NSW GOVERNMENT

NSW Resources Regulator

INVESTIGATION REPORT

REPORT INTO THE SERIOUS INJURY OF A WORKER AT APPIN NORTH MINE

8 June 2019

NSW Resources Regulator

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Executive summary

On 8 June 2019 a labour-hire worker was tasked with assisting with the installation of a new scraper conveyor at the underground coal mine known as the Appin North Mine (the mine) which is located approximately 30 kilometres northwest of Wollongong in NSW.

The worker was washing coal fines and muck into a sump located at the lower end of the scraper conveyor while the conveyor was operating. The worker was located on a steel enclosure on top of the scraper conveyor. The steel enclosure was covered with a finer mesh (tech mesh), which was installed as an interim measure to prevent fingers entering the scraper conveyor.

The worker continued to hose down the coal fines while standing on the conveyor and walking on the steel enclosure. Unbeknown to the worker, when he got to the end of the tech mesh there was a gap in the steel enclosure under the mesh. The worker's foot bent the tech mesh down and his foot and a small section of the mesh became entangled in the scraper conveyor. The worker pulled his foot out of the scraper conveyor, and while doing so, suffered serious and permanent injuries to his toes and foot.

This was only the second time the worker had been in the Appin North scraper conveyor drift.

The investigation identified that:

- lights in the scraper conveyor drift we out of service and the workers relied on the use of their cap lamps as the only source of light
- a safety rail was previously installed perpendicular to the scraper conveyor which would have prevented the worker from accessing the area were the incident occurred
- the safety rail was removed to allow for the installation of the new scraper conveyor
- the area designated for accessing the drift, which was parallel to the scraper conveyor, was covered in coal fines due to the scraper conveyor being out of service
- the scraper conveyor did not have the emergency stop lanyard in place at the time of the incident
- the mine had not undertaken the introduction to site procedure for the new scraper conveyor
- the new scraper conveyor had not undergone any operational risk assessment
- no person had undertaken any assessment of the risk of:
    - installing the tech mesh on top of the steel enclosure

- operating the scraper conveyor with the safety rails and emergency stop lanyard not in place.

The investigation identified that there was poor management and control of the replacement project with key personnel being replaced part way through the project, coupled with a poor handover to new team members. This was compounded by having no project plan in place which resulted in:

- a lack of understanding of the steps and processes that had already been undertaken
- a lack of understanding of the steps and processes that had yet to be undertaken
- an ad hoc process to rectify issues that arose during the installation
- a lack of understanding/assessment of hazards caused by ad hoc decisions
- a lack of understanding of the risks by senior project team members in relation to operating the scraper conveyor without key safety controls in place
- reliance on an experienced low-level worker to ensure all hazards were controlled
- utilisation of the lowest documented risk assessment process (take two) to identify and control hazards in a very modified work environment.

Recommendations

This incident highlights the hazards associated with the operation of plant underground and the need to ensure all plant is subject to operational risk assessment when:

- new equipment is introduced to the site
- changes to the plant are to be undertaken
- plant needs to be operated while controls, such as safety rails, are not in place.

Mine operators should:

- ensure permanent fixed guarding or other barriers are in place on conveyors to prevent access to and contact with moving parts
- confirm that all control measures are in place and are effective to ensure the health and safety of any person conducting inspections, cleaning or maintenance on fixed plant
- ensure all procedures are followed to ensure any hazards posed by equipment introduced to the site are eliminated or minimised to as low as reasonably practical

- consider developing project plans prior to undertaking major installations of new equipment to allow a staged approach to be approved and monitored for compliance
- ensure an appropriate level of risk assessment is conducted involving appropriately skilled staff members prior to operating equipment that is in an abnormal state (repair or installation)
- ensure that any out of scope work, when installing new equipment, has an appropriate risk assessment undertaken prior to approving the out of scope work
- ensure all safe work procedures/work instructions related to the installation of equipment are provided to all supervisors and workers involved in the installation process
- develop procedures to control potential hazards if work on the installation process is to occur when key advisory staff, such as engineers or trade persons are not on shift (i.e. weekend night shift)
- consider, and where reasonably practicable, apply Australian standard AS/NZS 4024.1-Safety of machinery series in regard to guarding on fixed plant.

Contents

1. Purpose of the report

This report describes the mining workplace incident investigation (the investigation) conducted by the NSW Resources Regulator (the Regulator) to establish the cause and circumstances of the incident that occurred at the Appin North underground coal mine.

2. Investigation overview

2.1. Major safety investigations

The Regulator investigates major workplace incidents in the NSW mining, petroleum and extractives industries. The Regulator carries out a detailed analysis of incidents and report findings to enhance industry safety and to give effect to our Compliance and enforcement approach.

2.2. Legislative authority to investigate

Investigators are appointed as government officials under the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and are deemed to be inspectors for the purposes of the *Work Health and Safety Act 2011* (WHS Act). The Regulator has also delegated some additional functions to investigators, including exercising the power to obtain information and documents for the purposes of monitoring compliance with the WHS Act.

2.3. Regulator response

The incident was reported to the Regulator on 9 June 2019. The Regulator's initial response was to deploy inspectors to the site to undertake an assessment of the incident and to secure the scene.

The Regulator commenced an investigation on 20 June 2019. The investigation included:

- scene assessments
- notices being issued
- witness interviews
- obtaining information and documents from relevant parties
- issuing an investigation information release.

3. The incident

3.1. Involved parties

3.1.1. Mine operator and holder

At the time of the incident Endeavour Coal Pty Limited (Endeavour Coal) was the mine holder (holder of the mine lease) for the Appin Colliery which encompasses the Appin North Mine.

Endeavour Coal was also the nominated operator for the mine and exercised the management and control of the mine, employees, contractors and the scraper conveyor.

3.1.2. Mastermyne Pty Ltd

Mastermyne Pty Ltd (Mastermyne) was the worker's employer at the time of the incident.

The company was founded in 1996 and provides services and supplementary labour to the mining sector.

3.1.3. Illawarra Coal Holdings Pty Ltd

Illawarra Coal Holdings Pty Ltd (Illawarra Coal) holds 100% of the shares in Endeavour Coal. The ultimate holding company of Illawarra Coal is South32 Limited.

Illawarra Coal acted as an agent for Endeavour Coal and entered into a contract with Mastermyne on 21 November 2016. The contract was to supply services and company supervised general supplementary labour for the Appin Colliery.

3.1.4. The worker

The worker was 58 years old and had worked in the mining industry since 2010.The worker commenced working for Mastermyne on 18 February 2017. However, he had worked at the Appin complex on and off since December 2014.

At the time of the incident, the worker was undertaking work as supplementary labour within the coal clearance team at the mine.

3.2. The mine

The Appin North Mine is an underground coal mine located about 30 kilometres northwest of Wollongong in NSW as shown in figure 1. The mine was formerly called the West Cliff Colliery prior to being incorporated into the Appin mine complex. West Cliff Colliery commenced coal production in October 1976.[1]

Figure 1. Location of Appin North Mine

3.3. Mining method

The mine utilises longwall mining to extract coal, which is then transported to surface via a conveyor system.

3.4. Incident location

The incident occurred on a conveyer located at the lowest level in the conveyor system at the bottom of the conveyor drift. The conveyor is located within Consolidated Coal Lease 724 (CCL724), held by Endeavour Coal.

3.5. Equipment involved

The equipment involved in the incident is a chain type conveyor known as a scraper conveyor.

[1] www.illawarracoal.com/minebase/minebase-t-z/326-west-cliff-colliery.html

A scraper conveyor is a material transportation device utilising a continuous, driven chain circuit equipped with regularly spaced cross members (flights). The chain travels through a channel or trough which prevents the transported materials from falling off the conveyor while the cross members drag or 'scrape' them forward to the discharge point.

The general structure of a scraper conveyor is depicted in figure 2. The new scraper conveyor installed at the mine is shown in figure 3.

Figure 2. General structure of a scraper conveyor[2]

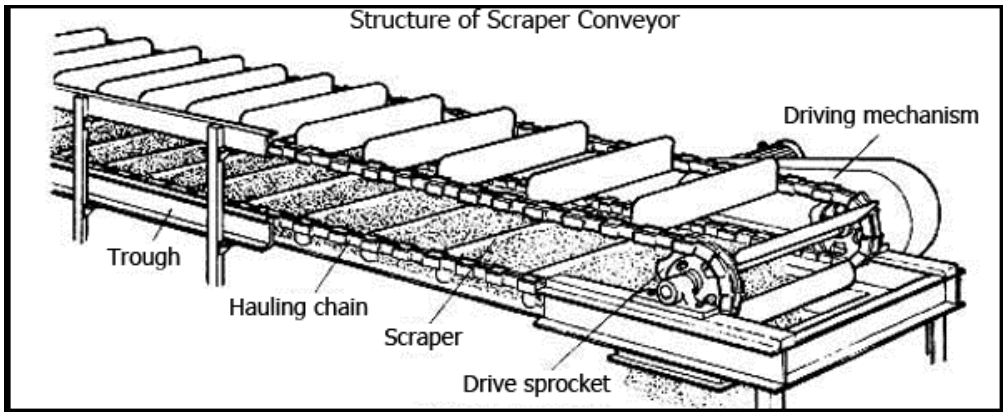


Figure 3. The new scraper conveyor at Appin North post incident

[2] www.mushroomequipment.blogspot.com/2015/06/what-is-scraper-conveyor.html

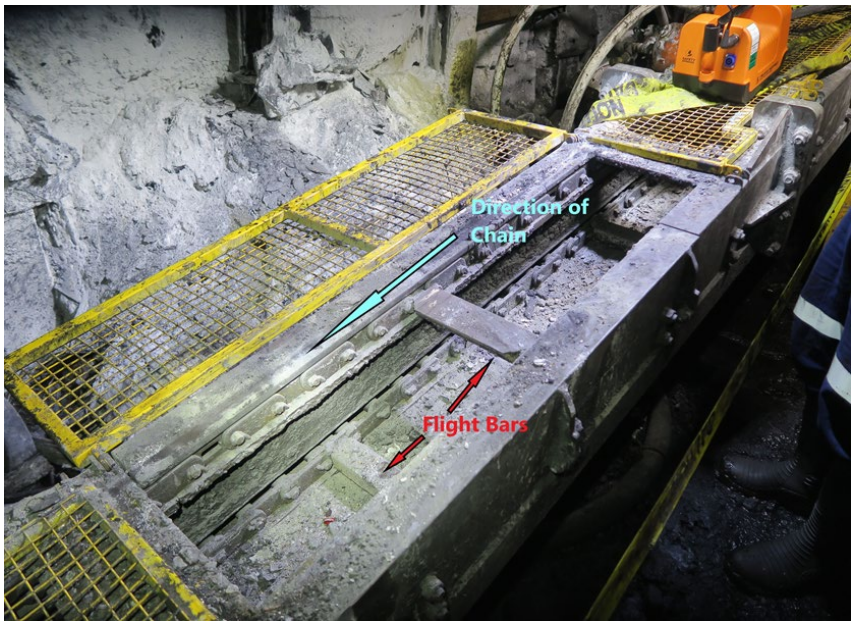
The scraper conveyor is used at the mine to recover coal fines from a concrete sump, shown in figure 4, that have been washed down from belt conveyors that are located at higher levels in the conveyor system. The scraper conveyor then deposits the waste material onto the main belt conveyor to allow it to travel out of the mine. To assist in the waste removal process, the mine also uses a slurry pump to remove the waste-liquid (water mixed with coal fines).

Without the scraper conveyor in operation, the coal fines build up over time in the conveyor drift.

Figure 4. Concrete sump at Appin North (scraper conveyor pick up area)

The scraper conveyer is fitted with flight bars to assist in removing the waste as can be seen in figure 5.

Figure 5. The new scraper conveyor showing flight bars and chain direction



Without the scraper conveyor in place, the waste has no way of being removed from the mine.

The existing scraper conveyor, which had been in place for over 30 years, had been subject to structural failure. The mine took the opportunity during a shutdown period to replace the scraper conveyor.

The design and manufacture of the new scraper conveyor was based on the existing scraper conveyor. Although, the new scraper conveyor was designed to have shorter modules to allow for easier transport into the mine for installation and the guarding was different when compared to the old conveyor.

4. The incident

To assist the investigation, the mine surveyed the scene and produced a plan of the incident site which is found at figure 6.

As shown in the survey plan, the lower end of the conveyor is identified as the sump, which is a concrete sump that the scraper conveyor is lowered into and coal fines are captured. The coal fines are then transported to the area identified as the boot end, where they are deposited onto the main conveyor.

4.1. Personnel

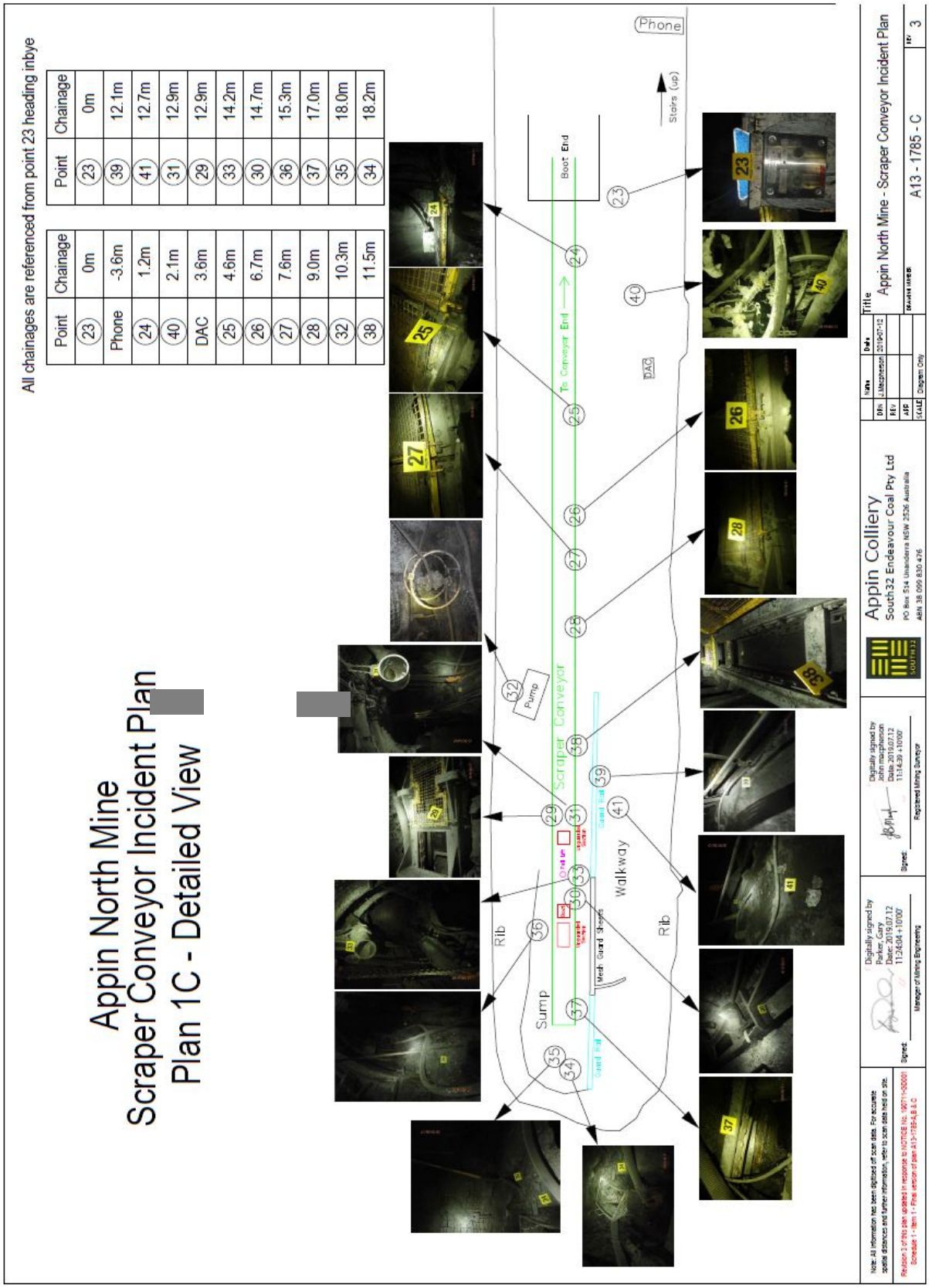
The process to install the new scraper conveyor had commenced in February 2019. Several personnel had been involved in getting the new scraper conveyor installed and operational.

The personnel present at the time of the incident was the injured mine worker and the conveyor drift attendant.

The worker usually worked at the Appin East Mine. His first experience in the scraper conveyor drift at Appin North had been his shift on the day before the incident.

The drift attendant had about eight years of experience in and around the conveyors at the mine. His duties were generally to monitor the operation of the conveyors to ensure efficient running of the conveyors and undertaking cleaning duties.

Figure 6. Survey plan of the scene



4.2. The incident

At about 10:00 pm during the nightshift of 8 June 2019, the drift attendant and the mine worker spoke with the maintenance supervisor about cleaning out the scraper conveyor drift. This task involved the use of a hose to wash coal fines towards the concrete sump. A pump extracted the slurry and the conveyor removed particulate matter from the sump.

An examination of the conveyor inspection report of the deputy for the shift indicates that there was coal spillage under the full length of the conveyor belt. Before they could perform the wash down procedure, they needed to have the scraper conveyor working.

The men were working using the light from their cap lamps as the permanent lighting in the scraper conveyor drift had been disabled due to a fault in the fittings.

There was also a high level of noise in the conveyor drift due to the operation of the conveyor, ventilation and the slurry pump.

The drift attendant turned on the conveyor and used a hose to clean the drift, while the injured worker monitored the movement of material on the conveyor system. The worker took over the hosing of the drift at about 11:00 pm.

As the drift floor adjacent to the conveyor, that was normally used as a walkway, was covered in coal debris, as shown in figure 7, the worker used the steel covered conveyor as a walkway, as it was a safer option, being flat and sturdy.

Figure 7. Walkway covered in material

As the worker continued to use the hose, he walked toward the concrete sump end of the scraper conveyor. He approached a lift point section on the conveyor, installed to allow the conveyor to be lifted with a chain block (refer to figure 6 Survey Plan – location 29).

The worker stepped on a section of the conveyor adjacent to the lift point which was covered in a lightweight mesh (tech mesh). The tech mesh covered an opening in the conveyor that did not have the support of an underlying yellow steel grate (guard). The section of tech mesh was attached at one end to part of the yellow steel guard with plastic cable ties.

The worker was unable to see that there was a void underneath the tech mesh, when he placed his foot on this section and commenced to place weight on the foot the tech mesh bent down. Both the workers foot and the section of tech mesh became entangled with the flight bars of the moving scraper conveyor as shown in figures 9 and 10.

Figure 9. Location where the workers foot got entangled

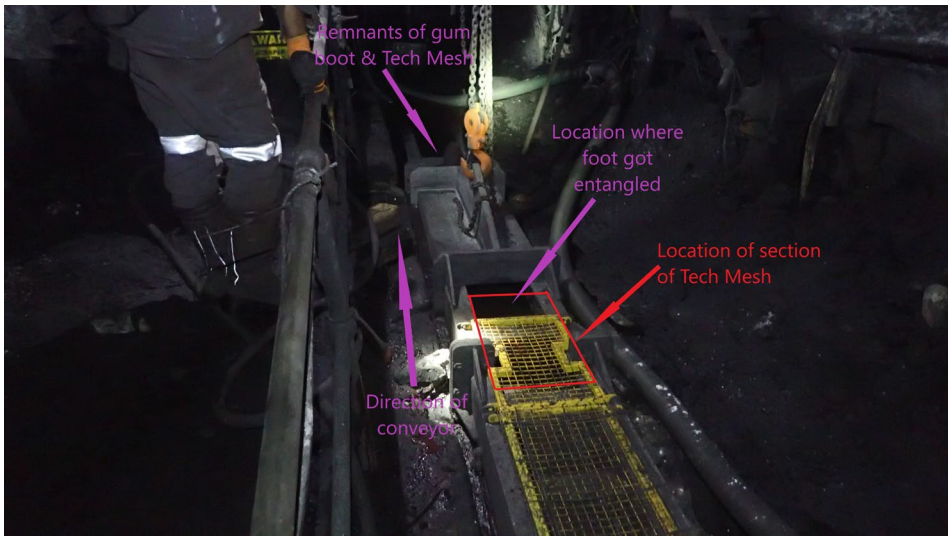


Figure 10. The void post-incident

The scraper conveyor's motion then dragged the worker's foot and tech mesh towards the lift point. The worker had to forcibly remove his foot from the conveyor. The worker was able to remove his foot in part due to the fact he was wearing gumboots and not lace up safety boots.

If the worker had not been able to remove his foot from the entanglement, the moving conveyor would have dragged the worker further into the conveyor, which would have resulted in a potential life-threatening situation.

The drift attendant noticed that there was an issue and had to run back up the conveyor drift from the bottom end (refer to figure 6 Survey plan – adjacent to location 37) to the control panel (location 23) to turn off the conveyor.

The emergency stop lanyard, which previously ran parallel to the conveyor, had not yet been re-installed.

The gumboot and tech mesh were still entangled in the conveyor and by the time the drift attendant turned off the conveyor had ended up on the other side of the lift point (refer to figure 6 Survey plan – location 30) as shown at figure 11.

The drift attendant checked the worker's condition before he left to get help. The injured worker was evacuated to the surface.

Figure 11. Gumboot and mesh entangled in conveyor flight bar

4.3. Injuries

The worker suffered severe crush injuries to his right foot, which included a complete laceration of the sole, multiple fractures of the forefoot, degloving of the right great toe, degloving of the fourth toe and degloving of the plantar fat pad.

Upon arrival at the hospital, the worker underwent a debridement procedure on his right foot. He had an operation which involved the amputation of the great toe and partial amputation of the fourth toe as well as over 60 sutures to reattach the plantar fat pad to the sole of his foot.

Subsequent to the initial surgery, there were concerns that half of the foot may require amputation. Following another round of surgery to undertake debridement of the foot and further amputation of the injured toes, a decision was made that the foot may have been viable and further surgery was avoided.

After his treatment, the worker suffered blood clots and severe pain from nerve damage requiring medical treatment. The injuries sustained during the incident will have a lifelong impact on the worker, including ongoing medical complications.

5. Investigation

The investigation examined the incident, actions leading up to the incident, causal factors and the actions of the mine operator and original equipment manufacturer (OEM).

The investigation activities included scene assessments, examination of the mines safety management system including policy and procedures, and interviews with relevant parties.

The investigation team:

- issued statutory notices to preserve the scene and assist the investigation
- issued 23 notices requiring information and documents
- undertook 14 formal interviews with mine workers.

6. Investigation findings

The investigation found there was a failure to follow the mine's policy and procedures in relation to the site introduction process for the new scraper conveyor and a failure to identify and control the risks associated with:

- installation of the tech mesh
- cleaning activities with the conveyor operating while safety controls were not in place
- undertaking the cleaning activities while the lighting in the drift was out of commission.

6.1. Chronology of events

The mine made the decision to replace the scraper conveyor during a shutdown period with an estimated commissioning timeframe of February 2019.

The sequence of events associated with the activity were:

June 2018

Removal of old scraper conveyor.

September 2018

Change in the leadership personnel of the team tasked with the scrapper conveyor replacement project.

February – April 2019

The new scraper conveyor was delivered, and the mine's coal clearance team commenced the installation.

Tech mesh was fitted to the top of the conveyor.

3 April 2019

The new scraper conveyor was electrically commissioned and connected to the electricity supply but left in an isolated position.

15 May 2019

Mine personnel started to intermittently run the scraper conveyor to clear coal fines from the area.

7 June 2019

The injured worker's first time working in the scraper conveyor drift.

Manually cleaning out coal fines, the scraper conveyor was not operated on this shift.

About 8:00 pm on 8 June 2019

The injured worker commenced his shift and was asked again to assist the drift attendant to continue the work in the scraper conveyor drift at the Appin North part of the mine.

About 10:00 pm on 8 June 2019

The injured worker, drift attendant and the coal clearance supervisor went into the scraper conveyor drift. The conveyor had been seated in the sump by workers on the previous shift.

The workers were tasked with cleaning the scraper conveyor drift. The drift attendant turned on the scraper conveyor to assist with removing the material from the drift.

About 11:00 pm on 8 June 2019

The injured worker took over the hosing duties and the incident occurred.

6.2. Management of the project

There was a change in personnel in the coal clearance team part way through the scraper conveyor replacement project. There was a minimal handover undertaken between the outgoing and incoming supervisors of the project.

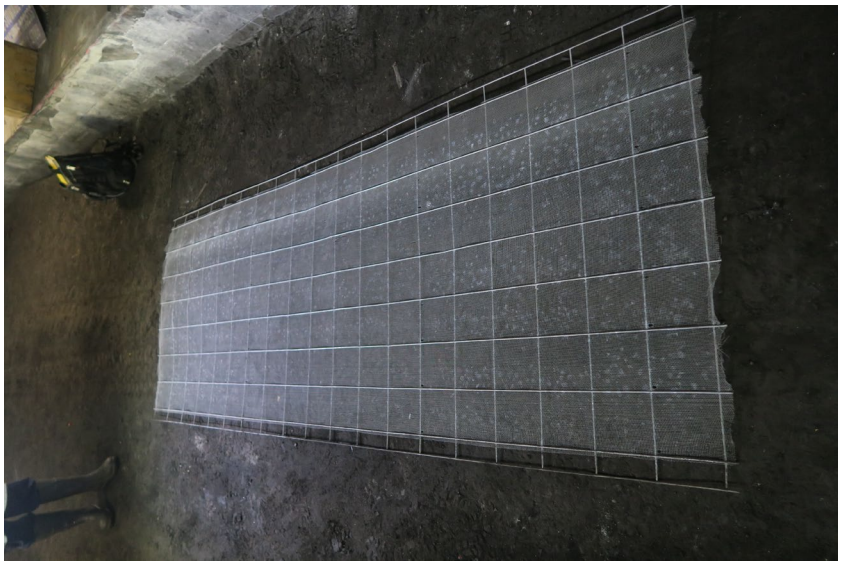
This, coupled with the fact that there was no project plan in place to guide the replacement of the scraper conveyor, meant that the new team operated on the understanding that:

- it was a like for like replacement
- it was a reasonably straight forward process
- it had to be completed to allow mining to recommence.

6.3. Installation of tech mesh

The tech mesh that was installed on top of the yellow steel grate is made of a fine wire mesh gauze attached to a larger square steel mesh. Tech mesh is normally used to form the base for shotcreting and is also known as shotcrete mesh. An example of tech mesh is shown in figure 12.

Figure 12. A sheet of tech mesh at the mine



A labour-hire worker was instructed by mine personnel from the coal clearance team to fit tech mesh to the top of the yellow steel guard as a safety control to prevent anyone putting their fingers through the holes and getting them entangled in the conveyor. This was a temporary measure while a new guard with smaller holes was being manufactured.

There was little planning and only a general instruction to fit the tech mesh to the top of the yellow steel guard using plastic cable ties, as shown in figure 13.

Figure 13. Tech mesh fitted to the top of the yellow guard on the scraper conveyor

There was a section in the scraper conveyor that measured 270 millimetres in width and 290 millimetres in length adjacent to the lift point (refer to figure 6 Survey plan – location 29) that was not covered by the yellow steel guard.

The worker partially covered the open section with the tech mesh, leaving a small gap closest to the lift point. The location of the gap can be seen in figures 9 and 10.

Due to the general instructions that the labour-hire worker received, it was left to him to make the decision to leave this gap, which he did as he understood workers shovelled material onto the scraper conveyor via this location.

The mine confirmed that there was no authorisation to fit the tech mesh, nor was there any documents to establish that there had been an assessment of hazards in relation to fitting the tech mesh.

The effect of the installation of the tech mesh and the fixed lighting not working contributed to the inability of workers to identify that there was an open void beneath the tech mesh.

6.4. Management of risk

The mine has an established and implemented safety management system (SMS). The SMS has a principal control plan to manage the risks to health and safety associated with the mechanical aspects of plant.

In accordance with the mine's SMS, the process to be followed to ensure the new scraper conveyor posed no risk to any person prior to its operation was:

- site introduction of the conveyor
- change management process completed for any changes to the original design
- mechanical and electrical commissioning.

Apart from the electrical commissioning, the mine had not undertaken any of the above processes prior to the incident.

6.4.1. Operational risk assessment

The mine relied on an existing risk assessment document identified as the 'Qualitive Risk Assessment for Operation and Maintenance Drift Conveyor'.

One of the risks the document identified was that of a person falling onto a moving conveyor which could result in a single fatality or permanent impairment.

Hazards identified related to the risk included insufficient guarding, slip and trips and housekeeping.

The preventative controls identified included isolation standard, emergency lanyard, competent, trained and authorised personnel, lighting and guarding.

An examination of the circumstances of the incident as they related to the document revealed that the risk event eventuated, contributing factors included removal of safety rail (guard), impaired lighting and housekeeping.

Safety controls that were compromised at the time included the missing safety rail (figure 14), the missing emergency lanyard (figure 15), the drift being non-compliant with the standard AS/NZ4024 (Safety of Machinery) (figure 16), a lack of mechanical commissioning and non-operational lighting in the drift.

Figure 14. Missing safety rail

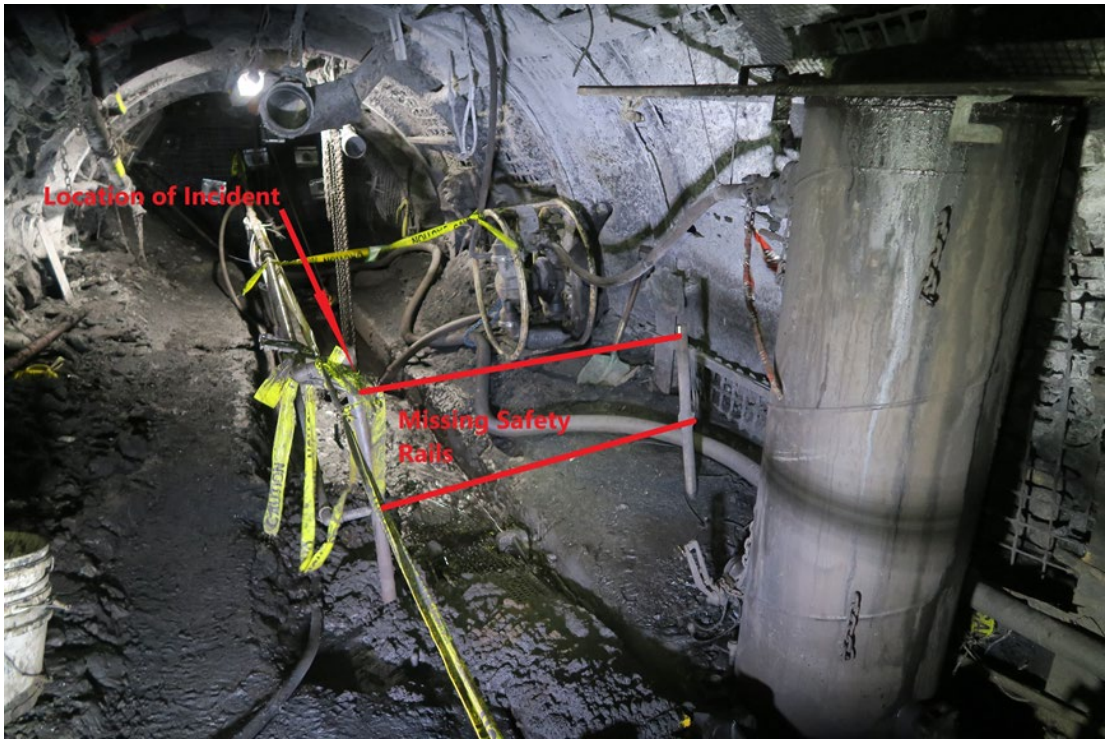


Figure 15. Emergency lanyard control box with missing lanyard

Figure 16. The compromised safety rail height and warning sign partially covered

The mechanical engineering manager was not aware of the existing risk assessment document and stated that if the introduction to site procedure had been undertaken it would have identified the document for consideration as part of the installation process.

The shift maintenance supervisor was also not aware that the risk assessment document existed and stated he would have most likely gone through the document with the workers.

6.4.2. Assessment of risk for the task

There was no risk assessment undertaken specifically related to running the scraper conveyer without the safety rail or emergency lanyard in place.

The only assessment of risk associated with what the workers were tasked to do was the lowest level of assessment, namely a personal risk assessment called a 'take two', which the drift attendant normally completed before cleaning the conveyor drift. On this occasion, even though the conveyor was in an abnormal state. The assessment was left for the drift attendant to complete.

Although the deputy had checked with the drift attendant to ensure he had completed a 'take two' risk assessment, he did not review the assessment.

The maintenance supervisor thought that the conveyor had undergone the mechanical commissioning process and an operational risk assessment, as he was not familiar with the scraper conveyor he relied on the Deputy doing their inspections to identify any safety issues.

The project manager was aware of the build-up of material near the top level of the safety rails, potentially making them ineffective. He anticipated that the issue would have been addressed in a task analysis but could not recall seeing any documents related to any assessment.

6.4.3. Appin change management procedure

The purpose of the procedure is to help people ensure risks associated with change are implemented in a systematic and controlled manner. The procedure is essential to ensure:

- correct risk controls are in place to safely manage change
- understanding how the future state differs with the current state
- engineering/technical reviews are completed prior to implementing a modification or change
- notification of change is communicated to relevant personnel, groups and legislative bodies
- the change is coordinated, tracked, reviewed and completed
- material risk controls are current.

The project manager had formed the belief that the replacement was a like-for-like replacement and the change management procedure did not apply.

The project manager was aware of the change management procedure but had not been trained in the use of the procedure and was unaware that the tech mesh had been installed on the conveyor.

His view was that the people working on the conveyor had the authority to put the tech mesh on if they assessed it as a minor change.

There were no documents in relation to any change management process being undertaken in relation to the new scraper conveyor nor the installation of the tech mesh.

6.4.4. Equipment safeguarding

The mine had in place a standard of engineering practice for equipment safeguarding that related to managing the hazards of fix plant at the mine. The purpose of the document was to provide minimum requirements for developing suitable equipment safeguarding systems for all site plant and equipment. The document detailed that any equipment not in accordance with the standard AS/NZ4024.1-2006 Safety of Machinery must:

- be subject to a risk assessment and the safety controls approved by senior management at the mine
- have new equipment to site managed by the ‘Introduction to site procedures’

- have replacement equipment, other than on a like for like basis, managed by the 'Change management procedure'
- have a site procedure for power on maintenance where temporary removal of guards is necessary on operating plant for commissioning prior to removal of the guards.

At the time of the incident, the scraper conveyor did not meet the standard AS/NZ4024.1-2006 Safety of Machinery, there was no risk assessment approved by senior management, no introduction to site undertaken nor any compliance to the power on maintenance procedure.

6.4.5. Drift belt scraper conveyor installation

The mine had developed a procedure on 7 March 2019 to ensure the safe installation of the scraper conveyer.

The procedure referenced the job instruction for cleaning drift and the isolation steps.

The procedure detailed that workers were to re-install guards on conveyor, upon job completion re-install sump handrails, pack up all equipment and remove from the area and ensure area is free from rubbish and debris when all work is complete.

There was confusion among the workers and supervisors in relation to whether the activity on the night was part of the installation process, commissioning process or was a work task to clean out the scraper conveyor drift.

At the time of the incident, communication was not ideal, the guards had not been fully reinstalled, the sump handrails had not been fully re-installed, and the work area was not free and clear of obstructions.

6.4.6. Commissioning of the scraper conveyor

The purpose of commissioning new plant such as the scraper conveyor was to ensure that it was safe to operate and operated as designed.

The mine considered that the new conveyor had undergone electrical commissioning and mechanical commissioning, but the mechanical commissioning had not been documented.

The mechanical engineering manager's view was that the electrical commissioning was done but the mechanical commissioning had not been completed at the time of the incident.

He explained that as part of the mechanical commissioning, an assessment of guards, no go zones and safety devices would have been undertaken prior to the conveyor being ready for use.

The reason he gave for why the conveyor did not go through the mechanical commissioning stemmed from a failure to complete the site introduction process for the conveyor.

There was no formal feedback link to inform deputies of the status of new equipment underground. Deputies may have assumed that if new plant was underground, it had been through the appropriate site introduction and commissioning process.

The coal clearance mechanical coordinator was responsible to ensure the mechanical commissioning was undertaken. However, as the coal clearance mechanical coordinator was only intermittently at work, the mechanical commissioning process was not followed.

6.4.7. Job instruction for cleaning of drift

There was a written job instruction associated with cleaning the conveyor drift in place.

The document included instructions that, while the scraper conveyor was operating, workers were to look for person coming in contact with conveyor, put the guard rail in place and engage the emergency stop button.

The drift attendant had a copy of the job instruction and completed his normal take-two risk assessment. They only completed a higher-level task analysis if they were doing something they had never done before.

The maintenance supervisor on the shift had not seen the document before and was not aware that it existed. His expectation was that the procedure would have been identified when the introduction to site risk assessment was undertaken, which never occurred.

6.4.8. Conveyer isolation and safety standard

The mine's conveyor isolation and safety standard stated that:

- personnel conducting isolations on conveyers must ensure the correct isolations are applied in each case and seek clarification from their supervisor if unsure prior to work commencing or commencing work
- if access to a guarded area is required, full energy isolation and confirmation must be completed in accordance with Appin standards of engineering practice and the overarching isolation standard
- safe and unsafe zoned areas are determined by task specific locations on the conveyer.

The deputy on the shift when the incident occurred was informed that the work they were doing was part of the commissioning of the scraper conveyor. He understood that the mine's conveyer isolation procedure did not apply, as it was not a functioning conveyor.

He also believed that the conveyor was fully enclosed and the impact of the missing rail did not pose a hazard to the workers. He was of the view that he had been given permission to allow the scraper conveyor to be operated to facilitate the installation process.

6.4.9. Supervision arrangements

The document titled 'Supervision Arrangements' details how supervision is managed at the mine.

The purpose of the document is to provide the necessary supervision to protect all persons from risks to their health and safety arising from work.

Supervision is identified as a risk control to protect workers from risks arising from work carried out. Factors that may influence effective supervision included:

- changes to work activities not communicated
- application of risk controls - operating procedures not followed
- persons working alone or in remote locations
- deputy performing other duties
- deputy / supervisor competency.

The roles and associated responsibilities involved in the supervision of workers by deputies and other supervisors included monitoring compliance to risk controls and procedures.

6.4.9.1. Supervision by deputies

Deputies are assigned to inspection districts (areas in the mine) to conduct statutory inspections and supervise workers and monitor compliance with legislation and the safety management system.

The mine expects deputies to regularly attend the places where people under their supervision are working.

6.4.9.2. Supervision during the shift

The mine notified that there was a dual responsibility for supervision of the workers on the shift. The deputy on shift, as well as the maintenance supervisor, was responsible for the supervision of the engineering activity in the area.

The deputy had only worked at the Appin North site for about three months and had not been involved in the replacement of the scraper conveyor. He received a briefing from the undermanager about the what was happening during the shift on 8 June 2019, which included:

- due to illness, the mine was one deputy short on the shift and he had to cover for the missing deputy
- the workers were to carry on with getting the scraper conveyor operational
- they were in the process of commissioning the conveyor and getting it into the concrete sump
- they were going to run the scraper conveyor to try and get it to cut its way down into the sump
- the end of the conveyor was covered in waste material.

The deputy was told that the paperwork about the commissioning went to the tradesmen, however the tradesmen were not on shift. He did not receive any instruction or paperwork in relation to additional controls or specific procedures being required for the work that was to be undertaken during the shift.

The deputy spoke to the drift attendant prior to work commencing and was told they:

- had been unsuccessful at getting the conveyor to bed right down during the previous shift
- needed to clean out the bottom end of the conveyer as it was buried in waste material
- needed to run the scraper conveyer to help it cut down into the sump.

The deputy spoke to the engineer on shift and was told:

- it was okay to walk on the yellow steel guard
- the tech mesh was fitted to prevent fingers getting damaged
- the conveyor needed to be operated to clear the waste material.

When the deputy inspected the drift prior to the incident he:

- was not able to see that there was a void underneath the tech mesh and assumed the steel guard ran the full length under the tech mesh
- was not aware that the lighting in the drift was not operational and assumed when the drift was re-powered it would have been illuminated by the roof lighting
- considered the risk of running the scraper conveyor and formed the opinion that as the new conveyor had the guard in place it was safer than the old one.

Following his inspection, the deputy:

- instructed the drift attendant to do a take-two before he turned on the conveyor
- instructed the drift attendant to remove himself from the drift if he did not make it back for the second inspection
- spoke to the drift attendant and confirmed that he did not intend to work past the lift point (refer to figure 6 Survey Plan – location 29) on the conveyor
- thought he was the only supervisor for that task on shift that day.

The maintenance supervisor told investigators that he:

- had been in the role for about 12 months
- had no other involvement in the installation of the scraper conveyor, apart from being asked to organise and deliver the injured worker to help in the scraper conveyor drift
- thought supervision of the workers would fall back onto the deputy

- did not speak to the deputy about what work was to occur
- only gave the workers a general instruction to clean the area
- inspected the drift before the incident but cannot recall any discussion about turning the conveyor on
- did not assess any hazards while he was in the conveyor drift
- was of the understanding that it had gone through the introduction to site and commissioning processes
- was informed by the drift attendant that the safety rail and emergency lanyard had not been fitted
- recalls giving the workers a general direction not to do anything stupid or dangerous.

6.4.9.3. Training

There was no authorisation process in place at the mine for operating the scraper conveyor.

The injured worker had not received any training in relation to working on the scraper conveyor and the mine relied on the drift attendant directing the worker.

The worker had undertaken other training including:

- West Cliff Underground Induction
- Generic competency isolation rules
- Risk and change management
- Conveyor Operations (Appin)
- Conveyor safety awareness (Competency for Appin)
- Safety Management System Overview.

The drift attendant had received on the job training many years ago in relation to operating the scraper conveyor as well as instructing others in a familiarisation process for the Appin North conveyor system.

The training the drift attendant had completed at the mine including:

- Conveyor System Inspection
- Isolation Rules
- Conveyor Operations

- Conveyor Safety Awareness
- Appin North Drift Winder Familiarisation
- Risk and Change Management
- Safety Management System Overview
- Apply Risk Management Processes
- Risk Management Course Risk and Change Management.

7. Standards

This section refers to the mine's Standard of engineering practice (refer 6.4.4) and its stated use of Australian Standard AS/NZ4024.1-2006 Safety of Machinery series as the requirement for fixed plant and conveyor safeguarding.

It should be noted that there are legislative requirements related to plant at a workplace, including specific provisions for guarding used as a control measure.[3]

7.1. AS/NZS 4024.1:2014 – Safety of machinery

At the time of the incident, the standard series identified in the Standard of engineering practice had been superseded by AS/NZS 4024.1:2014 – Safety of machinery – series.

There are various parts within the standard that deal with conveyors, including:

- AS/NZS 4024.1201:2014- General Principles for design - Risk assessment and risk reduction
- AS/NZS 4024.3610:2015 Conveyors – General Requirements
- AS/NZS 4024.3612:2015 Conveyors – Chain conveyors and unit handling conveyers
- AS/NZS 4024.1100:2014 Application guide
- AS/NZS 4024.1703:2014 Human body measurements—Principles for determining the dimensions required for access openings.

[3] Work Health and Safety Regulation 2017, Chapter 5 Plant and structures; Work Health and Safety (Mines and Petroleum Sites) Regulation 2014, Schedule 2 Principal control plans—matters to be addressed.

The objective of the standard is to enable those who design, manufacture, supply, control, use and maintain machinery, to minimise the risks to the health and safety of people working with or near machinery.

The standards identified that the most serious and fatal incidents occur on conveyers during cleaning, maintenance or unsafe access.

The information in the standards included, but were not limited to, documenting that persons responsible for conveyors should:

- risk assess to consider hazards in assembly, installation and commissioning
- risk assess to consider if hazards are generated by complimentary protective measures
- ensure guards do not give rise to additional hazards[4]
- understand that drawing in, trapping and entanglement are hazards associated with conveyors[5]
- consider making the emergency stop system being accessible to any person that may be at risk of being on the conveyor.[6]

The standards recommend that:

- procedures should include commissioning to determine that the conveyor is safe for operation
- a commissioning plan be developed to verify installation against design requirements and should consider verification that guards comply with the standard
- commissioning criteria should include that emergency stops are functional and labels, as well as guards, are in place
- access to or work in a danger zone shall not be permitted while the conveyor is running[7]
- periodic inspections and test should include that guards are in place, pull wires (lanyard) are functional and warning signs are readable.

The standard further documents that safeguards should:

[4] Ibid [40-41].
[5] Standards Australia, AS/NZS 4024.3610:2014 *Safety of machinery Conveyors - General requirements*, [13].
[6] Ibid [31].
[7] Ibid [59-60].

- be designed to prevent other body parts from becoming caught or entangled
- have guard rails, fences or close-fitting guards installed where a person has access to loading points
- be designed to consider people climbing on or around the guard
- consider as minimum a force of 450 N is to be applied to the surface at any point and the deflection added to the safety distance[8]
- where removable guards are not interlocked and are removed for maintenance or cleaning they shall be replaced and the pull wire reinstated before energy is restored to the drive motor.[9]

7.1.1. Chain conveyors and unit handling conveyers

Chain conveyors have additional requirements documented in AS/NZS 4024.3612 which identifies typical hazards. These include:

- shearing and crushing hazards
- entanglement hazards
- draw in hazards.[10]

The standard stated, among other information, that the flights and chain which create a risk to health and safety shall be safeguarded or fully enclosed and if this is not practical, other risk controls are to be implemented.[11]

7.2. External audit of scraper conveyor

After the incident, the mine completed works in the conveyor drift and engaged a consultant to conduct an audit on the guarding installed in the scraper conveyor drift.

The consultant, among other issues, recommended that:

- the walkway be kept free of debris so as not to affect the freeboard of the guards
- nuts, that could not work loose or to be removed without use of a tool, be installed on guards

[8] n6, [57-58].
[9] n6 [62-63].
[10] Standards Australia, AS/NZS4024.3612:2015 *Safety of machinery Conveyors - Chain conveyors and unit handling conveyors* [9].
[11] Ibid 3.3.5.3 [16].

- an emergency stop lanyard system be installed and commissioned
- the mine consider adopting a pre-start requirement for the scraper conveyor
- isolation procedures for a range of maintenance activities be established
- an isolation sign / board be established in the area of the chain conveyor.

7.3. Mine investigation findings

The mine undertook an Incident Cause Analysis Method (ICAM) investigation into the incident and found a number of contributing factors that were present in the lead up to the incident including:

- urgency to get the task done to meet operational requirements (clearing fines from the drift)
- install team did not reinstall safety rail as required by work instructions
- the mine's system to verify that the handrail was installed was ineffective
- no mechanical commissioning was completed to verify controls were in place and effective
- supervision arrangements did not identify that the safety rail was not in place
- the work site was congested, including a pump obscuring the location of the missing safety rail
- organisational acceptance of not having the conveyor isolated while operating with:
    - guards up (long-term), and
    - without the safety rail in place (short term).
- job instruction not followed (the safety rail being in place whilst operating the scraper conveyor)
- perception they could complete the job safely without isolation based on a take-two assessment
- the system in place to verify that the warning sign was in place, was ineffective.
- training / familiarisation requirements documented in Appin North Drift Winder training document are not clear, and obtaining the requirements is difficult
- multiple levels of risk and change management were not completed in accordance with SMS
- the hazard of covering the scraper conveyor inlet hole with tech mesh was not identified
- change management process was not completed when the tech mesh was installed.

7.4. Mine post-incident actions

The mine undertook works post-incident in the scraper conveyor drift which included:

- replacing the guard covering the top of the conveyor with a guard that had smaller openings to prevent finger intrusion
- bolting guards down to prevent opening of covers
- installation of new fencing adjacent to the conveyor
- installation of new fencing perpendicular to the conveyor
- re-installation of the emergency stop lanyard
- installation of two warning signs
- the repositioning of the pump
- cleaning the walkway down to the concrete floor
- installation of new fencing around the tail end (delivery end) of conveyor
- installation of the underground intercom communication system (DAC) in the conveyor drift
- re-establishing the roof lighting in the conveyor drift
- extending the discharge point to prevent a build-up of material on the walkway.

The mine also improved administrative controls by:

- making procedures available in the scraper conveyor drift
- making the isolation requirements clearer in the procedure
- making the procedure for the scraper conveyor align with requirements for all conveyors on site
- updating training for working with conveyors to include the scraper conveyor.

8. Recommendations

This incident highlights the hazards associated with the operation of plant underground and the need to ensure all plant is subject to operational risk assessment when:

- new equipment is introduced to the site
- changes to the plant are to be undertaken
- plant needs to be operated while controls such as safety rails are not in place.

Mine operators should:

- ensure permanent fixed guarding or other barriers are in place on conveyors to prevent access to and contact with moving parts
- confirm that all control measures are in place and effective to ensure the health and safety of any person conducting inspections, cleaning or maintenance on fixed plant
- ensure all procedures are followed to eliminated or minimised, to as low as reasonably practical, all hazards posed by equipment introduced to the site
- consider developing project plans prior to undertaking major installations of new equipment to allow a staged approach to be approved, followed and monitored for compliance
- ensure an appropriate level of risk assessment is conducted involving appropriately skilled staff members prior to operating equipment that is in an abnormal state (repair or installation)
- when installing new equipment, ensure that any out of scope work has an appropriate risk assessment undertaken prior to approving the out of scope work
- ensure all safe work procedures/work instructions related to the installation of equipment are provided to all supervisors and workers involved in the installation process
- develop procedures to control potential hazards if work on the installation process is to occur when key advisory staff, such as engineers or trade persons are not on shift (i.e. weekend night shift)
- ensure supervisory staff understand their roles and responsibilities when there are dual supervisory responsibilities for tasks
- consider and where reasonably practicable apply Australian standard AS/NZS 4024.1-Safety of machinery series in regard to guarding on fixed plant.