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NSW Resources Regulator

INVESTIGATION REPORT

REPORT INTO THE DEATH OF BRIAN BRYANT

Grawin Opal Fields, 14 October 2020

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Executive summary

Incident overview

On 14 October 2020, Mr Brian Bryant sustained fatal injuries when working at an opal mine within the Grawin Opal Fields, near Lightning Ridge, NSW. Mr Bryant travelled to the Grawin Opal Fields in the days prior with friends for the purpose of mining opal in an underground mine located within mineral claim 51724 (MC 51724) and mineral claim 28809 (MC 28809).

A powered material hoist, also known as a 'long throw', was installed within the main shaft in MC 51724. The hoist was used to transport opal dirt to the surface from the underground workings. The hoist system consisted of steel guide rails, an electric motor, a hydraulic retarder, a hoist rope winder drum, steel wire rope and a steel bucket. The hoist shaft was at a depth of approximately seven metres. An access ladder was also installed in the shaft. On the surface, the shaft opening was surrounded by a perimeter fence with an improvised cover (vehicle bonnet) placed over the opening.

At about 1:45 pm, Mr Bryant was working underground in the opal mine with another worker when he identified that the hoist bucket had failed to return down the main shaft. He informed the worker that he would go to the surface and check on the hoist. Mr Bryant exited the mine using the emergency exit shaft. Once on the surface, Mr Bryant turned off the generator used to supply power to the hoist. About 10 minutes later the worker, who had remained underground, heard a noise in the main shaft. He made his way to the shaft where he found Mr Bryant lying in the sump at the base of the shaft adjacent to the hoist bucket. The worker checked Mr Bryant, who was unresponsive. Mr Bryant was wearing a hard hat and safety boots, however, was not wearing a safety harness or using any type of fall arrest system. The worker removed Mr Bryant from the sump, checked for signs of life and formed the view that he was deceased. The worker made his way to the surface and alerted other workers at the mine of the incident. Emergency services were contacted while one of the other workers entered the mine and commenced CPR on Mr Bryant.

Investigation findings

The investigation determined that the risk to health and safety to which Mr Bryant was exposed was death or serious injury caused by a fall from height. The investigation was unable to determine whether Mr Bryant:

- fell from the surface when positioned immediately adjacent to the hoist shaft while the shaft cover was removed;
- fell while he was climbing on one of the structures within the shaft, being the hoist frame or

the access ladder; or

- was struck by the hoist bucket while on the surface and adjacent to the shaft opening, or within the shaft itself, causing him to fall down the shaft and into the sump.

The investigation found the following factors contributed to the incident:

- The risks associated with working at heights had not been adequately assessed and an appropriate working at heights system was not installed at the mine – no fall protection device or fall arrest system was in use by Mr Bryant or other workers at the mine nor was such a device or system available on the date of the incident; and
- The risks associated with working around falling objects and beneath suspended loads had not been adequately assessed and control measures implemented at the mine.

Recommendations

Mine operators have a duty to identify workplace hazards (such as falls from height, working around falling objects and working beneath suspended loads), assess risks arising from identified hazards and, so far as is reasonably practicable, eliminate or control risks to health and safety in accordance with the *Work Health and Safety Act 2011* and Work Health and Safety Regulation 2017.

It is recommended that duty holders:

- ensure a **mine safety management system or plan** appropriately addresses risks to health and safety associated with working at heights, working beneath suspended loads and falling objects
- provide adequate protection against the risk of a **fall from height** by providing and maintaining a safe system of work that includes the following:
  - a **fall prevention device**, such as a secure fence, edge protection and covers, so far as is reasonably practicable; or
  - (if it is not reasonably practicable to provide a fall prevention device) **a fall arrest system**, such as a safety harness, so far as is reasonably practicable; and
  - **training** in relation to the risks, **safe work procedures** and **safe use of ladders**.
- provide adequate protection against risks associated with **falling objects or work beneath suspended loads**, including buckets, by providing and maintaining systems of work that:
  - **prevent** an object from falling freely so far as is reasonably practicable; or

- (if it is not reasonably practicable to prevent an object from falling freely) **arrests** the fall of a falling object, such as a secure barrier and / or a safe means of raising and lowering objects, so far as is reasonably practicable; and
- define **exclusion zones** that workers are prohibited from entering having regard to falling objects and work beneath suspended loads.

- ensure all **plant and equipment is maintained** by appropriately qualified personnel and **regularly inspected**.

Contents

Executive summary....3
Incident overview....3
Investigation findings....3
Recommendations....4
1. Purpose of the report....8
2. Investigation overview....8
2.1. Major Safety Investigations....8
2.2. Legislative authority to investigate....8
2.3. Regulator response....8
3. Involved parties....8
3.1. The mine....8
3.2. Mine operator and mineral claim holder....9
3.3. The deceased....9
4. Opal mining at Lightning Ridge and surrounding fields....9
5. The incident....11
5.1. Incident location....11
5.2. The main shaft....12
5.3. The hoist....14
5.4. Hoist operation....16
5.5. The incident....18
5.5.1. Incident chronology....18
5.5.2. Cause of death....20
6. The investigation....21
6.1. Investigation activities....21
6.1.1. The incident scene....21
6.1.2. The main shaft....21
6.1.3. The hoist components....22

6.2. Hoist functionality testing 24
6.3. Previous issues with hoist operation 25
6.4. Safety management system 25
7. Investigation findings 26
7.1. Risk to health and safety 26
7.2. Identification and assessment of the risk 27
7.3. Foreseeability of the risk and incident 27
7.4. Reasonably practicable measures 28
8. Recommendations 29

1. Purpose of the report

This report describes the mining workplace incident investigation (the investigation) conducted by the NSW Resources Regulator into the cause and circumstances of the death of Mr Brian Bryant at Mineral Claim 51724 (MC 51724) within the Grawin Opal Fields, near Lightning Ridge, on 14 October 2020.

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 reports its findings to enhance industry safety and to give effect to its *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* (WHSMPS Act) and are deemed to be inspectors for the purposes of the *Work Health and Safety Act 2011* (WHS Act). The Regulator has delegated some additional functions to investigators including exercising the power to obtain information and documents for the purpose of monitoring compliance with the WHS Act.

2.3. Regulator response

The incident was reported to the Regulator on 14 October 2020 and inspectors were immediately deployed to the site. Investigators attended the following day and commenced an investigation.

On 29 October 2020, the Regulator published an Investigation Information Release (IIR20-12) to provide information concerning the incident and recommendations to the mining industry.

3. Involved parties

3.1. The mine

The mine is an underground opal mine located within the Grawin Opal Fields, near Lightning Ridge. The mine is operated under MC 51724 and MC 28809 in the Richard's Hill area of the opal fields.

The mine is about seven metres underground and is accessed by a main hoisting shaft. The mine has a

secondary means of egress in the form of an emergency exit shaft. Both shafts are fitted with a ladder.

'Mullock' or 'opal dirt' is transported from the underground workings of the mine to the surface using a material hoist and bucket powered by a generator located on the surface of the mine. The bucket travels along a guide rail located in the main shaft to the surface where it dumps the overburden before returning back down the main shaft.

Neither shaft was fitted with a fall arrest system. The mine had no fall prevention devices installed other than a make-shift cover which was placed over the opening of the main shaft.

3.2. Mine operator and mineral claim holder

Mr Bryant was the mineral claim holder and nominated operator for MC 51724 and MC 28809. On 26 August 2004, an ordinary mineral claim to mine opal on MC 51724 was granted to Mr Bryant. He was the only holder of this claim. On 15 July 2008, an ordinary mineral claim to mine opal on MC 28809 was granted and transferred into Mr Bryant's name, making him the third claim holder for this site. Mr Bryant continued to renew both claims with the Regulator up until the date of his death.

3.3. The deceased

Mr Bryant resided at Llanarth, near Bathurst NSW, and took up opal mining as a hobby in his later years. He completed a Mine Safety Awareness Course on 24 August 2004 and a Mine Operator Workshop on 26 August 2004.

The *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* (WHSMPS Regulation) was amended on 13 April 2018 to include clause 7B that mandates a requirement that operators of an opal mine undertake additional safety training specified by the regulator before 13 April 2023 and every five years thereafter. Mr Bryant had not completed the additional safety training prior to the incident but, in accordance with clause 7B, he had until 13 April 2023 to do so.

Mr Bryant was 70-years old at the time of his death.

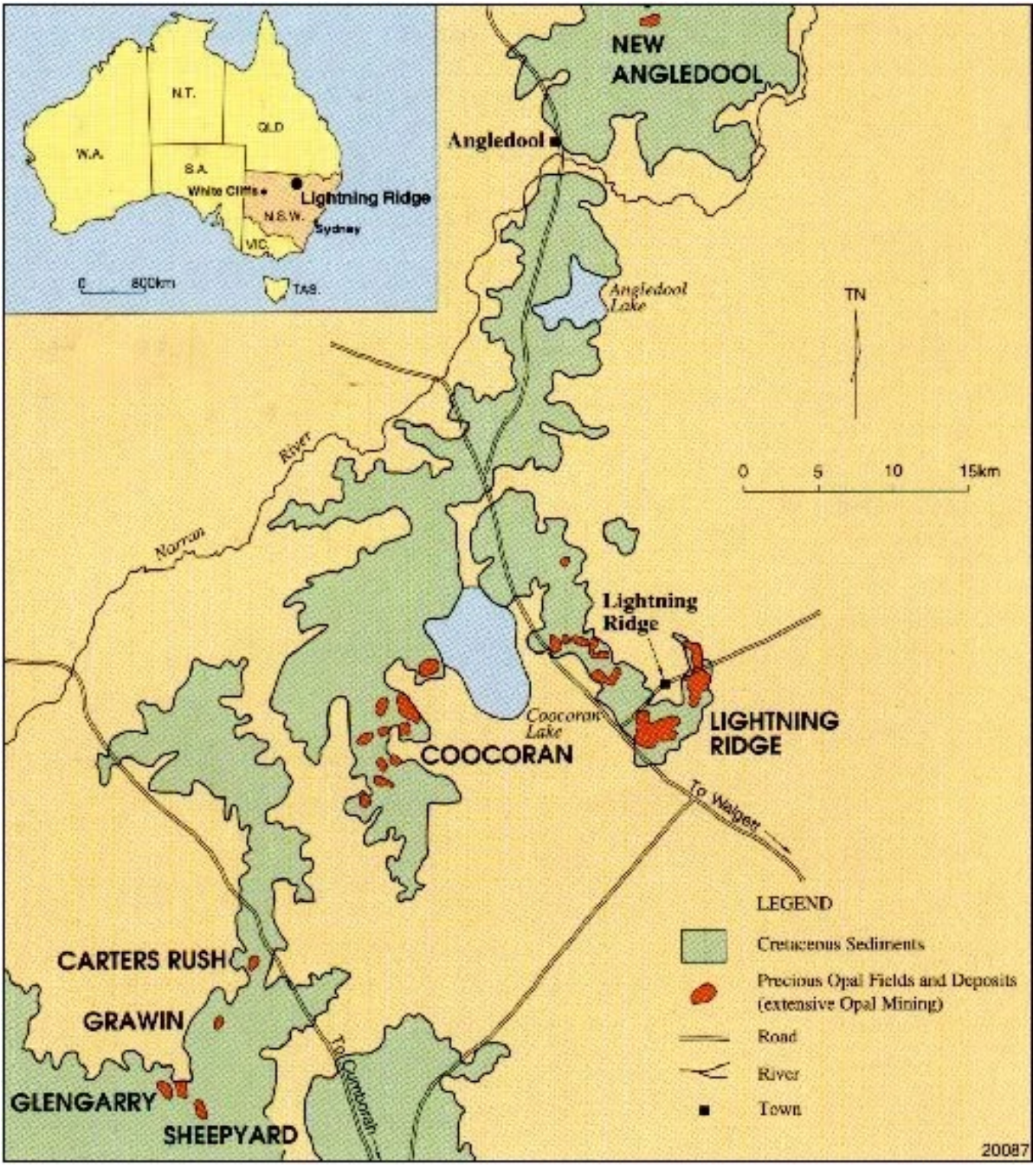
4. Opal mining at Lightning Ridge and surrounding fields

Opal was first discovered in the Lightning Ridge area by European settlers in the 1880s. The black opal mined at Lightning Ridge is a unique and highly valued gemstone generally found six to eighteen metres below ground level.

Opal mining generally occurs along defined low ridgelines (so called 'ridge country') where the opal bearing material is closer to the surface. There are more than 200 distinct opal fields that occur on the

ridge country within NSW. The main opal field groups located at Lightning Ridge are Coocoran, Grawin, Carters Rush, Glengarry, Sheepyard, Wyoming, Jag Hill and Mehi (Figure 1).

Figure 1: Location of Grawin Opal Fields, NSW

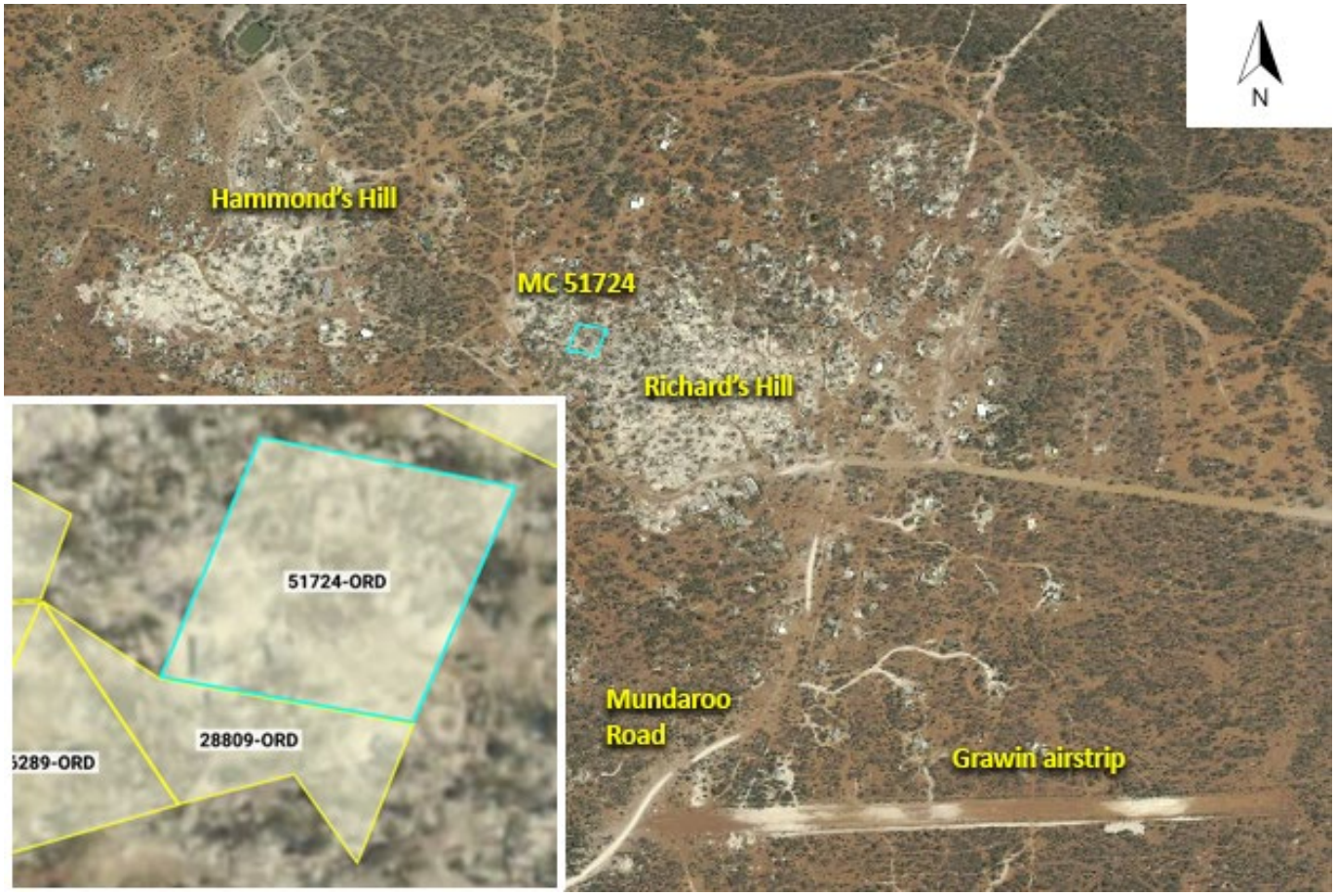


5. The incident

5.1. Incident location

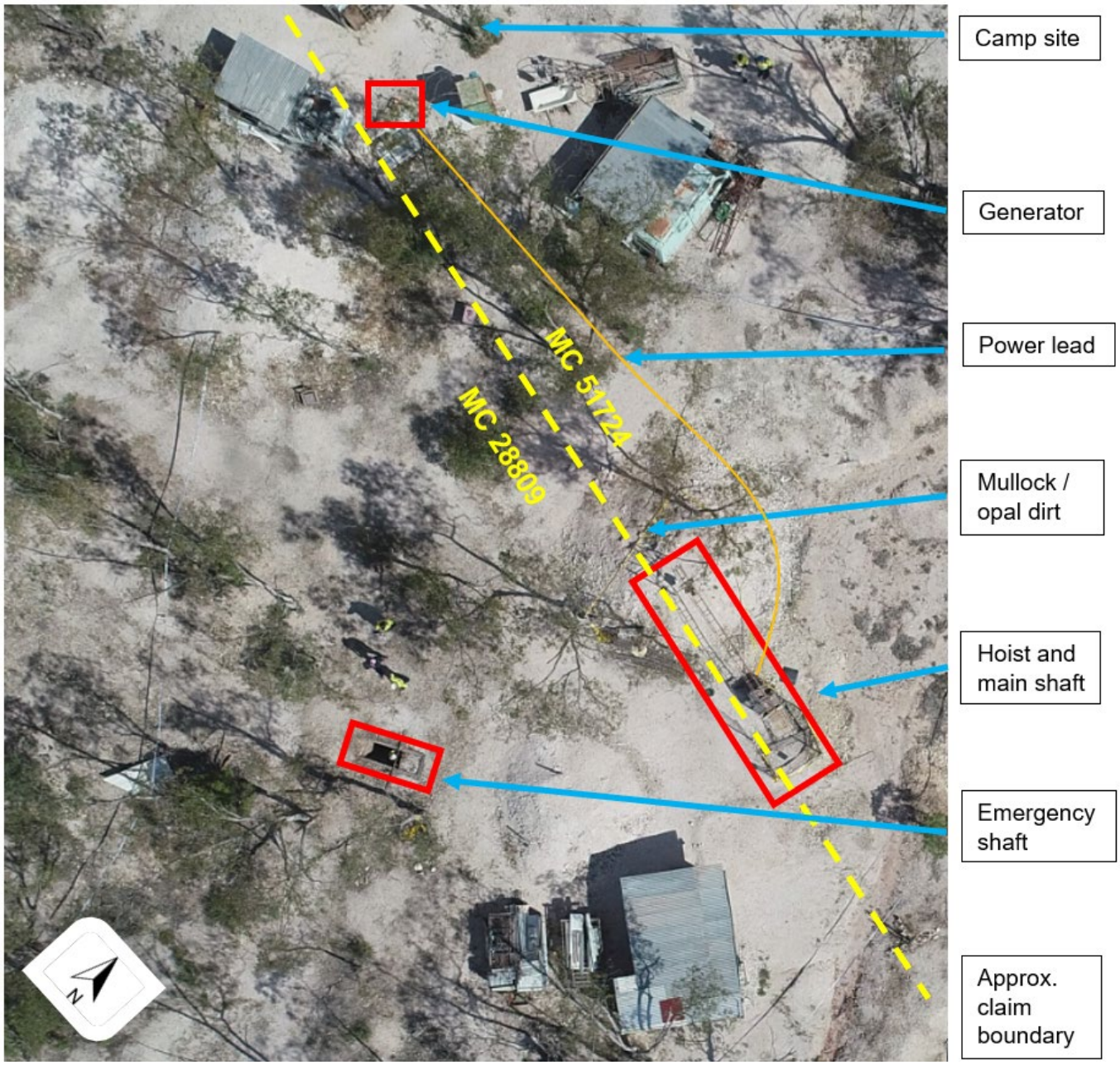
MC 51724 and MC 28809 are located within the Richard's Hill area of the Grawin Opal Fields (Figure 2).

Figure 2: Map showing location of MC 51724 (and MC 28809 below) at Richard's Hill, Grawin



The main shaft containing the powered material hoist (the hoist), also commonly referred to as a 'long throw', is located in MC 51724 adjacent to the claim boundary line. Other notable features on the surface of this claim include the main camp site, the generator within the main camp site and the electrical lead supplying power from the generator to the hoist motor. The emergency shaft, which connects to the main shaft via the underground workings of the mine, is situated within MC 28809 (Figure 3).

Figure 3: Aerial photograph of MC 51724 and MC 28809 in the Grawin opal fields



5.2. The main shaft

The main shaft, within which the hoist was located, was approximately seven metres from the sump to the surface and was fitted with an access ladder. The shaft opening was enclosed by a perimeter fence and was provided with an improvised cover (a vehicle bonnet) (Figures 4, 5 and 6).

Figure 4: Hoist machinery cage and perimeter fencing around the hoist shaft

Figure 5: The entrance *to the hoist shaft*

Figure 6: The steel bucket inside the hoist shaft

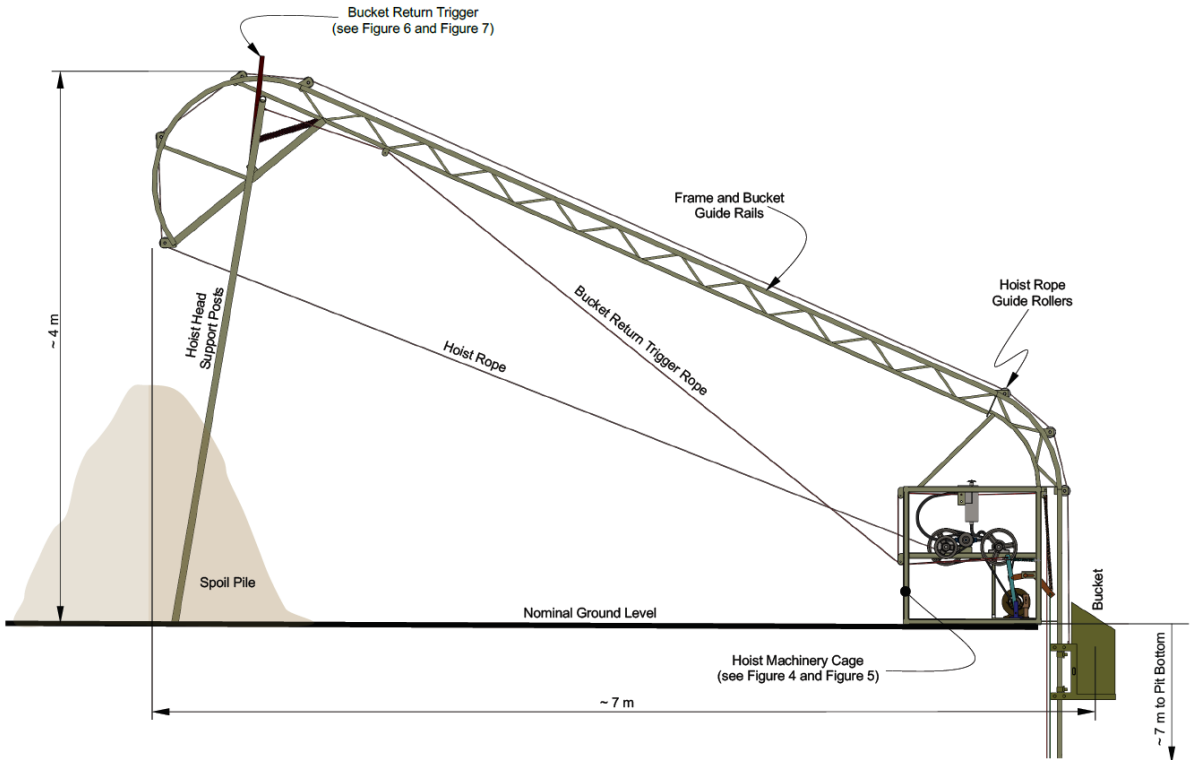
5.3. The hoist

The hoist was located within the main shaft on MC 51724 and used to raise opal dirt to the surface. The hoist system consisted of a steel frame and bucket guide rails, an electric motor, a hydraulic retarder, a hoist rope winder drum, steel wire rope and a steel bucket (Figures 7 and 8). The investigation found that the hoist had been assembled using recycled components including a 30+ year-old electric motor and an agricultural spraying equipment pump.

The hoist was purchased second hand by Mr Bryant over 10 years prior to the incident from an elderly man known only as 'Gilgandra John' who died long before 14 October 2020. The investigation established that Mr Bryant was the sole operator of the hoist.

Figure 7: Hoist and opal dirt pile

Figure 8: Hoist frame and machinery arrangement



5.4. Hoist operation

During normal operation, opal dirt was transported to the surface using the steel material bucket which was activated by pulling a wire cable that extended down the hoist shaft and connected to an engagement lever. Once activated by the engagement lever, the electric motor would engage with the hoist rope drum through the belt and pulley system within the hoist machinery cage to raise the bucket to the crest of the frame (Figures 9 and 10).

Lugs protruding from each side of the bucket would come into contact with a bucket return trigger lever when the bucket neared the crest of the frame above the dumping point. Once dumping was complete, the hoist rope drum would disengage from the electric motor allowing the bucket to descend along the guide rails under its own weight (Figure 11).

The steel bucket had no brake and, accordingly, there was no means to bring the bucket to rest or hold it stationary (except at the end of its travel at the base of the sump). Instead, the hoist was fitted with a retarder system to limit the bucket descent speed.

Figure 9: General view of hoist machinery cage

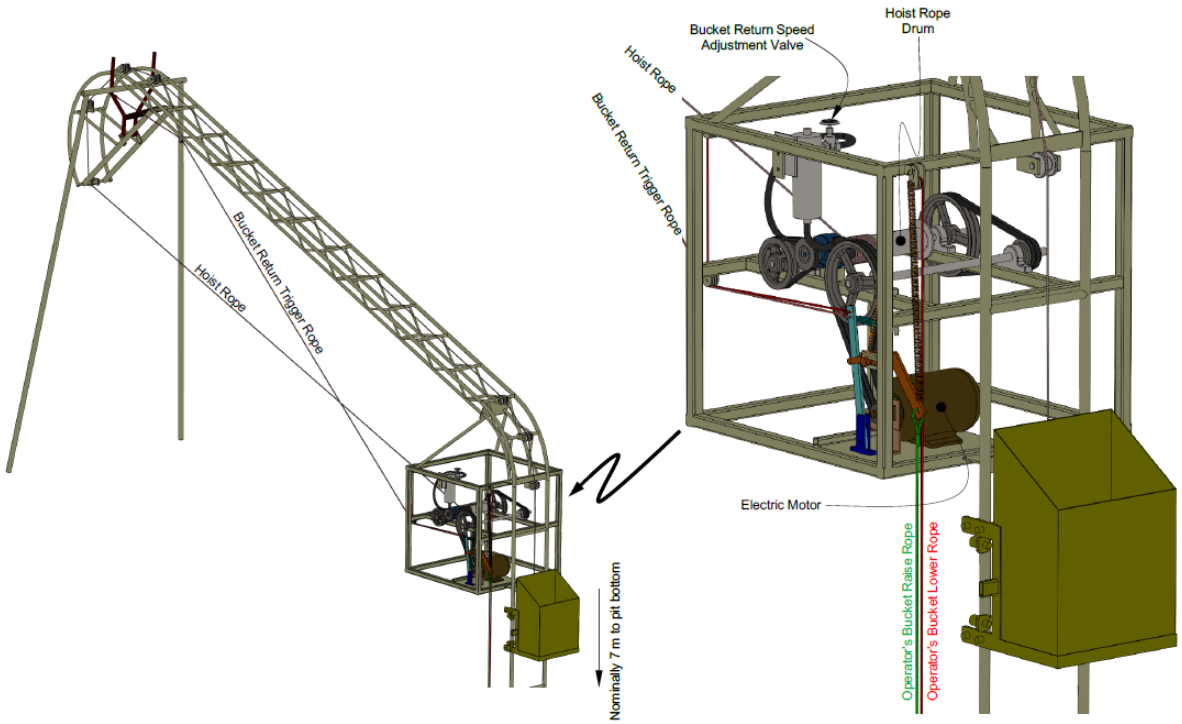


Figure 10: Hoist machinery operation

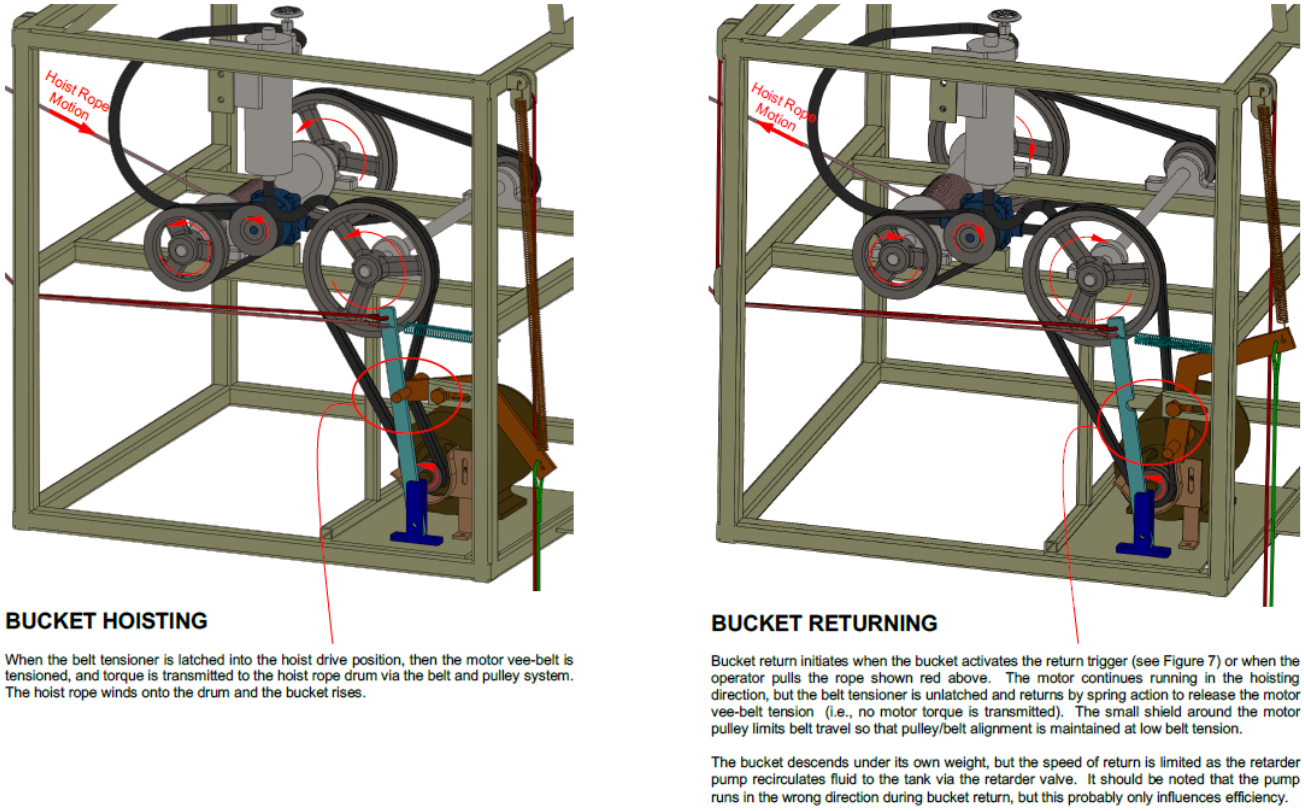
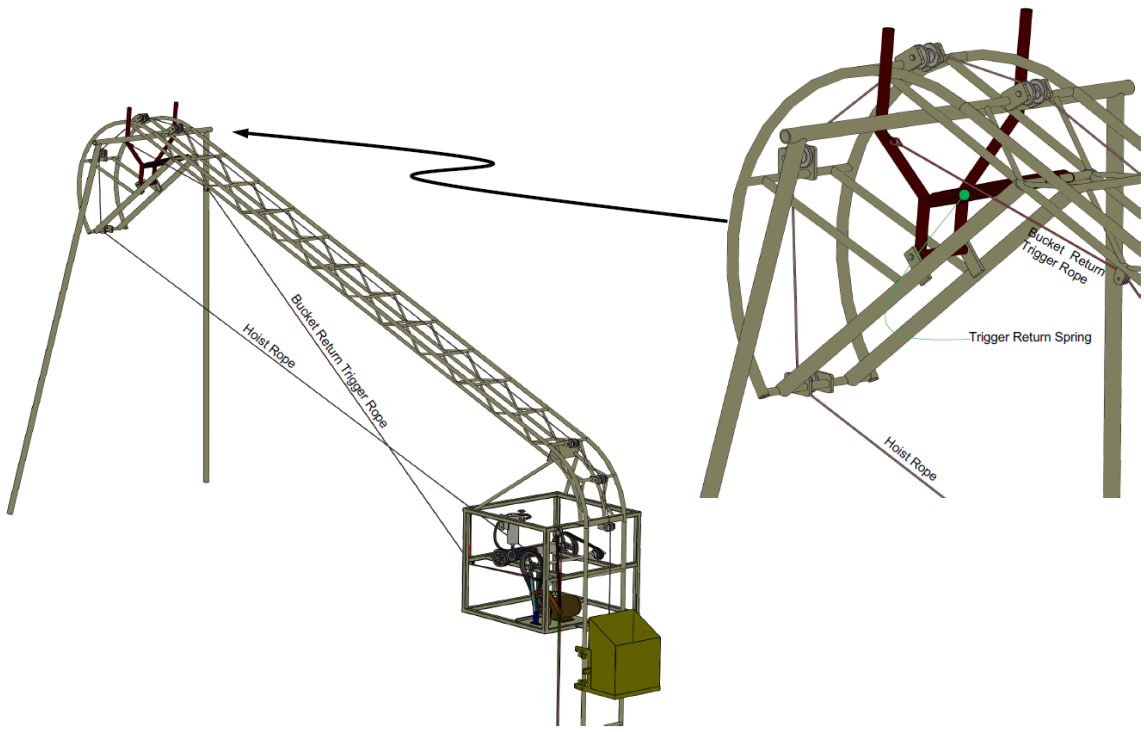


Figure 11: Bucket return trigger on hoist frame



5.5. The incident

5.5.1. Incident chronology

SATURDAY 10 OCTOBER 2020	
Mr Bryant and workers 2, 3 and 4 arrived at the Grawin Opal Fields.	

TUESDAY 13 OCTOBER 2020	
Mr Bryant conducted a test run of the hoist where it operated as expected. He activated the hoist motor and the bucket, which was resting on top of the closed shaft cover, raised the bucket to the crest of the frame, after which it descended as usual. While the bucket was descending the hoist frame, Mr Bryant opened the shaft cover allowing the bucket to travel to the base of the shaft. After this, he and worker 2 commenced mining for opal in the underground workings of MC 51724 and MC 28809.	

WEDNESDAY 14 OCTOBER 2020	
12:00 to 12:30	Mr Bryant and worker 2 entered the underground workings of MC 51724 and MC 28809 to commence mining for opal. Workers 3 and 4 remained above ground where they sorted through opal dirt transported to the surface by the hoist.
About 13:45	Mr Bryant told worker 2, while they were both underground, that the bucket had failed to return down the main shaft. Mr Bryant said he would go to the surface to find out what was going on and exited via the emergency exit shaft. Soon after reaching the surface Mr Bryant advised worker 2 that there was an issue with the reel and the wire and that he was going to turn off the generator. The generator provided power to the hoist and the portable lights inside the mine. After this conversation, the lights in the mine turned off, indicating to worker 2 that the generator providing power had been turned off. Workers 3 and 4 did not observe Mr Bryant's activities while on the surface.

WEDNESDAY 14 OCTOBER 2020	
About 13:50 to 14:00	Worker 2 continued to use a hand tool to mine for opal, using his head-lamp for light, during which time he found 'some colour'. He approached the main shaft and informed Mr Bryant, who was still on the surface, of his find. Mr Bryant verbally acknowledged the information provided by worker 2. Worker 2 could not recall seeing the bucket in the main shaft at this time. Around 5 to 10 minutes later worker 2 returned to his position, which was not within direct line-of-sight of the sump, when he heard a loud noise coming from the main shaft. He stated that it sounded as if the bucket was coming down the ladder faster than usual. He then heard the bucket hit the boards in the base of the sump. Worker 2 went to investigate the noise and found Mr Bryant unresponsive in the sump with significant injuries to the top and right side of his head.
14:00	Worker 2 exited the mine and informed workers 3 and 4 that he believed Mr Bryant was deceased. The incident was reported to emergency services via '000' and worker 3 entered the mine to commence CPR on Mr Bryant.
14:09	Emergency services were dispatched from Lightning Ridge and arrived at the incident location at approximately 14:45.
15:20	Inspectors from the Regulator arrived at the incident location.
15:50	State Emergency Service (SES) commenced setting up vertical rescue (VR) equipment over the emergency shaft.
17:20	NSW Ambulance paramedic and SES personnel entered the mine via the emergency exit shaft using VR equipment to assess Mr Bryant's condition.
17:40	NSW Ambulance paramedic returned to the surface and confirmed that Mr Bryant was deceased.
17:45	NSW Police Rescue Squad began to arrive at the incident location.
20:20	NSW Police Crime Scene officers arrived at the incident location.

WEDNESDAY 14 OCTOBER 2020	
21:30	NSW Police Rescue Squad and Crime Scene personnel entered the mine to conduct an examination.
22:20	Mr Bryant's body was recovered from the mine. He was wearing personal protective equipment (PPE) including safety boots and nitrile-coated gloves but no safety harness.
23:30	Mr Bryant's body was transported to Department of Forensic Medicine, Newcastle for a medical examination.

THURSDAY 15 OCTOBER 2021	
00:30	NSW Police released the incident scene to the Regulator. A non-disturbance notice was issued and the scene was secured by inspectors overnight.
09:30	Investigators arrived at the incident site and commenced an investigation.

5.5.2. Cause of death

On 21 October 2020, a post-mortem examination was conducted with the direct cause of death identified as 'head and neck injuries'. No underlying or other significant conditions were identified as having contributed to Mr Bryant's death.

On 22 October 2020, investigators met with the forensic pathologist responsible for conducting the examination and were informed of the following:

- The majority of external injuries observed were around Mr Bryant's head. A laceration on the right-hand side of his frontal scalp suggested contact with a sharp object; and
- It was likely that Mr Bryant fell from a height given the injuries identified during the examination.

6. The investigation

6.1. Investigation activities

The investigation examined the incident including the circumstances leading up to it, the cause of it and the actions of the involved workers. The investigation activities included scene assessments, mechanical inspections, functionality testing of the involved plant, examination of safety management systems and interviews with relevant parties.

6.1.1. The incident scene

The incident scene was located within MC 51724 and MC 28809. A police cordon was established around the main shaft and the emergency shaft. There were other structures on the site including two cabins containing sleeping quarters and basic amenities. A search was conducted within these areas and, notably, no fall arrest or fall prevention devices were sighted.

6.1.2. The main shaft

The main shaft was located within MC 51724 adjacent to the northern boundary line of MC 28809 (Figure 3). The shaft opening measured approximately 1.4 metres by 0.7 metres. The distance from the base of the sump to the shaft opening was approximately 6.7 metres.

A metal ladder was attached to the eastern wall of the shaft and extended down to the base of the sump. An electrical cable ran down this ladder to supply power to portable lights and tools used by workers. The bucket guide rails extended down the western wall of the shaft. Wire cables ran down this ladder which functioned to hoist the bucket within the shaft. An additional wire was situated next to the guide rails which was connected to the hoist engagement lever within the hoist machinery cage on the surface. There were no fall arrest or fall prevention devices present within the main shaft.

There were two sections of steel piping installed across the base of the sump and two sections of timber laid across the pipes in a lattice style configuration. This area denoted the base of the sump and was used to arrest the fall of the bucket into the lower level of the mine, which had been mined by a previous claim holder.

Limited natural lighting in the underground workings of the mine necessitated the provision of artificial lighting in the area being mined prior to the incident. The ambient conditions were cool and dry.

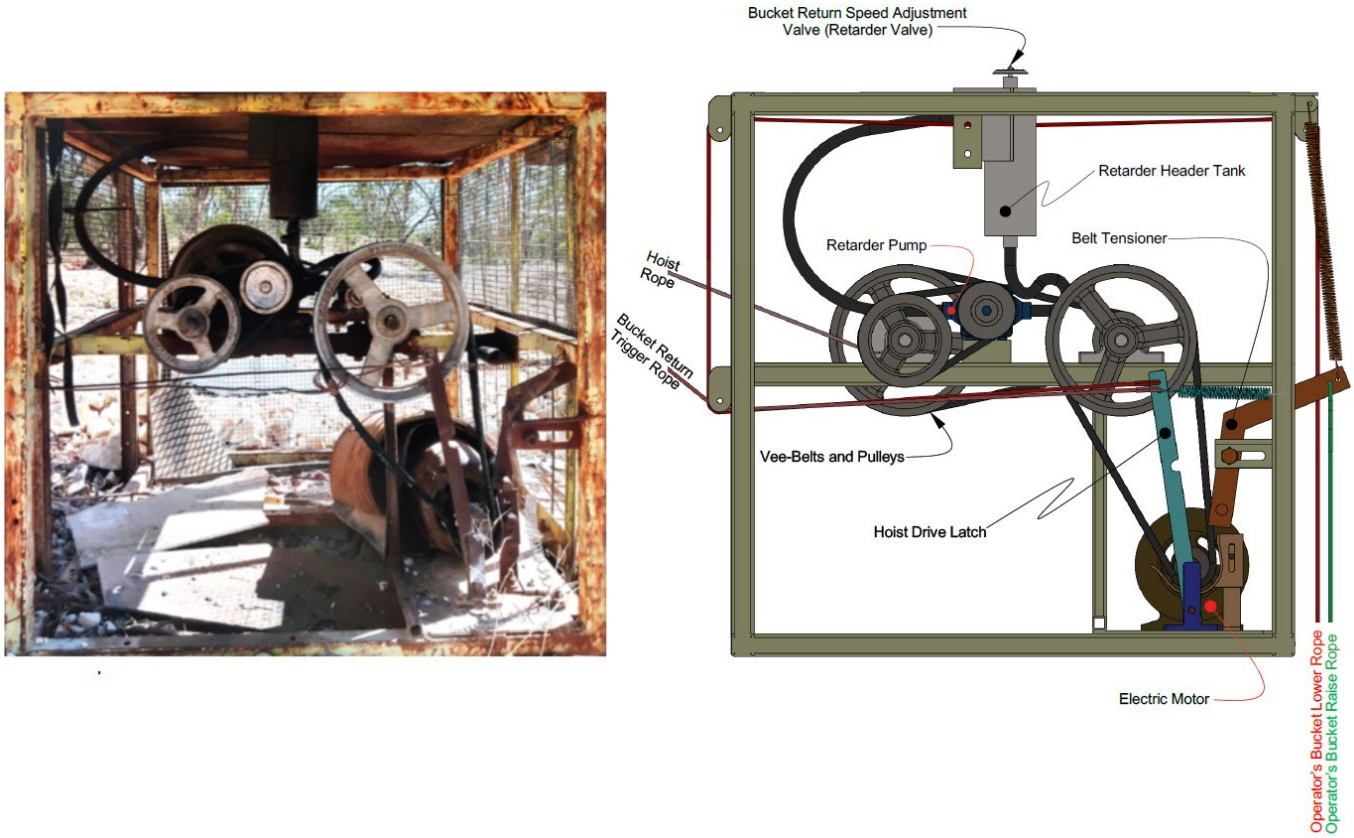
Interviews with involved workers revealed that the main shaft was used as the primary means of access for workers entering and exiting the underground workings of the mine.

6.1.3. The hoist components

The hoist frame, bucket and machinery components (Figure 12) were examined during attendance at the site.

There were no issues identified with the condition of the frame and guide rails or the steel bucket.

Figure 12: Hoist machinery components



Initial observations of the hoist revealed that the bucket engagement lever was in an upward position and the belts within the machinery cage were not engaged, indicating the hoist was in descent mode (i.e. the electric motor was not supplying power to the belt and pulley system to raise the bucket to the surface). The hoist bucket was empty, which is consistent with the hoist having dumped the contents of the bucket on to the opal dirt pile prior to it failing to return to the base of the sump.

Excess rope was found on the surface adjacent to the hoist machinery cage and in the bucket at the base of the shaft. It is possible that the rope spooled in this manner after mis-tracking off the rope path guide rollers towards the end of the incident (Figure 13).

Figure 13: Excess wire spooling at the surface and in the bucket


Signs of wear and tear were evident on the wire cable and the vee belts within and near to the hoist machinery cage (Figure 14). Despite their poor condition, they did not impede the overall functionality of the hoist during post incident testing.

Figure 14: Wear and tear observed on wire cable and vee belt


6.2. Hoist functionality testing

Functionality testing was conducted on the hoist at the mine under controlled conditions. There were no issues identified with operation of the electric motor and the generator, the vee-belt and pulley system, the retarder or the bucket return trigger.

However, testing revealed that the hoist failed to operate as expected on a number of occasions, with the following issues identified and actions taken to remedy each issue:

1. Insufficient tensioning on the engagement lever wire resulted in disengagement of the motor during bucket ascent from the sump. The engagement lever wire was manually adjusted by inspectors resulting in correct operation.
2. Insufficient bucket momentum on return to the sump resulted in the bucket stopping on the guide rails above the hoist machinery cage. The hoist frame was manually shaken by inspectors resulting in the bucket continuing its descent down the frame and into the sump.
3. Entanglement of the bucket guide wheel with the engagement lever wire caused the bucket to become jammed on the guide rails approximately half-way down the shaft (Figure 15). The bucket was manually lifted to the surface by inspectors using the hoisting wire cable and the engagement lead wire was untangled from around the bucket guide wheel. The bucket was then loaded with opal dirt and descended to the base of the sump.

Of significance, during instances 1 and 3 above, the inspector was required to stand within close proximity to the hoisting shaft in order to remedy these fault conditions.

Figure 15: Entanglement of the bucket guide wheel with the engagement lever wire

6.3. Previous issues with hoist operation

The investigation established that there had been previous occasions where the hoist failed to operate as expected. Notable examples included:

- On several occasions the hoist rope came off the drum in the hoist cage requiring the rope to be respooled onto the drum.
- On one occasion the bucket returned to the sump after failing to dump a load of opal dirt on the surface.
- Some years ago, the bucket failed to operate correctly and go over the edge of the hoist frame at the slope before the vertical drop. Application of oil or grease to the bucket wheels resolved the issue.
- On one occasion the bucket fell down the shaft and broke the boards in the sump.

6.4. Safety management system

The WHSMPS Regulation requires a mine operator to ensure that a safety management system (SMS) is established and implemented with respect to mining activities undertaken at the mine.

A SMS document or plan must set out the following:

- the systems, procedures, plans and other control measures that will be used to control risks to health and safety associated with mining operations at the mine
- the induction procedures for workers at the mine
- the emergency procedures and all other matters in the emergency plan for the mine.

The investigation found Mr Bryant kept a hardcopy folder titled ‘Mine Safety Management Plan’ in his vehicle which included the following information:

- general site safety rules applicable to workers and visitors at the sites
- the ‘Lightning Ridge Opal Mining Safety Guidelines’ published by the Regulator (formerly the NSW Department of Mineral Resources (DMR)) in 2002
- a ‘Mine Safety Management Plan’ booklet from DMR (undated) which contained instructions and templates about how to establish and implement:
  - a log book to record daily activites undertaken on the site
  - a daily workplace inspection checklist (including surface machinery prestart checks)
  - risk assessments and safe work procedures (SWPs) for site-specific hazards identified by the mine operator

- a training/competency register for workers and contractors working at the site
- a maintenance schedule to ensure all plant and equipment used onsite is regularly inspected and maintained.

The investigation was unable to identify any documentary or other evidece of the above being implemented in practice by Mr Bryant at the mine.

Notably, like Mr Bryant, worker 2 (who usually worked underground with Mr Bryant) had previously completed both the Mine Safety Awareness Course and the Mine Operator Workshop.

7. Investigation findings

7.1. Risk to health and safety

The investigation identified that the primary risk to workers' health and safety at the mine was serious injury or death associated with a fall from height. The risk of a fall arose from hazards associated with working from an elevated work area (i.e. ascending or descending one of the structures within the shaft) or working in the vicinity of an opening (i.e. adjacent to the unprotected shaft opening) in the absence of adequate protection against the risk such as a fall prevention device or fall arrest system such as a safety harness.

The absence of any direct evidence of the actions of Mr Bryant immediately prior to, and at the time of, the incident results in the precise mechanism of his fatal injuries being unable to be definitively established.

The circumstantial and medical evidence, however, narrows the potential mechanism down to the following three reasonable hypotheses, all of which involve Mr Bryant falling when he was either:

- working on the surface in the vicinity of the open shaft (after which the falling hoist bucket fell down the shaft)
- climbing on one of the structures, being either the access ladder or hoist frame, within the shaft (after which the falling hoist bucket fell down the shaft); or
- struck by the hoist bucket either while on the surface or while he was climbing on one of the structures within the shaft.

Despite the lack of certainty regarding the mechanism causing Mr Bryant's fatal injuries, the investigation definitively established that no fall protection device or fall arrest system was in use by him or other workers at the mine nor was such a device or system available on the date of the incident.

The evidence supports a finding that the hoist bucket was located on the surface above the shaft opening immediately prior to the incident and that Mr Bryant and the hoist bucket fell down the shaft

around the same time.

The investigation identified that a further potential risk to a worker's health and safety was serious injury or death arising from work beneath a suspended load or falling object that was not controlled by measures that adequately prevented an object free falling or provision of a system to arrest the fall of a free falling object.

The steel bucket had no brake and there was otherwise no means to bring the bucket to rest or hold it stationary. During normal operation of a long throw hoist there is no need for workers to be in the vicinity of a bucket as it ascends and descends within the hoist shaft, however, when maintenance or repair activities are required to be undertaken, the bucket presents a risk to workers when it is not grounded within the base of the shaft or on top of the closed shaft cover.

7.2. Identification and assessment of the risk

Mr Bryant, as the mine operator, maintained a folder titled 'Mine Safety Management Plan' containing several safety related documents including the 'Lightning Ridge Opal Mining Safety Guidelines' published by the department (Regulator) in 2002 and a booklet titled 'Mine Safety Management Plan'. The booklet contained instructions and templates to assist in undertaking risk assessments.

The 'Lightning Ridge Opal Mining Safety Guidelines' contains information regarding the use of fall arrest equipment where a fall from height risk exists and the safe operation, maintenance and inspection of equipment used in mining operations.

The investigation found no evidence that any risk assessment of hazards associated with undertaking work at the mine had been undertaken.

7.3. Foreseeability of the risk and incident

The risk of serious injury or death arising from a fall from height was reasonably foreseeable. The risk was well known to the opal mining community and potential consequences, together with available control measures, had been communicated to industry through published safety alerts, incident notifications and other guidance materials (such as the Resources Regulator's 'Opal and Gemstone Mining Guide' and Safe Work Australia's 'Model code of practice - Managing the risk of falls at workplaces').

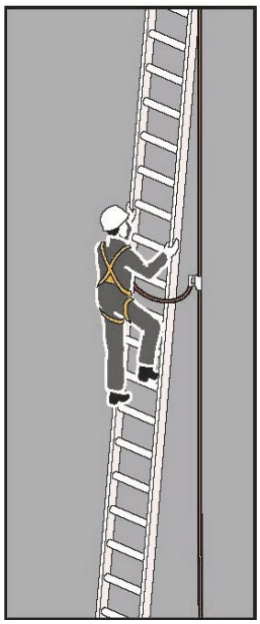
7.4. Reasonably practicable measures

Mine operators have a duty to manage risks to health and safety associated with a fall by a person from one level to another that is reasonably likely to cause injury to the person or any other person. Mine operators must also provide a safe means of access to and exit from a workplace.

Where it is not reasonably practicable to eliminate the risk of a fall, adequate protection against the risk must be provided. This includes the provision and maintenance of a safe system of work including the provision of, so far as is reasonably practicable, a fall prevention device or a fall arrest system such as a safety harness (refer Part 4.4 Falls of the Work Health and Safety Regulation 2017).

The regulators Opal and gemstone mining guide (first published in 1994) includes the following at pages 47 and 48:

> *Safe Work Australia has a model code of practice - Managing the risk of falls at workplaces. It suggests the use of anchorage lines or rails when using ladders. The following explains what the code of practice suggests could be used to minimise the risks when using a ladderway in an opal or gemstone mine:*
>
> ***Anchorage lines or rails (when using ladders every day)***
>
> *The code of practice recommends that anchorage lines or rails are used with a long vertical ladder. Anchorage lines or rails are temporary or permanent fall arrest systems, which can be installed to provide continuous fall protection for people using ladders.*
>
> *Figure 16 With the use of an anchorage line system, the person climbing has continuous fall protection (extracted from the Opal and gemstone mining guide)*



Safety considerations:

- Temporary systems comply with the AS/NZS 1891 series of Standards
- The locking device is attached to the frontal attachment point of the harness and the lanyard assembly is a maximum of 300 millimetres length
- The point of connection onto the ladder by the climber is near the base of the ladder to allow the connection before ascending begins and to provide continuous connection to the disconnecting point when at a higher level
- Free fall is limited to a maximum of 600 millimetres
- Permanent systems are made of wire or rail construction and are installed according to the manufacturer's instructions.

In the event that hoist maintenance or repairs are required, mine operators should ensure that the material bucket is situated within the base of the shaft or on top of the closed shaft cover prior to commencement. Where maintenance or repairs are required to the surface components of the hoist, the shaft cover should be closed to prevent an inadvertent fall from height into the shaft.

Where the above measures are not reasonably practicable (i.e. during cleaning of the hoist sump), an operator should ensure that the hoist bucket is effectively isolated or 'locked out' to avoid any unintentional release of the bucket into the hoist shaft. In all instances, a safety harness should be worn where there is a risk of falling into or from within an open shaft.

Mine operators also have a duty to manage risks to health and safety associated with working beneath suspended loads or falling objects if the object is likely to injure the person (refer Part 3.2 Division 10 Falling objects of the Work Health and Safety Regulation 2017). Adequate protection includes the provision and maintenance of a safe system of work that, so far as reasonably practicable, prevents an object from falling freely or, if that is not reasonably practicable, arrests the fall of a falling object.

Lower order safety hierarchy controls, such as exclusion of personnel from no-go zones presenting a risk to health and safety, offer satisfactory alternatives in some situations and must be considered through a risk assessment prior to being implemented at an opal mining site.

8. Recommendations

Mine operators have a duty to identify workplace hazards (such as falls from height, working around falling objects and working beneath suspended loads), assess risks arising from identified hazards and, so far as is reasonably practicable, eliminate or control risks to health and safety in accordance with the *Work Health and Safety Act 2011* and Work Health and Safety Regulation 2017.

It is recommended that duty holders:

- ensure a **mine safety management system or plan** appropriately addresses risks to health and safety associated with working at heights, working beneath suspended loads and falling objects
- provide adequate protection against the risk of a **fall from height** by providing and maintaining a safe system of work that includes the following:
  - a **fall prevention device**, such as a secure fence, edge protection and covers, so far as is reasonably practicable; or
  - (if it is not reasonably practicable to provide a fall prevention device) **a fall arrest system**, such as a safety harness, so far as is reasonably practicable; and
  - **training** in relation to the risks, **safe work procedures** and **safe use of ladders**.

- provide adequate protection against risks associated with **falling objects or work beneath suspended loads**, including buckets, by providing and maintaining systems of work that:
  - **prevent** an object from falling freely so far as is reasonably practicable; or
  - (if it is not reasonably practicable to prevent an object from falling freely) **arrests** the fall of a falling object, such as a secure barrier and / or a safe means of raising and lowering objects, so far as is reasonably practicable; and
  - define **exclusion zones** that workers are prohibited from entering having regard to falling objects and work beneath suspended loads.
- ensure all **plant and equipment is maintained** by appropriately qualified personnel and **regularly inspected**.