

# **Final Report**

Rail inquiry RO-2019-101 Safe-working occurrence, Westfield yard, Ōtāhuhu, Auckland 24 March 2019

April 2020



## **About the Transport Accident Investigation Commission**

The Transport Accident Investigation Commission (Commission) is a standing commission of inquiry and an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas.

The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. It is not the Commission's purpose to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. However, the Commission will not refrain from fully reporting on the circumstances of and factors contributing to an accident because fault or liability may be inferred from the findings



Figure 1: Location of occurrence

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## **1** Executive summary

#### What happened

- 1.1. At about 1850 on Sunday 24 March 2019, a work group was completing rail track repairs in a protected work area that had been established in KiwiRail's Westfield yard in Ōtāhuhu, Auckland. The protected work area was in the process of being disestablished before the work party departed from the site.
- 1.2. The rail protection officer in charge of the site was approached by a signals technician who was required to carry out work within the protected work area.
- 1.3. Unaware of the exact nature of the signals technician's intended work, the rail protection officer lost situational awareness and allowed the technician into the protected work area without following the requirements prescribed in KiwiRail's Rail Operating Rules and Procedures.
- 1.4. As a result, the signals technician was not considered to be part of the work group and was therefore not accounted for using the lock-on procedure. The technician was still working within the protected work area when, without any prior knowledge, the electronic blocking protection<sup>1</sup> was removed, putting the technician at risk from rail traffic.

#### Why it happened

- 1.5. The Transport Accident Investigation Commission (Commission) found that it was very likely that a safe-working incident occurred as a result of the electronic blocking protection being removed at the rail protection officer's request, while the signals technician was still working on the track.
- 1.6. The Commission also found that the rail protection officer's request to remove electronic blocking was likely due to the rail protection officer and the signals technician not utilising non-technical skills effectively to develop a shared mental model of the work to be undertaken by the signals technician. Had both parties communicated more effectively and agreed a work plan, it is highly likely that the incident could have been avoided.
- 1.7. Neither party had a clear understanding of the other's intentions, nor did each thoroughly question the other. Because the rail protection officer misunderstood the intentions of the signals technician, it was decided that the prescribed procedure was not required to be followed. This was contrary to KiwiRail's Rail Operating Rules and Procedures and resulted in the omission of a key safety defence that could have prevented the incident occurring.

#### What we can learn

1.8. The key lesson arising from the inquiry is that all personnel undertaking safety-critical roles should adhere to the principles of non-technical skills to ensure that they share the

<sup>&</sup>lt;sup>1</sup> A protection activated on the signalling system operated by train control when required to ensure that signals and points are not cleared into a protected work area, or to prevent conflicting rail movements.

same mental models and have a clear understanding of what is required of themselves and others to complete the tasks safely.

## Who may benefit

1.9. Rail operators and all safety-critical workers may benefit from the key lessons of this inquiry.

# 2 Factual information

### Narrative

- 2.1. At about 1850 on Sunday 24 March 2019, a KiwiRail work group was operating in a protected work area (PWA) that had been established within a section of KiwiRail's Westfield yard known as Ōtāhuhu triangle (Figure 2).
- 2.2. The PWA had been established at 1000 on 23 March. Its purpose was to protect the work group carrying out repairs to damaged track from a minor derailment. Although the work group was not present, the track had remained closed to rail traffic for Saturday night.



#### Figure 2: Schematic diagram of Ōtāhuhu triangle

- 2.3. The repair work was planned to be completed by 1800 on 24 March, but due to delays it was extended by a further hour until 1900.
- 2.4. The PWA was being managed by a rail protection officer (RPO), who was responsible for ensuring that all personnel within the worksite were protected from rail movements. This was in accordance with KiwiRail's Rail Operating Rules and Procedures.
- 2.5. The RPO was located near 1655 points<sup>2</sup>, in a safe area outside the PWA, so that they could be approached by visitors requiring access to the worksite (Figure 2).
- 2.6. A signals technician had also been requested to attend the worksite after a work vehicle had reportedly crossed the track within the PWA, and in doing so had possibly caused damage to 1666B points.

<sup>&</sup>lt;sup>2</sup> A movable part of the track which guides rail traffic from one track to another

- 2.7. By about 1850 track repairs had been completed and the RPO was in the process of clearing the worksite of all personnel and equipment. This was in preparation for handing the track back to train control<sup>3</sup> for normal operations.
- 2.8. At this time the RPO was approached by a signals technician who was responsible for the worksite secondary protection<sup>4</sup> (see section 2.24). The RPO and the signals technician briefly discussed the signals technician's work and the RPO agreed that the signals technician could enter the PWA.
- 2.9. At 1859 the RPO contacted train control and informed the controller that the worksite was clear of all personnel and equipment and was ready to be handed back. The train controller, who was aware that the secondary protection was still in place, questioned the RPO regarding the status of the signals technician. The RPO advised the train controller that the signals technician was working clear of the track and was not part of the original PWA.
- 2.10. The train controller again asked for verification that the signals technician was not working on the track. The RPO responded that the signals technician was clear of the track. The train controller accepted this information, but asked the RPO to contact the signals technician and ask them to contact train control.
- 2.11. The train controller cancelled the track possession authority<sup>5</sup> and removed all electronic blocking around the PWA. The track was now available for normal operations, although the two sets of points secured by the signals technician as secondary protection remained inoperable from train control.
- 2.12. At 1908 the signals technician contacted train control. The train controller queried what was happening with the secondary protection. It became apparent to the train controller that the signals technician was working on the track and was unaware that the RPO had handed the worksite back to train control.
- 2.13. The train controller then re-established electronic blocking to protect the signals technician for the duration of the work. The train controller also informed the on-duty network control manager of a potential safe-working breach.
- 2.14. The network control manager reviewed the circumstances of the incident and contacted the RPO by telephone. As a result of the conversation the RPO returned to work and underwent drug and alcohol testing. The test delivered a negative (clear) result.
- 2.15. There were no rail movements in the area during the period in which the signals technician was working without protection.
- 2.16. At 1952 the signals technician completed work on the points and contacted train control to confirm that work had been completed and secondary protection removed, and that the electronic blocking was no longer required. Train control removed the electronic blocking and the site returned to normal operations.

<sup>&</sup>lt;sup>3</sup> The national train control centre housed in Wellington Railway Station, where train movements and track occupations are authorised by train controllers.

<sup>&</sup>lt;sup>4</sup> A method of cordoning off a worksite to enhance 'primary protection', which is the method prescribed in the relevant rules and procedures that must be utilised to establish a protected work area.

<sup>&</sup>lt;sup>5</sup> The times and limits agreed between train control and the authority holder to take sole occupancy of a section of track.

## Site examination

- 2.17. The site was located at the southern end of the Westfield yard. Three tracks consisting of "the straight leg, north siding and the west leg" formed a triangle around a large area of land used for industrial storage (Figure 3).
- 2.18. There was no direct line of sight between the RPO and the signals technician due to the curvature of the track.



#### Figure 3: Satellite view of Ōtāhuhu triangle (Credit: Google Earth modified by the Transport Accident Investigation Commission) Site protection

- 2.19. The worksite was protected by utilising KiwiRail's Rail Operating Rules and Procedures rule 908 Blocking. There was also a requirement for a secondary protection method, which on this occasion consisted of securing the points away from the PWA.
- 2.20. In addition to the electronic blocking protecting the worksite, the work group itself was working under KiwiRail's Rail Operating Rules and Procedures rule 902 Managing a protected work area. Rule 902 dictates that all personnel who need to work within a PWA must contact the RPO to be briefed, signed on to a worksite register and 'locked on'<sup>6</sup> using a personal padlock (Appendix 1).

<sup>&</sup>lt;sup>6</sup> The terminology used to describe someone following the procedure laid down in Appendix 1.

2.21. Rule 902 also stated the limited circumstances in which personnel were excluded from locking on in accordance with normal procedure. The type of work the signals technician was carrying out was not among the limited circumstances.

#### Electronic blocking and secondary protection

- 2.22. Electronic blocking was the primary means of protecting the worksite, although secondary protection was also required due to the possibility of rail traffic moving on adjacent tracks.
- 2.23. The RPO was responsible for communicating with train control to gain possession of the track and establish electronic blocking protection.
- 2.24. Secondary protection arrangement instructions required that the points allowing entry to the worksite were secured in position by a qualified signals technician. This was to be done in such a manner that traffic was directed away from the worksite and could not be moved inadvertently towards the worksite (Appendix 2).
- 2.25. The means of securing the points was to de-energise them from a trackside signal equipment panel by removing the fuse to the motor that operated the points.

#### Key personnel

- 2.26. The RPO had 18 years' experience in the role and held all relevant qualifications and a current certification.
- 2.27. The signals technician had 17 years' experience in the role and held all relevant qualifications and a current certification.
- 2.28. The train controller had two years' experience in the role and held all relevant qualifications and a current certification.

## **3** Analysis

## Introduction

- 3.1. The safe separation and protection of track workers from rail vehicles is a fundamental premise of any rail operation. It is therefore essential that robust and proven safe methods of working are in place to prevent potential interactions between workers and rail traffic.
- 3.2. On this occasion the RPO allowed a signals technician to enter the PWA without following the procedure prescribed in rule 902 and as a result a significant safety barrier was breached.
- 3.3. The following analysis discusses the events and circumstances surrounding the cancellation of the PWA before it was handed back to train control, while a worker was still present and working on the track.

#### **Circumstances**

- 3.4. Immediately prior to the incident the work group was in the process of disestablishing the worksite. Members of the work group had been required to work for an additional hour past their rostered time of 1800 to ensure that the track repair work was completed.
- 3.5. As soon as the worksite was handed back to train control for operational use, the work group members were considered to have completed work for the day and were then free to leave the site.
- 3.6. However, just as the RPO was preparing to hand the site back to train control they were approached by a signals technician who had been instructed to inspect some trackside equipment. The work being undertaken was within the PWA, some distance away from the RPO's location and out of line of sight.

#### The incident

- 3.7. The RPO reported that during their conversation with the signals technician, the signals technician stated that they needed to examine a set of points, and asked the RPO whether it was necessary to lock on. The lock-on procedure would have allowed the signals technician to inspect the trackside equipment safely. However, this would have also delayed the cancellation of the PWA.
- 3.8. The RPO reported that they were unaware that the signals technician was inspecting points for potential damage. Instead, they had incorrectly assumed that the work was related to removing the secondary protection in preparation for handing the track back to train control. As a result, the RPO responded that locking on would not be required.
- 3.9. The RPO reported that when the signals technician requested access they were focused on clearing the work group from the PWA so that the track could be handed back to train control. Although the RPO did not recall feeling any perceived pressure by the additional time already worked by the work group, handing the track back to train control would have allowed the work group to complete their work.
- 3.10. The signals technician reportedly did not advise the RPO that the work on the points could take some time. The signals technician was also of the view that the PWA could

not be handed back to train control while secondary protection, which only the technician could remove, was still in place.

3.11. This series of misunderstandings and procedural lapses allowed the signals technician to commence carrying out work in the rail corridor with a false sense of security. Unknown to the technician, the RPO believed that the technician was working clear of the track and had already advised train control that electronic blocking could be removed. Although the secondary protection was still in place, the removal of the electronic blocking potentially put the signals technician at risk from rail traffic exiting nearby sidings.

#### **Risk controls**

- 3.12. Several non-physical safety barriers were in place to prevent unauthorised access to the PWA. These included:
  - the promulgation by KiwiRail of a special bulletin for the work being undertaken, which specified the type of protection required for the duration of that work (Appendix 2). The special bulletin also stipulated the specific rules and conditions under which the work was to take place
  - the content of the special bulletin, which was included in the pre-start safety briefing attended by the RPO
  - rules and procedures governing work within worksites, which were in place. All personnel involved were trained in these rules and were qualified to work on the track
  - primary protection and secondary protection, which were established in accordance with the relevant rules and procedures. The secondary protection (securing of points) was also a physical barrier preventing rail traffic entering the PWA.
- 3.13. These barriers should have provided adequate safe-working controls. However, their effectiveness was compromised by the non-technical skills employed by the involved personnel.

#### Non-technical skills

- 3.14. The Rail Safety and Standards Board of the United Kingdom defines non-technical skills as "the cognitive, social and personal resource skills that complement technical skills and contribute to safe and efficient task performance". While technical skills describe what you need to do and know for a given safety-critical task, non-technical skills describe how you do that task. The non-technical skill components can be broken down further into sub-categories that include situational awareness, conscientiousness, communication, decision-making and action, co-operation and working with others, workload management and self-management.
- 3.15. All the key personnel involved in this incident had undergone training in non-technical skills. Nevertheless, the incident highlighted the importance of these skills in creating a safe working environment and ensuring that there are no misunderstandings particularly skills in communication, possessing a common mental model, challenge and response, and situational awareness.
- 3.16. Had the signals technician and RPO communicated more effectively regarding the nature and potential implications of the signals technician's intended work, they would have likely shared the same mental model and understood the consequences of the work requirements. This transfer of knowledge would have also likely improved the RPO's

situational awareness and led to a better understanding of the need to lock on the signals technician.

- 3.17. There was a missed opportunity for the signals technician to challenge the RPO on the necessity to lock on. The challenge would have also likely led to the RPO gaining a better understanding of and greater clarity on the proposed work. In addition, had the signals technician advised the RPO that the work could take some time, the RPO might have been prompted to decline access to the PWA.
- 3.18. Had each been better aware of the other's needs, a simple solution such as the signals technician arranging for their own protection directly through train control was possible. This would then have allowed the work group to complete their work and depart.
- 3.19. Unfortunately, the challenge made by the train controller to the RPO requesting the whereabouts of the signals technician went unheeded. The RPO's mental model was that the technician was working clear of the track. This challenge was a further opportunity for the RPO to stop, reassess the environment and regain situational awareness.
- 3.20. All of the opportunities presented above were instances where a better use of nontechnical skills could have minimised the likelihood of the incident occurring.
- 3.21. The Transport Accident Investigation Commission (Commission) has raised the issue of non-technical skills in several rail occurrence reports, including in a recommendation to the Chief Executive of the NZ Transport Agency (002/12):

The Commission recommends to the Chief Executive of the NZ Transport Agency that (the agency) require the Executive of the National Rail System Standard to develop standards to ensure that all rail participants meet a consistently high level of crew resource management, and communication that includes the use of standard rail phraseology.

- 3.22. As a result of this recommendation KiwiRail implemented training programmes that included the principles of non-technical skills. All personnel involved in this incident had been trained to some extent in these principles, but the incident highlighted the importance of continuation training to ensure that these principles remain prominent in the workers' minds as an important tool in planning for any safe-working scenario.
- 3.23. On 3 April 2017 the NZ Transport Agency said it was continuing to work with KiwiRail on addressing the recommendation. At the time of publication the recommendation remains open.
- 3.24. The Commission does not intend to make a further recommendation on this matter.

#### **Other potential factors considered**

- 3.25. Shift-rosters for all personnel were received by the Commission and were compliant with fatigue management standards. Although the work period was extended by one hour, there was no evidence of fatigue having been a factor in the occurrence.
- 3.26. The RPO undertook a drug and alcohol test soon after the occurrence. There was no indication of drugs or alcohol being a factor.
- 3.27. All personnel involved had received the respective training and were qualified for the roles they were undertaking at the time of the occurrence.

# 4 Findings

- 4.1. It was very likely that a safe-working incident occurred as a result of electronic blocking being removed at the rail protection officer's request, while the signals technician was still working on the track.
- 4.2. The rail protection officer's request to remove electronic blocking was likely due to the rail protection officer and the signals technician not utilising non-technical skills effectively to develop a shared mental model of the work to be undertaken by the signals technician.

## **5** Safety issues and remedial actions

## General

- 5.1. Safety issues are an output from the Commission's analysis of factors that have contributed to the occurrence. They typically describe a system problem that has the potential to adversely affect future operations on a wide scale.
- 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.
- 5.3. Recommendations are made to persons or organisations that are considered the most appropriate to address the identified safety issues.
- 5.4. In the interests of transport safety it is important that safety actions are taken, or any recommendations are implemented, without delay to help prevent similar accidents or incidents occurring in the future.
- 5.5. No new safety issues or recommendations were identified during the course of this investigation.

## 6 Recommendations

#### General

- 6.1. The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector.
- 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. No new recommendations were issued.

# 7 Key lessons

7.1. All personnel undertaking safety-critical roles should adhere to the principles of nontechnical 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 the tasks safely.

## 8 Data summary

Date and time	24 March 2019, at about 1850 <sup>7</sup>	
Location	Ōtāhuhu triangle in the Westfield yard	
Operating crew	one rail protection officer, one signals technician, one train controller	
Injuries	nil	
Damage	nil	

<sup>&</sup>lt;sup>7</sup> Times in this report are New Zealand Daylight Savings Times (universal co-ordinated time +13 hours) and are expressed in the 24-hour mode.

## **9 Conduct of the inquiry**

- 9.1. On 26 March 2019 the NZ Transport Agency 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. On 12 April 2019 Commission investigators conducted interviews with the train controller and network control manager.
- 9.3. On 30 April 2019 Commission investigators conducted a site visit and interviewed the signals technician and the manager of the RPO.
- 9.4. On 21 May 2019 Commission investigators conducted an interview with the RPO.
- 9.5. The Commission obtained the following documents and records:
  - the signalling and interlocking diagram for Ōtāhuhu triangle
  - train control diagrams relevant to the occurrence
  - copies of incident reports completed by personnel involved in the occurrence
  - witness statements and interviews
  - the training records for involved parties
  - work rosters for the involved parties covering the lead-up to the occurrence
  - copies of the special bulletin promulgated by KiwiRail relevant to the occurrence
  - rules and regulations pertaining to PWAs
  - recordings of calls to and from train control relevant to the occurrence
  - copies of forms completed by the RPO during the establishment of the PWA.
- 9.6. On 2 December 2019 the Commission approved a draft report for circulation to five interested persons for their comment.
- 9.7. Five submissions were received. The Commission considered the submissions, and no changes were required to the final report.
- 9.8. On 3 April 2020 the Commission approved the final report for publication.

# **10 Report information**

## **Abbreviations**

PWA	protected work area
RPO	rail protection officer
Commission	Transport Accident Investigation Commission
Glossary	
electronic blocking	a protection activated on the signalling system operated by train control when required to ensure that signals and points are not cleared into a protected work area, or to prevent conflicting rail movements
points	a movable part of the track which guides rail traffic from one track to another.
protected work area	a worksite that has been cordoned off either electronically or by other means to prevent unauthorised rail traffic or personnel entering the area
secondary protection	an additional method of cordoning off a worksite to enhance primary protection
train control	the national train control centre housed in Wellington Railway Station, where train movements and track occupations are authorised by train controllers

## **11** Notes about Commission reports

#### **Commissioners**

Chief Commissioner	Jane Meares
Deputy Chief Commissioner	Stephen Davies Howard
Commissioner	Richard Marchant
Commissioner	Paula Rose, QSO

#### **Key Commission personnel**

Chief Executive	Lois Hutchinson
Chief Investigator of Accidents	Aaron Holman
Investigator in Charge	David Manuel
General Counsel	Cathryn Bridge

#### **Citations and referencing**

This final report does not cite information derived from interviews during the Commission's inquiry into the occurrence. Documents normally accessible to industry participants only and not discoverable under the Official Information Act 1982 are referenced as footnotes only. Publicly available documents referred to during the Commission's inquiry are cited.

#### Photographs, diagrams, pictures

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

#### Verbal probability expressions

This report uses standard terminology to describe the degree of probability (or likelihood) that an event happened or a condition existed in support of a hypothesis. The expressions are defined in the table below.

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	

\*Adopted from the Intergovernmental Panel on Climate Change

## Appendix 1: KiwiRail guide to rule 902





## **Appendix 2: Special bulletin 313**

Special Bulletin No.**313** 20 March 2019

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KiwiRail #

#### Track Work Protection Arrangements Westfield Saturday 23 March to Sunday 24 March 2019

Protected Work Area		Rule	Work Details
Westfield	Westfield	908	1000 Sat to 1800 Sun
1655, 1666A Points	1618 Signal	Blocking	Formation Upgrade North Leg
(work must not foul points)	North Siding		Otahuhu Triangle
North Siding and West Leg			
Line Impassable: Line impassable between the above points during the hours of work.			
Secondary Protection Arrangements: During the hours of work No's. 1655, 1666A points will be secured in the normal position. Certificate: The Signals member in charge on each occasion, must certify to Train Control the points have been secured in the required position and on completion of work must give a certificate to Train Control that the above mentioned points have been restored to normal operation.			



#### Recent railway occurrence reports published by the Transport Accident Investigation Commission (most recent at top of list)

	(most recent at top of list)
RO-2019-102	Clinton derailment, 29 March 2019
RO-2018-102	Freight train SPAD and wrong-routing, Taimate, 1 October 2018
RO-2018-101	Metropolitan passenger train, derailment, Britomart Transport Centre, Auckland, 9 May 2018
RO-2017-106	Mainline locomotives, Wrong-routing and collision with work vehicle, Invercargill, 16 November 2017
RO-2017-105	Collision between freight Train 353 and heavy motor vehicle, Lambert Road, leve crossing, near Kawerau, 6 October 2017
RO-2017-104	Unauthorised immobilisation of passenger train, at Baldwin Avenue Station, Avondale, 17 September 2017
RO-2017-101	Signal Passed at Danger 'A' at compulsory stop boards protected worksite, Pongakawa, Bay of Plenty, 7 February 2017
RO-2017-103	Potential collision between passenger trains, Wellington Railway Station, 15 May 2017
RO-2017-102	Signalling irregularity, Wellington Railway Station, 3 April 2017
RO-2016-101	Signal passed at danger leading to near collision, Wellington Railway Station, 28 May 2016
RO-2016-102	Train 140 passed Signal 10R at 'Stop', Mission Bush Branch line, Paerata, 25 October 2016
RO-2015-103	Track occupation irregularity, leading to near collision, between Manunui and Taumarunui, 15 December 2015
RO-2014-105	Near collision between train and hi-rail excavator, Wairarapa Line near Featherston, 11 August 2014

RO-2013-101 Derailment of freight Train 345, Mission Bush Branch line, 9 January 2013

# TAIC Kōwhaiwhai - Māori scroll designs

TAIC commissioned its kōwhaiwhai, Māori scroll designs, from artist Sandy Rodgers (Ngati Raukawa, Tuwharetoa, MacDougal). Sandy began from thinking of the Commission as a vehicle or vessel for seeking knowledge to understand transport accident tragedies and how to prevent them. A 'waka whai mārama (i te ara haumaru) is 'a vessel/vehicle in pursuit of understanding'. Waka is 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 represent the individual inquiries.

Sandy acknowledges Tane Mahuta in the creation of this Kowhaiwhai.

#### 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 aviation.

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

#### Marine: 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 'Marine'.

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

#### Rail: rerewhenua - flowing across the land

# <u>NGRARS</u>

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.