Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Rail Occurrence Investigation No. 2006/009
Final

Collision between

Prime-mover/low loader combination and Ballast train 4MR1

Tailem Bend, SA

4 October 2006

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

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

Abstract

At about 1100 on 4 October 2006, a prime-mover/low loader combination collided with train 4MR1 at the Magpie Drive level crossing, Tailem Bend, South Australia. At the time of the accident the crossing was controlled by passive signs comprising ‘Stop’ sign assemblies (RX-2) and approach warning signs.

The ATSB investigation into the accident concluded that it is likely that the truck did not come to a halt at the ‘Stop’ sign controlling the crossing. The driver was possibly distracted by the presence of the road-junction ahead and/or a preoccupation with arriving at his destination on time, which may have diverted his attention from the risks associated with negotiating the level crossing. The investigation also found that the viewing angle to the north-west of the crossing was substandard and coupled with restricted visibility from the truck driver’s cab would have made it difficult for the truck driver to see the train without coming to a complete halt at the stop sign.

The investigation established that there was nothing the train crew could have done to prevent the accident. As a consequence of the collision the prime mover was heavily damaged and the trailer was written off, the truck driver suffered minor injuries. Damage to the train was confined to structural damage on the drag box and the onboard electrical system of the lead locomotive.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

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

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 ATSB INVESTIGATION REPORTS

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: the occurrence would probably not have occurred; or 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 1100[1] on 4 October 2006, an eastbound prime-mover/low loader combination drove into the path of a ballast train (4MR1) on the Defined Interstate Rail Network (DIRN) at the passive level crossing[2] of Magpie Drive near Tailem Bend in South Australia.

Following the collision, the train (under an emergency brake application) continued for approximately 620 m before coming to a stop. The prime-mover and trailer were split in two by the collision with the prime-mover lying on its right-hand side straddling the Pinnaroo line just adjacent to the accident site. The truck's trailer was pushed approximately 85 m along the track before being dislodged from the front of the locomotive and was left partially obstructing the standard gauge rail line.

The speed limit for train 4MR1 was 80 km/h, it was travelling at close to this speed at the time of the collision. The speed limit for road traffic along Magpie Drive is 100 km/h, however, road traffic is required to come to a halt at the stop signs controlling the level crossing. At the time of the collision the truck was observed to be traversing the crossing at a low speed, estimated to be 10 km/h to 20 km/h.

The driver of the truck suffered minor injuries and was taken to hospital for observation. The crew of the locomotive were uninjured but received trauma counselling.

The emergency response was both timely and adequate. There was minor damage to the locomotive, the truck prime mover was heavily damaged and the truck's trailer was destroyed as a result of the collision. Damage to fixed infrastructure included the destruction of a signal and a cable pit on the south-west side of the level crossing. There was minor damage to the track.

The investigation concluded that it is likely that the truck did not come to a halt at the 'Stop' sign controlling the crossing. The driver was possibly distracted by the presence of the road-junction ahead and/or a preoccupation with arriving at his destination on time, which may have diverted his attention from the risks associated with negotiating the level crossing. The investigation also found that the viewing angle to the north-west of the crossing was substandard and coupled with restricted visibility from the truck driver's cab would have made it difficult for the truck driver to sight the train. Neither the truck driver nor the company that he worked for had any history of traffic offences or non-compliances that would indicate an increased risk for this type of accident.

The investigation also established that there was nothing the train crew could have done to prevent the accident.

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

2 The level crossing was controlled by advance warning signs and a 'Stop' sign (RX-2) assembly as prescribed by Australian Standard AS1742.7-1993. No pavement markings were provided as the road was unsealed.

Safety actions recommended as a result of the investigation relate to:

- Consideration of measures to reduce the road/rail interface risk at the Magpie Drive level crossing. Such measures[3] should include the practical application of the ALCAM,[4] including opportunities for level crossing closure and/or options for improving sighting and viewing angle for conformance with the Australian Standard AS1742.7-2007, *Manual of Uniform Traffic Control Devices, Part 7: Railway Crossings*.
- Enhancing train conspicuity.
- Development of a formal Level Crossing Interface Agreement.
- Expanding the role of the Department for Transport, Energy & Infrastructure's Level Crossing Unit to include ongoing level crossing education and audit roles.

3 **Safety at Railway Level Crossings** At an Australian Transport Council (ATC) meeting on 2 June 2006, the Australian Government and State and Territory Transport Ministers agreed to commence innovative work on implementing a national level crossing behavioural strategy. The behavioural strategy forms part of the ATC's National Railway Level Crossing Safety Strategy and builds on the work of the National Road Safety Strategy. The Behavioural Strategy will work towards the national development and delivery of programs though each jurisdiction aimed at modifying road user behaviour to improve railway level crossing safety.

4 **ALCAM - Australian Level Crossing Assessment Model.** A computer based model developed by Australian railway owners/operators and road authorities for the determination of risk ratings for individual level crossings and thereby allowing those agencies to prioritise level crossing upgrading works.

1 FACTUAL INFORMATION

1.1 Overview

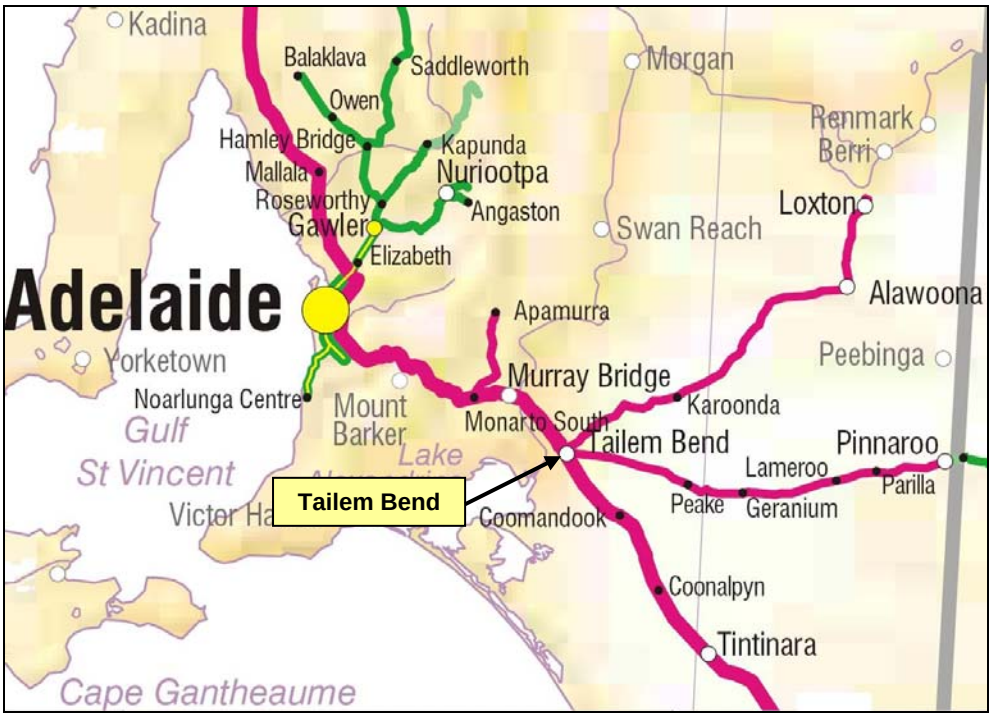
At approximately 1100 on 4 October 2006, an eastbound prime-mover/low loader combination drove into the path of South Spur Rail Services (SSRS) locomotive NA1874 on the Defined Interstate Rail Network (DIRN) at the passive level crossing of Magpie Drive near Tailem Bend, South Australia. The truck driver escaped with only minor injuries, the train crew were not injured.

Following advice of the collision the ATSB initiated an investigation under the *Transport Safety Investigation Act 2003* (TSI Act).

1.1.1 Location

Tailem Bend with a population of 1,600 people is located approximately 100 km east of Adelaide near the junction of the Princes and Dukes Highways.

Figure 1: Location of Tailem Bend, SA (Railways of Australia).

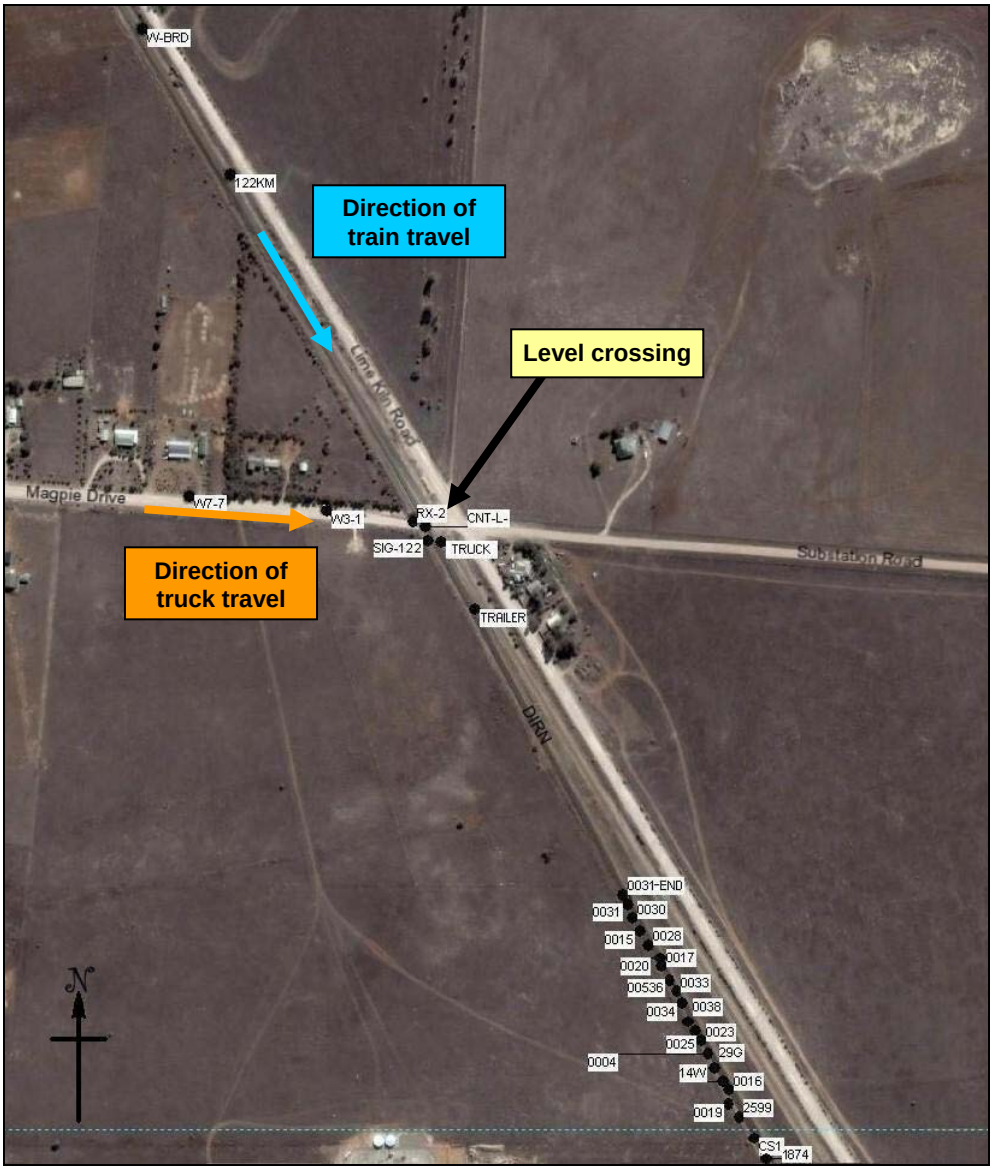


Map - Geoscience Australia. Crown Copyright ©.

The accident occurred on the Magpie Drive level crossing which crosses the Adelaide to Melbourne standard gauge (DIRN) rail corridor and the adjacent Pinnaroo line at Tailem Bend.

The DIRN at this location is owned and operated by the Australian Rail Track Corporation (ARTC),[5] the Pinnaroo line is managed and operated by Genesee & Wyoming Aust. Pty. Ltd. (GWA)[6]

Figure 2: Aerial view Magpie Drive level crossing showing accident site.



Aerial Photograph - Google Earth. Copyright ©.

The railway crossing at Magpie Drive is jointly managed by the ARTC and GWA with the road, associated alignment and approach warning signs being managed by the Coorong District Council (CDC). The ARTC, GWA and the CDC do not have an 'Interface Agreement' covering their respective maintenance responsibilities,

5 ARTC – Is responsible for access to and management of the Adelaide to Melbourne rail corridor and for maintenance of the level crossing within the rail property boundary.

6 GWA – Is responsible for access to and management of the section of line from Tailem Bend to Pinnaroo including the maintenance of the level crossing within the rail property boundary.

although the three organisations would appear to understand their responsibilities based on the appropriate provision of warning signage.

Magpie Drive is approximately 400 m north of the junction of the Princes and Dukes Highways and is accessed from either Railway Terrace 650 m to the west of the crossing or Lime Kiln Road/Substation Road 28 m to east of the crossing.

Travelling along Magpie Drive, in an easterly direction, the visibility of the rail line and rail traffic is obstructed by vegetation bordering the northern side of Magpie Drive and the north-western side of the rail corridor. Magpie Drive (Fig. 2) intersects with the Adelaide to Melbourne rail line and the Pinnaroo line at an angle of close to 60 degrees. After passing over the level crossing, Magpie Drive intersects with Lime Kiln Road and is re-named as Substation Road.

Figure 3: Stop and approach warning signs (Inset 'Stop' sign assembly) approaching the level crossing.

The level crossing is passively[7] controlled by signage that requires road users to 'Stop and Give Way' to trains. Magpie Drive is classified by the CDC as an unsealed local road.

The speed limit for road traffic along Magpie Drive is 100 km/h. The speed limit for trains on the DIRN is up to 115 km/h.

There was no history of previous accidents at this location.

7 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)

1.1.2 Train information

Train 4MR1 consisted of two locomotives (NA1874 and CS1) hauling 18 wagons with a total length of 259 m and gross weight of 1,783 tonnes. The maximum allowable speed for train 4MR1 was 80 km/h. SSRS was providing the train crew, rollingstock and locomotives on a contracted basis to the ARTC for the running of ballast between Coomandook and Tailem Bend.

Crew of locomotive

The train was crewed by a driver and a co-driver. The train driver had passed initial certification with the Australian National Railways in 1977, the co-driver had passed certification with Queensland Rail in 1993.

The driver of NA1874 joined Momentum Rail[8] in July 2005 and immediately commenced service with SSRS's South Australian operations. He had received further training after joining SSRS. He had previously driven the route over which the accident occurred.

The co-driver joined Momentum Rail in October 2004 and started service with SSRS's South Australian operations in June 2005. He had also received further training after joining SSRS and driven the route over which the accident occurred.

Momentum Rail uses the National Transport Commission (NTC) *National Standard for Health Assessment of Rail Safety Workers*, hereinafter referred to as the National Health Standard, as a basis for health assessment of its 'Safety Critical Workers'. The driver and co-driver were medically examined in October 2004 and June 2005 respectively. Records indicate that both were 'Fit for Duty – Meets all relevant medical criteria' as prescribed by the National Health Standard.

1.1.3 Truck information

James Contract Supplies Pty Ltd (JCS) was the owner and operator of the road vehicle involved in the accident. JCS is a privately owned company operating out of South Australia and is primarily engaged in the manufacture of stainless steel purpose built vessels and equipment. However the company also has a separate transportation and crane hire business involved in the haulage of over-dimensional and heavy loads. The company undertakes transportation tasks both intrastate and interstate.

The truck and trailer combination involved in the accident consisted of a Mack Titan prime mover hauling a drop deck trailer with an overall length of 19 m. The tare weight of the vehicle was 18 tonnes and could operate to a maximum gross weight of 42.5 tonnes. The cab design of the truck is such that a driver looking to the left through the passenger door towards the 'B' pillar[9] has restricted vision. This is a common characteristic with many trucks of similar design. On this occasion the

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8 Momentum Rail - A specialised rail labour hire organisation and subsidiary of South Spur Rail Services.

9 The roof of a truck is supported by pillars. They are known as 'A' pillars and 'B' pillars, see Fig. 4. The 'A' pillars are at the front. They are located where the windshield meets the front side windows/doors. The 'B' pillars, are located between the back of the front side windows and the rear of the cab of the truck.

trailer was not loaded as it was travelling from Adelaide to Tailem Bend to collect a power transformer from the ElectraNet substation (H114) located off Substation Road.

JCS was not required to be accredited by the SA Department for Transport Energy and Infrastructure (DTEI) under the 'Heavy Vehicle Accreditation Scheme' however, JCS operates a comprehensive 'Quality Management' system which includes independent auditing of truck maintenance. All evidence indicates that the truck and trailer involved in the accident was being effectively maintained in accordance with this scheme. DTEI has no record of any incidents or non-compliances relating to JCS.

Figure 4: Mack Titan prime mover involved in collision.

Truck driver information

The driver of the truck was a 43 year old male from South Australia. He had worked for JCS for approximately 15 years on a casual basis before being made a permanent employee on 17 July 2004. He was appropriately licensed to drive heavy motor vehicles and had extensive experience driving a variety of truck types over interstate and intrastate routes. He had been driving the Mack truck and drop deck trailer combination involved in the collision for a period of about 19 months prior to the collision.

He was medically examined on 31 August 2004 at the Work Health Clinic, Gillman, SA before being employed on a full time basis by JCS. Records indicate that he 'Meets the criteria as set out in the *Commercial Drivers Health Assessment*'. Routine alcohol and drug testing at the time of the medical examination was negative.

The driver had no recorded convictions for traffic offences but had been involved in some minor incidents/accidents.

1.1.4 Train control

The ARTC network between Adelaide and Wolsley (SA border) uses a centralised train control system (CTC) that provides real time control and monitoring of field hardware, such as signals and points. Train 4MR1 had authority to occupy the section of track between Tailem Bend and Coomandook when the entering block signal located at the Melbourne end of the Tailem Bend yard was cleared for its passage through the section.

1.1.5 Environmental conditions

The accident occurred at approximately 1100. It was a hot day with gusty northerly winds, there was some dust in the air around the accident site but visibility remained good. The driver of the Mack truck had the windows of the vehicle up/closed with the air conditioner switched on.

The minimum and maximum temperatures for the day at Murray Bridge were 8.8°C and 37°C respectively. At the time of the accident, the wind direction was northerly and blowing at approximately 40km/h. The temperature was approaching 30°C.

1.2 The occurrence

1.2.1 Truck driver account

On the day of the accident the truck driver started duty at JCS's Wingfield depot, in SA. After booking on duty he was advised that he was required to collect a power transformer from the ElectraNet substation (H114) located off Substation Road, at Tailem Bend. The scheduled pick-up time was 1100. After being briefed he left the depot at approximately 0800. He arrived early and decided to stop at a Tailem Bend roadhouse for a coffee and light meal before proceeding to the job site.

At about 1030 the truck driver left the roadhouse and started to look for the ElectraNet site but became lost. He rang the Wingfield depot at 1050 from Karoonda Road, Tailem Bend, seeking further directions. After receiving this information he drove in the general direction of the ElectraNet substation and could see at a distance the boom arm of the mobile crane that would be used to lift the transformer. At around this time (1056) the truck driver made a second telephone call to the Wingfield office in Adelaide. He received further information then travelled in a southerly direction until coming across Magpie Drive, turned east onto Magpie Drive and headed towards the ElectraNet substation.

As the truck approached the railway crossing, it slowed and then proceeded to cross the railway line. At approximately 1100, when the truck was part way over the level crossing, train 4MR1 collided with its trailer. Following the collision the truck driver climbed out of the cab with assistance being offered by two local residents.

1.2.2 Train crew account

The train crew signed on duty at approximately 0810 on the 4 October 2006. They departed their hotel accommodation in Adelaide and travelled by car to Callington to prepare the train for the days work. This included engine, brake and other safety

checks. The train driver spoke to the ARTC train controller at approximately 0900 requesting a train path but was held in the Callington siding awaiting the passage of train 4AM8 (Overland) through Monarto South en-route from Adelaide to Melbourne.

Ballast train 4MR1 eventually departed from Callington at 1008 stopping for five minutes at Murray Bridge to collect some Transfield employees. The train then departed from Murray Bridge at 1038 for its final destination of Coomandook where it would run-around the crossing loop, swap ends and proceed back to Murray Bridge discharging ballast along the way as required.

Train 4MR1 passed through Tailem Bend shortly before 1100, it was logged passing the Up Home Signal, No. 24 at 1059:55. It was now 2,250 m from the Magpie Drive level crossing and was travelling at speed of 70 km/h. It continued on its journey towards Coomandook. The train was now heading in a south-easterly direction and when near the whistle board, approximately 500 m from the Magpie Drive level crossing the train driver sounded the whistle and then sounded it again when close to the crossing.

As the train entered the crossing at a speed of 77 km/h, the train driver heard a very loud bang and then saw dust and debris flying in front and to the side of the locomotive. At this stage the train driver was unaware that he had collided with a truck as he had not seen any vehicle approaching the crossing from the west. The co-driver saw a flash of what he thought may have been a vehicle, pass in front of the train. As the train passed over the crossing the driver checked the train's rear vision mirror and saw a prime mover on its side, lying in the middle of the level crossing.

Following the collision, damage to the train brakes and air hoses caused the emergency brakes to apply bringing the front locomotive to a stop approximately 618 m from the level crossing.

The co-driver immediately contacted the ARTC train controller requesting the attendance of the emergency services. He then walked back to the collision site to determine the extent of the truck driver's injuries and damage to the truck.

1.2.3 Witness account

There were no witnesses who observed the events just before the accident, however, a local resident did hear the train approach the site, turned towards the crossing and observed the truck as it slowly traversed the crossing in front of the train. The truck did not appear to brake or accelerate at any stage while traversing the level crossing. As the train entered the crossing it collided with the truck's trailer, approximately half way along its length. The trailer was then torn away from the prime mover by the force of the collision and dragged along the line before becoming dislodged approximately 85 m south of the crossing. The force of the collision caused the prime mover to roll onto its right hand side. The prime mover was clear of the ARTC standard gauge line but fouling the Pinnaroo line. The trailer was partly fouling the standard gauge line.

1.3 Post occurrence

Response

The co-driver of train 4MR1 contacted the Adelaide train controller just after the accident, at 1102:02. The ARTC train controller telephoned the SA Police at Tailem Bend at 1104:41. The Police were on site along with SA Ambulance services about 16 minutes after the collision.

The Police took control of the accident site until the arrival of a representative from the ARTC who assumed the role of site controller.

Figure 5: Photo of damaged prime-mover.

Figure 6: Photo of trailer.

Figure 7: Photo of locomotive, NA1874, showing extent of damage.

Site recovery

There was only minor damage to train 4MR1 which was carrying ballast for track maintenance purposes, no dangerous goods were being carried at the time of the accident. There was minor spillage of diesel from the truck, this probably occurred at the time of the collision and/or when the truck rolled over. The truck and trailer were lifted/towed (Fig. 8) away from the rail lines and then removed.

Restoration work started once all site evidence had been collected. The train returned/was pushed back to Tailem Bend at 1614.

Figure 8: Photo of site recovery, damaged trailer approximately 85 m from collision site.

1.3.1 Toxicology

The train crew and truck driver were breath tested by the SA Police, all returned zero readings.

1.3.2 Loss and damage

Damage to the locomotive comprised crushing of the drag box, onboard electrical systems and brake gear along the length of the leading locomotive. The truck was heavily damaged with notable twisting of the chassis, extensive body distortion and associated panel damage. The trailer was written off. Figures 5, 6 and 7 are photographs of the truck, trailer and damage to the front of locomotive NA1874. The truck driver suffered minor injuries, there were no injuries to the crew of the train.

The ARTC incurred an estimated loss of less than $100,000 associated with damage to its track and signal systems.

South Spur Rail Services incurred combined losses in the order of $200,000 with damage to the drag box and onboard electrical systems of the lead locomotive.

JCS incurred combined losses to the truck and trailer, estimated at $200,000.

2 ANALYSIS

The accident occurred when a truck and trailer combination owned and operated by JCS drove into the path of SSRS locomotive NA1874 on the Magpie Drive level crossing just outside the township of Tailem Bend in South Australia. The crossing was controlled by 'Stop' signs (RX-2 assembly) and approach warning signs as prescribed by the Australian Standard, AS1742.7-1993. The Standard deals with signs and markings associated with railway level crossings.

The ATSB's investigation of the accident at Magpie Drive on 4 October 2006 has identified that:

- There were no deficiencies that related to the mechanical condition of the locomotive.
- There were no defects in the track or signalling system.
- The train crew were appropriately trained and qualified, medically fit and fatigue is not considered to have been a factor.
- There were no identified deficiencies that relate to the mechanical condition of the truck, ie the prime-mover and trailer combination.
- The history of the truck operator JCS and the driving record of the truck driver gave no indication of factors likely to have contributed to the accident.

Safe driving and proper observance of road rules by drivers of motor vehicles when traversing level crossings is essential to road/rail safety. The *South Australia - Australian Road Rules under the Road Traffic Act 1961* at Part 10, Section 123, Clause (c) and (d) stipulate:

> A driver must not enter a level crossing if –
>
> (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; …

Further, Section 121, Clause (a) and (b) stipulates:

> A driver at a level crossing with a stop sign must:
>
> (a) stop at the stop line or, if there is no stop line, at the stop sign; and
>
> (b) give way to any train or tram on, approaching or entering the crossing.

The road rules, together with effective motorist education, the design of level crossings, road alignment and the provision of stop and approach warning signs are all defences that help to prevent road and rail systems coming into conflict. However, prima facie, a driver of a motor vehicle errs if they enter a level crossing when a train is approaching the crossing or where there is a risk of a collision with a train.

2.1 Sequence of events analysis

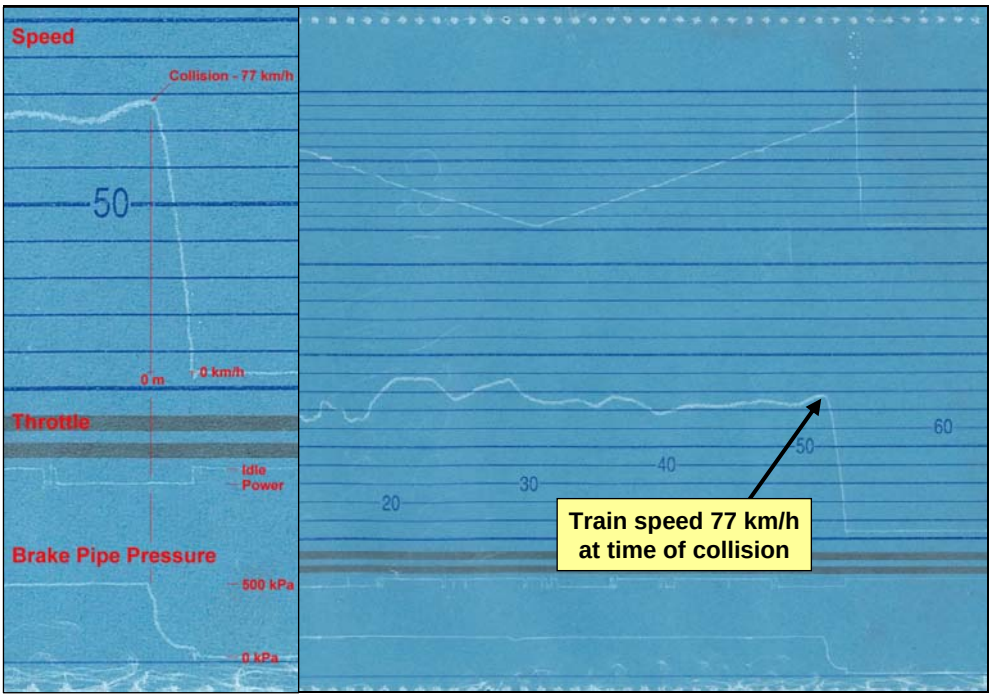
Passage of train

At the time of the accident, train 4MR1 was under the direction of the ATRC South train controller. Signals, points, track and train movement data were recorded by the Central Train Control (CTC) system. Some critical timing events were available for down load and analysis.

The event loggers on locomotives NA1874 and CS1 (extract at Fig. 9) capture time, speed, distance, brake and vigilance activation. The speed recorded by the event data loggers was corrected for wheel diameter and synchronised with the CTC clock/time. The CTC and locomotive data was used to reconstruct the timing of the collision. The examination of this data has established that:

- The collision occurred at 1101:43.
- The speed of the train at the time of collision was 77 km/h; this was 3 km/h below the maximum permitted speed for the train.
- The train brakes were applied as a direct consequence of the collision when air was lost from the train braking system. This was corroborated by the train crew who also stated that they were unaware of the truck until after the collision.

Figure 9: Extract of data download 'Hasler' event data logger from CS1



The train crew stated that the locomotive:

- headlight was on full beam at the time of collision; and
- the whistle was used in accordance with standard operating procedures, ie when approximately 500 m from the level crossing and again when near the level crossing. However, it was a hot day with gusty northerly winds and the driver of the truck had the windows of the vehicle up/closed with the air conditioner switched on. This would have made it difficult to hear the train's whistle.

An inspection of the headlight and whistle of locomotive NA1874 was conducted while the train was at the accident scene. This inspection established that:

- The head lights were on and in good working condition and should have been visible to the truck driver.
- The whistle was in a good working condition.

Passage of truck - truck speed

The truck did not have an on-board data recorder that could be used to provide information regarding whether the truck actually came to a halt at the 'Stop' sign and/or what the speed of the truck was at the time of collision. However, it was established that the truck driver telephoned the Wingfield office in Adelaide on two occasions, 1050 and 1055:55 respectively, seeking route directions. The duration of the mobile telephone call on these two occasions was 86 and 83 seconds respectively. Based on the telephone records and events recorded by the train's data logger, it was calculated that the second telephone call was terminated 5 minutes and 48 seconds before the collision which occurred at 1101:43. It is therefore considered highly unlikely that the truck driver was using his mobile telephone as he approached the level crossing.

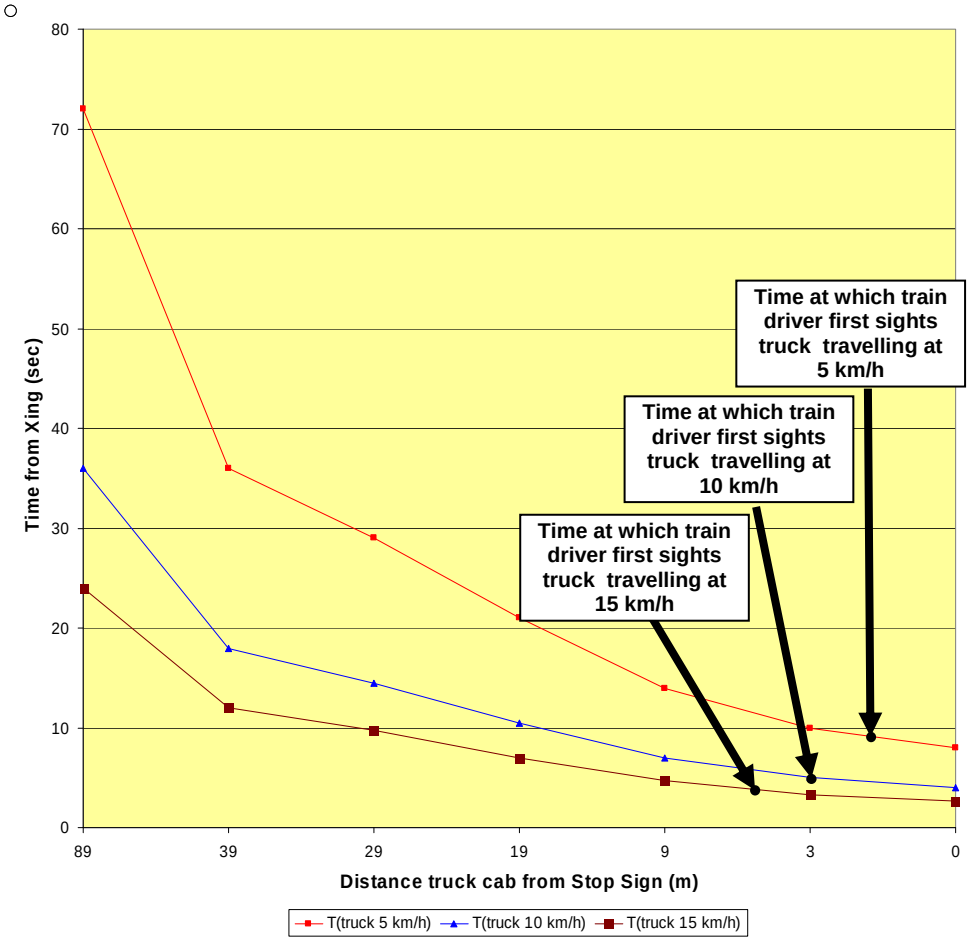
There was no evidence of skid marks on the road surface before or on the level crossing, this was to be expected as the truck driver said that he did not see the train.

Just before the collision, a local resident heard the train, turned and saw the truck traverse the crossing in front of the path of the train. The witness estimated the truck to be travelling at a speed of approximately 10 km/h but could not confirm whether the truck had come to a halt at the 'Stop' sign before proceeding over the crossing.

Based on interviews with the train crew, neither the train driver nor co-driver saw the truck at stop at the level crossing or even approach it at low speed.

During the interview with ATSB investigators the truck driver said that he believed he would have stopped, but he was not certain. He suffered head injuries as a result of the collision and had some difficulty in recalling aspects of the accident.

Figure 10: Tailem Bend – Sighting Times Calculation



Note: Based on data download from 'Hasler' event data logger from CS1

The attached graph at Fig. 10 is a time versus distance plot for the truck (speed 20 km/h, 10 km/h and 5 km/h) approaching the 'Stop' sign and train 4MR1 approaching the level crossing at 77 km/h.

An examination of these plots shows that had the truck been travelling at 5 km/h it should have been visible to the train crew for at least nine seconds before it traversed the level crossing and then for a further 10 seconds while passing over the level crossing. That is, it should have been visible to the train crew for a total time of 19 seconds preceding the collision. Had the truck been travelling at a higher speed of 10 km/h the available sighting time would have been 11 seconds and at a speed of 20 km/h, 8 seconds.

Had the truck been stopped at the crossing before proceeding over it, it is highly likely that the train driver and/or co-driver would have seen it stopped at the crossing as the available sighting time would have been greater than 19 seconds.

Based on these timings it is concluded that the truck probably did not stop at the crossing before proceeding over it and was probably travelling at a speed of between 10 km/h to 20 km/h as it approached and traversed the crossing.

Summary

Train 4MR1 was in possession of the necessary safeworking authority to occupy the Tailem Bend to Coomandook section of track. It was travelling at the prescribed track speed and being operated in accordance with the relevant rules and procedures.

Based on statements from the train driver/co-driver the train headlight and whistle were working and operated as prescribed.

Visibility at the time of the accident was good. The train crew did not sight the truck in the lead-up to the collision, which tends to support the hypothesis that it probably did not come to a halt at the 'Stop' sign and thus the train crew were unable to take any effective avoiding action.

The remainder of analysis therefore, focuses on the safety issues which may have been causal in the collision. This includes the level crossing alignment/visible sighting distances, placement of stop signs, approach warning signs and/or the actions of the driver of the truck.

2.2 Level crossing signage standards

Australian Standard 1742.7-1993[11]

Railway level crossings in South Australia generally comply with the requirements of the Australian Standard *Manual of uniform traffic control devices (AS1742.7-1993), Part 7, Railway crossings*. This Standard is one of a series of 13 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.

For example a passive level crossing with 'Stop' sign control is required to have a specific configuration of approach warning signs and pavement markings[10]. These warning signs are displayed in a specific order (Fig. 11, 12 and 13) to an approaching motorist as detailed here-under:

- The advance warning sign - 'Railway level crossing ahead', W7-7(L), on the left-hand side of the road and optionally a W7-7(R) sign on the right-hand side of the road.
- The 'Stop Sign Ahead', W3-1, sign 70 m in advance of the W7-7 sign(s).
- 'Railway level crossing stop assembly' (RX-2) sign, 180 – 250 m in advance of the W3-1 sign.

Passive and active level crossing control - Standard AS1742.7 defines:

- a passive control level crossing as:

10 Stop lines and barrier lines are not required on unsealed roads.

> 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.

- an active control level crossing as:

> The control of the movement of vehicular or pedestrian traffic across a railway level crossing by devices such as flashing light signals, gates or barriers, or a combination of these, where the device is activated prior to and during the passage of a train through the crossing.

AS1742.7-1993 does not prescribe which type of level crossing control (passive or active) is to be used. Nor does it prescribe the level of control used, for example, whether the traffic control should be by way of a 'Stop' or 'Give Way' sign at a passive crossing or whether boom gates are to be installed at an active crossing. The Standard simply states:

> The type of control used at a railway level crossing will depend on the requirement of individual locations taking into account safety, traffic volume, geometry and other considerations.

In making a determination regarding the type of control, sighting distance and approach viewing angle are important factors requiring consideration. Although sighting warrants vary from State to State they have generally been consistent with that documented in AustRoads *Rural Road Design - A Guide to the Geometric Design of Rural Roads* AP-G1 03[11]. AP-G1 03 is also largely consistent with the newly revised Australian Standard, AS1742.7-2007 which includes information on sighting distances and driver viewing angles. It is worthy of note that the new standard, AS1742.7-2007, also states:

> Where the sight distance available to a road vehicle is less than that required for stop sign control, regardless of whether it meets the requirement for give-way sign control, passive control shall not be used at the crossing. If the crossing is to remain open, alternative measures shall be applied. These may include the restoration of sight distance by sight benching in cuttings, clearing, geometric alteration of the crossing or changing to active control.

Conformance with AS1742.7-1993[11]

All of the required signage (Fig. 11, Fig. 12 & Fig. 13) was found to be present on the western approach to the Magpie Drive level crossing. The signs were in a very good condition and clearly visible to approaching road traffic. Road pavement markings were not provided and are not required at this location as the road is unsealed. During discussions with the Coorong District Council it was noted that they did not have a scheduled maintenance program covering the inspection of level

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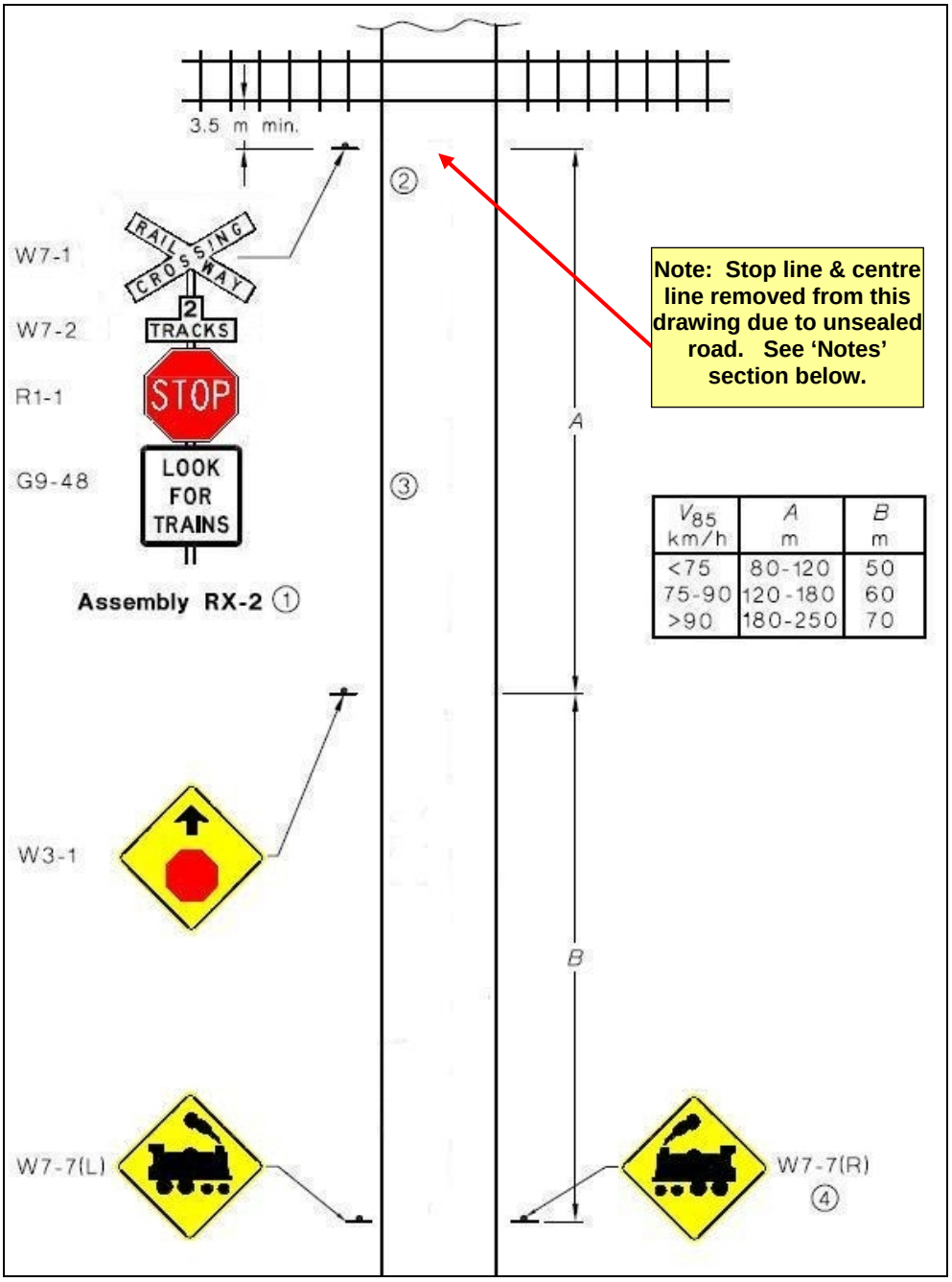
[11] At the time of this accident a new version of the Australian Standard AS1742.7 was in draft form but had not been publicly released. The new standard came into force on 20 February 2007. AS1742.7-1993 was used in accessing compliance of signage, positioning of signage, etc, but does not include guidelines for stopping distances, sighting distances and viewing angles. The sighting requirements specified within AustRoads *Rural Road Design - A Guide to the Geometric Design of Rural Roads* AP-G1 03 has been used in making this assessment and are consistent with guidelines contained in the newly published version of AS1742.7-2007.

crossings and approach warning signage. These programs should desirably be in place to ensure quality of infrastructure and currency of standards are maintained.

Figure 11: AS1742.7-1993, Standard signage and road marking layout for 'level crossing with straight approach controlled by stop signs (Passive Control)'.



V_{85} km/h	A m	B m
<75	80-120	50
75-90	120-180	60
>90	180-250	70

NOTES:

1 If more than one track, the TRACK sign W7-2 is added below W7-1. The alternative RAILWAY CROSSING position sign *with target board*, W7-6, may be required (see Clause 6.2.1).
2 Stop lines (see Clause 7.3) are required on sealed roads at level crossings controlled by stop signs.
3 The barrier line (see Clause 7.5) should extend at least to the W7-7 sign.
4 The right-hand side sign, W7-7, is for optional use on busy roads (see Clause 6.2.3)

The following inconsistencies were identified with the positioning of signage on the western approach to the Magpie Drive level crossing.

- The distance of the RX-2 assembly was 7.2 m from the crossing, the Standard specifies a minimum distance of 3.5 m. Although this is not a non-conformance, reducing the distance between the 'Stop' sign and railway track does improve sighting along the track. Unfortunately this action also has a negative impact in that it further degrades the viewing angle which is already poor.

Figure 12: Photograph of advance warning sign W7-7, W3-1 and 'Stop' sign assembly RX-2.

Figure 13: Left photograph of advance warning sign W7-7(L), W3-1 and 'Stop' sign assembly RX-2, right photograph RX-2 assembly.

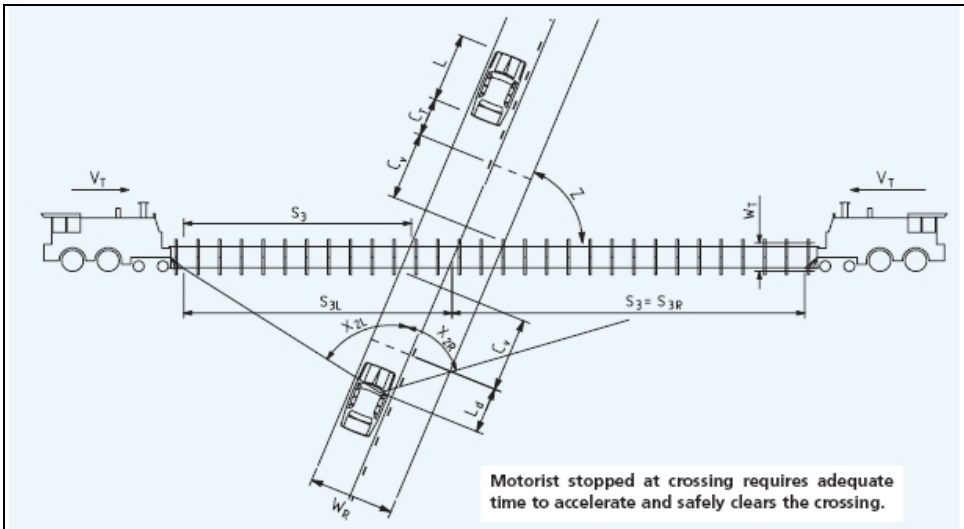
- the distance between the ‘Railway level crossing ahead’ signs W7-7 (L&R) and the ‘Stop Sign Ahead’ sign W3-1 was 60 m in excess of the requirement specified in the Standard.

Warrants, passive level crossing

Australian Standard 1742.7-1993 requires that when making a determination regarding the type of level crossing control, sighting distances and approach viewing angles shall be considered.

‘Stop’ sign control at a level crossing requires that the driver of a motor vehicle has sufficient sighting distance (including viewing angles) along the track when stopped to clearly see any approaching train, and then be able to accelerate safely clear of the crossing before the train arrives.

Figure 14: Approach distances and viewing angles



Notation (units and/or general case assumptions are shown in brackets):

S_3 Minimum distance of an approaching train from the point of impact with a road vehicle, when the driver of the road vehicle must first see an approaching train in order to safely cross the tracks.

S_{3L} Minimum distance of an approaching train from the intersection of the road centre line and the mid point of the rail tracks, when the driver of a road vehicle must first see a train approaching from the left in order to safely cross the track from a stopped position at the stop or holding line (m).

S_{3R} Minimum distance of an approaching train from the intersection of the road centre line and the mid point of the rail tracks, when the driver of a road vehicle must first see a train approaching from the right in order to safely cross the track from a stopped position at the stop or holding line (m).

V_T The speed of the train approaching the crossing (the allowed operating speed of trains, as advised by the rail authority) (km/h).

L Length of road vehicle (m).

L_d Distance from the driver to the front of the vehicle (general case assumption = 1.5m).

C_V Clearance from the vehicle stop or holding line to the nearest rail (general case assumption = 3.5m).

C_T Clearance or safety margin from the vehicle stop or holding line on departure side of the crossing (general case assumption = 5m).

W_R Width of the travelled way (portion of the roadway allocated for the movement of the vehicles) at the crossing (m).

W_T Width, outer rail to outer rail, of the rail tracks at the crossing (1.1m for single track, 5.1m for double track).

X_{2L} Vehicle driver viewing angle measured from at the STOP line to a train approaching from the left at distance, S3 from the crossing.

X_{2R} Vehicle driver viewing angle measured from at the STOP line at the road centre line to a train approaching from the right at distance, S3 from the crossing.

Z= Angle between the road and the railway at the crossing (degrees).

Ref. AustRoads AP-G1 03

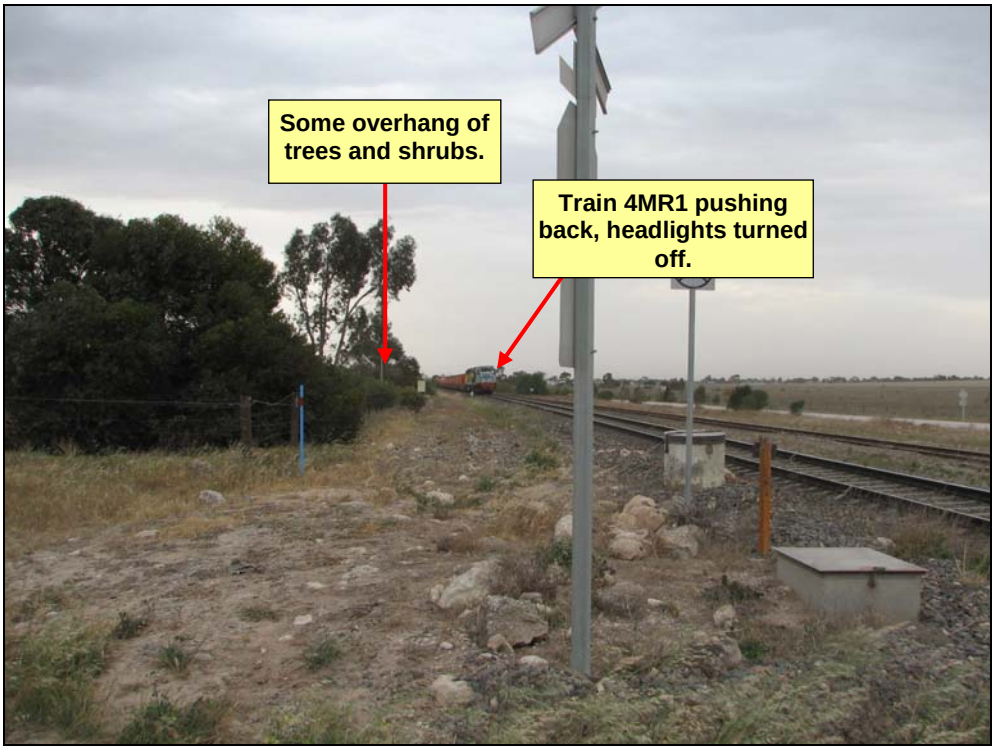
AustRoads *Rural Road Design - A Guide to the Geometric Design of Rural Roads* AP-G1 03 provides guidelines for the calculation of sighting distances and viewing angles at level crossings.

Track speed along this section of line is 115 km/h for the appropriate class of train (4MR1 was limited to a maximum speed of 80 km/h). Six hundred and thirty metres available sighting is required for a train approaching at the full line speed of 115 km/h. Magpie Drive provides marginal sighting distances at this track speed.

However, using the formulae contained in AP-G1 03, only 400 m sighting S_{3L} is required for a motorist to accelerate and safely clear the Magpie Drive level crossing with a train approaching from the left having a speed of 80 km/h.

An inspection of the Magpie Drive level crossing revealed that greater than 500 m sighting was available to the left; however, the same standard prescribes that the maximum viewing angle measured from the 'Stop' sign to a train approaching from the left should not exceed 110 degrees. The viewing angle at the Magpie Drive crossing was close to 120 degrees. This means that the amount of head twist required of the truck driver was excessive. This, coupled with sighting constraints imposed by the 'B' pillar of the truck involved in the collision, would have created significant problems for the truck driver in sighting the train, particularly if he did not come to a complete halt at the 'Stop' sign.

Figure 15: Train 4MR1 pushing back towards Tailem Bend, late afternoon of 4 October 2006.



It was noted that there was a line of trees on private property that parallels the railway line, (north-western side) offset by approximately 9 m to 10 m. Some of these trees were overhanging into the right-of-way (Fig. 15) and impinged on sighting along the track.

Summary

Signage was in a very good condition and in compliance with AS1742.7-1993. There were some minor inconsistencies with the location of signage, however, it is considered that none of these were factors in the collision.

Sighting along the track in a north-westerly direction (direction from which train was coming) was in excess of 500 m. The AustRoad code, AP-G1 03, requires a sighting distance of 400 m for a train travelling at 80 km/h. Adequate sighting distance was therefore available to the driver of the truck to see the approaching train if he had come to a halt at the 'Stop' sign.

The viewing angle to the north-west of the crossing was close to 120 degrees. The AustRoad code, AP-G1 03, prescribes a maximum viewing angle not greater than 110 degrees. It is therefore reasonable to assume that a poor viewing angle coupled with restricted visibility from the truck driver's cab would have made it difficult for the truck driver to sight the train.

Vegetation along the north-western side of the track partially infringed sighting, however, had the truck driver come to a complete halt at the 'Stop' sign the train should have been clearly visible at a distance of 500 m.

2.3 Road/Rail interface

Level crossing assessment – South Australia

Two reports into a fatal level crossing accident between a bus and a train at Park Terrace, Salisbury on the 24 October 2002, one by Vince Graham and the other by the ATSB, recommended a review of the manner in which level crossing safety was managed in South Australia. These reports recommended that all level crossings in South Australia be risk assessed using a computer based model, the Australian Level Crossing Assessment Model (ALCAM), for the determination of risk ratings for individual level crossings. The ALCAM is essentially a risk assessment tool that takes into account over 70 factors for each level crossing site including the characteristics and the control present. The model enables multiple proposed mitigation methods to be evaluated to assist in the determination of the optimum treatment of each individual level crossing. The ALCAM also allows agencies to prioritise level crossing upgrade works on the basis of a consistent evaluation methodology across a range of level crossing sites. The two reports further recommended that a program be undertaken to prioritise and implement risk mitigation strategies including closure of crossings wherever possible.

There are 1,138 public access level crossings in South Australia of which 878 are passively controlled. Of these, 155 are controlled by 'Give Way' signs, 444 by 'Stop' signs and 279 have position markers only. The Level Crossing Safety Improvement Upgrade Program is an initiative of the South Australian Government, aimed at reducing the risk to road and rail users at level crossings. Under this program $ 7.7 million has been allocated over the last five years to address key issues like compliance to standard, queuing, short stacking/departure and sighting distances as well as the upgrade of two level crossings from passive to active control. The Level Crossing Unit (LCU) from the Department for Transport, Energy and Infrastructure (DTEI) manages the program on behalf of Government. However the LCU does not have any direct operational management responsibility

for rail level crossings which rests with the relevant road authority and railway owner, in this case the CDC and the ARTC/GWA respectively. To help co-ordinate the process of level crossing management across the state, a State Level Crossing Strategy Advisory Committee (SLCSAC) was established. This committee consists of representatives from a range of stakeholders, including road and rail, police, Royal Automobile Association (RAA), the rail regulator, operators and local authorities.

The manner in which level crossings have been selected for upgrade has varied in recent times. Historically, the order in which level crossings were selected for upgrade was based (primarily) on an assessment of a particular level crossing's accident history, the frequency of road and rail traffic and cost to upgrade. There is now an industry transition to the ALCAM. All level crossings in South Australia have been assessed using this model and prioritised accordingly.

The Magpie Drive level crossing at Tailem Bend was identified by DTEI as having a sighting problem due to the angle of the road and rail intersection and a short stacking/departure problem due to the closeness of the railway line and Lime Kiln Road. The Magpie Drive level crossing at the time of drafting this report had been assessed using the ALCAM as a medium priority crossing and had not been scheduled for any immediate remedial works.

2.4 Driver of the truck

Route experience

The truck driver was required to collect a power transformer from an ElectraNet substation located off Substation Road (extension of Magpie Drive) at 1100. Based on his statement it was evident that he was unfamiliar with the route, in fact he became lost and required directions from the Wingfield office in Adelaide. He telephoned the office at 1050 and 1055:55 seeking directions.

Previous hours of work

The truck driver's roster sheets containing the hours of work for the seven days before the accident contain no breach in terms of allowable driving hours as prescribed by the National Driving Regulations. The driver was in fact working a standard/routine day 0800 through to 1600 day. Fatigue is not considered to be a factor in the collision.

Presence of road-junction

The junction of Magpie Drive and Lime Kiln Road was only 28 m (distance from the centre of track to the centre of Lime Kiln Road) apart. Intersecting roads and other road traffic can distract a motorist from looking for a train or indications of an oncoming train. Research has established that roads which intersect with a level crossing, closely followed by a road junction, require an increase in the number of decisions a motorist must make and that this can distract the motorist from looking for a train (NTSB, 1998). In fact a nearby road intersection may become a significant distraction to the motorist simply because the motorist is aware of it. The NTSB found that if on the departure side of the level crossing a road intersection is

visible to an approaching motorist, the motorist's attention may be drawn towards that intersection and away from the crossing.

Attention

Based on the interview with the truck driver it is evident that he became lost and would have arrived at the ElectraNet substation site somewhat late. A mobile crane was on site waiting to lift a transformer onto the trailer of his truck. He could see the boom arm of the crane at a distance and would not have wanted to delay the work. It is therefore likely that he was focusing significant attention on the navigation process, and his timely arrival at the ElectraNet site.

Maintaining attention is a complex process which requires an individual to maintain some level of alertness. Failures of attention can occur because unnecessary or distracting information intrudes on the cognitive process. Under these conditions an individual's attention may become narrowly focused on information unrelated to the driving task. Research by Garland, D.J., Wise, J.A. and Hopkin, V.D. (1999) has found that stressors not only narrow an individual's attention, they reduce information intake and there is a reduction in mental capacity. It has also been observed that there is an increased tendency to address dominant or probable sources of information in the task environment as cited by Broadbent (1971).

The junction immediately after the level crossing and mental resources required in locating the ElectraNet substation possibly drew the driver's mental resources away from the task of traversing the level crossing. Other research by Wachtel, P.L. (1967) has found that under stress, the scanning of information is scattered and poorly organised. If the driver was preoccupied with other tasks he was probably ineffective in scanning his environment and hence may not have perceived the presence of the train, or the risk associated with the level crossing.

Summary

The truck driver had not driven the route before, he was unfamiliar with the topography, was running late and under pressure to arrive at an ElectraNet substation site to collect/load a power transformer.

The truck driver was unaware of the presence of the train and possibly unaware of the level crossing.

Based on the available evidence it is concluded that the truck driver probably did not come to a stop at the crossing. However, it was not fully clear whether this was an intentional violation or if he was simply distracted by the presence of the road-junction ahead and/or focusing his attention on navigating and arriving at the ElectraNet substation in a timely manner and for these reasons failed to recognise the presence of the level crossing. The latter hypothesis is supported by observations made by witnesses who gained a distinct impression that the truck driver did not appreciate the presence of the level crossing and appeared to be pre-occupied with the road intersection and arrival at the substation.

On the balance of available information it is considered most probable that the truck driver did not come to a stop at the crossing because he was distracted by a combination of internal and external factors comprising:

- preoccupation with navigating to the ElectraNet substation site (internal)
- concern about arriving at the ElectraNet substation late (internal)
- the presence of an intersection immediately after the crossing (external).

2.5 Safety at level crossings

In a report tabled at the Australian Transport Council (ATC), 'National Railway Level Crossing Safety Strategy' dated August 2003, the ATC identified a series of 'Strategic Actions' (Appendix 5.1) aimed at the cost-effective improvement of level crossing safety. In its report, the ATC cited an ATSB report that identified 46% of fatalities at railway level crossings are as a result of 'Unintended driver error'.

The level crossing accident at Magpie Drive on 4 October 2006 involved a number of the issues identified in the ATC report; in particular, train conspicuity, car and truck driver responses, site assessment, stakeholder education and information, funding, enforcement, and coordination.

The South Australian Government established the SLCSAC to advise initially the Minister for Transport, but more recently the Minister for Road Safety on issues regarding railway crossings. The committee has recently changed its focus from operational intervention into a more strategic approach to level crossing management and has a clear role in considering issues arising from accidents such as occurred at the Magpie Drive level crossing and aligning its strategies to those proposed in the ATC report.

Train Conspicuity

The National Railway Level Crossing Safety Strategy's strategic action to address the issue of train conspicuity is:

> Ensure that road users can see either an approaching train (locomotive or carriages), or a train that is already on the railway level crossing.

The train head light was on and in good working condition at the time of the accident and should have been clearly visible to the truck driver, it was however noted that the light blue colour[12] of locomotive NA1874 could make seeing it (Fig. 15) difficult under certain circumstances, eg background lighting, time of day and geographic location/vegetation, etc. Although not considered a factor in this collision, enhancing the visibility of locomotives may assist motorists in seeing them.

12 Note: The colour scheme of locomotives/trains is not mandated in any standard.

Car and Truck Driver Responses

The strategic action to address the issue of car and truck driver responses is:

> Ensure that drivers identify railway level crossing sites, and respond appropriately.

Since the tabling of the ATC report, there have been a number of initiatives aimed at improving public awareness regarding level crossings safety.

Site Assessment, Prioritisation and Treatment

The strategic action to address the issue of site assessment, prioritisation and treatment is:

> Ensure that railway level crossing sites, including pedestrian crossings separate to road crossings, are designed and constructed to an appropriate standard.
>
> Close level crossings where appropriate.

The ALCAM model has been used by the DTEI LCU in developing a risk profile for all level crossings in South Australia. The work done by the LCU is commendable and should continue including undertaking regular reviews to ensure that data remains current and the implementation of appropriate level crossing control treatments and maintenance is appropriately monitored.

Opportunities exist at Magpie Drive level crossing for reducing the interface risk by closure of the crossing, realignment of the road or upgrading the crossing to an active warning system. At the time of undertaking the investigation, Lime Kiln Road was being sealed. It is considered this action will further increase the road/rail interface risk at the crossing due to a potential increase in road traffic volumes. During discussions with Council representatives it was revealed that they were considering opportunities for the closure of the crossing as good access for road users is available at Trevena Road and North Terrace (both active crossings), this initiative is supported by the ATSB.

Stakeholder Education and Information

The strategic action to address the issue of stakeholder education and information is:

> Develop awareness and understanding through participation amongst the public, engineers, the police and others to improve responses, engineering and enforcement (may be similar to U.S. ‘Operation Lifesaver’)

Australian state/territory transport authorities have been working with stakeholders to improve level crossing safety. For example, working with local government agencies to ensure compliance with approach signage and road markings as specified in AS1742.7-1993. Consideration should be given to expanding the role of the LCU to provide further assistance to road/rail authorities in coming to an understanding of design, construction and maintenance requirements for safe level crossing management/strategies and to guard against degradation of these strategies.

The role of the LCU may also include some form of education and auditing role to better oversight and improve the effectiveness of risk mitigation strategies employed by road and rail authorities at level crossings.

Funding

The strategic action to address the issue of funding is:

> Seek additional funds for railway level crossing safety.
>
> Allocate funds for railway level crossing treatments within the context of broader transport infrastructure priorities.

Following on from the reports into a fatal level crossing accident between a bus and a train at Park Terrace, Salisbury on 24 October 2002 the South Australian Government allocated $7.7 million over a five year period for addressing key issues related to level crossings, such as compliance to standard, queuing, short stacking/departure and sight distance as well as the upgrade of two level crossings from passive to active control. By comparison the Victorian Government has allocated $250 million over a ten year period for the upgrading of 90 level crossings from passive to active control and road/rail (grade) separation.

Legislation, Regulation and Enforcement

The strategic action to address the issue of legislation, regulation and enforcement is:

> Ensure that laws and penalties are clear, understood, appropriate and enforced.

Witnesses interviewed indicated that after the accident they had taken a greater interest in observing vehicles traversing the Magpie Drive level crossing. Since the accident they had frequently observed motorists fail to stop at the crossing.

Coordination

The strategic action to address the issue of coordination between jurisdictions is:

> Develop consistency in information, assessments, standards and practices between States.

While not a safety issue, the ATSB found that the ARTC/GWA and the CDC did not have an 'Interface Agreement' covering their respective maintenance responsibilities for this level crossing. 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 fund and provide the approach warning signage. Therefore the lack of a formal agreement potentially exposes organisations to risk, particularly where items are not provided/maintained in accordance with mandated standards because the responsibilities between the parties are ill-defined.

3 FINDINGS

3.1 Context

From the evidence available, the following findings are made with respect to the collision between a prime-mover/low loader combination and ballast train 4MR1 at the Magpie Drive level crossing, Tailem Bend, SA on 4 October 2006.

The findings identify the different factors that contributed to the accident and should not be read as apportioning blame or liability to any particular individual or organisation.

3.2 Contributing factors

These findings identify the various events and conditions that increased safety risk and contributed to the incident.

1. The collision occurred because the driver of the truck entered the level crossing while a train was on the approach and probably had not come to a halt at the 'Stop' sign as prescribed.

2. The truck driver was probably preoccupied by a combination of internal and external factors including:

   - navigating to the ElectraNet substation site (internal)
   - arrival at the ElectraNet substation in a timely manner (internal)
   - the presence of an intersection immediately after the crossing (external).

3. The viewing angle to the north-west of the crossing was excessive, close to 120 degrees. It is possible that the poor viewing angle coupled with any restricted visibility from the truck driver's cab would have made it difficult to sight the train.

3.3 Other safety factors

These findings identify other events and conditions that increased the safety risk.

1. Track speed along this section of line is 115 km/h for the appropriate class of train (4MR1 was limited to a maximum speed of 80 km/h). A distance of 630 m available sighting is required for a train approaching the crossing at the full line speed of 115 km/h. Magpie Drive provides marginal sighting at full line speed.

2. It would appear that vehicles traversing the Magpie Drive level crossing regularly fail to come to a halt at the stop signs.

3. During the investigation it was noted that the Australian Rail Track Corporation, Genesee & Wyoming Aust. Pty. Ltd. and the Coorong District Council do not have an 'Interface Agreement' covering their respective maintenance responsibilities. While not an issue for the accident, maintenance responsibilities need to be clearly defined.

4. It was noted that the Coorong District Council did not have scheduled maintenance program covering the inspection of level crossings and approach warning signage for the council's area of responsibility.

5. The level crossing at Magpie Drive had been identified by the Level Crossing Unit of Department for Transport, Energy and Infrastructure as having a sighting problem due to the angle of the road and a short stacking/departure problem due the proximity of the Lime Kiln Road intersection.

6. Opportunities exist for expanding the role of the Level Crossing Unit to provide further assistance to road/rail authorities to better manage risk mitigation strategies employed at level crossings.

7. The light blue colour of the lead locomotive (NA1874) may have been difficult to see when viewed against the background lighting/colour of the vegetation near the accident site.

3.4 Other key findings

These are findings that are not defined as safety factors or may be positive events and conditions that reduced the risks associated with the incident.

1. Train 4MR1 was in possession of the necessary safeworking authority to occupy the Tailem Bend to Coomandook section of track, it was travelling at the prescribed track speed and being operated in accordance with the relevant rules and procedures.

2. There were no deficiencies that relate to the mechanical condition of the locomotive. Train speed, braking, headlight illumination and the sounding of the whistle were appropriate.

3. There were no defects in the track or signalling system.

4. The train crew were appropriately trained and qualified, medically fit and fatigue is not considered to have been a factor.

5. There were no factors identified that relate to the performance of the train crew in their handling of the train. The train crew were unable to take any avoiding action.

6. There were no deficiencies that relate to the mechanical condition of the prime-mover and trailer combination.

7. The history of the truck operator James Contract Supplies Pty Ltd and the driving record of the truck driver gave no indication of factors likely to have contributed towards the accident

8. Breath testing of the train crew and truck driver by the SA Police returned zero readings.

9. Level crossing signage was in a very good condition and generally in compliance with AS1742.7. There were some minor inconsistencies with the location of some signage, however, this should not have prevented the truck driver from appreciating that there was a level crossing ahead and that he was required to stop.

10. Visibility at the time of the accident was good, adequate sighting distance was available along the track. Vegetation on the north-western side of the crossing should not have prevented the truck driver from seeing the oncoming train had he come to a stop as required.

4 SAFETY ACTIONS

As a result of its investigation, the ATSB makes the following recommendations with the intention of enhancing future rail/road safety. Rather than provide prescriptive solutions, ATSB recommendations are designed to highlight safety issues that need to be considered. Recommendations are directed to those agencies that should be best placed to action the safety enhancements intended by the recommendations, and are not necessarily reflective of deficiencies within those agencies.

RR20070004

The ATSB recommends that the Australian Rail Track Corporation (ARTC) examine opportunities with Genesee & Wyoming Aust. Pty. Ltd. (GWA) and the Coorong District Council (CDC) for reducing the road/rail interface risk at the Magpie Drive level crossing[13]. This should include opportunities for closure of the crossing and/or realignment strategies that will improve both sighting and viewing angles.

RR20070005

The ATSB recommends that Genesee & Wyoming Aust. Pty. Ltd. (GWA) examine opportunities with the Australian Rail Track Corporation (ARTC) and the Coorong District Council (CDC) for reducing the road/rail interface risk at the Magpie Drive level crossing[13]. This should include opportunities for closure of the crossing and/or realignment strategies that will improve both sighting and viewing angles.

RR20070006

The ATSB recommends that the Coorong District Council (CDC) examine opportunities with the Australian Rail Track Corporation (ARTC) and Genesee & Wyoming Aust. Pty. Ltd. (GWA) for reducing the road/rail interface risk at the Magpie Drive level crossing[13]. This should include opportunities for closure of the crossing and/or realignment strategies that will improve both sighting and viewing angles.

RR20070007

The ATSB recommends that South Spur Rail Services examine opportunities for enhancing the conspicuity of its locomotives.

RR20070008

The ATSB recommends that the Australian Rail Track Corporation improve communications with Genesee & Wyoming Aust. Pty. Ltd. and the Coorong District Council in relation to the inspection and maintenance of level crossings,

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13 The ARTC/GWA and the CDC should liaise with the SA Department for Transport, Energy & Infrastructure's Level Crossing Unit (LCU) regarding design and maintenance strategies that are available for reducing the road/rail interface risk at level crossings and to gain assistance with the assessment of options using the ALCAM. Upgrading the crossing to active protection is unlikely to be a realistic option at this location as the crossing was identified as a medium priority on the LCU priority list. However, the LCU should undertake a review in light of the accident and ensure the CDC is fully aware of appropriate risk mitigation strategies that can be implemented to minimise the road/rail risk at this location.

including the development of a formal 'Level Crossing Interface Agreement' that adequately addresses their specific responsibilities and requirements of AS 4292.1[14] Section 7 – Interface Management.

RR20070009

The ATSB recommends that the Genesee & Wyoming Aust. Pty. Ltd. improve communications with the Australian Rail Track Corporation and the Coorong District Council in relation to the inspection and maintenance of level crossings, including the development of a formal 'Level Crossing Interface Agreement' that adequately addresses their specific responsibilities and requirements of AS 4292.1[14] Section 7 – Interface Management.

RR20070010

The ATSB recommends that the Coorong District Council improve communications with the Australian Rail Track Corporation and Genesee & Wyoming Aust. Pty. Ltd. in relation to the inspection and maintenance of level crossings, including the development of a formal 'Level Crossing Interface Agreement' that adequately addresses their specific responsibilities and requirements of AS 4292.1[14] Section 7 – Interface Management.

RR20070011

The ATSB recommends that the Coorong District Council develop a program for the regular inspection of all level crossings in the district to ensure that road alignment, markings and signage conform to Australian Standard AS1742.7, *Manual of Uniform Traffic Control Devices, Part 7: Railway Crossings.*

RR20070012

The ATSB recommends that the Department for Transport, Energy and Infrastructure examine opportunities to expand the role of the Level Crossing Unit to include some form of auditing role to better oversight the management of risk mitigation strategies employed by road authorities/councils and railway owners at level crossings in order to monitor the effectiveness and minimise the potential for any gradual degradation of these strategies.

14 Australian Standard AS4292.1 Railway safety management – General requirements.

5 APPENDIXES

5.1 National Railway Level Crossing Safety Strategy

Strategic Response

Issue	Strategy
Train Conspicuity	Ensure that road users can see either an approaching train (locomotive or carriages), or a train that is already on the railway level crossing.
Car and Truck Driver Responses	Ensure that drivers identify railway level crossing sites, and respond appropriately.
Pedestrian Responses	Ensure that pedestrians identify railway level crossing sites, and respond appropriately. Ensure that people with disabilities are provided with appropriate information by way of site design and other initiatives.
Site Assessment, Prioritisation and Treatment	Ensure that railway level crossing sites, including pedestrian crossings separate to road crossings, are designed and constructed to an appropriate standard. Develop appropriate Australian design standards for railway level crossing protection equipment including the operation and timing of flashing lights, boom barriers, pedestrian signals and gates, and active advance warning signs. Develop uniform criteria for the establishment of the level of protection for road vehicle and pedestrian crossings. Ensure that designs are appropriate for people with disabilities and other vulnerable road users. Close level crossings where appropriate. Investigate low cost treatments including active warning signs, beacons, strobe lights and other alerting devices at railway level crossings.
Stakeholder Education and Information	Develop awareness and understanding through participation amongst the public, engineers, the police and others to improve responses, engineering and enforcement (may be similar to U.S. 'Operation Lifesaver').
Data Collection	Enable effective national data comparisons.
Funding	Seek additional funds for railway level crossing safety. Allocate funds for railway level crossing treatments within the context of broader transport infrastructure priorities.
Rail Industry Involvement	Industry involvement in engineering, education and enforcement programs. Ensure appropriate train standards and operation.
Legislation, Regulation and Enforcement	Ensure that laws and penalties are clear, understood, appropriate and enforced.
Coordination	Develop consistency in information, assessments, standards and practices between States. Implementation of the Strategy should be well managed, co-ordinated, monitored and reviewed.

5.2 Submissions

Section 26, Division 2, and Part 4 of the *Transport Safety Investigation Act 2003*, requires that the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate, for the purposes of:

a) Allowing the person to make submissions to the Executive Director about the draft; or

b) Giving the person advance notice of the likely form of the published report.

The final draft of this report was made available for comment to the following directly involved parties:

a) Australian Rail Track Corporation

b) Genesee & Wyoming Aust. Pty. Ltd.

c) Coorong District Council

d) South Spur Rail Services

e) James Contract Supplies

f) Department for Transport, Energy and Infrastructure (South Australia)

g) the train crew of 4MR1

h) the truck driver

i) resident Lot 55 Magpie Drive, Tailem Bend.

The Australian Rail Track Corporation, the South Spur Rail Services and the Department of Transport, Energy and Infrastructure (South Australia) have made a number of comments and observations on the draft report issued to directly involved parties. Comments and observations have been incorporated into this report where they are supported by valid evidence and agreed to by the investigation team.

5.3 References

Australian Transport Council (2003). National railway level crossing safety strategy. August 2003.

Australian Transport Council (2006). National Railway Level Crossing Safety Strategy.

Australian Transport Safety Bureau (ATSB) Monograph 10 (2002). Level crossing accidents: fatal crashes at level crossings.

Broadbent, D.E., (1971). Decision and Stress

Commonwealth of Australia report on 'Train Illumination' (June 2004).

Garland, D.J., Wise, J.A., Hopkin, V.D. (1999). Handbook of aviation human factors. Lawrence Erlbaum Associates, Ltd.

National Transportation Safety Board (1998). Safety at passive grade crossing. Volume 1: Analysis. Safety study NTSB/SS-98/02. Washington DC.

Wachtel, P.L. (1967). Conceptions of broad and narrow attention. Psychological Bulletin, 68, 417-429.

5.4 Media release

Driver distraction leads to level crossing collision

The ATSB has found that a collision between a train and low loader truck occurred because the truck driver was probably distracted and did not see the train approaching.

The Australian Transport Safety Bureau investigated the collision which occurred at the Magpie Drive level crossing, Tailem Bend, South Australia, on 4 October 2006.

At the time of the accident the crossing was controlled by passive 'Stop' signs and approach warning signs. It is likely that the truck did not come to a halt at the 'Stop' sign controlling the crossing as the driver was possibly distracted by the presence of the road-junction ahead and/or a preoccupation with arriving at his destination on time, which may have diverted his attention from the risks associated with negotiating the level crossing.

The investigation also found that the viewing angle to the north-west of the crossing was substandard and coupled with restricted visibility from the truck driver's cab would have made it difficult for the truck driver to sight the train.

The investigation established that there was nothing the train crew could have done to prevent the accident.

In the interest of enhancing future road/rail safety the ATSB has made a series of recommendations which include opportunities for closure of the level crossing and/or options for improving sighting and viewing angle, enhancing train conspicuity, and expanding the role of the Department for Transport, Energy & Infrastructure Level Crossing Unit's role to include an ongoing level crossing education and audit role.

Copies of the report can be downloaded from the ATSB's internet site at www.atsb.gov.au, or obtained from the ATSB by telephoning (02) 6274 6478 or 1800 020 616.

Collision between Prime-mover/low loader combination and
Ballast train 4MR13, Tailem Bend SA, 4 October 2006