Final report RO-2017-105: Collision between freight Train 353 and heavy motor vehicle, Lambert Road level crossing, near Kawerau, 6 October 2017

# Final Report

Rail inquiry RO-2017-105
Collision between freight Train 353 and heavy motor vehicle

Lambert Road level crossing, near Kawerau

6 October 2017

Approved for publication: December 2018

# Transport Accident Investigation Commission

## About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (Commission) is a standing commission of inquiry and an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector and the public, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

## Commissioners

| | |
|---|---|
| Chief Commissioner | Jane Meares |
| Deputy Chief Commissioner | Peter McKenzie, QC (until 31 October 2018) |
| Deputy Chief Commissioner | Stephen Davies Howard |
| Commissioner | Richard Marchant |
| Commissioner | Paula Rose, QSO |

## Key Commission personnel

| | |
|---|---|
| Chief Executive | Lois Hutchinson |
| Chief Investigator of Accidents | Captain Tim Burfoot |
| Investigator in Charge | Peter Miskell |
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# Important notes

## Nature of the final report

This final report has not been prepared for the purpose of supporting any criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 makes this final report inadmissible as evidence in any proceedings with the exception of a Coroner's inquest.

## Ownership of report

This report remains the intellectual property of the Transport Accident Investigation Commission.

This report may be reprinted in whole or in part without charge, provided that acknowledgement is made to the Transport Accident Investigation Commission.

## Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1982 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

## Photographs, diagrams, pictures

Unless otherwise specified, photographs, diagrams and pictures included in this final report are provided by, and owned by, the Commission.

## Verbal probability expressions

The expressions listed in the following table are used in this report to describe the degree of probability (or likelihood) that an event happened or a condition existed in support of a hypothesis.

| Terminology<br><br>(Adopted from the Intergovernmental Panel on Climate Change) | Likelihood of the occurrence/outcome | Equivalent terms |
|---|---|---|
| Virtually certain | > 99% probability of occurrence | Almost certain |
| Very likely | > 90% probability | Highly likely, very probable |
| Likely | > 66% probability | Probable |
| About as likely as not | 33% to 66% probability | More or less likely |
| Unlikely | < 33% probability | Improbable |
| Very unlikely | < 10% probability | Highly unlikely |
| Exceptionally unlikely | < 1% probability | |


Location of accident

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## Abbreviations

| | |
|---|---|
| ALCAM | Australian Level Crossing Assessment Model |
| Commission | Transport Accident Investigation Commission |
| Council | Whakatāne District Council |
| KiwiRail | KiwiRail Holdings Limited |
| the level crossing | Lambert Road public road level crossing |
| the Manual | the NZ Transport Agency's Traffic Control Devices Manual, Part 9, Level crossings, second edition, amendment 1, effective December 2012 |
| the truck | Hino 500 series heavy motor vehicle |
| Waste Management | Waste Management NZ Limited |

## Glossary

| | |
|---|---|
| e-ruc system | a management tool that records the times and locations of vehicle events, such as when a vehicle's ignition is turned on and off, the vehicle enters and/or exits a geo-fenced site, the vehicle turns or the vehicle is stopped, and the vehicle's speed and global positioning system (GPS) location, at predetermined time intervals. The system determines that the vehicle has stopped when its speed falls to less than four kilometres per hour |
| passive controls | signs that control the movements of vehicles across a railway level crossing, requiring road users to comply with those signs and detect approaching trains by direct observation |
| sighting distance | the minimum distance to an approaching train from the centre of a level crossing, when a road vehicle driver must first see an approaching train in order to clear the level crossing safely ahead of that train |

## Data summary

**Vehicle particulars**

| | |
|---|---|
| Train type and number: | freight Train 353 consisting of a DL-class locomotive hauling 29 empty log-carrying wagons |
| Train length: | 433 metres |
| Train weight: | 572 tonnes (including the locomotive) |
| Train operator: | KiwiRail Holdings Limited |
| Heavy motor vehicle: | Hino 500 series heavy motor vehicle converted to service waste wheelie bins (first registered 19 August 2016) |
| Vehicle operator: | Waste Management NZ Limited |
| Licensed rail access provider: | KiwiRail Holdings Limited |
| **Date and time** | 6 October 2017 at about 1131[1] |
| **Location** | Lambert Road, near Kawerau, 3.42 kilometres[2] Murupara Branch line |
| **Persons involved** | two: the train driver and the heavy motor vehicle driver |
| **Injuries** | one: heavy motor vehicle driver (fatal) |
| **Damage** | moderate to the locomotive, extensive to the heavy motor vehicle |

[1] Times in this report are New Zealand Daylight Savings Times (universal co-ordinated time + 13 hours) and are expressed in the 24-hour mode.
[2] The location of the level crossing is the distance from a reference point at Kawerau.

# 1. Executive summary

1.1. Shortly before midday on Friday 6 October 2017, a Waste Management NZ Limited truck was servicing domestic waste bins along the no-exit Lambert Road, near Kawerau. There was a railway level crossing where the Murupara Branch railway line crossed Lambert Road. The level crossing was protected by stop signs, which required all road users to stop and look for trains before proceeding over the crossing.

1.2. The truck had reached the end of Lambert Road and turned around, and was stopping periodically to service bins on the other side of the road. When the truck entered the level crossing it was struck by an empty log train that was travelling from Kawerau towards Murupara.

1.3. The train struck the left side of the truck at a speed of about 63 kilometres per hour. The truck driver was thrown clear of the truck and was fatally injured. The truck was significantly damaged.

1.4. The Transport Accident Investigation Commission (Commission) found that it was very likely the truck did not stop and was travelling at about 48 kilometres per hour as it entered the level crossing. There were no technical issues found with the truck that could have contributed to the accident.

1.5. The Commission found no issues with the manner in which the train was being driven that could have contributed to the accident, and the level crossing was well signposted in accordance with the required rail and road standards.

1.6. Notwithstanding the likelihood that the truck did not stop, the Commission found that even if it had, the driver would not have had sufficient view lines for the truck to clear the level crossing from a stop if a train had been just out of view.

1.7. The Commission also found that the legislation needs to be clearer on the allocation of responsibility between licensed rail access providers and road controlling authorities for ensuring the safety of rail users and road users at public road level crossings.

1.8. The Commission identified two safety issues:

- the legislation is not clear on the allocation of responsibility between licensed rail access providers and road controlling authorities for ensuring the safety of road and rail users at public road level crossings
- sighting distances for road users at level crossings are one of the factors used to determine the appropriate level of protection required, yet the growth in vegetation around railway level crossings can change sighting distances[3] in a relatively short time and render the level crossings unsafe.

1.9. The Commission made two recommendations to the Chief Executive of the NZ Transport Agency, one recommendation to the Chief Executive of KiwiRail Holdings Limited and one recommendation to the Chief Executive of Local Government New Zealand to address these issues.

1.10. The key lessons identified arising from the inquiry into this occurrence are:

- road users must always approach railway level crossings with extreme care, particularly those level crossings that have passive protection only in the form of Give Way or Stop signage
- wearing seatbelts will increase the chances of people surviving accidents.

[3] The sighting distance is the minimum distance to an approaching train from the centre of a level crossing, when a road vehicle driver must first see an approaching train in order to clear the level crossing safely ahead of that train.

## 2. Conduct of the inquiry

2.1. The accident occurred at 1131 on Friday 6 October 2017. The NZ Transport Agency notified the Transport Accident Investigation Commission (Commission) soon after the accident occurred. The Commission opened an inquiry under section 13(1) of the Transport Accident Investigation Commission Act 1990, and appointed an investigator in charge.

2.2. Commission investigators liaised with on-site personnel from the New Zealand Police Serious Crash Unit to ensure that volatile evidence was photographed and recorded. The Commission investigators travelled to the Lambert Road public road level crossing (the level crossing) on Tuesday 10 October to conduct a site examination.

2.3. The Commission's investigators interviewed a New Zealand Police Serious Crash Unit investigator, the next of kin of the driver of the Hino 500 series heavy motor vehicle (the truck), Waste Management NZ Limited (Waste Management) personnel, the driver of the train, the resident who made the first phone call to the emergency services, and an engineer from the road controlling authority, Whakatāne District Council (Council).

2.4. The Commission engaged an authorised crash vehicle inspector from Vehicle Testing New Zealand Limited to assist with the examination of the truck wreckage.

2.5. The Commission obtained the following records and documents for analysis:

- the data downloaded from the train's event recorder
- the train control diagram
- the train controller's voice recordings
- the train driver's training records and timesheets
- the data downloaded from the truck's management system
- the truck driver's training records, safety observation reports and results of random drug and alcohol tests
- the level crossing site survey data.

2.6. On 18 July 2018 the Commissioners considered the draft report and approved it to be sent to interested persons for consultation.

2.7. Four written submissions were received. As a result of those submissions further investigation work was undertaken.

2.8. On 24 October 2018 the Commission approved a revised draft report for consultation with four interested persons.

2.9. Three written submissions were received. The Commission considered the submissions, and changes as a result of those submissions have been included in the final report.

2.10. On 12 December 2018 the Commission approved the final report for publication.

## 3. Factual information

### 3.1. Narrative

3.1.1. On Friday 6 October 2017, the truck was servicing roadside 'wheelie' bins in the Kawerau area. At 1123[4] the truck turned left from State Highway 34 to Lambert Road (see Figure 1). The truck had been set up as a dual-control vehicle[5]. The driver was operating the truck from the left-hand controls (the kerb side of the vehicle).

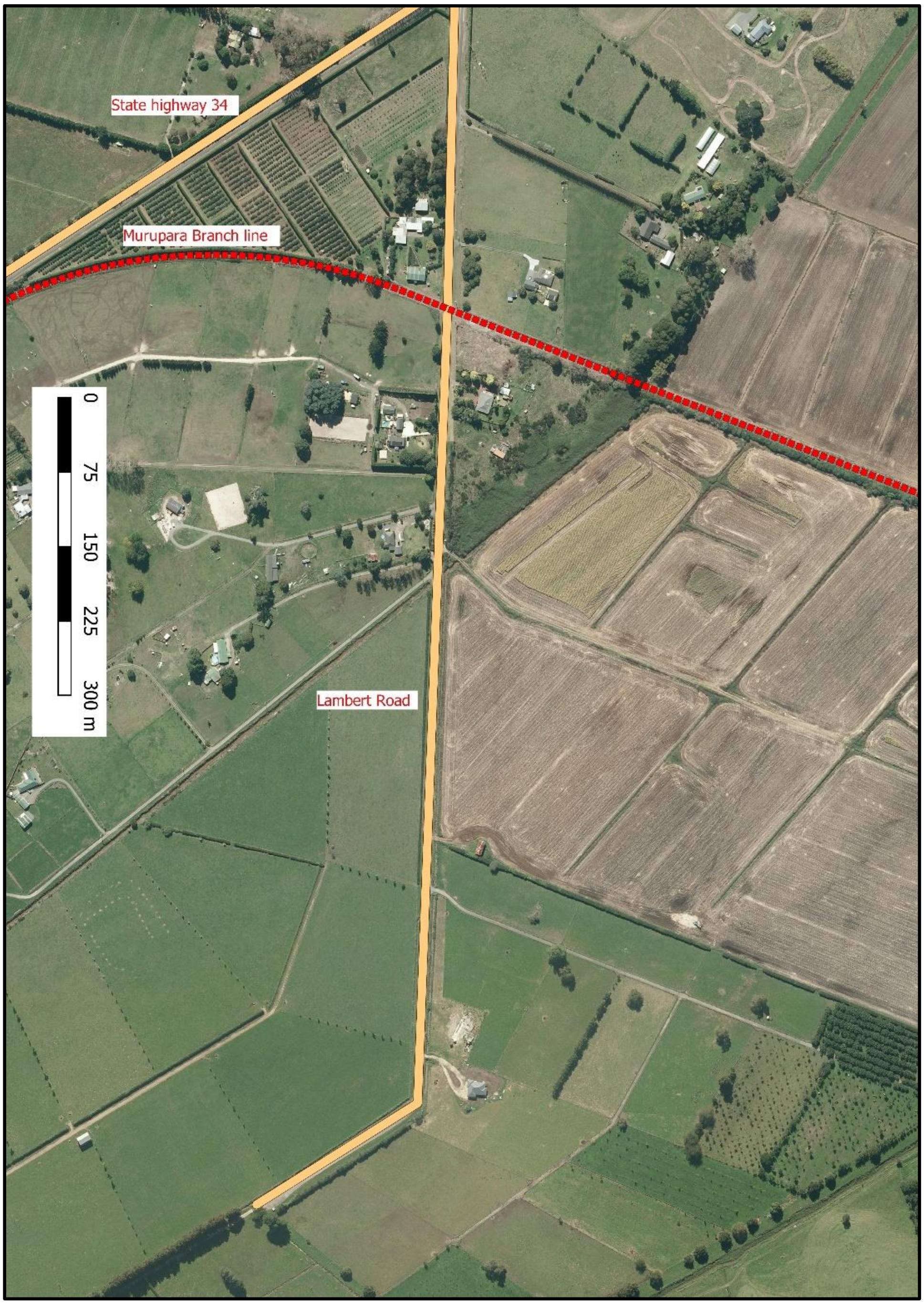


Figure 1
The location of Lambert Road

[4] Vehicle times were taken from a download of the truck's global positioning system-based road-user-charge system that recorded speed against time and recorded when the truck stopped (slowed to less than four kilometres per hour).
[5] A vehicle that can be driven from either side of the driving cab – the left side when servicing roadside waste bins.

3.1.2. The truck stopped twice to service bins before it passed over the level crossing in a southbound direction at about 1125. The level crossing was where the Murupara Branch railway line crossed Lambert Road and was protected by 'passive' compulsory stop signs. The truck did not stop at the level crossing.

3.1.3. The truck continued southbound, servicing the bins along Lambert Road. It turned at the end of the road and travelled back towards the state highway, servicing bins on the other side of the road.

3.1.4. It was daylight but the was sky was overcast and light drizzle was falling.

3.1.5. The truck stopped at five more locations to service bins, the last of which was 126 metres before reaching the level crossing. The last recorded stop was at 1131:02.

3.1.6. Meanwhile a freight train, comprising a single locomotive hauling empty log wagons, had departed from Kawerau travelling towards Murupara and was approaching the level crossing.

3.1.7. At 1131:25[6], when the train was about 140 metres from the level crossing, the driver sounded the train whistle as a standard warning to road users.

3.1.8. The first time the train driver saw the truck was when it appeared close in front of the train travelling from right to left. The train was travelling at about 63 kilometres per hour when it struck the left-hand door of the truck at 1131:33, rotating it nearly 270 degrees and rolling it onto its left-hand side (see Figure 2). The truck driver was ejected from the driving position and was fatally injured.

3.1.9. The front of the train was 323 metres past the level crossing when it stopped. The locomotive and the wagons stayed on the track.

Figure 2
The damaged truck
(photograph provided by New Zealand Police)

[6] Train times were taken from the download data of the train's event recorder system.

## 3.2. Road and level crossing information

3.2.1. Lambert Road was a sealed, two-way, no-exit public road providing access to 16 properties. The road was 1,329 metres long[7], running in a southerly direction from the state highway. The northbound approach to the level crossing[8] was straight for about 900 metres. The road was 5.5 metres wide at the level crossing. A December 2013 road survey carried out by the Council reported 36 vehicles per day passing over the level crossing.

3.2.2. Lambert Road had no posted speed limits. The Council confirmed that the maximum authorised road speed was 100 kilometres per hour.

3.2.3. The Lambert Road level crossing was protected with passive controls[9] in accordance with the NZ Transport Agency's Traffic Control Devices Manual, Part 9, Level crossings, second edition, amendment 1, effective December 2012[10] (the Manual).

3.2.4. KiwiRail Holdings Limited (KiwiRail) was the licensed rail access provider and was responsible for all signage within the rail corridor. Signage was located on the left-hand side of the crossing in the direction the truck was travelling at the time. It was the standard pole-mounted STOP assembly consisting of a crossbuck 'RAILWAY CROSSING' mounted above a 'STOP' sign, and the optional 'LOOK FOR TRAINS' sign (see Figure 3). The signage was in good condition.


Figure 3
The STOP sign assembly for the northbound approach to the Lambert Road level crossing

3.2.5. The Council was responsible for installing and maintaining signage in advance of a level crossing. A 'Level Crossing Ahead' warning sign in the form of a symbolised steam locomotive was installed on the left-hand side of the road on the northbound approach, 174 metres back from the level crossing (see Figure 4).

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[7] The information was provided by Whakatāne District Council.
[8] The direction in which the truck was travelling when it was struck.
[9] Signs that control the movements of vehicles across a railway level crossing, requiring road users to comply with those signs and detect approaching trains by direct observation.
[10] Traffic Control Devices Manual, Part 9, Level crossings, second edition, amendment 1, effective from December 2012.

Figure 4
The warning sign for the northbound approach to the Lambert Road level crossing

3.2.6. An advisory sign was positioned on the left-hand side of the road, a few metres past where the truck last stopped to service a waste bin. The sign advised that a compulsory stop sign was 120 metres ahead (see Figure 5). The sign assembly was positioned correctly and was in good condition.


Figure 5
The warning sign and road markings for the northbound approach to the Lambert Road level crossing
(photograph provided by New Zealand Police)

3.2.7. The Manual required the Council to install and maintain the road markings. When approaching the level crossing northbound, the word 'RAIL' and the letter 'X' were painted on the road before and after the railway level crossing warning sign (see Figure 5). The road markings at the level crossing included a yellow limit line, a centreline and the word STOP (see Figure 6).

3.2.8. The yellow line was 4.3 metres from the nearest rail when measured along the road centreline. The Manual required the limit line to be not less than 2.4 metres from the nearest rail.

3.2.9. Records provided by the Council showed that there had been a non-injury accident in 2010. A car had stopped too close to the rail tracks and had been clipped by a passing train.


Figure 6
The road markings for the northbound approach to the Lambert Road level crossing

## 3.3. The truck

3.3.1. The truck was a special-purpose, dual-steering, automatic Hino 500 series vehicle that had been converted for the purpose of emptying bins. It was fitted with a large container on the rear and a hydraulic arm on the left side of the truck behind the cab (see Figure 7). The truck had a single steering axle at the front and two axles at the rear. Records showed that the most recent certificate of fitness inspection had been carried out on 17 August 2017, and that the certificate was due to expire on 22 February 2018. The truck had undergone three certificate of fitness inspections since first entering service.


Figure 7
A Hino 500 heavy motor vehicle configured similar to the accident truck
(photograph provided by New Zealand Police)

3.3.2. The truck was subjected to a regular maintenance regime. An 'A' maintenance service was required every 150 hours or 5,000 kilometres and a 'B' maintenance service every 300 hours or 10,000 kilometres. A comprehensive brake check was carried out during the 'B' service because of the frequent stop/start activity that the truck performed. The maintenance services were contracted out to a third party.

3.3.3. The most recent 'A' service had been carried out on 19 August 2017 with 28,823 kilometres recorded on the odometer. The most recent 'B' maintenance service had been carried out on 16 September 2017, 20 days before the accident. The truck had travelled 2,733 kilometres between service checks and accumulated 190 engine running hours. There was nothing of significance recorded on the most recent 'B' maintenance service sheet.

3.3.4. A post-accident examination was conducted of the truck[11]. The examination confirmed that the dual control was in the left-hand-drive position. There was no evidence of pre-existing mechanical faults on the truck.

## 3.4. Rail operating information

3.4.1. The movements of rail vehicles and track access on the 58-kilometre-long Murupara Branch line were managed from the National Train Control Centre in Wellington using a track warrant control operating system. A train could not enter any part of the main line without the driver holding the authority of a track warrant. In this case the train driver held a valid track warrant to occupy the section of track that crossed the Lambert Road level crossing.

3.4.2. The train operating schedule allowed for 12 planned freight train movements per day on the Murupara Branch line: six return movements between Kawerau and Murupara. The trains conveyed empty log wagons from Kawerau and returned loaded with logs. The number of daily train movements varied depending on commercial requirements. On average there were eight train movements per day. The trains did not operate to a strict timetable.

[11] The Commission engaged an authorised crash vehicle inspector from Vehicle Testing New Zealand to assist with conducting the examination.

3.4.3. Freight trains operating on the Murupara Branch line were restricted to a maximum authorised line speed of 65 kilometres per hour.

## 3.5. Personnel

### The driver of the train

3.5.1. The Kawerau-based train driver's certification was current. The train driver had 43 years' driving experience and had worked out of the Kawerau depot for the previous 39 years.

3.5.2. The driver had worked three shifts from 0315 to 1035 on consecutive days starting on Saturday 30 September and finishing on Monday 2 October. The driver had been rostered off duty on Tuesday 3 October and Wednesday 4 October and was on annual leave on Thursday 5 October. The train driver started work at 0705 on Friday 6 October 2017. At the time of the accident the train driver was on their second and final return trip between Kawerau and Murupara.

3.5.3. The train driver was not asked to submit to post-incident drug and alcohol testing. Clause 3.2.2 of KiwiRail's Drug and Alcohol Policy stated in part:

> Employees will not be tested after
>
> level crossing and trespass fatalities.

3.5.4. KiwiRail advised that the train driver was not tested because of the right-of-way provisions contained in section 80 of the Railways Act 2005, which stated in part:

> **80 Rail vehicles have right of way**
>
> (a) the train driver is entitled to assume, for the purposes of determining at which it is reasonable for [their] rail vehicle to travel past a level crossing… that all persons, animals, and vehicles not using the railway line will keep clear of the railway line.

### The driver of the truck

3.5.5. The driver of the truck had been employed by Waste Management, Whakatāne, since 2012.

3.5.6. The truck driver held a current driver licence with endorsement for classes 1F, 2F and 4F, appropriate for the truck being driven. The class 4 endorsement allowed a driver to operate a rigid vehicle with a gross laden weight in excess of 18,000 kilograms. The vehicle had a gross mass of 22,000 kilograms.

3.5.7. The driver of the truck was familiar with the route, having last driven it on Friday 22 September 2017. The driver had been on annual leave from Wednesday 26 September until Tuesday 3 October inclusive, followed by one day of sick leave before returning to work at 0700 on Thursday 5 October 2017. The driver's logbook showed the work period finished at 1730 that day.

3.5.8. The truck driver did not make an entry in the logbook on 6 October 2017. The vehicle trip recorder showed that the truck exited the depot at 0710:59.

3.5.9. There was no activity on the truck driver's mobile phone at the time of the collision. Toxicological samples were obtained and tested. There was no evidence of alcohol or performance-impairing substances in the driver's system.

3.5.10. Waste Management had a policy of conducting random drug and alcohol tests of at least 10% of its staff every month. The truck driver had been tested nine times while employed by Waste Management and had always returned a zero reading for alcohol and negative results for performance-impairing substances.

3.5.11. The driver had undergone three in-cab driving assessments while working for Waste Management. On 13 January 2015 the assessor had identified two critical errors, one of which related to not stopping at a compulsory stop sign. The assessor had stated in part:

> … (did not come to a complete stop) at compulsory stop sign when turning left from McGarvey Road onto Peace Road.

3.5.12. The most recent driver assessment had been carried out on 26 October 2016. No critical operational or driving errors had been identified and the assessor's comments had been positive.

# 4. Analysis

## 4.1. Introduction

4.1.1. The data from the train's event recorder confirmed that the train driver had the train complying with all applicable rail system requirements as it approached the level crossing, including the authorised line speed.

4.1.2. An examination of the truck following the accident did not identify any pre-existing mechanical fault that could have contributed to the accident. However, the extent of the damage to the truck meant that the possibility could not be excluded.

4.1.3. The Commission concluded that it was very likely that the truck did not stop before proceeding over the level crossing. However, even if it had done so, there would have been an insufficient sighting distance available to the driver to clear the level crossing had the train been just out of view. This conclusion and safety issue are discussed in more detail in the following analysis.

## 4.2. What happened

4.2.1. Data downloaded from the truck's global positioning system (GPS)-based road-user-charge system (e-ruc)[12] showed that the truck entered Lambert Road from the state highway at 1123:44 and travelled southbound, stopping periodically to service waste bins.

4.2.2. Figure 8 shows the locations at which the truck's speed dropped to less than four kilometres per hour (recorded as the truck having stopped). Each of these stoppages corresponded to an address where a waste bin had been positioned on the roadside. The data showed that the truck stopped to service bins either side of the level crossing, but did not stop at the level crossing, which was protected by a compulsory stop sign.

4.2.3. The truck continued south to the end of Lambert Road, turned around and proceeded northbound, stopping to service bins positioned on the other side of the road. The last recorded stop was made at 1131:02, when the truck was 126 metres from the level crossing.

[12] A management tool that records the times and locations of vehicle events. such as when a vehicle's ignition is turned on and off, the vehicle enters and/or exits a geo-fenced site, the vehicle turns or the vehicle is stopped, and the vehicle's speed and GPS location, at predetermined time intervals. The system determines that the vehicle has stopped when its speed falls to less than four kilometres per hour.

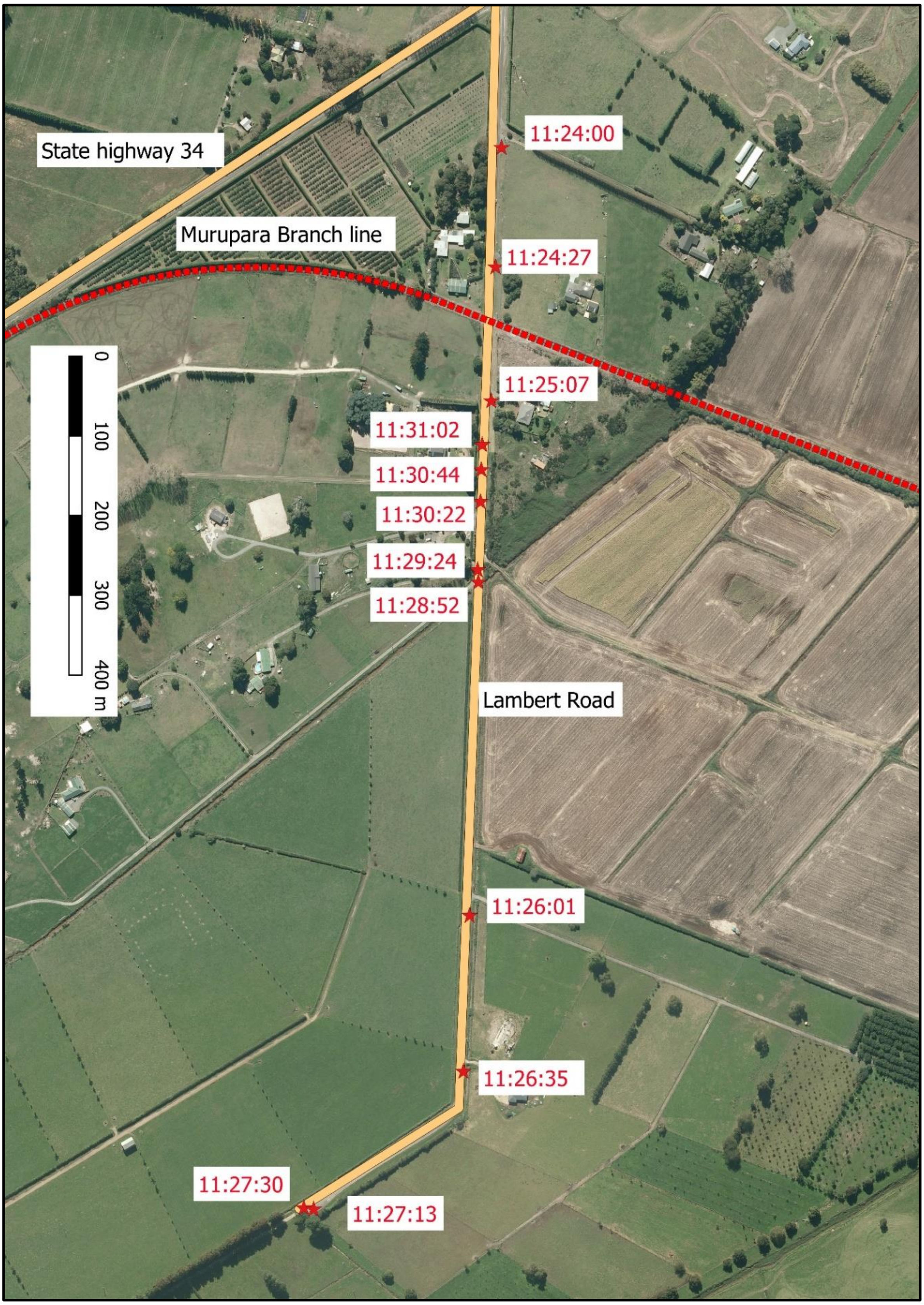



Figure 8
Diagram showing truck stopping times on Lambert Road
(underlying imagery courtesy of Land Information New Zealand[13])

[13] Bay of Plenty 0.25 metre Rural Aerial Photos 2011-2012.

4.2.4. The train and the truck collided at 1131:33 according to the train event recorder, about 31 seconds after the truck had last stopped[14]. The post-accident examination of the truck instrument panel identified that the speedometer had 'captured' the speed at about 48 kilometres per hour and the tachometer similarly 'captured' the revs at 1,700 revolutions per minute (see Figure 9). The speed and rev counter readings were likely to have been the readings when power was lost to the instrument panel as a result of the collision. Therefore, the truck was likely to have been travelling at close to 48 kilometres per hour at the time of impact.


Figure 9
The truck instrument panel after the collision
(photograph courtesy of New Zealand Police)

4.2.5. The data downloaded from the train's event recorder showed that it was travelling at about 63 kilometres per hour when the train driver sounded the locomotive whistle at 1131:25, warning road users of the train's approach. The train was about 141 metres from the level crossing when the driver activated the whistle.

4.2.6. The driver of the train said that the truck was first seen when it was just about to enter the level crossing directly in front of the train. There was no time to drop down into the 'safe position' between the brake pedestal and the rear wall of the locomotive cab[15] or to take any other preventive action.

4.2.7. Similarly, there was no evidence in the form of skid marks to suggest that the truck driver became aware of the train in time to take preventive action.

4.2.8. It was very unlikely that the truck stopped before entering the level crossing because of the following factors:

- the speed at which the truck appeared in front of the train driver
- the truck speed and engine revs captured on the truck's instrument panel

[14] It was not possible to validate with absolute accuracy the times obtained from the train event recorder against those obtained from the truck e-ruc system.
[15] Drivers are taught to place themselves into this position in the event of an imminent collision.

- the fact that, shortly beforehand, the truck had not stopped before entering the same level crossing when travelling southbound on Lambert Road.

4.2.9. It was virtually certain that the truck driver was aware of the level crossing. The various warning signposts and paint markings on the road were in good condition and in accordance with the railway and road authority standards. Also, the truck driver had worked Lambert Road many times before, so would have been well aware of the level crossing's presence.

4.2.10. The Commission considered other possible reasons for the truck driver not stopping at the level crossing.

4.2.11. The toxicology results showed that there was no impairment. It was unlikely that the truck driver was fatigued because the work involved day shifts only, and the driver had only recently returned to work from having been on leave. The driver was frequently starting and stopping the truck with the high degree of precision required to service the waste bins. This suggested that the driver was alert at the time and unlikely to have fallen asleep.

4.2.12. Mobile phones are known to be common sources of distraction. However, the driver's phone was recovered and the phone records established that the phone was not being used at the time of the accident.

4.2.13. The Commission could only conclude that the driver did not consistently stop at the level crossing. One explanation for the driver not stopping was a low expectation of encountering a train at the level crossing.

4.2.14. With an average eight trains each day, the frequency of trains travelling through the level crossing was not high. At the time of day that the driver would normally have been working Lambert Road, the KiwiRail master train control plan had two trains passing through the area, with a possible 55 minutes between trains. It is not known if the truck driver had ever previously encountered a train at the level crossing while working along Lambert Road or was aware of the train running times.

4.2.15. Freight trains do not run to strict schedules and road users must expect trains at any time. On the day of the accident, train services on the Murupara Branch line were running about 30 minutes ahead of the train control plan.

## 4.3. Survivability

4.3.1. The dual-control truck was being operated from the left-hand seat at the time of the collision, which was where the train first hit the truck. Waste Management's Safe Driving Policy required seatbelts to be worn at all times. After the accident the seatbelt was found to be unlocked. It was therefore unlikely that the driver was wearing a seatbelt at the time of impact.

4.3.2. It could not be determined whether the driver would have survived had a seatbelt been worn. Nevertheless, wearing a seatbelt will generally increase the chances of a person surviving an accident, which is a lesson arising from this inquiry.

## 4.4. Sighting distance at the level crossing

*Safety issue – Sighting distances for road users at level crossings are one of the factors used to determine the appropriate level of protection required, yet the growth in vegetation around railway level crossings can change sighting distances in a relatively short time and render the level crossings unsafe.*

4.4.1. Level crossings are different from roads in that the overall risk profile is skewed towards a low-probability but high-consequence event. As such, level crossings are protected through the use of appropriate traffic control devices. The devices installed are dependent on a range of factors including:

- the level crossing type
- the volume and speed of rail and road traffic
- the mix of road and rail traffic using the level crossing
- the alignment of the road approach to the level crossing
- other physical attributes of the level crossing and its surrounds.

4.4.2. There are 1,388 public road level crossings on the national rail network. Of those public road level crossings, 715 (52%) have active protection. There are 419 crossings protected by flashing lights and bells and 296 have half-arm barriers and flashing lights and bells. The other 673 public road level crossings are all protected with passive signs, either 'Give Way' or 'Stop' signs. The Lambert Road public road level crossing is one of 393 protected with 'Stop' signage.

4.4.3. The Australian Level Crossing Assessment Model (ALCAM) is an assessment tool adopted by New Zealand that is used to identify key potential risks at all level crossings and to assist in the prioritisation of level crossings for upgrade. The ALCAM process involves collecting data by way of level crossing site surveys, and collecting both train and road data from the respective rail and road authorities. The ALCAM assessment output data showed that the Lambert Road public road level crossing presented a relatively low risk; it rated 965 out of 1,388 public road level crossings on the rail network.

4.4.4. Passive controls are generally used where there are low volumes of both road and rail traffic, which make the likelihood of a collision low. The Lambert Road public road level crossing met the requirement for passive controls, having six to eight daily rail movements and an average of 36 vehicle movements passing over the level crossing each day. Stop signs are used at those level crossings where the road user has insufficient time to sight an approaching train and stop before reaching the level crossing limit line.

4.4.5. The most recent ALCAM site survey at the Lambert Road level crossing had been carried out on 18 June 2011. The survey had reviewed the road traffic control measures in place and recorded various parameters that included the:

- width of the road
- maximum distance between the limit line and the closest rail
- angle between the roadway and the railway track
- road approach gradient
- maximum sighting distance available from the road user's eye position, taken from one and a half metres behind the limit line.

4.4.6. The survey data was then used to calculate the minimum sighting distance that a road user required to clear the level crossing safely ahead of an approaching train. The measured and calculated sighting distances were compared to determine what, if any, corrective action was required. Appendix 1 sets out the procedure for calculating sighting distances at level crossings.

4.4.7. For the northbound approach to the level crossing, the calculated minimum re-start sighting distance required for a truck of the type involved in this accident was 183 metres. That distance compared favourably with the 423 metres of available sighting distance recorded at the time of the ALCAM survey.

4.4.8. During the seven years since the ALCAM survey, vegetation on the boundary of a private property adjacent to the level crossing had grown to a height of about two metres. As a result, the maximum sighting distance available to the truck driver had been reduced from 423 metres to 83 metres (see Figure 10). This meant that even if the truck had stopped at the yellow limit line, the truck driver would not have had sufficient time to clear the level crossing safely in the event of a train approaching from just out of the driver's view.

4.4.9. Furthermore, even if the driver had tried to look for trains as the truck approached the level crossing, the train would have been obscured by a high hedge that ran parallel to the road.


Figure 10
The view looking east towards Kawerau when stopped at the yellow limit line

Figure 11
The view from a truck looking towards Kawerau after the vegetation was cleared (photograph courtesy of New Zealand Police)

4.4.10. Subsequent to the accident KiwiRail worked with the owner of the adjacent property to improve the sighting distance (see Figure 11).

4.4.11. Maintaining sighting distances at level crossings is critical for the safety of road users. While most of the factors that are considered when deciding on the level of protection to give a level crossing are unlikely to change significantly over time, vegetation growth can relatively quickly render a level crossing unsafe.

## 4.5. Responsibility for maintaining sighting distances at public road level crossings

*Safety issue –The legislation is not clear on the allocation of responsibility between licensed rail access providers and road controlling authorities for ensuring the safety of road and rail users at public road level crossings.*

4.5.1. As the main rail access provider, KiwiRail maintained a programme for controlling vegetation around the public road level crossings within its rail corridor. However, the mechanisms for controlling road traffic at level crossings are diverse. In this example, one or more of the following mechanisms could have been used to ensure the safety of road vehicles and rail vehicles at the Lambert Road level crossing:

- remove the vegetation to improve the sighting distance at the level crossing
- improve the view lines for vehicles approaching the level crossing so that a 'Give Way' sign could be used instead of a 'Stop' sign
- reduce the speed of trains over the level crossing to allow long vehicles stopped at the level crossing sufficient time to cross safely
- install active level crossing protection.

4.5.2. Level crossings are the intersection of two jurisdictions: the rail access provider and the road controlling authority. Relevant legislation[16] is not clear about what entity or entities have ultimate responsibility for ensuring the safety of both rail users and road users at public road level crossings.

4.5.3. The Commission has raised a similar issue in its watchlist item 'Safety for pedestrians and vehicles using level crossings', which highlights that the safety of pedestrians and vehicles using level crossings has been compromised because of ambiguities in the responsibilities of road and rail authorities.

4.5.4. The Commission is recommending that, in the long term, the NZ Transport Agency take action to clarify the responsibilities of licensed rail access providers and road controlling authorities for safety at rail level crossings, and is also recommending that the NZ Transport Agency work with licensed rail access providers and road controlling authorities to ensure that the safety of rail users and road users is not compromised by the growth of vegetation around level crossings.

4.5.5. The Commission is also recommending that, in the short term, where KiwiRail becomes aware of vegetation affecting the sighting distances at level crossings for which it is the licensed access provider, it work with the relevant road controlling authority to remove or control that vegetation.

4.5.6. The Commission is also recommending to Local Government New Zealand that, in the short term, where road controlling authorities become aware of vegetation affecting the sighting distances at level crossings, they work with the relevant licensed access providers to remove or control that vegetation.

[16] Railways Act 2015 and Local Government Act 1974.

# 5. Findings

5.1. There was no mechanical issue with the train or any issue with the manner in which it was driven that would likely to have contributed to the accident.

5.2. There was no pre-existing mechanical issue found with the truck that contributed to the accident. However, the extent to which it was damaged in the collision meant the possibility could not be excluded.

5.3. There was adequate compliant signage warning road users of the rail level crossing, and it is virtually certain that the driver of the truck was aware of its presence.

5.4. It is very likely that the driver of the truck did not stop at the compulsory stop limit line before entering the Lambert Road public road level crossing in front of the train.

5.5. It is very likely that the driver of the truck was not wearing the fitted seatbelt at the time of the collision. Although this was a safety issue, it was not possible to determine whether it was a factor contributing to the fatality.

5.6. The sighting distance for road users of the Lambert Road level crossing did not meet the minimum standard as set out in the NZ Transport Agency's Traffic Control Devices Manual. It was possible that drivers of long motor vehicles that did stop at the stop sign would not have had sufficient time to clear the level crossing if a train were just out of view.

5.7. The legislation needs to be clearer on the allocation of responsibility between licensed rail access providers and road controlling authorities for ensuring the safety of rail users and road users at public level crossings.

# 6. Safety issue

6.1. Sighting distances for road users at level crossings are one of the factors used to determine the appropriate level of protection required, yet the growth in vegetation around railway level crossings can change sighting distances in a relatively short time and render the level crossings unsafe.

6.2. The legislation is not clear on the allocation of responsibility between licensed rail access providers and road controlling authorities for ensuring the safety of rail users and road users at public road level crossings.

# 7. Safety actions

### General

7.1. The Commission classifies safety actions by two types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that would otherwise result in the Commission issuing a recommendation

(b) safety actions taken by the regulator or an operator to address other safety issues that would not normally result in the Commission issuing a recommendation.

### Safety actions addressing safety issues identified during an inquiry

7.2. KiwiRail worked with the adjacent land owner to improve the sighting distance at the Lambert Road public road level crossing.

### Safety actions taken to address other safety issues

7.3. Whakatāne District Council surveyed all its level crossings for compliance with signage and sighting distance standards and found no issues to address.

# 8. Recommendations

### General

8.1. The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector. In this case, recommendations have been issued to the NZ Transport Agency to address the long-term solution and to the major rail access provider, KiwiRail, to address the short-term solution.

8.2. In the interests of transport safety, it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

### Recommendations made to the NZ Transport Agency

8.3. The sighting distance for road users at the Lambert Road level crossing did not meet the minimum standard as set out in the Manual. It was possible that drivers who did stop at the stop sign would not have had sufficient time to clear the level crossing if a train was just out of view.

Maintaining sighting distances at level crossings is critical for the safety of road users. While most of the factors that are considered when deciding on the level of protection to give a level crossing are unlikely to change significantly over time, vegetation growth can relatively quickly render a level crossing unsafe.

The legislation is not clear on the allocation of responsibility between rail access providers and road controlling authorities for ensuring the safety of rail and road users at public road level crossings.

**On 13 December 2018 the Commission recommended that the Chief Executive of the NZ Transport Agency take the necessary action to clarify the allocation of responsibilities between licensed rail access providers and road controlling authorities for maintaining sighting distances at public road level crossings. (031/18)**

**On 13 December 2018 the Commission recommended that the Chief Executive of the NZ Transport Agency work with licensed rail access providers and road controlling authorities to ensure that they meet their responsibilities for maintaining sighting distances at public road level crossings. (032/18)**

On 17 January 2019, the Chief Executive of New Zealand Transport Agency replied, in part:

> The NZ Transport Agency has accepted these recommendations. In order to comply with these recommendations and enhance its regulatory oversight of the industry the Transport Agency is currently recruiting more personnel into the rail regulatory space.
>
> The full-time positions will not be entirely dedicated to level crossing safety, but they are expected to help provide a system approach to evaluating the critical risk and system assurances across the country. The work will be complementary to the current ALCAM assessments (which deal with the assessments of level crossing safety on an individual basis) and other level crossing work in progress. It is not intended to deter from the efforts of those processes.
>
> The Transport Agency (Rail Regulator) intends to apply a holistic approach to the road rail interface. The complexities of relationships between local authorities and the rail access providers in managing level crossing is to be more centralised in order to maintain a consistent approach to construction, regulation and safety.
>
> While significant progress has been made it is accepted that as the rail industry grows, particularly in the suburban areas, the management of level crossing construction and protection will require greater scrutiny, primarily for the reasons of

increased train frequencies and the number of incidents of damage to rail protection systems.

### Recommendation made to KiwiRail

8.4. Until the responsibilities for the maintenance of sighting distances at public road level crossings have been clarified, it is important for the safety of rail users and road users that there are effective programmes to control vegetation growth around public road level crossings.

**On 13 December 2018 the Commission recommended to the Chief Executive of KiwiRail that, until the NZ Transport Agency has clarified the responsibilities for maintaining sighting distances at public road level crossings, where KiwiRail becomes aware of vegetation affecting the sighting distances at level crossings for which it is the licensed access provider, it work with the relevant road controlling authority to remove or control the vegetation. (033/18)**

On 18 December 2018, the Acting Chief Executive of KiwiRail replied:

> KiwiRail accepts the recommendation as presented and will ensure that, where it is brought to KiwiRail's attention that vegetation is affecting sighting distances at particular public read level crossings for which it is access provider, it works with the relevant road controlling authorities to manage that vegetation.
>
> KiwiRail will also liaise with the NZ Transport Agency as required in order for the Agency to clarify the legal responsibilities for maintaining sighting distances at public read level crossings.

### Recommendation made to Local Government New Zealand

8.5. Until the responsibilities for the maintenance of sighting distances at public road level crossings have been clarified, it is important for the safety of rail users and road users that there are effective programmes to control vegetation growth around public road level crossings.

**On 13 December 2018 the Commission recommended to the Chief Executive of Local Government New Zealand that, until the NZ Transport Agency has clarified the responsibilities for maintaining sighting distances at public road level crossings, where road controlling authorities become aware of vegetation affecting the sighting distances at level crossings, they work with the relevant licensed access providers to remove or control the vegetation. (034/18)**

On 17 January 2019, the Chief Executive of Local Government New Zealand replied:

> Local Government has no comment on the [recommendations] and will await discussions on the recommendations with NZTA in due course.

### Notice of recommendations to the Secretary for Transport

8.6. On 13 December 2018 the Commission gave notice to the Secretary for Transport of the recommendations made to the NZ Transport Agency that it:

**take the necessary action to clarify the allocation of responsibilities between rail access providers and road controlling authorities for maintaining sighting distances at public road level crossings (031/18)**

**work with all rail access providers and road controlling authorities to ensure that they meet their responsibilities for maintaining sighting distances at public road level crossings. (032/18)**

### Notice of recommendations to Local Government New Zealand

8.7. On 13 December 2018 the Commission gave notice to the Chief Executive of Local Government New Zealand of the recommendations made to the NZ Transport Agency that it:

**take the necessary action to clarify the allocation of responsibilities between rail access providers and road controlling authorities for maintaining sighting distances at public road level crossings (X031/18)**

**work with all rail access providers and road controlling authorities to ensure that they meet their responsibilities for maintaining sighting distances at public road level crossings. (032/18)**

### Notice of recommendations to the NZ Transport Agency

8.8. On 13 December 2018 the Commission gave notice to the Chief Executive of the NZ Transport Agency of the recommendations made to KiwiRail and Local Government New Zealand:

**that until the NZ Transport Agency has clarified the responsibilities for maintaining sighting distances at public road level crossings, where KiwiRail becomes aware of vegetation affecting the sighting distances at level crossings for which it is the licensed access provider, it work with the relevant road controlling authority to remove or control the vegetation. (033/18)**

**that until the NZ Transport Agency has clarified the responsibilities for maintaining sighting distances at public road level crossings, where road controlling authorities become aware of vegetation affecting the sighting distances at level crossings, they work with the relevant licensed access providers to remove or control the vegetation. (034/18)**

# 9. Key lessons

9.1. Road users must always approach railway level crossings with extreme care, particularly those level crossings that have passive protection only in the form of Give Way or Stop signage.

9.2. Wearing seatbelts will increase the chances of people surviving accidents.

# Appendix B - Sight distances at level crossings

## B1 Introduction

Appendix B describes the formulae and parameters used to assess sight distance available at level crossings.

The design vehicles adopted for these calculations are:

- the maximum length vehicle generally able to use New Zealand roads without special conditions, namely 22m
- the maximum design vehicle, which is set at 25m (vehicles greater than 20m may use roads subject to conditions described in Land Transport Rule: Vehicle Dimensions and Mass 2002, which also requires vehicles over 25m long to have written permission from the rail access provider to cross any level crossing), or
- the maximum length single-unit vehicle (truck or bus) able to use New Zealand roads without special conditions, namely 12.6m (except for a limited number of buses which are permitted to be 13.5m).

Vehicle stopping, start-up and clearance parameters used for each of these vehicles are listed in Table B1 Vehicle stopping, start-up and clearance parameters. The vehicle dimensions and performance characteristics used in these procedures are subject to change if new information becomes available.

When assessing sight distances at level crossings, views obstructed by permanent features such as terrain and buildings should be clearly distinguished from views obstructed by growth such as hedges or fencing. It is always preferable to remove view obstructions than install Stop controls at crossings. The Railways Act 2005 gives the rail access provider powers to remove or lower trees, hedges and walls that obstruct level crossing views.

## B2 Approach visibility

A road vehicle driver approaching a level crossing with a Give Way (RP2) sign needs to be able to either:

- see an oncoming train in time to stop before reaching the level crossing, or
- continue at the approach speed and cross the level crossing safely ahead of a previously unseen train or a train far enough away to be clearly not a collision threat.

The required sight triangles to achieve this, shown diagrammatically in Figure B1 Approach visibility at passive-controlled level crossings, are calculated as stated on the next page.

### B2.1.1 Vehicle stops after seeing train and before reaching the level crossing

The value of $S_1$, the minimum distance of an approaching road vehicle from the nearest rail at which the driver must be able to see an approaching train from either direction in time to stop if necessary before reaching the level crossing, ie to stop at the give way line, is given by:

$$S_1 = \frac{(R_T + B_T)V_V}{3.6} + \frac{V_V^2}{254\,(d + G)} + L_d + C_V \quad \text{...(1)}$$

Where:

$d$ = coefficient of longitudinal deceleration (see Table B3 Coefficient of deceleration for road vehicles (trucks)).

$G$ = approach grade in metres per metre, positive upgrade, negative downgrade.

$R_T$ = total perception reaction time in seconds (general case assumption 2.5 seconds).

$B_T$ = brake delay time in seconds (see Table B1 Vehicle stopping, start-up and clearance parameters).

Other notations are described in Figure B1 Approach visibility at passive-controlled level crossings.

### B2.1.2 Vehicle able to continue at speed and cross safely before train reaches level crossing

The sight triangle requirements are given by $S_1$ and $S_2$ in Figure B1 Approach visibility at passive-controlled level crossings.

The value of $S_1$ is the same as in (a) above.

The value of $S_2$, the minimum distance at which the road vehicle driver needs to be able to see the train approaching from either direction in order to cross safely ahead of it, is given by:

$$S_2 = \frac{V_T}{V_V}\left[\frac{(R_T + B_T)V_V}{3.6} + \frac{V_V^2}{254\,(d + G)} + \frac{W_T}{\sin Z} + 2C_V + L\right] \quad \text{...(2)}$$

Where:

$L$ = length of design vehicle (see Table B1 Vehicle stopping, start-up and clearance parameters).

Other notations are defined in equation (1) or described in Figure B1 Approach visibility at passive-controlled level crossings.

A train, if present, needs to be visible to a road vehicle driver between any two points within the sight triangle.

## B3 Restart view

A road vehicle driver when stopped at the stop line needs to be able to see far enough along the railway to be able to start off, cross and clear the level crossing safely before the arrival of any previously unseen train. The required sight triangles to achieve this are shown diagrammatically in Figure B2 Crossing visibility at passive-controlled level crossings.

Distance $S_3$ is the minimum distance at which an approaching train from either direction must be seen in order for the design vehicle to start off and clear the level crossing by the safety margin shown in Figure B2 Crossing visibility at passive-controlled level crossings. Distance $S_3$ is given by the following:

$$S_3 = \frac{V_T}{3.6}\left[J + G_s\left[2\frac{\frac{W_R}{tanZ} + \frac{W_T}{sinZ} + 2C_V + L}{a}\right]^{1/2}\right] \qquad ...(3)$$

Where:

$J$ = sum of the perception time and time to depress clutch (general case assumption two seconds).

$L$ = length of design vehicle (see Table B1 Vehicle stopping, start-up and clearance parameters).

$a$ = average acceleration of the design vehicle in starting gear (see Table B1 Vehicle stopping, start-up and clearance parameters).

$G_S$ = grade correction factor (see Table B2 Grade correction factors).

Other notations are described in Figure B2 Crossing visibility at passive-controlled level crossings.

## B4 Sighting angles

In order to ensure a motor vehicle driver can see along the prescribed sight triangles without excessive head movement or sight obstruction by parts of the vehicle itself, the following maximum sighting angles shown in Figure B1 Approach visibility at passive-controlled level crossings and Figure B2 Crossing visibility at passive-controlled level crossings, measured from the direction of travel of the vehicle at the point or points at which sightings must be made, should be available:

a. Maximum angles when approaching give way-controlled level crossings:
   i. to the left ($X_{1L}$) – 95 degrees
   ii. to the right ($X_{1R}$) – 110 degrees.

b. Maximum angles when approaching stop-controlled level crossings:
   i. to the left ($X_{2L}$) – 110 degrees
   ii. to the right ($X_{2R}$) – 140 degrees.

For the purpose of calculating sight triangles, the following figures are used:

- Distance from driver's eye to the nearest rail when stopped at the stop line – 5m.
- Height of driver's eye above road level – 1m.
- Height of train headlight above rails – 2.6m.

## B5 Vehicle deceleration factors

The value $d$, the coefficient of deceleration, in equations (1), (2) and (3) is the uniform deceleration rate for a vehicle approaching a level crossing that may be required to stop on the approach due to the presence of a train and is given in table B3 below.

**Table B1** Vehicle stopping, start-up and clearance parameters

| Vehicle type [see B1] | $B_T$ (s) | $J$ (s) | $L$ (m) | $a$ (m/s$^2$) |
|---|---|---|---|---|
| Maximum length vehicle | 1.0 | 2.0 | 22.0 | 0.36 |
| Maximum design vehicle | 1.0 | 2.0 | 25.0 | 0.36 |

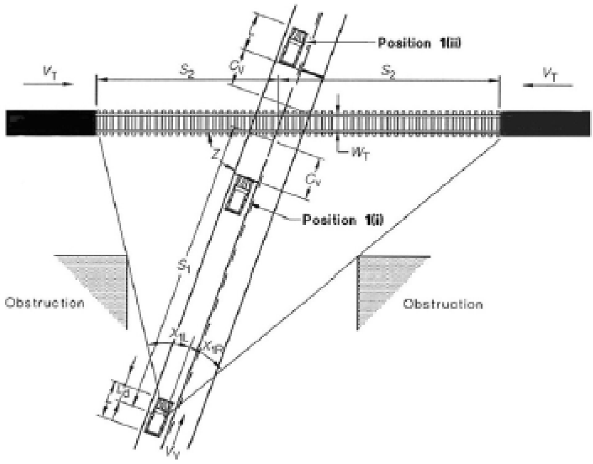
**Table B2** Grade correction factors

| Grade (m/m) | Grade correction factor ($G_S$) |
|---|---|
| -0.12 | 0.52 |
| -0.10 | 0.57 |
| -0.08 | 0.63 |
| -0.06 | 0.70 |
| -0.04 | 0.79 |
| -0.02 | 0.88 |
| 0.00 | 1.00 |
| 0.02 | 1.12 |
| 0.04 | 1.25 |
| 0.06 | 1.39 |
| 0.08 | 1.54 |
| 0.10 | 1.69 |
| 0.12 | 1.85 |

**Table B3** Coefficient of deceleration for road vehicles (trucks)

| Vehicle speed (km/h) | Coefficient of deceleration ($d$) |
|---|---|
| <95 | 0.29 |
| 95-105 | 0.28 |

**Figure B1** Approach visibility at passive-controlled level crossings




Position 1(i): Driver approaching level crossing sights train, judges that a stop is needed, decelerates and stops at the limit line.

Position 1(ii): Driver approaching the level crossing either cannot see approaching train or sights train too far distant to be a collision threat, continues at speed and crosses ahead of the train.

Legend (general case assumptions are shown in brackets):

- $S_1$ = minimum distance of an approaching road vehicle from the nearest rail when driver must be able to see an approaching train in time to stop if necessary before reaching the level crossing limit line (m).
- $S_2$ = minimum distance of a train from the level crossing at which a road vehicle driver at distance $S_1$ from the level crossing can proceed at speed and safely clear the level crossing ahead of that train (m).
- $V_T$ = the highest-authorised speed of a train approaching the level crossing (km/h).
- $V_V$ = the 85th percentile road vehicle speed at the position at which a driver will first recognise and react to the level crossing controls (km/h). (The road speed limit plus 10 percent may be used where the 85th percentile speed is not known.)
- $C_V$ = clearance from the vehicle limit line to the nearest rail (general case assumption 2.4m).
- $L_d$ = distance from the driver to the front of the vehicle (general case assumption 2m).
- $W_T$ = width, outer rail to outer rail, of the railway lines at the level crossing (m).
- $X_{1L}$, $X_{1R}$ = sighting angles (see B4).
- $Z$ = angle between the road and the railway at the level crossing (degrees).

## B6 Pedestrian sight distances

At a level crossing where there is no active control for either roadway or pedestrian traffic, for a train approaching from either direction, the sight distance ($SD$) in metres to oncoming trains to enable pedestrians to cross safely is as follows:

$$SD = \frac{V_T}{3.6}\left[\frac{D}{V_P} + 2\right] \quad \text{...(4)}$$

Where:

- $V_T$ = the highest-authorised speed of the train approaching the level crossing (km/h)
- $V_P$ = the walking speed of pedestrians normally adopted as 1m/s. Where there is significant use by mobility-impaired pedestrians, a walking speed of 0.8m/s is recommended. The formula also provides a safety margin of two seconds providing, eg an allowance for pedestrian reaction and acceleration time
- $D$ = the pedestrian level crossing distance in metres, measured as follows:
  - where pedestrian mazes are provided – from one pedestrian maze opening to the other
  - where there are no pedestrian mazes but there are tactile ground surface indicators (TGSI) at holding positions – from one trackside edge of the TGSI to the other
  - where there are no pedestrian mazes or TGSIs – from outer rail to outer rail plus 4.8m (standard rail gauge is 1.07m, thus for a single railway line $D$ would be 5.87m while for a double railway line $D$ would typically be 9.87m).

## B7 Example view lines

Table B4 Examples based on equations 2, 3 and 4 provides some example outcomes from equations 2, 3 and 4 based on differing train speeds, vehicle lengths or pedestrian safety margins, and incorporates some typical values for the other parameters used.

Table B4 Examples based on equations 2, 3 and 4

| Train speed $V_T$ (km/h) | Restart view $S_3$ (m) | | Approach visibility $S_2$ (m) | | Pedestrian view $SD$ (m) |
|---|---|---|---|---|---|
| | Vehicle length $L$ | | Vehicle length $L$ | | |
| | 12.6m | 25m | 12.6m | 25m | |
| 40 | 149 | 179 | 97 | 121 | 87 |
| 70 | 261 | 313 | 169 | 213 | 153 |
| 80 | 298 | 358 | 193 | 243 | 175 |
| 100 | 373 | 448 | 242 | 304 | 219 |
| 110 | 410 | 492 | 266 | 334 | 240 |

The notations and parameters used for these calculated distances are described in table B5 below.

Table B5 Notations and parameters used in calculations for values for table B4

| Parameter | Notation and values |
|---|---|
| Highest-authorised train approach speed | $V_T$ |
| View along the railway line at 5m from nearest rail | $S_3$ |
| Minimum view along the railway line at 30m from the nearest rail based on a driver approaching the level crossing slowing to 20km/h ($V_V$) | $S_2$ |
| Desirable view along the railway line at 4m from the nearest rail for all pedestrian level crossings, unless automatic warning devices have been installed | SD |
| Vehicle lengths – the maximum length of a rigid unit vehicle (eg truck or bus) is 12.6m (except for a limited number of buses which are permitted to be 13.5m). However, truck and trailer combinations are, subject to restrictions, permitted to be 25m long without requiring a special over-length permit. These two vehicle lengths have been chosen for the purposes of the example calculations in Table B4 Examples based on equations 2, 3 and 4 | $L$ = 12.6m<br>$L$ = 25m |
| Approach grade | $G$ = 0 |
| Deceleration rate of truck | $d$ = 0.29 |
| Perception plus reaction time | $R_T$ = 2.5 sec |
| Brake delay | $B_T$ = 1.0 sec |
| Start-off time (including brake delay) | J = 2.0 sec |
| Vehicle acceleration across crossing | $a$ = 0.36m/sec2 |
| Vehicle 85th percentile speed | $V_V$ = 20km/h |
| Set-back limit line from nearest line | $C_V$ = 3m |
| Driver's eye from front of vehicle | $L_d$ = 2m |
| Distance a pedestrian walks - WT plus 4.8m | $D$ = 5.87m |
| Pedestrian walking speed | $V_p$ = 1.0m/sec |
| Width of the roadway at the crossing | $W_R$ = No effect if $Z$ = 90° |
| Width, outer rail to outer rail, of the railway lines – assumed to be single track | $W_T$ = 1.07m |
| Angle between road and railway at the crossing | $Z$ = 90° |
| Grade correction factor – based on approach grade **G = 0** | $G_S$ = 1.0 |

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| | |
|---|---|
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| RO-2017-102 | Signalling irregularity, Wellington Railway Station, 3 April 2017 |
| RO-2016-101 | Signal passed at danger leading to near collision, Wellington Railway Station, 28 May 2016 |
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| RO-2014-101 | Collision between heavy road vehicle and the Northern Explorer passenger train, Te Onetea Road level crossing, Rangiriri, 27 February 2014 |
| RO-2012-103 | Derailment of freight Train 229, Rangitawa-Maewa, North Island Main Trunk, 3 May 2012 |
| RO-2012-105 | Unsafe recovery from wrong-route, at Wiri Junction, 31 August 2012 |

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