



Australian Government
Australian Transport Safety Bureau

Derailment of coal train EF01

Duaringa, Queensland | 24 January 2018



Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation
RO-2018-005
Final – 28 June 2019

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Publishing information

Published by: Australian Transport Safety Bureau
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

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Addendum

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Safety summary

What happened

At 1347 on 24 January 2018, loaded Aurizon coal train EF01 encountered a track buckle at Duarina, on Aurizon Network's Blackwater System between Emerald and Rockhampton, Queensland. The buckle resulted in 17 wagons in the train consist derailing, damaging 502 m of track on the down line and 54 m of track on the adjacent up line, with rails, sleepers and overhead line equipment requiring replacement. Thirteen coal wagons were extensively damaged and not expected to be repaired. There were no injuries.

What the ATSB found

The ATSB found the track buckle had formed on a falling 1 in 50 grade at the point of the track where ballast cleaning and track stabilisation work had been completed less than 12 hours earlier. The ballast cleaning operational plan did not consider compressive stress in the continuous welded rail as a risk at this location.

The compressive stress, steep grade, proximity to a turnout and high ambient temperature meant the track structure had a limited capacity to constrain lateral forces. While the ballast cleaning, track resurfacing and dynamic track stabilisation work met Aurizon Network's civil engineering track standards, negative operational outcomes were not anticipated when a risk assessment was done for the site.

What has been done as a result

While work was conducted to re-open the Blackwater System, de-stressing was performed on the down line on the approach to the point of derailment, and on the up line on both sides of the turnout adjacent to the point of derailment.

Aurizon Network has changed its procedures to ensure a temporary speed restriction is applied to all work sites on which ballast undercutting has been performed. The restriction is to remain in place until rail adjustment or stress testing has been completed and it has been determined that the rail stresses are within accepted limits. In addition, sites with a high risk of compressive rail stress will be identified and added to the site hazard map before conducting ballast cleaning.

Safety message

The incident highlights the importance of developing, maintaining and consulting a network hazard register to identify locations at risk of buckling, and producing site-specific risk assessments that consider rail stress when planning track disturbing maintenance work.

The incident also demonstrates that effective rail stress management is dependent on a knowledge of the rail stress free temperature and the identification of any variations from that stress free temperature.

The occurrence

At 1110¹ on 23 January 2018, Aurizon Network's Plasser RM900 High Output Ballast Cleaning Machine began undercutting work along a straight section of the down line² between Duaringa and Aroona, Queensland (Qld) from 103.130 km³ to 102.800 km. The work was part of planned track maintenance on Aurizon Network's Blackwater System between Emerald and Rockhampton.

Without dismantling the track, the ballast cleaning machine undercut the ballast bed with a moving chain beneath the rails and sleepers, removed contaminated and degraded ballast, screened it to eliminate contaminants and replaced the screened ballast under the track.

Work concluded at 1505, at a point just before the 11 A/B turnout⁴ at the eastern end of Duaringa yard. Plasser 09-2X Continuous Action Tamping machine MMA505 then tamped⁵ and aligned the track, and performed dynamic track stabilisation,⁶ completing its first pass through the work site at 1730.

Three loaded coal trains subsequently passed over the re-opened down line. MMA505 began its second and final pass through the work site at 0200 on 24 January, tamping, re-aligning and stabilising the track. Another eight loaded coal trains passed over the down line between 0248 and 1332.

At 1345 on 24 January, the loaded coal train EF01 passed signal DA14 at the western end of Duaringa, rolling at 66 km/h. It was the twelfth loaded coal train to pass over the down line since ballast undercutting and dynamic track stabilisation had been completed.

As the train began to descend the 1 in 50 grade⁷ the driver applied and progressively increased the dynamic brake.⁸ When the train passed signal DA16 at the eastern end of Duaringa at 57 km/h, the lead locomotive's dynamic brake controller was set at B8.

On the steep falling grade, the driver supplemented the dynamic brake with a brake pipe reduction of 100 kPa and increased the dynamic brake to its maximum setting at B10. At this point, the driver noticed a track buckle forming ahead of the train, just before the 11 A/B turnout on the down line.

At 1347, train EF01 negotiated the track buckle at 53 km/h, throwing the lead locomotive and wagons from side to side, as they passed over it. The driver placed the automatic brake handle in the full service position and made an emergency radio call, warning other trains in the vicinity that the train may have derailed.

Looking back from the locomotive, the second driver reported that several wagons appeared to be off the line. The driver placed the automatic brake handle in the emergency position at 48 km/h,

¹ All time references in this report are in Eastern Standard Time (EST).

² Up describes travel west from the Central Line start point at Rocklands (6 kilometres south of Rockhampton) to Winton. Down describes travel east from Winton to Rocklands. Where there are two adjacent tracks on which rail traffic can travel in either direction an up train from Rocklands to Winton will have the up line on the left and the down line on the right. A down train from Winton to Rocklands will have the down line on the left and the up line on the right.

³ Distances shown in this report are kilometres from the Central Line start point at Rocklands.

⁴ A turnout is a mechanical installation with allows trains to be guided from one track to another. At the eastern end of Duaringa yard a pair of turnouts numbered 11 A/B and 11 C/D form a crossover on which trains can move from the down line to the up line and vice versa.

⁵ Mechanised consolidation of crushed stone ballast under the sleepers to restore track stability.

⁶ Ballast cleaning and tamping may reduce the resistance of the track structure to buckling. This resistance can be restored over time with the passage of trains, but it requires the imposition of a temporary speed restriction on the work site. Track consolidation can be achieved faster and in a more controlled manner by using a dynamic track stabiliser to apply horizontal vibration and a vertical load to simulate the passage of trains over the track section.

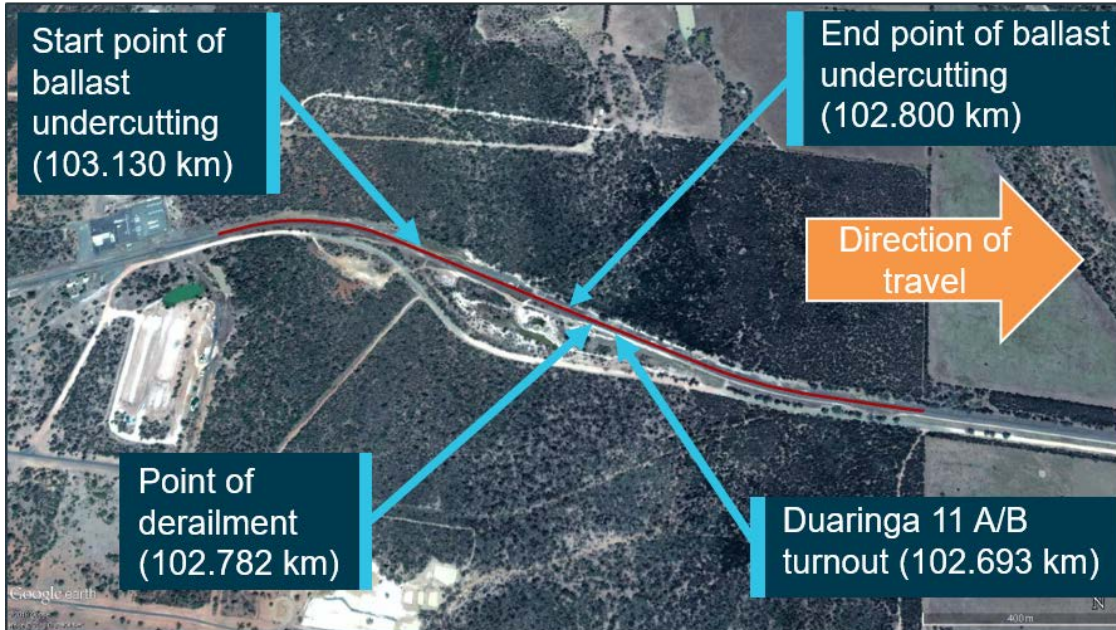
⁷ Descending a 1 in 50 grade, the elevation decreases by one metre for every 50 horizontal metres travelled.

⁸ Dynamic braking uses a locomotive's traction motors as generators to control train speed. On a 3800 class electric locomotive dynamic brake is available between B1 (minimum) and B10 (maximum).

reducing the train's brake pipe pressure to 0 kPa at an emergency rate and fully applying the brakes.

Line voltage was lost, indicating that the 25kV AC overhead line equipment had been damaged, and at 1348, the train came to a halt; 65 seconds after the lead locomotive had passed over the track buckle (Figure 1).

Figure 1: Position of train EF01 after the derailment, and area of ballast undercutting on the Duaringa to Aroona down line



Source: Google Earth annotated by ATSB

Wagon 12 on the train, the first to derail, travelled for 502 m in a derailed state before the train stopped. Wagon 20 had also derailed and wagon 24 appeared to have derailed and then re-railed. Flange marks found on the head of the rail showed the leading wheelset of the leading bogie of wagon 12 had climbed over the rail at the 102.782 km mark—identified as the initial point of derailment.

Examination of the wagons behind the lead locomotive after the derailment, including those that had not derailed, showed their auto-couplers and drawbars had experienced movement from side to side well beyond their normal range of operation, consistent with running through a short 'S' shaped track buckle at considerable speed.

Strike marks to the sides, wear plates and upper surfaces of the draw gear housings became more pronounced further back in the train consist. This indicates that the amplitude of the track buckle had increased as the train ran through it. The first light contact was noted on the auto-couplers between the wagons 4 and 5 and significant strike marks were identified on the four auto-couplers and drawbars between wagons 6, 7, 8, 9 and 10. Severe strike marks found on the auto-coupler and draft gear housings between wagons 10 and 11 showed the track buckle had developed into a full 'S' shape by the time they passed over it.

The 13 wagons in positions 33 to 45 were completely derailed. Eleven were on their sides, spread across the up and down lines at the eastern end of Duaringa, over the 11 A/B and 11 C/D turnouts and along the northern side of the track (Figures 2 and 3).

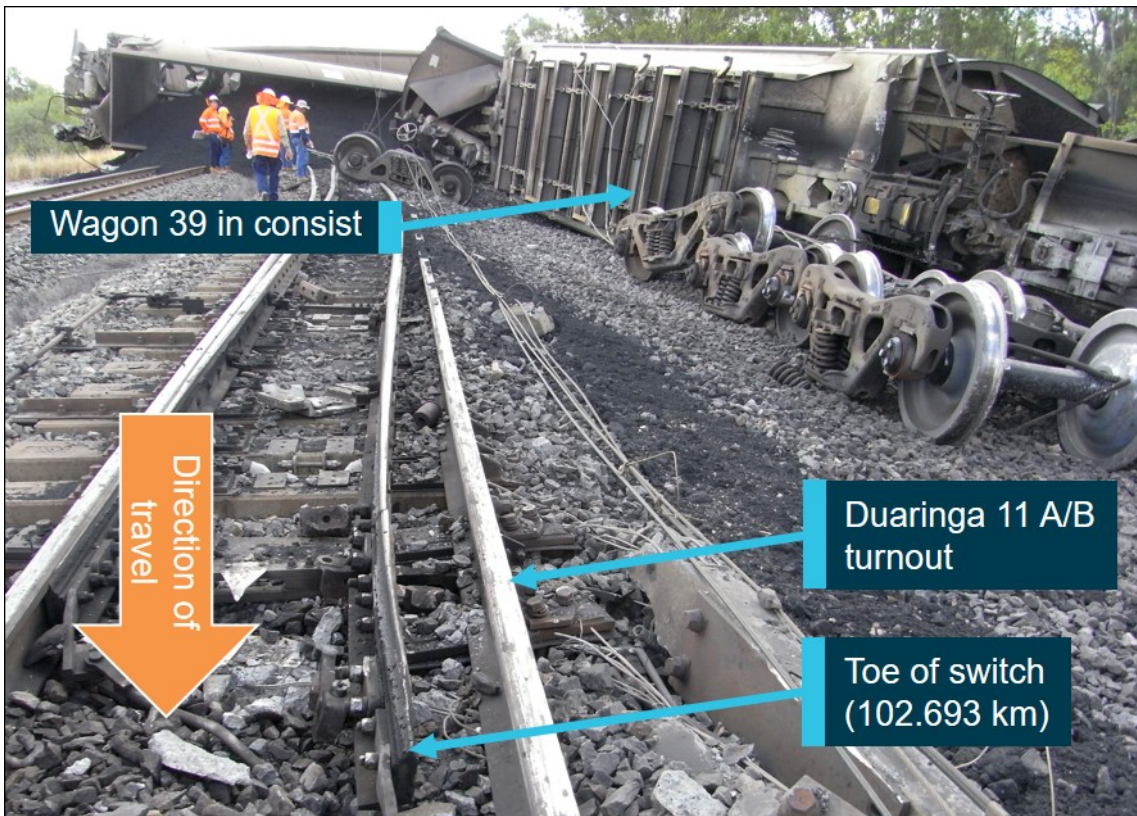
Figure 2: Derailed wagons 33 to 46 on the Duaringa to Aroona down line



Source: Aurizon annotated by ATSB

Two derailed wagons remained upright, but off the track. The leading bogie of wagon 46 had derailed, but its trailing bogie remained on the track. The rail vehicles behind the partially derailed wagon, including six loaded wagons, the mid-train remote locomotive, another 50 loaded wagons and the end-of-train remote locomotive, remained on the track.

Figure 3: Looking back towards the point of derailment over the damaged 11 A/B turnout.



Source: ATSB

There were no injuries. Of the 17 wagons that derailed, 13 were extensively damaged and not expected to be repaired. In addition, 502 m of track on the down line and 54 m of track on the adjacent up line was damaged, with rails, sleepers and overhead line equipment requiring replacement.

Context

Train EF01

Aurizon train EF01 was operating from Boonal Balloon, 9 km east of Blackwater, to the R G Tanna coal terminal at the Port of Gladstone, Queensland. It had been loaded with coking coal at Boonal Balloon, with 102 coal wagons and an estimated gross mass of 11,004 tonnes. The 1,722 m train included lead locomotive 3804, 52 wagons, mid-train locomotive 3813, another 50 wagons and end-of-train locomotive 3808.

Stress free temperature

In the past, rail track was laid with short lengths of jointed rail up to 25 m long, which expanded and contracted with the rise and fall of the ambient temperature. Today, most main line rail track is laid with continuous welded rail, which is less expensive to maintain and has a longer lifespan than jointed rail, but expands and contracts significantly with variations in temperature.

When the state of the rail is neither in tension nor in compression, it is at its stress free temperature. Over weeks, months or years, the stress free temperature of a specific track section may be reduced if it is subject to rail creep (see *Rail creep* below), lateral shift, track disturbing work (such as re-ballasting) or an extended period of hot weather. As the stress free temperature is lowered, the compressive forces present in the rail increase and the track section may become vulnerable to buckling.

Continuous welded rail that has been disturbed is returned to the required stress free temperature by restressing. Rail anchors and fasteners are removed, and if the rail is in tension it is cut and a new section of rail is added. If the rail is in compression it is cut and a section of rail is removed.

Rail creep

Rail creep is the longitudinal movement or migration of rail in one direction, due to temperature changes, train operations, maintenance activities or inherent rail stresses from manufacture or construction. It occurs when thermal and train dynamic forces exceed the longitudinal resistance provided by the rail anchors and resilient fasteners that secure rails to the sleepers.

Compressive rail stress may accumulate over time as a direct result of creep, at the bottom of descending grades where heavy train braking occurs and in track sections adjacent to fixed points such as level crossings, bridges and turnouts.

Rail creep can be monitored by marking datum points on a fixed structure (such as an overhead line equipment mast) and the rail adjacent to that structure, and comparing that initial position with its position several weeks or months later. Movement of the datum point on the rail away from its initial position indicates that creep has occurred.

Environmental conditions

The closest Bureau of Meteorology weather station to the derailment site was located at Blackwater, about 85 km west of Duaringa. On the day of the derailment, the maximum temperature recorded at Blackwater was 37.0 °C. There was no rainfall recorded in the 24-hours preceding the derailment.

At the time of the derailment (1347), the weather was fine and hot. The minimum overnight temperature was 22.8 °C, and for the week preceding the derailment, the weather was dry and hot with every day exceeding 34 °C.

A maximum rail temperature of 43 °C was recorded while the ballast cleaning work was conducted between 1110 and 1505 on 23 January 2018. The next day at 1600, more than 2 hours

after the derailment, the rail temperature was 48 °C and the ambient temperature at the derailment site was 34 °C.

Preparation for ballast cleaning work

Under the *Rail Safety National Law (Queensland)*, part 3 Regulation of rail safety, sections 99 and 100, a safety management system must provide risk management systems and procedures for eliminating, reducing, identifying and assessing risks, and a register of risks.

A site survey was conducted on 10 November 2017, more than 2 months before the ballast cleaning work began. Workers from the ballast cleaning and drainage team located overhead line equipment cables, bond wires and stay wires, signage, drains and old signal mast bases that would impede the operation of the ballast cleaning machine, and assessed the ballast profile, prepared a site hazard map, identified waterways near the work site and made provision for the disposal of waste.

The presence of rail stress at the work site was not considered, and the maintenance superintendent responsible for this track section was not asked to provide the ballast cleaning team with information on any rail stress issues or track buckle history at the work site.

Hazard location register

Aurizon's *Civil Engineering Track Standards – Track Stability CETS 10* stipulated that hazard locations on the rail network must be recorded in its Hazard Location Register. The rail infrastructure manager is required to identify locations where track instability had been recorded previously, where monitoring had demonstrated that the potential for instability exists, and where there were increased longitudinal forces and other destabilising factors that reduce the lateral resistance or strength of the track.

The track stability standard noted that hazards may exist at locations where the stress free rail temperature is unknown, at the bottom of descending grades, near fixed structures such as turnouts, and where track disturbing work has been conducted.

Track instability had not been recorded previously on the down line at the eastern end of Duinga yard and the track section did not appear in Aurizon's Hazard Location Register.

Other track misalignment occurrences

The ATSB has investigated nine previous derailments attributed to track misalignment or buckle events, including:

- [RO-2015-025](#) – Derailment of iron ore train ND575 near Tom Price, Western Australia, 15 December 2015
- [RO-2014-003](#) – Derailment of grain train 9130 at Emu, Victoria, 12 February 2014
- [RO-2013-006](#) – Derailment of train 3MC1 near Locksley, Victoria, 12 February 2013
- [RO-2013-002](#) – Derailment of intermodal train 3PS6 at Yunta, South Australia, 17 January 2013
- [RO-2010-015](#) – Derailment of train 1MP5 at Goddards, Western Australia, 28 December 2010
- [RO-2009-004](#) – Derailment of freight train 6MB2 at Tottenham, Victoria, 30 January 2009
- [RO-2008-012](#) – Derailment of train 3DA2 near Katherine, Northern Territory, 4 November 2008
- [2006001](#) – Derailment of freight train 3AB6 at Yerong Creek, New South Wales, 4 January 2006
- [2005002](#) - Derailment of train 6MP4 at Koolyanobbing, Western Australia and train 6SP5 at Booraan, Western Australia, 30 January 2005 (two different events on the same day).

Although these occurrences involved a variety of track owners and rail operators, and were unique in their details, there are some common factors. These factors should be considered in mitigating the risk of derailment from track buckling events. For example:

- Trains travelling along a track, particularly in one direction, can result in a redistribution of longitudinal rail stresses along the track. Fixed points, such as level crossings, turnouts, or bridge structures, can further compound the risk of longitudinal rail stress redistribution, resulting in increased track-buckling risk. Signals located on falling grades may also contribute to rail creep, as rolling stock braking and wheel/rail forces induce additional longitudinal rail stress.
- During hot weather, the effects of track disturbing works require prudent management.
- Ballast quality and profile is essential for providing resistance against lateral track movement.
- To assist maintenance workers in determining the potential risk of track buckling events, effective creep monitoring points should be considered, particularly at high-risk areas such as curves, and near fixed points, such as railway crossings, turnouts and bridge structures.
- Track owners should consider heat speed restriction strategies during periods of high ambient temperature to reduce the risk of track buckling and derailments.
- Management and quality assurance processes need to be robust to ensure that track work is conducted in accordance with prescribed standards.

Safety analysis

Introduction

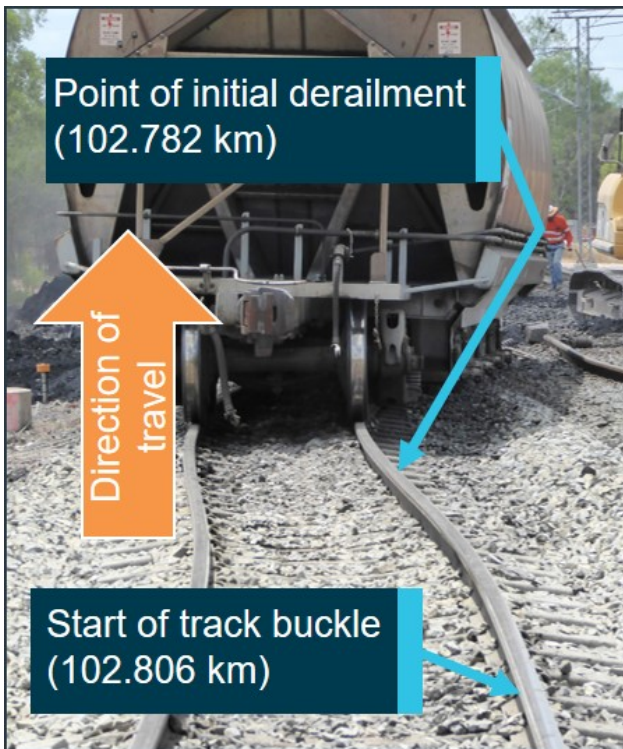
The completed ballast cleaning, track resurfacing and dynamic track stabilisation work conducted on the down line at Duaringa complied with Aurizon Network’s Civil Engineering Track Standards. In addition, there was no evidence to suggest that train handling or a rolling stock defect caused the derailment. Consequently, the investigation focused on the management of track stability and rail stress.

Track buckle and derailment

On sections of track laid with continuous welded rail, track buckles usually form when high ambient temperatures, excessive compressive forces, track disturbing work and train dynamics compromise the stability of the track structure.

At Duaringa, these factors acted together upon the short section of track between the end point of the ballast undercutting work (102.800 km) and the fixed point associated with the 11 A/B turnout (102.693 km). A track buckle was seen by the driver to begin to form as loaded coal train EF01 approached (Figure 4).

Figure 4: Track buckle, point of derailment and last derailed wagon (46 in consist)



Source: ATSB

As the train passed over it, the amplitude of the buckle increased. The lead locomotive and first 11 wagons ran over the track buckle without derailing before the wheels of wagon 12 were unable to steer through it. The right-hand wheel of the leading wheelset of the leading bogie climbed over the head of the rail and derailed at 102.782 km.

The buckle developed laterally and assumed a full 'S' shape. Wagons 33 to 45 were subject to extreme lateral forces as they passed over it and derailed completely.

Risk assessment

The conditions at this location were conducive to the accumulation of compressive rail stress and the track buckled less than 12 hours after dynamic track stabilisation work had been completed. Those conditions (temperature and falling grade ending at a fixed point) presented operational hazards that, if identified, could have been planned for and mitigated. It is likely that the rail was in a compressive state⁹ before ballast cleaning work began.

The risk assessment conducted for the maintenance activities considered a range of factors. However, it did not consider any risks to the operation of trains.

If compressive rail stress had been identified as a hazard at the site, it is likely that arrangements would have been made to impose a temporary speed restriction on the track section on completion of the ballast cleaning work. A temporary speed restriction would have reduced the risk of a train derailment.

Hazard location register

Track instability had not been recorded previously on the down line at the eastern end of Duaringa yard and the track section did not appear in Aurizon's Hazard Location Register. In the Ballast Cleaning Operational plan, compressive rail stress was not considered a hazard at this location, and it was not included on the site hazard map. Stress testing was not conducted before the ballast cleaning work began, and it was not performed after the work had been completed.

It seems likely that the Hazard Location Register was primarily a record of occurrences, rather than a resource used proactively during planning for work, comparing and analysing locations on the network with similar characteristics and identifying common hazards.

After the work on the down line at Duaringa had been completed, the site was not treated as a hazard location. Dynamic track stabilisation partially restored the track's stability after the ballast cleaning work, but it was the only remedial measure applied to the track.

Indicators of rail stress

Aurizon's track stability manual advised that track prone to rail creep problems included track adjacent to fixed structures such as turnouts, areas with steep grades and areas where high braking occurs. This is consistent with the area where the track buckle developed just before the Duaringa 11 A/B turnout on a falling 1 in 50 grade.

Rail creep markers and rail stress monitors had been trialled on Aurizon's Central Queensland coal network at Edungalba (approximately 20 km east of Duaringa) between 2010 and 2012, but they had not been installed at Duaringa. Aurizon engineering staff advised the ATSB that there was no history of track buckling at the eastern end of Duaringa yard and the track section was not regarded as high-risk for track buckling.

Aurizon engineering personnel involved in conducting the ballast cleaning work advised that the stress free temperature¹⁰ of the down line rail at the eastern end of Duaringa yard was not known.

⁹ Track buckles develop from the release of compressive rail stress accumulated over an extended period of time.

¹⁰ The temperature at which the rail, fixed to the sleepers and forming the track structure, is the same length as it had been in its unrestrained state before installation.

Findings

From the evidence available, the following findings are made with respect to the derailment of Aurizon coal train EF01 between Duaringa and Aroona on 24 January 2018. These findings 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

- A track buckle formed on the down line at the eastern end of Duaringa yard due to the combined effect of a high ambient temperature, excessive compressive rail stress, recent track disturbing ballast cleaning work and dynamic uplift from an approaching train. The magnitude of the buckle was sufficient to derail the train as it passed over it.
- The risk assessment conducted before ballast cleaning work began on the down line between Duaringa and Aroona addressed immediately observable hazards, but it did not consider compressive rail stress to be a hazard at this location.
- **When planning track disturbing work, Aurizon’s normal practice was to use its Hazard Location Register as a record of past occurrences at a specific location. Aurizon did not use the Hazard Location Register as a resource to consider the situational characteristics of a location that may increase risk, such as continuous welded rail, track gradient and proximity to fixed points such as turnouts or level crossings. [Safety issue]**
- **A variety of techniques to indicate and record rail stress at specific locations are available, however Aurizon had not used any of these techniques in some locations with elevated risk of rail stress, such as tangent track on steep grades. As a result, Aurizon could not readily determine the presence or absence of compressive rail stress at these locations. [Safety issue]**

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.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the [aviation, marine, rail - as applicable] industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

Use of hazard location register

Number:	RO-2018-005-SI-01
Issue owner:	Aurizon
Operation affected:	Rail: Infrastructure
Who it affects:	Train crew and passengers on board trains on Aurizon-owned track

Safety issue description:

When planning track disturbing work, Aurizon’s normal practice was to use its Hazard Location Register as a record of past occurrences at a specific location. Aurizon did not use the Hazard Location Register as a resource to consider the situational characteristics of a location that may increase risk, such as continuous welded rail, track gradient and proximity to fixed points such as turnouts or level crossings.

Proactive safety action taken by Aurizon

Action number: RO-2018-005-NSA-001

During the investigation, Aurizon advised that:

- To assist in identifying potential track buckle locations, all work sites were required to be assessed for risk, with a focus on track leading up to fixed points, locations with a history of track buckling and sections on which loaded coal trains descend steep grades. Risk assessments were also required to consider ballast condition, rail stress free temperature, site temperature and forecast temperature.
- Sites with a high risk of compressive rail stress will be identified and added to the site hazard map before conducting ballast cleaning.

Related safety action was also proposed or introduced to reduce safety risk associated with track buckling (see *Additional safety action*).

Current status of the safety issue

Issue status: Adequately addressed.

Justification: The ATSB is satisfied that the safety action will reduce the risk associated with the safety issue.

Management of rail stress

Number:	RO-2018-005-SI-02
Issue owner:	Aurizon
Operation affected:	Rail: Infrastructure
Who it affects:	Train crew and passengers on board trains on Aurizon-owned track

Safety issue description:

A variety of techniques to indicate and record rail stress at specific locations are available, however, Aurizon had not used any of these techniques in some locations with elevated risk of rail stress, such as tangent track on steep grades. As a result, Aurizon could not readily determine the presence or absence of compressive rail stress at these locations.

Proactive safety action taken by Aurizon

Action number: RO-2018-005-NSA-002

During the investigation, Aurizon advised that it was implementing the following actions:

- Review and align Civil Engineering Procedure 44 - Measurement of Rail Stress Free Temperature and the Track Stability Manual (AZN NA MAN 12 6170 005) to define the maximum permitted time between completing track disturbing works and performing a rail stress test, and action to be taken should those test results fall outside acceptable limits.
- Review the management of rail stress on completion of ballast removal works.

In June 2019, Aurizon also advised that:

- Aurizon currently maintains and controls a register of known stress free temperatures of sites located within the Central Queensland Coal Network. Aurizon has committed to a program of work to ensure that the register progressively covers a greater percentage of the network, enabling more effective asset management in the extreme weather periods.
- The stress free temperature register highlights areas of high risk or concern for all seasons, but especially leading up to and throughout the hot weather period when track buckling is at a higher risk of developing into incidents.

Current status of the safety issue

Issue status: Adequately addressed.

Justification: The ATSB acknowledges that Aurizon has taken (or is proposing to take) safety action to improve their knowledge of rail stress throughout its network. Although this proactive safety action does not specifically address all aspects of the safety issue, the ATSB believes the risk of derailments will be reduced by this safety action, together with the other action in relation to the other safety issue with its hazard location register (RO-2018-005-SI-01).

Additional safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

During the investigation, Aurizon advised that it had taken the following safety actions:

- The Duaranga-Aroona down line (on the approach to the point of derailment) and the Aroona-Duaranga up line (adjacent to the point of derailment, on both sides of the 11 C/D turnout) were de-stressed to relieve any remaining compressive forces.

- Sites on which ballast undercutting work has been performed had a temporary speed restriction (TSR) of 40 km/h applied. The restriction was required to remain in place until rail adjustment or stress testing had been completed and the rail stresses were confirmed as being within acceptable limits.

In addition, Aurizon advised that it was also implementing the following additional actions such as:

- Review the planning, prestart and handback processes for works involving heavy machinery, mechanised production or large ballast removal works and include a process for the identification of track buckle risks and appropriate controls.
- Review and align SAF/STD/0075/CIV/NET Hot Weather Precautions for Track Stability, SAF/STD/0077/CIV/NET Module 10 – Track Stability and the Track Stability Manual (AZN NA MAN 12 6170 005) to establish clear guidelines for instances in which ballast is removed or renewed, and the actions taken to protect the track asset from the risk of a stress-related derailment.
- Discuss with Network Operations the risks associated with completing work in hot weather and the management of rail stress.
- Review and amend the current checklist, used to hand back completed work sites, to cover all aspects of track-related disturbance work in hot weather.
- Develop a program to train, certify and guide those workers handing track assets back into service, taking into consideration minor and major works, light and heavy axle load tracks and appropriate levels of qualification.
- Develop and implement a local process to improve communication between the superintendents responsible for works and maintenance.
- Consider fitting outward-facing video recording equipment to locomotives.

General details

Occurrence details

Date and time:	24 January 2018 - 1347 EST	
Occurrence category:	Accident	
Primary occurrence type:	Train derailment	
Location:	At the 102.782 km on the Central Line, between Duaringa and Aroona, Queensland	
	Latitude: 23° 42.771' S	Longitude: 149° 41.384' E
Rail Infrastructure Manager	Aurizon Network	

Train details

Train operator:	Aurizon	
Train number:	EF01	
Type of operation:	Coal	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Damage:	Substantial	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Aurizon
- Personnel involved in planning and conducting the ballast cleaning work.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (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 Aurizon, key personnel involved in planning the work and the Office of National Rail Safety Regulator (ONRSR).

Submissions were received from ONRSR and Aurizon. The submissions were reviewed and where considered appropriate, the text of the report was 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 operations involving the travelling public.

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.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

- (a) the occurrence would probably not have occurred; or
- (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or
- (c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interest of improved transport safety.

Other findings: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.

Australian Transport Safety Bureau

Enquiries 1800 020 616

Notifications 1800 011 034

REPCON 1800 020 505

Web www.atsb.gov.au

Twitter @ATSBinfo

Email atsbinfo@atsb.gov.au

Facebook [atsbgovau](https://www.facebook.com/atsbgovau)

Linkedin [Australian Transport Safety Bureau](https://www.linkedin.com/company/atsb)

Investigation

ATSB Transport Safety Report Rail Occurrence Investigation

Derailment of coal train EF01, Durranga, Queensland
on 24 January 2018

RO-2018-005

Final – 28 June 2019