Transport Accident Investigation Commission

Final report

Tuhinga whakamutunga

Rail inquiry RO-2021-104
Passenger train 6205
Train derailment
Kāpiti
17 August 2021

October 2024

The Transport Accident Investigation Commission
Te Kōmihana Tirotiro Aituā Waka

No repeat accidents – ever!

"The principal purpose of the Commission shall be to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future, rather than to ascribe blame to any person."

Transport Accident Investigation Commission Act 1990, s4 Purpose

The Transport Accident Investigation Commission is an independent Crown entity and standing commission of inquiry. We investigate selected maritime, aviation and rail accidents and incidents that occur in New Zealand or involve New Zealand-registered aircraft or vessels.

Our investigations are for the purpose of avoiding similar accidents and incidents in the future. We determine and analyse contributing factors, explain circumstances and causes, identify safety issues, and make recommendations to improve safety. Our findings cannot be used to pursue criminal, civil, or regulatory action.

At the end of every inquiry, we share all relevant knowledge in a final report. We use our information and insight to influence others in the transport sector to improve safety, nationally and internationally.

Commissioners

Chief Commissioner	Jane Meares
Deputy Chief Commissioner	Stephen Davies Howard
Commissioner	Richard Marchant (until 31 October 2022)
Commissioner	Paula Rose, QSO
Commissioner	Bernadette Roka Arapere (from 1 December 2022)
Commissioner	David Clarke (from 1 December 2022)

Key Commission personnel

Chief Executive	Martin Sawyers
Chief Investigator of Accidents	Naveen Kozhuppakalam
Lead Investigator for this inquiry	Jason Lawn
Commission General Counsel	Cathryn Bridge

Notes about Commission reports
Kōrero tāpiri ki ngā pūrongo o te Kōmihana

Citations and referencing

The citations section of this report lists public documents. Documents unavailable to the public (that is, not discoverable under the Official Information Act 1982) are referenced in footnotes. Information derived from interviews during the Commission's inquiry into the occurrence is used without attribution.

Photographs, diagrams, pictures

The Commission owns the photographs, diagrams and pictures in this report unless otherwise specified.

Verbal probability expressions

For clarity, the Commission uses standardised terminology where possible.

One example of this standardisation is the terminology used to describe the degree of probability (or likelihood) that an event happened, or a condition existed in support of a hypothesis. The Commission has adopted this terminology from the Intergovernmental Panel on Climate Change and Australian Transport Safety Bureau models. The Commission chose these models because of their simplicity, usability, and international use. The Commission considers these models reflect its functions. These functions include making findings and issuing recommendations based on a wide range of evidence, whether or not that evidence would be admissible in a court of law.

Terminology	Likelihood	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	

Figure 1: Electric multiple unit Matangi class passenger train, like the occurrence train

Figure 2: Location of train derailment
(Credit: Toitū Te Whenua, LINZ)

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1 Executive summary
Tuhinga whakarāpopoto

What happened

1.1. On 17 August 2021 a Transdev Wellington-based passenger train was operating a scheduled service from Waikanae to Wellington on the North Island Main Trunk line[1] known as the Kāpiti line[2].

1.2. At about 0544 the passenger train departed Paekākāriki station in a southerly direction, conveying 82 passengers and three train crew under heavy rainfall conditions[3].

1.3. At about 0547 the passenger train, travelling at about 70 kilometres per hour, was rounding a right-hand curve next to the hillside when the train driver sighted a landslide[4] covering both main lines approximately 40 metres in front of the train. The train driver applied the emergency brake, but the train struck the debris from the landslide, derailing three of the four passenger cars before coming to a complete stop.

1.4. No passengers or crew suffered any injuries, and all were evacuated safely to a nearby location.

Why it happened

1.5. Because of the curvature of the track and the speed of the train, there was only a short sighting distance to the landslide debris across the track. The train driver did not have enough distance or time to stop before reaching the landslide. When the train came across the debris, the debris disengaged the train's wheel-rail interface, derailing the train.

1.6. The Kāpiti area had experienced heavy rainfall in the hills adjacent to the rail corridor, which overwhelmed the waterways and drainage systems that would normally have moved water away. The meteorological information provided to KiwiRail predicted rainfall in most places in the North Island, with totals of 25 millimetres or more over a 24-hour period for western areas south of Hamilton and the Bay of Plenty.

What we can learn

1.7. As the frequency of severe weather events increases, risk assessments for transport infrastructure become vital to ensure hazards are identified and appropriate controls are applied.

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[1] The North Island Main Trunk line is the portion of the rail network between Auckland and Wellington.

[2] The Kāpiti line is located between the Waikanae and Wellington stations.

[3] The National Institute of Water and Atmospheric Research (NIWA) classification system, based on guidance from the World Meteorological Organization, classifies heavy rainfall as between 10 and 50 millimetres of rainfall within a one-hour period or rainfall greater than 100 millimetres in 24 hours.

[4] A landslide happens when a portion of earth moves down a hillside and causes debris to flow and build up.

1.8. Engineering systems and real-time monitoring can assist with providing those in the transport sector with accurate information from which to make timely and informed safety decisions.

Who may benefit

1.9. Rail personnel and passengers, transport operators, infrastructure designers and infrastructure maintainers may benefit from the findings in this report.

2 Factual information
Pārongo pono

Narrative

2.1. At about 0415 on 17 August 2021, the train driver (driver) arrived at Paekākāriki railway station to complete required prestart paperwork and start their shift.

2.2. At about 0430 the driver met the train manager[5] allocated to the shift. The driver started the electric multiple unit[6] (EMU) train located at the station and completed the required prestart safety checks to get the train ready for service.

2.3. At about 0505, train control[7] changed the departure signal to 'proceed' and the crew departed Paekākāriki station on the up main line[8] in a northerly direction bound for Waikanae to start the first scheduled passenger service of the day (*see* Figure 3).

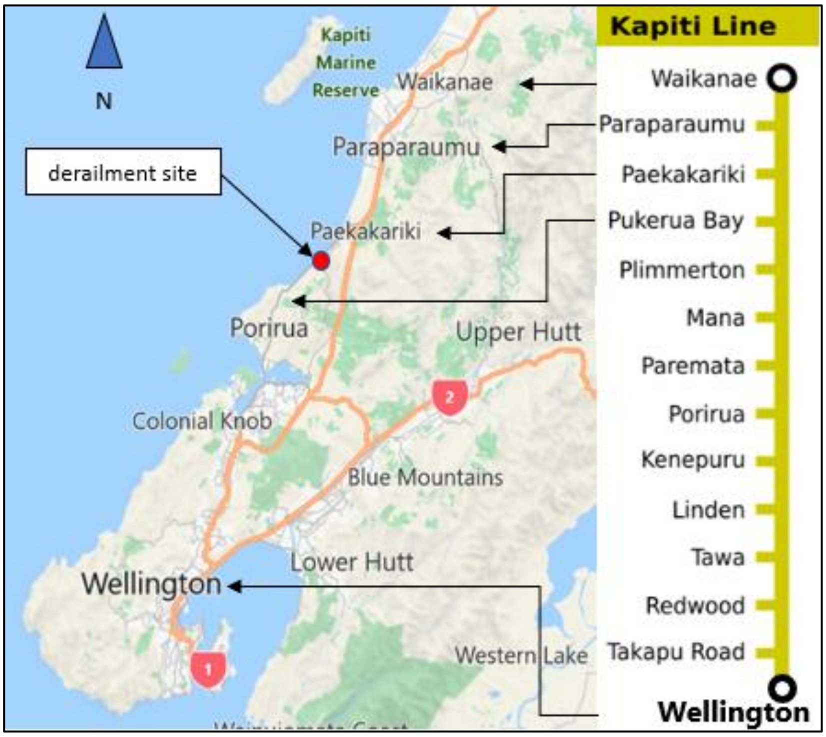

Figure 3: Station location map for the Kāpiti line
(Credit: Google and Metlink)

2.4. The train passed a passenger train travelling south to Wellington on the adjacent down main line as it approached Waikanae station.

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[5] A train manager is responsible for the onboard train requirements and is the conduit to the train driver when the train is ready to depart or on the opening and shutting of the train's car doors.

[6] An electric multiple unit train operates on an overhead power source that directs power to the train's traction motors inside the carriages.

[7] Train control is where rail vehicle movements on the rail network are controlled.

[8] A portion of rail track on a multiline rail network on which trains are run in the up direction.

2.5. The train arrived at Waikanae station on schedule and the crew prepared the train for the waiting passengers. The passengers boarded passenger train 6205[9] and the train departed Waikanae station on the down main line in a southerly direction on time at 0530.

2.6. At Paekākāriki station the passenger operator (PO) joined the train service to provide customer service to the passengers and to be the interface between the Train Manager and the passengers.

2.7. After departing Paekākāriki station at 0544, the driver took the train up to the 90-kilometre-per-hour (km/h) line speed and entered a section of track that followed the hillside on the left.

2.8. At about 0546 the train entered a right-hand curve, and the driver applied the train brake, reducing the speed to approximately 70 km/h as required for the section of track ahead (*see* Figure 4, number 1).

2.9. At about 0547, as the train entered a small section of straight track, the driver saw a large amount of water flowing off the hillside and across the track approximately 40 metres (m) in front of the train (*see* Figure 4, number 2). Simultaneously a landslip crossed both the down main line and the up main line in front of the train (*see* Figure 4, number 3).

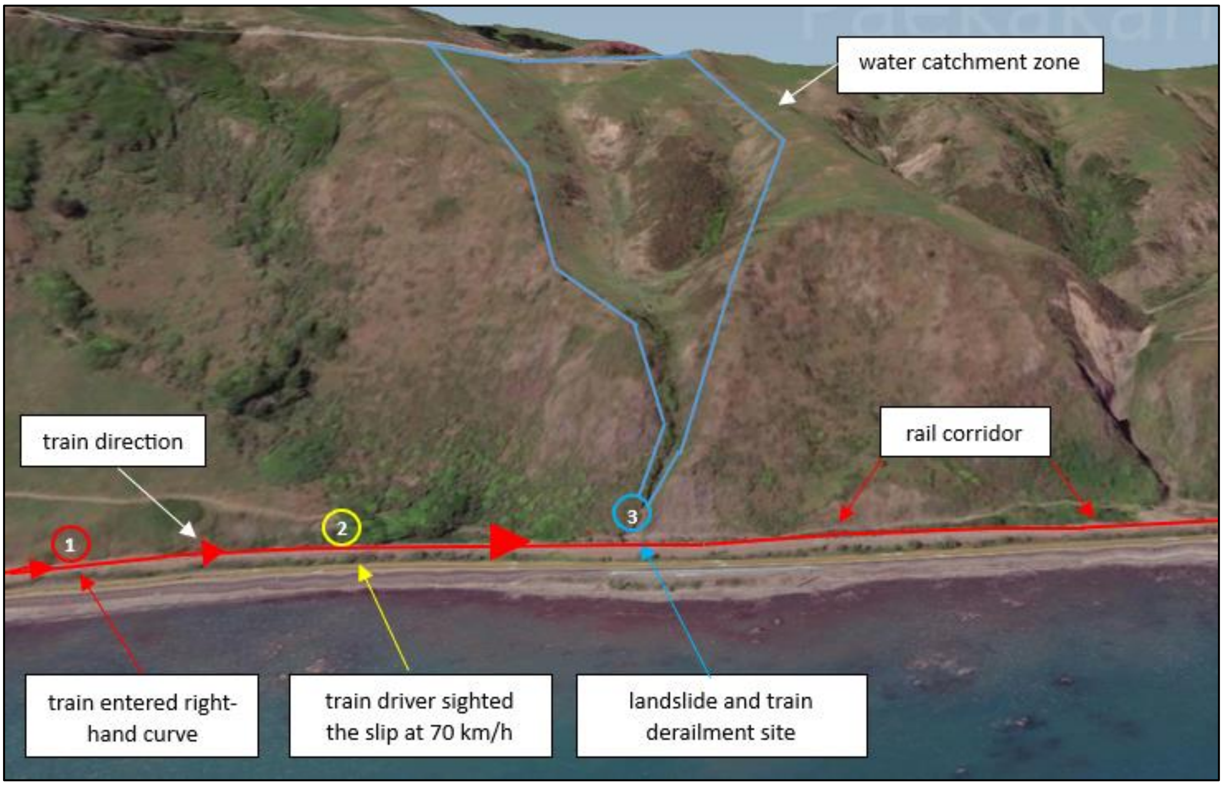

Figure 4: Location map leading up to the derailment site

[9] Train service 6205 is the scheduled train service that runs between Waikanae and Wellington train stations on the NIMT.

2.10. Debris and rainfall water overwhelmed a drainage culvert[10] near the derailment area, below the rail corridor.

2.11. At 0547:07 the driver applied the train's emergency brake. However, they were unable to stop the train – which initially travelled at approximately 69 km/h – before striking the slip debris.

2.12. The debris acted as a ramp, with the train's leading wheels riding up onto the debris and derailing the first, second and third passenger cars before coming to rest approximately 50 m past the slip (*see* Figure 5).

Figure 5: Derailed carriage and debris against and under carriage

(Photographed at approximately 1210)

2.13. The rear passenger car came to a stop before encountering the debris and remained on the track.

2.14. During the derailment the train's pantograph[11] lost contact with the overhead wire, resulting in the train losing its overhead power source (*see* Figure 6).

[10] A piece of drainage infrastructure that connects stormwater pipes in order to direct water flow to an adjacent area. The culvert at the slip site was located on the hill side of the rail corridor, went under the rail lines and opened on the embankment where the road met the road shoulder area. This allowed debris to flow on to State Highway 1.

[11] A device mounted on a train to transfer current from one or several contact wires.

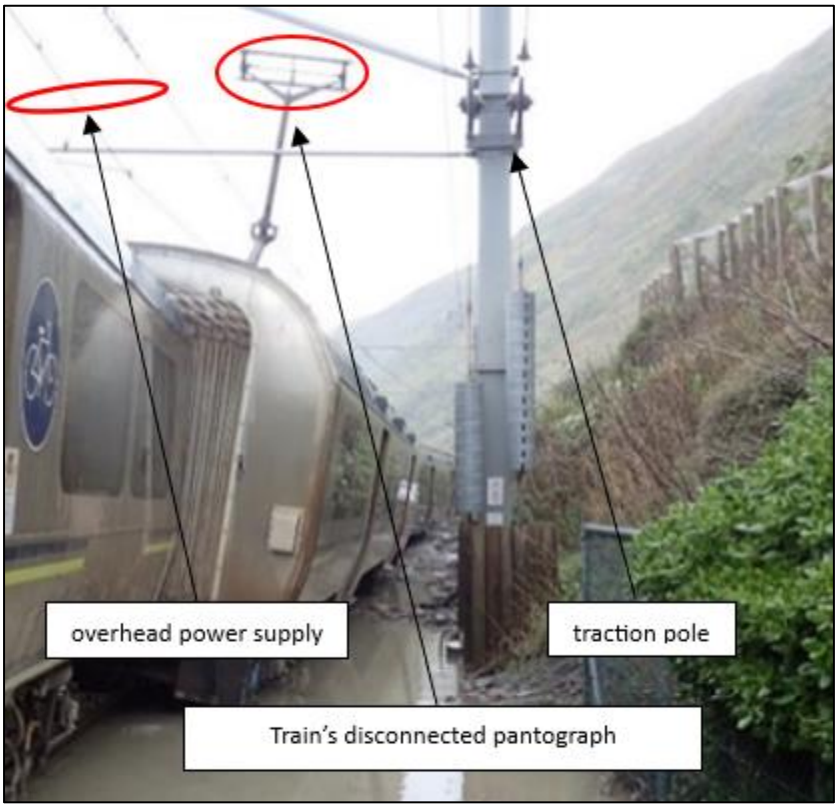

Figure 6: Disconnected pantograph and power-supply connection
(Photograph taken at approximately 1220)

2.15. At 0547:14 the train lost the back-up battery system, located under the train, when it was damaged by the debris and water flowing down the hillside.

2.16. At about 0549 the driver became aware of the loss of power and attempted to call train control on the in-cab back-up portable radio[12], but was unsuccessful. The driver made several attempts but was unable to establish clear communication with train control.

2.17. At about 0550 the driver took their personal mobile phone from their work bag and called train control to inform it of the derailment and request that it stop all train movements in the area.

2.18. At 0552 train control placed all controlled signals to stop, holding opposing and following train movements in the area of the derailment. The Network Control Manager called Transdev Wellington, alerting it to the derailment accident and location.

2.19. Transdev Wellington organised a Rail Incident Co-ordinator (RIC)[13] to deploy to the accident site along with rail infrastructure and train maintenance staff.

2.20. At about 0552 the onboard Train Manager and driver met at the train's front cab to update each other and determine if anyone had been injured in the accident. They

[12] The in-cab back-up portable radio operated on a rechargeable battery system and was stored in the cab of the train.

[13] The Rail Incident Co-Ordinator controls rail-type incidents, such as derailments, and communicates what is happening at the incident site to train control.

confirmed that there were no reported injuries, and all passengers were capable of evacuation on foot.

2.21. Two off-duty Transdev Wellington staff who were travelling on the train offered to help in the evacuation process if required.

2.22. Police arrived at about 0600 and closed State Highway 1 between Paekākāriki and Pukerua Bay, as debris were blocking the left-hand side of the road.

2.23. At about 0625 the RIC and rail infrastructure workers arrived on site and began planning the evacuation of the passengers.

2.24. At about 0630 the live overhead power lines[14] were earthed and isolated, making it safe for the passenger evacuation.

2.25. At about 0640 the RIC and train crew assessed the safest evacuation route for all passengers north along the rail corridor to a flat area near the roadside (the Fisherman's Table carpark).

2.26. At about 0650 the RIC and train crew started the evacuation process for the 82 passengers. They prepared the train's four evacuation egress points, which were at each end of the train and at the centre door on carriages number two and four (*see* Figure 7).

2.27. At about 0717 the passengers began disembarking the train and were guided by the RIC, train crew and the two off-duty Transdev Wellington staff along the rail corridor to the safe area.

[14] Overhead power lines operate with a current of 1500 volts, which powers the train as it operates under them. They are connected by the train's adjustable pantograph to transfer the power to the train's traction motor system.

Figure 7: Passenger evacuation egress point from the train
(Photographed at about 1215)

2.28. At about 0745 all passengers and train crew had arrived safely at the assembly point at the Fisherman's Table carpark, approximately 1.3 kilometres (km) from the accident site, where alternative transport was provided for the passengers (*see* Figure 8).

Figure 8: Site evacuation map and assembly point

2.29. At about 0810 emergency services departed the accident site and the process of removing the train started.

Personnel information

2.30. The driver had operated metro passenger trains since 2010 and had been employed by Transdev Wellington since 2016. They had 43 years' driving experience in both passenger and freight train services. Their last safety observation before the accident had taken place on 26 May 2021. This had included assessments of their signals and rule-based knowledge of the main line, and a review of their train-handling practices.

Train information

2.31. Train service 6205 was an EMU consisting of two powered passenger cars connected to two non-powered passenger cars, with a maximum seating capacity of 294 passengers. The train's total length was 86.12 m and the total tare weight was 155.6 tonnes. The maximum allowable speed was 100 km/h operating[15] on an overhead powerline voltage of 1500 volts direct current.

Meteorological information

2.32. MetSolutions provided KiwiRail with weather forecast information on the 16 August 2021 of predicted rainfall to most places in the North Island, with totals of 25 millimetres (mm) or more in a 24-hour period for western areas south of Hamilton and the Bay of Plenty.

2.33. Meteorological weather station data obtained by the Transport Accident Investigation Commission (the Commission) for the Mackays Crossing area on 17 August 2021, located approximately 4.7 km from the accident location, recorded 27.1 mm of rainfall in the three hours before the derailment (*see* Figure 9). There were periods of rain with embedded thunderstorms that resulted in localised downpours, with northerly wind flow averaging 67 km/h (*see* Figure 10) and a temperature of approximately 13.5 degrees Celsius[16].

Time	Rain volume	Accumulative volume
0300 - 0400	3.7mm	3.7mm
0400 - 0500	11.1mm	14.8mm
0500 - 0600	12.3mm	27.1mm

Figure 9: Hourly rainfall volumes from Mackays Crossing near the accident location.
(Credit: MetService)

[15] The maximum speed of the train service travelling on the Kāpiti line.

[16] The MetService record of the weather pattern that occurred off the Kāpiti coast on the morning of 17 August 2021.

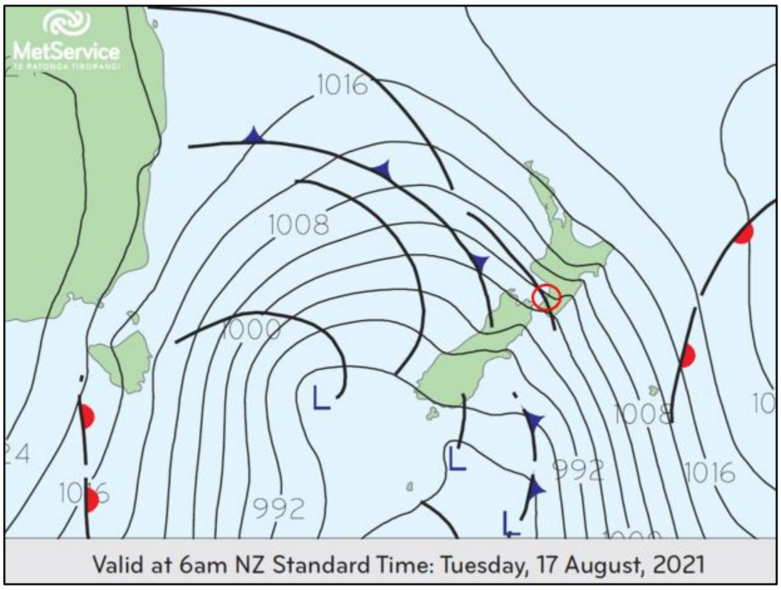

Figure 10: Barometric pressure chart

(Credit: MetService)

Train data recorder

2.34. The EMU was fitted with a Tranzlog data recorder system[17] (*see* Figure 11). The downloaded data confirmed that the train speed and train handling controls made by the driver were in accordance with the operating rules and procedures.

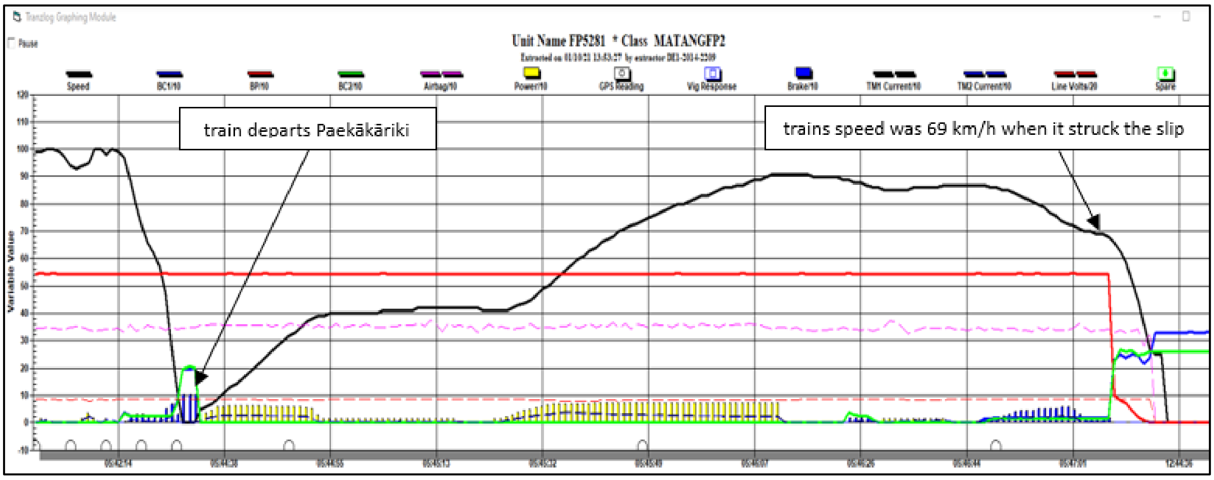

Figure 11: Tranzlog data of train departing Paekākāriki station and the lead-up to and after striking the slip

(Credit: Transdev Wellington)

[17] Tranzlog is a type of data recorder installed in main line locomotives. It records and stores data from the locomotives' control inputs for up to 30 days.

Other data sources

2.35. The Commission obtained forward-facing CCTV (closed-circuit television) footage from the derailed train and the train that had previously travelled over the derailment site without incident, together with weather-station and rainfall data near the accident site, train control radio and phone call voice recordings, train control graphs and signal logs.

Site and wreckage information

2.36. The section of track where the derailment occurred was at 36.037 km on the North Island Main Trunk line (NIMT), which is about 3 km south of Paekākāriki. At this location the rail corridor is about 3.5 m above State Highway 1 and has a steep embankment down to the road.

2.37. The slip site was a steep portion of hillside escarpment approximately 250 m above the track, which had a catchment area funnelling into the valley next to the rail corridor (*see* Figure 12).

2.38. There was limited access in the rail corridor to the elevated site where the train was derailed. It took two days to recover the train and clear remaining debris and to allow track workers to fix the portions of both main lines and restore inundated track ballast foundations.

2.39. A joint operation was conducted to remove the train from the derailment site. This included staff from Transdev Wellington, Hyundai Rotem and KiwiRail who removed the debris, re-railed the train and fixed the track infrastructure.

2.40. Two days after the derailment, KiwiRail restored the accident site to allow both freight and passenger trains to resume operations on the portion of closed track and applied a temporary speed restriction to all train movements to the portion of track where the slip had occurred.

Figure 12: Rear portion of train with debris across the up and down main lines
(Credit: KiwiRail).

Tests

2.41. On 26 January 2023, the Commission conducted tests on the accident train's radio system. These included tests of both the in-cab main radio and the in-cab back-up portable radio.

2.42. Commission tests included emergency calls to train control via the train's in-cab main radio to check the power, and via the in-cab back-up portable radio to check transmission at the accident site. The radio test results are discussed in the analysis section of this report.

Organisational information

2.43. Transdev Wellington operates passenger train services throughout the Wellington metropolitan region under a lease agreement with Greater Wellington Regional Council. The Council owns the EMUs.

2.44. KiwiRail is a New Zealand state-owned enterprise, operating trains and rail vehicles, controlling rail movements on the national rail network, and maintaining the railway infrastructure as the rail access provider.

Other occurrences

2.45. Between 2005 and 2023 there were 15 recorded slip events between Paekākāriki and Pukerua Bay (*see* Figure 13).

Figure 13: Previous slip events on the NIMT
(Credit: KiwiRail)

Other Commission inquiries:

RO-2010-102

2.46. On 30 September 2010, a northbound passenger train struck a slip and derailed between Plimmerton and Pukerua Bay. A southbound passenger train travelling on the opposing main line then struck the derailed train. The Commission opened inquiry RO-2010-102 into this occurrence and made three safety recommendations regarding crashworthiness, the need for automatic alerts for train control following an emergency brake activation, and slope stability risk assessments for areas posing risks within the Wellington metropolitan rail network.

RO-2021-106

2.47. On 13 December 2021, an adverse weather event with heavy rainfall resulted in streams and waterways being overwhelmed along the NIMT in the Hunterville area.

The water undermined the track formation, causing the derailment of a northbound freight train. The Commission opened inquiry RO-2021-106 into this occurrence.

RO-2023-102

2.48. On 29 January 2023, heavy rain in the Bay of Plenty region overwhelmed streams and waterway systems in the Te Puke area, resulting in the derailment of a freight train. The Commission opened inquiry RO-2023-102 into this occurrence.

3 Analysis
Tātaritanga

Introduction

3.1. Safe rail operations rely on a safety management system being applied effectively. An effective system ensures that rail vehicles on a network can operate with the highest possible level of safety integrity.

3.2. For this to occur, both rail operators and the rail access providers must have robust measures in place to understand and mitigate foreseeable risks that can affect the rail network.

3.3. In this accident, such measures should have included:

- analysing the slope stability of hillsides
- providing reliable back-up power systems
- providing reliable radio communication
- developing incident-recovery controls.

Slope stability risk assessments

Safety issue 1: KiwiRail had completed a slope stability risk assessment along the Kāpiti rail corridor and identified a medium stability risk at the accident site. However, insufficient mitigation measures were put in place, increasing the risk to the rail corridor from the slope instability.

3.4. As the rail access provider, KiwiRail must ensure that the risks that could affect the safety of the rail corridor are well understood. KiwiRail had a slope management programme in place at the time of the incident, which included a Slope Hazard Rating Assessment Tool (the risk assessment tool). The risk assessment tool, prepared by KiwiRail in 2009/2010, was used to assess the risks associated with cut and fill slopes and natural slopes adjacent to the rail network throughout New Zealand.

3.5. In 2011 and again in 2019, the risk assessment tool identified the catchment area where the slip occurred as of medium risk.

3.6. Following the derailment, KiwiRail commissioned an independent geotechnical land survey of the hillside's slope stability where the slip occurred. This included surveys of rainfall catchment zones, waterflow from rainfall, and land stability. The survey report found that existing and future risks remained at the site that required further mitigation.

3.7. KiwiRail implemented a temporary slip-detection monitoring system at the site along with a weather monitoring and live-camera alert system connected to the Wellington-based national train control centre. KiwiRail also had a debris protection barrier installed in June 2023, designed to catch and screen similar debris flows.

3.8. The Commission's investigation found that, had a debris protection barrier been in place, it is **very likely** the debris would have been retained above the rail corridor and would not have reached the track.

3.9. More broadly, in 2022, as part of the Wellington Metro Upgrade Project, KiwiRail in partnership with Greater Wellington Regional Council engaged engineering geologist advisors to review the risk assessment tool then develop an updated assessment approach that prioritised slope risk management activities that would improve the network resilience. One of the recommendations of the review was to update the technical guidance in the risk assessment tool to detail and document the hazard and risk analysis, risk matrices, key definitions, descriptions and notes, as well as any new parameters developed. It was also recommended that the 34 slopes along the Wellington Metro network, identified as having missing data, be assessed and that the location and condition of the existing slope protection and remedial works be recorded.

3.10. KiwiRail advised the Commission that the following work would be undertaken:

- explore the option of continuing the development of the risk assessment tool for other metropolitan areas across the national rail network
- reviewing the risk assessment tool and testing and implementing a minor project to make risk rating scores applicable across the national rail network
- assessing the 34 slopes along the Wellington Metro network identified as having missing data
- identifying the location and condition of the slope protection and remedial works that had already been recorded but, because of an error, were not available to the reviewers
- preparing a new Task Instruction[18], due to be published in 2024 with the reviewed Slope Risk Level.

Weather monitoring and alert settings

Safety issue 2: KiwiRail's rainfall-monitoring settings and weather risk matrix did not take into account periods of moderate or heavy rainfall in a short period of time, which have the potential to cause damage to rail infrastructure.

3.11. KiwiRail has a contract with a meteorological service provider to supply weather information across the rail network. The provider communicates rainfall predictions and weather-related information to KiwiRail in the days before an expected weather condition or event. This information is collated into areas corresponding to broad weather zones, then assessed in a weather risk matrix table. The table is used to calculate the potential risk of weather events on the rail corridor. KiwiRail also had at the time of the accident a rail resilience map that identified areas of the rail corridor subject to weather-related risks (*see* Figure 14).

[18] A Task Instruction is issued by KiwiRail and provides details of the requirements covering a specified topic. For example, the Level Crossing Alarms and Barrier Installations Task Instruction covers the testing, description, installation and maintenance requirements for level crossings.

Figure 14: Rail resilience map showing the risk profile across the network (red – very high risk, amber – high risk, yellow – medium risk and green – low risk)
(Credit: KiwiRail)

3.12. Upon receiving weather forecast information, the Network Control Manager emails information about potential risks to KiwiRail regional rail managers and field production network managers to assess the impacts and implement mitigations if required.

3.13. Because of the nature of thunderstorms, their weather patterns and any associated rainfall are difficult to predict. This means that any issues related to thunderstorms in the rail corridor have to be identified through the trackside rainfall monitoring system or visually identified and reported by rail vehicle operators to train control.

3.14. The total rainfall between 0300 and 0600 on 17 August 2021 was 27.1 mm. Under the National Institute of Water and Atmospheric Research's (NIWA's) hourly rainfall classification table, two of the three hours equated to heavy rainfall[19].

3.15. KiwiRail had live rain-monitoring systems along the rail corridor, including near where the derailment occurred. However, these monitoring systems were not set up to activate an alarm if the 24-hour rainfall exceeded 25 mm, as occurred in the three hours prior to this derailment.

3.16. KiwiRail's weather risk criteria table outlines the three risk profile settings based on rainfall over time, along with wind speed thresholds, that could affect the rail corridor (*see* Figure 15).

3.17. On this occasion the total rainfall forecast in the Kāpiti region did not trigger a heightened alert based on the risk matrix. On the day of the derailment, 27.1 mm of

[19] The NIWA classification system, based on guidance from the World Meteorological Organization, classifies heavy rainfall as between 10 and 50 mm rainfall within a one-hour period or rainfall greater than 100 mm in 24 hours.

rain fell in the three-hour period immediately before the accident. Although of short duration, this intensity of rain contributed to the slip across the rail corridor when drainage systems became overwhelmed.

Region	Lines	**Yellow** Significant weather but minimal impact expected on network	**Amber** Elevated risks of impacts at high, very high, and extreme risk locations on network	**Red** Potential for widespread impacts on network
Wellington Region (WN)	NIMT, WRAPA, Wellington	**24-hour rainfall totals >25 mm** **Wind gusts >80 km/h**	**Widespread rainfall with event totals >50 mm (within 48 hours) Wind gusts >120 km/h Risk of impacting Swell in WN harbour (aligns with >6m offshore)**	**Extreme Widespread weather event such as an ex-tropical cyclone, Event rainfall totals exceed 200mm.**

Figure 15: Weather risk criteria
(Credit: KiwiRail)

3.18. In other regions, such as the north and south of Kaikōura, a weather Triggered Action Response Plan (TARP)[20] is in place to gauge both actual and cumulative rainfall and measure the impacts of that rainfall on the rail network. The weather TARP identifies the rainfall risks and takes a rule-based approach to rail-track inspections and returning the rail network to operation after an adverse weather event.

3.19. Had the tolerance settings of the live rain-monitoring system been based on the intensity of rainfall as well as volume over a 24-hour period, it is **very likely** that train control would have been alerted to a higher-than-normal intensity of rain that had the potential to affect the safety of the rail network.

Automatic emergency alert system

Safety issue 3: Passenger train services in Wellington and Auckland do not have the capability to send automatic radio calls to train control when an emergency brake is applied. This could result in a delay in implementing a response to an emergency. The risk is even greater for a multi-line track, where a derailment has the potential to enter the operating area of an oncoming rail vehicle.

3.20. Engineering systems can put in place mechanisms for when human performance and time-based control applications are not sufficient. Systems such as automatic radio emergency response alerts[21] are common in other parts of the rail industry within New Zealand and around the world. Not having such systems installed in metropolitan passenger trains could lead to delays in responses to emergencies and create additional risks for other rail vehicles using the same network.

3.21. Both the Wellington and the Auckland metropolitan passenger trains are fitted with manual in-cab emergency radio buttons on the drivers' consoles (*see* Figure 16 for the locations). Each requires the driver to activate and depress a button with a hand in an

[20] A trigger action response plan (TARP) outlines the process to be followed if an occurrence happens.

[21] Automatic radio emergency response alerts are sent to train control when brakes are placed in the emergency position or the braking system loses air.

emergency situation. Currently this system does not work in conjunction with a train's emergency braking system to send an automatic radio call to train control, alerting it of an emergency. The Commission found in this accident that the driver did not have enough time after applying the emergency brake to activate the in-cab emergency radio button manually before the train's power was disconnected.

Figure 16: Driver's in-cab equipment positions

3.22. If an automatic alert system had been fitted to the train, it is **very likely** that the in-cab main radio would have sent an emergency alert call to train control. Train control was not immediately aware of the derailment and therefore was not able to respond immediately and put in place safety barriers to protect the derailed train and other rail vehicles.

Emergency training

Safety issue 4: Transdev Wellington did not provide ongoing practical training to educate drivers on the importance of applying the train's in-cab emergency radio button simultaneously with the emergency brake.

3.23. Training staff in any safety system[22] is a vital part of comprehensive theory and practical-based learning. Ensuring that a safety system can be followed, and the desired outcome(s) reached in a timely manner is critical when operating a passenger rail service.

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[22] In relation to a rail participant, the safety system is the written record of all the rail participant's management and operational policies and practices that relate to the safe conduct of its rail activities and includes the rail participant's operational and training manuals.

3.24. As the Wellington metropolitan passenger trains are not fitted with an automatic alert system and instead rely on drivers to simultaneously apply the emergency brake and the in-cab emergency radio button, a higher level of training is needed to ensure drivers respond appropriately in an emergency. In an emergency, rapid communication to train control of the emergency ensures appropriate action is taken quickly to mitigate any further incidents or accidents (for example to approaching rail traffic on the opposing line).

3.25. Transdev Wellington provided theory and practical training for drivers on the application of the in-cab emergency radio button and the application of the emergency brake, including:

- In cab emergency equipment available when an emergency situation occurs
- Location diagrams the in-cab equipment and what the equipment does when activated
- Radio base calling and emergency communications procedures
- Prestart equipment checks of the emergency equipment
- Low adhesion defensive driving skills
- Matangi brake system and the four types of brakes available
- Safety observations requirements and process of emergency situations

3.26. Transdev Wellington's Emergency Communication training content covers the location, use of equipment and procedures to follow in an emergency. It notes that during an emergency activation of the in-cab emergency radio button may require activation of the emergency brake simultaneously, leaving it to the driver's discretion at the time of the emergency (*see* Figure 17). If the driver was incapacitated after activating the emergency brake, they would not be able to then activate the in-cab radio emergency button and train control could be unaware of the emergency. However, if they are applied simultaneously and the driver becomes incapacitated, train control will have been alerted to the emergency.

Emergency Communication

During an "Emergency" follow this procedure:

- Activate the Radio Emergency Button located on the front panel (may require activation of the Emergency Brake simultaneously).
- When the Radio Emergency Button is activated, the call will be logged with the Train Controller corresponding to the channel the radio was on when the button was activated.
  If this Train Controller does not respond to the call, the call will automatically go to other Train Controllers until the call is accepted / acknowledged.

Note: When activating the Radio Emergency Button there is a time lapse of approximately 8 seconds before a voice call can be made.

Figure 17: Transdev Wellington emergency communication procedure document

3.27. The investigation looked at other rail operator's emergency training requirements and found that ongoing training to maintain skills and competencies gave the operator greater confidence that the skill or competency remained current.

3.28. While Transdev Wellington provided training for operating in-cab emergency equipment they could have gone further by providing regular ongoing practical training opportunities for drivers to operate both the in-cab emergency radio button simultaneously with the emergency brake application. This would better assist drivers to recall appropriate actions in order to ensure train control are alerted to an emergency at the earliest opportunity.

The radio system

Safety issue 5: Because of the limitations of the in-cab back-up portable radio systems on Wellington EMU trains, radio coverage was not available in some areas along the NIMT. Consequently, train crew may not always be able to communicate with train control during emergencies. This could have led to delays in implementing safety measures and providing timely assistance.

3.29. Radio communication is a critical part of operating a safe rail system. Radio communication between train control and a rail vehicle and between rail vehicles is necessary in ensuring clear and timely safety-critical communication.

3.30. There are two types of radio system in the EMU class of train that operates the Wellington commuter services. The first system is the in-cab main radio, which is a very-high-frequency (VHF), 25-watt system that relies on the train's power system or back-up battery to operate. The in-cab main radio uses a land-based repeater system to communicate with train control. The second system is the in-cab back-up portable radio. The back-up portable radio is independent of the train's power systems and has its own battery source. The in-cab back-up portable radio is a VHF 5-watt system that works off the land-based repeater system, similarly to the in-cab main radio.

3.31. The Commission's investigation found that the radio coverage and signal strength of the in-cab back-up portable radio were not sufficient to enable the driver to communicate with train control. Following the derailment, the driver had to use their personal mobile phone to inform train control of the accident.

3.32. On 27 February 2023 the Commission conducted a series of tests using the in-cab back-up portable radio on an empty EMU train along the Kāpiti line. The results demonstrated that at and around the derailment site the coverage and strength of the radio signals were compromised when the radio was:

- used in the cab and passenger compartments
- near topographic features and hillside landscapes
- in inclement weather
- near or in a tunnel.

3.33. The investigation found that some areas of the rail network had ineffective radio coverage when communicating with train control using the in-cab back-up portable radios.

3.34. The in-cab back-up portable radios were not subject to regular field-based assessments of signal strength and communication clarity. However, the working order of each in-cab back-up portable radio was tested annually by a KiwiRail radio technician. The investigation also found that there was no independent safety assessment of the in-cab back-up portable radio system by the rail regulator Waka Kotahi.

Safety issue 6: Metropolitan train services in Auckland and Wellington did not complete prestart back-up portable radio checks to confirm the system was fully functional. This posed a risk that the radio might not be able to be used to communicate with train control in an emergency.

3.35. Regular testing of a train's communication equipment is safety-critical for any rail operation, as it reduces the likelihood of the equipment failing or not working to its desired capabilities.

3.36. Immediately following the derailment, the train's main power source disengaged. This meant the train was reliant on the back-up battery for power to run systems such as the in-cab main radio, lighting and air conditioning. However, the back-up battery was also damaged in the derailment and was not operational.

3.37. The lack of power meant that the in-cab main radio could not be used to alert train control to the derailment. The driver tried the in-cab back-up portable radio (which was independent of the onboard power supply) several times but could not make clear contact with train control. The driver then used their personal mobile phone to contact train control and inform it of the derailment.

3.38. The metropolitan rail operators in Auckland and Wellington complete daily testing of the onboard radio equipment, but there is no testing to ensure the equipment can be used to contact train control or that it can be used across the entire network on which the trains operate on. This meant there was no knowledge of any limitations of the safety-critical communication equipment.

3.39. KiwiRail mainline freight and long-distance passenger train services are required to undertake pre-service radio checks with train control (both in-cab main radios and in-cab back-up portable radios) before operating on the rail network. This is different from the approach taken by metropolitan passenger train operators before trains enter service on the rail network.

Safety issue 7: Waka Kotahi had not undertaken any safety assessments of Transdev Wellington's radio systems and network coverage. This likely reduced its understanding of the system's limitations and how it affected rail safety.

3.40. Waka Kotahi[23] had not completed any Ordinary Safety Assessments (OSAs)[24] of the in-cab main or in-cab back-up radio systems or the network coverage on Transdev Wellington's metropolitan trains in the previous five years.

3.41. Waka Kotahi had been made aware of a radio issue on the Wairarapa line through the Rimutaka tunnel, which had been raised by a Transdev Wellington Health and Safety representative in a 2022 OSA. Waka Kotahi stated that discussions were ongoing in relation to the tunnel radio issues and that it was working with the operators to resolve those issues.

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[23] At the time of the accident the rail regulator was known as Waka Kotahi New Zealand Transport Agency.

[24] OSA is a safety assessment undertaken of all parts or any part of a rail participant's rail activities to enable the Director of Land Transport to gain appropriate assurances that those rail activities will continue to be conducted safely or to determine the action that must be taken by the rail participant so that those assurances may be gained.

Derailment TARP

Safety issue 8: There was no TARP (Triggered Action Response Plan) between Transdev Wellington (the rail operator) and KiwiRail (the network provider) that described the process to be followed when a main line passenger train derailed. This created a risk that train crews and Network Control Managers would not always follow safe processes in evacuating passengers.

3.42. System processes and procedures are vital when accidents and incidents occur. These can be taught theoretically and practically to ensure they are followed. Without these processes and procedures, ad hoc responses may be the result without their being a full understanding of the hazards or consequences of any action taken.

3.43. At the time of the derailment there was no TARP between the rail operator (Transdev Wellington) and the rail access provider (KiwiRail) for a main line train derailment.

3.44. Following the derailment, a joint working party was set up by Transdev Wellington and KiwiRail to develop and implement a derailment TARP. The objective of the joint working group was to develop a TARP to ensured known risks were mitigated effectively and produce guidelines. On 3 March 2023 KiwiRail informed the Commission that the working group had produced a draft TARP that would be endorsed and implemented by both the Auckland and the Wellington metropolitan commuter operators, heritage operators and KiwiRail. The expected implementation date of the derailment TARP was December 2024.

4 Findings
Ngā kitenga

4.1. The investigation found that had a debris protection barrier been installed, it is **very likely** the debris would have been contained above the rail corridor and would not have reached the track.

4.2. The weather service provider used by KiwiRail predicted rainfall for a large area south of Hamilton on the day of the accident, but did not alert of a short, heavy rainfall event in the Kāpiti area. Therefore, risk mitigations were not in place at the time of the derailment.

4.3. Had KiwiRail's trackside rainfall-monitoring stations been set to alert short heavy rainfall periods it is **very likely** that train control would have been advised of the weather event.

4.4. If an automatic alert system had been fitted to the train, it is **very likely** that the in-cab radio would have sent an emergency alert call to train control.

4.5. The driver did not have enough time before the train lost all power to depress the manual in-cab emergency radio button after applying the emergency brake.

4.6. The train's back-up power system failed because of the extensive damage caused when the train struck the slip and derailed.

4.7. The in-cab back-up portable radio could not provide clear communication to train control after the train derailed. This delayed safety and recovery measures being put in place.

4.8. Rail operators of metropolitan passenger train services are not currently required to test train radios with train control.

4.9. While Transdev Wellington provided training for operating in-cab emergency equipment they could have gone further by providing regular practical training opportunities for drivers to operate both the in-cab emergency radio button simultaneously with the emergency brake.

4.10. At the time of the accident, there was no Triggered Action Response Plan for main line train derailments.

4.11. Waka Kotahi had not undertaken any safety assessments for radio systems and network coverage, so did not have any understanding of their limitations.

5 Safety issues and remedial action
Ngā take haumaru me ngā mahi whakatika

General

5.1. Safety issues are outputs from the Commission's analysis. They may not always relate to factors directly contributing to an accident or incident. They typically describe a system problem that has the potential to adversely affect future transport safety.

5.2. Safety issues may be addressed by safety actions taken by a participant. Otherwise, the Commission may issue a recommendation to address an issue.

Safety issue 1: KiwiRail had completed a slope stability risk assessment along the Kāpiti rail corridor and identified a medium stability risk at the accident site. However, insufficient mitigation measures were put in place, increasing the risk to the rail corridor from the slope instability.

5.3. In September 2021, KiwiRail completed an internal investigation into the derailment, and on 19 November 2021 produced a geotechnical risk assessment report on the slope stability at the accident site. As a result of the risk assessment, KiwiRail implemented immediate risk mitigations at the slip site, designed and installed a debris-protection barrier on the hillside escarpment and installed live monitoring of the slip site.

5.4. More broadly, in 2022 KiwiRail, in partnership with Greater Wellington Regional Council, engaged engineering geologist advisors to undertake a slope rating review that prioritised slope risk management activities that improved network resilience. The review report made several recommendations, including to:

- update the risk assessment tool
- assess the 34 slopes along the Wellington Metro network that were identified as having missing data
- record the locations and conditions of the existing slope protection and remedial works along the Wellington Metro network
- explore the option of continuing the review/update of the risk assessment tool.

5.5. In the Commission's view, these safety actions have addressed the safety issue. Therefore the Commission has not made a recommendation.

Safety issue 2: KiwiRail's rainfall-monitoring settings and weather risk matrix did not take into account periods of moderate or heavy rainfall in a short period of time, which have the potential to cause damage to rail infrastructure.

5.6. No safety action has been taken to address this safety issue. Therefore the Commission has made a recommendation in Section 6 to address this issue.

Safety issue 3: Passenger train services in Wellington and Auckland do not have the capability to send automatic radio calls to train control when an emergency brake is applied. This could result in a delay in implementing a response to an emergency. The risk is even greater for a

multi-line track, where a derailment has the potential to enter the operating area of an oncoming rail vehicle.

- On 21 August 2024, Transdev Wellington informed the Commission that it would raise an engineering change request to implement this recommendation and submit it to Metlink for approval and funding.
- The Commission acknowledges Transdev Wellington is taking safety action to address this safety issue. However, until the automatic alert system is in place, the safety issue will remain. Therefore the Commission has made a recommendation in Section 6 to address this issue.

Safety issue 4: Transdev Wellington did not provide ongoing practical training to educate drivers on the importance of applying the train's in-cab emergency radio button simultaneously with the emergency.

- On 21 August 2024, Transdev Wellington informed the Commission that it will review the training of locomotive engineers in the context of the recommendation to link the emergency brake to an automatic train control alert to ensure all locomotive engineers are fully conversant with the operation of cab controls.
- The Commission acknowledges Transdev Wellington is taking safety action to address this safety issue. However, until the training syllabus is in place, the safety issue will remain. Therefore the Commission has made a recommendation in Section 6 to address this issue.

Safety issue 5: Because of the limitations of the in-cab back-up portable radio systems on Wellington EMU trains, radio coverage was not available in some areas along the NIMT. Consequently, train crew may not always be able to communicate with train control during emergencies. This could have led to delays in implementing safety measures and providing timely assistance.

- On 21 August 2024, Transdev Wellington informed the Commission that it will raise an engineering change request to implement this recommendation and submit it to Metlink for approval and funding.
- The Commission acknowledges Transdev Wellington is taking safety action to address this safety issue. However, until the limitation of the in-cab back-up portable radio are rectified, the safety issue will remain. Therefore the Commission has made a recommendation in Section 6 to address this issue.

Safety issue 6: Metropolitan train services in Auckland and Wellington did not complete prestart back-up portable radio checks to confirm the system was fully functional. This posed a risk that the radio would not be able to be used to communicate with train control in an emergency.

- On 21 August 2024, Transdev Wellington informed the Commission that it will raise an engineering change request to implement the back-up radio communication check part of this recommendation and submit it to Metlink for approval and funding.
- The Commission acknowledges Transdev Wellington is taking safety action to address this safety issue. However, until regular checks of the radio system are in place, the safety issue will remain. Therefore the Commission has made a recommendation in Section 6 to address this issue.

Safety issue 7: Waka Kotahi had not undertaken any safety assessments of Transdev Wellington's radio systems and network coverage. This likely reduced its understanding of the systems limitations and how it affected rail safety.

5.7. Since the accident, Waka Kotahi has introduced the Rail Regulatory Risk Framework (known as R3F) to provide for a more comprehensive assessment of a rail licence holder's safety system. Waka Kotahi informed the Commission that R3F includes emergency response planning that requires rail licence holders to test their own systems, assumptions and responses to identify gaps.

5.8. In the Commission's view, the safety action has addressed the safety issue. Therefore the Commission has not made a recommendation.

Safety issue 8: There was no TARP between Transdev Wellington (the rail operator) and KiwiRail (the network provider) that described the process to be followed when a main line passenger train derailed. This created a risk that train crews and Network Control Managers would not always follow safe processes in evacuating passengers.

5.9. On 3 March 2023, KiwiRail supplied the Commission with a draft TARP for main line train derailment procedures. KiwiRail has advised the Commission that the first phase of the TARP will be implemented across the rail industry by December 2024.

5.10. In the Commission's view, this safety action has addressed the safety issue. Therefore the Commission has not made a recommendation.

6 Recommendations
Ngā tūtohutanga

General

6.1. The Commission issues recommendations to address safety issues found in its investigations. Recommendations may be addressed to organisations or people and can relate to safety issues found within an organisation or within the wider transport system that have the potential to contribute to future transport accidents and incidents.

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

Recommendations

6.3. On 25 September 2024, the Commission recommended that KiwiRail review the trigger settings of its rainfall-monitoring equipment and weather risk matrix to ensure they can identify and respond to moderate or heavy rainfall that occurs within a short time period. **[004/24]**

6.4. On 1 October 2024, KiwiRail replied:

> KiwiRail has accepted and implemented this recommendation. Our new Severe Weather TARP addresses this recommendation and was published on 26 September 2024.

6.5. On 25 September 2024, the Commission recommended that Transdev Wellington and Auckland One Rail take action to fit automatic alert systems to emergency brake activations on its passenger train services, to alert train control to an emergency at the earliest possibility. **[005/24]**

6.6. On 1 October 2024, Transdev Wellington replied:

> This recommendation is Under Consideration. Transdev Wellington will raise an engineering change request to implement this recommendation and submit it to Metlink for approval and funding. Greater Wellington Rail Limited via Metlink, own the rolling stock and approve and fund any alterations. We note there may be occasions where an emergency radio call would be appropriate, a trackside fire for example, but the use of the emergency brake would not be applied. Similarly, testing the emergency brake (a frequent occurrence) would not require an emergency notification to train control.

6.7. On 29 September 2024, Auckland One Rail replied:

> In relation to this recommendation the AOR EMUs will alert TC if the mushroom emergency brake is depressed.
>
> and on 15 October 2024:
>
> Accepted and implemented. In an emergency LEs are trained to activate the emergency brakes using the emergency device. This will automatically send an emergency call to alert Train Control.

6.8. On 25 September 2024, the Commission recommended that Transdev Wellington review and improve the training on the application of the in-cab emergency radio button simultaneously with an emergency brake application. **[006/24]**

6.9. On 1 October 2024, Transdev Wellington replied:

> This recommendation is Under Consideration. Transdev Wellington will review the training of locomotive engineers in the context of the recommendation to link the emergency brake to operation of emergency radio button to alert train control. As noted in the report, our training allows the locomotive engineer to decide if an emergency notification to train control is warranted as they are in charge of the train and understand the context of emergency brake use.

6.10. On 25 September 2024, the Commission recommended that Transdev Wellington review the back-up portable radio system, particularly the equipment, coverage and signal strength along the network, to ensure it can transmit clear communication between train crews and train control. **[007/24]**

6.11. On 1 October 2024, Transdev Wellington replied:

> This recommendation is Under Consideration. Transdev Wellington will raise an engineering change request to implement this recommendation and submit it to Metlink for approval and funding. As previously advised, Greater Wellington Rail Limited via Metlink, own the rolling stock and approve and fund any alterations. Transdev Wellington has raised concerns about the radio coverage across the network during Wellington Network Agreement discussions which both KiwiRail and Metlink attend. It remains our belief that KiwiRail and Metlink should address the cause of poor network radio coverage and provide suitable infrastructure to allow both onboard and hand-held radios to function effectively.

6.12. On 25 September 2024, the Commission recommended that Transdev Wellington and Auckland One Rail implement regular checks of the onboard radios (both in-cab main radios and in-cab back-up portable radios) in their passenger trains to ensure they can communicate with train control. **[008/24]**

6.13. On 1 October 2024, Transdev Wellington replied:

> This recommendation is Under Consideration. Transdev Wellington will raise an engineering change request to implement the back-up radio communication check part of this recommendation and submit it to Metlink for approval and funding. As previously advised, Greater Wellington Rail Limited via Metlink, own the rolling stock and approve and fund any alterations. The main radio is used to call train control when departing yards; if this radio fails the train is unable to depart the yard and enter the network. There is also a self-test function on this radio which operates every time the train is powered up. The onboard radios are subject to annual certification by KiwiRail and are checked by Hyundai Rotem every 'B' check.

6.14. On 14 May 2024, Auckland One Rail replied:

> I would consider this has been accepted and implemented.
>
> The secure radio is recertified on an annual basis by a radio technician and was last carried out in April 24.
>
> Part of the preparation for use is a self-check of the radio by the operator. The trains are remotely controlled by Train Control and Wiri Operations. Therefor the radio must be operational to allow the authority to move to occur.

7 Key lessons
Ngā akoranga matua

7.1. Assessing slope stability and the effects of adverse weather on and around the rail corridor is essential to identifying hazards and putting in place mitigation measures.

7.2. Effective and reliable radio communication systems across the rail network are essential features of a safe rail operation.

7.3. Effective training for staff on rail safety systems is crucial to ensure they are prepared when an incident or accident occurs.

7.4. Engineering controls and the automation of safety alert systems provide further protection during times of high workload and crew stress.

7.5. Triggered Action Response Plans (TARPs) provide a high level of oversight and preparedness for possible incidents and accidents before they occur.

7.6. The increase in adverse weather events is having direct impacts on the safe operation of the rail network.

8 Data summary
Whakarāpopoto raraunga

Vehicle particulars

Train type and number:	passenger train 6205
Classification:	Electric Multiple Unit (EMU)
Year of Manufacture:	2011
Operator:	Transdev Wellington
Date and time	17 August 2021, 0547
Location	Paekākāriki
Operating crew	one train driver, two train crew
Injuries	none
Damage	extensive damage to the leading and rear carriages of the train

9 Conduct of the inquiry
Te whakahaere I te pakirehua

9.1. On 21 August 2021 Waka Kotahi notified the Commission of the occurrence. The Commission subsequently opened an inquiry under section 13(1) of the Transport Accident Investigation Commission Act 1990 and appointed an Investigator-in-Charge.

9.2. The Commission obtained documentation and records including:

- the Tranzlog data of the locomotive
- signal logs
- mobile phone records
- maintenance records
- track and infrastructure records
- train control voice recordings
- training and safety documentation
- slope stability risk assessments.
- radio signal and portable radio testing.

9.3. The Commission conducted interviews with the train's crew, the radio technician and the Transdev Wellington training and development manager and facilitator.

9.4. On 21 August 2021 the Commission conducted a site examination and examined the locomotive.

9.5. On 15 November 2023 the Commission approved a draft report for circulation to seven interested parties for their comment.

9.6. Five interested parties provided submissions and two interested parties replied that they had no comments. Any changes as a result of the submissions have been included in the final report.

9.7. Following preparation of a final report and recommendations, a further submission relating to safety issues was received from one interested party. Changes as a result of this submission have been included in the final report.

9.8. On 25 September 2024, the Commission approved the final report for publication.

Abbreviations
Whakapotonga

EMU	electric multiple unit
km	kilometres
km/h	kilometres per hour
m	metres
mm	millimetres
NIMT	North Island Main Trunk
NIWA	National Institute of Water and Atmospheric Research
OSA	Ordinary Safety Assessment
RIC	Rail Incident Co-ordinator
TARP	Triggered Action Response Plan
WMO	World Metrological Organisation

Glossary
Kuputaka

automatic emergency alert system	an automatic alert system that uses the train's radio system to send a call to train control automatically when the train's brake is moved into the emergency position or a rapid loss of air to the braking system occurs
down main line	a portion of rail track on a multiline rail network on which trains are run in the down direction
driver	the train driver
evacuation egress points	points located at the ends of EMU train cabs, allowing access from the train to the ground via a ramp and handrail system
heavy rainfall	the National Institute of Water and Atmospheric Research (NIWA) classification system, based on guidance from the World Meteorological Organization, classifies heavy rainfall as between 10 and 50 millimetres of rainfall within a one-hour peric or rainfall greater than 100 millimetres in 24 hours
multiline	a line that incorporates an up and a down main line adjacent to each other
Ordinary Safety Assessment	a safety assessment undertaken of all parts or any pa of a rail participant's rail activities to enable the Director of Land Transport to gain appropriate assurances that those rail activities will continue to b conducted safely or to determine the action that mu be taken by the rail participant so that those assurances may be gained
pantograph	A device mounted on a train to transfer current from one or several contact wires.
safety system	in relation to a rail participant, this means a written record of all the rail participants' management and operational policies and practices that relate to the

	safe conduct of its rail activities, and includes the rai participants' operational and training manuals
Tranzlog	Tranzlog is a type of data recorder installed in main line locomotives. It records and stores data from the locomotives' control inputs for up to 30 days.
up main line	a portion of rail track on a multiline rail network on which trains are run in the up direction

Appendix 1 NIWA hourly rainfall classification

Display Category	Value Range	Precision	Icon	Comments
Nil	< 0.1 mm/h			Converts to zero
Light	>= 0.1 to < 2.5mm/h	0.1 mm		from WMO
Moderate	>= 2.5 to < 10 mm/h	0.1 mm		from WMO
Heavy	>= 10 to < 50 mm/h	0.1 mm		from WMO
Violent	>= 50 mm/h	0.1 mm		from WMO

[25]

[25] As provided to the Commission by NIWA.

Kōwhaiwhai - Māori scroll designs

TAIC commissioned its four kōwhaiwhai, Māori scroll designs, from artist Sandy Rodgers (Ngāti Raukawa, Tūwharetoa, MacDougal). Sandy began from thinking of the Commission as a vehicle or vessel for seeking knowledge to understand transport accident tragedies and how to avoid them. A 'waka whai mārama' (i te ara haumaru) is 'a vessel/vehicle in pursuit of understanding'. Waka is a metaphor for the Commission. Mārama (from 'te ao mārama' – the world of light) is for the separation of Rangitāne (Sky Father) and Papatūānuku (Earth Mother) by their son Tāne Māhuta (god of man, forests and everything dwelling within), which brought light and thus awareness to the world. 'Te ara' is 'the path' and 'haumaru' is 'safe' or 'risk free'.

Corporate: Te Ara Haumaru - the safe and risk free path

The eye motif looks to the future, watching the path for obstructions. The encased double koru is the mother and child, symbolising protection, safety and guidance. The triple koru represents the three kete of knowledge that Tāne Māhuta collected from the highest of the heavens to pass their wisdom to humanity. The continual wave is the perpetual line of influence. The succession of humps represents the individual inquiries.

Sandy acknowledges Tāne Māhuta in the creation of this Kōwhaiwhai.

Aviation: Ngā hau e whā - the four winds

To Sandy, 'Ngā hau e whā' (the four winds), commonly used in Te Reo Māori to refer to people coming together from across Aotearoa, was also redolent of the aviation environment. The design represents the sky, cloud, and wind. There is a manu (bird) form representing the aircraft that move through Aotearoa's 'long white cloud'. The letter 'A' is present, standing for a 'Aviation'.

Sandy acknowledges Ranginui (Sky father) and Tāwhirimātea (God of wind) in the creation of this Kōwhaiwhai.

Maritime: Ara wai - waterways

The sections of waves flowing across the design represent the many different 'ara wai' (waterways) that ships sail across. The 'V' shape is a ship's prow and its wake. The letter 'M' is present, standing for 'Maritime.

Sandy acknowledges Tangaroa (God of the sea) in the creation of this Kōwhaiwhai.

Rail: rerewhenua - flowing across the land

The design represents the fluid movement of trains across Aotearoa. 'Rere' is to flow or fly. 'Whenua' is the land. The koru forms represent the earth, land and flora that trains pass over and through. The letter 'R' is present, standing for 'Rail'.

Sandy acknowledges Papatūānuku (Earth Mother) and Tāne Mahuta (God of man and forests and everything that dwells within) in the creation of this Kōwhaiwhai.

Transport Accident Investigation Commission

Recent Rail Occurrence reports published by the Transport Accident Investigation Commission (most recent at top of list)

RO-2023-102	Freight train 360, derailment, Te Puke, 29 January 2023
RO-2023-101	Hi rail vehicle collision near Te Puna, 86.43 km East Coast Main Trunk Line, 10 January 2023
RO-2023-103	Safe working irregularity, 3.85km, Johnsonville line, tunnel 5, 4 May 2023
RO-2022-104	Shunt train L51 and heavy goods vehicle, level crossing collision and derailment, Whangārei, 7 December 2022
RO-2022-102	L71 Mainline Shunt, derailment and subsequent rollover, Tamaki, 1 June 2022
RO-2022-101	Passenger train, fire in auxiliary generator wagon, Palmerston North, 11 May 2022
RO-2022-103	KiwiRail W6 shunt and Metro (Go Bus) Route 60 bus, near miss at Selwyn Street level crossing, Christchurch, 8 August 2022
RO-2021-105	Unintended movement resulting in locomotive and wagon entering Picton Harbour, Picton, 1 September 2021
RO-2021-106	Derailment of Train 220, South of Hunterville, 13 December 2021
RO-2021-103	Te Huia passenger service, train parting, North Island main trunk line, Paerata, 19 July 2021
RO-2021-102	Freight Train 391, collision with light truck, Saunders Road, Marton, 13 May 2021
RO-2021-101	Serious injury during shunting operations on board the Aratere, Interislander ferry terminal, Wellington, 9 April 2021
RO-2020-101	Level crossing collision, Mulcocks Road, Flaxton, 10 February 2020
RO-2020-104	Safe working irregularity, East Coast Main Trunk Line, Hamilton – Eureka, 21 September 2020
RO-2020-103	Collision between bus and locomotive, Clevely Line level crossing, Bunnythorpe, 16 September 2020

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