QUEENSLAND COURTS

OFFICE OF THE STATE CORONER
FINDINGS OF INQUEST

CITATION:	**Inquest into the death of Pekka Tuppurainen**
TITLE OF COURT:	Coroners Court
JURISDICTION:	Cairns
FILE NO(s):	2009/589
DELIVERED ON:	20 August 2013
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FINDINGS OF:	Kevin Priestly, Coroner
CATCHWORDS:	Coroners: inquest, underground mine at Mt Isa, inadvertent entry of loader into stope, traumatic asphyxiation of operator, adequacy of control measures, adequacy of remedial action, implications of incident for effectiveness of safety management system.

REPRESENTATION:

Counsel Assisting:	Mr Tate of Crown Law i/b Northern Coroners Office
Ms Lorraine Chapman:	Mr B Charrington, Counsel i/b Sciacca's Lawyers & Consultants
Mount Isa Mines Ltd/ Xstrata:	Mr M Burns, Senior Counsel i/b Minter Ellison Lawyers

Introduction

Pekka Tuppurainen was employed as a loader operator and was working in the underground mine known as George Fisher South, located about 20 km north of Mt Isa. He had many years experience as a miner, starting with Mt Isa Mines in 1975 and transferring to George Fisher Mine in 2003.

Between 11.15 and 11.40pm on Tuesday 19 May, 2009 Mr Tuppurainen was operating a loader in the course of a backfilling over a sheer vertical drop in the form of a stope between sublevels 8E to 8C, when the loader went over the edge and into the stope.

At about 11.40pm Shift Supervisor Mr Mark Jones arrived at the location to check on Mr Tuppurainen and discovered the loader in the stope. It was positioned upside down and partially submerged in the pile of backfill waste material rising from sublevel 8C. He raised the alarm and a mine rescue emergency was initiated. Mr Jones called to Mr Tuppurainen but there was no response. Music was heard coming from the loader as well as the sound of the reversing beeper. Mr Jones obtained permission to go to sublevel 8C although he was not allowed to enter the stope. Mr Jones went to that level and again called to Mr Tuppurainen. There was no response. Superintendents arrived at the scene and started assessing the situation. The area was secured. It took some time to ensure the stope was safe to enter. Eventually, Mr Davis, Acting Mine Manager, was able to enter the stope, climb the waste material and access the cabin of the loader. He found Mr Tuppurainen was deceased and left the stope. A mines rescue officer also accessed the cabin and confirmed that assessment.

Mines personnel withdrew to the surface to plan the safe recovery of the body of Mr Tuppurainen and the loader. Later, another loader was remotely operated by line of sight to remove material beneath and around Mr Tuppurainen's loader and lower it to the floor of sublevel 8C. It was then dragged clear of the stope. The body of Mr Tuppurainen was recovered from the cabin and taken to the surface.

On 25 May 2009 Dr Urankar conducted an autopsy including internal examination of Mr Tuppurainen and concluded he died from traumatic asphyxiation. She reported there were no significant injuries sustained in the incident to account for his death. However, she was shown photographs of the scene depicting Mr Tuppurainen in the cabin surrounded by a significant amount of rock and dirt, particularly around his chest and covering his face. Dr Urankar found dirt present in the lower airways suggesting he was alive during the incident and did not succumb to natural disease. She thought the pressure of the dirt on the chest and abdomen would severely restrict movement of the chest wall and diaphragm preventing sufficient respiration leading to asphyxia and death. Alternatively, or in combination, there was obstruction of the airways by the dirt leading to a lack of oxygen.

I am required to make findings about who died, when the person died, where the person died, what caused the person's death (the medical cause of death) and how the person died. Most of the required findings can be made on the available information. The question of how Mr Tuppurainen died requires more detailed consideration. In pursuing this course, I am mindful that a Coroner is precluded from including in the findings any statement or comment that a person is or may be guilty of an offence or civilly liable for something (s.45(5) and s.46(3) of the Coroners Act 2003).

In addition to the required findings, I am mindful that a Coroner may, whenever appropriate, comment on anything connected with a death investigated at an inquest that relates to public health or safety and ways to prevent deaths from happening in similar circumstances in the future.

A key question relevant to how Mr Tuppurainen died is what Mr Tuppurainen was doing in the moments before the loader went over the edge of the stope? This question may only be answered through an analysis of the findings of the scene investigation, a consideration of the work practices or methods in place, and the experience and knowledge of Mr Tuppurainen. The next question is how the mine operator managed the hazard of inadvertent entry into the stope during backfilling. This involves looking at the extent to which this hazard was identified, the control measures selected and implemented, and their effectiveness. The next question is whether there were other controls measures that might have been used; and if so, what are the implications of the absence of those control measures for the effectiveness of the safety management systems under which the mine operated.

Before considering these issues, a more detailed understanding of the people, organisations, places, machinery and work methods involved in this incident is required.

Inspectors from the Mines Inspectorate within Qld Mines and Energy, Mr Phillip Casey (Lead Inspector) and Mr Richard Horsburgh, conducted an investigation into the fatality. The Lead Inspectors Report to the Chief Inspector of Mines (the Mines Investigation Report) was admitted into evidence. The conclusions of that report formed the basis for discussions during directions hearings about what matters were accepted facts and what matters remained in issue requiring further investigation, particularly through the examination of witnesses.

I have used images, sketches and other material extracted from that report to establish the physical setting of the incident.

The George Fisher Mine is an underground zinc lead silver mine with two distinct areas of operation, George Fisher South (GFS) and George Fisher North (GFN), with some degree of interconnection.

Mr Tuppurainen was an employee of Mt Isa Mines Ltd, a company owned by Xstrata plc.

Mr Tuppurainen worked in D Crew at George Fisher South. His Shift Supervisor was Mr Jones who normally had 13 persons reporting to him, consisting of 6 loader operators, 3 truck drivers, 1 production driller, 1 ring firer and 2 servicemen.

D Crew was one of four crews that reported to the Operations Superintendent Mr Saltmer. He was one of 7 Superintendents who reported to the Acting Mine Manager Mr Tim Davis, who reported to Mr Anthony Kocken, General Manager Mining, who reported to Mr Kevin Hendry, Site Senior Executive.

Mr Tuppurainen worked 12 hours per day on a work roster comprising four day shifts, four days off, four night shifts and four days off. He was on his second of four night shifts at the time of the incident.

The main method used to mine in GFS was bench stoping to access narrow steeply dipping vein-like ore bodies. Horizontal tunnels or drives about 5m wide and 5 m high were used to access the panel being mined.

Included in the Appendix to my findings is an extract from the Mines Investigation Report that explains the mining method, the backfilling method, the backfilling product, the stope being filled and the loader in use. Photographs, plans, schematics and drawings accompany the explanations. The reader is encouraged to familiarise themselves with these aspects before returning to consider my findings.

Surrounding Circumstances

The narrative starts with preparations earlier that day for the backfilling operation.

During the morning of Tuesday 19 May, Max Bragg, Loader Operator, cleaned up the drive to the stope for the survey team to safely access and survey the stope. He constructed a bund (earth wall) on the north side of the stope. A survey team then visited the site and conducted a Cavity Modelling Survey to better establish a three-dimensional perspective of the void, particularly the edge of the stope.

A risk assessment for backfilling the stope was completed on the afternoon of 19 May, 2009. It was conducted by a multidisciplinary team comprising Mr Isles, Planning Engineer; Mr DaSilva, Senior Rock Mechanic Engineer; Mr Healy, Geologist; and Mr Saltmer, Operations Superintendent. An experienced Loader Operator normally would participate but none was available at the time of the assessment and the Mine Manager's permission was obtained to continue in the absence of the operator.

The conventional approach to backfilling a stope was to establish an earthen wall or bund (to form a 'stop log') across the full width of the drive at the edge of the stope. The loader operator approached the stop log with a raised, loaded bucket extending over and beyond the stop log and tipped the bucket into the stope. The stop log established the limit to forward travel of the loader relative to the edge. However, at this location the backfilling operation required the loader operator to backfill over what is known as a pillar. It was a 5m section of solid rock floor before which a panel had been mined and backfilled in a like manner. The floor on the opposite side of the stope had already been drilled in anticipation of removing further panels. Therefore, access from that side of the stope was excluded. Although a pillar is the original solid rock, the fact that both sides of the pillar had been mined through blasting and, in this instance, one side backfilled; the integrity of the pillar had to be carefully reviewed.

Mr Da Silva inspected the site in the week before and Mr Saltmer inspected the site on the day before this incident. Although they found no issues with the integrity of the pillar, they were mindful of the fact that there were known fault lines intersecting in the vicinity of the stope. The risk assessment reflected a cautious approach. One of the hazards identified in the risk assessment was ‘Filling over Pillar’. The existing control which the team identified was a Safe Working Instruction known as SWI 7453009. The level of risk was calculated using a risk matrix at 17.

SWI 7453009 provides a procedure summarised as follows:

- Mark up the site by placing the backfill marker level with the canopy and visible to the operator while the bucket is a minimum of 1m from the edge;
- Construct a stop log at the edge about 1.5m high and across the complete width of the edge (without proceeding past the Backfill Marker); and
- Always maintain a formed up stop log and floor of the backfill site.

The SWI then refers to “Push Stop Log Forward” and outlines the method of doing so. However, the described method assumes the rill (top of the pile of dumped material) is level with the edge from which the operator is dumping. Initially the operator tips over the bund until the rill reaches the level of the floor of the drive. The operator then pushes the bund or stop log forward onto the rill and continues dumping across the top of the rill until reaching the floor of the opposite side. The training package’s for mucking (operating a loader underground) fully covers the knowledge and skills required for this operation.

Returning to the Backfill Risk Assessment, it identified additional controls in respect of the hazard “Filling over Pillar” as follows:

> Dump and Push. Shift Supervisor and Operator to check pillar integrity prior to starting back fill operations. Do not fill over pillar if its condition is found to be suspect.

The requirement for ‘dump and push’ was intended to keep the loader further from the edge compared to dumping over the stop log. The loader operator dumped material in front of the stop log, not over it, and pushed that load into the stop log, forcing the back of the stop log over the edge.

The use of ‘additional controls’ resulted in a reduction of risk from 17 to 8, a level considered acceptable to the team conducting the risk assessment. The additional controls gave rise to additional tasks. The Operator and Shift Supervisor were required to check pillar integrity before starting backfilling and not to fill over the pillar if its condition was poor. The Shift Supervisor was required to monitor, on an ongoing basis, backfill operations throughout the shift.

However, no documented procedure existed to guide operators about how to perform dump and push at a vertical edge. The manner of performing dump and push was not included in any training package.

Mr Jones, Night Shift Supervisor, arrived at work about 5pm, went underground and met with Mr Saunders, Day Shift Supervisor to discuss the shift changeover and the work plan.

Mr Tuppurainen arrived at work about 6.45pm and shortly afterwards, Mr Bragg, the Loader Operator from the day, shift arrived at the surface. They discussed aspects of the loader's operation that Mr Tuppurainen was taking over. At 7pm, Mr Tuppurainen went with his crew underground to the Crib Room. Planned underground blasting occurred at 7.39pm and the all clear was given at 8.21pm. In the meantime, Mr Jones discussed the work plan with his crew and allocated each member their jobs. Mr Tuppurainen was asked to perform the backfilling operation. Mr Jones showed Mr Tuppurainen the completed Backfill Risk Assessment and discussed its contents. At about 8.25pm, Mr Tuppurainen drove his Loader to a location near the stope. At 8.42pm, Mr Ron Lester, Service Truck Operator, serviced the loader. At this point, Mr Jones collected Mr Tuppurainen and took him in his vehicle to inspect the stope. At the site, they viewed it from a number of locations. Mr Tuppurainen was shown from which pass the material was to be collected and the path to use to access the stope. Mr Tuppurainen returned to his loader and started backfilling.

Mr Jones told the court that he later returned to check on Mr Tuppurainen. He was on foot inspecting the drive on the other side of the stope and saw Mr Tuppurainen performing dump and push off the edge for about three or four bucket loads. In his interview with the Mines Investigators, Mr Jones described what he saw:

> *So he was just getting dirt, putting it down and pushing it forward. Go back, get another bucket, put it down, go back, put another bucket and push it forward. So it's just a, you're not getting every bucket, you're just building a bund. When it gets high enough he just pushes it forward and it's just a continual process. So you don't push every bucket. You'll push, well when the bund gets big enough to push you push it. So but he had a huge pile there. So I can't say how many buckets or anything but I was there for probably, well I was there for a few minutes cleaning up.*

His evidence at hearing was to the same effect.

At 11.08pm, Jayson Evans, Fuel Truck Operator, refuelled Mr Tuppurainen's loader on sublevel 8E. This was the last sighting of Mr Tuppurainen before the incident. The next person to visit the site was Mr Jones when he discovered the loader in the stope.

Scene Investigation

There are two photographs in the Appendix that depict the scene of the incident and relevant features.

Flicker Light and Candy Pole

The candy pole and flicker light are warning devices installed to assist the operator in fixing his position relative to the edge. The flicker light was found on the left wall, back from the crest edge and operating normally. The candy pole is a white wooden pole encircled with red reflective tape. It was positioned at the footwall and found with the bottom end forward of the crest edge. The perspective from which the photograph is taken does not depict this feature. However, other photographs of the scene show the bottom end on an angle and forward of the upper end. The position of the flicker light and candy pole was consistent with the position of a stop log.

Floor

The floor was the top of a solid rock pillar extending 5m back from the edge. The floor was clean right through to the edge. There is an issue about the extent to which there was the remnants of a stop log present when rescuers and other witnesses arrived. There were tyre marks of the loader leading to the edge.

Crest Edge and Profile

The survey information available to the Mines Investigators showed the crest edge before and after the incident. Although there was a difference, it was not considered significant, the Senior Surveyor reporting “the crest edge remained virtually the same”.

The edge profile was not a straight right angle line. It was rounded. A plan view of the edge showed the footwall extended further forward than the middle section and hanging wall.

Roof and Wall Markings

In the top left hand quarter of the above photograph is an area identified by reference to photograph 0851 (see photograph in Appendix). That shows the location where scrape marks as well as damage to mesh and plates were found. The Mines Investigators considered the markings and damage consistent with contact from the left hand corner of the loader bucket while in the raised position.

The Void

Inspection of the void in a basket from overhead of the northern edge at 8E level revealed fall-off beyond the crest edge from the foot wall. It was not possible to determine whether it was prior to, during or after the incident. There were also markings on the footwall curving from the horizontal to the vertical, continuing down the footwall consistent with the likely path of the loader.

A post accident survey of the void showed about 212 cubic metres of back fill was placed in the stope. This equated to about 26 bucket loads. About 12 bucket loads were removed from the stope to recover the loader. Therefore, Mr Tuppurainen was calculated to have tipped a total of about 38 buckets into the stope. The risk assessment conducted for the backfilling operation anticipated 1,450 cubic metres or 175 loader sized buckets.

Loader

The loader was found lying upside down in the stope on the rill. It was positioned against the hanging wall with the rear facing out of the stope at the draw point. The lights and reversing beeper were on. Although the bucket of the loader was found in the slightly crowded position, the state of the hydraulics was such that it could not be concluded the post impact position of the hydraulics was indicative of its position before going over the edge.

A mechanical inspection was later conducted of the loader and no evidence was found to establish a link between any aspect of the condition of the loader and its entry into the stope. The nature and extent of the damage to the loader did not assist in determining how the incident occurred.

Visibility was dependent on the lights of the loader. All four reversing lights, three headlights and one cabin forward light were found in working condition.

The Mines investigation could not establish which gear the loader was in at the time of the incident. The loader was found with reverse gear selected. However, this finding does not necessarily mean that the loader was operating in that gear at the time of entering the stope. The gear selection of reverse may have occurred afterwards.

Operator Competence

Mr Tuppurainen was an experienced and competent operator who had undergone comprehensive and recurring training.

A loader operator or mucker was required to have the following competencies depending on the tasks to be performed:

- Loader ticket - training included standard operating procedures and familiarisation with original equipment manufacturers information. When assessed as competent, the operator was taken through a conversion checklist for other types and sizes of loaders.
- Basic mucking – the basic skills of mucking including site preparation, loading, tipping, tramming, stockpile mucking, or pass tipping, truck loading, incline and decline mucking, roadway and ramp construction, sump and settler mucking.
- Advanced mucking – mucking a development heading, production mucking and mucking rises.
- Specialist mucking – pushing off a stope and backfilling into an open stope or bench.
- Line of sight mucking – mucking with the benefit of a remote control within visual range.

- Tele-remote mucking – mucking with the benefit of a remote control from another location.

The training records reveal that Mr Tuppurainen was assessed as competent in advanced mucking, the competency required for the procedure he was carrying out at the time of the incident. He had completed refresher training in advanced and specialist mucking competencies as recently as March 2009. Mr Tuppurainen was very experienced in conducting backfilling operations including backfilling of stopes.

The training material including written assessments for Mr Tuppurainen and was reflective of his knowledge. An assessment on 18 July 2002 included questions and answers in written form, including the following:

> What is the minimum height of a stop log? *½ wheel size.*
> What is the minimum distance a stop log can be built from a stope edge? *3 meters.*
> When can mucking into a stope without a stop log be conducted? *When rill is made and smaller void than unit.*
> What must be constructed if backfilling operations' are to be conducted? *Stop log.*

No mention is made of dump and push. Co-incidentally, Mr Saltmer was the supervisor that signed off on that assessment.

Mr Tuppurainen completed a Specialist Mucking Assessment Package in September 2003. Again the questions and answers are instructive and read as follows:

> Why is a floor mucked to solid? *To check for faults and cracks*.
> What is the minimum height of a stop log? *1.5 meters*.
> What is the minimum distance a stop log can be built from a stop edge? *3 meters*
> When can mucking into a stope without a stop log be conducted? *Never*
> What must be constructed if backfilling operations are to be conducted? *A stop log*

I note that training contemplated mucking the floor 'to solid' to check for faults and cracks.

Mr Tuppurainen's competency in backfilling was assessed against specific criteria that included 'stope edge clean up' and 'building a stop log at stope edge'. Again, he was found competent.

The March 2009 assessment included similar questions and answers as well as a similar practical competency assessment. No mention is made of dump and push. Nor did training contemplate any circumstance in which a stope might be backfilled in the absence of a rill. It was submitted on behalf of Xstrata and stated in evidence by personnel in supervisory and management positions that dump and push was a task that involved no more that the performance of a combination of skills that loader operators were taught to perform albeit in a different operational context.

However, during the Mines investigation, it became immediately apparent that there was considerable variation between operators and managers about how dump and push is performed. That variation remained apparent through evidence at hearing. Such a variation was indicative of a need for standardisation and training to that standard.

Although it might be concluded that dump and push was a high risk activity that should have been the subject of a risk assessment and the subject of control measures incorporated into a training package; the real issue is whether dump and push was should have been used as a control measure in the first place.

Analysis of Surrounding Circumstances

There were no witnesses to the incident. Therefore, what happened must be explored based on an analysis of the nature of the operations being conducted, the associated hazards and control measures used, and the observations of the scene. To some extent, I am assisted by expert opinions based upon an analysis of this information as well the background, training and experience of Mr Tuppurainen.

There are a number of possibilities that were explored during the Mines investigation, Xstrata's investigation and the coronial investigation; summarised as follows:

- Mr Tuppurainen was performing dump and push when he pushed most of the stop log into the stope and inadvertently followed through in the loader;
- He was pushing off the edge to clean up the floor in preparation for an inspection of the floor and in the early stages of that operation, inadvertently drove over the edge; or
- He was operating without a stop log, possibly dumping directly into the stope.

Mines investigators, in conjunction with Xstrata, carried about a number of attempts to reconstruct different scenarios using a similar loader and various earth stop logs.

Trials were conducted on 4 September 2009 and 28 October 2009 that involved the operation of a loader doing dump and push into a void. Photographs and video were taken of the trials. The first trials established that a loader with a full bucket in the crowded position was unlikely to run through a two or three bucket stop log at speed. However, a dump and push at slow speed would push through a stop log with little apparent effort. The second trials established that the stand-off distance from the edge while doing dump and push was about 1.2 m more than the conventional tipping over the stop log and if power was suddenly taken off while conducting dump and push, the loader was likely to stop.

Xstrata relied on the opinion of Dr Grigg, an experienced Senior Engineer, based on observations from the scene immediately after the incident, to support the proposition that Mr Tuppurainen was operating without a stop log and was tipping over the edge immediately prior to entering the stope. Dr Grigg concluded that there was a low probability that dump and push was being performed shortly before the incident and a high probability that Mr Tuppurainen was tipping over the edge without a stop log in place.

Much of the evidence that Dr Grigg relied upon included a detailed analysis of images of the scene taken during the police, Mines and Xstrata investigations. He also relied on observations of a number of witnesses who visited the scene immediately afterwards. In short, a number of witnesses thought there should have been more signs of a stop log if one was in place prior to the loader entering the stope. Further, there was no sign of damage at the edge of the stope or on the bottom of the loader consistent with it bottoming out when the front wheels left the edge. Some observers thought the this absence was indicative of a loader under speed.

The first issue with this approach is considering the reliability of the witness's observations. Mines investigators interviewed many of the witnesses immediately after the incident and their records of interviews were included as attachments to the Mines Report. I reviewed and compared the reported observations of each witness in initial record of interviews with Mines with their subsequent statements relied by Dr Grigg. I also reviewed the images of the scene and considered whether the factual foundation for the opinions of Dr Grigg was established on credible, reliable and consistent evidence. However, I found there was insufficient detail and clarity in the images, a lack of completeness in some witness accounts and some variation in manner of expression between witness accounts about the same features.

Mines investigators considered it unlikely that Mr Tuppurainen was operating without a stop log in place. Mr Casey, the Lead Investigator, said that Mr Tuppurainen was an experienced operator who was unlikely to take that risk. He said Mr Tuppurainen was a witness in an earlier fatality involving inadvertent entry of a loader into a stope (26/1/91) and had experienced a near miss himself when a loader he was operating bottomed out on an edge thereby saving him from entry into a stope. Mr Casey observed that Mr Tuppurainen was acutely aware of the dangers and was seen earlier that shift with a 'huge bund' when checked by Mr Jones. There was also the prospect of further checks by Mr Jones about which Mr Tuppurainen was aware and that non-compliance with the requirement for a stop log was a serious breach giving rise to possible termination of employment.

Mr Walker, then Senior Safety Advisor, reported in his statement that he worked as Mr Tuppurainen's shift boss between 2006 and 2008. He considered Mr Tuppurainen a competent and experienced loader operator. He also commented that Mr Jones was a very good supervisor and would not tolerate any dangerous behaviour. He was a 'real stickler' in relation to safety and required everything to be done by the book.

The Mines investigators analysis raised the possibility he was cleaning the floor and edge in preparation for re-establishing a stop log.

This latter possibility might explain why little remained of the stop log, if that observation was accurate. But it begs the question why would have Mr Tuppurainen felt the need to clean off and re-establish a stop log. A possibility is that the stop log became too large to manage. It will be recalled that Mr Jones saw Mr Tuppurainen dump a number of bucket loads before attempting to push the stop log forward. Another possibility flows from the initial concerns about the integrity of the pillar (as expressed in the Backfill Risk Assessment) that led to the decision to use dump and push in the first place. It will be recalled that the additional controls from the Risk Assessment required a joint inspection of pillar integrity before starting backfilling, a direction not to fill over the pillar if its condition was found suspect and a requirement for the supervisor to regularly monitor backfilling operations. Perhaps the integrity of the pillar was playing on Mr Tuppurainen's mind. Certainly, the training package contemplated cleaning the floor for the purpose of an inspection.

One of the difficulties in assessing the possible scenario's is the fact that the dump and push method was never risk assessed and trialled in control conditions before implementation and subjected to periodic review. All of this was by-passed upon the mine adopting a better control measure through the use of temporary steel stop logs.

If dump and push was risk assessed, perhaps all hazards associated with too large a stop log would have been identified. Perhaps too, how and when to review the integrity of a pillar, after how many trips back and forth over it, would have been addressed. I simply don't know what hazards and complications are associated with dump and push and how they might be managed.

For these reasons, I am unable to come to any final view about what Mr Tuppurainen was doing when he inadvertently entered the stope beyond finding that he was backfilling a stope when the loader fell into it. The possibilities remain, without any one particular possibility being more likely.

Howsoever Mr Tuppurainen was conducting the backfilling operation, if there were control measures which would have, in any event, prevented or substantially reduced the risk of inadvertent entry, what he was doing becomes academic. If, for example, temporary steel stop logs would have prevented this death; that is the end of the matter. It does not matter, in terms of lessons to be learnt, whether Mr Tuppurainen was compliant with an unsafe work method, non-compliant for whatever reason, or just doing as best he could with challenges or complications associated with an unsafe work method.

It is interesting that Xstrata did not attempt to develop a safe working method for dump and push. Mr Callaghan did his bow tie analysis of the activity and came up with another control measure – temporary steel stop logs; a preventative measure used in an adjacent associated mine. Not one witness was able to explain why that control measure was not used in this mine. Yes, the other mine used steel stop logs for ejector trucks, a different backfilling machine. But the principle remained the same.

Remedial Action

What remedial action was taken after this incident?

On 20 May 2009 the Mines Inspectorate issued a direction that backfilling was to cease until a risk assessment was completed for all bench stopes.

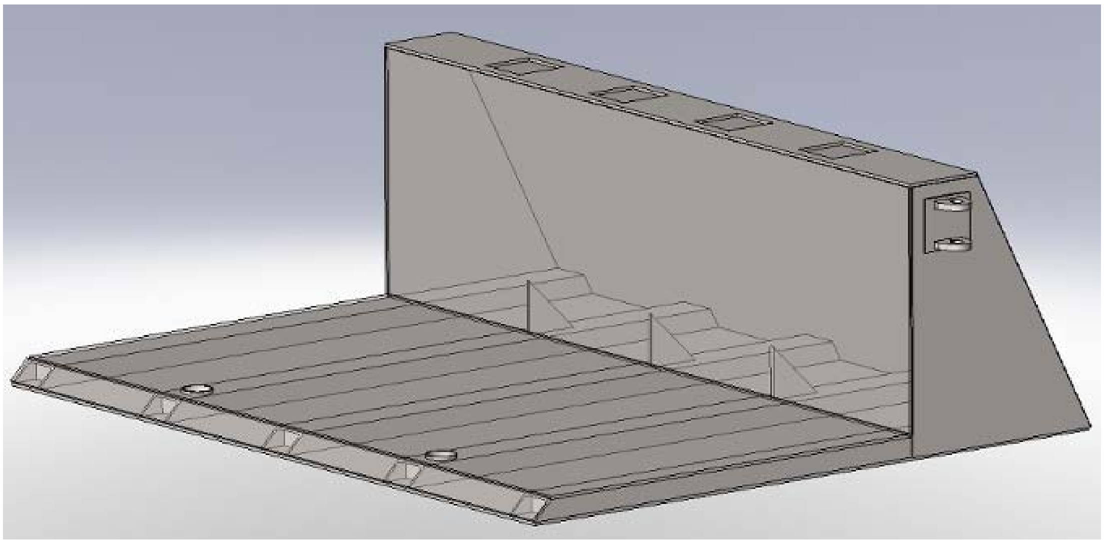
Although investigations continued into how and why the loader entered the stope, the Mines Inspectorate and Xstrata explored opportunities for immediate improvement in safety during backfilling operations.

Mr Callaghan, then Health Safety and Training Superintendent at Xstrata Zinc, conducted a safety review known as a “bow tie analysis” for backfilling at vertical openings. He reports that this process took three weeks and identified all hazards and appropriate control measures. In short, he arrived at the conclusion temporary steel stop logs be used as a control measure in the absence of a rill at the edge of the stope.

Steel stop logs were introduced in place of earth stop logs for backfilling where there was a vertical edge. Each temporary steel stop log cost approximately $9000 and the mine reported 45 in place at the time of the hearing. When a rill is established, the temporary steel stop log is removed and an earthen stop log is built. The operator pushes the earth stop log forward, allowing the void to be completely filled.

Accompanying the introduction of temporary steel stop logs were new Backfill Risk Assessments, new Backfill Procedures and associated training packages for loader operators and supervisors. The new backfilling procedure makes it clear that prior to commencement, a backfill risk assessment must be completed, read and understood by the operator, a removable steel stop log be installed for any work being conducted within 3 m of vertical opening, and visual indicators be installed including two Candy polls, one Flicker light and vertical edge delineation streamers. New checklists were devised for completion by the operator’s supervisor as a step to ensuring all pre-requisites are satisfied before backfilling operations commence.

Mines published a Guidance Note in August 2010 to disseminate to industry the lessons to be learnt from this incident. It included the following depiction of a steel temporary stop logs. The publication included extensive guidelines about managing hazards associated with vertical edges.



Mr Jones gave evidence at the hearing that he witnessed the introduction of the temporary steel stop logs and considered the operation much safer through their introduction. Mr Bragg, Loader Operator, expressed a similar opinion.

Implications for the Safety Management System

In the context of a safety management system, why wasn't the need for temporary steel stop logs earlier identified and actioned?

That question became more interesting when it was discovered that an adjacent associated mine used steel stop logs although in the context of ejector trucks in backfilling operations.

There is no corporate history was discernable from documents within the management system about the introduction of dump and push. Neither could any of the managers explain its introduction.

One of the documented procedures that Xstrata identified as addressing backfilling was Pro 34-03-04 Backfilling Stopes. It is wholly predicated on the use of temporary steel stop logs and once a rill was established, the steel stop log was removed and a temporary material stop log was built. The dump and push method was then used to advance the material across rill to the other side of the void. This procedure originated in George Fisher North and contemplated the use of a loader, not ejector truck (as did the SWI).

So why wasn't this procedure followed? Firstly, the workers and immediate supervisors did not appear to know about this procedure, and secondly, temporary steel stop logs were not available in this mine.

Mr Saltmer, GFS Production Superintendent, told the court that when he worked in the lead mine, temporary steel stop logs were available and used. When he started in GFS, there were no temporary steel stop logs and he followed the practice that was already in place of using dump and push. Mr Saltmer saw no practical reason why temporary steel stop logs could not have been used in GFS as they were in GFN at the time of the incident. Why the confusion about what procedures applied to which mine and use of temporary steel stop logs?

Again, there is a historical context as well as an audit trail that is relevant to these questions.

Mr Callaghan provided a statement that outlines some of the history of the safety management systems used at George Fisher Mines.

In the mid 1990's Mount Isa Mines Ltd purchased a safety, health and environment management system (SHMS) known as ICI System which provided a framework in accordance with Australian Standard (AS) 4801 and included documents which specified how to manage key components of the management system. This included, for example, incident methodology and hazard and risk management methodologies. It required departmental level procedures and job specific training.

When Xstrata assumed control of the Mt Isa mines in June 2003 the SHMS was still heavily based on the ICI System. Xstrata operated a sustainable development management system (SDMS). So there was a need to progressively adapt the ICI System to meet the requirements of the SDMS. While managing this transition, it was important to retain the operational practices and procedures within the mining operations until reviewed. There was the added complexity of compliance with the requirements of the mines legislation. In late 2004 Xstrata decided to appoint two separate Site Senior Executives (SSE) to head up the two different mining operations (along commodity lines) conducted on the one mining lease. The Mines legislation required a SSE be appointed as the most senior person representing the operator near or at the site and in control of the site. The SSE is legislatively responsible for ensuring implementation of an effective safety and health management system. The strategy of 2 SSE's was developed to reflect the broader Xstrata business model of providing for separate commodity business units for copper and zinc/lead. Given the division across the site based on commodity lines, it was thought that the objectives of the mining legislation would be better met with the appointment of two sites senior executives so that each could concentrate on their own business unit.

Xstrata is a global mining venture with many mines across different locations involving different commodities and different mining techniques. Clearly, uniform and consistent management standards were necessary across all of its operations. In comparison, Mt Isa Mines was conducted as a local operation until it was acquired by Xstrata.

Therefore, the challenge for Xstrata was to integrate and adapt the Mt Isa safety management system with its global management system on commodity based business lines while complying with Queensland mines legislation. This had to be achieved while continuing operations.

I digress from the historical narrative to give the reader some appreciation of the enormity of this task.

In 2004 Xstrata introduced its sustainable development standards to the Mt Isa operations and expanded the 17 strategic level statements to incorporate four additional standards that were specific to North Queensland operations. The 21 standards were:

- 1000 Health & Hygiene Management
- 1010 Safe for Work
- 1030 Injury Management
- 1100 Leadership, Strategy and Accountability
- 1110 Legal and Other Obligations
- 1130 Planning and Resources
- 1140 Communication and Engagement
- 1150 Emergency Preparedness and Response
- 1160 Training, Competence and Behaviour Management
- 1170 Monitoring and Review
- 1180 Incident Management
- 1190 Risk and Change Management
- 1200 Site Access and Security
- 1210 Contractors, Suppliers and Partners
- 1220 Document Management and System Review
- 1260 Product Stewardship
- 1290 Control of the Work Environment
- 1400 Biodiversity and Land management
- 1450 Sustainable Communities
- 1500 Life Cycle management – Projects and Operations
- 1550 Catastrophic Hazards

Each standard was supported with Procedures, Instructions, Forms and Guidelines.

The most obvious link between senior management and the Sustainable Development Standards was the requirement in STD -1190 (above) for a Risk Register. STD-1190 relevantly provides that risks, hazards, and like aspects associated with Xstrata's operations be identified, risk assessed, eliminated or controlled and monitored.

In Part 3.1, it reads:

> SD risk management process shall be established to drive continual improvement in SD performance through:
>
> Systematic identification of SD risks, hazards and aspects by competent persons
> Assessment of risks using recognised criteria and measures
> Prioritisation of the risks and their subsequent recording in a 'risk register' reviewed annually
> Implementation of controls in accordance with a 'hierarchy of controls'
> Review of the effectiveness of implemented controls
> Providing suitable training to those affected by the change

Updating all relevant documentation reflecting the change eg. Procedures.....

This Part sets out the key steps in the risk management process, whether for safety or otherwise:

Systematic identification of hazards, assessment of risks, prioritisation and recording of risks in a risk register, implementation of controls, review of effectiveness, training and maintaining currency of relevant documentation.

Part 3.11 deals with Risk Registers:

3.11.1 Each Department within a Profit centre shall establish a departmental Risk Register which shall be recorded in CURA (governance, risk & compliance database). The Risk register shall be established in consultation with key knowledgeable personnel within that department and external specialists as required.

The Risk register shall contain all catastrophic hazards which are typically those that have a high or extreme rating.......................”

Xstrata relied on the existing Risk Register at George Fisher Mining on taking over which listed the following safety and health risks:

- **Ground failure**
- Mobile equipment colliding with persons
- Mobile equipment colliding with other equipment
- Plant or equipment design faults causing potential pinch points or crushing risks to exposed workers, unguarded moving equipment with the potential to injure workers, entanglement with moving parts (machine guards)
- Fire and/or explosion in the Mine from leaking gas supply, diesel leak or spillage, build up of combustible/explosive gases, electrical malfunction.
- Musculoskeletal injuries to workers from manual tasks and ageing work group
- Unplanned/uncontrolled initiation of explosives
- Fire in the explosives magazine
- Fire in the fuel bay
- Entrapment in a heading due to fire
- Injury resulting from exposure to dust/chemicals from tailings at paste fill operation
- Loss of containment of flowing material e.g., paste fill
- **Fall from height by a person resulting in serious injury or fatality**
- Electric shock/electrocution
- Lifting equipment failure (cranes-structures-lifting anchors-other equipment)
- Falling objects
- Legionella
- Working in confined spaces
- Tyre/split rim failure
- Pressure vessel fire/explosion (nitrogen, O2, propane, acetylene cylinders)
- Lead exposure
- Office fire
- Electrical fire
- Hazardous substances (arsenic, cadmium, dust, fumes, asbestos, refractories, gases)
- Lightning strike
- Major structural failure (including subsidence)
- Bulk diesel fuel release

A Risk Register is the top hierarchical document for risk identification in a safety context. Most of the operational documents addressing the identified hazards flow from or are referenced to this document. For example, once hazards are identified, strategies by which the hazard is to be controlled and documents relevant to those controls are referenced in the Risk Register. This top down approach is designed to give some assurance to senior managers that all serious or high-risk hazards are identified and their risks are managed.

There was some debate about whether the risk that eventuated in this case was identified in the Risk Register. Mines reported that the risk of persons in mobile equipment exposed to vertical edges was not directly identified in the Risk Register. However, Xstrata directed my attention to the risks in bold within the list, namely "Fall from height by a person resulting in serious injury or fatality" and submitted this covered the present case.

The Risk Register included a column for Internal Controls/Management Response relevant to working at height that stated:

> Approved contractors. Daily inspections (maintenance), Design/engineering purchasing standards, Housekeeping audits, incident report system, risk assessment and task analysis system, Insurance details, qualified personnel for repairs, Significant incidents reported, Design/engineering standards, Planned maintenance, storage and handling procedures, training and retraining records/matrices, third party crane and gear inspection, lifting equipment checklist, Safe Work Instructions, tool box talks, disciplinary procedures, formal system of lifting equipment (man baskets) instigated and overseen by Technical Support Superintendent.

In another column titled "Improvement required/Planned/ Mitigating actions", the Register states: "Work at height training now includes technical services personnel such as rock mechanics, surveyors and geologists".

A few rows below this entry, appears another hazard identified as "Lifting equipment failure (cranes – structures – lifting anchor's – other equipment)". Under the column headed Internal Controls/Management Response, the same entry appears as Falls from Height.

The operational level documents that Xstrata submitted to the Mines Inspectorate and to this inquiry as relevant to inadvertent entry of a loader into a stope were identified as follows:

- MIM Vertical Openings PRO-131600;
- MIM Backfilling Stopes PRO-34-03-04;
- MIM Specialist Mucking Procedure PRO034-03-03.

If you compare the list of Internal Controls for "Fall from Height" with the content of these procedures, the connections are nebulous. Given the history of similar incidents at Mt Isa Mines, 'vertical openings' should have featured prominently and explicitly as a risk as should the strategies and controls relied upon to manage that risk.

This is but one example of the challenges of integrating the Xstrata SDMS with the Mt Isa Mines SHMS.

I return to the historical narrative.

In 2005 Xstrata released an audit protocol that detailed the requirements within each element of each standard. Site documents, procedures, forms and training packages were reviewed and implemented so that the full intent of the corporate expectations, as reflected in the standards, could be met.

On completion of the audit, Xstrata commenced upgrading the content of the safety and health management system. Clearly, this was a massive undertaking. The process started in 2006 with a review at operational level to assess the volume of documents to be managed and the means by which the documents were to be controlled. Issues were discovered with the capture of corporate knowledge. When experienced employees left the company, corporate history was lost. It was also discovered that some of the existing information technology capabilities were limited and unable to support the more effective document control procedures that were required. Two document controllers were employed, one in 2006 and the other in 2008, to receive the documents from the process controllers, ensure quality, and make sure the documents were appropriately reviewed, authorised and distributed to the workforce via an intranet. A better document control process was launched in 2007. Decisions about which documents required prioritisation for updating remained with the departments, safety and health advisers, training coordinators and relevant operation’s managers.

In his statement, Mr Callaghan addressed the magnitude of the task, at operational level, in reviewing the procedures and documentation. He reported work started in 2006 and was ongoing when he left Xstrata zinc in early 2011. He expected that work to continue as an ongoing process in each of the operations for some time to come.

Mr Leeman started as Safety Advisor with George Fisher Mine in 2004. He reported to the Mine Manager and continued in that role until early 2009 when he became Senior Advisor in Risk and Audit, reporting to Mr Callaghan. In his statement, Mr Leeman detailed steps taken in 2008. Between February and March 2008 the concept of a Supervisors Inspection Book was discussed and implemented to support Supervisors in performing inspections. The Inspection Book was conceived as a tool to ensure a more structured and consistent approach to the identification and management of hazards. The inspection system was updated. Mr Leeman tracked Supervisors compliance with the inspection system through periodic reviews of Inspection Books.

In October 2008, vertical openings became the focus of attention. Although discussions were underway since early October for a planned audit of vertical openings, an incident occurred on 17 October at another Xstrata underground mine where a loader breached a mullock stop log and went into an ore pass. This was discussed between Inspector Casey and Mr Hendry, then Mine

Manager. The incident involved a loader entering an ore pass and there was discussion about the use of steel stop logs at such sites. Mr Hendry requested Mr Leeman to arrange for a risk assessment of vertical openings including stopes. The risk assessment was planned as a precursor to an operational review. I note an ore pass is a different type of vertical opening in comparison to a stope. That risk assessment was undertaken.

It seems that the earlier incident flagged the need to prioritise the review of backfill procedures and documentation.

In February 2009 Mr Callaghan asked Mr Leeman to conduct an audit of backfill risk assessments. It was completed on 11 February. He attended the site where a backfilling operation was being performed. He recalled the procedure in place at the time was PRO 34-03-04 and SWI 7453009, the same documents in place at the time of Mr Tuppurainen's death. Mr Leeman reported to Mr Callaghan as follows:

> Procedures
>
> > Both SWI 7453009 and PR0-340304 are dated and due for revision (the SWI shows workers using a mucker bucket as an anchor point for fall prevention).
> >
> > Any common or standard hazards and controls which regularly appear in the majority of backfill risk assessments should be included in any revised documents.

Then later in his report:

> Practice
>
> - It was evident that the risk assessment had been communicated to the Mucker we visited today, Corey Owens, at 2FWN53 8L Corey was in the process of backfilling HMR.
> - PR0-340304 Backfilling Stopes is not followed strictly and the procedure in practice is modified by different operators to varying degrees, due in part to the age of the procedure and developments in equipment and methods over the years.
> - There was no rill established on this stope
> - There was no steel stop log in place
> - There was an earthen bund in place
> - There was a marker pole on the wall in line with the earthen bund
> - There was no flashing light in place

There was no reference to dump and push. At the inquest, Mr Leeman was unable to recall how the backfilling operation was performed. In any event, and more importantly, his report acknowledged the absence of a steel stop log and the use instead of an earthen bund where no rill was established.

There was no doubt at this stage in the minds of the safety managers that the procedures for backfilling required review. That review did not occur before this incident. It is impossible to assess whether this review should have been given earlier attention or higher priority compared to possibly many other operational procedures requiring review. In any attempt to consider the timeliness of Xstrata's response to the need for review of the backfilling procedure would require a retrospective audit to establish the state of the safety management system as at 2003 and progress made in integrating and reviewing the systems to 2008. This is a near impossible undertaking and not one that Mines or this coronial investigation could undertake. Clearly, Xstrata was aware of the need to review the backfilling operational procedures and was working steadily towards that goal.

We have already seen what Xstrata did in the aftermath of the death of Mr Tuppurainen to address the hazards of inadvertent entry into a stope. The new backfilling procedure has already been addressed, as has the use of an engineering control in the form of steel stop logs. In the broader context of vertical openings, there are 47 newly developed documents comprising procedures, forms, assessment packages and safe work instructions guiding safety.

Mr Hearn, Chief Operating Officer, Xstrata Zinc Australia, reported that the 2008 and 2009 risk register did not specifically reference working in close proximity to vertical openings as a risk. The view had been taken that this was covered under the "fall from height by a person resulting in serious injury or fatality" and "ground failure" risks; which were included in the risk register. Following the incident, the risk of working in proximity to vertical openings was specifically included. The risk refers to the potential for personnel, machinery and equipment to fall into passes or stopes.

The training and assessment packages were updated and now specifically refer to vertical openings as hazards which may arise when during mucking operations.

Mr Hearn also reported on advances made in the remote operation of a loader by a person either on the surface or underground using a combination of on-board computers, cameras, lasers and operator software. This initiative removes the requirement for a loader operator in the cabin while backfilling. This is a capital intensive initiative costing approximately $380,000 per unit (excluding infrastructure and consoles) with about 10 currently operating. Mt Isa Mines has also invested heavily in a research project involving proximity detection as a means of vertical edge protection and collision avoidance. However, trials revealed some shortcomings with the software and hardware. Although the mine spent approximately $950,000 on the proximity detection trials, it now has sourced alternative software and hardware, which it has committed to implementing. The opportunity was taken to effect other improvements. A review was conducted of all job description and action plans for managers. All positions from senior management to operational supervisors now have detailed job descriptions defining their responsibilities relevant to safety. The auditing processes have been refined, and include annual as well is triennial audits conducted by third parties external to the company.

Findings required by s45

Identity of the deceased Pekka Tuppurainen

Date of death 19 May 2009

Place of death George Fisher Mine, 20km north of Mt Isa

Cause of death 1(a) traumatic asphyxia, due to a
(b) mine accident (loader operator)

How he died –

1. Mr Tuppurainen was operating a loader during the course of backfilling when the loader went over the edge and into the stope. It fell a considerable distance before coming to rest partly buried in the backfill material. Mr Tuppurainen died almost immediately due to traumatic asphyxiation. His body was found in the cabin of the loader and surrounded by the backfill material.

2. Xstrata plc was the owner of Mt Isa Mines Ltd, the operator of the mine and employer of Mr Tuppurainen.

3. The backfilling of this stope was risk assessed with a focus on rock geology and stability. The conventional backfilling procedure involved a loader dumping over an earth stop log until the rill was level with the floor of the drive and then the stop log was advanced across the top of the rill to the level of the floor on the other side. In this manner, the earth stop log acts as a safety barrier preventing inadvertent entry into the stope. However, for geotechnical reasons, what was described as an additional control measure was specified in the risk assessment known called dump and push. Instead of dumping over the stop log, the loader operator dumps the backfill material at the front of the stop log and pushes it into the stop log so the back of the stop log falls into the stope. This method puts a further distance between the front wheels of the loader and the edge of the stope.

4. While I find that Mr Tuppurainen and the loader accidentally entered the stope, I am unable to find what Mr Tuppurainen was specifically doing or how he was performing dump and push when the loader entered the stope. A number of possibilities were explored during the inquest and none is more likely than the other.

5. Following this incident, Xstrata reviewed the backfilling procedure and decided to use temporary steel stop logs whenever backfilling involved vertical edges.

6. In the months prior to this incident, Xstrata had identified a need to review the backfilling procedure and in particular, a need to consider the use of temporary steel stop logs in this mine.

7. If a temporary steel stop log was in place while Mr Tuppurainen was backfilling, his death is likely to have been avoided.

8. I was unable to determine whether the potential use of temporary steel stop logs should have been identified earlier than February 2009 or whether the review of the backfill procedure should have been given earlier or higher priority. Xstrata was working through the integration of its management system with Mt Isa Mines safety management system and was progressively reviewing all operational documentation. In the course of this review, it identified issues with the backfill procedure. In any event, I am unable to determine whether any such review would have been completed and new procedures implemented before this fatality. Changes to safe working procedures often taken many months, if not years, to fully implement.

9. At an operational level, Xstrata has made major capital investments in exploring the potential benefits of new technology to mitigate the risks to personnel working near vertical openings. Although it has experienced some set backs to these programs, it continues to invest financially in this direction.

10. Remedial action was not limited to an operational level. Opportunities for improvement relevant to safety were identified and actioned throughout the management system.

11. I am satisfied that, between the Mines Inspectorate and Xstrata plc, all required remedial action has been taken to reduce the risk of a fatality through inadvertent entry of a loader into a stope. The lessons to be learnt were identified and disseminated to the mining industry. No further action is required.

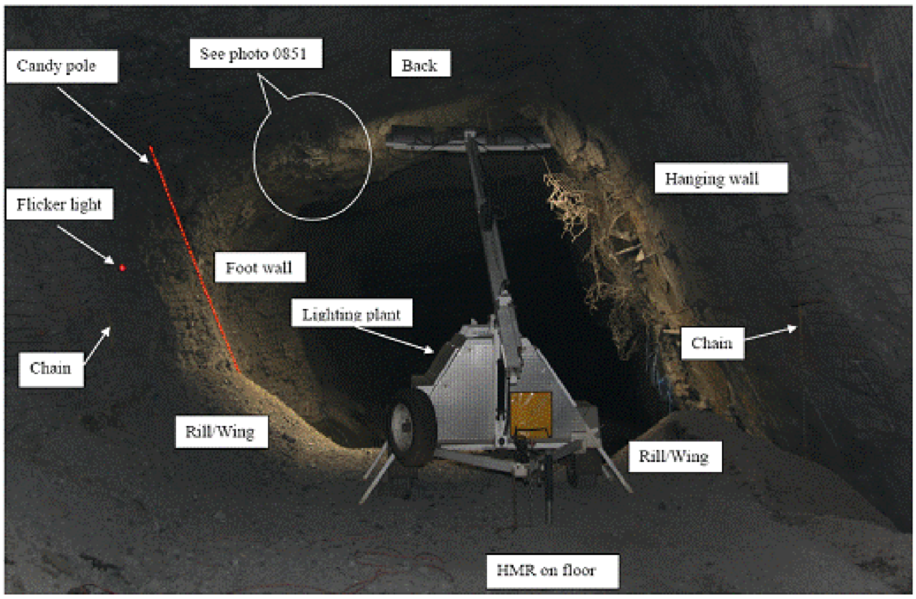
Accordingly, there are no recommendations.

I close the inquest.

Kevin Priestly
Coroner

Cairns
20 August 2013

Appendix to Findings



This photograph depicts a view of the edge of the stope with temporary lighting in place. This is the perspective that Mr Tuppurainen would have had in view when he approached the stope. The location of the candy pole and flicker light is shown on the left side. These are reference marks placed by the operator to assist in determining the edge or location of the stop log. The reader should also note the identification of the foot wall to the left and hanging wall to the right.

The above photograph was taken from the opposite side of the void looking back to the edge over which the loader entered the stope.

The following sections explains the bench stoping life cycle, the backfilling method, the backfilling product, the stope being filled and the equipment in use.

9.1.1 Bench Stoping

The bench stoping method is suited to the mining of narrow vein steeply dipping orebodies. The method entails the development mining of a drive to the extremes of the ore body on two levels (along strike) and then extracting the ore body in between on a retreat basis by drilling down holes, blasting and leaving pillars at appropriate intervals. The section of ore taken out between pillars is referred to as a panel. The panels are only of a small tonnage and production rates are reliant on a quick turnover including backfilling of the voids created. The mining sequence is from the bottom upwards.

The benching method at GFS follows the following sequence[50]:

1. Outline the geology, plan and risk assess the development drives and issue a Primary Development Design (PDD).
2. Mine the extraction (or mucking) drive off the crosscut access to the extent of the ore body with the appropriate ground support pattern. Drive dimensions are normally 5 metres high x 5 metres wide but the width can be wider at times following the width of the orebody.
3. Mine the drilling drive above from the crosscut access to the extent of the ore body with the appropriate support pattern

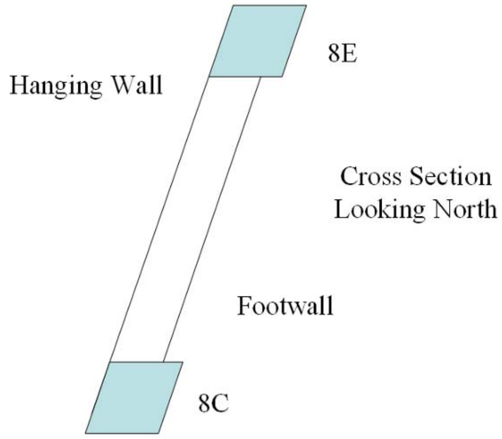


Figure 3 Schematic Cross Section Looking North

4. The drives are mapped by geology and level plans are created.
5. A stope design is undertaken which considers geological information and geotechnical design specifications which includes, spans, pillar locations, tramming routes and tipping points.
6. Survey mark up of drill ring spacings on the drilling (top) horizon.
7. The stope is then drilled out with down holes by a production drill rig
8. A firing and mucking risk assessment is conducted by a multidisciplinary group
9. The slot area which is close to the back end of the stope is then fired in lifts (sections) up to the crown (breakthrough) shot which is a minimum of 8m.
10. As soon as the crown is through, the remaining rings are fired in one or two additional shots.

[50] Appendix 1 – ROI Mr. J. GROBLER, 4 August 2009

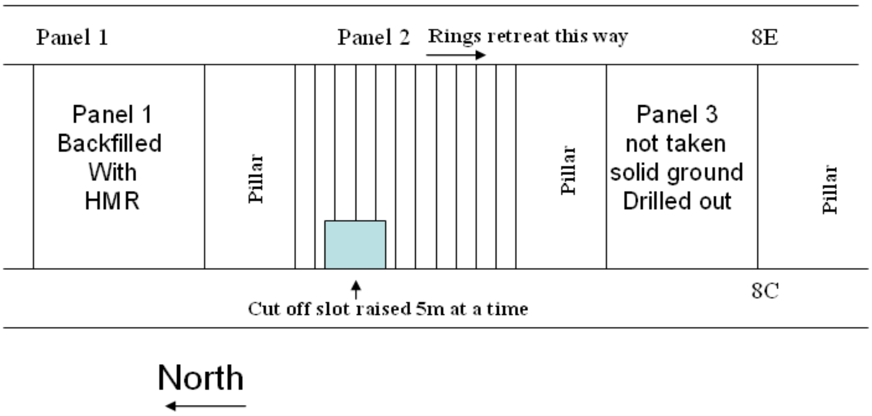


Figure 4. Schematic Cross Section Looking East

11. The stope is mucked out by a loader from the drawpoint on the mucking horizon either conventionally, tele-remote or by line–of–sight remote.
12. The stope is inspected for ore mining completion by operational personnel and this is then confirmed by the geology section
13. A CMS is conducted. This is a computerised survey pickup of the void undertaken by surveyors.
14. A backfill risk assessment is conducted by a multidisciplinary group
15. Backfill material is tipped from the top horizon until the stope is full

As part of bench design, pillars of 4 to 5 metres are designed between panels based on geotechnical stability and other design criteria. Extraction is mainly done on a retreat basis, but backfill could be on an advance or a retreat basis depending on specific circumstances.

9.1.2 The Backfilling Method

Mr. TUPPURAINEN’s task was to remove HMR material from the L54 Fill Pass on 8E Sub-level and deposit it into the empty stope void of 7N53 panel 2. This process, which progressively fills the void is known as backfilling. It is normally done conventionally (not by remote control) as it is quicker and gives the ability for closer visual assessment of the ongoing filling progress.

L54 Pass extends from the surface to 8E, with the pass filled with HMR tipped in from the surface. Normally a stope would be backfilled from the side on which the stope is retreating, because there is usually no access to the opposite side. In this situation there was access because of an additional crosscut between the drives. It was also a shorter route for the loader to go to the northern edge to tip instead of what would have been the usual tipping edge on the southern side.

Backfilling is a repetitive task, in this case driving (conventional operation) into L54 and picking up a bucket of HMR, reversing out and driving forwards around to the stope, a distance of some 110 metres, dump the bucket and then reverse back around to L54 and repeat the activity. The drive where the backfill material was sourced ran parallel to the stope void drive.

Queensland Government

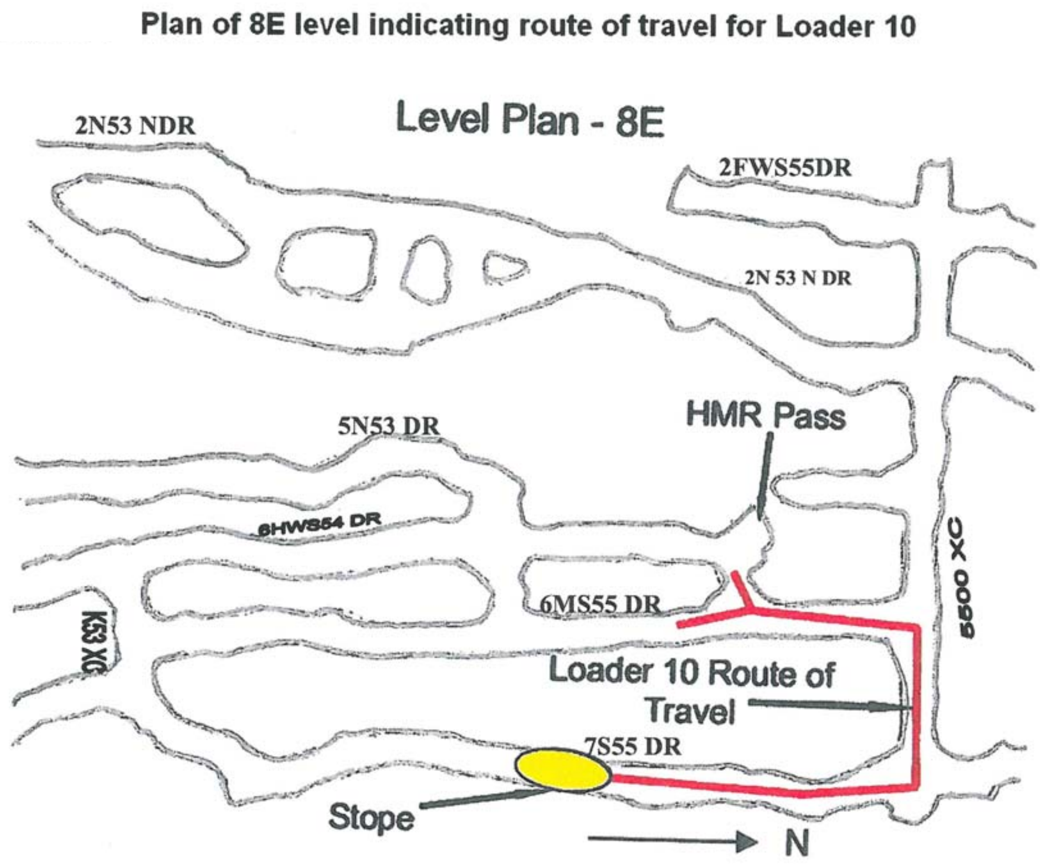


Figure 5. Schematic Plan View of 8E Sublevel Indicating Route of Travel of Loader LD10

As the edge being tipped over involved a sheer vertical drop, (in this case 29 metres by the footwall bedding to the floor of 8C Sublevel), it was normal for a mullock (waste rock) stoplog (or barrier) to be used until a rill is established up to the stoplog. The stoplog would then be advanced to progressively fill the void to the level (8E Sublevel in this instance).

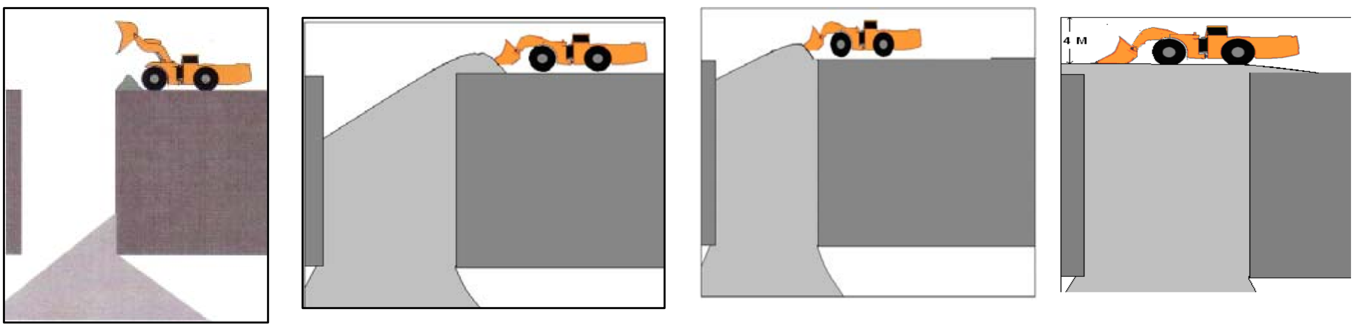


Figure 6. Illustration of Bench Stope Backfilling

Tipping to an edge that would be used for an extended period of time, such as a larger stope or pass, may mean a more substantial engineered barrier would be installed such as a reinforced concrete or steel barrier.

9.1.3 The Backfill Product

The product being used to backfill 7N53 Panel 2 was Heavy Medium Reject (HMR) which is the reject (or waste) material from the Heavy Medium Plant (HMP) at the Zinc Lead Concentrator in

Mount Isa. HMR has a relatively uniform size of =<15mm and does not have significant fines to bind and is therefore relatively free flowing.
HMR is stockpiled and transported to the mine from Mount Isa by back loading the ore transport trucks and is used for a number of purposes, in this case as backfill for a mined underground void.[51]

98% of the GFS mining voids are filled with HMR

Xstrata Photo No. 0722 depicts HMR

9.1.4 7N53 Panel 2, 8E to 8C Sublevels

7N53 Panel 2 was the second of 5 panels to be taken in the 7N53 Bench, 8E-8C. The panel was designed to have a span of 13 metres and a vertical height of 24 metres.[52]

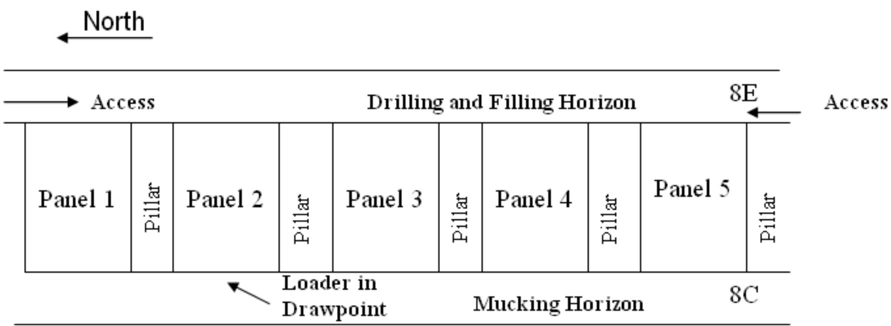


Figure 7. Schematic Cross Section Looking East

[51] Appendix 2.11 – Letter from Mr. B. CALLAGHAN 29 June 2009
[52] Appendix 2.12 – Bench Note For 7N53 P2 8C-8E, Section 4, April 2009

9.1.5 Loader

The loader being used by Mr. TUPPURAINEN was a Caterpillar Model R2900G, site Unit Number LD10. It had been purchased new and commissioned at the mine on 7 November 2008. It had accrued 2,436 engine hours at the end of the day shift of 19 May 2009 and 2,438.9 engine hours after the accident.[53]

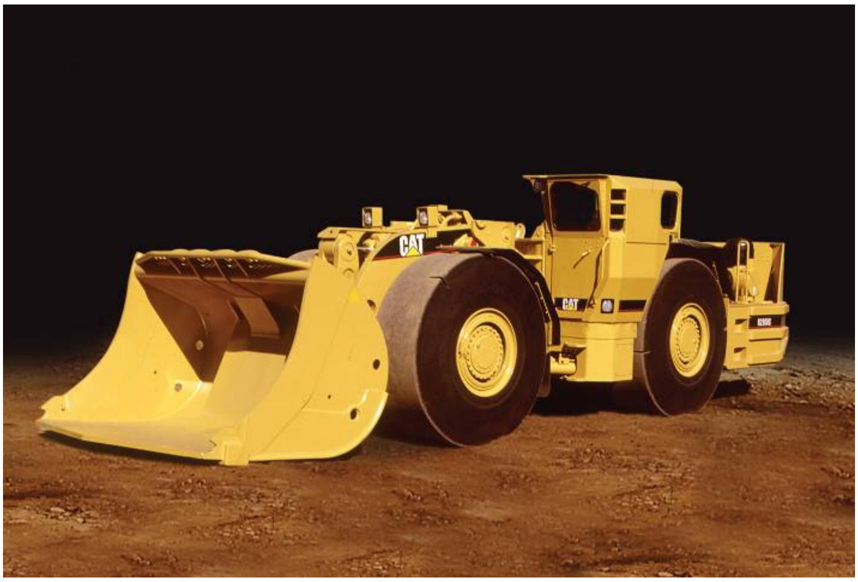


Photo of an Elphinstone R2900G Loader

The R2900G is a low profile centre articulated underground loader where the operator is seated on the left hand side of the unit, (if looking from the rear), facing inwards. The operator's line of sight when operating the loader conventionally is primarily to his left to travel forwards and to his right to reverse the unit. As the underground environment is always dark the operator relies on the lighting on the unit for his vision in the environment.

R2900G Load Haul Dump[54]	
Weight (empty)	50.424 tonnes
Length (maximum)	11.302 metres
Width (maximum)	3.176 metres
Width across tyres	2.898 metres
Height (over cab)	2.888 metres

[53] Appendix 4 – Mechanical Report on Caterpillar R2900G JLK00872 Loader Unit Number LD10
[54] Appendix 2.13 – Caterpillar Operation and Maintenance Manual 2900 G December 2008, Page 56