

## Investigation report

# Near collision between haul truck and light vehicle at Maules Creek Mine

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## Executive summary

A loaded haul truck narrowly avoided a collision with a light vehicle containing 2 occupants that had stopped at an intersection at 1.52pm on 6 December 2021. The incident occurred at Maules Creek Mine near Narrabri.

The light vehicle had turned onto an access road and travelled towards a T-intersection between that road (through road) and ramp 6 (the terminating road). A short time later, the haul truck entered the access road at the same point as the light vehicle and began travelling towards the intersection. The haul truck operator did not see the light vehicle ahead of him.

There was a sweeping left-hand bend on the access road before the intersection. The bend was less than 100 metres from the intersection. A windrow was built on the left side of the road on the bend. It ranged in height between 2.8 and 3.6 metres.

The light vehicle approached the intersection about the same time as another haul truck that had ascended Ramp 6. The light vehicle stopped about 19 metres before the intersection to give way to the second truck. The second truck operator stopped the truck 12 metres before the intersection. He did not see the light vehicle stopped at the intersection but did see the haul truck approaching and waited to give way to it.

The haul truck operator did not see the light vehicle stopped at the intersection until he had rounded the bend and was about 65 metres away from it. The windrow on the bend had obscured the haul truck operator's view of the light vehicle's location and there were several points of distraction in the area. The haul truck was travelling about 35 kph around the bend. The haul truck operator applied the truck's retarder but did not apply its service (emergency) brake. The light vehicle operator saw the haul truck approaching in the rear-view mirror. He tried to move the light vehicle forward, but it stalled and only advanced several metres. The haul truck operator believed that he could not stop the truck before it reached the light vehicle and steered the truck into the left roadside windrow to avoid a collision. The haul truck's front right-side wheel missed the light vehicle by less than one metre. The 2 vehicles finished about 1.65 metres apart.

Nobody was physically injured in the incident.

## Investigation findings

There were multiple factors that contributed to the incident including:

- heavy and light vehicles used the same roadways
- the windrow height, curvature of the bend and the proximity of the bend to the intersection reduced the haul truck operator's sight distance of the light vehicle
- no effective controls were implemented to manage the limited sight distance at the intersection
- a flat spot was not established at the top of Ramp 6, resulting in the other truck stopping on a grade and potentially reducing its operator's ability to see the light vehicle

There were several points of distraction in the area, including:

- another busy intersection was constructed 52.7 metres from the intersection.
- a bunded area that enabled vehicle access was several metres from the intersection.
- a large rock was on the right edge of the road on the exit of the bend.
  - Inspections conducted by mining supervisors failed to identify the above issues. There was limited oversight of the way intersection inspections were conducted at the mine.
  - Road audits did not involve using survey measurement data to ensure roads and intersections met the mine's standards.
  - Numerous blind spots existed from the cabins of the involved trucks.

- The haul truck operator did not apply the truck's service (emergency) brake.
- There was a risk of workers at the mine being killed or seriously injured as a result of a collision between heavy and light vehicles near the intersection.
- The mine operator identified the risk of collisions at intersections before the incident.
- To control the risk the mine operator relied on:
  - a controlled work environment
  - fit-for-purpose equipment
  - competent people
  - safe work practices.

## Recommendations

### Mine operators

Mine operators are reminded of their duty to identify hazards and manage risks to health and safety in accordance with the provisions of the *Work Health and Safety Act 2011* and *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and Regulations.

It is recommended that mine operators:

#### Road design

- Separate heavy and light vehicle traffic where reasonably practicable.
- Include the smallest vehicle that uses a road in assessments of sight distance.
- Ensure that windrow heights, curvature of bends and the bends near intersections do not impede sight distance.
- Undertake rigorous assessments at each stage of road planning and construction to ensure that maximum sight distance can be achieved.
- Ensure that the information relied upon to plan and design roads matches the actual topography and conditions in the mine.
- Minimise potential points of distraction near intersections.

#### Audit and compliance

- Use technologies such as drones and other survey tools to ensure that roads are built to the required standards.
- Undertake regular audit activities to ensure that supervisors conduct road inspections in a comprehensive and effective manner.

#### Training

- Ensure that workers associated with road design and construction understand the importance of and reasons for separation distances, flat spots and maximum sight distance at intersections.
- Reinforce the requirement for workers to report hazards in workplaces.
- Provide practical training in the application of emergency braking systems.

### Workers

Workers have a duty to take care for their own health and safety and that of their co-workers. They must also comply as far as they are reasonably able with mine operators work instructions, policy and procedures, to ensure worker safety and compliance with the *Work Health and Safety Act 2011* and *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and Regulations.

It is recommended that workers:

- are observant for road hazards
- promptly report or respond to any road hazards that exist
- familiarise themselves with the emergency stopping systems of any mobile plant they operate
- consider what impact their stopping locations may have on visibility to and from their vehicle.

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# 1. Purpose of the report

This report describes the mining workplace incident investigation conducted by the NSW Resources Regulator into the cause and circumstances of an incident where a haul truck narrowly avoided colliding with a light vehicle containing two occupants at Maules Creek Mine near Boggabri on 6 December 2021.

## 2. Investigation overview

### 2.1. Major Safety Investigations

The Regulator investigates critical workplace incidents in the NSW mining, petroleum and extractives industries. The Regulator carries out a detailed analysis of incidents and report 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* and are deemed to be inspectors for the purposes of the *Work Health and Safety Act 2011*. The Regulator has also delegated some additional functions to investigators including the power to obtain information, documents or evidence in relation to a possible contravention of the WHS Act or for the purpose of monitoring compliance with it.

### 2.3. Regulator response

The incident was reported to the Regulator on 6 December 2021 and mine safety inspectors and investigators were deployed to the mine and an investigation commenced.

The Regulator published an [investigation information release](#) (IIR21-13) on 22 December 2021 to provide information about the incident to the mining industry.

As part of the investigation, the Regulator engaged an external road safety consultant to review the circumstances of the incident and provide a report.

## 3. The incident

### 3.1. Parties involved

#### 3.1.1. The mine

Maules Creek Mine is 45 km south-east of Narrabri. It is an open cut coal mine that has a large fleet of ultra-class mining equipment used to strip and transport mined materials.

#### 3.1.2. Mine operator and holder

The nominated mine operator and person conducting the business or undertaking (PCBU) controlling the work that was taking place at the time of the incident was Maules Creek Coal Pty Ltd. The mine operator was a wholly owned subsidiary of Whitehaven Coal Limited.

#### 3.1.3. Hitachi EH5000 (RDT028) haul truck operator

The Hitachi EH5000 haul truck operator worked at the mine for 3 months at the time of the incident. He was employed by a labour hire company.

#### 3.1.4. Light vehicle operator

The light vehicle operator worked at the mine for 6 years and was experienced in operating light vehicles.

#### 3.1.5. Light vehicle passenger

The light vehicle passenger worked at the mine for about 7 years at the time of the incident.

### 3.1.6. Caterpillar 789C (RDT895) haul truck operator

The Caterpillar 789C haul truck operator worked at the mine for 3.5 months at the time of the incident. He was employed by a labour hire company.

## 3.2. Incident location

The incident occurred at the T-intersection of Ramp 6 (the terminating road) and the access road to in pit dump 275 (IPD275) (through road) (the intersection). There was a sweeping left-hand bend on the southern approach to the intersection. A windrow was constructed on the left (northern) side of the road. A windrow is 'a hard barrier designed to prevent access by people and equipment'. The height of the windrow varied between 2.8 and 3.8 metres.

The intersection was opened on 16 November 2022. The adjacent intersection at the entrance to IPD275 was opened on 1 December 2022. The distance between these 2 intersections was 52.7 metres.

Figure 1 - Overview of incident location



## 3.3. Mobile plant involved

### 3.3.1. Hitachi EH5000 haul truck (RDT028)

The Hitachi haul truck was assigned the mine identifier RDT028. It had a rigid body and 296 tonne pay load that was generally used for transporting overburden. It had an electric braking system and retarder for ordinary operational use. It also had a pedal-operated service brake that provided additional braking capacity in emergency situations.

### 3.3.2. Light vehicle

The light vehicle was a white 2019 Toyota Landcruiser ute assigned the mine identifier LV100. At the time of the incident, it had an operating orange flashing light 2.1 metres above ground level. It also had an orange flag 3.5 metres above ground level and an illuminated flagpole.

### 3.3.3. Caterpillar 789C haul truck (RDT895)

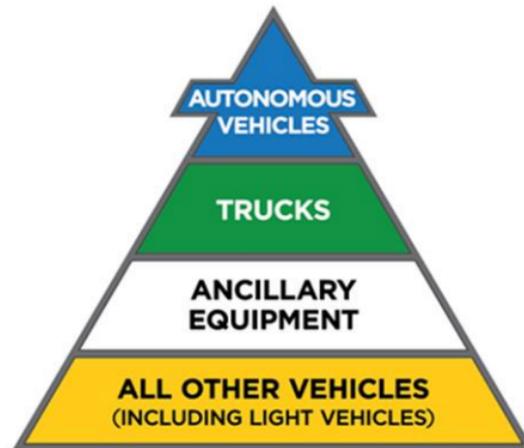
The Caterpillar 789C was a rigid body haul truck that was assigned the mine identifier RDT895.

### 3.4. Road rules used at the mine

The mine operator implemented a hierarchical right-of-way system to manage heavy and light vehicle movements at intersections in August 2021. Before that, NSW road rules were followed at the mine. The investigation determined the incident was not attributable to any uncertainty associated with that change. The weight of the evidence was that workers (including those involved in the incident) had adjusted to the change by the time the incident occurred.

Under the hierarchy system, vehicles are classified by type. Light vehicles are classified lower in the hierarchy than haul trucks. The 2 haul trucks involved in the incident had the same classification. Vehicles lower on the hierarchy were required to give way to vehicles higher on the hierarchy. Vehicles with the same classification were required to give way to the left.

Figure 2 – Hierarchy system



The Vehicle Hierarchy is supported by the follow rules:

1. Vehicles lower on the hierarchy give way to vehicles higher on the hierarchy
2. All equal categories give way to the left
3. When only **two vehicles** of the same hierarchy category approach **head on** at an intersection, the crossing vehicle gives way
4. If operators are uncertain, they are to use positive communications to validate vehicle hierarchy

The mine's rules required any vehicle travelling behind another vehicle to maintain a separation distance of 50 metres unless positive communication was achieved.

### 3.5. The incident

At about 1.52pm on 6 December 2021, the light vehicle containing a driver and passenger left a drill area southwest of the incident location. It made a right turn on to the IPD275 access road and travelled in an easterly direction.

The loaded haul truck left an excavation area west of the incident location, bound for the IPD275 dump. A short time after the light vehicle entered the IPD275 access road, the haul truck turned left on to the same road and travelled in the same direction some distance behind the light vehicle.

The haul truck operator did not see the light vehicle ahead of it on the road. As the haul truck and the light vehicle travelled along the IPD275 access road, the Caterpillar truck ascended Ramp 6 bound for IPD275.

In accordance with the hierarchy rules, the light vehicle gave way to the Caterpillar truck (higher on the hierarchy), which was on its right on Ramp 6. The light vehicle stopped about 19 metres before the southern entry to the intersection and left of the centre of the lane it was travelling in.

The light vehicle operator's practice was to stop some distance back from intersections and slowly

move or creep forward. He did this to place additional distance between himself and heavy vehicles entering intersections. He did not slowly move or creep forward on this occasion. He may have been distracted by a conversation that he was having with the passenger.

The Caterpillar truck stopped 12 metres from the entry to the intersection where the average grade was about 9 percent. The Caterpillar truck operator's practice was to stop some distance back from intersections in order to provide a buffer between his vehicle and other vehicles using the intersection. Based on the available evidence, it appears that the Caterpillar truck and the light vehicle arrived at the intersection around the same time.

As the haul truck approached the bend before the intersection, its operator saw the Caterpillar truck at the top of Ramp 6. It was unclear how far the light vehicle was behind the haul truck was at this point.

The light vehicle came to a stop near the intersection before the haul truck rounded the bend. The haul truck operator's view towards the position of the light vehicle was obscured by a high windrow on the left (northern) side of the road.

The Caterpillar truck operator was unaware of the presence of the light vehicle. He was unable to see the light vehicle stopped near the intersection giving way to him because it was obscured by the pillar on the left hand side of the truck's cabin (and possibly equipment mounted to that pillar).

Being unaware of the existence of the light vehicle, the Caterpillar truck operator stopped the truck at the intersection to give way to the haul truck, which he saw approaching from the left. (Vehicles of equal hierarchy were required to give way to the left). Had he seen the light vehicle, he would have assumed the right of way and entered the intersection (lower classification vehicles are required to give way to higher classification vehicles).

The haul truck was travelling about 35 kph as it travelled around the bend. As it reached the apex of the bend, the haul truck operator saw the light vehicle stopped near the intersection. He was about 65 metres from the light vehicle at this time. The haul truck operator applied the truck's retarder but did not activate the service brake. The light vehicle operator looked in his rear vision mirror and saw the haul truck travelling towards him at speed. He put the light vehicle into gear and tried to move forward and to the right to increase the distance between it and the Hitachi truck. However, the light vehicle's engine stalled and it only moved forward by several metres.

Figure 3 - Paths of travel prior to incident



The haul truck operator realised additional evasive action would be needed to avoid a collision with the rear of the light vehicle. He steered the truck to the left, narrowly avoiding a collision with the

light vehicle and causing the front of the truck to hit the left roadside windrow. The rear right side of the haul truck stopped 1.65 metres from the rear left side of the light vehicle.

Nobody was physically injured as a result of the incident.

Figure 4 - Position of vehicles following incident



Figure 5 - Position of Hitachi truck and light vehicle following incident



## 4. Investigation findings

### 4.1. Identified hazard[s]

The investigation identified the following hazards existed at the mine at the time of the incident:

#### 4.1.1. Heavy and light vehicles using the same roads

Roads at the mine were generally shared by heavy and light vehicles. This created an environment in which heavy and light vehicle interactions could occur.

#### 4.1.2. The roadside windrow

The windrow on the left side of the road (in the direction travelled by the haul truck) ranged in height between 2.8 and 3.8 metres. The light vehicle was 2.1 metres high. Testing conducted by investigators from the cabin of the haul truck confirmed that the windrow precluded the haul truck operator from being able to see the light vehicle until he was between 65 and 88 metres away from it. The haul truck operator's view of the Caterpillar truck as he approached the intersection was not obscured by the windrow.

**NOTE:** The distances referred to in section 4.1.2 relate to the finishing position of the light vehicle after the light vehicle operator tried to move out of the path of the haul truck. It is believed that the light vehicle was positioned several metres rearward of that point when it stopped at the intersection to give way to the Caterpillar truck.

Figure 6 – View from cabin of haul truck when about 100 metres from the light vehicle – light vehicle not visible



Testing conducted as part of the investigation identified the light vehicle became partially visible to the haul truck operator when he was about 88 metres away from it. However, as can be seen by Figure 7, it is difficult to identify the light vehicle even with the benefit of hindsight. Additionally, the presence of the Caterpillar truck at the intersection (and other distractions referred to in Section 4.1.5) drew the haul truck operator's attention away from the light vehicle.

Figure 7 - View from cabin of haul truck when it was about 88 metres from light vehicle - light vehicle partially visible



As the haul truck continued to travel along the road approaching the intersection, the light vehicle continued to be fully or partially obscured by the windrow as shown by Figure 8 and Figure 9.

Figure 8 - View from cabin of Hitachi truck when it was about 80 metres from the light vehicle - light vehicle not visible



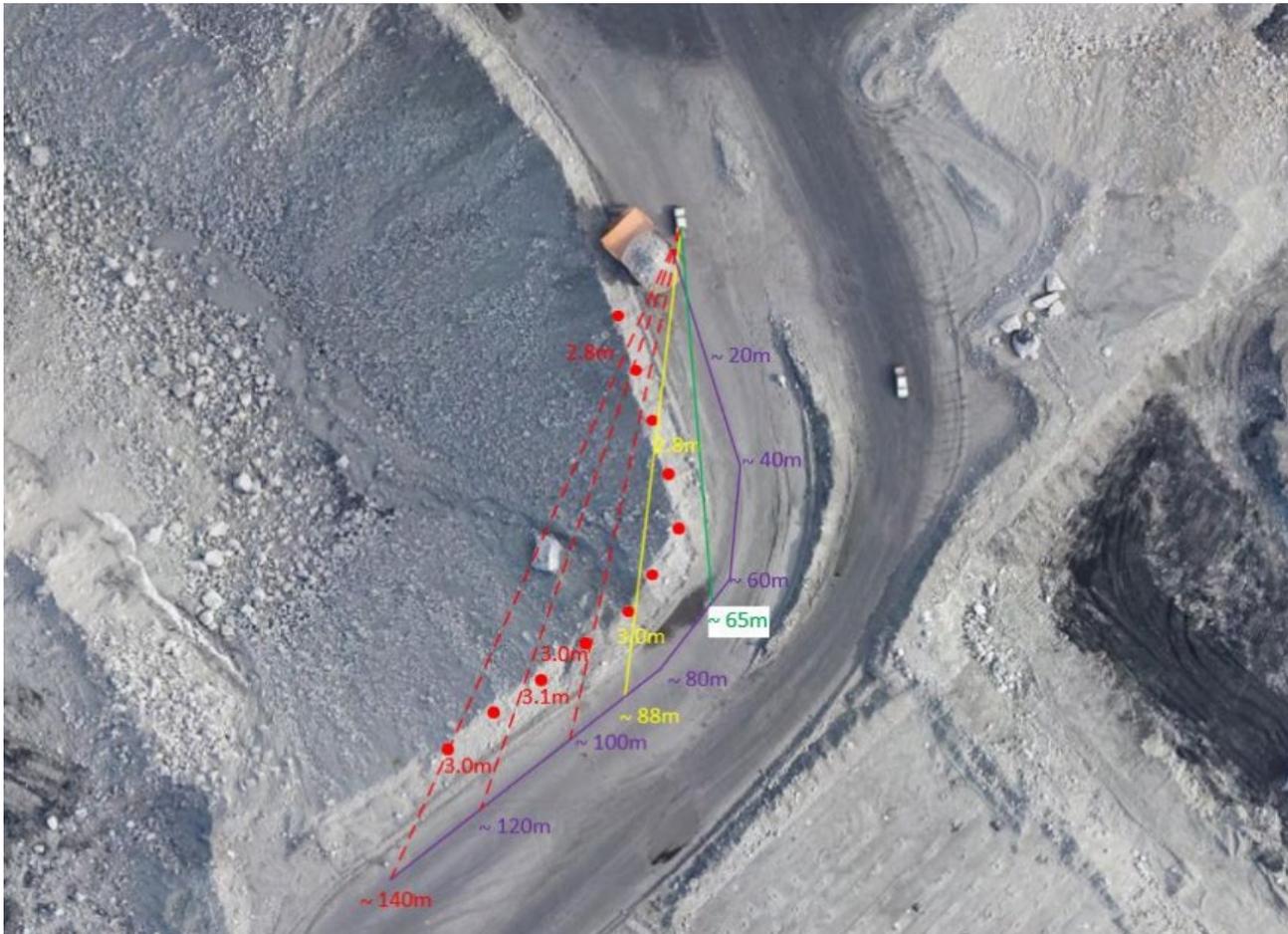
Figure 9 - View from cabin of haul truck when it was about 65 metres from the light vehicle - light vehicle now visible



The light vehicle became more fully visible when the haul truck was about 65 metres away from it. It remained visible from that point onwards.

The effect of the roadside windrow on line-of-sight distances of the light vehicle from the cabin of the haul truck are plotted in Figure 10.

Figure 10 - Plot of lines of sight from cabin of Hitachi truck

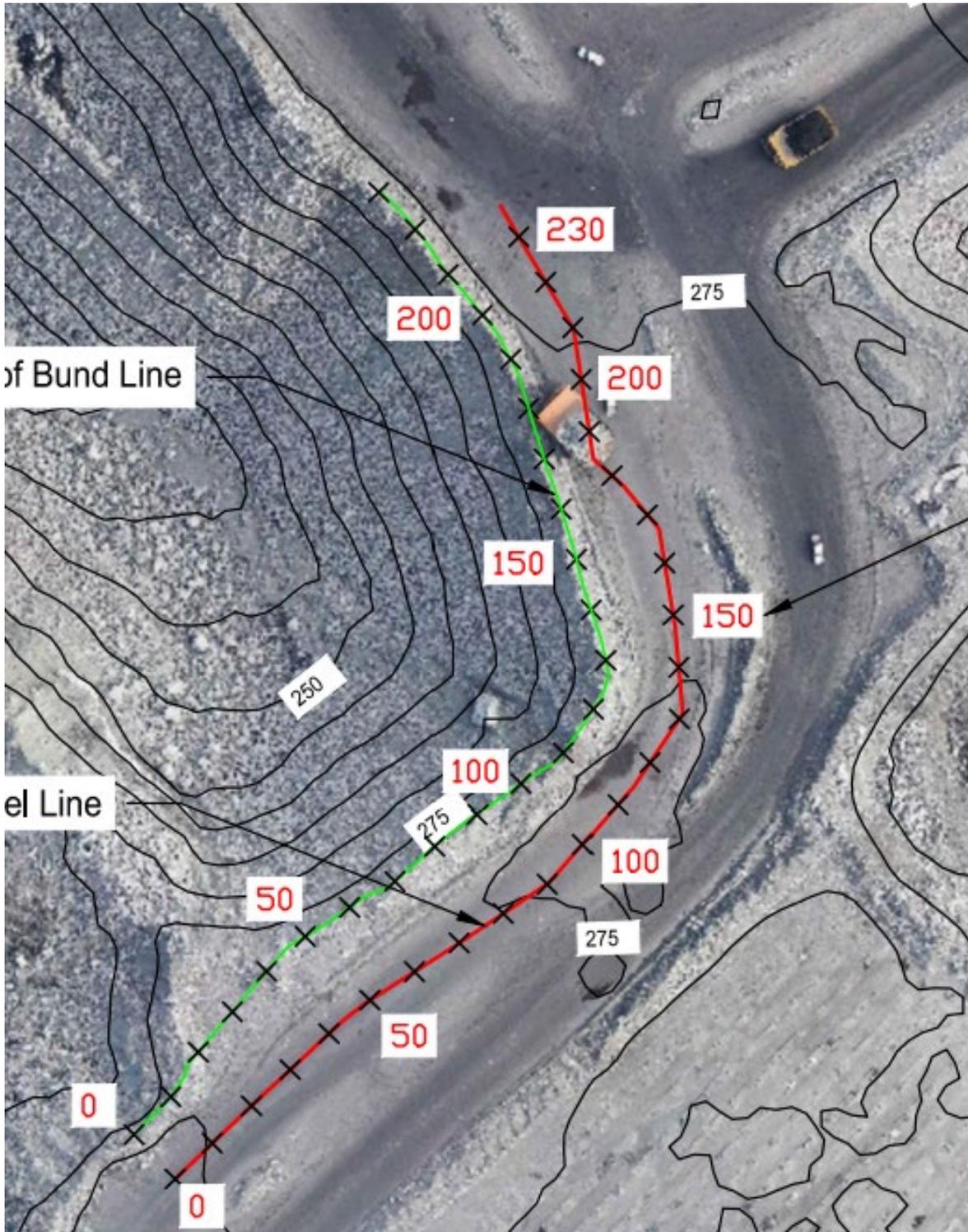


### 4.1.3. Opening up the angle of approach to the intersection

The effect of the roadside windrow heights on the haul truck operator's sight distance was exacerbated by the relatively short distance between the intersection and the preceding bend. As shown in Figure 11, the distance between the intersection and entry to the bend was about 85 to 90 metres (each cross represents 10 metres).

Increasing the radius of the inside curve of the bend, or opening up the angle of approach to the intersection, would have created a more open curved approach and improved the line of sight to the intersection, thereby increasing the sight distance of vehicle operators.

Figure 11 - Long section distances at the incident location



### 4.1.4. Stopping distances of haul truck

The haul truck had a large stopping distance because of its mass. The stopping distances of a laden Hitachi EH5000 haul truck were tested by the mine operator. The testing involved using the retarder only at various speeds and a combination of the retarder and the service brake at 30 kph. The external road safety consultant engaged as part of the investigation examined the testing results and added the relevant reaction times to the braking distances established by the mine operator (the ‘PRT Distance (m)’ column). The results of the testing are detailed below.

#### 4.1.4.1. Haul truck stopping distances - retarder only

At the time of the incident, the haul truck was travelling about 35 kph as it travelled around the bend. The testing identified that at this speed, the total stopping distance was 65.6 metres when using only the retarder. This was significant given that the haul truck operator’s sight distance of the light vehicle was between 65 and 88 metres (as discussed in section 4.1.2).

However, having regard to the presence of the Caterpillar truck and the other distractions referred to in Section 4.1.5, it is unlikely that the haul truck operator would have seen the light vehicle until he was less than 65 metres away from the light vehicle.

Figure 12 - Haul truck stopping distances - retarder only

**Table 3-2: HV1 (Hitachi) stopping distances (retarder only)**

Speed (km/h)	Braking Distance (m)	PRT Distance (m)	Total Stopping Distance (m)
15	11	6.25	17.25
20	17	8.3	25.3
25	25	10.4	35.4
30	35	12.5	47.5
35	51	14.6	65.6
40	73	16.7	89.7
45	94	18.75	112.75
50	105	20.8	125.8

#### 4.1.4.2. Haul truck stopping distances – retarder and service brake

Stopping distances when using the haul truck’s retarder and service brake at a speed of 35 kph were not determined. However, analysis of the testing results performed at 30 kph determined that the total stopping distance at this speed was 31.5 metres (compared to the above 47.5 metres with the use of the retarder only). A corresponding decrease in stopping distance would be expected if the service brake was applied at 35 kph.

### 4.1.5. Points of distraction near intersection

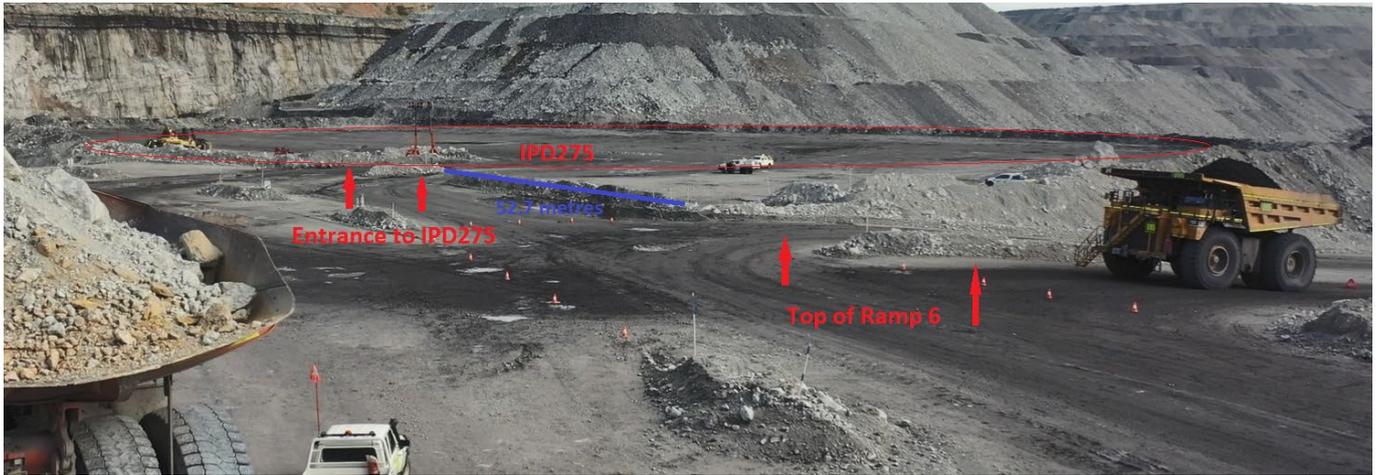
There were several features of the area near the intersection that provided potential points of distraction for vehicle operators. They included the following:

#### 4.1.5.1. In pit dump 275

An intersection at the entry of IPD275 dump (off the IPD275 access road) was constructed on 1 December 2021. The distance between the intersection and the IPD275 intersection was 52.7 metres. IPD275 was a busy location. Both of the trucks involved in the incident were enroute to IPD275. CCTV of IPD275 showed that there were at least 2 trucks on the dump at the time of the incident.

Trucks accessing IPD275 were a potential point of distraction for operators approaching the intersection. The haul truck operator told investigators he was looking into IPD275 as he approached the intersection. This distracted his attention away from the light vehicle.

Figure 13 - Proximity of IPD275 intersection to incident intersection – a truck operator’s perspective



#### 4.1.5.2. Bunded area

A bunded area was constructed to the side of the westbound lane of Ramp 6. There was nothing preventing vehicles entering and exiting the bunded area from the IPD275 access road. It was not demarcated as a no-go zone as it should have been if the area was not in use.

The bunded area had the appearance of a road, although the mine operator told investigators it was not a road. It said the bunded area was established between 10 and 15 November 2021 to house a lighting tower. Regardless of its actual or intended use, the area was an additional distraction for vehicle operators approaching the area.

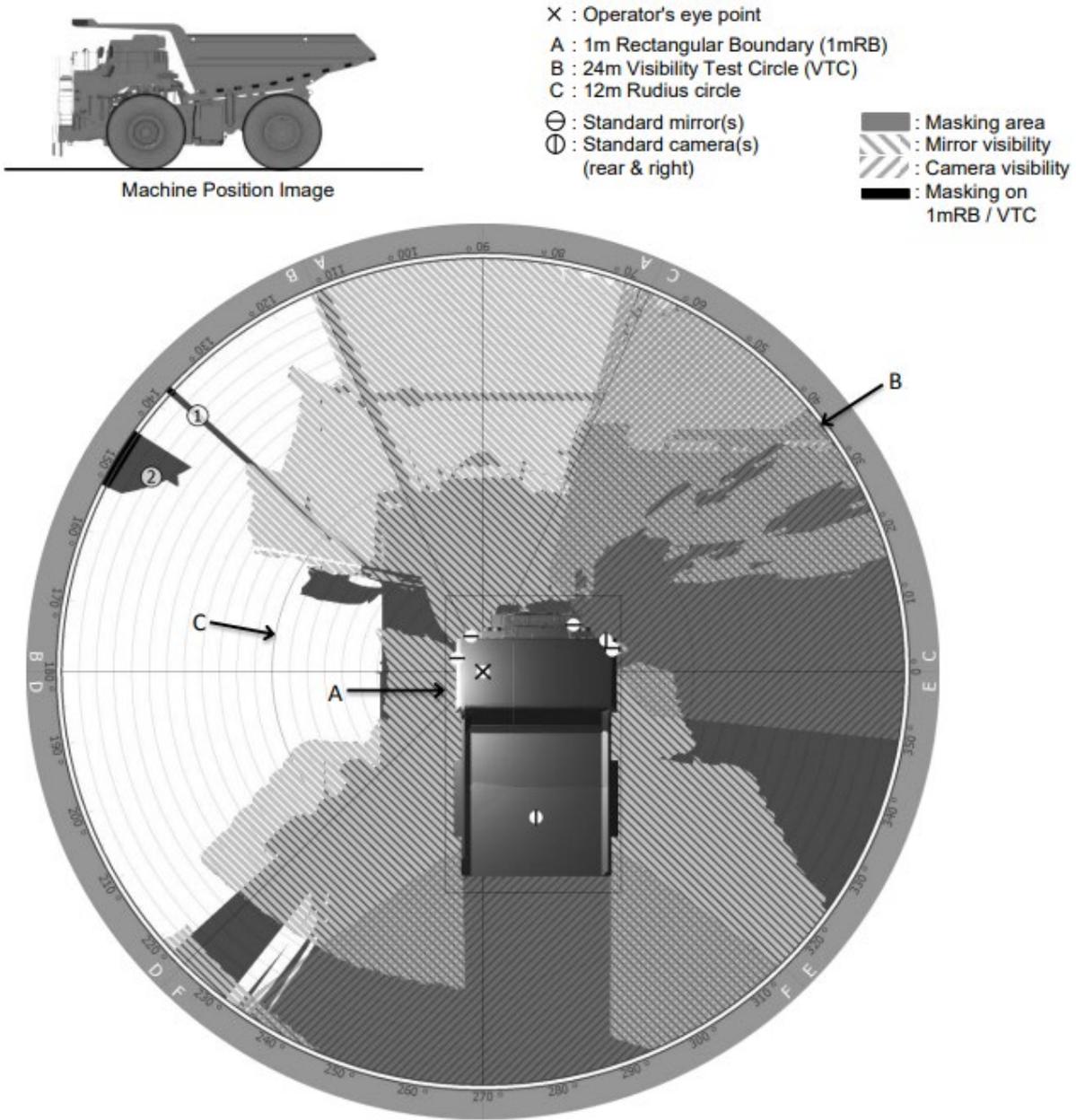
Figure 14 - Bunded area off the access road to IPD275



### 4.1.6. Blind spots obstructing the view from the operator's cabins of the haul trucks

Numerous blind spots exist from the cabin of Hitachi EH5000AC-3 trucks as shown by the following visibility map:

Figure 15 - Visibility map for Hitachi Machine Model EH5000AC-3



Aftermarket instrumentation retrofitted by the mine operator on the front left pillar of the haul truck's cabin may have further reduced the operators' view.

Figure 16 - View from cabin of Hitachi truck



#### 4.1.7. Light vehicle's stopping position

The light vehicle stopped about 19 metres before the intersection and slightly to the left of the centre of the lane it was travelling in. This reduced the limited sight distance that the haul truck operator had as he approached the light vehicle. This is evident from Figures 17 and 18 that show the haul truck operator's sight distance would have increased from 65 to 70 metres if the light vehicle was positioned further forward and to the right of the centre of the lane.

Figure 17 - Sight distance analysis based on incident

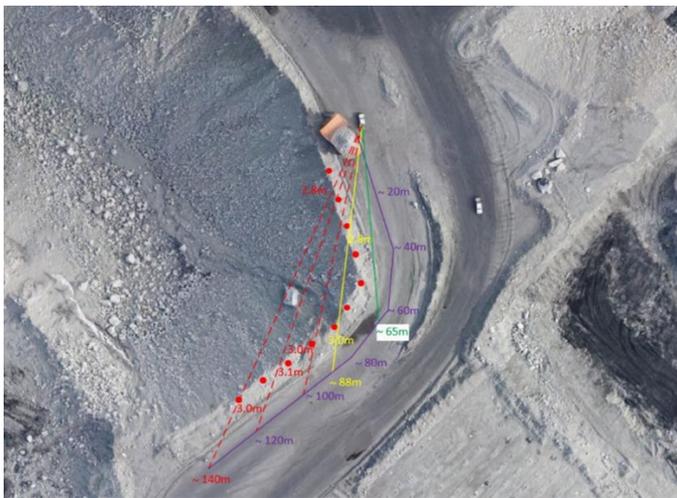
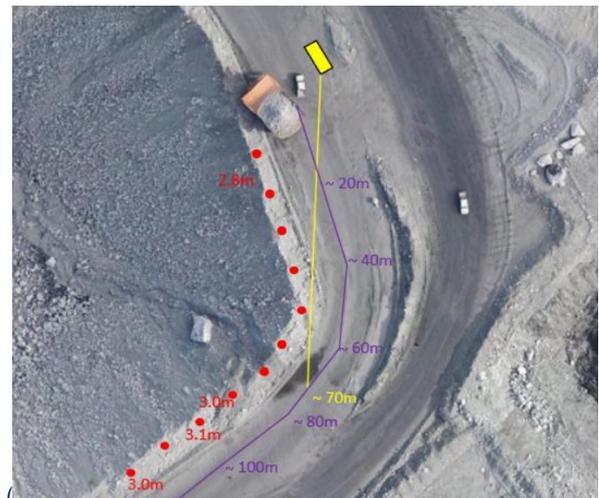


Figure 18 - Alternate sight distance analysis



#### 4.1.8. Caterpillar truck's stopping position

The light vehicle was fully obstructed from the Caterpillar truck operator's view by the pillar of the truck cabin and instrumentation mounted to it. Had the Caterpillar truck been positioned further forward, the operator's field of view would have been different. It is unclear if this would have made the light vehicle more visible to the Caterpillar truck operator.

### 4.1.9. Absence of flat spot at top of ramp 6

Where the Caterpillar truck stopped at the top of Ramp 6 had a grade of 9 percent.

Figure 19 - Stopped position of Caterpillar truck showing grade

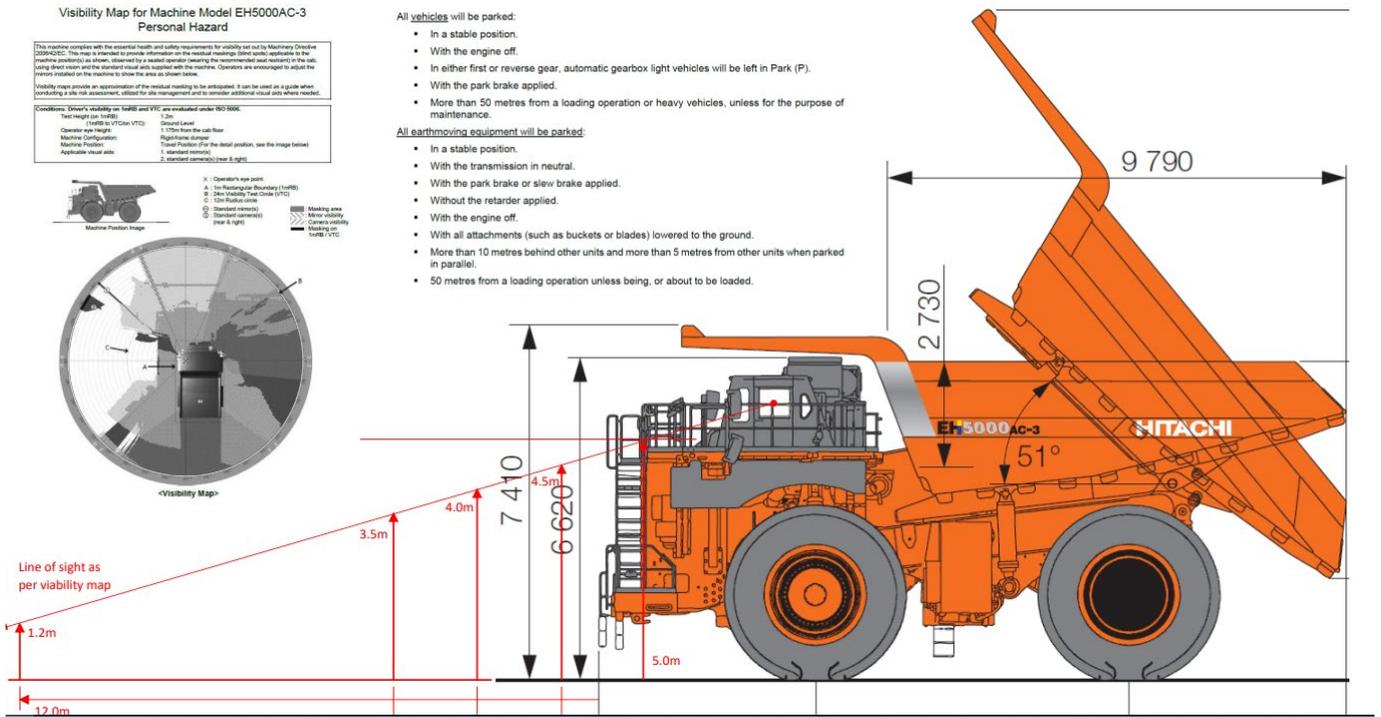


This may have impaired the operator's ability to see the light vehicle by changing the angle of his field of view, effectively increasing the size of the truck's height related blind spot.

Figure 20 - Height related blind spot



Figure 21 - Visibility from an EH5000 truck



### 4.1.10. Rock on road

There was a large rock on the right edge of the northbound lane on the exit to the bend before the intersection. It provided an additional point of distraction. The haul truck operator stated he saw the rock on previous runs through the area and was looking out for it as he travelled around the bend.

Figure 22 - Large rock on road



Figure 23 - Position of rock on road



## 4.2. Risk to workers

The investigation identified the relevant risk to workers health and safety was death or serious injury as a result of a collision between heavy and light vehicles near the intersection.

The risk had the potential to cause multiple deaths in a single event thereby meeting the definition of a 'principal hazard' set out in clause 5 of the Work Health Safety (Mines and Petroleum Sites) Regulation 2014 (WHSMPSR) and, in turn, creating obligations concerning the development and implementation of a principal hazard management plan under Division 2 of the Regulation.

## 4.3. Foreseeability of the risk and incident

The mine operator foresaw the risk of interactions between heavy and light vehicles before the incident. In accordance with clause 23 of the WHSMPSR, the mine operator identified roads as a principal hazard at the mine. Having done so, it undertook a risk assessment as required by that clause.

The risk assessment was reviewed on 8 July 2021 in connection with the implementation of the hierarchy system at the mine. The risk assessment specifically identified vehicle interactions between large and small mobile plant as a hazard.

## 4.4. Relevant controls

The mine operator implemented the following controls that were relevant to the above risk:

### 4.4.1. Controlled work environment

- Risk management practices
- Inspections by open cut examiner (mining supervisor) each shift and mining engineering manager each week
- Road designed in accordance with standards and procedures
- Maintenance of roads
- Audits, including critical control monitoring and planned task observations
- Hazard identification and reporting process.

## 4.4.2. Fit-for-purpose equipment

- Introduction to site process
- Prestart inspections
- Defect management process
- Planned and scheduled servicing.

## 4.4.3. Competent people

- Pre-employment medical
- Relevant training
- Competency system
- Fatigue management, drug and alcohol screening etc.

## 4.4.4. Safe work practices

- Relevant plans and procedures (see section 5.5)
- Communication of hazards, changes and instructions.

## 4.5. Procedures to control hazards

The mine operator implemented a range of plans, standards and procedures that were relevant to control the risk. They included:

### 4.5.1. Roads or other vehicle operating areas principal hazard management plan

This is an overarching plan that referenced the procedures detailed below among others. The plan was developed to manage the principal hazard in compliance with clause 24 of the WHSMPR.

### 4.5.2. Procedure – Approaching mobile plant in the mine

The procedure relevantly required:

- operating vehicles in the mine to maintain a separation distance of 50 metres from other vehicles and mobile plant unless positive communications are established. (Vehicles were not required to maintain a separation distance of 50 metres when travelling along roads except, as set out in section 3.5 of this report, when following another vehicle.)
- light vehicles to be fitted with an illuminated flag at least 3.5 metres from ground.

### 4.5.3. Procedure – Load haul and dump operations

This procedure primarily related to loading and dumping but required truck operators to arrange for any large rocks that spilt onto a road to be cleared.

### 4.5.4. Procedure - Safe operation of a haul truck

This procedure relevantly required:

- operators to drive to conditions
- truck operators not to operate the service brake at a speed of more than 8 kph except in emergency situations.

### 4.5.5. Standard – Road and dump design (the standard)

In respect to roads, the standard required:

- dual access haul roads to be 3 times the width of the widest haul truck regularly using the road, i.e., the incident area was required to be a minimum of 28.8 metres wide
- windrows to be built to a **minimum** height of the centre axle of the largest truck using the road, i.e., the windrow heights in the incident area needed to be a minimum of 1.88 metres (with no maximum height prescribed by the standard)

The standard prescribed 3 types of intersections being haul road, on-bench and ancillary. Ancillary intersections were not relevant to the incident (other than in relation to the bunded area for the light tower) and will not be discussed further.

The standard did not define what a haul road intersection was. It defined on-bench intersections as having the following criteria:

- 1 to 3 fleets used the intersection (a fleet was an excavator and the trucks and other mobile plant that serviced that excavator)
- the intersection would exist for less than a month
- vehicles travelled through the intersection at a speed of less than 30 km/h.

On-bench and haul road intersection both had the following requirements:

- Intersections were to be located so as to allow for maximum sight distance
- Intersecting roads were to be as close to 90 degrees as possible
- 20 metre flat spot required on all approaches to the intersection (or where this was not possible, speed reductions could be used as a control).

On-bench haul roads required a spacing of 50 metres between intersections, whereas haul road intersections required a spacing of 75 metres.

Where the above requirements were unable to be met, a risk assessment was to be undertaken and approved by the general manager. Intersections were required to be inspected, tested (using a light and heavy vehicle) and approved by a mining supervisor before opening.

### 4.5.6. Standard – Vehicles and driving

In addition to the above information relating to vehicle hierarchy and separation distances, this standard prescribed a maximum speed limit of 60 kph. It did not provide any specific limits when approaching intersections or rounding bends.

## 4.6. Effectiveness of controls

### 4.6.1. Road and dump design standard

#### 4.6.1.1. Windrow heights

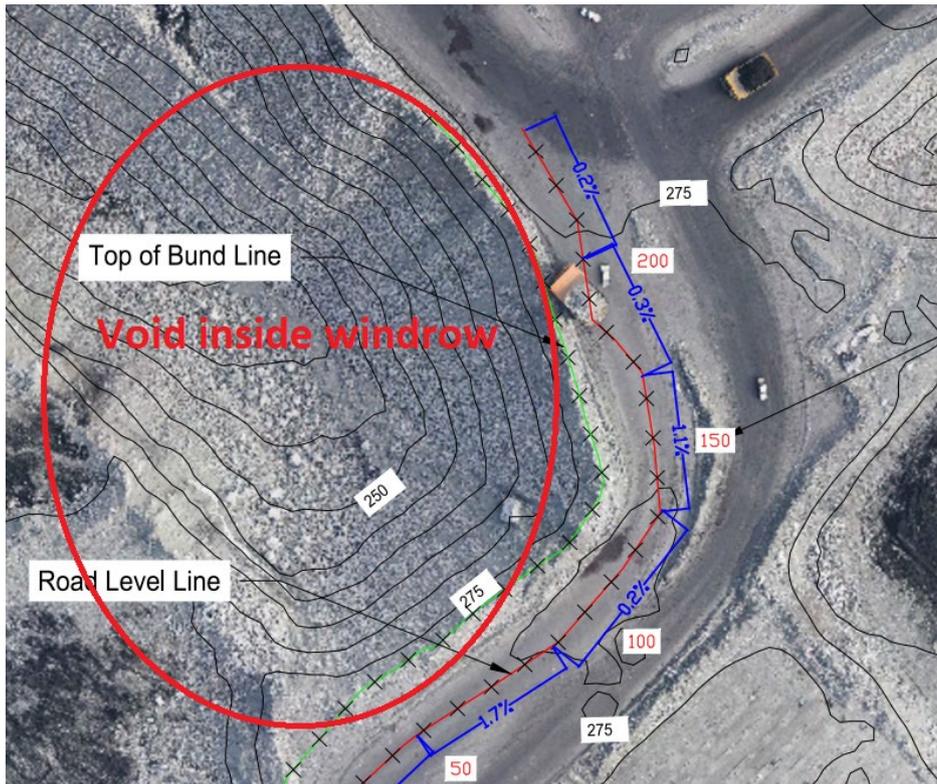
The standard prescribed minimum but not maximum windrow heights. Significantly, the haul truck operator's view of the light vehicle at the time of the incident was obscured, in part, by the height of the windrow that ranged from about 0.3 to 1.3 metres above the minimum height prescribed by the standard.

Mining supervisors responsible for confirming that roads met the standard did not have a gauge by which they could assess windrow heights. It made assessing the standard quite subjective. Varying opinions were provided by mining supervisors to investigators about the appropriateness of the windrow heights near the intersection.

Generally, the mining supervisors who saw the windrow before and after the incident believed that it was an appropriate height. A significant factor in this belief was that there was a deep void on the

other side of the road and higher windrows were required to avoid the risk of vehicles entering the void.

Figure 24 - Contour survey showing void



Mining supervisors generally did not use tools such as laser measuring devices to determine windrow heights and it was not a requirement prescribed by the mine operator. Varying information was obtained about the availability of these tools at the time of the incident.

#### 4.6.1.2. Intersection type

The planning documents given to mining supervisors tasked with building and inspecting intersections did not detail the type of intersection required (i.e., haul road or on-bench). The information was generally provided verbally by the production superintendent to mining supervisors. However, in practice, mining supervisors were often required to make their own determination about what type of intersection was required.

The investigation identified there was some uncertainty about what type the incident intersection was intended to be. For example, the mining engineering manager considered the intersection was an on-bench intersection, whereas the mining supervisor, who inspected the intersection prior to opening, considered it to be a haul road intersection. The investigation was unable to determine with any certainty what type of intersection it was intended to be.

There were no procedures at the mine for reclassifying intersections when their use changed. For example, if more fleets began using the intersection or it remained in existence for longer than a month.

The uncertainty about the intersection type may have created an environment that permitted the entrance to the adjacent IPD275 to be constructed 52.7 metres away from the intersection (consistent with an on-bench haul road), rather than the 75-metre separation distance required for haul road intersections.

The investigation determined the potential for vehicle operators travelling through the incident intersection to be distracted by the adjacent IPD275 intersection would likely increase the closer the 2 intersections were positioned to one another.

Notably, the haul truck operator stated that he was looking into IPD275 as he approached the intersection.

### 4.6.1.3. Maximum sight distance

The standard did not provide guidance for mining supervisors about what ‘maximum sight distance’ meant. It is unlikely that ‘maximum’ was intended to be an absolute term. In practice, it generally meant as far as possible having regard to existing mining operations.

For example, had Ramp 6 been built to the north, it would have permitted the intersection to have been built further away from the preceding bend. However, the presence of IPD275 meant this was not possible without significantly altering the mine plan.

As Figure 26 shows, the mining activity that was occurring adjacent to the intersection, the preceding bend and IPD275 meant that there were very few options about where a road could be built. However, increasing the radius of the inside curve of the bend, or opening up the angle of approach to the intersection, would have created a more open curved approach and improved the line of sight to the intersection thereby increasing the sight distance of vehicle operators.

Figure 24 - Incident area



## 4.6.2. Inspection and testing

### 4.6.2.1. Inspection of intersection – 16 November 2021

The intersection was inspected on 16 November 2021 by a mining supervisor. The inspection was deficient having regard to the following:

- A heavy vehicle was not used to ensure that light vehicles were clearly visible to heavy vehicles.
- The supervisor knew that there was not a flat spot at the top of Ramp 6 (as required by the standard).
- The inspection did not identify that the windrow on the left-hand side of the road was too high.
- The inspection did not assess whether a light vehicle stopped at the intersection would be visible to a truck approaching from the rear.
- An outdated inspection checklist was used to record the inspection. This outdated checklist stated that the requirement for sight distance was ‘Light vehicles are clearly visible to HVs whereas the updated checklist that ought to have been used required ‘maximum line of sight’.

#### **4.6.2.2. Subsequent inspections of the intersection**

Mining supervisors were required to inspect the area around the intersection at each shift. Between the time when the intersection was first opened and the time of the incident, mining supervisors had not raised any concerns about the area. It should be noted that only limited activity occurred at the mine between 22 November and 3 December 2021 because of flooding.

The investigation identified that the failure by mining supervisors to detect any issues may have been attributable to complacency, an expectation that the intersection would have been designed and tested in accordance with the required standard and a belief that the intersection largely complied with the standard.

#### **4.6.2.3. Inspection of the entrance to IPD275**

The mine operator was unable to provide evidence that the intersection at the entrance to IPD275 was inspected before it was opened on 1 December 2021. The IPD275 intersection was constructed during the day shift on 1 December 2021. The mining supervisor who oversaw the construction of the IPD275 intersection was unable to conduct an inspection as there were no heavy vehicles available due to the flood. A note to that effect was made in the mine operator's road changes table. There were no personnel on site during the night shift on 1 December 2021 and as such it would not have been possible for an inspection to have been conducted. A comprehensive inspection of the IPD275 intersection may have identified that it was a potential point of distraction for vehicles passing through the incident intersection.

### **4.7. Systems of work**

#### **4.7.1. Planning**

##### **4.7.1.1. Sight distance assessments**

The planning and design of roads at the mine was undertaken by the senior mining engineer. The senior mining engineer stated sight distance was a factor he considered when designing roads. However, it was apparent from the information he provided to investigators, the assessments of light vehicle sight distance he made when designing roads, was based on their flags being visible rather than the vehicles themselves.

Video footage taken by investigators from the cabin of the haul truck demonstrated that the light vehicle flag was difficult to distinguish from the surroundings until the truck was at the apex of the bend before the intersection. It would have been difficult for the haul truck operator to see the flag over the windrow, particularly given the various points of distraction referred to in section 4.1 of this report. Most of the supervisors and workers interviewed believed light vehicle flags were helpful during daylight but were most effective at night because of their illuminated flag poles.

##### **4.7.1.2. Planning documents**

The design documents provided to mining supervisors were limited in detail. They provided limited information about windrow heights, road widths, grades and drainage. Although mining supervisors were expected to apply these criteria from the road and dump design standard, the designs did not always conform to the location.

For example, during the construction phase of the intersection, mining supervisors identified that the design plan did not permit the required 20 metre flat spot to be constructed at the top of Ramp 6. It did not identify that the road to IPD275 was wider than required and that if it was reduced in width there would have been sufficient space to establish a flat spot at the top of the ramp.

Although mining supervisors discussed making some changes to the plan that would have permitted a flat spot to be established, the ramp was ultimately commissioned without the flat spot required by the standard.

Figure 25 - Insert from IPD275 plan



#### 4.7.1.3. Design compliance

With the exception of the controls listed in section 4.4 and 4.5 of this report, there were no processes followed at the mine to ensure that newly constructed roads complied with the intended design plan and the standard.

### 4.8. Training and instruction

#### 4.8.1. Stopping locations

There was no documented information at the mine about where light and heavy vehicles should be positioned when stopping to give way at intersections. The mine operator stated some information about where to stop at intersections was given to operators in videos and slides provided to operators as part of the hierarchy training. However, some of the material in some of these videos and slides supports the decisions of the light vehicle and Caterpillar truck operators to stop back from the intersection. This material depicts light and heavy vehicles stopped some distance back from intersections.

Figure 26 - Training animation showing light vehicle stopped 10 metres from an intersection and in the left part of the lane (each pole is 5 metres)

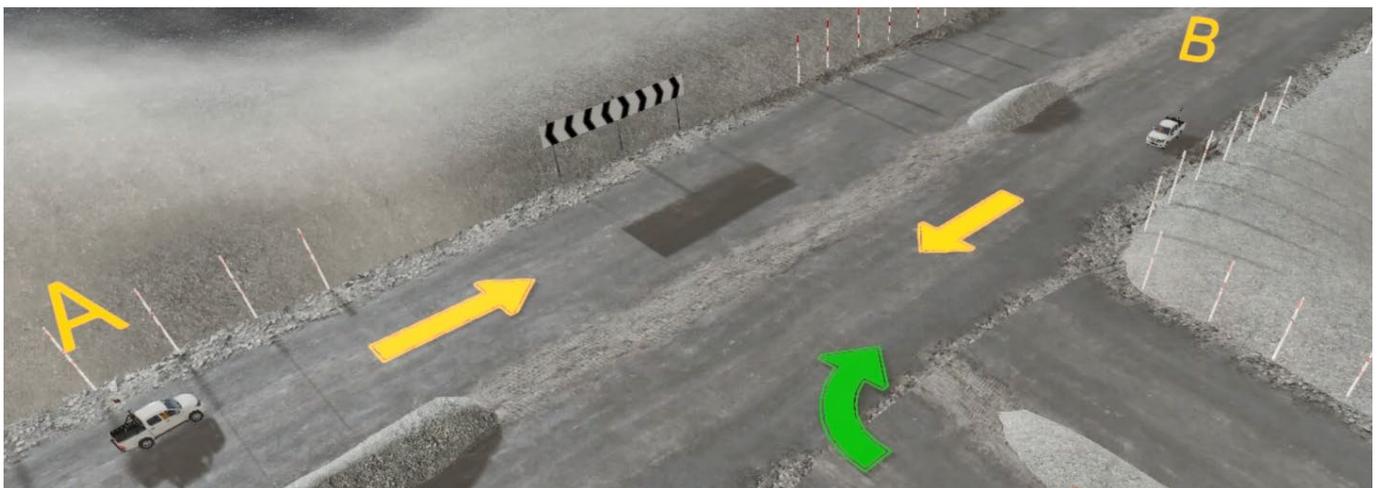
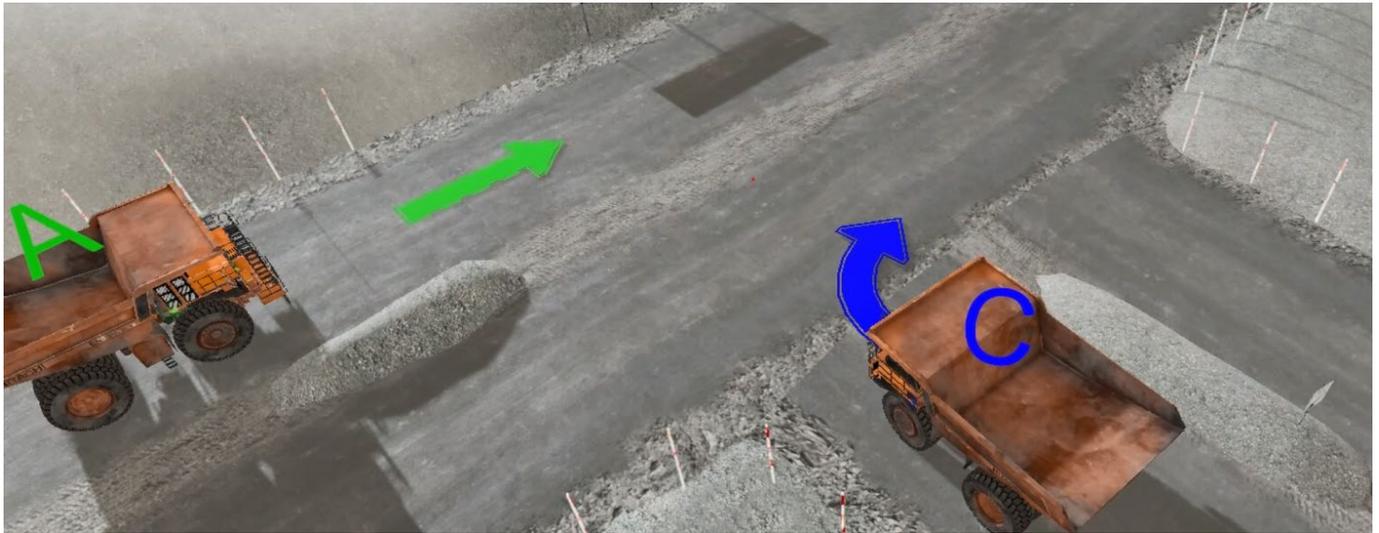


Figure 28- Training animation showing heavy vehicle A stopped about 8 metres from an intersection



## 4.8.2. Use of service brake

The mine operator’s training did not involve activating the service brake of haul trucks at a speed above 8 kph. The mine operator believed that activating the service brake at speed created risks of operators being injured and equipment being damaged.

The mine operator’s procedures required the maintenance team to inspect haul trucks whenever the service brake was activated at speed in order to ensure that no damage was caused.

The haul truck operator had activated the service brake at very low speeds as part of his training. The only reason he could provide about why he didn’t activate the service brake during the incident was the training discouraged its use except in emergency situations and that, when the incident arose, he did not think to apply it.

## 4.9. Supervision

The mine operator stated it ensured that mining supervisors inspected intersections in accordance with the standard through the use of a critical control monitoring system. The system involved the mine’s operations manager and others reviewing various records and observing practices at the mine. The mine operator had undertaken critical control monitoring of vehicle interactions on 4 occasions in the year before the incident. Mining supervisors generally felt there was little oversight of their road inspections by the mine operator.

## 4.10. Mine operator’s investigation of incident

### 4.10.1. Root cause and contributing factors

The mine operator investigated the incident and made the following findings:

**Root cause** - *The haul truck operator not identifying light vehicle on the roadway or intersection until in the immediate vicinity.*

#### Contributing factors

- 1. The Caterpillar truck failed to identify the light vehicle at the intersection causing them to stop to give way to the haul truck. The haul truck operator observed this action and assumed right of way in accordance with the mine’s road rules.*
- 2. The intersection construction and use impacted visibility of the light vehicle.*
  - a. The light vehicle was stopped about 19 m back from the intersection.*
  - b. The Caterpillar truck was stopped about 12 m back from the intersection.*
- 3. The service (emergency) brake was not applied by the haul truck operator.*

4. *There was reliance on operator situational awareness due to blind spots in the truck cabs.*

### 4.10.2. Other findings

There were a number of other findings that are worthy of comment.

1. *The haul operator was not focused on the immediate travel path, with focus on the Caterpillar truck stopped at the intersection and the access for the dump.*

The information provided by the haul truck operator to investigators was that in addition to looking at the Caterpillar truck, he was looking along his path of travel (evidenced by him looking out for the rock on the road) as well as the intersection and dump.

2. *Haul truck operator was not focused on the immediate travel path and not driving to conditions.*

The mine operator stated this was based on the following statement made by the haul truck operator: 'on approaching the corner before the dump noticed coal truck coming up ramp was coming to stop at intersection allowing me through'.

It stated the conditions he was not driving to were 'the visibility of the full road surface being maintained to 50 metres in front of the truck'. This information does not support the finding. It was noted speed data obtained from the mine operator showed that the haul truck operator approached the bend before the intersection about the same speed as other operators had that day. Additionally, there were no prescribed speed limits that applied to trucks when they were travelling around intersections and approaching bends.

### 4.10.3. Key issues not addressed in investigation report

The investigation report did not address or refer to 2 measures raised by the haul truck operator about how the incident could have been avoided:

1. The inside corner bund height allowing the vehicle to be more visible
2. Increased distance between the corner and intersection.

## 4.11. Details of actions taken post incident

### 4.11.1. Changes made to the incident area

The mine operator did not materially alter the distance between the bend and the intersection. The main changes it made were:

- reduction of IPD275 access road width permitting the required flat spot to be established at the top of Ramp 6
- improved demarcation of roads. This was achieved by pegging out the roads and reconstructing them.

The mine operator stated it did not alter the roadside windrows when the remedial works were completed on 9 December 2021.



### 4.11.2.1. Intersection sight distances

The standard was revised on 2 June 2022 to provide additional rigour around intersection sight distances. It added the following criteria for measuring sight distance:

*Sight distance should be measured for the driver eye height of the lowest vehicle using the road (e.g., utilise 1.5m for a light vehicle) to largest vehicle with the longest stopping distance (e.g., truck) and should consider horizontal and vertical planes.*

It also provided additional controls in the form of speed limitations that apply when intersection sight distance was limited as shown in the following table:

Figure 28 - Safe intersection sight distances

Safe Intersection Sight Distance (SISD)	Speed (km/h)
30m	20
50m	30
70m	40
90m	50
110m	60

### 4.11.2.2. Weekly width and grade audit

A requirement was introduced for all roads to be scanned on a regular basis using survey data to ensure that their grades and widths complied with the standard. A procedure was developed for the process, which included undertaking remedial works when identified as being required.

Figure 29 - Survey imagery used to ensure compliance



### 4.11.2.3. Other significant measures

Other significant measures that have been undertaken since the incident to minimise the risk include:

- an additional risk assessment was undertaken in relation to the standard that resulted in centre bunds becoming mandatory on approaches to haul road intersections and considered for other types of intersections
- updating the construction of the intersection checklist to highlight the requirement for light vehicles and heavy vehicles to be used to test the controls at intersections prior to opening
- developing shift inspection checklists that area supervisors were required to complete each shift. They required supervisors to assess road grades, visibility, lane width among other criteria

- supply and use rangefinder distance measuring devices by supervisors to enable more accurate measurements to be taken
- simulation of service brake application included as part of practical driver training.

## 4.12. Reasonably practicable measures

### 4.12.1. Road and dump design

Figure 35 illustrates a range of reasonably practicable construction designs identified during the investigation, which the mine operator could have used to minimise the relevant risk. The reasons for several of these key measures are detailed below.

Figure 34 - Safer intersection design



#### 4.12.1.1. Separation of light and heavy vehicles

The Regulator published the following recommendation to industry in December 2020 in relation to the separation of light and heavy vehicles:

*Although it is not mandated, it was strongly recommended to mine operators who had not implemented such measures, that they look to adopt similar principles where reasonably practicable.*

Even if it was determined that it was not reasonably practicable to establish separate roadways for heavy and light vehicles, it would have been reasonably practicable for a light vehicle corridor to be established on the southern approach to the intersection. This would have provided protection for the light vehicle and required operators to stop on a safer part of the road.

#### 4.12.1.2. Opening up the angle of approach to the intersection

Increasing the radius of the inside curve of the bend, or opening up the angle of approach to the intersection, would have created a more open curved approach and improved the line of sight to the intersection thereby increasing the sight distance of vehicle operators and distance available to safely stop a vehicle.

## 4.12.2. Other reasonably practicable measures

### 4.12.2.1. Systems of work

- Prescribing maximum windrow heights of 2.56 metres at the mine which, according to the external road safety consultant, would have provided a sufficient barrier to redirect and/or ground the haul trucks used at the mine to a halt whilst improving line of sight for operators approaching intersections
- Provision of specific documentary information to mining supervisors about intersection type before construction.

### 4.12.2.2. Training

- Provision of information to heavy and light vehicle operators about where to stop vehicles at intersections.
- Additional training for mining supervisors about conducting intersection inspections.

### 4.12.2.3. Supervision and monitoring

- More robust supervision and review of intersection inspections undertaken by mining supervisors to ensure they were adequate.

## 5. Recommendations

### 5.1. Mine operators

Mine operators are reminded of their duty to identify hazards and manage risks to health and safety in accordance with the provisions of the *Work Health and Safety Act 2011* and *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and Regulations.

It is recommended that mine operators:

#### 5.1.1. Road design

- Separate heavy and light vehicle traffic where reasonably practicable.
- Include the smallest vehicle which uses a road in assessments of sight distance.
- Ensure windrow heights, curvature of bends and the location of bends near intersections do not impede sight distance.
- Undertake rigorous assessments at each stage of road planning and construction to ensure that maximum sight distance is able to be achieved.
- Ensure the information relied upon to plan and design roads matches the actual topography and conditions in the mine.
- Minimise potential points of distraction near intersections.

#### 5.1.2. Audit and compliance

- Use technologies such as drones and other survey tools to ensure that roads are built to the required standards.
- Undertake regular audit activities to ensure that supervisors conduct road inspections in a comprehensive and effective manner.

#### 5.1.3. Training

- Ensure workers associated with road design and construction understand the importance of and reasons for separation distances, flat spots and maximum sight distance at intersections
- Reinforce the requirement for workers to report hazards in the workplace.
- Provide practical training in the application of emergency braking systems.

## 5.2. Workers

Workers have a duty to take care for their own health and safety and that of their co-workers. They must also comply as far as they are reasonably able with mine operators work instructions, policy and procedures, to ensure worker safety and compliance with the *Work Health and Safety Act 2011* and *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and Regulations.

It is recommended that workers:

- are observant for road hazards
- promptly report or respond to any road hazards that exist
- familiarise themselves with the emergency stopping systems of any mobile plant they operate
- consider what impact their stopping locations may have on visibility to and from their vehicle.