Report 10-101: wrong route setting, high-speed transit through turnout, near miss and SPAD (signal passed at danger), Tamaki, 13 August 2010

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Final Report

Rail inquiry 10-101
wrong route setting, high-speed transit through turnout, near miss and SPAD (signal passed at danger),
Tamaki, 13 August 2010

Approved for publication: October 2012

Transport Accident Investigation Commission

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The Transport Accident Investigation Commission (Commission) is 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, 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

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.

Source: mapsof.net

Location of accident

General location of Tamaki

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Abbreviations

Abbreviation	Description
Commission	Transport Accident Investigation Commission
CRM	crew resource management
DMU	diesel multiple unit
ITD	individual train detection (method of track occupancy)
km/h	kilometre(s) per hour
m	metre(s)
PIC	person-in-charge
SPAD	Signal Passed at Danger
TAIC	Transport Accident Investigation Commission (the Commission)
Veolia	Veolia Transport Auckland Limited

Glossary

Term	Description
aspect (of a signal)	the combination of illuminated coloured lights and the relative position of the grouped display heads showing at a railway signal mast. Each aspect has a particular meaning to train drivers
blocking	a method of track protection where the signaller blocks a section of track between 2 controllable points in order to prevent rail movements within the blocked section and allow track workers to occupy the track
compulsory stop protection	a method of protection for personnel working on the rail network, where approaching trains are required to stop at a compulsory stop sign and obtain permission from the person-in-charge of the worksite to proceed through the site. Also referred to by the rule number that describes the protection method: Rule 905
controlled network	the part of the New Zealand operational rail network where all train movements and track occupations are controlled by the national network controller (KiwiRail)
crossing	the section of a turnout where the 2 inside rails cross over as the 2 separate tracks lead away from the single entry track
Down Main line	the track in a double-line system that leads towards a nominated reference point, i.e. the track metrage decreases as the train advances. (In this incident the Down Main line led away from Britomart)
Eastern Line	a Veolia term that describes the railway passenger line between Westfield Junction and Britomart via Glen Innes (including Tamaki)
foul time	a method of protection for track workers during their track occupation when they are using light tools or using vehicles near to the track
mimic display	an electronic display that simulates the status of a large, widely spread or remote process on a smaller operator display such as a computer screen. Mimic displays are widely used in many industries and transport systems
metrage	a rail industry term meaning the position on a track as measured in metres from the origin of that line and as marked with fixed marker posts
person-in-charge	the name given to the person-in-charge of protecting personnel working at a worksite
points	the general name for a turnout (may also be called a switch)

Term	Description
set back	to reverse a rail vehicle. Normal rail movements are only in the forward direction so a 'set back' procedure must be approved by the respective train controller
switch	a part of a turnout, but also used as the general name for a turnout
train register	a networked computer software system for recording train movements through a particular signal box control zone
turnout	the proper name for a section of rail and associated control devices that provides 2 diverse route options from a single track. The normal route is straight through and the reverse (or alternative) route usually turns out and away from the straight-through route
Up Main line	the track in a double-line system that leads away from a nominated reference point, i.e. the track metrage increases as the train advances. (In this incident the Up Main line led towards Britomart)

Data summary

Vehicle particulars	
Train type and number:	diesel multiple unit (DMU) Train 2238
Classification:	ADC 855 (leading) and ADL 805
Year of manufacture:	1981
Operator:	Veolia Transport Auckland Limited (Veolia)
Other operators involved:	KiwiRail (train controller, signal box controllers and track workers)
Occurrence particulars	
Date and time:	13 August 2010 at 1336
Location:	Tamaki Station limits, North Island Main Trunk, Auckland
Persons involved:	the train driver, 4 crew and approximately 100 passengers
Injuries:	nil reported
Damage:	nil reported
Time references:	all times stated in this report are in New Zealand standard time expressed in the 24-hour format

1. Executive summary

1.1. On 13 August 2010 a scheduled Auckland passenger train ('the passenger train') with about 100 people on board travelled from Papakura to Britomart Station in central Auckland via Westfield and Tamaki Stations. An unscheduled shunt was signalled to follow the passenger train from Westfield as far as Tamaki, so that it could enter a rail siding.

1.2. There was a miscommunication when details of the shunt were passed from the Otahuhu to the Auckland signal box controller and as a result the Auckland signal box controller confused the running order of the 2 trains. Not realising that the shunt was behind the passenger train, he set the route at Tamaki to divert the shunt to the opposite Down Main line in preparation for entering the rail siding from there. This wrong route setting for the passenger train was the first of a set of 4 related incidents.

1.3. A worksite had been set up within the Tamaki Station limits to enable work to be undertaken by the work gang. The Tamaki Station limits were a short distance from Panmure Station. The passenger train was supposed to stop at Panmure Station then continue through the worksite along the usual Up Main line. The driver of the passenger train was not aware that the route had been incorrectly set to divert his train to the Down Main line. His train had passed a yellow signal before Panmure, which told him that the next signal around the corner and out of sight from within Panmure Station was not displaying green. Instead the next signal was a 'low speed' signal, advising the driver that the points were set to divert his train to the Down Main line and that his train was to be travelling at no more than 25 kilometres per hour (km/h).

1.4. The passenger train stopped and exchanged passengers at Panmure. The train was running behind schedule owing to several small delays. Before departing from Panmure Station the driver called the work gang and asked for permission to pass through the worksite. He was granted permission to pass through 'at normal speed'. The person in the work gang who responded had noticed that Points No.15 at Tamaki had moved to set the route for the next train across to the Down Main line, but did not mention this to the driver of the passenger train.

1.5. Keen to make up lost time on the schedule, the driver accelerated the passenger train away from Panmure Station with the intention of reaching full speed. He appeared to have forgotten that the previous signal had been yellow and was not expecting the next signal to be a low-speed signal. His train rounded the bend, where he eventually noticed the next signal. Despite braking his train heavily, it went through the low-speed cross-over to the Down Main line at nearly twice the maximum speed limit of 25 km/h. This was the second incident.

1.6. The passenger train reacted violently as it went through the cross-over to the other line, but did not roll over or derail. None of the people on board was injured, but some were shaken by the violent movement of the train.

1.7. One of the track workers was walking beside the Down Main line at the time, with his back to the approaching passenger train. As the driver was bringing his train to a stop, it narrowly avoided striking the track worker. This was the third incident.

1.8. The driver of the passenger train was also shaken by this experience, but after a short pause he decided that the signal box controller's intention must have been to re-route his train to the Up Main line farther down the track, so without speaking with the signal box controller or with train control, he moved his train along the Down Main line towards the next set of points. He was not looking at the signals, but instead was looking at the railway line ahead to check that the points were set to take his train across to the Up Main line. When he saw that they were not, he stopped his train, but not before he had passed a red signal that required him to stop. This was the fourth incident.

1.9. The Transport Accident Investigation Commission's (the Commission's) findings included that the wrong route for the passenger train had been set through a combination of poor communication and failure to adhere to standard procedures when switching Tamaki Station to manual control. If the driver had driven his train to the signals, the wrong route setting should not have created any danger to his train and its occupants, but systems that had been put in place to help drivers remember previous signals were not well designed for the task and

not routinely used by train drivers. Opportunities for correcting or preventing all 4 of these incidents were lost through substandard levels of crew resource management (CRM) that should have had all of the rail participants working as a team to manage safe railway operations.

1.10. A lack of clarity in the daily work bulletin issued to all rail participants and the failure to follow standard procedures when switching the Tamaki Station signal box to manual contributed to the signal box controllers being unaware that a compulsory-stop-protected worksite existed within the Tamaki Station limits.

1.11. A number of safety actions were taken by KiwiRail to address immediate safety issues around communication, and as part of the upgrade to the Auckland rail network the signal boxes involved with this incident have been decommissioned and incorporated into the Wellington National Train Control Centre. These safety actions have superseded the need for other safety recommendations.

1.12. The Commission is making recommendations to the Chief Executive of the New Zealand Transport Agency to address safety issues concerning: systems to help train drivers remember the status of signals their trains have already passed when having to deal with the distraction of stopping at intervening stations; and the clarity of daily work bulletins disseminating important operating information to rail personnel.

1.13. The key lessons from the inquiry into this occurrence were:

- safe rail operations are reliant upon good communication between all operating personnel
- all individuals and groups of individuals working in the rail industry need to understand fully and be working to a common objective before safe rail operations can be achieved
- documents created for the purpose of providing essential information to rail participants should be clear, unambiguous and in a format suitable for the intended recipients.

2. Conduct of the inquiry

2.1. This set of incidents occurred on 13 August 2010 and was verbally notified to the Commission on the same day. After making preliminary enquiries, the Commission opened an inquiry on 18 August 2010.

2.2. Two Commission investigators visited the site, then interviewed witnesses around Auckland over 3 days from 24 August 2010. After a preliminary analysis, further interviews were arranged in Auckland for 2 days from 2 November 2010.

2.3. Evidence was gathered from various sources including train control telephone and radio audio recordings, the passenger train's Tranzlog data recorder files, train control system records, train register system files, industry operating rules, signalling and interlocking diagrams, photographs, equipment manuals, personnel records, staff medical records, Veolia and KiwiRail operational guides and records and Auckland metro railway CCTV (closed-circuit television) files.

2.4. An external specialist in human factors was engaged to review the human factor aspects of the incidents.

2.5. Once the preliminary key issues had been identified, Commission investigators met with KiwiRail and Veolia operational managers, and representatives from the NZ Transport Agency, on 16 March 2011. This was to inform them of the facts of the incidents determined by the Commission so far, to explain the Commission's process for consulting on its draft final report and to discuss potential recommendations arising from the Commission's inquiry.

2.6. The draft final report was submitted for the Commissioners' consideration at the May 2011 Commission meeting. The Commission approved the draft final report for circulation to interested persons for comment on 22 February 2012.

2.7. Comments were sought from 17 interested persons on 11 May 2012 and received from 3. These submissions were considered and a number of changes made. On 29 August 2012 the Commission approved a revised draft final report to be circulated to 2 interested persons for further comment. The final report was approved for publication with minor revisions by the Commission on 24 October 2012

3. Factual information

3.1. Introduction

Overview of the incidents

3.1.1. An Auckland metro passenger train with about 100 people on board was on a scheduled trip from Papakura to Britomart Station in central Auckland along the Eastern Line via Glen Innes (see Figure 1). An unscheduled shunt, which had been holding at Westfield, was signalled by the Otahuhu signal box controller to follow the passenger train to Tamaki. The Otahuhu signal box controller then phoned through the shunt's details to the Auckland signal box controller to set a route for it through to Tamaki.

3.1.2. The Auckland signal box controller believed the shunt was the only rail vehicle between Westfield and Tamaki, so immediately set a route for it to cross to the Down Main line at Tamaki. The passenger train arrived at Tamaki first and therefore encountered a wrong route that had been set for the shunt. The driver of the passenger train did not respond to a signal in time to avoid taking the wrong route through an 'S'-shaped turnout at well above the speed limit, nearly hitting a track worker before finally stopping beyond a signal at stop.

3.1.3. Passing a signal at stop is termed a SPAD (signal passed at danger), which is regarded as a serious incident and initiates a formal investigation and reporting process.

Background information

3.1.4. The Auckland metro rail network is used by scheduled commuter rail and both scheduled and unscheduled freight operations. This type of unscheduled shunt movement was a familiar action for the signal box controllers and occurred about 3 to 5 times per weekday. The last movement had been completed less than 2 hours before this incident.

3.1.5. On the day of the occurrence, track maintenance work was being carried out by the work gang on the Up Main line within the Tamaki Station limits. Entry to the worksite was controlled by a compulsory stop board placed at the north end of the Panmure Station platform. All trains on the Up Main line were required to stop at this point and seek permission from the person-in-charge of the worksite before they could proceed beyond the compulsory stop board.

3.1.6. A 'wrong route setting' is where a train is presented with a signal aspect that is not intended for it. The normal expected response in accordance with the Rules[1] is that the train driver would recognise that the signal aspect was not intended for that train, the train would be stopped and the driver would contact the local train controller to resolve the situation. The train control staff interviewed estimated that wrong route settings occurred in the Tamaki area about one or 2 times per month and they were usually resolved as described. This incident was an exception.

[1] Rail Operating Rules and Procedures, Section 2, Rule 10 – Obedience with Signals.

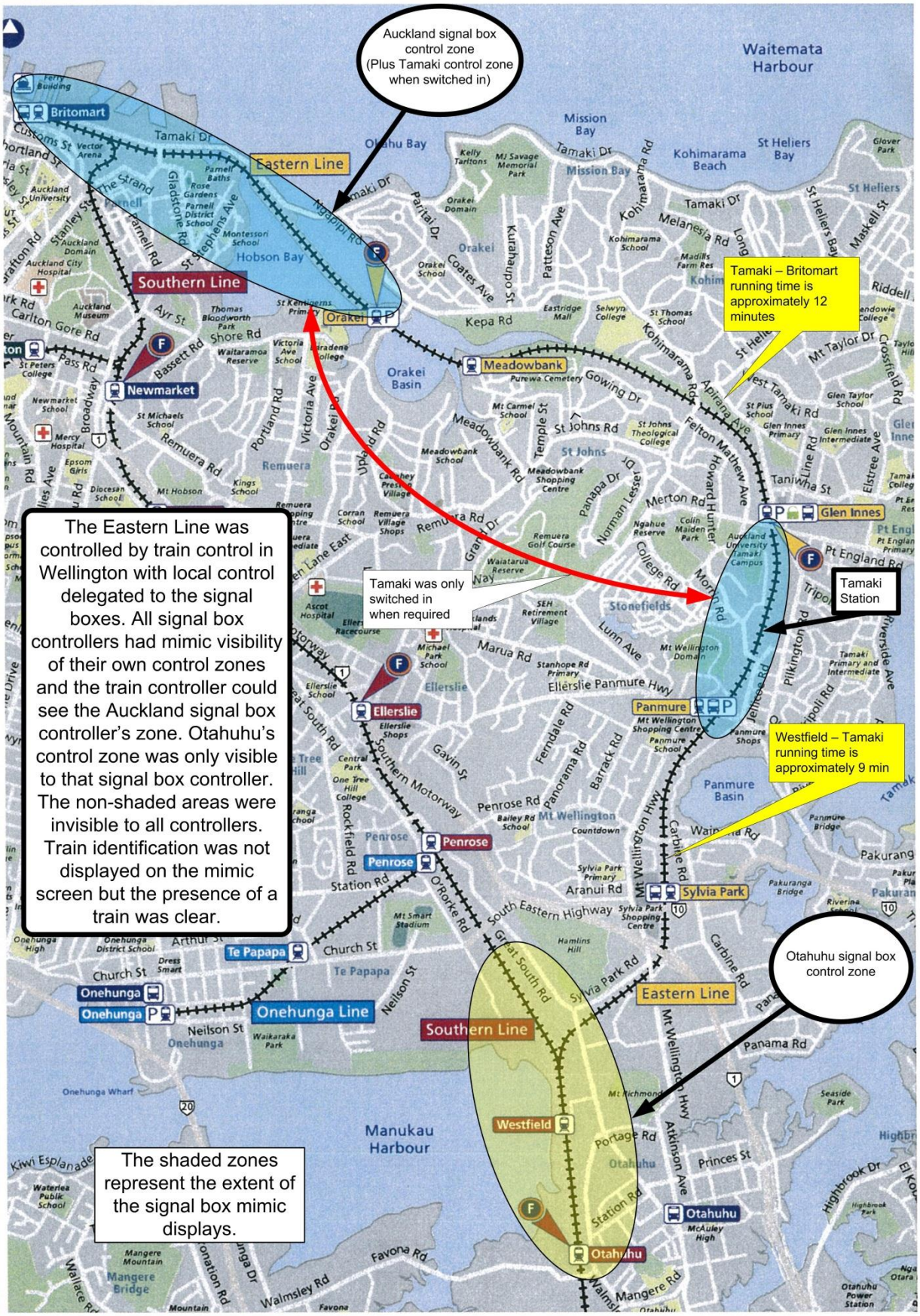

Figure 1
Auckland area signal box control zones

3.2. Narrative

3.2.1. On 13 August 2010, Train 2238, a scheduled diesel multiple unit (DMU) passenger train (the 'passenger train') was travelling on the Up Main line from Papakura to Britomart via Westfield, Sylvia Park and Glen Innes. It departed from Papakura at 1250 and was due to depart from Westfield at 1318.

3.2.2. An unscheduled shunt locomotive, Shunt L9, (the 'shunt') was at Westfield yards waiting to follow the passenger train to Tamaki. At Tamaki, the shunt would then be routed to the Down Main line so that it could be set back to enter a siding near Panmure Station called the Carbine Road Siding.

3.2.3. See the timeline (Appendix 4) and the annotated track layout drawing (Figure 4) for a visual presentation of these event sequences.

3.2.4. Tamaki Station had been 'switched in'[2] before 1319 in order to provide blocking for the work gang.

3.2.5. The passenger train was delayed for 1.5 minutes at Westfield while a fitter repaired the windscreen wiper for the driver. It then departed from Westfield at 1320. The shunt departed from Westfield at 1321 and followed as closely as the automatic signals would allow. At Sylvia Park the shunt was within line of sight of the passenger train.

3.2.6. The Otahuhu signal box controller had sought approval from the train controller for the shunt movement and manually entered a scheduled departure time of 1320 for it into his train register on the Otahuhu tab. When it had departed at 1321 he updated his train register and advised the Auckland signal box controller by phone by saying "Following the subby[3], L9, light engine, Tamaki". This abbreviated verbal message was meant to convey that the shunt was to be signalled to follow the passenger train as far as Tamaki. The Otahuhu signal box controller did not include the departure time for the shunt or the train reference number of the passenger train. The signalling and safe working rules[4] required the train running order to be advised to the next signal box controller, but did not define how it was to be described.

3.2.7. The Auckland signal box controller estimated an arrival time for the shunt at Tamaki, then manually entered its details into his train register on the Auckland tab. A realistic estimate would have been about 9 minutes, including station stops, but the Auckland signal box controller allowed only 4 minutes' running time from Westfield to Tamaki with an estimated arrival at Tamaki of 1325. He also incorrectly entered the movement as a 'departing' event for the shunt at Tamaki, when it should have been entered as an 'arrival' event.

3.2.8. Immediately after the Auckland signal box controller entered the details on his train register, he set a route for the shunt to cross to the Down Main line at Tamaki. This included switching Points No.15 from normal to reverse and Signal 16AC to 'low speed' (red over a short-range, low-speed yellow light). Intermediate Signal 67024 automatically followed the status of Signal 16AC and changed from 'clear-proceed' (green) to 'caution' (yellow).

3.2.9. At about the same time, the Auckland signal box controller phoned the train controller to seek permission to send the shunt directly back to the Carbine Road Siding from the Tamaki Down Main line rather than park it on the siding that was occupied by the work gang. The train controller approved this.

3.2.10. Meanwhile the passenger train stopped at Sylvia Park Station, where 12 wheelchair-bound passengers and their minders were waiting to board. The wheelchair pick-up had been prearranged through the Veolia customer services supervisor. The train manager on board the passenger train had been advised and he had informed his crew and the driver to be prepared for a delay at Sylvia Park. Normally a station stop would be about 30 to 40 seconds, but the stop that day took 5.6 minutes.

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[2] Switching in the station is to switch the signals and points to manual control.
[3] 'Subby' was a local colloquial name for a suburban passenger train, as commonly used by the Auckland area signal box controllers.
[4] Rail Operating Procedures, Section L1.1, paragraph 1.3.3.

3.2.11. Auckland Transport measures Veolia's on-time train performance at 3- and 5-minute windows around the scheduled times. The signalling and safe working rules expect scheduled trains to be running within 5-minute windows. Veolia provided a worksheet[5] schedule to drivers for them to compare actual running times with the schedule at 'timed stops' along their routes. The timed stops along this section of track for the passenger train were the departure from Otahuhu – 1316, the departure from Glen Innes – 1328, and the arrival at Britomart – 1342. The passenger train was 6.5 minutes behind schedule when it departed from Sylvia Park. The driver had not advised the train controller or a signal box controller of the delay to his service. He said later that he was attempting to make up time before reaching Britomart.

3.2.12. The Auckland signal box controller was preparing to hand over his panel to the Newmarket signal box controller, who would then merge it with his own and control both from the Newmarket desk. The Auckland signal box controller had expected the shunt to be at Tamaki by this time, but it had not shown up on the mimic display, so he rang the Otahuhu signal box controller to confirm the departure time. This was confirmed and they discussed possible reasons for the delay to the shunt. The Auckland signal box controller then concluded that it had been delayed by a compulsory-stop-protected worksite, when in fact it had been delayed behind the late-running passenger train.

3.2.13. As the passenger train approached Panmure, the driver sounded the horn at the inner warning board for the compulsory-stop-protected work area as required. He recalled seeing the Intermediate Signal 67024 displaying a 'caution' signal.

3.2.14. The train stopped at Panmure Station for 70 seconds, increasing the total running time to an estimated 7 minutes behind schedule. The driver called the person-in-charge of the worksite on the radio for clearance to pass his compulsory stop board. The No.2 person-in-charge approved this request with the phrase, "Proceed through my worksite at normal speed". The driver read back the clearance.

3.2.15. At about the same time, the Auckland signal box controller handed over his panel to the Newmarket controller and left the signal box to catch a train to Otahuhu, where he was to complete his shift relieving in the Otahuhu signal box. The handover between signal box controllers was completed just as a train was seen on their mimic displays going through Points No.15 at Tamaki. They both thought that it was the shunt, when in fact it was the passenger train.

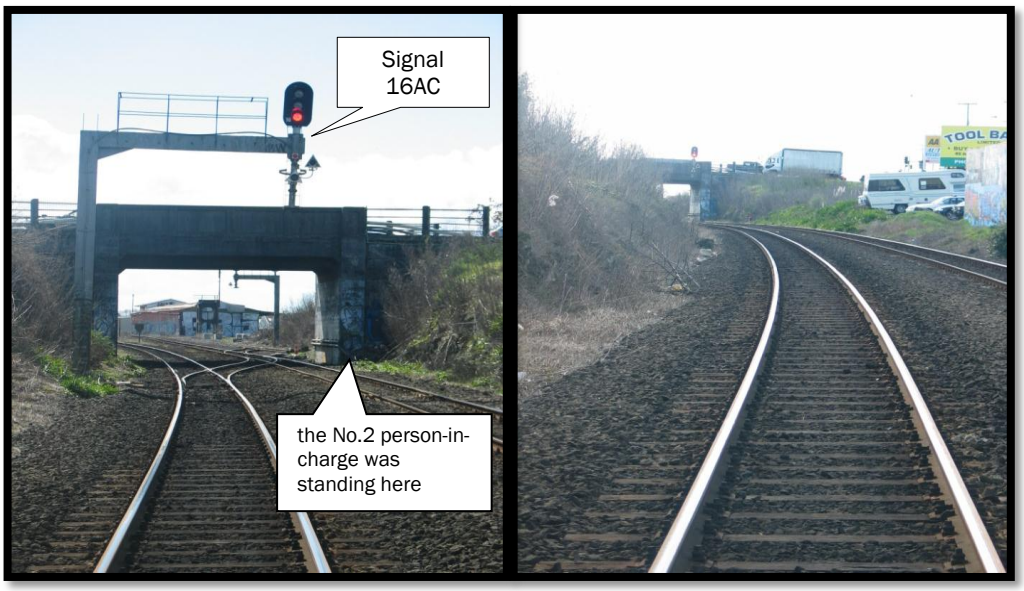

Figure 2
Signal 16AC close and at a distance

[5] Called the 'locomotive engineer suburban worksheet'.

3.2.16. The passenger train had left Panmure Station and accelerated under full throttle towards the normal 90 km/h speed limit for the line. The distance between the compulsory stop board at Panmure platform and Signal 16AC was approximately 500 metres (m) and the track was on a gentle climbing gradient with a left-hand curve. Signal 16AC was placed high above the centre of the 2 tracks on a gantry and visible from at least 200 m (see Figure 2). The work gang was clear of the track, standing to the right-hand side of the driver near the eastern buttress of the Morrin Road overbridge.

3.2.17. When the work gang came into the driver's view, he sounded the horn. He recalled that he received what he thought was a hand movement in response from the work gang. At about this time the driver noticed that Signal 16AC was showing a 'low speed' signal, which meant that his train should have been travelling at no more than 25 km/h at the signal and he should have been prepared to stop before any obstruction. This would have appeared as a red light on the top 3-colour indicator. It meant that Points No.15 was set to direct his train from the Up Main line to the adjacent Down Main line. The driver had been expecting to see a green light, and although he reacted quickly and braked hard, the train entered the turnout at between 40 km/h and 55 km/h.

3.2.18. The train swayed abnormally as it passed through the 'S'-shaped cross-over line but remained on the rails. The passengers were shaken and rolled about but no-one reported injuries. Witness accounts indicated that the train rolled on the bogies and lifted an unusual amount on the suspension at the centre of the train, where the 2 cars were coupled. A loud hiss of escaping air was also heard from both inside and outside the train. The train and the track were undamaged by the incident.

3.2.19. The driver slowed the train to a halt just past Signal 12A. The train had travelled an estimated 115 m in 9.5 seconds from Signal 16AC to where it stopped.

3.2.20. The person-in-charge of the worksite had been walking north near the Down Main line towards his parked vehicle. He was using a protection method called individual train detection (ITD)[6]. This was a standard method of protection during a track occupation, where the person was individually responsible for their own lookout and for their safe clearance from moving rail vehicles.

3.2.21. The person-in-charge was facing the direction from which trains normally came on the Down Main line when the passenger train approached him from behind, passed close by and stopped just in front of him. He had not heard the train approaching nor was he aware that it was approaching from behind him.

3.2.22. It was unusual for a passenger train to be routed to the Down Main line at Tamaki. The driver said that he was expecting to be redirected to the Up Main line at the north end of Tamaki Station so, having remained stationary for about 20 seconds, he moved the train slowly towards the north end of the Tamaki Station limits at approximately 30 km/h. The driver said that when he realised that the north-end Points No.3 were not set to route his train to the Up Main line, he braked his train but it stopped a few metres past the ground Signal 8B, which was at stop. This constituted a SPAD incident at Signal 8B (Figure 3).

3.2.23. The driver then made a base-call[7] on the radio to train control and described his situation as having been wrong routed to the Down Main line at Tamaki.

3.2.24. The train controller replied that he thought the train was the wrong train in the wrong place and asked the driver to hold where he was. The train controller contacted the Newmarket signal box controller by phone to advise him of the wrong routing. Once the SPAD at Signal 8B was realised, the driver of the passenger train was relieved of his duties.

[6] The individual train detection track occupation method is described in the Rail Operating Rules and Procedures, Section 9 – Track Safety Rules, Rule 917.

[7] Base-call is a single-button feature of the radio that sends a coded signal on the selected channel. Recipients with the matched receiving equipment hear a ringing tone and the train vehicle identification number is displayed.

Figure 3
Tamaki Signal 8B

3.3. Description of the track and signals at Tamaki

3.3.1. An extract from the Tamaki track signalling and interlocking diagram is shown in Figure 4 and the full diagram is provided in Appendix 1 for a more detailed view of the track through Tamaki Station.

3.3.2. The rail track between Otahuhu and Britomart via Tamaki is a double line, with the left-hand track facing north dedicated to travel towards Britomart (the Up Main line) and the other for traffic travelling away from Britomart (the Down Main line).

3.3.3. The signals were controlled automatically under a control system described in the Double Line Automatic Signalling Regulations. The control system detected the presence of a train on the track and automatically changed the signals to maintain a safe distance between consecutive trains.

3.3.4. Tamaki was a decommissioned passenger station and only used for shunt movements. Normally passenger rail traffic would pass straight through the Tamaki Station limits in accordance with the automatic signalling, without slowing or stopping. The station would normally be in automatic ('switched out') mode. When rail movements were required within the Tamaki Station limits, such as the shunt, the Auckland signal box controller would take manual control of Tamaki (switch in) and make the required control changes. The station controls could be switched between automatic and manual by clicking on a button on the mimic display.

3.3.5. Within the Tamaki Station limits there was one siding and 2 back-shunt stub tracks to assist with shunting movements. Most of the up and Down Main line sections within the Tamaki Station limits were designated bi-directional.

Tamaki SPAD - Track Layout

(signalling and interlocking diagram was current at 13 August 2010)

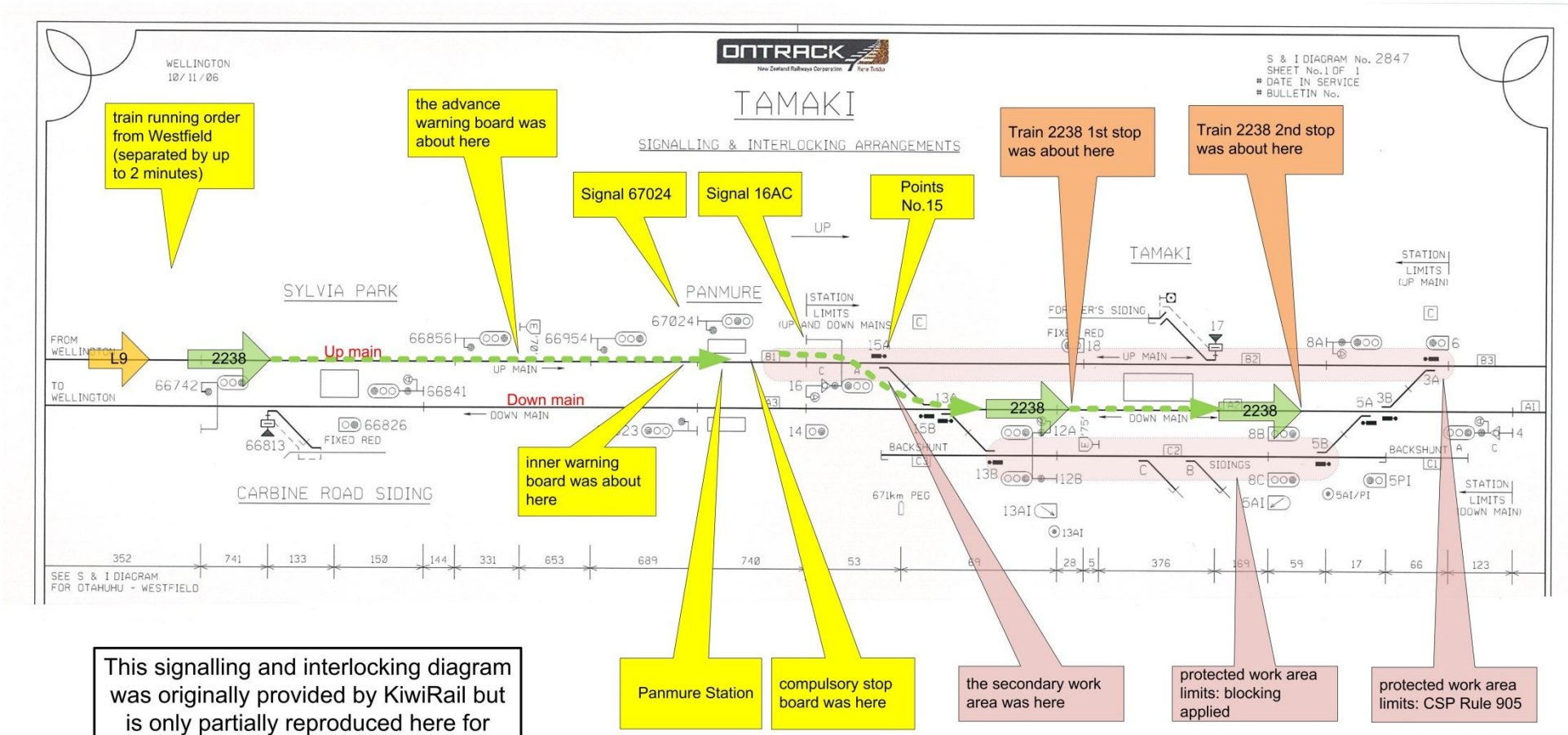

Figure 4
Tamaki track layout

3.4. Train control in the area

3.4.1. Train operations within the Auckland metro area were controlled by the Auckland train controller located in the Wellington National Train Control Centre. The operation of some high-activity zones within the area was delegated to local signal box controllers (see the shaded signal box control zones in Figure 1), but the train controller still retained overall responsibility for train movements through those zones. The signal box controllers provided a local interface with train drivers, but still required approval from train control before dispatching movements from a station or terminal other than scheduled passenger movements.

3.4.2. The Otahuhu signal box managed local traffic passing through Otahuhu and Westfield Stations and the southern Auckland rail junctions to Southdown, Penrose and Tamaki. It also controlled the entry of all locomotives and passenger trains from the Westfield maintenance facility to the controlled network.

3.4.3. The Auckland signal box managed the entry/exit of trains at Britomart Station and Tamaki Station.

The train register

3.4.4. The signal box controllers used a networked computer display (called the 'train register'; see Figure 5) to record train movements within their respective control zones. The train controller in Wellington used the information entered by the signal box controllers to plot actual rail movements against scheduled times on a train control diagram. The Auckland signal box controller's train register display was similar to the example from Otahuhu shown in Figure 5.

3.4.5. The train register was pre-programmed with the published train timetable, but unscheduled services had to be entered manually at the time by the respective signal box controllers. Any person with access to the networked system could look at displays for other locations, but company policy was that signal box controllers were only able to enter data for their own locations. Train movements were automatically sorted on the train register display by the time for an event at the location. The user display was usually scrolled to display a window, with the current time near the top of the page and future times towards the bottom.

3.4.6. Tamaki was not set up with its own location display page, so standard practice was for the Auckland signal box controller to use the single Auckland display to log movements at both Tamaki and Britomart Stations. Tamaki movements would be separated from Britomart events by about 12 minutes' running time, and the signal box controller would add notes in the comments column of the Tamaki movements to note that they were not travelling the full line distance to Britomart.

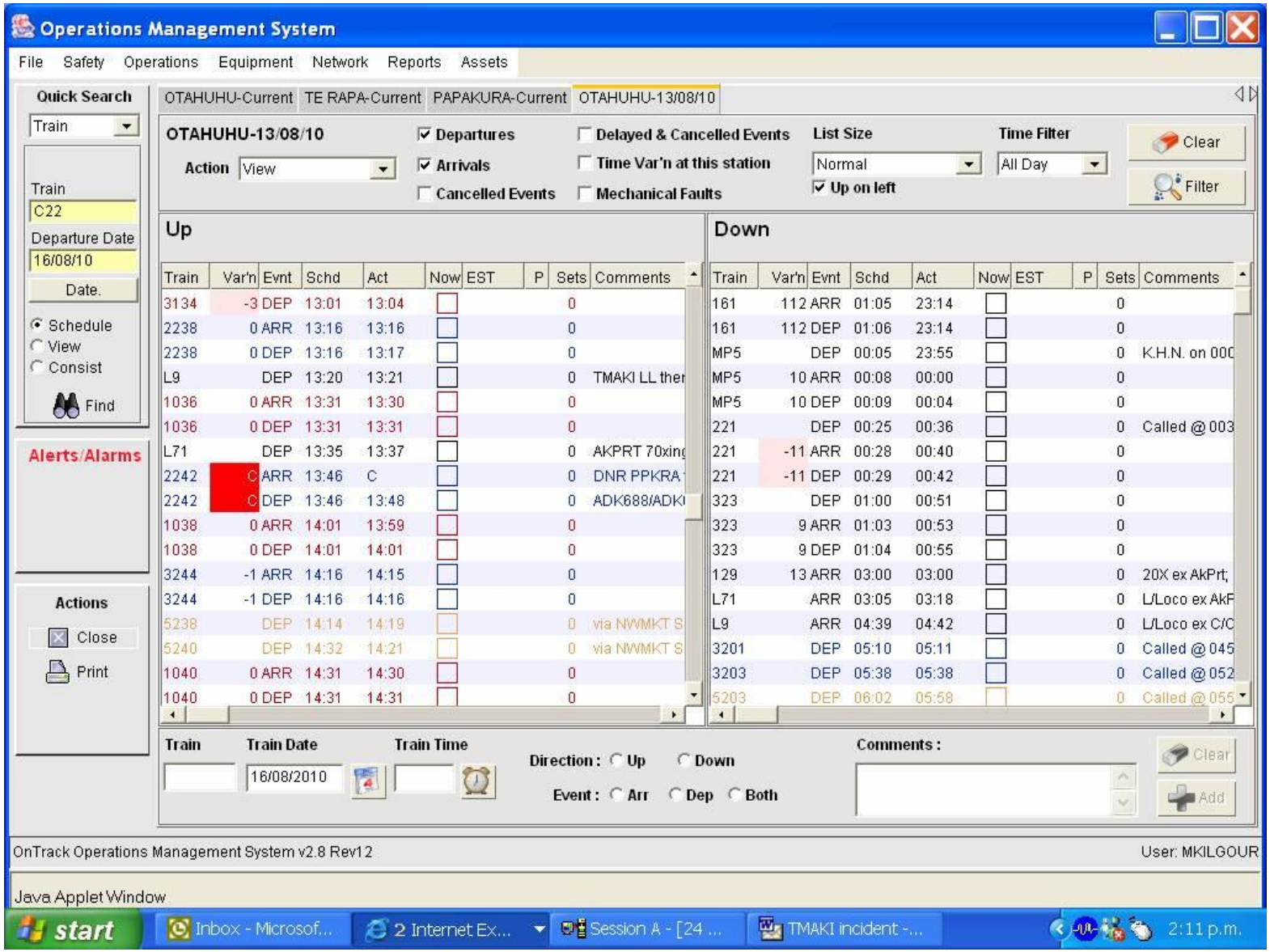

Figure 5
Signal box controller's train register display (example from Otahuhu)

The train control mimic display

3.4.7. The Eastern Line, which runs between Westfield and Britomart via Tamaki, was usually controlled automatically, but the signal box control zones (as shown in Figure 1) could be manually controlled. The Wellington-based train controller and the Auckland signal box controller each had a mimic display that represented Tamaki Station (shown as one of the blue zones in Figure 1) to enable them to control the zone remotely. The rest of the Eastern Line was not represented on a mimic display for either controller.

3.4.8. The mimic display showed the real-life status of points and signals and approximate train locations. The top horizontal line of the Tamaki mimic display (Figure 6) represents the Up Main line going from Westfield (left) to Britomart (right). The Down Main line going away from Britomart is the centre line and the Tamaki siding is the bottom line. The status of all points within station limits is shown by the yellow directional status lines, with the identifying numbers adjacent and letters identifying the normal (N) and reverse (R) positions. Signals are represented by the signal identification numbers and coloured symbols for the current status. The track segment is red when it is occupied by a train, but the length of the red segment is not relative to train length.

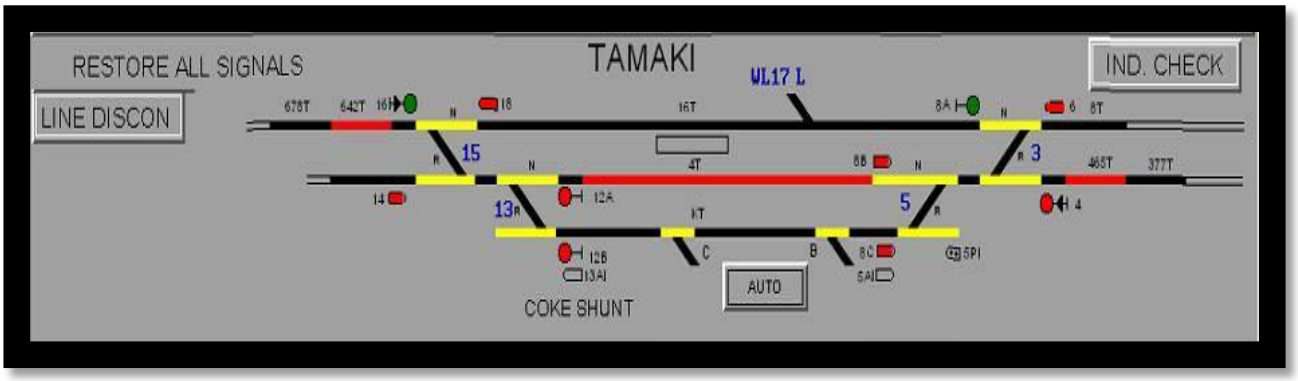

Figure 6
Tamaki mimic display

3.4.9. The status of the Tamaki mimic display shown in Figure 6 was the actual display after the passenger train had set back to clear Points No.3 on the day of this incident and after the SPAD. The shunt is the red line before Signal 16AC (labelled as 16) and the passenger train is within station limits on the Down Main line but clear of Signal 8B. A passenger train that was travelling from right to left is shown stopped before Signal 4 on the Down Main line. The points were in the normal position of straight through on the up and Down Main lines. The button at the bottom is the controller's Tamaki Station manual/automatic cursor control button shown in the manual control state (if the button was pressed the station would switch to auto).

3.5. Track work at Tamaki

3.5.1. On the day of this incident, a three-man track maintenance gang (the 'work gang') was working within the Tamaki Station area, replacing an insulated track circuit joint on the Up Main line near Forster's Siding (see Figure 4).

3.5.2. Industry safety rules required that track occupants use an approved form of track occupation protection to ensure their protection from harm by rail vehicles. The protection method selected by the person-in-charge was 'compulsory stop protection' on the Up Main line only, as defined by Rule 905 in the rail operating rules[8] (see Appendix 2).

3.5.3. This could only be applied to a single track in a double-track area where the separation distance from all work personnel and the work area was greater than 4 m to the centre of the

[8] KiwiRail Rail Operating Rules and Procedures, Section 9 – Track Safety Rules, Rule 905.

adjacent track. If this separation could not be assured, both tracks had to be protected. The required separation distance was met at the planned work area.

3.5.4. Compulsory stop protection is a planned track occupation between stated times. Signs are placed at specific distances from the work area in the direction from which trains would be travelling as they approach the work area, and standard actions are required as instructed by these signs.

3.5.5. The compulsory stop board was placed at the end of the Panmure Station platform, where a driver could see it during passenger operations and seek clearance before moving away from the platform.

3.5.6. The compulsory-stop-protected work area for this site was approved then advised to the industry via an official bulletin (see Appendix 3) containing a standard set of information. It stated: the type of protection applied; that it applied to the Up Main line only; the metrage limits of the protected work area; the nearest stations on both sides of the protected work area; the time and date of the planned work; the general type of work being carried out; and the contact details for the person-in-charge. The bulletin did not mention that the work was within the Tamaki Station limits. KiwiRail said that it was not its "policy at the time to mention that the protected work area included station limits at a given location".

3.5.7. The driver of the passenger train, the 2 signal box controllers, the train controller and the person-in-charge of the work gang had copies of the daily bulletin with them or in their workplaces and were required under their respective operating licences to familiarise themselves with current bulletins at the start of each working shift.

3.5.8. On the day, the work gang completed its planned work earlier than the approved track occupation period of 0900 to 1500, and the person-in-charge decided to use the remaining time for a small, unplanned job to replace some loose bolts at the rail crossing near Points No.15A.

3.5.9. The full conditions for use of Rule 905 compulsory stop protection could not be met at the new work area because Points No.15A were less than 4 m from the adjacent track and the Down Main line would have been obstructed.

3.5.10. The person-in-charge did not request protection on the Down Main line. Instead he decided to add a protection system to manage the risk from the less than 4 m of track separation. He supplemented the compulsory-stop-protected work area with a protection method called Individual Train Detection and used an observer.

3.5.11. The person-in-charge and his No.2 evaluated the job then decided they needed additional equipment and material from the vehicle before they started work. The person-in-charge wanted to bring his vehicle closer to the secondary work area, so he requested 'foul time'[9] protection from the Auckland signal box controller to apply to the Tamaki siding so he could park his vehicle on the siding. Three minutes after this conversation the controller switched Points No.15 to reverse for what he thought would be the shunt. The work gang was standing beside the points and saw them move.

3.5.12. The person-in-charge handed control of his compulsory-stop-protected secondary work area and the radio to his No.2 person-in-charge and proceeded to walk along the Down Main line towards his vehicle, which was parked within the Tamaki Station limits but clear of the tracks. The No.2 person-in-charge and the observer stood clear of the Down Main line near the Morrin Road overbridge, ready to control rail traffic through the work area. They were there when the driver of the passenger train called to gain clearance to enter the compulsory-stop-protected site.

[9] Foul time is defined in Rail Operating Rules and Procedures, Section 9, Rule 918.

3.6. Other parties present

3.6.1. The passenger train was crewed by a driver, one train manager and 3 passenger operators and had approximately 100 passengers on board.

3.6.2. The shunt was crewed by a driver and his assisting rail operator.

3.6.3. The work gang had one person-in-charge, the No.2 person-in-charge and an observer. A separate emergency protection person was located near the compulsory stop board at Panmure Station in case a train failed to stop at it.

3.6.4. The Auckland signal box was manned by one signal box controller. This person was near a task change that required him to relocate to the Otahuhu signal box. Owing to the low workload at the time, he was able to hand control of the Auckland panel to the Newmarket signal box controller (in the adjacent room) for the last 30 minutes of his duty time on the Auckland panel. The Newmarket signal box controller was in control of the Auckland signal box when the passenger train passed through Points No.15.

3.6.5. The Auckland desk in the National Train Control Centre at Wellington was manned by one train controller. The network control manager at the Centre had overall responsibility for national rail movements conducted by all of the regional train controllers at the Centre.

Figure 7
ADL/ADC Diesel Multiple Unit like Train 2238

3.7. Description of the passenger train (Train 2238)

3.7.1. The passenger train was a 2-car DMU set. The trailer car ADC 855 was leading with the driver in the cab. The motor car ADL 805 was trailing.

3.7.2. The motor car had two 220-kilowatt under-slung diesel traction motors linked to the final drive units in the bogies through hydraulic transmission units. The trailer car had a single under-slung diesel engine and alternator set to provide electrical power for both cars.

3.8. Personnel information

3.8.1. The driver of the passenger train had recently gained his operating licence and had about 6 months' experience as a qualified driver. His on-the-job training phase had been interrupted owing to events outside work, but the refresher training carried out by Veolia after each break

brought him back to the same stage before he continued on-the-job training. He had passed all pre-licence tests and post-licence observations to date.

3.8.2. His allocated work shift in the previous 2 weeks had generally started between 0830 and 1300, with two 0600 starts.

3.8.3. The driver was considered to be medically fit for normal duties by the Veolia medical assessor at the time of this incident. The Rail Operating Rules and Procedures place the responsibility for daily assessments of fitness for duty on the respective operational staff[10], but the rules also require all rail personnel who have concerns about the fitness for duty of other rail personnel to report the matters to their managers. Managers and supervisors are expected to stand down rail personnel when they have concerns about their current fitness for duty. The driver considered that he was fit for work when he reported for duty on the day of this incident and no-one else had reported any concerns at the time.

3.8.4. The post-incident medical assessment of the driver conducted by his employer revealed that he had been undergoing long-term treatment for a condition at the time but that the condition had been under control and was not relevant to this incident. It also revealed that he had recently been experiencing overt stress symptoms, such as problems sleeping, headaches and exhaustion brought on predominantly by non-work issues. On the day prior to the incident he had not experienced any problems, but on the day of the incident he had had a headache that he self-medicated with Panadol.

3.8.5. The driver had started work at Westfield yard then travelled as a passenger into Britomart to collect his first train for the day. His first job was from Britomart to Papakura, where he had a short break before driving the passenger train from there back to Britomart. It was on this second trip that these incidents occurred.

3.8.6. The Auckland signal box controller had had about 2 years' experience since gaining his operating certificate and was familiar with both the Auckland and Otahuhu signal box operations. He said that he had felt rested and fit for duty that day.

3.8.7. The Otahuhu signal box controller was a senior member of the team with more than 7 years' experience as a signal box controller. At the time he was acting team leader. He said that he had felt reasonably rested and fit for duty that day.

3.8.8. The person-in-charge of the work gang and his No.2 each had more than 25 years of rail experience. The person-in-charge had a current licence to operate category J (multi-worksite) for which he had completed a refresher course 11 days beforehand, and his most recent safety observation had been carried out in January 2009.

[10] Rail Operating Rules and Procedures, Section 1 – General Rules, Rule 8(a) – Fitness for Duty.

4. Analysis

4.1. Introduction

4.1.1. This report covers 4 separate but connected incidents that occurred at Tamaki:

- a wrong route was set by the Auckland signal box controller for the passenger train
- the driver of the passenger train responded to the 'low speed' signal too late and his train followed the wrong route from the Up Main line to the Down Main line at a dangerously high speed
- the driver of the passenger train made a wrong assumption that his train would be re-routed from the Down Main line to the Up Main line and passed a red signal at stop (SPAD) by several metres
- a track worker was not actively looking in both directions for trains while walking near the track, so narrowly avoided being hit by the passenger train after it had taken the wrong route.

Ineffective communication was a factor common to all 4 incidents.

4.2. The wrong route setting

4.2.1. The Auckland signal box controller set a wrong route for the passenger train because he misunderstood the correct running order of the trains adjacent to the shunt.

4.2.2. When an unscheduled service like the shunt was to be signalled on to the controlled network at Westfield bound for Tamaki, there was a standard procedure that should have been followed. The driver of the unscheduled shunt would contact the Otahuhu signal box controller and request clearance for the trip to the Carbine Road Siding. The signal box controller would seek approval from the train controller for the movement, then set the signals for the shunt to depart from the Westfield yards at the approved time and conditions. The procedure was followed correctly up to this point.

4.2.3. The Auckland signal box controller needed to take manual control of the Tamaki signal box. He needed to know the correct order of the trains arriving at Tamaki and what worksite activity was occurring within the signal box control zone.

4.2.4. When the shunt entered the main line at Otahuhu bound for the Carbine Road Siding via Tamaki, this information needed to be passed to the Auckland signal box controller. In this case the Auckland signal box controller had already taken manual control of Tamaki because he had earlier had to arrange blocking protection for the work gang, so the Otahuhu signal box controller was responsible for passing on this information to him.

4.2.5. The rail operating rule (Rail Operating Rules and Procedures, Section L1.1, paragraph 1.3.3) said:

> When attended, it will be necessary to advise the adjacent Signalbox/Panel concerned of the running order of all trains, except suburban passenger services unless they are running 5 minutes or more late.

4.2.6. During interviews both signal box controllers and their manager said that this procedure was normally observed by giving the planned or actual time the shunt entered the Up Main line and the train number for the passenger train it was following. This would have been an effective way to pass on the information. It would have been better if the procedure had simply said this. However, the Otahuhu signal box controller did not follow that usual practice. He did not give the departure time of the shunt from Westfield and did not even give its destination as the 'Carbine Road Siding'. Nor did he give the train number of the passenger train it was following. Instead he said the shunt was following the 'subby'. The omission of this important information was the first of several communication failures that resulted in the wrong route being set for the passenger train.

4.2.7. The Auckland signal box controller erroneously thought that the 'subby' was another passenger train that had already passed through Tamaki, so he thought the shunt was the next train to arrive at Tamaki and set the route for it to cross to the Down Main line.

4.2.8. Following this incident KiwiRail issued a safety briefing to all signal box controllers (on 29 September 2010). The safety briefing reinforced the correct communication protocol described in the Rail Operating Rules and Procedures for use over radios[11] and instructed signal box controllers to apply the same principles when using telephones, which the signal box controllers had used in this case.

4.2.9. The rail operating rules for radio communication required that all messages be acknowledged and that when instructions were issued the instructions be read back and confirmed as correct by the sender. Even if that process had been followed by the signal box controllers on the telephone, this would not have resolved this situation because the Auckland signal box controller would simply have repeated back the information given to him by the Otahuhu signal box controller: "Following the subby, L9, light engine, Tamaki". He would have been none the wiser for what that actually meant.

4.2.10. Under different circumstances, if Tamaki had not already been switched in for manual control when the shunt left Westfield, the Auckland signal box controller should have contacted the train controller before doing so in accordance with operating rules[12]. The train controller should then have confirmed with the Auckland signal box controller the order of trains arriving at Tamaki. Had this happened it is highly likely that the Auckland signal box controller would have realised which passenger train the shunt was following. The wrong routing would have been avoided.

4.2.11. However, there was a longstanding local procedure that circumvented the application of this rule for Tamaki signal box. This local procedure removed the second opportunity to establish the correct order of the trains. It also removed an opportunity for the Auckland signal box controller to understand the situation fully regarding worksites within the Tamaki Station limits.

4.2.12. KiwiRail said that the reason for this local procedure for Tamaki was a management interpretation of a rule regarding 'attendance' at a signal box and the description of Tamaki as a 'switch out' station. KiwiRail's belief was that, as the Auckland signal box controller was continually in attendance at the Britomart main control room and as that person was also responsible for Tamaki, the 'station switch in' checking procedure did not apply. The rule had been revised in mid-2008 to prevent such a misinterpretation, but the local procedure for Tamaki had remained in place.

4.2.13. The operating function of a signal box is conceptually the same whether it is called a 'switch in' or 'switch out' signal box: it facilitates manual control of the local area. Tamaki was termed a 'switch out' signal box and its normal state was switched out to allow the signals to operate in automatic mode. 'Switch in' signal boxes were ones that had less than 24/7 attendance, so the rules were intended to cover the situation where a signal box controller would arrive and unlock the signal box then take over local signalling control for the area. Tamaki was not a physical signal box but the control mimic was displayed on the Auckland signal box control desk and operated from that desk when required. Whatever the term ascribed to the type of signal box, the signals within that control zone are in either automatic (switched out) or manual (switched in) mode and to switch in the signal box is to take over manual control. Therefore the rule (see footnote 12) about taking manual control of a signal box should have applied rather than the local procedure.

4.2.14. The control of Tamaki was transferred from the Auckland signal box controller to the train controller after this incident, removing any future likelihood of a recurrence of this wrong route setting.

[11] Section 12 – Radio Procedures.

[12] Rail Operating Rules and Procedures, Section 2 – Operating Rules, Rule 92(b)

4.2.15. If the Auckland signal box controller had been in doubt about the train running order, he could have positively identified the train in front of the shunt by any one of 4 methods:

1. He could have asked the Otahuhu signal box controller for the passenger train number.
2. He could have switched display tabs from his normal train register display to the Otahuhu signal box tab and seen what train number had left from there ahead of the shunt.
3. He could have asked the train controller.
4. He could have deduced the correct running order from his own Auckland train register based upon his estimate of the departure time of the shunt from Westfield.

The Auckland signal box controller did not use any of these options to identify which train was in front of the shunt. Instead he made an incorrect assumption that the 'subby' was a train he had just logged as arriving at Britomart.

4.2.16. However, the train register display was not user-friendly when it was used beyond its design purpose for movements at both Tamaki and Britomart, because trains were listed in the Auckland train register in the time order that they were arriving at or departing from Britomart. When the train register was also used to control movements at Tamaki it required the operator to interpret the display mentally to obtain the true running order. For example, the shunt was terminating at Tamaki but had left Westfield immediately after the passenger train, so their apparent arrival times at Britomart would be in the reverse order. The passenger train would arrive at Britomart in about 21 minutes and appear at the bottom of the list, while the shunt's arrival at Tamaki would be near the top in 9 minutes. The only indicator that the 2 trains were going to different destinations would be the Auckland signal box controller's notes in the comments column of his train register to identify that the shunt's arrival time was actually for Tamaki rather than for Britomart.

4.2.17. The Auckland signal box controller made 2 errors when he entered the event for the shunt into his train register for its planned movement to Tamaki. He entered the train as a departing event from Tamaki rather than arriving and he only allowed 4 minutes' running time to Tamaki, when the normal duration was about 9 minutes. These errors individually were minor, but they could have been an indication that the Auckland signal box controller was not focused entirely on the task at hand or that he was confused about which signal box control desk he was operating at the time.

4.2.18. The Auckland signal box controller said that he was rested but his shift pattern for the period immediately preceding this incident had been different from his normal patterns. He was normally based at Otahuhu but in the previous few days he had been at Auckland (2 separate signal boxes) for one day, Otahuhu for 2 days, then 2 days on a relief shift from 1000 to 1810 at all 3 signal boxes.

4.2.19. The duties in a normal shift would be to operate a single control desk for the whole 8-hour shift. The relief shift was intended to cover meal breaks for signal box controllers and consisted of multiple short stints (less than 2 hours each) at different signal boxes around Auckland. A person working this shift would have to settle into each new location, operate the control desk for an hour or so, then relocate to the next signal box to repeat the cycle. The fast cycle pattern of the relief shift duties demanded considerably more mental effort from a controller and may have facilitated minor errors.

4.2.20. On the day of the incident the Auckland signal box controller was just about to complete his fourth separate stint in the 2 signal boxes based in the Britomart main control room in the 3.5 hours he had been on duty. He then had to travel by train to Otahuhu for his last stint for the day.

4.2.21. The Auckland signal box controller said that the mental demands of the relief shift required him continually to anticipate the next control desk he was to operate because he had to swap so often between them.

4.2.22. When considering the poor information the Auckland signal box controller received about the train running order, it is feasible that his frequent change between control desks contributed to his losing awareness of what trains he was dealing with and in what order.

The bulletin information was not clear to all parties

4.2.23. Signal box controllers are required to read the current daily information bulletins at the start of their shifts. The daily information bulletin issued on 13 August 2010 (see an extract from it in Appendix 3) listed 13 protected worksites on the Auckland metro rail network that day. Two of those sites were within the Auckland signal box controller's zone: one at Tamaki and one at Orakei. The Auckland signal box controller said that, on the day of this incident, he had read the daily bulletin but neither he nor the Otahuhu signal box controller were aware of the compulsory-stop-protected work area on the Up Main line along the Eastern Line.

4.2.24. The Auckland signal box controller said that his reason for misunderstanding the bulletin was that it did not describe the location in terms he used every day: signals, points and stations. He also acknowledged that he could have found this information if required. The stations either side of Tamaki were named, but even though the work area was within the Tamaki Station limits, Tamaki was not named in the bulletin.

4.2.25. It is a safety issue if bulletins are sent out with important information that some recipients do not comprehend or disregard as being unimportant to them. The format of such an important document should be reviewed by KiwiRail in consultation with the target audience to ensure that it clearly conveys the appropriate information. The Commission has made a safety recommendation to the New Zealand Transport Agency to address this safety issue.

Findings

The Auckland signal box controller set the wrong route for the passenger train at Tamaki because he confused the running order of the trains and thought that the shunt was the next train to arrive at Tamaki.

The first reason for the Auckland signal box controller confusing the order of trains arriving at Tamaki was that the Otahuhu signal box controller did not give him clear information on which passenger train the shunt was following.

The proper rail operating procedure was for signal box controllers to contact train control before taking manual control of signal boxes in order to obtain important information such as the correct running order of approaching trains and any worksite activities within the signal box control zones. The established practice of not doing this for the Tamaki signal box compromised the safety of rail operations.

The Auckland signal box controller's relief shift duties required him to switch between signal box desks or move to other locations 5 times within 4 hours, which required him to adjust mentally to the signal box he was working while at times having to anticipate his task at the next signal box. It is possible that this disruptive work pattern contributed to his losing awareness of the trains he was signalling and consequently the order of trains arriving at Tamaki.

The Auckland signal box controller would have been aware that there was a protected worksite within the Tamaki signal box control zone if the correct operating rules had been followed or he had thoroughly read the daily work bulletin before switching in the signal box. However, the daily work bulletin should have made the fact clearer by directly referring to Tamaki when describing the limits of the work area.

4.3. Taking the wrong route at high speed

4.3.1. The train took the wrong route at high speed because the driver did not observe and correctly respond to the signals in front of his train. Signal 67024 before Panmure displayed yellow, which meant the driver should not have expected a green signal around the corner ahead after leaving Panmure. On most occasions on the same route the driver would have had both signals showing green; nevertheless, on this occasion Signal 67024 was yellow, so the driver should have driven his train with the expectation that he might have to stop at the next signal, or as in this case, had his train at a low speed for crossing to the Down Main line.

4.3.2. By coincidence, the inner warning board for the compulsory-stop-protected work area was positioned next to Signal 67024. The driver confirmed that he had seen the yellow caution signal. He said that he had associated the caution signal on Signal 67024 with the warning board for the compulsory-stop-protected work area within Tamaki. He had incorrectly concluded that the person in charge was controlling the signals for access to his work area.

4.3.3. The track signal and worksite warning board were independent of each other: the signal was controlling the train, and the warning board was warning of the worksite ahead. The interpretation that the driver expressed was unique, so it was examined further. Several driver trainers at the Veolia train driving school and the company safety investigator were questioned about the relationship between these 2 signalling systems, and the driver training syllabus and rail operating rules were reviewed. Other drivers involved with the investigation were also questioned. None of the people spoken to had made the same interpretation as the driver of the passenger train, and neither could it be inferred from the operating rules or training syllabus.

4.3.4. A more logical or believable scenario was that the driver simply forgot that Signal 67024 was displaying a yellow signal after he had stopped to exchange passengers at Panmure. It is not uncommon for train drivers to forget they had passed a caution signal. For example a driver may become distracted during an intervening passenger stop. The experience of some drivers forgetting a caution signal was one reason for installing a signal alert system in the cabs.

4.3.5. The train was fitted with a signal alert system that was intended to help drivers remember when they passed an advance signal that warned that the next signal would not be green. It is a driver-activated distance-measuring device that pulses a light and sounds a buzzer as the train approaches the next signal and is intended to counteract any intervening distractions, such as stopping at a station.

4.3.6. Drivers were expected to use the signal alert devices when passing signals displaying caution signals, as Signal 67024 was on this day. The signal alert button was not in common use by Veolia drivers and some drivers said they had adopted their own alternative methods for remembering caution signals. The driver of the passenger train did not use the signal alert device when he approached Panmure Station and he said he used no alternative system. If the driver had used the signal alert system it would have reminded him about the next signal just after his train departed Panmure.

4.3.7. One reason that Veolia gave for drivers not using the signal alert device was that the sound of its alarm was so similar to several other in-cab alarms that drivers were reluctant to use it. Another reason given was that once the driver pushed the button and the train had travelled a further 600 m, the alarm then sounded for a full 6 seconds with a loud, piercing warning tone that could not be cancelled by the driver. Trains approaching Britomart sometimes travelled close behind other trains and could therefore frequently pass yellow signals. If the signal alert system had been always used at yellow signals it would soon have lost its effectiveness as an alert and become a nuisance distraction.

4.3.8. While the intention of the signal alert system to minimise signals being passed at danger was a proactive measure designed to mitigate an identified risk, the fact that it has not been successful in operation means the issue will need to be revisited. The Commission has made a safety recommendation to the New Zealand Transport Agency to address this safety issue.

4.3.9. There were 2 other sources of distraction that could possibly have contributed to the driver forgetting or not realising that the next signal ahead was not green. They were that the driver

was overly focused on making up the delay to his train running schedule, and the misleading instruction given by the No.2 person-in-charge at the worksite.

4.3.10. The stop at Sylvia Park was longer than normal at 5.6 minutes, although the driver said that he had not noted how long it was. The driver stated in his interview that his train running behind time was on his mind and he was intent upon making up time before arriving at Britomart if at all possible. When questioned about this, he understood that catching up to his schedule would have been an impractical goal, but he considered that by minimising delays and taking advantage of the in-built slack in the timetable, he could reduce the total delay slightly by the time he reached Britomart.

4.3.11. It was the driver's responsibility to inform train control if his train was not running to schedule[14], but he had not done so. The train controller and the Auckland signal box controller were not aware of the delay to the passenger train and the next formal time check station was not until after Tamaki.

4.3.12. When the passenger train was ready to depart from Panmure Station, the driver obtained clearance from the No.2 person-in-charge to proceed past his compulsory stop board, but the response was misleading and contrary to current procedure at the time. He gave a speed reference in his clearance to the driver by using the phrase 'normal speed', which meant to a train driver the 'maximum allowable speed limit' for the train and the track at that point. The correct radio procedure at the time was not to indicate any speed unless the maximum speed was lower than normal speed.

4.3.13. Often trains are delayed at compulsory-stop-protected worksites as the track workers move their people and equipment clear of the track, so the driver may have expected to be delayed. However, in this case the work gang was clear of the track and waiting for the train. The incorrect phraseology used for the clearance was misleading, but the driver did not challenge it at the time. It was also compatible with the driver's intent to make up time because it would have allowed him to pass quickly through the worksite.

4.3.14. At this point there were 2 opportunities for communications to change the outcome. The driver could have queried the perceived speed clearance. Secondly, the No.2 person-in-charge was not required to advise the driver about the reverse condition of the points, but had he mentioned it, the information could have challenged the driver's mind-set that the next signal was green.

4.3.15. KiwiRail did not agree with the concept of the track worker giving information about the points position to the driver because it could lead to "unintended safety risks". By that KiwiRail meant that this advice could be seen as "overriding the importance of, and reliance on, the signalling system". The Commission does not agree. The concept of a train driver operating their train to the signals would not change. In this case the driver had already erroneously anticipated that the next signal was going to be green. Intervention by the No.2 person-in-charge could have changed the driver's expectation that the next signal would be green. Any communication that can improve the safety of the system should be encouraged. This is discussed further in the communications section of this analysis.

4.3.16. The driver said that he had never had his train diverted to the Down Main line at Tamaki, and he had not been informed of any wrong-line-running procedure for Tamaki at the time, so he had not expected his train to be routed anywhere else other than along the Up Main line.

4.3.17. Train drivers are trained to respond to the signals first and foremost, and not to drive according to assumptions. There could be a number of reasons for signals being held at red, or in this case at 'low speed'. Regardless of why the wrong routing occurred, if the driver had responded to the signals correctly the wrong route setting should not have been a danger to the train and its occupants.

4.3.18. The Commission considered other factors that could have affected the driver's awareness of the situation.

[14] Rail Operating Rules and Procedures, Section 2, Rule 90 (h).

4.3.19. The training records indicated that the driver was adequately trained and familiar with the route and signals he was likely to encounter on this trip.

4.3.20. The driver had reported for duty at Westfield that morning, collected his documentation and then had ample time to become familiar with the daily instructions and make his own notes while he was a passenger on a train to Britomart to collect his first train to drive.

4.3.21. The driver had been cleared as medically fit to drive at the time. The driver's post-incident medical check indicated that he had been experiencing some symptoms of stress. Stress is something that can affect human performance and quality of sleep, leading to fatigue. However, the driver's shift roster was not unusual and he had just begun a normal day shift, so fatigue was discounted as a contributing factor. This was supported by the train data recorder, which showed that on the trip from Papakura the driver had responded to the vigilance device and sounded the horn at level crossings and stations as required. In other words he appeared to have been driving his train normally.

4.3.22. The train's event recorder showed that the driver had accelerated to 55 km/h after departing from Panmure, and track distance information showed that the brakes had been applied about 100 m before reaching the points. Data from the train event recorder was consistent with the driver's explanation that he had left Panmure expecting to proceed through the worksite at normal speed.

4.3.23. When the driver did register that the signal was not as he had expected, the train data log showed that he reacted correctly to reduce the throttle to idle then apply full brake. Unfortunately this brake application was too late to prevent his train passing through the turnout at a speed that put the train at risk of rolling over or derailing.

Findings

The passenger train passed through the low-speed turnout at about twice the allowable speed limit because the driver was not expecting his train to be routed to the Down Main line and he did not respond correctly to the signals leading up to the turnout.

The most likely reason for the driver expecting the next signal, 16AC, to be displaying green was that while stopped at Panmure Station he forgot about the caution signal displayed on the previous warning signal that was telling him that Signal 16AC was not green.

The signal alert system that had been installed in the train cab to help the driver to remember if the last signal his train had passed was a caution was not used by the driver on this occasion and was not widely used by other drivers because, once activated, it could not be cancelled by the driver and sounded for 6 seconds with a loud, piercing warning tone.

The non-standard phraseology used by the No.2 person-in-charge of the work gang when calling the passenger train to the worksite area contributed to the driver's assumption that his train was clear to proceed at maximum speed from Panmure Station.

4.4. The signal passed at danger (SPAD)

4.4.1. The driver said he had been confused after his train crossed to the Down Main line at high speed and could not clearly recall the next sequence of events. He was aware that he had gone through the turnout above the speed limit and that his passengers had been concerned at the unusual train movements.

4.4.2. The driver had stopped his train in a safe position within the Tamaki Station limits and did not need to move immediately. At that point the driver should have contacted train control or the signal box controller to find out why his train had been routed to the Down Main line against his expectations, but instead he assumed that, if he continued, his train would be re-routed to the Up Main line.

4.4.3. The driver said that, rather than look for the signal, he had focused on the shiny rail ahead to confirm that the points were set correctly to take his train back to the Up Main line. When he realised that the points were still set for straight through, he stopped the train then called train control, but by that time his train had already passed Signal 8B showing red. If the driver had been travelling within the speed limit and looking for the signal, he would have had sufficient time to stop the train before Signal 8B and avoid the SPAD.

4.4.4. The driver was probably not in a fit state to drive the train after experiencing the shock of the initial over-speed crossing to the Down Main line. This is an example of where the train crew should have discussed their situation, and the train manager should have intervened before the driver was able to move his train on.

4.4.5. Veolia submitted that it would have been in breach of the Rail Operating Code and Rail Operating Rules and Procedures for the train manager to intervene at this point, but the Commission disagrees. In section 2 of the Rail Operating Rules and Procedures, Rule 104 states that: "In the event of unusual circumstances, the Guard/Train Manager on a passenger train has a shared responsibility with the Locomotive Engineer to provide protection for the train when necessary and assist to resume normal operations". The Rail Operating Rules and Procedures, Section 11, Rule 6.1 defines an over-speed crossing as a "serious irregularity" and Rule 6.5 further requires the train manager to accompany the driver in the cab while the train is moved to a safe position and secured to await the mandatory relief driver. On this occasion the train manager was in the same car as the driver and able to meet with the driver, but this is not always possible in the Auckland metro train fleet. A train crew familiar with and used to operating with good crew resource management would have handled this situation better, and possibly prevented the fourth incident, the signal passed at danger.

4.4.6. Veolia also submitted that there were physical constraints on some Auckland trains that would prevent train managers talking to drivers because there was no direct access to the drivers' cabs from all cars in the trains.

4.4.7. This lack of a suitable communication system between the train driver and train manager is a serious safety issue raised previously in a Commission report on an incident that occurred in 2006 (TAIC, 2006) and the subject of an existing open safety recommendation. The Commission recommended in that report that the Chief Executive of the New Zealand Transport Agency address the following safety issue:

> There is no requirement for operators of passenger trains to have effective communication between the locomotive engineer and the onboard person-in-charge of passenger operations that will facilitate good crew resource management and be effective in emergency situations. (016/08)

4.4.8. The Commission is concerned that a recommendation to address such a fundamental safety issue remains open after nearly 4 years. The Commission is also concerned that Veolia as the operator of passenger train services has not addressed this issue independently of the efforts of the Regulator.

Findings

The passenger train passed Signal 8B at danger (showing red) because the driver was not looking for the signal. Instead he had made an incorrect assumption about the route ahead set for his train without communicating with either the train controller or the signal box controller.

The driver of the passenger train was unlikely to have been in a fit state to drive his train farther after experiencing the shock of his train crossing to the Down Main line through the low-speed turnout at about twice the permitted speed limit.

The train taking the low-speed turnout at twice the permissible speed was a serious operating incident after which the driver was required to be stood down under the supervision of the network control manager, and accompanied and supported in the driving cab by the train manager to a point where a relief driver could be arranged.

In this case the train manager was in the same rail car as the driver, so had the opportunity to intervene and discuss the incident with the driver. However, the operating company had not provided the train crew with a means of effective communication that would allow them to co-ordinate an emergency response if the train manager had been in a separate rail car. This is a serious safety issue that the Commission has previously raised and has yet to be resolved.

4.5. Near miss with track worker

4.5.1. After the passenger train sped through the turnout to the Down Main line, it passed within a few metres of a track worker who was walking along the siding with his back to the train.

4.5.2. The work gang had not started the additional work so had not formally engaged any other form of protection, but the members had decided that they were going to protect the secondary work area with individual train detection plus use an observer once work started.

4.5.3. The track worker was alone and not inside a protected work area at the time, so he was operating with individual train detection, a method of protection that is normally used by track workers when moving around railway lines. As he walked near the Down Main line he was facing the direction from which he expected trains to approach, in the usual direction along the Down Main line. The track worker was unaware of the passenger train's presence until it passed him. He had apparently not registered when he saw Points No.15 switch to the Down Main line that any train approaching from the Up Main line would have been routed to where he intended to walk.

4.5.4. The track worker was nearly hit by the passenger train because he did not follow the rules for the track occupation method he was using at the time, which required him to "maintain a vigilant lookout for, and detect the approach of, a train or track equipment moving in either direction".

Findings

The near miss between the passenger train and a member of the work gang occurred because the track worker was not watching out in all directions as required by the individual train detection method of protection that he was using when he was walking near the track.

4.6. Communication

4.6.1. A common factor in these incidents was poor communication among the various participants. More interactive communication could have changed the outcome for the better. For example:

1. If the Otahuhu signal box controller had passed on the train number and its time of departure, it is unlikely that the Auckland signal box controller would have confused the order of the trains, and unlikely therefore that he would have set the wrong route for the passenger train.

2. If the Auckland signal box controller had asked the train controller for permission to switch in Tamaki, the correct running order would have been established and the signal box controller would have known about the worksite within the Tamaki Station limits.

3. If the driver had alerted the train controller about the delay at Sylvia Park, the Auckland signal box controller may have been reminded about the passenger train's position relative to the shunt.

4. If the Auckland signal box controller had questioned the person-in-charge about what he was doing at Tamaki when he applied for foul time on the siding, the signaller may have found out about the protected work area and the secondary work area or checked with the person-in-charge before switching Points No.15.

5. If the person-in-charge had questioned the Auckland signal box controller why Points No.15 had been moved, the signal box controller would have been made aware of the worksite within the Tamaki Station limits and made the person-in-charge aware that the station was switched in and under the signaller's control.

6. If the No.2 person-in-charge had said something to the driver of the passenger train about the points being in reverse, the driver could have been alerted that the next signal was not green and contacted the signal box controller or train controller to ask about their intentions for his train.

7. If the No.2 person-in-charge had used the correct phraseology when calling the passenger train through the worksite, the driver might not have accelerated his train towards the maximum line speed.

8. If the crew of the passenger train had been acting as a team, a discussion may have ensued after the over-speed crossing to the Down Main line, and the situation resolved with the train controller before the train resumed its journey and passed a red signal.

4.6.2. In the rail industry, many of the participants are acting alone in their workspaces; train drivers and signal box controllers, for example. This places more responsibility and reliance upon the person at the controls and more dependence upon communications between other solo operators and work groups for the combined safety of the industry. An added challenge is that individuals and groups might be working for different operators with different procedures. Good communication and a common understanding will be crucial to safe train operations. A method of achieving this is to use the principles of crew resource management (CRM).

4.6.3. In the railway industry, participants from multiple organisations, operating companies and crews need to interact, so the focus of any communications strategy to improve safety would need to include all participants. In a paper presented at the American Transportation Research Board annual meeting in 2004 (Morgan, Kyte, Olsen, & Roop, 2004) about the extent that CRM had been introduced across the North American rail industry, the authors identified that most applications of CRM up to 2004 were still strictly following the crews within a vehicle, but they also identified several other individuals who communicated where it could be of benefit. The researchers described the potential benefits of introducing CRM:

> By creating a safe working environment, encouraging teamwork, improving situational awareness, understanding technical proficiency, and practising error management, a work force will be created that communicates better, is more aware of its true situation, uses all of its available resources, and works better with one another.

4.6.4. A potential barrier is a 'silo culture'. Andrew Hopkins described a silo culture in his book about the inquiry into the Glenbrook accident in Australia (Hopkins, 2004) as a culture having features of secrecy, non-co-operation, restricted communication and antagonism between occupational groups and organisations; a culture where problems were usually seen as the exclusive concern of one group or another rather than as systemic problems that they all needed to resolve.

4.6.5. Not all of these features of a silo culture were apparent with this incident, but some were. For a successful outcome on the day of this incident the respective participants (such as the train driver, the respective signal box controllers, the train controller, the track workers and even the other train crew) all needed to communicate to ensure they all understood what was planned, then question each other if something in the plan changed or was unclear.

4.6.6. The various procedures were designed to link the actions of all these people to achieve the desired outcome. In some cases the procedures could have (and have since) been improved, but for the most part they simply were not followed. Each time this happened there was an opportunity for someone to intervene, question or challenge, but this did not happen.

4.6.7. CRM also depends on a change in attitude towards human error; the development of a just culture that recognises that human errors occur all the time and that everybody can make errors at any time. Even the most skilled operator is subject to human error.

4.6.8. If all rail participants are going to work together to break down any barriers and achieve uniformity in communications, they need to be operating to the same standards. A good way to achieve this is to have a common industry standard that all participants must meet.

4.6.9. The Commission has already made a recommendation to the Chief Executive of the New Zealand Transport Agency to form such a standard within the framework of the National Rail Safety Standards, with safety recommendation number 002-12 issued on 28 March 2012 (TAIC, 2011).

> The Commission recommends to the Chief Executive of the NZ Transport Agency that he requires 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 (002/12).

Terminology

4.6.10. A separate observation made during this investigation was the use of colloquial language by the Otahuhu signal box controllers (both signal box controllers involved with this incident were based at Otahuhu). The Carbine Road Siding was called the 'Coke' siding, the suburban train a 'subby' and the length of freight trains expressed in 'crossing totals' (a redundant term). While the use of colloquial language was not directly relevant to the wrong-route setting in this incident, it was a safety issue and it did indicate that the Otahuhu signal box controllers were not following company policy.

4.6.11. The safety risk of using colloquial language went back to previous administrations, but involved the same signal box. In 2005 the Commission investigated a wrong routing at Westfield and discovered that the use of unofficial names in radio communications from the Otahuhu signal box controller was contributory (TAIC, 2005). A safety recommendation was issued to Ontrack[15] at the time to ensure that official names as noted on the signalling and interlocking diagrams were used in radio communications (this has since been closed). The continued use of colloquial language is a concern.

[15] Safety recommendation 078/05 from Report 05-107.

Findings

Poor communication and specifically a lack of adequate crew resource management contributed to all 4 of these incidents.

The examples given in this report that show the results of using colloquial language, non-standard phraseology and inadequate crew resource management lend weight to the Commission's previous recommendation that the rail industry adopt a national communication standard with which all rail participants must comply.

5. Findings

5.1. The Auckland signal box controller set the wrong route for the passenger train at Tamaki because he confused the running order of the trains and thought that the shunt was the next train to arrive at Tamaki.

5.2. The first reason for the Auckland signal box controller confusing the order of trains arriving at Tamaki was that the Otahuhu signal box controller did not give him clear information on which passenger train the shunt was following.

5.3. The proper rail operating procedure was for signal box controllers to contact train control before taking manual control of signal boxes in order to obtain important information such as the correct running order of approaching trains and any worksite activities within the signal box control zones. The established practice of not doing this for the Tamaki signal box compromised the safety of rail operations.

5.4. The Auckland signal box controller's relief shift duties required him to switch between signal box desks or move to other locations 5 times within 4 hours, which required him to adjust mentally to the signal box he was working while at times having to anticipate his task at the next signal box. It is possible that this disruptive work pattern contributed to his losing awareness of the trains he was signalling and consequently the order of trains arriving at Tamaki.

5.5. The Auckland signal box controller would have been aware that there was a protected worksite within the Tamaki signal box control zone if the correct operating rules had been followed or he had thoroughly read the daily work bulletin before switching in the signal box. However, the daily work bulletin should have made the fact clearer by directly referring to Tamaki when describing the limits of the work area.

5.6. The passenger train passed through the low-speed turnout at about twice the allowable speed limit because the driver was not expecting his train to be routed to the Down Main line and he did not respond correctly to the signals leading up to the turnout.

5.7. The most likely reason for the driver expecting the next signal, 16AC, to be displaying green was that while stopped at Panmure Station he forgot about the caution signal displayed on the previous warning signal that was telling him that Signal 16AC was not green.

5.8. The signal alert system that had been installed in the train cab to help the driver to remember if the last signal his train had passed was a caution was not used by the driver on this occasion and was not widely used by other drivers because, once activated, it could not be cancelled by the driver and sounded for 6 seconds with a loud, piercing warning tone.

5.9. The non-standard phraseology used by the No.2 person-in-charge of the work gang when calling the passenger train to the worksite area contributed to the driver's assumption that his train was clear to proceed at maximum speed from Panmure Station.

5.10. The passenger train passed Signal 8B at danger (showing red) because the driver was not looking for the signal. Instead he had made an incorrect assumption about the route ahead set for his train without communicating with either the train controller or the signal box controller.

5.11. The driver of the passenger train was unlikely to have been in a fit state to drive his train farther after experiencing the shock of his train crossing to the Down Main line through the low-speed turnout at about twice the permitted speed limit.

5.12. The train taking the low-speed turnout at twice the permissible speed was a serious operating incident after which the driver was required to be stood down under the supervision of the network control manager, and accompanied and supported in the driving cab by the train manager to a point where a relief driver could be arranged.

5.13. In this case the train manager was in the same rail car as the driver, so had the opportunity to intervene and discuss the incident with the driver. However, the operating company had not

provided the train crew with a means of effective communication that would allow them to co-ordinate an emergency response if the train manager had been in a separate rail car. This is a serious safety issue that the Commission has previously raised and has yet to be resolved.

5.14. The near miss between the passenger train and a member of the work gang occurred because the track worker was not watching out in all directions as required by the individual train detection method of protection that he was using when he was walking near the track.

5.15. Poor communication and specifically a lack of adequate crew resource management contributed to all 4 of these incidents.

5.16. The examples given in this report that show the results of using colloquial language, non-standard phraseology and inadequate crew resource management lend weight to the Commission's previous recommendation that the rail industry adopt a national communication standard with which all rail participants must comply.

6. Safety actions

General

6.1. The Commission classifies safety actions by 2 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 (key safety actions)

(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 (other safety actions).

Key safety actions

6.2. **Signal-box-to-signal-box communications.** KiwiRail issued a safety briefing to all signal boxes on 29 September 2010. This briefing reinforced the correct communication protocol described in the Rail Operating Rules and Procedures for the use of radios, and instructed controllers to apply the same principles when using telephones.

6.3. **Local procedures contradicting standard safety rules.** KiwiRail did not change the local procedure for signal box controllers in regard to attendance at and control of switch-in/switch-out stations to comply with the current version of the Rail Operating Rules and Procedures, Section 2, Rule 92, but other events eliminated the need at Tamaki. Soon after this incident the responsibility for the control of Tamaki Station was reallocated to the train controller in Wellington, then in early 2011 the Auckland signal box was shifted to Wellington.

6.4. **Isolated signal box operators.** Following the planned reorganisation of the Auckland signal boxes that KiwiRail had initiated before this set of incidents occurred, the Auckland, Newmarket and Otahuhu signal boxes have been relocated to the Wellington National Train Control Centre and the operator control desks are now adjacent to the responsible Auckland area train controller's desk. This has increased the pool of available staff to relieve the Auckland signal box control desks, eliminated the safety concern about staff working the 'relief shift', and improved the working team environment for the signal box controllers.

6.5. **The train register being used for multiple locations.** KiwiRail has shifted the signal box control of Tamaki Station to the Auckland area train controller. This has removed the potential confusion that existed when the train register system was used to control movements at 2 separate locations and ensured that the person operating the Tamaki panel has full visibility of approaching trains and track occupations.

Other safety actions

6.6. **Technology solutions to SPADs.** KiwiRail advised that future planned upgrades to the Auckland metro rail network included automatic train protection to the European Train Control System Level 1 standard. The trackside equipment is being progressively installed in the Auckland metro rail network and has been completed where this incident occurred. The testing of the trackside system was scheduled to start in July 2012, with a prototype rail vehicle system installed in an SA/SD train set. The design of the on-board installation for the new EMUs has also started, but KiwiRail advised that the operator was responsible for on-train equipment. If automatic train protection system equipment had been fitted to the passenger train it would have automatically stopped the train near Signal 8B if the driver had not already applied the brake, but it would not have prevented the SPAD.

6.7. KiwiRail submitted that these future enhancements specified for on-train equipment in the new Auckland electric multiple units would satisfy the requirements of the safety recommendation described in section 7.4 so the recommendation is not necessary. The example submitted was the Driver Machine Interface and a speed warning system that would provide advance information to the driver of speed limit ahead at a turnout. It would also indicate the distance to go to an advance signal at stop and a calculated safe speed to travel in order to be able to stop the train before the signal.

6.8. The Commission recognises and agrees with the potential benefit that such systems would have in preventing a driver from taking a wrong route. However these systems were not in existence at the time the recommendation was published and if they are installed they would only be effective in the Auckland metro area and probably only on the new electric trains. Safety recommendation 023/12 described in paragraph 7.4 is aimed at a weakness in the existing signal alert system as fitted to the Auckland ADL/ADC and ADK/ADB DMUs and the SA/SD Push Pull trains and at addressing the general lack of use of the system by drivers. The outcome is likely to have a national impact because the system is also used in main line freight locomotives.

6.9. **Technology solutions to wrong routing.** KiwiRail has installed a new train control system called 'Rail 9000'. This system has been installed in the majority of the Auckland metro rail network. The Rail 9000 system functions implemented by June 2012 included visibility of all tracks to train controllers between Swanson in the north and Papakura in the south, thereby eliminating the gaps that had previously been automatically controlled but invisible. Rail 9000 also includes a train describer. This feature displays both the train identification number and its current location to train control. A further feature being developed will provide automatic route setting for each scheduled train based on the timetable. The train describer will automatically set the correct signals to drivers and be displayed on the mimic display for controllers. Current plans are to have this system operational during 2013. The future likelihood of a wrong route being set for a train has been reduced by the introduction of train describer technology and will be further reduced when the automatic route-setting feature of the Rail 9000 train control system has been fully commissioned.

6.10. **Improved track worker safety with signals.** KiwiRail has since provided local trackside control (termed 'lock-out') to Auckland metro running signals at some stations, so that track workers could hold them at stop to protect their occupation. This is seen as a positive step towards providing safer conditions for track occupancies.

6.11. **Signal improvements at Tamaki.** KiwiRail has since carried out substantial works within the Tamaki Station limits to remove the old station platform and upgrade the signals. The ground Signal 8B is now a pole mount and Signals 67024 and 16AC have been changed to a double-aspect type. This will improve the visibility of Signal 8B to make it similar to other main line running signals and improve the clarity of the signalling message to drivers approaching Tamaki on the Up Main line. The Up and Down Main lines on the Eastern Line have also been upgraded to allow bi-directional traffic and the Carbine Road Siding access modified to allow shunt locomotives a direct route to and from the Westfield yards without the need to cross at Tamaki. The situation in this investigation that led to the wrong routing when the shunt was following a passenger train is therefore unlikely to occur again.

6.12. **Recognition of driver fatigue.** Veolia Transport has since revised its training on fatigue management and recognition of the symptoms of fatigue. This is being provided by an outside contractor specialising in the subject. The first course was carried out in March 2011 and others have followed since then. Modules of fatigue management have also been added to entry-level packages for passenger operators and the certification courses for train managers and drivers. Veolia is also conducting dedicated fatigue courses to cover existing staff. The intent of these courses is to raise awareness of the symptoms of fatigue among operational staff and provide guidance on how to manage it.

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. In this case, recommendations have been issued to the New Zealand Transport Agency.

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. On 26 October 2012 the following recommendations were made to the Chief Executive of the New Zealand Transport Agency:

7.4. It is a known risk to the rail industry that train drivers may be distracted and forget a warning signal their train had recently passed. The signal alert device that has been installed in the train cab to help the driver to remember the last warning signal was not used by the driver on this occasion. It was also not being used widely by other drivers because, once activated, the alarm sounded for 6 seconds and could not be cancelled. The sound can be easily confused with other 'in-cab alarms'.

The Commission recommends that the Chief Executive of the New Zealand Transport Agency ensure that systems put in place by New Zealand train operators to mitigate this known risk are effective and result in the risk being eliminated or reduced to an acceptable level. (023/12)

On 7th November, Manager Rail Systems of New Zealand Transport Agency replied in part on behalf of the Director:

> … we will work with industry to see that the risk referred to in the preamble to this recommendation is eliminated, isolated or reduced. We believe that this will meet the overall objective of this recommendation.

7.5. The daily bulletin was not clear to the Auckland signal box controller on the location of the worksite within Tamaki Station and it was not user-friendly to signal box controllers because it gave locations expressed in kilometres rather than points or signal names (the language typically used by signal box controllers).

The Commission recommends that the Chief Executive of the New Zealand Transport Agency ensure that the daily bulletins that convey critical information to rail participants are presented in a clear and unambiguous way. (024/12)

On 7th November, Manager Rail Systems of New Zealand Transport Agency replied on behalf of the Director:

> This recommendation is accepted. Discussions on it will be initiated on the publication of the final report. These discussions will include, where appropriate, a projected timeframe for implementation. This will be advised to TAIC in due course.

8. Key lessons

- Safe rail operations are reliant upon good communication between all operating personnel.
- All individuals and groups of individuals working in the rail industry need to understand fully and be working to a common objective before safe rail operations can be achieved.
- Documents created for the purpose of providing essential information to rail participants should be clear, unambiguous and in a format suitable for the intended recipients.

9. Works cited

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Morgan, C., Kyte, T., Olsen, L., & Roop, S. (2004). Assessment of existing teams and crew resource management (CRM) training within the rail industry. *Transportation Research Board 2004 Annual Meeting CD-ROM, 11-14 January, Session #476.* Washington DC.

TAIC. (2005). *05-107 Diesel multiple unit passenger Train 3037, wrong routing, signal passed at danger and unauthorised wrong line travel, Westfield.* Wellington: Transport Accident Investigation Commission .

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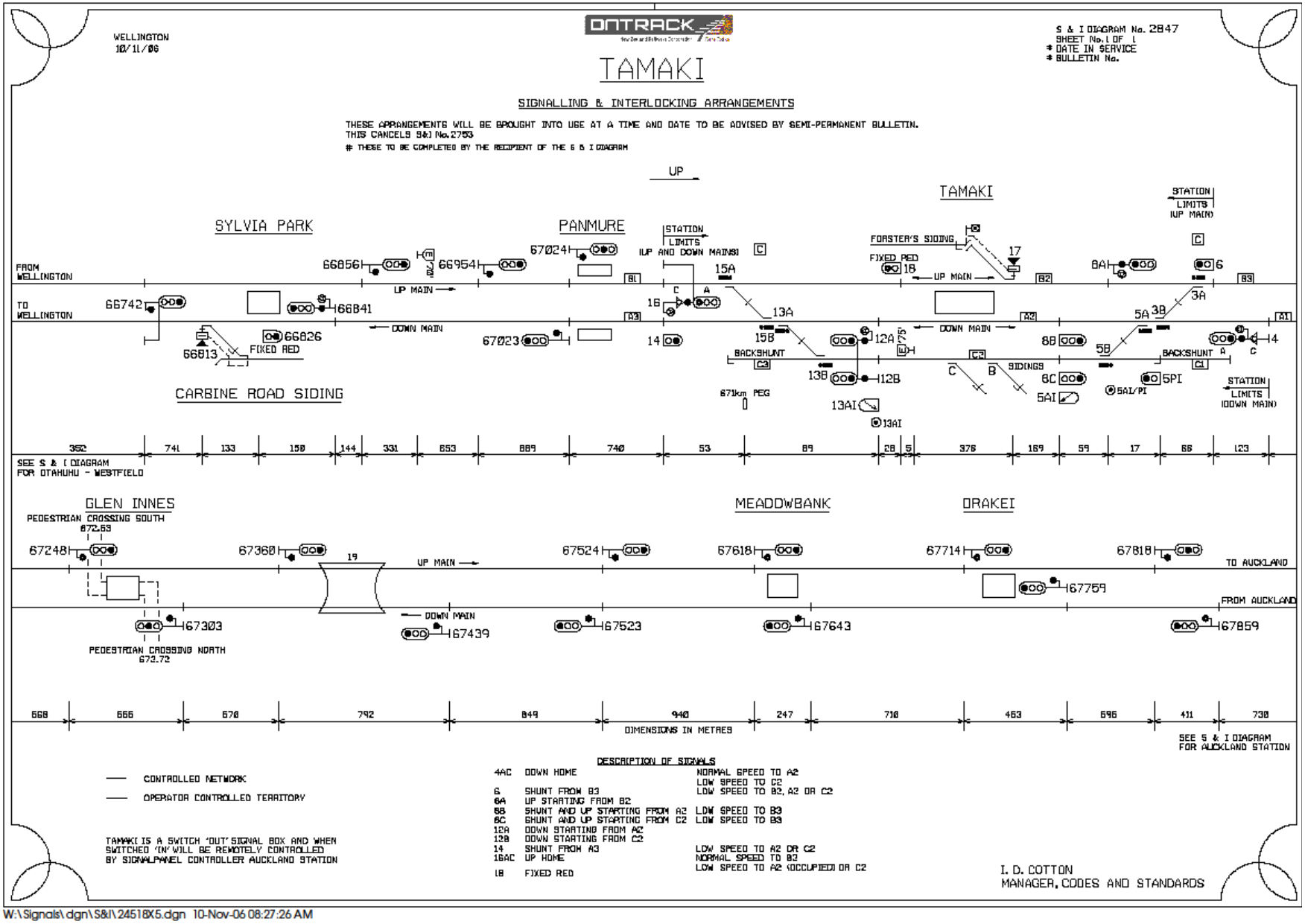
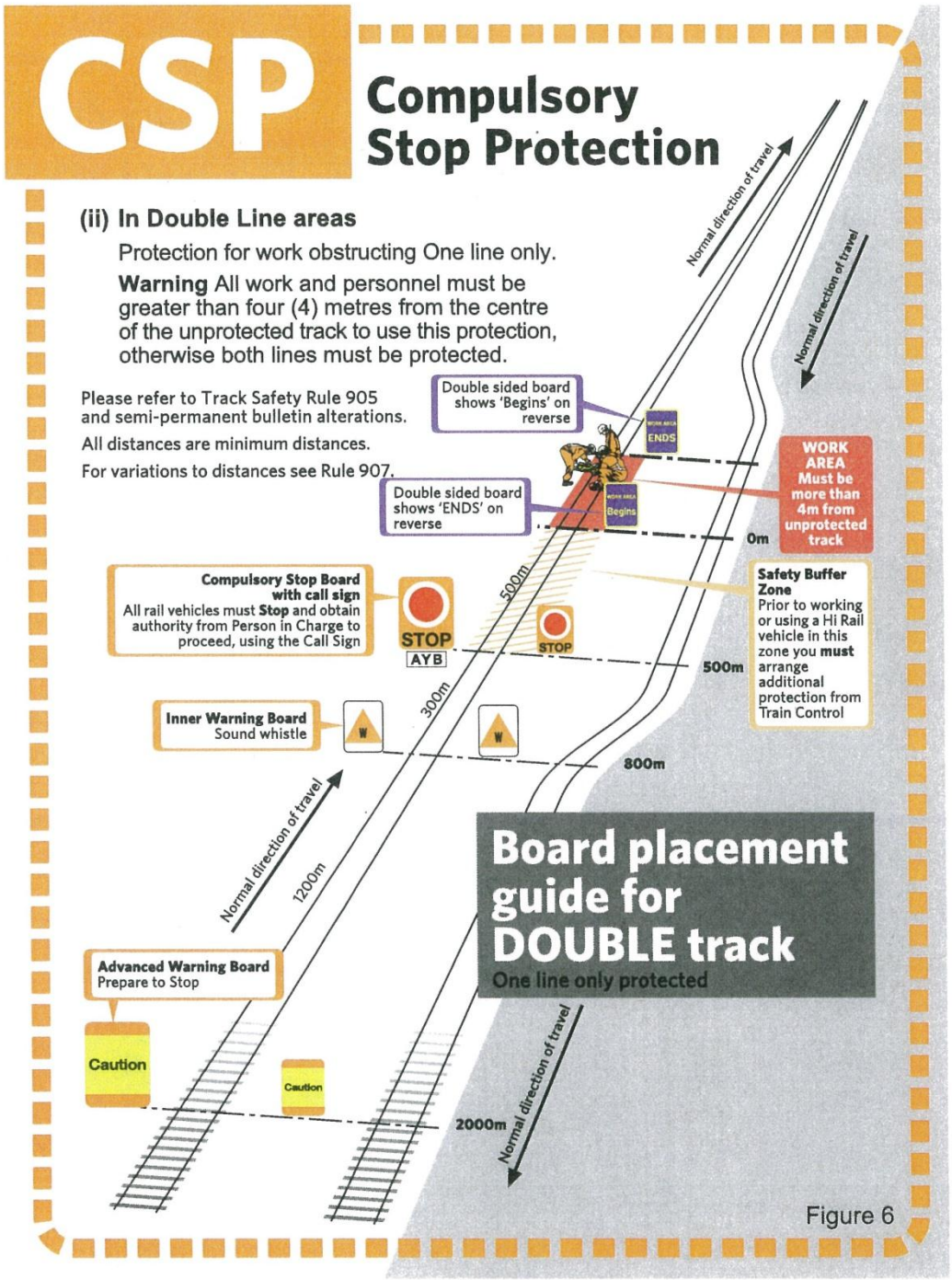
TAIC. (2011). *11 -101: Wrong line running irregularity, leading to a potential head-on collision, Papakura - Wiri, 14 January 2012.* Wellington: Transport Accident Investigation Commission.

Appendix 1: Tamaki signalling and interlocking diagram



Appendix 2: Compulsory stop protection: warning board placements



Information Bulletin – continued

Friday 13 August 2010
Pukekohe – Otiria and Branches

Pukekohe – Auckland (NIMT)

Protected Work Area		Rule	Work Details
650.80 km Takanini Up & Down lines	653.30 km Manurewa Up & Down lines	**905** Compulsory Stop Protection	Protection of contractors 0900 – 1500 021 (number removed) Call sign: **Alpna Sierra Uniform**
652.32km Te Mahia Up & Down lines	655.54km Homai Up & Down lines	**905** Compulsory Stop Protection	Protection of contractors 2300 previous day to 0200 0274 (number removed) Call sign: **Alpha Sierra Uniform**
670.45 km Panmure Up line	672.00 km Glen Innes Up line	**905** Compulsory Stop Protection	Track maintenance 0900 – 1500 027 (number removed) Call sign: **Kilo Hotel**
678.00 km Auckland Land Port Down line	677.30 km Orakei Down line	**905** Compulsory Stop Protection	Protection of contractors 0900 – 1500 021 (number removed) Call sign: **Alpha Papa Whiskey**
Down Advanced Warning Board(s) for services exiting Auckland Port Yard is erected at 115 signal. Rule 905 is modified accordingly.			
Auckland	Auckland	**909** Work Within Station Limits	Protection of contractors 2300 previous day to 0100 S. (Contact details removed)

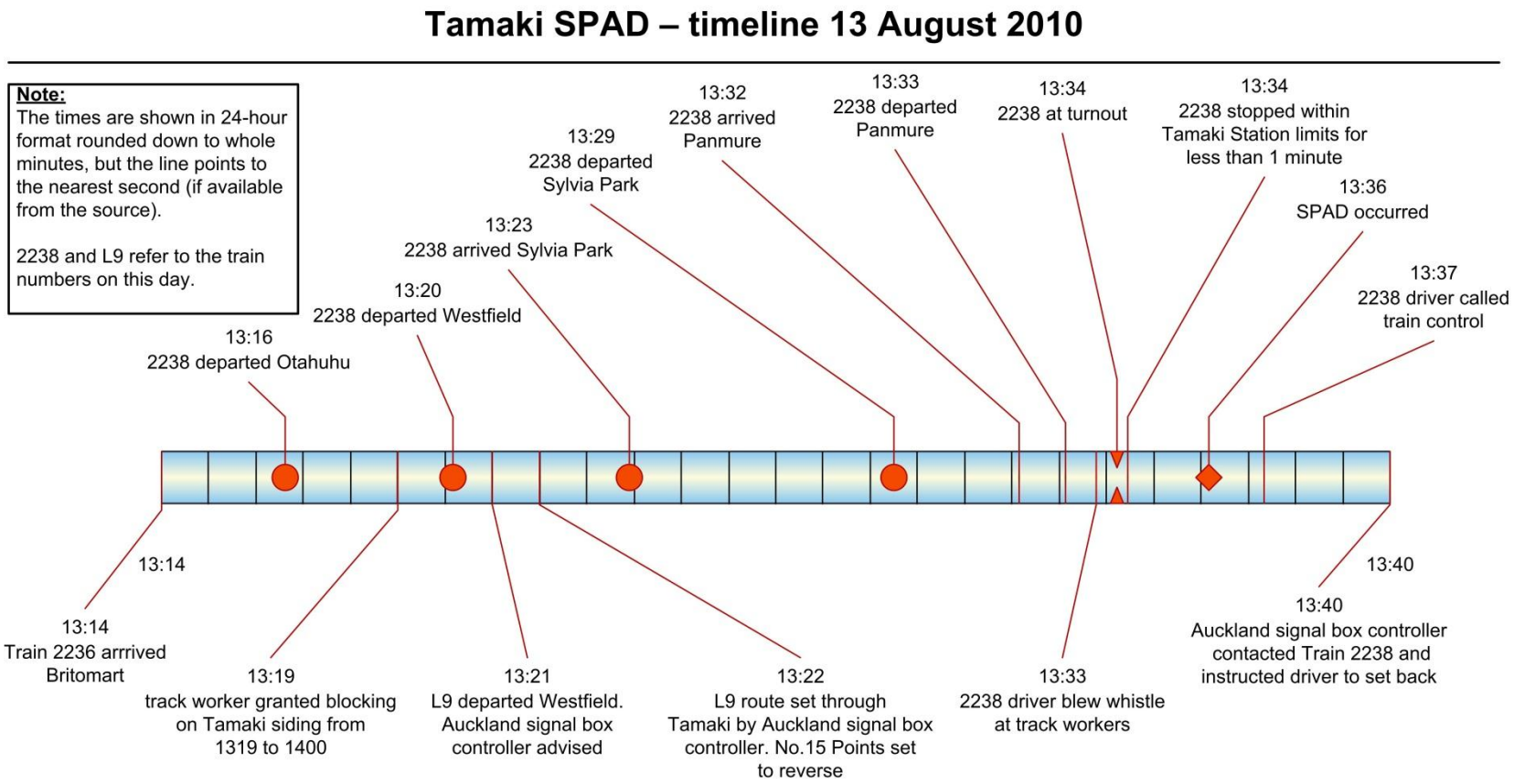
Helensville – Otiria and Branches

Protected Work Area		Rule	Work Details
Whangarei	Whangarei	**909 b**	New Bridge construction 0630 – 1800 T (Contact details removed)
			Call sign:

CSP in Tamaki station limits

Example CSP site where signals were in use by PIC

Appendix 4: Timeline of event



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

11-104	Freight Train 261 collision with bus, Beach Road level crossing, Paekakariki, 31 October 2011
10-102	collision between 2 metro passenger trains, after one struck a landslide and derailed between Plimmerton and Pukerua Bay, North Island Main Trunk, 30 September 2010
07-102	(incorporating inquiry 07-111) freight train mainline derailments, various locations on the national network, from 6 March 2007 to 1 October 2009
11-101	Wrong line running irregularity, leading to a potential head-on collision, Papakura - Wiri, 14 January 2011
08-102	Metro passenger train derailment, Sylvia Park, 14 April 2008 (incorporating inquiries 08-104 and 08-107) Diesel motor fires on board metro passenger trains, 3 June 2008 and 25 July 2008
08-111	Express freight Train 524, derailment, near Puketutu, North Island Main Trunk, 3 October 2008
08-112	Safe working irregularity resulting in a collision and derailment at Cass Station on the Midland line, 8 November 2008
09-102	Passenger fatality after falling between platform and passenger Train 8125, Newmarket West station, 1 July 2009
08-109	Passenger express Train 9113, platform overrun resulting in signal passed at danger, Fruitvale Road Station, North Auckland Line, 4 September 2008
07-114	Derailment caused by a wheel-bearing failure, Huntly, 19 October 2007, and 11 subsequent wheel-bearing failures at various locations during the following 12 month period
09-103	Passenger Train 1608, collision with slip and derailment, Tunnel 1, Wairarapa Line, Maymorn, 23 July 2009 (incorporating investigation 08-106, collision with slip and derailment on the Johnsonville Line)
09-101	(Incorporating 08-105): express freight train derailments owing to the failure of bogie side frames, various locations on the North Island Main Trunk, between 21 June 2008 and 7 May 2009
07-105	Push/pull passenger train sets overrunning platforms, various stations within the Auckland suburban rail network, between 9 June 2006 and 10 April 2007

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