

Inquiry RO-2012-105: Unsafe recovery from wrong-route
at Wiri Junction, 31 August 2012

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Final Report

Rail inquiry RO-2012-105
Unsafe recovery from wrong-route at Wiri
Junction, 31 August 2012

Transport Accident Investigation Commission

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

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Important notes

Nature of the final report

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

Ownership of report

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

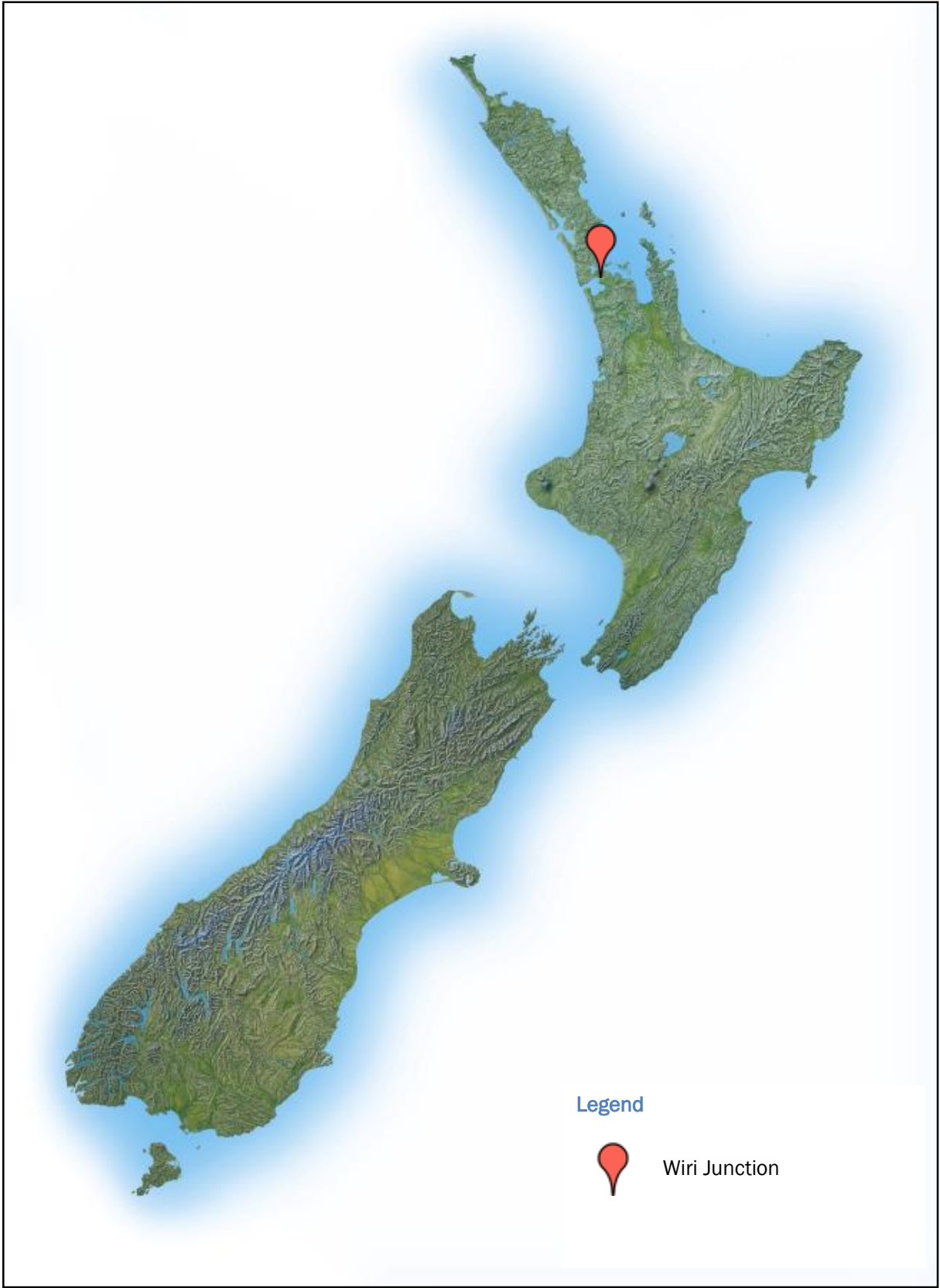
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Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1980 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams, pictures

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



Location of incident

Source: mapsof.net

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Abbreviations

Commission	Transport Accident Investigation Commission
km/h	kilometre(s) per hour

Glossary

down-main	the track of a double-track line that is normally used to head south. It is the left-hand track when facing south
interlock	a control system function where the next sequential control logic step is conditional on the state of one or more interlocked devices
medium speed	25 kilometres per hour unless the limit is increased by an associated speed board placed adjacent to the medium speed sign
mimic	a computer-generated diagram of the rail network used by a train controller to control rail movements. See the example in Appendix 1
normal speed	the lowest of a train's maximum speed, the track's posted speed limit and any temporary speed limits
set-back	the process of reversing a train
wrong-route	a signalled route that is not intended for a particular train

Data summary

Vehicle particulars

Train type and number:	diesel multiple unit V4207, Train 4207
Classification:	ADL #803 and ADC #853
Year of manufacture:	1982-1985 for use in Perth, Australia then imported and placed into service in New Zealand in July 1993
Operator:	Transdev Auckland Limited (at the time of this incident Transdev was trading under the name of Veolia)
Date and time	31 August 2012 at 0805 ¹
Location	Wiri Junction, Auckland
Persons involved	driver of Train 4207, driver of Train 1009 and a KiwiRail train controller
Injuries	nil
Damage	nil

¹ All times are described in the 24-hour format in New Zealand Standard Time.

1. Executive summary

- 1.1. On Friday 31 August 2012 a scheduled Auckland metropolitan passenger train was travelling south from Britomart Station to Manukau Station. The train had stopped at Puhinui Station to exchange passengers. While it was sitting at the station, train control set the wrong route for the train through Wiri Junction. The route was set to take the train straight through to Papakura instead of diverging to the Manukau Branch Line.
- 1.2. The signal ahead of the train was showing the driver that his train was routed for Papakura instead of Manukau. However, the driver did not recognise this.
- 1.3. The train controller realised his mistake and radioed the train driver with the intention of having him stop his train, but was too late to prevent the train entering the Wiri Junction section. On this occasion there was no conflicting traffic and the train was in no danger of overturning because the driver had kept the train speed down to 40 kilometres per hour on the assumption that his train would be routed across to the Manukau Branch Line.
- 1.4. However, a serious incident occurred during the process of recovering the train to the correct route. Through miscommunication between the train driver and the train controller, the driver drove his train straight back in the direction from which it had come, towards another passenger train approaching on the same line.
- 1.5. The trains stopped about 800 metres apart. There was no collision and no-one was injured.
- 1.6. The Transport Accident Investigation Commission (Commission) found that the wrong-routing occurred during a transitional period when train controllers were becoming familiar with the newly commissioned Manukau Branch Line. They altered an existing routine that for a time increased the risk of human error.
- 1.7. The Commission also found that the driver assumed the route ahead had been correctly set for his train then selectively read the 'proceed' aspect of signal 1803, but he did not recognise that it was also displaying the wrong route for his train.
- 1.8. The key **safety issue** arising from this incident was the miscommunication between the driver and the train controller, resulting from an ambiguous conversation when a set of clear and precise instructions were required but not relayed.
- 1.9. The Commission has already made a recommendation to the Chief Executive of the NZ Transport Agency in 2012 about ensuring high standards of crew resource management and communication across the rail industry. Since this incident KiwiRail has automated the train route selection for Wiri Junction, which should significantly reduce the likelihood of a future Manukau-bound train being signalled a wrong route through Wiri Junction.
- 1.10. In view of the above, the Commission has made no new recommendations arising from this inquiry.
- 1.11. The **key lessons** arising from this inquiry are:
 - train drivers must actively look at, correctly interpret and respond to all signals, rather than making assumptions about what lies ahead of their trains
 - communication between train controllers and train drivers must be clear and concise and leave both parties in no doubt as to what is going to happen next, particularly when resolving abnormal situations.

2. Conduct of the inquiry

- 2.1. The incident occurred on Friday 31 August 2012 at 0805. The NZ Transport Agency notified the Transport Accident Investigation Commission (Commission) within an hour of the incident.
- 2.2. The Commission requested further information and made preliminary enquiries, then on 4 September 2012 opened an inquiry under section 13(1) of the Transport Accident Investigation Commission Act 1990 and appointed an investigator in charge.
- 2.3. On 18 September 2012 investigators travelled to Auckland to conduct a site investigation and conduct interviews. Evidence collected and reviewed included: the audio records from train control; the train control system replay and event log; the Tranzlog event recorder from the train; Transdev Auckland Limited's (the operator's) investigation into this incident; formal interviews; and documentary records from both Transdev and KiwiRail.
- 2.4. On 25 February 2016 the Commission approved the report for circulation to interested persons for comment.
- 2.5. Submissions were received from two of the interested persons. The Commission has considered all submissions and any changes as a result of those submissions have been included in this final report.

3. Factual information

3.1. Narrative

- 3.1.1. On Friday 31 August 2012 a metropolitan passenger train was travelling south from Britomart Station, and was scheduled to arrive at Manukau Station at 0807.

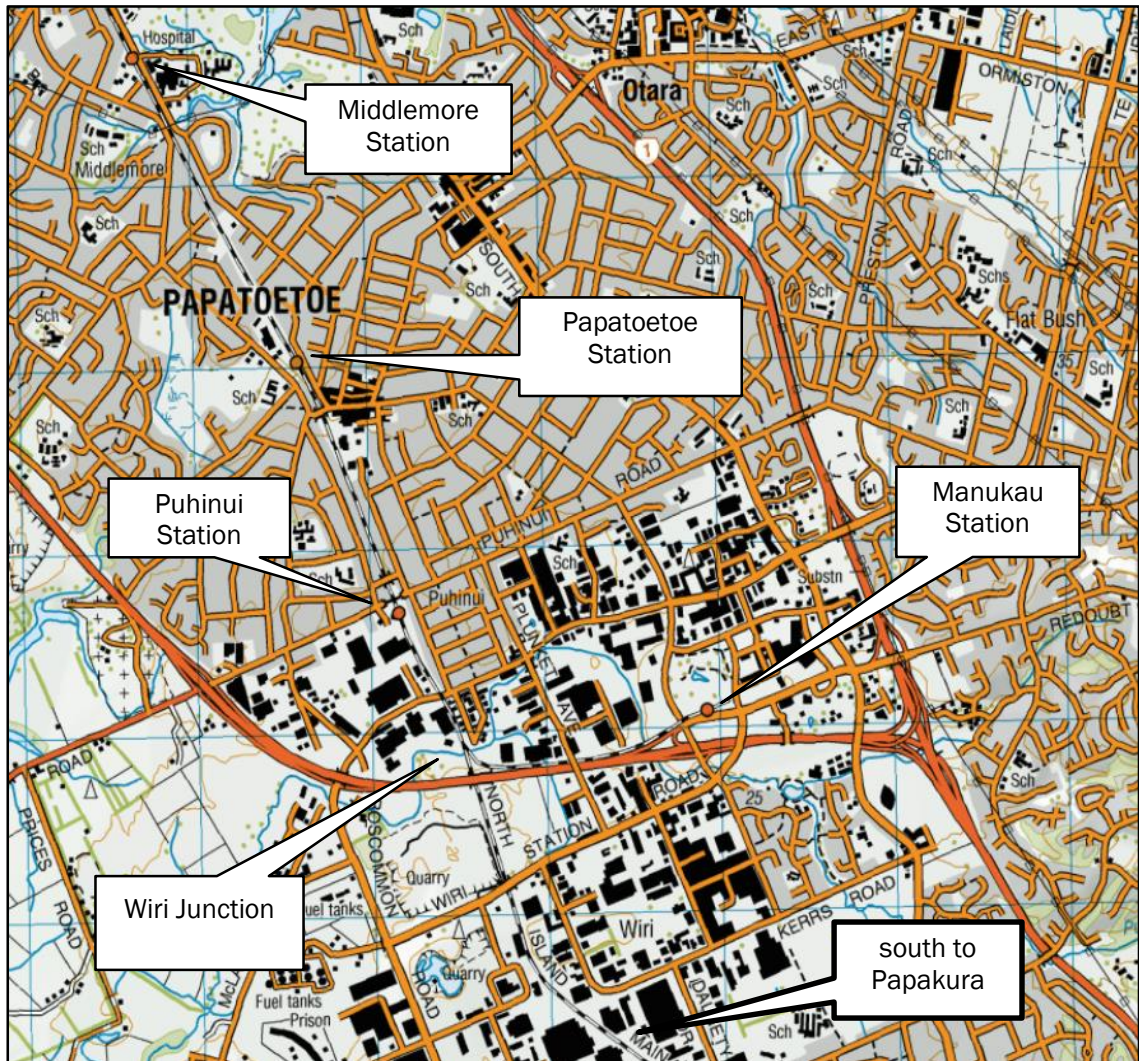


Figure 1
Area map

- 3.1.2. After the train passed through Middlemore Station (see Figure 1), three of the next four automatic signals along this straight displayed a 'flashing yellow over red' to indicate to the driver that there was a train ahead travelling in the same direction, but far enough ahead so that he could proceed at 'normal speed'². The fourth and last automatic signal before Puhinui Station was a steady 'yellow over red', indicating that the next signal, past Puhinui Station (signal 1803) would be at 'stop' (displaying 'red over red'). The train stopped at Puhinui Station to exchange passengers. Signal 1803 indicated the direction in which the train would be routed through Wiri Junction and the speed at which it was permitted to travel. It was about 170 metres ahead and visible to the driver when his train was berthed at the Puhinui Station platform (see Figure 2).
- 3.1.3. Once the passenger exchange was complete, the train manager signalled the driver that he was clear to depart. Signal 1803 was displaying 'red over red', so rather than depart the

² Normal speed is the lowest of a train's maximum speed, the track's posted speed limit and any temporary speed limits.

station and have to stop soon afterwards, the driver elected to remain at the station until the signal changed. The train remained at the station for a further 30 seconds.

- 3.1.4. Meanwhile, the train controller was at his workstation in the National Train Control Centre in Wellington, controlling the Wiri and Papakura control zones. The zones were displayed on adjacent computer screens. He had just set a route for a departing train at another station in the Papakura control zone, then looked over at the Wiri Junction area screen (the Wiri control zone is shown in Appendix 1). He signalled another train out from the Manukau Branch Line back to Britomart and saw the train berthed at Puhinui Station. Signal interlocking³ prevented his setting a route for the train at Puhinui Station until the other train departing Manukau had left the junction area, so he briefly returned to the screen for the Papakura control zone.



Figure 2
Signal 1803 as it was seen from Puhinui Station at the time of the incident

³ Interlocking is a control system function where the next sequential control logic step is conditional on the state of one or more interlocked devices.

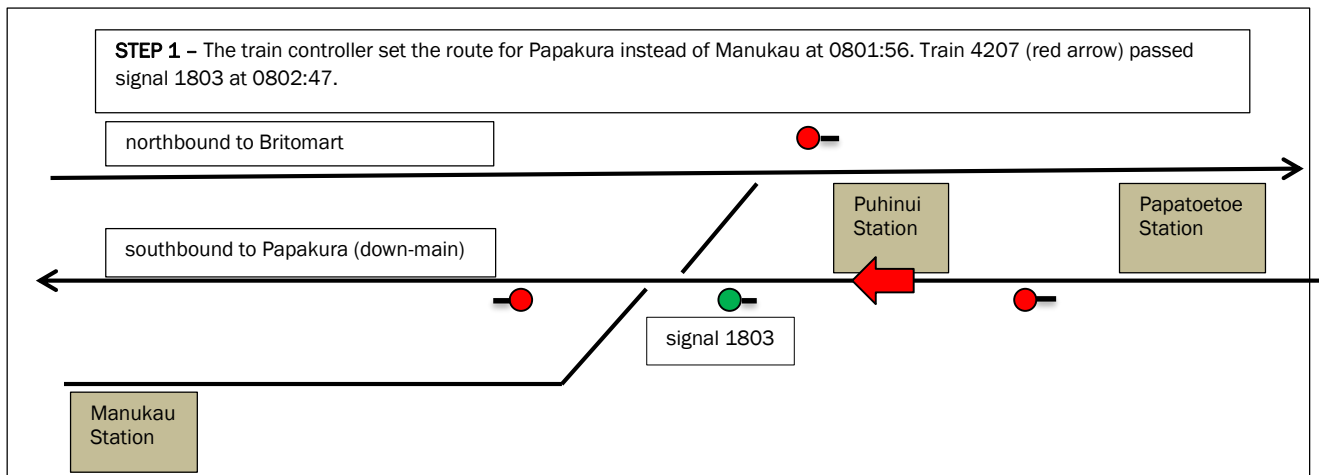


Figure 3
Step 1 of sequence

- 3.1.5. When the train controller looked back at the Wiri Junction screen, he saw that the train departing Manukau had cleared the area, so he set a route for the train at Puhinui Station, through Wiri Junction towards Papakura (see Figure 3). He then returned to look at the Papakura control zone screen. However, the train should have been routed to take the left branch to Manukau.
- 3.1.6. The train driver saw signal 1803 change to ‘flashing yellow over red’ (caution, proceed at normal speed), and departed Puhinui Station (see Figure 4). Normal speed meant anything up to 90 kilometres per hour (km/h). The driver had not recognised from his route knowledge that the signal should have been the opposite – displaying red on the top and either green or yellow on the bottom, to indicate that his train was routed across to the Manukau Branch Line and that he should only proceed at medium speed⁴. The driver knew that the speed limit for crossing to the Manukau Branch Line was 40 km/h, which was the speed to which he accelerated his train.

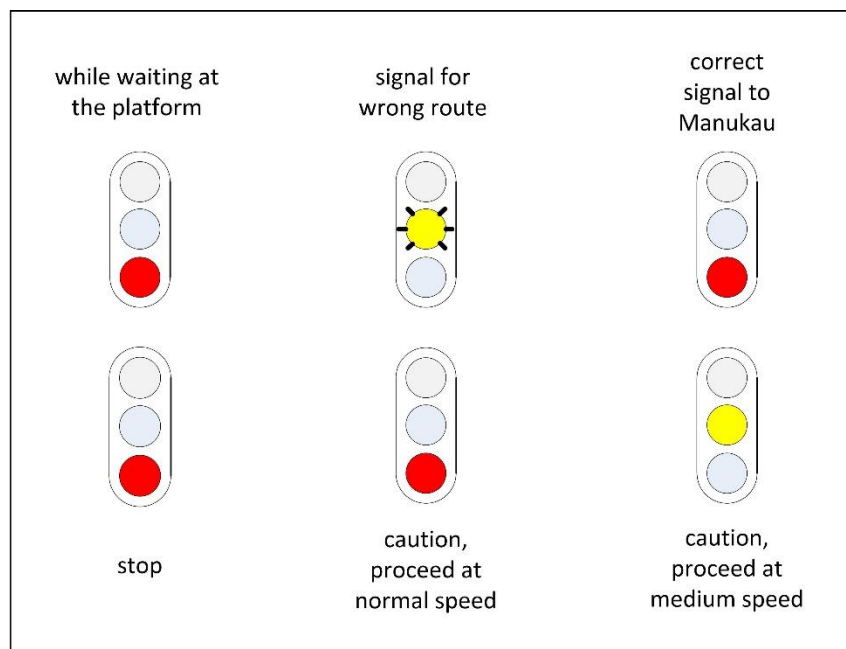


Figure 4
Signal 1803 as it was and as it should have been (right hand set)

⁴ Medium speed is 25 km/h unless increased by an associated higher speed board.

- 3.1.7. Twenty seconds after he had set the wrong route, the train controller realised he had made a mistake and called the driver⁵ in an attempt to stop the train before it reached signal 1803. The train controller said, “[Train] 4207, 4207, control.”
- 3.1.8. The train was nearing the signal when the driver responded with, “4207, control receiving, over”. At the same time the signal changed to ‘green over red’.

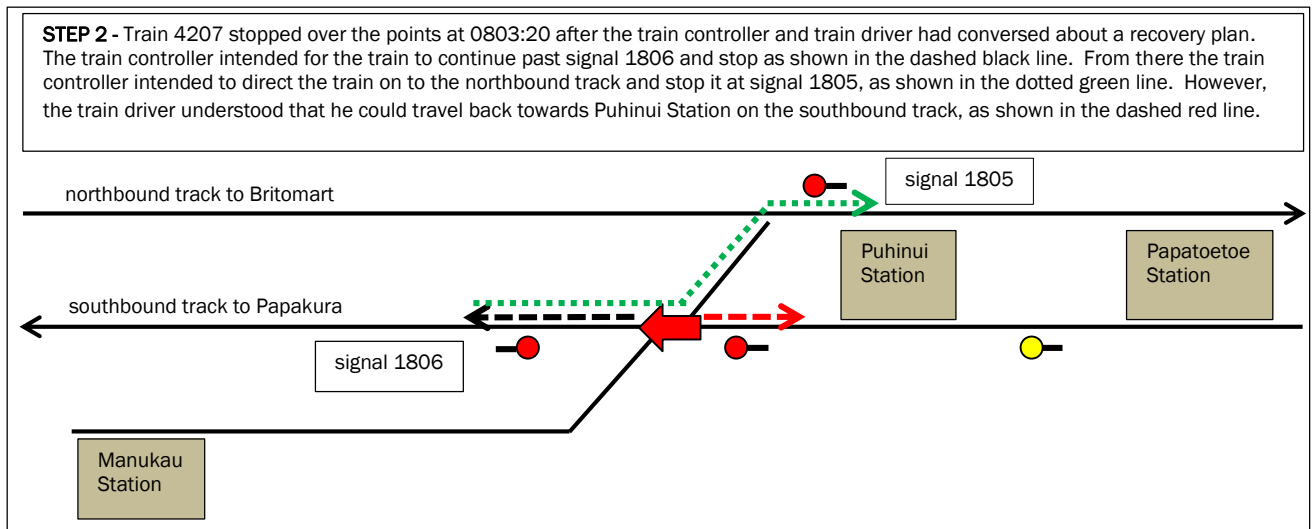


Figure 5
Step 2 of sequence

- 3.1.9. The train controller replied, “Sorry about that. Better take that, 1803 back and send you in the right direction.” The driver slowed the train to 30 km/h and asked the train controller to repeat his message. The train controller responded with, “Yeah, 4207, a bit late now. [Exact words could not be determined] inside 1806 signal on the down and change ends, over” (see Figure 5).
- 3.1.10. The driver then responded to the train controller and expressed his understanding of the train controller’s instruction by saying, “Copy that, change ends and be prepared to revert back to Puhinui, over”. The train controller responded with, “Yeah, roger mate. Thanks.”
- 3.1.11. The driver then stopped the train. It came to rest near the points for the Manukau Branch Line. Meanwhile another train that had been following Train 4207 was approaching Puhinui Station from Papatoetoe Station (see Figure 6).
- 3.1.12. The driver changed ends to the rear driving cab and, without any further communication with the train controller, proceeded at 40 km/h back along the down-main⁶ towards Puhinui Station. This put the train on a collision course with the other train. The other train was about one kilometre away around a curve and out of the driver’s line of sight.
- 3.1.13. The train controller saw on his screen that the trains were heading towards each other and urgently called for the reversing train to stop.
- 3.1.14. The driver responded while stopping his train clear of signal 1803. He then called the train controller to say he was ready for the next movement towards Manukau. At this point he looked up into the distance and saw the headlights of the opposing train directly ahead (see Figure 6).

⁵ See Appendix 2 for the radio communication transcript.

⁶ In the North Island, the down-main is the track of a double-track line that is normally used to head south. It is the left-hand track when facing south.

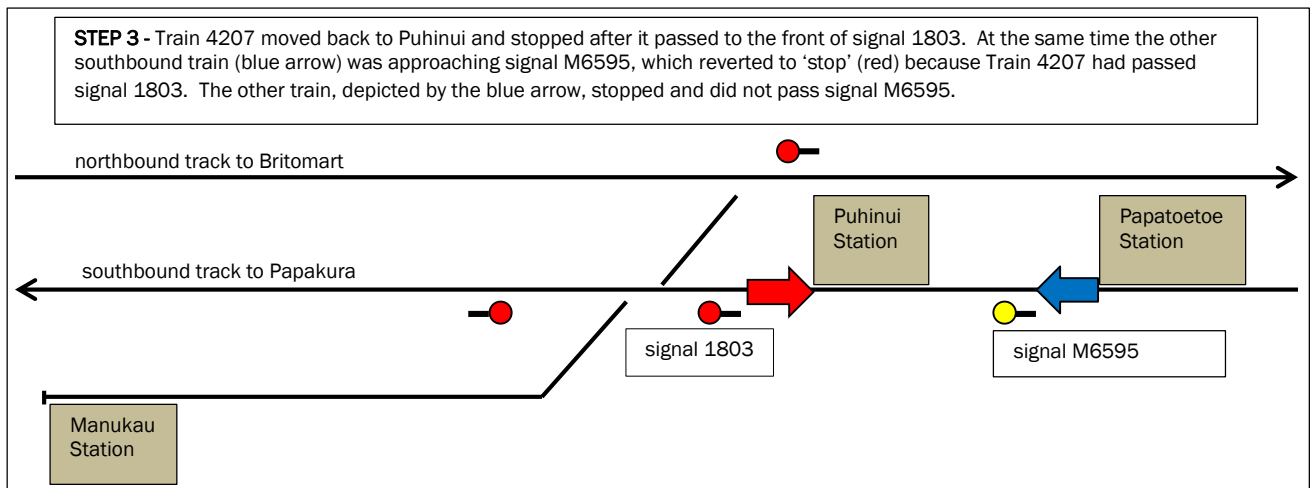


Figure 6
Step 3 of sequence

- 3.1.15. As the other train⁷ approached Puhinui Station from Papatoetoe, the driver heard the radio conversation between the train controller and the driver of Train 4207. He saw the train approaching head-on. The other train had already slowed for a speed restriction when signal M6595 ahead automatically reverted to 'red' (stop) because Train 4207 had passed signal 1803 and re-entered that section of track. The driver of the other train stopped his train before reaching the signal and advised the train controller of his status.
- 3.1.16. Both trains stopped facing each other approximately 800 metres apart.
- 3.1.17. Following the incident, Transdev⁸ stood down the train driver and KiwiRail stood down the train controller.

3.2. Personnel information

The train driver

- 3.2.1. The train driver had started his driver training with Transdev in November 2009 and become a qualified driver in November 2010. When the incident occurred the driver had 22 months' experience as a qualified driver.
- 3.2.2. The driver had been off work for a week with influenza. He had returned to work at 0505 on the Tuesday preceding the incident. He had driven one return trip between Britomart and Manukau that day, then three on Wednesday and three again on Thursday. On Friday he had started at 0455, had completed one return trip between Britomart and Manukau and was on his second return trip when the incident occurred. He estimated that he had had six hours' sleep each night that week and that he had been alert and fit to drive.
- 3.2.3. Following Transdev's internal investigation the driver was placed on a tailored support programme that effectively reset his post-qualified driver status to zero experience. He was subject to regular in-cab observations and random checks for a corrective period.
- 3.2.4. The driver underwent a drug and alcohol test following the incident. The results were clear.

The train controller

- 3.2.5. The train controller had initially started work with KiwiRail as a member of a track maintenance gang before retraining as a train controller. He had gained his first certificate to perform train control duties in 2008, then qualified for the Auckland control desk on 21 May

⁷ Train 1009.

⁸ At the time of this incident Transdev was operating under its previous trading name of Veolia.

2010. When this incident occurred he was a level-three controller for the Auckland area, which meant he was qualified to operate any of the Auckland train control zones.

- 3.2.6. He worked a standard rotating shift pattern, where the start time advanced one shift period for each group of working days, with adequate time off between each group. He had started work at 0640 that morning and said that he had felt rested and alert.
- 3.2.7. KiwiRail investigated the incident and as a result placed him on a close monitoring programme for the next nine months. This included additional safety observations, audits of his recorded train control conversations and theory assessments.
- 3.2.8. The train controller underwent a drug and alcohol test following the incident. The results were clear.

3.3. Track changes at Wiri Junction

- 3.3.1. Wiri Junction was undergoing significant change at the time of this incident due to a major rail upgrade project. The works had started in July 2011 and were staged over two years to keep the junction operational. The major tasks included providing a new double-track branch line to Manukau and a new entry/exit branch line from a new electric train maintenance depot that was also under construction. The associated changes included: rearranging signals for bi-directional running through the junction; new rail crossings between the up- and down-mains for both directions; new points and signals; relocating existing signals; and extending the limits of Wiri Junction. This incident occurred while the area was at stage five of seven construction stages.

3.4. Signals' interpretation

- 3.4.1. The railway signalling system in New Zealand is primarily a two-unit, speed-indication system. The top light is the A unit and the bottom the B unit. Each light unit can display green, red or yellow, or flashing green or yellow (see Figure 7).
- 3.4.2. The track is divided into separate sections, with track-mounted sensors to detect the track section that a train currently occupies. This information is presented on the train controller's screen as the train's location and is also used to control the signals automatically (see Appendix 1 for a train controller's mimic and train location).

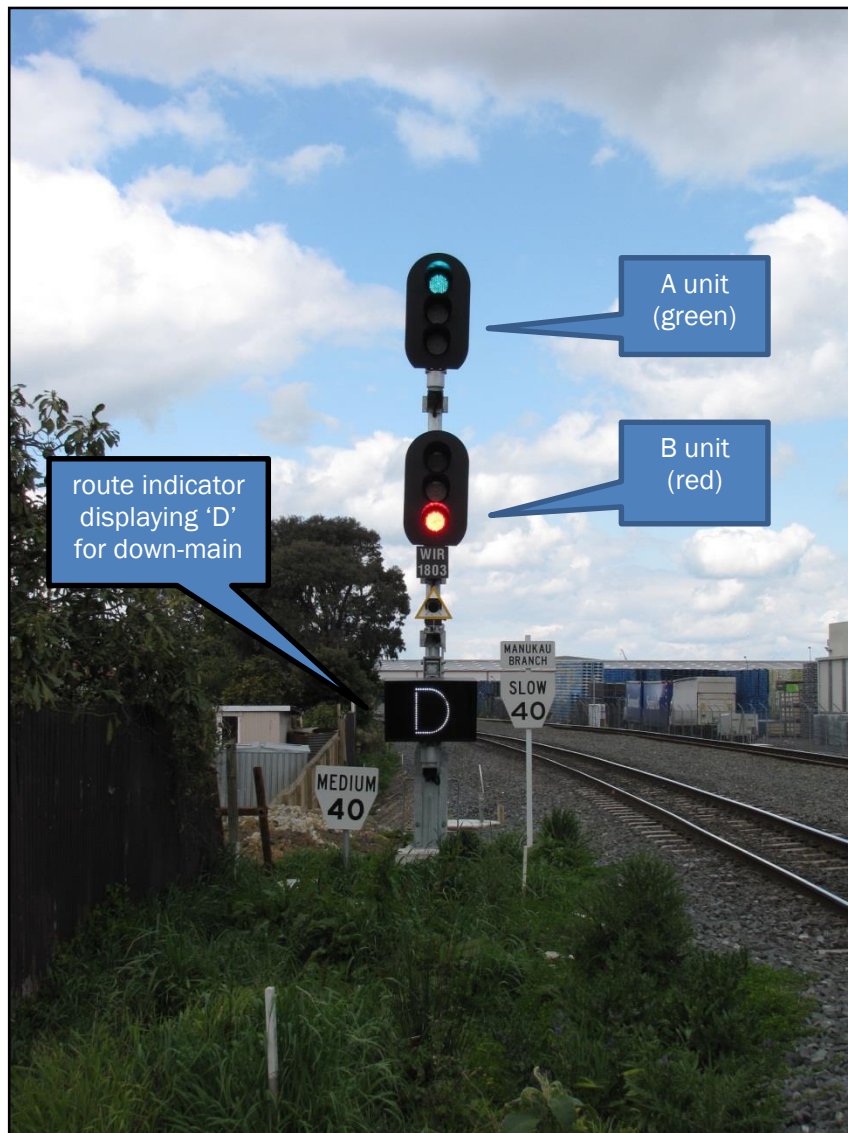


Figure 7
Signal 1803 displaying 'proceed at normal speed' (green over red)

3.4.3. Figure 7 shows signal 1803 telling drivers that their trains are routed straight ahead towards Papakura, 'proceed at normal speed'. When the B unit is red, the colour of the top A unit has the following meanings for the straight-through route:

- red light – the train must not pass the signal
- green light – there are no trains within the next three sections ahead (proceed at normal speed)
- steady yellow light – the next signal is red (proceed at normal speed but be prepared to stop)
- flashing yellow light – the next signal is steady yellow (proceed at normal speed – there is a train two sections ahead).

3.4.4. At Wiri Junction there are four options for the diverging route, so a route indicator has been fitted to signal 1803 to clarify which route is selected. The route indicator is directional and can usually only be seen at close range. It tells drivers which routes ahead have been set for their trains. In Figure 7 the 'D' signifies the 'down-main line' to Papakura. If the train had been routed for the Manukau Branch Line, 'MD' or 'MU' would have been displayed.

3.4.5. If the top A unit is steady red, a yellow or green on the bottom B unit indicates that the speed limit is reduced, and that the route ahead is diverging away from the main line. In this case the bottom B unit would also indicate whether the train must stop or can proceed to Manukau.

3.5. Operating rules for train recovery

3.5.1. The Automatic Signalling Rules⁹ describe how trains can be recovered to the correct routes in cases such as these. One method is for each step to be authorised using signals (see step 2 in Figure 5), which was what the train controller had intended to do in this case. A second method required the train controller to authorise the train to reverse back along the down-main to signal 1803, which was what the driver did. The second method required the use of a SWA-01 form¹⁰.

3.5.2. The SWA-01 form (see Appendix 4) would have had to be issued to the driver of the train about to reverse. The drivers of all trains that could have been potentially affected by the reverse manoeuvre would have had to be contacted before the authority was issued, and blocking would have had to be applied to a signal to prevent it being operated until the train controller had completed the recovery actions. A pad of blank forms is carried in each train and each clause of the form is completed during a radio conversation with the train controller. The train controller reads out the information that is to be entered at each clause and the driver writes it down and reads it back until the form has been completed and confirmed correct.

⁹ KiwiRail rail operating rules, Automatic Signalling Rules, rule 602.

¹⁰ The SWA-01 form is a standard written authority issued by a train controller to specific train drivers for a particular movement.

4. Analysis

4.1. Introduction

- 4.1.1. Setting the wrong route for a train should not in itself create a serious safety issue, as long as the driver recognises and complies with the signals. However, it does raise the level of risk. One potential consequence of a wrong-route¹¹ setting is the driver not recognising that a signal is indicating their train is about to follow a route different from the one they are expecting. It can result in the train taking an alternative route at too high a speed for the track geometry. The Commission has reported on two such incidents. One was a train that nearly rolled over when it passed through a turnout at Tamaki above the speed limit (TAIC, 2012) and the other was a similar event at Westfield, where the train did roll over (TAIC, 2015).
- 4.1.2. In this case the alternative route was straight ahead at normal speed instead of through the speed-restricted turnout to the Manukau Branch Line, so the risk of derailing was low. The main effect was a service delay and an inconvenience to the passengers.
- 4.1.3. The safety issue arising from this incident was the misunderstanding between the train controller and the driver during the recovery sequence, which resulted in a potential head-on collision with another train.
- 4.1.4. There were no issues associated with the track, the signalling system, the train, the environment, the rail operating rules and procedures or the positioning of signal 1803 that contributed to this incident. While radio reception from train control in this type of train in the Wiri Junction area may not have been as clear as in other areas, it did not contribute to the train taking the wrong route or to the misunderstanding during the recovery sequence.
- 4.1.5. The following analysis discusses the sequence of events that contributed to the train taking the wrong route. It also discusses the safety issue of poor communication between the train controller and the train driver.

4.2. The route setting

- 4.2.1. The train controller was qualified to control any of the Auckland control zones and was familiar with multitasking between the zones and across several computer screens. Each workstation had about nine computer screens. Train movements were nearing the morning peak but his workload was no different from that on other days at that time. He was managing two of the Auckland control zones at the time of this incident and was looking after about nine trains. He had been awake for at least four hours when the incident occurred and was about 90 minutes into his shift. His shift patterns had the normal advancing start times for a rotating shift and his food and liquid intake was normal. His drug and alcohol test was clear and there was no evidence to suggest a contributing medical cause. He quickly recognised that he had made a mistake and tried to correct it. He said that he had felt fine on the day and everything was running smoothly.
- 4.2.2. At the time of the incident train controllers had to set routes manually because the construction works at Wiri Junction were still in progress. They selected a train on the control workstation and its planned short-range destination point, then activated a route between those points. Minimal interlocking occurred to prevent a wrong route being set, so it was incumbent upon the train controller to set the correct route manually.
- 4.2.3. KiwiRail had commissioned the new Manukau Branch Line into service four months before this incident, on 15 April 2012. The train numbers for Manukau trains were prefixed with '41' or '42' to identify them clearly and to facilitate future automatic route setting. Previously, passenger trains entering Wiri Junction on the down-main could only pass straight through the junction, so the route was always set for Papakura. After the Manukau Branch Line opened a train controller had to identify a train and its intended route, then decide from four possible options at signal 1803 the end point to select for the manual route.

¹¹ A wrong-route is a signalled route that is not intended for a particular train.

- 4.2.4. KiwiRail records show that one wrong-route had occurred at the junction three days after the Manukau Branch Line opened, and three more during the 15 days prior to this incident. Each of these incidents had involved a different but also senior and experienced train controller. This incident was the second wrong-route that this train controller had set for trains passing signal 1803.
- 4.2.5. To put these errors into perspective, KiwiRail provided operational data that showed Auckland train controllers were manually setting 26,000 routes at junctions per month. The statistical error rate was four per month (0.015%).
- 4.2.6. According to KiwiRail's research into comparable business work practices, typical human error rates ranged between 10% and 30%, but for well managed processes they could drop to between 5% and 10%. Accordingly it believed that this wrong-route occurrence was statistically insignificant. While this research was not verified, a comparative table provided by the Australian Transport Safety Bureau¹² confirmed that the probability for human error in a non-routine operation when combined with other duties at the same time was around 10%.
- 4.2.7. The statistics highlight the importance of having defences in place during periods of high risk to guard against a single human error resulting in an accident. In this case a defence against the train controller making an error was the train driver (another human) correctly identifying and driving to the signals.
- 4.2.8. KiwiRail planned to provide automatic route setting within the train control system but could not activate it until the track layout changes at Wiri Junction were complete. The system automatically links a train number to its scheduled route for that train's final destination and provides interlocking along the way with other trains and their routes. Automatic route setting was commissioned across the Auckland metro rail network on 11 June 2013 and has since reduced the likelihood of a wrong-route being set at the junction. Manual routes are now only set for unscheduled trains (generally freight trains and work trains) or if the train running order needs to be adjusted manually after an unusual event.

Findings

1. The train was wrong-routed to Papakura instead of Manukau. The wrong-routing occurred during a period when train controllers were becoming familiar with the newly commissioned Manukau Branch Line and were setting routes manually.
2. The altered routine to set a route to Manukau manually, coincident with the morning peak train control workload, increased the risk of human error.

4.3. Following the wrong route

- 4.3.1. The driver said that he had been getting sufficient sleep and was alert. This was his fourth day back at work after being on sick leave for several days in the previous week. He had taken an over-the-counter cold relief tablet¹³ earlier in the morning. The operator's standard drug and alcohol test taken immediately after the incident was clear. The Commission's medical consultant concluded that, medically, the driver was fit to be working that day.
- 4.3.2. The driver was qualified with just under two years' experience driving trains. He had no recorded history of driving issues. He had never experienced a wrong-route before. He was familiar with the track and signals in the area and with the route to and from Manukau. He had driven there once already that morning and seven times in the previous three days. The driver was aware that his train was scheduled for Manukau and he was aware that signal 1803 should have displayed a 'proceed at medium speed' (red over green or yellow) when the points were set correctly to the Manukau Branch Line. However, when he looked up and saw

¹² ATSB Human Factors Course 2009, Individual actions by Melanie Todd, table on page 5.

¹³ Contained paracetamol and phenylephrine.

the signal aspect change from 'stop' to 'proceed' he did not notice that it was to proceed down the wrong route for his train.

- 4.3.3. When signal 1803 changed from 'stop' (red over red) to 'caution, proceed at normal speed' (flashing yellow over red) the driver did not comprehend that 'normal speed' would have been too fast (up to 90 km/h) for his train to take the turn-out across to the Manukau Branch Line. Nevertheless, he only accelerated his train to 'medium speed' (up to 40 km/h at that point), which is an indication that the driver only noticed the 'proceed' aspect and expected to be routed across to the Manukau Branch line.
- 4.3.4. There is further evidence supporting the above hypothesis. The driver later said that once the train was moving he had focused on the track ahead and that he would not normally have looked at the signal again until he was almost passing it. He said that he could not recall seeing what the route indicator displayed and thought it was normally blank for the down-main route. In fact the route indicator on signal 1803 is never blank. It normally signals 'D' for the straight-through Papakura line, or 'MD' or 'MU' for crossing to the Manukau Branch Line (refer to Figure 7). When the train controller realised his error and called the driver, the train was approaching signal 1803. It is possible that the radio call distracted the driver at the time he said he would normally have checked the signal. However, the opportunity to interpret the signal correctly was before the train left Puhinui Station.
- 4.3.5. The 'yellow over red' aspect to which signal 1803 changed was the same signal aspect that the driver had experienced at three previous signals along the straight between Middlemore and Puhinui Stations. 'Yellow over red' means 'proceed at normal speed'. The driver then proceeded at the lower medium speed limit of 40 km/h, the speed to which he was accustomed when routed to Manukau.
- 4.3.6. Train drivers are trained to drive to the signals. Misinterpreting signals is a recognised risk for train drivers. A technique that drivers often use to mitigate this risk is to 'call the signals', where a driver reads a signal aloud to focus their attention on the true meaning of the signal. This driver said that he did not practise calling signals to himself.
- 4.3.7. The importance of train drivers reading and interpreting signals correctly and not making assumptions about what lies ahead of their trains cannot be understated. In this case the driver's assumption erred on the side of safety, keeping his speed down to below 40 km/h for a 90 km/h section of track. However, if the situation were reversed and a Papakura-bound train was wrong-routed to the Manukau Branch Line, a driver misinterpreting the same signal could result in the train taking the cross-over at a dangerously high speed.

Finding

- 3. The driver assumed that the route ahead had been correctly set for his train. He then selectively read the 'proceed' aspect of signal 1803 but did not recognise that it was also displaying the wrong route for his train.

4.4. Recovery

Safety issue: The radio communication between the train controller and the train driver was open loop, and after it had ended neither party really understood the other's intentions.

- 4.4.1. The recovery plan to get the train from where it had stopped to Manukau should have been routine (see Figure 5). It required the train to be moved forward beyond the points' interlocking zone, then the train controller to use signals to redirect it to the correct route.
- 4.4.2. Precise and clear communication between train controllers and train drivers is crucial to safe rail operations. The audio records show that the train controller was anxious to correct his mistake before the train passed signal 1803. His first message to the driver was neither

precise nor clear. The driver had some difficulty interpreting what the train controller had said, so he slowed his train and asked him to repeat it. The train controller then said it was a “bit late now” because the train had passed signal 1803 and he described where he would have preferred the driver to have stopped.

- 4.4.3. The driver responded more formally in an attempt to clarify the situation. He stated his interpretation back to the train controller: “change ends and be prepared to revert back towards Puhinui”, and received confirmation from the controller that he was correct. The driver braked at this point and the train stopped near the points for the Manukau Branch Line.
- 4.4.4. The train would have had to return in the direction from which it had come in order to be routed to the correct line, but how the controller intended to achieve this was not made clear to the train driver. The controller intended to reposition the train under the protection of signals. The driver was under the impression that he was to set his train back far enough towards Puhinui Station so that it was on the right side of signal 1803, and that was what he did.
- 4.4.5. The rules that would have permitted such a movement first required a SWA-01 form to be issued to the driver and communicated to the driver of each train potentially affected by the set-back¹⁴ manoeuvre, including the other train that was following and approaching Puhinui Station. The driver had been trained in the use of the SWA-01 procedure, but had not used one in his two years of driving. He should have been familiar enough with the rules to realise that what he was about to do required a SWA-01 procedure to be completed before setting his train back. More importantly, however, a clear instruction from the train controller would have been sufficient to avert the violation of the rail operating rules for setting back a train towards an opposing train.

Communication

- 4.4.6. Clear communication between participants in the rail industry is critical to rail safety, particularly when using radio, as the parties are likely to be remote from each other and have different views of a situation. The Commission has previously issued several recommendations to the rail industry arising from its inquiries after finding that poor standards of communication and crew resource management have been factors contributing to accidents and incidents¹⁵. Crew resource management¹⁶ is where rail participants make use of all the resources available to ensure they all work with consistent information to ensure a successful execution of the plan/task. For this to be achieved the participants must have a clear understanding of instructions, communicate succinctly and engage multiple minds to ensure that operations are conducted safely.
- 4.4.7. For example, the Commission found that unclear radio conversations contributed to a hi-rail vehicle nearly being struck by a passenger train at Paerata (TAIC, 2011 A) and a freight train being wrong-routed at Wiri Junction (TAIC, 2011). Following these two incidents the Commission made the following recommendation to the Chief Executive of the NZ Transport Agency, on 28 March 2012:

The Commission recommends to the Chief Executive of the NZ Transport Agency that he require the Executive of the National Rail System Standards to ensure that all rail participants meet a consistently high level of crew resource management and communications that includes the use of standard rail phraseology (002/12).
- 4.4.8. This incident is an example showing there is still room for improvement in the way some rail participants are communicating.

¹⁴ Set-back is the process of reversing a train,

¹⁵ Examples are safety recommendation 002/12 and reports 07-108, 08-110 and 11-101.

¹⁶ KiwiRail has named the concept ‘non-technical skills’.

- 4.4.9. The safety recommendation is still open and the NZ Transport Agency is running a project to meet the intent of the recommendation. For that reason the Commission has not made a new recommendation to the regulator to address this safety issue.

Findings

4. The train was driven back towards Puhinui Station without the required protection from other train movements, which created a head-on situation with another passenger train.
5. Miscommunication between the train driver and the train controller resulted in each having a different understanding of how the train would be recovered to its correct route.
6. The miscommunication between the driver and the train controller arose from a casual and ambiguous conversation at a time when a set of clear and precise instructions should have been issued.

5. Findings

- 5.1. The train was wrong-routed to Papakura instead of Manukau. The wrong-routing occurred during a period when train controllers were becoming familiar with the newly commissioned Manukau Branch Line and were setting routes manually.
- 5.2. The altered routine to set a route to Manukau manually, coincident with the morning peak train control workload, increased the risk of human error.
- 5.3. The driver assumed that the route ahead had been correctly set for his train. He then selectively read the 'proceed' aspect of signal 1803 but not recognise that it was also displaying the wrong route for his train.
- 5.4. The train was driven back towards Puhinui Station without the required protection from other train movements, which created a head-on situation with another passenger train.
- 5.5. Miscommunication between the train driver and the train controller resulted in each having a different understanding of how the train would be recovered to its correct route.
- 5.6. The miscommunication between the driver and the train controller arose from a casual and ambiguous conversation at a time when a set of clear and precise instructions should have been issued.

6. Safety actions

General

- 6.1. The Commission classifies safety actions by two types:
- (a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that would otherwise result in the Commission issuing a recommendation
 - (b) safety actions taken by the regulator or an operator to address other safety issues that would not normally result in the Commission issuing a recommendation.

Safety actions addressing safety issues identified during an inquiry

- 6.2. None identified

Safety actions addressing other safety issues

- 6.3. KiwiRail turned on the automatic route-setting functionality in the train control software 12 months after this incident when the last stage of the construction works in the Wiri Junction area was completed. This improvement has significantly reduced the likelihood of a future Manukau-bound train being signalled a wrong route through Wiri Junction.

7. Recommendations

General

- 7.1. 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.
- 7.2. In the interests of transport safety, it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

Recommendations

- 7.3. No new recommendations have been identified.

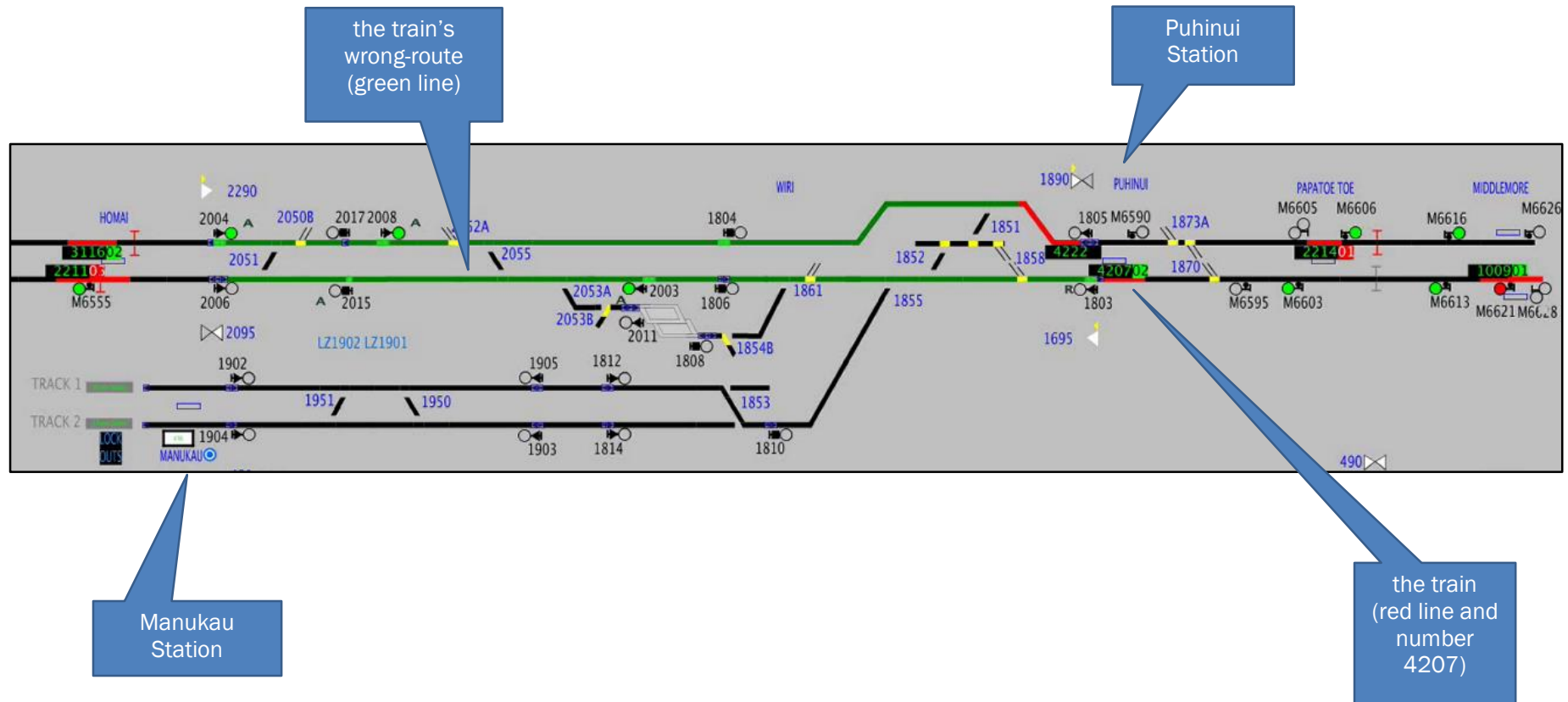
8. Key lessons

- 8.1. Train drivers must actively look at, correctly interpret and respond to all signals, rather than making assumptions about what lies ahead of their trains.
- 8.2. Communication between train controllers and train drivers must be clear and concise and leave both parties in no doubt as to what is going to happen next, particularly when resolving abnormal situations.

9. Works cited

- TAIC. (2011). *Rail report 11-105, Freight train 228 wrong-routed into closed section of track, Wiri Junction, South Auckland, 12 November 2011*. Wellington: Transport Accident Investigation Commission.
- TAIC. (2011 A). *Rail inquiry 11-106, Hi-rail vehicle nearly struck by passenger train, Crown Road level crossing near Paerata*. Wellington: Transport Accident Investigation Commission.
- TAIC. (2012). *Report 10-101, Wrong route setting, high-speed transit through turnout, near miss and SPAD (signal passed at danger), Tamaki, 13 August 2010*. Wellington: Transport Accident Investigation Commission.
- TAIC. (2015). *14-102, High-speed roll-over, empty passenger Train 5153, Westfield, South Auckland*. Wellington: Transport Accident Investigation Commission.

Appendix 1: Train controller's screenshot

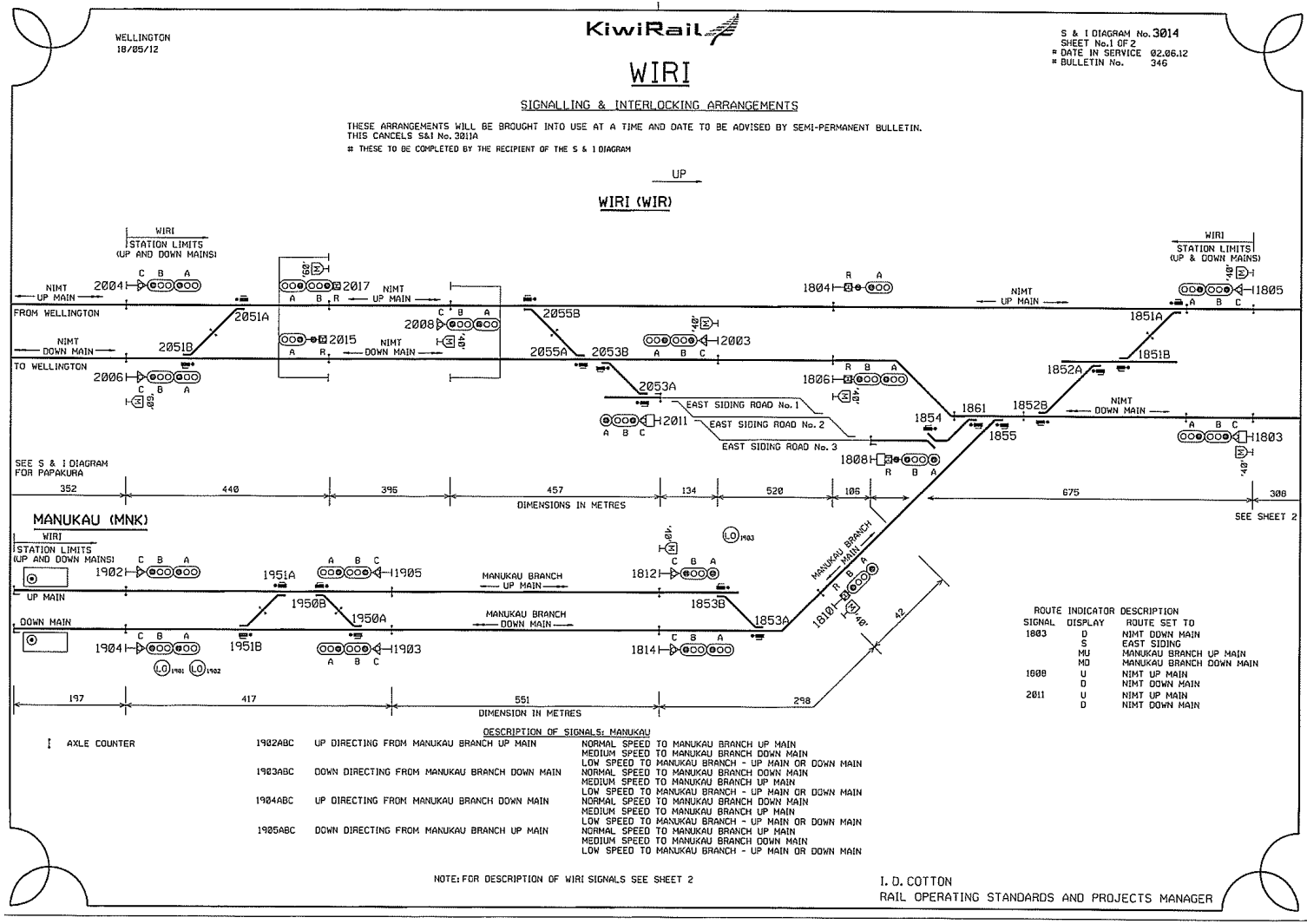


Appendix 2: Radio transcript

Time (24h-sec)	Source	Message
0802-23	[TC]	4207, 4207, control?
0802-31	[Driver]	4207, control receiving, over.
0802-35	[TC]	Sorry about that. Better take that, 1803 back and send you in the right direction.
0802-53	[Driver]	Control, 4207. Repeat your last over.
0803-09	[TC]	Yeah, 4207, a bit late now. [Exact words could not be determined] inside 1806 signal on the down and change ends, over.
0803-24	[Driver]	Copy that change ends and be prepared to revert back to Puhinui over.
0803-32	[TC]	Yeah, roger mate. Thanks.
0805-43	[TC]	4207! 4207! Control.
0805-46	[Driver]	4207 receiving control. Go ahead.
0805-51	[TC]	Just stop there mate. Stop there!
0805-59	[Train 1009]	1009 calls in to say he has stopped short of M6595. Acknowledged by train control. (summarised).
0807-04	[Driver]	4207 to control, receiving? Over.
0807-10	[TC]	4207, control.
0807-14	[Driver]	Yeah with your permission I will just change ends if that's what you want me to do? Over.
0807-18	[TC]	Ah, well stay there mate. I said to you to go down and change ends inside 1806 signal. You've just set straight back in front of a train coming towards you. Might be a bit of a wait unfortunately, over.
0807-36	[Driver]	No worries there control, I'm stopped short of the platform but inside the directing, over.
0807-44	[TC]	Yeah roger, thanks.

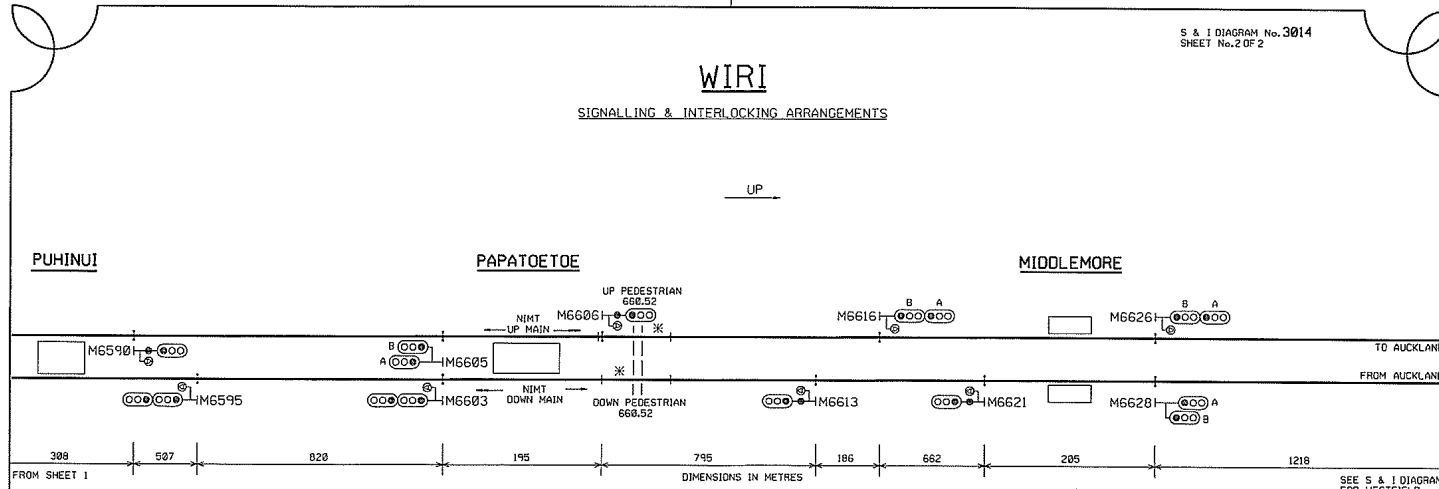
Note Some words in this audio recording were difficult to interpret due to the way they were spoken, but in the circumstances this transcript is an accurate representation of what was said. It has been reviewed by several listeners, including the two participants.

Appendix 3: Signals and interlocking diagram



WIRI

SIGNALLING & INTERLOCKING ARRANGEMENTS



FROM SHEET 1 SEE S & I DIAGRAM FOR WESTFIELD

* TRACK CIRCUIT FOR HRV ON AND OFF TRACKING


	DESCRIPTION OF SIGNALS WIRI
1803ABC	DOWN HOME FROM NIMT DOWN MAIN NORMAL SPEED TO NIMT DOWN MAIN MEDIUM SPEED TO MANUKAU BRANCH MAIN LOW SPEED TO NIMT DOWN MAIN OR MANUKAU BRANCH MAIN OR EAST SIDINGS No.3
1804AR	UP DEPARTURE FROM NIMT UP MAIN NORMAL SPEED TO NIMT UP MAIN RESTRICTED SPEED TO NIMT UP MAIN
1805ABC	DOWN HOME FROM NIMT UP MAIN NORMAL SPEED TO NIMT UP MAIN MEDIUM SPEED TO NIMT UP MAIN OR NIMT DOWN MAIN OR MANUKAU BRANCH MAIN LOW SPEED TO NIMT DOWN MAIN, MANUKAU BRANCH MAIN OR EAST SIDINGS No.3
1806ABR	UP DEPARTURE FROM NIMT DOWN MAIN NORMAL SPEED TO NIMT DOWN MAIN MEDIUM SPEED TO NIMT UP MAIN RESTRICTED SPEED TO NIMT DOWN MAIN OR NIMT UP MAIN
1808ABR	UP DEPARTURE FROM EAST SIDING ROAD No.3 MEDIUM SPEED TO NIMT UP MAIN OR NIMT DOWN MAIN RESTRICTED SPEED TO NIMT UP MAIN OR NIMT DOWN MAIN
1810ABR	UP DEPARTURE FROM MANUKAU BRANCH MAIN MEDIUM SPEED TO NIMT DOWN MAIN OR NIMT UP MAIN RESTRICTED SPEED TO NIMT DOWN MAIN OR NIMT UP MAIN
1812ABC	UP DIRECTING FROM MANUKAU BRANCH UP MAIN RESTRICTED SPEED TO NIMT DOWN MAIN LOW SPEED TO MANUKAU BRANCH MAIN
1814ABC	UP DIRECTING FROM MANUKAU BRANCH DOWN MAIN MEDIUM SPEED TO MANUKAU BRANCH MAIN LOW SPEED TO MANUKAU BRANCH MAIN
2003ABC	DOWN DIRECTING FROM NIMT DOWN MAIN NORMAL SPEED TO NIMT DOWN MAIN MEDIUM SPEED TO NIMT UP MAIN LOW SPEED TO NIMT DOWN MAIN OR NIMT UP MAIN
2004ABC	UP HOME FROM NIMT UP MAIN NORMAL SPEED TO NIMT UP MAIN RESTRICTED SPEED TO NIMT UP MAIN
2006ABC	UP HOME FROM NIMT DOWN MAIN LOW SPEED TO NIMT UP MAIN NORMAL SPEED TO NIMT DOWN MAIN MEDIUM SPEED TO NIMT UP MAIN LOW SPEED TO NIMT UP MAIN OR NIMT DOWN MAIN OR EAST SIDING ROAD No.1
2008ABC	UP DIRECTING FROM NIMT UP MAIN NORMAL SPEED TO NIMT UP MAIN MEDIUM SPEED TO NIMT DOWN MAIN LOW SPEED TO NIMT UP MAIN OR NIMT DOWN MAIN OR EAST SIDING ROAD No.1
2011ABC	DOWN DIRECTING FROM EAST SIDING No.1 MEDIUM SPEED TO NIMT UP MAIN OR NIMT DOWN MAIN LOW SPEED TO NIMT UP MAIN OR NIMT DOWN MAIN
2015AR	DOWN DEPARTURE FROM NIMT DOWN MAIN NORMAL SPEED TO NIMT DOWN MAIN RESTRICTED SPEED TO NIMT DOWN MAIN
2017ABR	DOWN DEPARTURE FROM NIMT UP MAIN NORMAL SPEED TO NIMT UP MAIN MEDIUM SPEED TO NIMT DOWN MAIN RESTRICTED SPEED TO NIMT UP MAIN OR NIMT DOWN MAIN

I. D. COTTON
RAIL OPERATING STANDARDS AND PROJECTS MANAGER

Appendix 4: SWA-01 form

Rail Operating Procedures

Section: 10.1 –Train Control

	Safe Working Authority	SWA 01								
1	<input type="checkbox"/> Authority Number 1XXX _____ day / / date									
2	<input type="checkbox"/> Operator of _____ at _____ is authorised to									
3	<input type="checkbox"/> Pass No. _____ Signal* / Board* at Stop	<ul style="list-style-type: none"> • and proceed in accordance with fixed signals* • for shunting purposes* 								
4	<input type="checkbox"/> Pass No. _____ Signal* / Board *at Stop	<ul style="list-style-type: none"> • and proceed on the _____ main in accordance with fixed signals / Station Entry board • for shunting purposes* 								
5	<input type="checkbox"/> Set back from _____ in accordance with fixed signals / Station Entry board to _____									
6	<input type="checkbox"/> Points No.'s / / at _____ are secured for the movement									
7	<input type="checkbox"/> Call clear and complete of Intermediate Signal No* _____ / Block section*									
8	<input type="checkbox"/> Other Instructions _____ _____									
Safety Assurances										
Line Clearances										
9a	<input type="checkbox"/> Last train No. _____ cleared limits at _____ hours/*previous day									
9b	<input type="checkbox"/> Last track occupancy cleared limits at _____ hours/*previous day									
Blocking										
10a	<input type="checkbox"/> Blocking has been applied to prevent conflicting movements									
10b	<input type="checkbox"/> Opposing Train No. / / advised of this authority at / hrs.									
Following movement										
11a	<input type="checkbox"/> Following Train No. _____ Confirmed Stationary at _____ Location									
11b	<input type="checkbox"/> Following movements cleared section at _____ hrs									
Authorised by _____ name Train Controller										
Repeated correct at _____ hrs										
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Safe Working Authority Original		April 2011								



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