Australian Government

Australian Transport Safety Bureau

RAIL SAFETY INVESTIGATION
2002/0003

Level Crossing Collision Between Steam Passenger Train 8382 and Loaded B-double Truck

Benalla, Victoria
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Contents

EXECUTIVE SUMMARY

At about 1250 on Sunday 13 October 2002 an historic steam passenger train, 8382 carrying a wedding party, collided with a fully loaded B-double flour truck on a railway level crossing at Benalla, Victoria.

The B-double truck did not give way and crossed the level crossing in the path of train 8382. The evidence to the investigation was that the B-double driver did not see the train until he was actually crossing the rail track. The train was so close that he did not have time to accelerate his vehicle clear. The probability is that the train crew had no reason to suppose that the B-double would not stop at the crossing and as the B-double started to cross the train crew could do nothing to avoid or mitigate the collision.

The train driver, fireman, and one footplate[1] visitor on the locomotive were fatally injured. Another footplate visitor was seriously injured as a result of the collision. No other injuries were reported.

The collision occurred on the Saleyards Road railway level crossing located approximately 1.1 kilometres from Benalla township on the Benalla – Yarrawonga/Oaklands branch line. The level crossing was a passive crossing protected by 'give way' and other warning signs on the road approaches. As a result of the collision, locomotive K183 and tender, carriage DT319 (power supply van) and the leading bogie of carriage BK712 derailed.

The B-double truck was owned and operated by Greenfreight Pty Ltd based in Wodonga. The train was operated by West Coast Railway. The train locomotive was owned by the Victorian Government and managed by Steam Rail Victoria Inc based in Newport. The carriages from the train were owned and maintained by West Coast Railway.

After impact, the train locomotive left the tracks and ploughed into soft earth next to the railway line. The locomotive was tipped onto its side and the tender was pushed into the locomotive cabin. The tender also distorted the crew compartment roof shearing the bolts holding the boiler safety valve assembly. High pressure steam vented into the atmosphere and into the crew compartment.

In accordance with the Terms of Reference, the investigation was limited to factors directly affecting safe rail operation. Other factors directly involving the B-double truck do not form part of this report.

The train and track infrastructure and maintenance systems were found to be in operational condition and conducted in accordance with accepted procedures. The train was running on an appropriate track authority. The qualifications, training and re-training procedures were appropriate and had been followed. The scheduling of train staff was not a factor in the collision, though the report recommends a review of rostering for special trains by the Rail Tram and Bus Union, particularly crews in secondary employment. The medical condition of the rail safety workers involved met the required standard and no medical factors were implicated in the cause of the collision. Post collision emergency management and response procedures were effective and efficient.

1 Footplate refers to the locomotive cabin of a steam locomotive.

The locomotive was displaying its headlight on high beam. The train was so close to the truck as they both approached the crossing, and was also sounding its whistle, it is not possible to determine what level of conspicuity, if any, would have alerted the B-double driver.

A number of factors were identified as being critical to safe railway operation at Saleyards level crossing. The level of protection at the Saleyards Road level crossing could be improved for heavy goods vehicles accessing Saleyards Road from the east. The sighting distance, based on a train speed of 80 kph, may be insufficient to allow heavy goods vehicle to cross and clear the level crossing in safety.

Additionally, the risk assessment process used by VicRoads and the Benalla Rural City Council to determine the level of protection used at railway level crossings on approved B-double routes could be improved.

The investigation makes several safety recommendations (see section 6.1) to the Victorian Department of Infrastructure, VicRoads, Benalla Rural City Council, Freight Australia, West Coast Railway, Rail Tram and Bus Union, Standards Association of Australia, and the Victorian Level Crossing Committee. The recommendations relate to reviewing railway level crossings on B-double routes, footplate visitors, fatigue management, and Australian Standards. One review should encompass level crossing protection treatments and include any significant changes such as traffic flow and type, speed and vegetation. The active involvement of the rail industry in level crossing issues is also recommended. A community education programme is recommended to address the dangers of railway level crossings to road and pedestrian users.

Additional recommendations include consideration of the type of road and rail traffic as part of the Australian Standard for level crossing protection.

1 INTRODUCTION

1.1 Terms of reference

The Victorian Minister for Transport, the Hon Peter Batchelor, requested the Australian Transport Safety Bureau (ATSB) to undertake an independent investigation into the collision between steam locomotive K183, and its consist[2], and a loaded 'B-double' truck at the Saleyards Road level crossing, Benalla. The accident occurred at about 1255 on 13 October 2002 on the broad gauge section of line in the Benalla – Yarrawonga section about 1.1 kilometres north of Benalla station. The investigation was conducted in accordance with the provisions of the Transport Act 1983 (Victoria) as amended.

The Terms of Reference for the investigation were:

> The Investigation will examine all relevant matters including:
>
> 1. The immediate events leading to the collision, including determination of the relative contribution of rolling stock, infrastructure and operating procedures.
> 2. Train maintenance systems.
> 3. The track authority.
> 4. Qualification, training and re-training procedures for relevant staff.
> 5. Scheduling of train staff to heritage and special interest.
> 6. Operating procedures and effectiveness of such procedures.
> 7. Medical condition of the rail safety workers involved in the collision.
> 8. Post collision emergency management arrangements and procedures.
> 9. Conspicuity of the engine and tender.
> 10. Any specific issues relating to the Saleyards Road crossing and its approaches.
> 11. Final report format to follow the model Draft AS Guidelines for rail safety investigations.

1.2 Limits of the investigation

This investigation had been limited to railway specific factors in accordance with the terms of reference issued by the Victorian Department of Infrastructure. Railway factors generally include: the train; track and infrastructure; level crossings; train and track control. Other matters considered were interfaces between railway factors and other parties.

This report does not include all factors relating to the Greenfreight B-double or the actions of the driver of that vehicle. Factors specific to the B-double truck and driver have been investigated by the Victoria Police Major Collision Investigation Unit and do not form part of this report. Factors specific to the operation of the B-double truck include, amongst others: the condition of the truck; the condition, medical or otherwise, of the driver; driver training and qualifications; the speed and route of the truck; and the actions and observations of the driver.

As part of the investigation, the driver of the B-double was interviewed by the investigation team. The interview was conducted under section *129R Power of inspector to require information or documents, of the Victoria Transport Act 1983* (as amended). Therefore, information provided

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2 'Consist' refers to the types of carriages within a train unit.

to the investigation team by the B-double driver in accordance with section 129R, has the protection of section 129S *Protection against self-incrimination, of the Victoria Transport Act* 1983 (as amended). An extract of section 129S follows:

> **‘129S. Protection against self-incrimination**
>
> (1) A person required to provide any information, to give any evidence, or to produce any document or thing, under this Subdivision or Subdivision 6 is not excused from providing the information, giving the evidence or producing the document or thing on the ground that the information, evidence, document or thing may tend to incriminate him or her.
>
> (2) Any information provided, evidence given, or document or thing produced, by a person under this Subdivision or Subdivision 6 is not admissible against him or her in any proceedings, whether civil or criminal, nor can it be made the ground of any prosecution, action or suit against him or her other than in proceedings for perjury or giving false information’.

A number of contributory factors have become apparent during this investigation that were considered to be outside the Terms of Reference. The investigation did not examine, in depth, or recommend safety actions with respect to such factors. Nevertheless, the road transport industry needs to be aware of factors mentioned in this report regarding the design and operation of B-double trucks.

2 INVESTIGATION METHODOLOGY

The purpose of this investigation is to enhance rail safety on the Victoria rail network, by determining the direct events which led to the accident and the factors which may have influenced those events. Of particular importance is the need to understand what the accident revealed about the environment in which this particular rail operation was being conducted, and to identify deficiencies with the potential to adversely affect future safety.

The analysis of this accident is based on the Reason model[3] of accident causation in modern technological systems. The report was written using the format contained in the Australian Standard 5022-2001 'Guidelines for rail safety investigation'.

During the investigation, information was obtained and analysed from a number of sources, including:

- visits to the accident site;
- inspection and analysis of the rollingstock involved in the collision;
- recorded train and train control information;
- track and rolling stock maintenance records, procedures and standards;
- the history of organisational and infrastructure changes associated with the accident site;
- interviews with personnel directly associated with the accident;
- interviews with management and safety personnel of organisations relevant to the accident;
- a review of organisational documentation;
- local shire council records;
- VicRoads documentation;
- staff training curriculum for Safeworking employees; and
- organisational contracts.

In addition, technical analysis and reports were provided from relevant experts on aspects of train brake systems.

The investigation team acknowledges the full cooperation received from all parties to the investigation, both individuals and organisations.

[3] REASON, J. 1990, Human Error, (Cambridge University Press: Cambridge) ; REASON, J. 1997, Managing the Risks of Organisational Accidents, (Ashgate Publishing Limited: Aldershot)

3 FACTUAL INFORMATION

At 1250 on 13 October 2002 an historic steam passenger train collided with a B-double road vehicle on Saleyards Road level crossing, about 1.1 km north of Benalla railway station. Three people on the foot plate were killed and another seriously injured in the accident.

3.1 Background

Benalla is located in the north east region of Victoria, approximately 209 kilometres from Melbourne. Benalla railway station is 195.251 km from the zero kilometre post at Spencer Street Station, Melbourne, on the main northern rail link between New South Wales (Sydney) and Victoria (Melbourne). Benalla is a junction station for the broad gauge[4] branch line to Yarrawonga and Oaklands. A map of the Benalla region is at appendix 8.3.

The Saleyards Road level crossing is located approximately 1.1 km from Benalla railway station on the Benalla – Yarrawonga/Oaklands branch line. The branch line operates mostly freight trains and a small number of special passenger trains.

This branch line is managed by Freight Australia through its control centre in Melbourne. The authority for using the section is a paper order known as Train Order Working (block working[5]). The maximum permissible line speed is 80 km/h, but a circular issued by Freight Australia established a 65 km/h speed limit for the special train.

The Saleyards Road level crossing services the nearby Benalla stockyards and various other mostly small business traffic, and is designated as a 'B-double' approved route.

The steam locomotive (K183) was owned by the Victorian Government and managed by Steam Rail Victoria Inc, based in Newport. The carriages hauled by K183 were registered to West Coast Railway based in Geelong. The train was carrying a wedding party function.

The B-double truck was owned and operated by Greenfreight Pty Ltd based in Wodonga. The truck was fully loaded with flour being transported from Avenel (Victoria) to a bakery located in Blacktown (NSW).

3.2 Sequence of events

Special train 8382 (K183 and consist) carried a wedding party from Melbourne to Yarrawonga on 12 October 2002. The party stopped at Yarrawonga overnight and was scheduled to return at 1100 the next day. Due to the late running of the train the previous night and the crew requiring a minimum rest period of eleven hours, the train departed at 1142, 42 minutes late. The driver had received the track authority from a train controller at 0948.

The train progressed along the line towards Benalla, passing through several regional towns, crossing approximately 38 level crossings. The driver sounded the train whistle regularly when approaching these crossings and to acknowledge interested passers-by.

Approaching Benalla, about 4 km north of the Benalla Station, the broad gauge track runs in a 167 degrees (T) direction before entering the transition of a curve about 3.5 km north of the station. This curve of about 500 m in length has a radius of about 805 m, with the exit from the curve about 3 km from the station and about 1760 m from Saleyards level crossing. From the

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4 Broad gauge, 1600 mm between rails

5 'Block working' means only one train in a section of line at any one time.

exit of the curve, the track runs in a 189 degrees direction for 1500 m, crossing Racecourse Road about 600 m north of Saleyards level crossing, to a point about 268 m north from Saleyards Crossing. At this point, the track curves over a short distance of about 200 m (with radius 805 m) to a heading of about 177 degrees.

Based on the train recorder, two minutes before the collision train 8382 was travelling at 39 km/h (10.83 m/s), gradually increasing to 48 km/h (13.33 m/s), and the locomotive was 1600 m from Saleyards level crossing. The locomotive crossed Racecourse Road level crossing 45 seconds before the collision.

From the cab the fireman (on the right side of the cab) may have seen the B-double ahead as it travelled parallel with the track. There is no reason why this should have caused any concern. Also it is probable that no anxiety was caused when the B-double turned into the crossing, the likely assumption being that the B-double would come to a stop to allow the train to clear the crossing. It would have only been in the last seconds that there would have been a realisation that the B-double was not going to stop.

The Greenfreight B-double truck had departed Avenel fully loaded with flour. The driver intended to stop for a short period in a residential area of Benalla. Approaching Benalla the driver had followed the approved B-double route around the township onto the Midland Highway, turning right into Racecourse Road, right into Gillies Street running parallel to the railway line, and finally left into Saleyards Road Level crossing. See appendices 8.4 and 8.5 for details of approved B-double routes in the Benalla area.

At Gillies Road (670 m north of Saleyards level crossing) the truck would have to reduce speed and engage a low gear to turn through 90 degrees onto Gillies Road and start to travel in a southerly direction parallel to the rail track. The B-double having accelerated from the junction with Racecourse Road, would have had to reduce speed and changed down to a low gear to negotiate the turn into Saleyards Road level crossing.

FIGURE 1:
Racecourse Road deviation into Gillies Street

At 1250 special train 8382 collided with the Greenfreight B-double truck while it was on the Saleyards Road level crossing. As a result of the collision, locomotive K183 and tender, carriage DT319 (power supply van) and the leading bogie of carriage BK712 derailed, and one other carriage of train 8382 partially derailed. Locomotive K183 left the tracks on the level crossing and ploughed into soft earth to the left of the level crossing. The locomotive came to rest turned onto its right side and rotated in an anti-clockwise direction by the tender and train.

3.3 Injuries

The driver, fireman, and a footplate visitor on steam locomotive K183 were fatally injured. Another footplate visitor survived the collision and was taken to hospital in a critical condition with severe injuries. None of the passengers suffered physical injuries.

Other than shock, no injuries were reported by the driver of the 'B-double' truck.

3.4 Damage

3.4.1 Damage to the steam train

Locomotive K183 and tender left the tracks and ploughed into soft earth. The momentum from the following carriages rolled the locomotive and tender on their right side, folding the tender and locomotive together causing the tender to come in contact with the backhead of the boiler of K183. The tender also came in contact with the locomotive cab roof forcing the leading edge against the safety valve assembly, shearing the holding bolts and lifting the valve assembly from its mount on the boiler.

FIGURE 2:
Cab roof pushing against safety valve assembly

FIGURE 3:
Damaged mounting studs on boiler

The resulting release of pressure vented steam from the boiler into the atmosphere and the cabin area. A large area of the cabin roof was clean of soot and coal dust, indicating a steam blow entering the cabin, which would have inundated the crew with steam.

FIGURE 4:
Evidence of steam blow in crew cab

The locomotive, K183, and tender were substantially damaged as a result of the collision and subsequent derailment. The motion gear and the cabin of the locomotive were damaged. The boiler was suspected to be damaged. The fusible metal plugs[6] located inside the fire box had partially fused when the water level dropped as a result of the locomotive lying on its side.

6 Fusible metal plugs are a safety device used to protect the boiler from overheating due to low water levels. If the boiler overheats the metal plugs will melt allowing water and steam to extinguish the fire.

FIGURE 5:
Damage to crew cab

The consist of the train was relatively undamaged. The power van DT319, the carriage following the tender, had derailed and sustained body damage on the leading end from the locomotive tender. The passenger carriage after the power supply van, BK712, had derailed a leading bogie, with no visible signs of damage. The remaining carriages, BRS221, BRS225, and WAL951 trailing, were undamaged.

FIGURE 6:
Damage to locomotive K183

3.4.2 Damage To The B-double Truck

The steam locomotive impacted with the last trailer of the B-double. The impact point was in the front half of the last trailer, above the first trailer's tri-axle wheel set. The last trailer received major damage. The first trailer received damage to the tri-axle wheel set. The prime mover was undamaged.

FIGURE 7:
Damage to leading triaxle set

FIGURE 8:
Damage to second trailer

3.4.3 Damage to infrastructure

The collision caused the leading wheel set (pony truck) on the steam locomotive to derail on the level crossing. The wheel set was forced against the gauge face of the rail causing the left wheel to climb over the rail. The force applied to the rail caused the rail to warp or kink, consistent with sudden high lateral flange forces. Approximately 25 m of line was torn from its correct position after the initial point of drop off.

After the recovery process, re-railing commenced, replacing the damaged portion of track including resurfacing of the level crossing.

FIGURE 9:
Damage to infrastructure

3.4.4 Crashworthiness of trains

The accident demonstrated that, in this instance, a set of random circumstances coincided that exposed the train crew to a particular risk.

Under a different set of circumstances the length of the boiler may act as some form of frontal impact protection. But in this case, the movement of the tender into the cabin roof and against the safety valve assembly effectively formed a conduit (or funnel) to project steam into the footplate area when the safety valve holding bolts sheared.

Apart from the power supply van, the rest of the carriages remained upright and undamaged.

3.5 Crew details

3.5.1 Train crew details

The driver of K183 was employed by Freight Australia as a train driver operating from the Melbourne depot. He had been a driver for 22 years, three of those years qualified as a steam driver. The driver had also been a driver trainer for 11 years with Freight Australia.

The fireman of K183 was employed by Pacific National as a driver operating from the Melbourne depot. He had been a driver for 22 years, almost two of those years qualified as a steam fireman. The fireman had previously qualified as a fireman with the Public Transport Corporation (Victoria) about 10 years before joining Pacific National.

Table 1:
Crew details

	Driver K183	*Fireman K183*
Gender	Male	Male
Age	43	45
Classification	Driver	Driver
Medical Status	Medically fit	Medically fit
Training	Current	Current

The driver and fireman of the steam locomotive were declared fit for duty in accordance with the requirements of their fulltime employers, and their fitness was also verified by the Rail Tram and Bus Union (RTBU) and West Coast Railway (WCR) prior to crew rostering. Both the driver and fireman were considered medically fit for duty at the time of the collision and train crew medical factors were not considered to be factors in the collision.

There were two footplate visitors at the time of the accident. The first footplate visitor was a young male who had joined the train at Yarrawonga to travel to Benalla, on an invitation from the driver. He was part of a support crew for the locomotive, responsible for loading coal into the tender from a truck.

The second footplate visitor was a female, who was a staff member working on the train. She had been invited by the fireman to ride on the steam locomotive from Yarrawonga to Benalla.

3.5.2 B-double driver details

The driver of the B-double was a male aged 28 years. The driver was employed by Greenfreight as a permanent employee. The driver had been driving trucks for almost six years in total, three of those years driving B-double trucks.

The driver had grown up in Benalla and family still reside there. At 16 years of age he joined the Benalla State Emergency Service. From the age of 18 he worked with the road rescue team for five years, responding to several road accidents. He was familiar with the Benalla area.

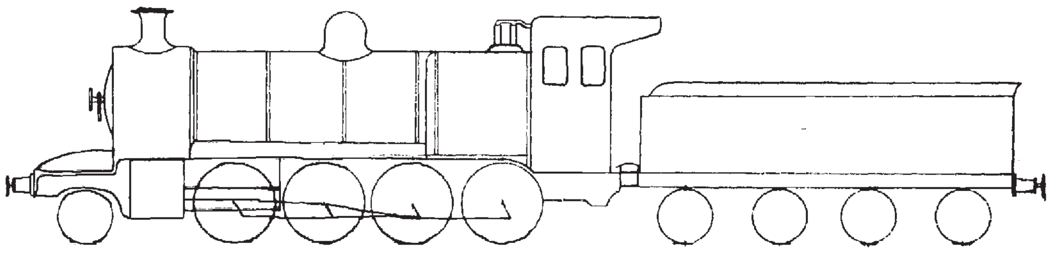
The driver had finished work at 2300 on Saturday 12 October 2002. At about 0830 on Sunday he received a telephone call asking if he could work on his day off. The driver agreed and started work at 0915. He drove from Wodonga to Avenel, swapped trucks, and drove the loaded B-double bulk flour truck back through Benalla, via the approved B-double routes, to the point of collision.

3.6 Train information

Train 8382 was designated as an historic passenger train, hauled by a steam locomotive K183, with passenger carriages.

Locomotive K183 was built in 1943 at Newport Workshops and entered service on 9 September 1943, being allocated to various depots throughout Victoria during its active service. K183 was removed from service in December 1977 and placed on static display in a park near Yarragon railway station until reclaimed by Steamrail in March 1982 for restoration. The locomotive was maintained and operated by Steam Rail Victoria. The registered owner of the locomotive was the State of Victoria, registration K183 and boiler registration number 87-0001. Locomotive K183 was regularly maintained, using a distance and time based assessment, due to the sporadic use of the engine. The most recent inspection conducted on 6 June 2002 certified the locomotive to operate at line speeds of up to 80km/h. The boiler of K183 was certified to operate at its designed pressure of 175PSI[7]. All wheels of the locomotive had been re-profiled during June 2000 and had travelled less than 5000 km since that date.

FIGURE 10:
Schematic of locomotive and tender



Wheel arrangement	2 – 8 – 0 'Consolidation'
Roadworthy weight	104 tons 12 cwt (106.3 tonnes)
Axle load	13 tons 10 cwt (11.8 tonnes)
Operating boiler pressure	175 PSI (1206 kPa[8])
Tractive effort	28,650 lbs (85%) (12995 kilos)
Factor of Adhesion[9]	4.16
Overall length	60' 3 3/8" (over buffers) (18.4 m)
Overall height	13' 8" (4.2 m)
Tender capacity – water	4,200 gals (19,093 litres)
Tender capacity – coal	7.1 tons (6.5 tonnes)
Operating range – water	50-70 miles (80 – 112 km)
Operating range – coal	200 miles (322 km)
Maximum speed	50 mph (80 km/h)

The various carriages were owned, operated, and maintained by WCR. The rolling stock was subjected to regular maintenance regimes with inspections at regular intervals. The carriages utilised on train 8382 were found to be 'fit for traffic'.

The gross tonnage of train 8382 was 230 tonnes with a length of 126 m.

Following the collision access to the driving cab was not possible until the recovery operation lifted the locomotive tender clear and the bodies of the deceased individuals had been removed. At this stage the locomotive independent[10] and train[11] brake handles were found to be in the service position, the regulator (throttle) was found in the closed position and the reverser wheel

7 PSI' denotes pounds per square inch, a unit of pressure.

8 'KPa' denotes kilopascals, a unit of pressure.

9 Factor of adhesion is the ratio of maximum tractive effort, expressed in pounds, to the adhesive weight, also in pounds, of a locomotive. It will usually be about 25% of the adhesive weight for a locomotive with two or four cylinders. The adhesive weight is that part of the locomotive weight carried on the driving wheels which can therefore contribute towards adhesion.

10 Independent brakes operate on the locomotive and tender only.

11 Train brakes operated throughout the train.

was found in the ‘nine inch’ position. The fire box was closed. The headlight switch was found in full or high beam position.

It is therefore probable that when the footplate crew realised that a collision with the B-double was imminent the independent and train brakes had been applied and the steam to the cylinders had been cut off by closing the throttle. Given the position of the reverser wheel, it is therefore probable that the locomotive was under power (lightly steaming) as it approached the level crossing.

The speed recording chart was examined by the investigation team. The chart indicated that the train had accelerated over the previous minutes from 24 mph (38.6 km/h) up to 30 mph (48.2 km/h) at the point of impact. The braking system on the passenger carriages was inspected prior to removal, and found to be functioning correctly. The locomotive was inspected by an independent brake expert. The report notes:

> The driver’s brake valve was examined more closely and it was found to be in good condition with acceptable and correct movement available.
>
> The air brake connections between the tender and the locomotive were examined and found to be in good working order.
>
> The rear of the Locomotive-Tender was then examined where the Main Reservoir and Brake Pipe isolating cocks and connections were found to be in good order. Both of the cocks were in the on position, indicating that the brake pipe connection to the train was correct and would have been operating correctly at the time of the collision.
>
> Due to the collision damage, it was not possible to test the brake handle on Kl83.
>
> Accordingly, the handle was removed from K183 and installed on another Steamrail K-class locomotive, K153, a working locomotive which was stored nearby.
>
> **Static Test**
>
> As the locomotive K153 was not operating, a Y-class diesel locomotive was coupled to it and the air supply from the diesel was connected to the Main Reservoir pipe of K153.
>
> This ensured that the brake equipment operation would be consistent with normal operation, where main reservoir air supply is regulated through the locomotive brake handle to the train brake pipe.
>
> Subsequent testing of the brake handle was then consistent with normal operation.
>
> Brake handle movement and operation was correct and the brake response and timing for charging, application and release were normal.
>
> There was no evidence of air leakage and the brake valve maintained the applied pressure in accordance with brake handle demand.
>
> Operation of the train brake equipment was therefore considered to comply with normal pressures and timings. Brake release on each occasion was correct.
>
> The tests conducted were in accordance with the specified brake maintenance test procedures.
>
> Prior to moving the train on the forward journey to Yarrawonga the driver would have conducted a continuity and function test of the brake systems and would have reported any defects, had any been detected. There is no record of any such report.
>
> At Yarrawonga, where the train terminated, the locomotive and its tender were removed from the train and turned around before coupling to the train for the return trip.
>
> When coupled to the train again, the train brake is then tested again on the day of incident, for continuity of the air supply pipes and for correct operation of the brakes.

The train cannot depart unless the brake operates correctly.

From inspections and tests subsequently conducted on the train following the collision, Brake-Pipe and Main Reservoir pipe continuity were found to be unimpaired and all brake functions of the train, especially in the Emergency brake, were found to be operating correctly.

The condition of the carriages, locomotive, tender, and power supply van prior to the accident was not considered to be a contributing factor in the collision.

3.7 B-double

3.7.1 Truck information

B-double trucks have a maximum length of 25 m with a combined general mass of 62.5 tonnes. The B-double truck was owned and operated by Greenfreight Pty Ltd based in Wodonga. The prime mover was a Kenworth K104, cab over type design, built in October 2000. The trailers were Kockums bulk flower transport trailers. The trailers were fully loaded with flour weighing approximately 62 tonnes combined weight. When loaded the flour would settle half way to the bottom of the trailer. The complete B-double had a length of 25 m. Greenfreight regularly operated B-double flour trucks between Avenel and Blacktown. Drivers tended to drive the same route and three drivers were assigned to each B-double route.

No recorded data was available from the B-double truck to assist in the investigation process.

Make	Kenworth
Model	K104
Engine	CAT C15-455
Max Power	350kW @ 1600 rpm
Max Torque	2237Nm @ 1200 rpm
Transmission	Fuller RTL0209 18B (18 speed)

FIGURE 11:
Schematic of complete B-double

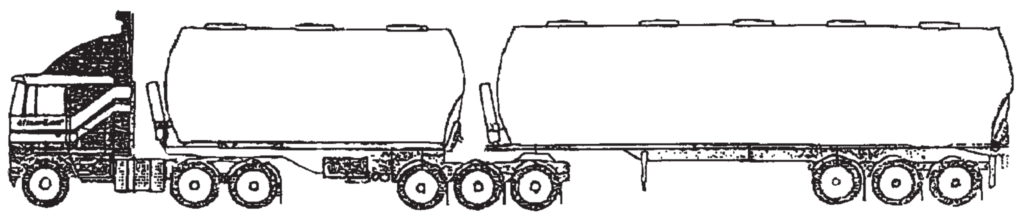


FIGURE 12:
Greenfreight prime mover Kenworth K104 cab-over design

3.7.2 B-Double approved route

Access in Victoria was allowed where B-double vehicles could operate safely with other traffic and where the road infrastructure was suitable. The route followed by the B-double, including Gilles Road and Saleyards Road, is shown as approved in the VicRoads information bulletin *B-double and Higher Mass Limit Trucks, July 2001 (publication number 00170/2)*. An extract is at appendix 8.4.

The driver of the Greenfreight B-double followed the designated B-double route from the Hume Highway to Saleyards Road. This involves traversing Racecourse Road to the Gillies Street junction, turning right into Gillies Street and travelling south for about 580 m, parallel to the railway line, before turning into Saleyards Road.

3.7.3 Saleyards Road level crossing

Railway level crossing protection in Victoria is based upon guidelines contained in the *Australian Standard Manual of uniform traffic control devices (AS1742), Part 7, Railway crossings*. The Standard specifies traffic control devices to be used to control and warn traffic at and in advance of railway crossings. It specified the way in which these devices are to be used to achieve the level of traffic control required for the safety of rail traffic and road users. Requirements and guidance are also given in appendices on the illumination and reflective qualities of signs, on their installation and location, and on selection of the appropriate sign size.

The level of protection is largely dictated by the volume and type of road, pedestrian and rail traffic. Control of road traffic at level crossings is by passive or active road control measures and train operating procedures. Passive control relies mainly on fixed message signs and pavement markings, whereas active control includes train-actuated signalling devices, movable barriers and gates as a train approaches. Both passive and active controls are supplemented by both audible warnings (horns) sounded at whistle boards and visual warnings (headlights) fitted to the trains and used in accordance with railway practice.

Train drivers are required to sound the train whistle when approaching level crossings. A whistle board (white post with white 'X') was provided 400 m on the approach to each level crossing. When the train passes the whistle board the driver is required to sound the train whistle and again when the train is closer to the level crossing.

FIGURE 13:
Picture of whistle board in situ on approach to Saleyards Rd level crossing

The Saleyards Road level crossing is a passive control level crossing. A passive control level crossing is defined by the *Australian Standard 1742, part 7, 1993* as:

> The control of movement of vehicular and 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.

The immediate road approach to the crossing of approximately 35 m is level and perpendicular to the railway line. The crossing is protected by a 'standard treatment', as defined by AS1742 part 7 1993, consisting of 'give way' signage. No holding lines were marked on the road bitumen approaching the railway level crossing to indicate a safe position for vehicles to stop.

At the time of the accident the approach view on the Gillies Street approach was clear with some vegetation on the Benalla side of the level crossing. The approach view from the Saleyards Road (eastern) approach was obscured by vegetation, limiting sighting distance on the Yarrawonga (northern) side of the level crossing to approximately 250 m.

The Saleyards Road level crossing is used relatively frequently by articulated vehicles including B-doubles. An aerial photo (appendix 8.2) shows wheel track marks on the road and dirt shoulder in the vicinity of the Saleyards Road level crossing. This indicated that trucks crossed the railway line from Gillies Street, conducted a U-turn in Saleyards Road, and crossed the railway line to access commercial property on Gillies Street.

3.8 Track and other infrastructure

3.8.1 Track

The Benalla to Yarrawonga line was opened in 1883, the Yarrawonga to Oaklands section opened in March 1938. The broad gauge[12] line is managed by Freight Victoria Limited trading as Freight Australia. The track is 40 kg rail in 74 m straight lengths and 37 m curved lengths. The rail is fastened on timber sleepers by dog spikes and rail anchors.

A number of local residents were interviewed by the investigation team. Their perception of the Yarrawonga – Benalla line was that it is a seasonal line, only operational during the grain harvest season. The railway operators of the line, Freight Australia, indicated that on average there are three train movements on the line per week. Records indicated that the actual train movements in a two month period prior to the accident, over the Benalla – Yarrawonga line, amounted to 20.

The design and condition of track infrastructure was not considered to be a contributing factor to the collision.

3.8.2 History of the Saleyards Road level crossing

Records indicated that one other accident occurred in December 1971. The accident involved a passenger rail motor and a truck carrying sheep. The impact resulted in a ruptured fuel tank on the truck causing a fire to engulf the whole truck. Reports from the accident suggest that the truck was travelling in the same direction (parallel) as the rail motor. The driver of the truck did not see or hear the approaching train.

3.9 Train control

The movement of trains is controlled by a train controller located in Melbourne. The authority for a train movement in the section of line between Benalla – Yarrawonga – Oaklands is a train order system. The section is divided into two sections of train order working, Benalla to Yarrawonga, and Yarrawonga to Oaklands. Benalla and Oaklands is described as train order terminal stations, Yarrawonga is an intermediate train order station.

The object of train order working is to prevent more than one train being in a section at the same time. Trains are not to enter the section unless the driver was in possession of a train order issued by the train controller. To prevent more than one train entering the section the train controller is required to endorse the train control graph with the train order number, issue time, departure time, and exit or clearance time from the section. This method is the primary means of protection to prevent unsafe movements.

The method of train control was not considered to be a contributing factor in the collision.

3.10 Environmental factors

The collision occurred on a mainly fine dry day with an ambient air temperature of 21 degrees Celsius. At the time of the collision the sun had an azimuth[13] of 336 degrees and an elevation[14] of about 59 degrees. Based on the geometry of the track and the time of the collision, the sun

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12 Broad gauge is 1600mm between rails.

13 Azimuth is the horizontal angle from true north.

14 Elevation is the vertical angle above the horizon.

would have been high in the sky. The environmental conditions at the time of the collision were not considered to be factors in the collision.

3.11 Organisational context

3.11.1 Accreditation and audit

The Victorian Rail system operates on the principle of 'co-regulation'. The state regulatory body, the Department of Infrastructure (DOI), accredits rail operators based on the regulator's approval of a company's Safety Management System (SMS).

Steamrail is an accredited rollingstock provider but engaged West Coast Railway, as an accredited operator, to operate the train on railway lines managed by accredited managers of infrastructure.

The SMS is contained in the Steamrail Management Safety Manual (MSM). The MSM is a general safety policy manual which is supported by other more detailed operational documents covering the various areas of operation, which included engineering, maintenance and train operation.

Both West Coast Railway and Steamrail were audited regularly by DOI.

3.11.2 Operating procedures

The special train was operated under the West Coast Rail 'operating procedures'. The train was certified to operate on main lines in accordance with WCR operating procedures. Under these, the train was required to have a conductor and two locomotive crew - a driver and a fireman. A timetable schedule was prepared and a circular advertised by Freight Australia.

3.11.3 Rostering and fatigue management

Qualified train drivers permanently employed by other operators are used to operate heritage trains.

There is an agreement among Steamrail, West Coast Railway, and the Rail Tram and Bus Union Locomotive Division covering the employment of drivers to crew heritage trains. A record of the driver's current medical status and qualifications is kept on file by the RTBU and WCR. Details of an upcoming heritage special train are given to the RTBU, and a driver selected according to availability and required knowledge, experience, and qualifications. Drivers in the Victorian rail network, who wish to do so, 'express an interest' to the RTBU to drive heritage trains.

Only appropriately qualified drivers that are rostered off duty by their primary employer are considered for the secondary heritage duty. Both primary employers of the locomotive crew on K183, Pacific National and Freight Australia, use a fatigue management system in rostering staff. Extra duties carried out on rostered days off duty are not considered when rostering for primary duties. It is the responsibility of the locomotive staff and RTBU rostering staff to adhere to minimum rest break periods. The RTBU, however does not have a system of managing hours for drivers of heritage or special interest group trains, their fitness in terms of fatigue management is assessed on their duties before being assigned to 'special train' driving.

Both drivers had been rostered off duty for several days by their primary employers.

Train crew fatigue is not considered to be a contributing factor in the collision. They observed their compulsory rest time between arriving and departing Yarrawonga, although, the train driver did contact Control to obtain the track authority at 0948. However, fatigue management by the RTBU for secondary employment requires review.

3.11.4 Qualifications and training

Locomotive drivers used to staff heritage trains were required to have a minimum of five years locomotive driving experience, a Workcare Steam Certificate (boiler certification), to have passed a theory course in steam locomotive operations, route knowledge, and to have been assessed as competent by an 'on-the-job' trainer. Locomotive firemen (2nd person) were also required to have locomotive experience, Workcare Steam Certificate (boiler certification), and to have completed a bridging training course.

The majority of qualifications were obtained through the employees' primary employing organisation and verified by heritage operators. Any shortfall in training, such as steam qualifications, was met by the heritage operator.

Re-assessment of specific heritage train qualifications was conducted on a three yearly cycle, or every six months if the crew had not used an individual qualification in that time.

Both the driver and fireman held current, valid qualifications at the time of the accident.

3.12 Emergency response

Emergency services attended soon after the collision. A number of 8382 passengers had called '000' to request assistance. Victoria Police, Country Fire Authority, State Emergency Service, and Ambulance service personnel all responded from Benalla township. The site was initially controlled by local Police until Police from the Major Collision Investigation Unit attended and assumed command.

A Steamrail mechanical fitter was travelling with the train. The mechanical fitter was able to inspect the locomotive and advise emergency services of any hazards. Emergency services were then able to perform their duties.

4 ANALYSIS

4.1 Introduction

The driver of the B-double did not give way to train 8382 as the train approached and entered Saleyards Road level crossing. The driver stated that he was first aware of the train when the B-double cab was crossing the tracks.

A number of safeguards (defences) in the rail and road system are designed to prevent such accidents. Factors that are considered relevant to this accident include:

- B-double approved routes;
- Railway level crossing protection;
- Conspicuity of the locomotive and tender;
- The number of people on the locomotive footplate; and
- Observance of road rules.

4.2 B-double approved route

4.2.1 Risk management

B-double routes are designated roads gazetted for use by appropriate vehicles.

The local council, Benalla Rural City Council, has the responsibility to assess the risk associated with supporting applications for proposed B-double routes on local roads within the council area. Such local roads include Saleyards Road, Gillies Street, Racecourse Road and the Northern Bypass Road. The risk assessment includes factors such as road and rail traffic volume, pedestrian use, road and track alignment and the distance that trains can be seen from the road approaching and at the crossing.

It is apparent that at the time of the accident, the risk assessment did not include an allowance for heavy goods vehicle size (particularly length) and acceleration from slow speeds and from stop.

4.3 Railway level crossing protection

4.3.1 Introduction

Level crossings pose a certain level of risk to both rail and road traffic. Trains, depending on their size and inertia, have a much greater stopping distance than a road vehicle. The emphasis at level crossings is therefore to manage the road traffic to detect an approaching train. The *Australian Road Rules – Road Traffic Act December 1999* states that 'a driver at a level crossing with a give way sign or give way line must give way to any train or tram on, approaching or entering the crossing'. A railway level crossing protected by a give way sign relies upon the road vehicle driver detecting the presence of an approaching train. Give way signs are ineffective if the road vehicle driver does not detect the presence of an approaching train.

When arriving at a passive level crossing the driver of any vehicle can only proceed across the track safely if he/she is certain that there is no train in the proximity. At a 'give way' this knowledge depends on having seen the train as the crossing is approached or by stopping and looking along the track in both directions. The distance that a driver can see along the rails must be sufficient so that, if a train is just out of view, the vehicle has sufficient time to cross and clear the track before any approaching train could cover the 'sighting distance'[15]. The sighting distance is a function of permissible train speed and an assessment of the time for any given vehicle to cross the rail corridor.

For very practical reasons the onus is on the vehicle driver to assess whether or not it is safe to cross. There are, however, a number of factors relating to the road vehicle that include but are not limited to:

- the angle of the vehicle with the rail track;
- the field of visibility from the driving position;
- acceleration of the vehicle;
- the variability in reaction time and driving style between individuals; and
- the length of the vehicle.

The visibility looking to the left from the driver's position in the cab of a heavy goods vehicle is somewhat limited at angles over 90 degrees from directly ahead. Even drawing up at a slight angle to the perpendicular can affect the visibility significantly.

The Victorian Government has a Level Crossings Upgrade Program for upgrading level crossings, in which it invests up to $3 million a year. The program is managed by the Victorian Level Crossing Committee, comprising the Public Transport Division, VicRoads and VicTrack in liaison with rail operators. Priorities for upgrading level crossings is determined on a risk management basis that looked at the volume of road and rail traffic, pedestrian use, the crossing's crash history, visibility for motorists and train drivers, the number of rail tracks at the crossing and the cost of the upgrade. However, risk management does not consider the variety of road or rail traffic using the crossings, such as B-doubles and steam trains.

4.3.2 Saleyards Road level crossing

The Saleyards Road level crossing services commercial premises on Saleyards Road. In addition there is a heavy haulage depot just to the west of Gilles Street, opposite the Saleyard level crossing. Vehicles from the depot use the crossing regularly, as indicated in appendix 8.2.

The permissible line speed for trains is 80 kph and, depending on the growth of vegetation the northern sighting distance when stopped 3.5 m from the centre of the rails from an eastern road approach is about 250 m. A train 251m from the crossing travelling at line speed would cover the distance in 11.29 seconds. A heavy vehicle would have, at the barest minimum, 11 seconds to react (assess) and accelerate over a distance of 33.6 m from a stopped position. Based on figures from the United States Federal Aviation Administration (FAA) advisory circular[16], reaction time should be assessed as being in the order of 6.5 seconds.

The sighting distance from a western road approach on the Saleyards Road level crossing is mostly unrestricted in the northern direction.

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15 Sighting distance. There are various definitions of sighting distance. For the purposes of this report it is the 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 is first able to see an approaching train.

16 FAA advisory circular 90-48C *Pilot's role in collision avoidance*.

The type of control used at a railway level crossing generally depended upon the requirements of individual locations taking into account pedestrian and traffic volume, and the distance a road vehicle driver is able to first sight an approaching train.

The visibility looking to the left from the driver's position in the cab of a heavy goods vehicle is somewhat limited at angles over 90 degrees from directly ahead. Even drawing up at a slight angle to the perpendicular can affect the visibility significantly.

Generally drivers of B-double trucks, due to the cab design restrictions of the cab, are only able to see slightly behind a right angle to the left in direction of travel. Additionally, the field of vision from the side mirrors would also have been restricted to the following trailers. With this limited field of view, it is estimated that based on the turning radius and the direction of travel of a B-double truck, truck drivers may only be able to see 40 m of track to the north turning into the Saleyards Road level crossing from Gillies Street. With the B-double truck turning in towards the level crossing, train 8382 was approximately 160 m north of Saleyards Road level crossing and could have been closing at closing at 13.33 m/s (Note: the closing speed could have been as much as 22.22 m/s).

In this case the sighting distance is not a consideration. It is not possible to state categorically that the B-double driver did not look, but he stated he did not see the train until the last seconds before impact.

However, in general terms the permissible train line speed at 80 km/h, the sighting distance to the north from an eastern road approach to Saleyards Road level crossing allows 11 seconds for a vehicle driver to assess whether a train is in sight and to cross the rail corridor.

4.4 Conspicuity of the engine and tender

4.4.1 Visual conspicuity

Locomotive K183, and tender, were finished with a dark navy blue paint. The smoke box and funnel were finished in matt black. At the front of the locomotive there was a large headlight with a high and low beam, and a mirror reflector. The high beam bulb was rated at 250 watts at 32 volts. The diameter of the headlight was about 45 cm. At the time of the collision it was established that the headlight was on high beam. The globe from the headlight was inspected and found to be operational. Either side of the headlight were the locomotive numbers with an illuminated white background. Either side at the front of the locomotive were white marker lights. On this occasion an organisational name plaque was mounted at the front of the train, above the train buffers, with white lettering approximately 30 cm high on a black background.

The operation of steam locomotives is sufficiently unusual for the presence of a train not to be lost in a 'routine background'.

Given the locomotive's speed and steady acceleration, together with the position of the controls, it is probable that the locomotive would have been exhausting steam and smoke from the funnel. Both would add to the conspicuity of the train.

FIGURE 14:
Enthusiast photographs of locomotive K183

The National Transportation Safety Board of the United States of America (NTSB) in a Safety Study[17] discussed whether the driver of a road vehicle expects to see a train when approaching a railway level crossing. An excerpt from that study noted that:

> One factor that can affect whether a driver looks for a train is the driver's expectation of seeing a train. The driver's perception that a train is not likely to be at the crossing is

17 NTSB Safety Study PB98-917004.

> reinforced each time that driver passes the crossing without seeing a train. Researchers have reported that a driver's response to a potential hazard is a function of both the perceived probability of the adverse event occurring and of the driver's understanding of the severity of the consequence of the event. A person's perception of the probability of a given event is strongly influenced by past experience, and the frequency with which the driver encounters a train at a crossing will influence the likelihood of that driver stopping.

Maurino, Reason et al (1995) discuss the propensity for individuals to experience skill-based slips and lapses, slips in attention and perceptual errors while undertaking well-practiced, familiar and largely automatic tasks, 'with only intermittent checks on progress by conscious attention'.

> Attentional slips in which we fail to monitor the progress of our routine actions at some critical choice point, often following a change in either our routine or the surrounding circumstances. The upshot is that we do what is customary or habitual in those circumstances rather than what was then intended.
>
> Perceptual errors in which we misrecognize some object or situation. Here, expectation and habit play a large part. Many train accidents, for example, have been due to the driver expecting (on the basis of past experience) to see a green signal, whereas the actual signal was red.[18]

Doing routine jobs in an automatic state releases the mind to be elsewhere (Reason 1990).

A number of reports[19] had tested various methods to improve train conspicuity. The results of such reports have been inconclusive, although the fitting of ditch (fog) lights has been recommended and generally adopted by the industry. Visual conspicuity, in this instance, was not considered to be a contributing factor in the collision.

4.4.2 Audible conspicuity

The locomotive whistle was operational on K183. The whistle was a five chime whistle mounted directly to the boiler. The whistle operated on the boiler steam pressure. Evidence from witnesses is that the locomotive driver sounded the locomotive's steam whistle approaching the crossing as required by safeworking procedures. After the accident a decision was taken by the investigation team that to test the whistle on another "K" class locomotive would be inaccurate and/or misleading, considering boiler pressure and the acoustic environment.

The issue of whether a truck driver can hear a train horn is relevant. Ambient noise levels from the engine and transmission of a B-double truck may play a role in 'masking' a train horn. Further, truck drivers may hear the train whistle, but this information may not enter their consciousness.

As an example, an investigation[20] conducted by the NTSB involving a school bus level crossing collision indicated that the locomotive's horn could not be heard by the bus driver until the train was less than 100 feet (30.4 m) from the bus. An appendix[21] to a NTSB Safety Study investigated train horn audibility further. The appendix reads:

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18 Maurino, D., Reason, J., Johnston, N. and Lee R; (1995), Beyond Aviation Human Factors, Ashgate Publishing, Aldershot.

19 ATSB report CR217 Prospects for improving the conspicuity of trains at passive railway crossings; VicRoads internal report (untitled) 1991; Austroads report AP-R208 Reducing collisions at passive railway level crossing in Australia.

20 NTSB highway accident report NTSB/HAR-96/02.

21 NTSB Safety Study PB98-917004, appendix F.

Appendix F

Supplemental Investigationon Train Horn Audibility

In December 1996, the Safety Board, in cooperation with Oklahoma Operation Lifesaver, the Oklahoma Department of Transportation, and Burlington Northern Santa Fe Railroad, conducted tests in Oklahoma City, Oklahoma, to determine the audibility of a train horn within 13 different passenger and emergency vehicles representing the current generation of highway vehicles. Testing was conducted according to the specifications established in American National Standard S12.18–1994,[1] using a Bruel & Kaer audiometer type 2232, a sound level calibrator type 4230, and a 1-inch wind screen. The test horn, a three-chime Leslie horn, was mounted on a locomotive positioned 100 feet from the test vehicles, and had a sound level of 96 dB(A)[2] at 100 feet from the source, as required by the FRA's regulations. The Safety Board measured (1) the insertion loss for each highway vehicle,[3] (2) the audibility of the train horn with the highway vehicle engine idling, and (3) the audibility of the train horn with the highway vehicle engine idling and the air conditioning fan on the "high" setting. Testing showed a maximum insertion loss of 33 dB, in a 1986 Chevrolet Corvette, and a minimum insertion loss of 17 dB, in a 1986 Freightliner cab-over tractor (table F–1). Safety Board measurements determined that in one test vehicle (a 1997 Thomas/Ford school bus) the sound level of the train horn was not audible above the noise level of the idling engine. In seven test vehicles, the sound level was not audible above the idling engine and fan noise. In no test vehicle that had both the engine idling and the fan operating did the train horn provide the 10 dB above ambient noise level necessary to 'alert' a motorist to the train (table F–2). Because the ambient noise levels within a highway vehicle increase with additional noise from sources such as road surface texture, radio use, environment and conversations within the vehicle, the levels in the Safety Board's tests are an underestimation of the interior noise levels that occur in everyday driving.

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1 Acoustical Society of America. 1994. Procedures for outdoor measurement of sound pressure level. American National Standard ANSI S12.18-1994. New York, NY: American National Standards Institute. 18p.

2 There are different scales by which to measure sound levels; '(A)' denotes the decibel scale by which human hearing is measured. As used in the report and in this appendix, the levels are assumed to be measured by this scale.

3 Insertion loss is the difference between the measured values of a sound from an exterior sound source taken outside the highway vehicle and inside the vehicle.

Table F–1.
Insertion loss from vehicle shell of current generation highway vehicles.[a]

Highway vehicle	Insertion loss (decibels)
1986 Freightliner cab-over truck-tractor	17
1996 Freightliner conventional truck-tractor	18
1996 Thomas/International school bus	21
American La France fire truck	21
1994 Dodge Ram 1500 pickup truck	26
1990 Ford F-350 ambulance	27
1997 Thomas/Ford school bus	27
1978 TMC Crusader coach bus	28
1991 Chevrolet Lumina	28
1996 Ford F-250 diesel pickup truck	28
1987 Mercedes 300 SDL turbo	29
1995 Oldsmobile Achieva	32
1986 Chevrolet Corvette	33

(a) Insertion loss is the difference between the measured values of a sound from an exterior sound source taken outside the highway vehicle and inside the vehicle.

Table F–2.
Noise level of a 96-decibel train horn measured in the interior of current generation highway vehicles 100 feet (30.4 metres) from the train horn.

In decibels

Highway vehicle	In vehicle interior with windows closed	In vehicle interior with windows closed and engine idling	In vehicle interior with windows closed, engine idling, and fan running
1986 Freightliner cab-over truck-tractor	79	10	8
1996 Freightliner conventional truck-tractor	78	12	7
1996 Thomas/International school bus	75	11	-2
American La France fire truck	75	5	0
1994 Dodge Ram 1500 pickup truck	70	25	4
1990 Ford F-350 ambulance	69	8	4
1997 Thomas/Ford school bus	69	-2	-11
1978 TMC Crusader coach bus	68	8	-1
1991 Chevrolet Lumina	68	21	1
1996 Ford F-250 diesel pickup truck	68	12	2
1987 Mercedes 300 SDL turbo	67	14	0
1995 Oldsmobile Achieva	64	17	-2
1986 Chevrolet Corvette	63	1	-3

In this study a 1986 Freightliner cab-over truck tractor was tested. This type of truck is indicative and similar in design to B-doubles that use the Saleyards Road level crossing. The results of the test suggest that 8–10 decibels actually penetrated the vehicle and internal ambient noise. The NTSB Safety Study indicated that the threshold for 'alerting' a motorist is 10dB above ambient noise levels.

4.5 Number of people on the locomotive footplate

There is no evidence to suggest that the number of people on the footplate contributed to the factors that collectively contributed to the collision. The number, however, did result in extra people being put at high risk.

Operating procedures allow a maximum of four people (including crew) at any one time to ride on the locomotive footplate. The number therefore conformed to the West Coast Railway accredited operating procedures.

It would be a great pity to limit the numbers of persons allowed on the footplate of historic steam trains. Given the vulnerability of the footplate in the event of a speed derailment, however, a review of the procedures would provide an objective basis for determining the maximum number allowed on the footplate.

5 CONCLUSIONS

5.1 Findings

1. Train 8382 was travelling at 30 mph (48 km/h) immediately prior to the collision with the B double truck.
2. The brakes on train 8382 and locomotive K183 had been applied.
3. The regulator/throttle lever in locomotive K183 was in the closed position.
4. The locomotive and carriages of train 8382 were fit for travel.
5. Train 8382 had the appropriate authority to travel between Yarrawonga and Benalla.
6. The driver and fireman were qualified and medically fit for duty.
7. Both drivers were rostered off duty by their primary employers.
8. There was no fatigue management liaison between the RTBU and primary employers of train drivers for heritage train operations.
9. The locomotive K183 headlight was on high (full) beam.
10. The locomotive K183 whistle was functioning and was used approaching Saleyards Road level crossing.
11. The fusible boiler plugs in locomotive K183 had partially fused.
12. The locomotive roof had pushed against the safety valve assembly causing steam to release to atmosphere inundating the crew cab.
13. There were two crew members and two footplate visitors on locomotive K183 at the time of the collision.
14. The number of people on the footplate did not exceed the permitted number.
15. Three people from the locomotive of train 8382 were fatally injured.
16. One person from the locomotive of train 8382 was seriously injured.
17. In the event of an accident affecting the locomotive, steam trains have identifiable risks associated with steam under pressure. This poses different and greater risk to people on the 'footplate' from those in a diesel or electric train cab.
18. The Saleyards Road railway level crossing is a passive level crossing in accordance with Australian Standard 1742 part 7. However, no holding lines were marked on the road bitumen to indicate a safe position for road vehicles to stop.
19. The eastern road approach to Saleyards Road railway level sighting distance to the north, based on a line speed of 80 kph, provides minimal time for a heavy goods vehicle to cross the rail corridor.
20. The design of B-double cabs inhibits sighting distances to the left at angle approaches to level crossings.
21. Community perception was that the railway line is rarely used outside grain harvest season.
22. Australian Standard AS1742 part 7 does not take the type of vehicle into account.

5.2 Significant Factors

1. The Greenfreight B-double truck driver did not 'give way' to the approaching train, resulting in a collision and derailment.
2. Given the circumstances of the collision on 13 October 2002, no action by the train crew could have avoided the collision.

6 RECOMMENDED SAFETY ACTIONS AND SAFETY ACTIONS INITIATED

6.1 Recommended Safety Actions

6.1.1 The Victorian Department of Infrastructure

RR20020014
Arrange for a review of risk methodology for railway level crossing protection treatment levels on B-double approved routes, including line markings and signage.

RR20020015
Monitor the review of procedures for varying level crossing protection when local factors change, such as traffic flow and type, speed, and vegetation.

RR20020016
Monitor the review of the number of steam locomotive footplate visitors allowed.

6.1.2 VicRoads

RR20020017
Review all existing railway level crossing protection treatment levels on B-double approved routes, including line markings and signage.

RR20020018
Develop community education programmes on the use and dangers of railway level crossings.

RR20020019
Review procedures for varying level crossing protection when local factors change, such as traffic flow and type, speed, and vegetation.

RR20020020
Actively involve the railway industry with level crossing safety issues.

6.1.3 Benalla Rural City Council

RR20020021
Review all existing railway level crossing protection treatment levels on B-double approved routes, including line markings and signage, in particular the Saleyards Road level crossing.

RR20020022
Develop community education programmes on the use and dangers of railway level crossings.

RR20020023
Review procedures for varying level crossing protection when local factors change, such as traffic flow and type, speed, and vegetation.

RR20020024
Actively involve the railway industry with level crossing safety issues.

RR20020025
Review the B-double route on the Racecourse Road, Gillies Street, and Saleyards Road level crossing.

6.1.4 Freight Australia

RR20020026
Monitor the review of all existing railway level crossing protection treatment levels on B-double approved routes, including line markings and signage.

6.1.5 West Coast Railway

RR20020027
Review the number of footplate visitors allowed at any one time whilst the locomotive is in motion.

6.1.6 Rail Tram and Bus Union

RR20020028
Review the fatigue management process applied to crew rostering for special trains, particularly crews in secondary employment.

6.1.7 Standards Association of Australia

RR20020029
Review AS1742 part 7, with consideration to long and heavy vehicles such as B-doubles and increasing risks associated with these vehicles.

6.1.8 Victorian Level Crossing Committee

RR20020030
In conjunction with relevant authorities review all existing railway level crossing protection treatment levels on B-double approved routes, including line markings and signage, in particular the Saleyards Road level crossing.

RR20020031
Pursue a more cost effective method of upgrading railway level crossings to provide active protection with no negative impact on safety.

6.2 Safety Actions already initiated

6.2.1 The Victorian Department of Infrastructure

The Victorian Department of Infrastructure has advised that;

> At present a national risk assessment model is being developed for rail level crossings. Victoria is party to the development of that model. The model was published on 25 May 2004 and is in the process of undergoing triale (sic) in Victoria.

6.2.2 VicRoads

VicRoads has advised that;

> In view of the findings and recommendations in the earlier draft ATSB report, VicRoads has initiated a review of all passive rail crossings in Victoria to ensure compliance with AS1742.7, with particular attention given to those that are on B-double route. The review, in conjunction with Local Government, includes a review of the suitability for B-doubles of all passive rail crossings on B-double routes…
>
> VicRoads procedures are comprehensive, and include visual inspection, rating (according to traffic volume, crash history, cost/benefit analysis), and Committee review. Notwithstanding the limited options that exist for varying level crossing protection (being limited to active, passive and grade separation treatments), VicRoads is actively involved in considering alternative means of assessment. For example, it currently trialling aspects of a Queensland model for rail level crossing assessment, known as the Australian Level Crossing Assessment Model 'Alcam'…
>
> VicRoads staff have also reviewed the crossing, and I am advised that they are satisfied with this route as a B-double route.

7 SUBMISSIONS

7.1 The Victorian Department of Infrastructure

The Department Of Infrastructure made a number of comments and observations on the draft report issued to directly involved parties. The comments and observations have been incorporated into the body of the report.

7.2 VicRoads

VicRoads made a number of comments and observations on the draft report issued to directly involved parties. The comments and observations have largely been incorporated into the body of the report.

Additionally VicRoads has advised;

> Local Government has responsibility for the management of local roads, including traffic management. However, VicRoads has the regulatory power, by virtue of Regulations 510 and 512 and Clause 11 of Schedule 2 to the Road Safety (Vehicles) Regulations 1999 (RSVR), to approve the use of roads (including those managed by Local Government) by B-doubles, either through the issue of a permit or a notice in the Victoria Government Gazette (VGG). In view of the management responsibility of Local Government, VicRoads seeks the consent of the relevant municipality for the use of a local road by B-doubles, before granting a permit or issuing a notice in the VGG…
>
> Northern Bypass Road and Saleyards Road are both local roads. In this case, the relevant municipality asked VicRoads to gazette the Northern Bypass Road as an approved B-double route… In regard to Saleyards Road, a transport operator has provided VicRoads with written support from the relevant municipality for use of Saleyards Road by B-doubles… Communication has occurred between the municipality and VicRoads, regarding gazetting Saleyards Road. However, no correspondence has been located…
>
> VicRoads is responsible for funding and approving the program of local Community Road Safety Councils which function independently. The Councils, which consist of local stakeholders, including community groups, local government, police and VicRoads, consider and take action on local road safety issues. VicRoads' North Eastern Region advises me that the Council has not raised the Saleyards Road railway crossing as an issue in recent times, and is not aware of it being raised in the past.
>
> As stated… formal mechanisms do exist and VicRoads is active in regard to road related safety issues including issues at rail level crossings. VicRoads, through its Road Safety Department, also considers issues raised through correspondence from other road users and train drivers in respect to rail crossing issues. VicRoads is actively involved in a number of road/rail safety committees and like initiatives.

7.3 West Coast Railway

West Coast Railway made a number of comments and observations on the draft report issued to directly involved parties. The comments and observations have largely been incorporated into the body of the report.

Additionally West Coast Railway has commented;

> My comments are that this particular accident indicated the vulnerability of the steam locomotive in this accident because of a soft drain beside the track. Therefore my submission is that the comment on Page 17 needs to be amended to particularise this

accident because if any one of the elements leading to the collision and derailment were eliminated the catastrophic result may not have occurred. There is little history of accidents like this with a result like this. Drivers of diesels and electric trains have different exposures that may be catastrophic and that there are examples of this to be found…

Saleyards Road Level Crossing, Page 32 (5th paragraph) relates to the distance from the turn at Race Course Road to the point of impact and the following paragraphs examine the truck drivers limitations and contains conjecture about his driving behaviour in approaching the crossing. No reference is made to a possibility or conjecture that the driver may have known the train was present and that he tried to beat the train at this particular crossing as he approached from the west side which was clear vision. The limitations referred to in the paragraph may have not influenced what occurred at all and it could be argued any references to behaviour in the report is conjecture should not be included in the report…

Referenced to the example test of the USA, I would submit is irrelevant and be excluded from the report because it does not relate to any facts in this case…

7.4 Steamrail Victoria Inc

Steamrail Victoria Inc made a number of comments and observations on the draft report issued to directly involved parties. The comments and observations have largely been incorporated into the body of the report.

Additionally Steamrail has commented;

We question the relevance of the mention of the number of footplate visitors. There is no indication in the report that the number of footplate visitors affected the outcome of the accident…

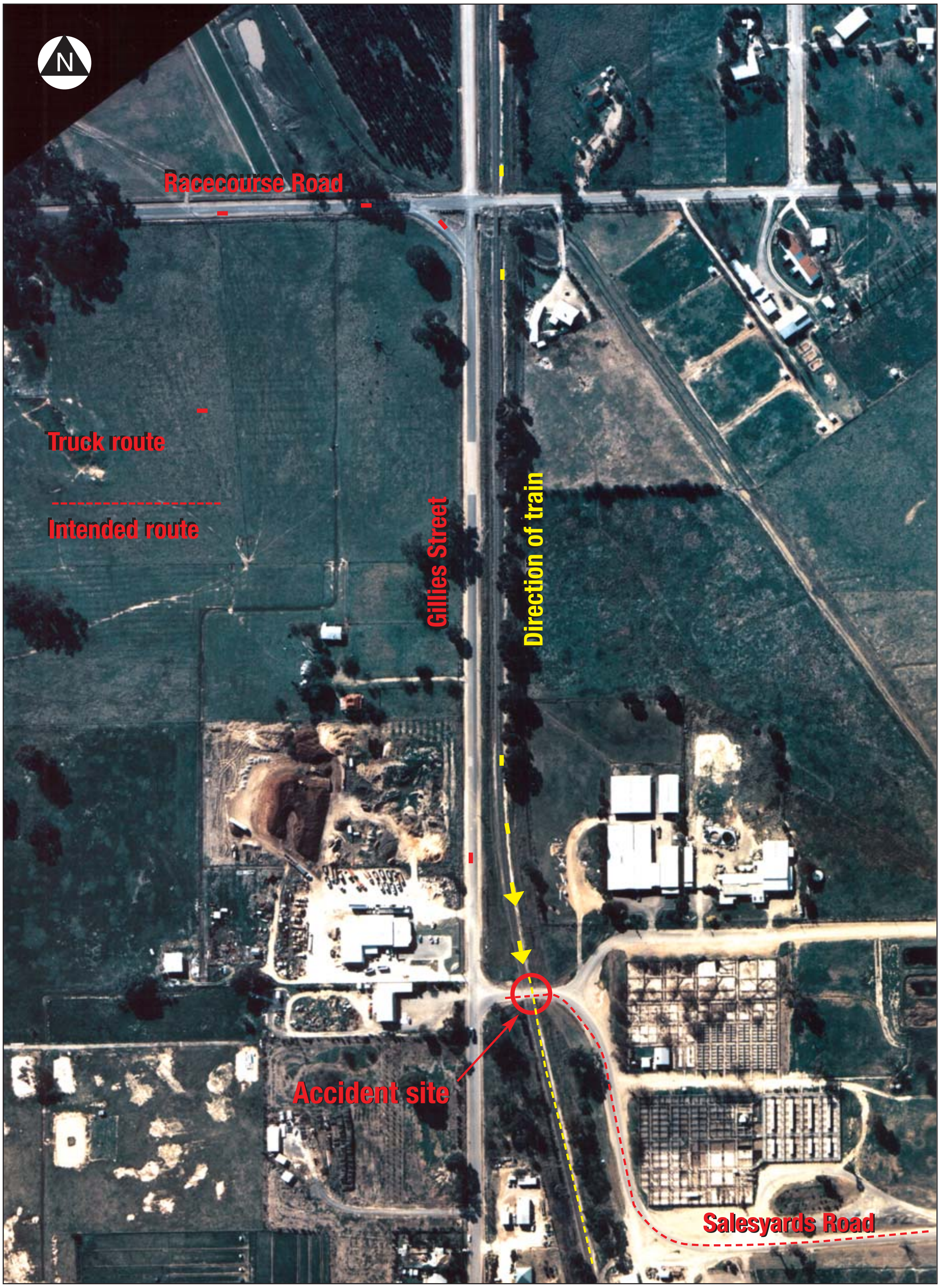
It should be noted that many diesel and electric trains have driving cabins at the front of the locomotive. Under some circumstances, this can lead to a greater risk to crews in the event of a collision than with a cabin in the middle of the locomotive. We therefore believe the risk is different but not greater…

Given the train was travelling (sic) at 48kp/h at the time of the collision and that the train was only scheduled for a maximum of 65kp/h (sic) on the Yarrawonga-Benalla section of track, it is extremely misleading to use 80kp/h (sic) as the quoted sighting distance example. While this speed is theoretically possible, it was not the speed at the time of the collision. Based on Table 3, the sighting distance required by the truck would have been 229m. Given that the crossing is only 1 km from the stop board at Benalla yard, it is highly unlikely that any train travels at 80kp/h (sic) across this crossing…

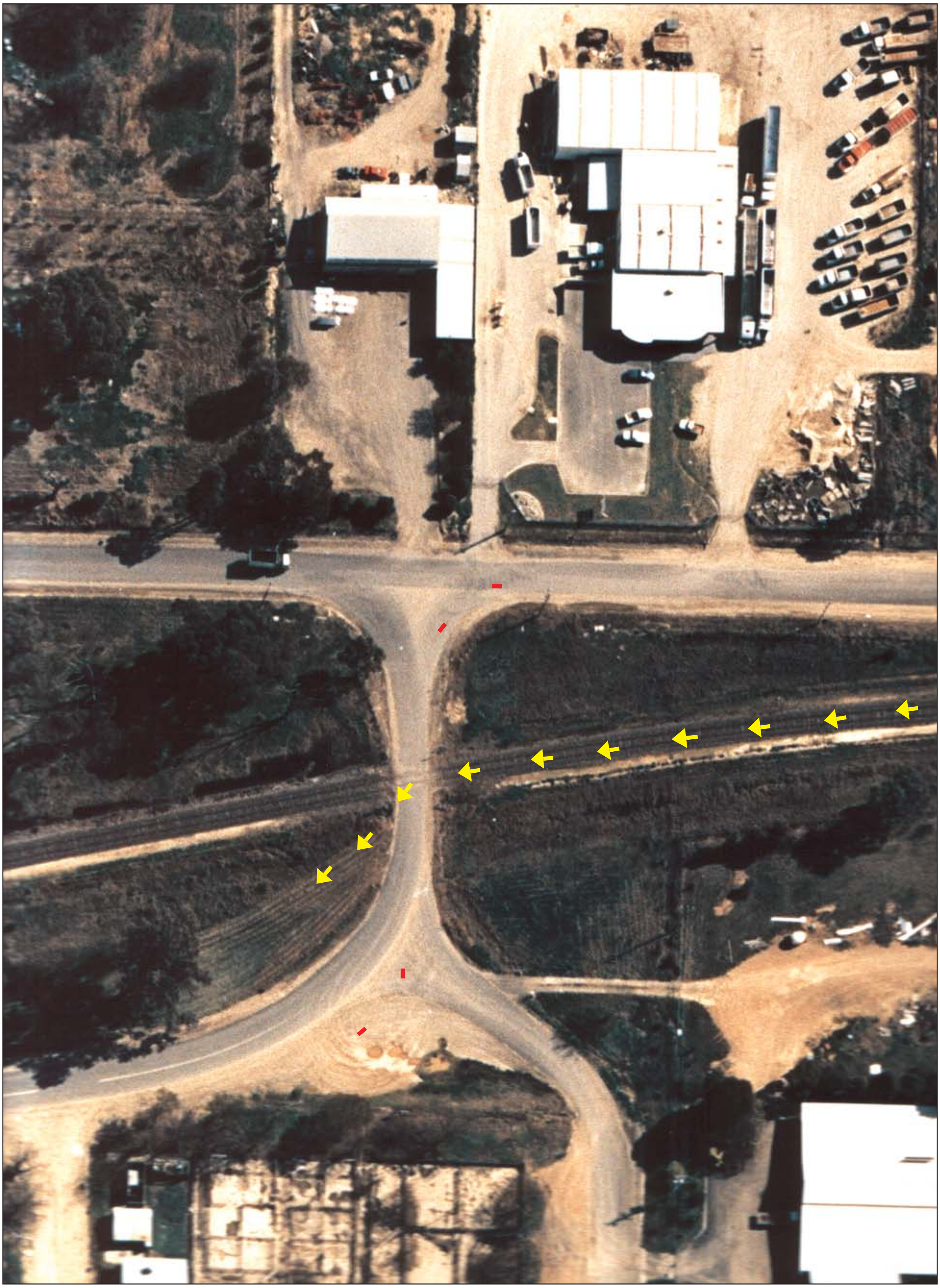
The use of the American report into train horn audibility is irrelevant as the whistle type on K183 is significantly different from that used in the report. Steamrail has two other K class locomotives running the same boiler pressure and would welcome the testing of the noise level of these whistles. We do not believe that a conclusion can be drawn based on the current evidence…

8 APPENDICES

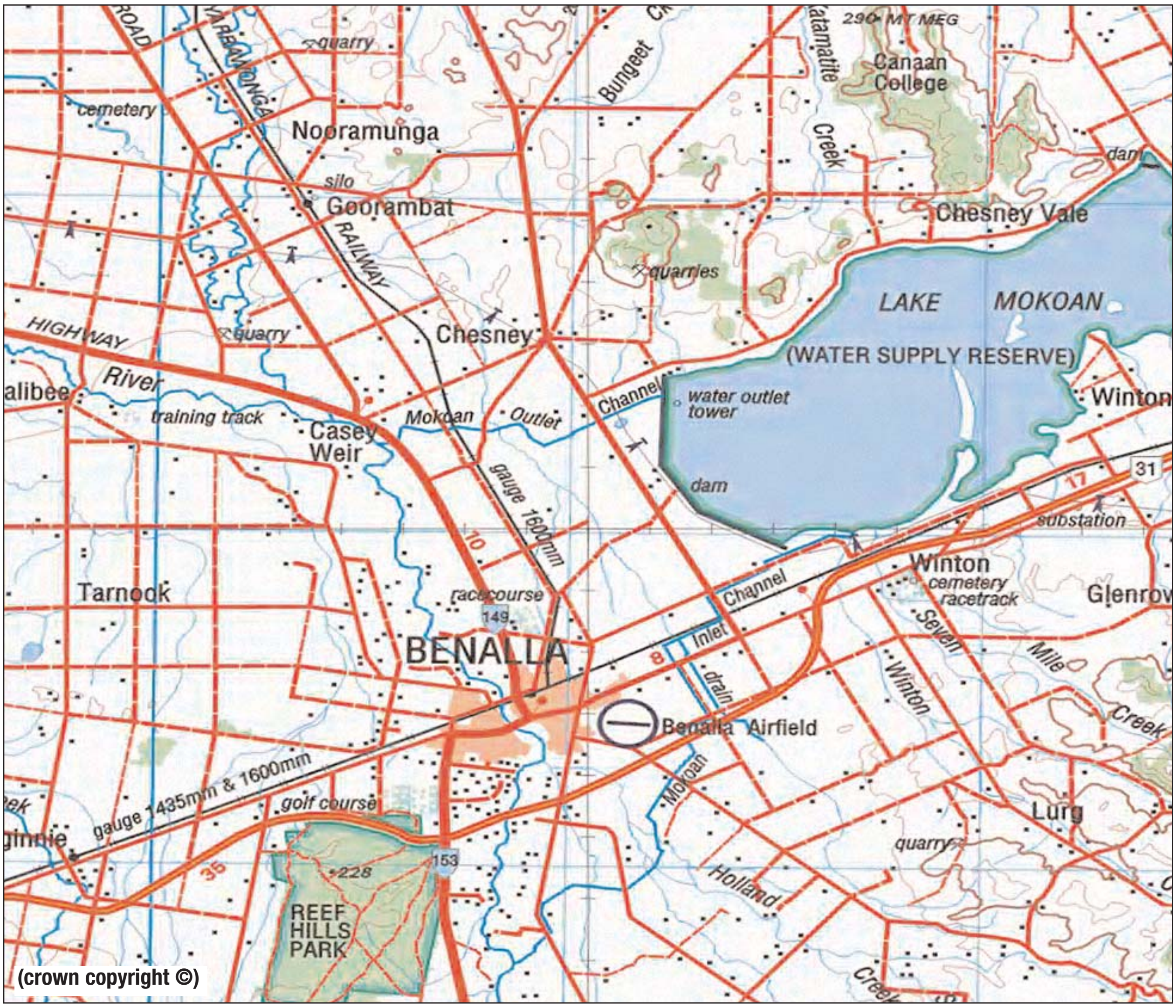
8.1 Accident site overview



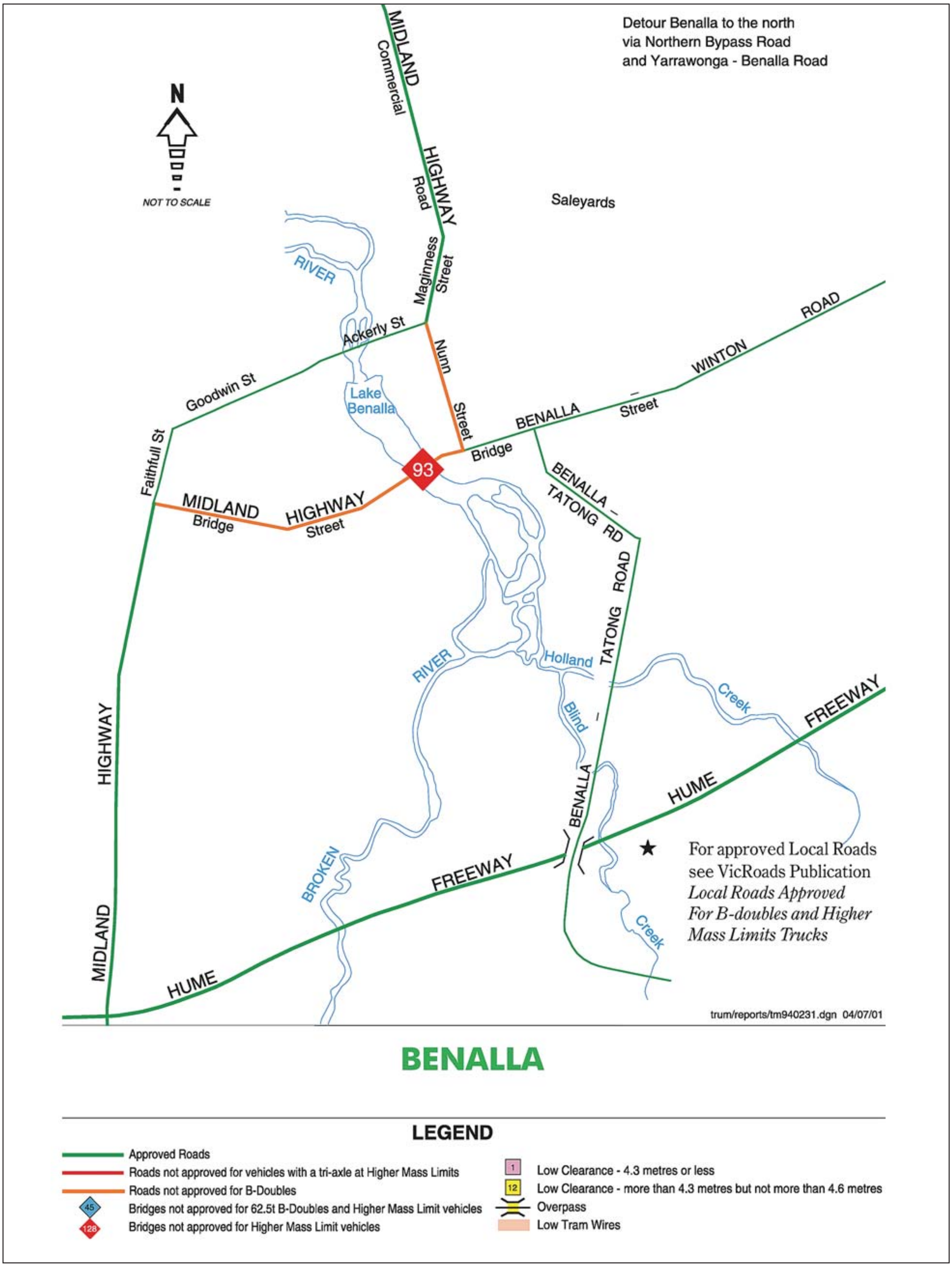
8.2 Accident Site



8.3 Benalla Region Map



8.4 B-double route map for Benalla area(from VicRoads B-doubles and higher mass limits trucks - July 2001, publication number 00170/2)



8.5 Local roads approved for B-double use in Benalla

(from VicRoads - Local roads approved for B-doubles and higher mass limits trucks - July 2001, publication number 00794)

BENALLA (VSD Map 309)

Ackerly Avenue

Baddaginnie-Benalla Road

Faithful Street

Firth Street

Gillies Street

Goodwin Street

Old Thoona Road

Northern Bypass Road

Racecourse Road

Saleyards Road

Samaria Road between Benalla-Winton Road and Kilfeera Road

Witt Street between Benalla-Winton Road and Saleyards Road

Level Crossing Collision Between Steam Passenger Train 8382 and Loaded B-double Truck

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