Transport Accident Investigation Commission

Final report
Tuhinga whakamutunga

Rail inquiry RO-2023-102
Freight train 360
Derailment
Te Puke
29 January 2023

June 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 incidents and accidents 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.

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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: The DL 9020 locomotive involved in the accident

(Credit: KiwiRail)

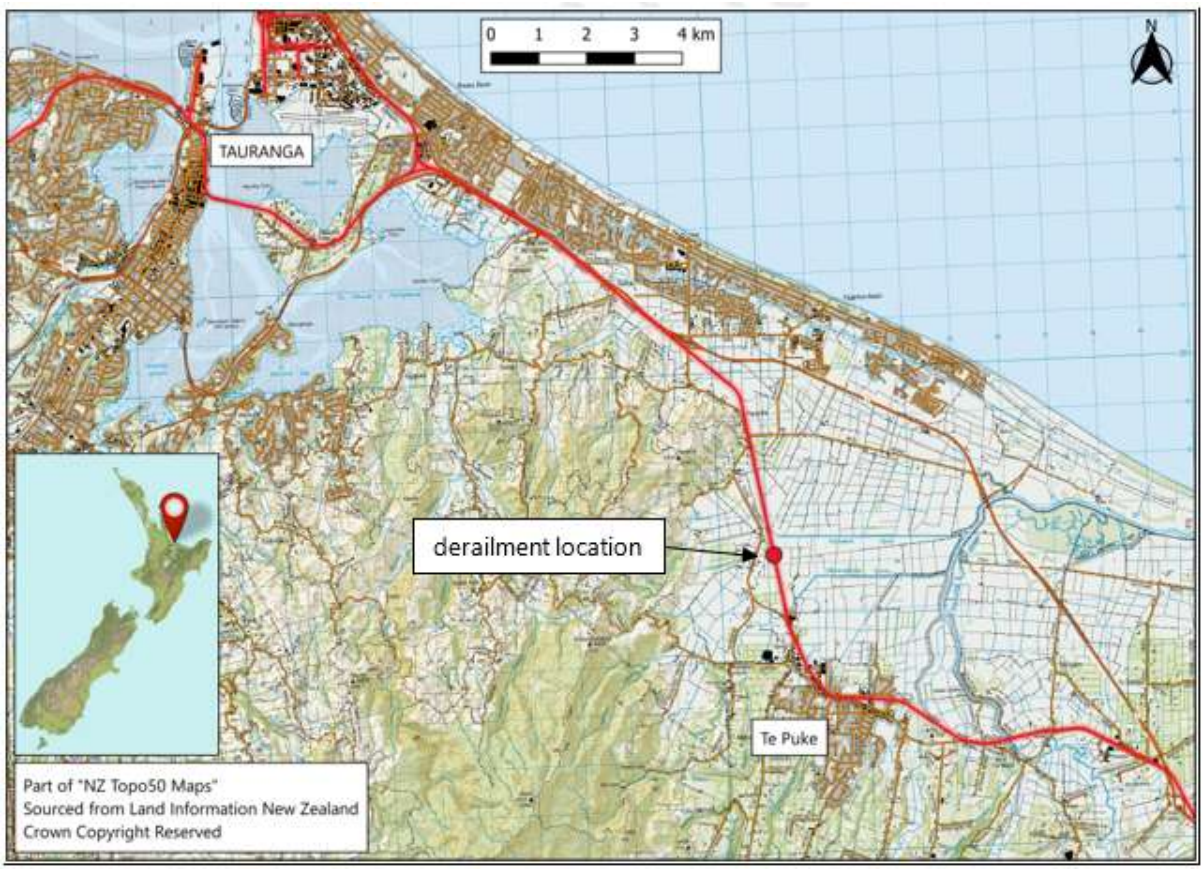

Figure 2: Location of the derailment

(Credit: Toitū Te Whenua, LINZ)

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1 Executive summary
Tuhinga whakarāpopoto

What happened

1.1. On 27 and 28 January 2023, the Bay of Plenty region was experiencing heavy rainfall[1]. On 28 January, the crew of a KiwiRail freight train (train 385) observed and reported to Train Control[2] a high water level at rail bridge 85 on the East Coast Main Trunk[3] line (ECMT) north of Te Puke.

1.2. On receipt of the information, Train Control arranged for a track inspection to be conducted to assess the risks. The track inspection occurred at an incorrect location, resulting in clearance being given for trains to resume normal operations.

1.3. At 0330[4] the next day, a KiwiRail freight train (train 360) conveying 39 wagons, with the same crew on board who had reported the high water the previous day, departed Kawerau rail terminal bound for Tauranga.

1.4. At about 0430 the train, travelling at approximately 60 kilometres per hour, encountered substantial floodwater across the track north of Te Puke, not far from rail bridge 85. The crew felt the locomotive drop downwards before the emergency brake activated automatically, stopping the train approximately 150 metres past the floodwater.

1.5. The crew disembarked to see what had activated the emergency brakes. They discovered that only the first five wagons[5] were behind the locomotive, with the other 34 wagons missing. Of the five wagons behind the locomotive, four had uncoupled.

1.6. It was later discovered that of those 34 wagons, 11 had derailed[6] approximately 100 metres down the track.

1.7. The crew reboarded the locomotive and contacted Train Control before moving the locomotive and the one remaining wagon forward to higher ground.

Why it happened

1.8. The Bay of Plenty region had been experiencing heavy rainfall two days prior to the derailment. Rainfall that fell during that period overwhelmed rivers and waterways in and around Te Puke, including the drainage system along the rail corridor.

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[1] Greater than 100 millimetres of rainfall over a 24-hour period or a period of rainfall between 10 and 50 millimetres per hour as classified by the National Institute of Water and Atmospheric Research, Taihoro Nukurangi (NIWA).

[2] Train contro1l is the personnel responsible for authorising rail vehicle movements on the national rail network.

[3] The rail line extended between Hamilton, Tauranga and Kawerau.

[4] Times used in this report are expressed in the 24-hour format based on New Zealand Daylight Time.

[5] A wagon is a rail vehicle that moves freight on the rail network.

[6] An event that occurs when a rail vehicle's wheels disengage their connection with the top of the rail head.

1.9. At its peak, the water level around the accident site rose approximately 3.5 metres[7], causing scouring and washout of the rail track's supporting formation[8].

1.10. Without the supporting formation, the track was not able to support the weight of the train as it passed over the compromised section. This resulted in the decoupling and derailment of some of the wagons.

What we can learn

1.11. As the frequency of severe weather events increases, risk assessments for transport infrastructure become more significant. Therefore, ensuring hazards are identified and appropriate controls are applied is essential.

1.12. All personnel undertaking safety-critical roles should adhere to the principles underlying the application of non-technical skills to ensure that they share the same mental models and have a clear understanding of what is required of themselves and others to complete tasks safely.

1.13. Engineering systems and real-time monitoring can assist in providing accurate information with which personnel can make timely and informed decisions and ensure a safe transport system.

Who may benefit

1.14. Rail personnel, transport operators, infrastructure designers, maintainers of the infrastructure and anyone involved in planning and responding to the impacts of weather events on transport networks may benefit from the findings.

[7] This measurement was taken by Transport Accident Investigation Commission investigators during the site visit.
[8] The track formation is the supporting material used under and around rail sleepers; it supports the track and includes the lower supporting compacted materials used in construction.

2 Factual information
Pārongo pono

Narrative

Severe weather warning

2.1. On the morning of Thursday 26 January 2023, Meteorology Solutions Limited (MetSolutions)[9] provided an escalated weather alert and MetService[10] provided a severe weather alert by email to KiwiRail's Network Control Manager (NCM)[11].

2.2. MetService provided a severe weather warning for heavy rain and strong northeasterlies for parts of the upper North Island, including significant rainfall in western Bay of Plenty, where heavy rain warnings were in force. The heavy rain warning for the Bay of Plenty west of Whakatāne stated:

> Valid: 24 hours from 4:00pm Fri 27 Jan to 4:00pm Sat 28 Jan
> Forecast: Expect 100 to 140 mm [millimetres] of rain about the ranges, with 60 to 90 mm elsewhere. Peak rates of 10 to 20 mm/h [millimetres per hour] expected about the ranges from Friday evening through to around dawn Saturday.
> Note, once the heavy rain eases, showers are expected through the rest of the weekend.

2.3. MetSolutions provided a summary of significant rain and wind impacts for Friday and Saturday, which included:

> Heavy rain for BOP Sat [Bay of Plenty on Saturday] with event totals reaching 100+ mm, esp. west of Tauranga, and for the Tokoroa and Rotorua line areas. More rain for Sun [Sunday], but less intense.

2.4. MetSolutions also provided updated information on the risks for all areas in its Weather Risk Matrix[12] (*see* Figure 3).

[9] MetSolutions is contracted to KiwiRail to provide general weather updates three times a week and further alerts (escalated weather alerts) when severe weather is predicted.
[10] MetService is New Zealand's national weather authority.
[11] The Network Control Manager is the supervisor of a train control centre.
[12] In the Weather Risk Matrix, the four colour codes are Green – no impact, Yellow – minimal impact, Amber – high to very high impact, and Red – widespread impacts across the network.

Forecast		
	BOP	
Date	ECMT	Forecast comments
Friday, 27 January 2023		Rain spreads to most of the North Island, then eases Upper NI later in the day. 1. Totals 25 to 50 mm in many western places about and north of Taranaki, including National Park, and with 50 to 75 mm for Upper NI, AK, and BOP. 3. Northeast wind gusts 80+ km/h for exposed parts of Upper NI and AK. Risk of gusts 90 km/h for east parts of AK Metro area pm/evening hours which could pose a risk of overhead lines.
Saturday, 28 January 2023		1. Rain continues over much of the North Island with risk of totals reaching 25 mm in many places. 2. Heavy sustained rain for BOP 100+ mm, esp. inland such as Tokoroa and Rotorua lines and in areas just east of Kaimai Tunnel. 3. Risk of a period of heavy rain for East NI south of about Napier with 75+ mm in places - which reaches escalated risk criteria.
Sunday, 29 January 2023		Further periods of rain for Upper NI, AK and BOP with 25+ mm in places. Escalated risk levels continue for BOP.

Figure 3: An extract from the MetSolutions Weather Risk Matrix for the Bay of Plenty East Coast Main Trunk

2.5. At 2034 on 26 January, MetService emailed an updated severe weather warning to the NCM. The expected volume of rain for the area of the Bay of Plenty west of Whakatāne was greater and over a longer period:

> Valid: 30 hours from 12:00pm Fri 27 Jan to 6:00pm Sat 28 Jan
> Forecast: Expect 120 to 160 mm of rain about the ranges, with 60 to 90 mm elsewhere. Peak rates of 10 to 20 mm/h expected about the ranges from Friday evening through to Saturday afternoon.
> Note, the warning validity end time may be extended in the next issue.

2.6. At 0947 on 27 January, MetService provided a further updated severe weather warning to the NCM. The expected volume of rain for the area of the Bay of Plenty west of Whakatāne was even greater, with increased rates possible in thunderstorms, and for a longer period:

> Valid: 33 hours from 10:00am Fri 27 Jan to 7:00pm Sat 28 Jan
> Forecast: Expect 130 to 180 mm of rain about the ranges, and 70 to 110 mm elsewhere. Peak rates of 15 to 25 mm/h from this evening, especially about the ranges, however, rates of 25 to 35 mm/h are possible in thunderstorms.

2.7. As the weather information was received by the NCM from MetSolutions and MetService, and in accordance with procedure, the NCM forwarded the information to all Field Production and Operation Managers around the country (*see* Appendix 1). The NCM did not alert the regional managers to the severe weather warnings.

2.8. The Bay of Plenty Field Production Manager received the NCM's emails and in response alerted the track inspectors to the forecast weather conditions for the upcoming weekend. They also contacted the Bay of Plenty Regional Field Production Manager to confirm receipt of the severe weather warning and to ensure that staff, contractors and provisions would be in place if required during the weekend period.

2.9. On 27 January the Bay of Plenty region began experiencing heavy rain in what would evolve into a significant weather event due to a sub-tropical low[13] pressure system that was moving across northern parts of New Zealand.

2.10. Heavy rain continued to fall throughout 28 and 29 January. Train services on the East Coast Main Trunk (ECMT) continued to run to their normal schedules throughout this period.

Train crew observation and track inspection

2.11. On 28 January at about 0630, the crew[14] of train 385 (the crew) observed a significantly high water level as they crossed rail bridge 85 north of Te Puke (*see* Figure 4).

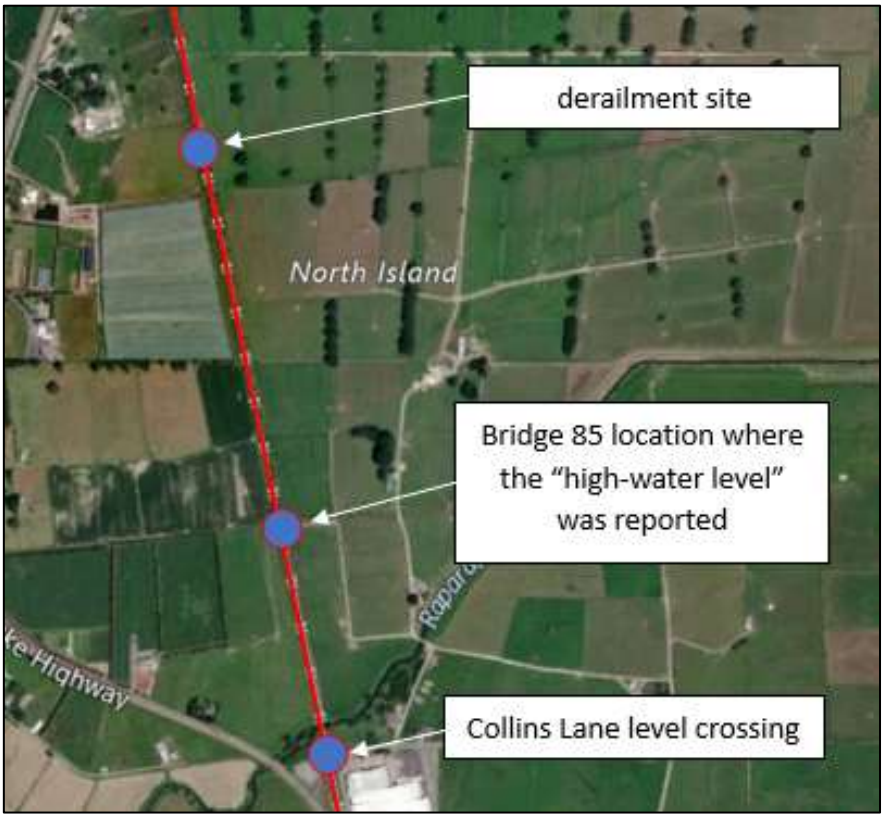

Figure 4: Aerial map showing the location of bridge 85

2.12. Concerned, the crew radioed Train Control that the water level was getting up to the rail bridge, and other waterways in the area looked flooded. To confirm the location of the water, Train Control repeated back to the crew "east side of Te Puke". The crew replied, "yer roger the Mount[15] side of Te Puke are all getting high". The Mount is to the west of Te Puke, not the east.

[13] Sub-tropical low is a type of weather condition that can bring heavy rain with possible thunderstorms and downpours. It may also bring strong and gale-force winds.

[14] The train crew comprised a trainee locomotive engineer (trainee) and a supervising locomotive engineer known as a minder. The crew was involved in the derailment on the following day.

[15] The 'Mount' is a reference to Mount Maunganui (*see* Figure 5).

2.13. Neither the crew nor Train Control included the track meterage[16] or any track structures as reference points when communicating the location of the high water to assist in obtaining a common understanding of where the issue was located. Following the radio call from the crew, the Train Controller[17] called the support desk[18] (known as 155 operators) to request a track inspection[19].

2.14. At about 0735, a 155 operator contacted a track inspector and informed them that "water was coming through the bridge east of Te Puke". A track meterage of 119.190 kilometres (km) ECMT was given. This location was approximately 4 km south of the location of the high water levels observed and reported by the crew.

2.15. At about 0815 the track inspector arrived at Collins Lane level crossing and called Train Control to gain authority to on-track[20] and start the track inspection south to Pongakawa station (*see* Figures 4 and 5).

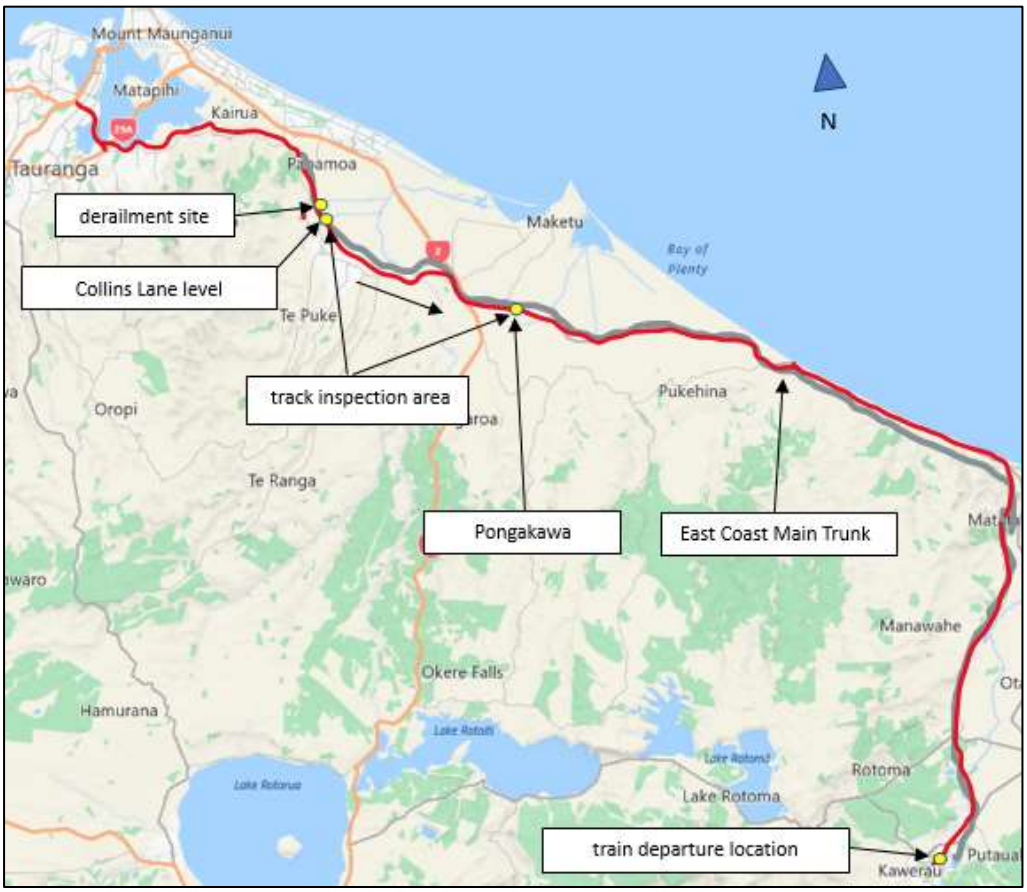

Figure 5: Map of the ECMT between Tauranga and Kawerau

[16] Each rail line is identified by track meterage starting from a 0.000 km location and is set out in half-kilometer and full-kilometer sections until the end of the line.

[17] A rail employee who controls rail vehicle movements on a rail network.

[18] The KiwiRail support desk takes incoming communications and network-related issues and organises staff to complete various maintenance tasks on and inspections of the rail network.

[19] A track inspection is undertaken by a certified rail person, who conducts inspections of the track and structures within the rail corridor.

[20] The term used to position a road rail vehicle known as a hi rail vehicle on a level crossing or track access site to engage the vehicle's rail wheels with the track for rail operation.

2.16. At about 0905 the track inspector arrived at Pongakawa station, having completed the track inspection. They radioed Train Control and gave clearance to run trains at normal speeds, having found no visible track or infrastructure issues to report. The maximum line speed for the track was 70 kilometres per hour (km/h).

2.17. From that time until the accident occurred, eight trains travelled along the ECMT and across bridge 85. None of the crew reported observing high water at any point along the route.

The accident event

2.18. At about 0300 on 29 January, a trainee locomotive engineer[21] (the trainee) and a locomotive engineer minder[22] (the minder) arrived at Kawerau rail terminal to complete pre-departure paperwork. They were the same crew who had observed and reported on the high water level at bridge 85 on the previous day.

2.19. They boarded the locomotive allocated for train 360 and carried out shunting movements[23] to attach 39 freight wagons[24].

2.20. At about 0325 train 360 departed Kawerau rail terminal on time and began travelling towards Tauranga in clear weather conditions.

2.21. The one-hour journey from Kawerau to the south side of Te Puke was uneventful. Light rain had started falling as the train arrived at Te Puke.

2.22. As the crew travelled over bridge 85, they noted that the water had subsided.

2.23. At about 0432, while the train was travelling at 65 km/h, the trainee applied the brake to reduce the speed in preparation for a 40 km/h temporary speed restriction[25] on the next rail bridge, approximately 1.5 km ahead.

2.24. The train's speed had reduced to 57 km/h when the trainee identified a large area of flooded farmland on the left-hand side of the track and alerted the minder.

2.25. As the train's headlights illuminated the track ahead, the crew observed water flowing over the track approximately 50 metres (m) ahead of the train.

2.26. The minder then directed the trainee to "release the brakes and go"[26].

2.27. The train entered the flooded section of track, and the crew felt the locomotive drop downwards, immediately followed by an application of the automatic emergency brake. The train came to a stop approximately 150 m further down the track.

2.28. The activation of the emergency brake simultaneously sent an emergency call through the train's radio system to Train Control. Train Control immediately

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[21] A locomotive engineer undergoing on-job training prior to certification.

[22] A person who is assigned to a trainee locomotive engineer to provide supervision and guidance while the trainee locomotive engineer drives the train.

[23] The positioning and connecting of rail vehicles or wagons together or disconnecting them.

[24] Rail vehicles that move freight on the rail network.

[25] A temporary speed restriction reduces the speed limit on a track while track-related faults are waiting for repair or undergoing repair. Caution speed boards are placed next to the track, alerting a train driver 1.5 km ahead and allowing the crew to reduce the train's speed before it reaches the known fault. This temporary speed restriction had been in place for a period of time before the weather event.

[26] This direction meant releasing the train's brake application to the wagons and enabling the train to move forward to higher ground.

contacted the crew, who reported that the train had lost air pressure, and they would investigate what had happened.

2.29. The crew disembarked from the locomotive and began walking towards the rear of the train. When they arrived at the fifth wagon, they realised that they could not see the remaining 34 wagons. From their location, they could see that the track's formation[27] had washed down the embankment (*see* Figure 6).

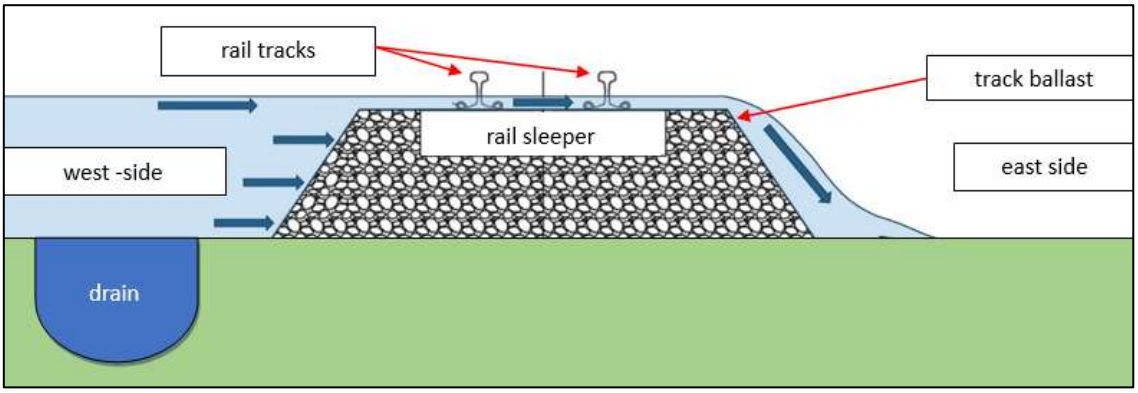


Figure 6: Diagram of track formation and water loading

2.30. On inspection, the crew found that four of the five wagons remaining with the locomotive had decoupled (*see* Figure 7), leaving only one wagon still connected to the locomotive. The crew then returned to the cab of the locomotive.

Figure 7: One of the four decoupled wagon connections.

[27] Track formation is a supporting material used under and around rail sleepers; it supports the track and includes the lower supporting compacted materials used in construction.

2.31. The minder radioed Train Control and informed them that the rear 34 wagons were missing and that they needed to move because of unstable track formation and flooding at their current location.

2.32. At about 0448 the crew moved the remaining connected wagon and the locomotive forward approximately 500 m north and waited for assistance.

2.33. At about 0615 KiwiRail staff arrived at the site and carried out an inspection of the front and rear portions of the train. The inspection revealed that 11 of the 39 wagons had derailed and a large portion of the track had been damaged.

2.34. The track was closed for 20 days to allow for repairs to be completed and the recovery of the train's wreckage.

Personnel information

2.35. The trainee had approximately 150 hours' driving experience and had been employed by KiwiRail since 2021. They had completed their theory-based training and were undergoing the practical driving on-job training[28] to become a fully certified locomotive engineer. They had recently undergone a safety observation assessment[29] as part of their training requirement to complete 150 driving hours.

2.36. The minder had 10 years' driving experience and had been employed by KiwiRail since 2013. They had recently undergone a safety observation and were fully certified for the role.

2.37. Both crew underwent drug and alcohol testing after the accident. Both tests indicated negative (clear) results.

Train information

2.38. Train 360 was 592 m long and weighed 1785 tonnes. It was powered by a DL class diesel electric locomotive and hauling 39 wagons. The first nine wagons were carrying paper pulp, and the remainder were loaded log wagons.

Meteorological information

2.39. The Bay of Plenty region had experienced heavy rainfall, a total volume of 131.8 mm in the two-day period prior to the train derailment (*see* Figure 8).

2.40. The meteorological information received by KiwiRail is detailed in paragraphs 2.1 to 2.10.

[28] On-job training spans the period when a trainee completes practical train driving training a minimum time period of 1040 hours before a full certification assessment can be conducted.

[29] An eight-monthly observation conducted by a certified assessor to review the practical competence of a rail staff member.

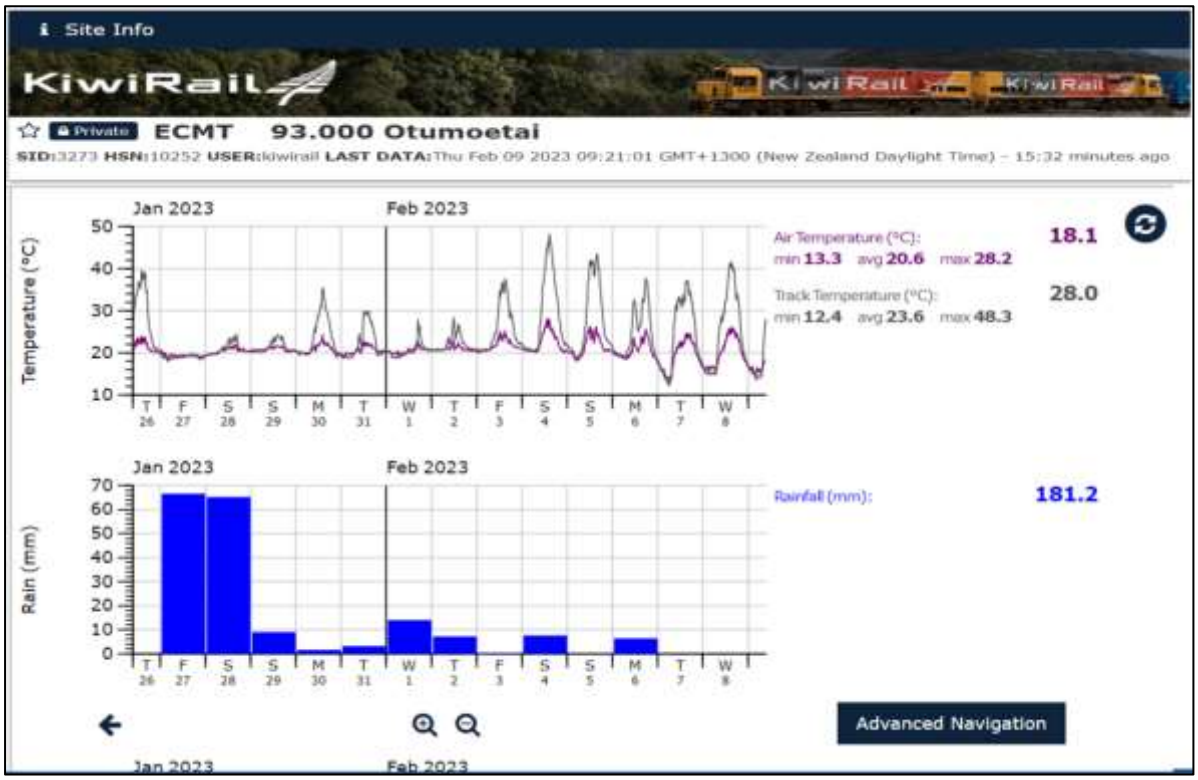


Figure 8: Rain and temperature data collected on the ECMT at Otūmoetai, near the accident site
(Credit: KiwiRail)

Recorded data

2.41. The locomotive was fitted with a Tranzlog data recorder. The Tranzlog download was obtained by the Transport Accident Investigation Commission (the Commission) and the verified data was used in this report (*see* Figure 9).

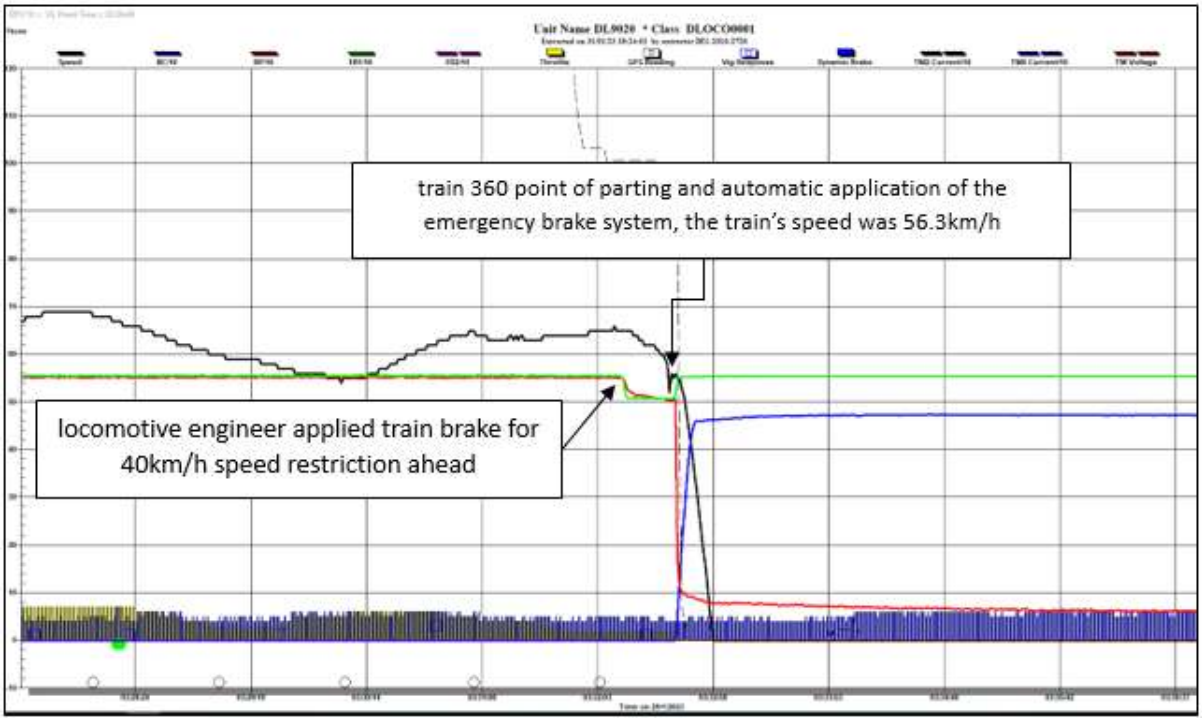


Figure 9: Tranzlog data for train 360

Site and wreckage information

2.42. The accident site was at 115.715 km on the ECMT north of Te Puke. The track and infrastructure were maintained and inspected by KiwiRail. The derailment occurred on an elevated embankment that was between 2.4-3.5 m in height[30] with farmland on either side (*see* Figures 10 and 11).

Figure 10: Derailment site from west side (drone footage taken at 0800 on 29 January 2023)
(Credit: *NZ Herald*. Labels added by Transport Accident Investigation Commission)

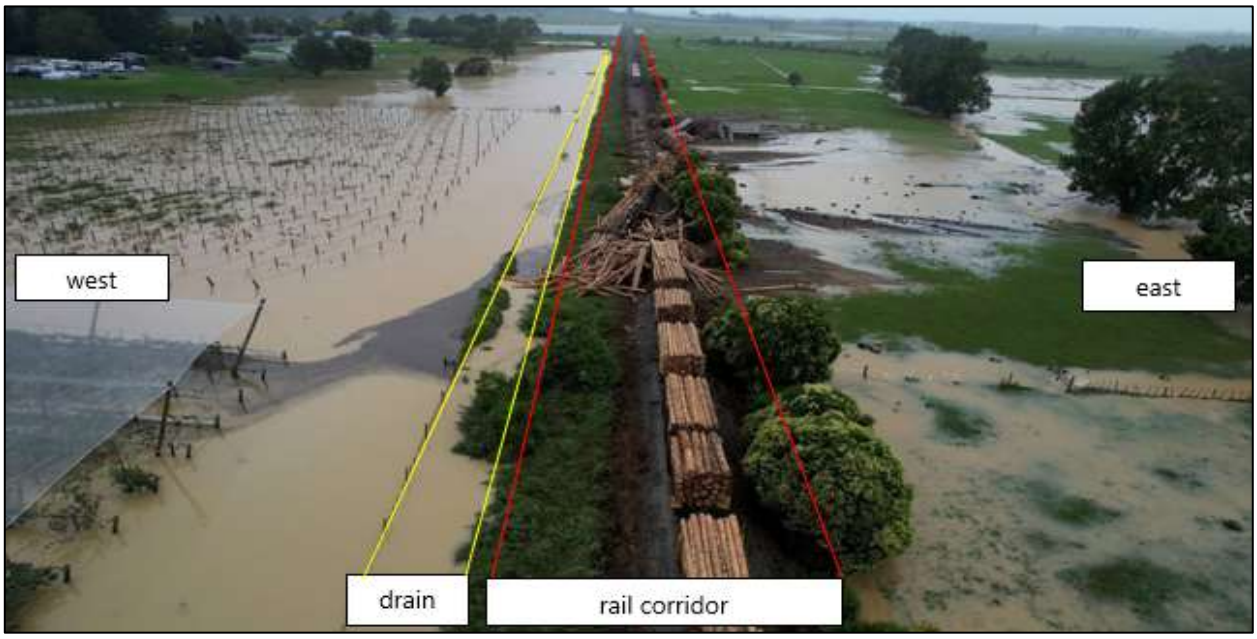


Figure 11: Derailment from rear of the train (drone footage taken at 0800 on 29 January 2023)
(Credit: *NZ Herald*. Labels added by Transport Accident Investigation Commission)

[30] This measurement was taken by Transport Accident Investigation Commission investigators during the site visit.

2.43. Running adjacent to the west of the rail corridor was a drainage system. The drainage system was owned and maintained by the Bay of Plenty Regional Council.

Figure 12: Derailed wagons and ballast debris on the eastern side of the rail corridor

Figure 13: Derailed wagons and washed-out track formation

Organisational information

2.44. KiwiRail Holdings Limited (KiwiRail) is a New Zealand state-owned enterprise. It operates trains and rail vehicles, controls rail movements on the national rail network and maintains the railway infrastructure as the rail access provider.

2.45. The Bay of Plenty Regional Council maintains the Flaxton and Collins drains as part of the Kaituna river catchment scheme.

Previous inquiries

RO-2021-104 Passenger train 6205 derailment, Kāpiti, 17 August 2021

2.46. On 17 August 2021, a Wellington-based passenger train was operating a scheduled service from Waikanae to Wellington on the North Island Main Trunk[31] line. The area had experienced moderate rainfall in the hills adjacent to the rail corridor, overwhelming the waterways and drainage systems that would normally have moved water away.

2.47. The train rounded a right-hand curve next to the hillside, and the driver sighted a landslide covering both main lines in front of the train. The driver applied the emergency brake before the train hit the slip debris, derailing and losing all power. There were no injuries to crew or passengers.

RO-2021-106 Derailment of Train 220, south of Hunterville, 13 December 2021

2.48. On 13 December 2021, an adverse weather event with heavy rainfall[32] resulted in streams and waterways being overwhelmed in the Hunterville area along the North Island Main Trunk line. The investigation found that floodwater had undermined the track formation, causing the derailment of a northbound freight train.

2.49. The Commission identified the safety issue that there were no severe weather-warning or flood-monitoring measures in place in the accident area.

2.50. KiwiRail undertook safety action to address this safety issue. That action included completing a hydrology assessment and flood modelling, planning the replacement of existing culverts with pipes, and planning the installation of a flood-monitoring system by April 2023.

2.51. As a result of the safety action taken by KiwiRail, the Commission did not issue a recommendation.

[31] The portion of the rail network between Auckland and Wellington.

[32] Greater than 10 mm up to 50 mm of rainfall in a 24-hour period, as outlined by the National Institute of Water and Atmospheric Research, Taihoro Nukurangi.

ATSB[33] Investigation RO-2021-004 Derailment of freight train 4BM4, Nana Glen, New South Wales, 25 February 2021

2.52. On 25 February 2021, a southbound Pacific National freight train derailed near Nana Glen, New South Wales, Australia. Floodwaters had built up and overtopped the track, consequently washing away the ballast. The investigation found that the track manager had not adequately identified or addressed the risk of flooding along the rail corridor or the culvert near the accident site and had not undertaken formal assessments to determine the need for, or the locations of, remote weather-monitoring stations to detect extreme weather events.

2.53. While some safety actions were taken following this accident, the ATSB issued a recommendation to develop guidance for crew to respond to and report extreme wet weather events or floodwater in the rail corridor.

[33] The Australian Transport Safety Bureau is Australia's national transport safety investigator.

3 Analysis
Tātaritanga

Introduction

3.1. On 29 January 2023, the derailment of freight train 360 occurred at Te Puke along the ECMT. There were no injuries or fatalities. The derailment caused significant damage to the rail wagons and the cargo being transported.

3.2. The day before the derailment, a passing train crew had reported a higher-than-normal water level. As a result the track had been inspected, but at an incorrect location due to a misunderstanding of the location between the crew and Train Control.

3.3. The investigation found safety issues in the following areas: KiwiRail's adverse-weather procedures; the lack of emphasis in training on reporting unusual weather conditions; and oversight of the maintenance of waterways adjacent to the rail corridor.

3.4. The following section analyses the circumstances surrounding the event to identify those factors that increased the likelihood of the event occurring or increased the severity of its outcome. It also examines any safety issues that have the potential to adversely affect future operations.

Adverse weather procedures

Safety issue 1: KiwiRail's current response to adverse weather conditions is not fit for purpose and is not consistent throughout New Zealand's rail network, increasing the risk of a rail accident occurring.

3.5. Weather alert systems and robust procedures to respond to alerts are critical parts of operating a safe rail network. Well-known procedures and timely communication are crucial when a weather event is forming and occurring and after it passes, to ensure potential safety risks to the rail corridor can be monitored and responded to.

3.6. KiwiRail receives weather information three times a week, and when escalating weather conditions are identified the updates are provided daily or twice daily, depending on the severity of the events.

3.7. KiwiRail's process at the time of the accident was to collate and distribute weather forecast information in emails. The information included the expected weather forecast and matrix table[34] thresholds for the following days.

3.8. The weather information and the weather matrix table are guides for the NCM and Field Production and Operations Managers to review and respond to if needed. The weather matrix table categorises expected weather conditions and their potential impacts on the rail network (*see* Figure 14) but does not include risk mitigations to ensure safe operation. Those are covered in KiwiRail's Train Control Instructions (*see* Appendix 1) and Operating Rules (*see* Appendix 2).

[34] The matrix table is used in conjunction with the weather forecast to outline potential risks to the rail network.

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
Bay of Plenty (BOP)	**ECMT**	**24-hour rainfall totals >25 mm** **Wind gusts >80 km/h** **Thunderstorm/downpour risk**	**Widespread heavy rainfall with event totals >100 mm (within 48 hours)** **Wind gusts >120 km/h** **Wave/Swell >3.5 m**	**Widespread heavy rain with event totals >200 mm (within 48 hours)** **Wind gusts >140 km/h**

Figure 14: Weather matrix table for Bay of Plenty region

(Credit: MetSolutions)

3.9. The weather matrix table comprises nine regions that cover the rail network throughout New Zealand (*see* Figure 15).

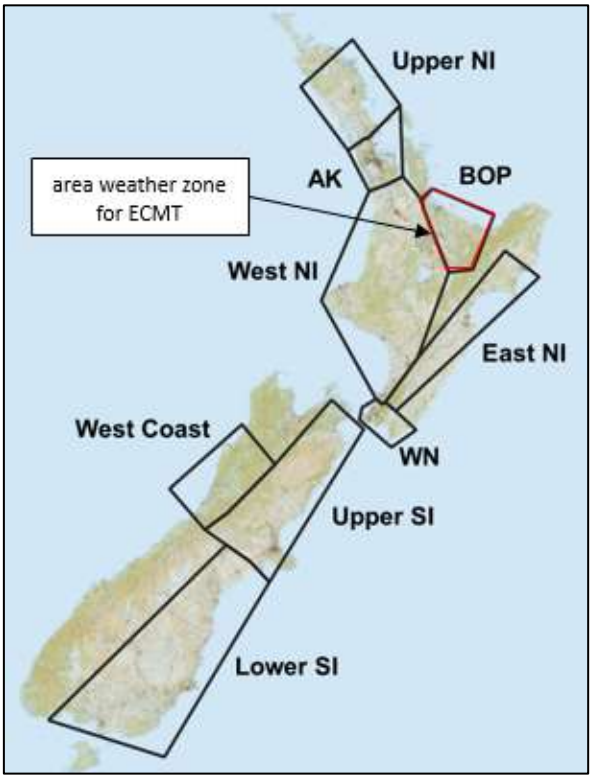


Figure 15: The nine regions

(Credit: MetSolutions)

3.10. The weather information received by KiwiRail between 27 and 29 January included a severe weather warning for the Bay of Plenty region. Yellow and amber warnings were given due to forecast rainfall (*see* Figure 16).

3.11. The weather matrix table does not include mitigation measures appropriate for each warning level to ensure the safe operation of the rail network in those conditions. The process of assessing the response to a weather forecast of adverse conditions is completed by Field Production Managers and network managers as per KiwiRail's Operating Rules.

Forecast		
	BOP	
Date	ECMT	Forecast comments
Friday, 27 January 2023		Rain spreads to most of the North Island, then eases Upper NI later in the day. 1. Totals 25 to 50 mm in many western places about and north of Taranaki, including National Park, and with 50 to 75 mm for Upper NI, AK, and BOP. 3. Northeast wind gusts 80+ km/h for exposed parts of Upper NI and AK. Risk of gusts 90 km/h for east parts of AK Metro area pm/evening hours which could pose a risk of overhead lines.
Saturday, 28 January 2023		1. Rain continues over much of the North Island with risk of totals reaching 25 mm in many places. 2. Heavy sustained rain for BOP 100+ mm, esp. inland such as Tokoroa and Rotorua lines and in areas just east of Kaimai Tunnel. 3. Risk of a period of heavy rain for East NI south of about Napier with 75+ mm in places - which reaches escalated risk criteria.
Sunday, 29 January 2023		Further periods of rain for Upper NI, AK and BOP with 25+ mm in places. Escalated risk levels continue for BOP.

Figure 16: Weather matrix table received by KiwiRail prior to the accident

(Credit: KiwiRail)

3.12. The rail resilience map was designed to help with hazard assessments for civil works and the management of severe weather events (*see* Figure 17). The map colour-coded and ranked areas of the rail network that were subject to flooding, slope instability and scouring of bridge supports.

3.13. The rail resilience map for the section of track between 115.00 km and 117.00 km ECMT and the surrounding land where the accident occurred was assessed as flood prone, with the risk of a flood 'likely', the consequences 'major' and the overall risk rating 'very high' (*see* Appendix 3). Neither the NCM nor the Field Production manager referred to the map after receiving the report of high water. If they had referred to the map, it is **likely** they would have identified that the area at which the crew reported high water was flood prone.

3.14. The Bay of Plenty region Field Production Manager did not acknowledge[35] receiving the weather-related information from the NCM and nor did the NCM escalate the information to the regional manager as required in the Operating Rules (*see* Appendix 1).

[35] The acknowledgement process required the Field Production Manager to reply by email to the NCM, confirming they had received the weather information. If the information was not acknowledged, the NCM was required to escalate the information to the regional manager.

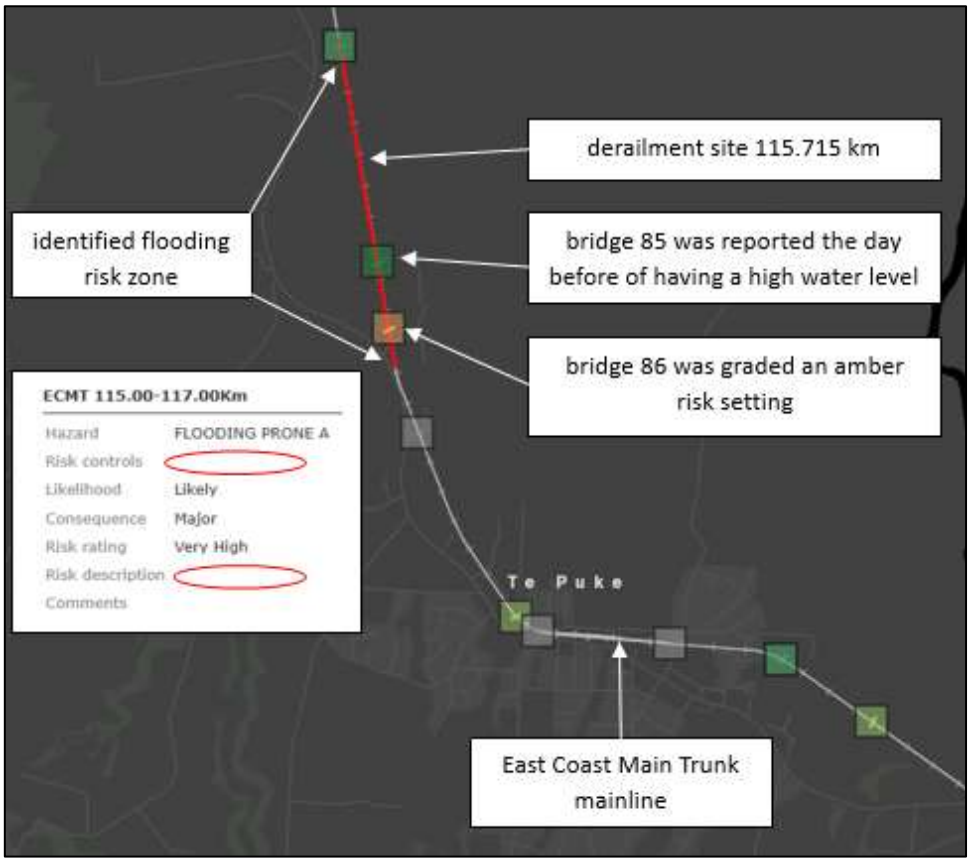


Figure 17: The rail resilience map at the accident site

(Credit: KiwiRail. Labels added by Transport Accident Investigation Commission)

3.15. In 2022, in response to a derailment, KiwiRail updated its Operating Rules to include mitigation measures for different levels of floodwater:

- At any depth, if flood water is flowing and likely to dislodge the ballast or has dislodged the ballast then stop the train and wait for further instructions from Train Control.
- Flood water that is still (not moving) and:
  - Below the rail head – normal working is permitted.
  - To the top of the rail head – maximum operating speed is 10 km/hr.
  - Above the top of the rail head – stop the train and wait for further instructions from Train Control.

3.16. The investigation found that, at the time of the accident, KiwiRail's weather response guidance was not consistent across New Zealand's rail network. For example, in the South Island the main North Line between Christchurch and Picton operated a weather Triggered Action Response Plan (TARP)[36], which covered both rainfall forecast and antecedence rainfall levels[37].

3.17. The TARP provided clear guidance on the appropriate mitigation measures at varying rainfall volumes (*see* Figure 18).

[36] TARPs are used to give guidance on responding to and acting on or following tested procedures for an event.
[37] The volume of water soaked into the ground that could adversely affect soil stability with future rainfall.

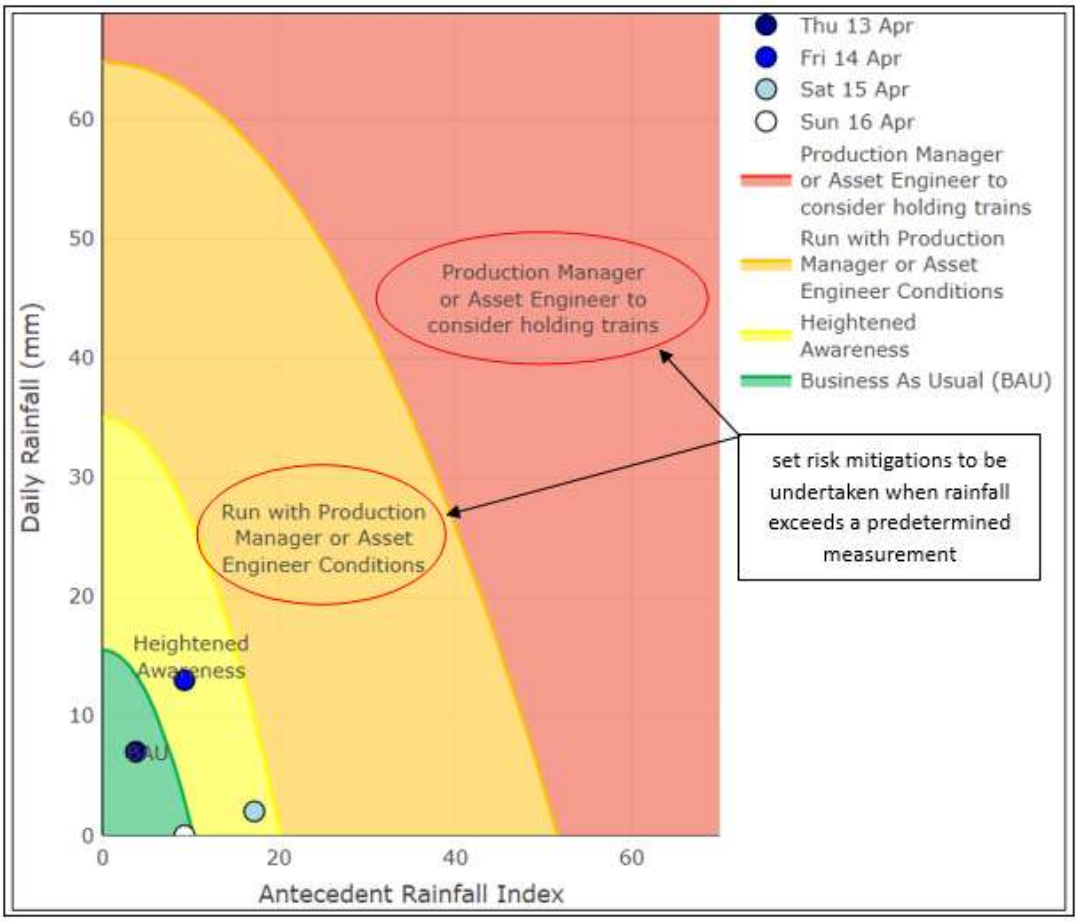


Figure 18: Extract from South Island Main North line TARP

(Credit: KiwiRail and MetSolutions)

3.18. Had there been a TARP in place in the Bay of Plenty region, it is **likely** the forecast rainfall would have triggered a heightened awareness and proactive rather than responsive track inspections and/or track closures.

Real-time weather-alert systems

3.19. Real-time weather-alert systems are widely used in rail operations around the world and in some parts of New Zealand's rail network. When correctly installed and located, they allow a high level of monitoring oversight across the network, alerting rail operators of changing and adverse conditions.

3.20. KiwiRail has a number of heat and rainfall monitoring devices (*see* Figure 19) in place along the ECMT. The devices can be set to send alarms to Train Control when certain temperatures or rainfall volumes are reached.

Figure 19: Weather monitoring device
(Credit: Harvest)

3.21. The closest device was approximately 22 km from the accident site. The device was not set to send an alarm to Train Control but had live monitoring available through KiwiRail's weather platform, Harvest.

3.22. The device recorded 137 mm of rain in the 52-hour period between 27 to 29 January. The rainfall recorded exceeded the yellow and amber levels in the weather matrix table.

3.23. The rainfall monitoring device nearest to the area reported as having high water was not accessed or monitored and the device had not been set to alert Train Control when rainfall levels exceeded the amber warning settings. It is **likely** that risk controls would have been put in place to avoid an accident if Train Control had received a warning or the live rainfall had been monitored. The monitoring equipment should have been utilised to its full extent.

Training in reporting unusual weather conditions

Safety issue 2: The training given to locomotive engineers and other rail personnel on the procedures for reporting and receiving unusual weather-condition information was inadequate. This meant the procedures to ensure the safe operation of trains were not initiated in accordance with KiwiRail's Operating Rules (Section 1 – General Rules, rule 6(b)).

3.24. Training in and the ability to apply theory-based rules are essential to ensure rail operators' safety.

3.25. The investigation found that the training provided for KiwiRail rail personnel did not emphasise the importance of knowing and understanding the rules for reporting and responding to unusual weather conditions. While the training included an examination, the different weather severity levels and corresponding risk controls were not included. The weather-related risks were not subject to ongoing safety observation assessments or included in rules-based revalidation programmes.

3.26. Another aspect of the training was non-technical skills (NTS), including effective communication. Having the ability to communicate effectively is especially important when tasks are infrequent and individuals have differing mental models.

3.27. NTS can be defined as the cognitive, social and personal resource skills that complement technical skills and contribute to safe and effective task performance.

Sub-categories of NTS include situational awareness, communication, decision-making, leadership, teamwork, workload management and self-management.

3.28. The effective use of NTS is an important defence in capturing and/or mitigating the effects of human error. It is even more important in systems that, in the absence of more robust engineering controls, are primarily reliant on individual performance and less-effective administrative controls.

3.29. As part of their NTS training, Train Controllers are advised to proactively communicate certain intentions to field personnel to facilitate situational awareness and allow opportunities to detect and correct errors.

3.30. The investigation found that when the crew reported a higher-than-normal water level to Train Control, critical information was not transferred between the parties (*see* Appendix 2). That information included the bridge number, the track meterage location and confirmation of a shared understanding. Instead, when Train Control sought confirmation of the location and asked, "east side of Te Puke?" the crew replied, "yer roger the Mount side of Te Puke are all getting high".

3.31. Train Control could not identify the precise location of the observed high water level, as the information provided by the crew was not detailed enough. This meant Train Control advised the service desk of an incorrect location for the observed high water level.

3.32. The support desk informed the track inspector that the issue was water leaks from a bridge and the location was 119,190 km on the ECMT, which was approximately 4 km from the location of the observed high water level.

3.33. Based on the information received, the track inspector started the inspection 2 km away from the observed high water level at bridge 85 and inspected an area in the opposite direction (*see* Figure 5).

3.34. Had the crew provided and Train Control received and passed on the accurate location of the observed high water level, it is **very likely** the track inspector would have inspected the correct location and implemented appropriate risk mitigations in response to what they discovered.

Maintenance of waterways

Safety issue 3: KiwiRail did not have adequate awareness of the maintenance of third-party waterways within the rail corridor, including culverts. The insufficient maintenance of the waterways within the corridor increased the risk of the waterways not functioning as designed.

3.35. Effective maintenance plans are a vital component of ensuring that infrastructure remains fit for purpose, particularly when it can be adversely affected by weather.

3.36. The Bay of Plenty Regional Council owned the drainage system adjacent to the section of rail corridor where the accident occurred. The drainage system was part of the Kaituna river catchment control scheme, which included the Flaxton drain (1308 m long) and the Collins drain (442 m long). Both drains flowed into a canal system (*see* Figure 20).

Figure 20: Locations of drains and rail infrastructure

3.37. Where the Flaxton drain and Collins drain intersected, the vegetation on both sides had grown down to the water level (*see* Figure 21).

Figure 21: Vegetation at junction of Flaxton drain and Collins drain

(Photograph taken on 1 February 2023)

3.38. Located approximately 60 m south of the accident site was a single, 750 mm diameter concrete culvert, owned and maintained by KiwiRail. The culvert allowed water to flow beneath the rail corridor and was approximately 0.5 m above the Flaxton drain. The purpose of the culvert was to move excess water from the farmland in the east to the Flaxton drain in the west. It was not designed for flood mitigation.

3.39. However, when floodwaters breached the top of the Flaxton drain, the culvert allowed water to move from the drain east onto farmland (*see* Figure 22). Eventually the culvert was also overwhelmed by the volume of floodwater, resulting in the water crossing over the track, undermining the track formation and washing out the ballast.

Figure 22: Culvert allowing floodwater to move east onto farmland
(Credit: KiwiRail – photograph taken at approximately 10:00 on 29 January)

3.40. The maximum capacity of the drainage system maintained by the Council was a daily rainfall of 37 mm for a maximum of three consecutive days, a one-in-five-year weather event. The heavy rainfall that fell during 27 and 28 January 2023 exceeded that capacity.

3.41. When attending the accident site after the floodwater had subsided, the Commission investigators found the culvert was partially blocked on the western side by a vertically positioned wooden railway sleeper and that vegetation had grown into the area where the Flaxton drain met the culvert (*see* Figure 23).

3.42. Subpart 1 of Part 3 of the Railways Act 2005 provides licensed access providers (being KiwiRail in this accident) with specific powers for the purpose of protecting the rail corridor. Section 74 addresses drains within the rail corridor and places the obligation to pay for the maintenance of drains on, above and under any railway infrastructure that is part of a sewerage or stormwater drainage system under the control of a road controlling authority or local authority, on that authority.[38] In order

[38] Section 74(1), Railways Act 2005.

to maintain the drain, the authority needs the prior consent of the licensed access provider, which may not be unreasonably withheld in an emergency.

3.43. Section 77 of the Railways Act 2005 allows licensed access providers to, among other things, maintain and carry out protective work on the bank of a river or stream for the purpose of protecting the railway or preventing or lessening the risk of damage to railway infrastructure.[39] A licensed access provider can also give notice to the occupier or owner of land abutting any railway structure to remove, lower or trim to the satisfaction of the licensed access provider any tree or hedge if the work is necessary to prevent damage to the railway infrastructure or obstruction to a channel, ditch or drain associated with that railway.[40]

3.44. Had KiwiRail been aware of the vegetation growth in the drainage system adjacent to the rail corridor, it is **likely** KiwiRail would have requested Bay of Plenty Regional Council to carry out maintenance.

Figure 23: Western entrance of culvert

3.45. Remedial works post the accident were completed by the Bay of Plenty Regional Council. This work included the removal of a culvert within Collins drain located near bridge 85, which was removed due to its being blocked with compacted soil. Upon its removal, a smaller pipe was found within the culvert. The culvert removal created an open drainage system up to and under bridge 85 (*see* Figure 24).

[39] Section 77(1), Railways Act 2005.
[40] Section 77(3)(a), Railways Act 2005.

Figure 24: Remedial work at Bridge 85 after the accident

(Credit: Bay of Plenty Regional Council)

4 Findings
Ngā kitenga

4.1. KiwiRail's Network Control Manager did not follow the operator's procedures for adverse-weather-event. They forwarded a weather notification to all managers when they should have assessed the severity of the notification and the areas of the rail network that would likely be affected.

4.2. Had the Network Control Manager and manager referred to the rail resilience map, it is **likely** they would have identified that the area where the crew reported high water was flood prone.

4.3. Had there been a TARP in place for the Bay of Plenty region, it is **likely** the forecast rainfall would have triggered a heightened awareness, and KiwiRail would have carried out proactive rather than reactive track inspections and/or track closures.

4.4. The rainfall monitoring device nearest to the area reported as having high water was not set to alert Train Control or the Network Control Manager when rainfall exceeded the amber warning settings. It is **likely** that risk controls would have been put in place to avoid an accident if Train Control or the Network Control Manager had received such a warning.

4.5. Had the crew provided, and Train Control received and passed on, the accurate location of the observed high-water level, it is **very likely** the track inspector would have inspected the correct location and implemented appropriate risk mitigations in response to what they discovered.

4.6. Had KiwiRail been aware of the vegetation growth in the drainage system adjacent to the rail corridor, it is **likely** it would have requested Bay of Plenty Regional Council to carry out maintenance.

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

General

5.1. Safety issues are an output from the Commission's analysis. They may not always relate to factors directly contributing to the 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 recommendations to address the issues.

Safety issue 1: KiwiRail's current response to adverse weather conditions is not fit for purpose and is not consistent throughout New Zealand's rail network, increasing the risk of a rail accident occurring.

5.3. In response to the accident, KiwiRail commenced a risk-based review of all its severe weather event management processes, controls and trigger action responses. The programme of work will look at existing systems, events and incidents, monitoring systems, lessons learned, gaps and concerns.

5.4. KiwiRail is taking steps to introduce organisation-wide adverse weather event standards and processes. There will be a six-stage approach: Stage 1: Notification/Alert; Stage 2: Preliminary assessment; Stage 3: Conference call; Stage 4: TARP-based action plan; Stage 5: Monitoring; and Stage 6: De-escalation and close out.

5.5. KiwiRail intends to have the adverse weather event standards and processes in place throughout New Zealand by the end of 2024.

5.6. The Commission acknowledges KiwiRail is taking safety actions to address this safety issue. However, until the adverse weather event standards and processes are in place throughout the network, the safety issue will remain. Therefore the Commission has made a recommendation in Section 6 to address this issue.

Safety issue 2: The training given to locomotive engineers and other rail personnel on the procedures for reporting and receiving unusual weather-condition information was inadequate. This meant the procedures to ensure the safe operation of trains were not initiated in accordance with KiwiRail's Operating Rules (Section 1 – General Rules, rule 6(b)).

5.7. No 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: KiwiRail did not have adequate awareness of the maintenance of third-party waterways within the rail corridor, including culverts. The insufficient maintenance of the waterways within the corridor increased the risk of the waterways not functioning as designed.

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

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.

New recommendations

6.3. On 24 April 2024 the Commission recommended that KiwiRail review its adverse weather response system and processes to ensure they are effective in maintaining a safe rail network. **(012/24)**

6.4. On 14 May 2024, KiwiRail replied:

> This recommendation is accepted. We are developing the Adverse weather TARP and targeting completion of this rollout in 2024.

6.5. On 24 April 2024 the Commission recommended that KiwiRail place greater emphasis on training rail personnel in reporting unusual weather conditions (in accordance with KiwiRail's Operating Rules, Section 1 – General Rules, rule 6(b)), to ensure they retain currency. **(013/24)**

6.6. On 14 May 2024, KiwiRail replied:

> This recommendation is rejected. KiwiRail's view is that the training for rail personnel that is included in the RSR training component that relates to rule 6(b), is sufficient in so far as it is a low-level control for managing adverse weather. The complexity of weather events would also preclude any meaningful training as it would otherwise require a significant number of scenarios to be credible. Our Adverse weather TARP – see response to recommendation 012/24 – was developed in consideration of this position and rail personnel knowledge in the way we will manage adverse weather events going forward.

6.7. On 24 April 2024 the Commission recommended that KiwiRail satisfy itself that all waterways within the rail corridor, including those owned by third parties, have effective and up-to-date maintenance programmes to ensure that the waterways can function as designed. **(014/24)**

6.8. On 14 May 2024, KiwiRail replied:

> This recommendation is under consideration and will require further discussions with external parties.

7 Key lessons
Ngā akoranga matua

7.1. Accurately identifying and reporting risks that could affect the safety of the rail network is a vital layer of protection to ensure a safe rail operating system.

7.2. It is important that rail personnel are appropriately trained to respond effectively to adverse weather and adverse track condition notifications.

7.3. The maintenance of waterway systems is vital to ensure the system can work to its design specifications.

7.4. As the frequency of adverse weather events increases, rail operators and those responsible for the infrastructure need to respond to future-proof the safety of rail operations.

8 Data summary
Whakarāpopoto raraunga

Vehicle particulars

Train type and number:	freight train 360
Classification:	freight
Year of manufacture:	2014
Operator:	KiwiRail

Date and time	29 January 2023, 0435
Location	Te Puke
Operating crew	a trainee locomotive engineer and a minder
Injuries	nil
Damage	11 wagons derailed and extensively damaged, track and track formation extensively damaged

9 Conduct of the inquiry
Te whakahaere I te pakirehua

9.1. On 29 January 2023, 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. Commission investigators attended the site on 30 January and conducted a site investigation.

9.3. The Commission obtained records and information from sources that included:

9.4. locomotive engineers and four KiwiRail rail personnel

9.5. Tranzlog data from the locomotive

9.6. Train Control voice recordings

9.7. Train Control graphs

9.8. meteorological data for the area

9.9. rail formation specifications

9.10. drainage and culvert specifications

9.11. KiwiRail's severe weather procedures.

9.12. On 22 February 2024 the Commission approved a draft report for circulation to seven interested parties for their comment.

9.13. Five interested parties provided detailed submissions, one interested party did not respond and one interested party replied that they had no comment. Any changes as a result of the submissions have been included in the final report.

9.14. On 24 April 2024, the Commission approved the final report for publication.

Abbreviations
Whakapotonga

ECMT	East Coast Main Trunk
km	kilometres
km/h	kilometres per hour
m	metres
mm	millimetres
mm/h	millimetres per hour
NCM	Network Control Manager
NIWA	National Institute of Water and Atmospheric research
NTS	non-technical skills
TARP	Triggered Action Response Plan
train 360	the train number and service that derailed

Glossary
Kuputaka

derailment	an event that occurs when a rail vehicle's wheels disengage their connection with the top of the rail head
East Coast Main Trunk	the railway network that runs from Hamilton to Tauranga and Kawerau and is connected to various other mainline rail networks, stations and rail sidings to operate trains and rail vehicles for the movements of commuter passengers and freight
locomotive	a rail transportation vehicle that provides motive power to pull or push other rail vehicles on a rail network
locomotive engineer	an engineer certified by examination to operate in-cab controls for train speed and braking applications to conform with the signal indications on the rail network
Network Control Manager	the supervisor of a Train Control centre
support desk	a KiwiRail service that takes incoming communications and network-related issues and organises staff to complete various maintenance tasks on and inspections of the rail network
track formation	material used under and around rail sleepers that supports the track, and includes the lower supporting compacted materials used in construction
track meterage	each rail line is identified by track meterage starting from a 0.000 km location and is set out in

	half-kilometer and full-kilometer sections until the end of the line
Train Control	the personnel responsible for authorising rail vehicle movements on the national rail network
Train Controller	a rail employee who controls rail vehicle movements on a rail network
trainee locomotive engineer	a locomotive engineer undergoing on-job training prior to certification
Triggered Action Response Plan	a plan used to give guidance on responding and acting or following tested procedures in an event
wagon	a rail vehicle used to transport goods and equipment on the rail network

Appendix 1 Train Control Instruction M007 -Severe Weather Advisory Management

Severe Weather Advisory Management

Effective Date: 09 June 2022	Issued and Approved by: Tim Waetford	Version 3	Page 1 of 3

Severe Weather Advisories may be received from multiple information streams, including –

- MetService weather alerts
  - Notifications will be received for Thunderstorm Watch, Severe Weather Watch and Severe Weather Warning. **Only Severe Weather Warnings** need to be actioned, other notifications should be noted for your information.
- Meteorology Solutions Limited
  - This includes specific TARP's for SH73 and the MNL.
- Train Crew or Field Staff advising of severe weather conditions (RORP Rule 6(b))
- Report from Public sources via TC Emergency line.
- River Level Monitoring systems

The following steps are to be followed on receipt of Severe Weather advice, in accordance with RORP Rule 6 (b): -

1. The NCM is to determine the geographic area of the railway that could be affected.

2. If an Advisory is received via email, this notification must be forwarded on to the applicable NCM Network Status Update email distribution lists.

3. The NCM must obtain an acknowledgement from each Production Manager that they have received each advisory. Acknowledgements should be obtained before the commencement of the warning or on issue if the warning is effective immediately.

    I. Any non-acknowledgement of warning information is to be escalated to the Regional Infrastructure Manager.

4. SWW conditions must be entered for affected lines into OMS, and a print of these conditions attached with the aid memoir.

5. The distribution of each MetService warning and acknowledgement must be recorded on the NCM's severe weather warning aid memoir, and each warning attached to the back of the aid memoir.

Note: It is important that all updates are carefully read and are passed to Production Managers as exposed areas and forecast details can change.

If weather deteriorates rapidly or unexpectedly, consider enforcing Level 2 Adverse Weather restrictions, suspending rail services, and running additional line inspections. This should be arranged in consultation with the Regional Infrastructure Managers.

- Known trouble spots for flooding, slips and falling trees
- Snowfall causing issue with infrastructure reliability or road access for relief or emergency purposes.
- Any requirement for line inspections before the resumption of rail services.

River Level Monitoring Systems –

Depending on region, some high-risk rivers have automated monitoring systems which will be triggered during high rainfall events.

Specific detail can be found in –

- TC Instruction A019 for the Lower North Island
- TC Instruction C001 for the Waipaoa River (PNGL)
- TC Instruction S002 for the Canterbury Region

If you receive any river level alert not described in the above instructions, or other reports of high river levels or debris building up against bridge structures, this should be escalated to the relevant Field Asset Engineer and the line closed until clarification is received.

Post Event Considerations –

Planned line clearances and any requirement for Line & Asset inspections should be communicated to the business giving as much notice as possible.

Where HRV access is not possible due to road closures or heavy snowfall, consideration should be given to using light locomotive movements to run through the area with Infrastructure staff on board checking for potential hazards.

At the cessation of all Severe Weather alerts, all applicable Conditions should be removed from OMS and updates provided to the business via eTxt or email accordingly.

Appendix 2 KiwiRail Operating Rules, Section 1 – General Rules, Rule 6(b) Reporting Unusual Weather Conditions

(b) Reporting Unusual Weather Conditions

Warning
Severe weather may cause flooding, obstructions to the line, track damage, slips or washouts

Train crews and other Rail Personnel encountering severe or adverse weather conditions likely to affect the safety of operations are to inform Train Control.
Train Control must immediately initiate the procedures required to ensure the continued safe operation of trains.

Two Weather Warning levels are used following notification of unusual weather.

(i) Warning types

Level 1 Severe Weather Warning is advisory information for train crews and infrastructure personnel to be alert for conditions that may damage the line such as falling trees and flooding, and to report any such risks immediately to train control.
Examples are:

- above average rain fall, or high winds
- rivers flowing from catchment areas with heavy rainfall
- sustained periods of poor weather.

Level 2 Adverse Weather Restriction is a speed restriction of 40km/h or less applied to specified areas due to a high risk of weather conditions damaging the line. When such a restriction is applied the Area Infrastructure Manager or their delegate, will determine increased inspection frequencies and provide regular condition updates to Train Control.

(ii) Notification

Risk of Severe Weather that could cause damage to the line by way of storm, heavy rain, high wind or sustained bad weather must be notified to Train Control immediately by any rail personnel.

Train Control may also receive advice of such conditions from:

- weather forecasters or
- local authorities - local river, wind or flood monitoring sites or
- information from other agencies or
- general public.

On receipt of Severe Weather advice or information, Train Control or the Network Control Manager must:

- immediately notify the Area Infrastructure Manager or their delegate of all relevant available weather information
- issue a Level 1 warning to all train crews using the Conditions section, of the speed restriction system
- verbally advise en route trains
- endorse Train Control diagram
- notify Rail Operators (via text messaging).

(iii) Assessment and Application of Restrictions

When notified of a Level 1 warning, the Area Infrastructure Manager or their delegate must determine the need for increased inspections and advise all relevant personnel under their control.

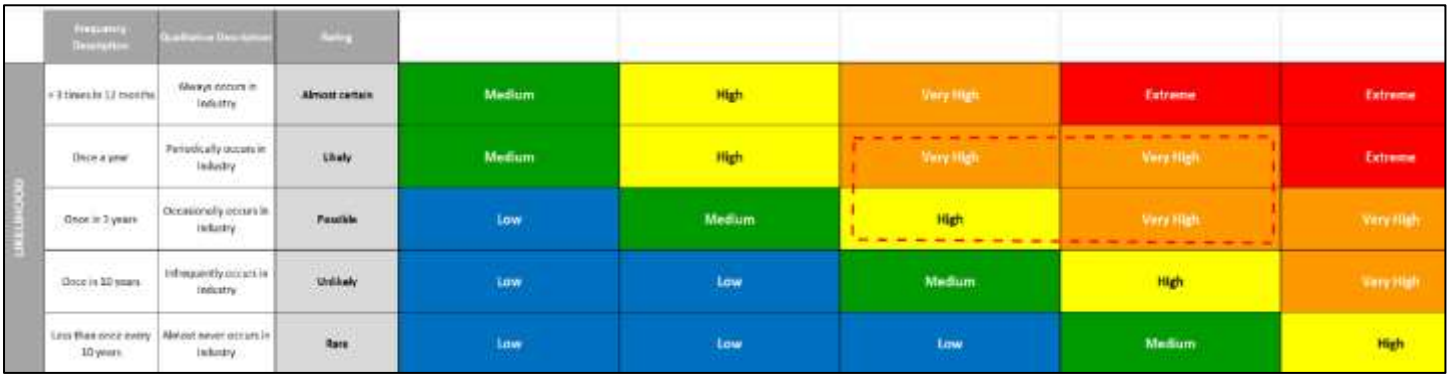
The Area Infrastructure Manager or their delegate may also declare a Level 2 Adverse Weather Restriction or close the line in accordance with Clause (c).

Should information indicate multiple events in an area, Train Control or the Network Control Manager, has authority to either:

- apply a Level 2 blanket 40km/h speed restriction for all trains, or
- suspend the movement of all trains pending inspection.

Appendix 3 Rail resilience map risk assessment tool and consequence impact

Likelihood and frequency table



LIKELIHOOD	> 3 times in 12 months	Always occurs in industry	Almost certain	Medium	High	Very High	Extreme	Extreme
	Once a year	Periodically occurs in industry	Likely	Medium	High	Very High	Very High	Extreme
	Once in 3 years	Occasionally occurs in industry	Possible	Low	Medium	High	Very High	Very High
	Once in 10 years	Infrequently occurs in industry	Unlikely	Low	Low	Medium	High	Very High
	Less than once every 10 years	Almost never occurs in industry	Rare	Low	Low	Low	Medium	High

Impact / consequence table

	Moderate	Major
Service Delivery	• Inability to provide service: o Premier Freight OTP <80% o Interislander sailed vs planned <80% • Metro services 30mins-2 hours (in peak or events) o Scenic 1-7 days	• Inability to provide service: o Premier Freight OTP <75% o Interislander sailed vs planned <75% • Metro services 2 -24
People	• Significant employee disengagement • Threat of industrial action • Resistance to business improvement by employee representatives • Unavailability of key capability for key projects	• Industrial action significantly affecting delivery of one or more major services for a significant period • Annual staff turnover of between 10% and 25% in critical technical areas
Customer	• Significant localised customer dissatisfaction	• Considerable widespread customer dissatisfaction
Stakeholder Confidence / Reputation	• Dissatisfaction resulting in action by a group of stakeholders • Community complaint, reputation damage or exposure to a regional audience	• Shareholding Minister may express concern to the Board • Community complaint, reputation damage or exposure to a nationwide audience
Commercial / Financial Sustainability	• Shortfall of between 5% and 10% in EBITDA against agreed budget • Cash shortfall of between $10-20m	• Shortfall of between 10% and 25% in EBITDA against agreed budget • Cash shortfall of between $20-50m
Regulatory	• Fines of $100,000 - $500,000 for failure to comply with legal, regulatory or contractual requirements • Criminal prosecution punishable by fine	• Restriction on rail or maritime operations • Criminal prosecution punishable by suspended sentence • Fines > $500,000 for failure to comply with legal, regulatory or contractual requirements
Technology	Loss of system integrity or information availability which could have a serious adverse effect on operations, assets or individuals.	Loss of system integrity or information availability which could have a major adverse effect on operations, assets or individuals.

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-2023-101	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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