



**Report 98-107**

**Train 411**

**wrong line running**

**Ngaruawahia**

**15 May 1998**

### **Abstract**

On Friday 15 May 1998, at approximately 2220 hours, Train 411, a southbound express freight, was mistakenly routed on to the wrong main at Ngaruawahia. This operating irregularity was not responded to appropriately and the train was permitted to continue running in the down direction on the up main to Te Rapa, some 12 km south. Safety issues identified were the training and experience of staff used for relief duties in the Te Rapa signal box, the acceptance by locomotive running staff of inappropriate authorisation and the potential hazard to road traffic at level crossings during the wrong line running. A number of safety actions were taken by the operator and two safety recommendations were made to address the safety issues.



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## Glossary of abbreviations

DLAS	Double Line Automatic Signalling
TA	Train Advice
LE	locomotive engineer
RO	rail operator
LTSA	Land Transport Safety Authority
Tranz Rail	Tranz Rail Limited
CRM	Crew Resource Management

# Transport Accident Investigation Commission

## Rail Incident Report 98-107

<b>Train type and number:</b>	Express freight 411
<b>Date and time:</b>	15 May 1998, 2220 hours
<b>Location:</b>	Ngaruawahia
<b>Type of occurrence:</b>	Wrong line running
<b>Persons on board:</b>	Crew: 1
<b>Injuries:</b>	Crew: Nil Others: Nil
<b>Nature of damage:</b>	Nil
<b>Investigator-in-Charge:</b>	R E Howe



# 1. Factual Information

## 1.1 Narrative

1.1.1 Train 411 was a rostered Tranz Rail Limited (Tranz Rail) express freight operating between Auckland and Te Rapa (near Hamilton) on Friday 15 May 1998.

1.1.2 The normal double-track section at Taupiri (south of Huntly) had been reduced to single line running due to a blockage of the down main at 2022 hours, when southbound Train 211 hit an abandoned car at a private level crossing.

1.1.3 As was normal when such unplanned blockages occur on track operating under Double Line Automatic Signalling (DLAS), wrong line running was authorised by Block of Line Train Advice. This allowed down (southbound) trains to use the up main under controlled conditions and thus continue services past the obstruction.

1.1.4 Train 411 was rostered behind Train 211 and arrived at Huntly at approximately 2050 hours, where it was held due to the level crossing collision. Train 203, the southbound *Northerner* express passenger, was running behind Train 411 and scheduled at Huntly at 2210 hours.

1.1.5 At 2147 hours Train Control had a clear understanding of the blockage at Taupiri and was able to issue Train Advice (TA) 2722 to the locomotive engineer (LE) of Train 411 for his train to be routed on the up main between Huntly and Ngaruawahia. Ngaruawahia was the first locality south of Taupiri where trains could cross back from the up main to the down main following wrong line running. The Signalling and Interlocking diagrams for the Ngaruawahia/Te Rapa section showing all points and signals referred to in this report are attached as Appendix 1.

1.1.6 Requirements of the TA included:

. . . the train must travel cautiously. Special care must be taken at level crossings as the automatic warning devices may not operate properly . . .

Number 411 must not pass over number 24 points at Ngaruawahia until the locomotive engineer has obtained verbal authority from the signalmen at Te Rapa . . .

1.1.7 Train 411 arrived at Ngaruawahia and stopped at number 24 points at 2219 hours and the LE contacted Te Rapa signalman as required by TA 2722. Unlike Train Control, Te Rapa signal box did not have voice recording equipment and there is no record of the communication with the signalman.

1.1.8 The LE of Train 411 stated that on contacting the Te Rapa signalman he was told he was clear to pass Signal 21 at red and he would be directed over to the down main.

1.1.9 Train 411 proceeded across the single line bridge and passed Signal 21 at red. The LE stated that he soon realised he was travelling on the up main instead of being directed to the down main and contacted the signalman. The signalman was already aware that the train was on the wrong main when contact was made and told the LE, "You have gone too far, it doesn't matter carry on" and advised the LE that he would be routed to the down main further south at Horotiu.

1.1.10 As Train 411 approached Horotiu the signalman instructed the LE to carry on to Te Rapa on the up main. Train 411 continued to Te Rapa and entered arrival and departure road number 2 from the north end.

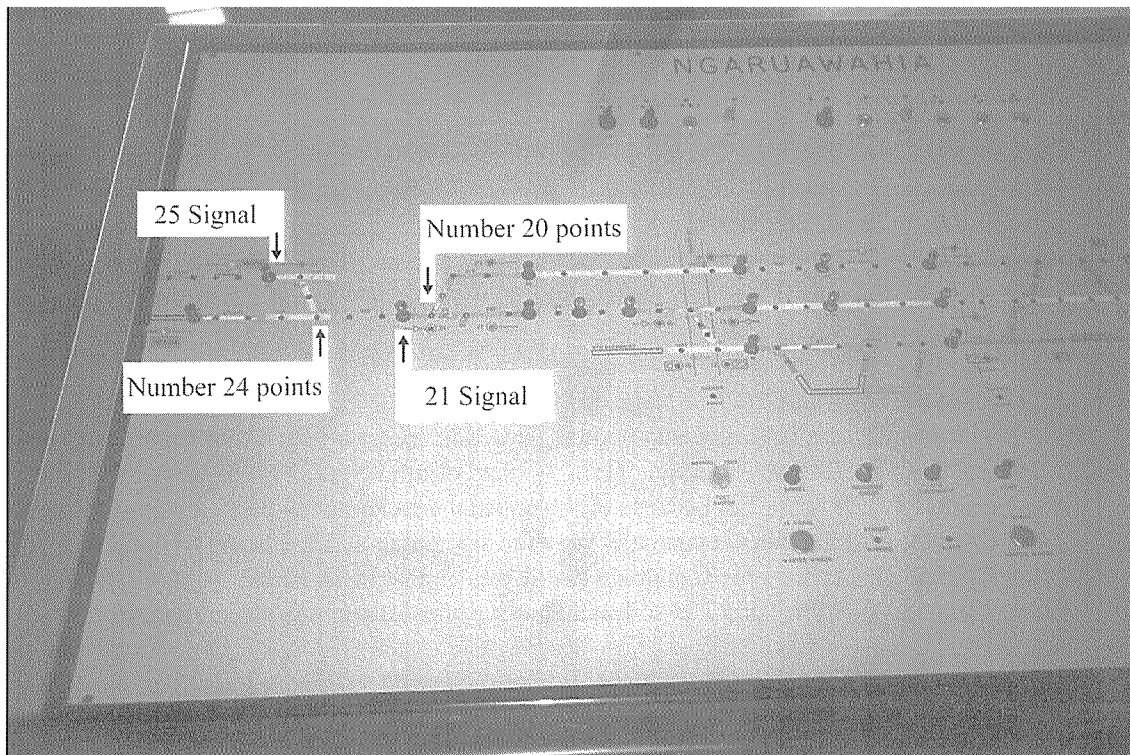
- 1.1.11 Between Ngaruawahia and Te Rapa, Train 411 ran for approximately 12 km in the down direction on the up main without appropriate authority from Train Control.
- 1.1.12 At approximately 2240 hours on 15 May 1998 a motorist near Te Kowhai Road at Te Rapa observed what she thought was a failure of the level crossing protection to operate in time on the approach of the southbound train. She reported this to the Tranz Rail 0800 number at 0130 hours on 16 May 1998 and this was the catalyst to the eventual formal notification of this incident on 18 May 1998. Neither the signalman nor the LE of Train 411 reported any irregularity at the time.
- 1.1.13 The possible failure of the level crossing protection was first discussed between signals staff and the signalman on the morning of 17 May and it was then that the signalman explained that Train 411 had travelled on the up main to Te Rapa.
- 1.2 The signalman's actions**
- 1.2.1 The signalman on duty at the time was a rail operator (RO) certified in signal box duties who relieved during the absence of permanent staff.
- 1.2.2 The signalman was facsimiled a copy of TA 2722 and was expecting to route Train 411 from the up main to the down main at Ngaruawahia. To achieve this he correctly locked number 24 points in the normal position which set the through route on the up main. He stated he became "a bit over cautious" and elected to lock number 20 points in the position he thought was required to route Train 411 from the up main to the down main. However, he instead inadvertently locked number 20 points in the reverse position which left a route set for Train 411 to continue down the up main.
- 1.2.3 As a result of locking number 20 points in the reverse position, the signalman could not set up a proceed indication on Signal 21. Until March 1998 Signal 21, the Down Home signal for Ngaruawahia, displayed indications for normal speed to the up main, medium speed to the down main, or low speed to the down main if occupied. In March 1998 the up main indication had been fixed at red and the low speed light altered to not illuminate. This meant Signal 21 could display a proceed indication only when number 20 points were set at normal for a train routed to the down main.
- 1.2.4 The signalman stated he was aware of these and other changes concerning alterations to down signals on the up main at Ngaruawahia.
- 1.2.5 The signalman did not check the setting of number 20 points following his failure to get a proceed indication on Signal 21. He assumed his failure to get a proceed indication on Signal 21 was because he had locked number 24 points in the normal position, and on this assumption he verbally authorised the LE of Train 411 to pass Signal 21 at stop.
- 1.2.6 The signalman could follow the progress of Train 411 by successive lights which illuminated on his panel as track circuits were claimed by Train 411. Shortly after he had authorised Train 411 to pass Signal 21 at stop, his panel illuminations showed him that the train was proceeding down the up main.
- 1.2.7 It was at this stage that contact was again made with the LE of Train 411 and the signalman gave his verbal authority to continue to Horotiu.
- 1.2.8 As Train 411 proceeded to Horotiu the signalman attempted to set a route from the up main to the down main at Horotiu without success. He stated that at this time he was concerned about the possible delay to Train 203 following Train 411.



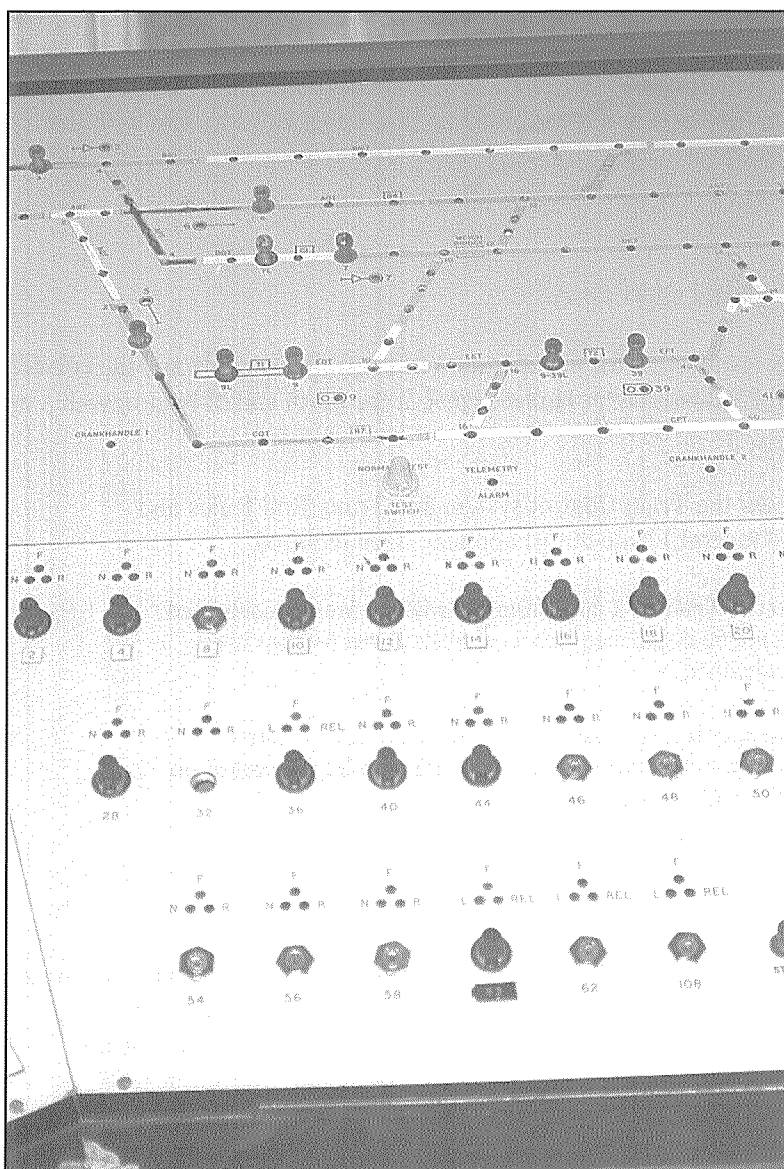
- 1.2.9 He then authorised the LE of Train 411 to continue on the up main to Te Rapa and was able to set a route which would take the train to the arrival and departure road number 2. He stated that in doing this he considered that there was no danger “as long as speed over level crossings was kept to a minimum” as he was in control of the panel and no trains were going north. He recalled asking the LE of Train 411 to “please be careful” with his speed over the crossings but could not remember an acknowledgement.
- 1.2.10 At 2158 hours Train Control had requested the signalman at Te Rapa to advise him when Train 411 was clear at Ngaruawahia points. This was necessary for Train Control to be able to authorise Train 203 to leave Huntly. Train 411 had cleared Ngaruawahia points at approximately 2220 hours but because of the unusual developments the signalman did not advise Train Control. Train Control eventually rang the signalman at 2234 hours to request progress on Train 411 and was told by the signalman that it was almost in Te Rapa. At 2240 hours Train Control issued a TA for Train 203 to leave Huntly some 30 minutes behind normal time.
- 1.2.11 The signalman was not alone in the signal box as the events leading to the wrong line running unfolded. He had been joined at approximately 2140 hours by a relieving LE awaiting his train. The relieving LE remained in the signal box until Train 411 neared Te Rapa at approximately 2230 hours.
- 1.2.12 The signalman and the relieving LE knew each other well and had been chatting before the arrival of TA 2722 at approximately 2150 hours. The signalman stated that from that point on their mutual interest was the progress of Train 411 and their discussions were centred on this. The signalman stated that the relieving LE was aware of all developments concerning the progress of Train 411 from Ngaruawahia to Te Rapa and commented on possible actions to deal with the situation as it unfolded.

### 1.3 Signalling system

- 1.3.1 Ngaruawahia to Te Rapa was worked under DLAS.
- 1.3.2 The signalman at Te Rapa was responsible for the operation of controlled signals and the correct signalling of trains from Signal 25 Down Outer Home Signal at the north end of Ngaruawahia up to, and including, Te Rapa.
- 1.3.3 The area was one operating under the Train Control system and Tranz Rail Rules and Regulations, Operating Rules (General,) Rule 90 (g) applied. This required:
- (g) Authority to Dispatch Trains** - Trains from lines which are not controlled by Train Control must not be dispatched into a controlled area without his permission being first obtained.
- Trains, other than passenger trains, must not be dispatched from stations without the authority of Train Control. Passenger trains may be dispatched on schedule time unless Train Control directs otherwise . . .
- 1.3.4 Ngaruawahia station limits were between Signal 25 (Down Outer Home) and Signal 1 (Up Home).
- 1.3.5 Signal 15 (C on Sheet 1 of Appendix 1) and Signal 6 (D on Sheet 1 of Appendix 1) had been part of a two-way signalling system at Ngaruawahia which had been required in the past to accommodate yard tracks and a main line crossover at the south end. These facilities were removed some years ago and Signal 6 had been designated as a fixed red. In March 1998 Signal 15 was designated a fixed red and the low speed light altered so that it did not illuminate.



**Figure 1**  
 Part of the Te Rapa signal box control panel (showing the northern limit of the signal box control area at Ngaruawahia)



**Figure 2**  
 Three position keys for individual point setting (part of the Te Rapa control panel)

- 1.3.6 A signalman could authorise passing signals at stop in accordance with Double Line Automatic Signalling Regulation 7 which stated:

**7. Signalman May Authorise Passing of Signals at “Stop”** - Any signal except an Intermediate signal, may be passed at “Stop” on receipt of verbal or written instructions from, or the exhibition of proper hand signals by, the Signalman. The Signalman must not give such verbal or written instructions or hand signal when a fixed signal can properly be used for the movement. The permission to pass a signal at Stop must be given only when the train or shunting movement is stopped at the signal concerned . . .

The Te Rapa signalman could authorise passing of Signals 21 and 15 under this regulation.

- 1.3.7 Signal 6 was the signal controlling the despatch of Train 411 from Ngaruawahia station and so required the authority of Train Control before Train 411 could pass it at stop (see 1.3.3). Train Control did not give this authority.
- 1.3.8 Signal 15 at Horotiu (E on Sheet 1 of Appendix 1) and Signal Y<sub>1</sub> at Te Rapa (F on Sheet 2 of Appendix 1) were both facing signals passed at red under the signalman’s verbal authority to allow Train 411 to enter Te Rapa yard. Although the signalman was able to authorise these movements, Train 411 should not have passed Signal 6 without appropriate authority from Train Control.

#### 1.4 Te Rapa signal box

- 1.4.1 Te Rapa signal box operated on a route-setting principle with the particular system used being the “Entrance-Exit” system. The control panel took the form of a track diagram with push buttons mounted in the line of the track (see Figure 1).
- 1.4.2 The “Te Rapa Local Instructions for signalman: Te Rapa to Ngaruawahia” included the following description of the route setting:

A route is set up by first depressing the entrance button and with this held down, operating the exit button. Both buttons are held until the white indication light inside the transparent entrance button begins to flash, when the buttons may be released. The flashing button light indicates that the route is available and that controls have been set for its registration.

No further action on the part of the signalman is required, setting and locking of the route proceeds automatically and completion of this stage is indicated on the diagram by the illumination of a line of white lights along the route. As soon as all points have completed their movement, and provided tracks are unoccupied (in the case of a normal or medium speed movement), the signal will clear and the flashing light and the entrance button will be extinguished, indicating that the setting up of the route has been completed . . .

Clearance of a signal is indicated by the red light in the signal symbol on the diagram changing to green.

- 1.4.3 The Local Instructions also included the following instructions regarding individual motor points control:

7. **INDIVIDUAL MOTOR POINTS CONTROL**

Three position keys having normal, centre and reverse positions, are provided for each set of points. [See Figure 2] With the key in the centre position the points are available for operation by route setting circuits. By moving the key to the left and pushing the start button for the particular interlocking the points can be set normal. Similarly by moving the key to the right and pushing the start button they can be set reverse. Under these conditions the points cannot be operated by route setting circuits, but it is possible to set up a route over the points in the position in which they are locked.

Points cannot be pre-selected. If a key switch is moved to the normal position when the points are locked reverse and the start button pushed a code will be sent out but the points will not respond. Before a further code can be sent the start button must be pushed once more.

Associated with the points key are normal (N), reverse (R) and free (F) indication lights. Incorporated in the track indication lights on the diagram is an 'out of correspondence' indication. This takes the form of a flashing red aspect in the pivot light of the points concerned. This indication will normally appear for a few seconds only while points are in transit and any prolonged illumination will indicate failure.

It should be noted that in this installation points do not restore to normal after use but remain in their last operated position. In fact, there is in general no strictly normal position, the names normal and reverse being used for convenience only. Points are said to be lying normal when they are set in the direction shown on the panel and S. & I. Circular.

- 1.4.4 For the majority of main line points the normal position was for the straight through road and the reverse position sets a route for the diverging road. This is shown on a signal box control panel by a continuous coloured route for the normal position and a discontinuous coloured route for the reverse position. However because number 20 points were used in the facing direction to take down trains from the single line section to the down main using the diverging road, the diverging road was the normal route.
- 1.4.5 Te Rapa signal box was operated by one person and staffed 24 hours a day by a roster of four full-time signaller. At the time of the incident a pool of three certified staff was used for relievers to cover annual leave and sickness demands.

1.4.6 The recent pattern of relief for the three certified relieving staff:

	Reliever A		Reliever B		Reliever C	
<b>Date certified in signalman's duties</b>	13 June 1997		15 September 1994		24 June 1993	
<b>Designation</b>	RO		RO		Train Examiner Operations (TXO)	
	Chronological work pattern from certification 6/97 to 5/98 (weeks)		Chronological work pattern from 4/96 to 5/98 (weeks)		Chronological work pattern from 8/97 to 5/98 (weeks)	
	normal duties	signalman duties	normal duties	signalman duties	normal duties	signalman duties
	2	-	-	2	-	1
	-	1	34	-	2	-
	7	-	-	2	-	1
	-	1	49	-	3	-
	27	-	-	1	-	1
	-	1	10	-	3	-
	6	-	-	-	-	2
	-	2	-	-	3	-
					-	2
					2	-
					-	1
					13	-
					-	1
					2	-
						2
<b>Total (weeks)</b>	<b>42</b>	<b>5</b>	<b>93</b>	<b>5</b>	<b>28</b>	<b>11</b>

Reliever A was on duty at the time of the incident.

## 1.5 Signalman certification

1.5.1 Following their training the certification of staff in signalman duties involved a written test paper and observation of practical operations, including oral questions.

1.5.2 In the case of Reliever A, this certification followed seven weeks full-time, on-the-job training with an experienced signalman in the Te Rapa signal box during early 1997.

1.5.3 Reliever A was then observed working the signal box over a four-hour period and then observed and examined over an eight-hour period, after which he was certified on 15 June 1997.

## 1.6 Rules and Regulations and Code requirements

1.6.1 The Tranz Rail Rules and Regulations and Rail Operating Code contained various provisions applicable to the incident.

1.6.2 Rule 19 required:

**19. Block of Line Train Advices** - When necessary any portion of line may be temporarily closed to traffic by the issue of a "Block of Line" train advice. A portion of line so blocked is, for the period stated in the train advice, absolutely closed to all trains, locomotives, or vehicles, except such as may be specifically authorised by the train advice to enter or be within the blocked section during that period but trolleys and hi-rail vehicles may be operated normally.

When a train advice imposing a block of line states that at the termination of the block of line a nominated employee (named) will certify that the line is clear and safe for traffic, the necessary advice must be given personally to Train Control or Officer Controlling Train-running by telephone or telegram by the employee nominated, and the block of line must be deemed to remain in operation until this clearance is given.

When any work interferes or is likely to interfere with the safety of the line or the safe working of trains during any period of block of line, protection must be provided unless specific authority to the contrary is given by the Officer Controlling Train-running.

1.6.3 Double Line Automatic Signalling Regulation number 10 required:

**10. Running Direction on Double Lines** - Trains must run on the left-hand line in the direction in which they are travelling except as otherwise authorised by the Officer Controlling Train-running.

1.6.4 Rule 6 (d) of the General Rules required:

**(d) Reporting Signalling Irregularities or Defects** - Any employee who observes any irregularity or defect in the working or exhibiting of signals (fixed or hand) must report the matter to Train Control or the Officer Controlling Train running.

1.6.5 Rule 97 of the Operating Rules (General) relating to the "control and working of stations" required:

**97. Irregular Working of Signals** - Any irregular working of a signal or the failure of a signal to operate properly, must be reported immediately by the employee observing the irregularity, to Train Control or Officer Controlling Train-running.

Signalmen or other employees must not operate any signal or apparatus except in the authorised manner, and must not interfere with any apparatus or instrument.

1.6.6 The Rail Operating Code Section 1, General, paragraph 7.0 "making reports" required:

Irregularities, derailments, defects in, or accidents involving damage to locomotives or rolling stock including faulty loading and incidents relating to the running of trains, particularly those resulting in delays to passenger trains, stalls, partings and incidents which could affect the operating safety of the system must be reported. It is essential for written advice relating to the incident to be available so that all safety aspects may be assessed and steps be taken to prevent a recurrence before allowing the rolling stock or equipment to be returned to service. Considerable delays and inconvenience result when operating staff fail to report such matters in writing immediately or at the completion of the shift.

Any irregularity in the working or displaying of signals (fixed or hand), plus defects in, fixed structures, permanent way or communications and live stock or other obstructions on the line, must also be reported to Train Control.

## 1.7 Locomotive event recorder

- 1.7.1 The locomotive event recorder was extracted and the long log, which gave day, time and speed every 10 seconds for seven days prior to the completion of the recording was supplied for analysis.

## 1.8 Level crossing protection

- 1.8.1 When running wrong line from Huntly to Ngaruawahia under Block of Line TA Train 411 crossed three protected level crossings:

km	crossing	type of protection	location at or between
571.67	Tregoweth Lane	B	Taupiri and Huntly
565.18	Kainui Road	B	Ngaruawahia and Taupiri
560.06	Old Taupiri Road	F	Ngaruawahia

B = Barrier arm protection

F = Flashing lights and bells protection

- 1.8.2 When double line traffic is being worked over a single line using pilot-working<sup>1</sup>, Double Line Automatic Signalling Regulation 12 (f) “precautions when running on wrong line” required:

(i) *Locomotive Engineers of trains running on the wrong line* must be cautious and must make frequent use of the locomotive whistle, particularly approaching level crossings.

When a train is running on the wrong line the speed must be reduced to 10 km/h over level crossings because the road traffic is not aware of the unusual conditions and that automatic warning devices, where provided may not operate properly . . .

Normal level crossing protection is activated by the approach of a train well in advance of the crossing to ensure adequate warning for road traffic. When wrong line running, there is no advance warning and protection is not activated until the train reaches the crossing in question.

- 1.8.3 The authorised wrong line running from Huntly to Ngaruawahia was by Block of Line TA and not by pilot-working. The requirements of Block of Line TA 2722 included:

The train **MUST** travel cautiously. Special care **MUST** be taken at level crossings as the automatic warning devices may **NOT** operate properly

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<sup>1</sup> pilot-working is the Tranz Rail term for the standard procedure for operating the DLAS double-line traffic over a single line as defined in the DLAS regulations. It is based on an appointed pilotman travelling with the LE. Tranz Rail advised that the simpler Block of Line TA procedures are used in preference to pilot-working when responding to blockage of a line in a double line area.

- 1.8.4 When running without correct authorisation on the wrong line from Ngaruawahia to Te Rapa, Train 411 crossed 10 protected level crossings. These are shown in the following table.

km	crossing	type of protection	location at or between
559.67	Waingaro Road	F	Ngaruawahia
559.55	Jesmond Street Pedestrian	F	Ngaruawahia
559.41	Princess Street	B	Ngaruawahia
558.74	Ellery Street	B	Ngaruawahia
557.61	Havelock Road	B	Horotiu and Ngaruawahia
556.55	Saulbrey Road	B	Horotiu and Ngaruawahia
555.54	Duxfield Road	B	Horotiu and Ngaruawahia
553.90	Te Kowhai Road	B	Horotiu
549.80	Ruffell Road	B	NZ Apple & Pear Bd Sdg and Horotiu
548.10	Te Kowhai Road	B	Te Rapa Public and Apple & Pear Bd Sdg

- 1.8.5 The LE stated that he slowed down for the level crossings between Ngaruawahia and Te Rapa but that his speed may have been higher than usual when wrong line running because of the time pressure on him. He knew that Train 203, the *Northerner* passenger express, was held up behind him, and he had clear views of all level crossings on the generally straight track alignment.

## 1.9 Personnel

- 1.9.1 The LE of Train 411 had 28 years railway service, 10 of which were as LE. He held a current operating certificate for the duties concerned and was familiar with the route.
- 1.9.2 The LE was working a normal shift pattern. His shift had commenced at 1810 hours on 15 May 1998 and he had worked a 44 hour week over five shifts preceding the incident. He reported his recreational patterns as normal and no undue fatigue on the day of the incident.
- 1.9.3 He had undergone his annual medical examination on the Wednesday preceding the incident. He was referred to a diabetes diet clinic on the Thursday due to his weight and recently diagnosed non-insulin diabetes. However, he stated the medical examination and related follow-up did not create any worries or stress that would have affected his work place performance.
- 1.9.4 The LE stated that as soon as he realised he was on the wrong line after passing Signal 21 he felt “uncomfortable”. After contacting the signalman and receiving instructions to proceed to Horotiu, and later to Te Rapa, he followed the instructions although “it just didn’t feel right, I felt uncomfortable all the way down.”
- 1.9.5 The LE stopped Train 411 at Signal 6 for approximately 50 seconds. Signal 6 was 1.2 km past Signal 21 and Train 411 took approximately four minutes to cover this distance.
- 1.9.6 When interviewed some time after the incident, the LE of Train 411 could not recall why he stopped at Signal 6 but felt it was either because of the signal’s aspect, or because of traffic on the adjacent Ellery Street level crossing.
- 1.9.7 The LE did not challenge the signalman’s instructions to pass Signal 6 at stop, as he believed that the signalman controlled all movements from Ngaruawahia to Huntly. He did not report the incident for the same reason.



- 1.9.8 The RO relieving as signalman had 24 years railway experience. He had been on shunting duties for 14 years and had been certified for remote control operations between Te Rapa and Horotiu in November 1996. On 13 June 1997 he was certified for signalman duties in Te Rapa signal box. He held current certification for signalman duties at Te Rapa.
- 1.9.9 On 15 May the signalman was approaching the end of his second week of relief duties. The first week had involved day shifts totalling 43 hours. The second week involved evening shifts. Due to rostered days off and leave he was on his third shift of the week when the incident occurred.
- 1.9.10 The signalman stated that he was in good health, that he was under no private or work-related stress, and that his sleep and recreational patterns were normal.
- 1.9.11 Following his initial certification he did not feel fully confident and at ease when relieving because, as he put it, “There is always a lot of, what we call, little traps that you fall into when you are up there, and there is that many that to find out every one the guy training you can’t think of every situation that you could possibly get into and advise you how to rectify it. There are just so many, I think each time I’m up there I learn something new all the time.” However he said he felt comfortable when asked to relieve in May, although admitting “for the first time I’m a bit anxious, but once I’m half way through the shift I start to gain my confidence, that is on the first shift I come in to relieve. While things aren’t happening I actually do some experimenting with the panel by setting up routes and seeing if it was still the correct procedure and all that and slowly gaining my confidence throughout the shift. But by the second or third night I’m okay with it. On this particular night I was okay with four to midnight.”
- 1.9.12 He said that during his on-the-job training he could not recall any time that wrong line running had been required and that this was the first occasion such an operation had occurred while he was relieving. Appointed Te Rapa signalmen confirmed that wrong line running was rarely required in the Huntly to Ngaruawahia section.
- 1.9.13 The signalman stated that he was not aware at the time of the incident that he had the authority under DLAS Regulation 1 to authorise the train to set back after passing Signal 21. This stated:

**1. Train Not to Set Back**

- a) After leaving a station, trains must not set back unless authorised by a train advice.  
NOTE - When setting back trains must be able to stop clear of level crossings with automatic alarms as the alarms may not operate until the train is on the crossing.
- b) Trains and shunting movements which are wholly within the Home or Outer Home Signals at a station and are within the signalled area may not reverse direction except on the authority of the Signalman who must first satisfy himself that it is safe for the intended movement.
- c) When shunting at a station involves going outside station limits setting back on the main line is permitted on authority of the Signalman provided any part of the movement does not involve passing the next Intermediate signal in advance.

He was also not aware that his authority extended only to Signal 6 and that he could not authorise the passing of Signal 6 at stop.

- 1.9.14 The signalman did not consider that he was distracted by the presence of another person in the signal box, and emphasised that all considerations and decisions were his. However he did consider that the comments from a qualified LE may have unknowingly influenced those considerations and decisions.

- 1.9.15 The signalman stated he did not report the irregularity at the time “because I was in an embarrassing position and I was just going to let sleeping dogs lie and wait until I heard from someone, because I had a feeling I was going to hear from someone”.
- 1.9.16 When first asked about the reported failure of level crossing alarms to operate correctly the signalman was forthcoming about the events that had occurred as they related to the report from the public, and assisted fully with the investigation which followed.

## **1.10 Crew Resource Management**

- 1.10.1 Crew Resource Management (CRM) is a general term covering crew management in highly operational situations; for example on ships, in control rooms of power plants, in aircraft, and in medical operating theatres.
- 1.10.2 The way human beings interact, communicate and make decisions in such situations is quite similar. Equally errors in such situations are also similar. Training in this area was developed in the airline industry as a result of research which showed that most aircraft accidents occur as a result of crew management errors rather than technical malfunction.. The concept has since been adopted and formally adapted to suit the maritime industry.
- 1.10.3 Examples of common CRM failings are preoccupation with minor technical problems, failure to delegate the tasks and assign responsibilities, failure to set priorities, inadequate monitoring, failure to use available data, failure to communicate intent and plans, and failure to detect and challenge deviations from standard operating procedures. The last was a key factor in this incident.
- 1.10.4 Although the principles of CRM have application to certain rail operating environments CRM training has not been adopted in the rail transport industry to the same extent as in the air and marine industries. Tranz Rail advised that they have no formal training covering CRM in the operating environment incorporating the interface between Train Control, signalboxes and locomotive cabs.

## **2. Analysis**

### **2.1 Introduction**

- 2.1.1 The incident can be broken down into two distinct phases:
- the passing of Signal 21 at stop causing Train 411 to enter the wrong line
  - the continued unauthorised passage of Train 411 on the wrong line to Te Rapa, past Signal 6 at stop.

### **2.2 Passing of Signal 21 at stop**

- 2.2.1 The signalman’s action in authorising the passing of Signal 21 at stop was influenced by the following significant factors:
- Train 411 arrived at Ngaruawahia travelling on the wrong line under the authority of a Block of Line TA. Although this was a standard Tranz Rail procedure for dealing with a line blockage in a DLAS area, it was not a common event. The signalman had not been exposed to such an operation, either during training or when relieving, before the incident.

- The normal action when accepting a down train on the down main was to use route setting from Signal 25, the Ngaruawahia Down Outer Home. A signalman could not route set from Signal 25 when accepting a down train on the up main.
  - It was possible to route set Train 411 to the down main from Signal 21. However, because of the unusual routing he was dealing with, the signalman elected to use individual motor points control to set number 20 points. This was an optional method for setting up the route for Train 411. Had he been more familiar with route setting, and the flexibility of the system, the incident would not have occurred.
  - The signalman set number 20 points to reverse, believing this was the required position to route Train 411 to the down main through the diverting road.
  - For most main line points, this would have been a correct assumption. However, in the case of number 20 points, normal setting was for the diverting route to the down main.
  - Having set the points, the signalman could not get a proceed indication on Signal 21 when he plunged for a light (the aspect had been fixed at red). This should have alerted him to check the setting of 20 points because a red light was the expected result for number 20 points set for a down movement to the up main.
  - Because of his unfamiliarity with the effect of wrong line running to Ngaruawahia he wrongly assumed that because number 24 points was locked at normal that was the reason he could not get a proceed signal on Signal 21, and on this basis he authorised the LE of Train 411 to pass Signal 21 at stop.
- 2.2.2 At the time of the incident the signalman had been on duty for approximately 6.5 hours of his 8.25 hour shift. There was no indication that fatigue was a factor in the incident.
- 2.2.3 The incident occurred despite the fact that the signalman was nearing the end of a two-week relief period and that he considered he had re-familiarised himself with the working of Te Rapa signal box.
- 2.2.4 The potential consequences of the signalman inadvertently authorising a train to pass Signal 21 at stop on to the wrong main included possible collision if a train had been waiting on the up main at Signal 17. However, because Train 411 was stopped near 24 points a high speed entry to the up main was not possible. In the event Train 411 passed Signal 21 (approximately 300 m before Signal 17) at 13 km/h and the potential for collision had a train been waiting on the up main was minimal.
- 2.2.5 The passing of Signal 21 at stop causing Train 411 to enter the wrong line was an operating irregularity. Procedures were available to deal with such irregularities, either by Train 411 continuing on the up main by TA authorisation, or by Train 411 setting back. The signalman's knowledge and experience, based on his initial training and exposure since that training, left him ill-equipped to respond correctly to the irregularity.
- 2.2.6 The initial training and certification of the signalman were practical and unhurried. The lack of specific exposure to wrong line running to Ngaruawahia should not have been a problem if he had, and maintained, a full understanding of Te Rapa signal box operation.
- 2.2.7 The signalman's pattern of relief (see 1.4.6) showed five weeks acting as signalman over 11 months with no "double-up" periods with certified staff or other exposure to signal box working to maintain his skills. Although it is likely that he had sufficient knowledge when certified his short and infrequent periods of relief had adversely affected his retention of knowledge and ability to respond to unusual circumstances. Although he was confident when dealing with normal day to day operations, his knowledge and skills were found wanting in the unusual, but not unexpected, events of 15 May 1998.

2.2.8 As can be seen from the table in paragraph 1.4.6, the relief pattern for Reliever B left a greater potential for erosion of skills through lack of exposure than that for Reliever A.

### **2.3 Passing of Signal 6 at stop**

2.3.1 The signalman's action when authorising Train 411 to pass Signal 6 at stop, and then subsequently to continue to Te Rapa, was influenced by the following significant factors:

- his stated lack of understanding of the limits of his authority
- his stated lack of knowledge of the required action to respond to the original passing of Signal 21 at stop which took Train 411 to the wrong line
- the unusual nature of the down signals on the up main at Ngaruawahia (Signals 15 and 6 retained, but fixed at red)
- the presence of a qualified LE in the signal box.

2.3.2 It is of note that in authorising Train 411 to continue into Te Rapa on the wrong line, the signalman routed the train through the area (Horotiu/Te Rapa) for which he had been certified for remote control operations in 1996, and over which he worked regularly.

2.3.3 His failure to route Train 411 to the correct main at Horotiu was a further indication of his unfamiliarity with the capabilities of the Te Rapa signal box system. By this stage he had realised he had compounded his original error and he set a route into Te Rapa yard from Horotiu despite his operating experience in this area which should have told him such movements required specific TA authority.

2.3.4 In deciding on a route into Te Rapa, the signalman chose one that did not require the Te Rapa general shunter to be called upon to hand-wind any points, thus avoiding involving any additional staff in his corrective action.

2.3.5 As Train 411 proceeded on the wrong main, the signalman's efforts to correct the situation had no effect initially, and his concerns increased. His final solution, and the lack of any report on the obvious irregularities, indicated the depth of his concern and his reluctance to report an embarrassing irregularity he saw as safely, but incorrectly, resolved.

2.3.6 Although the signalman stated that while trying to route Train 411 to the down main at Horotiu he was concerned about the possible delay to Train 203 following, it was apparent that this concern was not a major influence on his actions. Train 203 could have departed from Huntly as soon as Train 411 was reported clear of Ngaruawahia. The signalman's preoccupation with trying to correct his error resulted in this clearance going unreported for approximately 14 minutes.

### **2.4 Analysis of event recorder**

2.4.1 The event recorder long log was analysed to calculate distance from speed and time, and these were related to datum points to derive details of train stoppages and speed at specific localities.

2.4.2 The analysis showed that Train 411:

- stopped near 560.2 km for 50 seconds (just prior to 24 points)
- stopped near 558.7 km for 50 seconds (just prior to Signal 6)
- stopped in the arrival departure road number 2 at Te Rapa.

2.4.3 The speed of Train 411 over level crossings between Ngaruawahia and Te Rapa was derived as:

<b>Road</b>	<b>Speed</b>
Waingaro Road	Less than 10 km/h
Jesmond Street (Pedestrian)	Less than 10 km/h
Princess Street	10 km/h
Ellery Street	Less than 10 km/h
Havelock Road	55 km/h
Saulbrey Road	46 km/h
Duxfield Road	43 km/h
Te Kowhai Road (Horotiu)	20 km/h
Ruffell Road	55 km/h
Te Kowhai Road (Te Rapa)	Less than 10 km/h

Note: The lowest speed within plus or minus 150 m of a crossing locality is listed to allow for positional tolerances.

## **2.5 Level crossing protection**

2.5.1 Of the 10 crossings involved, four were crossed at a speed well in excess of the 10 km/h required by Regulation 12 (f) (see 1.8.2). The speeds derived confirm the LE's recollection (see 1.8.5) of "higher than usual" speed as he, despite his misgivings, responded to the signalman's directions.

2.5.2 Although TA 2322 did not define a speed (see 1.8.3) the practical effect of pilot-working and running under Block of Line are similar for level crossings and the 10 km/h should also have applied under Block of Line operation.

2.5.3 A down train on the up main did not activate level crossing protection until it was at the particular crossing. For this reason a maximum speed of 10 km/h was required in such circumstances. Despite the clear views for road and rail traffic between Ngaruawahia and Te Rapa on the night there was significant potential for a level crossing collision to occur at train speeds around 50 km/h.

## **2.6 Crew Resource Management**

2.6.1 The training and experience of the LE of Train 411, and to a lesser extent the LE in the signal box at Te Rapa, should have provided a defence against the escalation of this incident once Train 411 had past Signal 21 to the wrong line.

2.6.2 The LE of Train 411 should have been aware that Signal 6 could not be passed on the signalman's instructions. Although he had misgivings, he allowed these to be overcome by his incorrect assumption as to the authority of the signalman. Train 411 passed Signal 15 without stopping but was stopped at Signal 6 for 50 seconds. The LE was not sure why he stopped at this locality and it does indicate his possible increased concern at passing this signal. In the event the LE did not take the opportunity to challenge the signalman. It is likely such a challenge would have avoided escalation of the original incident arising from risk exposure at level crossings and possible track occupation which the signalman may not have been aware of.

2.6.3 The presence of a qualified LE in the signal box at the time was not prohibited by Tranz Rail and such a presence was not uncommon. The LE's presence had the potential to provide increased support for the signalman to deal correctly with the deviation from standard operating procedure facing him. On this occasion, such support was not supplied and the LE in the signal box did not challenge the signalman's actions.

## 2.7 Reporting of the incident

- 2.7.1 It is of concern that the incident came to light only because of an alert and motivated member of the public. Tranz Rail had recognised the importance of reporting irregularities and had set up a reporting system to facilitate effective investigation and follow-up action. The success of such a reporting system is almost totally reliant on the staff. It is, therefore, essential that a culture exists in Tranz Rail in which staff are encouraged to report irregularities so that the safety of the system they are working in can be improved. The fact that this irregularity was not reported by three key operating staff, all of whom were familiar with the sequence of events, raises a doubt as to the full acceptance of such a culture within Tranz Rail.

## 3. Findings

Findings and safety recommendations are listed in order of development and not in order of priority.

- 3.1 The LE of Train 411 and the signalman held the appropriate certification for the duties being carried out.
- 3.2 The signalman's incorrect manual setting of number 20 points was the initiating factor contributing to the incident.
- 3.3 The signalman's use of manual point setting instead of route setting, which led to the incorrect setting of 20 points, was due to a lack of familiarity with signal box operation since initial certification.
- 3.4 The signalman's action in authorising the LE of Train 411 to pass Signal 21 at stop, and his failure to correctly respond when the wrong line running was detected, were also due to a lack of familiarity since certification.
- 3.5 The signalman's action in authorising Train 411 to pass Signal 6 at stop showed a lack of appreciation of the limits of his authority, and contravened DLAS Regulation 10.
- 3.6 The actions of the signalman and the LE may have been influenced by the presence of the redundant down signals on the up main at Ngaruawahia.
- 3.7 The knowledge and experience of the LE of Train 411 should have prompted him to challenge the signalman's actions in verbally authorising Train 411 to pass Signal 6 at stop.
- 3.8 The unusual sequence of events and the LE's concern as they unfolded probably contributed to his failure to maintain a speed of 10 km/h or less over all level crossings.
- 3.9 The presence of a qualified LE in the signal box was unlikely to have distracted the signalman from carrying out his duties and should have helped him respond to the sequence of events which occurred.
- 3.10 The application of CRM principles of challenge and response initiated by either of the LEs could have prevented the escalation of the original incident.
- 3.11 The failure of the signalman and two LEs to report this serious irregularity raises concern as to the effectiveness of Tranz Rail's irregularity follow-up policy to create a culture conducive to prompt notification.

## 4. Safety Actions

- 4.1 Following the incident the signalman was removed from relief duties until he was re-certified. As at January 1999 he had not been.
- 4.2 Other appointed and relief staff working the Te Rapa signal box attended a refresher course and were re-certified immediately following the incident.
- 4.3 The LE of Train 411 was removed from driving duties until he had attended retraining. He was re-certified following the retraining and restored to full driving duties.
- 4.4 In July 1998 Tranz Rail issued the following instruction regarding signal box relief at Te Rapa:

In order to maintain an appropriate level of exposure to working in the signal box the following program is to be implemented for those employees trained for relief coverage.

Each employee is to be rostered to a minimum of one shift per month. This shift should be either a late or a night shift and is to be attended in addition to the rostered signal person.

Each employee is to be rostered as relief signalperson for a minimum of one week each six months . . .

This brought Te Rapa into line with similar procedures for other signal boxes throughout the Tranz Rail system.

## 5. Safety Recommendations

- 5.1 On 18 March 1999 it was recommended to the Managing Director of Tranz Rail that he:
  - 5.1.1 Introduce formalised crew resource management training for Train Control Operators, Signalmen and LE's based on the training available in the aviation and marine industries. (001/99)
  - 5.1.2 Reassess the Tranz Rail irregularity follow-up policy to ensure that it is positioned sufficiently towards a corrective action culture as distinct from a punishment culture so that prompt reporting of irregularities is encouraged. (002/99)
- 5.2 On 12 April 1999 the Managing Director responded as follows:
  - 5.2.1 **001/99**  
Service Delivery will review the crew resource management training available within New Zealand for the aviation and marine industry to assess its suitability to meet the requirements of our operation. If accepted such training would be linked into our current training requirements for Locomotive Engineers, Signalbox and Train Control staff.
  - 5.2.2 **002/99**  
Your response to Tranz Rail's submission on the preliminary Safety Recommendation has been noted and it is disappointing to see that while you recognised the commitment already put in by the Company, you are not prepared to recognise this within the report by changing the recommendation to a safety action.

Tranz Rail believes that the submission made outlines the Companies action & intent already being taken in regard to this safety recommendation and have nothing further to add.

Tranz Rail's submission made in response to the preliminary safety recommendation included:

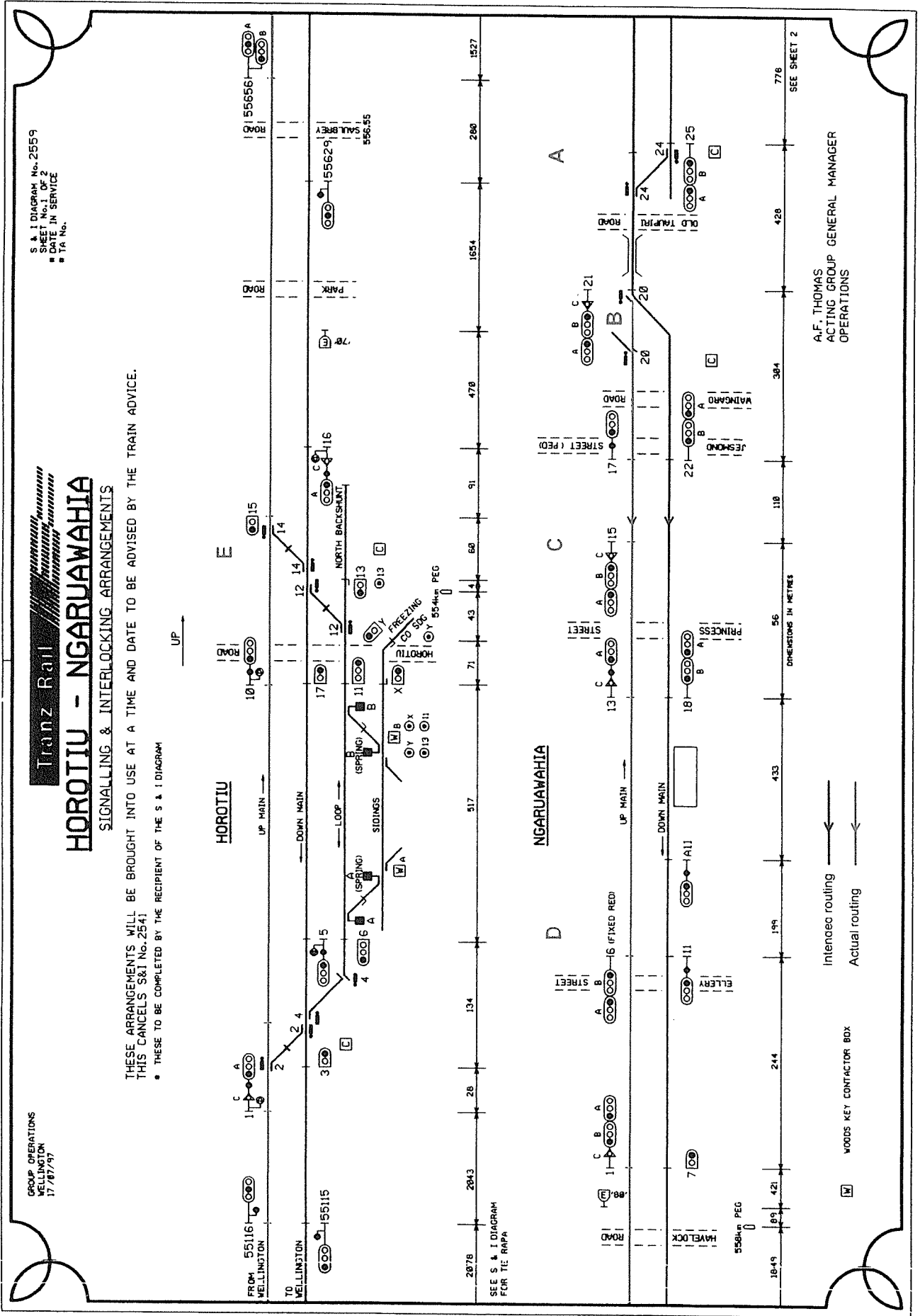
For the last two years Tranz Rail has had an Accident Prevention Programme in place, the objective of which is to develop a culture of no blame in order to ensure that the basic cause of an accident/incident is identified to enable appropriate preventative action to be implemented. It is Service Delivery's policy that this programme covers all operating staff.

In view of this the Safety Recommendation should be changed to a Safety Action that the Company has already undertaken, nevertheless we will reinforce the need to emphasise the corrective action rather than the punishment culture.

Approved for publication 31 March 1999

Hon. W P Jeffries  
**Chief Commissioner**





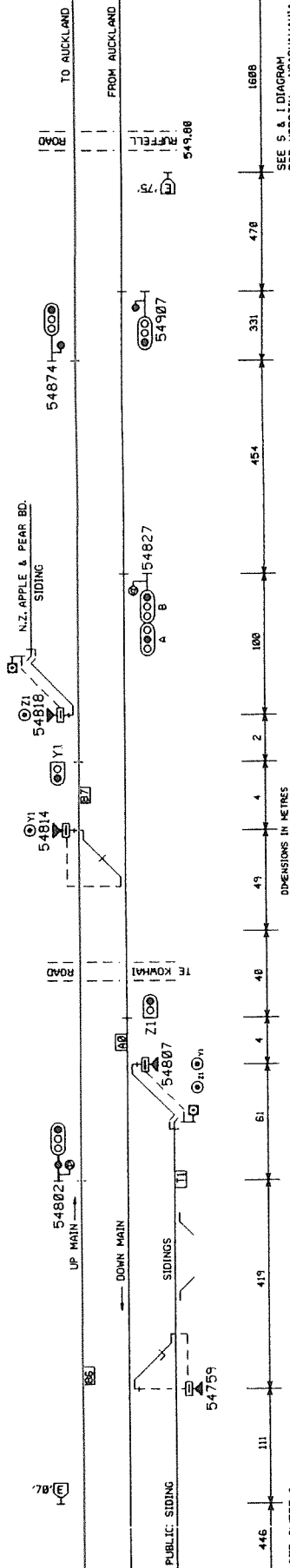


# TE RAPA

## SIGNALLING & INTERLOCKING ARRANGEMENTS

UP →

F



446 111 419 61 4 48 49 4 2 100 454 331 478 1688  
DIMENSIONS IN METRES  
SEE SHEET 3

SEE S. A. I. DIAGRAM FOR HOROTIU - NGARUAWAHIA

DESCRIPTION OF SIGNALS  
Y1 DOWN SHUNT FROM B7 LOW SPEED TO BE AND T1  
Z1 UP SHUNT FROM A8 LOW SPEED TO B7

(E)78' EXPRESS GOODS SPEED BOARD  
"SLOW 70"

L. R. MAJOR  
GROUP GENERAL MANAGER  
SERVICE DELIVERY

S & I DIAGRAM No. 2522  
SHEET No. 3 OF 4

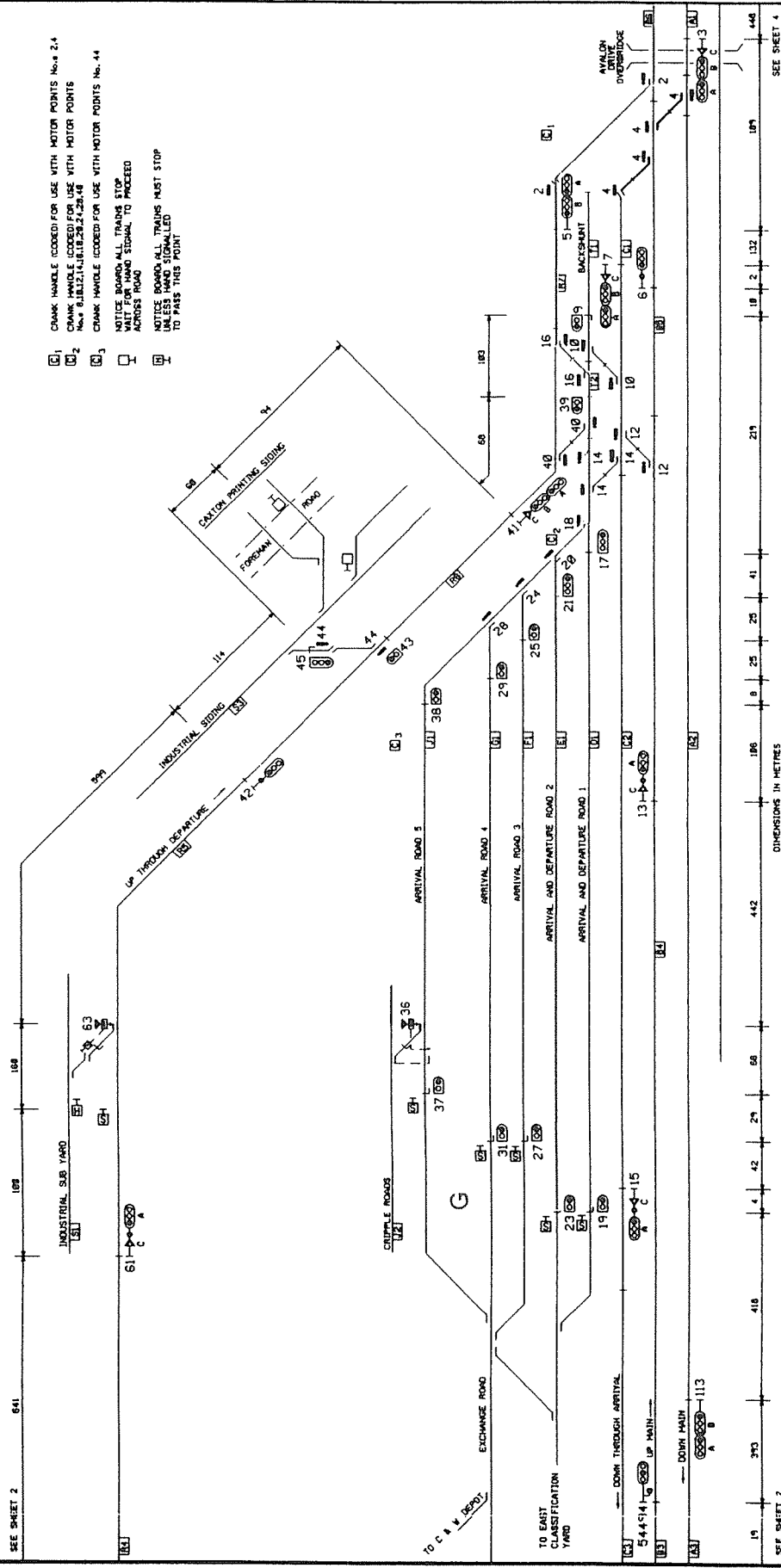
Tranz Rail

# TE RAPA

## SIGNALLING & INTERLOCKING ARRANGEMENTS (TRP)

UP

- 1 CRANK HANDLE CODED FOR USE WITH MOTOR POINTS Nos 2,4
- 2 CRANK HANDLE CODED FOR USE WITH MOTOR POINTS Nos 8,10,12,14,16,20,24,28,48
- 3 CRANK HANDLE CODED FOR USE WITH MOTOR POINTS No. 44
- 4 NOTICE BOARD, ALL TRAINS STOP WAIT FOR HAND SIGNAL TO PROCEED ACROSS ROAD
- 5 NOTICE BOARD, ALL TRAINS MUST STOP AT THIS POINT AND BE MANEUVERED TO PASS THIS POINT



L. R. MAJOR  
GROUP GENERAL MANAGER  
SERVICE DELIVERY

FOR DESCRIPTION OF SIGNALS PLEASE TURN OVER

