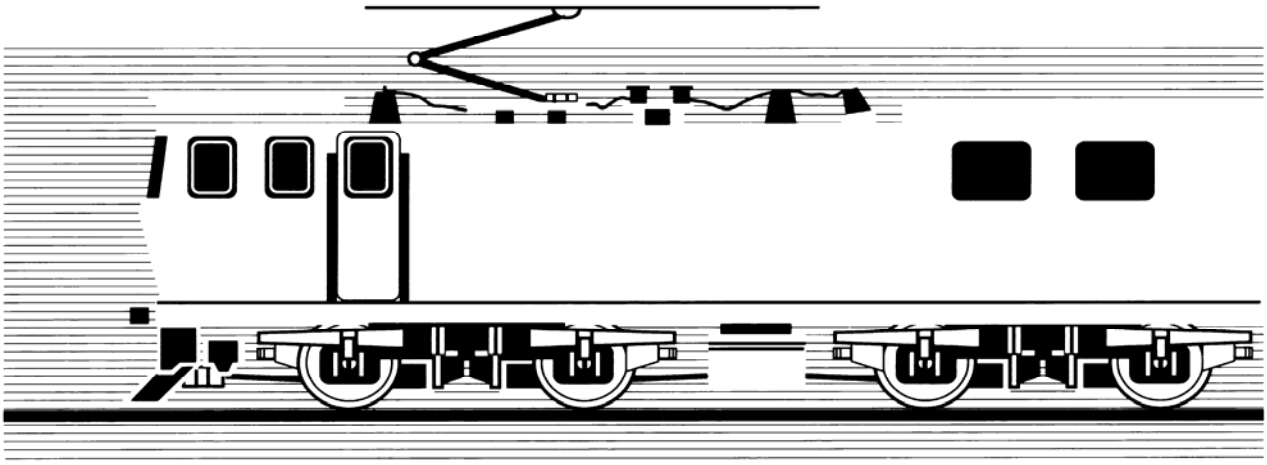
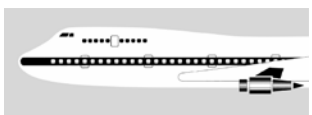
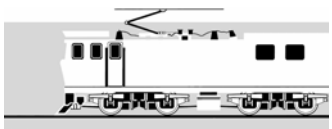


RAILWAY OCCURRENCE REPORT

05-120 **Report 05-120, express freight Train 142, runaway wagons, Mercer** **1 September 2005**


TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Report 05-120

express freight Train 142

runaway wagons

Mercer

1 September 2005

Abstract

On Thursday 1 September 2005 at about 1625, a rake of 6 wagons that was left unattended on the Down main line during a shunting movement within station limits at Mercer, ran away to the south. The wagons were stopped after they had travelled about 450 metres towards Koheroa Road level crossing.

Favourable track gradients and the actions of a staff member prevented the wagons rolling any further. There were no injuries or equipment damage.

Safety issues identified included:

- the training, certification and assessment processes for new personnel
- brake application and communication standards during shunting operations
- the old wheel-type handbrake.

A related safety issue identified included:

- the criteria for conveying wagons with brakes cut out.

Because of the safety actions taken by the Chief Executives of Toll NZ Consolidated Limited and ONTRACK, no safety recommendations have been made.

Contents

Figures

Abbreviations

AAR	Association of American Railroads
km	kilometre(s)
kPa	kilopascals(s)
OJT	On-the-job training
Toll Rail	Toll NZ Consolidated Limited
TXO	train examiner operations
UTC	coordinated universal time

Data Summary

Train type and number:	express freight Train 142
Date and time:	1 September 2005 at about 1625[1]
Location:	Mercer
Persons on board:	crew: 2
Injuries:	nil
Damage:	nil
Operator:	Toll NZ Consolidated Limited (Toll Rail)
Investigator-in-charge:	Vernon Hoey

[1] Times in this report are New Zealand Standard Time (UTC + 12) and are quoted in the 24-hour mode.

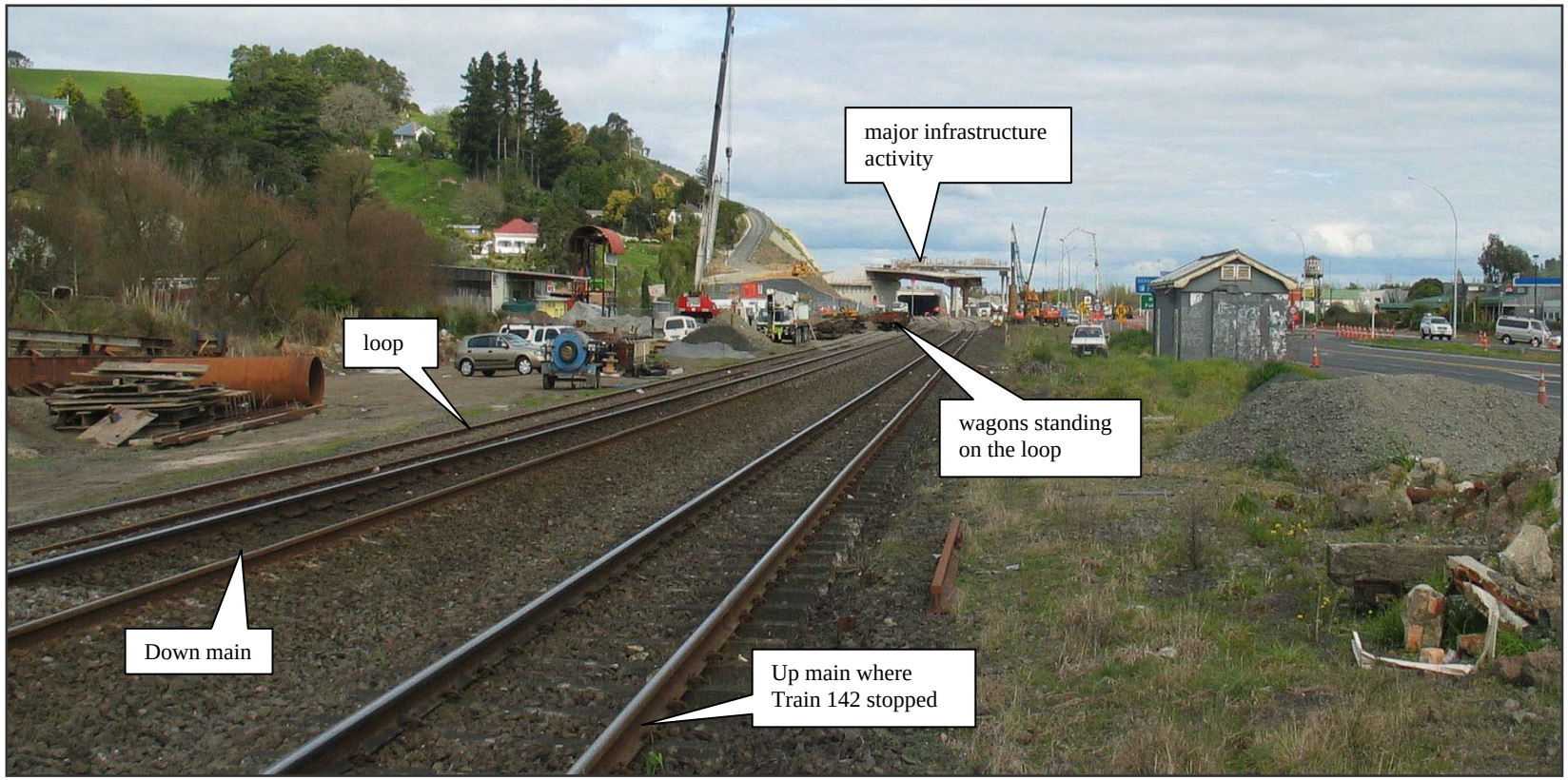


Figure 1
Mercer, looking south

1 Factual Information

1.1 Narrative

1.1.1 On Thursday 1 September 2005, Train 142 was a scheduled express freight train travelling from Huntly to Mission Bush, the rail terminal for New Zealand Steel Limited's steel production mill complex. Train 142 consisted of 2 locomotives in multiple hauling a rake of loaded coal wagons.

1.1.2 The train was crewed by a locomotive engineer with responsibility for the safe operation of the train, and a train examiner operations (TXO) with responsibility for the safe movement of the train during loading, unloading and shunting activities.

1.1.3 During earlier loading operations at the Kimihia mine near Huntly, the TXO received a cell-phone call from his manager, instructing him to undertake an unscheduled shunt at Mercer. Loading was completed at about 1355, and Train 142 departed Huntly at 1414.

1.1.4 At about 1516, the train stopped on the Up main line at Mercer and the TXO cut off the locomotives from the coal wagons, securing them with both air and handbrakes. The TXO then established from a Transfield Services[2] staff member that a rake of 15 wagons, comprising 6 empty EWR class wagons sitting behind 9 empty US/USQ class wagons, was on the loop. The rake needed to be transposed to bring the 6 EWR wagons to the north end (see Figure 2).

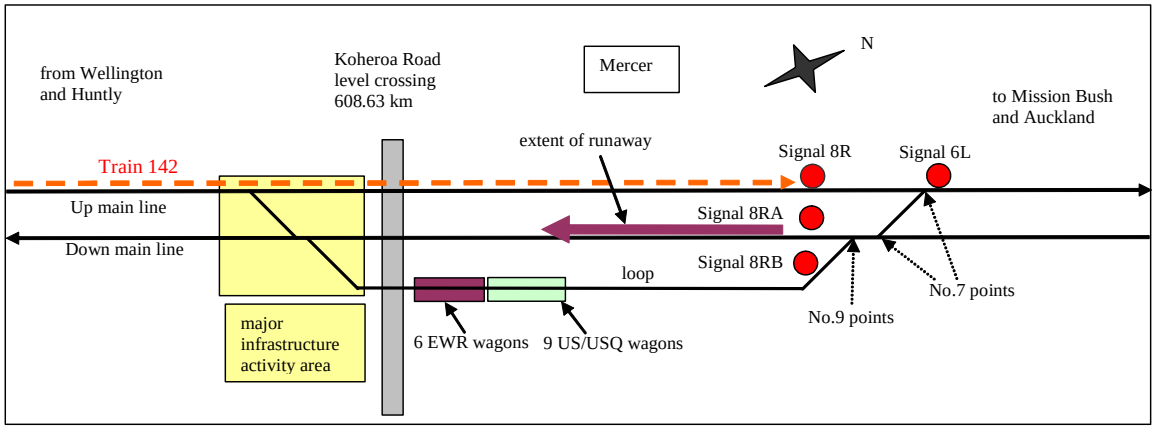


Figure 2
Site diagram of Mercer (not to scale)

1.1.5 At about 1532, the TXO piloted the locomotives onto the wagons on the loop via No.7 and No.9 points. While the air brake system was being pressurised, the TXO checked and released the handbrakes. About 20 minutes later, the TXO piloted the movement from the loop to the Up main line and stopped beyond Signal 6L, where it waited for a southbound train to pass on the Down main line (see Figure 3).

1.1.6 At about 1621, the train controller signalled a route and the TXO instructed the locomotive engineer to propel the wagons onto the Down main line. The TXO stopped the movement when the 6 EWR wagons were inside Signal 8RA. The TXO cut off the 6 EWR wagons and reported that he applied the air brakes and one handbrake. The TXO then instructed the locomotive engineer to return to the Up main line beyond Signal 6L with the 9 US/USQ wagons (see Figure 3).

[2] Transfield Services was responsible for the inspection, maintenance and renewal of the rail infrastructure.

1.1.7 At about 1625, the TXO looked back and saw that the EWR wagons were moving slowly towards Koheroa Road level crossing. The TXO ran after them and attempted to apply the handbrakes on 2 of the wagons. When this was unsuccessful, the TXO resorted to placing pieces of ballast on the rail, which eventually stopped the wagons after they had travelled about 450 metres.

1.1.8 The locomotive engineer radioed train control and advised details of the incident.

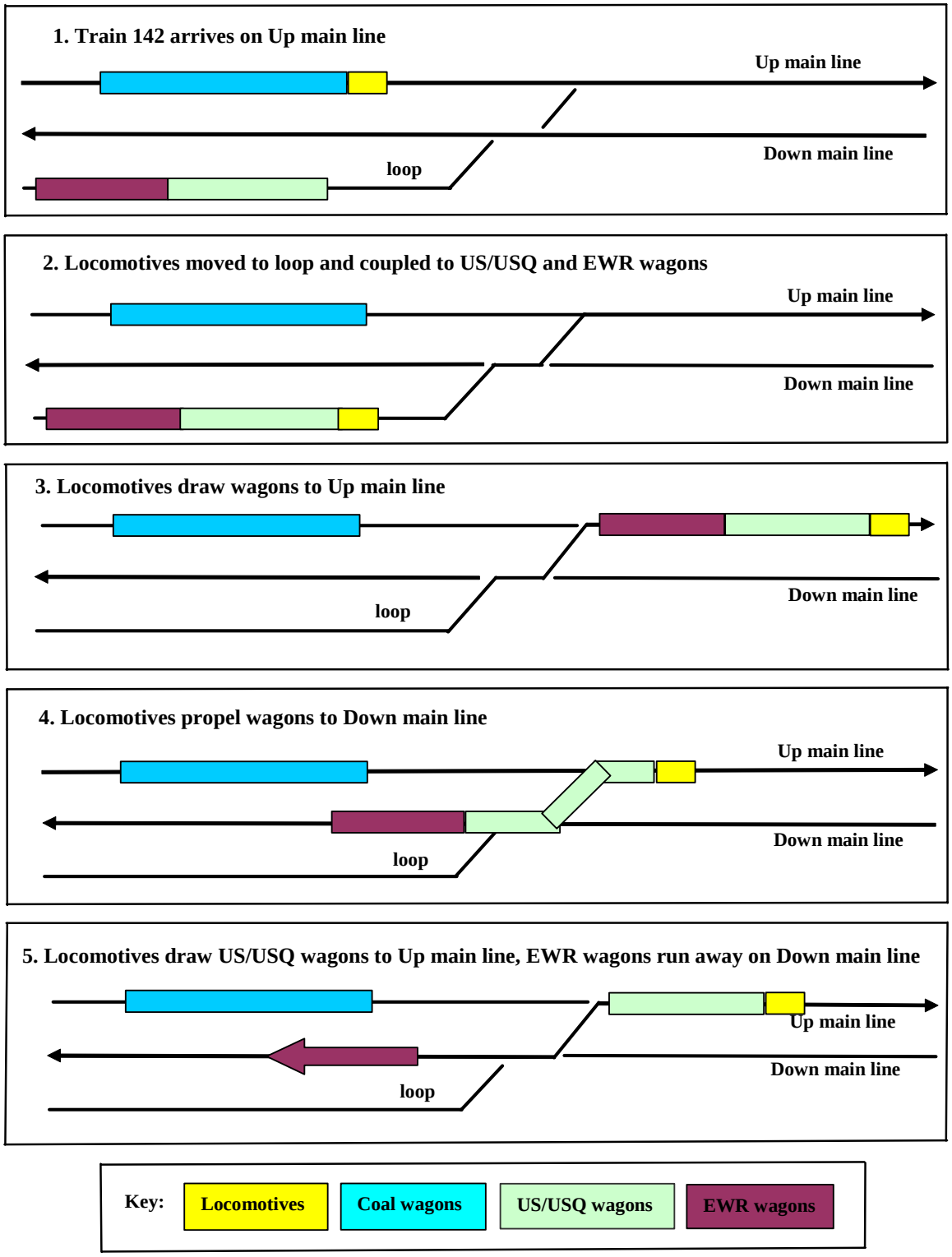


Figure 3
The shunting movements undertaken at Mercer (not to scale)

1.2 Site information

1.2.1 The North Island Main Trunk through Mercer was double track. Trains ran on the left-hand track in the direction of travel, with northbound trains on the Up main line and southbound trains on the Down main line.

1.2.2 A loop was provided at Mercer, but no safety points were installed at either end because shunting was not scheduled there.

1.2.3 The track gradient on the Down main line within station limits at Mercer changed several times over short distances. The gradient descended from about the 609.730 kilometre (km) at signal 8RA to about the 608.930 km where it climbed to Koheroa Road level crossing (see Figure 4).

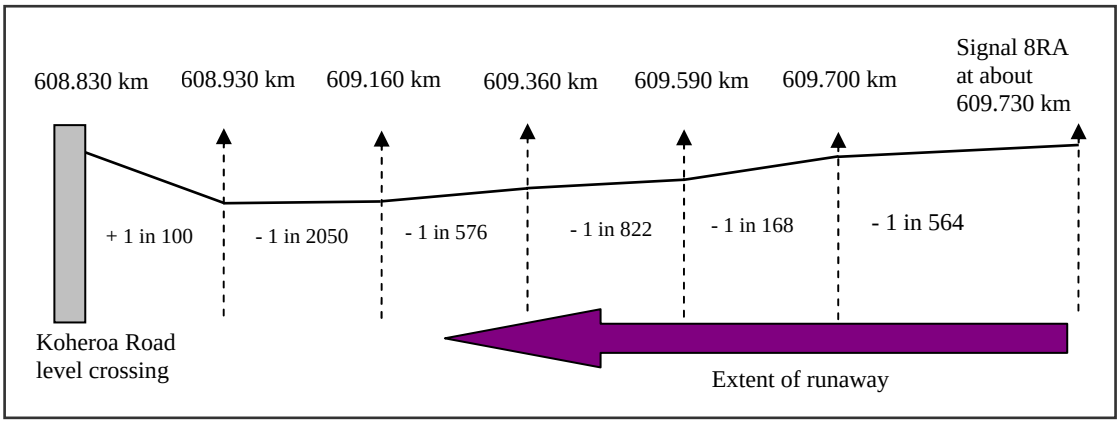


Figure 4
Gradients on Down main line at Mercer (not to scale)

1.3 Operating systems

1.3.1 Mercer was a crossing station remotely controlled from the national train control centre in Wellington. Double line automatic signalling was in use. The signalling system allowed train controllers to route an Up or Down train to the loop to change the running order of trains.

1.3.2 At the time of the incident, special operating procedures were in place at the south end of Mercer because of major infrastructure activity associated with the widening and realignment of the parallel State Highway 1 that also required realignment of the North Island Main Trunk. The loop at Mercer was closed for normal train movements, but was available for use by work trains and mobile track maintenance vehicles involved in the realignment work.

1.4 Personnel

Train examiner operations (TXO)

1.4.1 The TXO joined Toll Rail in January 2005. On 11 February 2005, he passed a practical assessment and competency test at the end of a formative training programme at Toll Rail's training facility at Woburn, near Wellington. From that date he was licensed to commence on-the-job training (OJT) that provided an opportunity to gain further experience by applying the skills learned during his formative training. A close-out component of the OJT was Toll Rail's responsibility to subsequently provide the TXO with local knowledge certification.

1.4.2 On 22 April 2005, the TXO underwent a yard operating safety assessment at Mission Bush, during which it was recorded that he met the general requirements for the application and release of wagon handbrakes.

1.4.3 On the day of the incident, the TXO's first duty had been to direct the unloading of coal Train 140 at Mission Bush. He then travelled on the empty Train 141 to Huntly where, after a changeover of locomotive engineers, he shunted and piloted the train to the Kimihia mine for reloading.

1.4.4 The TXO said that during the reloading, he received a cellphone call from his manager, instructing him to perform a shunt at Mercer, the details of which would be advised later. When he told the locomotive engineer of the instruction, the locomotive engineer asked him whether he was certified to shunt at Mercer. The TXO replied that he was not.

1.4.5 The TXO telephoned his manager and informed him that he was not certified to shunt at Mercer. The manager told him that all operating staff were certified to shunt at Mercer, so the TXO agreed to do the shunt.

1.4.6 The TXO said that after arriving at Mercer, he cut off the loaded coal wagons from the locomotives at Mercer and secured them by opening the brake cock on the first wagon and applying 2 handbrakes, as was his normal practice. He recalled that some time later he returned to the unattended coal wagons and applied a third handbrake.

1.4.7 The TXO said that the Transfield Services staff member told him that the wagons had arrived in the wrong configuration from Westfield, and that the request to change the standing order did not really need to be done until Saturday.

1.4.8 The TXO said that after piloting the locomotives onto the loop and coupling them to the wagons, he walked down one side of the rake to the last EWR wagon, checking and releasing the handbrakes on the way. He said that he was familiar with the Association of American Railroad's (AAR's) wheel-type handbrake fitted to the coal wagons, but not with the old wheel-type handbrake on the EWR wagons. The TXO recalled receiving theory training on the old wheel-type handbrake during his formative training at Woburn but said that there were no suitable wagons in the yard that they "could have a look at".

1.4.9 The TXO said that he had to look under the wagons to see whether the thread of the worm drive was applying or releasing the brakes. When he had established that turning the wheel anticlockwise released the brakes, he went along and turned each handbrake wheel until it could not move any more. There were no markings on the EWR wagons to show on [applied] or off [released] as opposed to the AAR handbrake on the coal wagons, which had this feature (see Figure 5).

Figure 5
Inscription on AAR handbrake

1.4.10 The TXO repeated the checking process on the opposite sides of the wagons while he walked back to the locomotives. He then confirmed with the locomotive engineer that the air pressure was okay, before instructing him to move and stop on the Up main line when the last wagon was beyond Signal 6L.

1.4.11 After the train controller signalled the route, the TXO piloted the movement to the Down main and stopped when the last EWR wagon was inside Signal 8RA. He said that he lifted the brake cock on the last US/USQ wagon quickly, followed by a slower lifting over a period of a few seconds of the brake cock on EWR 115. He said that he then positioned himself on the other side of the wagons, separated the couplers between the 2 wagons and turned the handbrake wheel on EWR 155 about 4 revolutions clockwise until "it locked up and would not move any more". He said that this was his normal practice when separating locomotives from coal wagons during loading operations.

1.4.12 The TXO instructed the locomotive engineer to return with the 9 US/USQ wagons to the Up main line beyond Signal 6L to wait for a route to the loop to be signalled. After the consist moved away, he looked back and saw that the EWR wagons were moving away from him towards the south. He said that he ran after the wagons but found it difficult on the uneven ballast. He said that after he caught up with the slow-moving wagons he tried to apply 2 handbrakes, but when he realised this was having no effect he resorted to placing pieces of ballast on the rail in front of the moving wagons. He estimated that the wagons reached a speed just above walking pace.

1.4.13 The TXO discussed the matter with the locomotive engineer, who agreed to inform the train controller of the incident. The TXO further secured the EWR wagons by placing more ballast between the wagon wheels. He then waited until a manager arrived from Te Rapa.

Locomotive engineer

1.4.14 The locomotive engineer had been employed by Toll Rail and its predecessors for 28 years. He had been a certified Grade 1 locomotive engineer for about 22 years and held a current operating certificate.

1.4.15 On the day of the incident, the locomotive engineer started work at Te Rapa at 1045 and travelled by road to Huntly where he waited for Train 141 to arrive. He said that he met the TXO before departing for Kimihia.

1.4.16 The locomotive engineer said that after loading had been completed, the TXO told him that they had been instructed to shunt at Mercer. He checked with the train controller regarding the appropriateness of using Train 142 for the shunt, and concluded that the shunt had to be done, even though the service would be delayed as a result.

1.4.17 The locomotive engineer said that after he had moved the 15 wagons from the loop and stopped on the Up main line clear of Signal 6L, he discussed with the train controller the options for the next phase of the shunting movements. The train controller told him that a route to the Down main line would be signalled after the passage of a southbound train.

1.4.18 The locomotive engineer said that after the route was signalled he propelled the wagons onto the Down main line and stopped the movement by making 2 applications of the train brake. He said that he realised that the TXO intended to separate the 6 EWR wagons inside Signal 8RA without needing to push the whole movement past the signal. He said that shortly after the movement had stopped, the TXO instructed him to return to the Up main line beyond Signal 6L.

1.4.19 The locomotive engineer returned to the Up main, and a short time later he saw the TXO running after the wagons. He said that even though he was now some distance from the runaway, he was able to see from shadow movement that the EWR wagons were moving. After he radioed the TXO to confirm what was happening, he telephoned the train controller and advised details of the incident.

1.5 Westinghouse air brake system

1.5.1 The Westinghouse air brake system was a standard, fail-safe train brake used by railways all over the world. It was based on the simple physical properties of compressed air. In New Zealand, locomotives were equipped with air compressors that automatically regulated the pressure to a maximum of 550 kilopascals (kPa). In the cabs of the locomotives was a brake (valve) handle (see Figure 6) connected to a number of brake control valves that allowed a locomotive engineer to control the speed of a train by lowering and raising the level of air pressure which applied and released the train's brakes respectively.

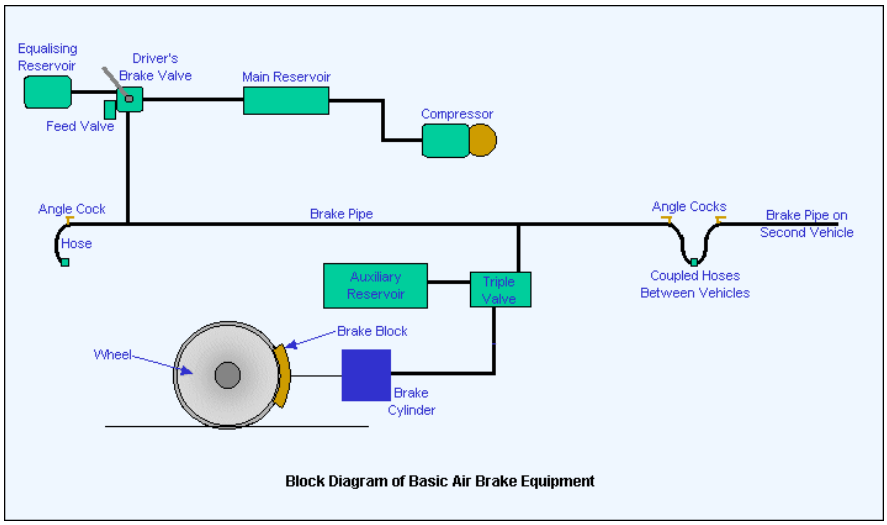


Figure 6
Diagram of a train's air brake system (not to scale)

1.5.2 The compressed air was transmitted along the length of a vehicle through a brake pipe. Flexible hoses, connected to the brake pipe, were provided at the ends of each vehicle. When the flexible pipes were coupled together at the formation of a train consist and a locomotive was attached, the air pressure was transferred from one vehicle to another. A brake (angle) cock was located where the flexible hose joined the brake pipe (see Figure 6). The brake (angle) cock allowed shunting staff to retain or vent any captured air pressure when a rake of wagons was cut off from a locomotive during shunting activities.

1.5.3 Each time a locomotive engineer applied the brake, the reduction of air pressure was detected in a triple valve on each coupled vehicle. When the pressure on the brake pipe side of the triple valve fell, the auxiliary reservoir pressure on the other side pushed a slide valve over, opening a connection between the auxiliary reservoir and the brake cylinder. Auxiliary reservoir air was then fed to the brake cylinder, forcing its piston to move against spring pressure and cause the brake blocks to be applied to the wheels. Air would continue to pass from the auxiliary reservoir to the brake cylinder until the pressure in both was equal.

1.5.4 This process was repeated each time the locomotive engineer moved the brake handle to apply the brake and increase the braking application. The more the air pressure was reduced, the greater the force that was applied by the brake blocks on the wheels.

1.5.5 A locomotive engineer was required to make a minimum 75 kPa reduction in air pressure on the train brake to stop a train. After the train had stopped, this reduction was maintained by the locomotive engineer and confirmed to the person on the ground by radio. Having confirmed the reduction, the person on the ground then applied the required number of handbrakes on the wagons to be separated before moving in to uncouple the buffers.

1.5.6 This process ensured that the unattended wagons were adequately braked because over a period of time, the captured air pressure in the wagons would gradually bleed off and the air brakes would eventually release. The rate of bleeding off depended on the number of wagons in the rake and the air-tightness of the braking components. Therefore, it was critical that handbrakes were applied when the unattended vehicles were to be isolated for any length of time.

1.6 Locomotive event recorder

1.6.1 Data downloaded from the event recorder on DFT 7010, the lead locomotive on Train 142, showed the following in part:

- at 1554:32, the propelling movement of the 15 wagons travelling from the Up main to the Down main stopped
- at 1554:34, the train brakes were released and an ease-up[3] movement occurred with the throttle being placed in notch 1 while the reverser[4] was still in the reverse direction
- at 1554:50, the throttle was placed back to idle and the movement stopped with the locomotive's independent brake[5]
- between 1554:56 and 1555:03, the reverser was moved to the forward direction, the throttle was placed in notch 1 and the locomotive's independent brakes were released.

1.7 Formative training and certification

1.7.1 The TXO received introductory training in rules and codes for freight train shunting duties and freight train inspection during a formative training period at Woburn. The training syllabus included the securing of trains when locomotives and wagons were detached.

1.7.2 An additional one-day course provided the TXO with theoretical training on elements for "on call emergencies" which would allow him to assist with the operations of freight trains that were crewed with a locomotive engineer only. The training syllabus required a field trip to the localities and over the lines on which the TXO would be rostered to operate. Because of the local nature of the field trip, the responsibility to carry out this training was transferred to the TXO's manager.

1.7.3 A training specification document was provided to the manager that listed the TXO's training aspects, required to be completed locally. The document did not incorporate the requirement for the manager to arrange a field trip for the TXO to all intermediate locations and the key elements to be covered during the trip.

1.7.4 On 11 February 2005, the TXO completed his formative training at Woburn and he returned to Mission Bush to commence his OJT period. On 22 April 2005, the TXO completed his OJT, and was certified as competent to undertake shunting duties and other allied duties at Mission Bush and locations where the coal trains were routinely loaded. The field trip did not occur, with the result that he was not certified to shunt intermediate locations, such as Mercer.

[3] A term used to describe the bunching of vehicles principally to release a locked coupling hook.
[4] The mechanism by which a locomotive engineer directs the direction a locomotive will travel.
[5] The braking system that operates the air brakes on locomotive(s) only without affecting the air brakes on any coupled wagons.

1.8 Safety observations/theory assessments: rail personnel support

1.8.1 ONTRACK's Rail Operating Procedures stated in part:

> This instruction applies when rail personnel have been identified as **needing support** to attain or return to levels of competency that will assist them in achieving, or returning to the required operating standards. They fall into four categories:
>
> - New Rail Personnel
> - Rail Personnel involved in significant operating breaches
> - Rail Personnel with personal problems that could affect operating performance
> - Rail Personnel whose work ethic is identified as a potential risk e.g. Failure to follow basic procedures, works long hours regularly etc.
>
> Additional Observations and Theory/Assessments to be given Rail personnel identified as needing support are set out in the table below:

1-3 months	4-9 months
Monthly Safety Observations	Bi-monthly Safety Observations
Theory/Assessment at end of three month period (also at commencement of cycle for new personnel)	Theory Assessments at end of six and nine months

> - The table identifies the minimum support Rail Personnel are to be given.
> - The cycle commences from the time the Rail Personnel are given a certification in the case of new Rail Personnel, and for other personnel identified as needing support, from the time the personnel return to full operating duties.
> - "A" level Safety Observations must be applied.
> - At the completion of the support cycle Rail personnel will return to normal Safety Observations/Theory Assessments.
> - Should personnel not respond to the additional support during any stage of the support cycle, Managers must consider temporary or permanent withdrawal of the Rail personnel – certification.

1.8.2 During the period between 11 February 2005 and the date of the incident, the TXO was subjected to only one formal assessment, the safety observation performed on 22 April 2005. The TXO should have received 4 safety observations and 2 theory assessments in the period.

1.9 EWR wagons

1.9.1 The EWR wagons were owned by ONTRACK and had been modified from standard US class flat deck wagons. There were 37 wagons in the class, all of which had been specially fitted with centrally mounted hand-operated cranes to load and unload lengths of rail. The handbrakes were of the old wheel-type and were mounted below the wagon deck level. When the wagons were converted, the wheel handbrakes were retained so as not to protrude into the open deck space when lengths of rail were loaded, transported and unloaded (see Figure 7).

Figure 7
An EWR wagon
(courtesy of ONTRACK)

1.9.2 The 6 EWR wagons and the 9 US/USQ wagons had travelled from Westfield to Mercer as part of the consist on Train 227 at about 0645 on the day of the incident. The documentation for Train 227 was not retained after the train journey to Te Rapa to show the technical status of the wagons.

1.9.3 A post-incident on-site examination of the 6 EWR wagons found that the air brake was cut out on EWR 171. This meant that although air pressure was being supplied through the wagon, a cut-out valve had been applied to prevent air entering the wagon's triple valve to activate the brakes. This action was generally taken to allow a wagon with defective air brakes to remain in a train consist until it could be scheduled for repair.

1.9.4 It was later established that EWR 293 also had its brakes cut out, but the TXO had reinstated the air brakes on this wagon during subsequent shunting movements after the incident.

1.10 Wagon maintenance

1.10.1 Maintenance of the EWR wagons was contracted to Toll Rail, which maintained the wagons in accordance with its Mechanical Code M2000, issued on 1 May 2001. The Code required wagons to be checked at the following frequency:

- a pre-departure check
- a B-check, carried out when 2 or more brake blocks were changed, or after an incident with no upper limit
- a C-check, carried out before a depot pass-out but with an upper limit of 27 months.

1.10.2 The pre-departure check did not incorporate a check of the handbrake mechanism but the person conducting the check was required to ensure the handbrakes were released and, in the case of lever-type handbrakes, ensure the lever was in its crotch.

1.10.3 Wagon Brake Manual M9200/04 dated 21 May 1997 and Significant Information Notice Mw-018 dated April 1999 detailed the requirements for enabling the braking systems on wagons to be maintained in a safe and efficient condition.

1.10.4 The Manual and Notice required the handbrake to be inspected and tested for correct operation during the B-check. During the C-check, the handbrake was required to be checked for correct operation, and wear, and adjusted if required. No special provision was made for the maintenance of the old wheel-type handbrake.

1.10.5 In relation to wheel-type handbrakes, the Manual stated the following in part:

> Once set up, these should need no further adjustment. On wagons fitted with AUSCOPAC-type brakes, the blocks should apply firmly with between one and one and a half turns of the handbrake wheel. On other wagons it may take between one and six turns. Incorrect operation can be caused by incorrect brake rigging setting, or by a previous alteration such as shortening or lengthening a chain.

1.10.6 Dates of the last B-check and the last and next scheduled C-check on the EWR wagons were:

EWR	Last B-check	Last C-check	Next scheduled C-check	Next C-check upper limit
115	21 Apr 2005	21 May 2004	21 May 2006	21 Aug 2006
333	25 Feb 2005	15 Sep 2003	14 Sep 2005	15 Dec 2005
156	4 Jul 2005	4 Jul 2005	4 Jul 2007	4 Oct 2007
171	10 May 2005	16 Dec 2003	15 Dec 2005	17 Mar 2006
237	5 May 2005	16 Dec 2003	15 Dec 2005	17 Mar 2006
293	5 May 2005	5 Dec 2003	4 Dec 2005	6 Mar 2006

Note: the wagons are listed in the same standing order in this, and subsequent tables, as at the time of the incident. EWR 293 was positioned at the south end of the rake.

1.10.7 All 6 EWR wagons were within maintenance code requirements.

1.11 Post-incident test results on EWR wagons

Handbrakes

1.11.1 After the incident, the handbrake systems on the EWR wagons were examined at Westfield. The handbrakes were separately applied and each wagon tested for movement using a large pry bar under a wheel set. Results were as follows:

- EWR 115, 333 and 156 moved with some force
- EWR 171, 237 and 293 did not move.

The handbrake wheel required an average of about 10 to 15 turns to apply the brake fully.

Air brakes

1.11.2 After the incident, the air brake systems on the rake of EWR wagons were examined at Westfield, retaining the same standing order. With air pressure charged at 550 kPa, the wagons were connected to a single car tester and an air release of 75 kPa, to 475 kPa, was made.

1.11.3 Ten minutes later the following observations were made:

EWR	Result
115	Brakes held
333	Brakes had released after 7 minutes
156	Even though air was discharging from behind a brake cock, brakes held
171	Brake cut out, no brakes applied
237	Brakes had released after unknown time
293*	Brakes held

*Note: in addition to EWR 171, the brakes on EWR 293 were cut out at the time of the incident.

1.11.4 A second test was carried out. After an initial air release to 475 kPa, a further release was made to simulate the train-separation actions taken by the TXO between the last US/USQ wagon and EWR 115 on the day of the incident. Other than on EWR 171, which had its brakes cut out, the brakes on the wagons held after 10 minutes, including on EWR 156, which was still leaking air.

1.11.5 The final phase of the testing included the placing of a load cell on a wheel set to measure brake force pressure in kilonewtons[6] and the following results were recorded:

EWR	Handbrake force	Air brake force
115	8.03	9.05
333	9.07	17.69
156	7.46	Indeterminate result due to air leak
171	7.12	Brakes cut out, no result
237	9.65	16.00
293*	9.13	17.60

*Note: in addition to EWR 171, the brakes on EWR 293 were cut out at the time of the incident.

Differing sequences for air brake applications

1.11.6 Using the 6 EWR wagons involved in the incident, an evaluation was made of the braking-related actions of the locomotive engineer and the TXO. A locomotive was placed at one end of the wagons and a train end monitor placed at the other. The results were:

Test	Brake reduction in locomotive	Closing sequence of brake cocks between locomotive and first wagon	Result of brake application on wagons	Air pressure at train end monitor
1	75 kPa	Closed simultaneously	Brakes remained applied after 10 minutes	260 kPa
2	75 kPa	Closed wagon cock first/delay closure of locomotive brake cock allowing air pressure to vent from the wagon cock	Brakes remained applied after 10 minutes	280 kPa
3	75 kPa followed by release of train brake	Close locomotive brake cock first/2 seconds later close wagon brake cock	Brakes on all wagons released	Not recorded, brakes released

1.11.7 The purpose of evaluating these sequences was to determine the likelihood or impact of the person controlling the train brake releasing the brake within seconds of the person on the ground lifting the brake cock, and in particular whether a release throughout the rake of wagons being separated would be obvious to either member. The evaluation concluded that:

- the initial 75 kPa reduction by the person controlling the train brake applied the wagon brakes
- the person controlling the train brake initiating a release resulted in sufficient airflow through the brake pipe to then release the wagon brakes
- the person on the ground closing either brake cock within the next 2-second period was too late to prevent the wagon brakes releasing
- the subsequent brake release on the wagon brakes was not noticeable to either person.

1.11.8 This test demonstrated the importance of the sequential timing of the actions taken by a locomotive engineer operating the brake control valve and the person operating the brake cocks. A variance of a few seconds between the actions of the 2 staff members determined whether the brakes were applied or released correctly.

[6] A measure of force that imparted an acceleration of one metre per second to a mass of one kilogram.

1.12 Types of wheel handbrake

1.12.1 There were 2 types of wheel handbrake mechanisms in use on rolling stock in New Zealand.

AAR wheel

1.12.2 The AAR wheel-type handbrake was fitted to later-generation wagons including the coal wagons. It could be fitted on one end or one side of a wagon. Braking force was applied by turning the wheel clockwise about one to 6 revolutions. Release was achieved by quick release level or turning the wheel anticlockwise (see left-hand picture in Figure 8). The TXO was familiar with this type of handbrake and was able to see from the tension in the chain when the brakes had applied.

Old wheel type

1.12.3 The old wheel-type handbrake was fitted to a small number of service wagons such as the EWR and other classes owned by ONTRACK, and to some of Toll Rail's log wagon fleet operating in the Bay of Plenty. Braking force was applied by turning the wheel clockwise about 10 to 15 revolutions. The handbrake mechanism was located out of sight behind the wagon side frame. Release was achieved by turning the wheel anticlockwise (see right-hand picture in Figure 8). The TXO had not operated this type of handbrake previously.

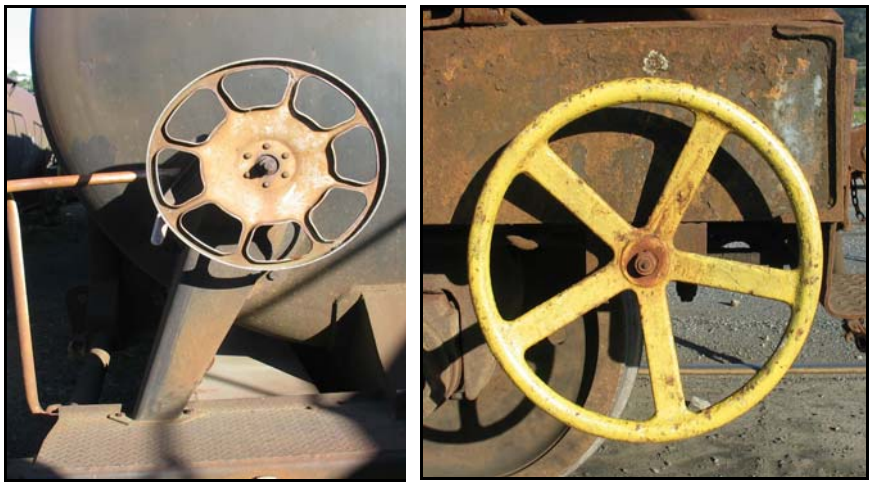


Figure 8
The 2 wheel-type handbrakes

1.13 Handbrake operation

1.13.1 Toll Rail's Operating Code stated, in part, the following instructions for the operation of wheel-type handbrakes:

> **7.1 Brake Identification**
>
> *** Wheel type**
>
> These handbrakes are designed to hold a wagon at stop. The brake is dangerous to apply to moving vehicles and should only be applied when the wagon is stationary.
>
> **7.3 Operation of wheel type**
>
> Turn clockwise to apply. Pull handle to release or in some cases wind off anticlockwise.

1.14 Running of unbraked vehicles

1.14.1 Toll Rail's Operating Code stated, in part, the following restrictions of running unbraked wagons on a train:

> **6.5.10 Running of Unbraked Vehicles**
>
> **(a)** Except as permitted, there must be either two bogie braked vehicles or the equivalent at the rear of the train.
>
> **(b)** Vehicles which are unbraked must be distributed throughout the train.
>
> **(c)** Unbraked vehicles must not be placed together on a train.
>
> **(d)** Except as permitted in the rules, the number of unbraked vehicles must NOT exceed: -
>
> **Freight and Express Freight / Unit Trains: -**

Number of Vehicles on Train	Vehicles with Inoperative Brakes permitted
0 – 5	Nil
6 – 15	1
16 – 25	2
26 – 35	3
36 – 45	4
46 – 55	5
56 – 65	6
66>	One for every ten additional vehicles or part thereof

1.14.2 The person undertaking a train examination at origin, or at an en route location where wagons were attached, had to report to Amicus[7] a bad order[8] status for any wagon found with its brakes cut out.

1.14.3 EWR 171 and EWR 293 were not bad ordered and were separated by one wagon only for the journey on Train 227.

1.15 Locomotive braking

1.15.1 There were no reported braking issues with the locomotives on Train 142.

2 Analysis

2.1 A series of latent conditions contributed to the formation of the safety hazard that occurred during the shunt at Mercer. The latent conditions were created during the TXO's formative training at Woburn, his OJT period and finally his certification at Mission Bush because elements within those processes had not been completed for various reasons. However, and just as importantly, events on the day also contributed to the formation of the safety hazard.

2.2 The TXO had been called upon to shunt at a location that he had not previously shunted. He knew that he had not been certified for Mercer, and understandably did not know that he was required to be. The TXO was reliant on his local manager who should have been familiar with his certification details, or prudently taken steps to refresh himself with the company's certification requirements at the time the TXO telephoned from Kimihia. However, in view of the safety action taken by Toll Rail that changed the OJT prescription/sign off-form following the incident, no safety recommendation covering this issue has been made.

2.3 At that point in time, the TXO felt that he had little choice but to comply with the instruction when the local manager informed him that he was certified to shunt at Mercer.

[7] Amicus was Toll Rail's principal computer-based operating and information system.
[8] A status in the Amicus system that identified mechanical defects requiring repair on rail vehicles.

2.4 However, the locomotive engineer should have then supported the TXO by refusing to carry out the shunt on safety grounds. If the locomotive engineer had called his manager at Te Rapa and explained his situation, it was highly likely that cancelling the shunt would have been confirmed as the correct decision.

2.5 The 2-person crewing of Train 142 was probably the reason why the local manager chose this train to perform the shunt. However, when the TXO expressed his non-certification concerns, the local manager should have reviewed the TXO's personal file, assuming it was up to date, which would have confirmed that local certification was required before the TXO could shunt at Mercer. Instead the local manager's response would have created additional uncertainty in the TXO which would have been further reinforced by the locomotive engineer continuing with the shunt despite knowing that the TXO was not certified for the locality.

2.6 Being in that frame of mind it was not surprising that, when the TXO uncoupled the EWR wagons on the Down main line, he was not focused on some aspects of the train-separation tasks, resulting in the wagons being left with insufficient braking.

2.7 Having agreed to do the shunt, the TXO was then confronted with the old wheel-type handbrake on the EWR wagons, with which he was unfamiliar. If the Amicus system had been accessed and enquiries made, it would have been seen there was no warning regarding the braking condition of EWR 171 and EWR 293 because they were not bad ordered. It was not known if the TXO saw the position of the brake cut-out cocks on the 2 wagons during his pre-shunt inspection and it was also not known if either wagon had been visually identified to show that its brakes had been cut out.

2.8 By that stage, the TXO was probably focusing on completing the shunt and persevered with the task as best he could. However, the TXO had 2 options to counteract his lack of knowledge of the handbrake and provide for the security of the EWR wagons before they were cut off on the Down main line. These options included:

- placing ballast or other suitable material under a number of wheels
- seeking guidance from the locomotive engineer or possibly the Transfield Services staff member.

2.9 The syllabus for the formative training at Woburn included practical training on the old type of wheel handbrake to reinforce the theory training and the documented standard that all wheel-type handbrakes were turned clockwise to apply the brakes. However, due to the unavailability of suitable wagons in Wellington at the time, the practical element of the TXO's training relating to the old wheel-type handbrake did not occur. When he was confronted with the old wheel-type handbrake, the TXO was initially unsure which way to turn the wheel because of his non-exposure to this type of handbrake mechanism. However, the TXO counteracted this lack of knowledge by looking at the worm drive under the wagons because there were no visual clues such as on the AAR handbrake. For the same reason, he was also unsure of the number of revolutions required to apply the brake.

2.10 The TXO had become familiar with the AAR-type handbrake on the coal wagons with its inscribed on and off instructions. From the brake position he could easily see when the brakes had applied and released. However, the old wheel-type handbrake on the EWR wagons had no instructions for the wheel movement. Given the need to keep the flat deck of the EWR wagons clear, the retention of the old wheel-type handbrake was a necessity.

2.11 However, EWR wagons and the small number of other ONTRACK wagons similarly equipped with the old wheel-type handbrake were not part of the mainstream wagon fleet. EWR wagons usually travelled between major terminals on scheduled freight services, then to and from ONTRACK's worksites on work trains. This resulted in lower utilisation and a reduced exposure to operating staff in comparison with Toll Rail's wagon fleet. Nevertheless the EWR wagon fleet was adequate for ONTRACK's infrastructure maintenance purposes.

2.12 Given the limited dispersal of the EWR wagons, they probably seldom travelled to terminals such as Mission Bush and they would likely not have been seen there for months, or even years. At the time the AAR-type handbrake was introduced to New Zealand, it would have been prudent to have similar marked instructions on the wagons that were equipped with, and were to retain, the old wheel-type handbrake in the long term. However, in view of ONTRACK's proposed actions after the incident, no safety recommendation covering this issue has been made.

2.13 Because the TXO had not been assessed in the safety observations and safety assessments scheduled for newly appointed persons, the opportunity was lost to assess and monitor his progress regularly and possibly identify and correct any non-conforming practices. However, in view of the safety action taken by Toll Rail after the incident, no safety recommendation covering this issue has been made.

2.14 The locomotive event recorder data showed that an ease-up movement occurred after the propelling movement had stopped on the Down main line, although the TXO could not recall it occurring. The data showed that the train brakes were released and the throttle was advanced to the first notch. Because the ease-up movement occurred over a 16-second period and the throttle was not advanced beyond the first notch, the movement probably only travelled a short distance.

2.15 Because the independent brake, rather than the train brake, was then used to stop the ease-up movement, full air pressure would have been retained throughout the rake of wagons, keeping the brakes released. However, depending on the extent of the ease-up, the train brakes should have been reapplied with a minimum 75 kPa reduction in brake pipe pressure initiated by the locomotive engineer after the ease-up was completed and before the brake cocks were lifted. Overall, it would have been prudent for the TXO to have separated the EWR wagons at the same sequence and to the same degree of completeness as he did in separating the locomotives from the coal wagons on Train 142. On that occasion it was apparent that he followed procedures and was even concerned enough about the ongoing security of the unattended coal wagons to return some time later and apply a third handbrake.

2.16 What triggered the movement of the EWR wagons could not be determined, but it could possibly have been the compressed drawgear playing out. That the runaway occurred when most, if not all, the wagons were sitting on a descending gradient of 1 in 168 indicated that there was no air or handbrake force applied. However, because of the flatter gradients beyond the 609.590 km, the slow speed of the wagons and the 1 in 100 ascending gradient beyond the 608.930 km, it was unlikely they would have reached Koheroa Road level crossing or encroached into the major infrastructure work area beyond.

2.17 From subsequent tests and field simulations, it was likely that the TXO closed the brake cock at about the same time as the locomotive engineer released the brakes on stopping the propelling movement from the Down main line and before the ease-up movement began. It was unlikely that the TXO operated the brake cock again. Having turned the handbrake wheel about 4 revolutions before it locked up, the TXO probably thought that the handbrake had been applied. If he had been more familiar with the old wheel-type handbrake, he probably would have applied more force and turned the wheel for the required number of revolutions until he was satisfied that the brakes had applied.

2.18 Nevertheless, it was clear the EWR wagons were left without any applied braking force and although the wagons had only travelled a short distance from the loop to the Down main line, the roller bearings must have been warm enough to allow the wagons to run away easily. Even allowing for the almost level gradients at Mercer, and given the non-effectiveness of the brakes on 2 of the 6 EWR wagons, it was critical that some braking force be applied.

2.19 Toll Rail's rules for the running of unbraked vehicles stated that vehicles that were unbraked must be distributed throughout a train. The rule wording suggested that it was not intended for the 2 unbraked wagons on Train 227 from Westfield to be separated by only one other wagon. However, the number and positioning of the unbraked wagons during the shunting movements at Mercer did not contribute to the incident. In view of Toll Rail's intention to review its separation requirements for wagons travelling with brakes cut out on a train, no safety recommendation covering this issue has been made.

3 Findings

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

3.1 The unattended wagons ran away on the Down main line at Mercer because they were left with insufficient braking restraint.

3.2 The initiator of the runaway could not be determined, but it was enough to cause the wagons to roll on gradients that would have provided minimal assistance.

3.3 The ease-up movement was stopped with the locomotive's independent brake rather than the train brake, resulting in full brake pipe pressure being retained in the EWR wagons, which kept the brake released.

3.4 Had a 75 kPa reduction been made and maintained in the train brake pipe, the brake application should have been adequate to hold the unattended EWR wagons, even though 2 of them had inoperative air brakes and a third had an air leak.

3.5 Practical training had not been provided to reinforce the theory training the TXO had received on the old wheel-type handbrake.

3.6 Without an intuitive understanding, and because this was the first time he had encountered the handbrake on the EWR wagons, he was unsure about the operation of the old wheel-type handbrake.

3.7 There were no instructions at the old wheel type handbrake position on the EWR wagons to show on and off positions.

3.8 The TXO was not certified to shunt at Mercer.

3.9 The TXO had not received the increased frequency of safety observations and theory assessments scheduled for newly appointed rail personnel.

3.10 The local manager for rail operations was not aware that the TXO had still to complete his formative training programme.

3.11 When the TXO had queried the local manager about his certification, the local manager should have checked to see if he was certified and could have avoided influencing the TXO to perform the shunt.

3.12 Even though the TXO experienced the handbrake locking up on EWR 115, there were no defects that would have prevented any of the handbrakes being applied with the required number of revolutions on all 6 EWR wagons.

3.13 To achieve proper braking, communication and sequencing of actions between the locomotive engineer and the ground-based person were critical.

4 Safety Actions

4.1 On 11 May 2006, Toll Rail advised in part that:

Toll Rail initiated a review of procedures associated with securing wagons detached from trains or shunting movements following a subsequent incident at Mercer after which it was possible to fully investigate what took place with the co-operation of the operating personnel involved. The first part of this review identified a number of procedural changes that are about to be introduced. Specifically, these changes include:

- Where two persons are involved, verbal interaction between the person controlling the locomotive and the person detaching the wagon/s as each step is completed.
- A specific sequence for application of the handbrake relative to the air brake to maximise brake block pressure.
- Code instructions will be changed to define procedures on a step-by-step basis.

It is important to note that both the existing and revised procedures will only be effective if fully complied with, particularly the primary defence requiring the application of handbrakes.

The second part of the above review is examining the compilation of a matrix defining the number of wagon and locomotive brakes to be applied relative to gradients. This part of the review has been initiated by Toll Rail Engineering, but some further analysis is needed to reach a conclusion.

4.2 On 27 June 2006, ONTRACK advised in part that:

ONTRACK intends, in principle, to have decals applied to its wagons fitted with old-style wheel hand brakes showing the direction to turn the wheel.

The decal will probably only show the direction to turn the wheel to apply the brake.

ONTRACK intends talking to our maintenance provider re fitting to the wagons.

4.3 On 29 June 2006, Toll Rail advised in part that:

As a result of Toll Rail's internal investigation the On Job Training prescription/sign off form for Rail Operators based at Mission Bush was changed to ensure it included key operational elements at all intermediate stations encountered by staff from that location. The Safety Observation process caters for ongoing competency either by actual or on site observations or questions about local conditions at specific sites.

4.4 On 12 September 2006, Toll Rail advised in part that:

A review will examine variable conditions that may occur as a result of the positioning of unbraked vehicles in a train consist.

This will be prioritised within the Engineering Technical Committee projects. It is anticipated an outcome will be known in 6 months.

4.5 On 4 October 2006, Toll Rail advised in part that:

> The safety observations supported the local assessors' review of the TXO's competency. The assessor signed off the candidate as fully competent to operate on 22 April 2005 but this was not formally closed out by the Toll Rail manager who was required to obtain a final certification from the training and development manager at Toll NZ's Woburn training centre.
>
> This was an administrative omission as the certificate from the Toll Rail manager, based on the assessor's assessment of competency, would have resulted in the formal certification being issued.
>
> Apart from the 22 April 2005 assessments, the Train Examiner Operations did not undertake ay further Safety Observations or Theory Assessments after the completion of formative training on 11 February 2005.
>
> These omissions were detected during Toll Rail's internal investigation into this incident and referred to the relevant managers for remedial action.

Approved on 5 March 2007 for publication

Hon W P Jeffries
Chief Commissioner

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