# MAGISTRATES COURT *of* TASMANIA

## CORONIAL DIVISION

**IN THE MATTER OF THE CORONERS ACT 1995**

**AND**

**IN THE MATTER OF AN INQUEST TOUCHING THE DEATH OF LARRY PAUL KNIGHT**

**FINDINGS, RECOMMENDATIONS AND COMMENTS of Coroner Rod Chandler following an inquest held in Launceston on 22 July to 25 September and 11 November 2008.**

**26 February 2009**

# TABLE OF CONTENTS

# PREAMBLE

At 9.23pm on Anzac Day 2006 the Beaconsfield Gold Mine ("BGM") at Beaconsfield experienced a local magnitude 2.3 seismic event. It caused multiple falls of ground within the mine, most significantly on the 925m level. Larry Paul Knight ("Mr Knight") was working on that level with two co-workers. He was buried by a fall of ground and suffered fatal injuries. His co-workers were entrapped for 14 days before being rescued. Pursuant to a direction of the Chief Magistrate I have conducted an Inquest into Mr Knight's death and these are my findings, recommendations and comments arising from that Inquest.

# 1. INTRODUCTION

## 1.1. HISTORICAL OVERVIEW

1.1.1. Beaconsfield is a small township located approximately 40 kms. north of Launceston. Gold was first discovered in the Beaconsfield area in 1877, its host source being a geological structure known as the Tasmania Reef. The discovery led to the development of the Tasmanian Gold Mine which operated until 1914 when the mine workings were abandoned and permitted to flood. To that date mining had extended to a vertical depth of 454 metres.

1.1.2. In 1969 steps were initiated by a variety of different and changing entities to re-open the mine and resume gold production. By mid 1996 the mine had been de-watered to a depth of 375 metres allowing for exploration by diamond drilling. This confirmed the presence of high grade ore at depths beneath the old workings. Progressively, decline and access drives were developed enabling the mining of ore from these lower levels. In September 1999 the mine's new treatment plant produced its first gold bar from the new workings. Since then, the mine's development and production of gold has been ongoing to the present. By Anzac Day 2006 the mine's decline had been advanced to just below the 1100 metre level and ore extraction had progressed to the 980 metre level.

## 1.2. MINE OWNERSHIP/MANAGEMENT

1.2.1. From 1992 BGM was owned and operated by the Beaconsfield Mine Joint Venture ("BMJV"). A 51.51% interest in BMJV was held by Allstate Explorations NL ("ALX") and its related companies, namely Allstate Prospecting Pty Ltd ("APPL") and ACN 070164653 Pty Ltd ("ACN"), (together referred to as "The Allstate Group"). The other joint venture participants (collectively known as "the BCD companies") were Beaconsfield Gold NL and its two subsidiaries, Beaconsfield Operations Pty Ltd and Beaconsfield Tasmania Pty Ltd which together held the remaining 48.49% interest. The Allstate Group, as the holder of the majority interest, was entitled to appoint the manager of BMJV and ALX was its appointment.

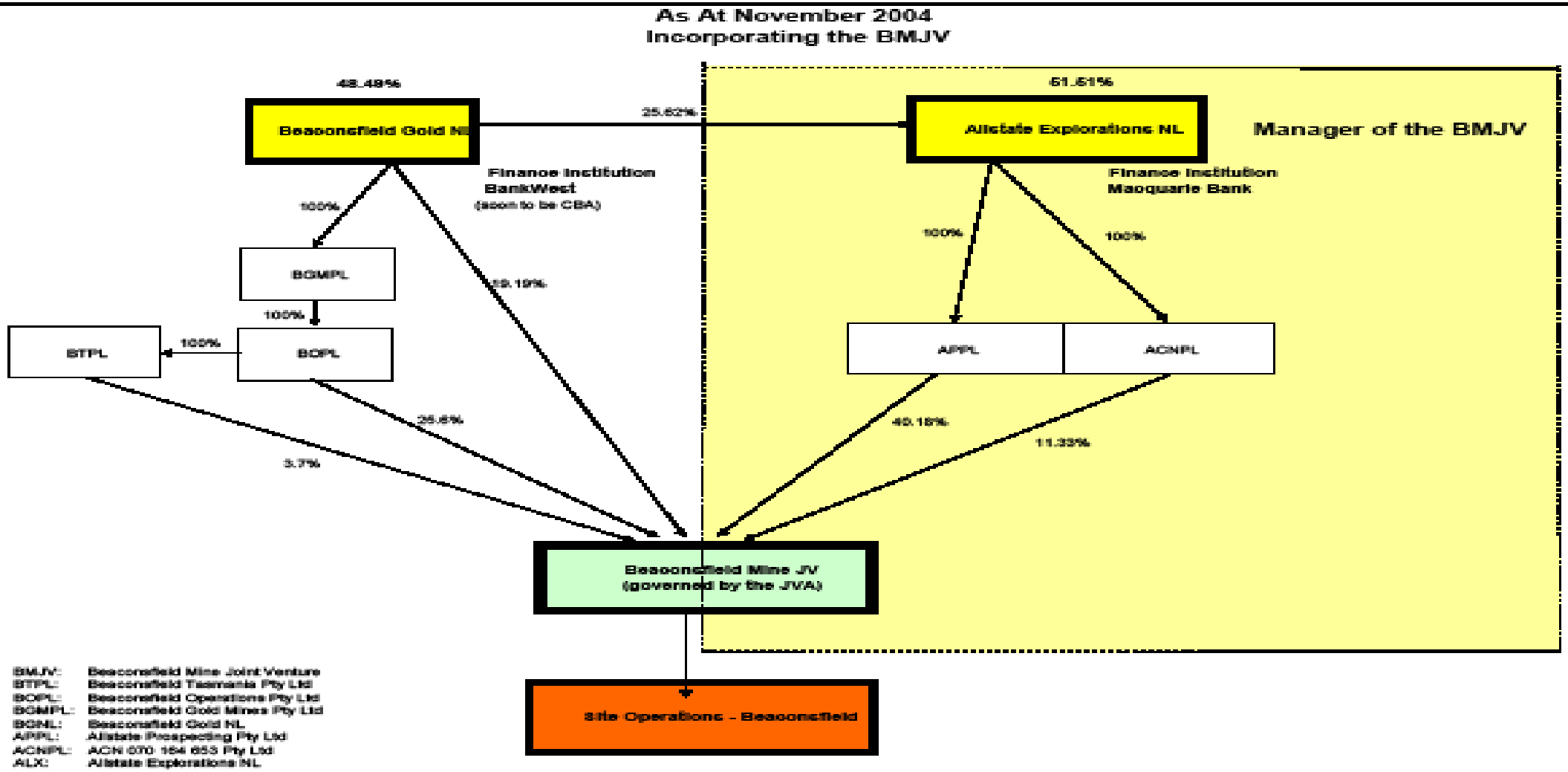


Fig. 1 depicts the corporate structure.

1.2.2. The Allstate Group's financier was Macquarie Bank. The BCD companies were financed by Bankwest.

1.2.3. On 8 June 2001 accountants Michael Ryan and Antony Woodings were appointed joint and several administrators of the Allstate Group when creditors of each of its companies resolved that each should enter into a deed of company arrangement. In his capacity as an administrator of both ACN and APPL Mr Ryan was the representative for both companies on the BMJV management committee. As an administrator of ASX Mr Ryan also assumed responsibility for its obligations as BMJV manager.

1.2.4. The Allstate Group had a secured loan with Macquarie Bank for $21m. In addition it had in place hedging arrangements with Macquarie Bank with a negative value of $13m. Under the lending arrangements Macquarie Bank at all times was entitled to appoint a receiver and manager.

1.2.5. By a Funding Deed dated 21 September 2001 the Allstate Group and the BCD Companies entered an agreement with their bankers to facilitate cash call arrangements and to secure sufficient funds for the operation of the mine. It was a term of the Deed that the banks had a right to accelerate its expiry if, for two consecutive months costs incurred were 15% higher than budget or a cash shortfall was suffered greater than 15%. This term was removed when the parties entered into a Traditional Arrangements Deed dated 11 March 2004.

1.2.6. It needs also to be noted that by the time of the Traditional Arrangements Deed Mr Ryan had negotiated the sale to Macquarie Bank of inter-company loans within the Allstate Group totalling approximately $77m. The sale price was $300,000 which amount was paid out to unsecured creditors with those creditors retaining the right to any further payments. By this arrangement Macquarie Bank became entitled to recover what it could of the inter-company loans as an unsecured creditor.

1.2.7. I am able to determine at this point that there is not any evidence to show that the sale of the inter-company loans to Macquarie Bank was a factor relevant to Mr Knight's death.

1.2.8. ALX, as manager, was responsible for management of the mining operations for which it was entitled to a fee. The manager reported to a management committee constituted by one committee representative each from ACN and APPL and one committee representative from the BCD companies. It met quarterly. ALX, as manager, was entitled to be represented at the meetings. Senior mine management including Mr Matthew Gill, its Resident Manager, attended and made presentations but were not entitled to vote. Representatives of the joint venturers' financiers attended as observers.

1.2.9. The management committee was responsible for the overall management of BMJV's activities at BGM. Its duties included setting the mine's operating budgets and making decisions upon its future operations including capital funding. It had the power to give directions to the manager and to veto any decisions it may make.

1.2.10. The management for BGM was employed by ALX. Mr Gill was the resident manager and he reported directly to Mr Ryan in his capacity as manager of BMJV.

1.2.11. The mine's management structure comprised six divisions headed by six managers, namely a Mill Superintendent, Administration Manager, Occupational Health and Safety Officer, Underground Manager, Mine Maintenance Manager and Chief Geologist. Each of these Divisional Managers reported to the Resident Manager, Mr Gill. Those Divisional Managers who had a direct involvement in the events surrounding Mr Knight's death were the Occupational Health and Safety Officer, Mr Rex Johnson; the Underground Manager, Mr Pat Ball; and the Chief Geologist, Mr Peter Hills. Mr Grant MacDonald, the mine's Senior Geologist, Mr Adrian Penney, its Geotechnical Geologist and Mr Simon Arthur, the Senior Surveyor were all sited in Mr Hills' division and reported directly to him.

1.2.12. Mr Stephen Saltmarsh, the mine's Senior Supervisor along with four Shift Supervisors, two Mining Engineers and two Training Officers all reported directly to Mr Ball as Underground Manager. The Operators or Miners (over 60 in number) reported to their Shift Supervisors.

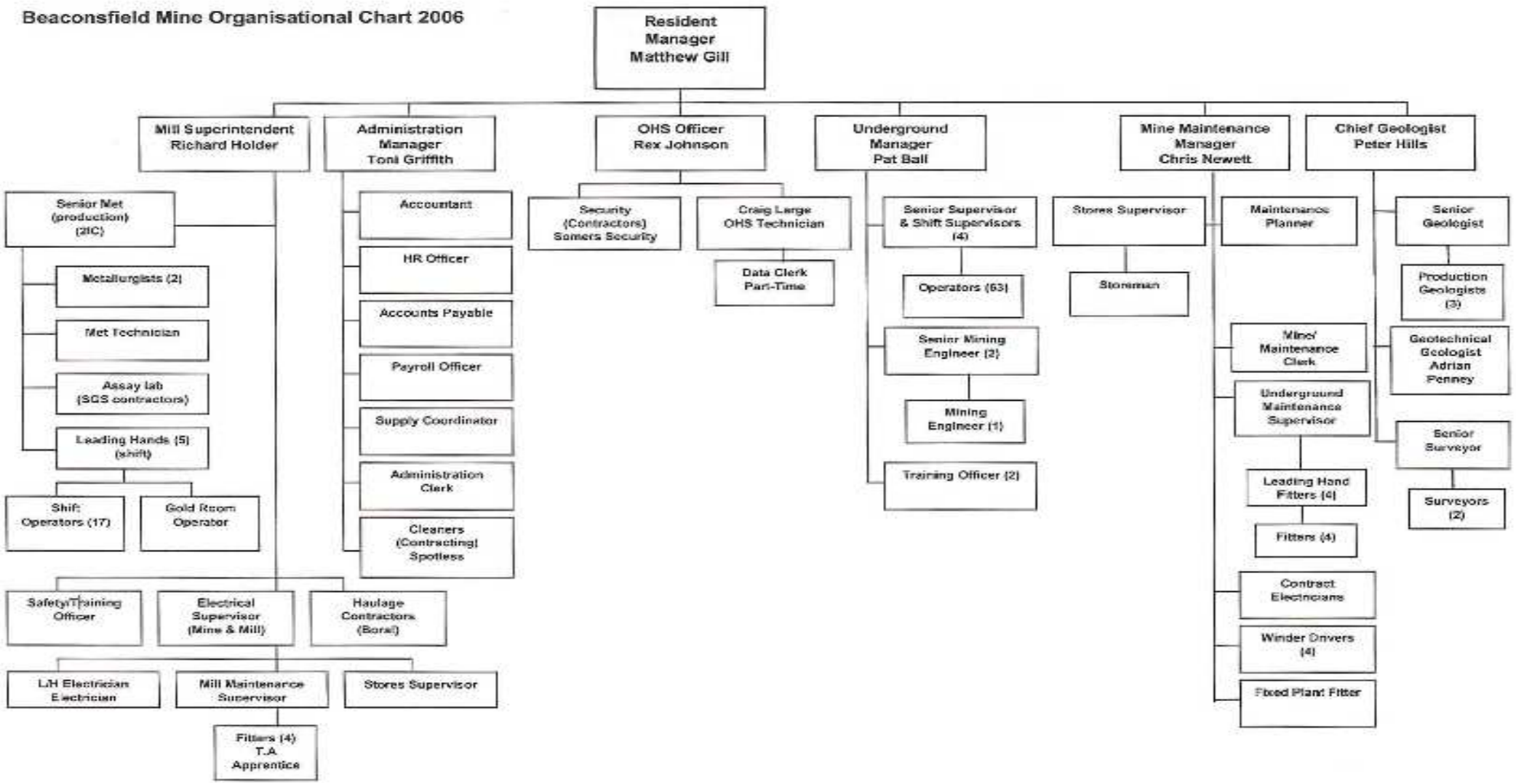


Figure 2 sets out the mine's organisational structure in diagrammatic form.

## 1.3. THE GEOLOGY

1.3.1. Coffey Mining Pty Ltd was engaged to undertake an investigation of the Anzac Day event. Its resultant report ("the Coffey report") includes a concise summary of BGM's geological environment. It's convenient that I set it out here:

> *"The Tasmania Reef is hosted by the Ordovician aged, siliclastic sedimentary sequence of the Salisbury Hill and Eaglehawk Gully Formations of the Denison Group. The dominant lithologies in the underlying Salisbury Hill Formation are medium grained quartz pebble conglomerates (Cabbage Tree Conglomerate, 2CG and Wet Beds) that are inter-bedded with fine to medium grained quartz sandstones. This unit also has thin (<0.1m thick) shale layers. The overlying Eaglehawk Gully Formation is dominated by calcareous quartz sandstones with minor limestone.*
>
> *The host rocks have been subjected to intense faulting and folding that has resulted in the bedding now dipping at approximately 50° - 70° to the northeast. There is a distinctive moderately inclined fold in the stratigraphy that occurs between 965 and 1100m below surface. Regional scale faulting has also allowed the development of transverse shears that dip between 50° - 70° towards the south east and generally transect the stratigraphy approximately perpendicular to strike. It is one of these transverse structures, the Tasmania Shear, which hosts the Tasmania Reef. The Tasmania Shear has locally offset the stratigraphy by approximately 30 to 40m in a right-lateral sense. The Tasmania Shear has been traced over at least 350m along strike and is currently interpreted to be open at depth.*
>
> *The Tasmania Reef has an average width of 2.5m but can range from a few centimetres up to 10m. The reef generally follows the Tasmania Shear structure but numerous instances have been mapped where the reef splays and diverges from the shear. These deviations are generally localised with the exception of the F1 intersection in the western flank of the orebody. The intersection of the Tasmania Shear and the F1 structure is a complex zone with numerous small scale shears. In this instance, mineralisation is hosted by a series of en echelon veins that effectively step across from the through-going Tasmania Shear some 20 m onto a footwall structure. Ore hosted in this system accounts for approximately 10 - 15% of the total ore reserve.*
>
> *The Tasmania Reef itself is the result of a series of fluid injections along the sheared conduit and predominantly consists of laminated vein quartz and laminated ankerite sulphide. Inclusions of strongly altered wall rock in the reef have been identified in geological mapping and can range in size from less than one metre in area to many tens of metres."*

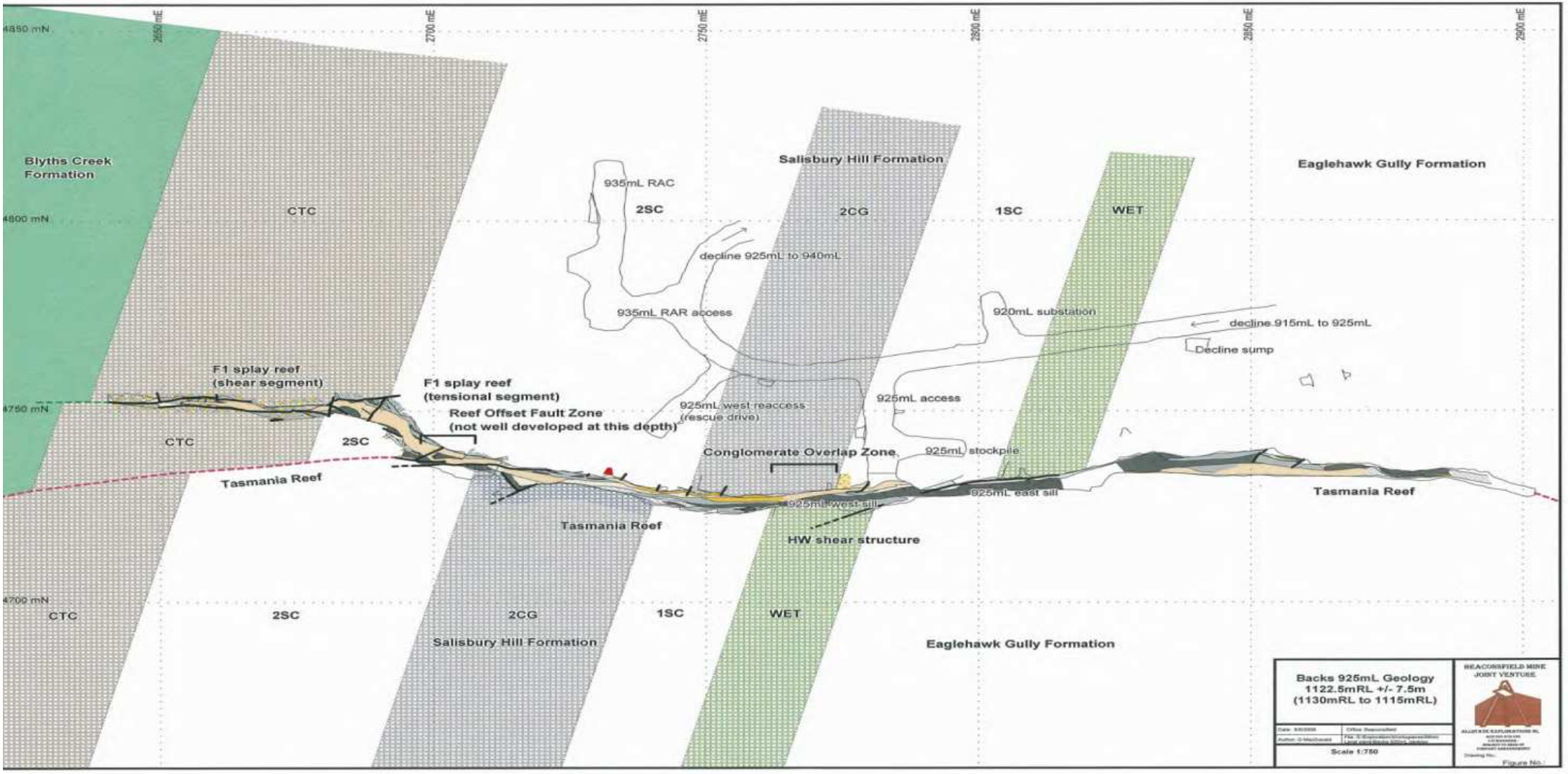


Fig. 3 depicts the geology on 925mL.

## 1.4. STRUCTURES

1.4.1. It is accepted that the mining environment at BGM is affected by shear structures which the authors of the Coffey Report have categorised as follows:

"• *The Tasmania Shear - typically a thin sheared surface that generally forms a discrete hangingwall plane to the quartz ankerite reef. (Note: this includes an unmineralised section which extends from the reef where the F1 intersection departs the shear).*

• *Hangingwall expression of the Tasmania Shear - there is a distinct departure of the reef away from the hangingwall of this structure below 925L - it is currently interpreted that the reef re-joins the shear hangingwall around the 1000L.. (Note: This shear is also variously described as the "C-Shear" or the "C-Hanging Wall Shear").*

• *The F1 Splay Intersection - a complex series of thin (<3cm) clay filled structures effectively offset the reef towards the north-west in the vicinity of the F1 Splay, particularly above 860mL. The F1 splay itself is a series of en echelon tensional gashes linking the Tasmania Reef and the F4 Reef.*

• *Bedding parallel faults - numerous 1 to 3 cm thick clay / chlorite filled structures that can be traced over several tens of metres into the footwall both along strike and down-dip. These shears sometimes have localised offsets of the earlier quartz rich phase of the reef up to 1m across strike. These shears are interpreted to pre-date the ankerite / sulphide phase of mineralisation and hence do not comopletely transect the mineralised reef from footwall to hangingwall. They are not well interpreted by the mine geologists in the hangingwall due to the lack of development but are likely to be as prevalent in the hangingwall."*

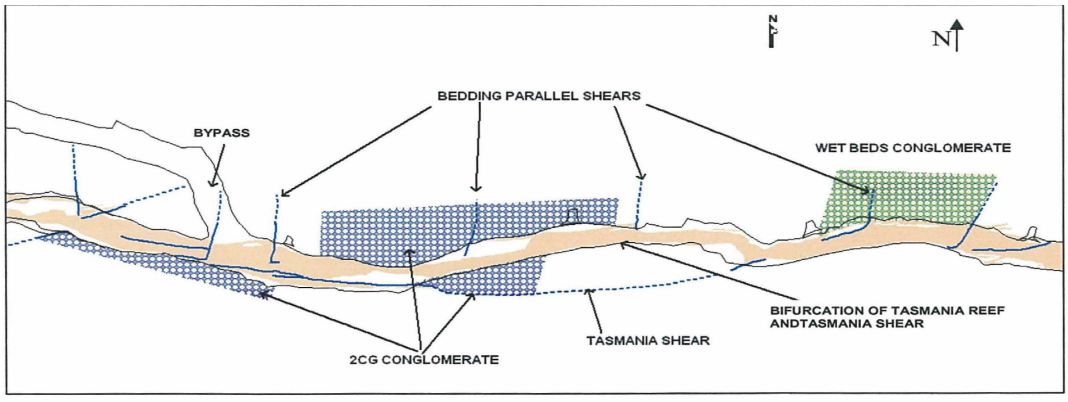


Fig. 4 depicts the structural setting of the 955 level where the departure of the reef from the Tasmania Shear hanging wall is well developed.

## 1.5. ROCK MASS PROPERTIES

1.5.1. By application of the Rock Mass Rating system BGM rated the reef rocks between "fair" and "good" whilst the host rock is classed" good." However, the rock mass properties are better described:

1.5.2. In the Coffey Report which includes this comment:

> *"During site visits to the mine, Coffey Mining have observed that the quartz/ankerite reef material is strongly microfractured. The microfractures are healed discontinuities in the reef that appear throughout this unit. It was noticed that in the initial stages of early drive development that the reef generally behaves as a fairly massive rock unit. However, as mining progresses, it was observed that increased strain causes the reef to break on the pre-existing microfractures. The resultant block size is very small, generally less than 10x10x10 cm. The end product is a cohesionless rock mass with significantly reduced strength. Microfracturing is not as prevalent in the host rocks but has been observed in the immediate footwall rock surrounding the reef."*

1.5.3. And by Professor Kaiser (a Canadian consultant engaged to assist Coffey Mining) who states in his report:

> *"Examination of the Ankerite and Quartz in slightly to highly stressed situations showed that it is highly friable, i.e., when stressed, it fractures and tends to disintegrate into a cohesionless rock mass with very small block sizes (cm- range). As shown in the Table 1, the respective rock mass strength loss due to disintegration is about 50% and the related modulus reduction is about 50 to 65%. It is postulated that very little strain, in the order of 1 to 2%, will be required to cause this transition from the undisturbed to disturbed state or ,from peak to residual strength. In other words, the residual strength could be reached when the HW-FW convergence reaches 4-8 cm in a 4m wide drive."*

## 1.6. MINING LAYOUT/MINING METHOD

1.6.1. It will assist to better understand the circumstances of the Anzac day event if I set out at this point a brief outline of the mine's layout, the mining method and the evolution of that method as mining progressed through to April 2006.

1.6.2. The underground workings at BGM are accessed via a vertical shaft to the 375mL. Below that level access is via a 4.5m×4.5m gently spiralling decline developed in the footwall of the Tasmania Reef. The Reef is accessed from the decline by cross-cuts or access drives. Mining is from ore drives or sills mined along the Reef.

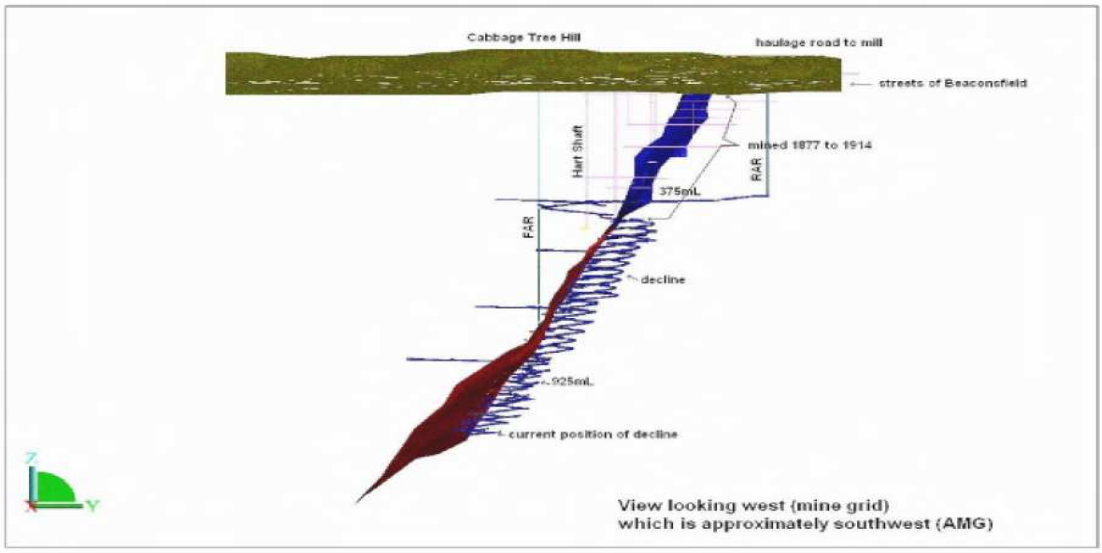


Fig. 5 is a west view which depicts the orientation of the ore body within the Tasmania Reef and shows the location of the decline developed to facilitate access to the ore body.

1.6.3. Ore and waste are hauled by truck from operating areas and hoisted via the vertical shaft to surface using a 6 tonne skip. At surface the materials are separately stockpiled with the ore being re-loaded and trucked to the treatment plant for processing.

1.6.4. Since the re-commencement of mining operations in the 1990's there have been changes in the mining method employed as mining progressed to greater depths and it became necessary to manage the effects of increased stress and induced seismicity (subjects which will be addressed in detail later). For mining below the 840mL a mining design known as the modified Avoca method was adopted. In simple terms it means, "top down, bottom up." It is more fully described in BGM's Ground Control Management Plan ("GCMP") version C in these terms:

> *"The design features of the modified Avoca method are a 38m vertically high block comprising 3 sill drive levels and 4 half upper benching lifts. …….. Figure (6) is a diagrammatic representation of the 38m high block of the modified avoca method and can be described as follows:*
>
> *Initially the three sill drives are excavated at pre-determined levels:*
>
> *1. 1 level at the base of the stoping block (Bottom Sill Level - BSL)*
>
> *2. 1 intermediate sill drive level (ISL) with a floor level 16m above the floor of the BSL*
>
> *3. 1 top sill drive level (TSL) with a floor level 27m above the floor of the BSL*
>
> *Once the BSL is completed, a 5-6 metre half upper stope is extracted (BSL Lift 1). This first lift is required to allow the placement of cemented rock fill (CRF), which is*

*placed to within 4m of the stope backs and the heading rehabilitated. The remaining 7 vertical meters is then stoped out (BSL Lift 2) to the ISL. This lift is filled with unconsolidated waste rock fill or sand fill from the ISL access. The 7m ISL Lift 1 stope is then removed and again, unconsolidated waste rock fill or sand fill is placed, this time from the TSL access. The final crown pillar extraction (TSL Lift 1) is then stoped out. This last retreat is fired out to the CRF floor of the stoping panel above. The CRF at the base of each stoping block is used to provide a competent pillar, allowing 100% extraction of the gold bearing reef and minimizing dilution, which would otherwise be incurred from rock fill above.*

*During stoping of BSL Lift 2 or ISL Lift 1, the stope can stop for a number of reasons (Geotechnical, Scheduling, etc.) and unconsolidated waste rock dumped into the stope. The stope brow will then be re-slotted (Avoca slot) after enough waste fill has been placed, and the heading will then restart production."*

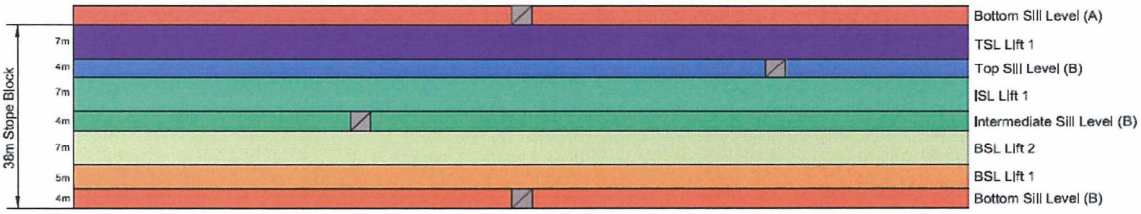


Fig. 6 - Schematic Diagram of the Modified Avoca Mining Method

1.6.5. By about February 2004 the decline had been progressed to a level which enabled the development of the 940mL block. Mining of the access to the 940 level began in March 2004. It was planned for production in the 940mL block to be completed by about July 2006.

1.6.6. The 940mL block was designed to accommodate the modified Avoca method, it being 38m in height and comprising the bottom sill at 940mL, the intermediate sill at 925mL and the top sill at 915mL.

1.6.7. Following the modified Avoca sequence the 940mL sill was mined and filled, this work being completed by August 2005. In September 2005 production commenced in the western end of the 925mL sill when a 15m stope was extracted. The mining of an adjoining 13m stope commenced on 3 October 2005. However, on 9 October a 350 tonne fall of ground occurred on 925mL east of the stope being mined and in an area known as the F1 offset fault zone. This was followed on 26 October by another 350 tonne fall of ground, this time on 915mL but also in the area of the same fault zone. This second fall of ground caused BGM to cease its mining of the 940 block until it determined whether production could be safely resumed.

1.6.8. Mining on 925mL re-commenced in February 2006. In the intervening period BGM had sought and received advice from multiple industry consultants upon the feasibility of safely mining those parts of the mine affected by seismicity, including the 940 block. I will be considering in detail the role of these consultants and their advice later in these findings. At this point it is sufficient to observe that following the involvement of the

consultants a decision was taken by BGM to abandon the modified Avoca method and instead to proceed with an alternative extraction method which it labelled "checkerboard" and which it was satisfied would reduce the risk of falls of ground by better alleviating the high levels of stress in the top sill of the stoping block and by reducing the occurrence of large seismic events on the Tasmania Shear.

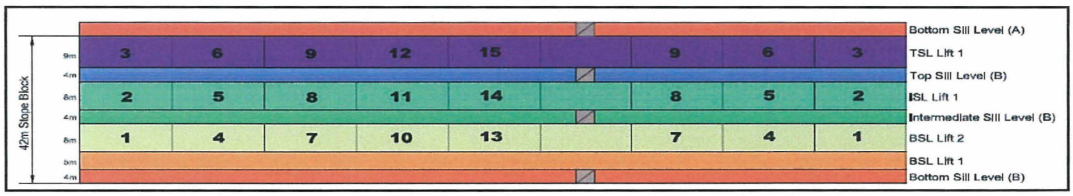


Fig. 7 is a diagram of the checkerboard mining method designed for a 42m high stoping block.

1.6.9. A comparison of Fig.6 with Fig. 7 shows that checkerboard principally differs from the modified Avoca method in that it requires each sill to be mined in small panels (set at about 20m each) and for each panel, once mined, to be backfilled before proceeding by mining the panel above. In simple terms the checkerboard method involves a more incremental and vertical approach than the modified Avoca method.

1.6.10. It was not possible, when mining resumed in February 2006, for the full checkerboard method to be employed in the 940 stoping block because the entire bottom sill and the western-most portion of the intermediate sill had already been mined. Other changes to the checkerboard sequencing were also made because of ground conditions. I will deal with these in more detail later.

## 1.7. GROUND SUPPORT

1.7.1. Mining excavations, whether they be for development or production purposes, require a ground support system to maintain their integrity.

1.7.2. A factor relevant to ground support design is whether dynamic loading is anticipated. This can arise from repeated loads, moving loads, impact loads, blast vibrations or seismic waves. It contrasts with static loading which arises from forces that are applied slowly and then remain nearly constant with time. Where dynamic loading is anticipated the ground support components should possess a yielding capacity.

1.7.3. BGM had available a range of components which could be utilised for ground control, both in dynamic and in static conditions. They were:

1.7.4. **Split-sets.** A split-set is a friction bolt or dowel consisting of a slotted high strength steel tube and face plate. Split-sets are installed by pushing the bolt into a slightly undersized hole. The resulting bolt deformation generates a frictional force between the bolt and the rock. When the bolt is loaded axially, this force resists motion.

Each split-set has a plate for surface anchorage. They were available at BGM in 4 different lengths; ie 0.9m, 1.5m, 1.8m and 2.4m. The length used in the 915 and 925 levels at the time of the Anzac day rockfalls was 2.4m.

1.7.5. **Cable bolts.** A cable bolt is a long steel cable which is inserted and then grouted into the rock it is intended to support. There are many different types. The standard used at BGM in static conditions was a single strand Garford bulbed cable bolt. However, in wide excavations in ore drives where seismicity or ground movement was expected 6.5m dynamic cable bolts were available. These dynamic cable bolts incorporate a mechanism that allows the cable to pull through a mechanical anchor grouted into the rock at a pre-determined load allowing about a 0.6m deflection. Another method of using cable bolts was to de-bond the bolts for a certain length (usually about 4m), giving the de-bonded sections the ability to stretch during a seismic event.

1.7.6. **Threadbars (also known as Posimix bolts or Gewi-bars).** A threadbar is a resin anchored rock bolt. The type used at BGM was inserted with a resin capsule pushed ahead of it into the drillhole. A spiral thread on the bolt broke open the capsule and mixed the resin as the bolt was inserted and spun, thereby bonding it to the rock. The threadbars used at BGM were 2.4m in length.

Threadbars were installed by BGM to provide increased dynamic reinforcement in zones of increased seismicity and rockmass deformation. However, there is some debate as to whether threadbars do offer dynamic support.

1.7.7. **Modified cone bolts.** These were introduced by BGM after the October 2005 rockfalls. They comprise a smooth 2.4m bar fitted with a forged cone at the end inserted into the rock. A resin compartment is inserted ahead of the bolt. The resin is released and mixed by a small paddle on the end of the cone. Under dynamic loading the bolt is designed to yield by ploughing through the resin thereby absorbing the energy of the rock deformation.

1.7.8. **Mesh.** This comprises 2.4m×3.0m mesh sheets made of galvanised wire in 100mm×100mm squares which are affixed to an excavation's back and sidewalls with friction bolts. The mesh forms a passive surface support. It is not designed to carry excessive loads of broken rock but is aimed at preventing small pieces of rock from falling from a blocky rockmass or from a rockmass undergoing stress changes.

1.7.9. **W-Straps.** These comprise either 1.8m or 3.0m steel strips which are used in conjunction with split sets or other rockbolts and smart plates to provide enhanced surface support.

1.7.10. At BGM split sets and mesh was the standard ground support in ore development drives. 1.8m split set bolts at 1.5m spacing were used with W-straps to support the hanging wall and footwall whilst 2.4m split set bolts at 1.5m spacing with straps and mesh were used for support of the backs. However, this support was enhanced by additional support in specific areas of the mine as conditions required.

1.7.11. Professor Kaiser made it plain in both his report and in his evidence that the correct use of a combination of different ground support elements provided the most effective minimisation of the risk of falls of ground. In his report he said that two design criteria must be satisfied when selecting support components; load and deformation capacity. He stressed the need for the compatibility of all the elements in the support system.

### 1.8. THE LEGISLATION AND WORKPLACE STANDARDS TASMANIA (WST)

1.8.1. Prior to 1995 mine safety was governed by the Mines Inspection Act 1968 and the regulations made under that Act, namely the Mines Inspection (General) Regulations 1991. This legislation incorporated prescriptive standards for workplace safety specific to the mining industry. In 1995 the Workplace Health and Safety Act 1995 ("the Act") was enacted. It repealed the Mines Inspection Act 1968 replacing the prescriptive regime with a "duty of care" based scheme. The Workplace, Health and Safety Regulations 1998 ("the Regulations")were introduced 3 years later.

1.8.2. Mr Roy Ormerod is the current General Manager and Director of Industry Safety at WST. As at Anzac Day 2006 the mining inspectorate comprised Mr Fred Sears, the Chief Inspector of Mines and Mr Mark Smith, a Senior Inspector of Mines.

# 2. EVENTS ON ANZAC DAY 2006

### 2.1. EVIDENCE

2.1.1. Mr Knight, Mr Todd Russell and Mr Brant Webb were all rostered to work the night shift on 25 April 2006. Their shift boss was Mr Gavin Cheeseman. They were directed by Mr Cheeseman to complete the erection of a bund wall beneath the brow of the recently mined panel numbered 10 (see Fig. 8) on 925mL. This task had been commenced on the previous night shift by Mr Russell when he, aided by Mr Darren Geard, had used a jumbo rig to drill eye-bolt holes in the back and walls of the drive.

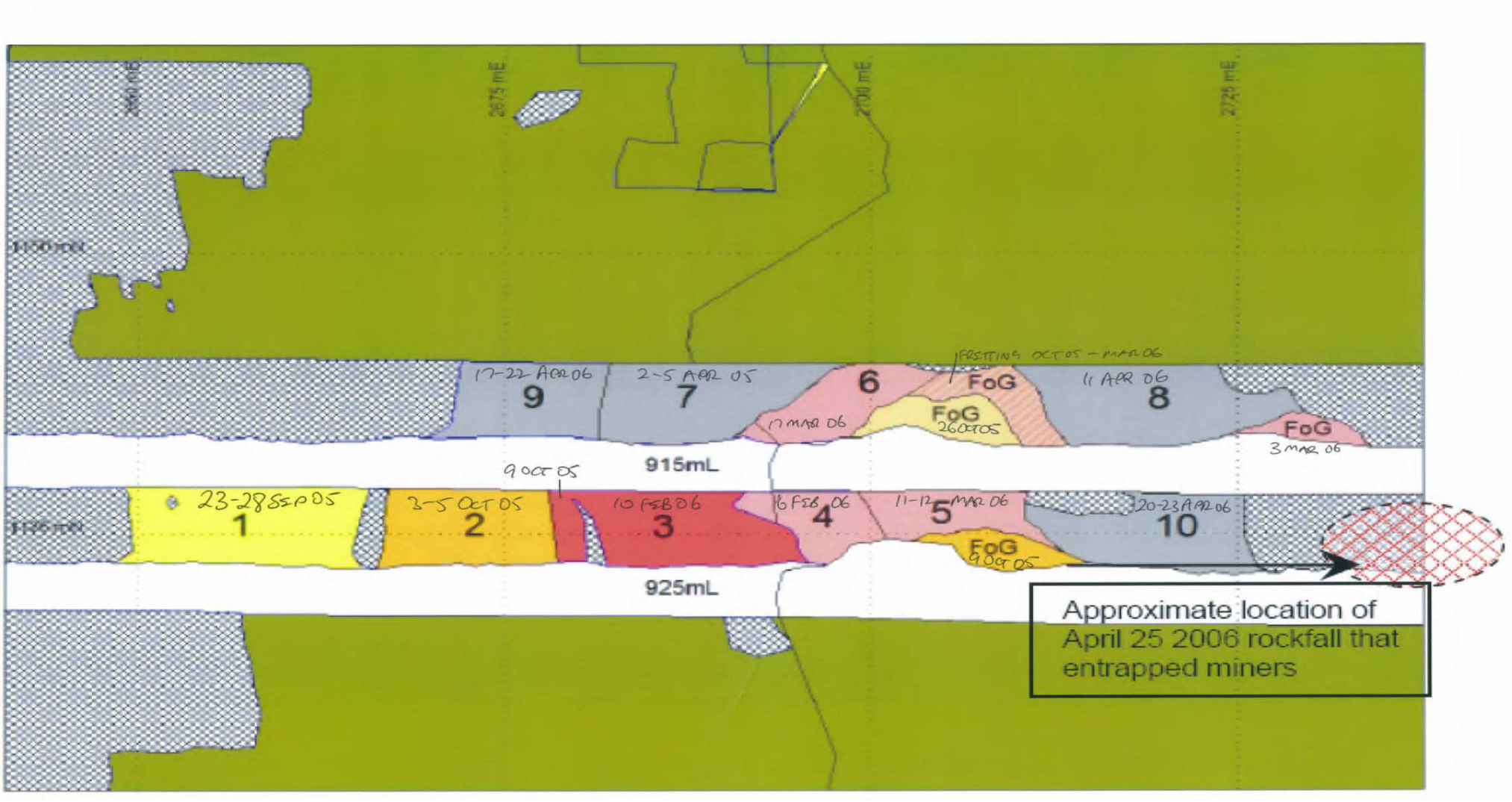


Fig. 8 illustrates the intermediate and top sills of the 940 stoping block with the individually numbered stopes. The hand-written dates on the panels indicate their firing days. Note that the date on panel 7 should read 2-5 Apr 06.

2.1.2. Mr Russell proceeded to 925mL in bogger no. UL07 which he used to build the bund with waste rock. Whilst he was carrying out this work Mr Knight, along with Mr Webb, were collecting the machinery and materials needed for the erection of the mesh wall above the bund. Sometime between about 7.15 and 7.30pm they made their way to 925mL. Mr Knight drove a telehandler and Mr Webb a utility loaded with wire cable and mesh. When they arrived Mr Russell had finished building the bund and had parked the bogger in the area of the access. The utility was unloaded and then driven from the drive to enable access for the telehandler. It was driven into the drive and positioned before the bund. It was fitted with an open metal cage. The next task was to erect the mesh wall. This required the cable to be threaded through the eye-bolts and for it to be then tensioned using shackles and clamps. After this, mesh was to be fastened to the cable with D shackles.

2.1.3. The cable was installed and tensioned by Mr Russell and Mr Webb working from the metal cage which was manoeuvred into position, as required, by Mr Knight from the cabin of the telehandler. He also acted as "gofor" collecting materials and tools for Mr Russell and Mr Webb when needed. The installation and tensioning of the cable was either completed or virtually completed. It was about this time that Mr Cheeseman arrived to check on progress. He gave the workers the "thumbs up" and left. At this time both Mr Russell and Mr Webb were still in the cage. They had asked Mr Knight to start "bringing up" the mesh. Meantime Mr Russell was about to have a drink of water. His next memory was that *"it's black, it's dark and we're covered in rock……."* and that *"it happened quicker than what you could blink."*

2.1.4. It is clear upon the evidence that at 9.23pm a local magnitude 2.3 seismic event occurred at BGM and that it caused three falls of ground within the 925m drive and another in the 915m drive. Of those in the 925m drive, the largest comprising about 800 tonnes engulfed the telehandler and caused the entrapment of Mr Russell and Mr Webb within the metal cage. The second of about 120 tonnes was smaller and occurred about 5 metres to the rear of the telehandler and in the area of a remote cuddy. The third and much smaller fall of ground occurred in the area of the access to the drive.

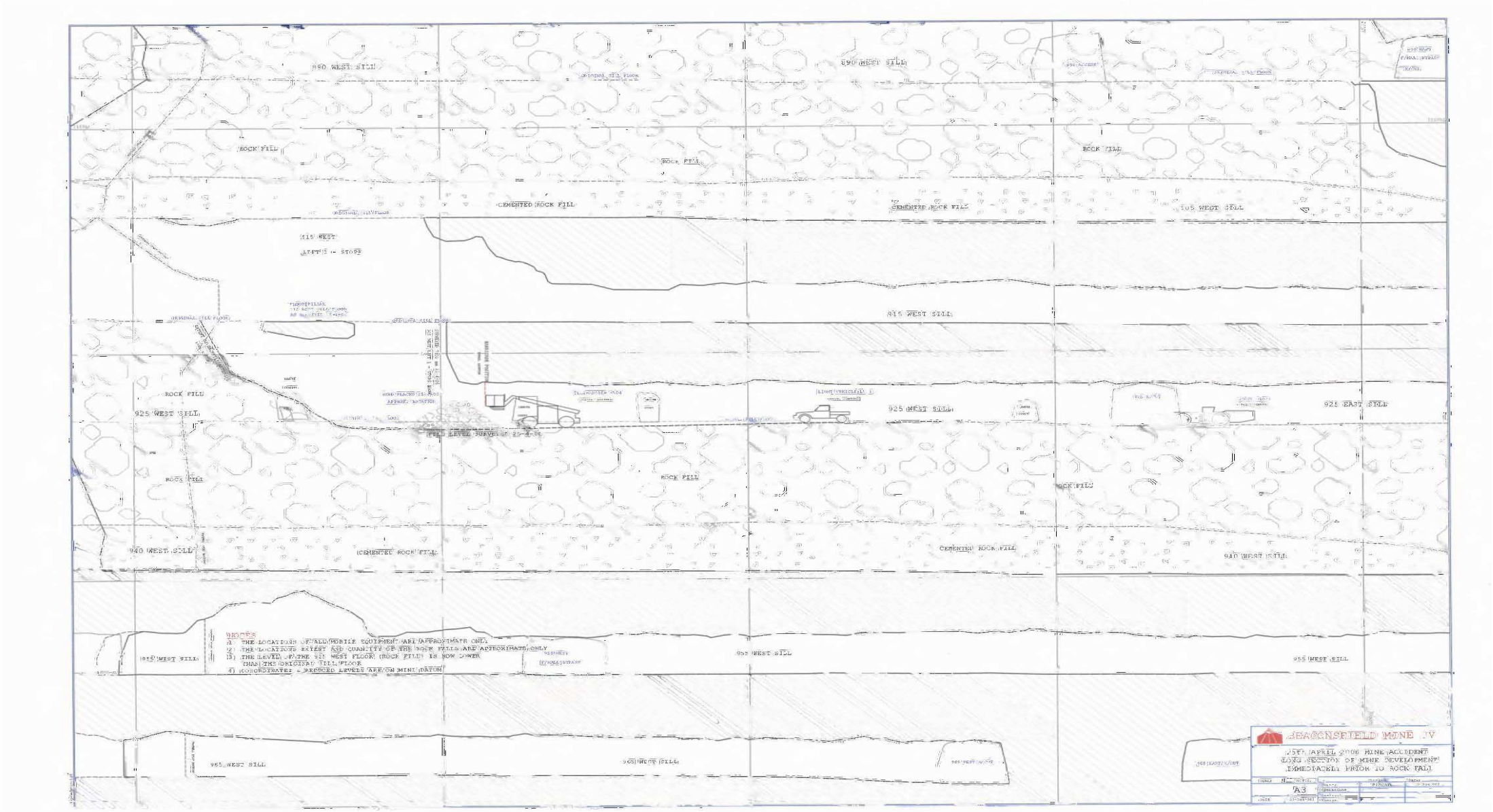


Fig. 9 is a long section depicting the 940 stoping block after the Anzac Day event

## 2.2. THE IMMEDIATE AFTERMATH

2.2.1. A remote controlled bogger was used to remove the material from the falls of ground in the area where Mr Knight and his co-workers had been working and transport it to a stockpile where it was closely inspected. On the morning of 27 April 2006 bogger operator, Mr Walter Hvala used the bogger to convey one bucket load of the fallen material to the stockpile. He was firm in his evidence, firstly that the bucket load had been drawn from the fall of ground to the rear of the telehandler and in the area of the remote cuddy and secondly, that there remained other material within that fall of ground. Mr Hvala then had mechanical difficulties with the bogger. Before he was able to resume bogging he was informed that a body had been found in the stockpile. He was then directed to return to the surface.

2.2.2. The body was identified to be that of Mr Knight. A post-mortem examination was later conducted by State Forensic Pathologist, Dr Christopher Lawrence. It was the opinion of Dr Lawrence that Mr Knight had died as a result of multiple injuries sustained in a rock fall. Specific injuries to Mr Knight's head, upper neck and chest were all consistent with having been sustained in a rock fall. It was the further opinion of Dr Lawrence that Mr Knight died shortly after the falls of ground on Anzac Day and that his death did not occur at or about the time the body was recovered with the remote bogger.

2.2.3. On Sunday 30th April Mr Ball, along with an unidentified person, walked to the rear of the rock fall containing the telehandler. Mr Ball spontaneously called out, *"hello."* He then heard a *"hello"* in reply. Mr Ball then quickly established that both Mr Russell and Mr Webb were alive but were trapped within the rock fall. They were both successfully freed nine days later via a purpose-built rescue tunnel.

## 2.3. FINDINGS

2.3.1. I find that Mr Knight died on 25 April 2006 on level 925 of BGM at Beaconsfield. At the time of his death Mr Knight was aged 44 years having been born on 30 September 1961. He had resided with his partner and family at 77 Relbia Rd. in Relbia, south of Launceston.

2.3.2. I am satisfied, accepting the opinion of the State Forensic Pathologist, that Mr Knight died from multiple injuries sustained in a rock fall. I am also satisfied, again accepting the opinion evidence of Dr Lawrence that Mr Knight died within a short time of the rock fall. I specifically reject the notion that Mr Knight survived the rock fall but was fatally injured in the recovery operation undertaken by BGM and involving the use of a remote controlled bogger.

2.3.3. Two falls of ground occurred on Anzac Day in the area where Mr Knight and his colleagues were working. I am satisfied upon the evidence, particularly that of Mr Hvala, which I accept, that Mr Knight was buried in the separate fall of ground to the rear of the telehandler and in the area of the remote cuddy and not in the larger fall of ground which engulfed the telehandler along with Messrs. Russell and Webb.

2.3.4. It is irrefutable that the falls of ground occurring on Anzac Day 2006 were a direct consequence of a local magnitude 2.3 seismic event. It is also irrefutable that this seismic event was not a natural phenomenon but rather was a response to the mining activity being carried out at BGM. These matters make it necessary for me to examine

the relationship between seismicity and the mining operation at BGM and particularly its impact upon the risk to worker safety.

# 3. SEISMICITY

## 3.1. WHAT IS IT?

3.1.1. In a report provided to Special Investigator A. G Melick S.C., Geo-technical consultant Mr Scott Marisett explained mining induced seismicity in these terms:

> *"Mining induced seismicity is the response of the rock mass to stress redistribution as a result of mining activities. The response mechanism can be either a forced movement on an existing structural defect such as a fault, shear or bedding plane (as opposed to a passive movement where a block slumps, slides or falls under the influence of gravity), the failure of intact rock (strainburst) or a combination of the two previously mentioned mechanisms. Seismicity occurs when the force per unit area is greater than the strength of the rock mass continuum. Seismicity can take the form of many small incremental events where stored energy is released over a long period of time; it can take the form of a single event when the majority of the stored energy is released instantaneously; or a combination of the two.*
>
> *High stress is the major catalyst for mining seismicity. Stress results from a combination of the mass of the overburden (and therefore typically increases with increasing depth) with local and regional tectonic influences which may act to intensify or ameliorate it. The stress field is necessarily three dimensional (as is the rock mass) and anisotropic. The three dimensional components (i.e.: principal stresses) of the stress field are mutually orthogonal and the component orientation is influenced by local geological features and mining voids. The minor principal stress is typically (but not always) the component closest to vertical."*

And,

> *"The increasing occurrence of mine seismicity and rockbursts is generally associated with the increasing depth of mining but may also be influenced by other factors such as a high horizontal stress regime and localised rotation of the stress void due to the creation or extension of mining voids. It is widely accepted that there are two modes of rock mass response that lead to instability, mine seismicity and rockbursts which are movement on natural or mining-induced planes of weakness, and fracture of the intact rock itself (usually close to the excavation boundaries or abutments). In either case, excess energy is released from around the source of the instability and propagates through rock mass as a series of seismic waves. These waves will induce dynamic stresses and associated displacements within the rock mass. As well as compressive and shear body waves, surface waves may result near excavation boundaries. Waves may be refracted and reflected at direct interfaces and void boundaries of various kinds."*

3.1.2. Dr Glenn Sharrock is currently a university lecturer in rock mechanics. He had previously provided a report to BGM which I will refer to in detail later. In his evidence at the inquest he explained seismicity in terms better understood by the lay person. He said:

*"….in teaching seismicity we start by saying that seismicity is the sound of rock breaking. So if you imagine placing a piece of rock in some sort of testing machine and jacking it up, the rock will reach a point where it breaks, it releases an elastic wave that travels through the rock. So seismicity is that elastic wave. When the wave interacts with an excavation and causes damage, that's called a rock burst."*

*"So there's two separate things-there's seismicity which could be damaging and then there's a rock burst which is the damage that occurs when an elastic wave hits an excavation."*

*"…..in the strict definition of rock bursting, rock bursting is an uncontrolled release of energy so there will always be a seismic event related-actually related with that release of energy. So for instance, if you imagine a case like this Tasmanian Reef fault, we had a fault that slipped. When that fault slips, the rock breaks or the fault breaks and you get a wave that's generated that travels along at about four thousand metres a second, it hits the excavation. If the excavation is damaged it may collapse or it may be damaged, it may not, the way it may travel through. That's one mode of seismicity. Another mode is where the event is coincident with the excavation. For instance, a highly stressed pillar could explode. That would be a pillar burst……So, in that case the damage occurs at the same site as the seismic event."*

3.1.3. There are other seismically active mines in Australia and elsewhere. Many are required to manage seismic events significantly greater in magnitude than those occurring at Beaconsfield including the event on Anzac Day.

### 3.2. WHEN DID IT FIRST PRESENT?

3.2.1. BGM first became aware of mining induced stress and seismicity in 2002 when sill driving on 760mL. On 27 June 2003 this comment was included in a memorandum from Mr Ball to all underground personnel: *"It is becoming apparent that as we are mining deeper the ground is becoming more seismically active, popping and cracking etc. This will eventually lead to rocks falling unannounced from competent looking backs and walls."*

# 4. BGM'S RESPONSE TO SEISMICITY

### 4.1. STRESS TESTING

4.1.1. The first step taken by BGM was to commission reports from Coffey Mining. That firm began a stress testing program in August 2003. A report to BGM in January 2004 incorporated the conclusion that *"…there is increased risk of rockburst in both development and stoping below the 880 level."* In a further report made the following month Coffey Mining advised that zones of high deviatoric stress would be encountered below 800mL, particularly on the western end of the ore body.

### 4.2. MR MIKE TURNER

4.2.1. Mr Turner is a mining and geotechnical engineer who, in 2004 was employed by AMC Consulting Pty Ltd ("AMC"). [In October 2005 Mr Turner became a self-employed consultant trading as Turner Mining and Geotechnical Pty Ltd.]

4.2.2. At the invitation of BGM Mr Turner visited the mine from 14 to 16 April 2004. This was the start of an ongoing consultancy arrangement developed with Mr Turner under which he made regular visits to the mine and provided it with his written advices. He also acted as geotechnical mentor for Mr Penney.

4.2.3. In his report following the April visit Mr Turner included these conclusions:

- Falls of ground which had occurred on the 870 and 890 levels could have been the result of a seismic event that caused previously jointed and fractured rock mass to unravel and fall,

- That a seismic monitoring system should be installed,

- That the ground support in the backs and footwall would not be sufficient to contain seismic events and that 2.4 metre split sets and straps were recommended. (At this time 1.8 metre split sets were the norm.)and

- That the modified Avoca method was suited for mining of the 905mL and 940mL blocks and for the next two levels below but thereafter the *"stope fill, stope fill"* method would need to be implemented.

4.2.4. Mr Turner's next mine visit was from 6 to 8 July 2004. In his report of the visit he observed that there were shear events occurring in the footwall and he suspected that there may also have been hanging wall shear events. He made this comment, *"These events are capable of causing major shakedown damage, especially if located close to inadequately supported areas."*

4.2.5. On 23 December 2004 Mr Turner provided the mine with a further report following a series of seismic events which had occurred on 840mL and 850mL. He made comment upon several significant events on 10 December which he considered were *"likely to have significantly weakened the rock mass in the area."* With respect to a large event occurring on the 960 level he said, *"This indicates there are structures that can slip following changes to the mining induced stresses, possibly the thin carbonaceous bands near the contacts of the 2SG…"*and later, *"….there are structures which can slip at Beaconsfield and that the stress redistributions following such movement can result in seismic related pillar and support failure."*

4.2.6. In the same report Mr Turner also observed that the installation of rod extensometers would be a helpful tool for designing suitable ground support.

4.2.7. In their written submissions counsel-assisting submit, *"A review of the reports to date reveals that, at least by the end of 2004, all of the elements of the risk of a shakedown event in an ore drive due to the fragmented nature of the rock mass had been identified, as had the need for the design of suitable support and measuring the deformation of the rockmass."*

I accept this submission.

4.2.8. Mr Turner next visited BGM on 22 February 2005 and provided it with his report on 31 March. The report:

- notes an increase in stress and seismicity which was likely to continue with depth and would make mining conditions more difficult.

- Includes this comment; *"Adjustments to the extraction sequence are possible for the current pre-developed levels that will reduce peak pillar stresses and should therefore reduce the ground control problems. Retreating the upper two levels of each mining block together will reduce the peak loading on the uppermost pillar (and retreating all three pillars together will have even more of a beneficial impact)."*

- Recommends that numerical modelling be undertaken to assess the failure criteria leading to seismicity.

- Proposes that ground support be upgraded in ore drives where elevated levels of rock mass deformation and seismicity are expected. This included 915mL.

4.2.9. It is apparent that by February 2005 Mr Turner was noting an increase in the levels of stress and seismicity and that, in his view, there was a need for BGM to adjust its extraction sequence. Subsequent email communication with Mr Penney further illustrates Mr Turner's view. These are particularly noted:

- On 18 April 2005 Mr Turner advised that he had informed Mr Hill that the increasing seismic activity in the hanging wall was a definitely *" cause for alarm"* and indicated that the extraction sequence needed adjusting, eg 2 or 3 levels being brought back together.

- On 5 May 2005 an email to Mr Penney included this comment; *"….I am still worried the stopes will be mined too long before backfilling. Everyone should now be convinced that the mine is seismically active-and a major guideline is to keep stope openings as small as possible. If you need to have longer stopes you should be cable bolting the hanging wall-and that will slow you down more than filling."*

- On 25 May 2005 Mr Turner emailed Mr Penney and said; *"The larger events are getting more frequent and worrying - I hope you are seriously considering extracting 2 or 3 levels together and installing more support? Otherwise we think you will end up occasionally losing the last level if this continues. And the length of the ore drives needing additional support will tend to increase. And….some of the larger events are happening away from blast time. (combines to possibly to expose equipment and personnel to seismicity in areas only supported with split sets and mesh, which could be insufficient, especially if corroded…….Should we send a letter to Matthew and Peter expressing AMC's concerns?"*

4.2.10. The 940 block was designed and developed with the intention that it would be mined using the modified Avoca method. Mr Turner, in his early advice, as I have noted, indicated that this mining method was suitable for that mining block. Later, when Mr Turner became increasingly concerned by the increases in the stress and seismicity the development of the 940 block was complete and the option of managing the stress by increasing the depth of the 7 metre pillars was not feasible. Another option was to adjust the extraction sequence. However, I make the observation that although the evidence indicates that Mr Turner suggested that BGM adjust its extraction sequence as a means of better managing the increased stresses, his suggestion was not acted upon and BGM continued with the modified Avoca method through to October 2005.

## 4.3. SEISMIC MONITORING

4.3.1. Acting on the advice of Mr Turner BGM hired a stand-alone micro-seismic monitoring system (SAQS) which was commissioned in April 2004. It consisted of 6 uni-axial geophones connected to a single seismometer. It was installed firstly to determine the level of microseismic activity and secondly to help decide whether a real-time, mine-wide monitoring system should be installed. Data collected by the system was transmitted to consultants in Perth for processing and interpretation.

4.3.2. In August 2005 BGM installed a 12-channel ISS micro-seismic system (ISS) to replace SAQS. (It ran in tandem with SAQS for a total period of 2 months). ISS consisted of nine uni-axial and one tri-axial 14Hz geophones connected to two seismometers capable of relaying event data to the mine's geotechnical office in real time. All events recorded by the system were automatically processed to determine the event time and estimate the event location and magnitude. Personnel, both on surface and underground had access to the data via computer terminals.

4.3.3. An analysis of the pre-Anzac Day seismic data carried out by Coffey Mining highlighted these matters:

- The number of events and event magnitudes increased with the increasing depth of mining,
- There was a distinct increase in the cumulative number of events per day in early August 2005 that corresponded with the changeover to the ISS system,
- Sharp increases in the number of events were seen in October 2005, January, February, March and early April 2006 and
- Peaks of intense seismic activity were interpreted to correspond to production stope blasting in highly stressed sill pillars when followed by relatively quieter periods.

## 4.4. ROCK NOISE REPORTS/ROCK FALL REPORTS

4.4.1. In September 2003 BGM adopted a rock noise reporting procedure with the purpose of collating a database with detail of the date, time, relative location and proximity to the work area, noise intensity, rock mass response and comments upon the worker's actions upon each event. To March 2006 BGM had received 248 Rock Noise reports.

4.4.2. An analysis of the data undertaken for the Coffey Report shows that in over half of the Rock Noise reports either falls of ground, strain bursting (rock splitting) or discernable air replacement was recorded. A separate analysis undertaken by Mr Marisett suggested an overall reporting trend ranging from 2.1 reports to 13.6 reports per 28-day interval. However, from August 2005 the reporting rate was relatively consistent at 4.03 reports per 28-day interval. This date coincided with BGM's commissioning of the ISS system suggesting that at least some underground workers were of the view that the ISS system made redundant the need to report rock noise.

4.4.3. As a supplement to the Rock Noise Reports BGM did, in early 2004, introduce Rockfall Incident Reports. Relevant to this subject the mine's GCMP (both C and D versions) includes this provision under the heading "Mandatory Guidelines":

*"Any < 1 tonne rock fall or failure of ground support must be immediately reported to the underground shift supervisor, recorded and then reported to the Underground Manager. When deemed necessary by the Underground Manager follow up inspections and reporting are to be conducted before re-entry into the area."*

4.4.4. By application of these criteria 25 Reports of falls of ground were generated for the period February 2004 to 25 April 2006 (but excluding the falls of ground following the 2.3 seismic event). Mr Penney extracted data from the Reports which he provided to the Australian Centre for Geomechanics ("ACG").

4.4.5. BGM accepts that the Reports do not include record of a 30 tonne fall of ground which occurred in the 980W drive on 23 April 2006. (I refer to this event in more detail later in these findings). However, it is submitted on behalf of the Knight family and the AWU that the evidence shows that multiple other rockfalls had occurred which met the criteria for reporting but were not the subject of Reports. It's convenient for me to deal with this evidence and make the necessary findings at this point.

- Mr Chris MacKay was employed on an ore crew in 2005. It was his evidence that he was working on 925mL in October using a remote bogger to carry ore to a stockpile. He had *"stopped for a smoke"* and was sitting on the bogger when he saw a *"cloud of dust coming out of the stope that I had just exited."* He said that he could *"feel the bogger lift up off the ground even though it weighed 19 tonnes."* Although Mr MacKay could not be sure of the date of this incident he believed that it may have been the event occurring on 9 October 2005 and involving a 350 tonne fall of ground. BGM's Rockfall Incident Report for an event on this day indicates that it did not expose personnel to danger because it occurred after a firing and during a 12 hour re-entry period. The evidence does not permit me to make a finding upon the date of this rockfall. If it occurred on 9 October then the Rockfall Incident Report is incorrect because the event clearly did expose personnel to danger. If it occurred on a different but unknown date then it is clear that it was not the subject of a Rockfall Incident Report when it should have been.

- Mr Warren Borrill was employed by BGM as a jumbo operator. He was interviewed in June 2006 and said that *"About 2 years ago a jumbo I was operating was half buried at level 790. I was standing on the jumbo at the time."* I do not accept that this incident was not the subject of a Rockfall Incident Report. Rather, I am of the view that the incident involving Mr Borrill, in all likelihood, is that fall of ground said to have occurred on 780mL on 15 May 2004 and which is the subject of Report no. 19-1-2.

- The production portion of BGM's monthly report prepared by Mr Ball for March 2006 indicates that a 433 tonne rockfall was recovered from 925mL in that month. It also records a rockfall of 354 tonnes in 955mL. Mr Ball did not have an explanation for these entries in the monthly report and could not attribute them with confidence to any fall of ground which was the subject of a Rockfall Incident Report. However, the evidence upon this discrete subject was very meagre and is in my view insufficient for me to make a finding that either of these falls of ground was the subject of a rockfall which was not captured by BGM's reporting system.

- The March monthly report also refers to a 535 tonnes fall of ground on 915mL. I am satisfied that this material was the result of *"fretting"* from an area where the rockfall

on 26 October occurred. I am also satisfied that this fall by *"fretting"* was not the subject of a separate Rockfall Incident Report although BGM's own criteria required a Report to have been made.

4.4.6. Following the Anzac day event Coffey Mining undertook an analysis of the 25 Incident Reports to obtain a spatial understanding of the locations of the falls of ground. It comments that the Reports allowed a more in-depth examination of the nature of the falls, their relationship to mine activity and performance of ground support. It deduced:

- Over two thirds of reported falls occurred in sheared or faulted and blocky ground conditions,
- 64% of reported falls were greater than 50 tonnes,
- 72% of the reported falls had failure depths greater than 1m and 40% of the reports cited depths of failure exceeding 2m,
- 60% of falls occurred in supported ground of which over 50% were supported solely by friction bolts, and,
- With regard to ground support performance, these points appear:
    - Lack of surface support (44%),
    - Bolts too short (24%) and
    - Incorrect installation of support (16%).

I accept this analysis.

4.4.7. In his report Mr Marisett makes this comment upon the Coffey analysis:

> *"To put that in perspective, over a twenty-nine month period there were 25 rockfall incidents where 16 rockfalls exceeded 50 tonnes. 18 rockfall incidents had a failure depth exceeding 1m, and 10 incidents had a failure depth that exceeded 2m. In the Author's experience that is an exceptionally high number of rockfalls for such a period."*

4.4.8. Coffey Mining also plotted the 25 reported rockfalls plus the Anzac Day falls on a longitudinal section of the underground workings. It showed:

- A cluster of falls around 2700m east which coincided with the F1 offset fault zone and,
- Another alignment of rock falls occurring around 2770m east which was coincident with the 2CG conglomerate overlap zone. (ie the conglomerate unit within the Salisbury Hill Formation).

# 5. ROCKFALLS IN OCTOBER 2005

## 5.1. FALL ON 9 OCTOBER

5.1.1. As I have noted earlier in these findings a 350 tonne fall of ground occurred on 9 October 2005 on 925mL and was between 2707mE and 2713mE. It happened following a production blast at crib time and involved a local magnitude 0.8 seismic event.

5.1.2. BGM sought Mr Turner's advices upon this fall of ground. Mr Turner was able to provide his advice without visiting the mine. He opined:

> *"(The fall of ground) was…..a combination of previous rockmass damage due to stress and seismic activity had weakened the ground. The seismicity following the 925 Level production blast at crib-time on 9 October 2005 was large enough to cause movement of the damaged zone and this caused support failure. The largest event in the area was ML= -0.8, which would not be large enough to cause the damage observed in intact rock. AMC is of the opinion that an appropriate pattern of Threadbars and cablebolts would have been sufficient to support this area, which was only supported with split sets and mesh at the time of the fall."*

5.1.3. It is noted that the completed Rockfall Incident Report describes the failure mechanism as *"seismic shakedown"* with a failure height between 2.0 to 4.99m. The potential contributing factors are indicated to be *"bolts too short"* and *"lack of surface report."*

## 5.2. FALL ON 26 OCTOBER

5.2.1. The fall of ground on this day involved a similar tonnage and followed a local magnitude 2.1 seismic event. The major fall of ground occurred on 915mL with a smaller fall occurring on 925mL in the area of the 9 October fall. 880mL and 955mL also sustained damage.

5.2.2. The Rockfall Incident Report shows the failure mechanism to be *"seismic shakedown"* with a height of failure of 2.0 to 4.99m. The ground support is described as *"combination of cable bolts and other bolts"* with mesh support. *"Bolts too short"* and *"lack of surface support"* are identified as potential contributing factors.

5.2.3. Mr Penney, in a written report of the event observed, inter alia:

- 915mL was the worst affected,
- The ground support (including threadbars but with no strapping) had *"failed beyond the embedment length of the reinforcement and has fallen out under its own weight."*
- 925mL suffered fresh stress damage,
- The event was likely to have been a shakedown event and
- A local magnitude 0.7 event had been recorded in the 915 hanging wall two days previously. A later inspection revealed about a 40 tonne fall of ground in the same area where the fall ground occurred after the 2.1 event.

5.2.4. On 1 November Mr Gill forwarded a memorandum to Mr Ryan. It is entitled, *"Seismicity/Ground Control Management Status Report."* It includes these observations of the 26 October event:

*"1) The event on 26th was the largest recorded to date, eclipsing the previous largest event on the 9th October. Prior to that, the previous highest recorded was 1.3 in May 2004 i.e. we have had a significant recent increase in magnitude.*

*2) It is possible that the 9th October event, and subsequent smaller ones, had already weakened the general rock mass such that the 2.1 event was all that was needed to "shake down" the compromised rock mass.*

*3) Re-entry times were not a safety control measure at the time of the 26th event i.e. people and/or equipment could have been in the area at the time, but for the fact that it occurred at Firing Time, and ground support re-hab plans had yet to be issued following the event in the same heading on the 24th .*

*4) The size and surprise of the 26th event is a cause of major concern."*

5.2.5. It is apparent that by this time BGM was aware that stress redistribution, a fractured rock mass and seismicity were all factors capable of contributing to a rockfall. It is also apparent that BGM was by this time aware that rock mass could fracture beyond the ground support which included 2.4 metre threadbars in a shake down event.

# 6. EVENTS POST- OCTOBER ROCKFALLS

## 6.1. PRODUCTION HALT

6.1.1. After the 26 October event BGM immediately ceased all half upper production stoping because, as Mr Gill stated in his 1 November memorandum, *"this activity…. has in the past. contributed to the major seismic events experienced to date."*

## 6.2. REPORT TO WST

6.2.1. On 28 October Mr Hills met with Mr Sears of WST in Hobart and reported on the recent events at BGM. Mr Sears was informed that production had been halted and that consultants were being retained to help in the investigation of the rockfalls and the way forward. Mr Hills provided Mr Sears with sketches, plans, JMAP data and the GCMP (revision C).

## 6.3. *"ACTIONS GOING FORWARD"*

6.3.1. In his memorandum to Mr Ryan on 1 November Mr Gill sets out the proposed action plan which is headed *"Actions Going Forward."* It states:

*"a). Complete the level-by-level audit of currently installed ground support, relative to the current standards, given that many areas were mined prior to the current evolved standards being adopted,*

*b). Complete a back analysis of the stope block by stope block stress modelling review,*

*c). Answer the geotechnical question "Are our current ground support standards sufficient for the seismicity being experienced?", and if they aren't, "What is required?"*

*d). Implement any improved ground support installations as a result of the audit, and/or modelling and/or geotech review.*

*To assist in the above, we will have our own technical team, plus two consultants (Glen Shorrick (AMC) and Richard Butcher).*

*e). Produce a production schedule for the next 2 months and model that extraction sequence to determine any immediate high risk areas, and what can be done to minimise same. Again, we will use our team and AMC.*

*Only once we have performed the above and are satisfied that we have an appropriate plan for each stoping block going forward will we re-commence full scale ½ Uppering production.*

*f). We will need to determine a PR plan to handle the significant community outrage issue; however our first priorities are safety and then production.*

*g). The senior management team met today to review the technical issues, and will meet again tomorrow to discuss cost controls during this severely restricted production period."*

# 7. CONSULTANTS

## 7.1. INTRODUCTION

7.1.1. At this point I propose to set out the purpose of each consultant's engagement as part of Mr Gill's action plan along with some pertinent information upon their advice and/or recommendations except with respect to ground support which I will deal with separately in these findings.

## 7.2. DR GLEN SHARROCK

7.2.1. In 2006 Dr Sharrock was employed by AMC as an operational rock mechanics engineer. His services were retained by BGM through AMC to:

- analyse the available information and build a model for the root cause of the 2.1 event,
- estimate the geotechnical parameters for use in a forward analysis of the mine, in particular failure criteria for pillars and
- provide numerical models and materials to assist the mine in future forward analysis of mining options.

7.2.2. Dr Sharrock visited the mine in early November 2005 and provided his final report on 30 January 2006. However, a draft report was provided to BGM sometime in December 2005 along with a power point summary of his advice.

7.2.3. As to the mechanism for the 26 October event Dr Sharrock explains that during the period May 2004 to October 2005 expansion of the mining front resulted in increased shearing potential over a large area of the unmineralised western end of the Hanging Wall fault. Energy was stored on the fault and was unable to slip in a controlled

progressive manner because of clamping from the 915 and 925 pillars (and possibly the stiff conglomerate units). In late September yielding of the 915 and 925 pillars at, but not limited to the locations of the falls of ground, allowed the energy stored on the fault to be released in the 2.1 event (principally through deconfinement of the fault from the mining of the western end of the mineralised zone, and kinematic freedom provided by the offset fault).

7.2.4. Dr Sharrock included in his report these observations:

- The checkerboard sequencing could be adapted to reduce the chance of a recurrent event. However, the potential remained for further large and damaging seismic events and these could occur despite use of the checkerboard sequence.

- The short to medium term prospect of further large and damaging seismic events made it necessary to carefully consider the design of ground support and firing designs, forward analysis using numerical modelling of the extraction sequence and its impact on key faults, such as the Hanging Wall shear and the offset fault.

- The fault slip model needed to be tested and verified as mining proceeded because of the possibility of other undiscovered structures or mechanisms which may be the root cause of large and damaging seismic events.

7.2.5. It was Dr Sharrock's further evidence that once a mine had experienced a significant seismic event then its forward planning should be undertaken in the expectation that a similar event will occur. Such planning would be similar whether the previous event had been 2.0 or 2.5 in magnitude.

## 7.3. MR MIKE TURNER

7.3.1. I have mentioned Mr Turner earlier. He re-visited the mine from 8 to 10 November to conduct a review of the ground support. As part of the review Mr Turner, in collaboration with Mr Penney, devised a ground support audit form which they then completed for each of the stoping levels. Mr Turner's report of the review is dated 14 November. Naturally it focuses upon the ground support issues and I will return to it shortly.

7.3.2. Mr Turner re-visited the mine on 28 and 29 March 2006 and carried out a further audit of the ground support. This visit was subsequent to a further fall of ground believed to have occurred on 3 March and resulted from a 0.5 seismic event. The fall of ground was in a "no entry" portion of the 915 ore drive at 2725mE and involved 50 to 100 tonnes. The Rockfall Incident Report records potential contributing factors to be deficiencies in the ground support, (indicated to be "bolts too short" and "lack of surface support") plus ground conditions (described as "sheared or faulted" and "blocky").

7.3.3. Mr Turner's report dated 21 April 2006 included these comments:

- *"There were several indications of high stresses in the 915, 925, 955 and 960 Levels, such as rocknoise, slabbing, loading up of bolts, and bulking of failed material behind the mesh. The performance of the support systems in these areas and changes in underground conditions relative to stoping and seismicity will all have to be continually*

*checked. Extended re-entry periods and additional support rehabilitation could be required."* And,

- *"There is still a possibility of another large-magnitude seismic event due to movement along one of the western faults, similar to the October 2005 event."*

## 7.4. DR PETER MIKULA

7.4.1. Dr Mikula is a self-employed geotechnical engineer based in Kalgoorlie. He was engaged by BGM to provide it with, in his words, *"training guidance in the analysis and understanding of seismicity so that the mine would be better able to manage the hazard."* He visited the mine on 14 and 15 November, had an underground inspection, attended a close out meeting with some of BGM's technical staff and then provided his report dated 25 November. Dr Mikula explained that it was not his brief, as asserted by Mr Melick in his report ("the Melick report"), to review the reports of the other consultants retained by BGM.

7.4.2. It was Dr Mikula's view that the falls of ground on 915 and 925 levels in October 2005 were due to pressure through the pillars and did not have a structural cause, ie were not due to the presence of a joint plane or free surface. The 2.1 event was, in his opinion, the *"largest of a family of events on the HW shear."*

7.4.3. Dr Mikula's report included a list of actions for BGM to carry out *"to get a handle on the understanding of the seismicity."* He considered them to be concepts only and that they required further work if they were to be implemented. His report included his thoughts on practical steps to manage pillar-crush events. In his view stress levels in pillars would be reduced by adopting a tandem stoping method which would involve the lifting of two, three or four stopes together so that during the course of the retreat the brows of all the pillars in the stoping block would remain in a vertical line. He pointed out that it was important to backfill the stopes *"as you go"* because it supports the hanging wall against the footwall and also *"to a lesser extent it can reduce the stress that builds up in the pillars."* The observation was also made that on levels 915 and 925 mining should retreat away from the junction of the HW shear and the Offset Fault and that this strategy was usually adequate if there was only one problem structure. However, it was necessary to be alert to the fact that in a mine with multiple problem structures the mining away from one can mean mining towards another. Dr Mikula made the observation in evidence that the possibility of the HW shear being a linking structure was a matter that *"I'd be concerned about,"* particularly as it may have constituted a problem structure towards which mining was retreating.

## 7.5. MR FRANS BASSON

7.5.1. Mr Basson was a senior technical engineer employed by AMC. BMG engaged him to carry out a 12 month forward analysis for future mining using Map3D and based upon the site specific failure criteria developed by Dr Sharrock. Mr Basson visited the mine in late January 2006 and provided a draft report to BGM on 27 February. His final report was delivered on 9 March 2006.

7.5.2. In his report Mr Basson identified four factors as having a higher potential hazard associated with stoping. These were:

*"**Factor 1***

*Stoping close to the Western Offset Fault Zone. Especially stoping directly north of the HW Fault could result in significant events on the HW Fault. The ground around the intersection between the HW and Offset Faults previously resulted in significant fall of ground incidents."*

*"**Factor 2***

*Stoping in the vicinity of the conglomerate overlap zones normally generates a higher than normal intensity of smaller magnitude events. The current overlap is between the Wet and 2CG conglomerate zones, but the overlaps change with depth."*

*"**Factor 3***

*Stoping the last two levels of a stoping block in the conventional way where the stopes are extracted from bottom to top, previously resulted in increased seismic activity and difficult stoping conditions. This is a result of high stress in the remaining pillars, and modelling should highlight these areas. The modelling indicates that the checkerboard pattern should greatly alleviate the difficulty traditionally associated with the stoping of the last two levels."*

*"**Factor 4***

*Excessive hanging wall spans needs to be identified by the mine personnel, and support requirements adjusted accordingly."*

7.5.3. The report incorporates Mr Basson's predictions upon the stress conditions likely to be experienced on each mine level as mining proceeds. In respect of the mining schedule specifically for April 2006 he makes these comments upon levels 915 and 925:

*"915 level: (West of Offset Fault)*

*Combination of Factors (1) and 3.*

*According to the failure criteria the pillar will be failed. The pillar is not isolated and should not fail dynamically. Stoping this month should be roughly 30m away from the HW and Offset-fault intersection. The stoping will still release clamping on the HW Fault that could result in seismic events.*

*Stoping could still result in seismicity, but it should occur away from the current workings on this level, but could affect stoping operations on 915 level east of the fault and 925 level.*

*915 level: (East of Offset Fault)*

*Combination of Factors (1) and 3.*

*According to the failure criteria the pillar will be failed.*

*Stoping will occur from the fault intersection and then away.*

*Slot cutting could be hazardous, thereafter conditions are expected to be difficult in the stope with difficult drilling conditions and the potential for pillar yielding that could result in seismic events. This stoping should not be done simultaneously with other stoping that has the potential of generating slip on the HW-fault (915 level west of the Offset-fault or 925 level stoping planned for the month).*

*925 level: Combination of Factors (1) and 3.*

*According to the failure criteria the pillar will be failed.*

*Stoping will occur from the fault intersection and then away.*

*Slot cutting could be hazardous, thereafter conditions are expected to be difficult in the stope with difficult drilling conditions and the potential for pillar yielding that could result in seismic events. This stoping should not be done simultaneously with other stoping that has the potential of generating slip on the HW-fault (915 level stopes east and west of the Offset-fault).*

*940 level: No stress related difficulties expected."*

7.5.4. Mr Basson also makes this general comment applicable to April, *"The two stopes on 915 level and the stope on 925 level could all mobilise the HW-fault, it is thus recommended that the three stopes are not mined simultaneously, but in different time periods during the month."*

7.5.5. It was not part of Mr Basson's brief to make a recommendation on whether the anticipated mining conditions in April 2006 were so hazardous that mining at levels 915 and 925 should not proceed at all. He said that in any event such a recommendation could not be made based solely on the modelling itself and that it was a matter for BGM to take the information that he had provided and for it to decide whether the risk was too great or not. It was his evidence that once BGM had received the material provided by him that it would be *"logical"* for BGM to *"do some type of assessment"* of the risk associated with mining at those levels.

7.5.6. It was Mr Basson's further evidence that he was not surprised that a significant seismic event occurred on 25 April 2006, although he was a little surprised that the event was as big as 2.3. He pointed out that it is difficult to be completely precise as to the size of the larger seismic events and that the Anzac Day event could in fact have been either larger or smaller than the 2.3 recorded. It was his view however that the Anzac Day event was most probably larger than the event on 26 October 2005 because the damage underground indicated that it was more substantial.

## 7.6. DR DANIEL HEAL

7.6.1. Dr Heal is a geomechanical engineer who, in early 2006, was employed by the Australian Centre for Geomechanics as project leader for its Mine Seismicity and Rockburst Risk Management Project. BGM was a minor sponsor of the project. In February 2006 Dr Heal visited BGM to install a Mine Seismicity Risk Analysis Program (MS-RAP) and to provide some training for Mr Penney in its use. Subsequently, Dr Heal prepared and provided BGM with a report (it is dated March 2006) containing an analysis of BGM's seismic data to March 2006 using the MS-RAP software. The analysis assessed the degree of seismic hazard within the mine and identified those areas rated as having a "moderate to high" or greater seismic hazard. These areas included the western half of the ore drive on 915m level and the 925m level ore drive west of its access.

7.6.2. The report explains that the seismic hazard rating alone can not be used to determine whether or not rockburst damage is likely to occur at a particular location but that it must be considered along with two other factors, namely "excavation vulnerability" and "exposure."

## 7.7. SUMMARY

7.7.1. The falls in October 2005, particularly that on 26 October following the 2.1 seismic event clearly demonstrated that stress and seismicity were not being safely managed by BGM and that it needed to re-assess its mining operations in the affected area of the mine. It had no choice at this time but to close down that portion of the mine. If the future mining of that area was to be an option then BGM also had no choice but to first acquire a better understanding of stress and seismicity, its relationship to its mining operations and, if possible, its safe management. Its action in seeking the assistance of outside consultants for advice was proper and necessary. These are some salient observations which I glean from the consultants' advice:

- No-one recommended the cessation of mining in the seismically affected areas although this was not a topic upon which BGM sought the consultants' specific advice.

- That further large seismic events as occurred on 26 October 2006 could be anticipated and any plan for future mining should be prepared on this basis.

- That a mining plan prepared to provide for a magnitude 2.0 event would be similar to a plan for a 2.5 event even though the energy released by the latter would be significantly greater.

- That seismic activity within the mine should be closely monitored and assessed on a daily basis. Particular care should be taken if small-scale activity stops as this could indicate that fault/slip is held up and storing up energy for a large event.

- That a disciplined approach to the mining of the seismically affected areas was required with each step being documented.

- That the modified Avoca method for ore extraction should be abandoned and that BGM move to implement the checkerboard or similar extraction method.

- That ground conditions on levels 915 and 925 required the schedule for ore extraction to be well planned and carefully executed with regard to be had to the following matters:

  1. that the two stopes on 915 level and the stope on 925 level could all mobilise the HW-fault and thus should not be mined simultaneously but in different time periods during the month.

  2. that mining should retreat away from the junction of the HW shear and the Offset Fault.

  3. the need to be alert to the fact that retreating from one problem structure may mean mining towards another and

  4. that each mined panel should be backfilled before proceeding to mine the next panel.

# 8. GROUND SUPPORT

## 8.1. NOVEMBER REVIEW

8.1.1. Up to October 2005 BGM's standard ground support regime for ore drives less than 6 metres in width provided for a combination of split sets with mesh and W-straps. As I have noted Mr Turner undertook a ground support review at the time of his visit in early November 2005. His report following this review included these observations:

- The ground support on levels 915 and 925 was not up to the level required to survive large seismic events and

- Support damage indicated the falls to be within the shakedown category with the mesh and bolts being mainly intact and the rockmass unravelling around the bolts.

8.1.2. In his report Mr Turner recommended the installation of additional support for both 915mL and 925mL. His recommendations are included in these comments:

> *"**915 West** - The narrow width of the 915, combined with the fact that the 940 stope has already been mined lead to high risk of further seismic related damage. During one of the underground visits for the review (9 November 2005) there was a ML= 0.1 event close to the 915 overlap zone, confirming the high stress levels and fact that intact rock or structures are close to movement or failure. The event also occurred at 13:23, well outside blast time, when there was no mining activity in the area. There are signs of high stress and minor seismic damage along the footwall shoulder of the drive for most of the footwall 2CG exposure. Cone bolts are recommended with straps over the backs for the entire level as significant stress damage, deformation and seismicity is expected."*
>
> *"**925 West** - The 925 level to the west of 2700mE has been cut-off from the rest of the drive by major falls of ground in October. At the time of the review there were still fresh falls occurring between 2700mE and the stope brow. Extraction of these remaining reserves might be limited to wrecking of pillars and loading out of fallen ore using remote boggers. The hangingwall overbreak on the 940 stope has also*

*impacted on the 925 and will probably lead to severe dilution during stoping. Additional straps and Threadbars are required on the backs from the stope access to the fall prior to stoping recommencing."*

8.1.3. Following Mr Turner's advice BGM, in December 2005, installed threadbars (spaced 1.5m apart in rows) and straps in 925mL including that area where Mr Knight was working on Anzac Day. Also in accord with Mr Turner's advice cone bolts were installed in 915mL.

## 8.2. THE COMPRESSIVE ARCH (ALSO KNOWN AS THE PARABOLIC ARCH)

8.2.1. BGM's ground support regime for ore drives which incorporated split sets, threadbars and cone bolts had, as its underlying foundation, the parabolic or compressive arch. Mr Hill described its rationale in these terms:

*"The approach taken for the intensely jointed rock mass was to assume that the ground would behave as a beam a (sic) across its narrowest dimension. It was considered that the failure would be unlikely to be dominated by keystone wedges and that an unravelling mode of failure was more likely. Therefore the design endeavoured to support a mass of material equivalent to a parabolic arch of height equal to half the span."*

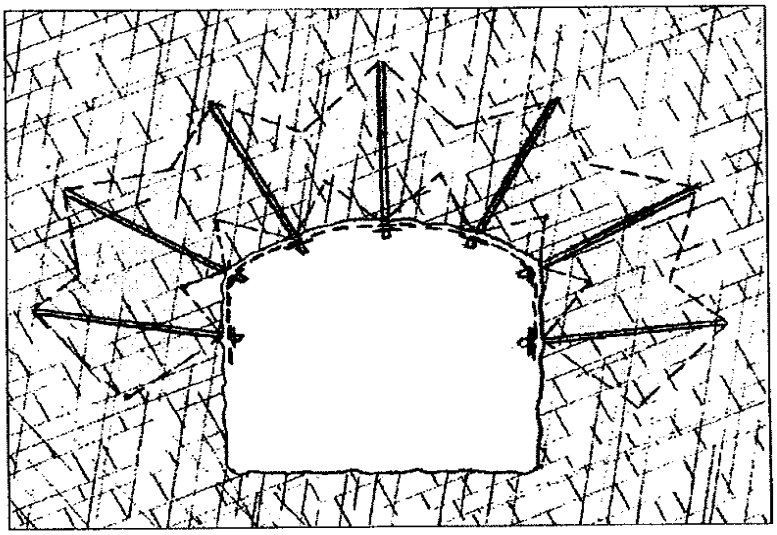

Fig. 10 shows in diagrammatic form an excavation supported by pattern bolting. It shows a zone of compressive strength in which interlocking of individual pieces is retained and a self-supporting arch is created.

## 8.3. OBSERVATIONS UPON GROUND SUPPORT INCLUDING THE COMPRESSIVE ARCH

8.3.1. **Dr Sharrock**

8.3.1.1. In his report of 30 January 2006 Dr Sharrock makes this Key Point upon ground support:

> *"The scope of this report does not extend to recommendations on ground support, however AMC advances the following comments, based on observations at the Fall of Ground ("FOG") locations: A zone of extensive stress induced damage exists in proximity to highly stressed pillars. The recent falls of ground highlight the potential for shakedown in wide, damaged sections of development in which damage extends beyond the support capacity. The BM ground control management plan should address the depth of failure issue and install cable bolts with appropriate surface support where required……"*

8.3.1.2. In his evidence given to the Inquest Dr Sharrock said that when he inspected level 925 during his November visit he considered the general ground conditions to be *"quite good"*. However, in the area of the falls of ground he said that there was a zone of damage which he described as *"quite deep"* with *"extensional cracks"*. This indicated *"classic stress induced failure"*. It was these observations which caused him to believe that BGM should consider installing longer ground support. In his view, the ground conditions were suited to the installation of cable bolts. He said that he had a lengthy discussion with Mr Penney on this subject and advised him of his views. He pointed out that there was clear evidence that the depth of failure exceeded the length of the existing ground support. He also advised Mr Gill of his views. Mr Gill did not accept that he was specifically advised of this by Dr Sharrock but accepts that the issue was raised at the close-out meeting. (I need to note that it was BGM's usual practice for its technical staff to meet with a visiting consultant at the end of his visit to be briefed on his views. These were known as close-out meetings.). According to Dr Sharrock, BGM's response was that Mr Turner was looking at the ground support system for management. When he returned to Perth Dr Sharrock said that he spoke to Mr Turner about the matter by telephone. Mr Turner said that in his view the longer bolts were not required and that he considered the ground was too damaged for the installation of cable bolts. In any event it was his view that the compressive arch provided adequate ground support.

8.3.1.3. It was Dr Sharrock's further evidence that he had had experience at Mt Isa Mines where he was required to assess ground conditions and make support recommendations, especially for brows of stopes. In this case he *"thought intuitively there was scope for a deeper support completely aside from the seismic issues, just as a static mining situation without considering seismicity."*

8.3.1.4. As to the compressive arch Dr Sharrock said that it works for *"very blocky"* material but *"if you have very small blocks that doesn't work. So if you think the rock is going to break into very small pieces that concept isn't going to work very well, that arching concept."*

8.3.1.5. I interpolate here to observe that I have earlier made comment upon the friable nature of the rock mass at the mine and its tendency, with increasing strain, to disintegrate into small block sizes. It's also relevant at this point to note that Mr Hill acknowledged in his evidence that he was aware of this characteristic of the rock mass.

8.3.1.6. It was the evidence of Mr Penney, Mr Hill and Mr Gill that they all interpreted Dr Sharrock's Key Point concerning depth of failure to relate only to those ore drives of a width greater than 6 metres. This interpretation may have been open to them. However, a moment's reflection shows it to be illogical. At the time of the report BGM's GCMP provided for cable bolts to be used in excavations greater than 6 metres in width. If Dr Sharrock intended that his comment only related to excavations of a width over 6 metres then it was completely unnecessary for him to suggest the installation of cable bolts as this was already the mine's standard. Rather, it is my firm view that Dr Sharrock intended by this Point to bring to BGM's notice the need, in his opinion, for it to install cable bolts in some circumstances where the drive width was less than 6 metres. The failure of the mine's technical staff to so interpret this Key Point is a matter which I will return to when addressing the matter of risk assessment.

8.3.1.7. It needs to be observed that the Anzac Day falls of ground on 925mL occurred in an area where the drive width was less than 6 metres.

8.3.2. **Dr Mikula**

8.3.2.1. On the subject of ground support Dr Mikula's report included these points:

- That threadbars are not a dynamic support although they do have a deformation capacity,
- Split sets, cone bolts and dynamic cable bolts are more able to survive seismic impulse,
- For comparative purposes 2 splitsets =1 cone bolt,
- The 915mL fall of ground on 26 October was beyond the capacity of the installed support and it was doubtful that a denser pattern of threadbars and split sets would have sufficed,
- Cone bolts or dynamic cable bolts with good surface restraint should have been able to restrain the fall of ground on 26 October,
- In the final lifts, with narrow sill pillars, seismicity could be too much for cables, so cone bolts (for example) are needed.
- Cone bolts should be considered in locations where large seismic events may be possible. At BGM *"my guess is that cones would be needed in and within say 20m of conglomerate stratigraphies and around the F1 splay offset fault area.*

8.3.2.2. It is necessary that I make these observations concerning Dr Mikula:

- In the Beaconsfield Investigation Report Mr Melick states that Dr Mikula's engagement required him *"to conduct an overall review of the consultants' reports"* and to review the recommendations made by Mr Basson, Mr Turner and the AMC Continuation Study team. It is clear upon the evidence that these statements are incorrect. Rather it is apparent that BGM required Dr Mikula to provide, in the words of Mr Hills, *"a bit of a holistic overview"* which Dr Mikula interpreted to mean a

*"more general overview of the mine from someone who hadn't seen it before but was perhaps aware of different ways of looking at things."*

- I am satisfied that Dr Mikula's report was compiled on the basis that it was a *"holistic overview"* and that none of the ideas or comments contained within it were intended by it's author to be final recommendations. I accept that it was Dr Mikula's expectation that if BGM's management considered that any of his ideas or comments were to be acted upon then they would instruct him to carry out a full analysis beforehand. Dr Mikula did not receive any such instruction.

- It was Mr Gill's understanding that one of the requirements of Dr Mikula's retainer was to conduct a peer review of Mr Turner's ground support system. This was specifically denied by Dr Mikula.

The confusion surrounding Dr Mikula's role is a matter which I will return to when discussing the subject of risk assessment.

8.3.3. **Dr Peter Fuller**

8.3.3.1. Dr Fuller is a senior principal engineer employed by Coffey Mining. He provided technical guidance to Coffey staff in the compilation of the Coffey Report and later in the development of the case for safety commissioned by BGM. He also carried out a peer review of the Coffey Report.

8.3.3.2. With respect to the compressive arch it was Dr Fuller's evidence that its key elements are:

1) That the rock within the beam remains in compression at all times,

2) That the self-weight of the beam and the forces generated within it are transferred via friction to the side abutments,

3) That the abutments remain rigid and

4) That the rock bolts are anchored so that they *"have the ability to apply compression downwards at all times."*

8.3.3.3. It was also observed that:

- If the smallest of the rocks within the rock beam are smaller than a quarter to a fifth of the bolt spacing then it is difficult to maintain compression within the arch.

- Mining operations can cause a progressively upward fracturing of the rock causing the rock mass to expand and thereby the arch to lose compression.

- The capacity of friction bolts to maintain the arch in compression diminishes as the depth of fracture increases and thereby reduces the bolts' anchorage length.

8.3.3.4. It was Dr Fuller's opinion that the compressive arch was not a suitable basis for ground support at the mine because the friable nature of the rock meant that the rock mass could not be maintained in compression.

8.3.4. **Professor Kaiser**

8.3.4.1. It was Professor Kaiser's evidence that the design of a compressive arch is aimed at creating a stable or self-supporting block of ground. In areas of friable rock (such as Beaconsfield) the arch beam will be destroyed if the rock mass breaks into small blocks. It was Professor Kaiser's further evidence that bolts need to be anchored into stable ground where the rock mass has disintegrated into loose rock. Ground will be sufficiently stable if it is self-supporting-it need not be unfractured.

8.3.5. **Mr Marisett**

8.3.5.1. It was his evidence that a compressive arch *"always has to have a competent anchor point, a competent piece of ground above for it to work."* His report includes this further comment, *"The reluctance to using longer rock bolts to help manage the depth of the disturbed zone within the reef is perplexing given frequency of rockfalls due to failed or ineffective ground support."*

8.3.6. **Conclusions**

8.3.6.1. Of all the consultants who proffered a view on the subject only Mr Turner was firmly of the view that the compressive arch was suited to the ground conditions at Beaconsfield, although it may be inferred that Dr Mikula was also supportive of it. Dr Sharrock had serious concerns about it, Dr Fuller dismissed it and Professor Kaiser and Mr Marisset fell well short of embracing it.

8.3.6.2. Dr Fuller's evidence upon the compressive arch was, in my view, particularly compelling and I accept it. I find that the compressive arch was unsuited as the basis for the mine's ground support system, at least within the 940 block and upon the lower levels.

8.3.6.3. In my opinion the unsuitability of the compressive arch, or, in the very least questions as to its suitability should have become apparent to BGM following the October rockfalls. This is a matter which I will return to when addressing risk management.

# 9. RESUMPTION OF MINING

## 9.1. FROM JANUARY 2006

9.1.1. By late January 2006 the decision had been taken by BGM to resume mining in the 940 stoping block. It is noted that at this time Mr Turner had visited the mine and provided his report following the October '05 rockfalls but he had not made his return visit to audit the ground support upgrade which he had recommended. By this time too Dr Mikula had visited the mine and provided his report and his further advices had not been sought. Dr Sharrock had also attended the mine and had delivered his draft but not his final report. However, to this point Mr Basson had not visited the mine and provided his report with a forward analysis utilising Dr Sharrock's preliminary work. As I have already noted Mr Basson's mine visit occurred in late January, his draft report with a power point presentation was provided on 27 February and his final report on 10 March.

9.1.2. BGM asserts that it would be unfair to criticise it for re-commencing mining prior to its receipt of Mr Basson's forward modelling asserting that it was beneficial to Mr Basson

for him to be able to evaluate ground conditions during stoping in January and February and then assess it against the predicted behaviour. It makes this assertion although it appears to directly contradict Mr Gill's *"Actions"* memorandum of 1 November 2005 which indicated, as I have already noted, that mining would not resume until, inter alia, the production schedule for the *"next 2 months"* had been modelled *"to determine any immediate high risk areas, and what can be done to minimise them."*

9.1.3. The reason for BGM resuming production prior to the forward modelling being completed is not apparent on the evidence. Whilst there may have been an advantage to Mr Basson in preparing his report for him to be able to assess actual mining conditions against his modelling predictions, there is no evidence that he requested mining commence so that this could be done, or even that he discussed the subject with mine management. In the result this apparent deviation from the action plan put in place by Mr Gill following the October falls of ground is another subject that I will return to when dealing with the subject of risk management.

9.1.4. As is shown in Fig. 8, panels numbered 1 and 2 had been mined in late September/early October 2005 and the western portion of panel 3 was being mined on 9 October when the fall of ground occurred on that same day to the east in the area of panel 5. Resumption of mining in the 940 block began with the removal of ore from the balance of panel 3. Beforehand, an access drive had been made from 900L joining 915L at its western end. This enabled access to the western portion of 915L and the backfilling of 925L stopes. Firing of the balance of panel 3 occurred on 10 February. It was backfilled. Then followed the mining and backfilling of panels 4 and 5 on level 925 with firing being completed on 12 March. This mining sequence was in effect a continuation of the modified Avoca method and hence was inconsistent with the checkerboard method advised by the consultants. However, it was consistent with their advice that mining retreat west from the HW shear and east from the Offset Fault. In this context the mining of panel 4 represented a westerly retreat whilst panel 5 was a retreat to the east.

9.1.5. It needs to be noted that at about this time a fall of ground occurred at 2725mE on level 915 in the area to the east of panel 8 in Fig. 8. This was a "no entry" area at the time and the precise date of the fall is not certain. However, BGM considers that it is likely to have occurred on 3 March and coincided with a 0.5 seismic event. It involved 50 to 100 tonnes. The Rockfall Incident Report recorded a depth of failure of between 2 to 4.9 metres with potential contributing factors being *"bolts too short"* and *"lack of surface support."*

9.1.6. On 17 March panel 6 on level 915 was fired and then mined. Then followed the mining of panel 7 on level 915 with its last firing being on 5 April. The extraction of both these panels represented a westerly retreat from the fault structure on level 915. It was at this point that it was open for BGM to implement "checkerboarding" which would have been in accord with Mr Turner's advice and required it to mine panel 10, backfill its stope and then mine panel 8. However, a decision was made to reverse this process by first mining panel 8 and then panel 10. What were the circumstances of this decision?

## 9.2. SEQUENCING REVERSAL

### 9.2.1. Evidence

9.2.1.1. Mr Turner re-visited BGM on 28 and 29 March 2006. He went underground with Mr Penney to carry out an audit of the ground support. At this time it was observed, according to Mr Penney, that the ground conditions on level 915 in the area of panel 8 were poorer than those in the area of panel 10 on the level below. It was felt that the ground conditions on the upper level may be worsened by the mining of the lower panel which may in turn prevent the safe extraction of the upper panel. It was in this context that Mr Penney recollected Mr Turner proposing that the sequencing be changed by mining panel 8 before panel 10.

9.2.1.2. Following the underground inspection Mr Turner completed audit sheets upon the ground support installed in each of the production drives. Each of the sheets was signed by Mr Turner and Mr Penney. They are dated 28 March 2006. The sheet for level 915 West describes the extraction sequence as *"Modelled in Map3D"* and includes this comment; *"Extraction sequence has been adjusted and must be followed."* It was Mr Penney's evidence that by this comment he and Mr Turner *"intended to show ….the switching to take the 915 stope before the 925 stope because of the observations that we had made underground."* It is pertinent for me to observe that the audit sheet completed for level 925 does not include any reference to an *"adjustment"* of the mining sequence and instead describes that level's extraction schedule as *"Modelled in Map3D. Stope to be mined under checkerboard method."*

9.2.1.3. At 9.00am on 29 March some members of BGM's management team had a de-briefing or close-out meeting with Mr Turner. Mr Ball was at this meeting. He said that the sequencing change was discussed and that all present agreed that it was an *"obvious thing"* because *"if we took 10 before 8 that would probably weaken the ground under 8 so that it was dangerous. So if we wanted to extract that pillar it would be safer to take 8 and then 10."* Mr Ball said that if it was not Mr Turner's suggestion to change the sequencing then *"he certainly didn't oppose it."* Mr Ball described the discussion as a *"comparative risk assessment"* for the sequence change.

9.2.1.4. Formal minutes of the de-briefing were not taken. However, Mr Ball did make his own handwritten notes. They do not refer to any discussion upon a change to the sequence nor do they record any decision on this subject. It is however clearly evident that by 6 April a decision to change the sequencing had been made because the minutes of the Shift Bosses Meeting made on that day show that panel 8 had been *"changed to the next panel to be extracted."*

9.2.1.5. Mr Turner's evidence in this area differs from Messrs Penney and Ball. He said that he did not have any recollection, at the time of his March visit, of recommending a change in the sequencing and that if he had done so it would have been mentioned in his report. Instead, his report only includes these relevant comments; *"The extraction sequence is currently in the process of changing over to the "checkerboard" pattern for the 915 and 925 levels. ……This sequence needs to be maintained to limit the stress levels in the 915 and 955 levels,"* and *"The checkerboard sequence should be implemented as soon as possible on the 925 and 915 Levels…….This sequence will reduce the stress levels on the upper, final pillar stopes, but will increase the stresses on the other levels."*

9.2.1.6. It was also Mr Turner's evidence that had the sequencing change been brought to his attention he would have recommended that panel 10 be supported with cone bolts because, by extracting panel 8 first, panel 10 would have been subject to an increased

level of stress. He did however make the point that the thread bars did successfully support panel 10 after panel 8 was mined.

9.2.1.7. It needs to be noted that although Mr Turner did not recall recommending the sequence change it was nevertheless his evidence that the change made *"total sense"* because *"the pillar above the fall of ground from the 3rd of March was already small, so if you'd have mined ten first that pillar would have failed even higher and you wouldn't have been able to access number eight."*

9.2.1.8. I also observe that on 7 April Mr Penney sent an email to Mr Turner. It included this paragraph; *"I have got the mining dept to stop the 915 F1 and start the checkerboard, taking 915 first, then the 925. They like the idea and Pat is keen to use Icon dets in a mass firing of the 915 level. I will be on the other side of the world that day."* It does not seem that Mr Turner replied to this email, perhaps because he was out of the country when it was sent and by the time he read it the sequence change was a *"done deal."*

9.2.1.9. I note that it was Mr Penney's evidence that he modelled the sequencing change using Map3D and that it indicated *"some very minor differences"* but he considered these to be *"within….what you would normally expect to be the error regions of this modelling method."*

9.2.2. **Findings**

9.2.2.1. I accept that the decision was taken to reverse the extraction sequence and mine panel 8 ahead of panel 10 because of concerns that the mining of panel 10 first may worsen ground conditions on the 915 level and thereby jeopardise the capacity to mine panel 8.

9.2.2.2. I also accept that the observations of ground conditions made by Mr Turner and Mr Penney when underground on 28 March was the catalyst for the sequencing change being discussed at the de-briefing the following day. I am unable to find that this change was a specific recommendation of Mr Turner or that he even made comment upon it at the de-briefing. Nevertheless, it is clear upon the evidence that it was a course which he did not oppose.

9.2.2.3. I am not satisfied that the decision to change the sequencing was made at that de-briefing session. Had it been I am confident that the matter was sufficiently important for Mr Ball, as Underground Manager, to have recorded it in his notes which I observe occupy a full page and are reasonably comprehensive. Instead, I find that the decision to change the sequencing was made by mine management sometime after the de-briefing session and before the Shift Supervisors' meeting on 6 April. This finding is consistent with Mr Penney's email notification of the decision sent to Mr Turner the following day.

9.2.2.4. It is pertinent for me to observe that BGM did not, after making the decision to change the sequencing, seek Mr Turner's advice upon the change's possible impact upon ground support, particularly for panel 10 and the ground to its east. In a similar vein Mr Turner did not, in his written report provided on 21 April make mention of the sequencing change or more importantly of his view that cone bolts should be installed in panel 10 if it was to be mined after panel 8. However, by the time he came to write his report Mr Turner may have considered it too late for him to comment on these matters.

9.2.3. **Expert opinion upon the sequencing change**

9.2.3.1. In the opinion of both Mr Basson and Mr Turner the mining of panel 8 ahead of panel 10 would have caused a greater level of stress in panel 10 than was indicated by Mr Basson's modelling based upon the previous extraction sequence. Both Mr Basson and Dr Mikula were also of the view that the change in sequence would have caused a material change in the stress affecting the area immediately to the east of panel 10 although this was not an opinion shared by Mr Turner. In Dr Mikula's further opinion the larger unfilled void brought about by the sequence change would have caused less confinement to the hanging wall and more stress to the rock in the general area although he acknowledged that this would be difficult to calculate. Too, it was his view that the mass firing of panel 8 using IKON detonators would have made *"conditions at number 10 more adverse"* including the pillar area immediately to its east. However, Dr Fuller expressed the view that the effect of the unfilled void *"wouldn't….be substantially different."* It was Dr Fuller's further opinion that the sequencing change warranted a re-assessment of the ground support on both levels 915 and 925, particularly in the light of the 3 March fall of ground.

9.2.4. **Comment**

9.2.4.1. Despite the sequencing change the mining of both panels 8 and 10 was successfully completed without incident. In my view the evidence is inconclusive as to whether the actual change in sequencing was a matter which impacted upon the ground conditions in the area to the east of panel 10 and thus was a factor causative of the falls of ground on Anzac Day.

9.2.4.2. The mining of levels 915 and 925 clearly required a cautious approach. It was consultancy advice that BGM implement the checkerboard method of ore extraction and forward analysis modelling was prepared on this basis. The proposal to mine panel 8 ahead of panel 10 contradicted the checkerboard method. These circumstances, in my view required a properly documented and comprehensive evaluation of the risks associated with the proposed sequencing change. Such evaluation did not, in my opinion, occur. If it had one surmises that it would have identified the possibility of the sequence change causing increased level of stress to the area east of panel 10 (notwithstanding Mr Penney's modelling) and the possible need for a re-assessment of the ground support for panel 10 and the area to its east. Had Mr Turner been involved in this process he would have recommended the installation of cone bolts in panel 10 in the least.

9.2.4.3. BGM's management of this issue is an illustration of the insufficiency of its risk management strategy put in place following the October '05 rockfalls. It is a matter which I refer to again at para. 15.10.3.

# 10. MINING OF PANELS 8, 9 AND 10

## 10.1. BEGINNING 11 APRIL

10.1.1. The mass firing of panel 8 using IKON detonators took place on 11 April with the fallen ore then being removed by bogger. The mining of panel 9 on level 925 then commenced with firings on 17, 19 and 22 April. These firings partly overlapped the

mining of panel 10 with firings of the latter panel taking place on 20, 21, 22 and 23 April. This brings me to a consideration of the issue of simultaneous mining.

### 10.2. SIMULTANEOUS MINING

10.2.1. Mr Basson, in his March 2006 report included this advice:

> *"the two stopes on the 915 level and the stope on 925 level could all mobilise the HW Fault, it is thus recommended that the three stopes are not mined simultaneously but in different time periods during the month."*

10.2.2. BGM's mine blasting records show that on 22 April 2006 eight holes were fired in panel 10 at the end of day shift and 2 holes were fired in panel 9 at the same time. Clearly these firings overlapped.

10.2.3. Both Mr Penney and Mr Hills understood Mr Basson, by using the phrase *"mined simultaneously,"* was recommending against firings in more than two stopes in the 940 block at the same time. An alternative interpretation was that *"mined simultaneously"* was a reference to the full mining cycle so that Mr Basson was recommending against any aspects of production occurring in more than one stope at the same time including boring, charge-up, firing and bogging.

10.2.4. It is apparent that the firing overlap on 22 April was in breach of Mr Basson's recommendation, whatever the interpretation. The more critical issue is whether this breach had any impact upon events on Anzac Day. Mr Basson explained that the purpose of his recommendation was to, *"progress the stoping in a more gradual way so you don't release too much clamping on the fault plane that could give you like a reaction, like a potential seismic event."* This meant that it was necessary to assess the degree of the overlap. As to this it was the tenor of Mr Basson's evidence that the firing of just the 2 rings in panel 9 at the same time as the firing in panel 10 was of little consequence. I accept Mr Basson's evidence on this subject. It follows that although the simultaneous firing on 22 April was strictly in breach of Mr Basson's recommendation it was not a factor relevant to those events occurring 3 days later.

# 11. EVENTS PROXIMATE TO ANZAC DAY

### 11.1. RATES OF SEISMICITY

11.1.1. The Coffey report includes an analysis of the seismicity in the period leading up to the Anzac Day event. It is submitted by counsel-assisting and approved by counsel for the family and the AWU that I should accept the report's conclusions upon this subject because the report was prepared for BGM with the involvement of its solicitors and was the result of an iterative process where it had input and had the opportunity to vet it for any inaccuracy. BGM has not identified any inaccuracy. In these circumstances Counsel's submission is reasonable and I accept it. On this basis I accept the following conclusions made in the Coffey report upon the rates of seismicity:

- Both the number of events and the event magnitudes had increased with the increasing depth of mining,

- The recorded seismicity for the period August 2005 to 24 April 2006 suggested that the Beaconsfield environment was capable of producing seismic events with magnitudes greater than 2.0. The Gutenberg Richter analysis showed a potential magnitude of 2.2.

- The source of the large magnitude events would most likely be fault slip mechanisms.

- Seismicity in the period from 12 to 17 April was relatively benign,

- There was an apparent increase in event frequency and magnitude following a production blast on 915mL on 17 April. There were 10 events recorded with a local magnitude greater than 0.0 following this blast and before the 25 April event. After 17 April there was also an increase in the number of daily events,

- In the week following 17 April clusters of seismic activity were evident back from the stope brows on both 915mL and 925mL due to fracturing occurring in the reef rock mass.

11.1.2. It is pertinent to observe that the Coffey conclusions are consistent with the following empirical evidence of shift-supervisor Dale Burgess:

> *"Basically we had over the previous three months to the Anzac day rockfall we seemed to be having accelerated seismicity and that was over the corresponding week prior to Anzac Day it became even more so.."*
>
> *"…(the events) predominantly focussed around the 915, 925, and 940, 955 regions- particularly the 915 and 925, but there was also a halo effect which we always had, and that's why I included the 980 and the 880 levels…"* and,
>
> *"(The events) seemed to concentrate on a set easting-which, I don't know that number of the easting but I'm assuming it would have been around brow position and, again, as it haloed away from there, the seismicity decreased the further it got away from the epicentre."*

11.1.3. It was the evidence of Mr Basson that the number of events occurring on 23 and 24 April would not have caused him concern because they were all small. It was also his evidence that the seismic graph for 23 to 25 April was *"reassuring I guess"* because it indicated that directly after firing *"the events came right down."* However, it needs to be observed that a similar decrease in seismic activity following firings was a feature which presented prior to the 2.1 event on 26 October 2005.

11.1.4. It is also pertinent for me to note that Mr Turner had, in his report dated 21 April 2006 reminded BGM firstly that seismicity was *"unpredictable."* In a similar vein Professor Kaiser observed that *"in burst prone mines the unexpected must be expected."* Too, Mr Basson made these comments of seismicity; *"My experience with seismicity is the moment you find a pattern it changes…….seismic events are notoriously difficult to get a pattern from….because there's so many."* On the same subject Dr Fuller made comment that once the possibility of a significant event is determined it is necessary to plan on the basis that such event will occur tomorrow.

11.1.5. I have previously made the observation at para. 7.2.5 that, in the opinion of Dr Sharrock, once a mine has experienced a significant seismic event its forward planning should be on the basis that a similar event will occur. Such planning would be the same for both a 2.0 or a 2.5 event.

## 11.2. GEOLOGICAL KNOWLEDGE AND SEISMICITY

11.2.1. In his initial report for Coffey Mining, Professor Kaiser expressed the view that the 2.3 magnitude event had been induced by the de-clamping of the C-shear due to mining between the 940 and 955 levels. He subsequently varied this view opining that the event may have been generated from two sources, firstly a fault slip of a highly clamped zone in the vicinity of the pillar (this refers to the C-shear) and secondly the failure of the sill pillar near where the fault reached the reef. Professor Kaiser made a third visit to the mine in mid-November 2006 when he observed the wall failure on the 925 level along a hanging wall shear. Afterwards he reported that *"hanging wall splay shears may provide another source of significant seismic activity."* He said that this opinion was based upon information which had not been available prior to Anzac day or even at the time when Coffey Mining's case for safety had been completed.

11.2.2. The C-shear extended between the 915m and 1000m levels. It was the evidence of Mr MacDonald, BGM's senior geologist, that he was aware of this structure prior to Anzac Day. He said that he was similarly aware of the series of shears existing in the hanging wall and occurring every 20 metres or so. However, it was his understanding that these structures were not considered as potential hazards because they had not demonstrated seismic activity. Messrs. Hills, Penney and Ball all held a similar view.

11.2.3. In his evidence Dr Sharrock stated *"…it's identifying these fault structures until you've actually had an event on that particular structure. It would be extremely abnormal for people to identify a particular structure…until you've actually had some activity on that structure."* It was the evidence of Dr Mikula too that it was necessary to look for signs of seismicity.

11.2.4. It was the evidence of Dr Heal that 925 level's seismic history did not indicate a shear in the hanging wall although it was Mr Marissett's assessment of the data that he was *"starting to see a fault highlighted by seismicity parallel to the ore body in the H/W."*

11.2.5. It is relevant to note that it was the evidence of Dr Mikula that he had not been briefed upon the mine's geology at the time of his visit. If at that time the structure in the hanging wall extending from the 940 to the 990 level had been brought to his attention this would have been a matter that he would have taken into account in considering whether mining should retreat from the F1 splay intersection. Similarly, Dr Fuller was of the view that such a structure *"ought to have been managed."*

## 11.3. MINING CONDITIONS

11.3.1. I have referred earlier (para. 7.5.3) to Mr Basson's modelling and his predicted ground conditions for April 2006, notably for both 915mL and 925mL that drilling conditions were expected to be difficult with a potential for pillar yielding that could result in seismic events. It is also pertinent to note that Mr Basson's failure criteria for April showed that all the pillars in the 940 block would fail as a result of stoping.

11.3.2. I am satisfied that the predicted difficult drilling conditions were in fact realised in 925mL as indicated by this evidence:

- Jumbo operator Warren Borrill testified that he drilled the last holes for firing on 925mL and that he *"could only drill a few holes at a time because they'd just collapse in behind you, the whole production closed up."* He said *"there was pressure coming in from somewhere."* Mr Borrill was asked by counsel, *"Had you experienced that difficulty in other areas of the mine?* and he answered, *"Not as bad as that, no, no,"*

- Mr Russell made this comment upon drilling conditions in 925mL on 24 April, *"Myself and a jumbo operator were putting-drilling pin holes to put eye bolts in to build the wall that we were building. We did find that the ground was very very drummy and didn't sound right so we actually pulled back from that area, probably another 3-4 metres, and continued to drill again and found that the ground there was a lot-a lot more solid than it was close to the brow"* and

- Shift-supervisor Gavin Cheeseman stated that he was aware of difficulties drilling up-holes in panel 10 because of *"the ground closing up"* due to *"ground pressure."* He said:

  *"…we were having trouble with the holes closing up and that is one of the reasons we didn't pre-bore the Avoca in there — the Avoca rings at that time because it was a waste of time because it would have closed up by the time we got it backfilled."*

11.3.3. Some shift plods, most notably those completed by Mr Cheeseman and Mr Burgess suggest that Mr Basson's expectation for increased seismic activity in April was also being realised. These plods are pertinent:

- 19 April, day shift---*"(12) hr re-entry (out lease) on 915WW. Check J map at 6.30am 20/4/06."*

- 22 April, day shift---*"check seismic activity before remoting."*

- 22 April, night shift---*"915 WW and 925W "active" all shift. 980W had a 0.2 seismic event at 2.30am-subsequently pulled men out of 980W and parked up jumbo-ground fell in!"*

- 23 April, day shift---*"check seismic activity 925."*

- 23 April, night shift---"all levels from 880-980 have been active in the last (36) hours."

11.3.4. The 0.2 event referred to in the night-shift plod for 22 April caused a 30 tonne fall of ground on 980WmL. At this time miners Phillip Malkin and Donovan Lightfoot were using a jumbo to install ground support in the area. Mr Malkin described the event in these terms:

*"……a massive explosion occurred……..when it happened I thought the explosion and rock fall had come from the hanging wall shoulder and backs. Rocks fell across the boom and the front of the jumbo. There was dust everywhere and, for a minute after it happened, I stayed under the protective canopy of the jumbo and waited until the dust settled."*

11.3.5. Mr Malkin reported this event to his supervisor Mr Burgess who recorded it in the shift plod. During his next night-shift on 24 April Mr Burgess, at about 3.30am sent an email to Mr Penney and copied it to Mr Ball. The email is headed *"980 West"* and states:

> *"Sunday morning at approximately 2:30am we experienced a seismic event (0.2) on the 980 level whilst ground supporting it. I would have thought it was related to the mid-shift firing of 955 West by-pass? It occurred East by (5) meters of the F1 "bend" in the area the previous lifts cables had been installed. Approximately 30 tonne fell out. I pulled the jumbo crew out for the shift. We have since gone back in (next shift) and meshed up the failure, however you may want to look at it to sure (sic) up the area with resin bolts in the (3) rows of straps already installed, and possibly even cable bolt through the wider section East of the failed zone etc before any further advance has been made? What do you think?"*

11.3.6. It was the evidence of Mr Malkin that in the days prior to Anzac Day he was nervous about the ground conditions on 925mL saying that the area *"made the hairs on the back of (his) neck stand up."*

11.3.7. On 21 April Mr Malkin was working as a relief shift-supervisor. One of his crew members was Mr Murray Gofton who was operating a bogger on 925mL. Mr Gofton said the ground was under *"extreme pressure."* It was Mr Malkin's evidence that he instructed Mr Gofton to use a larger bogger because he felt it would be safer. Later in that shift he was sufficiently concerned for Mr Gofton's safety that he instructed him to take an early crib break. There was a firing during the crib break in another part of the mine. When Mr Malkin returned he noted that *"there was water coming through the backs of the drive where the ground support stretched. The mesh on the backs of the drive had gone from square to diamond which to me indicated that the ground had moved."* Mr Malkin directed Mr Gofton to leave the area. He informed both Mr Saltmarsh and Mr Burgess of the condition of 925mL. It is pertinent for me to note that in the opinion of Dr Fuller the presence of water coming from the backs suggested that the *"block is completely fractured through to the source of the water and if that was water on the 915 floor …..it says that there's been fracturing certainly at some points running right through that block."*

11.3.8. Mr Hvala was operating a bogger on the 925 level on the day shifts of 24 and 25 April. It was his evidence that on the 24th *"I did hear rock noise but I didn't see any rock fall"* and *"there was no visual cracks or slumping of the ground at that level at that time."* As to the 25th he said, *"It was pretty quiet on the start of the shift…….no significant big noises"* but towards the end of the shift he did *"experience some ground movement, which was a lot more out of the ordinary I'd say, but I was concerned then and then did bring it up to the cross shift and the shift boss on that day."*

11.3.9. Surveyor Peter Wylie, with a co-worker, was to carry out a CMS survey of the stope on 925mL in the morning of 25 April. When they drove up to the brow *"some rocks did come off…….there probably wasn't a lot of material but enough to make bit of a noise."* Later, when they were waiting for the survey to be taken they did *"hear small rocks falling down within the sill drive and yeah, other seismic activity as well."* Mr Wyllie observed that the *"ground support still looked in pretty good condition…….I thought it looked as it should have been."* It was Mr Wylie's further evidence that at lunchtime he completed a rock noise report which he left on Mr Penney's desk. Mr Penney did not see the report that day. It was a public holiday and he was not at work.

11.3.10. Mr Cresswell was the shift boss on day shift on the 25th. He visited Mr Hvala on five occasions during the shift and considered that the 925mL drive *"looked okay, as it should be."*

11.3.11. On the night of Anzac Day Mr Russell described the conditions in these terms, *"….I never heard nothing, never seen nothing, it was, you know probably the quietest you know I've ever heard anything that night."* Mr Webb also said that there was not any rock noise but said that *"there was stretched mesh everywhere and there was straps everywhere stretching it as well…."*

11.3.12. **Mr Turner**

11.3.12.1. As already noted Mr Turner visited the mine on 28 and 29 March and provided a report dated 21 April. It included these further comments:

> *"Overall the stress related changes in ground conditions are currently being managed successfully. Seismicity is unpredictable however and continuous monitoring of high stress working areas is required to provide a warning of changes in conditions that could lead to fault slip, strain burst and rock bursts."* And
>
> *"Daily assessment of seismic monitoring in the fault areas is essential. Continued small-scale activity should be observed throughout, but care should be taken if the activity stops as this could indicate the fault-slip is held up and storing up energy for a large event."*

## 11.4. THE MINE'S RESPONSE

11.4.1. The *"continuous monitoring of high stress working areas"* as advised by Mr Turner was undertaken by:

1. the use of JMap to monitor seismicity. It was the evidence of Mr Hills and Mr Penney that they each reviewed JMap daily,
2. the use of MAP3D to monitor stress changes. It was the evidence of Mr Penney that he modelled all changes to the sequencing schedule including the reversal of panels 8 and 10.
3. inspections underground by Mr Hills and Mr Penney,
4. investigation of rockfall incident reports,
5. maintenance of formal shift supervisor reports,
6. shift plods and
7. shift change-over meetings.

11.4.2. In cross-examination Mr Ball acknowledged that he was unaware at Anzac Day of the following:

- Mr Malkin's nervousness of the ground conditions on 925mL. It was Mr Ball's evidence that *"If (Mr Malkin) felt that way, I should have known about it."*

- that on 21 April Mr Malkin instructed Mr Gofton, because of concerns for his safety, to use a larger bogger and later to take an early crib break,

- that after the crib break Mr Malkin observed water coming from the backs of the 925 drive,

- that on the same day Mr Gofton considered the ground within 925mL to be under *"extreme pressure."*

- that Mr Malkin had reported to Mr Saltmarsh and to Mr Burgess that he had observed water coming from the backs on 925mL,

- that the drilling conditions on 925mL were the most difficult that Mr Borrill had encountered and

- that Mr Cheeseman's crew had experienced difficulties drilling up-holes in panel 10.

11.4.3. With respect to the fall of ground which had occurred on the 980 level during the night-shift of 22 April Mr Malkin made these comments in a statement tendered into evidence:

> *"……Although it was a number of levels further down and a bit further west, this fall happened three days before the fatal fall on Anzac Day. I was concerned at the time that with all the ground movement, falls occurring and seismicity the large fall on 980 (which could easily have killed me and Donovan) did not cause alarm bells to ring for that section of the mine. No one investigated the fall or really asked about it. Pat Ball came up to me sometime latter (sic) and said to me that the reason they had not spoken to me about the fall of ground on 980 was that they were busy with a truck fire on the 23rd April 2006 nightshift."*

11.4.4. As I have noted, Mr Burgess, some 25 hours after the event, advised Mr Penney by email of the fall of ground involving Mr Malkin and Mr Lightfoot with copy to Mr Ball. Mine management's response to Mr Burgess' email is unclear. Mr Ball, as underground manager and the person responsible for responding to Mr Burgess' advice under the GCMP was unable to recall what steps, if any, he took. Mr Penney was silent on the subject. However, Mr Hills in a record of interview made during the Melick investigation asserted that Mr Penney had, on 24 April *"gone down and inspected the mine"* and that *"we had a look at J-map."* By this time Mr Burgess had seemingly taken the decision, without the involvement of the underground manager, to re-enter the 980 level and to *"(mesh) up the failure."*

11.4.5. I have earlier referred to the mine's GCMP and its mandatory guidelines concerning falls of ground. (para. 4.4.3) The fall occurring during the 22 April night-shift was clearly within the criteria prescribed by those mandatory guidelines. Compliance with them required Mr Burgess, as the shift supervisor, to immediately report the rockfall to Mr Ball, the underground manager who was obligated, before allowing re-entry, to make a follow up inspection and report if he deemed it necessary. The evidence shows that this did not happen. Instead, it is clear upon the evidence that Mr Burgess, on the next night-shift and without any inspection or even any consideration of an inspection by Mr Ball or his proxy permitted the 980mL to be re-entered and work to be resumed. By acting in this manner Mr Burgess clearly contravened the GCMP.

11.4.6. However, the rockfall on 980mL should have come to the notice of Mr Ball on the morning of 23 April, either by him reading the shift plod for the previous night shift or it being brought to his attention at or immediately after the shift change-over meeting. The evidence does not indicate whether this did occur. However, whether it did or it didn't I am satisfied and so find that neither Mr Ball nor any member of management on his behalf did, on 23 April, inspect or give consideration to an inspection of the fall of ground site notwithstanding the mandatory requirements of the GCMP. Any inspection which may or may not have been undertaken by Mr Penney on 24 April could only have been cursory and of little benefit in establishing the cause of the fall of ground and assessing the risk to worker safety. This is so because by this time the fallen ground had been bogged out and the area had been rehabilitated.

## 11.5. FINDINGS/COMMENTS

11.5.1. I am satisfied and so find that immediately prior to Anzac Day BGM had access to information including seismic data which should have alerted it to the real likelihood that the mine would experience another seismic event of a magnitude similar or greater to the 2.1 event which had occurred on 26 October 2005. I accept that seismicity, by its nature, is a totally unpredictable beast so that the timing of a future significant event could not be predicted.

11.5.2. The real likelihood of another 2.1 or greater event occurring at some indeterminable time made it incumbent upon BGM to have in place a full array of strategies including an adequate system of ground support to withstand the effects of such an event when it occurred. The planning for these strategies needed, in my opinion, to allow for a seismic event up to 2.5 in magnitude and to assume that it could occur tomorrow.

11.5.3. I am satisfied and so find that prior to Anzac day 2006 BGM was aware of a shear structure in the hanging wall and extending at least between levels 940 and 990. (that structure has come to be known as the C-shear) I am also satisfied that at the same time BGM was aware of the existence of a series of shears existing in the hanging wall and occurring in near 20 metre spacings.

11.5.4. However, in my view, I cannot be satisfied upon the evidence that prior to Anzac Day either the C-shear or the series of other faults located in the hanging wall had a demonstrated seismic history or at least a history of sufficient seismic activity to indicate that they or any of them constituted an immediate hazard to mining.

11.5.5. Nevertheless, it is perplexing that BGM did not brief Dr Mikula upon the mine's geology at the time of his visit so that he was aware of the existence of the shears at the time he provided his advice. This is a matter which warrants further comment in the context of risk management.

11.5.6. BGM was on notice that it needed to proceed with caution in its mining of levels 915 and 925 during April and that this required it to have in place processes to ensure, first that all relevant information upon ground conditions was conveyed to management, in particular Mr Ball as underground manager, and secondly that it was in a position to properly respond to that information. The evidence, in my opinion shows a failure in these processes as illustrated by Mr Ball's ignorance of relevant concerns and observations made by workers of the conditions on 925 level in the days immediately prior to Anzac Day. Most pertinent in this regard was the failure to ensure that its own

GCMP was complied with so that Mr Ball had immediate notice of the fall of ground on level 980 and the opportunity to make an immediate inspection of the damaged area.

11.5.7. I am firm in my view that the fall of ground occurring on the night shift of 22 April should have led to level 980 being closed until Mr Ball was notified and the scene inspected by him. However, it does not follow upon the evidence that such inspection would or should have led to the cessation of mining on the upper levels including 925 and this is so even if Mr Ball had been aware of all those matters itemised at para. 11.3.2. I am mindful in this regard that Mr Burgess and Mr Cheeseman, both experienced shift bosses, were of the opinion that mining could safely continue and this was Mr Cheeseman's view up to and including the night shift on Anzac Day.

11.5.8. I am unable to find that the failure of BGM's monitoring processes affecting level 925 was a factor which directly contributed to Mr Knight's death. However, I do find that this failure does reveal a serious deficiency in BGM's risk management strategy, a matter which I will also address later in more detail.

# 12. CAUSATION

## 12.1. EXPERT OPINIONS

12.1.1. As I have already noted, Coffey Mining undertook an investigation of the Anzac Day event for BGM. It described its investigation as *"a comprehensive review of various studies undertaken by previous consultants, several site visits, a re-interpretation of geological structure and the re-evaluation of the geomechanical characteristics and behaviour of the host and reef rock masses."* It concluded:

> *"The 2.3ML event is interpreted to have been generated by slip on an unmined section of the Tasmania Shear in the hangingwall of the workings. This structure diverges from the economically mineralised section of the Tasmania Reef at approximately 915L and rejoins some 80m down dip at the 980L. Mining on the 925L has effectively unclamped the structure which was then able to slip".*
>
> And:
>
> *"The main cause of the 925L fall of ground is the seismic shakedown of broken reef (Figure 19) that failed due to lateral closure and consequent straining caused by mining and the presence of cross-cutting bedding plane parallel shears. The friable nature of the reef rocks allowed the depth of failure to propagate rapidly under the lateral strain and increase the load on the support system. The increased depth of failure also decreased the anchorage capacity of the friction bolt elements. In this condition, the support system was unable to resist the additional forces from the arriving seismic wave and failed because of insufficient anchorage capacity or incompatibility between the various support system components. Coffey Mining believe that the timing and source location of the 2.3ML event was not reasonably predictable. The main conclusion is that the recommended support elements were too short or were not compatible (ie. One element was the weak link in the system)."*

12.1.2. Mr Marisset agreed with this interpretation accepting that the falls of ground were caused by seismic shaking and observing that the slip within the hanging wall occurred at least 10 to 20 metres from the fall of ground which consumed Mr Knight.

12.1.3. Coffey Mining listed these factors as having contributed to the Anzac Day falls of ground:

1. *The progressive stress/strain driven degradation of the quartz ankerite reef due to hanging wall and footwall convergence and possible blasting.*

2. *The presence of geological structures in the immediate fall areas-both the Tasmania Shear and bedding parallel shears forming release planes and allowing increased lateral closure.*

3. *The proximity of the production brow.*

4. *The shaking associated with the incoming seismic waves generated by the 2.3 ML event in the immediate hanging wall rocks adjacent to the 925 level and,*

5. *The recommended support system installed on the 925 Level in the area of the fatal FoG was unable to maintain the stability of the excavation.*

12.1.4. The Coffey Mining report describes the most common ground support element failures in these terms:

- *"Friction bolts pulled out of the backs but still hanging in mesh,*
- *Friction bolts with flattening at approximately 1.5m from the head of the bolt,*
- *Unfolded mesh sheets-often misshapen but generally with little evidence of strand weld failure,*
- *Torn W straps-especially where two straps were pinned by a single friction bolt and the strap had torn away from the bolt*
- *Failure of resin bolts at or near the surface fixture-possibly due to nuts stripping off the threaded end."*

The report goes on to say that these type of ground support failures *"indicate that the depth of support is insufficient to provide sufficient anchorage capacity for the system and that the surface retention connections (plates, nuts and straps) are inadequate."*

12.1.5. A like remark upon the length of ground support is made by Mr Marisset when he says, *"This sudden increase in energy could be sufficient to exceed the localised rock capacity and propagate the failure envelop beyond the effective embedment of the installed ground support at the various rock fall locations."*

12.1.6. On the subject of ground support compatibility the Coffey Mining report states:

*"BGM were advised by their external consultants to install a combination of 2.4m long point anchored resin rebar bolts and 2.4m long modified cone bolts with the existing friction bolts in an attempt to provide a system of support that was able to withstand the dynamic loading that was expected from mine seismicity. The recommended*

*system appears to have been based on an assumption that stress was resulting in rock bursting in which a relatively thin skin (~1m) of rock surrounding the excavation was suddenly fracturing and being ejected. This mechanism is, however, not interpreted to be the case in the majority of rock falls investigated as part of this study."*

12.1.7. It is noted that Professor Kaiser too opines that the seismic shakedown of insufficiently supported rock rather than rock burst was the primary cause of the Anzac Day falls of ground. He adds this comment upon the failure mechanism and ground support:

*"Due to the friable nature of the reef rocks, depth of failure propagates rapidly when the friable reef rocks are excessively strained to depths exceeding 1-2m. The installed support in the ore development drives consisting predominately of 2.4m splitset bolts at 1.5m spacing with mesh and straps, recent additions of resin point-anchored rebar in some areas and modified cone bolts (in selected sections) is not adequate to hold the broken rock in place. The bolts are too short or support system components are not compatible, leading to sequential overloading when the bolts are highly strained."*

## 12.2. PREDICTABILITY

12.2.1. I have noted above the opinion of Coffey Mining that *"the timing and source location of the 2.3ML event was not reasonably predictable."*

12.2.2. I have already accepted (para 11.5.1) that the timing of a significant seismic event cannot be predicted. Of course if it was otherwise the management of seismicity in a mining context would be greatly simplified. I therefore agree that BGM could not have reasonably predicted the timing of the 2.3 event to have occurred at 9.23pm. on Anzac Day 2006.

12.2.3. As I have also noted above, Coffey Mining concluded that the 2.3ML event on Anzac Day was generated by a *"slip on an unmined section of the Tasmania Shear in the hanging wall"* (ie. on the C-shear) I accept this conclusion. I have found (para. 11.5.4) that neither the C-shear nor the series of other faults identified in the hanging wall had a sufficient seismic history to indicate that they represented an immediate mining hazard. In these circumstances it follows, in my opinion, that BGM could not reasonably have predicted the 2.3 magnitude event occurring on the C-shear which in turn induced the seismic shakedown and resultant falls of ground on level 925.

12.2.4. However, the fact that the timing and location of the 2.3 magnitude event could not reasonably be predicted by BGM is not, in my opinion, a matter of critical importance in terms of worker safety. Of greater importance, in my opinion, is whether BGM was managing its mine in a manner which adequately allowed for the real likelihood that it could on any day, including Anzac Day 2006 experience a seismic event potentially as large as 2.5 in magnitude. Critical to this issue was the suitability and sufficiency of the ground support system, particularly having regard to the known fragmented nature of the rock mass.

## 12.3. DR FULLER'S SPECIFIC OPINION UPON GROUND SUPPORT

12.3.1. I have noted previously (para. 8.3) the opinions of Dr Fuller upon the ground support regime at BGM and in particular his view that the friable nature of the rock made it unsuited in the seismically active areas of the mine.

12.3.2. As I have also noted previously, the ground support on level 925 in the area of the Anzac Day rockfalls comprised a combination of 1.8m and 2.4m split sets at 1.5m spacing with straps and mesh plus 2.4m Posimix threadbars spaced 1.5m apart in rows. This was in accord with Mr Turner's advice and was compliant with the GCMP for excavations less than 6 metres in width.

12.3.3. As I have found at para. 2.3.3 Mr Knight was engulfed by a rockfall containing approximately 120 tonnes of rock. By Dr Fuller's calculations this rockfall involved a maximum depth of failure of about 2.3 metres and extended over a length of about 6.7 metres.

12.3.4. It was the opinion of Dr Fuller that if the ground support in the area of the 120 tonne fall of ground had included debonded 6 metre cable bolts installed in the standard pattern and mechanically connected to straps and mesh *"then it's extremely likely that that rockfall would not have occurred."*

## 12.4. FINDINGS

12.4.1. The rockfalls occurring on 925L on Anzac day 2006 were the result of seismic shakedown following a local magnitude 2.3 seismic event. I am satisfied, accepting the opinion of Coffey Mining, that that event was generated by a slip on an unmined section of the Tasmania shear in the hanging wall of the workings. The slip was located in the hanging wall near to where Mr Knight and his colleagues were working, perhaps as near as just 10 to 20 metres.

12.4.2. I have previously observed (para. 2.3.4) that the 2.3 seismic event was not a natural phenomenon. Rather, it was induced by mining activity at BGM, primarily in the 940 block, which caused an unclamping of the structures within the reef enabling them to slip.

12.4.3. I accept, it being the common view of the authors of the Coffey Report (see para. 1.5.2) and Professor Kaiser (see para. 1.5.3), supported by Mr Marisset, that the Tasmania reef rocks are highly friable and tend to disintegrate into a *"cohesionless rock mass"* when exposed to mining activity.

12.4.4. I am satisfied that by Anzac Day 2006 mining activity within the 940 block had caused the reef rocks, because of their friable nature, to degrade. This allowed the rapid propogation of the depth of failure within the ore drive on 925L thereby decreasing the anchorage capacity of the friction bolts, notably the split-sets within the ground support system. I am satisfied too that in this state the ground support system was unable to resist the very high straining effects of the 2.3 event and thus failed. The failure occurred because of the ground support's decreased anchorage capacity and/or an incompatibility between its components.

12.4.5. I am not prepared to make a positive finding that the fall of ground which engulfed Mr Knight would not have occurred if the ground support had included debonded 6m cable bolts. In my view this is a subject which requires greater analysis and calculation than

Dr Fuller was able to devote to it from the witness box with little forewarning. However, this is a matter which I will return to when considering risk management.

12.4.6. I accept that neither the timing nor the source location of the 2.3 magnitude event could have been reasonably predicted by BGM. However, for the reason explained above this is not a finding of critical importance in terms of worker safety.

# 13. PRODUCTION .V. SAFETY

## 13.1. ISSUE

13.1.1. A subject which has raised itself for consideration is whether worker safety was at any time compromised by the need for BGM to continue production and to remain financially viable. There are several aspects to this issue and I will deal with each in turn.

## 13.2. THE IMPACT OF CREDITORS

13.2.1. As I have already indicated the Allstate Group was in administration as at Anzac Day 2006. It had multiple unsecured creditors, most notably Macquarie Bank. That bank was also the Allstate Group's financier and a secured creditor for very significant advances. The BCD companies were indebted to its banker Bankwest. The evidence shows that representatives of both Macquarie Bank and Bankwest were entitled to attend BMJV management committee meetings where they were able to ask questions but were not entitle to a vote. However, there is not any evidence to show that at these meetings or elsewhere any actions of any of the creditors, but most particularly Macquarie Bank, influenced any of the financial or production decisions taken by BGM which may have adversely impacted upon or compromised worker safety. Allied to this I am also able to say that there is not any evidence that any decisions relevant to worker safety and made by BGM were affected because the Allstate Group was in administration at the time of Mr Knight's death.

## 13.3. ENGAGEMENT OF CONSULTANTS

13.3.1. Part of BGM's response to the October 2005 rockfalls was to engage a bevy of consultants to assist in the investigation of their cause and to advise upon the way forward. I have already detailed the advices of these consultants earlier in these findings. After the Anzac Day event BGM engaged Coffey Mining to undertake an investigation and to prepare a case for safety. I am satisfied that in each case the retention of the particular consultants was proper and appropriate and neither financial considerations nor the Allstate Group's administration was a factor which in any way inhibited their employment.

## 13.4. PRODUCTION IN APRIL 2006

### 13.4.1. Evidence

13.4.1.1. Mr Cheeseman described the speed of mining in April 2006 on levels 915 and 925 as *"flat out."* It was the evidence of Mr Burgess that there had been a poor start to production in the early part of the month but then production was *"accelerated."* In contrast it was Mr Cresswell's evidence that he did not consider the rate of mining to be particularly fast.

13.4.1.2. Mr Marissett described the mining sequence for April as being *"relatively aggressive."*

13.4.1.3. The minutes for the shift supervisors meeting on 21 April record this comment made by Mr Ball, "3000t behind for the month. Presents a wonderful opportunity to make heroes of ourselves in the next week. Jamie to issue detailed schedule to the end of the month." It was Mr Ball's evidence that he made this comment because he was "geeing up (the) troops." It was part of his job, he said, "to keep people motivated."

13.4.1.4. Mr Burgess said of Mr Ball's statement, "I remember reading it verbally off the – off the document to myself, it was never presented to me by management or any other management personnel [as a direction], and I wouldn't have taken any notice to it anyway it was a ridiculous thing to say anyway."

13.4.1.5. The shift plods for April show that about 10,750 tonnes of ore were hoisted over the 39 shifts to the end of day shift on 20 April. The plods also show for the next nine shifts ending at night shift on 24 April approximately 6000 tonnes of ore were hoisted which represents almost two thirds of the amount hoisted for the previous 39 shifts. It was accepted by Mr Gill that the shift plods show an increase in the level of production after 20 April and that by 24 April the 3000 tonne production deficit had been virtually made up.

13.4.1.6. There was also evidence that Mr Ball had often advised personnel that the mine would be closed down by Macquarie Bank if *"things got behind for two months running."* Mr Ball acknowledged that he had used words to this effect *"many times"* and that he did so because of the need to keep the workforce informed; *"that was simply to tell the hard facts of life…..that the administrator wasn't allowed to run at a loss."*

13.4.2. **Findings**

13.4.2.1. I accept that in the early part of April production had been slow and that by 20 April the mine was approximately 3000 tonnes behind its monthly production target. I also accept that there was an acceleration in production in the five day period ending at night shift on 24 April and that by this date the production deficit had been all but eliminated. I find too, that Mr Ball, by his comment made on 20 April intended to encourage the supervisors to strive to attain the month's production target. However, there is not any evidence to show that the acceleration in production was undertaken at the expense of worker safety. Nor is there any evidence that the acceleration of production in the period leading up to Anzac day was a factor which contributed to Mr Knight's death.

13.4.2.2. Mr Ball's comment concerning Macquarie Bank and the closure of the mine if losses were sustained over two months may have been motivated by a desire to keep the workforce informed. It may also have been another of Mr Ball's motivational tools. Whatever its purpose I am satisfied that Mr Ball, by making this comment, was not intending to encourage workers to put production before safety.

# 14. THE CASE FOR SAFETY

## 14.1. S39 NOTICE

14.1.1. Following the Anzac Day event WST issued BGM with a notice pursuant to s38 of the Act directing it to cease all mining operations save for care and maintenance.

Subsequently, a notice under s39 was also issued by WST. It required BGM to prepare a case to manage underground safety at the mine and for it to be independently reviewed and presented to WST before mining could recommence. In response, BGM commissioned Coffey Mining to prepare a Case for Safety which in turn was reviewed by SP Solutions before its approval by WST.

14.1.2. Critically, the Case for Safety authors concluded that mining in the seismically active portion of the mine should only proceed by utilising footwall drives thereby making it unnecessary for workers to access the ore drives during the process of ore extraction. Professor Kaiser has commented upon the use of this mining method at BGM in these terms:-

> *"The adopted approach of limiting all drive access for workers in the West Ore Zone and drilling from footwall drives is such a measure. By removing workers from high risk areas and creating workplaces in more stable, less burst prone ground (the stronger footwall rocks), the overall risk has been drastically reduced. This move is seen as being most effective in managing risk at Beaconsfield Gold Mine."*

14.1.3. It is my understanding that BGM, its workforce, including its union representatives, and WST are all unanimous in accepting that the current method of ore extraction adopted as a result of the Case for Safety represents *"best practice"*.

# 15. RISK ASSESSMENT

## 15.1. WHAT IS A RISK ASSESSMENT?

15.1.1. By Australian Standard AS 4360/2006 ("AS 4360") the process of risk assessment involves risk identification, risk analysis and risk evaluation. Risk identification is defined as the process of determining what, where, when, why and how something could happen. Risk analysis involves a systematic process to understand the nature of and to deduce the level of risk, while risk evaluation is that process of comparing the level of risk against risk criteria. Risk criteria can include associated costs and benefits, legal and statutory requirements, socio-economic and environmental aspects, the concerns of stakeholders, priorities and other inputs.

15.1.2. Professor Quinlan describes risk assessment as, *"a critical component of contemporary OHS management systems"*. He explains the process in these terms; *"At its most basic, the process of risk assessment seeks to assess the magnitude and likelihood of an incident or exposure in the workplace in order to form a basis for deciding the urgency and resources that should be devoted to particular problems. The assessment process follows the identification of all relevant hazards. This information is then used to devise a response or intervention and the effectiveness of the latter is then assessed to inform (and if need be modify) future responses thereby closing the loop…….The dimensions for assessing risk revolve around trying to assess, on the one hand, the magnitude (seriousness and consequences) of being exposed to the hazard and, on the other hand, the likelihood (or frequency) of exposure. Thus, for example a hazard which is rarely encountered and entails minimal costs may be assessed as a minimal risk requiring limited intervention whereas a hazard exposure that is relatively infrequent but has very serious consequences (causing serious injury or death) would require a significant response."*

## 15.2. THE LEGISLATION

15.2.1. The Regulations make some provision for risk assessment. R17 obligates an accountable person to identify all hazards arising in a workplace, assess the risk associated with those hazards and implement measures to control the risk. R18(3) obligates the accountable person to regularly review and if necessary revise each risk assessment and r18(4) requires a written record of the assessment to be kept if it indicates a significant risk to the health or safety of any person. By r19 the accountable person is obligated to ensure that the exposure of any person to an identified hazard is controlled to eliminate or minimise the risk. By r19(2) the control of risk is to be achieved through the progressive application of the following measures:-

a) The elimination of the hazard.

b) If elimination is not reasonably practicable, the substitution of the hazard by something that is a lesser hazard.

c) If substitution is not reasonably practicable, the isolation of the hazard from the person at risk.

d) If isolation is not reasonably practicable, the control of the hazard by engineering means.

e) If engineering means are not reasonably practicable, the control of the hazard by administrative means including the adoption of safe working practices and

f) If administrative means are not reasonably practicable, the use of personal protective equipment.

15.2.2. Those measures listed in r19(2) as the means to progressively eliminate or at least minimise risk to personnel were recognised by Mr Gill in a table he produced at the inquest entitled *"BGM Risk Assessment Process post-October 2005."*

15.2.3. In his report Professor Quinlan notes that in contrast to some other jurisdictions the Tasmanian legislation does not incorporate any specific guidance material in relation to risk assessment in the mining industry. He points out that the NSW Department of Primary Industry, for instance, has produced both a risk management guidebook and a guide for reviewing risk assessment of mine equipment and operations. In his opinion the production in Tasmania of guidance material on risk assessment specific to the mining industry, or alternatively the adoption of like material available or produced by other States would be of advantage, both to the mining industry and to the WST inspectorate. I agree with this comment.

## 15.3. THE CONCLUSIONS OF PROFESSOR QUINLAN

15.3.1. In his report Professor Quinlan includes these concluding opinions upon risk assessment:-

> *"832. With regard to whether the mine had done everything reasonably practical to avoid an incident such as that which occurred on Anzac Day 2006 the following observations can be made. The mine recorded both rockfall and seismic activity and*

*undertook detailed investigation into a number of rockfalls. The mine operated a rock noise reporting system and in 2005 significantly upgraded its seismic measurement array (J Map) to provide more accurate and 'real-time' information that could be used by both senior management and shift supervisors to minimise the risk exposure of mineworkers to falls of ground. The mine had also developed a Ground Control Management Plan that was upgraded progressively and employed expert consultants to provide advice on mining methods and ground support. Following the serious seismic events/rockfalls in October 2005 the mine acted decisively, closing a number of stopes, engaging a number of consultants to review seismicity and provide further input on extraction sequences and ground support (including an independent 'second opinion'), and modifying extraction sequencing and ground support before re-opening the affected areas.*

*833. At the same time, evidence indicates the response did not entail a thorough or systematic risk assessment that was duly documented for review, monitoring implementation of control measures and revision. As far can be determined, the risk ranking of ground control in the Catastrophic Risk Assessment implementation was not reassessed or revised in the light of this event, the GCMP was not subjected to an independent audit (duly documented), GAT was not assessed, and the same point can be made in relation to re-entry protocols (although practice was adapted in the light of the new seismic array and with Omori analysis being implemented). The mine did not develop a set of formal protocols in relation to determining 'red flags' for worker withdrawal, suspension of firing/stoping or urgent consideration in relation to seismic activity. Nor is there evidence that the mine reviewed the history of rockfall activity at the mine since seismicity had emerged as an issue to determine whether the frequency or location of falls (including their predictability with regard to location) indicated the need for additional measures (or should be used to determine 'red flag' action points in the future). Finally, the weight of evidence indicates mineworkers were not genuinely consulted as part of a risk assessment process following the October 2005 events. The mine sought to communicate information on the seismic events (though memos written in early November indicate not as much safety-related information was conveyed to them as was provided to the mine's administrator) and its proposed solutions. However, evidence indicates that mineworkers' views and experience was not sought, duly recorded or factored into management's deliberations (even if to be eventually discounted). This is especially unfortunate in the context of evidence that experienced mineworker held serious concerns about the safety of mining methods.*

*834. Arguably, all the measures just mentioned were reasonably practicable and, indeed, a number were specifically required under the Workplace Health and Safety Act, 1995 and Workplace Health and Safety Regulations, 1998 (such the requirement to undertake a thorough risk assessment following the October incident and to consult with the mine workforce with regard to this). The evidence available is not sufficient to state with confidence that the measures just identified, either individually or in combination, would have prevented the seismic event and rockfalls on the evening of 25 April 2006, or at least prevented workers being in the affected areas at the time. What can be concluded is that undertaking these measures would have amounted to a series of not insignificant steps towards minimizing the likelihood of an event such as that which occurred on Anzac Day 2006 with its tragic consequences."*

## 15.4. THE MATTER FOR CONSIDERATION

15.4.1. Professor Quinlan's conclusion that BGM's response to the October '05 rockfalls "*did not entail a thorough or systematic risk assessment that was duly documented for review, monitoring implementation of control measures and revision"* is rejected by BGM. It is a conclusion which requires my consideration as it is, potentially in my view, the aspect of BGM's risk management which has the most relevance to Mr Knight's death. A start point is to consider the evidence as it relates to the basic criteria for risk management as prescribed by AS 4360.

## 15.5. ESTABLISH THE CONTEXT

15.5.1. As a first step in the risk management process *"Establish the context"* requires the definition of the basic parameters within which the risks must be managed and sets the scope for the rest of the risk management process.

15.5.2. I have referred earlier to the *"Actions Going Forward"* portion of Mr Gill's memorandum of 1 November 2005 to Mr Ryan. (see para. 6.3.1) It sets out five steps to be undertaken and then concludes, *"Only once we have performed the above (five steps) and are satisfied that we have an appropriate plan for each stoping block going forward will we recommence full scale ½ Uppering production."* I am satisfied that by this memorandum Mr Gill adequately established the context and commenced the risk management process.

## 15.6. IDENTIFY RISKS

15.6.1. Although not expressly stated under the *"Actions going forward"* portion of Mr Gill's memorandum it can be readily inferred that the risk of rockfall was the relevant risk to be managed.

## 15.7. ANALYSE RISKS

15.7.1. As explained by AS 4360 risk analysis involves the development of an understanding of the risk and involves a consideration of the sources of risk, their positive and negative consequences and the likelihood that those consequences may occur.

15.7.2. In this instance BGM sought to acquire a better understanding of the risk by retaining independent consultants for their advice. I have set out significant portions of that advice at paras. 7 and 8. It's necessary that I make some further observations at this point in the context of risk management.

15.7.3. **Mr Turner**

15.7.3.1. Mr Turner, along with Mr Penney, did carry out a ground support review and audit in early November thus satisfying part (a) of Mr Gill's memorandum. They devised an audit form which was completed for each of the stoping levels. Mr Turner recommended the installation of additional support in some areas including levels 915 and 925. These recommendations were acted upon. (paras. 8.1.2 and 8.1.3) A second audit was undertaken by Mr Turner in late March 2006.

15.7.3.2. Mr Turner's November review and audit was undertaken without Mr Basson's modelling results being available. In his report Mr Turner advised that his own

comments and recommendations should be *"re-evaluated"* after the modelling results became available.

15.7.3.3. It should be noted that step a) of Mr Gill's memorandum required that the ground support audits be undertaken *"relative to the current standards."* This is a process quite distinct from an assessment of the sufficiency of the ground support standards which was necessary to answer the questions posed by step c) of the memorandum.

15.7.3.4. It is also noted that Mr Turner acknowledged in his evidence that at the time he was commissioned to carry out the ground support audit he was not made aware of the mine's complete rockfall history nor provided with a full set of its rockfall reports. He accepted that this material would have been helpful *"in assessing the effectiveness of the installed ground support."*

15.7.3.5. It needs also to be noted that Mr Turner, following his second audit reported on 21 April that there was *"still a possibility of another large-magnitude seismic event,"* that there was a need for the support systems to be *"continually checked"* and *"additional support rehabilitation could be required."*

15.7.3.6. It was submitted by counsel-assisting that Mr Turner, as the consultant most closely involved in the ground support design, should not have been retained to carry out the review and audit because he was in effect *"being asked to mark his own work."* I accept this submission.

15.7.4. **Dr Mikula**

15.7.4.1. As I have already noted at para 8.3.2.2 Mr Gill understood that one of Dr Mikula's tasks was to conduct a peer review of Mr Turner's ground support system but this was specifically denied by Dr Mikula. Instead, it was his view that his brief was to carry out a general overview of the mine's operations and that any ideas or comments made by him in his reports would not be acted upon without full analysis. It seems that this confusion led to BGM, or at least its Resident Manager, being of the view that Dr Mikula's report, in part, represented a peer review of the existing ground support system when in fact the report's author did not intend that this be so.

15.7.4.2. Dr Mikula's evidence included these observations (see para. 7.4.3):

- That there is a need to be alert to the fact that mining away from one problem structure can mean mining towards another and

- The possibility of the HW shear being a linking structure was a matter he'd *"be concerned about."* (It needs to be noted that BGM did not brief Dr Mikula upon its geology at the time of his visit.)

15.7.5. **Dr Sharrock**

15.7.5.1. Dr Sharrock carried out a back analysis and stress modelling review thus fulfilling step b) of Mr Gill's memorandum. He provided his final report to BGM on 30 January 2006 although a draft report with a power-point summary was provided sometime in the previous month.

15.7.5.2. As I have noted at para. 8.3.1 Dr Sharrock:

- Identified the potential for shakedown in wide sections where damage extended beyond the support capacity,
- Suggested that BGM's ground management plan should address the depth of failure issue and install cable bolts with appropriate surface support where required, and
- At least inferred that the friable nature of the rock mass made the compressive arch an unsuitable foundation for the ground support system.

15.7.6. **Mr Basson**

15.7.6.1. Upon BMG's instruction Mr Basson prepared a 12 month forward analysis for future mining utilising the formulae for the onset of damage and peak failure produced by Dr Sharrock. In doing so he satisfied step d) of Mr Gill's memorandum. However, as I have noted at para. 9.1, BGM had made the decision to resume mining before its receipt of even Mr Basson's draft report, a decision contrary to Mr Gill's memorandum which required all five steps of his action plan to be performed beforehand.

15.7.6.2. As I have previously noted (para. 7.5.3) Mr Basson reported that in April 2006 both the 915 and the 925 level pillars will have *"failed"* meaning that:

*"High deformation in the pillar material where the following could be expected:*

- *Drilling difficulty*
- *Additional support requirements and rehabilitation work*
- *A high potential for seismic activity resulting from pillar yielding."*

## 15.8. EVALUATE RISKS

15.8.1. By AS 4360 the purpose of risk evaluation is to make decisions based on the outcomes of risk analysis, about which risks need treatment and treatment priorities.

15.8.2. Sometime in January 2006 the decision was taken by BGM, specifically I presume by Mr Gill, who accepted that it was his responsibility, to resume stoping in the western portion of the mine and thereby assume the residual risk arising from that decision. However, the evidence is unclear upon the steps taken by BGM, prior to this decision, in its evaluation of those risks identified by its own risk analysis process. To illustrate:

- There is no evidence to explain the decision to resume mining in contradiction of Mr Gill's memorandum which had stipulated that forward modelling be completed beforehand.
- Mr Gill had, in his memorandum posed the questions, *"Are our current ground support standards sufficient for the seismicity being experienced?, and if they aren't, "What is required?"* However, there is not any evidence of BGM having undertaking an assessment of the sufficiency of its ground support standards so that these questions

could be answered nor is there any record evidencing why the decision was taken to resume mining without these questions being addressed.

- Dr Sharrock had identified an important depth of failure issue which Mr Gill acknowledged was raised by him at his close-out meeting yet there is no evidence to explain the evaluation of this concern by BGM and the basis for its rejection.

- There does not appear to be any evidence of BMG having considered the re-evaluation of its ground support after Mr Basson's modelling results became available although this had been advised by Mr Turner.

15.8.3. I have already noted at para. 9.2.2 the decision taken by BGM to reverse the mining of panels 8 and 10 contrary to the checkerboard sequencing method without a comprehensive evaluation of the risks associated with that decision.

## 15.9. TREAT RISKS

15.9.1. This involves identifying the range of options for treating risks, assessing these options and the preparation and implementation of treatment plans.

15.9.2. The evidence shows BGM elected to treat the risk of rockfalls when it determined to resume mining by:

- Upgrading the ground support as advised by Mr Turner,

- Adjusting its sequencing to mine away from the HW shear and the Offset Fault,

- Moving from the modified Avoca sequencing method to the chequerboard method and,

- Continuing to closely monitor seismic activity.

15.9.3. As has been noted Mr Knight and his co-workers were building a bund wall at the brow on 925 level at the time of the Anzac Day event. This is a notoriously hazardous area. There was evidence that the exposure of workers to the risk of rockfall in that area would be eliminated if the bund wall was made redundant. This issue was addressed by Mr Ball who gave evidence that BGM had experimented with *"piling big rocks up there to try and hold the backfill back"* and by *"stick(ing) explosives through (a) conduit to negate the need for a fence."* However, it was his evidence that neither of these options worked. He also said that *"we considered down holes"* but *"we got a lot of opposition from the drillers……they did not like them."* Too, as he pointed out, the drilling of down holes takes longer than up holes thus exposing the drillers to greater risk when working in the area of a brow. I accept Mr Ball's evidence upon this subject.

15.9.4. An option to treat the risk of rockfall was to abandon mining in the western portion of the mine. There is not any evidence that this was given any serious consideration by BGM. I accept that this was not proposed by any of the consultants but, as I have already noted, this was not an alternative upon which their opinion was sought.

15.9.5. It is pertinent to observe that the case for safety undertaken by Coffey Mining following the Anzac Day event concluded that mining of the western portion of the mine could

only be safely undertaken by removing workers from the production drives and utilising footwall drives. I note that mining engineer, Mr Gary Davidson described the case for safety as *"a broad risk analysis."*

## 15.10. MONITOR AND REIVEW

15.10.1. By AS 4360 ongoing review is essential. Factors that may affect the likelihood and consequences of an outcome may change, as may the factors that affect the suitability or cost of the treatment options. It is therefore necessary to repeat the risk management cycle regularly.

15.10.2. BGM had been forewarned by its consultants that mining conditions were going to be difficult on levels 915 and 925 during April, that the conditions needed to be closely monitored and that it should proceed with care. These circumstances required BGM, in my view, to have in place, as part of its risk management strategy, a monitoring system which ensured that its senior technical personnel had prompt notice of all pertinent information relevant to the ground conditions. The prompt communication of that information was necessary so that management was in a position to immediately reassess its treatment of the risk of rockfall and adjust it as necessary. The underground manager's ignorance of those matters referred to at para. 11.3.2 coupled with BGM's less-than- adequate response to the 22 April fall of ground are, in my opinion, clear evidence of a deficiency in the monitoring aspect of BGM's risk management system.

15.10.3. I have referred at para. 9.2.4.3 to BGM's handling of the sequencing change involving panels 8 and 10 on level 925 and its failure to undertake a comprehensive and documented evaluation of the risks associated with that change. This failure, in my view, is another illustration of the inadequacy of the monitoring aspect of the risk management strategy.

## 15.11. "RECORD THE RISK MANAGEMENT PROCESS"

15.11.1. Clause 3.8 of AS 4360 is headed *"Record the Risk Management Process"* and states;

> *"Each stage of the risk management process should be recorded appropriately. Assumptions, methods, data, sources, analyses, results and reasons for decision should all be recorded.*
>
> *The records of such processes are an important aspect of good corporate governance.*
>
> *Decisions concerning the making of records should take into account:*
>
> - *The legal and business needs for records;*
> - *The cost of creating and maintaining records and*
> - *The benefits of re-using information.*

15.11.2. The Minerals Industry Safety Handbook incorporates reference to AS 4360.

15.11.3. BGM submits that there has been adequate documentation of its risk management following the October rockfalls constituted by Mr Gill's memorandum of 1 November, a

memo dated 23 December '05 from of Mr Hills to Mr Gill and entitled *"Seismicity"*, the "Seismicity Risk Management Update" of March '06, the consultant's reports and other documentation relating to the consultants.

15.11.4. I do not accept BGM's submission and make these comments:

- Mr Gill's 1 November memorandum is evidence of the start point in the risk management process but little more;

- As it states, the "Seismicity Risk Management Update" is *"designed to ensure that the major seismic risks are identified in a general sense and to ensure that stakeholders are aware of what BMJV is doing about them."* The contents of the document are consistent with this description. Critically, it does not record the process undertaken by BGM in its decision-making for management of the risk of rockfalls.

- The memo of 23 December provides a summary to Mr Gill of the actions taken to that date. It records that *"stoping blocks (are) being progressively brought back into production as work is completed"* but I note does not detail the analysis or basis for the decisions to progressively resume production. It is noted also that the memo explains that *"Dr Mikula provided an overview of geomechanics and seismicity at Beaconsfield from a fresh perspective and a number of action items in his report have been or are being followed up."* The memo does not indicate which *"action items"* were being followed nor the rationale for doing so. Relevantly too, it is noted that Mr Hills does not report that Dr Mikula undertook a peer review of the ground support. Further, while the memo reports on the introduction of checkerboarding it does not include an analysis of the reasoning that led to that decision nor does it include any analysis or explanation for concluding that *"it should result in a safer working environment."*

- There does not exist a specific document that records the decision to resume mining, the reasons for that decision and, adopting the words of AS 4360, incorporates the *"assumptions, methods, data sources, analyses"* behind that decision. Rather surprisingly, there is not even any evidence, written or otherwise, indicating the date of that decision and the identity of the person or persons who made it.

- It was the evidence of both Mr Hills and Mr Ball that the decision to resume mining was to be taken by BGM after consideration of the consultants' advice and the resolution of any differences. This process, in my view, necessitated the creation of documentation which identified the advice, isolated the differences within it and provided an explanation for one opinion being preferred over another. No such documentation exists.

- The advice of Dr Sharrock provides a stark illustration of the above point. As I have said, his advice recorded his concerns upon depth of failure and the ground support, advice which contradicted the advice of Mr Turner. By acting as it did BGM clearly preferred Mr Turner's advice but no document exists which records the differing views and explains BGM's choice.

- As I have said, Mr Gill's memorandum of 1 November at c) posed two critical questions concerning ground support but there is not any documentation either

detailing the answers to those questions or providing an explanation for them not being answered.

- There is not any documentation to explain BGM's decision to resume mining before Mr Basson's modelling was complete and his report made available to both BGM and to Mr Turner.

- There is not any documentation evidencing BGM's decision to reverse the mining of panels 8 and 10 with record of the analysis of that decision.

- Both Mr Ball and Mr Gill gave evidence of a mining accident having occurred at Broken Hill and BGM undertaking a risk assessment to determine if a similar risk existed at its mine. Documentation put into evidence reveals a very full and detailed assessment. It is in contrast with the relatively meagre documentation created by the assessment undertaken following the October rockfalls. This was explained by Mr Ball on the basis that the Broken Hill assessment was carried out at operator level whilst the other was dealt with by the technical personnel. I do not consider this explanation to be credible.

## 15.12. THE ROCKFALL INCIDENT REPORTS

15.12.1. This is a subject which warrants specific comment in the context of risk assessment.

15.12.2. Following the 26 October rockfall BGM had to hand twenty of its own Rockfall Incident Reports which evidenced either a fall of ground greater than one tonne or the failure of ground support. As the Coffey Mining analysis shows, admittedly done after Anzac Day, a high proportion of these Reports concerned falls which occurred in sheared or faulted and blocky ground conditions where ground support was in place and there was evidence of failure depths greater than two metres and in a larger number greater than one metre. Some of these falls had endangered personnel. Mr Marissett has described the number of rockfalls occurring in the mine as *"exceptionally high."*

15.12.3. In my view, the information within the Rockfall Incident Reports by itself was sufficient to raise concerns about the adequacy of the ground support system and in particular whether the compressive arch should be maintained as the basis of that system.

## 15.13. EVIDENCE OF DR FULLER

15.13.1. At para. 8.3.6.2 I have found, accepting the evidence of Dr Fuller, that the compressive arch was unsuited as the basis for the mine's ground support system. At para. 12.3.4 I relate Dr Fuller's opinion that the fall of ground which engulfed Mr Knight would not have occurred if the ground support system had included debonded 6m cable bolts.

## 15.14. COMMENT BY MR MARISSET

15.14.1. It was the view of Mr Marissett that *"the mine went to great lengths identifying seismic hazards yet failed in the area of risk assessment."* It was his opinion, expressed in evidence, that after the consultants' advices had been received they should have *"sat down and sort of communicated their findings and then were given the opportunity to discuss any views…"*

15.14.2. I accept Mr Marissett's view on this subject and agree that a meeting involving all the consultants convened after all their reports were finalised would have been a very helpful supplement to the risk assessment process. In my opinion such a meeting would have facilitated an exchange of views, helped to clarify any ambiguities, identified areas of difference and enabled debate upon their resolution. All of this would, in my opinion, have better equipped BGM in the decisions it needed to make upon risk management. I accept that such a meeting would involve some cost and perhaps present some logistical challenges but these could be readily met by utilising a range of alternate communication options.

## 15.15. CONCLUSIONS UPON RISK ASSESSMENT

15.15.1. Professor Kaiser has made the observation that *"in burst prone mines the unexpected must be expected and multiple lines of defence other than ground support must be implemented to reduce the risk of injury."* One obvious line of defence is to have in place a systematic, comprehensive, rigorous and properly documented risk assessment process. It is my opinion that BGM did not abide by such a process in the period between the October '05 rockfalls and Anzac Day 2006.

15.15.2. It is my opinion that if BGM had put in place and systematically followed a thorough and comprehensive risk assessment process then it would, or at least should have brought to light multiple matters which were relevant to the assessment including:

- that Dr Mikula had not carried out a peer review of the ground support system, contrary to Mr Gill's belief,
- that Dr Mikula had not been briefed upon the mine's geology at the time of his visit and that as a result he was unaware of the C-shear structure extending from the 940 to the 990 level,
- that Mr Turner had not been provided with the mine's full rockfall history at the time he was instructed to carry out his audit,
- that there had not been a re-evaluation of the ground support as recommended by Mr Turner after Mr Basson's modelling became available,
- that one of those parameters for the risk assessment laid down by Mr Gill in his memorandum had not been met in that there had not been an assessment of the ground support standards as prescribed in step c),
- that the opinion of none of the consultants had been specifically sought on whether mining should be resumed in the 940 block. Focussed attention to that topic may have generated consideration of other mining methods including the use of footwall drives or at least alternatives to the bund wall, and
- The need to clarify Dr Sharrock's view concerning amendment to the GCMP, particularly whether his comments were intended to relate only to excavations over 6 metres in width.
- Mr Turner's view that cone bolts should have been installed in panel 10 on level 925.

15.15.3. It is my further view that a more systematic and thorough risk assessment process, particularly if it included a meeting as suggested by Mr Marissett would have:

- Brought to light and facilitated deliberated consideration of Dr Sharrock's very real reservations upon the suitability of the compressive arch as the foundation for the ground support system given the friable nature of the rock mass.

- Inevitably led to consideration of cable bolts as a suitable supplement to the ground support system and enabled the necessary engineering calculations for that option to be made,

- Enhanced the possibility of it being realised that the C-shear and the series of other shears within the hanging wall were structures that needed to be considered,

- Enabled the better consideration of the strategies necessary to properly monitor ground conditions when mining resumed to ensure that BGM was better informed of any changes and to be in a position to immediately respond to those changes.

15.15.4. The Case for Safety was in part a risk assessment. It determined, as I have noted, that the mining method being employed on Anzac Day could not be safely continued. Whilst it could not be fairly said that BGM was obligated after the October '05 rockfalls to put in place an equivalent process, the Case for Safety does nevertheless serve to illustrate the benefit of a comprehensive, thorough and disciplined approach to risk assessment.

15.15.5. In my view, it is on the subject of ground support that BGM's risk assessment process dramatically failed. In his memorandum of 1 November Mr Gill properly identified the need for the current ground support standards to be re-assessed. It was insufficient, in my view, to commission Mr Turner to audit his own work and for a general overview to be undertaken by Dr Mikula. The mine's rockfall history up to and including October 2005 made it glaringly obvious that a ground support system based upon the compressive arch was not performing satisfactorily and that the entire system required a comprehensive and independent re-assessment. The need for that re-assessment should have been reinforced by the concerns expressed by Dr Sharrock upon the ground support. Why BGM made the decision to resume mining without that re-assessment taking place and without answers to those questions raised by step c) of Mr Gill's memorandum has not, in my opinion been satisfactorily explained.

15.15.6. To summarise, I agree with the conclusion of Professor Quinlan that BGM's response to the October'05 rockfalls *"did not entail a thorough or systematic risk assessment that was duly documented for review…."*

15.15.7. I am unable to positively find that had BGM applied a more systematic and rigorous risk assessment either the seismic event on Anzac day 2006 with its associated rock falls would not have occurred, that workers including Mr Knight would have been excluded from the fatal rockfall area at the critical time or indeed that Mr Knight's death would have been avoided. However, it is my view that the likelihood of Mr Knight's death would have been significantly reduced had BGM adopted and applied a more thorough and rigorous risk assessment process. This is so in particular because such process would have, in all likelihood, identified the inadequacy of the ground support system and

led either to that system being varied or the mining method being changed before mining resumed.

# 16. WORKPLACE STANDARDS TASMANIA

## 16.1. REPORTING OF ROCKFALLS

16.1.1. An issue examined at the inquest was whether BGM had met its statutory obligation to give notice to WST of all dangerous incidents in the form of rockfalls, the implication being that if it had not then WST may have been compromised in its assessment of the need to inspect the workplace and to monitor its safety practices.

16.1.2. A workplace's obligation to give notice of a dangerous incident is contained in s47 of the Workplace Health and Safety Act 1995 which provides:

> *"(1) If at a workplace-*
>
> *(a) a person is killed or suffers serious bodily injury or illness; or*
>
> *(b) a dangerous incident occurs as a result of which a person could have been killed or could have suffered serious bodily injury or illness*
>
> *a person having control or management of the workplace must, by the quickest available means, notify an inspector of the particulars of the occurrence of the death, injury, illness or incident."*

16.1.3. It is submitted for BGM that s47 did not require it to give notice of a fall of ground where a person could not have been killed or seriously injured. Accordingly, it is said that those falls of ground occurring in areas of the mine which were not being traversed by personnel, for instance falls occurring in "no entry" areas or during exclusion periods, were not notifiable. I accept this interpretation.

16.1.4. It is BGM's further submission that it did fully comply with s47 and notified WST of all incidents required by that section. This however, does not seem to be correct. I have previously referred to the 30 tonne fall off ground occurring on 980WmL during night shift on 22 April and involving Mr Malkin and Mr Lightfoot. This event clearly exposed these two persons to the risk of serious injury and was an incident reportable under s47. There is also the incident involving Mr McKay which occurred on 925mL whilst he was remote bogging in the vicinity. That incident, as I have stated, occurred in October 2005 prior to the rockfall on the 26th but the evidence has not permitted me to determine whether it involved the major rockfall occurring on 9 October or was a separate event. If the latter then I am satisfied that it required notice under s47 but such notice was not given. If the former then I accept the evidence of Mr Hills that he informed Mr Sears of this incident when he visited him in Hobart on 28 October but of course notice at this time was some 19 days after the event and contravened the requirement for notice under s47 to be *"by the quickest available means."*

16.1.5. In the course of Mr Melick's investigation a table was compiled of the falls of ground at the mine in the period January 2004 to 25 April 2006. It includes many falls which neither caused nor threatened to cause death or serious injury and hence were not reportable under s47.

16.1.6. It was the evidence of Mr Sears that he was unaware of many of the falls of ground listed in the table, that he would have been alarmed if he had been aware of some of them and that he would have made some enquiries of the mine had the full picture been made to him. I accept this evidence. However, it is my view that had WST been fully aware of the fall of ground history any response on its part would have been, because of its resource limitations, modest at best and almost certainly ineffectual. The subject of WST resources is a matter I will return to.

16.1.7. I accept the observations made by Professor Quinlan, firstly that rockfalls are responsible for half of all mining deaths occurring in Tasmania during the last 20 years and secondly, that near misses can be very good predictors of future events. In his view the inspectorate should be given notice of any unexpected or unplanned fall of ground.

16.1.8. It was the evidence of Mr Sears that he had, since Anzac Day 2006, introduced a trial rockfall notification system at BGM obligating the mine to give notice of all falls of ground *"from the brow of the stope back into man entry areas"* on the basis that *"they are the ones that we are really interested in as they are the ones that pose a danger to personnel."*

16.1.9. In my view it is critical that the mining inspectorate be fully aware of all significant falls of ground occurring in a mine, particularly a mine which is seismically active. It is self-evident that without this information the inspectorate's capacity to monitor a mine's safety practices is compromised. As this case has illustrated, the obligation to notify under s47 (and to deliver monthly accident reports under r64 of the Regulations) does not ensure that WST is sufficiently informed of a mine's rockfall activity. It is thus my recommendation that the legislation be amended to ensure that WST has notice of all unplanned or unexpected falls of ground save for those either involving unsupported ground or occurring in areas not traversed by personnel. Such an amendment would be in accord with the parameters of the trial notification system now operating at BGM which Mr Sears says is working successfully and which he intends extending to other mines in the State.

## 16.2. ADEQUACY OF THE WST INSPECTORATE

16.2.1. As at Anzac Day2006 the mining inspectorate comprised Mr Fred Sears, the Chief Inspector of Mines and Senior Inspector, Mr Mark Smith. However, for many months prior to this time Mr Sears had been fully occupied dealing with matters arising from the deaths of three miners which had occurred in two separate events at the Renison Bell tin mine in 2001 and 2003. It seems that WST had not assigned any other person to carry out Mr Sears' usual duties during the time that he was involved with the Renison Bell matters. In the result sole responsibility for carrying out the inspectorate's inspection and enforcement function fell to Mr Smith. On 28 March 2006 Mr Smith wrote a memorandum to the Chief Inspector in the following terms:

> *"I believe it is appropriate to apprise you of the current situation regarding my workload as the only non-management mines inspector currently operating in the Office of the Chief Inspector of Mines.*
>
> *I have serious cause for concern about my/our ability to ensure the key safety messages and preventative actions are being implemented at workplaces under our jurisdiction……*

*As a lone individual with competing priorities for my time I have been unable to pursue these matters adequately enough.*

*Without resolving these matters there is a high potential for serious recurrences that would jeopardise the current safe operations and hence the buoyant resources sector in Tasmania because we have not been able to maintain the level of safety that has resulted from the recent fatalities of the last few years. With the number of close call events that are occurring and no follow up to ensure that proactive measures are implemented and it is only a matter of time before another catastrophic event occurs.*

*With the commencement of the initiative for the office of the Chief Inspector of Mines in July 2005 and the unsuccessful attempts to recruit personnel to fill the vacant positions there is a clear perception by some participants in the industry that Workplace Standards Tasmania are not taking safety in the mining industry seriously and they are getting away with matters that would normally be pursued to prosecution. We only visit sites as a reactive measure when a major incident occurs with little opportunity to conduct proactive education and enforcement visits."*

16.2.2. In the four weeks following this memorandum WST did not take any steps to provide Mr Smith with any additional personnel or other support.

16.2.3. It was the evidence of Mr Gill that he was for a time President of the Tasmanian Mineral Council. In this capacity he did, either in 2004 or 2005 make a submission to Government for the better resourcing of the inspectorate. He said the Government's response *"fell short."*

16.2.4. I am able to find that for at least one year prior to Anzac Day 2006 and almost certainly longer the inspectorate's level of staffing was grossly inadequate and that it was incapable of carrying out its core function of inspecting and enforcing best safety practices within the mining industry.

## 16.3. WST'S INVOLVEMENT WITH BGM BETWEEN OCTOBER 2005 AND 25 APRIL 2006

16.3.1. Immediately following the rockfall on 26 October Mr Hills telephoned Mr Sears to report its occurrence. Mr Sears advised that WST was unable to send an Inspector to site. Accordingly, Mr Hills, on the direction of Mr Gill, drove to Hobart to meet with Mr Sears and to fully report on the rockfall and related matters. As I have previously noted, that meeting took place on 28 October and Mr Sears was provided with sketches, plans, J Map data and copy of the Ground Control Management Plan, Revision C. It was Mr Sears' understanding from the meeting that BGM was *"going to investigate the matters,……..they were going to employ consultants……..they had in fact ceased production in that area of the mine that was the subject of seismic activity."*

16.3.2. Mr Sears, together with Mr Smith, attended at BGM on 2 November 2005. It seems that the purpose of this visit was not to address seismicity and the recent rockfalls but instead was in response to a written invitation made by Mr Gill on 5 August 2005 to be informed upon *"OH&S initiatives"* including a catastrophic risk review programme and *"Our Ground Control Management Plan including progress of managing seismicity"*. The

evidence shows that these matters were in fact discussed but there was no evidence of the 26 October rockfall and any related matters being raised. This is most surprising.

16.3.3. An inspector did not make another visit to the mine prior to the Anzac Day event. This evolved, Mr Sears explained, because of *"Our lack of resources to visit mines for many years"*. He described WST's resources as*"inadequate"*. I note that there was not any evidence adduced to contradict this testimony.

16.3.4. On about 23 March 2006 Mr Gill made contact with Mr Sears by telephone and provided him with a general overview on the mine's production, scheduling, ground support improvements and extraction sequence changes. On 12 April Mr Gill emailed to Mr Sears a copy of a memorandum prepared by Mr Hills entitled 'Seismicity Risk Management at Beaconsfield" with a powerpoint presentation attached.

16.3.5. Overall, WST described its response to the October rockfalls in these words:-

> *"WST was not involved in the decision to suspend mining in the seismically affected areas, as a result of the seismic event on 26 October 2005.*
>
> *WST did not investigate the seismic event of 26 October 2005…….*
>
> *WST was not involved in the decision to recommence mining at Beaconsfield in seismically affected areas."*

16.3.6. It is apparent upon the evidence that WST was content to permit BGM to manage the investigation of the October rockfalls and to devise the plan forward, with virtually no active involvement on its part. This non-involvement by WST constituted, in my view, an abrogation of its statutory duty to inspect, monitor and enforce safe work practices at the mine thereby denying Mr Knight that layer of protection which he was entitled to expect from a properly functioning inspectorate. However, I am unable to find upon the evidence that the greater involvement by WST in the events post October would have led to either the Anzac Day rockfalls being avoided or the prospect of their occurrence being markedly reduced. It therefore follows that there cannot be a finding that this non-action by WST was a factor contributory to Mr Knight's death.

16.3.7. I accept that the mining inspectorate's non-involvement with BGM at this critical time was a consequence of its lack of resources, most particularly the availability of inspectorate personnel with mine engineering expertise. It is apparent and I find that this situation was the direct result of a lack of commitment on the part of the Tasmanian Government to provide those resources.

## 16.4. CHANGES TO INSPECTORATE POST 25 APRIL 2006

16.4.1. In 2005 a State budget initiative was approved to raise the number of inspectors within the inspectorate from 2 to 5. Mr Ormerod explained that the intention at that time was to recruit two additional senior inspectors and an additional mining engineer with geotechnical experience. In June 2006 two inspectors (generalist) joined the inspectorate. The increase in personnel was short lived with one inspector leaving in October 2006.

16.4.2. Throughout 2007 attempts were made to fill the vacant mining engineer's position. Two interstate applicants were interviewed and offered the position. Both declined on account of better offers from their home States.

16.4.3. The Table which is set out below shows the comparable conditions for a mining engineer in 2006 across four States and clearly demonstrates Tasmania's non-competitive position.

| | **Tasmania** | **Queensland** | **NSW** | **WA** |
|---|---|---|---|---|
| 2006 | $78K + 9% | $105K + 12%+ vehicle | $142-$145K +9% | $115-$135K +5% |

16.4.4. In April 2008 a fourth inspector was appointed to the inspectorate after the salary for the position was significantly increased. This appointee has some specific mining engineering qualifications. It is my understanding that the fifth position has been recently filled so that the inspectorate now has a full complement of inspectors.

16.4.5. It was Mr Ormerod's further evidence that just prior to him appearing at the inquest the State Government had committed to providing WST with additional funding in the sum of $1.2 million over three years. He indicated that a *"fair proportion"* of this amount would be directed towards "*mine safety*".

16.4.6. As part of the 2005 budget initiative the Office of the Chief Inspector of Mines ("OCIM") was established as a dedicated mines inspectorate. It is to undergo a management restructure with the intention that it include units responsible for:

a) Compliance Major Projects

b) Major hazard facilities

c) Dangerous Substances

d) Mines/Quarries Processing

16.4.7. It is proposed that Mr Sears, as the Chief Inspector of Mines, would exercise managerial control over each unit. However, at the inquest it was raised with Mr Sears whether he would be required, because of insufficient resources, to devote much of his time to those units other than "*mines/quarries processing*" so that his particular skills and experience in mine engineering would not be utilised.

16.4.8. Following his evidence Mr Sears reviewed the budget for OCIM and consulted with Mr Ormerod with a view to ensuring that the inspectorate was adequately resourced. By letter dated 2 September 2008, Mr Sears advised:

> *"During my appearance at the Beaconsfield inquest, I gave evidence relating to the Office of the Chief Inspector of Mines (OCIM), and the allocated budget that included an additional $400,000.00 pa for 3 years. I said that I would analyse the budget*

*taking into account the new management structure, and present that to Mr. Ormerod for discussion. I can now confirm that the analysis was completed on Tuesday 26 August 2008 and was followed by a meeting that included: Mr. Ormerod (General Manager of Workplace Standards), Mr. Robert Kent (Acting Chief Inspector of Industry), Mr. Danny Dougherty (Manager of the Compliance and Major Hazards Facility Unit), and myself.*

*The budget analysis was presented and discussed. The outcome from the discussion was that Mr. Ormerod instructed me to immediately commence the recruitment process for:*

*1. An administrative assistant;*

*2. A person for the SSDS Unit, and*

*3. A person for the compliance unit.*

*I have commenced that process."*

16.4.9. A similar letter was sent by Mr Ormerod on the same day.

16.4.10. The evidence now suggests that the Tasmanian Government has finally dedicated sufficient resources to the inspectorate to ensure that it is adequately manned, both now and in the immediate future. However, it is of real concern that it has taken over 3 years for this point to be reached. It is also of concern that the OCIM, in its new format, is untested. It is my recommendation that an audit of its performance be undertaken each 12 months with a view to ensuring that it is continuing to meet its statutory functions. It is trite to say it but worker safety within the mining industry requires an involved, pro-active, vigilant and adequately resourced mining inspectorate.

# 17. THE LEGISLATIVE REGIME

## 17.1. MOOTED CHANGES

17.1.1. As I have already noted at para.1.8.1 workplace safety, as at Anzac Day 2006, was governed by the Workplace Health and Safety Act 1995 and the Workplace Health and Safety Regulations 1998. This legislation imposed a general "duty of care" regime upon all industries including mining and replaced a prescriptive regime which had previously specifically applied to the mining industry.

17.1.2. S.22 of the Act empowers the Minister to approve codes of practice *"for the purpose of providing practical guidance to employers, employees and any other person on whom a duty of care is imposed under (the) Act."* As at Anzac Day 2006 the Minister had not approved any code of practice for the mining industry. However, the industry did, in the absence of a mining-specific statutory framework adopt, via the Minerals Council, the Mineral Industry Safety Handbook. However, its provisions are not enforceable by statute and in any event, in the opinion of Mr Sears, *"(it) is a very generalist code"* which *"provides just…a little bit of guidance. I'm not too supportive of some elements in that code…"*

17.1.3. The situation that exists in Tasmania contrasts with other jurisdictions in Australia. For example, it is my understanding that Queensland, Western Australia, New South Wales and Victoria all have in place mining-specific legislative regimes.

17.1.4. On 21 May 2008 Coroner D J Jones handed down his findings upon the deaths of the three miners killed at Renison Bell which I have referred to earlier. [para.16.2.1] The findings include these comments and recommendations upon the Tasmanian mine safety legislation:

> *"These Inquests have highlighted what I perceive to be fundamental deficiencies in the current legislation applicable to mining in Tasmania. Whilst the current legislation, the Workplace Health and Safety Act 1995 is applicable to mining, it is a more generalized approach while mining requires more industry specific legislation due to the nature of its operations.*
>
> *Mining has always been referred to as being hazardous, certainly when considering underground mining. Such activity can only benefit by specific regulatory legislation to assist all involved in the issues of safety and safe workplaces."*

17.1.5. Professor Michael Quinlan of the University of New South Wales' School of Organisation and Management provided expert OH&S assistance to the Melick Investigation. He produced a very comprehensive report for the inquest. In para. 858 Professor Quinlan recommends:

> *"That WST undertake an urgent review to develop a suitable body of regulations to govern OHS in the Tasmanian mining industry (as well as supporting guidance material) to address such critical areas such as ventilation, risk assessment and the management of rockfalls (and drawing on best practice in other Australian jurisdictions) to be recommended to the Minister. Consideration should be given to establishing a separate set of mining regulations under the auspices of the WHSA or complementary legislation as is the case in New South Wales (another option would be stand alone mining legislation as is understood to be the case in Western Australia and Queensland). The development of specific regulations or an industry code of practice is not inconsistent with general duty legislation. Rather, the regulations or code would help to articulate and provide guidance on the standards and processes by which mining operations and other parties can comply with their general duty obligations. This is already the arrangement in a number of other jurisdictions when general duty provisions co-exist with specific regulations and codes applying to the mining industry. It is also the practice in other industries in Tasmania. For example, the detailed code of practice that applies to the forestry industry was developed with full industry involvement."*

17.1.6. I strongly endorse the comments of both Coroner Jones and Professor Quinlan.

17.1.7. It was the evidence of Mr Ormerod that WST now accepted the need for legislative change and that its view was that the change should be in the form of a body of regulations which were specific to safety within the mining industry. He said that as a preliminary step a workshop was convened for stakeholders on 5 March 2008. A tripartite steering committee supported by a reference group of industry participants was established. It was proposed that the reference group and steering committee would meet by August 2008. According to Mr Ormerod their aim was to develop and

introduce the mining-specific regulations by the end of 2008. (I observe that 2008 has now passed without those regulations having appeared.)

17.1.8. In those findings of Coroner Jones to which I have referred, it was recommended that six Australian Standards be adopted for application to the mining industry. They concerned safety management systems, risk management, safety requirements for conveyors and guidance on the application of exposure standards for atmospheric contaminants. It was Mr Ormerod's evidence that the Minister, on 4 June 2008, determined that the standards be adopted as an interim measure and steps were then taken for them to be incorporated within a Code of Practice under s22 of the Act.

17.1.9. It was Mr Ormerod's further evidence that WST is a participant in the development of a National Mine Safety Framework ("NMSF"). This, as I understand it, is a national project which has been ongoing for some time and which aims to produce nationally consistent mine safety legislation. The NMSF's steering committee has settled upon a number of key principles to form the basis for the proposed legislation including:

- Clear and specific legislative obligations to those involved in the mining industry;
- A requirement for effective risk-based health and safety management systems addressing all reasonably foreseeable hazards; and
- Genuine consultative arrangements between management and mine employees.

17.1.10. According to Mr Ormerod the Tasmanian Government intends that its proposed mining-specific regulations are consistent with the principles laid down by NMSF but that the adoption of these regulations shall not be delayed by the NMSF process.

## 17.2. FINDINGS AND COMMENT

17.2.1. It is plain that the current legislation, such as it is, is incapable of providing the mining industry with a proper OH&S framework within which to operate. It is in need of immediate review and reform. That reform requires the adoption of a body of regulations which specifically addresses the OH&S needs of the mining industry. The precise form and detail of such legislation is ultimately a matter a matter for the State Government, properly advised and after consultation with the industry and worker representatives. I agree that it is desirable, as far as is reasonably possible, for the Tasmanian regulations to be consistent with national guidelines.

17.2.2. It is heartening to know that the Tasmanian Government now accepts the need for reform in this area. It is vital that it remains committed to the review and reform process and that these longstanding deficiencies are promptly remedied.

## 17.3. INCIDENTAL MATTERS.

### 17.3.1. Time limit for prosecutions

17.3.1.1. S55 of the Act provides:-

*"(1) Notwithstanding anything in any other Act, proceedings for an offence against this Act may not be instituted later than 12 months after an Inspector becomes aware of the Act or omission alleged to constitute the offence.*

*(2) A person seeking to rely on ss (1) must show that the Inspector became aware of the relevant Act or omission at least 12 months before the proceedings were instituted."*

17.3.1.2. In the report upon his investigation, Mr Melick makes this comment:-

*"I also note that the provisions of Section 55 of the Act are unrealistic in that they require a prosecution being commenced within 12 months of an investigator becoming aware of a possible breach of the Act. I am not suggesting that any prosecution should flow from this incident, but in complex matters such as this it is often impossible to provide a complete report to the Director of Public Prosecutions within a 12 month period. Discussions with mining investigators have indicated that matters of this nature can often take up to two years, and accordingly I recommend that Section 55 be amended to allow prosecutions to be taken within two years of an investigator becoming aware of a possible breach of the Act."*

17.3.1.3. I agree that the 12 month time limit can, in some cases, be unrealistic and that amendment is desirable. I support the amendment proposed by Mr Melick.

17.3.2. **Responsible officer**

17.3.2.1. S10(1) of the Act obligates an employer to appoint a responsible officer for each workplace at which the employer carries on business. By ss(3) the employer must ensure that the responsible officer has sufficient authority to perform the duties of a responsible officer under the Act. By s23(1) the Director of Industry Safety may declare a workplace to be a designated workplace if he is satisfied that the work carried on or proposed to be carried on at the workplace is likely to be hazardous. Mines in Tasmania including Beaconsfield are designated workplaces. By s24(1) an employer, carrying on work at a designated workplace, must notify the Director of the responsible officer appointed under s10. By s24(2) the responsible officer at a designated workplace must be competent and appropriately qualified.

17.3.2.2. In his report at para. 59 Professor Quinlan recites BGM's history upon its Responsible Officers in these terms:-

*"In the case of the Beaconsfield Joint Venture, Matthew Gill was originally designated as the Responsible Officer in 1995. In 1997 Mr Gill wrote to Workplace Standards to inform them that he had appointed Peter Hills and K Kaestner to be Acting Responsible Officers in his absence (according to the Mine Peter Hills had already been appointed Responsible Officer for Area 3). In 1998 Mr Gill wrote to Workplace Standards that he had appointed Ian Reeves, Barrie Hancock and Peter Hills as Responsible Officers for three designated areas of the Mine's site. In 2000 Mr Gill wrote to Workplace Standards appointing Richard Holder as Responsible Officer for the treatment plant and tailings dam. In 2002 Mr Gill wrote to Workplace Standards notifying them that Peter Hills would henceforth be Responsible Officer, and the underground manager Pat Ball would henceforth be Responsible Officer for the mine."*

17.3.2.3. As can be seen from the above history, as at Anzac Day 2006 WST had notice that three persons, namely Richard Holder, Peter Hills and Pat Ball were all Responsible Officers under s10 for the workplace at Beaconsfield.

17.3.2.4. It was the evidence of Mr Sears that the Act should be amended so that there can only be one Responsible Officer for any mine at any time. Professor Quinlan has a similar view but with the rider that if compelling circumstances existed for the appointment of multiple Responsible Officers at a workplace then special application would need to be made to WST.

17.3.2.5. Professor Quinlan explained the reasoning for his opinion in these terms:-

> *"…….the very notion of appointing a Responsible Officer would have little meaning unless that person so appointed exercised overall control of the workplace and could therefore make critical decisions in relation to OHS not simply recommend them, be part of them, or make decisions but not others than might affect safety. For example, as Responsible Officer Mr Ball was a participant in decisions on mine design and mining methods - decisions that have a critical effect on the safety of underground workings - but he was not the only or final decision maker."*

17.3.2.6. I accept that a workplace should not have appointed to it more than one Responsible Officer and I recommend that the Act be amended accordingly.

# 18. SUMMARY OF FINDINGS/CONCLUSIONS

## 18.1. A BRIEF FACTUAL CHRONOLGY

18.1.1. On 25 April 2006 Mr Knight was working underground in the Beaconsfield goldmine on level 925. His work colleagues were Mr Todd Russell and Mr Brant Webb. Together they were erecting a mesh wall above a bund of waste rock. For that task Mr Knight was operating a telehandler which was fitted with an open metal cage. Mr Russell and Mr Webb were both working from the cage. Mr Knight collected tools and materials for them when required.

18.1.2. At 9.23 pm a local magnitude 2.3 seismic event occurred at the Beaconsfield Mine. On level 925 it caused several falls of ground. The largest, comprising about 800 tonnes, engulfed the telehandler and entrapped Mr Russell and Mr Webb. Mr Knight was buried in a separate fall of ground which had occurred immediately to the rear of the telehandler. It is estimated that this smaller fall of ground contained 120 tonnes of rock.

18.1.3. The 2.3 seismic event was not a natural phenomenon but rather was induced by the mining activities being undertaken at the mine.

18.1.4. It is apparent that since 2003 BGM had been aware that seismic activity was being generated by mining, particularly as it descended to lower levels. This led to BGM, during 2003 and 2004 seeking consulting advice upon seismic activity, its effect upon its mining operation and its management.

18.1.5. I am satisfied that by late 2004 it was known by BGM that because of the fragmented nature of the rock mass there was a risk of rock falls due to shake down and hence a

need for it to have in place strategies to manage the risk including suitable ground support.

18.1.6. On 9 October 2005 a 350 tonne fall of ground occurred on Level 925. It involved a local magnitude 0.8 seismic event and had followed a production blast. On 26 October there was a local magnitude 2.1 seismic event which occurred well beyond any production blasting. It caused major falls of ground upon both levels 915 and 925.

18.1.7. BGM's response to the 26 October fall of ground was to cease mining and to initiate a risk management strategy. That strategy included seeking the advice of independent consultants.

18.1.8. Sometime in January 2006 BGM took the decision to resume mining in the 940 level stoping block. That block included levels 915 and 925. This decision was taken on the basis that:

- There had been an upgrading of ground support in areas identified by an audit,
- The ground support system would continue to be based upon the compressive arch,
- That initially mining would retreat west from the H/W shear and east from the offset fault,
- That otherwise the mining sequencing method would change from the modified Avoca method to a checkerboard system.

18.1.9. The fall of ground on Anzac Day which caused Mr Knight's death led to the immediate closure of the mine and an investigation of its cause.

18.1.10. Mining at Beaconsfield resumed in 2007 after a case for safety which had been commissioned by BGM was approved by WST. It was a principal recommendation of the case for safety that mining in those areas of the mine affected by seismicity only proceed by the utilisation of footwall drives. This mining method eliminates the need for workers to work in the ore drives during ore extraction and thus eliminates the risk of a recurrence of the Anzac Day tragedy.

18.1.11. It is accepted by all stakeholders that the current method of ore extraction represents *"best practice."* This makes it unnecessary for me to make any further comment or recommendation upon the mine's present mining practices.

## 18.2. ISSUES ARISING

### 18.2.1. The Cause of the Anzac Day Event.

18.2.1.1. I find that the Anzac Day rockfalls on level 925 were the result of seismic shakedown following the 2.3 seismic event. I further find that the seismic event was generated by a slip on an unmined section of the Tasmania shear in the hanging wall of the mine workings. [ie. on the C-shear]. This slip was located perhaps as near as 10 to 20 metres from where Mr Knight and his colleagues were working.

18.2.1.2. The 2.3 event was induced by mining activity at the mine, primarily in the 940 block which caused an unclamping of the structures within the reef enabling them to slip.

18.2.1.3. I am satisfied that by Anzac Day 2006 mining activity within the 940 block had caused the reef rocks, because of their friable nature, to degrade. This allowed the rapid propagation of the depth of failure within the pillar on 925 level thereby decreasing the anchorage capacity of the friction bolts within the ground support system. In this state the ground support system was unable to resist the very high straining effects of the 2.3 event and thus failed.

18.2.1.4. I am satisfied that BGM could not have reasonably predicted that the 2.3 magnitude seismic event would occur at 9.23pm. on Anzac Day 2006. I am also satisfied that BGM could not have reasonably predicted that the C-shear would be the source location of that event. However, it is my opinion that neither of these matters is of critical importance in terms of worker safety at the mine.

18.2.1.5. Of greater importance, in my opinion, is whether BGM was managing its mine in a manner which adequately allowed for the real likelihood that it could on any day, including Anzac Day 2006, experience a seismic event potentially as large as 2.5 in magnitude. Critical to this issue was the suitability and sufficiency of the ground support system, particularly having regard to the known fragmented nature of the rock mass.

18.2.2. **The Ground Support Regime.**

18.2.2.1. The compressive arch was the underlying foundation for BGM's ground support regime. As at Anzac Day 2006 the arch was maintained on level 925 with a combination of 1.8m and 2.4m splitsets at 1.5m spacing with straps and mesh plus 2.4m Posimix threadbars spaced 1.5m apart in rows. This ground support was inspected and approved by Mr Turner when he undertook an audit on 28 and 29 March 2006.

18.2.2.2. Of all the consultants who proffered an opinion upon the suitability of the compressive arch only Mr Turner was firmly of the view that it was suited to the ground conditions at Beaconsfield although from his evidence it may be inferred that Dr Mikula was also supportive of it. Of the others Dr Sharrock had serious concerns about it, Dr Fuller dismissed it and Professor Kaiser and Mr Marisset fell well short of embracing it.

18.2.2.3. In my view Dr Fuller's evidence upon the compressive arch was particularly compelling. I accept it and find that the compressive arch was unsuited as the basis for the mine's ground support system, at least within the 940 block and upon the lower levels.

18.2.2.4. It is my further opinion that the unsuitability of the compressive arch, or in the very least questions as to its suitability, should have become apparent to BGM following the October 2005 rockfalls.

18.2.3. **Risk Assessment.**

18.2.3.1. This issue was considered in the context of BGM's response to the October 2005 rockfalls.

18.2.3.2. The fall of ground on 26 October in particular was a clear warning to BGM that seismicity within its mine was not being managed in a controlled manner. It also served

to give BGM notice that it could expect a further seismic event of a 2.1 or greater magnitude at some undeterminable time in the future. These circumstances created a very real risk for worker safety and required BGM to put in place and follow a systematic, comprehensive, rigorous and properly documented risk assessment process before it permitted mining to resume. It is my opinion that this did not occur.

18.2.3.3. As part of its risk assessment strategy BGM, quite properly, sought assistance and advice from a range of suitable consultants. These advices, when received, needed to be the subject of a properly planned and logical risk assessment process where advices on specific issues were separated, differences of opinion on those issues identified and a strict process followed in the analysis, resolution and management of those issues. All of this required documenting. Regrettably, this process was not followed.

18.2.3.4. The risk assessment process was particularly deficient in that it failed to ensure that a comprehensive and independent re-assessment of the ground support system was undertaken.

18.2.3.5. In a memorandum of 1 November 2005 Mr Gill properly identified the need for the then existing ground support standards to be re-assessed. It was insufficient, in my view, for BGM to commission Mr Turner to audit his own work and for a general overview to be undertaken by Dr Mikula. The mine's rockfall history up to and including October 2005 made it glaringly obvious that a ground support system based upon the compressive arch was not performing satisfactorily and that the entire system required a comprehensive and independent re-assessment. The need for that re-assessment should have been reinforced by the concerns expressed by Dr Sharrock upon the ground support. Why BGM made the decision to resume mining without that re-assessment has not, in my opinion, been satisfactorily explained.

18.2.3.6. I am unable to positively find that Mr Knight's death would have been avoided if BGM had undertaken a thorough and systematic risk assessment following the October falls of ground. Nevertheless, it is my view that the likelihood of Mr Knight's death occurring would have been reduced, perhaps significantly, if BGM had undertaken such an assessment. This is particularly so, in my, view because a thorough and systematic risk assessment would have, in all likelihood, identified the inadequacy of the ground support system and led, either to a variation to that system or to the mining method being changed before mining resumed.

18.2.3.7. A lesson to be learned from Mr Knight's tragic death is the critical importance of proper risk management practices to worker safety, particularly in a mining environment.

18.2.4. **Production in April 2006.**

18.2.4.1. I accept that in the early part of April 2006 production had been slow and that by 20 April the mine was approximately 3000 tonnes behind its monthly production target. I also accept that production was accelerated in the five day period ending at night shift on 24 April so that by this date the production deficit had been all but eliminated. However, there is not any evidence to show that this acceleration in production was undertaken at the expense of worker safety nor particularly was this acceleration in production a factor which contributed to Mr Knight's death.

**18.2.4.2. BGM's Financial State and the Influence of Macquarie Bank.**

18.2.4.3. The Allstate Group held a majority interest in BGM. Since June 2001 it had been in administration. Its financier was Macquarie Bank which had provided a loan of $21m. Also, the Allstate Group had in place a hedging arrangement with the Bank with a negative value of $13m. Further, in about March 2004 Mr Ryan in his capacity as administrator had negotiated the sale to Macquarie Bank of inter company loans within the Allstate Group. They totalled approximately $77m. The sale price was $300,000. By this arrangement Macquarie Bank became entitled to recover what it could of the inter-company loans as an unsecured creditor. These circumstances have given rise to two broad issues, firstly whether Allstate Group's level of indebtedness and the fact of its administration were matters which impacted upon BGM's decision making to the detriment of worker safety and secondly, whether Macquarie Bank sought, for its commercial advantage, to influence BGM's decision making so that worker safety was compromised.

18.2.4.4. I am able to specifically find that there is not any evidence that any of the decisions taken by BGM relating to its mining operations and production were to any extent affected by the Allstate Group's financial status or the involvement of the Macquarie Bank so that worker safety was compromised. I find that these were matters which did not play any part in Mr Knight's death.

18.2.5. **Workplace Standards Tasmania (WST) and related matters.**

18.2.5.1. I find that for at least one year prior to Anzac Day and almost certainly longer the level of staffing at WST's inspectorate was grossly inadequate and that it was incapable of carrying out its core function of inspecting and enforcing best safety practices within the mining industry.

18.2.5.2. I find that WST was content to permit BGM to manage the investigation of the October 2005 rockfalls and to devise the plan forward with virtually no active involvement on its part. I am satisfied that this non-involvement was a consequence of its lack of resources, most particularly the availability of inspectorate personnel with mine engineering experience.

18.2.5.3. It is my opinion that the inspectorate's non-participation in the investigation of the October rockfalls and the matters relating to it constituted an abrogation of its statutory duty to inspect, monitor and enforce safe work practices at the Beaconsfield mine. As such it denied Mr Knight that layer of protection that he was entitled to expect from a properly functioning inspectorate. However, I am unable to find upon the evidence that the greater involvement by WST in the events post October would have led to either the Anzac Day rockfalls being avoided or the prospect of their occurrence being markedly reduced. It therefore follows that there cannot be a finding that this non-action by WST was a factor which directly contributed Mr Knight's death.

18.2.5.4. Since Mr Knight's death a dedicated mines inspectorate has been created within WST. It is known as the Office of the Chief Inspector of Mines. The evidence indicates that this Office is now adequately manned. There is also evidence that the Tasmanian Government has committed sufficient funds to it to enable it to properly carry out its statutory functions. However, there has not been sufficient time to make an assessment of the effectiveness of this Office in its new format and the adequacy of its funding. It is

thus my recommendation that an audit of the Office be undertaken each 12 months to ensure that it is properly fulfilling its statutory duties.

18.2.5.5. It is plain that the current legislation, such as it is, is incapable of providing the mining industry with a proper occupational, health and safety framework within which to operate. In my opinion it is in need of immediate review and reform. On this subject I agree with and support the recent findings made by Coroner Jones concerning the deaths of three miners at Renison. The legislative reform should be specific to the mining industry but its precise form and detail is ultimately a matter for the State Government, properly advised and after consultation with the industry and worker representatives. I agree that it is desirable, as far as is reasonably possible, for the Tasmanian legislation to be consistent with national guidelines.

18.2.5.6. It appears from the evidence of the current management at WST that the Tasmanian Government now accepts the need for fundamental legislative reform. I urge the authorities to remain committed to such reform and to ensure that it is promptly implemented. It is long overdue.

18.2.5.7. There are some ancillary aspects of the current legislation which, in my view, would benefit from amendment. I make these specific recommendations:

- That s47 of the Act be amended to provide that WST be given notice of all unplanned or unexpected falls of ground save for those either involving unsupported ground or occurring in areas not traversed by personnel.

- That s55 of the Act be amended to enable proceedings for an offence under the Act to be instituted within two years, rather than one year, of an inspector becoming aware of a possible breach of the Act.

- That the Act be amended to ensure that only one person be appointed as the responsible officer for designated workplaces including mines.

## 18.3. FORMAL FINDINGS PER S.28(1)(A) - (F) OF CORONERS ACT 1995

18.3.1. I find that Mr Larry Paul Knight died on 25 April 2006 on level 925 of the Beaconsfield Gold Mine at Beaconsfield. Mr Knight was aged 44 years. He resided at Relbia with his partner and family.

18.3.2. I find, accepting the opinion of the State Forensic Pathologist, that Mr Knight died from multiple injuries sustained in a rock fall. It was mooted in the early stages of the investigation that Mr Knight may have survived the rock fall but died from injuries suffered in the course of the recovery operation. I specifically reject that notion.

18.3.3. The evidence does not permit me to make a positive finding that any person, corporation or other entity, by their conduct, directly contributed to Mr Knight's death.

**Dated :** Thursday, 26 February 2009 at Launceston in the State of Tasmania.

**Rod Chandler**

**CORONER**