THIS REVIEW

Key points which to be considered in relation to this review:

- Snowden has reviewed two documents compiled by BFP Geotechnical Consultants. The first of these (Geotechnical Assessment of the Golden Pike Cutback, Feb 2004) is a review of work undertaken by KCGM. This report reviewed the KCGM proposed slope design for the Golden Pike Cutback and utilised an alternate methodology (MRMR) to corroborate the proposed slope designs.
- The groundwater profile is assumed to be below the pit floor due to dewatering from the much deeper underground workings in the BFP Feb. 2004 report.

2.2 KEY ASPECTS OF THE PROPOSED GOLDEN PIKE CUTBACK DESIGN

Several key aspects of the proposed Golden Pike Cutback design need to be considered when assessing the impacts of the design:

- The proposed pit will be approximately 600 m deep.
- The proposed crest of the Golden Pike Cutback slope is situated to the west of the majority of the underground workings and as such is expected to have limited intersections with these workings in the upper half of the slope.
- The expected mining life of the slope is approximately 10 years until 2017
- The proposed new Golden Pike Cutback will be excavated predominantly through the Williamstown and Golden Mile Dolerites with some intersection within the Black Flag Beds and Paringa Basalt.

2.3 SLOPE PERFORMANCE TO DATE AT KCGM

The proposed new Golden Pike Cutback is located on the western side of the 'Super Pit' (see Figure 1). The dominant slope orientation being considered is the east south easterly dipping west wall slopes. The cutback slopes will be excavated through weathered Williamstown Dolerites and fresh Williamstown and Golden Mile Dolerites, Black Flag Beds and the Paringa Basalt. Within the current pit there is good exposures and therefore slope experience for the fresh Golden Mile Dolerite, Black Flag Beds and the Paringa Basalt.

Based on the significant history of open pit mining at the Super Pit (14 years) and the previous underground mining (>50 years), Snowden believes that there is a significant understanding of the rock masses, the defect patterns and the likely performance of any excavation within them.

2.3.1 Slope performance assessment

As is evident in Figure 2 and Figure 3 the performance of the current west wall slopes has been good. There are limited areas of instability noted and minimal rock fall debris (except for those associated with intersections with underground workings). Rock fall debris is increased below areas where the current slope intersects the underground workings (refer Figure 2 and Figure 3). Based on a visual assessment of the current slopes, these slopes are performing exceptionally well, well within acceptable batter scale instability tolerances. Additionally the blasting and batter cleanup practices and the general pit housekeeping standards are exceptionally high, allowing for potential to increase slope angles.

Figure 2 Super Pit west wall central

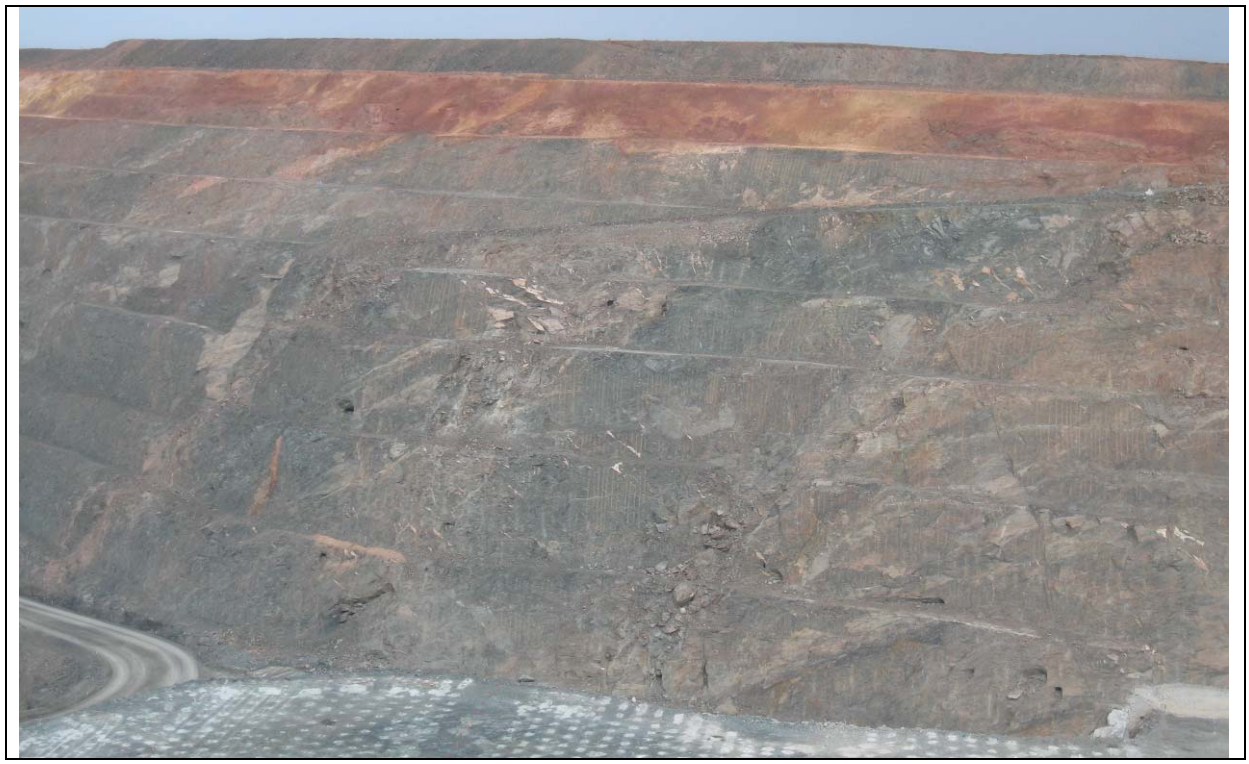
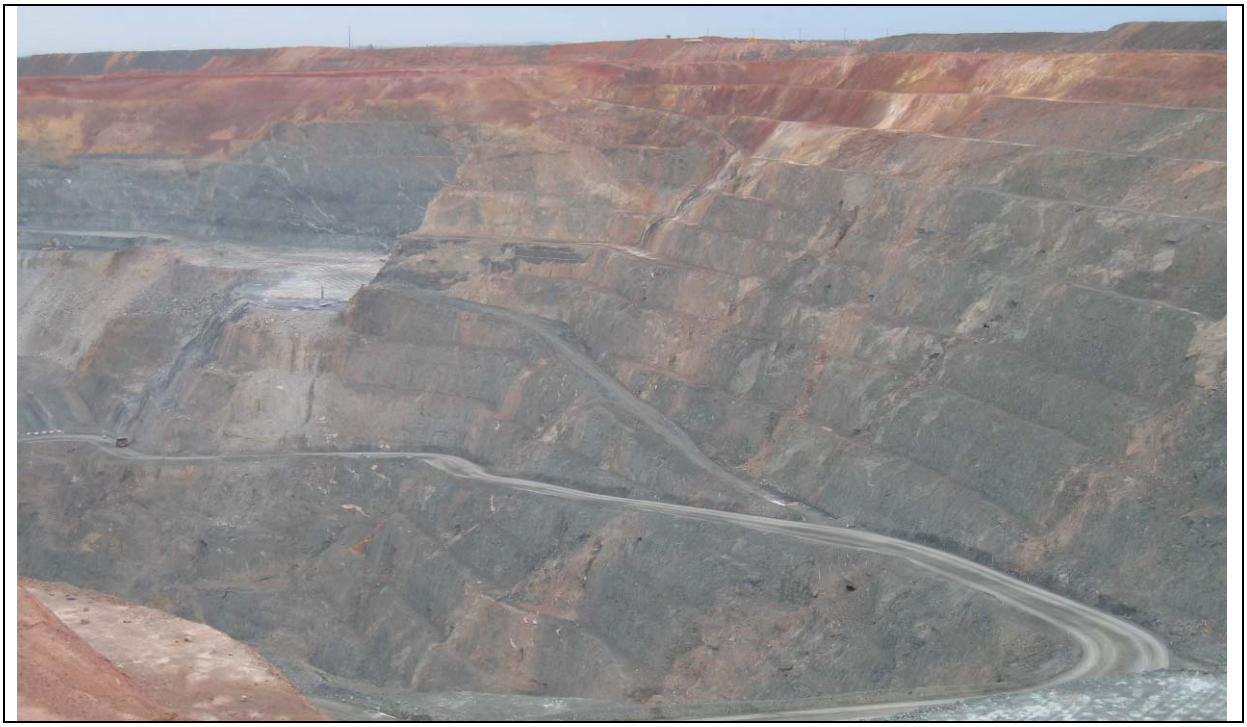


Figure 3 Super Pit west wall south



3 GOLDEN PIKE CUTBACK ENGINEERING ASSESSMENT

BFP undertook a review of the proposed Golden Pike Cutback pit wall design in February 2004. The following provides a brief discussion as to Snowden's view on the geotechnical engineering design work carried out by BFP to establish the Golden Pike Cutback design.

3.1 ROCK MASS

Based on the information provided in the BFP report entitled Geotechnical Assessment of the Golden Pike Cutback, rock mass strengths, estimated for the purpose of design, have been based on the assessment of data obtained from 43 diamond drill holes and utilising the RMR system (Rock Mass Rating System developed by Bieniawski see Hoek Kaiser & Bawden[1] for description). With the exception of the Williamstown Dolerite all other stratigraphic units have a significant number of drill hole intercepts. The rock mass in-put data for the Williamstown Dolerite has been supplemented with mapping data obtained from the nearby Union Club Pit which is located 5 km to the north.

A summary of the RMR data for the various rock mass domains is provided in Table 1

[1] Hoek, E., Kaiser, P.K., and Bawden, W.F., 1995: *Support of Underground Excavations in Hard Rock*, Pub. A.A. Balkema Rotterdam.

Table 1 RMR Summary

Stratigraphic Unit	Weathering	RMR_{89}	Classification	GSI[1]
Williamstown Dolerite	Weathered	47	Fair Rock	42
	Fresh	62	Good Rock	57
Golden Mile Dolerite (west of BFB)	Weathered	58	Fair Rock	53
	Fresh	64	Good Rock	59
Black Flag Beds	Fresh	62	Good Rock	57
Golden Mile Dolerite (east of BFB)	Fresh	68	Good Rock	63
Paringa Basalt	Fresh	77	Good Rock	72
[1]. GSI = RMR_{89}-5 (see Hoek, Kaiser & Bawden 1995)				

Snowden, with respect to assessing the likely rock mass shear strength within the Golden Pike Cutback, considers the quantity of data and process undertaken by BFP to determine rock mass strength as being adequate and in line with industry practice.

3.2 UBIQUITOUS DEFECTS AND MAJOR STRUCTURES

Ubiquitous defect patterns for the various rock masses have been interpreted from both geotechnically logged diamond drill core and mapping of pit and underground exposures. This has led to the identification of a number of dominant defect patterns within the Golden Pike Cutback area. Of the recognised defect patterns, seven sets occur within the Paringa Basalt and six sets occur within the remaining stratigraphy, namely the Williamstown and Golden Mile Dolerites and the Black Flag Beds. It should be noted that a majority of the recognised defect sets have steep dips, typically greater than 60°, one set with a shallow dip (13°) and limited defects with intermediate dips. The intermediate dipping sets have dip directions towards the west and south west and therefore are unlikely to be problematic for the Golden Pike Cutback which has walls that dip to the east and south east.

Large scale structures such as the Golden Mile or Golden Pike Fault are well understood at KCGM with a large quantity of mapping data available from both open pit and underground mapping programmes. Additionally these structures are typically vertical or sub vertical and therefore are less likely to have a significant impact upon slope stability.

Snowden, with respect to assessing the likely defect patterns within the Golden Pike Cutback, considers the quantity of data and process undertaken by BFP, to determine impact of defects upon slope stability as being adequate and in line with industry practice.

3.3 SEISMICITY

Based primarily on KCGM's precedent experience and some stability assessments, the likely impact of both mining induced and natural seismic events has been evaluated as part of the design process. Snowden, with respect to assessing the likely impact of seismicity upon the Golden Pike Cutback, considers the approach undertaken by BFP as being adequate and in line with industry practice.

3.4 SLOPE DESIGN

Slope design for the Golden Pike Cutback has been based on both previous slope experience at the Super Pit as well as slope experience with the Williamstown Dolerite from the Union Club Pit located 5 km to the north. Additionally, an assessment of kinematic failure potential has been undertaken to assess the likely impact of recognised defect patterns upon batter slopes. Overall slopes have been assessed using the rock mass strength information summarised in Section 3.1. Further checks on slope design have utilised the Slope Stability Chart developed by Haines and

Terbrugge[2] and the various rock mass classifications presented above. Note that Snowden considers that utilising this method in isolation is not adequate for large scale slope design as it does not explicitly address likely failure mechanisms, but used in conjunction with other methods and also slope experience it can be a useful tool.

Given that the proposed Golden Pike Cutback will have slopes greater than 600 m deep a potential failure mechanism which in Snowden's opinion has not adequately been assessed is that related to Stress induced failure. Snowden believes that despite the good slope performance to date, that given the increased scale of the slope from current experience and the likely implications of a slope failure that some degree of uncertainty associated with the proposed Golden Pike Cutback design does still exist. This conclusion is supported by analyses undertaken by BFP during the design of the pit abandonment bund and further discussed in sections 4 and 5

4 PIT ABANDONMENT BUND

BFP undertook a second assessment (BFP 2005) of the Golden Pike Cutback design, primarily to assess the zone of influence of any likely failure and therefore determine a pit abandonment bund location which varies from the generic DoIR guidelines. This piece of work did not assess kinematic stability but carried out detailed stress analysis using RocScience's 2D PHASES program. The models were calibrated against current slope experience and slope monitoring data following which, modelling of the new proposed Golden Pike Cutback was undertaken. Three sections were assessed, two orientated east west along northing's 48,700 mN and 48,800 mN and one orientated perpendicular to the proposed pit slope referred to as Oblique. The results of these analyses suggest that the design for the Golden Pike Cutback have factors of safety of greater than 2. Based on this assessment and the performance of fresh rock slopes to date at the Super Pit, BFP concluded that the potentially unstable zone will be limited to the weathered material and that this should be determined by projecting a 25° line from the position where the base of weathering intersects the proposed pit slope through to ground surface. The pit abandonment bund, which in this case is actually the much larger Environmental Noise Bund, should then be located 10m beyond this line.

Snowden has the following comments regarding this assessment

- Snowden understands that the modelling undertaken by BFP has adopted an 'elastic' material behaviour model (as it is not clear in the report). The impact of this is that the material in the models will never yield/fail and therefore will not shed load should rock strength/stress ratios fall below unity.
- Two of the three sections assessed run east west and therefore assess an apparent dip slope (i.e. flatter than actual) and therefore the conclusions drawn from these results maybe inconsistent with actual slopes.
- Results presented (see BFP 2005, figure 27 and 30) show areas where Strength Factors (i.e. ratio of strength to stress and Effective Factor of Safety) are less than 1.0 under the Golden Pike Cutback slope.
- The impact of seismicity and pit flooding has only been assessed for the apparent dip section 48,700 mN and therefore the conclusions drawn from these results maybe inconsistent with actual.

[2] Haines, A., Terbrugge, P.J., 1990: *Preliminary Estimation of Rock Slope Stability Using Rockmass Classification*, Published in the ISRM Journal.

5 SLOPE DESIGN REVIEW SUMMARY

Based on Snowden's review, the following summary comments are made:

- The quantity of data based on 43 drill holes and inpit and underground mapping is greater than most other mines would use for the design of a cutback at this scale
- Current operating practices and the results achieved are exceptional and therefore the continuation of these will ensure any proposed design is met and that there will be no adverse impacts upon slope stability
- The process undertaken to assess limit equilibrium and kinematic sliding leading to the development of slope design criteria for the Golden Pike Cutback are in line with industry practice.
- Given that the proposed Golden Pike Cutback will have slopes greater than 600 m deep a potential failure mechanism which has not been assessed as part of the Geotechnical Assessment of the Golden Pike Cutback, is that related to stress induced failure.
- Conclusions drawn from the 2D stress analyses undertaken for the assessment of the pit abandonment bund maybe inconsistent with actual as the key geotechnical section used for all assessments is oblique to the pit slope and therefore assesses an apparent dip slope (i.e. a slope that is flatter than actual).
- Notwithstanding the preceding comment, stress analyses presented in the Pit Abandonment Bund assessment indicate stress induced slope failure is unlikely whilst the ground water levels are drawn down as the pit is mined.
- Zones of low (less than 1) Strength Factor presented in the Pit Abandonment Bund assessment indicate rock failure within the modelled slope as ground water returns to it's natural levels once mining (and pumping) has ceased. The implications of this have not been addressed further by the design studies.

6 SNOWDEN RESPONSE TO PUBLIC COMMENTS

6.1 SUBMISSIONS RELATING TO DEPTH INCREASE

There are concerns with respect to:

- an increase in pit depth will lead to an increase in potential for pit slope failure
- location and size of the SEZ with respect to an increased pit depth.

Snowden concurs with the view that in general terms there is increased potential for failure for any given pit slope design with increasing pit depth. However in KCGM's case this is mitigated to a large degree by the good slope experience, a history of good design implementation practices and thorough assessment of the likely ground conditions prior to excavation but further work to assess the long term stability is required.

It is Snowden's understanding that the SEZ was implemented to mitigate risk's associated with fly rock (BFP Report - Geotechnical Assessment of the Golden Pike Cutback, Appendix B). Snowden concurs with the initial assessment made by the State Mining Engineer Jim Torlach, in 1992 (from BFP Report - Geotechnical Assessment of the Golden Pike Cutback, Appendix B) where he stated with respect to the SEZ, that the*" distance is determined by potential for fly rock from blasting, as a lesser distance would have sufficed to provide security from future subsidence of final pit wall perimeters".* Snowden believes that this is still the case with the proposed Golden Pike Cutback pit as it is highly unlikely that the entire slope will fail but further work to assess the long term stability is required.

6.2 SUBMISSIONS RELATING TO ABANDONMENT

There are concerns that pit abandonment should rigorously follow the DoIR guidelines. The guidelines have been developed as indicative rules for abandonment and as such each case should be assessed according the local geotechnical conditions and the final proposed excavation at time of completion. Where specific work has been undertaken to establish the likely abandonment zone then this should take precedent over the guideline which is a generic and based on historic experience.

6.3 SUBMISSIONS RELATING TO PIT WATER

There are concerns that water within the pit will impact on the stability of the proposed Golden Pike Cutback after completion of mining. Snowden in general terms concurs with this view that increased water levels in the pit will potentially impact upon stability. However this, in KCGM's case, is mitigated to a large degree by the good slope experience, a history of good design implementation practices and thorough assessment of the likely ground conditions prior to excavation. Snowden believes that the proposed slope will be stable during the life of the mining operation based on slope performance to date, but further work to assess the long term stability is required.

6.4 SUBMISSIONS RELATING TO OLD WORKINGS

There are concerns that old underground workings will impact upon the stability of the proposed Golden Pike Cutback. Snowden concurs that old underground workings could impact upon the stability of the proposed Golden Pike Cutback. Snowden believes that the stability of the proposed slope will be stable during the life of the mining operation based on slope experience to date, but further work to assess the long term stability is required.

7 CONCLUSIONS

Snowden's key conclusions include:

- The proposed slope design for the Golden Pike Cutback, based on current slope performance, appears adequate.
- Based on the stress analyses undertaken for the Pit Abandonment Bund assessment, stress induced slope failure is considered unlikely although this should be checked on geotechnical sections oriented normal to the wall.
- There is uncertainty associated with the location of the proposed Pit Abandonment Bund (Environmental Noise Bund) as the key section (48,700 mN) utilised to draw design conclusions is not perpendicular to the slope and therefore assesses an apparent dip (i.e. flatter) slope.
- There is uncertainty in the Pit Abandonment Bund location assessment, where some reported results (see BFP 2005 Fig. 27 and 30) have low Strength Factors (<1.0) which indicate rock failure and possibly the initiation of slope failure associated with rising ground water levels in the abandoned pit.