Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Rail Occurrence Investigation 2007/008
Final

Collision between Tandem Tip Truck and the *Indian Pacific* Passenger Train, 4SA8

Virginia, SA

13 December 2007

Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Rail Occurrence Report
2007/008

Final

Collision between Tandem Tip Truck and the *Indian Pacific* Passenger Train, 4SA8 Virginia, SA

13 December 2007

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office location: 15 Mort Street, Canberra City, Australian Capital Territory
Telephone: 1800 621 372; from overseas + 61 2 6274 6440
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117; from overseas + 61 2 6247 3117
E-mail: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

ISBN and formal report title: see 'Document retrieval information' on page v.

CONTENTS

THE AUSTRALIAN TRANSPORT SAFETY BUREAU vi

TERMINOLOGY USED IN THIS REPORT vii

EXECUTIVE SUMMARY viii

1 FACTUAL INFORMATION 1

1.1 Overview 1

1.2 Location 1

1.2.1 Train and crew information 3

1.2.2 Truck and truck driver information 4

1.3 The occurrence 5

1.4 Post occurrence 6

1.5 Toxicology tests 6

1.6 Loss and damage 7

2 ANALYSIS 8

2.1 Sequence of events analysis 8

2.1.1 Passage of train 8

2.1.2 Passage of truck – truck speed 9

2.1.3 Sounding of locomotive horn 9

2.2 Level crossing traffic control 10

2.2.1 Traffic control system effectiveness 11

2.2.2 Level crossing compliance 11

2.2.3 Sighting distance 13

2.3 Truck driver behaviour 14

2.3.1 Crossing awareness 14

2.3.2 Fatigue 15

2.3.3 Expectation 15

2.4 Other accidents 16

3 FINDINGS 18

3.1 Context 18

3.2 Contributing safety factors 18

3.3 Other safety factors 18

3.4 Other key findings 19

4 SAFETY ACTIONS..... 20

4.1 Department for Transport, Energy and Infrastructure (Level Crossing Unit) 20

4.1.1 Level crossing risk assessment 20

4.2 Australian Rail Track Corporation 20

4.2.1 Reducing road/rail interface risk..... 20

4.2.2 Road/rail interface agreement..... 21

4.3 City of Playford Council..... 21

4.3.1 Reducing road/rail interface risk..... 21

4.3.2 Road/rail interface agreement..... 22

4.4 Pacific National 22

4.4.1 Sounding of locomotive horn 22

APPENDIX A : SOURCES AND SUBMISSIONS..... 23

APPENDIX B : MEDIA RELEASE 25

DOCUMENT RETRIEVAL INFORMATION

Report No.	Publication date	No. of pages	ISBN
2007/008	27 June 2008	34	978-1-921490-45-3

Publication title

Collision between tandem tip truck and the *Indian Pacific* passenger train, 4SA8 – Virginia, SA 13 December 2007

Prepared by

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608 Australia
www.atsb.gov.au

Reference No.

Jun2008/Infrastructure 08181

Acknowledgements

The map section identified in this publication is reproduced by permission of Geoscience Australia, Canberra. Crown Copyright ©. All rights reserved. www.ga.gov.au.

The satellite view of the Virginia area as depicted at Figure 2 of this publication is reproduced with the permission of Google Earth.

The ATSB acknowledges the cooperation of all who participated and assisted in this investigation.

Abstract

At approximately 1417 on 13 December 2007 a tandem tip truck loaded with a 'bobcat' excavator drove into the side of the *Indian Pacific* passenger train (4SA8) at the passively controlled level crossing of Moloney Road near Virginia in SA. As a result of the collision, the truck driver was seriously injured. The locomotive drivers were shaken but not hurt. There were no injuries to passengers or the train's hospitality staff.

The investigation concluded that the accident occurred because the driver of the truck entered the level crossing while a train was on the crossing and that he did not come to a halt at the level crossing 'Stop' sign. It is likely that the truck driver was not expecting a train at the level crossing and accordingly did not stop.

Safety actions recommended as a result of the investigation include a review of the Australian Level Crossing Assessment Model (ALCAM) with respect to assessing the risks associated with level crossings having a history of incidents/accidents and measures to reduce the road/rail interface risk at the Moloney Road level crossing.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external organisations.

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 enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, 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 proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

TERMINOLOGY USED IN THIS REPORT

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, risk controls and organisational influences.

Contributing safety factor: a safety factor that, if it had not occurred or existed at the relevant time, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or (c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report.

Other key finding: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which 'saved the day' or played an important role in reducing the risk associated with an occurrence.

Safety issue: 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 operational environment at a specific point in time.

Safety issues can broadly be classified in terms of their level of risk as follows:

- **Critical safety issue**: associated with an intolerable level of risk.
- **Significant safety issue**: associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable.
- **Minor safety issue**: associated with a broadly acceptable level of risk.

EXECUTIVE SUMMARY

At approximately 1417[1] on 13 December 2007 a tandem tip truck loaded with a 'bobcat' excavator drove into the side of the *Indian Pacific* passenger train (4SA8) at the Moloney Road level crossing near Virginia in SA. As a result of the collision the truck driver was seriously injured.

Road traffic at the level crossing was passively controlled by 'Stop' signs[2], approach signage and pavement markings. The speed limit for road traffic approaching the level crossing was 80 km/h.

Passenger train 4SA8, the *Indian Pacific*, had an overall length of 379 m and a gross weight of 713 tonnes, it was being hauled by one locomotive. In the moments preceding the collision train 4SA8 was recorded as approaching Moloney Road level crossing at a speed of 92 km/h, this was 8 km/h below the maximum track speed limit at the location.

The view from the train to the south-east, the direction of the approaching truck, was significantly obscured by a row of greenhouses adjacent to the rail corridor. As the train passed clear of the greenhouses, the co-driver observed a truck on Moloney Road approaching the level crossing at an estimated speed between 20 and 40 km/h. The co-driver was certain the truck could not stop and that a collision was unavoidable. He checked the train's rear vision mirror on passing over the level crossing to witness the truck crash into the side of the train. The train driver immediately made an emergency brake application to stop the train. The train continued to decelerate and came to a stop with the front of the train 880 m beyond the point of collision.

The truck was extensively damaged by the collision with the force of the impact crushing the truck's cab. The truck driver was severely injured and trapped inside the cab with the truck partly fouling the crossing.

The train sustained some damage, mainly to the Motorail wagon (car carrier), power van and crew van. Most of the damage was superficial, however, the trailing bogie of the Motorail wagon was derailed.

The locomotive drivers were shaken but not hurt. There were no injuries to any of the passengers and the train's hospitality staff.

There was minimal damage to the track and fixed infrastructure.

The emergency response following the accident was both timely and effective.

The investigation found that the Moloney Road level crossing approach signage and road markings complied with the Australian Standard AS1742.7 – 2007 other than some very minor issues. It is unlikely that these issues would have contributed to the accident.

---

1 The 24-hour clock is used in this report to describe the local time of day, Central Daylight-saving Time (CDT).

2 'Stop' sign and 'Stop' sign assembly – Throughout this report 'Stop sign' and 'Stop sign assembly' refers to the 'Railway level crossing stop assembly (RX-2)' as defined within Australian Standard 1742.7-2007 at Clause 2.2.2 (page 12).

The investigation established that the truck driver lived in close proximity to the Moloney Road level crossing and frequently used it. He was aware of the double fatality that had occurred at the same crossing approximately one month earlier and thus should have been well aware of the level crossing and the need to stop to be able to adequately sight a train approaching from his left-hand side.

SA Police records established that the truck driver had never held a driver's licence in Australia and that the truck he was driving was unregistered at the time of the collision.

The investigation found that the train crew's actions were appropriate in the circumstances and that there was little effective action they could have taken to prevent or minimise the impact of the collision.

The investigation concluded that the accident occurred because the driver of the truck entered the level crossing while the train was traversing the crossing and that the truck driver did not come to a halt at the 'Stop' sign. It is likely that the truck driver was not expecting a train at the level crossing and had not been able to sight the train as he approached the crossing.

Safety actions recommended as a result of the investigation include a review of the Australian Level Crossing Assessment Model (ALCAM) with respect to assessing the risks associated with level crossings having a history of incidents/accidents and measures to reduce the road/rail interface risk at the Moloney Road level crossing.

1 FACTUAL INFORMATION

1.1 Overview

At approximately 1417 on 13 December 2007 a tandem tip truck loaded with a 'bobcat' excavator drove into the side of the *Indian Pacific* passenger train (4SA8) at the Moloney Road level crossing near Virginia, SA. As a result of the collision the truck driver was seriously injured. The locomotive drivers were shaken but not hurt. There were no injuries to any of the passengers and the train's hospitality staff.

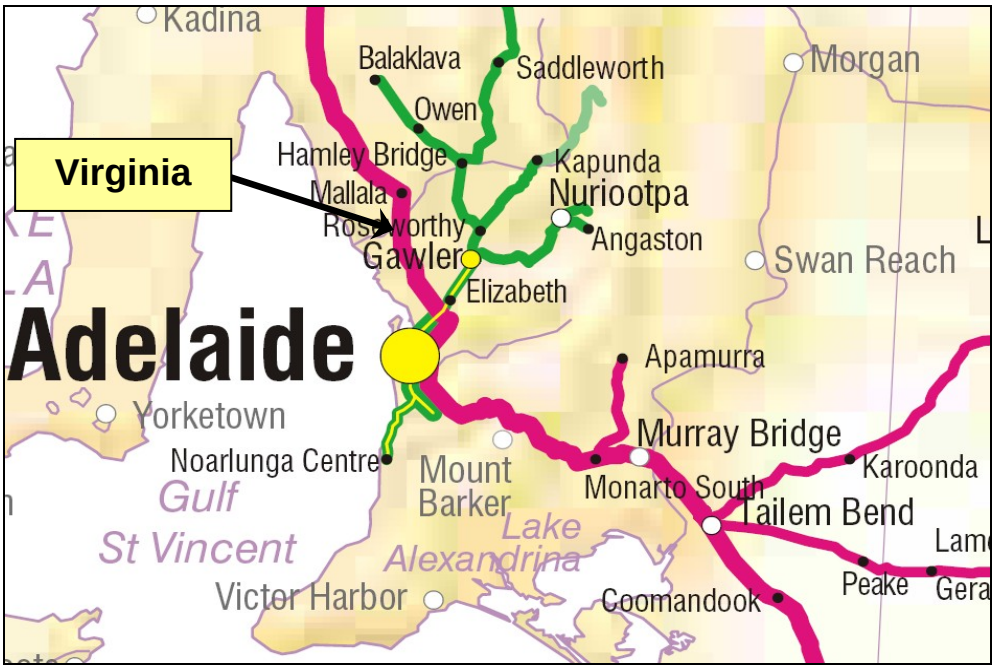
The truck was extensively damaged in the collision. The train sustained some damage, this was mainly to the Motorail wagon (car carrier), power van and crew van. Most of the damage to the train was superficial, however the trailing bogie of the Motorail wagon was derailed as a consequence of the collision.

There was minimal damage to the track and fixed infrastructure.

1.2 Location

The collision occurred on the Defined Interstate Rail Network (DIRN) at the Moloney Road level crossing located about 33.7 km north of Adelaide and 1 km south-east of Virginia, South Australia (Figure 1). The DIRN at this location is managed by the Australian Rail Track Corporation (ARTC). The maintenance of the road and associated approach warning signs for the level crossing is managed by the City of Playford Council (CPC).

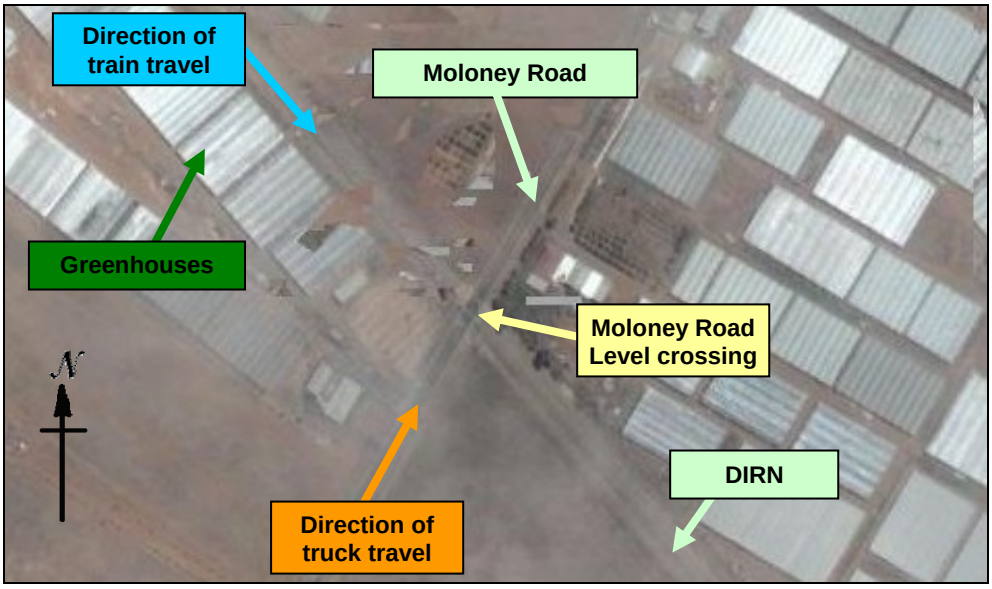
Figure 1: Location of Virginia, South Australia



Map - Geoscience Australia. Crown Copyright ©.

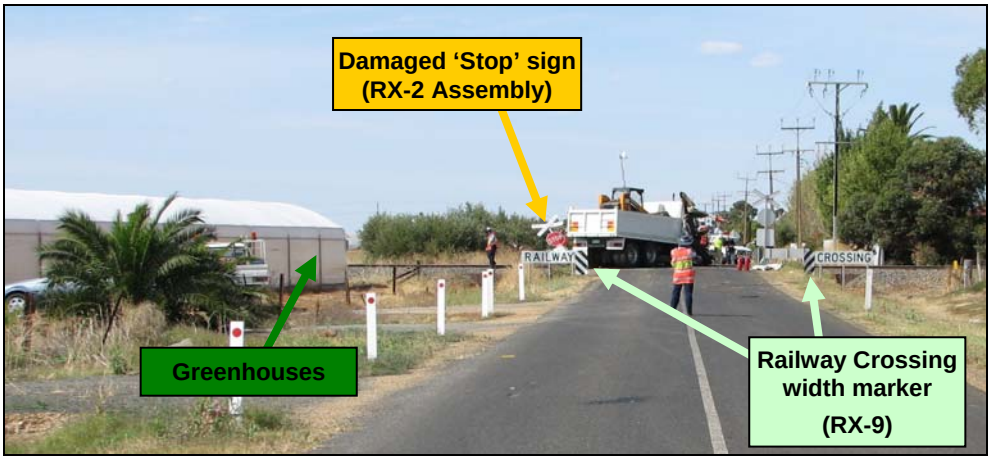
Moloney Road, (Figure 2), can be accessed from Penfield Road, 360 m to the north-east of the level crossing, or the Old Port Wakefield Road, 760 m to the south-west.

Figure 2: Aerial view of Moloney Road level crossing, Virginia SA



Moloney Road is a fully sealed local road, there is minimal grade differential at the road and track interface. The level crossing is passively[3] controlled by signs that require road users to stop at the 'Stop' sign and give way to trains on or approaching the level crossing. The road crosses the level crossing at an angle close to 70 degrees.

Figure 3: Site of collision, truck driver's view, travelling in a north-easterly direction



Travelling along Moloney Road in a north-easterly direction (the direction of the truck's travel) the visibility of the rail line to the north-west (the direction from which the train approached) is obstructed by a row of sheds used for horticultural purposes (greenhouses).

Sighting along the rail line remains obstructed until a motor vehicle is about 13 m from the crossing and near the 'railway crossing width marker assembly' (RX-9)

---

3 Passive Control - Control of the movement of vehicular or pedestrian traffic across a railway crossing by signs and devices, none of which are activated during the approach or passage of a train, and which rely on the road user including pedestrians detecting the approach or presence of a train by direct observation. (Source: AS1742.7-2007)

(Figure 3). The line of sight then opens up and sighting along the rail line is in excess of 650 m at the level crossing's stop line.

Figure 4: View from stop line looking towards direction of train travel

At the time of the collision, the speed limit for road traffic along Moloney Road was 80 km/h. The speed limit for trains approaching Moloney Road was 100 km/h increasing to 110 km/h just past the level crossing on the Adelaide side.

1.2.1 Train and crew information

The Indian Pacific train (4SA8)

Great Southern Rail (GSR) operates three interstate rail passenger services across Australia, comprising *The Ghan*, *Indian Pacific* and *The Overland*. The *Indian Pacific* is operated as a regular return passenger service twice a week between Sydney and Perth via Adelaide. Departure from Sydney is on Saturdays and Wednesdays, departure from Perth on the return service is on Wednesdays and Sundays.

Great Southern Rail provides the passenger cars and hospitality staff for these services, the locomotives and train drivers are provided by Pacific National.

At the time of the collision the train comprised one locomotive (NR120) hauling a Motorail wagon, power van, crew van, 11 passenger cars and a luggage van marshalled at the rear. The train had an overall length of 379 m and a gross weight of 713 tonnes. The Sydney to Adelaide leg of the journey for the *Indian Pacific* is timetabled to pass through the Moloney Road level crossing at approximately 1430 each Thursday, the day following its departure from Sydney (Wednesday).

Train drivers

The train driver operating the *Indian Pacific* was a 46 year old male with in excess of 28 years train driving experience. He was the acting Principal Driver for the Broken Hill depot at the time of the collision and responsible for mentoring new drivers on joining the depot. He was reaccredited on 19 June 2007, route qualified

for the Broken Hill to Adelaide section and regularly worked the route. The co-driver was a 58 year old male with approximately 30 years train driving experience. He was reaccredited on 30 June 2007, but not route qualified for the Broken Hill to Adelaide section at the time of the collision and was working under the direction of the driver.

At the time of the collision both the driver and co-driver were fit for duty.

GSR on-train staff

The GSR on-train staff numbered 13 and consisted of a train manager, a night manager, a Gold Service manager, two chefs, seven hospitality attendants and a train technician. The GSR staff are based in Adelaide. They take rest breaks in the crew van or an allocated cabin when not required for duty. General duties include attending to passenger requirements, train servicing and cleaning, train security and emergency response.

The GSR on-train staff emergency response training encompasses advanced resuscitation (including defibrillation and administering oxygen), fire safety/fighting, evacuation and assisting with train protection. In addition to this 'class-room' training, there is also scenario based practical emergency response training that is held on a periodic basis. Emergency response/first aid equipment such as fire extinguishers, axes, crowbars, sledgehammers, ladders, resuscitation kits (two), first aid kits, medical oxygen and defibrillator equipment are carried on board the train. In addition, there are two first response emergency medical kits, one containing medications that can be administered by the GSR train manager and one containing medications that can only be administered under the direction of a doctor.

All of the GSR on-train staff at the time of the accident held the appropriate and current certification for all aspects of their duties.

1.2.2 Truck and truck driver information

The road vehicle involved in the collision was a Hino tandem axle tip truck with an overall length of 8 m and gross vehicle mass (GVM) of 21 tonnes.

In South Australia motor vehicles are not subject to an annual inspection for roadworthiness. An examination of the truck by the SA Police following the collision did not identify any mechanical deficiencies that may have contributed to the collision. However, the vehicle was unregistered at the time of the accident.

Truck driver

The truck driver involved in the collision was a 41 year old male from South Australia. He lived in Virginia and in close proximity to the Moloney Road level crossing and frequently used it.

SA Police records indicate that the truck driver, born in New Zealand, had his licence disqualified while residing in New Zealand for drink driving offences. Since moving to Australia in 1997 he had not renewed/held a driver's licence and had been issued with two 'Expiation Notices', one on 6 June 1997 for speeding and a second on 6 March 2007 for driving without a licence. At the time of the accident

he was unlicensed and operating an unregistered motor vehicle, the truck involved in the collision.

1.3 The occurrence

At 1455 on Wednesday 12 December 2007, the *Indian Pacific* (4SA8) departed from Sydney Central Station on schedule with locomotive NR120 leading. The first part of the journey was from Sydney to Broken Hill (NSW). A rostered crew changeover occurred with the two train drivers involved in the collision joining the train at Broken Hill. The train departed from Broken Hill bound for Adelaide a little behind schedule at 0833 on Thursday 13 December 2007.

The journey after leaving Broken Hill was fairly uneventful with the *Indian Pacific* crossing trains at Yunta (195.84 km[4]) and Nantawarra (120.49 km[5]). The train continued on its journey towards Adelaide passing through the Two Wells crossing loop at 1410.

On the same day, Thursday 13 December 2007, the truck driver involved in the collision and a work colleague had planned to undertake some concreting work in the Adelaide hills. However, the job was cancelled so they decided to undertake rubbish removal at some units located in Ottoway, a western suburb of Adelaide.

After finishing the work, about 1330, they set off for home. The truck driver dropped his work colleague off on the Port Wakefield Road and continued on his way home. Noting that the driver has no recollection of events on the day of the accident, it is considered most likely that he continued travelling along the Port Wakefield Road, to where it intersects with the Old Port Wakefield Road, Virginia. He then probably continued travelling along the road turning right onto Moloney Road. He was now approximately 0.74 km (30 to 40 seconds) away from the Moloney Road level crossing. The train was now close to the Penfield Road level crossing, Virginia and about 800 to 900 m north-west of the Moloney Road level crossing, travelling at a speed of 93 km/h.

The temperature was about 34 degrees Celsius, the wind was variable, swinging north to west at an estimated speed of between 9 km/h to 20 km/h. The sun's azimuth[6] was 303 degrees at an altitude[7] of 71 degrees.

The train continued travelling towards the Moloney Road level crossing. At a distance of about 180 m from the crossing the train driver sounded the locomotive horn (Figure 6). His view to the south-east, the direction of the approaching truck, was significantly obscured by the greenhouses on the train's right-hand side adjacent to the rail line. The train maintain a speed of about 92 km/h.

Just after 1417, as the train cleared the greenhouses and just on entering the crossing, the co-driver observed a truck approaching from the right at speed

---

4 Distance in kilometres from a track reference point located at Coonamia in SA.

5 Distance in kilometres from a track reference point located at Keswick in SA.

6 Azimuth is the clockwise horizontal angle (in degrees minutes and seconds) from true north to the sun/moon. (Source: Australian Government, Geoscience Australia)

7 Altitude is the vertical angle (in degrees minutes and seconds) from an ideal horizon, to the sun/moon. (Source: Australian Government, Geoscience Australia)

(estimated to be between 20 to 40 km/h). The co-driver was certain a collision was unavoidable and checked the train's rear vision mirror on passing over the level crossing to witness the truck crash into the side of the Motorail wagon. He could see dust and debris flying near the point of impact and immediately alerted the train driver who made a full service brake application, followed by an emergency brake application[8].

The front of the train came to rest approximately 880 m past the level crossing.

1.4 Post occurrence

Immediately following the collision the train driver contacted the ARTC train controller and requested the attendance of the emergency services. He then spoke to the train manager to ascertain the wellbeing of passengers, hospitality staff and the condition of the train. He was advised that there were no injuries and that there was only minor damage to the train.

At about this time, the train manager also dispatched one of the chefs and the train technician to render assistance to the truck driver. The two GSR employees walked back to the accident site at Moloney Road and provided primary first aid assistance to the truck driver, their actions probably saved his life.

Ambulance services arrived at 1445 with a retrieval helicopter arriving approximately six minutes later and the SA Police being on site by 1507. Following their arrival, the Police took control of the site until all evidence was gathered and the site suitably cleared.

As a result of the collision, the truck driver suffered severe injuries, losing his right leg and part of his left foot. He had also sustained a significant head injury. After the truck driver had been medically stabilised by ambulance officers he was air lifted by helicopter (1500 hrs) to the Royal Adelaide Hospital to undergo emergency surgery.

In the meantime, GSR had arranged for the transfer of passengers by bus to the Keswick train terminal in Adelaide. Passengers were assisted in detraining by State Emergency Services (SES) personnel and GSR staff, they disembarked, climbing backwards down the train steps and were then transferred to waiting coaches located immediately adjacent the respective exit points.

1.5 Toxicology tests

Breath testing for alcohol of the train drivers by the SA Police following the accident returned zero readings. Toxicology testing of the truck driver also returned zero readings for alcohol and illicit drugs.

8 The type of brake application made when a train must be stopped in the minimum distance possible (Glossary for National Code of Practice - 2004).

1.6 Loss and damage

As a result of the collision the truck was extensively damaged. The train sustained damage to the Motorail wagon, power van and crew van. Most of the damage was superficial but the trailing bogie of the Motorail wagon derailed (Figure 5).

Following the collision GSR received three reports in relation to property damage. Two incidents involved damage to motor vehicles that were being transported on the Motorail wagon. The third report related to the damage of a suitcase and probably occurred as it was removed from the train.

Figure 5: Damage to power van (foreground) derailed bogie of Motorail wagon (background)

2 ANALYSIS

On 13 December 2007 a team from the Australian Transport Safety Bureau (ATSB) was despatched to investigate the collision at the Moloney Road level crossing.

Evidence was sourced from the train drivers, the SA Police, the Department of Transport Energy & Infrastructure, the City of Playford Council, the ARTC, GSR and Pacific National. Evidence included interviews, photographs, train running information, voice and data logs, engineering documentation, site surveys and other material.

The initial examination of this material established that there were no known mechanical defects or deficiencies with the train or truck which would have contributed to the accident. The train crew were appropriately trained, qualified, and medically fit at the time of the collision.

2.1 Sequence of events analysis

2.1.1 Passage of train

At the time of the collision, train 4SA8 was under the direction of the ARTC train controller located in Adelaide. The train driver had the correct authority to occupy the section of track between the Two Wells crossing loop and the Bolivar crossing loop, the section of track where the collision occurred.

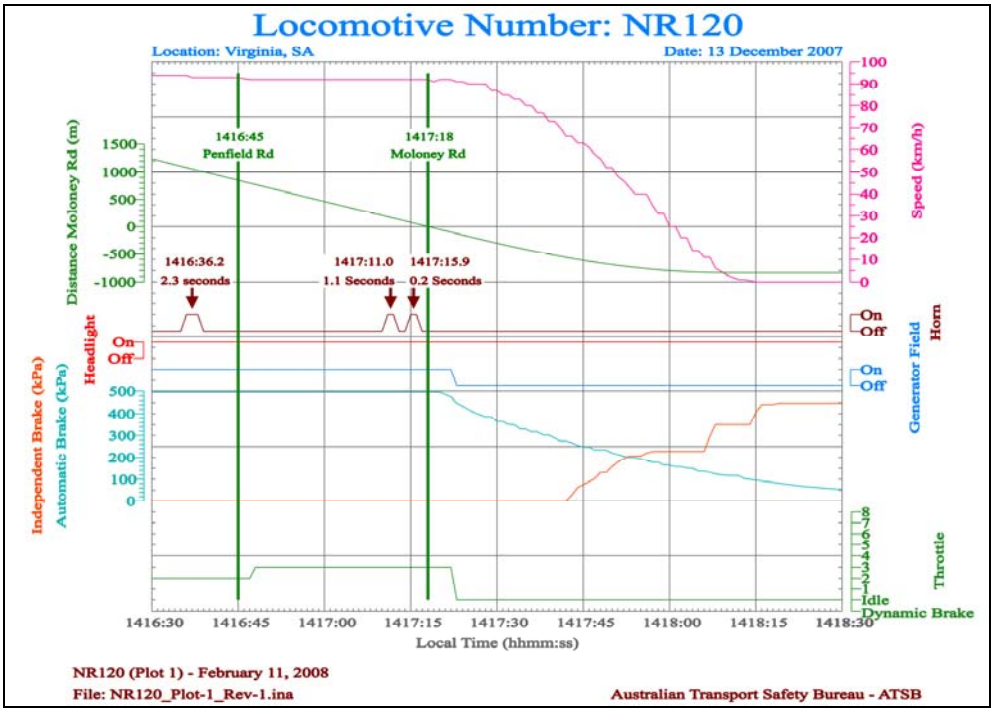
The data logger on locomotive NR120 captured time, speed, distance, brake, headlight, whistle and vigilance activation data. The speed recorded by the data logger was corrected for wheel diameter variation to accurately calculate the train's speed. An examination of data from the locomotive was used to reconstruct events leading up to the collision. Based on this information the following was concluded:

- The train was travelling at speed of 92 km/h, 8km/h below the maximum track speed at the time of the collision.
- The train's headlight was on full beam before and at the time of collision.
- The train's locomotive horn was sounded at 1416:36.2, 1417:11.0 and 1417:15.9 while approaching the Penfield and Moloney Road level crossings. Train 4SA8 entered the Moloney Road level crossing at 1417:18. Based on this information the locomotive horn was sounded at a distance of 1085 m, 178 m and 53 m from the Moloney Road level crossing.
- The collision occurred at approximately 1417:18, just as the train entered Moloney Road level crossing.
- The train brakes were applied approximately four seconds after the train had passed over the Moloney Road level crossing, i.e. about 100 m after the point of impact, when the driver became aware of the collision. This was corroborated by the train driver who stated that he applied the brakes as soon as he became aware of the collision.
- The front of the train came to a stop 880 m beyond the point of collision. The speed reduction achieved by the train is consistent with the braking effort achievable by this class of train.

An inspection of the headlight and whistle of locomotive NR120 was conducted while the train was at the accident site. This inspection established that:

- The headlights and ditch lights were on and in good working condition.
- The locomotive horn was in good working order.

Figure 6: Locomotive NR120 'loco log data' extract



2.1.2 Passage of truck – truck speed

The truck did not have an on-board data recorder that could be used to provide information regarding its speed.

However, tyre skid marks were found on the road surface extending from the rear truck wheels for a distance of approximately 0.4 m indicating that the truck was travelling at a very low speed when braking commenced and/or that the truck did not come to a halt at the 'Stop' sign and that the truck driver did not see the train and only applied the brakes in the very last moments before the collision. The latter is corroborated by the train's co-driver who said he saw the truck approaching at speed and stated that it did not come to a halt at the 'Stop' sign. The train's co-driver estimated that the truck was travelling at between 20 km/h to 40 km/h at the time of collision.

Based on the available evidence it is concluded that the truck did not come to a halt at the 'Stop' sign and that the truck driver probably did not see the train until just before the collision.

2.1.3 Sounding of locomotive horn

Historically the locomotive horn (audible warning device) has been considered an important aid in warning motorists of an approaching train. However,

soundproofing, air conditioning and entertainment systems in modern motor vehicles and trucks raise questions regarding the effectiveness of these devices.

A whistle sign was located 529 m in advance of the Moloney Road level crossing. An examination of the locomotive 'loco log data' extract (Figure 6) shows that the train horn device was sounded 54 m, 178 m and 1080 m in advance of the crossing but not at the whistle sign as prescribed in the ARTC 'Code of Practice for the Defined Interstate Rail Network'.

Calculations show that had the truck driver heard the locomotive horn when the train was at a distance of 178 m from the crossing he probably would have been able to respond to the warning signal and significantly reduce[9] the speed of the truck or bring it to a stop before entering the crossing. In the circumstances, the horn would also have been considerably more audible to the truck driver when the train was 178 m from the crossing than if it had been sounded at the whistle board 529 m from the crossing.

Based on the estimated speed of truck at time of collision, it is most likely that the truck driver did not hear the train horn or did not recognise it as the warning signal of an approaching train.

It is concluded that:

- There were no deficiencies that relate to the mechanical condition of the train. Train speed, braking, headlight illumination were appropriate.
- The train driver did not sound the train horn at the whistle sign as prescribed however it is unlikely to have been a factor that would have contributed to the accident. The train crew were unable to take any other avoiding action.

2.2 Level crossing traffic control

The traffic controls installed at the Moloney Road level crossing are passive[10] devices that rely on the road user detecting the presence of a train through direct observation. 'Stop' signs are necessary at this location as trains approaching the crossing are obscured, to a motorist approaching from the south-west, by the greenhouses (Figure 7) located on the left-hand side of the road.

At level crossings like Moloney Road that are controlled by 'Stop' signs, a motorist must come to a complete standstill at the crossing in order to have the opportunity to adequately sight an approaching train and to be able to make an informed decision as to whether it is safe to proceed over the crossing.

---

9 Estimated truck speed at time of collision was 20 to 40 km/h and is significantly higher than what would have been expected had the truck driver responded to the locomotive horn when first heard.

10 AS1742.7-2007 defines passive level crossing control as:

The control of movement of the vehicular or pedestrian traffic across a railway level crossing by signs and devices, none of which are activated during the approach or passage of a train, and which rely on the road user detecting the approach or presence of a train by direct observation.

2.2.1 Traffic control system effectiveness

Given the size and weight of most trains it is not possible for them to brake at anywhere near the rate of a road vehicle. Heavy freight and passenger trains may take several kilometres to slow from high speeds.

In most circumstances a train driver is unlikely to sight an approaching motor vehicle, and determine its intent to stop or not, until the train is relatively close to the level 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.

Figure 7: Motorist's view of Moloney Road level crossing, travelling in a north-easterly direction (direction of truck travel)

By comparison, road vehicles can stop relatively quickly. It is for this reason that regardless of the type of level crossing traffic control, the onus to stop and give way to trains rests with the motorist. Consequently, it is important that road signage is effective at warning a motorist that they are approaching a level crossing and that it provides sufficient distance to stop safely. Similarly, it is important that from the stopped position that there is sufficient sighting distance available for the motor vehicle driver to decide whether it is safe to proceed across the level crossing. The remaining part of the analysis will focus on these issues including level crossing alignment, sighting distances, placement of the 'Stop' signs, approach warning signs and the actions of the truck driver.

2.2.2 Level crossing compliance

Railway level crossing signage in South Australia must generally comply with the requirements of the Australian Standard AS 1742.7-2007 *Manual of uniform traffic control devices - Railway crossings.* This Standard is one of a series prepared by the Standards Australia Committee on Road Signs and Traffic Signals. The Standard describes the configuration of signage to be used to control and warn road traffic at, and in advance of, railway crossings and the manner in which signage is to be displayed.

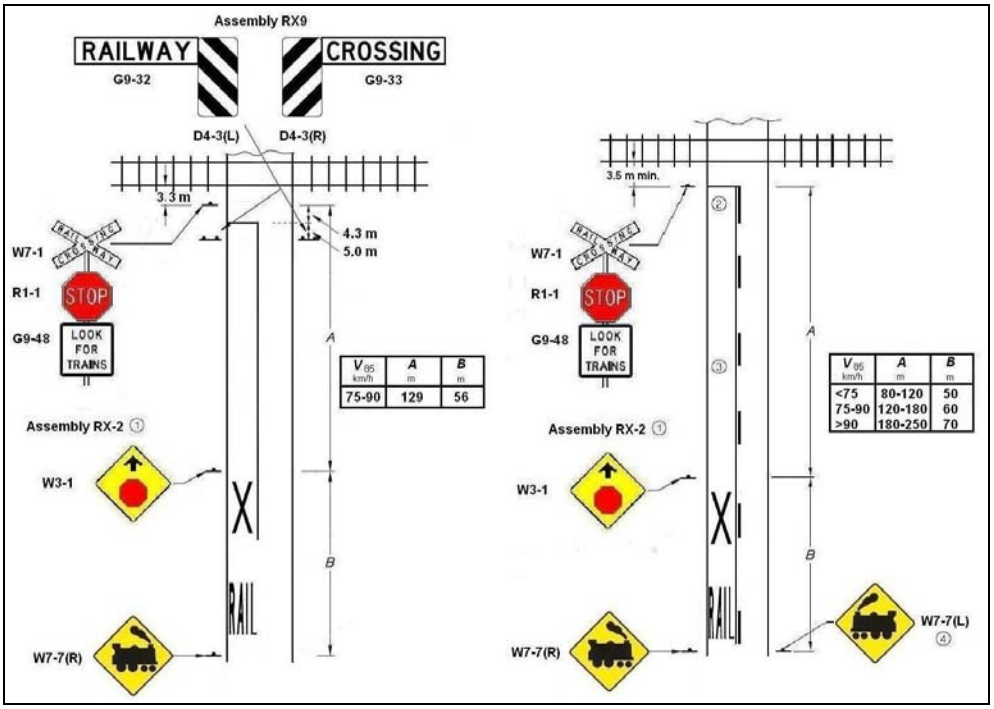
A specific configuration of approach warning signs and pavement markings is required on roads that have passive 'Stop' sign control. The warning signs are

displayed at specific distances (speed dependent) and in a specific order (Figure 9) as detailed here-under:

- The advance warning sign - 'Railway level crossing ahead', (symbolic train) W7-7(R), on the left-hand side of the road and optionally a W7-7(L) sign on the right-hand side of the road.
- The 'Stop Sign Ahead', W3-1, sign is positioned 60 m after the W7-7(R) sign and between 120 – 180 m before the 'Railway level crossing stop assembly' (RX-2) sign.
- The 'Railway level crossing stop assembly' (RX-2) sign is located not less than 3.5 metres from the nearest rail.

Figure 8: Signage at Moloney Rd level crossing on 13 Dec 07. RX-9 assembly is optional

Figure 9: Signage prescribed in AS1742.7-2007. W7-7(L) is optional



An examination of the signage (Figure 8) approaching from the south-west (direction of truck travel) established that it was generally in compliance with the requirements of the Australian Standard. There was only one issue that related to the positioning of the stop line in that it was set back from the RX-2 assembly by 4.3 m. The standard specifies that the stop line and RX-2 assembly should be adjacent to one another[11]. However, the location of the stop line was unlikely to have been a factor in this collision, but closing the distance between the RX-2 assembly and stop line could under certain circumstances improve sighting along the track.

During the investigation it was noted that the ARTC and the City of Playford Council did not have an 'Interface Agreement' current at the time of the collision

11 This issue was reported to the City of Playford Council by ARTC on 3 June 2003 and had not been corrected.

covering their respective maintenance responsibilities in relation to the level crossing. While there is currently[12] no obligation on the part of road authorities to enter into such an agreement, and in this case had no bearing on the accident, maintenance responsibilities for level crossings need to be clearly defined. The establishment of consistent standards/practices is necessary to ensure that all parties are aware of their responsibilities and accountabilities. For example approach warning signage is necessary and is generally provided by road authorities. However it has not always been clear who should provide and maintain such signage. Therefore the lack of a formal agreement potentially exposes organisations to risk, particularly where items are not provided/maintained in accordance with industry standards because the responsibilities between the parties are unknown/ill-defined and therefore not being addressed.

It is therefore highly desirable that the ARTC and the City of Playford Council have an agreement in place that clearly defines their responsibilities in relation to the Moloney Road level crossing and indeed other level crossings in the council's jurisdiction and that it should be compliant with AS 4292.1 Section 7 – Interface Management.

2.2.3 Sighting distance

With respect to sighting distance, AS 1742.7-2007 states that at a level crossing having 'Stop' sign control:

> The sight distance shall be sufficient for the road vehicle driver stopped at the railway crossing stop line to be able to start off and clear the crossing before the arrival of a previously unseen train.

Using the formulae contained within AS1742.7-2007, a truck of the class involved in the collision at Moloney Road when stopped on the stop line, on the south western side of the level crossing, needs about 395 m[13] sighting (S_3 Figure 10) to safely traverse the crossing with a train approaching at 100 km/h. The sighting distance to the left (S_3) from the stop line was found to be in excess of 650 m[14], and thus well in excess of the requirements of the standard.

Australian Standard 1742.7-2007 also prescribes that the maximum viewing angle measured at the stop line when looking for an approaching train should not exceed 110 degrees, looking to the left. An assessment of the Moloney Road level crossing's geometry revealed a viewing angle of 70 degrees for a vehicle stopped on the south western side at the stop line. This is significantly better that the 110 degrees specified by the standard and indicates that the amount of motor vehicle driver 'head twist' was not excessive in this instance and thus it was unlikely to be a factor in the collision. At the time of day when the accident occurred, 1417, the sun's azimuth was 303 degrees at an altitude of 71 degrees. Reflection and glare

---

12 The national model for rail safety legislation will introduce a requirement on road and rail authorities to have an 'Interface Agreement' defining organisational responsibilities. It is anticipated that the model provisions will be introduced in South Australia in late 2008, through amendments to the Rail Safety Act 2007.

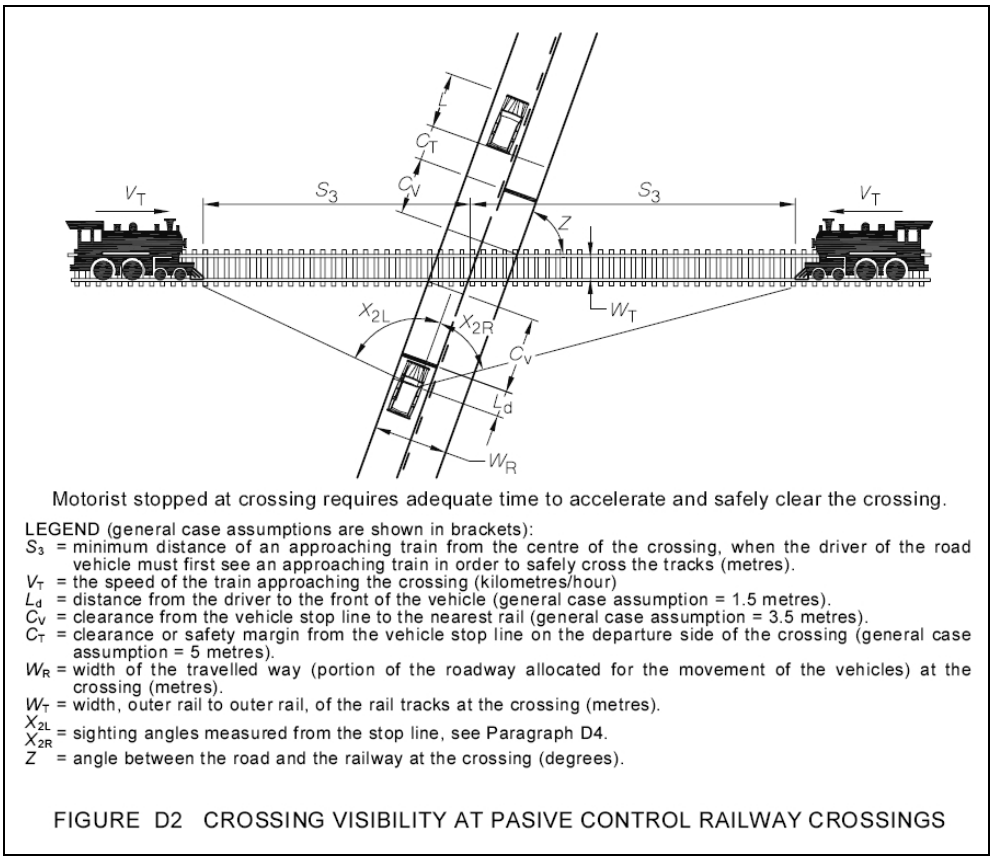
13 Calculation assumes a truck of length 8 m having an acceleration of 0.36 m/sec.

14 Note: A loaded semi-trailer, 19 m in length, (maximum allowable for this road) having an acceleration of 0.36 m/sec requires 458 m sighting. Therefore adequate sighting distance was available for all vehicle types that were allowed to use the Moloney Road level crossing.

was therefore unlikely to have been a factor that affected the visibility of the signs or of an approaching train.

In summary, had the truck driver come to a halt at the stop line as required he would have been able to clearly see the train, remain at a standstill at the stop line and then proceed safely over the crossing when the train had passed.

Figure 10: AS 1742.7-2007 approach distances and viewing angles sighting diagram



2.3 Truck driver behaviour

2.3.1 Crossing awareness

The 'Stop' sign and approach warning signs at the Moloney Road level crossing were substantially in compliance with AS 1742.7-2007 and would have been clearly visible to the truck driver. More importantly, the truck driver lived in close proximity to the crossing, had regularly used it and was aware of the double fatality that had occurred at the crossing approximately one month before the accident.

The greenhouses adjacent to the rail corridor completely obscure any train approaching the level crossing from the north-west for motorists driving along Moloney Road in a north-easterly direction. The truck driver's familiarity with the crossing meant he would have been fully aware of this impediment to sighting a train and the consequent need to stop at the level crossing. His failure to stop on this occasion was high risk behaviour, especially in light of his knowledge that

there had been a number of previous accidents at the site including the double fatality the previous month.

It is considered to be highly unlikely that the truck driver's actions in failing to stop at the crossing were due to a lack of awareness of the presence of the level crossing or a lack of knowledge associated with the dangers associated with the train sighting difficulties at the crossing or its previous accident history. It is likely that the driver's behaviour was influenced by other factors on this occasion or perhaps every occasion he negotiated the level crossing.

2.3.2 Fatigue

Fatigue can have a profound effect on driver performance. It can reduce attention, increase reaction time and affect memory. It can also affect a person's ability to judge distance, speed and time. Although the truck driver had no recollection of the collision and the preceding days[15], it was established that he generally worked a regular eight hour day starting at approximately 0800 in the morning and finishing at about 1600 in the afternoon. It was further established that he had not worked any extraordinary hours in the days preceding the collision, and had regular break periods including weekends off. It was noted, however, that on the evening preceding the accident he had had a fairly late night, approximately midnight, as a result of home maintenance activities. It was further noted that on the day of the collision the weather was hot so the heavy manual work he performed in the time leading up to the collision would have been physically demanding. In conclusion, fatigue may have been a factor but it cannot be established with any certainty.

2.3.3 Expectation

Although the truck driver regularly used Moloney Road, he stated that he seldom encountered a train at the crossing. With an average of only 15 train movements per day over the crossing the probability of encountering a train would be low. Crossing familiarity combined with an expectation that a train won't be present has the potential to lull motorists into becoming complacent and develop poor looking/crossing habits[16]. A road user's expectation that a train is unlikely to be at a level crossing is reinforced every time they traverse a level crossing and do not encounter a train. This may ultimately lead to a failure to adequately look for a train, and potentially, risky behaviour like routinely failing to stop at a crossing.

Based on the statement of the train's co-driver, the length of the truck skid marks and impact damage caused by the truck, it is evident that the truck driver did not come to a stop at the level crossing as required and was probably unaware of the presence of the train until just before the collision.

---

15 The truck driver suffered a significant head injury in the collision and had no recollection of the days preceding the accident and the collision.

16 Caird, Creaser, Edwards, and Dewar (2002) *A human factors analysis of highway-railway grade crossing accidents in Canada*

A violation is a deliberate act involving non-compliance with procedures and/or rules. Routine violations (Reason, 1990) are those which have become a normal way of operating and may involve cutting corners to reduce effort or discomfort and are commonly associated with a low perception of accident risk and/or risk of sanction associated with a lack of enforcement.

The truck driver had never held a driver's licence while in Australia, had previous convictions for driving an unregistered and uninsured motor vehicle, speeding offences and driving with excess blood alcohol levels which all indicate that he may have had an increased propensity to take risks.

Based on available evidence it is concluded that the truck driver probably did not intend to stop at the level crossing and was unaware of the presence of the train until just before the collision. It is quite probable that the truck driver's familiarity with the crossing, low expectation of encountering a train and his possible increased propensity to take risks were personal characteristics/factors that may have led to him failing to stop at the crossing and thus contributed to the collision.

2.4 Other accidents

There are 1,137 public access level crossings in South Australia of which 877 are passively controlled. All level crossings in South Australia have been assessed by the Department for Transport, Energy and Infrastructure (DTEI) Level Crossing Unit (LCU) using a computer based risk assessment model, the Australian Level Crossing Assessment Model (ALCAM). The model has been used as a basis for determining level crossing risk and upgrade priority. While the ALCAM takes into account over 70 factors for each level crossing, including local characteristics and controls, it does not include accident history when calculating a risk score. Accident and incident history has not been used as part of the ALCAM as these events are relatively infrequent and random in nature, additionally, 'near miss' incident data has been found to be unreliable as it is subjective and may vary for different train drivers according to their perception of the risk.

The Moloney Road level crossing had been assessed by the LCU as having sighting constraints due to the close proximity of the greenhouses, and this reaffirmed the need for 'Stop' sign control at the location. Sighting along the tracks was nevertheless excellent provided that a motorist came to a complete standstill at the 'Stop' sign/line.

Based on ALCAM calculations the Moloney Road level crossing was assessed as a medium risk crossing prior to a double fatality which occurred on 16 November 2007. Following that accident there was significant public pressure to enhance the safety of the crossing but a review of the crossing using the ALCAM established that there was only a minor increase in the risk score. Nevertheless strategies were being considered to enhance the safety of the crossing when the second serious accident (this accident) occurred. While investigating the two accidents the ATSB did note that the Moloney Road site has had a significant history of near misses/collisions with reported incidents occurring on:

- 22 May 2001 (minor injury)
- 10 March 2003 (minor injuries)
- 18 July 2004 (minor injuries), and
- 04 March 2005 (near miss).

- 03 October 2006 (minor injuries)
- 16 November 2007 (double fatality)

Although the LCU captures level crossing accident history and near miss data in a locally managed database, the Level Crossing Management (LXM) database, the process for assessing the overall risk at a level crossing is currently based on the risk score provided by the ALCAM and a qualitative evaluation of each site.

In this context, the ALCAM should be recognised as only one of many tools that should be used in the safety assessment of level crossings, other factors such as accident and incident data as well as site specific safety factors, stakeholder input, standards and other risk mitigation strategies also need to be considered. It is therefore desirable that a mechanism be considered to flag for attention, level crossings that may not have been identified as posing a high risk when assessed using the ALCAM but have a history of incidents and/or accidents. Alternatively the LCU, through the ALCAM Working Group, may wish to examine the ALCAM with respect to risk calculations and the inclusion of the level crossing's accident/incident history, with an appropriate weighting.

3 FINDINGS

3.1 Context

At approximately 1417 on 13 December 2007 a tandem tip truck loaded with a 'bobcat' excavator drove into the side of the *Indian Pacific* passenger train (4SA8) at the passive level crossing of Moloney Road near Virginia in SA. As a result of the collision, the truck driver was seriously injured.

Based on the available evidence, the following findings are made with respect to the collision but should not be read as apportioning blame or liability to any particular individual or organisation.

3.2 Contributing safety factors

1. The driver of the truck did not come to a halt at the 'Stop' sign as required and entered the level crossing at an estimated speed of 20 to 40 km/h while a train was passing over the crossing. The truck driver was probably unaware of the presence of the train until just before the collision.

2. It is probable that the truck driver's familiarity with the crossing, low expectation of encountering a train and possible increased propensity to take risks were personal characteristics/factors that may have led to him failing to stop at the crossing and thus contributed to the collision.

3.3 Other safety factors

1. During the investigation it was noted that the Moloney Road level crossing had a history of collisions and near misses. A mechanism should be considered to flag for attention, level crossings that have not been identified as posing a high risk when assessed using the ALCAM but have a history of incidents and/or accidents. *[Safety issue]*

2. The history of accidents and incidents at this location supports a need to undertake a further review of the road/rail interface risk and determine whether opportunities are available to enhance the safety of the site. *[Safety issue]*

3. During the investigation it was noted that the Australian Rail Track Corporation and the City of Playford Council did not have an 'Interface Agreement' covering their responsibilities with respect to the provision and maintenance of level crossing signage. Maintenance responsibilities need to be clearly defined. *[Safety issue]*

4. The sounding of the locomotive horn was not at the whistle board as prescribed, however there was time for the truck driver to take defensive action had he heard it. *[Safety Issue]*

3.4 Other key findings

1. The restricted visibility at the Moloney Road level crossing means that it is not possible for a motorist to see a train approaching the crossing unless the vehicle is stopped at the 'Stop' sign/line and the track is visually searched.

2. A review of the Moloney Road level crossing geometry revealed that the available sighting distance and viewing angle on the south-western side of the level crossing was better than that prescribed in Australian Standard 1742.7-2007. Had the truck driver come to a halt at the 'Stop' sign/line he should have been able to see the train.

3. There were no deficiencies that relate to the mechanical condition of the train. Train speed, locomotive braking, headlight illumination were appropriate.

4. The train crew were appropriately trained, qualified and medically fit at the time of the accident.

5. Breath testing of the train drivers for alcohol returned zero readings. Toxicology testing of the truck driver for alcohol and illicit drugs also returned zero readings.

4 SAFETY ACTIONS

The safety issues identified during this investigation are listed in the Findings and Safety 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 organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety actions, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft 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.

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

4.1 Department for Transport, Energy and Infrastructure (Level Crossing Unit)

4.1.1 Level crossing risk assessment

Safety Issue

During the investigation it was noted that the Moloney Road level crossing had a history of collisions and near misses. A mechanism should be considered to flag for attention, level crossings that have not been identified as posing a high risk when assessed using the ALCAM but have a history of incidents and/or accidents.

ATSB Safety recommendation RR20080026

The Australian Transport Safety Bureau recommends that the Department for Transport, Energy and Infrastructure (Level Crossing Unit) take action to address this safety issue.

4.2 Australian Rail Track Corporation

4.2.1 Reducing road/rail interface risk

Safety Issue

The history of accidents and incidents at this location supports a need to undertake a further review of the road/rail interface risk and determine whether opportunities are available to enhance the safety of the site.

Action taken by the Australian Rail Track Corporation

The ARTC has advised that following formal advice regarding the closure of the section of road over the level crossing by the City of Playford Council, they will take action to secure the site.

ATSB assessment of action

The Australian Transport Safety Bureau notes that the Australian Rail Track Corporation will take action to address this safety issue.

4.2.2 Road/rail interface agreement

Safety Issue

During the investigation it was noted that the Australian Rail Track Corporation and the City of Playford Council did not have an 'Interface Agreement' covering their responsibilities with respect to the maintenance of level crossing signage. Maintenance responsibilities need to be clearly defined.

ATSB Safety recommendation RR20080027

The Australian Transport Safety Bureau recommends that the Australian Rail Track Corporation take action to address this safety issue.

4.3 City of Playford Council

4.3.1 Reducing road/rail interface risk

Safety Issue

The history of accidents and incidents at this location supports a need to undertake a further review of the road/rail interface risk and determine whether opportunities are available to enhance the safety of the site.

Action taken by the City of Playford Council

The City of Playford Council has advised:

> Response: The City of Playford at a Council Meeting on 8 April, 2008 approved the closure of Moloney Road at the level crossing under the Roads (Opening and Closing) Act 1991.
>
> Comment: The process of closing the road has commenced.

ATSB assessment of action

The Australian Transport Safety Bureau notes that the City of Playford Council is taking action to address this safety issue.

4.3.2 Road/rail interface agreement

Safety Issue

During the investigation it was noted that the Australian Rail Track Corporation and the City of Playford Council did not have an 'Interface Agreement' covering their responsibilities with respect to the maintenance of level crossing signage. Maintenance responsibilities need to be clearly defined.

Action taken by the Australian Rail Track Corporation

The City of Playford Council has advised:

> Response: The City of Playford has written to the Australian Rail Track Corporation requesting provision of an Interface Agreement.

ATSB assessment of action

The Australian Transport Safety Bureau notes that the City of Playford Council has taken action to address this safety issue.

4.4 Pacific National

4.4.1 Sounding of locomotive horn

Safety Issue

The sounding of the locomotive horn was not at the whistle board as prescribed, however there was time for the truck driver to take defensive action had he heard it.

ATSB Safety recommendation RR20080028

The Australian Transport Safety Bureau recommends that Pacific National take action to address this safety issue.

APPENDIX A : SOURCES AND SUBMISSIONS

Sources of information

- Great Southern Rail
- Pacific National (Asciano)
- The Australian Rail Track Corporation
- The City of Playford Council
- The Department for Transport Energy & Infrastructure – SA.
- The South Australia Police Major Crash Investigation Unit
- The train drivers
- The truck driver.

References

- Australian Level Crossing Assessment Model.
- Australian Standard 1742.7-2007: Manual of uniform traffic control devices – Railway crossings
- National Transportation Safety Board (1998a). Safety at passive grade crossing. Volume 1: Analysis. Safety study NTSB/SS-98/02. Washington DC.

SUBMISSIONS

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

A draft of this report was provided to:

- Great Southern Rail
- Pacific National (Asciano)
- The City of Playford Council
- The Australian Rail Track Corporation
- The Department for Transport Energy & Infrastructure - SA
- Driver of train
- Driver of truck.

Submissions were received from:

Great Southern Rail, Pacific National, the City of Playford Council, the Australian Rail Track Corporation, the Department for Transport, Energy & Infrastructure – SA and one of the train drivers have made a number of comments and observations on the draft report issued to directly involved parties.

The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

APPENDIX B : MEDIA RELEASE

Level crossing collision at Moloney Road South Australia

The ATSB has found that a collision between the *Indian Pacific* passenger train and a tip truck occurred when the driver of the truck drove into the side of the train at the Moloney Road level crossing in SA.

The Australian Transport Safety Bureau has today released its final report into the collision which occurred on 13 December 2007. At the time of the accident road traffic at the crossing was controlled by 'Stop' signs and approach warning signs.

The investigation established that the truck did not come to a halt at the 'Stop' sign and concluded that the truck driver's familiarity with the crossing, low expectation of encountering a train and his possible increased propensity to take risks were factors that may have led to him failing to stop at the crossing.

The investigation concluded that had the truck driver come to a halt at the 'Stop' sign as required he would have been able to clearly see the train and then have been able to proceed safely over the crossing when the train had passed.

In the interest of enhancing future road/rail safety the ATSB has identified a series of opportunities to improve the road/rail interface risk at this location. The City of Playford Council is currently in the process of closing the road over the crossing as alternative access with active protection is close-by and available for public use. This action will eliminate the risk of any future collision at the level crossing.