Australian Government
Australian Transport Safety Bureau

Level crossing collision between freight train 8279 and truck, at level crossing 5318

near Yalboroo, Queensland | 29 August 2017

Investigation

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Addendum

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Safety summary

What happened

On the morning of 29 August 2017, freight train 8279 (one locomotive and 23 wagons) was travelling north from Mackay, Queensland. At about 0945, after passing over the Wintons Road level crossing, about 64 km north of Mackay, the train driver observed a truck approaching the next level crossing. The unsealed crossing (ID 5318) provided vehicle access between Wagoora-Yalboroo Road and the Bruce Highway. It was equipped with passive traffic control devices (stop signs).

The train driver sounded the train horn while observing the truck slow and stop at the crossing. The train driver noticed that the truck appeared to be facing slightly away from the approaching train when stopped, before it then proceeded to cross the track in front of the train. The train driver gave a second sustained sounding of the horn, placed the brake handle into the emergency position, before moving to the foot-well for protection.

Soon after, train 8279 collided with the driver's cab of the truck. The truck driver sustained fatal injuries. The train driver was shaken but otherwise unhurt.

What the ATSB found

The truck driver's ability to sight the approaching train was probably restricted due to the truck's cab-design and the likelihood that the vehicle stopped at an angle to the railway track. Once the truck proceeded into the path of the train, there was insufficient time for the train driver to stop the train before colliding with the truck.

The investigation also noted that road vehicles had progressively cut the corner when entering/exiting the private road, resulting in the gradual widening of junction at Wagoora-Yalboroo Road. This could influence the position of road vehicles when stopped at the crossing and in turn, affect the ability for drivers of some larger vehicles to sight an approaching train.

In considering the Queensland government's long-term level crossing safety strategy, the ATSB found that private (occupation) crossings had been specifically excluded. However, the ATSB notes that providing unrestricted public access to a private (occupation) crossings could present a level of risk similar to that of a public road crossing. While the program has achieved a wide range of positive safety initiatives and improvements, the ATSB found that exclusion of private (occupation) crossings from the strategy potentially removes an opportunity to further improve safety outcomes for all level crossing users across Queensland.

What's been done as a result

While the Queensland Level Crossing Safety Group (QLCSG) focus remains on the higher risk public level crossings, they acknowledge that private (occupational) level crossings also require management under the Rail Safety National Law. Stakeholders of the QLCSG agree to review the status and treatment at private level crossings used by the public (such as in this case). Where appropriate, private crossings will be included as a subset of public level crossings for the purposes of their safety strategy.

Queensland Rail (QR) conducted an audit of level crossing ID 5318. The installation was found to be consistent with the QR standard. However, some enhancements were identified and programmed for installation under routine maintenance activities.

With respect to all private (occupation) crossings in Queensland, QR is liaising with private property owners to enter into licence or interface agreements to ensure the safe operation and

use of the private level crossings. Where appropriate, private crossings would be closed or, if used by the general public, upgrade to public crossing status.

Safety message

Truck drivers are reminded that cabin designs can limit their view to the left out of the passenger window. As a result, when stopped at a rail level crossing, this can influence the distance away a train approaching from their left can be seen. Taking care to maximise this sighting distance is important to ensure a safe crossing.

Rail operators and governments should continue to implement programs for improved safety at railway level crossings. This should include considering safety strategies for private (occupation) crossings, especially where the level of risk may be similar to that of a public road crossing.

Contents

The occurrence

On 27 August 2017, train 8279 departed Acacia Ridge, Brisbane, Queensland, for Stuart Yard in Townsville. Train 8279 consisted of one locomotive (2813) and 23 wagons. The train was 480 m in length, with a total weight of 1370 t.

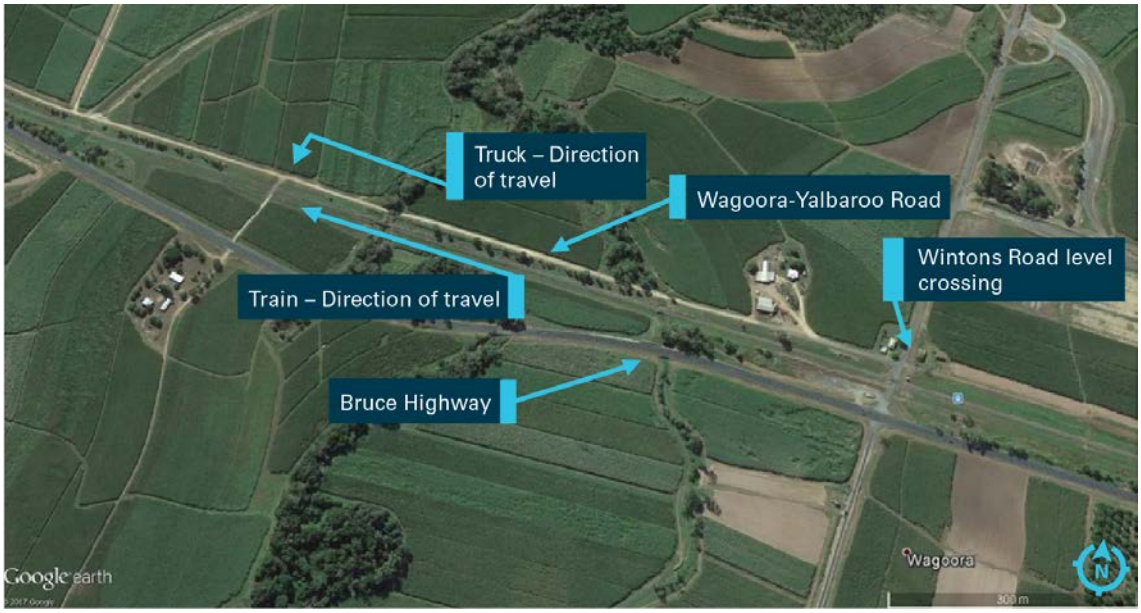
On the morning of 29 August 2017, train 8279 arrived at Mackay, about 964 km[1] north of Brisbane. A crew change was undertaken, before train 8279 departed Mackay at about 0845 Eastern Standard Time (EST), and continued traveling north.

At about 0937, train 8279 passed through a crossing loop at Calen (1018.590 km). The track largely runs parallel to the Bruce Highway (to the west) with sugar cane fields on both sides. About 8 km after the crossing loop, the track tops a rise before turning in a more westerly direction and descending towards Wintons Road level crossing. Wintons Road is a sealed road with active traffic control devices (flashing lights) at the level crossing.

At about 0945, train 8279 passed over the level crossing at Wintons Road (Figure 1). Soon after, while travelling at about 84 km/h,[2] the train driver observed a dust cloud ahead and assumed it was a vehicle travelling on the parallel unsealed road to the north—Wagoora-Yalboroo Road. The train driver then sighted a truck approach the next level crossing (1028.693 km). The unsealed level crossing was equipped with passive traffic control devices (Stop signs).

The train driver sounded the train horn while observing the truck slow and stop at the crossing. The train was about 230 m from the crossing. The train driver described the truck as having stopped at an angle facing away from the approaching train. The truck then proceeded to cross the track in front of the train. The train driver immediately gave a second sustained sounding of the horn (about 3 seconds), placed the brake handle into the emergency position, before moving to the foot-well for protection.

Figure 1: Aerial view of the level crossing approach and road alignment



The truck was travelling west along Wagoora-Yalboroo Road before turning left towards the railway crossing and the Bruce Highway. The train was also travelling west, parallel to the road. Source: Google Earth, annotated by ATSB

1 Rail distance measured from the track kilometre zero point located at Roma Street Station, Brisbane.

2 The posted speed limit was 100 km/h.

A few seconds later, train 8279 collided with the driver's cab of the truck. The train travelled a further 640 m before stopping. Shortly after, the driver of train 8279 contacted the Queensland Rail Network Control Centre to report the collision.

The truck driver sustained fatal injuries. The train driver was shaken but otherwise unhurt.

Context

Level crossings provide for traffic management where a railway line and road intersect. Crossings are usually categorised as either public crossings or private crossings. Public crossings provide unrestricted access to all road users (the general public) for everyday use. Private crossings (or 'occupation' crossings) are on private land and are often exclusively used by the landowner.[3]

The collision on 29 August 2017 occurred at a crossing defined by Queensland Rail (QR) as an *Occupation/Private rail crossing, QR ID number 5318*. The road provided vehicle access between Wagoora-Yalboroo Road and the Bruce Highway, and was about 120 m in length.

Standards for traffic control devices at railway crossings

Australian Standard 1742.7:2016 *Manual of uniform traffic control devices, Part 7: Railway crossings*, prescribes the requirements for road markings, roadside signs and configuration of traffic controls at railway crossings throughtout Australia. The standard states that the requirements are:

> …not applicable to railway crossings provided for the exclusive use of the occupier of private land or by other people with the knowledge and agreement of the occupier (sometimes known as 'occupation' crossings).

While crossing ID 5318 was classified as an occupation crossing, the road provided unrestricted access between Wagoora-Yalboroo Road and the Bruce Highway. Consequently, the crossing was almost certainly used as a public thoroughfare, in which case the requirements of Australian Standard 1742.7:2016 may apply. The minimum treatment specified in the standard was a RX-1 assembly (Give-way sign), subject to documented conditions.[4]

In 1997, QR engaged a consultant to develop an organisational standard for all occupation crossings on their rail network. The consultant report recommended a RX-2 assembly (Stop sign) as the standard for all occupation crossings. This recommendation exceeded the minimum treatment requirement of Australian Standard 1742.7:2016[5] and was consistent with the installation at crossing ID 5318 (Figure 2).

The consultant report also recommended minimum sighting distances at occupation crossings. For train speeds of 100 km/h on single track, the minimum sighting distance for a vehicle stopped at the stop sign was recommended as 450 m. QR records indicate that sighting distances at occupation crossing ID 5318 was in excess of 700 m.

In general, the traffic control devices installed at occupation crossing ID 5318 were consistent with the requirements documented in the QR organisational standard.

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3 Office of National Rail Safety Regulator (ONRSR) – *Policy: Railway crossings*

4 Conditions related to (road vehicle) approach speed, sighting and vehicle densities. If the conditions cannot be met, then full treatments would be required.

5 AS 1742.7:2016 specifies limitations on the use of minimum treatment crossings such as road traffic speed and visibility distance. Full passive control treatments would be required at crossings not meeting these limitations.

Figure 2: Traffic control devices at occupation crossing ID 5318

RX-2 assembly (Stop sign) to Australian Standard 1742.7:2016. Source: AS1742.7 and Queensland Rail

Environmental conditions

The closest Bureau of Meteorology (BOM) weather station was at Proserpine, about 56 km north of occupation crossing ID 5318. At 0900 (about 45 minutes before the collision), the weather was clear with a light south-easterly breeze and the temperature was about 22 °C.

The train driver reported seeing dust from a vehicle travelling on Wagoora-Yalboroo Road. Considering the road was north of the track and the wind was from the south-east, any dust would have been blown away from the railway line. It is very unlikely that the dust would have obscured the truck driver's vision of the approaching train.

The weather conditions were unlikely to have been a factor in the collision.

The sun's azimuth[6] and altitude[7] was 52° 09' 51" and 43° 42' 47" respectively. Therefore, the sun was relatively high in the sky, and to the north-east.

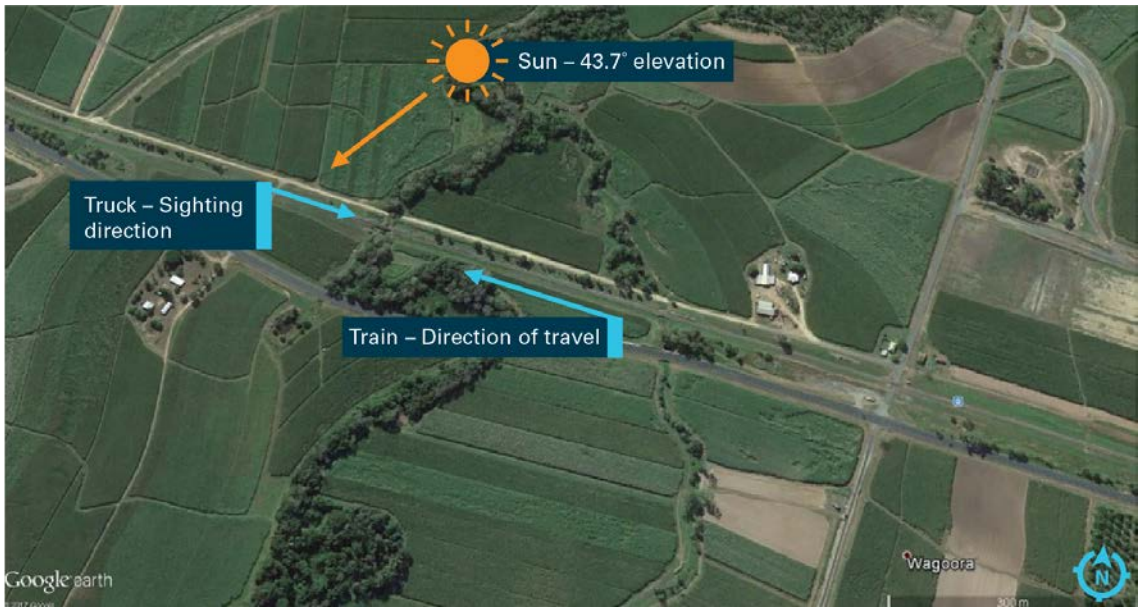
In this instance, train 8279 was approaching from the east. For a vehicle stopped at the crossing, the sun would have been almost directly behind the truck driver at an altitude of about 43° above the horizon (Figure 3).

It is unlikely that sun-glare or any other sun related effects would have been a factor in the collision.

6 Azimuth is the clockwise horizontal angle (in degrees, minutes and seconds) from true north to the sun/moon.

7 Altitude is the vertical angle (in degrees minutes and seconds) from an ideal horizon, to the sun/moon.

Figure 3: Sun position and sighting direction of truck driver



The sighting direction for the truck driver was towards the east. The sun was almost directly behind the truck driver at an altitude of about 43° above the horizon. Source: Google Earth, annotated by ATSB

Road vehicle

The vehicle was a 1983 Scania model P112 series 2, twin-steer truck and had been fitted with a flat tray body in May 2017 (Figure 4). The vehicle had a tare mass of 12.2 t and a gross vehicle mass of 26.5 t. Inspection, registration, insurance and modification certificates were all current.

The ATSB noted that the truck had a relatively prominent B-Pillar (Figure 4). The B-pillar of heavy vehicles is a feature known to obscure a driver's vision. It is likely that, under some conditions, a driver of this truck would experience a restricted view to the left due to the vehicle's B-pillar.

Figure 4: Road vehicle

The vehicle was a 1983 Scania model P112 series 2, twin-steer truck fitted with a flat tray body. The vehicle was loaded with a storage container, fuel tank and air compressor (inset). Note that under some conditions, it is very likely the truck driver's vision to the left may be restricted due to the vehicle's B-pillar. Source: Qld Police, Annotated by ATSB

At the time of the accident, the vehicle was loaded with a storage container, fuel tank and air compressor (Figure 4, inset). All were securely mounted on the flat tray body.

The storage container was relatively lightly loaded; an oil drum secured to the container frame, with a number of smaller fluid containers and hand tools stored on racks. The fuel tank[8] was found to be full (about 1650 lt).

There was no indication that the vehicle was overloaded. Similarly, and considering the fuel tank was full, it is unlikely that any load shift would have affected vehicle dynamics.

The damaged vehicle was examined by the Queensland Police Vehicle Inspection Unit. The inspection found an amount of water retained in the air (brake) system tanks. However, the report noted the train driver's observations that the truck had stopped at the crossing before proceeding, suggesting the brakes appeared to have been operating immediately prior to the incident. The report concluded that there were no obvious or apparent mechanical defects that could have contributed to the cause of the incident.

Road vehicle driver

The truck driver was appropriately qualified and had extensive experience driving heavy vehicles.

Fatigue

In the context of human performance, fatigue is a physical and psychological condition primarily caused by prolonged wakefulness and/or insufficient or disturbed sleep.[9] Fatigue can have a range of influences on performance, such as decreased short-term memory, slowed reaction time, decreased work efficiency, reduced motivational drive, increased variability in work performance, and increased errors of omission.[10] Fatigue impairment has been identified as causal in many transport related accidents.

The truck driver's work-hours were generally between 0630 and mid-afternoon. The driver had worked these times in the three days prior to the incident, having previously come off of a three-day break. It was evident that work was generally undertaken during daylight hours. There were also sufficient off-duty hours at night, providing ample opportunity for restorative sleep prior to commencing work the next day. In addition, full rest-days were provided, giving the opportunity for recovery away from the work environment.

On the day of the incident, the truck driver started work at 0630. He had worked in an on-site shed until about 0800 before travelling out to the cane fields in the truck. The accident occurred at about 0945, less than half way through the driver's normal workday. It was considered unlikely that the effects of fatigue were present either leading up to or at the time of the collision.

Medical and toxicology

Post-mortem examination found no evidence of any significant natural disease. Similarly, toxicology testing revealed no evidence of alcohol or drugs in blood and urine.

Looked but did not see

Research has shown that, in road accidents, critical/important information may have been detectible but the motorist did not attend to or notice it because their mental resources were

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8 External measurements: 900 mm x 920 mm x 2000 mm

9 National Transport Commission (2008). *National Rail Safety Guideline. Management of Fatigue in Rail Safety Workers*.

10 Battelle Memorial Institute (1998). *An Overview of the scientific literature concerning fatigue, sleep, and the circadian cycle, Report prepared for the Office of the Chief Scientific and Technical Advisor for Human Factors*, US Federal Aviation Administration.

elsewhere.[11] Furthermore, research into a phenomenon known as 'inattentional blindness'[12] has shown how a person may fail to detect an object even though they were looking directly at it.

The human mind has limited resources for perceptual and memory processing. To cope with this limitation, a mechanism called 'attention' acts as a filter to focus this resource on specific tasks. Research suggests that inattentional blindness can occur when attention is mistakenly filtered away from important information[13] and can be affected by mental workload, expectation, conspicuity and capacity.

In this case, the vehicle driver approached the railway crossing and was observed to have stopped at the stop sign, albeit at an angle facing away from the approaching train. It is possible that the driver looked towards the approaching train, but did not see or perceive its approach. Soon after stopping, the truck driver proceeded into the path of the train.

Expectancy

Expectancy can be understood as the extent to which an event or condition is expected to occur or be present at a particular time and place. An individual's expectation can influence their attention to (and preparation for) that event or condition.[14]

Studies undertaken into motorist behaviour have found that drivers who are familiar with a railway crossing are more likely to be involved in a crossing incident than drivers unfamiliar with the crossing.[15] An influencing factor is where motorists familiar with a crossing with relatively low train frequencies, don't expect a train since they are rarely seen.

The frequency of train movements across the railway crossing was relatively low—about 15 train movements per day. Therefore, while the truck driver was aware of the railway crossing due to regularly working in the area, the probability of him encountering trains was relatively low. It is therefore possible that the truck driver's familiarity with the railway crossing and a low expectation of encountering a train contributed to him not noticing the approaching train.

Driver Distraction

Distraction can be understood as a type of inattention, where a person's attention is diverted by a particular event or object. Driver distraction has been more specifically defined as 'the diversion of attention away from activities critical for safe driving toward a competing activity (occurring) voluntarily or involuntarily.'[16]

Driver distraction can involve a range of factors either inside or outside a vehicle that draw on limited human physical, visual and cognitive resources, and can result in a degradation of the driver's performance. For example, eating, drinking, operating devices integral to (or brought into) the vehicle (such as a mobile telephone), and smoking, are all activities that may distract from the driving task.[17]

While the source of distraction may often be physical, it can also be non-physical. For example, a situation where task-irrelevant thoughts interfere with task-relevant thoughts, may contribute to distraction and decrease task performance. A research study into the effects of irrelevant thoughts

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11 Green, M. & Senders, J. (2004). *Human error in road accidents*. Retrieved 13 March 2007 from www.visualexpert.com

12 Mack, A. & Rock, I. (1998), *Inattentional Blindness*. MIT Press: Cambridge, USA

13 Green, M (2004), Inattentional Blindness & Conspicuity. Retrieved 13 March 2007 from www.visualexpert.com

14 Wickens C.D. & McCarley, J.S. (2008). Applied Attention Theory. CRC Press: Boca Raton. pp 55-57.

15 Yeh, M. & Multzer, J. (2008). Driver Behaviour at Highway-Railroad Grade Crossings: A Literature Review from 1990-2006. Human Factors in Railroad Operations. United States Department of Transportation, Federal Railroad Administration: Washington DC.

16 Regan, M.A., Hallett, C. & Gordon, C.P. (2011). Driver distraction and driver inattention: Definition, relationship and taxonomy. Accident Analysis and Prevention, 43, 1771-1781.

17 Young, K.L., Regan, M.A., & Hammer, M. (2003). Driver Distraction: A review of the literature. Monash University Accident Research Centre. Available from: http://www.monash.edu.au/miri/research/reports/muarc206.pdf

and cognitive task performance concluded that 'when the proportion of irrelevant thoughts to relevant thoughts increases, performance suffers.'[18]

The truck driver was the sole occupant, so distraction by another person did not occur. The truck driver had a mobile phone, but there was no evidence of it being used at the time of the incident.

Based on the available evidence, there was nothing to indicate that the truck driver's attention had been diverted by a distracting object or event.

It is possible, however, that the truck driver's thoughts were directed towards other tasks. That is, rather than thinking about the task of look for an approaching train, the driver's attention may have been directed towards some other task-irrelevant thoughts.

Summary of driver behaviour

Other than witness observations, there was very little objective evidence for verifying driver behaviour. The truck was observed stopping at the crossing before the truck driver proceeded into the path of the train. There was no evidence to suggest that the effects of fatigue, drugs, alcohol, or any medical condition contributed to the collision.

In the absence of any evidence to the contrary, it is possible that the truck driver looked towards the approaching train but did not see or perceive its approach. It is also possible that distraction and a low expectation of encountering a train contributed to him not noticing the approaching train. However, the combination of the truck's cab-design (B-pillar) and that it stopped at an angle facing slightly away from the approaching train likely restricted the truck driver's ability to sight the train.

Rail vehicle

Freight train 8279 was operated by Aurizon and consisted of one locomotive (2813) and 23 wagons. The train was 480 m in length with a total weight of 1370 t.

The train was crewed by a single driver, who had about nine years' train driving experience. At the time of the collision, the train driver was appropriately qualified, assessed as competent and medically fit for duty.

The train driver was rostered to start work on 29 August 2017 at 0700, having had the previous two days off. The driver took control of train 8279 at 0830, about 75 minutes before the accident. It was considered very unlikely that train driver fatigue contributed in any way to the collision.

Following the accident, the train driver undertook routine drug and alcohol testing which returned a negative result.

Conspicuity

Conspicuity refers to an object's ability to capture attention. Physical factors that affect the conspicuity of an object include size, contrast and movement. The approaching train was large and travelling relatively quickly. However, from the truck driver's perspective, the perception of size and speed are likely to have been low due to its distance away (more than 200 m) and angle of approach (almost directly towards the truck driver).

The Rail Industry Safety and Standards Board (RISSB) develop and publish Australian Standards for the rail industry. Australian Standard AS 7531:2015 *Rolling stock standard – Lighting and Visibility* documents the requirements for lighting and rolling stock visibility and is applicable to new and existing locomotives.

The Australian standards states that the front of locomotives shall have areas of high visibility colour, either yellow, orange, orange-red or red. Locomotives shall also have white marker lights

[18] Pennie S. Seibert and Henry C. Ellis, Memory & Cognition (1991), Irrelevant thoughts, emotional mood states, and cognitive task performance, 507-513.

and at least one white headlight, mounted at least 2.3 m above the rail. The standard also makes reference to a requirement for visibility lights. The RISSB standard stated:

> The primary purpose of locomotive visibility lights is to enhance the visibility of the front-end locomotive of a train from the perspective of a driver of a motor vehicle approaching a level crossing.

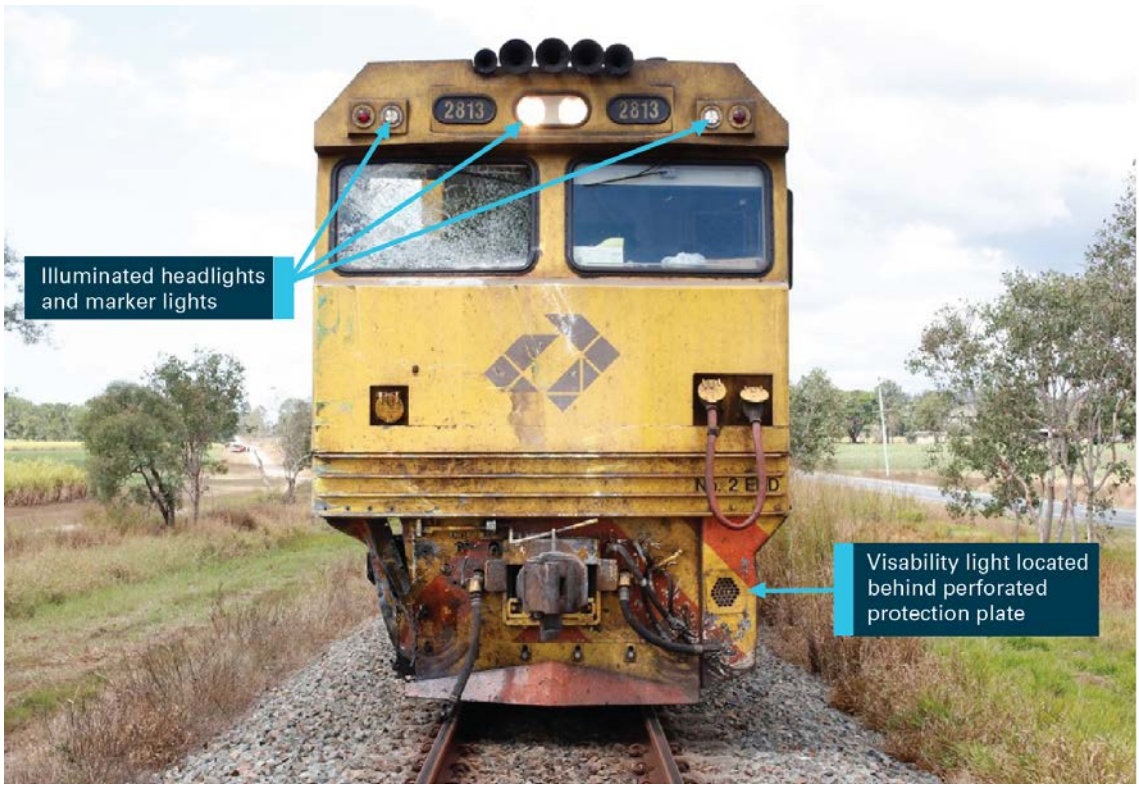
The two white visibility lights are mounted on either side of the locomotive front, between 600 mm and 1200 mm above the top of the rail. The standard stated that lights must alternately flash on and off when the horn is sounded, and continue flashing for at least fifteen seconds after the horn has been sounded

QR also publish their *Interface Standards* (MD-10-194, dated 23 July 2014) which prescribes the minimum requirements for rolling stock operating on QR infrastructure. The QR standard was largely consistent with the RISSB standards regarding colour, headlights and marker lights. While the QR standard also included the requirement for visibility lights, it did not make mention of any requirement for visibility lights to flash when the horn is sounded.

In this case, the front of locomotive 2813 was painted yellow as per the RISSB and Queensland Rail visibility standards.

The operational condition of the 2800 class locomotives headlights is a parameter recorded on the locomotive data log. In this case, the data log for locomotive 2813 indicates the headlights were illuminated on hi-beam while approaching the level crossing. Figure 5 also shows that both the headlights and the marker lights were still illuminated after collision.

Figure 5: Rail vehicle – Locomotive 2813 (post-collision)



To improve conspicuity, the front of locomotive 2813 was painted yellow and its headlights were illuminated. Source: Qld Police

The 2800 class locomotives also have visibility lights, which sit to the side of the coupler behind a perforated protection plate (Figure 5). The lights are manually controlled by the train driver and operate continuously when switched on, but do not flash when the horn is sounded.

When photographed following the collision, one of the visibility light was destroyed as a consequence of the collision and the other was not illuminated (Figure 5). The ATSB noted that a photograph of the driver's overhead console indicated the switch controlling the visibility lights was

in the off position.[19] The train driver advised that it is normal to travel with the visibility lights on, and recalled that the lights were on in this case.

Discussions with other drivers of 2800 class locomotives noted that it is routine to operate the train with the headlights and visibility lights on. When stopping at a station or crossing loop, a driver might turn the visibility lights off and switch headlights to low beam to avoid light glare affecting an opposing train/driver. However, when departing, drivers usually turn on both the locomotive generator field and the visibility lights at the same time, since these switches are adjacent each other. In this case, it was not unexpected that the headlights remained on after the train stopped following the collision and the train driver had secured the locomotive, as this would be normal practice when stopping. However, it could not be confirmed at what time the visibility lights were switched on or off, since the operational condition of the visibility lights is not a parameter recorded on the locomotive data log.

Locomotive 2813 incorporated all lighting and visibility features documented in the QR interface standard. However, an enhancement documented in the Australian standard (flashing lights when the horn is sounded) was not included on locomotive 2813.

In this instance, the headlights were switched on, but the condition of the visibility lights could not be verified. While visibility lights, and their flashing feature if available, may capture a road vehicle driver's attention under some conditions, it is unknown if it would have resulted in a different outcome in this case.

Audible devices

Given the size and weight of most trains it is not possible to brake at anywhere near the rate of a road vehicle. Heavy freight and locomotive hauled passenger trains normally take in excess of 1 km to stop from high track speeds, even if the train driver initiates an emergency application of the brakes.

In an event such as this, by the time the train driver observes a truck begin to move into the path of the train, there is insufficient time to take any avoiding action to prevent the collision other than sounding the whistle and applying the brakes. In this specific case, the brakes had only barely begun to take effect (speed reduced from 84 km/h to 83 km/h) as train 8279 traversed the crossing.

Historically, audible devices have been considered an important component in the systems used to warn motorists of an approaching train. However, soundproofing, air conditioning and entertainment systems in modern vehicles have generally reduced the effectiveness of audible warnings.[20] Similarly, surrounding sounds such as vehicle engine noise (potentially significant for heavy vehicles) and other road noises (nearby traffic) may reduce the ability for a vehicle driver to hear the sounding of a train horn.

In this case, the driver of train 8279 sounded the locomotive horn twice while approaching the level crossing. The first sounding was when the truck was observed having stopped at the crossing. The second sustained sounding was when the truck was observed starting to move into the path of the train, at which point the train driver placed the brake handle into the emergency position, before moving to the foot-well for protection.

Once the truck moved forward onto the crossing, a collision was inevitable considering the proximity of train.

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[19] The photographs were provided by Queensland Police. Metadata indicates that the photographs of the locomotive were taken about 2.5 to 3 hours after the collision.

[20] It should be noted that the use of portable entertainment systems (iPods etc.) has also significantly reduce the effectiveness of audible warning devices for bicycle riders and pedestrians.

Safety analysis

For this accident, there was no evidence to suggest that factors such as sun-glare, mechanical defect, fatigue, drugs, alcohol, or medical condition contributed to the collision. Similarly, the traffic control devices installed at this location were consistent with Queensland Rail's design standards for private (occupation) crossings.

In this case, the train driver described the truck as having stopped at an angle facing away from the approaching train. Consequently, the truck driver's ability to sight a train approaching from the left was examined further.

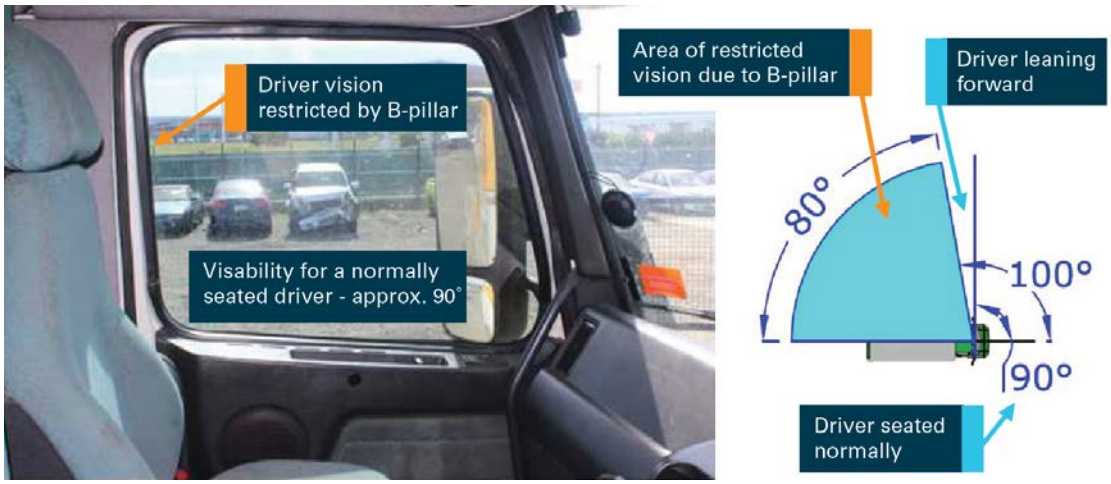
The ATSB also examined the long-term programs and strategies for improving safety outcomes for all level crossing users across Queensland.

Vision obstructions due to vehicle

While most vehicles exhibit features that may obscure a driver's vision, it is particularly true for heavy vehicles. Considering the cab-design of the vehicle involved in this incident (Figure 4), it is very likely that under some conditions, the driver's vision to the left would have been restricted due to the vehicle's B-pillar.

The Queensland Police conducted visibility testing using a vehicle with very similar side window and B-pillar configurations.[21] Testing showed that clear visibility was available to 90° for a normally seated driver simply turning the head to look out the passenger side window. If the driver was to lean forward over the steering wheel, the angle of vision increased to about 100°. However, vision beyond 100° to the left was not possible through the passenger side window (Figure 6).

Figure 6: Road vehicle visibility testing



Road vehicle visibility testing indicated a complete restriction to driver visibility beyond 100°, when the driver was looking out the left side passenger window. Source: Qld Police, annotated by ATSB

Table 1 shows the results of the Queensland Police road vehicle visibility testing and is presented in terms of road vehicle angle relative to the rail line. As this angle decreases, a road vehicle driver is required to look further to the rear of 90° to sight along the rail line. It is evident from testing, that sighting objects through the passenger side window is significantly reduced if the road vehicle stops at an angle to the rail line. If the vehicle angle relative to the rail line was less than 80°, the driver would be unable to sight the full distance along the rail line, even when leaning forward over the steering wheel.

[21] An undamaged 1983 Scania model P112 series 2, twin-steer truck was not available for examination.

Table 1: Road vehicle visibility – test results

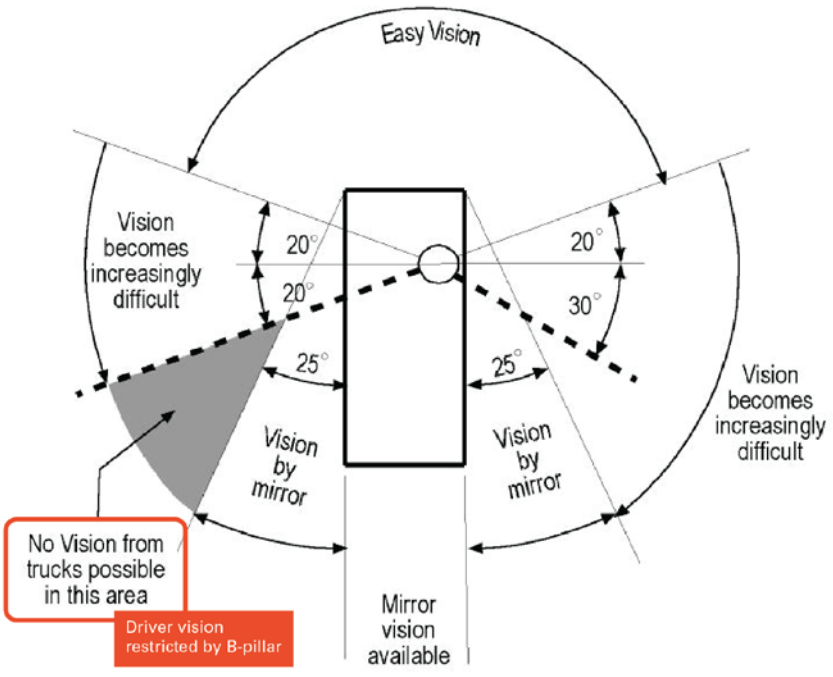
Vehicle angle relative to rail line and approaching train	Sighting distance along rail line for a truck driver seated normally and looking left	Sighting distance along rail line for a truck driver leaning forward and looking left
90°	Full train approach visibility	Full train approach visibility
85°	53 m	Full train approach visibility
80°	26 m	Full train approach visible
75°	17 m	54 m
70°	12 m	26 m

Results from road vehicle visibility testing on a vehicle similar in configuration to the incident vehicle, based on a stopping distance of 2.5 m before the rail line. Note, the measured results have been rounded to the nearest metre. Source: Qld Police

The Austroads *Guide to Road Design* provides guidance to road designers on the geometric design of all types of road intersections and crossings. The Queensland Department of Transport and Main Roads (TMR) publish their *Road Planning and Design Manual* that largely accepts the requirements documented in the Austroads publication.

The Austroads guide notes that there are no design rules dealing with visibility from vehicles, but makes reference to published information regarding restrictions due to vehicle design[22] (Figure 7). Considering the published restrictions due to vehicle design, TMR policy was that road centre lines should be designed to intersect at between 70° and 110° in both urban and rural situations.

Figure 7: Sight restrictions due to vehicle design



The Austroads guide notes that vision form the cab of a vehicle becomes increasingly difficult to the side and rear of the vehicle. The rectangle represents a vehicle; the circle represents the vehicle driver. Note the area highlighted indicating where vision from a truck may be restricted due to the vehicle's B-pillar. Source: Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*, Annotated by ATSB

The tests undertaken by Queensland Police showed similar results to the limitations documented in the road design guidelines. That is, vision out the left side passenger window became increasingly difficult as the angle increased to 20° behind 90°. At an angle variation of 20°, a driver

[22] Ackerman C. (1989): *Vehicle Characteristics* (Course notes titled *Traffic Engineering Practice* edited by Ogden and Bennett for Monash University, Melbourne)

in the test vehicle would only be able to sight another vehicle approaching from the left when it was within about 26 m.

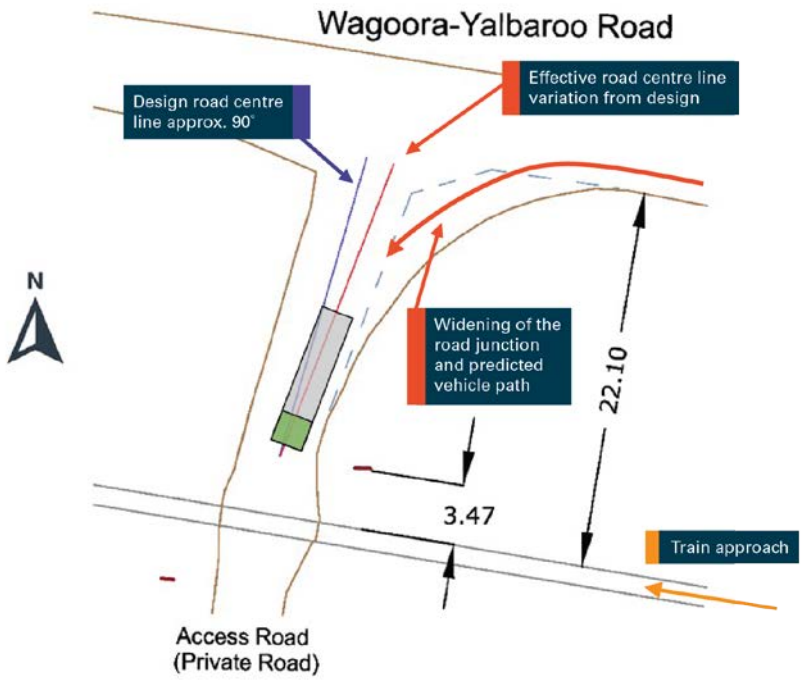
Road vehicles are capable of braking relatively quickly. In the context of a road intersection, the driver of an approaching road vehicle is likely to sight another vehicle starting to enter the intersection and take action to avoid an imminent collision.

However, given the size and weight of most trains it is not possible to brake at anywhere near the rate of a road vehicle, nor is it possible to rapidly accelerate or decelerate a train. Therefore, at railway level crossings, it is much more important for the driver of the road vehicle to take action to avoid a collision.

At level crossings protected by Stop signs, motorists are required to stop in order to look for any approaching trains. Consequently, sufficient sighting distance must be available for a motorist to see an approaching train in time to make an informed decision whether it is safe to proceed over the crossing. Australian Standard 1742.7:2016 includes design criteria for calculating sighting distance requirements at level crossings protected by Stop signs. For the configuration at occupation crossing ID 5318, at least 430 m sighting distance is required to provide adequate time for a large road vehicle to accelerate from stop and safely clear the crossing before the arrival of an approaching train. When considering the results of the visibility testing, this could only be achieved if the road vehicle has stopped at an angle greater than 80° to the rail line.

At the accident location, the private road intersected the rail line at an angle of about 90°. However, the junction between the private road and Wagoora-Yalboroo Road (approximately 19 m from the railway crossing signage) showed evidence of widening at its eastern corner. Both roads were unsealed, so widening probably occurred gradually as road vehicles progressively cut the corner when entering/exiting the private road. Consequently, the effective centre line of the road varied from the designed 90° (Figure 8). The ability for a road vehicle to cut the corner and enter the private road at an angle, combined with a relatively short distance to the crossing, may influence the positioning of larger vehicles when stopped at the crossing.

Figure 8: Road angle



The design angle for the road centre line at the level crossing was approximately 90° to the rail line. However, due to widening of the road junction eastern corner, the effective centre line of the road varied from the designed 90°. Source: Qld Police, annotated by ATSB

In this case, the train driver described observing the road vehicle having stopped at the crossing, but it appeared to be angled facing slightly away from the approaching train. Considering both the train driver observation and the geometry of the private road, the angle between the vehicle direction and the railway was very likely less than 90°. Visibility testing suggested that at almost any angle less than 90°, the truck driver's ability to sight sufficient distance along the rail line would have significantly reduced. However, there is insufficient evidence to determine the exact angle the vehicle stopped, nor what action the truck driver may have taken to check for an approaching train before proceeding over the crossing.

Railway level crossing safety strategy

A 2009 study found there were about 21,800 road/railway level crossings in Australia. Of these, about 8,800 were public road crossings and 13,000 were classified as private/occupation crossings.[23] While the number of private crossings is relatively high, they are normally provided for the exclusive use of a landowner to access private land. Private crossings are not intended as a thoroughfare for access by the general public, consequently the lower usage of the road lessens the level of risk that may arise from the crossing.

The Office of the National Rail Safety Regulator (ONRSR) publishes a document titled *Policy - Railway crossings*. The policy focus is on addressing public crossings which are generally considered a greater safety risk to road users. However, it notes that the application of the policy with respect to private crossings should also be considered in relation to risk. That is, regardless of a level crossing being defined as public or private, a rail infrastructure manager is still required to eliminate or minimise the risk that may arise from railway crossings, so far as is reasonably practicable. The policy states that ONRSR expects to see continuous improvement in the safety of railway crossings and ultimately seeks a reduction in the number of railway crossings.

The ONRSR policy refers to a Rail Industry Safety and Standards Board (RISSB) guideline for the consolidation of level crossings.[24] The guideline acknowledges that managing risk so far as is reasonably practicable may include permanently closing the level crossing to road/pedestrian traffic. The guideline suggests that multiple level crossings in close proximity (within a five kilometre distance or less) present prime opportunities for consolidation.

In July 2012, the Queensland government (Department of Transport and Main Roads) published their *Level Crossing Safety Strategy 2012-2021* as a '…commitment to further improve safety outcomes for all level crossing users'. The document detailed 12 key strategies, one of which is to '…eliminate level crossings where appropriate'.[25]

There are multiple stakeholders (state/local government and rail/road organisations) involved in managing safety risk at railway level crossings in Queensland. The Queensland Level Crossing Safety Group (QLCSG) provides a forum to bring these stakeholders together to work collaboratively to address the 12 key safety strategies. The QLCSG is chaired by the Department of Transport and Main Roads. Queensland Rail and the infrastructure manager for level crossing ID5318, is a stakeholder and active member of the group.

The QLCSG has documented[26] a number of achievements since the launch of the safety strategy. While increased education and enforcement has been significant, there has also been progress made with respect to reducing the number of level crossings in Queensland. This has been achieved by closing level crossings where possible, grade separations (overpasses), the closure of branch lines and by not introducing new level crossings onto the network.

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23 RISSB - National Level Crossing Stocktake (2009)

24 RISSB Guideline - Consolidation of public level crossings

25 The strategy compliments the Queensland government's *Road Safety Strategy 2015 – 2021.*

26 Queensland Level Crossing Safety Strategy 2012-2021 - 2013-2014 Annual Report. The strategy was also reviewed in 2017 with the intention to update and acknowledge further improvements.

It is evident that the strategy and actions to date are generally consistent with the ONRSR policy in that the removal of unnecessary or rarely used public level crossings has been considered.

However, the level crossing safety strategy and the QLCSG report both state that private (occupation) crossings are excluded and that private crossings are considered a workplace health and safety matter. Notwithstanding the exclusion, the QLCSG advised that issues in managing private (occupation) crossings has occurred informally in the past and will continue.

With respect to managing risk, the objective of work health and safety legislation[27] is largely consistent with that of rail safety legislation.[28] That is, the duty imposed is to eliminate or minimise the risk to health and safety, so far as is reasonably practicable.

As part of the management of risk at level crossings, Queensland Rail undertake data collection and assessment of all crossings (public and private) on their network. The data and assessments help guide Queensland Rail's programs for ensuring level crossings (public and private) are maintained in accordance with their documented standards. While crossing ID 5318 provided vehicle access similar to that of a public crossing, the data recorded relatively low risk scores for most elements of the assessment. The ATSB noted that the annual average daily traffic recorded at the crossing was 100 vehicles per day, seasonal. The seasonal notation suggested that the traffic was very likely associated with cane production and less likely associated with general public. However, it was also likely that much of the traffic used the crossing as a thoroughfare between the two public roads, rather than for the sole purpose of accessing a small strip of cane field adjacent the railway track.

While crossing ID 5318 was classified as a private (occupation) crossing, its unrestricted access as a thoroughfare between two public roads likely presented a level of risk similar to that of a public road crossing. Consequently, the strategies for addressing the risk should be consistent for those used as a public thoroughfare whether the crossing is a public or a private (occupation) crossing.

It was reported that the truck driver in this case was travelling between properties located on the Wagoora-Yalboroo Road and another located on the opposite side of the Bruce Highway. It is evident that in this case, crossing ID 5318 was being accessed as a thoroughfare between Wagoora-Yalboroo Road and the Bruce Highway.

There were a number of level crossings in the relative vicinity of crossing ID 5318 (both public and private). Of specific relevance was the Wintons Road level crossing, located about 900 m east. Wintons Road is a sealed road with active traffic control devices (flashing lights) at the level crossing. For the truck in this case, traversing the railway track at the Wintons Road level crossing was a viable and safer alternative for crossing the railway track (Figure 9).

However, road related issues should also be taken into account when considering alternative routes. For example, information provided the truck operator (Fox Hall Harvesting Group) suggested that road signage near the Wintons Road – Bruce Highway road intersection may pose sighting issues for drivers of larger vehicles such as tractors and trucks.

Some cane harvesting vehicles are not permitted to operate on the highway. Consequently, in some cases, the sole access to property may be via a private (occupation) crossing. However, the ATSB notes that this scenario is consistent with the intention of a private (occupation) crossing and its provision should not encourage unrestricted public access as a thoroughfare.

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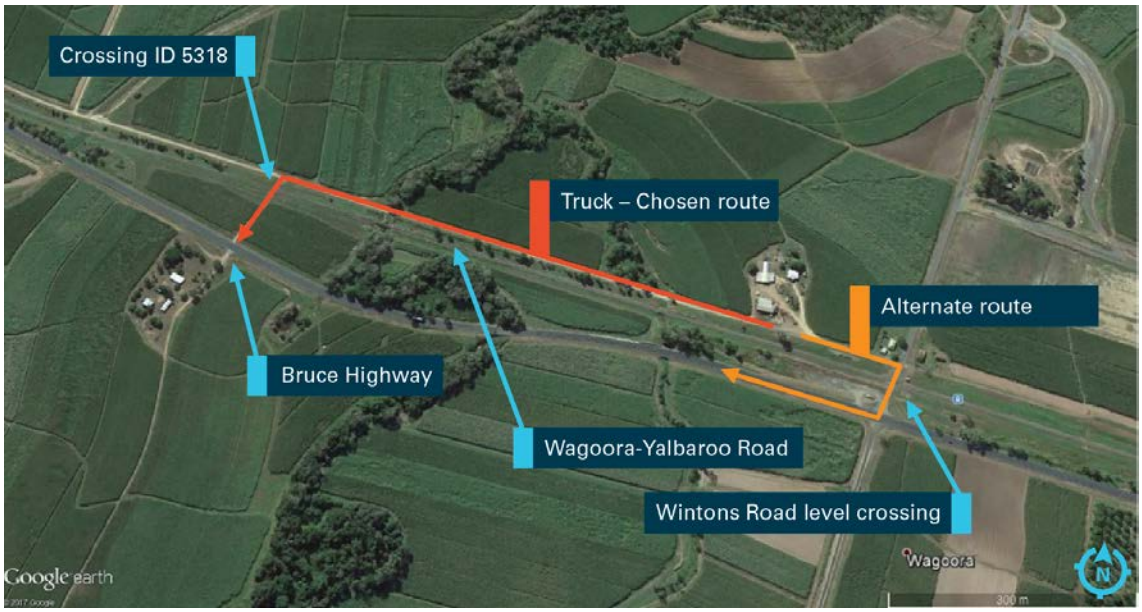
[27] Work Health and Safety Act 2011

[28] Rail Safety National Law (Queensland)

Figure 9: Chosen route (red) and alternative route (orange)



The truck was travelling between properties located on the Wagoora-Yalboroo Road and another located on the opposite side of the Bruce Highway via crossing ID 5318. There was a viable and safer alternative for travelling to the intended destination via Wintons Road with active traffic control devices (flashing lights) at the level crossing. Source: Google Earth, annotated by ATSB

In the absence of measures preventing unrestricted public access and considering the proximity of an alternative crossing with active traffic control devices (flashing lights), it is possible that crossing ID 5318 might present an opportunity for Queensland Rail to consider consolidation as encouraged by documented level crossing safety policies and safety strategies.

The exclusion of private (occupation) crossings from the Queensland level crossing safety strategy potentially removes an opportunity to further improve safety outcomes for all level crossing users across Queensland. This is especially the case for crossing ID 5318 and other private (occupation) crossings with a similar configuration, where unrestricted public access may present a level of risk similar to that of a public road crossing.

Findings

From the evidence available, the following findings are made with respect to the collision between freight train 8279 and truck, at level crossing ID 5318 near Yalboroo, Queensland on 29 August 2017. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- After stopping at the stop sign, the road vehicle driver then proceeded onto the level crossing and into the path of the train.
- There was insufficient time for the train driver to stop the train before colliding with the truck.
- The combination of the truck's cab-design and the likelihood that the vehicle stopped at an angle less than 90° to the railway track likely restricted the truck drivers sighting of the approaching train.

Other factors that increased risk

- Some private (occupation) crossings in Queensland, such as crossing ID 5318, provide unrestricted public access between two public roads. These crossings present a level of risk similar to that of a public road crossing where either a higher level of treatment may be applicable with respect to traffic control devices, or closure may be a consideration.
- The exclusion of private (occupation) crossings from the Queensland level crossing safety strategy potentially removes an opportunity to further improve safety outcomes for all level crossing users across Queensland. This is especially the case for crossing configurations where unrestricted public access may present a level of risk similar to that of a public road crossing.
- The combination of the widening of junction at Wagoora-Yalboroo Road with the relatively short distance to the railway crossing could influence the position of road vehicles when stopped at the crossing and in turn, could affect the ability for drivers of some larger vehicles to sight an approaching train.

Other findings

- While there is insufficient evidence to determine conclusively, there are a number of other factors that may have influenced why the truck driver proceeded onto the level crossing:
    - The truck driver looked towards the approaching train, but did not see or perceive its approach (inattentional blindness).
    - The truck driver's familiarity with the railway crossing and a low expectation of encountering a train contributed to him not noticing the approaching train.
    - The truck driver's attention may have been directed towards some other task-irrelevant thoughts.
- The traffic control devices installed at occupation crossing ID 5318 were consistent with the requirements documented in the Queensland Rail organisational standard.
- It is unlikely that sun-glare or any other environmental conditions contributed to the collision.
- There were no obvious or apparent mechanical defects to the truck that could have contributed to the collision.
- The locomotive was relatively conspicuous in colour (yellow), its headlights were illuminated and the train driver had sounded the train whistle twice while approaching the crossing.
- For both the truck driver and the train driver, it is unlikely that the effects of fatigue, drugs, alcohol, or any medical condition contributed to the collision.

- There was a viable and safer alternative for the truck to travel to the intended destination. This alternative involved traversing the railway track via a sealed road with active traffic control devices (flashing lights) at the level crossing.

Safety actions

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Proactive safety action taken by Aurizon

- External communications – Aurizon has ongoing engagement with local authorities (and in this case Mackay Regional Council) prior to sugar seasons, for the purpose of raising awareness of above rail operations during the sugar crushing.
- Internal communications – In addition to the existing 'pre-start' and 'tool box' talks provided for rail traffic crew, specific information has been shared with rail traffic crew subsequent to this occurrence to reinforce procedures and re-remind rail traffic crew of increased presence of vehicles due to the cane crushing season and to continue to report all occurrences as required and to continue to report near misses as required.

Proactive safety action taken by Queensland Rail

- On the 6 November 2017, Queensland Rail (QR) conducted an audit (site survey) to confirm site distances and the signage has been installed to the QR standard. The result of this audit found that the level crossing had appropriate sighting distance and signage for the controls in place in accordance with QR's level crossing standard for private crossings. It is assumed that during cane season the crossing is used by the land owner's trucks and harvesting equipment and it appears the crossing is well maintained.

  Whistle boards are installed at the 428 m from the crossing to the south and 375 m from the north. The audit identified that additional whistle boards should be installed at 250 m either side of the crossing due to the rail line speed of 100 km/h and that the R26 sign has started to fade and should be replaced. These will be addressed by the local asset manager under routine maintenance activities.
- Independently to this incident occurring, QR had already put in place an audit programme to assess all private crossings, upgrade them to the QR standard as necessary, and seek to enter into interface agreements. This programme was progressing at the time of the accident. Although the programme had not yet covered the specific location of this crossing at the time of the accident, QR is actively working towards improving or eliminating private crossings.
- QR is requesting the relevant party (local government or landholder) enter into an appropriate licence or interface agreement with Queensland Rail for the safe operation and use of the private level crossings. Audits have so far been completed within the Far North, North West and Mackay regions of Queensland. To date, the audits have identified eight crossings for closure (as they are no longer required by any party) and eight crossings that will be changed from a private status to a public status crossing as they appear to be used by the general public. One crossing has been identified as requiring relocation. As at May 2018, licence/interface agreements for 85 crossings have been sent to relevant parties in the shire areas noted above and 15 licence/interface agreements have been formalised.
- QRI reviews its level crossing standard on a 2 yearly basis and the current review is due to be completed in 2019. It has been identified in this review that consideration needs to be given to the frequency of audit of private level crossings.

Proactive safety action taken by Fox Hall Harvesting Group

Fox Hall Harvesting Group advised that they are prepared to erect no access signs as well as private property signs on both sides of the access road. They are also prepared to consider lockable gates and a fence on the boundary between the property and the railway easement to stop public use.

ATSB comment:

The ATSB acknowledges the willingness of the property owner to take action preventing public use of the private crossing. However, it is noted that any action should be done in consultation with the rail operator to ensure unintended hazards are not introduced.

Proactive safety action taken by the Queensland Level Crossing Safety Group (QLCSG)

At the QLCSG meeting held on 30 May 2018, the responsibilities under the Rail Safety National Law in relation to private (occupational) level crossings was acknowledged as being the primary means by which to manage safety at these locations. It was agreed that the QLCSG should remain focused on the higher risk public level crossings. However, in recognition of ATSB's draft finding, it was also agreed that rail infrastructure managers would undertake a one-off review of private level crossings that are being used by the public (similarly to Yalboroo). The intent would be to review their status and treatment, and where assessed, include them as a sub-set of public level crossings for the purposes of the Strategy and QLCSQ functions.

General details

Occurrence details

Date and time:	29 August 2017 – 0945 EST	
Occurrence category:	Accident	
Primary occurrence type:	Level crossing collision	
Location:	Level crossing 5318 near Yalboroo, QLD	
	Latitude: 20°50'49.7"S	Longitude: 148°41'41.9"E

Train details

Train operator:	Aurizon	
Registration:	8279	
Type of operation:	Freight	
Train details:	One locomotive (2813) and 23 wagons, 480 m in length, total weight of 1370 t.	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Minor	

Truck details

Registration:	Private	
Vehicle details:	1983 Scania model P112 series 2, twin-steer truck, fitted with a flat tray body	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Fatality	Passengers – Nil
Damage:	Destroyed	

Infrastructure

Track manager:	Queensland Rail
Level crossing details:	RX-2 assembly (Stop sign) to Australian Standard 1742.7:2016
Damage:	Nil

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Aurizon
- Queensland Rail
- Queensland Police Service
- Office of the national rail safety regulator
- Bureau of Meteorology
- Crew of freight train 8279

References

Australian Government, Geoscience Australia

Australian Level Crossing Assessment Model ALCAM

Australian Standard 1742.7:2016 *Manual of uniform traffic control devices, Part 7: Railway crossings*

Australian Standard AS 7531:2015 *Rolling stock standard – Lighting and Visibility*

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Queensland Rail *Interface Standards* (MD-10-194, dated 23 July 2014)

Rail Industry Safety and Standards Board - *National Level Crossing Stocktake (2009)*

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Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the next of kin, the crew of train 8279, Aurizon, Queensland Rail, Queensland Police Service, the Queensland Department of Transport and Main Roads, the trucking company and the Office of the National Rail Safety Regulator.

Submissions were received from the crew of train 8279, Aurizon, Queensland Rail, Queensland Police Service, the Queensland Department of Transport and Main Roads, the trucking company and the Office of the National Rail Safety Regulator. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation

Level crossing collision between freight train 8279 and truck, at level crossing 5318, near Yalboroo, Queensland, on 29 August 2017

RO-2017-012
Final – 11 September 2018