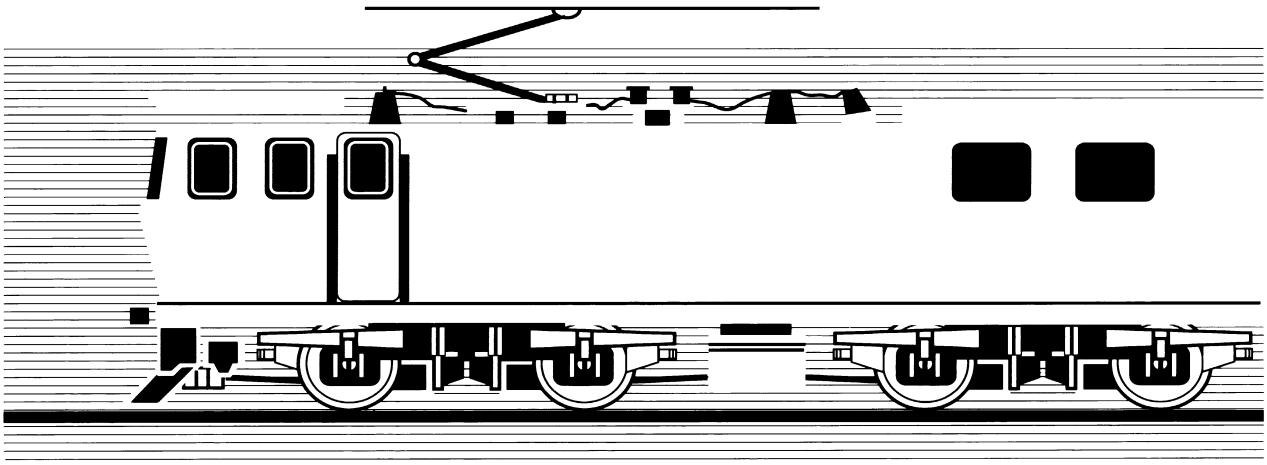
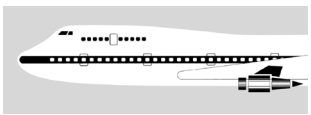
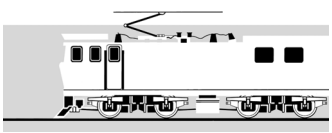


RAILWAY OCCURRENCE REPORT

02-121 express freight Train F 8829, derailment, Waikokopu 29 September 2002


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 02-121

express freight Train F 8829

derailment

Waikokopu

29 September 2002

Abstract

On Sunday 29 September 2002 at about 1240, express freight Train F 8829 derailed near Waikokopu, between Wairoa and Gisborne when eight wagons loaded with fertiliser dropped between the running rails while negotiating a tight radius curve.

There were no injuries.

The safety issues identified included:

- the ability of the inspection regime to monitor a known track defect and take timely corrective action
- the absence of standards to define life-expired track assets
- the over-loading of wagons conveying fertiliser on the Napier-Gisborne track section.

Three safety recommendations have been made to the Managing Director of Tranz Rail to address these issues.

Contents

Figures

Abbreviations

EM80	Track Evaluation Machine
hr	hour(s)
km	kilometre(s)
km/h	kilometres per hour
lb/yard	pounds per yard
LE1	locomotive engineer 1
LE2	locomotive engineer 2
m	metre(s)
PNGL	Palmerston North-Gisborne Line
POD	point of derailment
t	tonne(s)
TPR	treated pinus radiata
Transfield	Transfield Infrastructure Services Limited
Tranz Rail	Tranz Rail Limited
UTC	co-ordinated universal time

Data Summary

Train type and number:	express freight Train F 8829
Date and time:	29 September 2002 at about 1240[1]
Location:	Waikokopu
Persons on board:	crew: 2
Injuries:	nil
Damage:	significant track and wagon damage
Operator:	Tranz Rail Limited (Tranz Rail)
Investigator-in-charge:	P G Miskell

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

1 Factual Information

1.1 Narrative

1.1.1 On Sunday 29 September 2002, Train F 8829 was a special Napier to Gisborne express freight service consisting of locomotive DX5068 hauling 10 CF wagons loaded with fertiliser. The train weight was 583 t with a length of 161 m.

1.1.2 The train was crewed by a locomotive engineer (LE1) assisted by a second locomotive engineer (LE2). LE1 drove the train from Napier to Wairoa where, after a brief stop, LE2 took over and drove the train north from Wairoa.

1.1.3 LE2 was driving the train in Notch 1, descending a 1 in 50 gradient when he released the brake as he negotiated a 160 m radius, right-hand curve at about 35 km/h. The train speed did not increase as he expected, so the locomotive engineer looked towards the rear of the train and saw that a number of wagons had derailed. He immediately applied the brakes and stopped the train.

1.1.4 The wagon immediately behind the locomotive remained on the track but 8 of the next 9 wagons had derailed.

1.2 Site information

1.2.1 The Palmerston North-Gisborne Line (PNGL) was 392 km long. A large portion of the 212 km section from Napier to Gisborne ran through remote and isolated country. Because of the geography and number of long tunnels on this section, radio coverage on the route was not continuous and so did not meet Alternative Train Crewing standards for single-person running. Therefore, under Tranz Rail's crewing standard, trains operating in the area required a two-person crew.

1.2.2 The Napier-Gisborne section was a low-density freight-only line with one scheduled return service per week. Unit fertiliser trains operated as special services on an as required basis.

1.2.3 The point of derailment (POD) was recorded as 332.777 km on the PNGL. The train stopped about 300 m past the POD with the locomotive and 5 wagons on the north side of Bridge 260, 4 wagons on the bridge, and the rear wagon on the approach to the bridge (see Figure 1). Bridge 260 was a rail bridge over Nuhaka-Oputama Road.

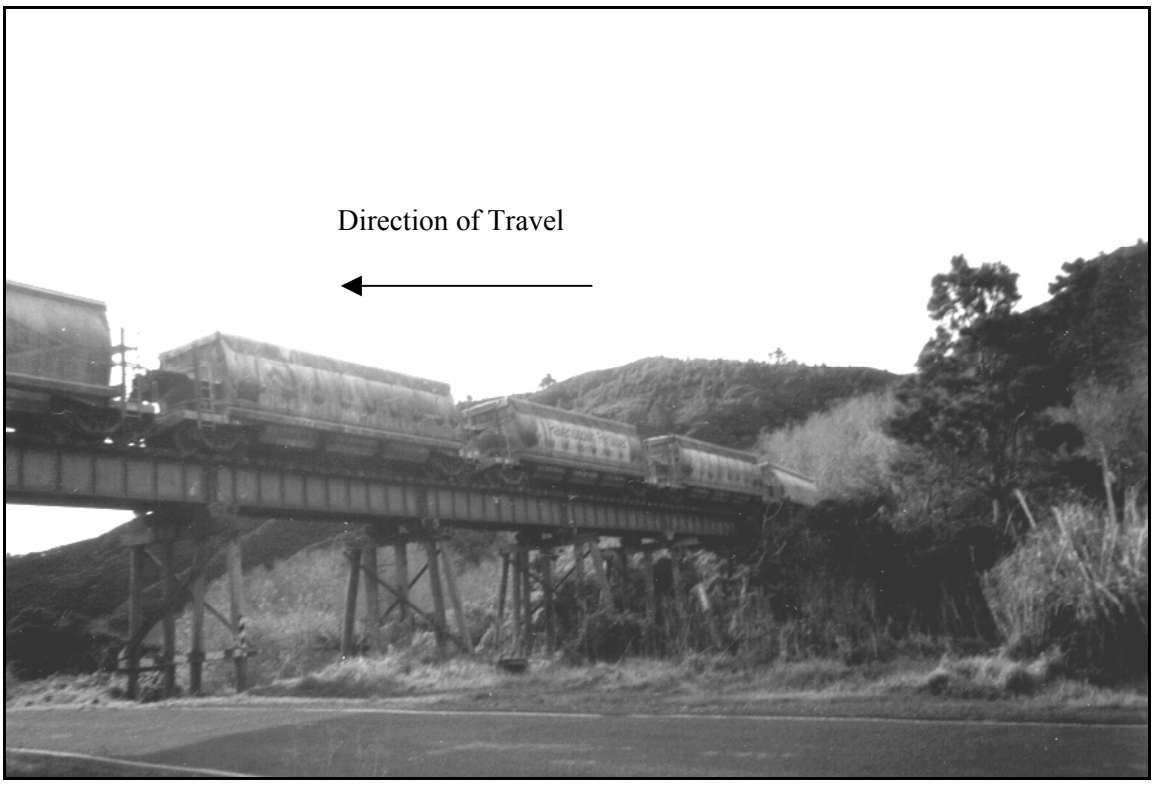


Figure 1
Derailed wagons on Bridge 260 PNGL

1.2.4 Details of the derailment was as follows:

- DX 5068 all wheels on the running rail
- CF 125 all wheels on the running rail
- CF 926 leading axle of leading and trailing bogie derailed
- CF 1015 leading axle of leading bogie derailed
- CF 978 leading axle of leading bogie derailed
- CF 955 leading axle of leading bogie derailed
- CF 713 all wheels on the running rail
- CF 1332 all wheels derailed
- CF 1021 all wheels derailed
- CF 1067 leading axle and all wheels of the trailing bogie derailed
- CF 1171 all wheels derailed.

1.2.5 The track between the POD and the bridge was destroyed (see Figure 2). However, all wagons remained on their wheels after the derailment.

1.2.6 The track on the 160 m radius curve approaching the bridge consisted of medium weight (75 lb/yard) rail on timber sleepers of mixed age and type.

1.2.7 In 1970 the derailment curve was fully resleepered with hardwood sleepers. In 1988 every fourth sleeper on the curve was replaced with a secondhand treated pinus radiata (TPR) sleeper. In 1996 the hardwood sleepers adjacent to the TPR sleepers were replaced with secondhand TPR sleepers leaving one hardwood sleeper every fourth sleeper. The remaining hardwood sleepers and a significant proportion of the TPR sleepers on the derailment curve had been

bored out when repositioning the N Type[2] fastening and had up to 6 pairs of holes at the high leg[3] end of the sleeper.

1.2.8 Because the derailment curve was less than 200 m radius there were 2 screw spikes through on the field side[4] of the high leg rail bedplate.

1.2.9 The rail on the curve was manufactured in 1957 to American Society of Civil Engineers standard and laid in 33 m lengths. There was minimal side wear on the high leg rail.

1.2.10 Inspection of the derailment site showed that:

- the POD was at 332.777 km in the body of a 160 m radius right-hand curve
- the POD was 2 m past a rail joint
- the static gauge at the POD was recorded as 1092 mm but there was evidence on the sleeper that the high leg rail fastening had been displaced laterally a further 30 mm
- the hardwood sleeper immediately after the POD was cross-bored 6 times and the bedplate was overhanging the sleeper edge by 40 mm (see Figure 3)
- sleepers immediately before the POD were skewed
- the first derailed wagon dropped between the rails
- about 12 sleepers on the bridge and the guardrail[5] on the first 2 bridge spans were damaged beyond repair
- the ballast shoulder profile on the high leg of the curve was less than standard. (see Figure 4)
- the curve was posted with the appropriate 40 km/h curve speed boards.

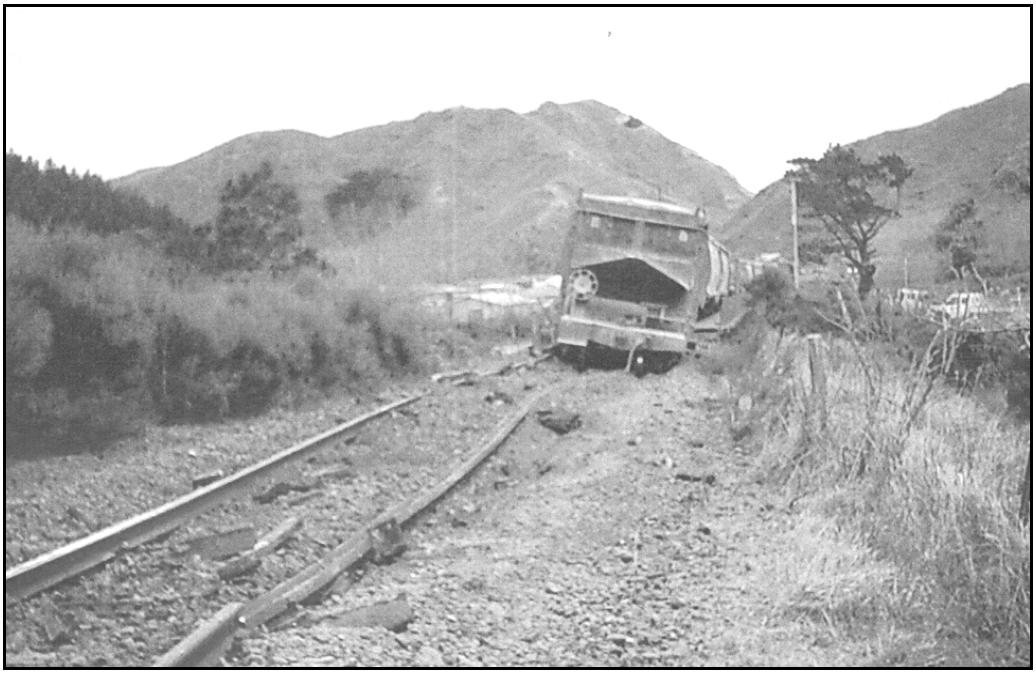


Figure 2
Damaged track past the POD

[2] The N type fastening consists of a canted bedplate under the rail secured by a minimum of 2 screw spikes with associated spring washer and rail clip.
[3] The high leg rail is the outside rail on a curve.
[4] The field side is the outside of the rail not in contact with the wheel flange.
[5] Guardrails are positioned parallel to and 230 mm from the gauge face of running rails over the entire length of bridges.

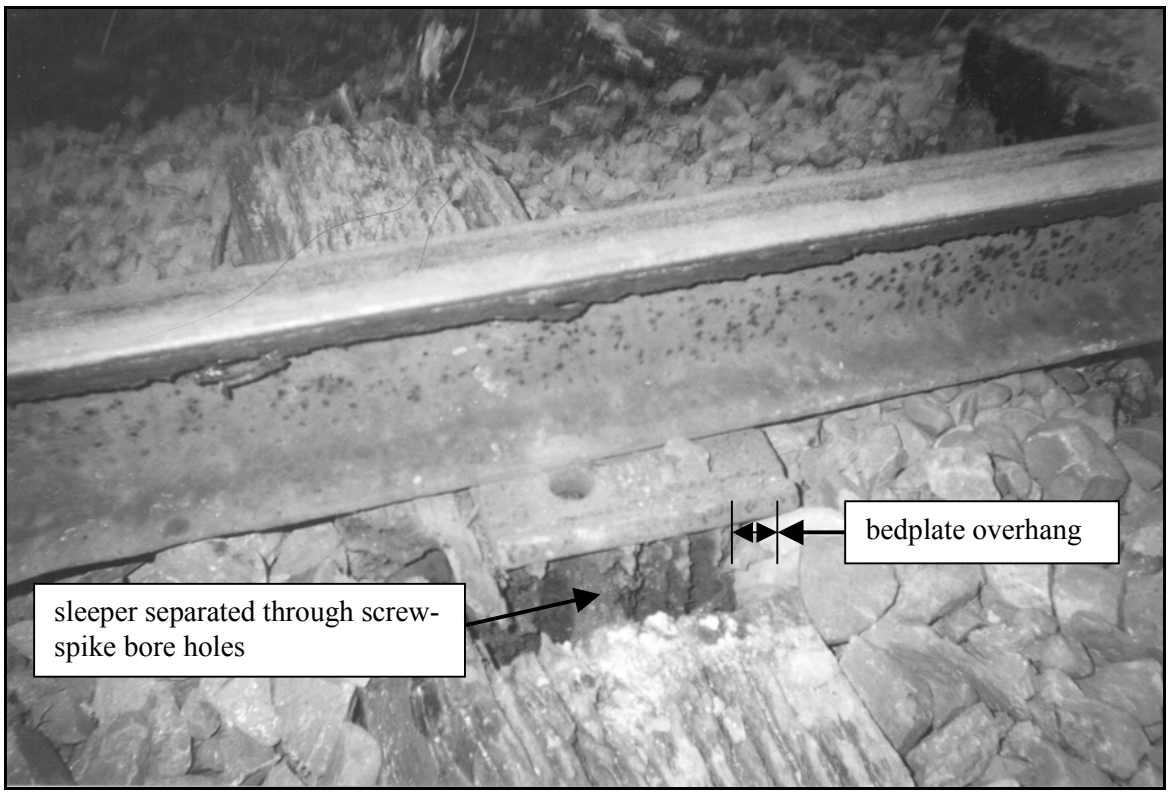


Figure 3
First sleeper past the POD

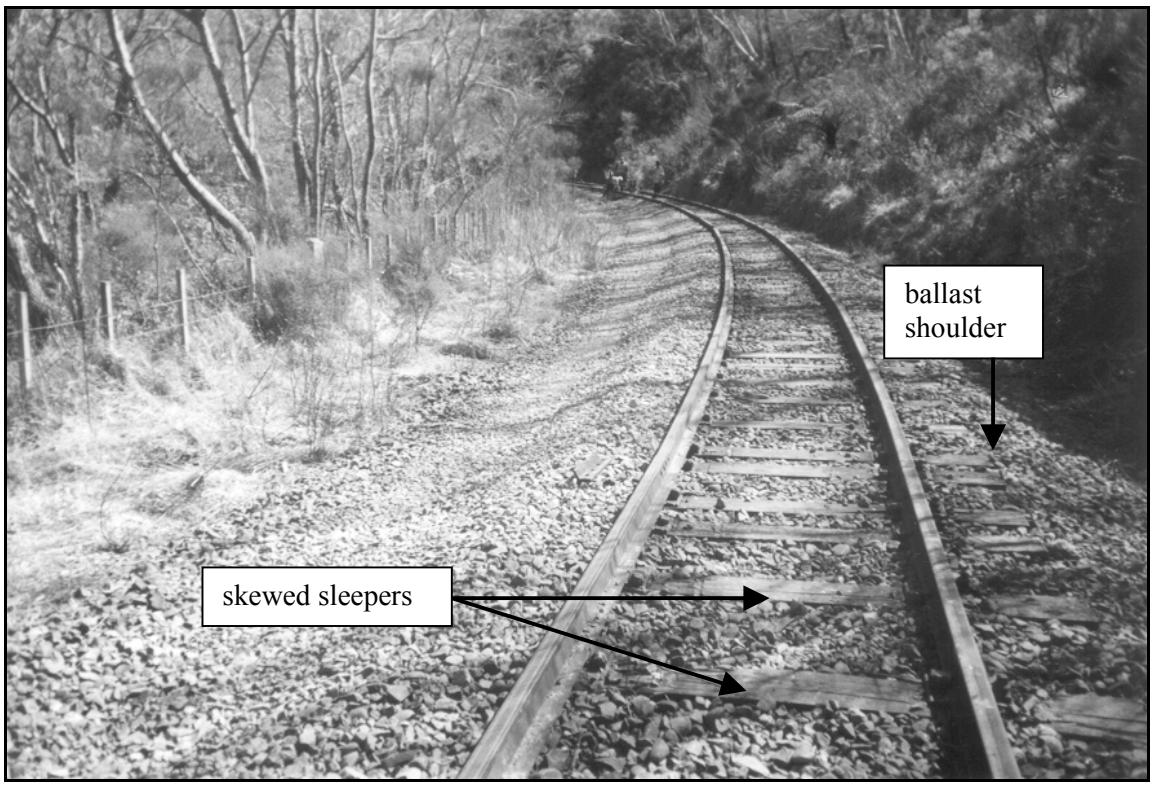


Figure 4
Ballast section on the derailment curve approaching the POD

1.3 Track standards for gauge

1.3.1 The standard gauge for straight track as defined in T200 Infrastructure Engineering Handbook was 1068 mm. For curves of radii less than 250 m the gauge standard increased by 6 mm to 1074 mm.

1.3.2 The national rail network was classified into 4 distinct speed categories with each speed category having differing maintenance tolerance levels for track gauge.

1.3.3 The track between Napier and Gisborne was classified as a speed category 2 line and as such had the following gauge tolerances (in mm):

- Priority 1 1093
- Priority 2 1089
- Priority 3 1088.

1.3.4 When track gauge exceeded the tolerance limits the following action was required:

- Priority 1 consider the need for a temporary speed restriction and fix within 30 days
- Priority 2 programme for maintenance
- Priority 3 note and review for action.

Irrespective of the action required, if any Inspector, Ganger, Manager or other track staff observe track conditions at or above Priority 1 tolerance then appropriate action is to be taken depending on the track conditions. Options are as follows:

- Record the non compliance
- Place the affected track section under speed restriction
- Pilot trains over the affected track until the track is repaired
- Stop all train movements over the affected track until the track is repaired.

1.4 Track inspections

1.4.1 The track was inspected and maintained by a service provider, Transfield Infrastructure Services Ltd (Transfield), to standards and inspection frequency determined by Tranz Rail.

1.4.2 A track inspector made a weekly inspection of the track on the PNGL and a contract manager was responsible for an annual engineering inspection.

1.4.3 The purpose of a track inspection was to ensure that the track and structures were safe for the passage of trains at authorised speeds until the next scheduled inspection. A track inspector was responsible for the mainline track on PNGL north of Woodville and from Masterton to Woodville on the Wairarapa Line, a total length of about 450 km.

1.4.4 The findings of the track inspection had to be reported on completion of each inspection run. The report detailed all defects, track geometry faults, and any items outside code limits or requiring attention to prevent further deterioration that had not been repaired by the track inspector.

1.4.5 The annual engineering inspection was primarily focused on the condition of track assets such as sleepers, rail wear, track formation, turnouts, level crossings, bridges and culverts. The

findings from the engineering inspection were entered into the track database and used to prepare the national annual, 5-year, and 10-year track renewal plans.

1.4.6 During the week ending 15 June 2002 the track inspector identified wide gauge on the derailment curve at 332.750 km and 332.770 km PNGL. A track gauge reading of 1100 mm was recorded some 7 m prior to the POD. The track inspector immediately contacted the local track gang, who realigned the high-leg rail to bring the track gauge within tolerance limits before the passage of the next scheduled train. The wide gauge was not included on the essential feature list[6] for the gang.

1.4.7 The last engineering inspection over the section of track prior to the derailment was carried out by the area co-ordinator during the week ending 12 April 2002 and the findings were recorded on the track log. These included a recommendation to replace the remaining hardwood sleepers and bored out TPR sleepers. The area co-ordinator recalled making a similar recommendation 4 years previously.

1.4.8 An infrastructure quarterly compliance report prepared by Transfield for the period ending September 2002 and addressed to Tranz Rail had not identified any exceptions or other issues of concern on the derailment curve.

Track Evaluation Machine (EM80)

1.4.9 Track and engineering inspections were supplemented by a track evaluation (EM80) run that measured track geometry such as gauge, cant and line and compared the actual readings against pre-determined priority 1, 2, and 3 tolerance limits. An exception report was printed with details of the location, type, and priority of the particular exceedance. The EM80 was a 2-axle diesel-powered recording unit driven by a locomotive engineer that generally travelled at line speed when recording on the Napier-Gisborne track section.

1.4.10 When measuring gauge the EM80 applied one tonne side pressure to simulate dynamic train forces.

1.4.11 Transfield's area co-ordinator was required to certify, within 30 days of the EM 80 run, that all Priority 1 exceedances had been corrected and list the exceptions and appropriate speed restrictions placed if considered necessary.

1.4.12 The Napier-Gisborne track section was classified as a Class C freight line and as such required at least an annual EM80 inspection but generally the line was recorded twice a year.

1.4.13 The last EM80 recorded the track geometry from Napier to Gisborne on 18 June 2002 and identified the track misalignment (Line) near the POD as outside Priority 1 tolerance limits.

1.4.14 The area co-ordinator visited the derailment curve on 16 July 2002 and certified that remedial action had been taken to bring the curve alignment back within tolerance limits.

1.5 Sleepers

1.5.1 Sleepers provided a connection between the rails, held them to correct gauge and transferred the rail load to the ballast and roadbed.

1.5.2 Second class timber sleepers were deemed suitable for laying in secondary lines such as the Napier - Gisborne track section providing the sleepers were generally sound with not more than 2 borings and bedplate cutting of not more than 20 mm. Some splitting was acceptable providing it was not excessive in the rail-seat area or extended through the full depth of the sleeper.

[6] The list is a record of any feature on a gang length that is to be specifically checked during every inspection of the length.

1.6 Approved track renewal plan

1.6.1 For the year ending June 2003, there were 12 approved sites on the PNGL track renewal plan. However, only one site was north of Napier and that was the replacement of both sleepers and rail at a Gisborne level crossing. All other recommended sites north of Napier had not met the justification for inclusion in the track renewal plan.

1.7 Train event recorder

1.7.1 The locomotive event recorder data confirmed DX5068 was in Notch 1 and travelling at 38 km/h at the time of the derailment. The maximum permitted speed on the derailment curve was 40 km/h.

1.8 Wagon loading

1.8.1 CF wagons were bogie wagons designed for a maximum gross load of 18 tonnes per axle, or 57 net tonnes per wagon. Wagon axle loading on express freight trains operating on the Napier - Gisborne track section was restricted to a maximum of 14.3 t. The restriction limited the permitted carrying capacity of CF wagons to about 42 net tonnes.

1.8.2 The CF wagons were loaded by the consignee using a programmable conveyor system to ensure weight restrictions were not exceeded. However, the conveyor was set up to load 44 t of fertiliser per wagon, giving a gross weight of 59.7 t or 14.9 t per axle. Although the site had a certified weighbridge to record wagon weight, no record was available for the time of the incident.

1.9 Personnel

Locomotive engineer 1 (LE1)

1.9.1 LE1 was locomotive engineer team leader in Napier. He was a first grade locomotive engineer with 27 years driving experience and held a current operating certificate. He worked 10 days in the fortnight up to the day before the derailment for a total of 95 hours 20 minutes. LE1 had 12 hours 50 minutes off duty before starting work at 0840 on the day of the derailment.

Locomotive engineer 2 (LE2)

1.9.2 LE2 was driving the train at the time it derailed. He had been driving trains on the PNGL since 1980 and gained his first grade certification in 1990. He worked the same shift as LE1 the day before the derailment.

Track inspector

1.9.3 The track inspector had been involved with track maintenance, renewals and inspection on the PNGL since 1966. He was appointed in December 1999 when the current track inspection regime was introduced. However, he had carried out the duties of a track inspector for more than a year prior to his appointment while the new role was trialled and evaluated.

Track ganger

1.9.4 The track ganger responsible for the day-to-day track maintenance between Raupanga and Gisborne had worked on the PNGL since 1974 and was appointed to a ganger position about 10 years later.

Area co-ordinator

1.9.5 The area co-ordinator was an experienced track manager. He was first appointed to a track manager position with similar responsibilities at another location in 1983 and returned to Napier

as track manager in 1986. He was responsible for track, structures and signals maintenance and renewals between Masterton and Woodville on the Wairarapa Line and the PNGL north of Woodville.

Track maintenance staff

1.9.6 Infrastructure maintenance was contracted out to Transfield from 23 March 2002. Although Transfield retained a significant number of Tranz Rail's staff, some adjustments had been made to gang locations and strength.

1.9.7 Prior to 23 March 2002 the Wairoa gang of 2 staff was responsible for the track section between Eskdale and Wairoa, a total of 96 km of track. A Gisborne gang of 2 was responsible for the track section between Wairoa and Gisborne, a total of 98 km of track.

1.9.8 The Gisborne track gang was abolished effective from 23 March 2002 and the revised boundaries for the Wairoa gang were from Raupunga to Gisborne, a total of 130 km of track. The Wairoa gang strength was not changed.

2 Analysis

2.1 The derailment

2.1.1 The position of the derailed vehicles, markings on the sleepers and sleeper condition indicated the leading axle on the leading bogie of wagon CF 926 derailed due to gauge spread. The N type bedplate assembly at the POD provided insufficient lateral restraint, and the resulting movement of the high-leg rail permitted the wheels to drop between the rails.

2.1.2 The wheel flange of the derailed vehicle then applied sufficient force to roll the high-leg rail out of the bedplates, which allowed the following wagons to also drop between the rails.

2.2 Wagon loading

2.2.1 The 14.3 t maximum axle load restriction was equivalent to restricting each wagon to a payload of 74% of the available capacity in each CF wagon. Although the consignee had control measures to limit the wagon loading for CF wagons conveyed on the Napier-Gisborne track section, the load limit exceeded the maximum allowable axle weight. With no records of actual weight at the time of the incident it was not possible to confirm the axle loading on each wagon.

2.2.2 With the conveyor system programmed to deliver 44 t of fertiliser to each wagon, the axle weight limit had been exceeded regularly over a period of time, which probably accelerated the deterioration of the track condition on the Napier-Gisborne track section.

2.3 Inspection

2.3.1 The track inspector was required to inspect a total of about 450 km of mainline track on a weekly basis. Allowing for crossing train services, road travel and writing up his findings, the track inspector was left with about 25 hours of available inspection time. To complete the regular mainline inspection he was required to achieve an average speed of almost 20 km/h as well as carry out minor maintenance on the way. Had the track inspector been responsible for a reduced length of track he would have been able to carry out a more detailed inspection rather than a superficial patrol. A safety recommendation has been made to the Managing Director of Tranz Rail to address this issue.

2.3.2 Mainline track should be surfaced to the top of the sleeper and the Napier-Gisborne section of the PNGL was standard in this respect. As a result the tops of the sleepers and rail fastenings

were clearly visible on the derailment curve and identification of poor material condition should have been possible.

2.3.3 Although Tranz Rail had standards for the suitability of sleepers to be laid in tracks, there were no corresponding guidelines or standards to determine when sleepers were no longer suitable for continued service. A safety recommendation has been made to the Managing Director of Tranz Rail to address this issue.

2.3.4 The traditional method of maintaining gauge standards was based on regular (weekly) inspections involving static gauge measurements and comparing the reading with the upper tolerance limit of 1092 mm. These inspections were supported by the EM80 inspection and an annual engineering inspection. The EM80 has the advantage over the static measurement by applying dynamic loading to the rail, which put the fastenings under similar forces to those applied by train loadings. The resulting gauge recorded by the EM80 can be greater than the static reading depending on the performance of the rail fastening.

2.3.5 On June 15 2002, gauge beyond the upper limit was identified on the derailment curve during a routine inspection and corrective action was taken. The EM80 run some 4 days later confirmed re-gauging had brought the gauge on the curve to within acceptable limits.

2.3.6 Despite the excessive number of 5 and 6 borings in the sleepers near the POD and obvious signs of bedplate movement, the curve was not placed on the essential features list. Had the curve been identified on such a list, the gauge would have been specifically monitored on a weekly basis, creating the opportunity to take further corrective action if required.

2.3.7 Had a temporary speed restriction been posted on the derailment curve for trains travelling from Napier to Gisborne (direction of loaded fertiliser wagons and down the gradient), significantly reduced lateral forces would have resulted on the high-leg rail fastening. In general terms dynamic forces increase in proportion to the square of the speed, so imposing a 50% reduction in posted curve speed would have reduced the lateral forces applied to the fastenings by 75% and significantly reduced the potential for gauge spread.

2.3.8 Declining tonnages on the line had brought uncertainty about its long-term viability. So Tranz Rail was reluctant to commit resources to it, leaving an aging track asset that was maintained by a reduced number of maintenance personnel. While the efforts of the track staff to maintain the track at minimum cost was recognised, had the recommendation to spot resleeper the derailment curve been accepted and included in the national track capital improvement plan it was likely that the derailment would have been avoided.

3 Findings

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

3.1 Train F 8829 derailed when the track gauge spread allowing the wheels of loaded fertiliser wagons to drop between the rails.

3.2 Fertiliser loadings in CF wagons had exceeded maximum limits over a period of time and probably contributed to the deterioration of the track.

3.3 The locomotive engineer had the train under control when negotiating the curve and did not contribute to the derailment.

3.4 The track had been inspected to the regulated frequency, but the length of track for which the track inspector was responsible resulted in a less detailed inspection than was desirable.

3.5 The wide gauge on the derailment curve was identified and short-term corrective action taken some 3 months prior to the derailment.

3.6 Had the area co-ordinator's recommendation to renew sleepers in the derailment curve been actioned, the resultant improvement in track condition would probably have averted the derailment.

3.7 Deteriorating sleeper condition had not been specifically monitored and wide gauge resulted.

4 Safety Actions

4.1 On 16 September 2003 Tranz Rail advised that the net weight of fertiliser conveyed in each CF wagon on the Napier-Gisborne track section had been reduced from 44 t to 40 t. This is equivalent to 14.2 t per axle. In view of this action no safety recommendation has been made regarding this issue.

5 Safety Recommendations

Safety recommendations are listed in order of development and not in order of priority.

5.1 On 1 October 2003, the Commission recommended to the Managing Director of Tranz Rail that he:

develop guidelines for the track inspectors to determine when timber sleepers are no longer suitable for continued service (036/03).

5.2 On 17 October 2003, the Managing Director of Tranz Rail responded in part:

> **036/03** Tranz Rail accepts this recommendation.
>
> Tranz Rail document CSP61 "Classification and Use of Second Hand Track Materials" contains guidelines for determining the suitability of timber sleepers for reuse.
> These same guidelines can be applied to sleepers in track. To further support these guidelines a photographic Asset condition Assessment Guide is being developed for sleepers and other assets.

5.3 On 1 October 2003, the Commission recommended to the Managing Director of Tranz Rail that he:

ensure that the lengths of track for which track inspectors are responsible, are such that appropriate inspections can reasonably be made in the time available (037/03).

5.4 On 17 October 2003, the Managing Director of Tranz Rail responded in part:

> **037/03** Tranz Rail accepts this recommendation.
>
> A review of Track Inspectors areas will be carried out to ensure that workloads have been consistently and reasonably allocated.

5.5 On 1 October 2003, the Commission recommended to the Managing director of Tranz Rail that he:

critically evaluate the track maintenance regime for the entire rail network to ensure that track standards are maintained appropriate for the line classification and speed category, and where sections of track are identified as being at risk, put in place appropriate defences until corrective action has been taken (038/03).

5.6 On 17 October 2003, the Managing Director of Tranz Rail responded in part:

> **038/03** Tranz Rail accepts this recommendation.
>
> Compliance with the documented track maintenance regime is routinely measured and evaluated by the existing systems for management review and maintenance contract performance auditing. These systems are designed to identify compliance, process and quality issues and ensure they are addressed.

Approved for publication 24 September 2003

Hon W P Jeffries
Chief Commissioner

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