Australian Government

Australian Transport Safety Bureau

Derailment of freight train 3MC1

Locksley, Victoria | 12 February 2013

Investigation

ATSB Transport Safety Report

Rail Occurrence Investigation

RO-2013-006

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Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 4150 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117, from overseas +61 2 6247 3117
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

Addendum

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Safety summary

What happened

Derailed wagons train 3MC1

Source: ATSB

On 12 February 2013, intermodal freight train 3MC1 derailed at Locksley, near Seymour in Victoria. The train consisted of two locomotives (GL107 leading and GL101 trailing) hauling 33 wagons having a trailing mass of 921.1 t and an overall train length of 885.5 m. There were no injuries but the last eight wagons derailed and about 800 m of track was damaged.

What the ATSB found

The ATSB determined that the derailment of freight train 3MC1 at Locksley was most likely the result of a track misalignment at the 127.768 km mark on the West Line of the interstate mainline. Hot weather in the period preceding the derailment, and trains travelling along the track, probably caused a redistribution of longitudinal rail stresses in a northerly direction towards the derailment site. The track structure near the derailment site probably had a reduced capacity to withstand lateral forces, due to track quality (ballast contamination). This, coupled with maintenance activities close to the derailment site, most likely initiated a redistribution of longitudinal forces towards the 127.768 km mark and increased the likelihood of a track buckling event.

What's been done as a result

Australian Rail Track Corporation track maintenance staff have been provided with additional training on the consequences of multiple track disturbances altering the stress free temperature of rail track. The training will provide an enhanced level of compliance with the requirements of procedure ETM-06-06 (Managing Track Stability - Concrete Sleepered Track).

Following the derailment and subsequent reinstatement of the track the Australian Rail Track Corporation undertook stress free temperature testing at ten sites near the 'Point of Derailment'. Tests established that the rail stress free temperature was within specified tolerances.

The Australian Rail Track Corporation has implemented a ballast remediation program on the Melbourne – Sydney rail corridor. This work will continue as programmed until completed, following which further works will be undertaken at sites having identified formation weakness.

Safety message

Track managers must consider the potential impact of track disturbing maintenance activities on lateral track stability, particularly in areas having poor ballast quality and during periods when temperatures are significantly higher than the rail neutral temperature.

Contents

The occurrence

Train 3MC1 was a Qube Holdings container service scheduled to work from West Gate Ports, Melbourne in Victoria through to Harefield in New South Wales. The train departed West Gate Ports at 1255[1] on 12 February 2013. A crew changeover occurred at Somerton (22.7 km)[2] with the relief crew, comprising a qualified driver and a driver's assistant, undergoing route certification training. Both drivers signed on as fit for duty at Somerton at 1300. On joining the train the driver completed prescribed pre-departure checks then set off from Somerton at 1348.

Figure 1: Location of Locksley in relation to Melbourne, Victoria

Source: Geoscience Australia

The train was operating under the direction of an Australian Rail Track Corporation (ARTC) Network Control Officer (NCO) located in Junee, New South Wales. Train 3MC1 passed through Donnybrook at 1406. It was then delayed for about 60 minutes in the Donnybrook to Wallan section because of signalling problems. Once the signalling problems had been resolved the train continued, crossing with train 8620, at Kilmore East.

The train passed through Seymour (Figure 1 and Figure 4) at 1626 and Locksley at about 1642, at a speed of 108 km/h. At about this time (1630) the temperature recorded at Mangalore Airport[3] was 30.6°C, (overnight minimum 14.3 °C at 0630) wind was blowing from the southwest at 24 km/h and no rain had been recorded in the preceding 24-hour period.

Shortly after traversing the Nagambie-Locksley Road level crossing (127.376 km) both drivers observed a large track misalignment (Figure 2) some distance ahead. The driver throttled off in an attempt to ride through the misalignment (127.768 km). The train continued over the misalignment and travelled a further kilometre at which time the driver assumed the train had not derailed. He was about to communicate details of the misalignment to the NCO when he observed a significant reduction in brake pipe pressure. This indicated a loss of air and the likelihood of a train

1 Local time was Australian Eastern Daylight Time. (Coordinated Universal Time (UTC) +11:00 hours).

2 Distance from a zero kilometre reference point near Melbourne's Southern Cross Station.

3 The Mangalore Airport is located about 14.5 km southwest of Locksley at Lat: 36.89 S, Long: 145.19 W, Height: 140.8 m.

parting/derailment. The driver immediately 'bailed off'[4] the independent brake and communicated to the NCO that the train had probably derailed.

Figure 2: Looking south towards Seymour – Site of track misalignment post derailment

Source: ATSB

The driver requested that the NCO warn trains approaching on the adjacent East line of a possible derailment. The NCO responded appropriately and began to issue warnings to oncoming traffic. The train driver also radioed approaching rail traffic signalling the possibility of the derailment.

Post Occurrence

When the train came to a stand both the driver and assistant disembarked and went to opposite ends of the train to protect the train from approaching traffic. The train driver walked to the rear of the train. On reaching the eighth to last wagon he noticed that the leading bogie had derailed. He observed that the next four wagons had also derailed and that either the front or rear bogies had been dragging alongside the track to the left side (western side of West line) in the direction of travel. The last three wagons, though still coupled to the train, had progressively dropped away off the left side of the track embankment with the last wagon (Figure 3) having completely slipped to the bottom of the formation. Although the train remained coupled, air was escaping from air hoses between the third last and second last wagons.

On reaching the end of the train the driver re-contacted the NCO and confirmed that the train had derailed but was not fouling the East line. The driver continued to walk towards Seymour about

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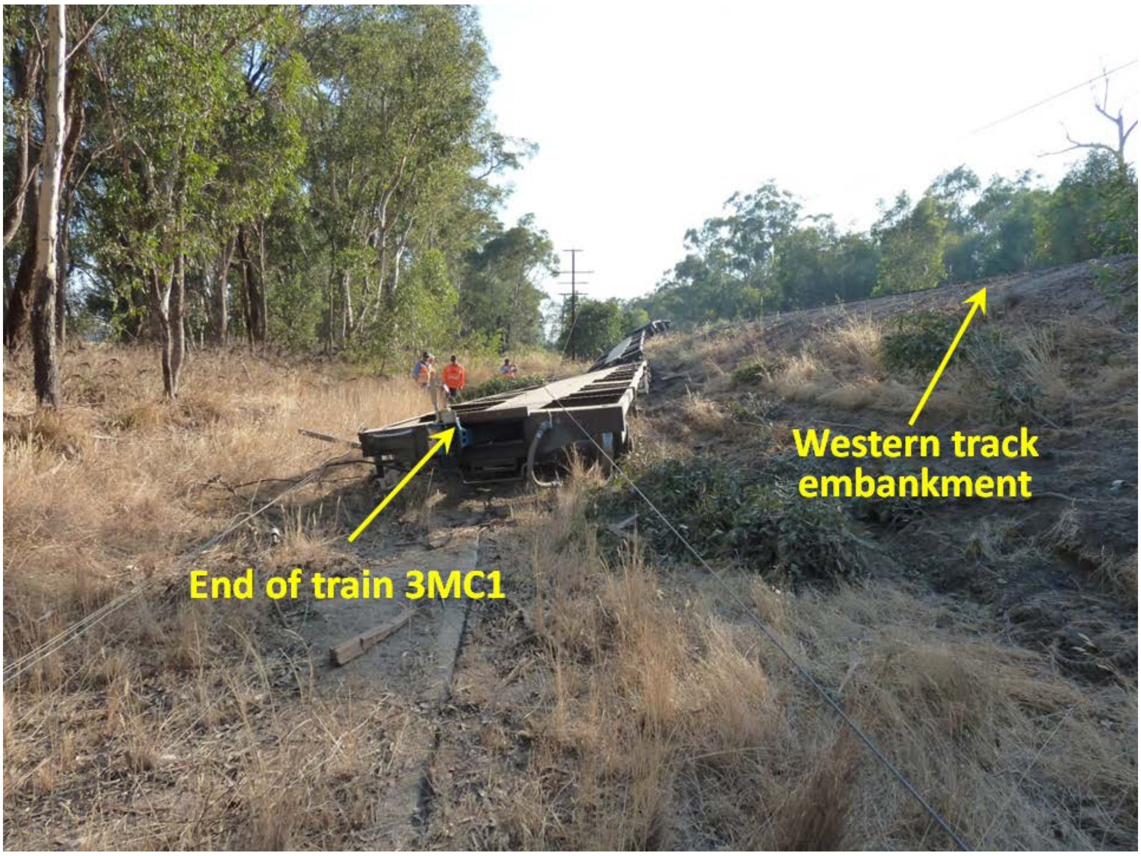
[4] 'Bail off' is a term used to describe the action of:
- preventing the locomotive(s) brake from applying automatically during a train brake application, or
- releasing the locomotive(s) independent brake during a train brake application.

500 m beyond the track misalignment. He placed three audible track warning signals[5] on the track before returning to the lead locomotive.

Victoria Police and emergency services arrived within five minutes of the derailment.

Figure 3: Train 3MC1 – End of train, last wagon in consist



Source: ATSB

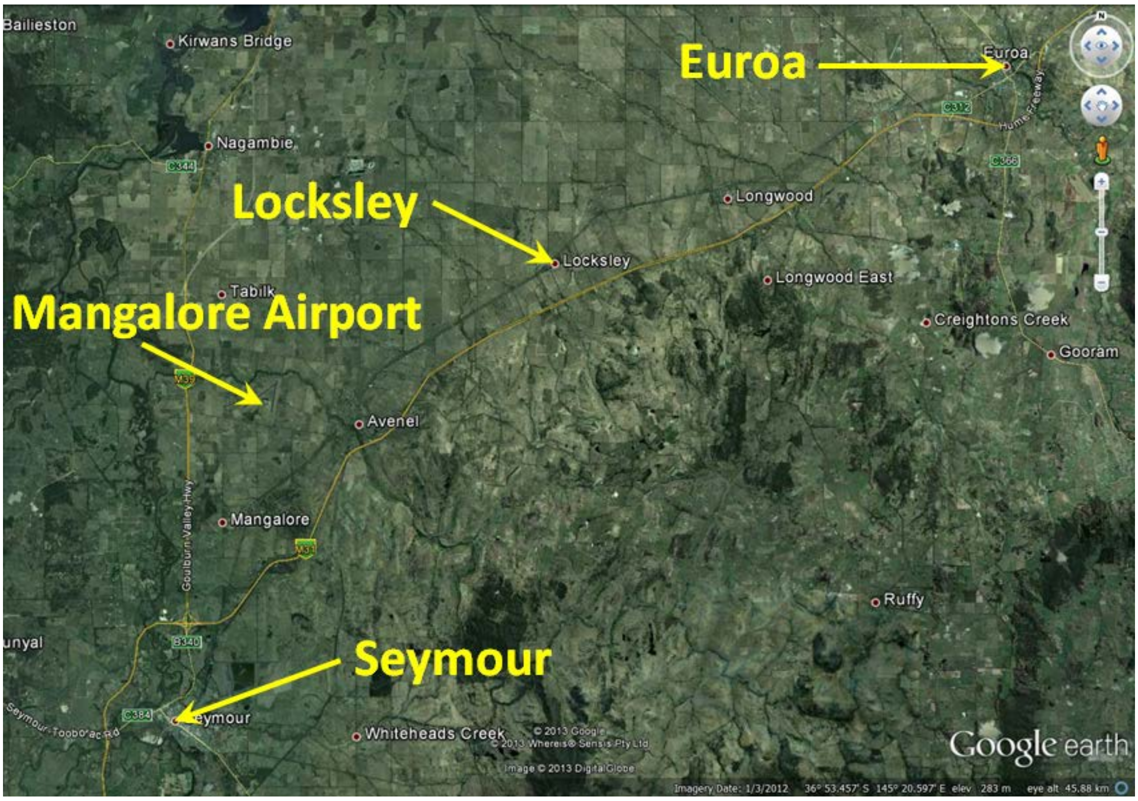
5 Devices to attract the attention of train crews and others. (Source: National Guideline, Glossary of Railway Terminology www.rissb.com.au).

Context

Location

Locksley is the site of a closed railway station adjacent the Defined Interstate Rail Network (DIRN). It is 127.55 km northeast of Melbourne and about 825 km southwest of Sydney (Figure 1 and Figure 4). It is approximately 29 km northeast of Seymour (Victoria) and about 2 km north of the Hume Freeway.

Figure 4: Location of Locksley, Victoria



Source: Google Earth

Train and train driver information

Train 3MC1 was operated by Qube Holdings Limited (Qube). It comprised two locomotives (GL107 leading and GL101 trailing) hauling 33 wagons with a trailing mass of 921.1 t and an overall length of 885.5 m.

Train 3MC1 was crewed by a qualified driver and a driver's assistant who were medically fit and appropriately qualified/certified for the route over which they were operating. The train drivers were tested for the presence of alcohol by the Victoria Police following the derailment; the results were zero.

Locomotives GL107 and GL101 were each equipped with data loggers. These loggers are used for capturing train information such as date/time, speed, brake pipe pressure, throttle position and distance travelled. Data from the recorders was used in examining the sequence of events leading up to the derailment.

There were no issues identified with rolling stock or train braking performance.

Train handling by the driver was not considered a factor that contributed to the derailment. The driver's response in alerting the Network Control Officer to the occurrence and subsequent actions in protecting the site significantly reduced the risk to other rail traffic.

Track Information

At the time of derailment, the DIRN from Melbourne to Sydney substantially comprised a single line (bi-directionally signalled) with crossing loops and passing lanes strategically located throughout its length. The section[6] from the Seymour Loop (99.772 km) to Wodonga Junction (302.347 km) comprised double line with bi-directional signalling.

The track through the derailment site was standard gauge (1435 mm) and consisted of 47 kg/m continuously welded rail[7] (CWR), fixed to concrete sleepers with resilient fastenings[8] supported on a bed of ballast having a nominal depth of 250 mm under the sleepers. The track leading into the derailment site transitioned out of a sweeping left-hand curve, (direction of travel) but was otherwise substantially straight and level. Track speed through this area was 115 km/h for the class of freight train involved in the derailment.

The track is managed by the Australian Rail Track Corporation (ARTC) under a long term lease arrangement with the State Government of Victoria. As part of the lease agreement the ARTC is responsible for infrastructure construction, maintenance and inspection. As part of its ongoing maintenance program the ARTC undertook a range of track work activities near the derailment site, comprising:

- Dip welds removed by installing closures[9] – April 2012.
- Removal of redundant Glued Insulated Joints – July 2012.
- Undercutting with excavator – July 2012.
- Resurfacing (tamping) – September 2012.
- Dip Weld Straightening – 29 January 2013.

Prior to 1 January 2013 the ARTC contracted this maintenance (the work identified in the dot points above) to private companies. After 1 January 2013 the ARTC assumed direct maintenance of its track assets using in-house resources.

Examination of track post derailment

An examination of the track at the 'Point of Derailment' (PoD) showed evidence of flange climb on the rail running face (western rail/West line) followed by witness marks on the rail head (Figure 5) and damage to sleepers where the wheel(s) had subsequently dropped off the rail head. There was evidence of significant horizontal sleeper displacement within the ballast bed, about 180 mm to the right (Figure 5 and Figure 6). There was no evidence of vertical misalignment.

Damage to sleepers was observed only after the point where the wheel(s) dropped off the rail. Undamaged sections of track were examined for gauge (1435 mm) and found to be within specified limits. Track spread/gauge widening was unlikely to have been a factor in the derailment.

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6 This section of track includes part of the former Victorian broad gauge (1600 mm) country line.

7 Continuous welded rail (CWR) – Track where the rail is joined by welding (and other non-moveable joints such as glued insulated joints) in lengths greater than 300 metres. Source: National Guideline Glossary of Railway Terminology (www.rissb.com.au).

8 A fastening that provides a degree of elasticity between the sleeper and rail with the aim of avoiding the loosening of the fastening due to vibration, as well as enhancing the ability of the fastening system to resist longitudinal creep forces and buckling forces associated with continuously welded rail (CWR). Source: National Guideline Glossary of Railway Terminology (www.rissb.com.au).

9 A length of rail shorter than standard length which is used to join sections of longer rails or to join turnout components. (Source: National Guideline, Glossary of Railway Terminology, www.rissb.com.au).

The track was also examined for signs of any broken/fractured rail immediately at or before the PoD, none were found.

Based on the train crew's observations and supported by site evidence, the ATSB concluded that the derailment of train 3MC1 was initiated by a horizontal track misalignment at the 127.768 km location.

Site observations of the track structure leading into/out of the derailment site appeared to suggest that the track was in good condition. However, on examination of the ballast shoulder (western side/West line) exposed by wagons that had derailed, it was observed that the ballast layer was heavily contaminated/fouled with fine material (fines).

Figure 5: Witness marks at PoD (127.768 km) shown by line of stones on rail head

Source: ATSB

Figure 6: Displacement of sleeper within ballast bed

Source: ARTC

Track stability

Track integrity is of prime importance in the running of a safe railway and is reliant on the inter-relationship of many track components, including the sub-base, ballast bed, sleepers, rail and fastening systems.

Although CWR provides significant advantages over traditional rail jointing methods (such as fish-plated track), track construction, stress adjustment and subsequent maintenance activities (for example, resurfacing, undercutting and removal of rail defects) can have an effect on track stability. If not well managed, the resultant disturbance to the track components from these activities can result in a track that is susceptible to buckling.[10]

Track buckling typically occurs when the longitudinal compressive forces, induced by thermal expansion, creep and dynamic vehicle loads produce a lateral buckling load that exceeds the passive restraining forces provided by the track structure. The cause of buckling is normally associated with the following factors:[11]

- high longitudinal rail forces (compressive rail forces)
- low lateral track resistance
- dynamic rail forces (vehicle loads)

Longitudinal rail forces

Longitudinal rail forces, those along the length of the track, can be considerable and are particularly sensitive to rail temperature. The neutral temperature, or stress free temperature for rail, is a theoretical temperature at which the rail is neither in tension or compression. If the rail temperature is greater than the neutral temperature, the rail will be in compression, with an

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10 Buckle common term used to describe a lateral track misalignment.

11 Track Buckling Research in CWR from US DOT's Volpe Center. http://www.volpe.dot.gov/coi/pis/work/archive/buckling.html

increased likelihood of track buckling. Conversely, if the rail temperature is less than the neutral temperature, the rail will be in tension, with an increased likelihood of the rail breaking.

Longitudinal rail forces are directly proportional to the difference between the rail neutral temperature and actual rail temperature. The ARTC *Track and Civil Code of Practice SA/WA & VIC - Infrastructure Guidelines - Section 6 Track Lateral Stability* prescribes a rail neutral temperature of between 35 °C and 40°C.

Higher compressive forces will occur, at a specific ambient temperature, where there has been an effective reduction in rail neutral temperature. It is therefore particularly important when CWR is cut and re-joined to ensure that the rail is correctly 'de-stressed', that is, the correct amount (length) of rail is re-inserted into the track at the specified (neutral) rail temperature and/or compensation made for the difference. Inserting too much rail in the track is equivalent to lowering the rail neutral temperature in that area and therefore would increase longitudinal compressive rail forces on hot days.

Examination of ARTC maintenance documentation, in particular Form RAP5391 *Weekly Return – Aluminothermic Welding/Adjustment* established that work was undertaken at the 127.470 km location, about 298 m before the identified Point of Derailment (PoD) on 30 January 2013. The work comprised replacement of a rail defect. A rail insert, about 4 m in length, was welded into track. During the period of work the rail temperature ranged from 12 °C (start) and 18 °C (end). Although ARTC documentation shows that temperature compensation was allowed for and rail length added, an error in process could result in the insertion of too much rail, effectively lowering the rail neutral temperature and increasing longitudinal forces.

Lateral track resistance

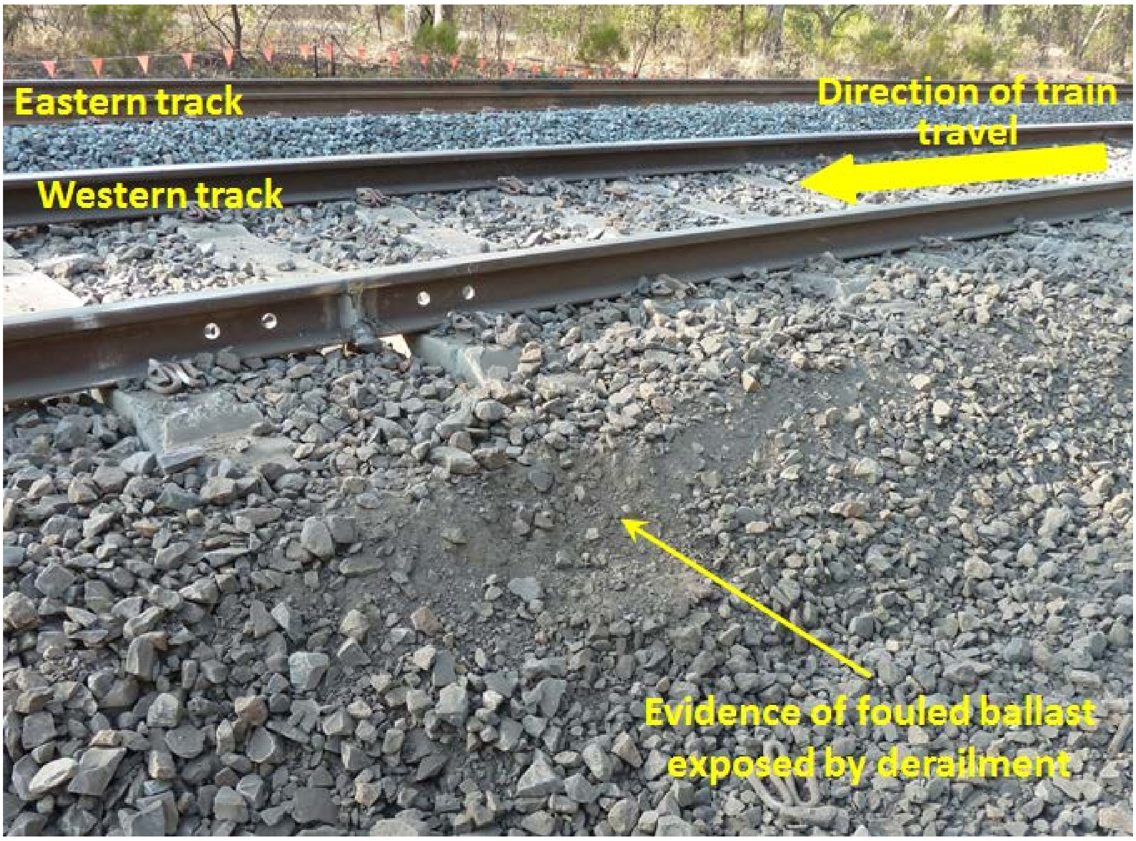
Buckling resistance in the lateral plane is contingent on the frictional interrelationship between sleepers and the surrounding ballast[12]. A buckle will develop when the lateral force exerted on the track structure exceeds the track's ability to resist those forces. If the frictional bond between sleepers and ballast is reduced the lateral force required to generate a misalignment is lowered. This may result in a track buckling event even in areas that were previously stable. The track's ability to resist lateral forces is influenced by:

- Sleeper type and weight plus ballast quality
- Compaction of ballast between sleepers plus ballast quality
- Ballast shoulder geometry

Ballast quality (angularity/sharpness of the ballast stone) is of critical importance in maximising lateral track stability. As ballast breaks down, finely ground particles (fines) choke the ballast and will entrap moisture leading to accelerated track degradation: see ATSB report RI-2011-015. The breakdown of ballast may be observed as track pumping with the formation of mud-holes during wet periods. When the track is dry (as typically occurs during the hotter summer months) and where the ballast within the crib[13] and/or shoulder[14] is deficient or in poor condition, the track will also be more susceptible to misalignment due to a lack of lateral resistance[15].

[12] Track Stability and Buckling - Rail Stress Management - Zayne Kristian Ole.
[13] Ballast area between sleepers.
[14] The ballasted section outside the sleeper ends.
[15] 'Improved knowledge of CWR track' - Coenraad Esveld.

Figure 7: Evidence of fouled ballast



Source: ATSB

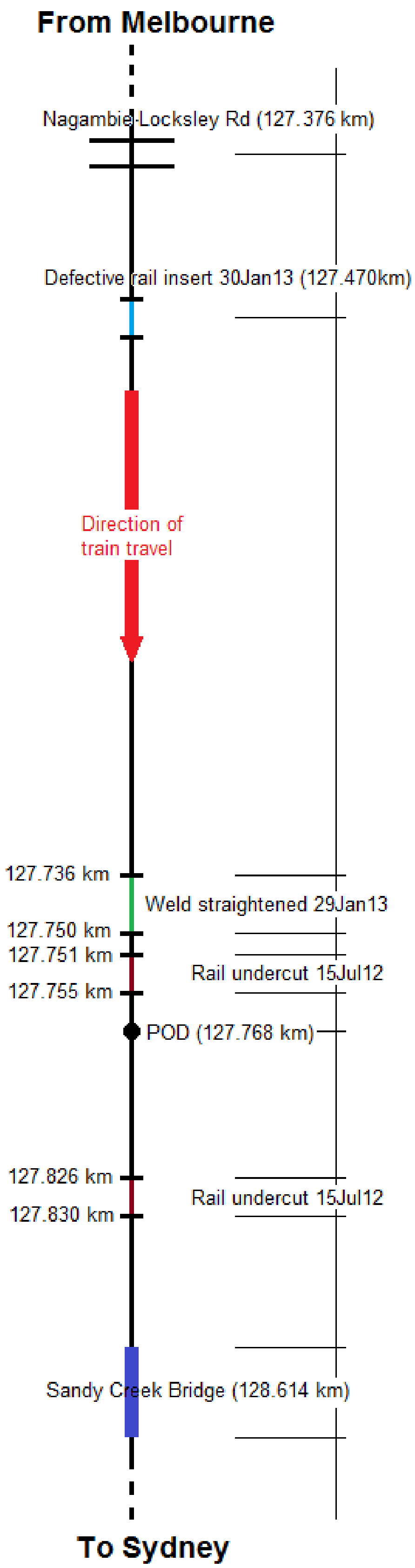
During this incident, derailed wagons ploughed into the ballast shoulder along the western (field) side of the West line. The exposed ballast shoulder and underlying formation (Figure 7) was observed to be heavily contaminated/fouled with fine material (fines) along much of the length. The PoD (127.768 km) was located between two track sections (127.751 km to 127.755 km and 127.826 km to 127.830 km) that had undergone undercutting/ballast renewal works associated with identified track pumping/mud-hole damage. As the track at the PoD was not part of this work, it is very likely that this track was structurally weaker than the repaired track and was therefore more prone to buckling.

The frictional bond between ballast and sleepers will degrade as a result of track maintenance activities[16] such as tamping, track renewal/replacement, weld straightening and associated works. These activities all reduce the track's ability to resist lateral movement until the ballast consolidates under traffic. It may take several weeks for this to occur, depending on traffic volumes/loads. During the consolidation period, the track is particularly susceptible to thermal forces.

During the post derailment site inspection it was observed that work was undertaken about 25 m before the derailment site (Figure 8). The work was identified as weld straightening on the western (field) side of the West line.

16 'Improved knowledge of CWR track' - Coenraad Esveld (Section 5.1).

Figure 8: Schematic showing work near site of track buckle (127.768 km)



Source: ATSB

The work was undertaken on 29 January 2013, 15 days before the derailment. The photograph (Figure 9) shows disturbance of the track, about 7 m either side of weld straightening activities. It was also identified that work, the replacement of a rail defect, was undertaken at the 127.470 km mark, about 298 m before the PoD on 30 January 2013.

Dynamic rail forces

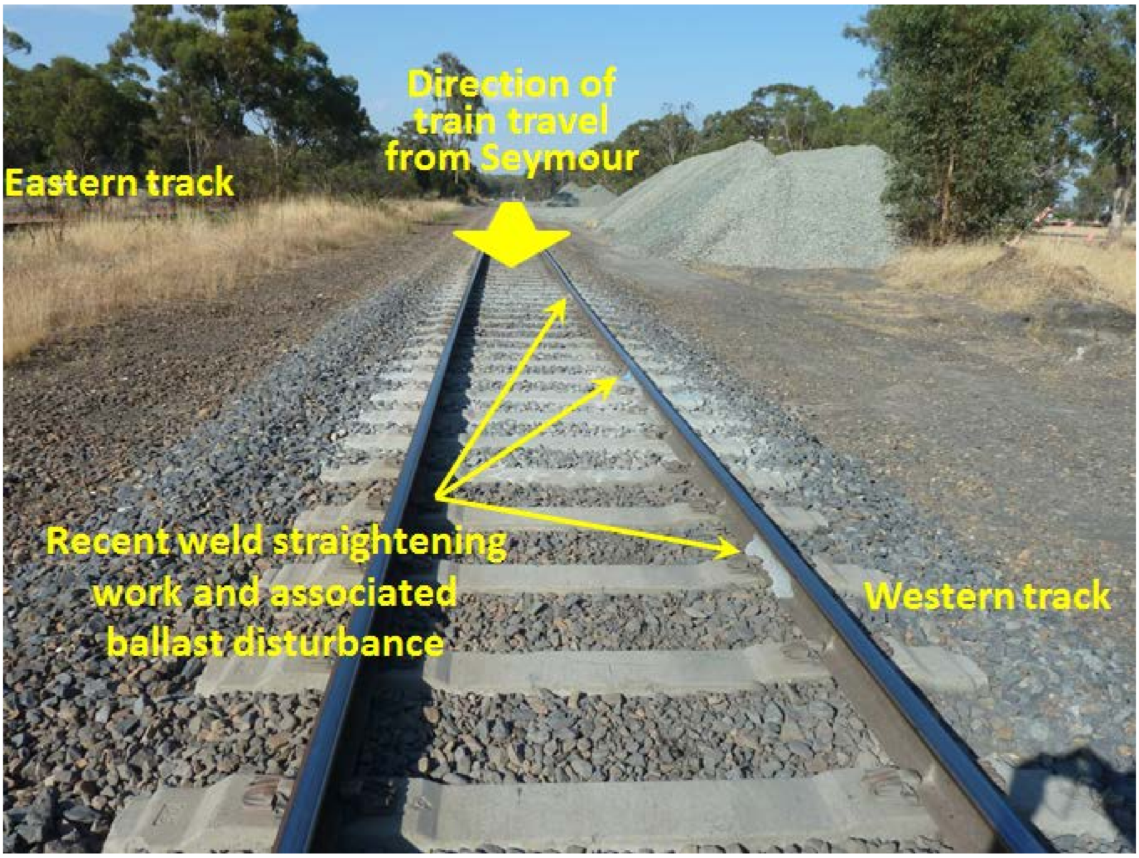
The long term effect of trains moving along a section of track can result in rail movement (creep) and an associated redistribution of longitudinal rail forces. The derailment near Locksley was about 380 m northeast of the Nagambie-Locksley Road level crossing (127.376 km) and about 850 m southwest of the Sandy Creek bridge (128.614 km). The track leading into the point of derailment transitioned from a sweeping left hand curve but was otherwise substantially straight and level. Typically, a train slowing into a fixed point (for example a level crossing or bridge structure) encourages bunching of the rail in the direction of train movement, thereby increasing the compressive forces within the track. Trains travelling through this area would normally be travelling close to the allowable track speed and therefore it is unlikely that compressive rail forces due to braking would occur.

Although the East and West lines are bi-directionally signalled trains tend to mainly travel in one direction (East line heading south to Melbourne and the West line heading north towards Sydney). On unidirectional track where travel is biased toward one direction, trains moving at constant speed tend to push the track in the direction of travel. Accordingly it is likely that these compressive forces coupled with recent track disturbances and high ambient temperatures induced the track to creep in a northerly direction, towards the derailment site.

Environmental conditions

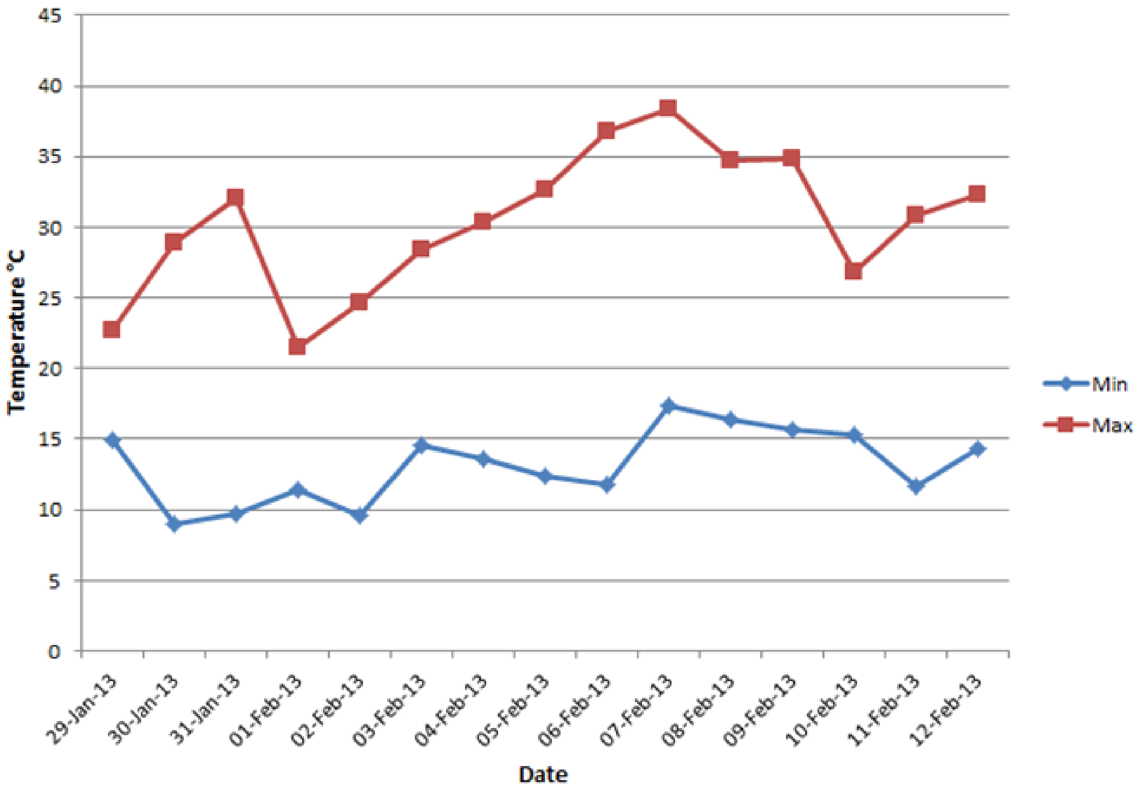
Mangalore is about 14.5 km southwest of Locksley; it is the site of the closest weather station. On the day of the derailment, the maximum temperature recorded at Mangalore was 31.6 °C, at about 1530. At the time of derailment (at about 1640) the temperature was about 30.6 °C. In the period preceding the derailment there was little cloud cover and the track was exposed to full/direct sunlight.

Figure 9: Weld straightening and associated ballast disturbance



Source: ATSB

Figure 10: Temperature from 29 January 2013 through to 12 February 2013 observed at Mangalore Airport.



Source: Bureau of Meteorology – Graph derived by ATSB

Experience has shown that where rail is subject to full sunlight, the rail temperature may be 15 °C to 20 °C higher than the corresponding ambient air temperature.[17] At some time before the derailment (about one hour) it was likely that the rail near the PoD attained a temperature of between 47 °C to 52 °C. The rail temperature was therefore well above the design neutral temperature resulting in high compressive rail forces. This, coupled with a large cyclic temperature variation (Figure 10) during the preceding fortnight and track disturbance activities, probably resulted in a redistribution of longitudinal stress concentration near the 127.768 km mark, giving rise to the track misalignment.

Track inspection

The inspection of track visually and by use of mechanised track geometry vehicles are two of the main methods for assessing track geometry and identifying defects, including areas having a potential risk of rail misalignment. The ARTC uses the *ARTC Track and Civil Code of Practice SA/WA & Vic* as the basis for mandating/assessing and recording the condition of its track and determining remedial maintenance actions.

The track near the PoD (127.768 km), both from 127.751 km to 127.755 km and 127.826 km to 127.830 km, had undergone undercutting and ballast renewal works on 15 July 2012 and resurfacing/tamping, from 127.500 km to 127.820 km, on 17 September 2012. The track through the area was examined using a mechanised track geometry car on 20 November 2012, about 3 months before the derailment. Although records show some evidence of a likely surface defect near the PoD these did not exceed set criteria and the site did not require corrective action.

The *ARTC Track and Civil Code of Practice SA/WA & Vic* generally prescribes that the interval between ‘Patrol inspections’ shall not exceed 7 days on mainline track. Records indicated that Patrol inspections were regularly performed, with one the day before the derailment (11 February 2013) that identified no defect near the location of the subsequent derailment. Also on the same day as the inspection, a track irregularity ‘dip in track’ was reported by a V/Line train driver close to the derailment site (127.900 km). The track was inspected in response to the report, but no track irregularity was found.

Managing Track Stability – Concrete Sleepered Track (ETM-06-06)

The ARTC procedure ETM-06-06 for the management of track stability of concrete sleepered track at section 1.11.5 considers ‘Special Locations’ and notes:

> Special locations are areas vulnerable to, or with a history of instability. Special locations may require rectification work or more detailed inspections to be performed on them prior to the high temperature season. Certain locations may not require any further action performed on them but will need to be more closely monitored during scheduled and unscheduled inspection. Consideration will need to be given to imposing speed restrictions at special locations at the onset of the high temperature season to mitigate the risk they may pose to the lateral stability of the track if the required rectification works have yet to be completed or by their nature, they cannot be eliminated.

The section then defines special locations to include:

- Areas affected by track disturbance (e.g. tamping) from May until and during the high temperature season;
- Sites with localised initiators;

Based on available evidence, the location near the PoD was affected by track disturbing maintenance activities during the high temperature season. Further, it was found that the ballast through the area was probably of a poor quality. EMT-06-06 at Attachment D: *Track Buckles –*

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[17] Investigation Report – 23 Nov 2002 by Darnick – Pacific National 6SP7 derailed, Section 5.7.4 Page 40. “… where rail is exposed to full sunlight the rail temperatures are usually 15 to 20'~ higher than the shade air temperatures recorded by the Bureau of Meteorology.”

Causes and Remedies identifies track having fouled ballast, glazed ballast bed, or mud holes as a potential area of high risk requiring the consideration of temporary speed restrictions for the effective management of track stability. These two factors, track disturbing activities/site with localised initiators (in this case poor ballast quality) are consistent with the criteria identified in the ARTC's procedure (ETM-06-06 section 1.11.5) as a risk to the lateral stability and therefore qualified as a 'Special Location'. However there was no evidence to suggest that the ARTC had instigated any specific action to manage the higher level of risk at this site.

Other track misalignment occurrences

The ATSB has investigated five previous derailments that were attributed to track misalignment/buckle events, these were:

- RO-2010-015 - Derailment of train 1MP5 at Goddards, WA, 28 December 2010
- RO-2008-012 - Derailment of train 3DA2 near Katherine NT, 4 November 2008
- RO-2006-001 - Derailment of freight train 3AB6 Yerong Creek, New South Wales 4 January 2006
- RO-2005-002 - Derailment of Pacific National train 6MP4 Koolyanobbing, Western Australia and Pacific National train 6SP5 Booraan, Western Australia on 30 January 2005. (Two occurrences on the same day at different locations)

Although each of these occurrences was unique in its own right and involved various track owners and rail operators, there are some common issues that are evident and should be considered in mitigating the risk of derailment from track misalignment/buckling. They include:

- The effects of track disturbing works need to be carefully managed particularly during periods of hot weather.
- Rail de-stressing operations if incorrectly managed can result in high longitudinal track forces increasing the risk of track buckling events.
- Ballast quality and profile is essential in protecting against the loss of lateral track resistance.
- Effective creep monitoring points, if available, assist maintenance staff in determining the potential risk of track misalignment events.
- Organisations should consider appropriate 'Heat Speed Restriction' strategies to lower the risk of derailment events arising from track buckling during periods of high ambient temperature.
- Project management and quality assurance processes, need to be robust to ensure that track work is carried out in accordance with prescribed standards.

Safety analysis

As train 3MC1 approached Locksley in Victoria, the locomotive driver saw a buckle in the track ahead and throttled off in an attempt to ride through it. The front portion of the train negotiated the buckle but as the train traversed the site the buckle probably grew under the train, becoming large enough to initiate the derailment of the eighth to last wagon and the remaining wagons. Based on the train crew's observations and supported by site evidence the ATSB concluded that the derailment of train 3MC1 was initiated by a track misalignment at the 127.768 km location.

Close examination of the ballast shoulder (western side/West line) exposed by wagons that had derailed revealed that the ballast layer was heavily contaminated/fouled with fine material (fines). This would probably result in a track structure that had reduced lateral resistance and was more prone to buckling.

The ATSB also established that track work was undertaken about 298 m and 18 m in advance of the derailment site about two weeks before the incident. This track work coupled with trains moving along the track and a large variation in temperature (during the two weeks preceding the derailment) probably resulted in a re-distribution of longitudinal rail stresses along the track concentrating near the 127.768 km mark. The redistribution of longitudinal rail stresses combined with a track structure that lacked sufficient lateral resistance were probably factors which led to the misalignment and subsequent derailment.

The combined effect of high ambient temperature, poor ballast condition and track disturbing maintenance are known to increase the risk of track misalignment (buckling). Consequently, the ARTC has a procedure (ETM-06-06) that considers locations subject to these conditions to be 'Special Locations'. The procedure requires specific action to manage the higher level of risk. On this occasion there was no evidence to suggest that the ARTC had instigated proactive action to manage the increased level of risk at this site.

Findings

On 12 February 2013 intermodal freight train 3MC1 derailed at Locksley, near Seymour in Victoria. There were no injuries but the last eight wagons had derailed and about 800 m of track was damaged.

From the evidence available, the following findings are made with respect to the derailment and should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- The derailment of freight train 3MC1 at Locksley, Victoria was initiated by a track misalignment at the 127.768 km location on the West Line of the interstate mainline.
- Hot weather and trains travelling along the track probably contributed to a redistribution of longitudinal rail stresses in a northerly direction towards the derailment site.
- Track disturbing maintenance activities close to the derailment site and a track structure that had reduced capacity to withstand lateral forces (heavy ballast contamination) probably increased the level of risk of a track buckling event.
- **The ARTC had not instigated proactive action to manage the increased risk of a buckling event in accordance with their procedure ETM-06-06 (*Managing Track Stability – Concrete Sleepered Track*) at section 1.11.5 - 'Special Locations'. [Safety issue]**

Other findings

- It is unlikely that the condition of the rolling-stock, the actions of the train driver including train speed and braking, or track spread/gauge widening contributed to the derailment.

Safety issues and actions

The safety issues identified during this investigation are listed in the Findings and Safety issues and actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the directly involved parties were provided with a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Track structural strength and maintenance activities

Number:	RO-2013-006-SI-01
Issue owner:	Australian Rail Track Corporation Limited
Type of operation:	Rail –Infrastructure maintenance
Who it affects:	All rail infrastructure managers

Safety issue description:

The ARTC had not instigated proactive action to manage the increased risk of a buckling event in accordance with their procedure ETM-06-06 (Managing Track Stability – Concrete Sleepered Track) at section 1.11.5 - 'Special Locations'.

Proactive safety action taken by: Australian Rail Track Corporation Limited

The Australian Rail Track Corporation has advised that:

> Track maintenance staff have been provided with additional training on the consequences of multiple track disturbances altering the stress free temperature of rail track. The training will provide an enhanced level of compliance with the requirements of procedure ETM-06-06 (Managing Track Stability - Concrete Sleepered Track).

Other action taken by the Australian Rail Track Corporation:

> Following the derailment and subsequent reinstatement of the track the Australian Rail Track Corporation undertook stress free temperature testing at ten sites near the 'Point of Derailment'. Tests established that the rail stress free temperature was within specified tolerances.
>
> The Australian Rail Track Corporation has implemented a ballast remediation program on the Melbourne- Sydney rail corridor. This work will continue as programmed until completed, following which further works will be undertaken at sites having identified formation weakness.

Action number: RO-2013-006-NSA-01

Action status: Closed

ATSB response:

The ATSB is satisfied that the action taken by the Australian Track Corporation addresses this safety issue.

General details

Occurrence details

Date and time:	12 February 2013 – 1641 ESuT	
Occurrence category:	Accident	
Primary occurrence type:	Derailment	
Location:	29 km northeast of Seymour, Victoria	
	Latitude: 36° 49.891’ S	Longitude: 145° 20.110’ E

Train details

Train operator:	Qube Holdings Limited	
Registration:	3MC1	
Type of operation:	Intermodal freight comprising two locomotives (GL107 leading and GL101 trailing) hauling 33 wagons with a trailing mass of 921.1 t and an overall length of 885.5 m.	
Persons on board:	Crew – 2	Passengers – N/A
Injuries:	Crew – 0	Passengers – N/A
Damage:	Minor	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Bureau of Meteorology
- Qube Holdings Limited
- The Australian Rail Track Corporation

References

ARA Glossary for the National Codes of Practice and Dictionary of Railway Terminology

ARTC Track and Civil Code of Practice SA/WA & Vic.

RISSB National Guideline - Glossary of Railway Terminology

Improved knowledge of CWR track - Coenraad Esveld

Investigation Report – 23Nov2002 by Darnick – Pacific National 6SP7 derailed, Section 5.7.4 Page 40.

Track Buckling Research in CWR from US DOT's Volpe Center

Track Stability and Buckling - Rail Stress Management - Zayne Kristian Ole (University of Southern Queensland Faculty of Engineering and Surveying, October 2008)

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to:

- Qube Holdings Limited
- Chief Investigator, Transport Safety Victoria
- Office of the National Rail Safety Regulator
- The Australian Rail Track Corporation
- Transport Safety Victoria
- Witnesses and individuals

Submissions were received from:

- Chief Investigator, Transport Safety Victoria
- The Australian Rail Track Corporation
- Transport Safety Victoria

The submissions were reviewed and where considered appropriate, the text of the draft report will be amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

24 Hours 1800 020 616
Web www.atsb.gov.au
Twitter @ATSBinfo
Email atsbinfo@atsb.gov.au

Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation
Derailment of freight train 3MC1, Lockslev, Victoria on 12 February 2013

RO-2013-006
Final – 11 October 2013