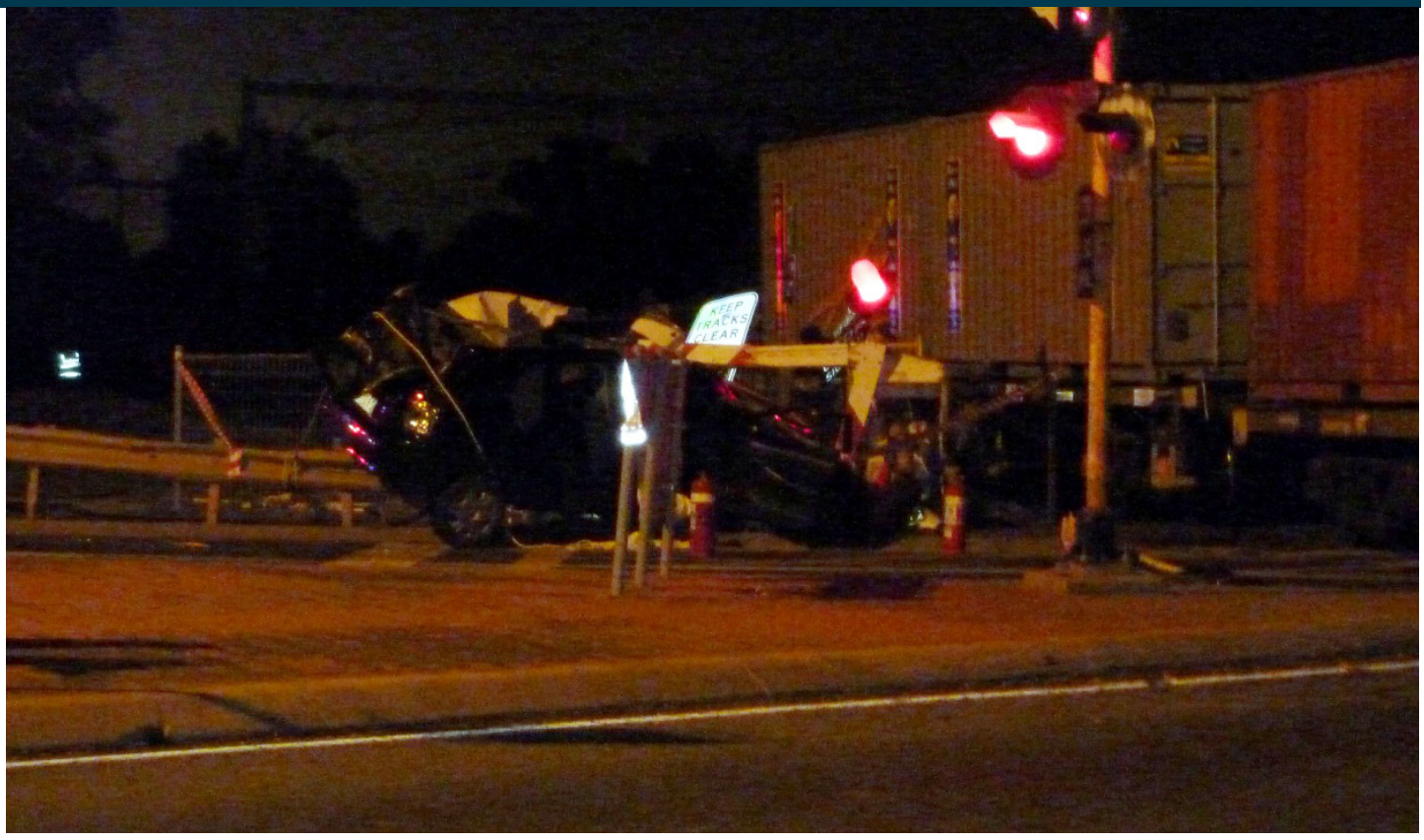
Australian Government
Australian Transport Safety Bureau

Level crossing collision between train 3PW4 and a motor vehicle

Werribee, Vic | 25 May 2012



Investigation

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Safety summary

What happened

On 25 May 2012, freight train 3PW4 collided with a motor vehicle (Toyota Corolla) that was fouling the railway track at the Cherry Street level crossing in Werribee, Victoria. The passenger in the Corolla died as a result of the collision and the driver was injured and required treatment in hospital.

What the ATSB found

The ATSB found that the driver of the Corolla had entered the level crossing when traffic was flowing relatively freely. Shortly after the Corolla entered the crossing, the lights, bells and boom barriers protecting the crossing began to operate for the approach of train 3PW4. Unbeknown to the Corolla driver, another vehicle had broken down just beyond the crossing. This led to her having to stop the Corolla in a position which was foul of the railway track.

When the crew of train 3PW4 saw the Corolla fouling the track, they made an emergency brake application. However, the train could not be stopped in time to prevent the collision.

The ATSB's investigation found that the level crossing signage and road markings were generally in accordance with the applicable Australian Standards and that the crossing warning lights, bells and boom barriers had operated correctly.

The ATSB also found that while the collision was a direct result of the Corolla being in a position foul of the approaching train, the safety issues involved were more complex and extensive. The investigation identified several opportunities to enhance the safety of the existing grade crossing including; changes to the road design, the provision of short range warning lights, improving the coordination of the crossing protection system with the nearby pedestrian traffic lights, reducing the length of the crossing and the provision of suitable refuge/escape area(s).

What's been done as a result

Metro Trains Melbourne has advised that they will investigate the potential benefits gained from fitting short range lights at this and other similar level crossings. They have also advised that the options available for shortening the level crossing length will be explored in consultation with the Wyndham City Council.

The Wyndham City Council has advised that actions have been taken to improve the coordination of the nearby pedestrian crossing lights and that further coordination improvements are being considered. Council officers are also investigating ways to provide escape/refuge areas.

Safety message

Although the road rules (*Victorian Road Safety Act 2009)* make motorists primarily responsible for avoiding a collision with a train when negotiating a level crossing, prudent road and level crossing design is essential in helping to mitigate the risk of road and rail vehicles colliding.

Where it is feasible, road and rail authorities should consider additional measures to enhance the situational awareness of motorists negotiating level crossings and to address the risks associated with traffic queuing.

It is also imperative that motorists approaching level crossings are extremely vigilant.

Contents

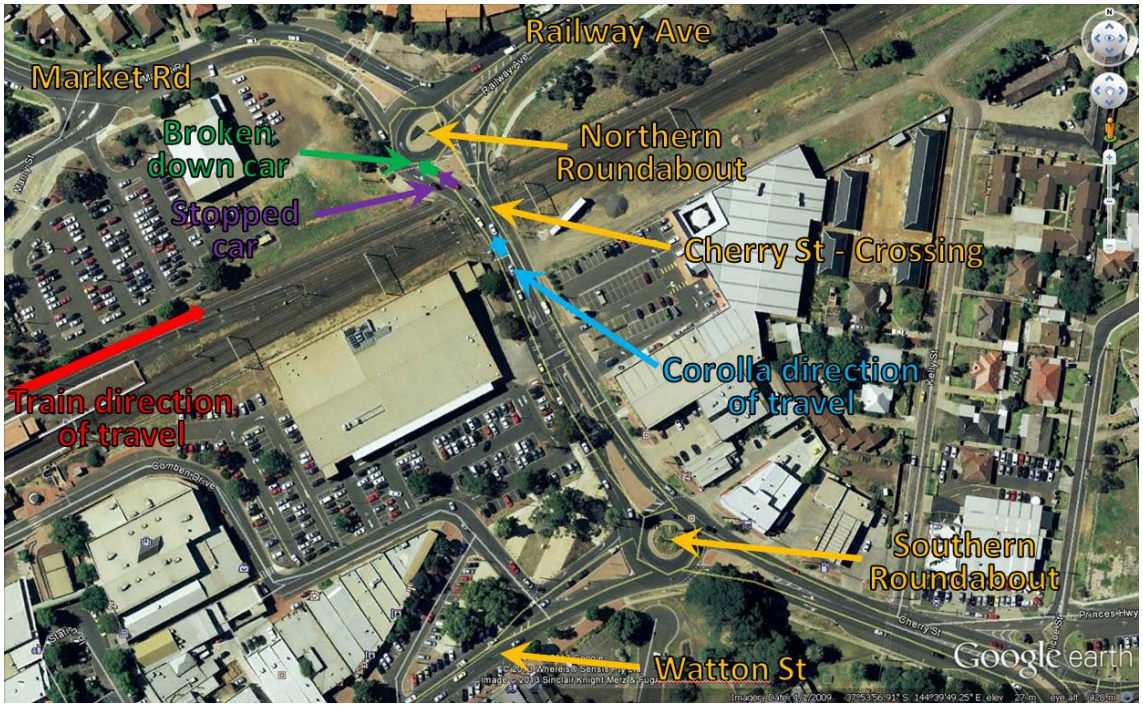
The occurrence

At 1700[1] on Friday 25 May 2012, traffic was starting to build up in and around Werribee, Victoria, as people started heading home at the end of the working day. It was overcast, raining and nightfall was approaching.

At this time, train 3PW4, a regular freight service operating between Perth and Wollongong, was travelling towards Werribee. The train was operating under the control of the Australian Rail Track Corporation's (ARTC) Network Control Centre West located in Adelaide (train control).

At about 1730, a motor vehicle (Holden Barina) was travelling in a northerly direction along Cherry Street. As the Barina traversed the level crossing (Figure 1) its engine stopped. It came to a stand, clear of the crossing, but obstructing the right-hand lane of Cherry Street just before the northern roundabout. The driver attempted to restart the Barina but was unsuccessful. He then switched on the vehicle's hazard lights and made a telephone call to a friend in order to get help.

Figure 1: Aerial view of Cherry Street level crossing



Source: Google Earth with annotations by the ATSB

Although the right-hand lane was obstructed by the broken-down Barina, road traffic in the left-hand lane continued to flow allowing cars to enter the northern roundabout. Traffic at the time was flowing relatively smoothly although there were brief periods when it slowed.

At 1740, a Toyota Corolla (Corolla) containing the driver and a passenger was travelling east along Watton Street in preparation to make a left-hand turn onto Cherry Street. The driver turned into Cherry Street at the southern roundabout and then moved to the right-hand lane in order to be ready to turn right onto Railway Avenue at the northern roundabout.

The Corolla was following another car in relatively free flowing traffic into the level crossing, unaware that the exit ahead was obstructed by the broken down Barina. Just after the Corolla entered the crossing, the flashing lights and bells activated, warning of the approach of train 3PW4 (Figure 2). No other vehicles followed the Corolla into the level crossing.

[1] The 24-hour clock is used in this report. Local time was Australian Eastern Standard Time (EST), UTC +10 hours

Figure 2: Closed circuit television (CCTV) footage showing the Corolla part way through the level crossing at 1740:44.52 when the level crossing lights begin to operate

Source: Chief Investigator Transport Safety with annotations by the ATSB

Train 3PW4 was now approaching the Cherry Street level crossing on the standard gauge track at a speed of 77 km/h. However, the train crew did not yet have a view of the level crossing due to the sweeping right-hand curve adjacent to Werribee Station platform.

At the same time, but some distance away, a suburban passenger train from Flinders Street, Melbourne was also approaching the level crossing on the down broad gauge line[2] (Figure 3).

The car ahead of the Corolla began slowing because of road congestion ahead and came to a stop in the right-hand lane behind the broken-down Barina but clear of the standard gauge track. The driver of the Corolla then stopped behind the vehicle ahead but was fouling the standard gauge track.

Vehicles in the left-hand lane, adjacent to the Corolla, began to move forward. However, the Corolla was now close behind the vehicle ahead and remained in the right-hand lane. The Corolla driver began sounding the horn and edging the car forward to urge the drivers ahead to move forward.

At about this time, the Corolla driver heard the crossing bells and realised that there was an approaching train. She edged the car further forward in an attempt to clear the standard gauge track but was now too close behind the car ahead to manoeuvre the Corolla into the, now clear, left-hand lane.

As train 3PW4 rounded the curve adjacent to the Werribee Station, the train crew saw the Corolla fouling the standard gauge track about 150 m ahead (Figure 3). The train driver immediately sounded the horn and made an emergency brake application.

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[2] In a double line area, the lines are referred to as the ‘down line’ and ‘up line’. Usually, the down line is used by trains travelling away from the state’s capital.

Figure 3: CCTV footage at 1741:19.97 showing Toyota Corolla

Source: Chief Investigator Transport Safety with annotations by the ATSB

Train 3PW4 entered the crossing at 1741:22 and collided with the passenger side of the Corolla. The impact of the collision spun the Corolla around and into the mast of the half-boom barrier and flashing lights located on the north-eastern side of the level crossing, extensively damaging the equipment.

As a result of the collision, the Corolla was severely damaged and the passenger was fatally injured. The driver suffered non-fatal injuries and was taken to hospital for treatment. The train sustained minor damage.

The train crew reported the collision to train control and, at 1744, train control reported it to the police and emergency services. Metropolitan Train Control Victoria (Metrol), the Country Train Control and Broad Gauge Victoria (Centrol) were also advised of the accident.

At 1748, the police and emergency services arrived on site.

At about 1800, Metro Trains Melbourne (Metro Trains) was called to attend the site and assess the infrastructure damage and test/repair the level crossing equipment. At about 1915, Works Infrastructure[3] attended the site to assess the ARTC's level crossing control equipment.

At 2105, investigators from the office of the Chief Investigator Transport Safety (CITS) arrived at the site to gather information on behalf of the Australian Transport Safety Bureau (ATSB).

When emergency services had finished on site, the police authorised train control to move train 3PW4. The train crew were relieved from duty by another crew and train 3PW4 departed the site at 2313. By 0120, Works Infrastructure had completed assessing and testing the standard gauge level crossing and interfacing equipment. The crossing was then available for normal operation but was left closed for work that had been scheduled for the weekend.

[3] Works Infrastructure was ARTC's third party signal maintenance contractor at the time of the incident.

Context

Train 3PW4

Train 3PW4 was a Pacific National Perth to Wollongong freight train carrying steel products. The train comprised two locomotives (NR64 leading and NR7 trailing) and 65 wagons. It was 1,193 m long and had a trailing mass of 2,978 t.

The train crew consisted of two drivers both of whom where medically fit for duty. They started their shift shortly before train 3PW4 departed Dimboola, Victoria, at 1147 on 25 May 2013.

Police attending the scene tested the train crew for the presence of alcohol, the result of which was a zero reading.

Train handling

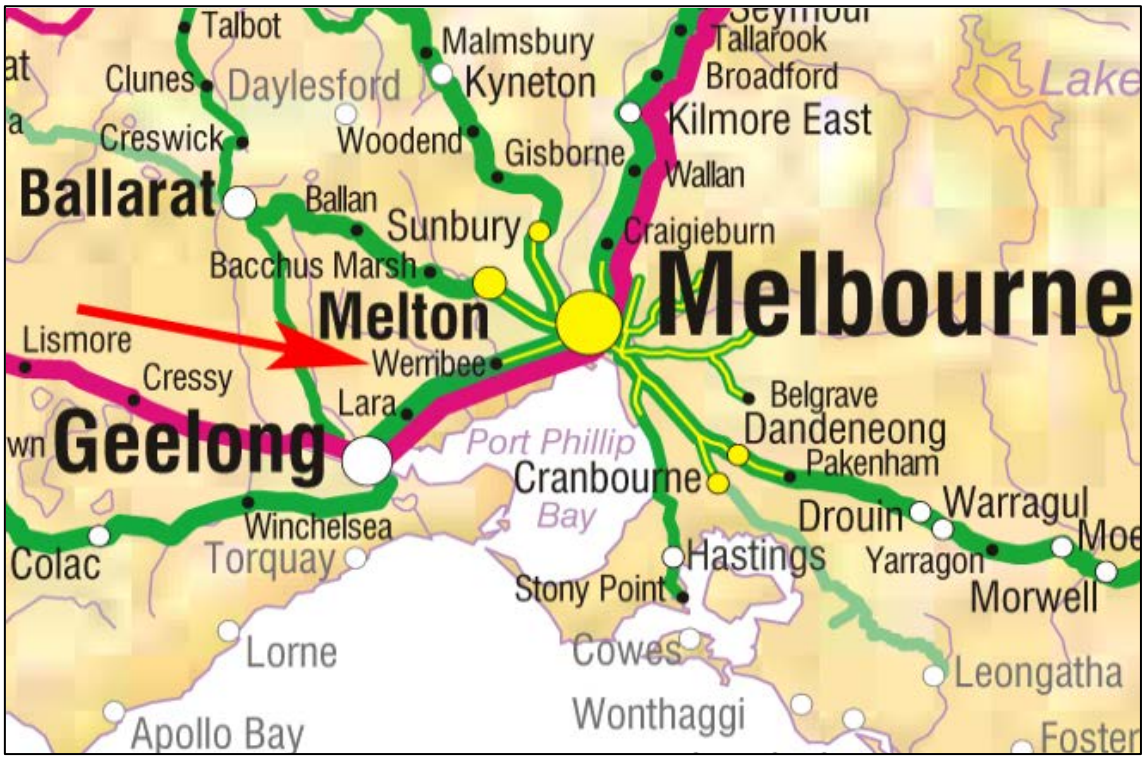
Based on an analysis of the available evidence, the handling of the train is considered to have been appropriate and within operational requirements. Therefore, train handling is not considered to be a factor in the collision.

Cherry Street level crossing

Location and site information

The Cherry Street level crossing is located in Werribee, Victoria, at the 31.456 km mark[4] on the Defined Interstate Rail Network (DIRN) (Figure 4).

Figure 4: Werribee, Victoria



Source: Geoscience Australia

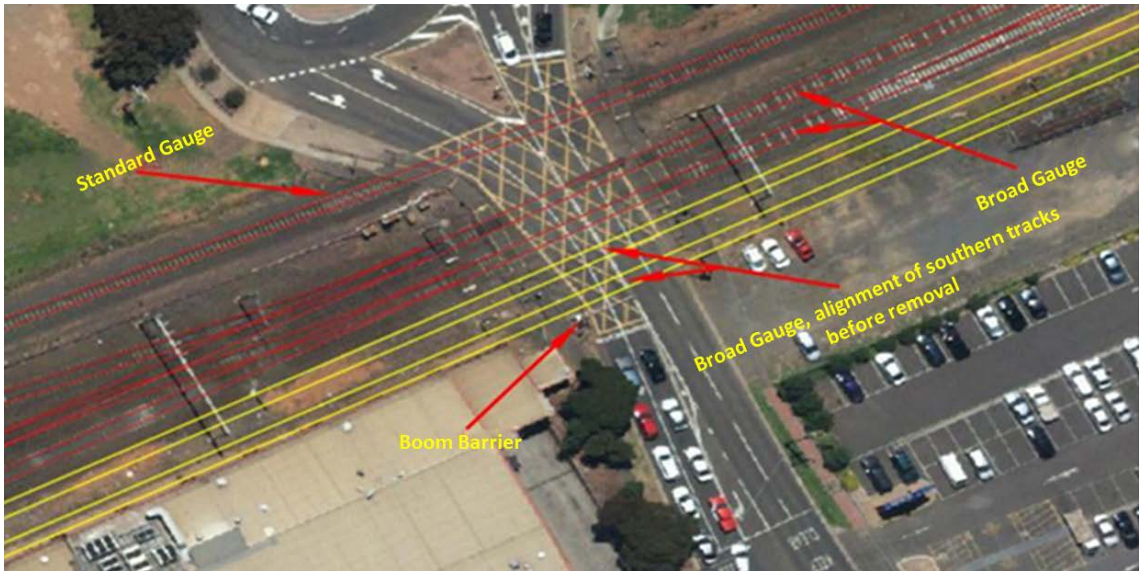
[4] Distance in kilometres from a track reference point in central Melbourne.

At the time of the collision, the level crossing had three bi-directional[5] tracks that crossed the roadway (Figure 1). Two of the tracks were up and down[6] broad gauge[7] tracks operated by Metro Trains Melbourne (Metro Trains). The third track was a standard gauge[8] track managed by the Australian Rail Track Corporation (ARTC). The standard gauge track speed limit on the approach to and through the Cherry Street level crossing was 80 km/h.

Level crossing history

The Cherry Street level crossing protection equipment was commissioned in October 1973 and comprised half-boom barriers, flashing lights, bells and associated road signage. At the time of commissioning, there were four broad gauge tracks that crossed Cherry Street (Figure 5).

Figure 5: Aerial view with decommissioned and removed tracks shown



Source: VicTrack & Department of Sustainable Energy with annotations by the ATSB

Since then, two of the broad gauge tracks located on the southern side of the crossing had been decommissioned and removed (Figure 6). At this time, the southern boom barrier, flashing lights and bells were not relocated towards the remaining tracks. This resulted in the stop line and level crossing equipment being about 10 m from the nearest running rail on the southern side of the crossing.

The standard gauge track on the northern side of the crossing (Figure 5) was commissioned in late 1995. The installation of this track required the relocation of the protection equipment on the northern side of the crossing.

Sometime after 2007, 'yellow box' pavement markings[9] (Figure 7) were added in an attempt to address motor vehicle queuing problems at the crossing. The crossing is currently about 34 m long from the stop line at the southern side to the end of the yellow box pavement markings on the northern side.

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5 Signalling which permits trains to be signalled normally in either direction on a running line.

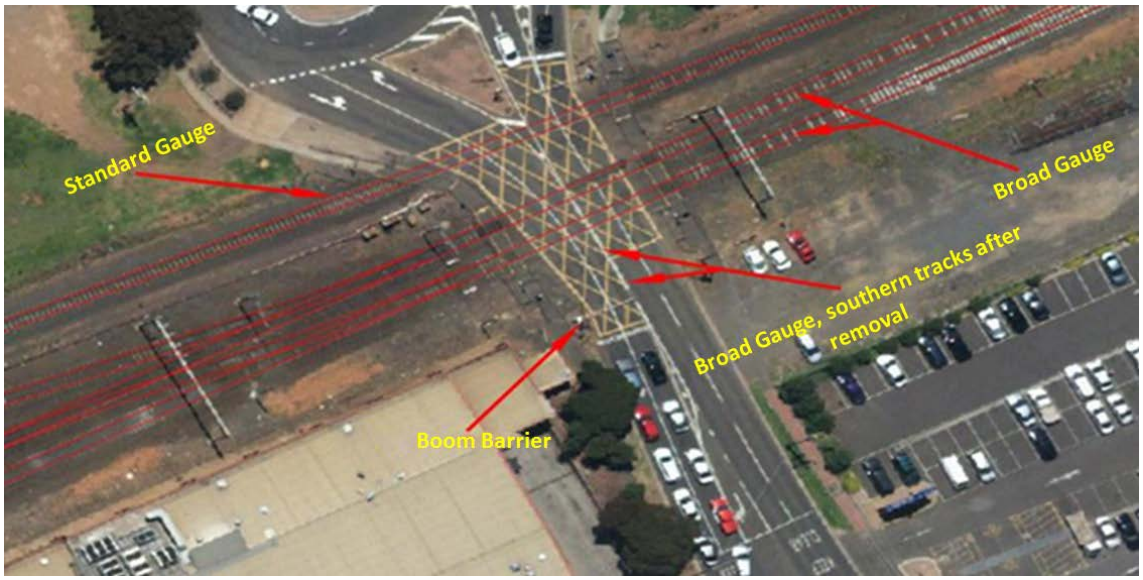
6 'Up' refers to trains running to Melbourne and 'Down' refers to trains running from Melbourne.

7 Broad Gauge (track): Track gauge of 1600 mm.

8 Standard Gauge (track): Track gauge of 1435 mm.

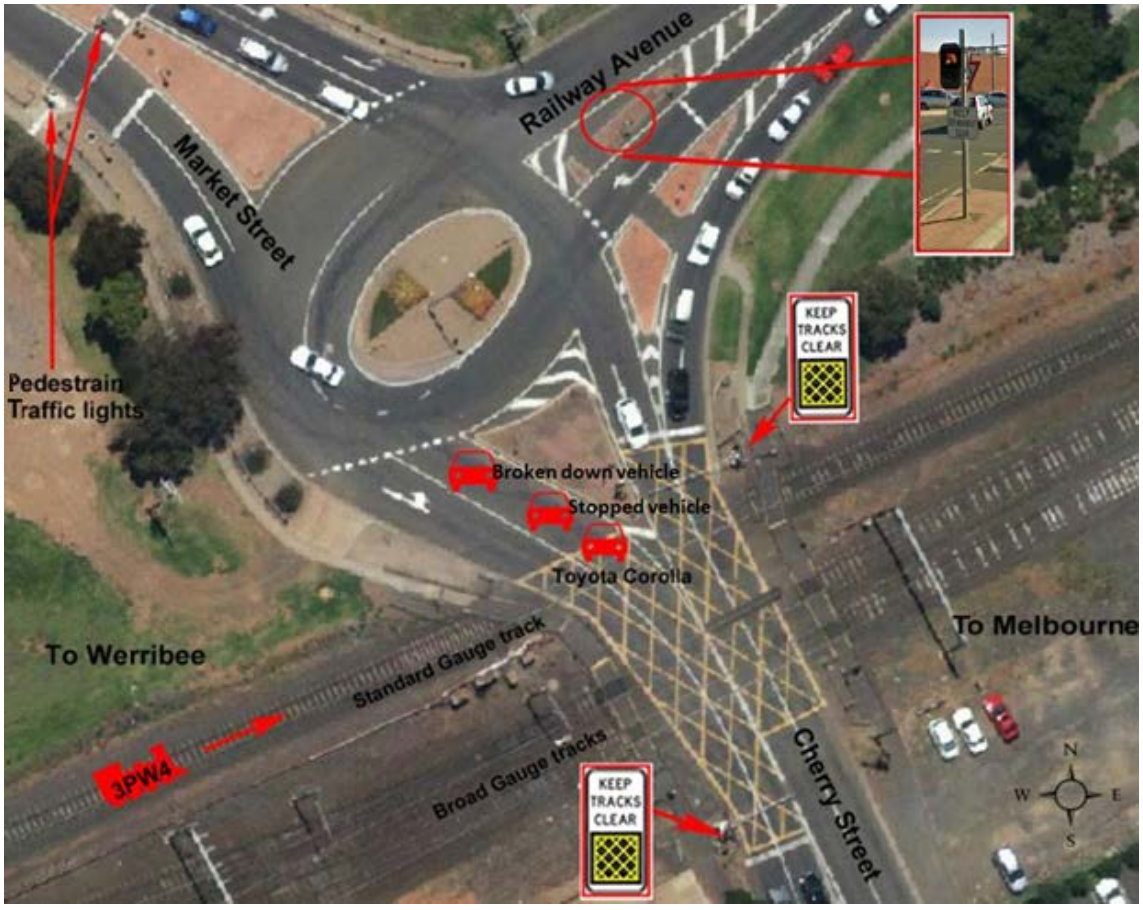
9 Yellow box pavement markings and road signage, as set out in the Australian Standard; AS 1742.7-2007 Manual of Uniform Traffic Control Devices Part 7; Railway Crossings clause 3.6.

Figure 6: Aerial view of the current standard and broad gauge tracks and the area where two redundant broad gauge tracks were removed



Source: VicTrack & Department of Sustainable Energy with annotations by the ATSB

Figure 7: Cherry Street level crossing layout also showing train and vehicle positioning



Source: VicTrack & Department of Sustainable Energy annotations by the ATSB

Coordinated road traffic lights (Figure 7) were also installed at the Railway Avenue entrance of the northern roundabout to assist the flow of motor vehicles exiting the level crossing when a train is approaching. Under normal traffic conditions (with no trains present) the traffic lights are not illuminated. The lights display amber and then red arrows to stop vehicles from Railway Avenue

entering the roundabout when a train is detected as approaching the level crossing. This promotes the free flow through Cherry Street level crossing of vehicles which might otherwise begin to queue if they had to give way to vehicles entering the roundabout from Railway Avenue.

Ownership and oversight

The Cherry Street level crossing half-boom barriers, flashing lights, bells, road markings and signage are maintained by Metro Trains who acts as the infrastructure owner through a lease arrangement with Victorian Rail Track (VicTrack). The Wyndham City Council (WCC) is responsible for the approach road markings and warning signs.

The traffic light equipment on the roads adjacent to the level crossing is owned and managed by VicRoads. The traffic light equipment controller outputs a signal to the railway crossing equipment via an interfacing cable. The level crossing equipment also outputs a signal via an interfacing cable to the traffic light controller.

Operation of the crossing protection systems on 25 May 2012

The level crossing boom barriers, lights and bells as well as the coordinated traffic lights are activated by the detection (via track circuits[10]) of trains approaching the Cherry Street level crossing on either the broad or standard gauge tracks. The broad gauge detection is independent of the standard gauge detection with the ARTC providing approaching train detection via its signalling system to Metro Trains.

While there was extensive damage to the level crossing equipment as a result of the accident, Metro Trains was able to undertake testing onsite of the level crossing equipment. The results of these tests confirmed that the level crossing equipment had operated correctly and to the current engineering design.

The ARTC also conducted tests on their level crossing operating equipment and these tests confirmed that their equipment operated correctly and as per the current engineering design.

A log obtained from the coordinated road traffic lights controller confirmed the correct operation and coordination of the traffic lights, which provides a 'railway phase'[11] to allow cars to clear the level crossing.

Witness accounts and an analysis of the CCTV recordings established that the level crossing equipment began to operate 36 seconds before the collision occurred, well in excess of that required by the standards. This information also confirmed that the Corolla had entered the level crossing and was one car length (about 5 m) beyond the southern-most stop line when the flashing lights began operating. The car driver was, therefore, unaware of the approaching train when she entered the level crossing, as the flashing lights and warning bells had not commenced operating.

Level crossing protection and risk control

Given the size and weight of most trains, it is not possible for them to brake at anywhere near the rate of a motor vehicle. Therefore, in most circumstances, a train driver is unlikely to sight an approaching motor vehicle and determine whether it will stop before, or clear, a level crossing until the train is relatively close to the crossing, by which time a collision may be imminent. In such circumstances, a train driver is unable to take any effective action to avoid the collision other than sounding the locomotive horn to warn the motorist, and (if time permits) make an emergency brake application.

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[10] A system that uses the rails of a railway as conductors so that the presence of a train in a section is detected when its wheels and axles complete the circuit between the rails.

[11] Refers to the timing of the traffic lights so as to prevent traffic entering the intersection that would restrict a clear route for traffic leaving the level crossing.

By comparison, a motor vehicle can be stopped relatively quickly. It is for this reason that, regardless of the type of level crossing control, the onus to take appropriate action is on the motorist. This is reflected in the Victorian road rules (*Victorian Road Safety Act 2009*). Part 10 – Level Crossings, Section 123 of the *Victorian Road Safety Act 2009* states:

> 123. Entering a level crossing when a train or tram is approaching etc.
>
> (1) A driver must not enter a level crossing if -
>
> (a) warning lights (for example, twin red lights or rotating red lights) are operating or warning bells are ringing; or
>
> (b) a gate, boom or barrier at the crossing is closed or is opening or closing; or
>
> (c) a train or tram is on or entering the crossing; or
>
> (d) a train or tram approaching the crossing can be seen from the crossing, or is sounding a warning, and there would be a danger of a collision with the train or tram if the driver entered the crossing; or
>
> (e) the driver cannot drive through the crossing because the crossing, or a road beyond the crossing, is blocked.
>
> Examples for paragraph (e) the crossing, or a road beyond the crossing, may be blocked by congested traffic, a disabled vehicle, a collision between vehicles or between a vehicle and a pedestrian, or by stock on the road.

In support of these rules, the VicRoad 'Road to Solo Driving' handbook (a plain English interpretation of the rules) states:

> **Keep clear of the train tracks**
>
> If there is traffic stopped on the other side of the railway crossing, you must not enter the crossing unless there is room for your vehicle on the other side – otherwise you could be stuck on the tracks in the path of an oncoming train. At some level crossings Yellow Box Markings painted on the road define the crossing area. You must not stop on the painted area.
>
> Trains need long stopping distances because they are heavy, so the train will be unable to stop in time regardless of what or who is stuck on the crossing.

Nevertheless, it is imperative that the design of level crossings (road alignment) and the protection system (signage, road markings, flashing lights/boom barriers) are fit for the purpose of preventing motor vehicles from coming into conflict with trains.

Australian Standard – Manual of uniform traffic control devices

The *Manual of uniform traffic control devices* consists of a series of fifteen Australian Standards. Part 7 of the manual (AS 1742.7–2007), titled *Railway crossings*, is specific to railway crossing control and signage and is divided into six main sections:

- Section 1 Scope and General
- Section 2 Signs, Devices and Assemblies - Description and Use
- Section 3 Pavement Markings
- Section 4 Application of Signs and Markings to Railway Crossings
- Section 5 Avoidance of Traffic Queuing on Crossings
- Section 6 Pedestrian and Bicycle Treatments at Railway Crossings

While the Cherry Street level crossing was installed under a previous version or issue of AS 1742.7, the analysis section of this investigation report assesses the crossing against the latest standard, AS 1742.7-2007, in an attempt to identify opportunities where road/rail safety can be enhanced.

Previous incidents

Previous incidents at this crossing

Information was obtained from Transport Safety Victoria (TSV) and the ARTC to identify any past incidents at the level crossing.

It was established that over a typical week[12], there were approximately 1,300 train movements through the Cherry Street level crossing. Approximately 1,218 of these were broad gauge passenger movements and 82 were standard gauge movements. Motor vehicle movements through the Cherry Street level crossing were about 19,500 vehicles per day.

Near miss data[13] for the period October 2010 until December 2012, sourced from TSV, indicated that of the 372 recorded near misses in Victoria during this period, nine occurred at the Cherry Street level crossing. Six of these involved standard gauge train movements.

This evidence suggests that queuing across the Cherry Street level crossing is probably occurring somewhat regularly. This was supported by the available ALCAM data and recent trackSAFE findings.

TrackSAFE

The trackSAFE Foundation is an Australian Rail Industry initiative that aims to reduce suicide, trespass and level crossing incidents on rail networks.

On 26 March 2013, trackSAFE released a list of what were considered, from the perspective of train drivers, the worst ten level crossings in each state of Australia. The Cherry Street level crossing was identified on this list as one of the highest risk crossings, with vehicles regularly seen queuing through the crossing.

ALCAM survey data for Cherry Street Werribee

The Australian Level Crossing Assessment Model (ALCAM) is a computer based risk assessment model used as a basis for determining level crossing risk. While ALCAM takes into account over 70 factors for each level crossing, including local characteristics and controls, it does not include a consideration of accident history.

VicTrack undertakes periodic ALCAM surveys of level crossings throughout Victoria on behalf of Public Transport Victoria. The last ALCAM survey carried out at the Cherry Street level crossing before the accident was completed in May 2006. The data captured at the time of this survey does not show that the level crossing was coordinated with the traffic lights at the northern roundabout, but available evidence indicates that they were coordinated at this time.

In February 2013, following this accident, another ALCAM survey was completed. This survey identified that the yellow box markings had been applied since the last survey. However, it does not make reference to any coordination of traffic lights or the pedestrian crossing lights on Market Street[14]. The survey flagged queuing as an ongoing high risk.

Park Terrace, Salisbury – South Australia

As part of the investigation process, the ATSB examined previous occurrences with queuing related issues, similar to Cherry Street. Of particular note was one accident investigated by the ATSB which occurred on 24 October 2002 at the Park Terrace level crossing in Salisbury, South Australia[15]. This collision involved a passenger train and two vehicles, a car and a bus. As a result of the collision, 4 people were killed and 26 injured.

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12 Typical week train movements includes all week day weekend timetabled traffic on the broad gauge and standard gauge. Data obtain does not include unscheduled or ad hoc train services.

13 Near miss data includes all protected, passive and unprotected level crossings for Victoria. Source: TSV

14 See section ‘Pedestrian operated traffic lights on Market Street’.

15 ATSB rail investigation report 2002/002.

The investigation established that as the train approached the level crossing, the train crew saw stationary motor vehicles fouling the track. Two of the motor vehicles had entered the crossing when the drivers could not pass through the crossing because the crossing/road beyond was blocked.

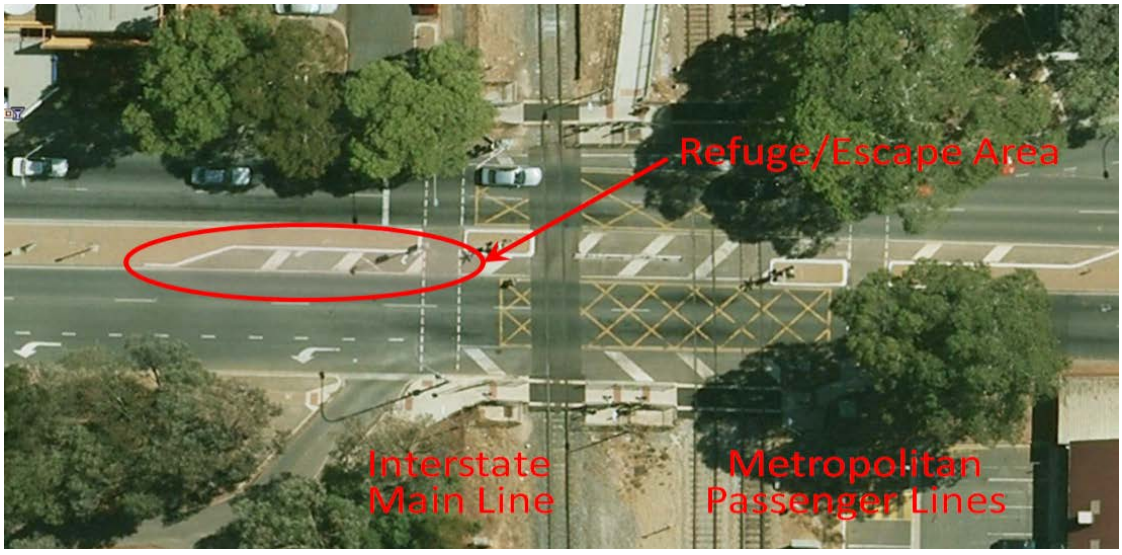
The ATSB investigation identified a number of safety factors including:

- road design (the number of entry/exit points)
- road traffic lights and the inter-link with the level crossing warning system
- the length of the crossing
- probable lack of awareness by road vehicle drivers of the road traffic rules as they relate to level crossings
- the lack of 'near hit safety' reporting at level crossings
- the lack of a focused body to oversight and undertake risk based assessments of level crossing safety.

As a result of the accident, the State Government of South Australia undertook a significant review of level crossing safety and introduced a range of initiatives including:

1) A review of the *Road Traffic Regulations 1996* and the subsequent introduction of 'Red Light' cameras as a deterrent at active level crossings that have a high incidence of queuing.
2) A working committee was established to review level crossing safety and to propose a range of strategies for identified high risk crossings including:
    - upgrade priority
    - opportunity for crossing closure
    - signalisation of crossing
    - the use of pre-emptive traffic light signal control. That is, the use of road traffic light signals on the entrance side of a level crossing interlocked with queue measurement technology on the exit side of the crossing. When a queue grows to a predetermined length (imminent risk of fouling the level crossing) the entrance road traffic signals are set to stop and prevent any further vehicles passing through the crossing until the queue is clear
    - Provision of escape/refuge areas (Figure 8).

Figure 8: Park Terrace, Salisbury showing refuge/escape post 24 October 2002



Source: Google Earth

Safety analysis

Motorist actions at the Cherry Street level crossing

While there are queuing controls such as the yellow box pavement markings, signage and coordinated traffic lights installed at the Cherry Street level crossing to mitigate queuing, motorists continue to queue through the crossing, particularly on the northbound side.

Research into the issue of non-compliance with rules and procedures has established four main predictors of non-compliant behaviour. These are:

> Expectation - the expectation that the rules have to be bent to get the job done, and nothing has changed (as a result)
>
> Powerfulness - the feeling that one has the ability and experience to do the job without slavishly following the procedures
>
> Opportunity - seeing opportunities that present themselves for short cuts or to do things 'better'
>
> Planning - inadequate work planning and advance preparation, leading to working 'on the fly' and solving problems as they arise[16]

Hudson[17] suggests that non-compliance is a natural human response to the presence of some or all of these predictive factors. When the length of the level crossing at Cherry Street is considered, along with the close proximity of the roundabout at Railway Avenue and subsequent road traffic delays, it is not surprising that the road users would look for ways to negotiate the crossing in a more 'efficient' manner than might be afforded by strictly following the rules.

On-site observations by ATSB investigators suggested that the traffic volume negotiating this crossing combined with the roundabout in close proximity creates a situation where the exit from the crossing is frequently blocked by slow moving traffic. In order to clear the crossing in a timely fashion, motorists are likely to routinely deviate from the rules by entering the crossing with the surrounding traffic in anticipation of clearing it.

According to James Reason:[18]

> These violations form part of a person's repertoire of skilled or habitual actions. They often involve corner-cutting (following the path of least effort between two task-related points). Such routine violations are promoted by inelegant procedures and a relatively indifferent environment. That is, one that rarely punishes violations or rewards compliance.

Each instance in which a motorist enters the unclear crossing and then clears it without incident reinforces this as a safe behaviour, with diminishing appreciation of the risk of being stopped on the level crossing behind slow moving traffic. Thus, the action is reinforced by a lack of negative consequence, either by way of coming to harm, or by being sanctioned for the noncompliant behaviour by way of policing.

Subsequently, road users learn that entering the unclear level crossing is an appropriate procedure as the traffic will clear in time for them to get across, other motorists are employing the same procedure and there are rarely any punishments or other negative consequences for this non-compliance. This eventually leads to a situation where motorists are queued across the track at a time that conflicts with train movements, resulting in a significant risk of collision.

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16 Hudson, P., Vujik, M.,Bryden, R., Biela, D. and Cowley, C. (2008*). Meeting Expectations: A New Model for a Just and Fair Culture SPE 111977*: Society of Petroleum Engineers.

17 Hudson et al (2008).

18 Reason, J. (2008). *The Human Contribution – unsafe acts, accidents and heroic recoveries.* Ashgate: Aldershot. pp 51-52

Factors influencing the Corolla driver's actions

On 25 May 2012, the driver of the Corolla acted like most other drivers would in her situation. She followed relatively free flowing traffic into the Cherry Street level crossing with the expectation that she would safely exit the other side. Unbeknown to her, the right lane just beyond the crossing was obstructed by a broken down car. As road traffic continued through the level crossing, the car ahead of the Corolla stopped behind the broken down car. The Corolla then came to a stand directly behind this car but was fouling the standard gauge track with a train now approaching. With little time to act (less than 30 seconds), the driver had to consider what was happening around her and how she would respond.

Human information processing is limited in that each person has finite cognitive resources available to attend to information or perform tasks during any particular time period. In general, if a person is focussing on one particular task, then their performance on other tasks will be degraded.[19] In the context of a motorist negotiating an actively protected level crossing with an unexpected obstacle, performance may depend on factors such as:

- Conspicuity of the broken down vehicle ahead
- Expectation in relation to a clear passage through the level crossing and activation of the crossing protection equipment
- Availability of visual and auditory cues to alert the driver to the oncoming train
- Layout of the crossing and roundabout
- Situation assessment and decision making processes
- Task competence such as driving experience and knowledge
- Other factors such as fatigue, drugs, alcohol, or medical condition.

Conspicuity

When interviewed, the Corolla driver stated that she followed the car ahead into the level crossing. When the car ahead slowed and eventually stopped, she became confused. She did not see either the broken down car or its operating hazard lights. This lack of perception was probably influenced by the visual conditions at the time (it was just on dusk with light rain falling) and the glare of headlights from surrounding traffic.[20]

Expectancy

The driver stated that she was familiar with the level crossing layout and the requirement to enter the crossing only when the exit on the other side of the crossing was clear of traffic, and to move through the yellow box markings without coming to a stop. She also stated that she had experienced the activation of the crossing protection on a number of occasions when she had stopped to permit train movements through the crossing. There was no evidence to indicate that she did not appreciate the risks associated with rail movements through the crossing.

The driver further stated that on approach to the crossing she assessed that the traffic was flowing through the level crossing and that she would be able to safely clear the crossing exiting with the flowing traffic. Like many other drivers, this was her normal practice when traversing the crossing and she had not previously experienced any problems with this approach.

Visual and auditory cues

The level crossing protection equipment (lights, bells and barriers) commenced operation just after the Corolla entered the level crossing and there were no readily apparent visual cues to warn the

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[19] Kahneman, D. (2011). *Thinking Fast and Slow*. Farrar, Straus & Giroux: New York.

[20] Approaching headlights in night-time driving has been identified as one of two major contributors to glare, which in turn influences visual conspicuity: Gray, R. & Regan, D. (2007). Glare susceptibility test results correlate with temporal safety margin when executing turns across approaching vehicles in simulated low-sun conditions. *Ophthalmic & Physiological Optics, 27*, 440-450.

driver of the oncoming train. The car traversed the crossing coming to a stop at the other side behind two other cars. The driver only became aware of the operating level crossing protection equipment when she was stopped behind the car ahead and heard the sound of the ringing warning bells. While the boom barrier at the northern entry to the level crossing (the other side of the road) was down, this was not conspicuous enough for the driver to notice it before she heard the bells.

Layout of the crossing and roundabout

Typically, visual cues such as traffic stopped and queuing ahead provide the approaching driver with information about whether or not the traffic ahead is flowing. This information can then be used to make a judgement about whether or not it is safe to enter the level crossing.

The visual cues at this level crossing when approaching from the south (as the Corolla driver did on 25 May) are not clear. The view of banked traffic at the crossing exit which would normally alert drivers to road blockage is not prominent in the view of a driver when approaching the crossing. Beyond the yellow box markings, there is only enough room for two vehicles to stand clear of the roundabout. Furthermore, at that point of the intersection, the road sweeps to the left, further reducing the view of traffic movement ahead. As a result, it is difficult for drivers of vehicles approaching the level crossing to accurately assess the flow of traffic ahead.

Situation assessment and decision-making

There were two people in the Corolla, the driver and a passenger in the front passenger seat. They were conversing normally while on approach to the level crossing and the driver did not recall anything in the conversation that would have distracted her from the task of driving the vehicle.

Once the Corolla was stationary behind the stopped vehicle, the driver commenced sounding the horn to alert the driver ahead to move forward. She was unaware that there was an approaching train or that there was a broken down car ahead. Therefore, at that time, she did not realise that she needed to consider moving out of the lane to avoid the obstacle ahead.

When the driver became aware that the level crossing protection equipment was operating, upon hearing the bells, her attempts to move the car forward to clear the track became more urgent. She edged the Corolla forward until it was right behind the car ahead. She considered ramming the car in front in order to clear the crossing. She also considered reversing, but had observed a train at Werribee Station on the broad gauge track to the rear and decided against that option. She finally decided that vacating the car was the only course of action available and alerted the passenger to get out of the car. However, by the time she made this decision the train had entered the crossing.

The driver's capacity to assess the unfolding emergency situation and determine an appropriate action must be considered in light of the situation and the very limited amount of time available. Decision making research has established that:

> Stressors such as time pressure, noise and ambiguity result in the following effects:
>
> - the stressors do not give us a chance to gather as much information
> - the stressors disrupt our ability to use our working memory to sort things out
> - the stressors distract our attention from the task at hand.[21]

Klein[22] goes onto explain that when time pressured we cannot sample as many information cues and, therefore, cannot gather all the facts to make a rational decision.

With the advantage of time and hindsight it is not difficult to determine that turning the Corolla into the left-hand lane or mounting the median strip to the right may have enabled the driver to move

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[21] Klein, G. (1999). Sources of Power. How People Make Decisions. The MIT Press: Cambridge, Massachusetts. p275.

[22] Klein, G, (1999). p275-276.

the car clear of the oncoming train. However, these options were not readily apparent to the driver in this rapidly unfolding and ambiguous situation.

Task competence

The driver resided in the local area and had travelled over the Cherry Street level crossing many times, both as the driver and as a passenger. She held a current Victorian driver's license and had a good driving record. When interviewed, she demonstrated an appropriate awareness of the road rules at level crossings.

Other factors

The driver was in good health and there was no indication that any medical factors affected her performance on 25 May 2012. Drug and alcohol testing carried out after the accident returned negative readings.

The driver had adequate sleep in the 24 hour period prior to the collision and there was no evidence to suggest that her actions were adversely affected by fatigue.

Level crossing protection and risk control

Level crossing length

The Cherry Street level crossing is about 34 m in length from the stop line at the southern side of the crossing to the end of the yellow box pavement markings on the northern side, with the stop line at the southern entrance located about 13.5 m from the nearest running rail.

According to AS1742.7 – 2007, the minimum distance the level crossing equipment assembly can be located from the nearest running rail is 3.5 m. The standard does not specify a maximum distance between the assembly and the nearest running rail.

Therefore, while the current arrangement meets the standard, the stop line and level crossing equipment assembly at the southern entrance to the crossing could be moved closer to the nearest running rail, reducing the length of the crossing, and improving an approaching motorist's view of both the up and down lines, as well as the traffic on the other side. This would marginally reduce the amount of time that a vehicle spends within the crossing but more importantly, it would improve the visual information available to motorists when assessing their ability to clear the crossing.

Short range lights

Short range lights, typically located on the opposite side of a crossing, are designed to warn approaching motorists in close proximity to the level crossing entry that the crossing equipment is operating. However, by virtue of their placement, short range lights are visible to, and can provide warning to drivers within the level crossing. This is particularly relevant for hearing impaired drivers who may not be able to hear the bells operating.

The Cherry Street level crossing was not fitted with short range lights, and thus, once the Corolla was within the crossing, there were no readily apparent visual cues to warn the driver of the oncoming train. Had the level crossing been fitted with short range lights, the driver would have been provided with a visual cue alerting her to the approaching train as soon as the flashing lights and bells began to operate. This would have provided her with greater situation awareness and more time in which to take appropriate action to clear the tracks.

Signalised coordination

With reference to the avoidance of traffic queuing on crossings, Section 5.2 of AS 1742.7–2007 states:

> 5.2 ELIMINATING THE PROBLEM
>
> Attempts shall be made to eliminate the problem by the following means:

(a) Closing, relocating or grade separating the crossing.

(b) If the downstream intersection is not signalized -

(i) changing priority of movement at the intersection; or

(ii) installation of traffic signals and linking as indicated in Item (d).

(c) If another downstream traffic constriction is the problem—

(i) removing the constriction or restoring capacity to the constriction; or

(ii) providing priority of movement through or past the constriction.

(d) If the downstream intersection is signalized, by linking the signals to the railway signal circuits such that priority is given to signal phases which will allow the crossing to clear prior to closure and arrival of a train.

(e) If there is a signalized intersection upstream of the crossing, by linking the intersection signals to the railway signal circuits so that traffic is restricted or prevented from reaching the crossing at critical times.

While the downstream traffic lights at the northern roundabout are coordinated with the Cherry Street level crossing equipment, there is still opportunity for further enhancement of traffic light coordination.

Pedestrian operated traffic lights are provided on Market Street approximately 60 m from the exit of the level crossing (Figure 7). The pedestrian traffic lights do not appear to coordinate effectively with the level crossing equipment. As a result, during a train/pedestrian phase, road traffic was observed to queue in advance of the pedestrian traffic lights. This can inhibit the free flow of traffic trying to exit the downstream side (Figure 9) of the Cherry Street level crossing.

Traffic congestion could be eased using the solutions identified at (c), (d) and/or (e) of AS 1742.7–2007, Section 5.2 (above).

Figure 9: Pedestrian Traffic Lights located on the exit of the roundabout on Market Street showing traffic queuing through the roundabout

Source: ATSB

Escape or refuge areas

Section 5.3 of AS 1742.7–2007 identifies the concept of infrastructure escape/refuge areas:

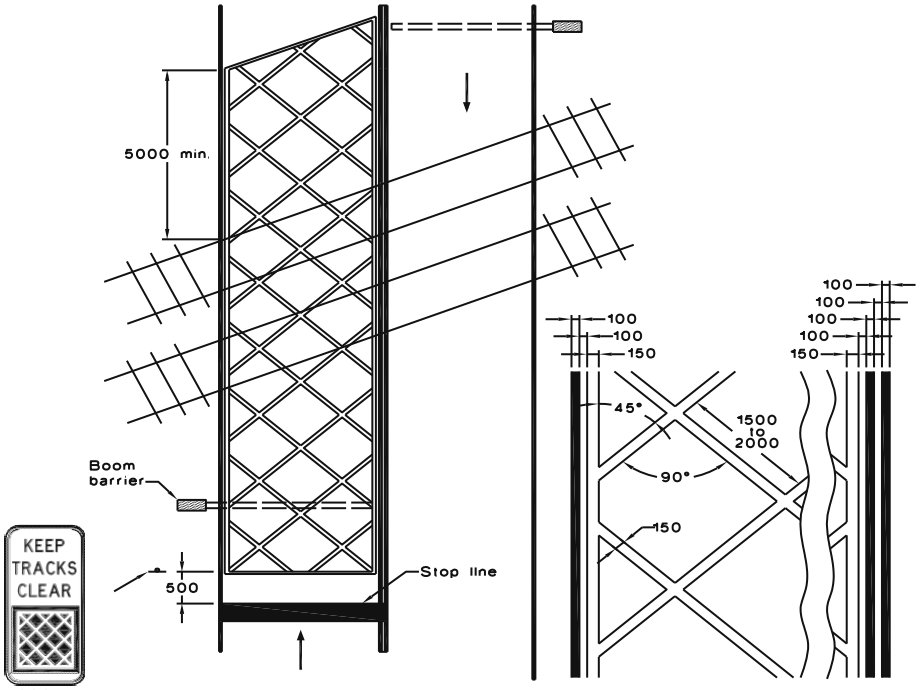
> *Escape or refuge areas should also be considered where practicable.*

At the northbound exit side of the Cherry Street level crossing there is a traffic island adjacent to the right-hand lane, just before the roundabout (Figure 7). Had there been an available refuge or escape area within the island, the Corolla driver may have had an opportunity to manoeuvre into this safety zone early in the sequence of events instead of edging forward and becoming trapped.

Pavement Markings and signage

The standard states that box markings shall only be used to discourage traffic queuing on a crossing. Where they are used, they should conform to the standard (Figure 10).

Figure 10: Australian Standard 1742.7-2007 layout of Yellow box pavement markings



Source: AS 1742.7 - 2007

The pavement markings at the Cherry Street level crossing were generally consistent with the requirements of AS 1742.7–2007. However, the yellow box markings at the northern end of Cherry Street, immediately before the roundabout, finished about 2 m beyond the nearest running rail rather than 5 m as set out in the standard.

Although the yellow box markings did not fully conform to AS 1742.7-2007, this factor was not considered to have contributed to the collision.

The investigation also found that post-accident, signage was installed by the Wyndham City Council just beyond the point where the yellow box markings finish on the northern exit of the crossing (Figure 11). Although the sign encourages motorists to move beyond the yellow box markings, the sign is not part of the AS 1742.7– 2007 suite of available signs.

Figure 11: Signage installed by Wyndham City Council post-accident

Source: ATSB

Findings

From the evidence available, the following findings are made with respect to the collision between train 3PW4 and a Toyota Corolla at Cherry Street level crossing, Werribee, Victoria, on 25 May 2012. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (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.

Contributing factors

- The Corolla driver entered the level crossing when traffic was flowing relatively freely and before the flashing lights and bells began operating for the approaching train. However, unbeknown to the Corolla driver, a motor vehicle just beyond the crossing had broken down and, as a result, the Corolla stopped and remained foul on the track.
- Train 3PW4 was unable to stop in time to avoid the collision.

Other factors that increase risk

- **The Market Street pedestrian crossing traffic lights do not effectively coordinate with the level crossing equipment. When these lights are operating, vehicles can be forced to queue through the roundabout and thus block traffic that is attempting to exit the level crossing while a train is approaching. [Safety issue]**
- **The level crossing is longer than necessary. Shortening it would reduce the amount of time that a motor vehicle spends within the crossing and improve the visual information available to motorists when assessing their ability to clear the crossing. [Safety issue]**
- **Once within the level crossing there are no readily visible cues (like short range lights) to alert a driver that the level crossing protection system is operating. [Safety issue]**
- **There is no available refuge or escape area within the traffic island at the northbound exit of the level crossing. [Safety issue]**

Other findings

- Testing of the level crossing by Metro Trains and the ARTC confirmed that at the time of the accident the level crossing equipment was operating correctly and as per design.
- The yellow box pavement markings on the level crossing do not conform to Australian Standard 1742.7-2007.
- Past ALCAM assessments do not reflect that the level crossing equipment is coordinated with the adjacent traffic lights on the Market Street/Railway Avenue roundabout.

Safety issues and actions

The safety issues identified during this investigation are listed in the Findings and Safety issues and actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisations. In addressing those issues, the ATSB prefers to encourage relevant organisations to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the directly involved parties were provided with a draft of this report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Pedestrian traffic light coordination

Number:	RO-2012-007-SI-01
Issue owner:	Wyndham City Council
Type of operation:	Rail - Infrastructure

Safety issue description:

The Market Street pedestrian crossing traffic lights do not effectively coordinate with the level crossing equipment. When these lights are operating, vehicles can be forced to queue through the roundabout and thus block traffic that is attempting to exit the level crossing while a train is approaching.

Response to the safety issue by: Wyndham City Council

The Council believes that the pedestrian crossing light is actually linked to the signal located on the eastern approach. Given the signal on the eastern approach is linked to the crossing signal, this means the pedestrian crossing is actually indirectly linked to the crossing signal. However, council has identified that better light coordination can be achieved at this location by:

- Inhibiting the pedestrian crossing to turn green when the boom gate is about to come down.
- Giving lesser green time for traffic on the eastern approach.

As a result of meetings between VicRoads and Council officers, the following changes have already been made:

- The setting of the delay timer to 0 seconds for the pedestrian crossing. This means the pedestrian introduction will be inhibited (can't turn green) from immediately the train call is received until the boom horizontal input is received. This is done to enhance the ability for traffic to clear from the roundabout.
- The setting of the pedestrian inhibition timer when boom horizontal input is removed to 60 seconds (previously set to 20 seconds). This means the signal on the north approach can stay green for traffic to clear through 40 seconds more than it used to be.

Council officers have contacted Metro Trains and VicRoads to attain relevant costing information to change the traffic light coordination (to give lesser green for traffic on the eastern approach). Once this information is attained, a business case will be put up by Council officers. Options that are currently being investigated are:

- Option 1 – Hold Railway Avenue traffic until the wig wag rail signals start. This will also give additional time for traffic on Cherry St to clear the roundabout.
- Option 2 – Hold Railway Avenue traffic until boom horizontal input is received.

Action number: RO-2012-007-NSA-004

ATSB comment:

The ATSB is satisfied that the actions taken and proposed by Wyndham City Council will adequately address this safety issue.

Level crossing length

Number:	RO-2012-007-SI-02
Issue owner:	Metro Trains / Wyndham City Council
Type of operation:	Rail - Infrastructure

Safety issue description:

The level crossing is longer than necessary. Shortening it would reduce the amount of time that a vehicle spends within the crossing and improve the visual information available to motorists when assessing their ability to clear the crossing.

Response to the safety issue by: Metro Trains

Metro Trains agrees that shortening the crossing may provide a risk benefit. This will be explored in conjunction with the Wyndham City Council.

ATSB comment:

The ATSB has reviewed Metro Trains submission and notes the intended action, but considers that further action is required to adequately address the safety issue.

ATSB safety recommendation - RO-2012-007-SR-005

The ATSB recommends that Metro Trains takes further action in consultation with Wyndham City Council in relation to the shortening of the Cherry Street level crossing.

Response to the safety issue by: Wyndham City Council

The Wyndham City Council notes that the additional length provides a warning to drivers as to where they should and should not go. In a way, the extended length appears to be working as additional signage warnings (and visual cue). Relocation of level crossing equipment is something that requires Metro Trains involvement.

ATSB comment:

The ATSB has reviewed Wyndham City Council and considers that further action is required to adequately address the safety issue.

ATSB safety recommendation - RO-2012-007-SR-006

The ATSB recommends that Wyndham City Council takes further action in consultation with Metro Trains in relation to the shortening of the Cherry Street level crossing.

Visual cues

Number:	RO-2012-007-SI-03
Issue owner:	Metro Trains
Type of operation:	Rail - Infrastructure

Safety issue description:

Once within the level crossing there are no readily visible cues (like short range lights) to alert a driver that the level crossing protection system is operating.

Response to safety issue by: Metro Trains

Metro Trains agrees that the addition of short-range lights may provide a general safety benefit and will explore the potential benefit of fitting short range lights at this crossing, and will also explore their potential at other similar crossings. It should be noted that modifications to the equipment beyond the scope of the current design will require approval and funding from VicTrack and Public Transport Victoria as the asset owner.

ATSB comment:

The ATSB has reviewed Metro Trains submission and notes the intended action, but considers that further action is required to adequately address the safety issue.

ATSB safety recommendation - RO-2012-007-SR-007

The ATSB recommends that Metro Trains takes further action in relation to the fitting of short range lights at the Cherry Street level crossing.

Escape or refuge areas

Number:	RO-2012-007-SI-04
Issue owner:	Wyndham City Council
Type of operation:	Rail - Infrastructure

Safety issue description:

There is no available refuge or escape area within the traffic island at the northbound exit of the level crossing.

Response to safety issue by: Wyndham City Council

Council officers are investigating ways to provide escape and/or refuge areas. Potentially this can be done by reducing the size of the island just north of the crossing. Once a possible solution has been identified, a business case will be prepared for the Capital Works Program.

ATSB comment:

The ATSB has reviewed Wyndham City Council's submission and notes their intention, but considers that further action is required to adequately address the safety issue.

ATSB safety recommendation - RO-2012-007-SR-008

The ATSB recommends that Wyndham City Council takes further action in relation to the provision of refuge/escape areas at the Cherry Street level crossing.

General details

Occurrence details

Date and time:	25 May 2012 – 1740 EST	
Occurrence category:	Accident	
Primary occurrence type:	Collision	
Type of operation:	Freight	
Location:	Cherry Street Level Crossing, Werribee, Victoria	
	Latitude: 37° 53.918' S	Longitude: 144° 39.788' E

Track details

Track	Continuously welded 60 kg/m rail on concrete sleepers
Gauge	Standard
Network owner/Corridor	ARTC – Adelaide – Melbourne; Defined Interstate Rail Network (DIRN)
Configuration	Bi-directional

Train 3PW4 details

Train operator:	Pacific National	
Rolling stock owner:	Pacific National	
Registration:	3PW4	
Type of operation:	Freight	
Loco & Consist	2 NR Class loco's, NR 64 leading NR 7 trailing; 65 wagons	
Length	1,192 m	
Weight	2,978 t	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Minor	

Car details

Type of Vehicle:	Toyota Corolla Hatchback	
Registration:	Private	
Persons on board:	Driver	Passengers – 1
Injuries:	Driver	Passengers – Nil
Fatalities:	Driver – Nil	Passenger -1
Damage:	Substantial	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Australian Rail Track Corporation
- Metro Trains Melbourne
- Chief Investigator Transport Safety
- Pacific National
- Victoria Police
- Coroners Court of Victoria

References

Australian Standard 1742-2007 Manual of uniform traffic control devices Part 7 Railway crossings

Victorian Road Safety Road Rules 2009

Transport Safety Victoria near miss data 2010-2012

Transport Safety Victoria Quarterly Incident Statistics – 2012 Q4 Heavy Rail.

ARTC Code of Practice for Victorian Main Line Operations (TA 20)

VicRoads Road to Solo Driving Handbook Part 4

Glossary for the National Codes of Practice and Dictionary of Railway Terminology

National guideline Glossary of Railway Terminology version 1 December 2010

Hudson, P., Vujik, M.,Bryden, R., Biela, D. and Cowley, C. (2008). Meeting Expectations: A New Model for a Just and Fair Culture

Reason, J. (2008). The Human Contribution – unsafe acts, accidents and heroic recoveries

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Submissions

Under Part 4, Division 2 (Investigation Reports), 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. 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 Australian Rail Track Corporation (ARTC), Metro Trains Melbourne (Metro Trains), Pacific National, Office of the National Rail Safety Regulator (ONRSR), Office of the Chief Investigator Transport Safety (CITS), Transport Safety Victoria (TSV), Victoria Police, Coroners Court of Victoria, Wyndham City Council and the motor vehicle driver.

Submissions were received from the ARTC, Metro Trains, Pacific National, ONRSR, CITS, TSV, Wyndham City Council and the motor vehicle driver. 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 Bureau 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 fare-paying passenger operations.

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 safety factors related to the transport safety matter being investigated. The terms the ATSB uses to refer to key safety and risk concepts are set out in the next section: Terminology Used in this Report.

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 train 3PW4 and a motor vehicle Werribee, Vic., 25 May 2012

RO-2012-007
Final – 18 December 2013