Australian Government

Australian Transport Safety Bureau

Level crossing collision between passenger train E820 and road vehicle

Wynnum West, Queensland, on 26 February 2021

ATSB Transport Safety Report

Rail Occurrence Investigation (Defined)

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Addendum

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Executive summary

What happened

On the afternoon of 26 February 2021, a Queensland Rail suburban express passenger train was approaching the Kianawah Road level crossing in the Brisbane suburb of Wynnum West, Queensland. The boom barriers were in the lowered position and other protection devices (flashing lights) were active at the level crossing.

At the same time, after stopping to give way to opposing road traffic at the intersection, immediately adjacent to the level crossing, a motor vehicle turned towards the crossing. It then continued through the level crossing, bypassing the lowered boom barrier, colliding with the train. The motor vehicle was destroyed, and the sole occupant was fatally injured. The only 2 occupants of the train, the driver and guard, were not injured.

What the ATSB found

The ATSB found that there was a 3.1 m gap between the tip of the boom barrier and the median island, which meant that the barrier only partially blocked road traffic that approached the level crossing from Lindum Road. In this instance, it was very likely that the driver of the motor vehicle followed the turn line markings on the road surface, which directed them past the end of the lowered boom barrier onto the level crossing and into the path of the approaching train. Safety concerns raised by local road users and work undertaken by the Government also indicated that the road-rail interface at the Kianawah Road level crossing was complex and visually noisy from a road user's perspective.

Queensland Rail had not been managing risk at level crossings in accordance with the requirements of its level crossing safety standard. In particular, the standard stated that public and pedestrian level crossings were to be assessed every 5 years or sooner. However, the Kianawah Road level crossing had not been assessed for 19 years. Some other level crossings with high instances of incidents and accidents had also not been assessed for 20 years.

It was also identified that, between 2016 and 2021, Queensland Rail had just one person qualified to assess all their public, pedestrian, private, maintenance, and construction level crossings, which numbered in the thousands. Of the 1,138 public level crossings that required assessment within the 5-year timeframe, just 52 were completed.

Further, Queensland Rail and the Brisbane City Council did not have a formal road-rail interface agreement in place at the time of the accident, although negotiations were ongoing. This was a missed opportunity to collectively identify any unique risks associated with the level crossing and manage and maintain those risks through an agreed process.

What has been done as a result

Following the accident at the Kianawah Road level crossing, Queensland Rail and the Brisbane City Council have formalised an interface agreement encompassing all level crossings where they have a shared responsibility. In addition, Queensland Rail:

- Has installed a new boom barrier at the level crossing, compliant with the Australian Standard (1742.7), that fully protects road users when approaching the active crossing from Lindum Road. In addition, rectified a safety issue where the boom barrier did not fully comply with the requirements of the Australian Standard at 29 other level crossings within its jurisdiction.
- Assessed the Kianawah Road level crossing in accordance with the Australian Level Crossing Assessment Model (ALCAM) to establish a current assessment risk score rating.

- Has trained 4 internal staff to undertake ALCAM assessments and introduced a procurement process to engage a contract firm to update outstanding regional ALCAM assessments over the next 5 years.

Safety message

Level crossings are a complex environment and are well known for their high-risk consequences. While the ultimate preference is to avoid or remove level crossings, this is often very costly and not a practical solution. Therefore, it is important that road authorities and rail infrastructure managers collectively manage these risks. To achieve this, they should enter into an interface agreement as soon as possible to identify and manage hazards and risks at the road and rail interface, so far as is reasonably practicable.

Further, it is also important that organisations ensure they follow the requirements of their safety management system, as it sets the minimum safety standard to ensure the effective management of risk.

Contents

The occurrence

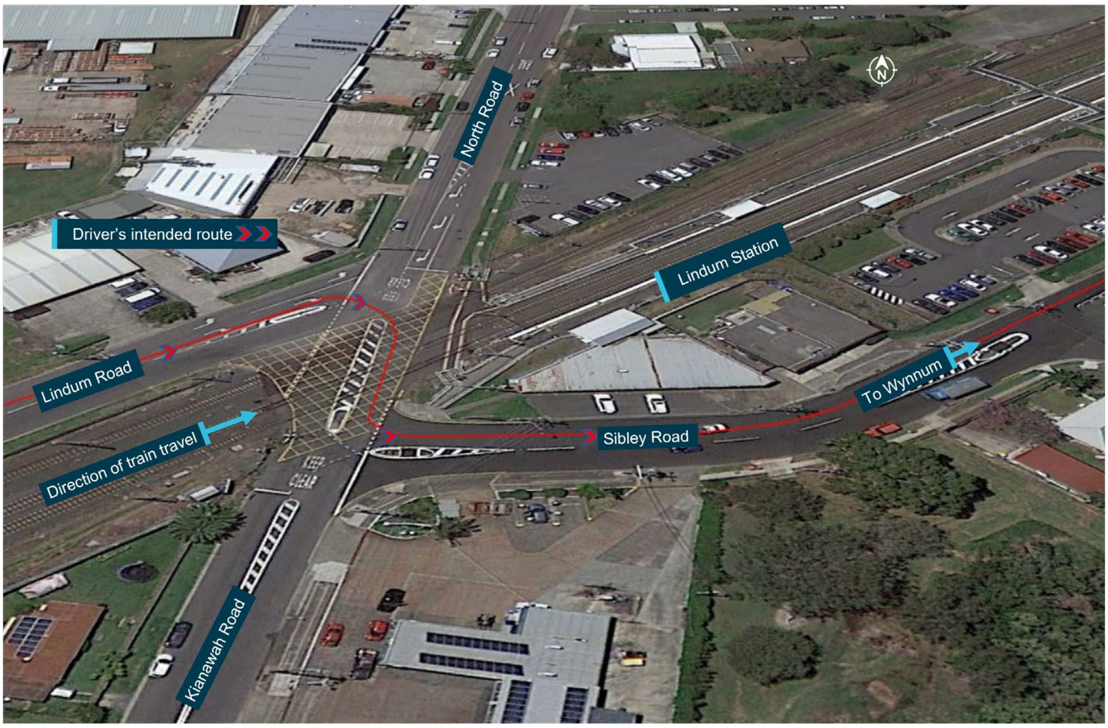
Events prior to the collision

On 26 February 2021, a Queensland Rail suburban express passenger train, designation E820, was being operated as a scheduled service between Roma Street and Cleveland, in Brisbane, Queensland.

About the same time, the driver of a small red motor vehicle was visiting an address in the Brisbane suburb of Hemmant. At about 1330 local time, they left that address to drive to the neighbouring suburb of Wynnum.

As the driver of the motor vehicle travelled along Lindum Road, in an easterly direction, they approached the intersection of Lindum Road and North Road, which was located on the northern side of the Kianawah Road level crossing. As illustrated in Figure 1, the likely intention of the driver was to turn right at the intersection and pass though the level crossing enroute to Wynnum. A friend reported to the Queensland Police Service they did not know if the vehicle driver had been through this intersection previously, but assumed they would have been using a navigation system to assist with directions.

Figure 1: Road user's likely intended route from Lindum Road through the level crossing



Source: Google Earth, annotated by the ATSB

Closed-circuit television footage from Lindum Station showed the motor vehicle approach the Lindum Road – North Road intersection and stopped in a queue behind 3 other road vehicles. During a pause in traffic, the first of the 3 vehicles turned right and could be seen passing through the level crossing.

At that time, the train approached the level crossing from the west, on the 'Up'[1] Cleveland line, with only a driver and guard on board. The universal traffic control[2] replay showed that the train activated the Kianawah Road level crossing automatic protection system at 1339:17, when it was 820 m from the crossing. The train's event recorder showed it was travelling at about 94 km/h at the time.

As the second vehicle in the queue moved away and passed through the level crossing, the flashing lights were active. As the third vehicle in the queue passed through the level crossing, the boom barriers at the crossing were lowering. Simultaneously, the driver of the small red motor vehicle moved forward and stopped at the intersection stop line. They delayed at the stop line to give way to a vehicle that was approaching from the north along North Road. That vehicle turned across the front of the motor vehicle into Lindum Road. After it passed, witnesses stated, and the station footage showed that the driver of the motor vehicle momentarily moved forward but came to a stop as another road vehicle (a utility vehicle) approached the intersection from North Road.

The event recorder showed that the train driver sounded the country horn[3] at the whistle board[4] to warn of the train's approach to the level crossing. The speed of the train was 94 km/h, and the train's headlights, visibility lights, and marker lights were illuminated.

At 1339:37, the universal traffic control replay and station footage showed that the boom barriers of the level crossing had fully lowered. The driver of the motor vehicle remained stationary at the stop line of the intersection waiting for the utility vehicle to pass on North Road. At that point, the train was about 280 m from the level crossing.

The driver of the utility stated that their intention was to turn right at the intersection (North Road – Lindum Road) into Lindum Road. As they approached the intersection, they noticed that the boom barrier at the level crossing was down (horizontal) and saw a train approaching the level crossing. As they turned right in front of the small red motor vehicle, they observed the driver looking left and right as if they were ready to move forward after they had passed. After turning into Lindum Road, the driver of the utility looked through the rear-view mirrors and observed the small red motor vehicle move off and approach the level crossing.

The accident

At 1339:44, the front of train camera showed that the small red motor vehicle was on the correct side of the road (to the left of the median island in direction of travel) as it entered the level crossing and passed to the right of the lowered boom barrier. At that time, the train was about 60 m from the level crossing and travelling at 94 km/h.

In interview, the train driver stated the vehicle was on the correct side of the road as it entered the crossing from their left (train's direction of travel). The driver indicated that the vehicle was travelling at a slow and consistent speed as it passed through the crossing, and the driver of the motor vehicle was looking straight ahead.[5] On sighting the vehicle, the train driver applied emergency braking and sounded the town horn.

At 1339:47, the front left side of the train collided with the motor vehicle at about 82 km/h. The train continued a further 280 m before coming to a stop. The sole occupant of the motor vehicle

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1 Up line: the rail line that facilitates train movements in an easterly direction towards Cleveland.

2 Universal traffic control: A system unique to Queensland Rail that assists network control officers safely route and monitor the movement of trains.

3 The train had 2 horns: town and country. The country horn was the louder of the 2 and would be sounded when approaching level crossings.

4 Whistle boards: are located at places where it is necessary for the driver to sound the horn. For example, level crossings, bridges, or tunnels.

5 The train driver's recall of the vehicle 'travelling at a slow and consistent speed' was consistent with speed calculations undertaken by the ATSB from the front of train closed-circuit television footage.

was fatally injured. The driver and guard were not injured, and the train sustained minor damage.

Context

Train information

Queensland Rail (QR) service E820 was an electric suburban train scheduled to run express from Roma Street Station to Cleveland Station. The service was worked by new generation rollingstock 769, and the driver was operating from driving cab 8769 at the time of the accident. The train consisted of 6 cars, with a length of 146.7 m and a weight of 260 t.

For visibility purposes, the front of the new generation rollingstock (leading cab) were fitted with light emitting diode headlights, white marker lights, and visibility lights that flashed alternately for 20 seconds when either the town or country horn was operated. At the time of the accident all visibility lighting on the front of the train was illuminated.

The train was equipped with a front of train camera and an event recorder, which contained closed-circuit television images and data relevant to the accident journey. There were no faults or defects recorded with the operation of the train, and at the time of the accident the braking system functioned as designed.

Train crew information

The driver was qualified to operate all classes of QR electric passenger trains, including the new generation rollingstock, and was route competent to operate within the Brisbane suburban rail network, which included the Cleveland corridor.

The event recorder showed that the driver operated the train in accordance with QR's operational guidelines on approach to the Kianawah Road level crossing and followed post-accident protocols immediately after the accident.

The driver and guard of train service E820 were drug and alcohol tested after the accident and both returned 0.00% readings.

Road vehicle driver information

The driver of the motor vehicle held a current Queensland driver's licence. The licence was subject to a condition, which required the driver to wear corrective lenses while driving. A friend of the driver, who was the last contact prior to the accident, advised the Queensland Police Service that the driver of the vehicle would have been wearing either glasses or contact lenses as they never drove without them.

The police advised that there were no prescription glasses found at the accident site and the forensic report indicated that there was no evidence of the driver wearing contact lenses. The police further stated that due to the high impact collision and debris at the scene, it was possible that the driver's glasses or contact lenses (if worn) were dislodged and overlooked when processing the accident site.

A toxicology report provided by the Queensland Health Forensic and Scientific Services indicated that the driver of the motor vehicle involved in the accident was not affected by alcohol or drugs.

An examination of the driver's mobile phone records showed that there was no call or short message service (SMS) activity around the time of the accident or immediately before.

Meteorological information

The weather at the time of the accident was fine and clear. The driver of E820 recalled it being a fine, clear, sunny day as they approached the Kianawah Road level crossing.

At about 1340, the sun was high in the sky (azimuth: 331.61° and elevation: 69.02°). Therefore, sun glare had negligible effect on the motor vehicle driver's approach to the intersection of Lindum and North Roads or the warning devices (half boom barriers and flashing lights) at the level crossing.

Rail and road information

Cleveland railway corridor

The Cleveland railway corridor was a branch line that extended from Park Road Station, an inner-city station, east through to Cleveland Station. There were 8 public level crossings on the corridor. The railway corridor catered mainly for electric suburban passenger trains although there was a third line (dual gauge line) specifically for freight trains, which branched off from the railway corridor at Lindum.

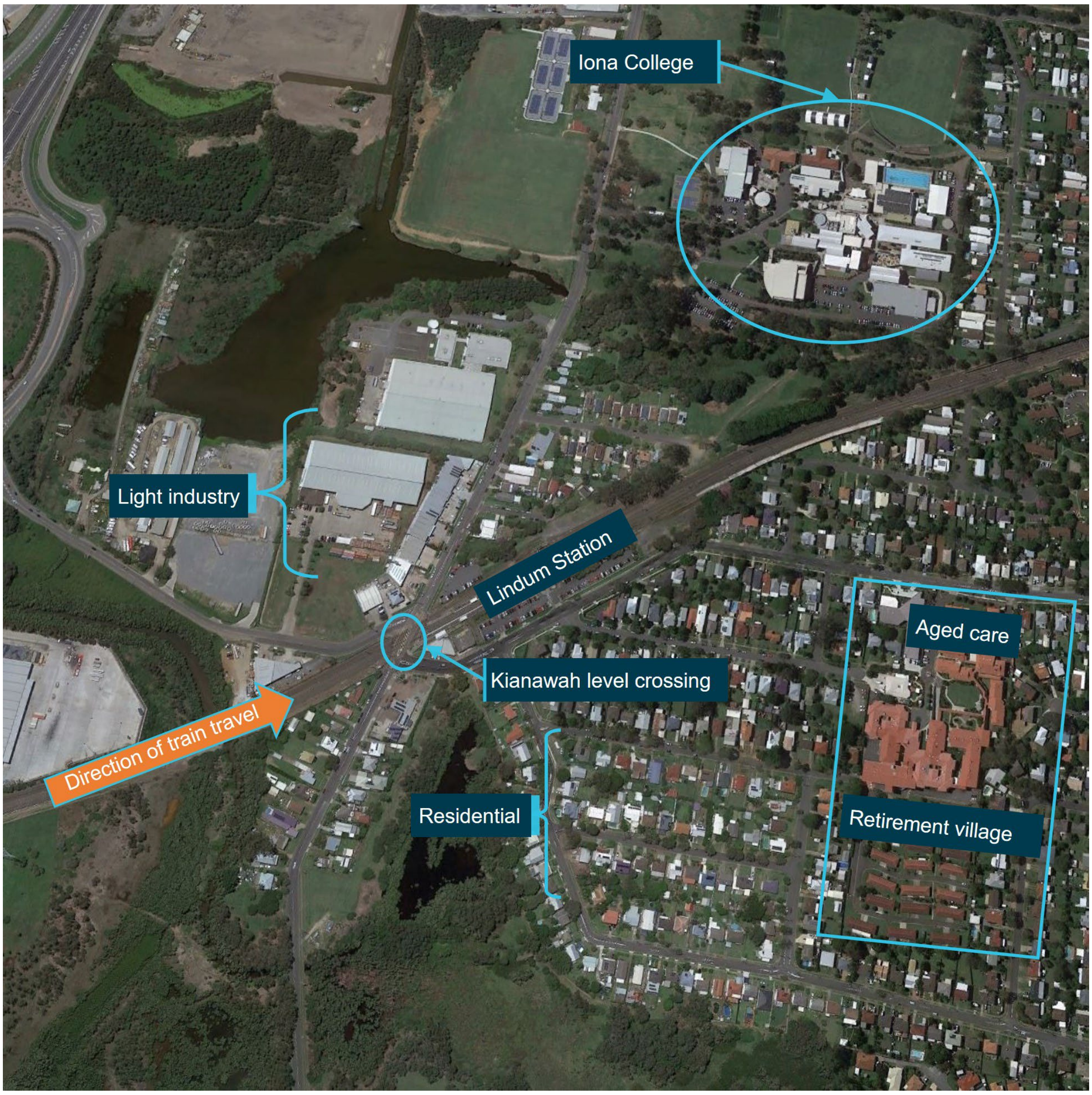
On a normal weekday there were more than 150 train services that traversed the railway corridor, most of them suburban trains. The maximum speed for suburban trains on the corridor was 100 km/h and 80 km/h for freight trains.

Accident location

The accident occurred at the Kianawah Road level crossing in the suburb of Wynnum West, which was located 17 km east of the Brisbane central business district or 14.1 rail km from Park Road. The area surrounding the level crossing was a mix of light industrial and low-medium density residential development. In near proximity to the level crossing was Lindum Station, Iona College (with a complement of 1,700 students), and a retirement village and aged care facility (Figure 2). The suburb had a population of about 16,000.

Brisbane City Council (BCC) controlled and maintained the road network, which included a multi-modal intersection on either side of the level crossing where the Cleveland passenger and Port of Brisbane freight rail lines separated the local road network. The rail corridor was controlled and maintained by QR.

Figure 2: Density of population surrounding the Kianawah Road level crossing



Source: Google Earth, annotated by the ATSB

Road and rail interface

North Road and Kianawah Road ran along a north-south axis that formed a continuous road that spanned the northern and southern side of the Kianawah Road level crossing. The roads intersected the rail corridor at a 45° angle. There was one traffic lane in each direction and a painted median island separated the 2-way traffic lanes that passed through the level crossing.

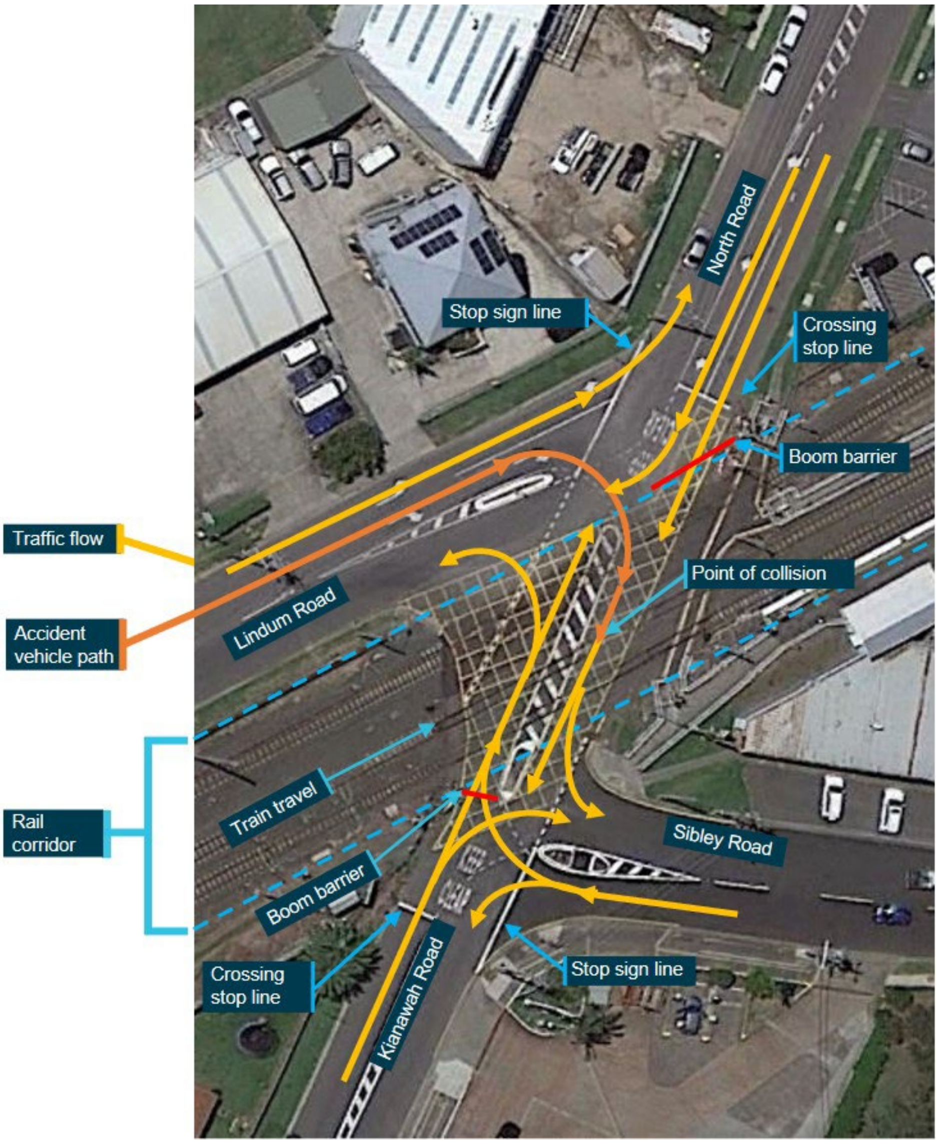
Immediately prior to the level crossing, there were 2 intersections, one on either side of the crossing. On the northern side, Lindum Road connected with North Road and on the southern side, Sibley Road connected with Kianawah Road (Figure 3).

The North Road approach to the level crossing had a stop line painted on the road pavement just prior to the North Road – Lindum Road intersection. The stop line only applied to road users when the level crossing protection devices were active. There was also a turn-right only traffic lane from North Road that connected with Lindum Road just prior to the level crossing.

Lindum Road divided into 2 lanes at the intersection. The left lane was for road traffic turning left into North Road away from the level crossing. The right lane was for traffic turning right and passing through the crossing onto Kianawah Road. At the Lindum Road – North Road intersection there was a stop sign with a related stop line relevant to Lindum Road. From the stop line, turn line markings painted on the road pavement guided road traffic towards the entrance of the level crossing at about a 40° angle. If the level crossing was active, road users in the right lane were required to remain at the stop line until the level crossing and opposing road traffic were clear.

Depicted in Figure 3 are the potential variations in road vehicle travel through the level crossing (yellow). The path of the motor vehicle involved in the accident (orange), the direction of the train's travel, and the point of the collision are also shown.

Figure 3: Kianawah Road level crossing showing intersections and general traffic flow



Source: Google Earth, annotated by the ATSB

Reported safety concerns

Over many years, members of the public have raised safety concerns about the Kianawah Road level crossing and its adjoining multi-modal intersections with the 3 levels of government.

In 2019, the Queensland Department of Transport and Main Roads undertook a review of 65 level crossings in south east Queensland to assist with developing a framework for prioritising upgrades. The review of each crossing considered the imperative for change, safety, network efficiency, and accessibility and connectivity. The Lindum Station level crossing was found to have less vehicles, buses, cyclists, and pedestrians than the average level crossing, along with a similar boom gate downtime. However, the crossing had more near misses and boom gate strikes than the average level crossing, likely indicating a heightened safety risk.

Consequently, in 2019-2020, the Queensland Government (Department of Transport and Main Roads), with support of the Australian Government, undertook a study to determine how to best enhance safety, network efficiency and accessibility to improve the Lindum Station precinct.

The study included a community engagement program (online engagement portal and a face-to-face component) allowing interested parties to provide feedback to enhance safety in the precinct for the local community and road users. One of the key topics raised, which was recorded in the subsequent report, was safety concerns relating to the level crossing and the complexities of the adjacent intersections. The report stated that:

> As many as 50 per cent of respondents have had a safety-related incident at the Lindum [Kianawah Road] level crossing and 58 per cent currently avoid using the level crossing due to safety concerns or congestion issues.

Information provided by the Department of Transport and Main Roads, relating to the level crossing and the adjacent intersections, stated:

> Safety
>
> - The level crossing has a significant history of safety occurrences, including a recent pedestrian fatality in February 2019, and a high number of boom [barrier] strikes and near misses over the previous decade
> - The intersections adjacent to the level crossing are complex and difficult to navigate for motorists, cyclists and pedestrians
>   - Driver confusion and frustration is likely contributing to increased risk taking by motorists, particularly for right turns, with a high [road accident] crash rate over the last five years, including three hospitalisations and the majority with failing to give way violations.
>
> Traffic efficiency
>
> - Currently the level crossing is closed between 28% and 36% of the time during peak periods, dropping to less than 20% in the inter-peak and off-peak periods
> - Vehicles approaching from Lindum Road are experiencing a one-minute delay on average during the morning and afternoon peak periods and can experience queues of over 100 metres in the morning peak period and 200 metres in the afternoon peak period.

The study investigated a number of short-term, medium-term, and long-term options for addressing the issues identified at the Lindum Station precinct. These ranged from upgrading and the signalisation of intersections adjacent to the level crossing, constructing an active transport bridge over the rail corridor, to providing a grade separated road over the rail.

Following the 2019-20 study, the Department of Transport and Main Roads, in conjunction with Brisbane City Council, Queensland Rail and the Australian Government Department of Infrastructure, Transport, Regional Development, Communications and the Arts commenced a jointly funded preliminary business case investigation into long-term options for the level crossing precinct including the viability of a future grade separated road overpass.

Brisbane City Council and Queensland Rail were also working with the Department of Transport and Main Roads to develop a new upgraded level crossing alignment with traffic signalisation to further improve safety. The project was jointly funded by all 3 levels of government and at the time of publication of this investigation report, it was currently in the design phase.

Reported occurrences

According to QR data, there have been numerous reported incidents at the Kianawah Road level crossing involving road vehicles passing through the crossing after the protection had activated. More specifically, during the 2-year period from March 2019 to February 2021, there were:

- 5 reports by train drivers of applying emergency braking due to a road vehicle passing through the crossing with the boom barriers down
- 5 reports where a boom barrier had been hit by a road vehicle
- 6 reports where a boom barrier had come down on top of a vehicle
- 14 reports of a road vehicle passing through the crossing while the boom barrier was already down
- 9 reports of a road vehicle passing through the crossing while the boom barrier was coming down
- 5 reports of multiple vehicles passing through the crossing while the boom barrier was coming down
- 9 reports of multiple vehicles passing through the crossing while the lights were flashing.

Given the nature of the reports involving multiple vehicles, it was likely that the number of vehicles passing through the crossing after the lights were activated and/or the boom barrier started descending was much higher than reported. There was insufficient detail in most reports to determine how many events were associated with vehicles entering the crossing from Lindum Road.

In the same period, there were also numerous reports of pedestrians passing through the pedestrian gates at the crossing when they were closed.

Additional data supplied by QR recorded that since December 2015, the Kianawah Road level crossing had the fifth highest collision/near miss occurrences of level crossings in south-east Queensland (Table 1).

Table 1: South-east Queensland level crossings collision/near miss information since December 2015

Ranking	Level crossing	Collision/near miss numbers
1	Old Beaudesert Road	26
2	Oates Avenue	19
3	Beenleigh Road	16
4	Nathan Road	16
5	Kianawah Road	15

Level crossing information

General information

The National Level Crossing Safety Strategy 2023-2032 (National Level Crossing Safety Committee, 2023) emphasised that level crossing occurrences result in a significant social and economic impact on individuals, communities, and business. While total avoidance or removal of level crossings is the ultimate preference, both these options are often very costly and not practical. The strategy noted the complexity of the road-rail interface:

> The nature of level crossings as an interface between road and rail transport is a complex environment so creating change to improve level crossing safety is a shared responsibility. While capital investment is part of the ongoing solution, strategic national collaboration is also at the forefront of actions.

The Office of the National Rail Safety Regulator stated in its *Rail Safety Report 2021-2022*:

> There are more than 20,000 level crossings in Australia and at all of them there exists a level of risk to safety – indeed, other than suicide and trespass, accidents at level crossings are the primary cause of railway related fatalities among the general public.
>
> There were 38 level crossing collisions between a passenger or freight train and road vehicle reported in the 2021–2022 financial year, resulting in three fatalities and three serious injuries:
>
> » two of the fatalities were road vehicle occupants and one was a cyclist;
>
> » all three of the serious injuries were road vehicle occupants; and
>
> » 66% of the collisions occurred at crossings protected by active controls, such as lights and boom gates, representing an increase of 56% from 2020–2021.

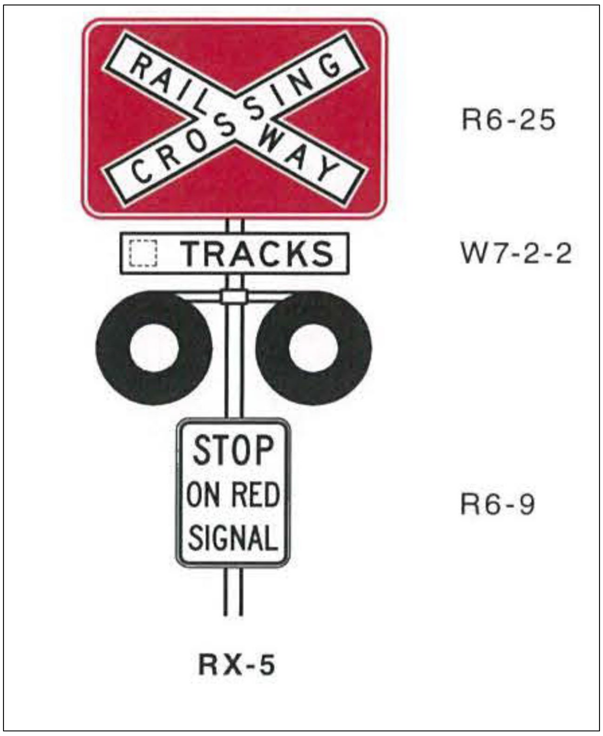
Level crossing traffic control devices

Flashing signal assembly

According to the Australian Standard (AS) 1742.7, (*Manual of uniform traffic control devices Part 7: Railway crossings*), the railway crossing flashing signal assembly (RX-5) shall be used at crossings that require flashing signal control. The assembly consisted of an R6-25 sign, W7-2-2 sign, R6-9 sign and a railway crossing flashing signal that consisted of twin red circle aspects arranged horizontally and equipped to flash alternately. They may also include provision of multiple flashing signals to cover all approaches and may be supplemented by boom barriers (Figure 4).

An inspection of the northern side of the Kianawah level crossing identified an RX-5 assembly was installed for approaching road traffic from both North Road and Lindum Road. The flashing signal of the RX-5 assembly was designed to flash automatically on the approach of a train. Post-accident functionality testing and an on-site observation conducted by QR, which included the warning devices at the level crossing, identified the flashing signals of the assembly were operating correctly.

Figure 4: Railway crossing flashing signal assembly (RX-5)



Source: Standards Australia

Boom barriers

Regarding the installation of boom barriers at level crossings, AS 1742.7 stated:

> Boom barriers shall comprise as a minimum, a boom extending from the left side of the roadway-
>
> (a) to the right hand kerb or edge of a one-way roadway;
>
> (b) to the edge of a median island; or
>
> (c) in the case of a two-way roadway, to the dividing line or centre of the roadway if no line is marked.
>
> The boom in its lowered state should be placed at right angles to the road centre-line.

The active protection at the Kianawah Road level crossing was supplemented by half boom barriers. Under normal operating conditions, the boom barriers activated automatically when the signalling system detected an approaching train. The red lamps fitted to the boom barriers were equipped with light emitting diodes.

The boom barrier on the northern side of the level crossing, measured 9.94 m. In its lowered state it fully spanned the entire width of North Road. However, the boom barrier only partially protected road traffic from entering the crossing from Lindum Road as it did not extend to the edge of the median island in accordance with AS 1742.7. As a result, a 3.1 m gap existed between the tip of the boom barrier and the painted median island (Figure 6). To understand the relevance of the 3.1 m gap, it is necessary to provide comparisons to appreciate the significance. The width of:

- a general traffic lane in an urban environment was 3.0–3.5 m[6]
- a typical bus was 2.5 m[7]
- the road vehicle involved in the accident was about 1.8 m.

Information provided by QR identified 29 other locations within its jurisdiction where the boom barrier of a level crossing did not comply with the requirements of AS 1742.7. In particular, the requirements of (b) and (c) above.

The boom barriers and their associated lamps had a design cycle time of 28 seconds prior to the arrival of a train at the crossing. The time and sequence order was:

- 8 seconds - lamp activation
- 10 seconds - boom barriers to lower
- 10 seconds - boom barriers in the horizontal position before the train's arrival.

A post-accident functionality test of the track circuitry and the activation of the boom barriers determined they operated as designed and within the requirements of AS 1742.7. In addition, all light voltages at the lamp terminals associated with the level crossing and boom barriers were assessed and found to be within tolerance levels.

Road signage

A BCC signs and pavement marking plan, relevant to roads approaching the Kianawah level crossing, showed an RX-7 assembly (Figure 5) was required on the left side of the roadway on approach to the Lindum Road – North Road intersection. The AS 1742.7 stated:

> An RX-7 assembly [combined W7-4 and W8-3(R) or W8-3(L) signs] shall be used to give advance warning on a through road of a crossing which is controlled by flashing signals when the crossing:
>
> (a) is on a side road; and
>
> (b) is too close to the intersection to provide the appropriate distance required for erection of the W7-4 sign on the side road …

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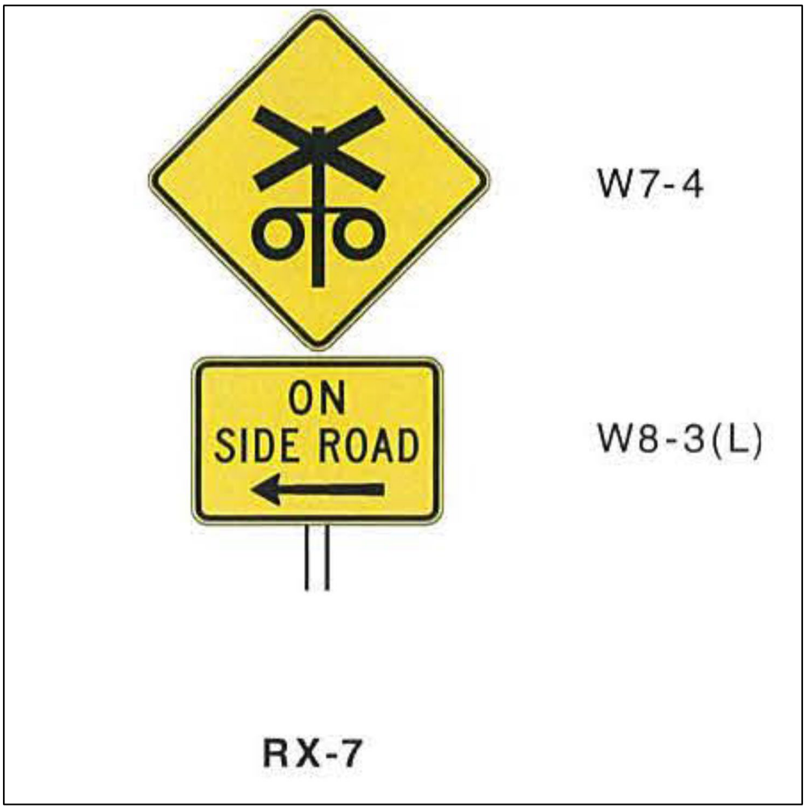
6 Austroads Guide to Road Design (2021) Part 3: Geometric Design.

7 A Volvo B7RLE is 2.48 m wide.

> The assembly shall be positioned on the through road on the left side of each approach to the intersection.
>
> For a side road on the right the W8-3(R) sign shall be used.

An inspection of road signage, conducted by QR on 3 March 2021, identified an RX-7 assembly on the left side of Lindum Road about 80 m from the intersection, however, the W8-3 sign was missing from the assembly. It could not be determined if the W8-3 signal was in place at the time of the accident.

Figure 5: Railway crossing flashing signals ahead on side road assembly (RX-7)



Source: Standards Australia

Stop lines

Regarding the requirement for stop lines, AS 1742.7 stated:

> At all railway crossings on sealed roads controlled by RX-2, RX-5, and RX-6 (STOP sign, flashing signals and gate control) assemblies, a stop line shall be provided on each approach to indicate the location at which vehicles must stop as and when required by law. It shall be placed at right angles to the road centre-line as follows:
>
> (a) At STOP signs - 3.5 m minimum back from the nearest rail at its closest point.
>
> (b) At flashing signal control - 3 m minimum back from the signal pedestal or boom barrier in its lowered position.
>
> (c) At gates - 3 m minimum back from the gates when closed to road traffic.
>
> In the absence of a dividing line or median, the stop line shall extend only to the centre of the seal.

A site inspection identified the stop line markings on the road pavement applicable to North Road and Lindum Road conformed with the AS.

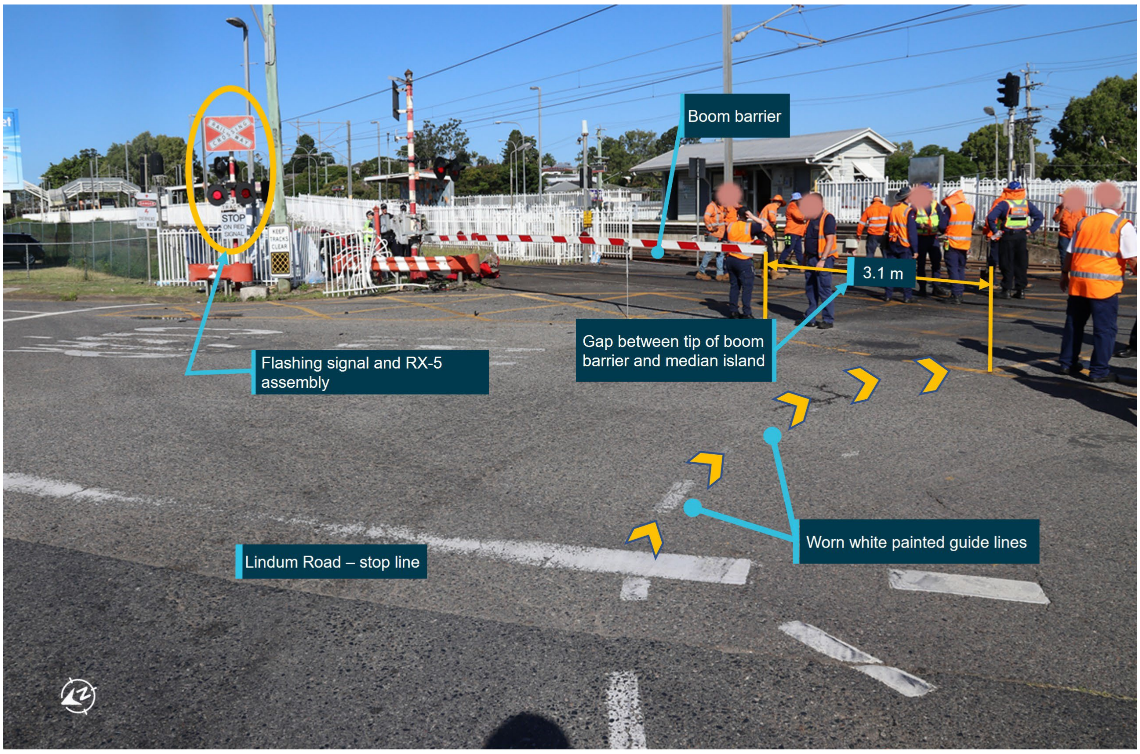
Turn lines

The AS 1742.14 (*Manual of uniform traffic control devices Part 14: Traffic signals - Section 6 - turn lines*), in part stated:

> Turn lines may be used within major or complex intersections to indicate the proper course to be followed by turning vehicles. They shall be used within an intersection to assist separation of traffic in the case of multiple turning lanes for the one turn. They are not required when the path to be followed is obvious to drivers under all conditions.

A site inspection identified faded/worn turn lines painted on the road surface starting at the stop line on Lindum Road and curving to the right to connect with the edge of the painted median island at the entrance to the level crossing (Figure 6). The entrance span (left side of the roadway, adjacent to the boom barrier, to the edge of median island) connecting Lindum Road to the level crossing measured about 12 m. Whereas, the road span entering the level crossing from North Road measured about 3.5 m.

Figure 6: Gap between boom barrier tip and the median island Lindum Road approach, and faded turn lines



Source: Queensland Police Service, annotated by the ATSB

Managing safety at level crossings

Historical information

In 1997, the Queensland Government convened an inquiry into Brisbane's Citytrain rail network. A focus of the inquiry was to provide recommendations to improve safety at railway level crossings. A conclusion from the inquiry stated:

> Level crossings are critical road intersections which provide essential amenity to road users and rail travellers. The government has no strategies in place to determine risks at crossings and therefore to address level crossing safety in a planned and systematic way. A system to fund level crossings across the state according to risk is required. This will also require a comprehensive audit to determine the current risks at individual sites. This demands cooperative effort by Queensland Transport, Queensland Rail, the Department of Main Roads, and local authorities. The committee

> concludes that a state-wide level crossing safety strategy is required. Criteria for gauging risks and prioritising sites for protection upgrades is needed to guide future investments in level crossing protection to maximise safety dividends.

From this conclusion relevant recommendations were made:

- That Queensland Transport undertakes a comprehensive safety audit of railway level crossings in Queensland. This audit should compile information about their road vehicle and train speed limits; types and volumes of road vehicle and train traffic carried; road and environment conditions; types of protection installed; accident history; alignments; and other risk factors.
- That Queensland Transport devises a methodology to quantify risks at railway level crossings and allocate priority for investment in safety upgrades.
- That Queensland Transport devises a state-wide strategy for railway level crossing safety upgrades.

Risk assessment tool

In 1999, as a result of these recommendations a ‘risk scoring matrix’ was developed as an assessment tool used to identify key potential risks at level crossings and to assist in the prioritisation of crossings for upgrades. In 2002, the assessment tool was re-named as the Australian Level Crossing Assessment Model (ALCAM), and a national committee was established to ensure its consistency of development and implementation. In 2003, ALCAM was endorsed by the Australian Transport Council and adopted by all states and territories as well as New Zealand. Since its introduction, ALCAM has been regularly reviewed and modified. For example, in:

- 2004, an updated version was released
- 2006, the introduction of ‘flags’ to highlight areas representing high levels of risk
- 2007, changes to align with AS 1742.7 (*Manual of uniform traffic control devices*)
- 2014, the release of an updated version.

The ALCAM risk score comprised of 3 separate components: how physical properties at each site will affect human behaviours; the control type, vehicle (or pedestrian) volumes and train volumes; and the expected outcome in the event of a collision. The score is expressed in terms of an expected number of equivalent fatalities per year and allows for a comparison of level crossings within a given jurisdiction based on the level of risk. In turn, a priority list can be produced, which can be used to assist in the development of safety improvement programs (Australian Level Crossing Assessment Model, 2016).

Queensland Rail level crossing assessments

Queensland Rail initially surveyed its public level crossings between 2001–2002, using the risk scoring matrix assessment tool, producing an individual risk score rating of each level crossing as a baseline. Table 2 shows QR’s top 20 level crossings based on their risk score. All the level crossings are in south-east Queensland.

As noted in the table, 9 of the level crossings were re-assessed between 2004–2016 using the ALCAM, while the remaining 11 had not been re-assessed since their initial survey. Of the top 20 level crossings by risk score, the Kianawah Road level crossing was ranked sixteenth.

Table 2: Queensland Rail’s top 20 level crossings by risk score

No.	Level crossing	Initial survey	Risk score	Reassessment
1	Boundary Road	4 December 2001	161515190	11 September 2008
2	South Pine Road	11 December 2001	101835834	25 October 2016
3	Mackie Road	2 January 2002	99067968	12 July 2016
4	Oates Avenue	8 January 2002	94970766	

No.	Level crossing	Initial survey	Risk score	Reassessment
5	Beenleigh Road	19 November 2001	87584304	
6	Todd's Road	8 January 2002	86299824	
7	Beams Road	11 December 2001	80649355	
8	Cavendish Road	6 December 2001	77831571	
9	Dawson Parade	21 February 2002	72420707	
10	Rowley Road	29 January 2002	63258456	
11	Wacol Station Road	19 November 2001	60117406	15 August 2006
12	Nudgee Road	11 December 2001	59015500	
13	South Pine Road	18 February 2001	57633975	8 February 2011
14	Osbourne Road	21 February 2002	56858762	6 October 2004
15	Samford Road	12 November 2001	52329280	19 February 2009
16	Kianawah Road	12 February 2002	46218266	
17	Warrigal Road	4 December 2001	37685078	
18	Sherwood Road	4 February 2001	37309859	6 October 2004
19	Nathan Road	4 December 2001	36079244	
20	St Vincents Road	5 March 2002	35740814	3 October 2012

Other factors to mitigate risk

As noted in the *ALCAM in Detail* report (Australian Level Crossing Assessment Model, 2016) although the ALCAM is a comprehensive tool for the assessment of level crossing hazards, it cannot be applied in isolation. The authorities responsible for safety at level crossings need to understand the limitations of the ALCAM and recognise the wider external context in which the risks at individual level crossings will be managed. Therefore, rail and road managers (that is, state and local government agencies) also need to consider other factors and measures to mitigate risk at level crossings, which include:

- risk assessments
- collision and incident occurrence history
- inspections and assessment history
- results of audits and assurance activities
- engineering experience (both rail and road)
- local knowledge of driver or pedestrian behaviour
- interface agreements
- standards and best practice.

Safety management system

General

It was a legislative requirement of accreditation that rail transport operators (RTOs) and rail infrastructure managers (RIMs) have an appropriate safety management system in place. QR, as the RTO and RIM, had such a system comprising of a suite of policies, standards, procedures, documents, and agreements, which together constituted the means to manage below and above rail operations.

Queensland Rail's level crossing safety standard

QR's level crossing safety standard (*MD-10-115*) formed part of its safety management system. The standard stated:

> Queensland Rail as the Rail Infrastructure Manager (RIM) shall conduct the actions as described within this standard and meet the intent of the Level Crossing Strategies of Queensland Rail, Queensland Level Crossing Safety Strategy and National Level Crossing Safety Committee.
>
> At grade level crossings introduce an interface which presents an undesirable safety risk and additional complexity to the railway. The RIM shall control the risks of the Queensland Rail portfolio of level crossings 'so far as is reasonably practical (SFAIRP) by the following actions:
>
> - Explore opportunities for grade separation or closing level crossings and seek to minimise any proposals to construct a public level crossing on a greenfield site, with a clear objective to add no further open level crossings to the network (Queensland Level Crossing Safety Strategy, Strategy #9)
> - Design and select appropriate level crossing locations and controls
> - Construct crossings to approved designs by competent workers
> - Assess risk, maintain and upgrade infrastructure as appropriate (Queensland Level Crossing Safety Strategy, Strategy #7)
> - Monitor existing level crossings for changes to the risk and continue the assessment of risk through application of the Australian Level Crossing Assessment Model (ALCAM)
> - Maintain level crossing infrastructure in accordance with Queensland Rail Standards and management of defects to an appropriate priority
> - Determine measures to manage risks and seek to enter into an interface agreement with the road manager of that road
> - Dispose of level crossings by denying access where controls have been removed, and removing level crossing infrastructure (lights, boom, signs, etc) where railways are closed.
>
> This standard sets out a consistent level of control measures for the RIM to apply to all crossings on track managed by Queensland Rail, and the responsibilities and processes the RIM should use in order to minimise the risk of accidents at level crossings.

To maintain safety of its level crossings, QR was required to perform distinct types of inspections/assessments. Patrol and track inspections were conducted more frequently than assessments. The inspections were performed by maintenance staff who were trained to visually check the condition of the track infrastructure, level crossings and their associated components at regular intervals. Depending on the type of inspection and whether the level crossing had active or passive controls, the frequency of the inspection varied. If the level crossing had active controls, a patrol inspection occurred every 96 hours. If the crossing had passive controls, an inspection was required every 7 days. A track inspection was scheduled annually.

Unlike inspections, the criteria for level crossing assessments had a separate set of requirements and measures to evaluate safety. Assessors were specifically trained to conduct assessments in line with these requirements and measures. In accordance with QR's level crossing safety standard (at the time of the accident), when conducting the assessment, the assessor evaluated the level crossing against the requirements of:

- the approved design for the crossing
- MD-10-575 *Civil Engineering Track Standard*
- AS 1742.7 *Manual of Uniform Traffic Control Devices Part 7: Railway Crossings*
- Queensland Department of Transport and Main Roads *Manual of Uniform Traffic Control Devices* (MUTCD)
- MD-15-51 *GSS Part 3 Signals and Level Crossings*.

The assessment was to be undertaken by a level crossing assessor on a site inspection and measurements were to be taken in accordance with the following references:

- Australian Level Crossing Assessment Model (ALCAM)
- applicable inspection, detailed assessment or ALCAM data collection forms (completed by field survey) and assessment process
- MD-10-575 *Civil Engineering Track Standard*
- MD-14-571 *Signalling Maintenance – Preventative Maintenance Check Sheet*.

Level crossings assessments

Version 1.0 of QR's level crossing safety standard released July 2010, and version 2.0 released June 2012, stated:

> Risk assessments of public and pedestrian level crossings must be carried out in conjunction with the road authority. A joint recommendation must be made on the control measures appropriate to the level crossing, to adequately control the risks identified.
>
> The level of protection required at the level crossing must be determined taking into consideration:
>
> - the recommendation provided by the QT risk assessment matrix
> - local knowledge including consideration of other site and surrounding specific conditions and problems that could affect the safety of the crossing. For pedestrian crossings this will include the proximity of schools, retirement villages, institutions, etc
> - vehicle and typical pedestrian behaviour at the crossing
> - minor improvements that would increase the level of safety.

Version 3.0 of the level crossing safety standard released March 2016, and version 3.1 released November 2017, stated:

> All public level crossings and pedestrian crossings in the Queensland Rail network shall [mandatory] be assessed using a recognised level crossing risk assessment model, i.e. the Australian Level Crossing Assessment Model (ALCAM). Proposed new public level and pedestrian crossings shall be assessed using ALCAM as part of the approval process.
>
> Queensland Rail will review public and pedestrian level crossings at least once every five years unless other changes to the crossing conditions require an assessment sooner. Responsible Road Managers will be invited to take part in these inspections in accordance with the relevant IA [interface agreement]. These inspections [assessments] shall be carried out to ensure the existing controls are still effective, ensure continuing compliance with the controls approved following the initial assessment for the crossing, and to verify that the conditions applying at the time of the initial assessment are still current.

Version 4.0 on the level crossing safety standard, released April 2020 and current at the time of the accident, stated:

> The Asset Manager [QR] shall conduct assessments on all types of level crossings including, public, pedestrian, private, maintenance and temporary construction level crossings. These assessments shall include track inspections, signalling equipment servicing, level crossing assessments and detailed level crossing assessments.

It further stated:

> Level Crossing Assessments and Detailed Level Crossing Assessments of public level crossings and public pedestrian crossings shall [mandatory] be assessed using the Australian Level Crossing Assessment Model (ALCAM). Proposed new public level and pedestrian crossings shall be assessed using ALCAM as part of the approval process.

Table 3 provided information on QR's level crossing inspection and assessment process.

Table 3: Types of inspection/assessment of level crossings

Type	Conducted by	Purpose	Frequency	How
Patrol inspection	Road patroller	safety of rail traffic operations	96 hours active 7 days passive	Visual
Track inspection	Track inspector	safety of rail traffic operations	Annually	Walking
Level crossing assessment	Level crossing assessor	controls are in place and complete check for changes in traffic or context	5 years	On-site
Detailed assessment	Level crossing assessor	confirm the risk score rating of the crossing	as required by incident or other assessment findings	on-site ALCAM public level crossing

Resource availability

It was a requirement of an RTO/RIM to ensure it had systems and procedures for estimating the resources, including people and equipment needed to operate and maintain railway operations and to implement, manage and maintain its safety management system.

As previously mentioned, all versions of QR's level crossing safety standard, since the release of version 3.0 in March 2016, noted that all public and pedestrian level crossings would be assessed using the ALCAM assessment tool. The standard also stated that level crossings would be assessed by a qualified assessor at the level crossing site at least once every 5 years. At that time, QR was responsible for the assessment of at least 1,138 public level crossings, and related pedestrian crossing if applicable.

Between 2016–2021, QR had one assessor qualified to conduct level crossing assessments. To comply with the level crossing safety standard, it meant the assessor was required to assess 227 public level crossings each year. In addition, the assessor was also required to assess pedestrian, private, maintenance and temporary construction level crossings according to the requirements of the standard. Information provided by QR, showed that during this time only 52 public level crossing assessments were conducted, which averaged 10 assessments per year.

Interface agreement

Prior to the introduction of the Rail Safety National Law (RSNL) Queensland in 2017, rail in Queensland was regulated by the provisions of the *Transport (Rail Safety) Act 2010*, and its supporting regulation. Both the past Act and the current Law required RIMs and road managers to identify risks to safety arising from rail or road crossings, determine measures to manage, so far as is reasonably practicable, those risks and seek to enter into an interface agreement.

According to the legislation, there was to be a written agreement between the relevant parties articulating the risk management process and framework necessary to identify and assess risks and have documented accountabilities/responsibilities of each party. According to the RSNL, and in part the superseded *Transport (Rail Safety) Act 2010*, an interface agreement was to include provisions for:

- implementing and maintaining measures to manage risks identified under section 99(1)(c) associated with the interface
- the evaluation, testing and (where appropriate) revision of measures in relation to identified risks and incidents considered
- the respective roles and responsibilities of each party to the agreement in relation to those measures

- procedures, by which each party to the agreement will communicate, monitor, and determine whether the other party complies with its obligations under the agreement
- a process for keeping the agreement under review and its revision.

The guidance material from the Office of the National Rail Safety Regulator, relevant to the development of an interface agreement, indicated that this requirement could be conducted by performing risk assessments.

Section 109 of the RSNL (*Identification and assessment of risks*) stated:

> A rail transport operator, rail infrastructure manager or road manager that is required under this Subdivision to identify and assess risks to safety that may arise from operations carried out by another person may do so—
>
> (a) by itself identifying and assessing those risks; or
>
> (b) by identifying and assessing those risks jointly with the other person; or
>
> (c) by adopting the identification and assessment of those risks carried out by the other person.

As mentioned, with the introduction of the Transport (Rail Safety) Act 2010, there was a requirement for RIMs and road managers to seek to enter into interface agreements. A provision in the Act allowed for a 2-year transition period to progress the requirements necessary for this to occur.

During the transition period, there was limited coordination between QR and the BCC to progress an interface agreement. However, just short of the 2-year transition period, on 23 August 2012, QR supplied BCC a draft copy of an interface agreement for consideration.

In the following years there were multiple meetings and discussions between QR and the BCC in order to progress the agreement, however, outstanding matters between the 2 parties blocked its enactment. During the negotiations, the state rail regulator (prior to 2017), and the Office of the National Rail Safety Regulator (after 2017), communicated with both parties in order to finalise the agreement. Nonetheless, unresolved matters between the 2 parties continued to hinder the progress of the agreement for many years after. At the time of the accident there was no interface agreement in place.

Queensland Rail's level crossing safety standard (version 4.0) current at the time of the accident, stated:

> If an interface agreement has not been accepted, the Asset Manager [QR] shall take reasonable steps to manage the safety of the level crossing to meet the requirements of the RSNL and making use of powers from the Transport Infrastructure Act 1994 (Queensland).

The previous versions of QR's level crossing safety standard (version 3.0 and 3.1) also stated:

> If an interface agreement has not been agreed to, the responsibilities for managing level crossing safety shall be in accordance with the Transport Infrastructure Act 1994, unless there are other documented local procedures in place.

Safety analysis

Introduction

The driver and sole occupant of a small red motor vehicle was fatally injured after colliding with a suburban passenger train at the Kianawah Road level crossing in Brisbane, Queensland. The occupants of the train, the driver and guard, were not injured and there was only minor damage to the train.

At the time of the accident, the protection devices at the level crossing (half boom barriers and flashing lights) operated as the train approached.

This analysis will discuss the driver's actions approaching and entering the intersection, the complexities of the intersection adjacent to the level crossing, and how conditions at the rail-road interface were confusing to road users. The length of the lowered boom barrier on the northern side of the Kianawah Road level crossing will also be examined. Further, it will discuss how risk at the crossing was not being managed in accordance with Queensland Rail's (QR's) safety management system, and the implications of QR and the Brisbane City Council not entering into a road-rail interface agreement in a timely manner.

Approaching and entering the level crossing

It was reported that the driver of the small red motor vehicle may not have been familiar with the intersection and was possibly using a navigation system to assist them with directions to their destination. As they travelled along Lindum Road towards the Lindum Road – North Road intersection they passed road signage (RX-7 assembly) providing information/advice of the upcoming level crossing. While it was unknown if the signage was fully intact at that time, the sign depicting the approaching level crossing was in situ and the driver was subsequently observed stationary at the stop line of Lindum Road.

The ATSB had considered if the driver was aware of the approaching intersection and adjacent level crossing, and whether their view of the flashing signal assembly (RX-5) on the opposite side of the intersection was obscured by other vehicles. However, there was insufficient evidence available to establish these factors.

After advancing to the front of the queue, and while stationary at the stop line, the protection devices of the level crossing were active, and the boom barriers had started to lower. At that time, the driver of the motor vehicle was observed actively looking in either direction for opposing road traffic. However, the ATSB could not determine whether the driver was aware of the active protection devices of the level crossing, if they had discounted them, or considered they did not apply to the passage of their vehicle.

Despite this, closed-circuit television footage and witnesses observed the vehicle move off from the stop line when a break in traffic became available. From the available evidence, it was very likely the vehicle followed the turn line markings on the road past the end of the lowered boom barrier into the path of the approaching train.

Complexity of road-rail interface

The intersections on either side of the Kianawah Road level crossing and the level crossing itself had a history of incident/accident occurrences. This was evidenced by the records provided by QR, which showed that, between December 2015 and February 2021, the level crossing had the fifth highest incident/accident numbers in south east Queensland. Likewise, for many years, residents have raised safety concerns relevant to the intersections and the adjoining level crossing.

Problems that existed for motorists using the Lindum Road turn-right lane was that it merged with North Road, Kianawah Road and the rail corridor at the level crossing. This created a condition where traffic from Lindum Road approached the entrance to the level crossing at a 40° angle, forming a significant 12 m wide entrance to the level crossing, as illustrated in Figure 3. This, and traffic activity connecting the various access roads at the intersection created complexity for road users. To reduce the complexity and driver confusion, turn line markings were painted on the road pavement connecting the stop line and the painted median island guiding road users from Lindum Road through the level crossing.

These details were consistent with the findings of the study initiated by the state government, and information provided by the Department of Transport and Main Roads, which concluded that the intersections adjacent to the level crossing were complex and difficult to navigate for motorists.

The study also reported that driver confusion and frustration at the intersections, particularly for motorists turning right from the side roads (Lindum Road and Sibley Road), was contributing to incidents/accidents between road vehicles at the intersections or between road vehicles and trains at the level crossing. This was more problematic in peak times or busy periods when traffic activity (both road and rail) intensified, therefore minimising the opportunity for road users to turn right from the side roads and pass through the crossing. Some local residents said that they would avoid the intersection due to delays and safety concerns.

The number of reported occurrences at the level crossing, the feedback received from road users, and the work undertaken by governments, all indicated that the road-rail interface at the Kianawah Road level crossing was complex and visually noisy from a road user’s perspective. Although the accident occurred outside peak periods, there was still sufficient road traffic at the intersection to heighten driver workload.

Boom barrier irregularity

In accordance with the Australian Standard 1742.7, (*Manual of unform traffic control devices Part 7: Railway crossings*), the boom barrier on the northern side of the Kianawah Road level crossing was to extend from the left-side of the roadway to the edge of the median island that separated traffic lanes. Its function was to block road traffic from North Road and Lindum Road when the level crossing was active. However, the boom barrier was too short and did not extend to the median island, forming a gap between the tip of the boom barrier and the median island.

The gap had no effect on road traffic approaching the crossing from North Road, as the boom barrier completely blocked road traffic from entering the level crossing. However, the 3.1 m gap between the tip of the boom barrier and the median island meant that the barrier only partially blocked road traffic that approached the level crossing from Lindum Road.

This was exacerbated by the turn line markings on the road pavement, although faded, which directed traffic towards the gap. These factors combined increased the risk of road users turning right from Lindum Road and bypassing the boom barrier while the crossing was active, which occurred on the day of the accident and could occur in vehicles as wide as a typical bus.

Another 29 locations were also identified with inconsistencies regarding the requirements for boom barriers, as stipulated in the Australian Standard.

Level crossing risk not managed

To constantly maintain safety, it is crucial that rail infrastructure managers commit to the ongoing risk management process, particularly at the road and rail interface of level crossings, which are well known for their high-risk consequences. The purpose of a level crossing assessment was to ensure that the existing controls were still effective, ensure continuing compliance with the controls approved following the initial assessment for the crossing, and to verify that the conditions applying at the time of the initial assessment were still current.

In 2001–2002, QR surveyed all their level crossings using the 'risk scoring matrix' as a standardised assessment tool to identify potential risks at crossings and to assist in the prioritisation of crossing upgrades. The results of these assessments were to establish a baseline for future assessments.

QR's intent was to manage risks at level crossings through the process of monitor and review using the Australian Level Crossing Assessment Model. This thinking was captured in their level crossing safety standard. The standard provided the minimum safety requirements of level crossings, which included the assessment of level crossings, responsibilities of the rail infrastructure managers, the processes to be used to minimise the risk of accidents at level crossings and having an interface agreement with the road manager. The standard was part of the QR safety management system.

The provisions of QR's level crossing safety standard, over time, has continued to meet the needs of the past *Transport (Rail Safety) Act 2010* and the current *Rail Safety National Law (Queensland)* from a safety perspective. The content material within the standard has continued to define the requirements and measures necessary to mitigate risk at level crossings. This included assessing public and pedestrian level crossings at least once every 5 years unless other changes to the crossing conditions required an assessment sooner.

The Kianawah Road level crossing was initially assessed for risk in February 2002. Records provided by QR showed that, at the time of the accident, some 19 years after its initial assessment, the level crossing had not been reassessed. Likewise, the ATSB also identified other level crossings within south east Queensland, some of them with high-risk scores and records of high incident/accident rates, which had not been reassessed since their initial assessment more than 20 years ago.

Had QR reassessed the Kianawah Road level crossing in accordance with their level crossing safety standard, it was very likely that the 3.1 m gap between the tip of the boom barrier (in its lowered state) and the median island, and the irregularity of the turn line markings on the road pavement guiding road users through that gap, would have been detected and rectified. Similarly, there were missed opportunities to identify that a further 29 level crossings had similar issues where the lowered boom barriers did not comply with the requirements of AS1742.7 *Manual of Uniform Traffic Control Devices Part 7: Railway Crossings*.

Insufficient resources to assess safety at level crossings

The purpose of level crossings assessments is to determine whether the control measures in place at the last assessment are still effectively managing the risks unique to that location. It is important to identify any new hazard/s or hazard/s that may not have been identified at the last assessment.

Equally important is that the organisation has sufficient resources available to ensure assessments are conducted within the required timeframes. These assessments, if conducted in accordance with QR's level crossing safety standard, provided assurance that risks at level crossings were being managed as far as is reasonably practicable.

Between 2016–2021, QR had one person appropriately qualified to assess all public, private, pedestrian, maintenance, and temporary construction level crossings within the rail network.

Records provided by QR showed that only 52 of the 1,138 public level crossings on the rail network were assessed over this 5-year period. Of the top 20 level crossings, according to their risk scores, just 2 were assessed. The QR level crossing safety standard stated that an on-site level crossing assessment of all crossings should be conducted every 5 years. However, based on the total number of level crossings, this task was impossible given the resources available.

Consequently, a substantial proportion of QR level crossings were not being assessed in accordance with its level crossing safety standard due to the lack of resources. In this case, it meant that the Kianawah Road level crossing had not been assessed since 2002, which was a missed opportunity to identify that the length of the boom barrier did not extend to the median island as required by the Australian Standard.

No interface agreement

Managing the risks of the road-rail interface was a shared responsibility between road authorities and rail infrastructure managers, formalised through an interface agreement. These agreements for public roads provided an opportunity for the relevant parties to conduct risk assessments, to identify and evaluate the risks at the interface, and control and maintain them through a systematic process. This established a coordinated approach to ensure risks at respective level crossings were identified and controlled.

Protracted negotiations between QR and the Brisbane City Council had commenced in 2012 and were ongoing. As a result, at the time of the accident, there was no interface agreement in place. Consequently, in accordance with QR's level crossing safety standard, they were to take reasonable steps to manage the safety of the crossing. Other than the original assessment of the Kianawah Road level crossing in February 2002, there were no records indicating that further assessments had been conducted on the level crossing. However, having an interface agreement in place at this location was particularly important given the complexity of the road and rail interface. In this case, had there been an agreement, the associated risk assessment would have likely identified the problem with the boom barrier length and corrective action would have resolved the matter.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

Safety issues are highlighted in bold to emphasise their importance. A safety issue is a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to a level crossing accident between an express suburban passenger train and road vehicle at Kianawah Road level crossing, Wynnum West, Brisbane, Queensland, on 26 February 2021.

Contributing factors

- The road user very likely followed the turn line markings on the road surface directing them past the end of the lowered boom barrier onto the level crossing into the path of the approaching train.
- The road-rail interface at the Kianawah Road level crossing was complex and visually noisy. This increased the risk of driver (vehicle) confusion and the potential for vehicle-train collisions.
- **Contrary to the relevant Australian Standard, there was a 3.1 m gap between the tip of the lowered boom barrier and the median island on the northern side of the Kianawah Road level crossing. With the turn line markings directing traffic towards the gap, this increased the risk of road users turning right from Lindum Road and bypassing the boom barrier while it was active.** (Safety issue)
- **Although Queensland Rail's internal standard required safety assessments of each public level crossing at least every 5 years, there had been no review or assessment of the Kianawah Road and other level crossings since 2001–2002.** (Safety issue)
- **Queensland Rail had insufficient resources available to assess all 1,138 public level crossings at 5 yearly intervals or sooner as required by its level crossing safety Standard, with only one person qualified to conduct level crossing safety assessments.** (Safety issue)
- **There was no formal interface agreement between Queensland Rail and the Brisbane City Council to jointly identify and manage ongoing and changing safety risks at the road and rail interfaces.** (Safety issue)

Safety issues and actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the rail industry, the ATSB may issue a formal safety recommendation or safety advisory notice as part of the final report.

All of the directly involved parties are invited to provide submissions to this draft report. As part of that process, each organisation is asked to communicate what safety actions, if any, they have carried out or are planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions will be provided separately on the ATSB website on release of the final investigation report, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website after the release of the final report as further information about safety action comes to hand.

Boom barrier irregularity

Safety issue description

Contrary to the relevant Australian Standard, there was a 3.1 m gap between the tip of the lowered boom barrier and the median island on the northern side of the Kianawah Road level crossing. With the turn line markings directing traffic towards the gap, this increased the risk of road users turning right from Lindum Road and bypassing the boom barrier while it was active.

Issue number:	RO-2021-005-SI-02
Issue owner:	Queensland Rail
Transport function:	Rail: Operations control
Current issue status:	Closed – Adequately addressed
Issue status justification:	The ATSB is satisfied that the installation of a longer boom barrier at the Kianawah Road level crossing, and the rectification of 29 other level crossings, where the boom barrier did not fully extend to the edge of a median island or the dividing line of the roadway, has addressed this safety issue.

Proactive safety action taken by Queensland Rail

Action number:	RO-2021-005-PSA-107
Action organisation:	Queensland Rail
Action status:	Closed

On 6 July 2023, Queensland Rail advised the ATSB that a new boom barrier of a length as required in the Australian Standard 1742.7 had been installed at the Kianawah Road level crossing on 25 October 2021. Around the same time, the Brisbane City Council updated the road markings and installed a new traffic island to ensure the boom barrier, when lowered, was positioned above the median traffic island.

In addition to correcting the boom barrier irregularity at the Kianawah Road level crossing, on 17 August 2023, Queensland Rail advised the ATSB that the 29 other locations where the boom arm did not fully extend to the edge of a median island or the dividing line of the roadway had all been corrected, with works completed in 2022.

Level crossing risk not managed

Safety issue description

Although Queensland Rail's internal standard required safety assessments of each public level crossing at least every 5 years, there had been no review or assessment of the Kianawah Road and other level crossings since 2001–2002.

Issue number:	RO-2021-005-SI-03
Issue owner:	Queensland Rail
Transport function:	Rail: Operations control
Current issue status:	Closed – Adequately addressed
Issue status justification:	The ATSB is satisfied that the assessment (Australian Level Crossing Assessment Model) of the Kianawah Road level crossing, undertaken by Queensland Rail addresses this safety issue. In addition, the ATSB is satisfied that Queensland Rail, through a program, is actively seeking to address safety risk at level crossings in accordance with its level crossing safety standard.

Proactive safety action taken by Queensland Rail

Action number:	RO-2021-005-PSA-109
Action organisation:	Queensland Rail
Action status:	Closed

On 17 August 2023, Queensland Rail advised the ATSB that they had conducted a site inspection and audit of the Kianawah Road level crossing on 21 March 2021, and an Australian Level Crossing Assessment Model (ALCAM) assessment rating was conducted on 1 October 2021. Additional detail on how Queensland Rail is planning to undertake ALCAM assessments of level crossings is detailed below:

- South east Queensland is developing a program to assess all public road and pedestrian crossings to the latest ALCAM and update the level crossing management database over the next 5 years.
- Within the regional business, a trial of drone technology was undertaken to determine if drones could be used to take measurements for ALCAM assessments to reduce risk and expedite the process. The trial concluded that existing technology did not support the ability to undertake ALCAMs using drone technology. However, Queensland Rail will continue to monitor developments in this area for future potential.
- At the same time as the drone trial was being undertaken, Queensland Rail reviewed existing data to identify high-risk regional crossings and commissioned a contractor to complete 95 ALCAM assessments. This work is approximately 65% complete with all high-risk assessments scheduled to be completed by the 'end of August 2023'.
- Queensland Rail is currently undertaking a procurement process to engage a contractor to update outstanding regional ALCAM assessment data by completing approximately 400 ALCAMs per year over the next 5 years.
- Queensland Rail's regional business holds ALCAM data for all level crossings, comprising 1,562 public and 863 private crossings. Of these crossings, 72 public and 17 private crossings have been completed using the current ALCAM methodology, with 71 of these assessments being completed since May 2023.

Insufficient resources to assess safety at level crossings

Safety issue description

Queensland Rail had insufficient resources available to assess all 1,138 public level crossings at 5 yearly intervals or sooner as required by its level crossing safety Standard, with only one person qualified to conduct level crossing safety assessments.

Issue number:	RO-2021-005-SI-04
Issue owner:	Queensland Rail
Transport function:	Rail: Operations control
Current issue status:	Closed – Adequately addressed
Issue status justification:	The ATSB is satisfied that Queensland Rail has addressed this safety issue by training and deploying additional resources and developing a program to assess all public road and pedestrian crossings over the next 5 years.

Proactive safety action taken by Queensland Rail

Action number:	RO-2021-005-PSA-01
Action organisation:	Queensland Rail
Action status:	Closed

On 17 August 2023, Queensland Rail advised the ATSB that they had trained 4 resources to undertake ALCAM assessments. Three of these staff are based in the south east Queensland business and one in the regional business. In addition, Queensland Rail is developing a program to assess all public road and pedestrian crossings to the latest ALCAM and update in the level crossing management database over the next 5 years. See proactive safety action RO-2021-005-PSA-109 for additional details.

No interface agreement

Safety issue description

There was no formal interface agreement between Queensland Rail and the Brisbane City Council to jointly identify and manage ongoing and changing safety risks at the road and rail Interface.

Issue number:	RO-2021-005-SI-01
Issue owner:	Queensland Rail and Brisbane City Council
Transport function:	Rail: Operations control
Current issue status:	Closed – Adequately addressed
Issue status justification:	The ATSB is satisfied that, as the level crossing interface agreement between Queensland Rail and the Brisbane City Council has been formalised, this safety issue has been addressed.

Proactive safety action taken by Queensland Rail and Brisbane City Council

Action number:	RO-2021-005-PSA-110
Action organisation:	Queensland Rail and Brisbane City Council
Action status:	Closed

On 17 August 2023, Queensland Rail advised the ATSB that a level crossing interface agreement had been formalised between Queensland Rail and the Brisbane City Council on 4 August 2021, which encompassed all level crossings in the Brisbane City Council area.

General details

Occurrence details

Date and time:	26 February 2021 – 1340 EST	
Occurrence class:	Accident	
Occurrence categories:	Level crossing collision	
Location:	Kianawah Road level crossing, Wynnum West, Brisbane	
	Latitude: 27º 26 32. 78' S	Longitude: 153º 08' 37.65" E

Train details

Track operator:	Queensland Rail	
Train operator:	Queensland Rail	
Train number:	E820	
Type of operation:	Non-revenue suburban passenger train	
Departure:	Roma Street, Brisbane, Queensland	
Destination:	Cleveland, Brisbane, Queensland	
Persons on board:	Crew – 2	Passengers – nil
Injuries:	Crew – nil	Passengers – n/a
Damage:	Minor damage to rollingstock	

Glossary

ALCAM	Australian Level Crossing Assessment Model
AS	Australian Standard. Standards are developed either by a national standards body (like standards Australia) or other accredited bodies. Any standards developed under the Australian Standard® name have been created in Australia or are adoptions of international or other standards.
BCC	Brisbane City Council. A local government in the state of Queensland.
QR	Queensland Rail. A rail transport operator and rail infrastructure manager in the state of Queensland.
RIM	Rail infrastructure manager. Means the person who has effective control and management of the rail infrastructure, whether or not the person owns the rail infrastructure or has a statutory or contractual right to use the rail infrastructure or to control, or provide, access to it.
RSNL	The Rail Safety National Law. The purpose of the Law is to provide safe railway operations in Australia.
RTO	Rail transport operator. An organisation or entity that is a rail infrastructure manager or a rolling stock operator or both.

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Queensland Police Service
- Queensland Rail
- Queensland Department of Transport and Main Roads
- train driver of service E820
- Office of the National Rail Safety Regulator
- witnesses
- closed-circuit television footage from Lindum Station and E820
- event recorder data.

References

Australian Level Crossing Assessment Model (2016). *ALCAM in Detail: An Introduction to the new ALCAM models (2014)*. Retrieved from https://alcam.com.au/media/1013/alcam-in-detail-update-august-2016.pdf

National Level Crossing Safety Committee (2023). *National Level Crossing Safety Strategy 2023-2032*. Retrieved from National-Level-Crossing-Safety-Strategy-2023-2032-FINAL-2023-04.pdf (tracksafefoundation.com.au)

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section 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 following directly involved parties:

- Queensland Rail
- Brisbane City Council
- train driver of service E820
- Office of the National Rail Safety Regulator.

Submissions were received from:

- Queensland Rail
- Brisbane City Council
- 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

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- 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, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

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

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining 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. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.