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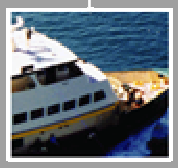


RAIL SAFETY INVESTIGATION REPORT

DERAILMENT OF FREIGHT AUSTRALIA LIMITED CEMENT SERVICE 4VM9

BETHUNGRA

22 DECEMBER 2004

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BETHUNGRA

22 DECEMBER 2004

OTSI File Ref: 03262

Date: 28 April 2006

Office of Transport Safety Investigations
Level 21, 201 Elizabeth Street
Sydney NSW 2000

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Established on 1 January 2004 by the *Transport Administration Act 1988*, the Office is responsible for determining the causes and contributing factors of accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence.

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The Office of Transport Safety Investigations also provides a Confidential Safety Information Reporting facility for rail, bus and ferry industry employees. The CSIRS reporting telephone number is 1800 180 828.

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EXECUTIVE SUMMARY

The Accident

At approximately 8:05pm (ESDT)[1] on 22 December 2004, freight service 4VM9, operated by Freight Australia Limited (FAL)[2], derailed whilst descending the grade at Bethungra, on the main South line (part of the Defined Interstate Rail Network (DIRN])) between Cootamundra and Junee in the Southern Region of NSW. 4VM9 consisted of four locomotives and 11 loaded bulk cement wagons and was enroute from Berrima to Melbourne. All 11 wagons from the train and 288 metres of track were severely damaged as a result of the incident. There were no reported injuries.

Findings

In relation to those matters prescribed by the Terms of Reference as the principal lines of inquiry, OTSI finds as follows:

a. Causation:

i. 4VM9 derailed when it traversed an area of misaligned and unstable track.

ii. The derailment occurred where the rail had been stressed for a considerable period of time and that track resurfacing work 16 days prior to the derailment would have exacerbated this stress.

iii. The initiation of emergency braking, at a speed 6km/h in excess of the posted speed limit, when the misalignment first became apparent, would have imparted additional stress to the track. However, the magnitude of this stress would not have been significant had the track been stable and properly aligned.

b. Anticipation and Management of Risk:

i. Two of the primary defences designed to prevent such occurrences, track inspections and track maintenance, failed over time. A third defence of managing an area with known deficiencies through the imposition of speed limits, was not employed.

ii. There were clear indications available to the NSW Rail Infrastructure Corporation (RIC), and subsequently the Australian Rail Track Corporation (ARTC), to suggest track instability in the area where the derailment occurred, but that these indicators were either unnoticed or not acted upon.

1 Times quoted in this report are Australian Eastern Summer Daylight Time.
2 Freight Australia Limited is owned by Pacific National Limited.

iii. Track inspection records for the previous 12 months, compiled by RIC and ARTC, implied that there were few problems within the section in which the derailment occurred. However, inspections of a relatively small area within the section by the Office of Transport Safety Investigations (OTSI), revealed that there were significant defects and that these were not a recent phenomena, suggesting that both RIC's and ARTC's inspections had been less than thorough.

iv. The transition of assets, records and systems from RIC to ARTC was problematic and that ARTC did not enjoy good visibility of the condition of the asset at the time of handover of responsibility, or indeed at the time of the derailment.

v. As at 22 February 2006, readily identifiable defects continued to exist in the area in which this derailment occurred.

c. Effectiveness of the Emergency Response:

i. The actions of 4VM9's crew after the derailment were both timely and effective.

ii. Junee Control did not observe the requirement, in ARTC Network Rules (ANTR 400), to send an emergency broadcast message about the incident to alert other train drivers in their area of control.

iii. The standard of communications employed by Junee Control did not conform to the requirements stipulated in Network Rule ANGE 204 and Network Procedure ANTR 721.

d. Other Matters that would Enhance the Safety of Rail Operations:

i. 4VM9's data-loggers were not fully functional on the day of the accident. This is a further example of an observation OTSI has made that rail operators in NSW are paying insufficient attention to the requirement to ensure data loggers/event recorders on board their locomotives are properly fitted and are regularly inspected, serviced and calibrated.

ii. The Independent Transport Safety and Reliability Regulator (ITSRR) does not have sufficient visibility of the condition of the track and related infrastructure in NSW and that, whilst it can and does undertake a range of actions to gain such visibility, the onus for providing ITSRR with such visibility should largely rest with those responsible for its operation, i.e., ARTC, RailCorp and CountryRIC.

iii. The phased transition of responsibility from RIC to ARTC continues and the attendant risks are of a magnitude which suggests that milestones and changes to plans, systems, policies and procedures should be subject to close oversight by ITSRR.

Recommendations

In order to prevent a recurrence of this type of accident, the following remedial safety actions are recommended for implementation by the organisations specified below:

a. Australian Rail Track Corporation:

i. Provide an assurance to ITSRR that all track related defects in the area of the derailment have been fully repaired.

ii. Review the competencies and training of those responsible for the conduct of track inspections and track maintenance to ensure that:

(1) track inspections are conducted in the scheduled timeframes and track maintenance is conducted in the prescribed manner, and

(2) staff can accurately recognise and interpret track related deficiencies and defects.

iii. Review the competencies and training of those responsible for the interpretation of data obtained from track inspections and the WTSA (Welded Track Stability Analysis) process to ensure that risk can be appropriately identified, categorised and managed.

iv. Audit inspection and maintenance programs to ensure that they are timely and comprehensive, and are performed to specified standards.

v. Improve formal communication procedures at Junee Control, and elsewhere as required.

vi. Reinforce the requirements of Network Rule ANTR 400 to ensure emergency broadcast messages are made immediately after incidents are reported, where appropriate.

b. Pacific National Limited:

i. Ensure that event recorders are properly fitted to its locomotives and that they are regularly inspected, maintained and calibrated.

c. Independent Transport Safety and Reliability Regulator:

i. Require infrastructure operators to provide it with an annual report identifying the condition of track and signalling related assets they operate on behalf of the Government of NSW.

ii. Require ARTC to provide an annual report identifying the status of the various programs by which it will assume full responsibility for the operation and maintenance of assets transferred from RIC.

iii. Monitor ARTC's track management systems and maintenance plans to ensure compliance with the related standards and accreditation requirements.

iv. Reinforce the requirement for rolling stock operators in NSW to have properly fitted and regularly inspected, serviced and calibrated event recorders in their locomotives.

PART 1 INTRODUCTION

Notification and Response

1.1 At 9:05pm on Wednesday 22 December 2004, both ARTC and Pacific National notified the Office of Transport Safety Investigations (OTSI) Duty Officer that FAL freight service 4VM9 had derailed at Bethungra at approximately 8:05pm.

1.2 As the incident occurred on the Defined Interstate Rail Network (DIRN), OTSI notified the Australian Transport Safety Bureau[3] (ATSB) of the incident, in accordance with established protocols. However, due to workload constraints at the time, ATSB sought OTSI's assistance to investigate the incident under s67 of the *NSW Rail Safety Act 2002.*

1.3 Based on the information provided by the reporters and ATSB's request, the Chief Investigator directed the deployment of OTSI Investigators to the incident site. The Investigators deployed by motor vehicle and arrived at the incident site at 11:30am on 23 December 2004 where they commenced the inspection, assessment and evidence collection process.

1.4 OTSI Investigators released the incident site for recovery and repair at 3:55pm on 23 December 2004.

Initiation of Investigation

1.5 As a result of the primary evidence collected by OTSI investigators at the incident site, the Chief Investigator initiated a Rail Safety Investigation in accordance with s67 of the *Rail Safety Act 2002*.

Interim Factual Statement

1.6 On 24 December 2004, the Chief Investigator notified all Directly Involved Parties (DIP) that OTSI was investigating the derailment and requested that each organisation nominate an officer to act as the point of contact for all inquiries made by the appointed OTSI Investigator in Charge. The Terms of Reference for the Investigation were provided to the DIPs with this notification.

1.7 An Interim Factual Statement notifying OTSI's investigation and describing the incident in terms of what had happened was published on the OTSI website on 5 January 2005.

[3] The ATSB is a Federal Government Authority with powers under the Federal *Transport Safety Investigation Act 2003* to investigate rail incidents on the Defined Interstate Rail Network.

Terms of Reference

1.8 The Chief Investigator established the following Terms of Reference to determine why the accident had occurred and what to do to prevent recurrence:

a. identify the factors, both primary and contributory, which caused the accident;

b. identify whether the accident might have been anticipated and assess the effectiveness of the risk management strategies of the respective organisations involved;

c. assess the effectiveness of emergency actions in response to the accident, and

d. advise on any matters arising from the investigation that would enhance the safety of rail operations.

Methodology

1.9 OTSI utilises the ICAM (Incident Cause Analysis Method) approach in the conduct of its investigations and applies the Reason Model of Active Failures and Latent Conditions to its analysis of causative and contributory factors.

1.10 The underlying feature of the methodology is the Just Culture principle with its focus on safety outcomes rather than the attribution of blame or liability.

Consultation

1.11 On 14 March 2006, a copy of the investigation Draft Report was forwarded to ARTC, PNL and ITSRR. The purpose was to provide these DIPs with the opportunity to contribute to the compilation of this Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and providing any commentary that would enhance the structure, substance, integrity and resilience of the Investigation Report. DIPs were requested to submit their comments by 28 March 2006. Submissions were received from all three DIPs.

1.12 The Chief Investigator considered all representations made by DIPs and where appropriate, reflected their advice in this Final Report. On 24 April 2006, the Chief Investigator informed DIPs which matters from their submissions had been incorporated in this Final Report and where any proposal was not included, the reasons for not doing so.

Investigation Report

1.13 This report describes the derailment which occurred at Bethungra on 22 December 2004 and explains why it occurred. The recommendations that are made are designed to contribute to the safe operating environment for rolling stock operators and to minimise the potential for a recurrence of this type of accident.

PART 2 FACTUAL INFORMATION

Accident Synopsis

2.1 At approximately 8:05pm (ESDT)[4] on 22 December 2004, freight service 4VM9, operated by Freight Australia Limited (FAL)[5], derailed whilst descending the grade at Bethungra, on the main South line, part of the Defined Interstate Rail Network (DIRN) between Cootamundra and Junee in the Southern Region of NSW. 4VM9 consisted of four locomotives and 11 loaded bulk cement wagons and was enroute from Berrima to Melbourne. All 11 wagons from the train and 288 metres of track were severely damaged as a result of the incident. There were no reported injuries.

Accident Narrative

Before the Derailment

2.2 4VM9, consisting of a single locomotive (G528) and 11 wagons, was loaded at the Blue Circle Southern Cement Works at Berrima in the NSW Southern Highlands. It was destined for Somerton, Melbourne. After arriving at Goulburn, the crew changed and marshalled three additional locomotives (X48, T388 and T409), that were required to be returned to Melbourne, into the consist. 4VM9 then departed Goulburn at 4:32pm.

2.3 The crew described their journey from Goulburn to the top of the Bethungra grade as relatively uneventful, although they noted that the engine of locomotive T409 had shut down between Yass and Bowning without indication, but that it had been restarted without difficulty.

2.4 As 4VM9 reached the top of the Bethungra grade, the driver reported that he had engaged full dynamic braking[6] as was his normal practice to control the train's speed during the descent.

2.5 Whilst the speed of the track for the descent was 80km/h, the driver recollected that he had allowed the train speed to drift to approximately 84km/h under dynamic braking. Information from a data logger subsequently indicated the 4MV9 reached a speed of 86km/h during the descent. Whilst admitting to exceeding the posted speed limit, the driver further stated that he anticipated that as the track levelled near the

4 Times quoted in this report are Australian Eastern Summer Daylight Time.

5 Freight Australia Limited is a fully owned subsidiary of Pacific National Limited

6 Dynamic braking is a wear reduction feature on various locomotives that reverses the operation of the electrical traction motors that drive the locomotive wheels to electrical generators. During dynamic braking, the electrical current generated by rotation of the wheels and traction motors is dissipated as heat through an electrical resistor bank to provide retardation or a braking effect on the rotation of the locomotive wheels.

454 kilometre post, the train's speed would reduce to 80km/h. The driver indicated that he was prepared to apply the train's brakes in the event that dynamic braking was insufficient.

The Derailment

2.6 At approximately 8:05pm, 4VM9 rounded a left-hand curve and came onto a straight track section immediately prior to the incident site (See *Photo 1*). Both crew members stated that they then observed a track misalignment of approximately 250mm-300mm, towards the Down or Eastern side of the track just past the 454 kilometre post, whereupon the driver immediately applied the emergency brakes. All four locomotives rode over the misalignment and remained on the track. However, the rest of the train derailed, with eight of the wagons toppling down the embankments on either side of the track. The leading locomotive came to a stand at approximately 454.400kms with the rear of the fourth locomotive standing at 454.324kms.

2.7 The assistant driver observed the passage of the train over the misalignment in a rear vision mirror and the subsequent derailment. He noted that the third and fourth locomotives shook violently before the leading wagon derailed. The driver recalled that various loose articles of equipment on the leading locomotive's dashboard were thrown onto the floor as the train rode over the misalignment,

After the Derailment

2.8 Although shaken, neither of the crew members was injured by the derailment. Immediately after 4MV9 came to a stand, the driver attempted to contact Junee Control, via the train's radio, to inform them of the incident. However, he was unable to establish contact on the radio and reverted to a mobile phone. At the same time, the assistant driver left the train and proceeded to lay protection[7] on the Up line at a point approximately 500m forward of the train.

2.9 After securing the locomotives, the driver then proceeded to place a track shorting clip on the Up line. This action changed signals before the incident site to stop. In the process, he observed that at least two wagons had come to rest in close proximity to the Up line and that damaged trees and wheel sets appeared to be foul of the line (*See Photo 2).* The driver and a local property owner, who had come to investigate the dust cloud from the incident, subsequently moved debris off the track.

[7] Audible Warning Devices are carried on the train as part of the emergency kit.

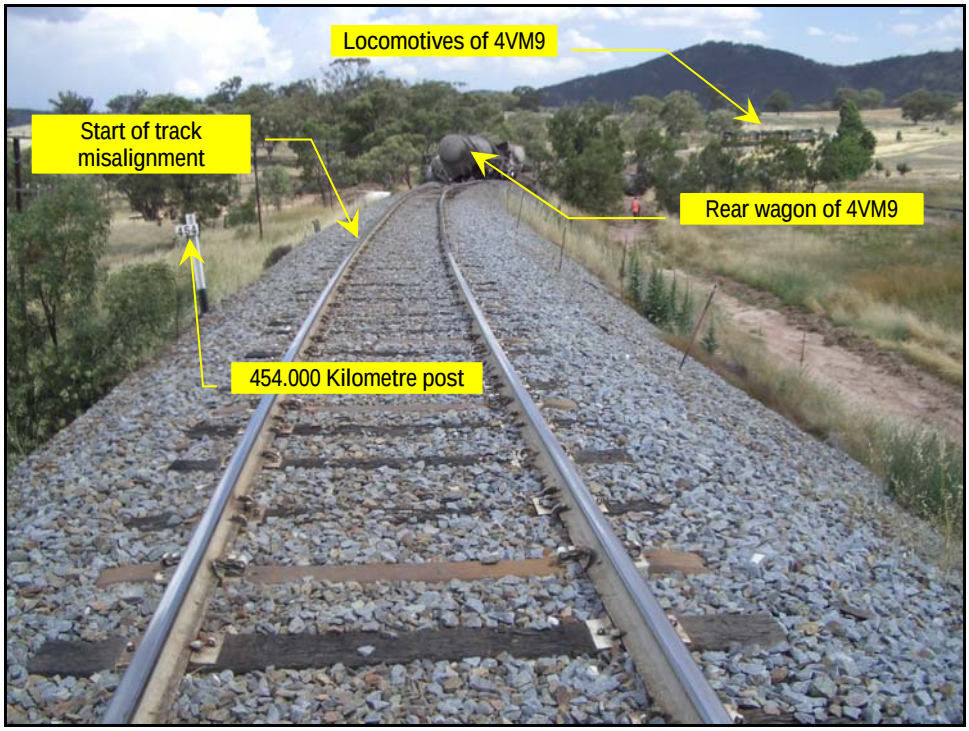

Photo 1: Looking towards the derailment site from the probable point at which the driver applied the emergency brakes.

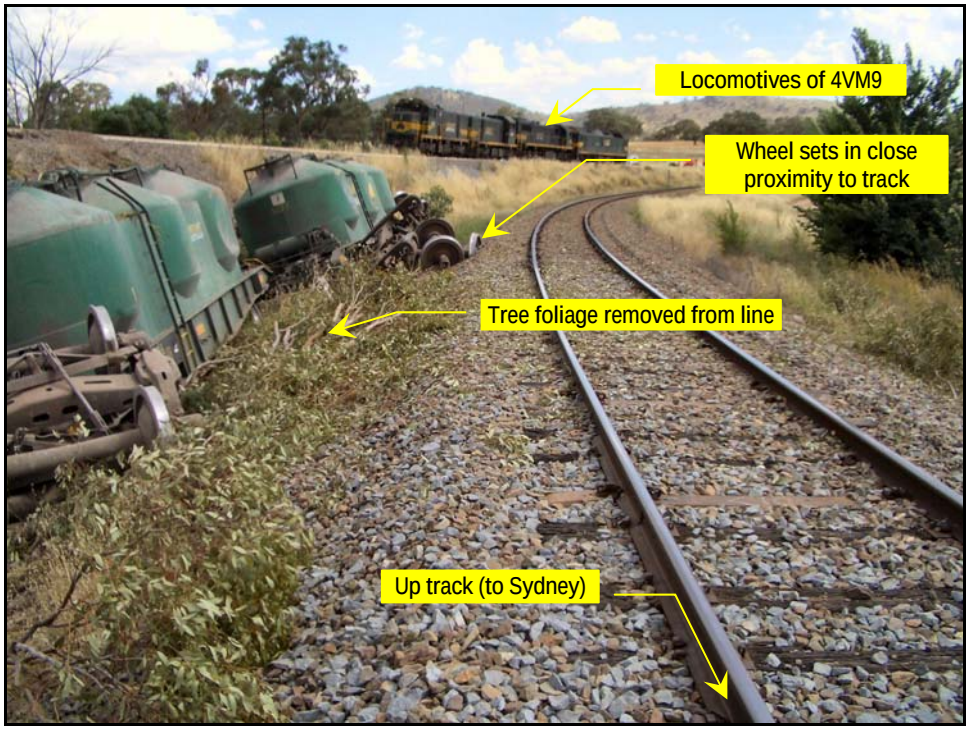

Photo 2: Incident site indicating proximity of derailed wagons and debris to the Up line.

2.10 Having contacted Junee Control, the driver communicated with FAL officers at Junee to advise them of the incident. These officers later arrived at the site at 9:00pm. After ascertaining the location of other trains in the region, Junee Control advised the Signaller at Cootamundra to hold all South-bound trains at Cootamundra until further notice. Junee Control then advised the driver that there were no other trains in the

immediate area and that all others heading towards the incident site had been stopped.

2.11 Both crew members were breath tested by Cootamundra NSW Police at 10:30pm and returned negative results.

Site Location

2.12 The incident occurred approximately two kilometres on the Sydney side of Bethungra (Lat. -34°45'00" Long. +147°52'00") (*See Figure 1*). Bethungra is located in the section between Cootamundra and Junee on the Main South corridor of the Defined Interstate Rail Network (DIRN)[8] between Sydney and Melbourne.

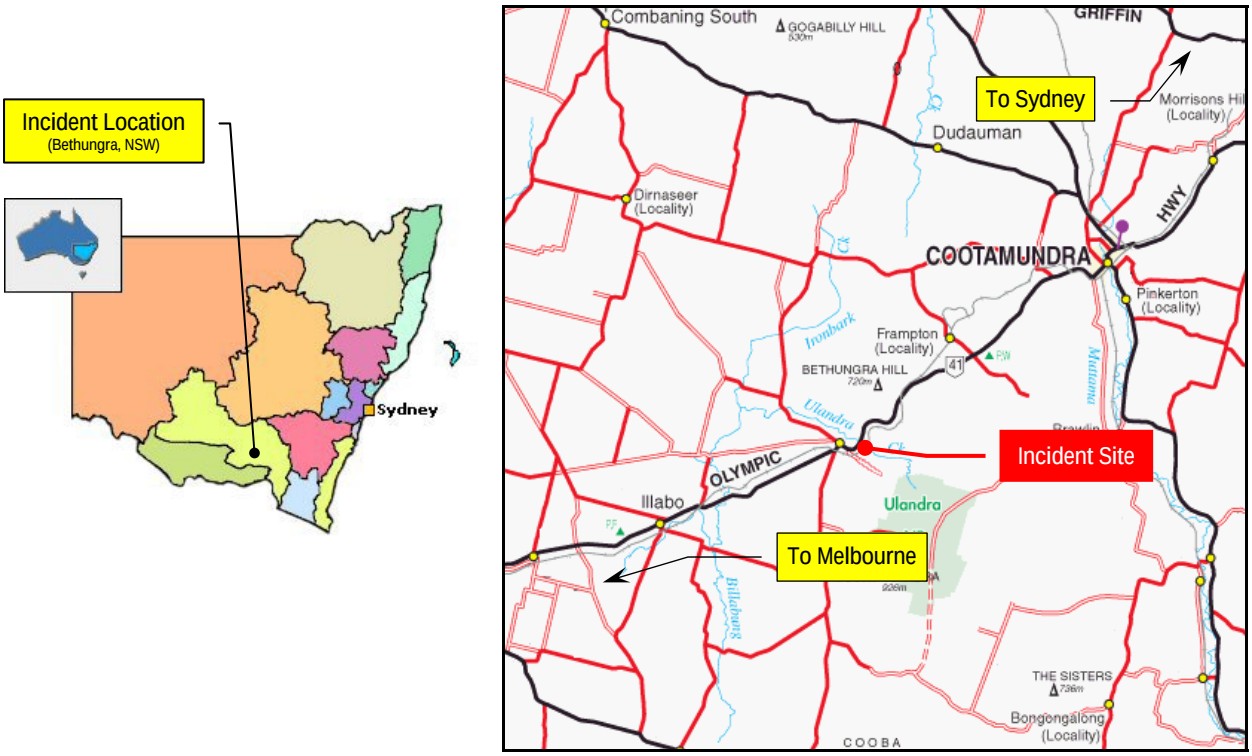

Figure 1: Bethungra Incident Location

2.13 This rail section is standard gauge, dual line, with a ruling gradient of 1:39. However, despite the section on the Bethungra grade being dual line, the Up and Down lines do not run in parallel. The Down[9] track descends the grade through a combination of cuttings and earth/rock embankments in a series of short straights and curves. The journey on the Up[10] track also adds another three kilometres distance to the journey between Melbourne and Sydney in comparison to the distance between Sydney and Melbourne.

[8] ARTC assumed responsibility for that portion of the DIRN that passes through NSW from the Rail Infrastructure Corporation in September 2004 as part of a 60 year lease arrangement with the NSW Government.

[9] Any track on which trains travel away from Sydney.

[10] Any track on which trains travel towards Sydney.

Track Information

Track

2.14 The derailment occurred on the Down track at kilometrage 454.036, at a point of transition into a 400m radius curve on a 1:44 falling gradient (*See Figure 2*).

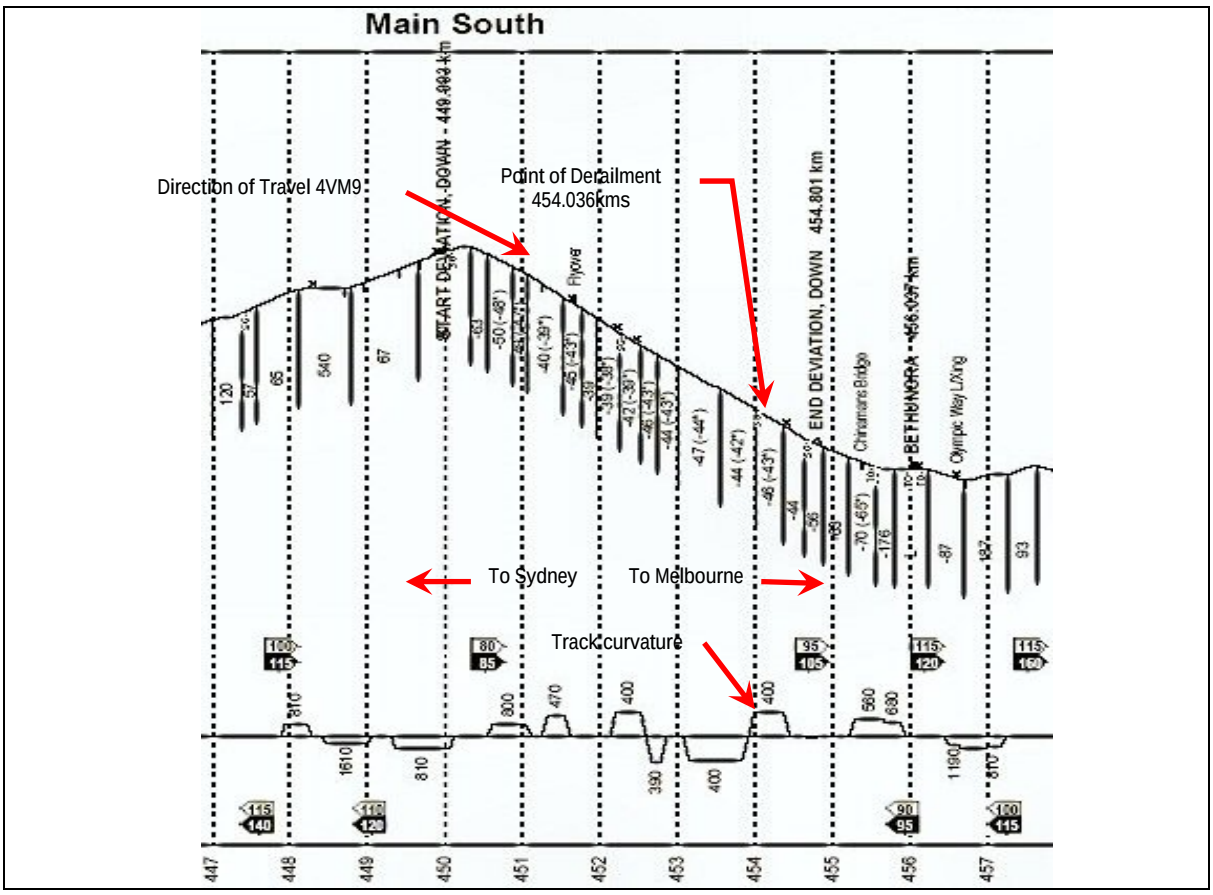

Figure 2: Curve and Gradient Diagram of Down Track.

2.15 The line is classified, under ARTC's Engineering Standard TDS 11, as Class 1 main line. Class 1 tracks generally conform to the following standards:

Rail Section	53kg/m or 60kg/m	Rail Type	Continuous Welded Rail (CWR) or Long Welded Rail (LWR)
Nominal Ballast Depth	270mm	Sleeper Type	Timber/Steel
Ballast Grade	Standard	Maximum Axle Load	25 tonnes
Maximum Train Speed (Freight)	80km/h	Sleeper Spacing	600mm
Sleeper Spacing/Skew Tolerance	20mm	Number of sleepers per Km	1666
Spacing Of Sleepers at Rail Joints	430mm	Anchor Pattern (Timber Sleeper)	*See TDS 8

2.16 The line curved down the grade through a combination of cuttings and earth/rock formations in a series of short straights and curvatures varying from 390m to 800m radius. The derailment occurred on an embankment, the top of which was approximately six metres higher than the surrounding ground. The rails were secured to a mixture of wooden and steel sleepers by Pandrol clips or dog spikes (on the wooden sleepers) or by "Rex Lok" fastenings (on the steel sleepers). "Fair" type track anchors were also fitted, in a ratio varying from 1:2 to 1:4, to control longitudinal movement of the rails where there were timber sleepers. There was no 'pattern' to the placement of the steel sleepers.

Operations Information

2.17 There were no temporary speed restrictions in place between Cootamundra and Junee at the time of the incident. The safe-working system for the section between Cootamundra and Junee is Rail Vehicle Detection System (RVDS). 4VM9 had a designated train path and signalled authority from Junee Control to traverse the section at the time of the incident.

Weather Conditions

2.18 The crew described the weather conditions at the time of the derailment (8:05pm) as being dry and clear with a setting sun. Meteorological records established that the sun set at 8:22pm.

2.19 Weather conditions recorded at Cootamundra Airport (approximately 20kms away) at 3.00pm on the day were described as follows:

Temperature:..... 34.2 degrees Celsius
Relative Humidity: 21%
Air Pressure: ..... 1006.2 HPa
Wind:..... NNW at 4 kph
Cloud Cover *..... 1/8th*

2.20 The maximum and minimum temperatures recorded on the day were 35.4 degrees Celsius and 18.5 degrees Celsius respectively. However, temperatures recorded in the region on the night before the incident had fallen to a minimum of 9.6 degrees Celsius.

Loss, Damage and Environmental Matters

2.21 The derailment destroyed a total of 288 metres of track and sleepers. All 11 wagons of 4VM9 derailed in the incident, with each wagon sustaining varying, but significant, degrees of damage to the wagon body and running gear. The contents of one wagon ejected through the end plate of the wagon hopper as the wagon came to an abrupt halt in a dry drainage causeway on the Eastern side of the track embankment. Officers from the NSW Environmental Protection Authority inspected the spilled cement and directed the construction of a coffer dam to contain the spill.

2.22 Unlike the wagons, the locomotives remained on the track, suffering only superficial damage to the coupler regions and left side underfloor equipment (See *Photos 3, 4* and *5*). Liquids collected in engine waste tanks had also splashed the underneath of each unit. The most noticeable damage occurred on the third and the fourth locomotives (T388 and T409) where various impact marks were apparent on their bogie frames and sanding valves. T409 also sustained damage to the air piping on its independent braking system.

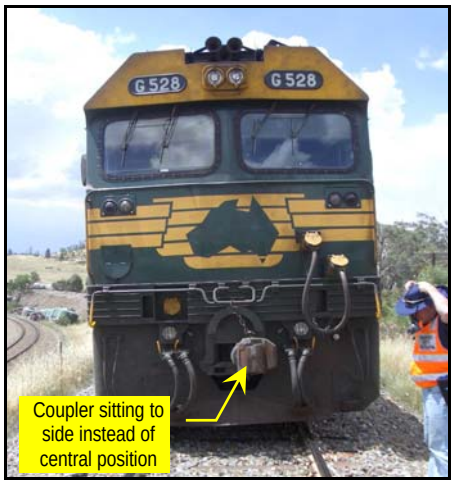

Photo 3: Position of front automatic coupler indicating the extent of lateral forces.

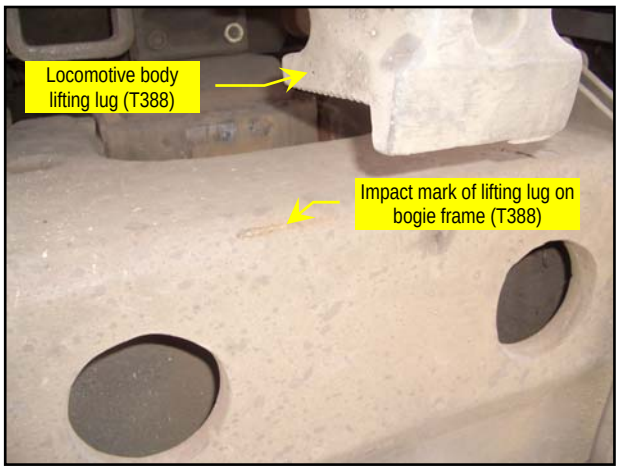

Photo 4: Impact marks on leading bogie of T388 indicating degree of bogie/body movement

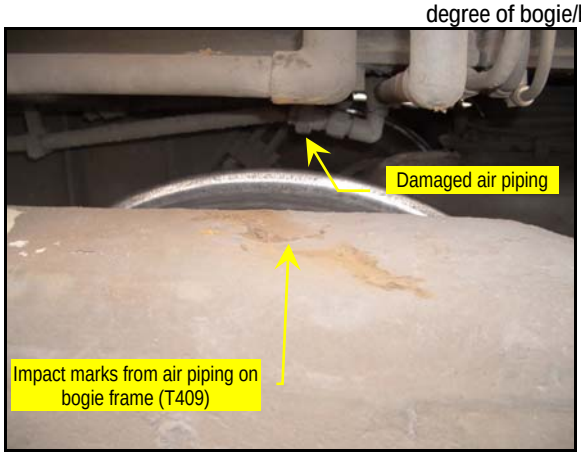

Photo 5: Impact marks on leading bogie and damage to piping of air brake system of T409

PART 3 ANALYSIS

Crew Information

3.1 4VM9 was operated by two experienced crew, based in Junee. Both crew members were very familiar with the route over which they were travelling and were within their respective medical and competency assessment periods. An analysis of their rosters indicated that they should not have been suffering from any form of work-related fatigue.

Train and Train Management

3.2 An examination of the load documentation established that 4VM9 was operating within allowable load limits at the time of the incident. Inspections and measurements taken from the rolling stock and bogies indicated that their condition did not contribute to causing the derailment. However, interpretation of the data from 4VM9's event recorders was complicated by the fact that the clock on the leading locomotive (G528) was set approximately 19 minutes slow; the clock on the second locomotive (X48) was not working; there was no tape in the third locomotive (T388) and there were indications that the logger on the fourth locomotive (T409) may have been defective. Nonetheless, the speed trace on the data logger fitted to the leading locomotive revealed that 4VM9 reached speeds of up to 90km/h on several occasions after leaving Goulburn, and that it reached a maximum speed of 86km/h approximately 200m from the point of the reported misalignment, after which the emergency brakes were applied. These determinations are consistent with the version of events provided by 4VM9's crew. OTSI noted that the maximum allowable speed in this area was 80km/h.

Emergency Response

3.3 The actions of 4VM9's crew after the derailment were timely and effective, and representatives from ARTC and FAL also responded in a timely and effective manner. However, OTSI was unable to find any record on voice tapes of Junee Control broadcasting an emergency message to alert drivers in the area to stop their trains, as required in ARTC Network Rule ANTR 400. OTSI also found that the Junee Control's communication was not consistent with protocols stipulated in Network Rule ANGE 204 and Network Procedure ANTR 721.

Factors Affecting Track Condition

3.4 Rail track is complex in structure with high levels of co-dependence between components. It must be closely monitored to quickly detect and correct component and geometry defects. The decision to move from jointed to continuously welded rail in NSW was made on the assumption that the overall track structure would be kept strong and rigid. In the absence of strength and rigidity, thermal stresses cannot be contained within the rail. Keeping the track structure strong and rigid begins with the maintenance of a well drained, full depth and full width ballast profile made up of well-graded, sharp rock. The ballast, in turn, must firmly contain high quality, heavy sleepers with tight-fitting or preferably resilient rail fastenings holding rail that is properly adjusted to length for the designed neutral temperature. The rail must also be kept on a designed alignment and prevented from moving longitudinally or 'creeping'. The track structure must act as a whole. Any deficiency in any component quickly degrades the adjacent component and the overall geometry and integrity of the track. Any deficiencies in components must be detected early and corrected quickly to prevent consequential effects. This is especially significant on curves of less than 400m radius. In some overseas railways, such curves are either excluded from continuous welding programmes or provided with special compensating devices such as expansion switches. At the very least, the tighter curves are provided with superior componentry and subject to special construction/maintenance measures to provide additional resistance to the release of stress by lateral movement. Heavy concrete sleepers with resilient fastenings are commonly used in such applications.

3.5 The most critical of those factors which cause a track misalignment in continuously welded rail is stress within the rail. It is the feature of track stability that is least visible and most difficult to detect. In NSW, rail is correctly adjusted if it is stress-free at a rail temperature of 35 degrees Celsius (which in rail terms is known as the 'neutral' temperature). Good track structure will resist stresses induced by rail temperatures up to 75 degrees Celsius.

3.6 Without actually cutting the rail, indicators or symptoms of excessive stress can only be detected by careful observation. Trained observers will examine alignment, creep, scratch marks at anchors, anchors bearing against sleepers, bulking of ballast in cribs ahead of sleeper movement, slight gaps in loose ballast at sleeper ends or a depression in the crib ballast behind the sleeper. These observations are detectable only by detailed walking inspection and measurement. They are not visible to the untrained eye, or at speed from either a hi-rail or engine cab ride.

Inspection and Maintenance Requirements

3.7 Track inspection requirements are contained in ARTC's Engineering Standard TEP 13 "Track Examination Handbook: System Overview". This standard stipulates that Class 1 lines must be inspected at the following intervals:

Inspection Type	Frequency	Inspection Requirements
Track Patrol	Twice Weekly (Maximum 3 Day Interval)	Conducted by track vehicle to ensure: • There are no obstructions to train movements or signalling equipment within (or potentially within) the structure gauge. • There is continuity of rails (i.e. no broken rails or joints, or loose or foul joints). • There are no imminent failures of track fastenings. • There are no major geometry exceedents (of derailment potential) without suitable protection. • There are no major deficiencies in supporting track structure (resulting from earthworks, bridges, structures, culverts, etc.). • That permanent & temporary speed signs are visible to train/track vehicle operators (are present, facing the right direction, not obscured by vegetation, graffiti, etc) & that temporary speed boards have been placed correctly, are accurate (have the right plates in the right order & working lights) & are standing securely.
Front of Engine	Monthly (Dependent on train running)	Non-specific examination to assist in the assessment of track by enabling the reaction of trains to the track structure to be observed (preferably at maximum allowable speed).
Detailed Walking	Each 3 Months	Thorough examination of the components of the track structure & the right of way to ensure that the components are satisfactory & contribute to a safe railway. Items examined include, but are not limited to: • Track geometry and adjustment. • Track components, including rails, fastenings, ties, joints, insulated joints, ballast profile and condition, lubricators. • Turnouts and special track work. • Bridge and structure conditions affecting track integrity. • Earthworks & drainage including geotechnical hazards. • Right of Way including: o Fencing & gates. o Weed & vermin control. o Firebreak condition, fire hazard control, access roads. o Vegetation fouling, or with the potential to foul the track. o Drainage including waterways & flooding. o Check of any undermining of track or structures. o Visibility, security & clearances of Permanent & Temporary Speed signs & other trackside safety signs.

3.8 In addition to the above, the maintenance regime requires staff to conduct a number of other regular track inspections. These inspections include:

a. ***Track geometry recording*** by a track recording train. This inspection graphs the condition of the track: to identify locations where track geometry parameters are exceeded; to categorise the severity of any exceedences and to inform the need for temporary speed restrictions to be placed on the track.

b. ***Sleeper inspection and marking***. This type of inspection examines the condition of the timber sleepers in the section and identifies those requiring renewal in the immediate future.

c. ***Welded Track Stability Analysis (WTSA)***. This is a series of measurements taken before winter and summer to identify areas of track instability, i.e., where there has been creep or pull-in that have the potential to buckle or break the rail in times of extreme temperature conditions.

Actual Track Condition

3.9 The derailment destroyed 288 metres of track (See *Photo 6*). OTSI spent a considerable amount of time examining track sections between 453.000kms to 453.500kms, and 453.600kms to 454.500kms, i.e., either side of the derailment to establish what the general condition of the track might have been at the derailment site prior to the accident. It noted:

a. There was evidence of "pull-in" of the track between 453.400kms and 453.600kms with the end faces on the Up side of the sleepers progressively being exposed. It appeared that this was not a recent phenomenon.

b. The rails in the damaged section had completely separated from all sleeper ties and all steel sleepers in this area were severely damaged or bent. The placement of steel sleepers was also irregular, varying from 1:3 to 1:12.

c. All timber sleepers damaged in the incident had shattered or splintered, indicating that the sleepers were aged and in a deteriorated condition. The condition of sleepers that were not damaged by the derailment generally varied from 'fair' to 'poor' as defined in ARTC Engineering Standard TMS 06, and there was no evidence of recent sleeper marking or renewal.

d. Most dog spikes examined were loose within the sleeper and easily moved by hand. This indicated that any longitudinal movement of the rails was only restrained by the steel sleepers or timber sleepers fitted with Pandrol clips.

Photo 6: Incident site looking towards Sydney showing extent of track damage.

e. The anchorage pattern on the rails conformed to ARTC Engineering Standard TMP8. However, excessive clearance between the lower side anchor and the sleeper indicated prolonged or long-term creep of the rails down the grade (See *Photo 7*). In addition, there were instances where rail anchors had embedded into the high side of a number of timber sleepers, indicating that the anchorage of the rails was ineffective and that the track had crept downhill.

f. The ballast condition in the section was clean and sharp with no evidence of sleepers having moved vertically.

g. The ballast profile conformed generally to the standards, although excess ballast was observed on the Up side of the embankment formation in the vicinity of 453.800kms. ARTC inspection records had also noted the same issue.

h. The track had misaligned, to the East, at 454.010kms (See *Photo 8)*.

i. There was a section of timber sleepers, with dog spike fastenings, immediately before the misalignment point. These sleepers were in a 'fair' condition but the rail was not effectively fastened to them.

j. There was no sign of heavy wear on the gauge face of the high side rail, so it did not appear that the rail had been subjected to prolonged and steep angles of 'attack' by wheel flanges.

k. The rails on the curved section of track where the derailment occurred had been painted white as part of a program to reduce the effect of heat on the track, but no other sections on the grade were treated in a similar way. This suggested to OTSI that the area of the derailment had been identified as vulnerable.

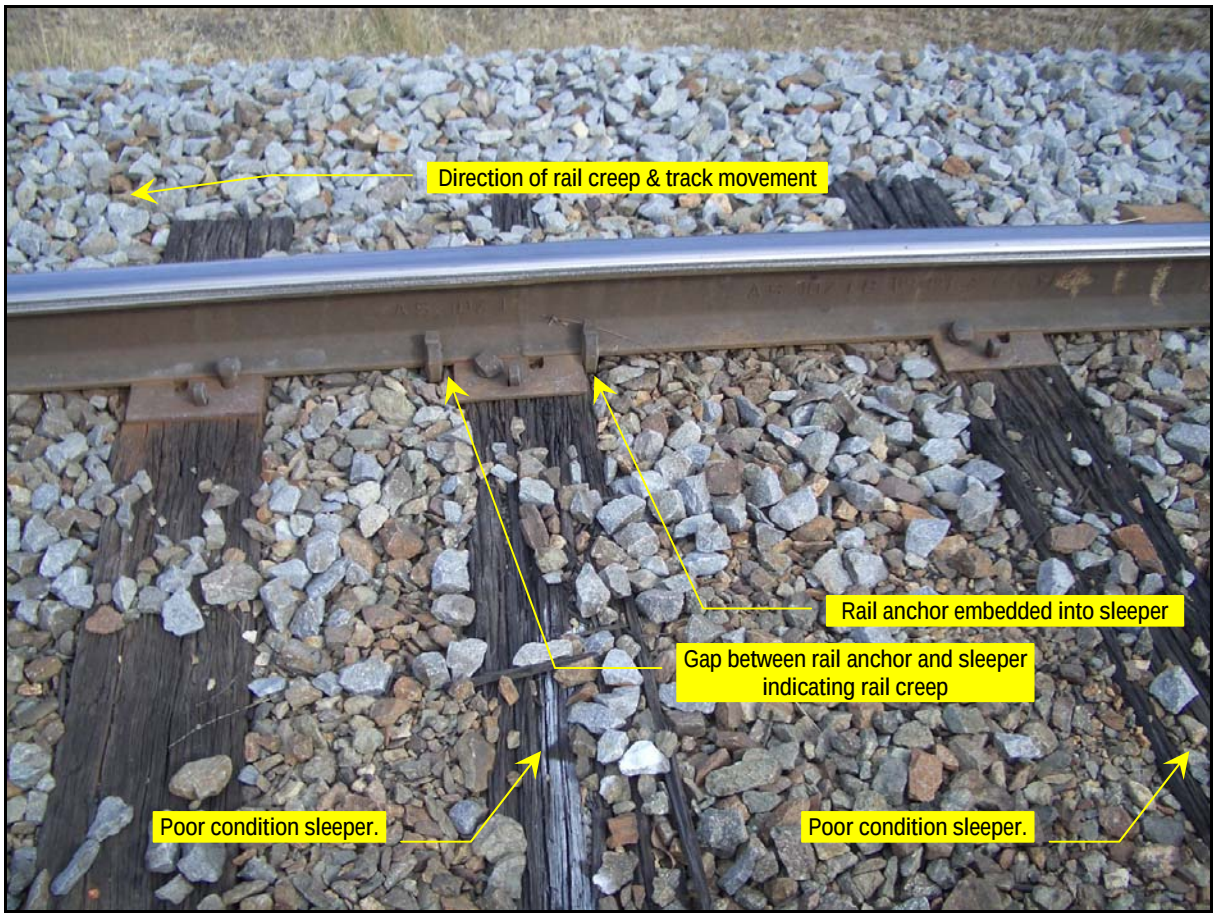

Photo 7: Indications of rail creep at 453.490kms.

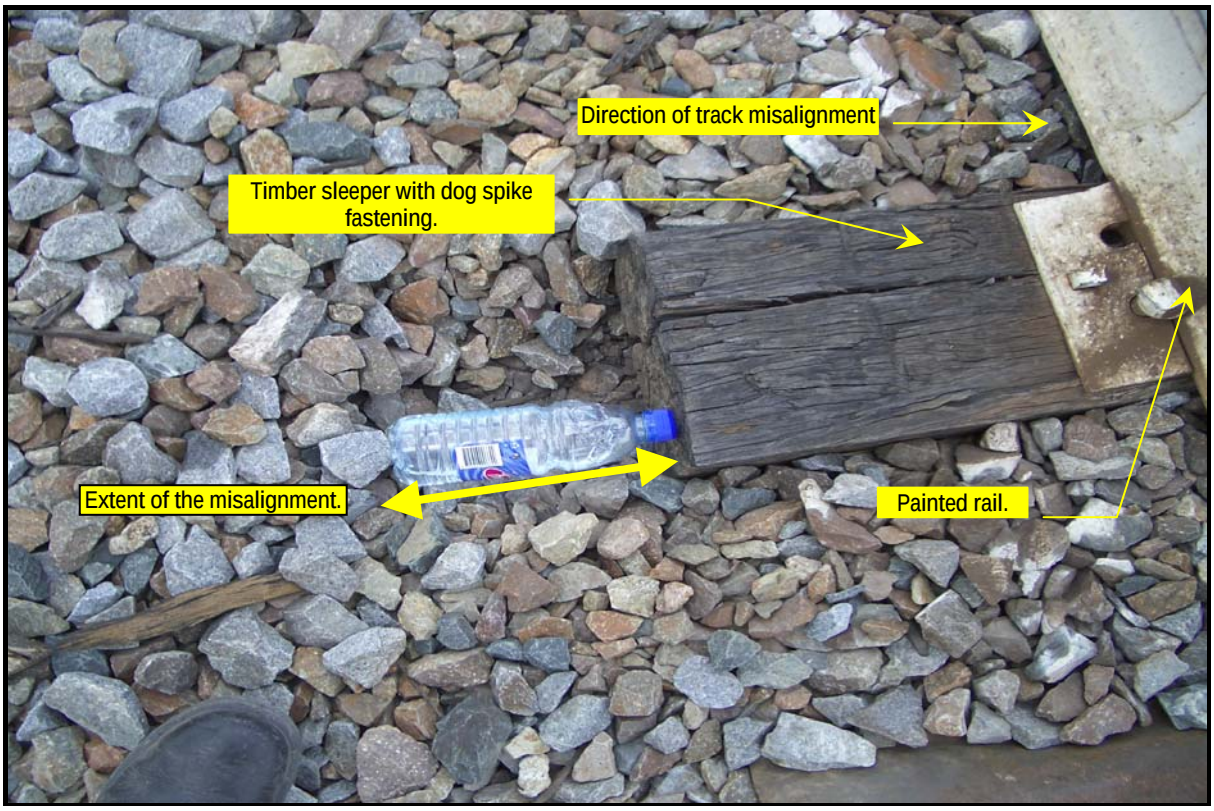

Photo 8: Apex point of misalignment found after the incident.

3.10 Responsibility for the inspection and maintenance of that part of the DIRN which is located in NSW transferred from RIC to ARTC on 5 September 2004. OTSI sought documentation from ARTC to review the frequency of the track inspections and maintenance. ARTC's investigation report into the derailment identified the following matters of significance:

a. There had been a misalignment at the same point in the summer of 2002-2003. The cause of the misalignment was attributed to the operations of a train similar in type to that which preceded 4VM9 through the section, however no evidence was provided to substantiate this. OTSI noted that the train in question did not appear to be overloaded; had been marshalled in accordance with normal practises, and that train management records indicated there was nothing unusual in its maintenance.

b. Anchoring in the area was described as being "good". OTSI noted that, whilst the anchoring pattern was consistent with the requirements of Engineering Standard TMP 08, which requires single anchoring on every second sleeper (or every sleeper if necessary) on a falling gradient steeper than 1:80 in the direction of traffic, the anchoring itself was poor and would not have prevented rail creep.