Rail Accident Report

Runaway and derailment of a wagon at Clitheroe, Lancashire
9 March 2020

Report 16/2020
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This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC
- the Railways and Transport Safety Act 2003
- the Railways (Accident Investigation and Reporting) Regulations 2005.

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Preface

The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

RAIB's findings are based on its own evaluation of the evidence that was available at the time of the investigation and are intended to explain what happened, and why, in a fair and unbiased manner.

Where RAIB has described a factor as being linked to cause and the term is unqualified, this means that RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident or incident that is being investigated. However, where RAIB is less confident about the existence of a factor, or its role in the causation of the accident or incident, RAIB will qualify its findings by use of words such as 'probable' or 'possible', as appropriate. Where there is more than one potential explanation RAIB may describe one factor as being 'more' or 'less' likely than the other.

In some cases factors are described as 'underlying'. Such factors are also relevant to the causation of the accident or incident but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, words such as 'probable' or 'possible' can also be used to qualify 'underlying factor'.

Use of the word 'probable' means that, although it is considered highly likely that the factor applied, some small element of uncertainty remains. Use of the word 'possible' means that, although there is some evidence that supports this factor, there remains a more significant degree of uncertainty.

An 'observation' is a safety issue discovered as part of the investigation that is not considered to be causal or underlying to the accident or incident being investigated, but does deserve scrutiny because of a perceived potential for safety learning.

The above terms are intended to assist readers' interpretation of the report, and to provide suitable explanations where uncertainty remains. The report should therefore be interpreted as the view of RAIB, expressed with the sole purpose of improving railway safety.

Any information about casualties is based on figures provided to RAIB from various sources. Considerations of personal privacy may mean that not all of the actual effects of the event are recorded in the report. RAIB recognises that sudden unexpected events can have both short- and long-term consequences for the physical and/or mental health of people who were involved, both directly and indirectly, in what happened.

RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of any inquest or fatal accident inquiry, and all other investigations, including those carried out by the safety authority, police or railway industry.

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Runaway and derailment of a wagon at Clitheroe, Lancashire, 9 March 2020

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Summary

At about 08:16 hrs on 9 March 2020, a loaded wagon ran away from a siding located within the Hanson UK cement works in Clitheroe. It travelled a distance of about 0.75 miles (1.2 km) on a falling gradient, before it derailed at Horrocksford Junction, where the freight-only branch line from the cement works connects to the main railway lines.

As it ran away, the wagon broke through the gates at the exit from the works and then ran over a level crossing on a public road, causing two cars to stop. Soon afterwards, the wagon passed over a second level crossing on a private road, which leads to a chemical works. Neither level crossing had its manually activated warning equipment switched on before the wagon passed over it.

On arriving at Horrocksford Junction, the wagon derailed at a set of trap points. As intended, this arrangement prevented the wagon from reaching the main lines. The derailed wagon stopped clear of the nearest main line and no trains were nearby at the time of the derailment. No one was injured in the accident, although there was minor damage to the wagon and severe damage to the track where the wagon had run derailed.

The investigation found that the wagon ran away because its handbrake was not effective at holding it in place on the gradient where it had been stabled. This was due to a combination of insufficient brake force being provided by the applied handbrake and the fully laden wagon being stabled on its own and on a gradient falling towards the exit from the cement works. The staff who stabled the wagon did not know the handbrake would not hold the wagon in place after they applied it, as the wagon's brakes were already pneumatically applied when they did this, and over time, the air in the brake system leaked away until the air brake was released. It is possible that a maintenance examination that was due before the accident, but which was not carried out, would have found the problem with the handbrake's effectiveness.

An underlying factor was that the parties responsible for the operation of trains at the cement works had not adequately assessed or controlled the risk of a rail vehicle running away from the cement works. RAIB also observed that the risks to users at one of the level crossings concerned were not being managed by Network Rail, and that potential evidence, which might have explained why the handbrake provided insufficient force to hold the wagon in place, was lost to the investigation.

RAIB has made three recommendations. The first is that GB Railfreight should work with the owners of industrial premises to improve its assessment of the risks of runaway vehicles. The second recommends that Hanson UK should assure itself that a suitable and sufficient risk assessment has been undertaken for all rail operations taking place on its site. The third recommendation is that freight operating companies review the adequacy of the processes followed for stabling vehicles on a gradient using handbrakes, particularly if a laden vehicle is to be left on its own. RAIB also identified two learning points. The first is a reminder of the importance of scheduled examinations of wagons taking place on or before their due dates. The second is a reminder about the importance of preserving items of evidence required for safety investigations.

Introduction

Definitions

1 Metric units are used in this report, except when it is normal practice to give speeds and locations in imperial units. Where appropriate the equivalent metric value is also given.

2 The report contains abbreviations and acronyms which are explained in Appendix A. Sources of evidence used in the investigation are listed in Appendix B.

The accident

Summary of the accident

3 At about 08:16 hrs on 9 March 2020, a loaded wagon ran away from a siding located within the cement works in Clitheroe, Lancashire (figure 1). The wagon left the works and continued to run away on the falling gradient towards Horrocksford Junction, where the branch line to the cement works connects to the main railway line (figure 2).

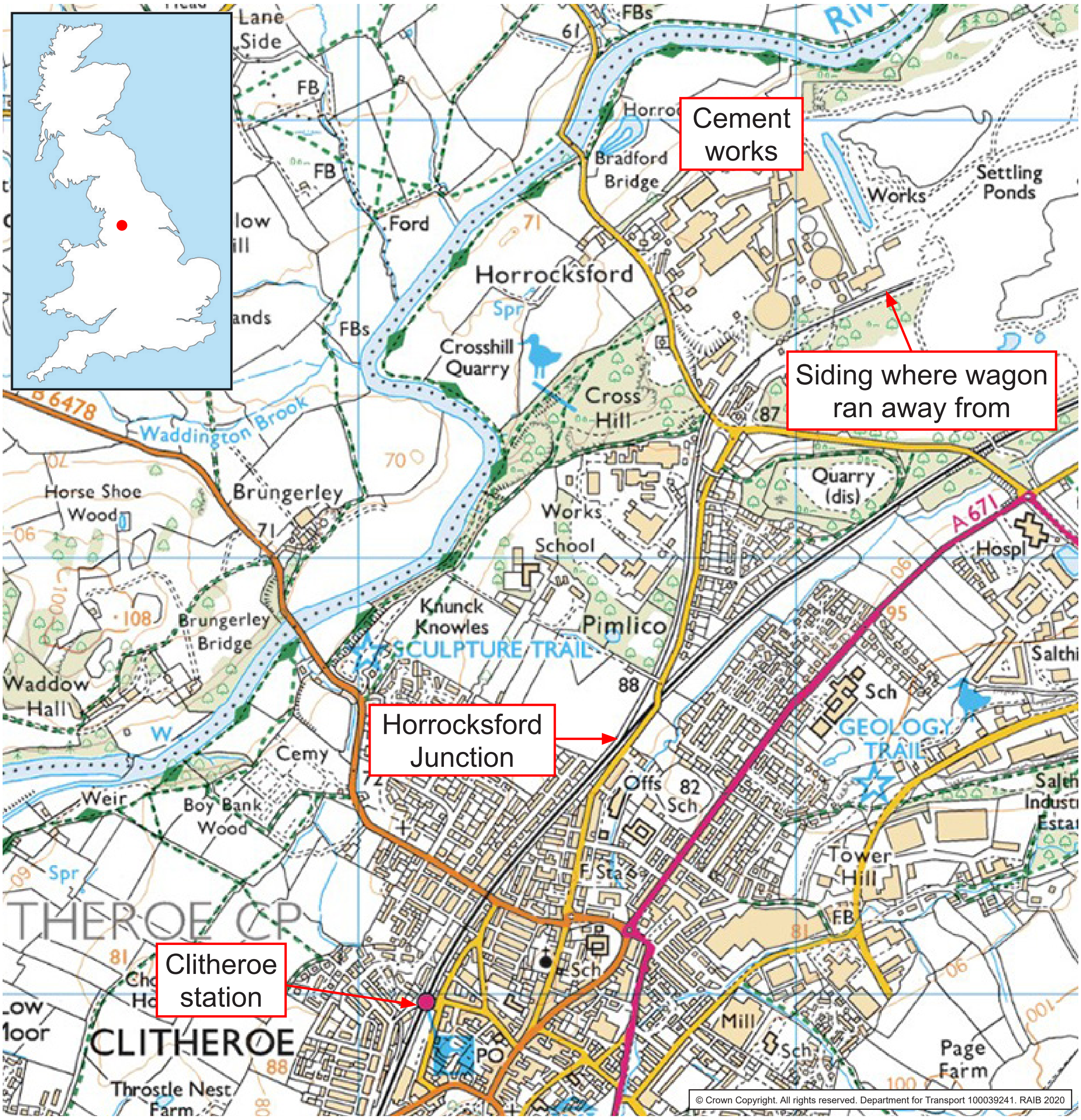

Figure 1: Extract from Ordnance Survey map showing location of accident

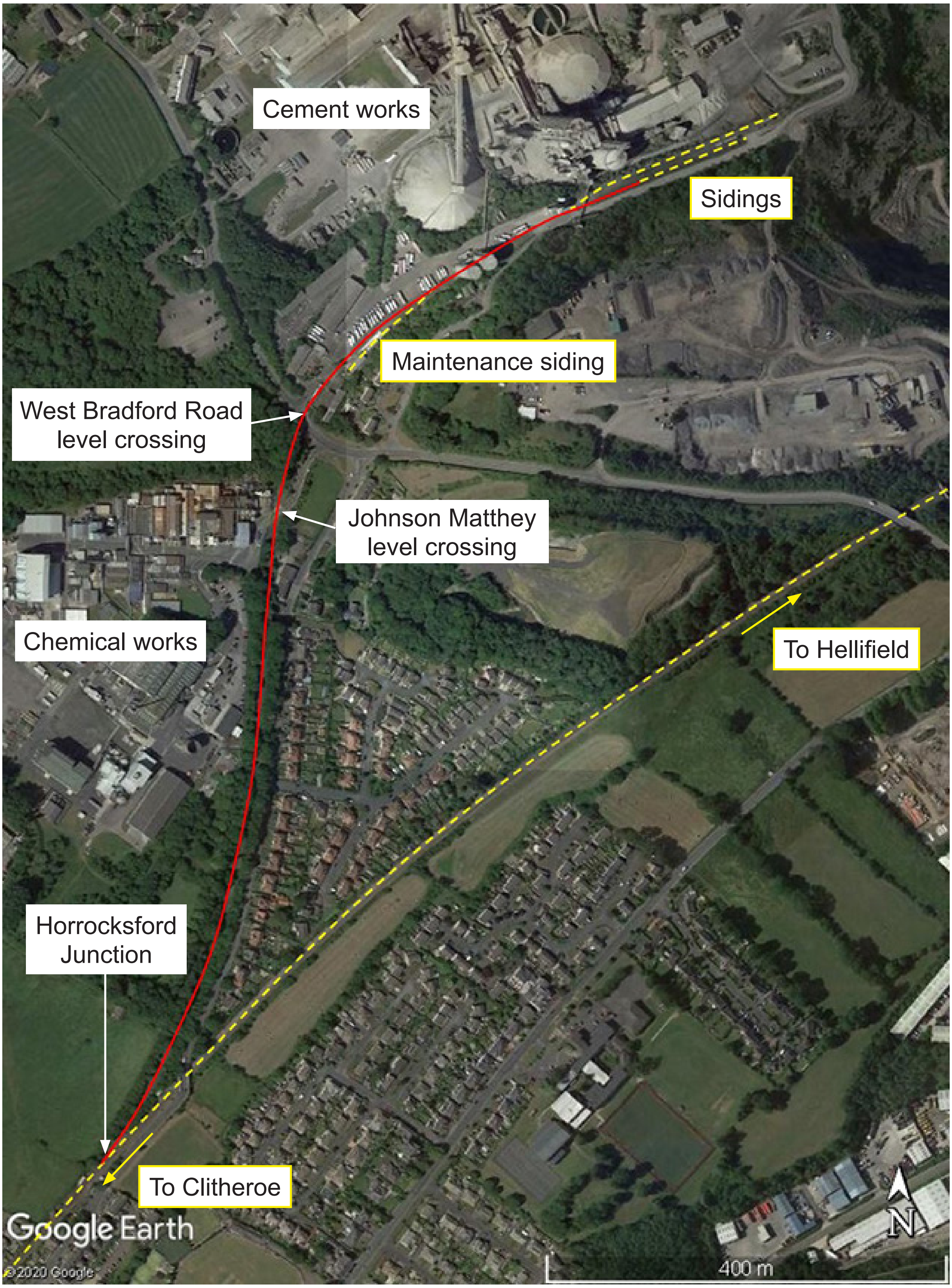

Figure 2: Google Earth view of the path taken by the runaway wagon

4 As it ran away, the wagon broke through the gates at the exit from the cement works and ran over West Bradford Road level crossing (figure 2) causing two cars to stop. A short distance later, the wagon also passed over Johnson Matthey level crossing (figure 2) which was clear of pedestrian and road traffic. Neither level crossing had its manually activated warning equipment switched on before the wagon passed over it (see paragraph 10), so users had no warning of the approaching wagon.

5 On reaching Horrocksford Junction, the wagon derailed at the end of the run-out rails associated with a set of trap points (figure 3). The trap points worked as intended to prevent such unauthorised movements from reaching the main line. The derailed wagon stopped clear of the main line and no trains were nearby when the derailment occurred. The wagon travelled a total distance of about 0.75 miles (1.2 km).

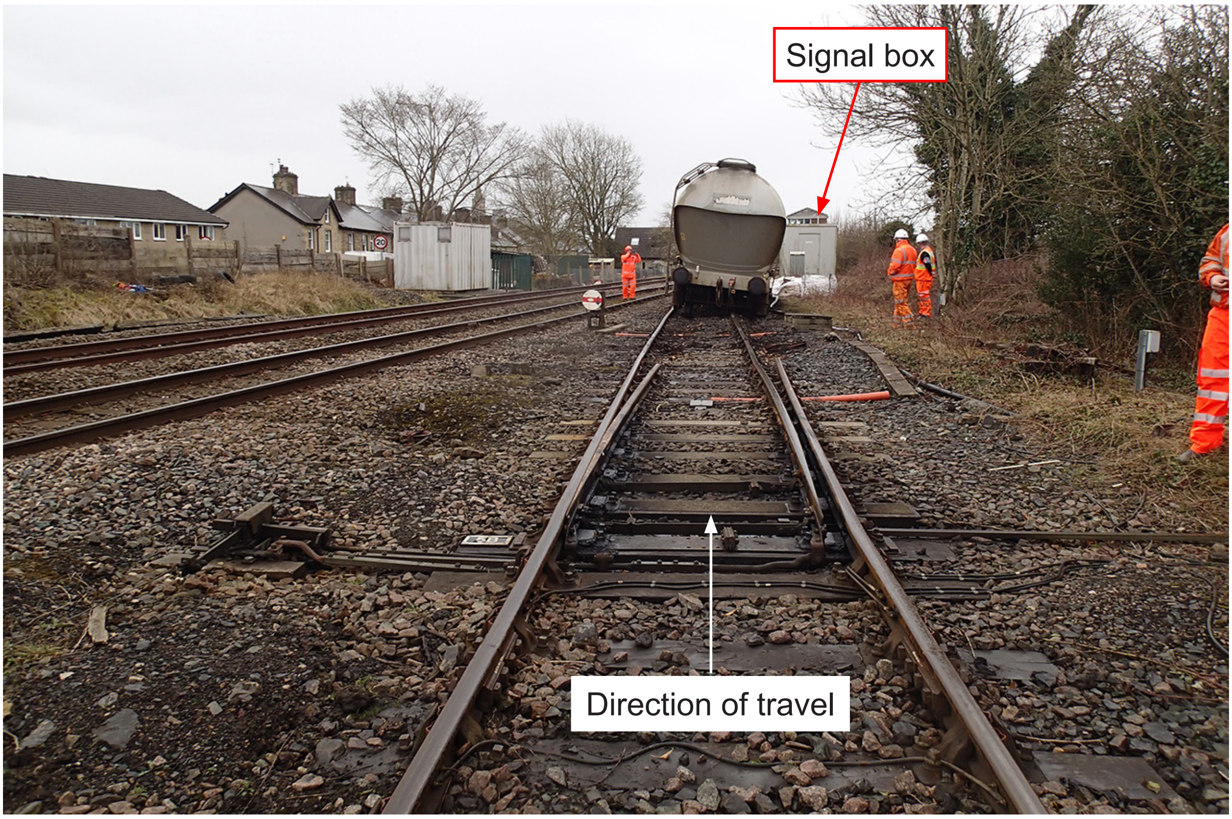

Figure 3: The derailed wagon beyond the trap points

6 Minor damage was sustained by the wagon and damage was caused to the track where the wagon ran derailed. The wagon was recovered during the night following the accident. Repairs to the track to allow access to the branch line and cement works were completed at 07:36 hrs on 13 March.

Context

Location

7 The wagon ran away from a siding within the Hanson UK cement works in Clitheroe. This is located at the end of a freight-only branch line which starts at Horrocksford Junction, on the line between Blackburn and Hellifield (figure 4).

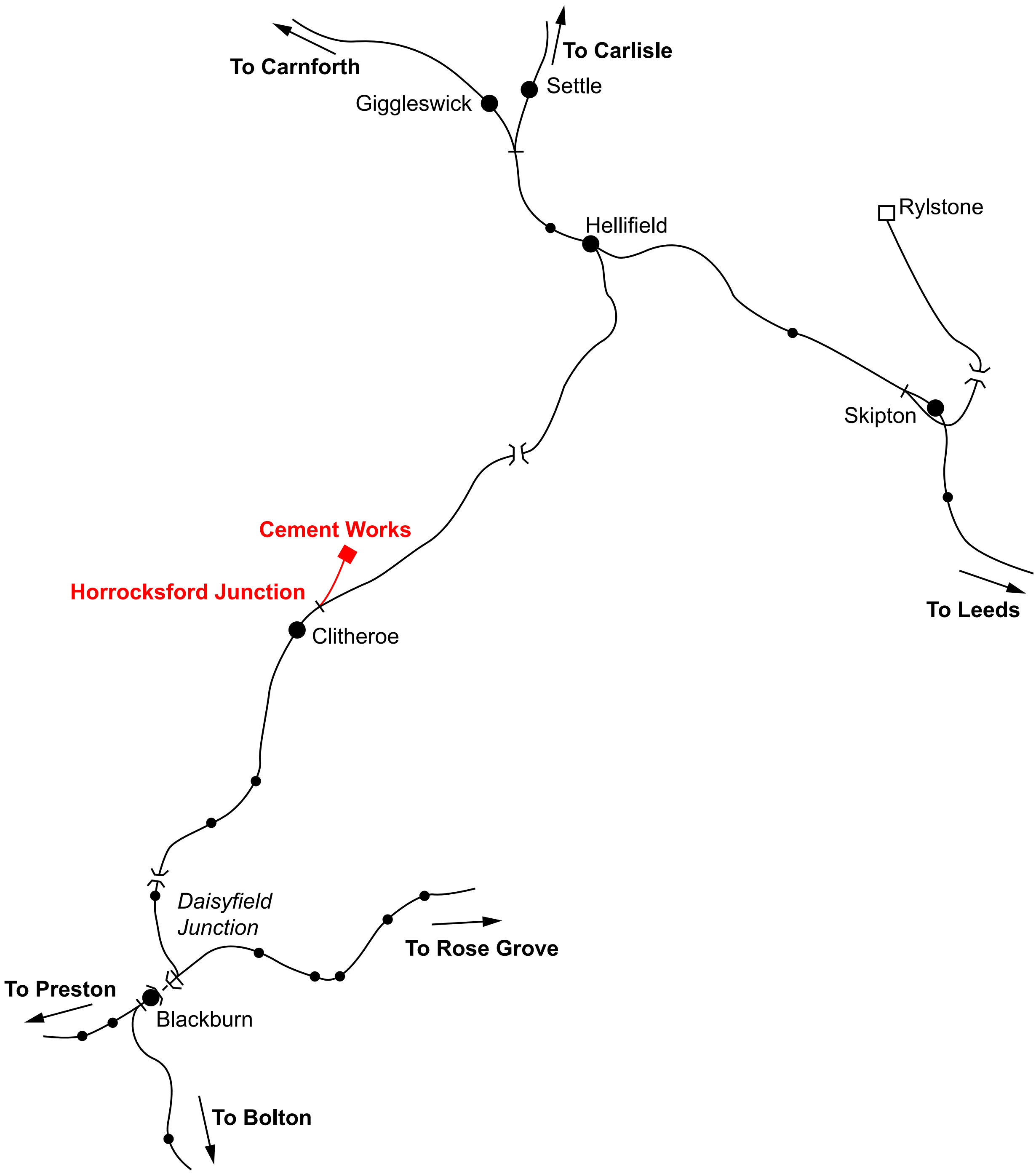

Figure 4: Location of Horrocksford Junction

8 At Horrocksford Junction, a single track leads onto the branch line. About 40 metres from the trap points (figure 3), the branch line then becomes double track for about 570 metres (figure 5). This provides a long loop for locomotives to run round trains and propel them (by pushing from behind) into the cement works. Beyond this loop, the railway continues as a single track into the cement works. The boundary where ownership of the infrastructure changes from Network Rail to Hanson UK (figure 5) is located about 0.5 miles (800 metres) from Horrocksford Junction.

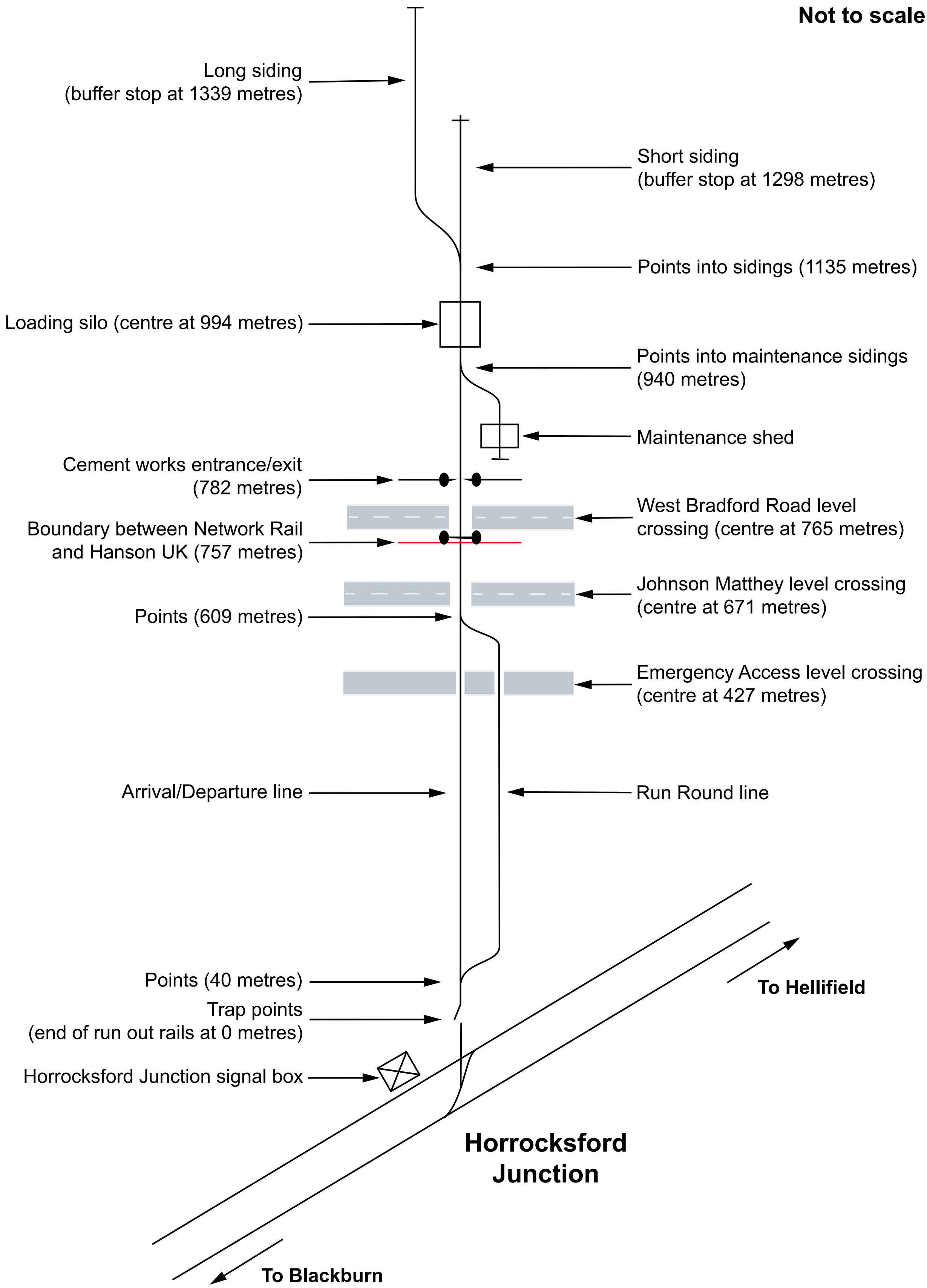

Figure 5: The level crossings and track layout on the branch line from Horrocksford Junction to the cement works and within it

9 Inside the cement works there are three sidings (figure 5). The first of these is the maintenance siding which is located between the site's entrance and the loading silo. This is used for wagon maintenance and stabling Hanson UK's two shunting locomotives. The remaining two sidings, referred to as the long siding and the short siding, are at the far end of the cement works.

10 There are three level crossings on the branch line (figure 5), two of which are on Network Rail infrastructure. One of these is the Johnson Matthey level crossing which provides access, via a private road, to and from a chemical works. The other crossing is not normally used as it provides access to the chemical works only in emergencies. The third level crossing is located where the railway crosses West Bradford Road, a public road with a 30 mph (48 km/h) speed limit. This level crossing is outside the cement works but is on Hanson UK's railway infrastructure (figure 5).

11 Network Rail publications state that the maximum permitted speed on the branch line is 15 mph (24 km/h), although the freight operating company that operates trains into and out of the cement works specifies that its locomotives must travel at a lower speed of 5 mph (8 km/h) when hauling wagons and 3 mph (5 km/h) when propelling wagons on the line. Train movements to and from the branch line are controlled by the signaller at Horrocksford Junction signal box.

12 The track gradient falls towards Horrocksford Junction for almost all the path taken by the runaway wagon. The gradient profile measured by RAIB is shown in figure 6.

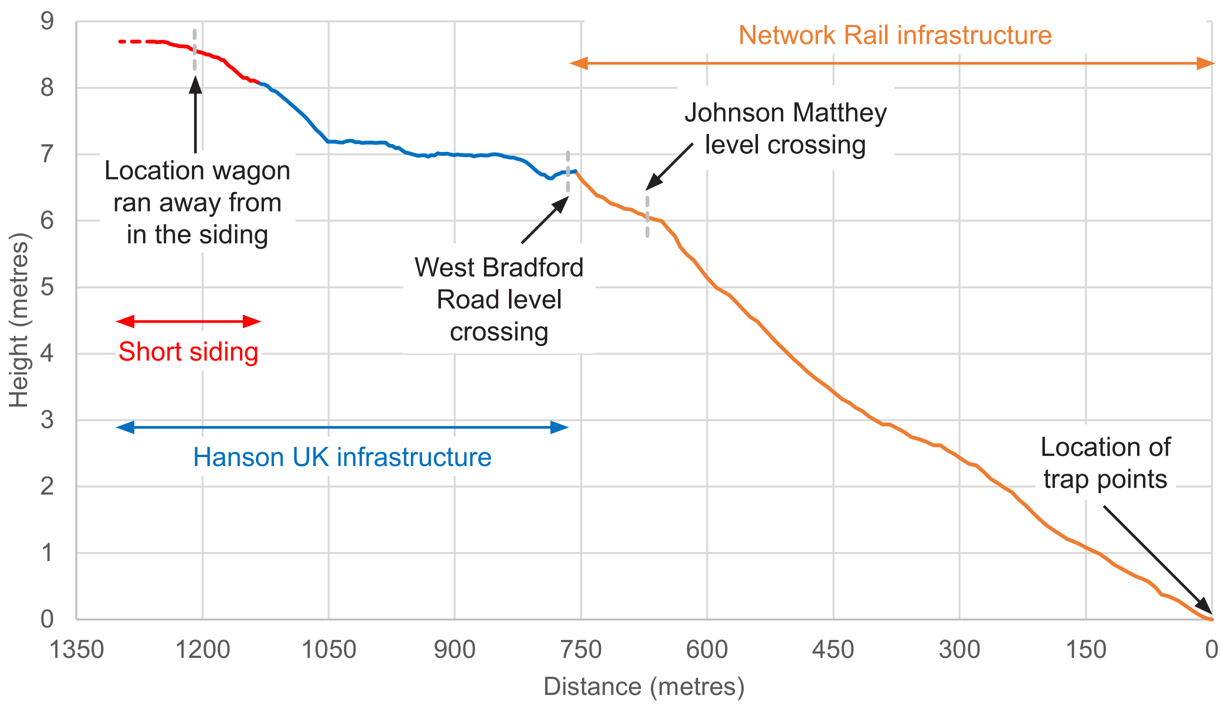

Figure 6: The track gradient profile from the siding where the wagon ran away from to the trap points at Horrocksford Junction

Organisations involved

13 Network Rail owns, operates and maintains the railway infrastructure at Horrocksford Junction and the branch line up to its boundary with Hanson UK. It employs the signaller at Horrocksford Junction signal box. It also employs the mobile operations manager who was in the signal box at the time of the accident as a result of a signalling equipment fault unconnected to the accident. Mobile operations managers provide first-line response to incidents that affect the operation of the railway.

14 Hanson UK, which is part of the HeidelbergCement Group, owns the cement works and is the customer for the train service running into and out of the works. Hanson UK owns, operates and maintains the railway infrastructure throughout the cement works, along with a very short length of the branch line up to its boundary with Network Rail, which includes the level crossing over West Bradford Road.

15 GB Railfreight Ltd was contracted by Hanson UK to operate the trains that run into and out of the cement works. It provided locomotives to haul these trains along with train drivers and staff to shunt, load and prepare the trains at the cement works. It employed the staff who stabled the wagon that ran away.

16 Brian Dent Holdings Limited, referred to as Dents, was contracted by Hanson UK to move wagons within the cement works. It provided drivers for the shunting locomotives at the cement works and staff to control these movements. These staff also assisted GB Railfreight staff when trains were arriving and departing.

17 VTG Rail UK Ltd, referred to as VTG, owned the wagon that ran away. It leased the wagon to Hanson UK as one of a fleet of wagons used to transport cement powder. VTG was the entity in charge of maintenance[1] for the wagon, so was responsible for controlling all maintenance work carried out on it.

18 DB Cargo Maintenance was contracted by VTG to carry out routine examinations and maintenance of the wagon.

19 Johnson Matthey PLC owned the private road into its chemical works that passes over the Johnson Matthey level crossing. It employed several hundred staff who used the crossing to access its site. Due to the nature of its work, heavy goods vehicles, many carrying dangerous goods, also used this level crossing.

20 All the organisations involved freely co-operated with the investigation.

Train involved

21 The wagon that ran away, number VTG10601, is a PCA tank wagon (figure 7). It is one of a fleet of PCA wagons that VTG (and its predecessors) has owned since it was built in 1982. Prior to the accident, wagon VTG10601 was in a set of wagons that was dedicated to transporting cement powder from Clitheroe to Avonmouth.

[1] A person or organisation responsible for the maintenance of rail vehicles that must ensure that, through a system of maintenance, the vehicles it is responsible for are safe to run on the main line railway network.

Figure 7: An example of a PCA tank wagon

22 VTG10601 is a two-axle wagon, with a frame that supports a tank which is used to carry cement powder. It has a pneumatically controlled brake system that applies two brake blocks onto the tread of each wheel. It also has a handbrake, that is manually operated using a wheel (figure 7). This applies two brake blocks onto each wheel at just one end of the wagon. The wagon has a gross mass of 50.75 tonnes when loaded and 12.65 tonnes when empty.

23 The wagon's maintenance regime requires it to have a planned preventative maintenance (PPM) examination every four months and a vehicle inspection and brake test (VIBT) examination annually. The aim of the PPM examination is that regular planned maintenance will reduce the number of failures in service. The purpose of the VIBT examination is to ensure that the wagon is in a serviceable condition and that its brakes are functioning correctly. The wagon is also subject to an in-service inspection every 28 days. This is a visual examination to check the wagon is fit to run on the rail network. Staff from DB Cargo Maintenance carried out all these wagon examinations at the cement works. Other planned maintenance activities were also carried out on the wagon at the cement works, such as pressure vessel checks on the wagon's tank that took place every 2.5 years.

24 The periodicities of these examinations were set by the VTG engineering team and were based on the expected annual mileage and use of the wagon. The number of days that a wagon was allowed to continue running in service beyond the due date for any scheduled examination was set by a system known as the Total Operations Processing System (TOPS).[2] Limits on TOPS allowed a wagon to be used up to 14 days beyond the due date of its PPM examination and up to 28 days beyond the due date of its VIBT examination.

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[2] TOPS is a computer system, widely used by the rail industry, that contains information on train services and rail vehicles. For vehicles that are authorised to run on the main line railway network, it contains information about their location, destination, load, brake force and maintenance status. It can be used to place restrictions on the rail vehicles which form a train, with these restrictions applied either automatically or manually by users.

25 VTG aimed to schedule its wagon examinations so that they took place close to the due date, rather than letting wagons remain in service until they reached the limit set by TOPS. However, for reasons of practicality, this arrangement sometimes allowed a wagon to remain in service for a few days beyond the due date of the examination. For this reason, the examination periodicities set by the VTG engineering team for each wagon fleet took into account the possibility that, on occasions, wagons would remain in service for a short period beyond the due date.

Staff involved

26 Two GB Railfreight ground staff,[3] an assistant train manager and a trainee rail operator, left wagon VTG10601 stabled in a siding in the cement works. The assistant train manager had been employed by GB Railfreight since 2013 and had passed his most recent competence assessment to perform ground staff duties in January 2019 (his next assessment was due in January 2022). He had passed a location specific competence assessment to allow him to carry out ground staff duties at Clitheroe cement works in May 2018. The trainee rail operator started working for GB Railfreight at the end of January 2020 so did not yet hold any competencies. He was working under instruction from the assistant train manager, who was acting as his mentor that day.

27 No other staff were directly involved with stabling the wagon. Although a GB Railfreight train driver moved the train to shunt the wagon into the siding, he was under instruction from the two ground staff at that time.

28 The fleet controller responsible for wagon VTG10601 had been employed by VTG in this role for over eight years. VTG had six fleet controllers for its 2900 wagons. Each fleet controller monitored when examinations and maintenance work were due on the wagons they were responsible for and arranged for the work to take place. This included the PPM and VIBT examinations for each wagon (paragraph 23).

External circumstances

29 It was daylight at the time of the accident. Sunrise was at about 06:30 hrs, but it was overcast and dull that morning. The local weather conditions, based on closed-circuit television (CCTV) footage, were cloudy. It was not raining at the time, although the ground was wet because it had been raining overnight. A local weather station, located 2.1 miles (3.4 km) away, reported that the air temperature in the Clitheroe area was 5°C.

[3] Staff employed to shunt trains and wagons, who can also check trains and carry out pre-departure tests on a train prior to it travelling on the main line railway network.

The sequence of events

Events preceding the accident

30 Because a PPM examination on wagon VTG10601 was due on Friday 21 February 2020, the VTG fleet controller arranged for it to be taken out of service. The wagon was stopped at the cement works in Clitheroe on Monday 24 February, so that this PPM examination could take place. While the wagon was out of service, the fleet controller also arranged for its tank to be checked (paragraph 23).

31 On Thursday 27 February, a specialist contractor completed the check on the wagon's tank. After this work was completed, the wagon was shunted out of the maintenance siding and put back into service before its scheduled PPM examination had taken place. The wagon was then loaded. This prevented the PPM examination from being done, because it can only be carried out when the wagon is empty.

32 On Friday 28 February, the fleet controller found out the wagon had been loaded before its PPM examination had been carried out, and that it had gone back into service. She therefore sent a request to the VTG engineering team to ask for the wagon's PPM examination to be deferred by up to seven days. This deferral was granted to allow the wagon to go to Avonmouth to be unloaded and then return to Clitheroe, where the PPM examination could then proceed. The wagon then ran in a train which made two round trips, loaded to Avonmouth and returning empty to Clitheroe, where it arrived on Thursday 5 March. Upon arrival, the train, including wagon VTG10601, was loaded again.

33 On Friday 6 March, the train again ran to Avonmouth and was unloaded upon arrival. When wagon VTG10601 was unloaded at 21:44 hrs, TOPS automatically placed a restriction on the wagon's use, known as an 'O' card, as the wagon's PPM examination was now overdue by more than 14 days (paragraph 24). The 'O' card restriction meant the wagon was not allowed to be loaded again but it was permitted to travel back empty to a location where its PPM examination would then take place.

34 On Saturday 7 March, the train ran back to Clitheroe and arrived at 11:45 hrs. This train was received and shunted into the cement works by the GB Railfreight assistant train manager and trainee rail operator. Once back in the cement works, all the wagons in the train, including wagon VTG10601, were loaded again. The assistant train manager and trainee rail operator then prepared the train so it would be ready for departure at 07:44 hrs on Monday 9 March, when it was due to leave for Avonmouth.

35 On Sunday 8 March, the assistant train manager entered the details for the train into TOPS, but TOPS rejected the train due to a problem with wagon VTG10601. The assistant train manager then noticed there was an 'O' card restriction on this wagon which meant the train could not depart the next day unless wagon VTG10601 was removed from it.

36 On Monday 9 March, at 06:15 hrs the assistant train manager arrived at the cement works with the driver for the train. The trainee rail operator arrived five minutes later. The assistant train manager explained to him and the driver that wagon VTG10601 needed to be removed from the train before it could depart. By 06:50 hrs, the assistant train manager had fuelled the locomotive, the driver had prepared the locomotive, and the trainee rail operator had released the handbrakes on all the wagons in the train ready for it to be moved.

37 At 06:56 hrs the train was shunted back into the long siding (figure 5) and the ground staff detached and secured the rear eleven wagons to leave wagon VTG10601 at the back of the remainder of the train. At 07:00 hrs, the front part of the train moved forward, and then back into the short siding to detach wagon VTG10601. The ground staff vented the brake pipe[4] on the wagon, which applied its air brake, and they disconnected the brake pipe and uncoupled the wagon from the train. The trainee rail operator applied the wagon's handbrake, and the assistant train manager then checked it, before leaving the wagon stabled in the short siding at 07:05 hrs.

38 By 07:20 hrs, the ground staff had shunted the train back into the long siding and recoupled it to the eleven wagons they had left there earlier. They then carried out a brake test of the reformed train. At 07:30 hrs, the assistant train manager called the signaller at Horrocksford Junction to tell him the train was ready and about to leave the cement works. The ground staff then manually operated the warning equipment on West Bradford Road level crossing and closed the gates at the Johnson Matthey level crossing. At 07:35 hrs, the train departed from the cement works. The trainee rail operator left the cement works at 07:55 hrs. The assistant train manager remained on site and went to the loading silo to find some paperwork for wagons that had been loaded earlier in the week. At 08:05 hrs he noticed wagon VTG10601 was still in the short siding as he walked back from the loading silo.

Events during the accident

39 RAIB calculated that at about 08:16 hrs wagon VTG10601 began rolling very slowly out of the short siding, through the loading silo and towards the exit of the cement works (figure 8). At 08:20 hrs the assistant train manager signed out at the main entrance to the cement works and set off in his car along West Bradford Road. As he approached West Bradford Road level crossing, he noticed two cars, one on each side, stopped at the level crossing. As he got closer to the level crossing, he caught a glimpse of the rear of a wagon heading away, towards the Johnson Matthey level crossing. After driving over the West Bradford Road level crossing, he immediately turned right onto the private road leading to the Johnson Matthey level crossing to catch up with the wagon.

40 At 08:21 hrs the wagon passed over the Johnson Matthey level crossing (figure 9). At the same time, the assistant train manager arrived at the level crossing in his car. He got out and ran alongside the wagon. He attempted to stop it but found the handbrake wheel would not turn any further in the direction needed to apply the brake. He returned to his car, got his mobile phone and made an emergency call to the signaller at Horrocksford Junction signal box to report that a runaway wagon was heading that way.

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[4] A pipe running the length of a train that controls, and sometimes supplies, the train's air brakes. A reduction in brake pipe air pressure, as happens when the pipe is separated or disconnected, applies the brakes.

Figure 8: The path taken by the wagon through and out of the cement works

41 At 08:23 hrs, just after the emergency call had ended, the signaller and mobile operations manager (paragraph 13) observed the wagon arrive at the end of the branch line and derail at the trap points (figure 3).

Figure 9: CCTV image of the wagon passing over the Johnson Matthey level crossing (image courtesy of Johnson Matthey)

Events following the accident

42 As there were no trains nearby, the signaller's first action following the derailment was to call the signaller in the adjacent signal box at Daisyfield to stop any trains approaching from the Blackburn direction. The signaller then reported the accident to the route control manager based in Manchester. While he did this, the mobile operations manager walked to the wagon to check if it had stopped clear of the main running lines, which it had (paragraph 5). Shortly afterwards, Network Rail appointed the mobile operations manager as the rail incident officer[5] for the accident. While in this role, the mobile operations manager preserved the scene of the accident so that it was not disturbed before RAIB arrived on site.

[5] A nominated and certificated role carried out by a member of railway staff, often a mobile operations manager, charged with the on-site command and control of an incident on behalf of the railway organisations that are involved.

Analysis

Identification of the immediate cause

43 The handbrake was ineffective in holding the loaded wagon on the gradient in the short siding.

44 The wagon ran away about 70 minutes after the ground staff had stabled it. The wagon did not immediately start to roll as it was initially held in place by its air brake. However, as is normal for many wagons, over time the air in the brake system slowly leaked away until the air brake was released. Once the wagon was solely reliant on its handbrake to hold it in place, it ran away.

45 Witness evidence indicates that the trainee rail operator applied the wagon's handbrake and that the assistant train manager checked it when they stabled the wagon. When RAIB inspected the wagon at Horrocksford Junction after the accident, it found that the handbrake indicators were pointing to the handbrake being in its applied position. RAIB also noted that the positions of the handbrake mechanism and brake cylinder piston showed the handbrake was in its applied position (figure 10).

46 There was no visible gap between the brake blocks and the wheel treads on the wheelset with the handbrake, and muddy marks on the wheel treads indicated that the wheels had been rotating as the wagon ran derailed through dirty ballast (figure 10). When RAIB released the handbrake, it took 7⅓ turns on the handbrake wheel to move to the fully released position. After the accident occurred there was no opportunity for anyone to change the handbrake wheel position, because the mobile operations manager was able to control access to the wagon from immediately after it derailed until RAIB arrived (paragraph 42).

47 Other evidence also supports the fact that the handbrake was in its applied position when the wagon ran away. When the assistant train manager tried to stop the runaway wagon at Johnson Matthey level crossing, he stated that he could hear a noise from the wagon's brake blocks rubbing against the wheel treads. He could also smell that the brake blocks were rubbing. These observations indicate that the brake blocks were in contact with the wheel treads and providing some brake force.

48 Using the measured gradient profile and the wagon's physical characteristics, RAIB calculated that the wagon would have been travelling at a speed of 6.56 m/s (14.7 mph / 23.7 km/h) by the time it reached the Johnson Matthey level crossing, if no brake force was applied. RAIB analysed the CCTV footage of the wagon passing over the level crossing and calculated that the wagon was travelling at 3.26 m/s (7.3 mph / 11.7 km/h), about half the expected speed of a wagon with no brake force. Therefore, it can be concluded that the handbrake was providing at least some brake force, but not enough to hold the wagon in place in the short siding.

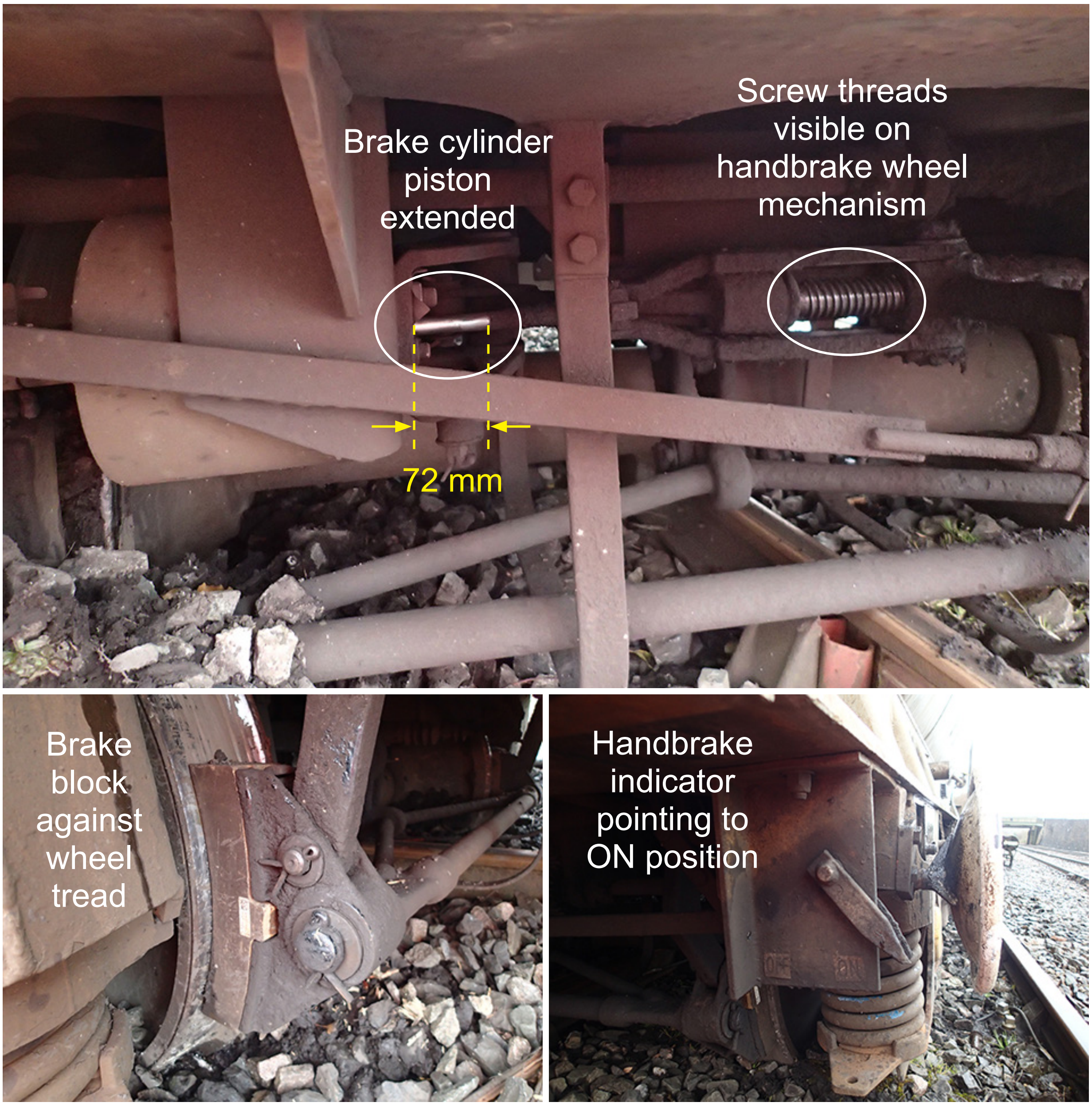


Figure 10: The positions of the wagon's handbrake indicator, handbrake mechanism, brake cylinder piston and brake blocks as found by RAIB after the accident

Identification of causal factors

49 The accident occurred due to a combination of the following causal factors:

a. The brake force provided by the handbrake was insufficient to hold the wagon where it was stabled (paragraph 52).

b. The wagon was stabled when it was fully laden (paragraph 72).

c. The wagon was stabled on its own and on a gradient falling towards the exit of the cement works (paragraph 79).

d. The wagon's handbrake was applied when the wagon's brakes were already pneumatically applied, delaying the runaway until a time when it was not detected and prevented (paragraph 84).

50 It is also possible that a scheduled preventative maintenance examination would have detected the reduced handbrake force on wagon VTG10601 had it taken place as planned (paragraph 90).

51 Each of these factors is now considered in turn.

Force provided by the handbrake

52 The brake force provided by the handbrake was insufficient to hold the wagon where it was stabled.

53 RAIB calculated the brake force required to slow the wagon down so that it passed over the Johnson Matthey level crossing at a speed of 3.26 m/s (7.3 mph / 11.7 km/h) (paragraph 48). The average gradient from the short siding to the level crossing was 1 in 216, so the component of force due to gravity acting down this slope on the laden wagon could be determined. Using the wagon's speed at the level crossing and the distance it had travelled, RAIB calculated the actual average acceleration achieved by the wagon when travelling down the slope, and then used this to determine the average force acting on the wagon as it ran away. RAIB also tested the wagon and measured its rolling resistance. From these findings, RAIB calculated that the brake force acting on the wagon to slow it down as it rolled down the slope was about 1,500 Newtons.

54 RAIB carried out further calculations to understand where within the short siding a laden wagon could run away if the handbrake was providing a brake force of about 1,500 Newtons. Calculations were carried out at each survey point where RAIB had measured the height of the track to survey the gradient. Figure 11 shows the results.

55 The ground staff stated that they left the wagon stabled about four wagon lengths, or 33 metres, from the short siding's fouling point.[6] Figure 11 shows that this places the wagon within a cluster of four survey points, over a seven metre length of track, where calculations show that the wagon would run away, given the available brake force. Either side of this length of track, the wagon either would not roll or only roll a short distance before stopping again.

56 Further calculations using the measured track gradient profile found that if the wagon ran away from any of the four points within this seven metre length of track and the brake force achieved by the handbrake was 1,515 Newtons, the wagon's speed would be 3.26 m/s (7.3 mph / 11.7 km/h) when it arrived at the Johnson Matthey level crossing (figure 12). This supported the findings from the initial brake force calculation (paragraph 53) which had used an average gradient.

57 After the wagon was recovered and taken back to the cement works, RAIB measured how much force it took to move the wagon when the handbrake was applied. A shunting locomotive was coupled to the wagon, with a load cell attached through the couplings. The shunting locomotive was then used to pull the wagon until it began to move against the applied handbrake, with the load cell recording the forces. The tests included applying the handbrake with the air brake released and applying the handbrake with the air brake applied. The air brake was then released before the test took place.

[6] The place where a vehicle standing on a converging line would collide with a vehicle passing on the other line.

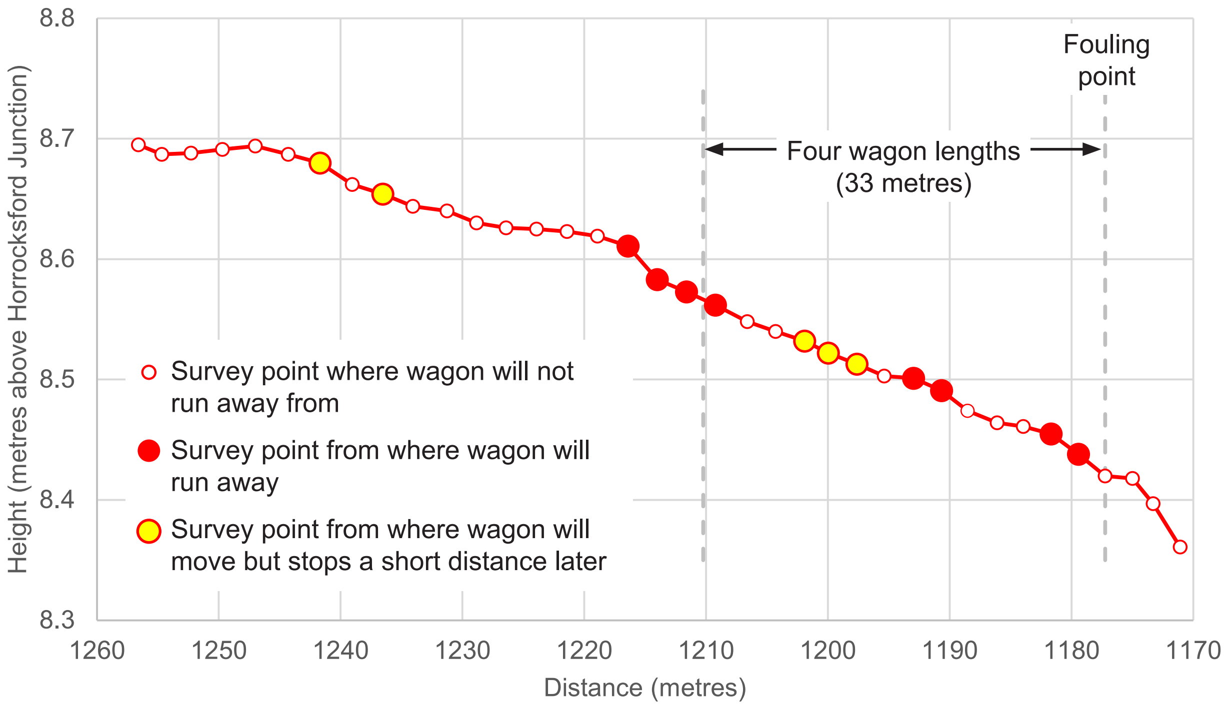


Figure 11: The calculated locations within the short siding that the wagon would run away from

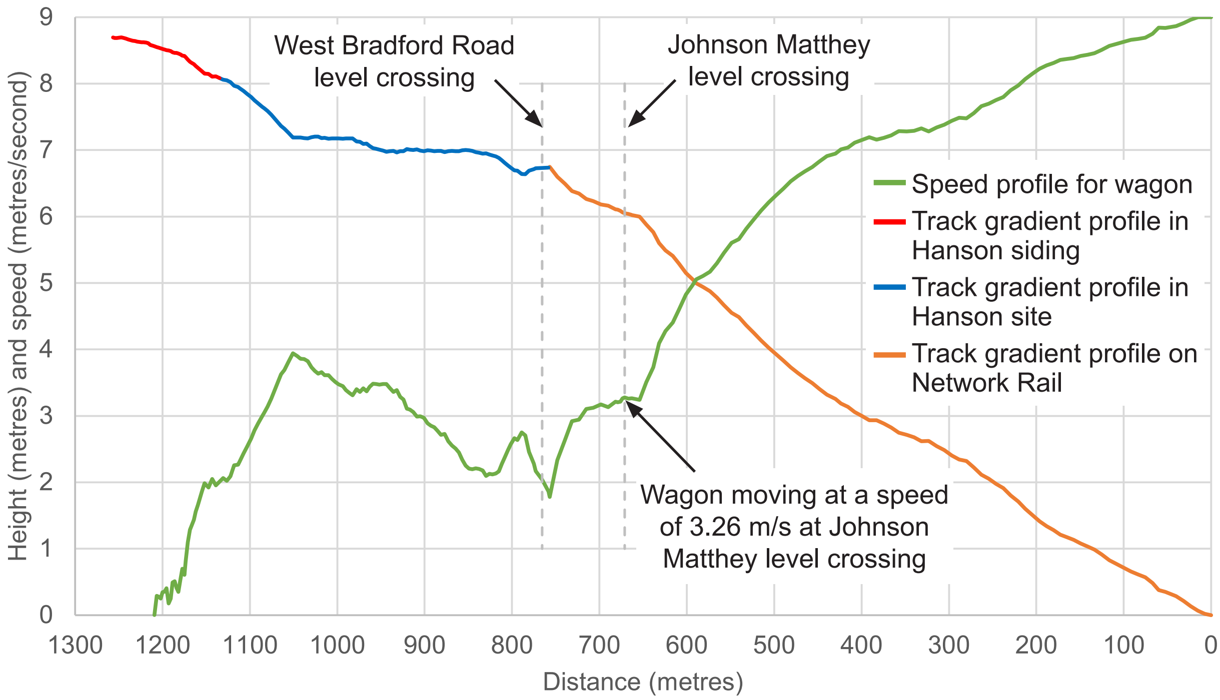


Figure 12: The calculated speed profile for a wagon running away from the short siding

58 Results showed the force needed to move the wagon against its handbrake ranged from 16,700 Newtons to 26,500 Newtons. This was eleven times to nearly eighteen times greater than the brake force that calculations show was being developed when the wagon ran away (see paragraph 71). Similar brake forces were measured on another laden PCA.

59 RAIB calculated that for a laden wagon to roll away when held by a brake force equalling the lowest of those measured (16,700 Newtons), the wagon would need to be on a gradient steeper than 1 in 30. None of the gradients in the short siding are this steep. RAIB also calculated that applying this level of braking force at the Johnson Matthey level crossing (where the assistant train manager had attempted to operate the handbrake wheel and found it fully applied) would have brought the wagon to a stand within 60 metres of the level crossing, rather than it running on to Horrocksford Junction. RAIB has concluded that the level of braking force provided by the handbrake during these tests was higher than that available before the runaway occurred.

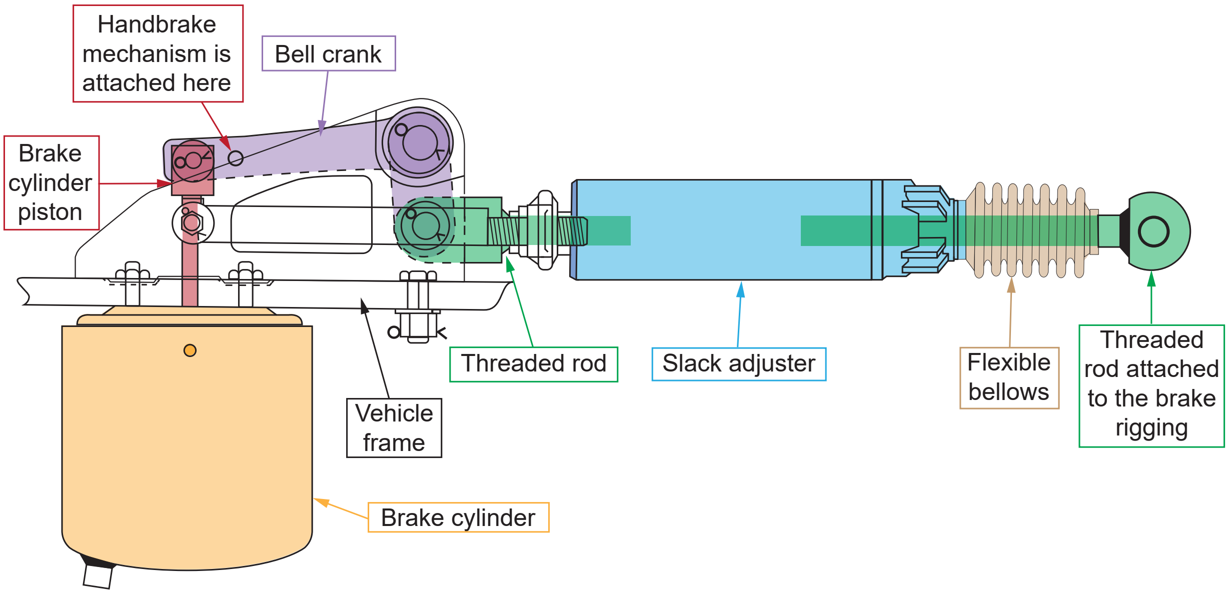
60 As the handbrake wheel is turned on a PCA wagon, the handbrake mechanism turns a screwed thread and pulls on the brake cylinder piston. As this piston is pulled out of its brake cylinder, its movement translates through a bell crank into a longitudinal movement which pulls, via the slack adjuster (see paragraph 65), on the brake rigging (figure 13). If the handbrake wheel is turned further, the piston is pulled out a correspondingly greater distance, which should result in a greater pull on the brake rigging. This in turn should cause the brake rigging to pull the brake blocks harder onto the wheel treads, generating a greater brake force.

61 RAIB examined the wagon on the day of the accident and recorded that there were 13 screw threads visible on the handbrake mechanism, and the mechanism had pulled the brake cylinder piston out by 72 mm (figure 10). RAIB found it took 7⅓ turns on the handbrake wheel to fully release the handbrake (paragraph 45). VTG vehicle maintenance instructions state it should take 6 turns on the handbrake wheel, plus or minus one turn, to move between the fully released and fully applied positions. When the handbrake was applied again, a maximum of 6 turns were possible to fully apply the handbrake.

62 When RAIB tested the wagon in May after it had been taken back to the cement works, it was again possible to turn the handbrake wheel a maximum of 6 turns to apply the handbrake from its fully released position. The number of turns on the handbrake was limited by how hard the brake blocks could be pulled against the wheel tread. With the handbrake fully applied after 6 turns, RAIB recorded there were 9 screw threads visible on the handbrake mechanism and that the brake cylinder piston had been pulled out by 49 mm (figure 14). The difference in the number of turns on the handbrake wheel could also be seen by the difference in the position of the handbrake indicator (figure 14).

63 During further tests, which were set up to include a very wide gap between the brake blocks and wheel treads, RAIB established that the handbrake wheel could only be turned a maximum of 7½ turns before the handbrake mechanism reached the limit of its movement. In this position, the number of screw threads and position of the brake cylinder piston were the same as found after the accident (figure 10). Given that the wagon's brakes were fully applied by the air brake when the ground staff applied the handbrake, the brake blocks were already pulled against the wheel tread by the air brake. Therefore, RAIB's tests suggest that the ability of the ground staff to turn the handbrake wheel by 7⅓ turns on the day of the accident meant that the movement in the handbrake mechanism was not restricted by the brake blocks being pulled against the wheel treads, but that the ground staff had instead reached, or got very close to, the limit of movement of the mechanism itself.

Brake System Components



How the brake system components move when brakes are applied

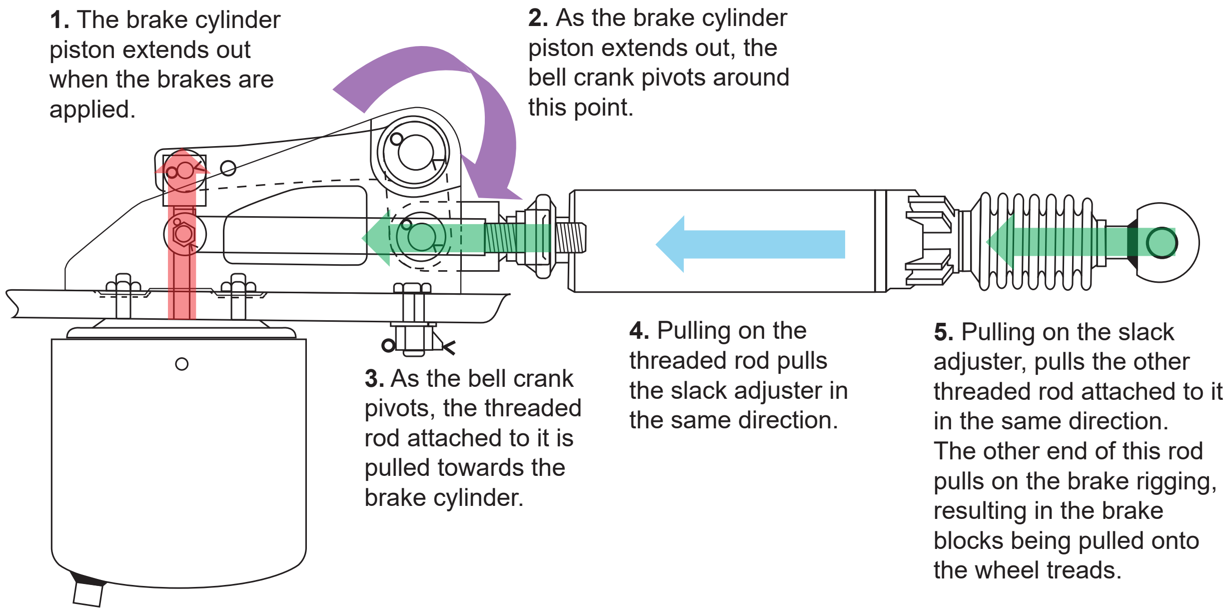


Figure 13: The brake system components from the brake cylinder piston to the brake rigging

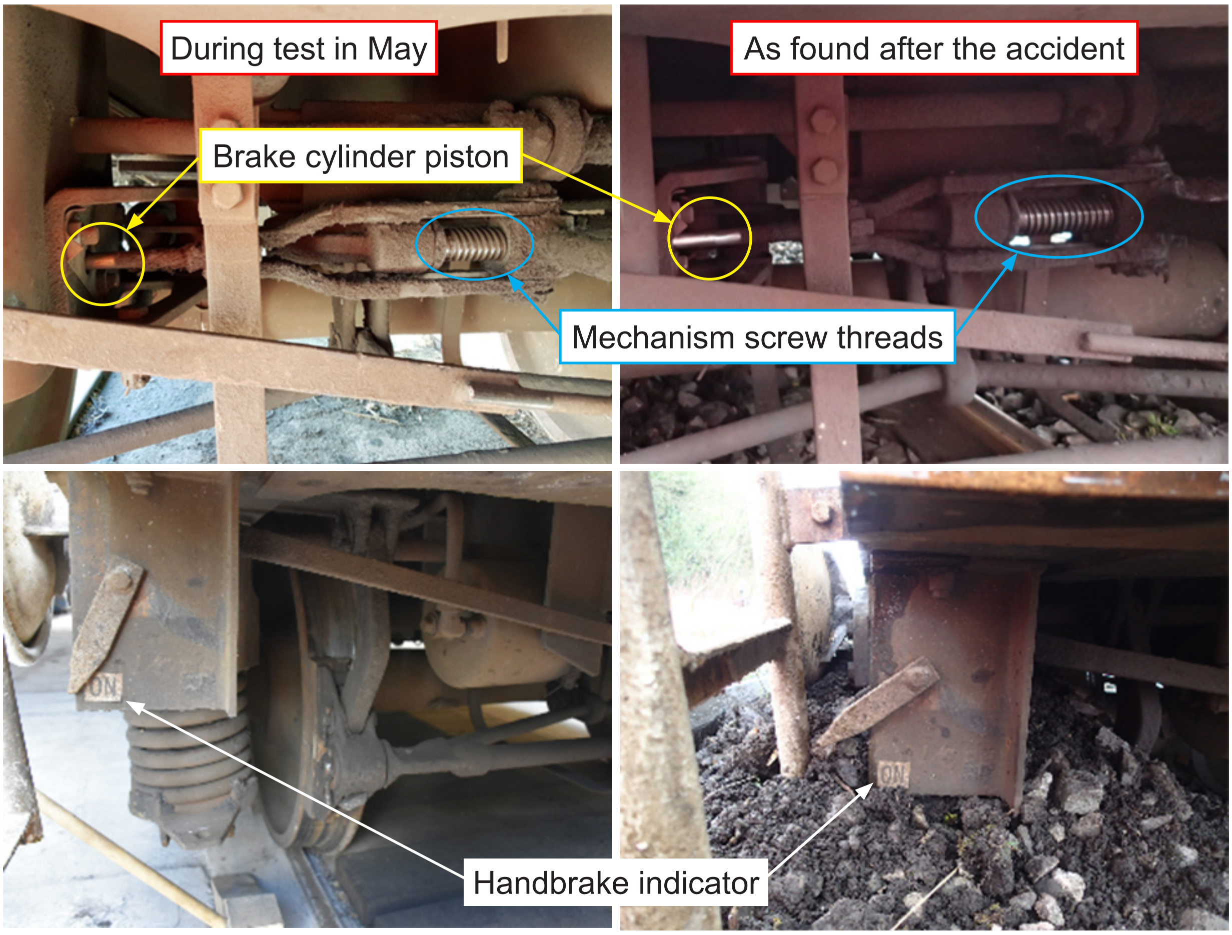


Figure 14: Comparison of the positions of the handbrake components during testing and as found after the accident

64 The difference in the positions of the handbrake mechanism as found after the accident and during the testing, should mean that greater brake force was generated on the day of the accident than was measured during testing. However, RAIB's calculations (paragraph 53) and tests (paragraph 62) showed this was not the case.

65 The only component between the handbrake mechanism, which pulls on the brake cylinder piston, and the brake blocks, that can affect the amount of brake effort generated, is the slack adjuster. Its function is to automatically take up any slack in the brake rigging caused by the brake blocks wearing in service. The slack adjuster does this by rotating on threaded rods which are attached to each end of it (figure 13). By automatically adjusting the length of these threaded rods, the slack adjuster maintains a gap of 4 mm between the brake blocks and wheel treads when the brakes are released. By maintaining a consistent gap as the brake blocks wear, the brake blocks provide a consistent braking effort for a given brake application, irrespective of brake block wear.

66 The slack adjustor was fitted to the wagon in July 2015 as a planned overhaul replacement. It was removed from the wagon after the accident so RAIB could witness one of VTG's contractors carry out a controlled strip down. However, the contractor concerned overhauled the slack adjuster straight away after receiving it (see paragraph 113) and its exact condition was not recorded as it was disassembled. RAIB later spoke to the staff who overhauled the slack adjuster, who stated that it was internally in good condition, and that none of the components within it were broken, worn or needed replacement.

67 The amount of wear on the brake blocks fitted to the wagon indicated that there had been a problem with how the brakes were functioning on this wagon. DB Cargo Maintenance had replaced all eight brake blocks on the wagon with new ones on 29 January 2020, five weeks before the accident. Using a sample of 20 new brake blocks, RAIB found the average thickness of a new brake block was 76 mm. When RAIB measured the thickness of the brake blocks fitted to the wagon, it found the four brake blocks fitted to the wheelset without the handbrake were 70 mm thick, whereas the four brake blocks fitted to the wheelset with the handbrake were 75 mm thick. This showed that the brake blocks on the wheelset without the handbrake had been applying greater braking force than those on the wheelset with the handbrake, which were hardly worn.

68 VTG stated that there can be differences in the rate of brake block wear at each end of a wagon due to brake equipment tolerances. However, these tolerances are unlikely to account for the large difference in wear rates found on wagon VTG10601 over such a short period. VTG also suggested that dragging brakes on the wheelset without the handbrake could have caused the brake blocks at that end to wear more quickly. As the air supply to the brake cylinders at each end of this type of wagon is provided by the same distributor, air-system-induced brake dragging will usually affect both ends.

69 RAIB has been unable to establish exactly why the handbrake provided insufficient brake force to hold the wagon after it was applied by the ground staff. Although possible problems within the brake rigging cannot be discounted, no evidence was found which indicated that such a problem existed and RAIB considers therefore that the most likely failure mechanism was that the slack adjuster was not working correctly. This is because it is the only component which lies between the handbrake mechanism and the brake blocks that is adjustable (paragraph 65). In addition, when the DB Cargo Maintenance staff changed the brake blocks at the end of January (paragraph 67), they would have needed to manually adjust the slack adjuster to widen the brake block gap, to create enough space for themselves to be able to take out the old brake blocks and fit the new ones. It is possible that, following this maintenance intervention, the slack adjuster did not fully adjust to make the threaded rods connected to it the correct length, even though it should have done so automatically.

70 A failure by the slack adjuster to automatically adjust the threaded rods to their correct length would result in a brake block gap that was wider than it should be. This would reduce the force generated by the brakes and result in brake blocks that are less worn (paragraph 67). It would also have allowed the handbrake mechanism to reach its limit of travel before the blocks were pulled hard on to the wheel treads when the ground staff applied the handbrake to the wagon (paragraph 63). It is also possible that some degree of adjustment by the slack adjuster took place, so that the brake force was still reduced, but that it was not obvious to ground staff that the brake block gap was larger than the required 4 mm when carrying out train preparation duties, or to maintenance staff carrying out an in-service inspection.

71 Tests carried out by RAIB on the wagon after the accident showed that the handbrake was working correctly (paragraph 58). This means that the fault which resulted in there being insufficient brake force to hold the wagon (paragraph 53) had apparently corrected itself, probably as a result of the dynamic forces the wagon was subjected to during the derailment.

Loading condition

72 The wagon was stabled when it was fully laden.

73 The GB Railfreight ground staff needed to remove wagon VTG10601 from the train because its PPM examination was overdue, otherwise the train could not depart (paragraphs 35 and 36). Wagons that are due to have a PPM or a VIBT examination at the cement works are normally removed from incoming trains, when they are empty, and then shunted into the maintenance siding (figure 5). One of the internal shunting locomotives, driven by a driver from Dents, is required to pull a wagon into the maintenance siding after an incoming train is split. GB Railfreight had documented the instructions and guidance on how to do this in its local operations manual. The local operations manual did not, however, contain any instructions or guidance about what to do when removing a loaded wagon from an outgoing train.

74 On the day of the accident, GB Railfreight ground staff could not stable wagon VTG10601 in the maintenance siding as no one from Dents was there to drive the internal shunting locomotive (see paragraph 76). Without this, the GB Railfreight ground staff could only stable the wagon in either the long or short siding using the train, and they shunted it into the short siding (paragraph 37).

75 Calculations undertaken by RAIB showed there were places within the short siding where a laden wagon would run away if its handbrake was only providing a brake force of 1,500 Newtons (figure 11, paragraphs 53 to 55). These calculations also showed that an empty wagon provided with this level of handbrake force would not run away from anywhere within the short siding. This is because the mass of an empty wagon is about a quarter of that of a laden wagon (paragraph 22), meaning the gravitational force acting on the wagon down the slope is correspondingly reduced.

76 Dents is usually advised by one of the fleet controllers at VTG, by email or telephone, when a wagon needs to be removed from an incoming train for maintenance work. Dents then provides a driver for the shunting locomotive and a second person to help shunt the wagon. Dents staff also tell the GB Railfreight ground staff who receive the train which wagons will need to be removed.

77 The fleet controller responsible for the PCA wagons operating out of Clitheroe could not find any records to show that she had contacted Dents to request that wagon VTG10601 was stopped for maintenance before it arrived back at Clitheroe on 7 March. This is why the wagon remained within the train and was loaded along with all the other wagons in the afternoon on 7 March.

78 On TOPS, the details for the incoming train on 7 March showed that there was an 'O' card on wagon VTG10601. This restriction meant that it should not have been loaded again (paragraph 33). However, the GB Railfreight ground staff, who had access to TOPS, were not required to check for restrictions on any wagons in the incoming train so did not know that wagon VTG10601 was 'O' carded, and so they loaded it, despite the restriction.

Gradient where stabled

79 The wagon was stabled on its own and on a gradient falling towards the exit of the cement works.

80 When the GB Railfreight ground staff stabled wagon VTG10601 on its own in the short siding, they left the wagon on an average gradient of 1 in 233, falling in the direction of the exit to the cement works (figure 15).

81 By stabling the wagon on its own and on a gradient, the GB Railfreight ground staff relied solely on it being held by its handbrake. Post-accident tests on the wagon (paragraphs 57 and 58) showed that a laden wagon with a correctly functioning handbrake would not run away on any of the gradients in the short siding. However, RAIB calculations showed that a laden wagon would run away from specific places within the siding if the force provided by the handbrake was reduced to 1,500 Newtons (figure 11). The GB Railfreight local operations manual included instructions on how to stable trains, which required the ground staff to apply the handbrakes on multiple wagons. However, it was silent about what should be done when stabling a wagon on its own. This meant that the ground staff were not required to take any extra steps to secure the wagon other than applying its handbrake.

82 The local operations manual did not include any instructions or guidance about where to stable wagons within the long or short sidings. The ground staff stabled the wagon about 33 metres from the fouling point in the siding (paragraph 54). This left the wagon on a gradient falling towards the exit to the cement works. If the ground staff had stabled the wagon within 50 metres of the buffer stop in the short siding (figure 17), it would not have run away out of the siding. They did not do this, because they expected that staff from Dents would soon be coming along that morning to move the wagon into the maintenance siding (paragraph 87).

83 The only information in the local operations manual about the gradients within the cement works refers to the gradient falling either side of the loading silo. This implies that the gradient in both sidings will fall throughout towards the buffer stops. This is incorrect, as the gradient actually falls towards the exit of the cement works for about the first 125 metres in each siding (figure 16) and only starts to level out and fall towards the buffer stops about 70 metres from the fouling point.

Figure 15: The view in both directions from where wagon VTG10601 was left stabled

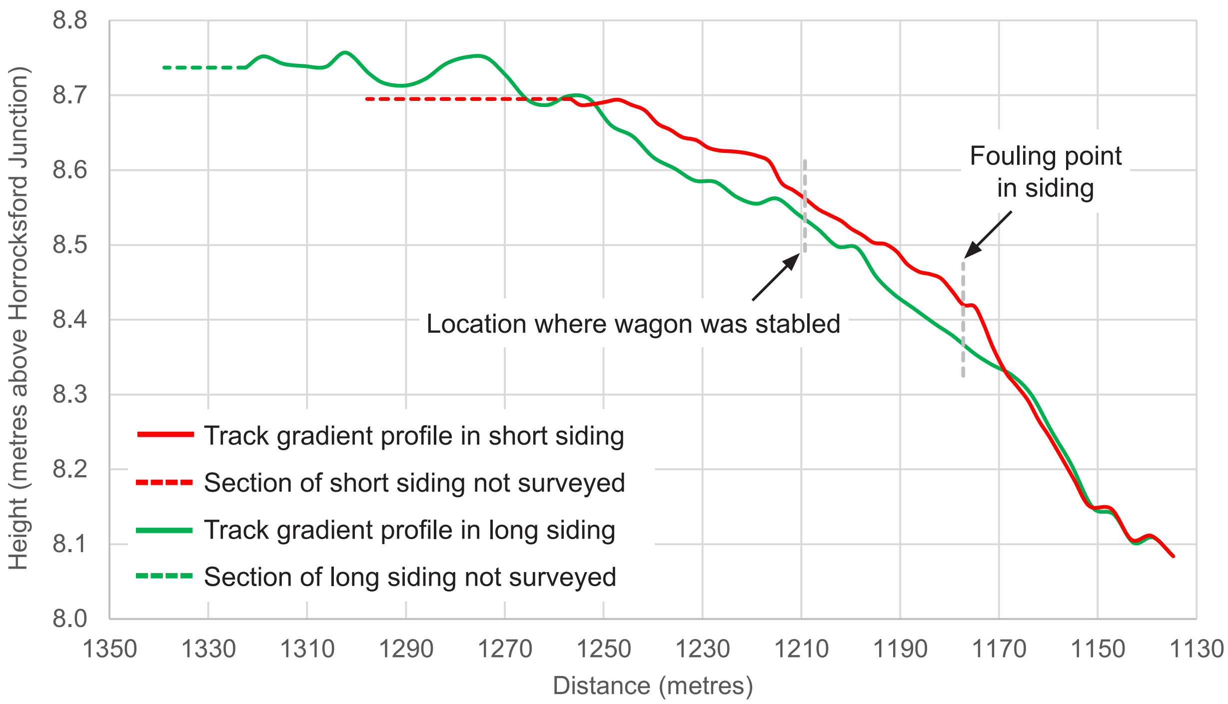


Figure 16: The gradient profile in the long and short sidings

Application of the handbrake

84 The wagon's handbrake was applied when the wagon's brakes were already pneumatically applied, delaying the runaway until a time when it was not detected and prevented.

85 When the wagon was shunted from the train, the ground staff disconnected and vented the brake pipe on the wagon while the wagon was still coupled to the train. This fully applied the air brake on both wheelsets. They did not pull the cord attached to the distributor[7] to vent the air from the brake system, and thus release the air brake, before they applied the handbrake.

86 Section E5 of railway industry standard GO/RT3056, 'Working Manual for Rail Staff - Freight Train Operations' (often referred to as 'The White Pages'), required the ground staff to release the air brake before applying the handbrake. GO/RT3056 states that not doing this could cause excessive strain on brake gear when the air brake is released, and there is an increased risk of injury with lever handbrakes when a subsequent attempt is made to release the handbrake.[8] GO/RT3056 does allow exceptions to this requirement to be authorised, normally only at locations where wagons are being stabled on a gradient. No exceptions to this requirement were in place at the cement works.

[7] The pneumatic component of an air brake system which responds to changes in brake pipe pressure and initiates charging and venting of the brake cylinders to apply and release the air brake.

[8] These requirements in GO/RT3056 are transferring to a new Rule Book module, GE/RT8000-TW4, which is due to be published in March 2021.

87 The ground staff did not follow GO/RT3056, by releasing the air brake before applying the handbrake when stabling wagon VTG10601, because they expected that the wagon would soon be moved. When the assistant train manager had left the wagon in the short siding, he expected that staff from Dents would move the wagon into the maintenance siding later that morning. Accounts vary as to whether the assistant train manager had agreed this with Dents prior to leaving the wagon in the siding.

88 If the ground staff had followed GO/RT3056 when stabling the wagon, and released the air brake before applying the handbrake, the wagon would have been in an unbraked state during this time. Because the wagon was on a gradient falling towards the exit to the siding, it would have rested against the rear of the train. Once the ground staff had applied the handbrake, the wagon would have remained resting against the train. However, as soon as the train began moving out of the siding, the wagon would have slowly rolled after it, revealing a problem with the handbrake. It is very likely that the ground staff, who would still have been working in the sidings at this time to reform the train (paragraph 38), would have noticed the wagon rolling away. While they would not have been able to prevent the wagon from colliding with the rear of the train at a low speed, the wagon would have been contained within the cement works.

89 If the ground staff had instead applied the wagon's handbrake with the air brake still applied, but then released the air brake afterwards, the wagon would have again rested against the rear of the train once the air brake was released. In this scenario, the wagon would again have slowly rolled after the train as soon as it began moving out of the sidings. Therefore, this method of securing the wagon would also have revealed a problem with the wagon's handbrake which the ground staff would have noticed as the wagon rolled out of the short siding. As in the previous scenario, the ground staff would have been unable to stop the wagon from colliding with the rear of the train at a low speed, but the wagon would have been contained within the cement works.

PPM examination

90 A planned preventative maintenance examination, which might have detected reduced handbrake force on wagon VTG10601, was not undertaken. This is a possible factor.

91 The PPM examination on wagon VTG10601 was due on 21 February 2020 and the wagon was stopped for maintenance work on 24 February (paragraph 30). However, the wagon was then placed back into service in error before DB Cargo Maintenance had carried out the wagon's PPM examination (paragraph 31).

92 The fleet controller at VTG became aware of this problem on 28 February and arranged for the wagon to travel to Avonmouth to be unloaded. It was intended that DB Cargo Maintenance would carry out the PPM examination once the wagon returned empty to Clitheroe. To allow this trip to take place, the fleet controller obtained, from the VTG engineering team, a seven day deferral of this examination, allowing the wagon to remain in service until 6 March (paragraph 32).

93 The deferral included a condition that DB Cargo Maintenance should carry out an in-service inspection (paragraph 23) on the wagon before it left Clitheroe on 28 February. As this inspection is primarily a visual check of components, RAIB considers that it is unlikely that it would have directly identified a problem with the handbrake. RAIB observes, however, that VTG was unable to provide any maintenance records or other evidence that showed that this in-service inspection took place before the wagon departed.

94 While the deferral was in place, the wagon made three return trips to Avonmouth. Each time it arrived at Clitheroe (on 2, 5 and 7 March) it was not removed for its PPM examination and instead remained in its train and was loaded again. The fleet controller uses information on TOPS and a spreadsheet to monitor when PPM and VIBT examinations are due on the wagons she is responsible for. However, after initially stopping wagon VTG10601 on 24 February for its PPM examination, she subsequently overlooked that the PPM examination was still due after the wagon went back into service on 28 February. The wagon then continued in service until TOPS placed a restriction on its use due to its PPM examination being overdue by more than 14 days (paragraph 33).

95 Had a thorough PPM examination taken place prior to the accident on 9 March, it is possible that staff from DB Cargo Maintenance would have found any problem with its handbrake that was evident at that time. The PPM examination includes an instruction to check the number of turns on the handbrake wheel when moving between the fully released and fully applied positions. If staff found that they were able to turn the handbrake wheel more than seven times, as found after the accident (paragraph 60), then the handbrake would have failed this check and further investigations of the failure would have followed.

Identification of underlying factor

96 The parties responsible for the operation of trains at the cement works had not adequately assessed or controlled the risk of a rail vehicle running away.

97 Hanson UK, as the owner of the cement works, has overall responsibility for the train movements into, out of and within the site. It contracted GB Railfreight and Dents to carry out all the train movements on its rail infrastructure, and relied on these two contractors to manage all the risks associated with such movements. Hanson UK did not carry out its own risk assessment of the rail related activities taking place within its site, even though it was required to do so by the relevant legislation.[9] Hanson UK also had a legal duty[10] to co-operate with other companies working on its site by ensuring that they were provided with information on any risks that might affect their employees and the measures required to control them.

[9] Regulation 3 of The Management of Health and Safety at Work Regulations 1999.

[10] Regulation 11 of The Management of Health and Safety at Work Regulations 1999.

98 The only assessment of risk found by RAIB which considered a rail vehicle running away from the cement works was in the GB Railfreight local operations manual (paragraph 72). It included a risk assessment covering a wide range of hazards and their associated risks. Each risk was scored by multiplying its likelihood by its severity with the resulting score allowing risks to be categorised as ‘low’, ‘medium’ or ‘high’. Hazards categorised as ‘medium’ risk required action to reduce the risks to as low as reasonably practicable. Hazards categorised as ‘high’ risk were intolerable and required controls to be applied to reduce the risk score or the activity was not allowed to take place.

99 Without any control measures, GB Railfreight scored the risk associated with the hazard of a runaway vehicle as a ‘medium’ risk, although RAIB noted that correctly applying the scoring criteria used by GB Railfreight should have resulted in its categorisation as a ‘high’ risk.

100 RAIB also noted that GB Railfreight’s risk assessment did not consider several factors that could increase the risk score associated with the hazard of a runaway vehicle:

- The likelihood of a runaway is increased when a vehicle is laden. A laden PCA wagon is about four times heavier than a tare wagon (paragraph 22), and as the vehicle’s mass is increased, the force acting on it down a slope is increased.
- The likelihood of a runaway is increased when a wagon is stabled on its own, as it is solely reliant on its own handbrake, a possible single point of failure. As a comparison, when a train is stabled anywhere within the cement works, the handbrakes are applied on either 10 wagons or half of the wagons in the train, whichever is the greater. This provides a significant level of redundancy which is absent when stabling a single wagon using just its own handbrake.
- The likelihood of a runaway is increased when a vehicle is stabled on a gradient. The track gradient within the cement works generally falls in the direction of the exit from the cement works (figure 6). This includes most of the short and long sidings (figure 16). The detail of the track gradient within the cement works and on the branch line was unknown until it was surveyed after the accident, and the information in the local operations manual about the track gradient was misleading (paragraph 83).
- The likelihood of a runaway is increased when a vehicle is stabled in the long or short siding. A wagon that runs away from either of these sidings can exit the cement works, whereas vehicles stabled in the maintenance siding can only run away for a short distance towards the end of the siding and so are contained within it.
- The severity of potential consequence is also increased because a runaway vehicle will pass over two level crossings, where it could collide with a vehicle or person, after exiting the cement works. The likelihood of a collision with both a vehicle or a person is increased, as they will have no warning of an approaching wagon at West Bradford Road level crossing because the warning equipment is manually operated by the ground staff. Employees and visitors to Johnson Matthey will similarly have no warning, as the gates which stop users passing over the crossing are also manually activated.

101 As Hanson UK had not carried out any risk assessment, and the GB Railfreight risk assessment had not considered the factors above, RAIB has concluded that the risk of a rail vehicle running away from cement works was not adequately assessed by either company.

102 While GB Railfreight's assessment of the risk of a runaway vehicle was not adequate, it had identified that it needed to implement control measures to reduce this risk. The controls GB Railfreight had assigned to the risk within the assessment had progressively reduced its score until it was categorised as a 'low' risk. RAIB, however, found that these control measures primarily relied on trained and competent ground staff following the required rules and instructions and exhibiting the required behaviours to do the work correctly, along with the use of supervision and monitoring visits to ensure compliance. The control measures also relied on vehicles having correctly maintained handbrakes. For this last control measure, GB Railfreight assumed that a maintained handbrake would function correctly, so alternative methods of securing a wagon, such as using wheel scotches, were not considered.

103 GB Railfreight was unable to provide evidence that any of the listed control measures that related to the supervision and monitoring of staff through visits by management were taking place. There were other control measures that GB Railfreight had included in the risk assessment to reduce the risk score (such as an employee confidential hazard reporting hot-line), but it is unclear how these control measures contributed to controlling the risk of a runaway vehicle. RAIB has therefore concluded that the risk of a rail vehicle running away from cement works was also not being adequately controlled by Hanson UK and GB Railfreight.

Observations

Risk assessment by Dents

104 The risk assessment carried out by Dents for the train movements it undertook within the cement works did not include an assessment of the risk of a vehicle running away.

105 Dents had risk assessed the activities it carried out when moving rail vehicles around the cement works. For each of the hazards it identified, Dents identified what control measures were required to reduce or eliminate the risk associated with that hazard. Dents then gave each hazard a risk rating, based on its likelihood and its severity, after the control measures had been applied.

106 Dents' risk assessment was focused on control measures to protect its staff from the hazards related to the train movements they were carrying out. It included hazards directly related to moving vehicles, such as its staff being trapped between or struck by rail vehicles. It also included hazards that could cause occupational injuries when carrying out tasks, such as lifting heavy items.

107 Dents' risk assessment did not consider the hazard of a vehicle running away or consider the increased risk of runaway which solo vehicles (such as those removed for maintenance) may pose (paragraph 100). Dents stated that it relied on Hanson UK and GB Railfreight to provide it with information about these hazards, but neither Hanson UK or GB Railfreight had adequately assessed or controlled these risks (paragraph 96). Consequently, Dents had no control measures in place to manage the risks associated with stabling vehicles on gradients within the cement works.

Management of Johnson Matthey level crossing

108 Network Rail was not managing the Johnson Matthey level crossing.

109 The railway infrastructure boundary between Hanson UK and Network Rail, as marked on the ground and shown in rail industry publications, is next to West Bradford Road level crossing, on the side closest to the Johnson Matthey level crossing (figure 5). The location of the boundary places two level crossings on Network Rail's infrastructure. One is the Johnson Matthey level crossing and the other is a user worked crossing[11] which provides emergency access to the Johnson Matthey site (paragraph 10).

110 The emergency access user worked crossing is on Network Rail's asset list and Network Rail had inspected and risk assessed it in accordance with its processes for managing level crossings. However, while the Johnson Matthey level crossing is on Network Rail's infrastructure, it is not on Network Rail's asset list. Consequently, Network Rail has no record of ever inspecting, maintaining or risk assessing this level crossing.

111 As Network Rail had not inspected or assessed this level crossing, it had never assessed the risk to its users or identified any factors that increased its risk score. This meant it was not managing any of the risks at this level crossing. The number of trains that pass over the level crossing each day is low and they also cross at low speed (paragraph 11). On the other hand, the number of road vehicles that use the level crossing each day is high and includes many heavy goods vehicles, which often convey dangerous goods such as chemicals. Other risk factors include the propelling of freight wagons over the crossing and the possibility of runaway wagons.

112 The crossing itself has some non-standard features (figure 17) which the owners of the chemical works have installed and maintained themselves over the years. Its gates are operated by the GB Railfreight ground staff, who then give the train permission to cross. The gate on one side is a powered sliding gate, while the gate on the other side is hinged and manually opened and closed by the ground staff. The level crossing has a non-standard miniature stop light on only one side, that displays a red or green light to road users, and there is also non-standard signage for road users and pedestrians on each side.

[11] A private level crossing where the barriers or gates are operated by the user. There is generally no indication of the approach of trains, but a telephone may be provided to contact the signaller.

Figure 17: The non-standard features at the Johnson Matthey level crossing

Loss of potential evidence

113 Potential evidence from the slack adjuster that was fitted to the wagon, and which might have explained why the wagon ran away, was lost.

114 At the request of RAIB, VTG arranged for the slack adjuster fitted at the handbrake end of wagon VTG10601 to be removed so RAIB could witness it being stripped down in a controlled manner. The aim of this work was to gather evidence about the slack adjuster to understand if it could have caused the handbrake to provide insufficient force on the day that the wagon ran away.

115 VTG tasked its wagon maintainer at Clitheroe, DB Cargo Maintenance, to remove the slack adjuster from the wagon. Once removed, DB Cargo Maintenance sent the slack adjuster to Sabre Rail, as VTG has had a contract with this company since September 2017 to overhaul and supply these parts. While Sabre Rail did not supply the slack adjuster fitted to the wagon in 2015 (paragraph 66), it had the required tools, test rigs and staff with the necessary skills and knowledge to strip the slack adjuster down, check its operation, overhaul and test it.

116 RAIB had arranged with VTG to witness the slack adjuster being stripped down at Sabre Rail's premises. However, when the slack adjuster arrived at Sabre Rail, it was not quarantined pending the controlled strip down as arranged, but instead it was subjected to a routine overhaul. This meant that an opportunity to gather evidence that could have explained why the wagon ran away was lost. Sabre Rail stated that this occurred because the slack adjuster was not labelled as a quarantined item when it was received, and so it was processed following Sabre Rail's normal procedures. DB Cargo Maintenance stated that it had labelled the slack adjuster as a quarantined item before sending it to Sabre Rail.

Previous occurrences of a similar character

117 RAIB searched rail industry databases and systems for previous accidents and incidents involving runaway wagons. Between 1998 and 2020, RAIB found 53 recorded events where one or more wagons had run away after being stabled:

- 32 (60%) were due to either staff not applying any handbrakes, or not applying sufficient handbrakes on vehicles in the train to hold it in place.
- 13 (25%) were due to defective handbrakes on vehicles. This included the runaway and derailment of wagons at Ashburys on 4 May 2010 (RAIB report 07/2011).
- The cause of the remaining 8 (15%) could not be identified from the information provided.

118 The rail industry databases and systems searched by RAIB did not include any runaway incidents that involved PCA type wagons. These wagons have been in service with VTG continuously since 1983, and there is no evidence that wagons of this type have a history of running away during their operational service.

Summary of conclusions

Immediate cause

119 The handbrake was ineffective in holding the loaded wagon on the gradient in the short siding (paragraph 43).

Causal factors

120 The causal factors were:

a. The brake force provided by the handbrake was insufficient to hold the wagon where it was stabled (paragraph 52, **Recommendation 1**).

b. The wagon was stabled when it was fully laden (paragraph 72, **Recommendation 1, Learning point 1**).

c. The wagon was stabled on its own and on a gradient falling towards the exit of the cement works (paragraph 79, **Recommendation 1, Learning point 1**).

d. The wagon's handbrake was applied when the wagon's brakes were already pneumatically applied, delaying the runaway until a time when it was not detected and prevented (paragraph 84, **Recommendation 3**).

121 A possible causal factor was that a planned preventative maintenance examination, which might have detected reduced handbrake force on wagon VTG10601, was not undertaken (paragraph 90, **Learning point 1**).

Underlying factor

122 An underlying factor was that the parties responsible for the operation of trains at the cement works had not adequately assessed or controlled the risk of a rail vehicle running away (paragraph 96, **Recommendations 1 and 2**).

Additional observations

123 Although not linked to the accident on 9 March 2020, RAIB observes that:

a. The risk assessment carried out by Dents for the train movements it undertook within the cement works did not include an assessment of the risk of a vehicle running away (paragraph 104, **Recommendation 2**).

b. Network Rail was not managing the Johnson Matthey level crossing (paragraph 108, see paragraph 132).

c. Potential evidence from the slack adjuster that was fitted to the wagon, and which might have explained why the wagon ran away, was lost (paragraph 113, **Learning point 2**).

Previous RAIB recommendation relevant to this investigation

124 The following recommendation, which was made by RAIB as a result of a previous investigation, has relevance to this investigation. RAIB believes that it had the potential to address some of the factors identified in this report.

Accident at Ashburys on 4 May 2010, RAIB report 07/2011, Recommendation 1

125 This recommendation read as follows:

Recommendation 1

Freight operators should ensure that their operating instructions include a 'pull test' when wagons are to be left to rely on their handbrakes for a time (DB Schenker reports that it has already taken this action).

126 The freight operating companies rejected the implementation of this recommendation, citing that:

- at many locations where wagons were stabled, alternative control measures existed to mitigate against runaway vehicles, such as trap points
- some operators were using wheel scotches to secure vehicles while others continued to use just handbrakes, which could cause confusion for staff as to which locations required a pull test to be carried out
- new entity in charge of maintenance processes had just been introduced, so operators were expecting the number of incidents due to poorly maintained brakes to decrease
- repeated pull tests could be detrimental to the wagon's brake components over time.

127 The final argument made by the freight operating companies was that given the range of locomotive types, wagons and the lengths of stabled trains, the results of a pull test would be too variable, so would not be a dependable indication of the ability of the applied handbrakes to secure the vehicles being stabled. The freight operating companies instead argued that they would assess the risk of wagons running away when stabled at a location and would apply controls to reduce the risk to as low as reasonably practicable.

128 The Office of Rail and Road (ORR) considered the arguments put forward by the freight operating companies for the non-implementation of this recommendation and agreed with the reasons given by the companies. ORR reported that as a pull test could not be applied with universal success, a blanket requirement to have one would not be workable. Consequently, this recommendation was not implemented.

129 At the time, RAIB wrote to ORR to raise its concerns that no action was taken to implement this recommendation. RAIB noted that where wagons were to be left unattended and reliant on their handbrakes, a suitable risk mitigation measure should be in place. Such measures should then remain in place until the freight operating companies could demonstrate that their handbrakes were adjusted and maintained to achieve a high level of reliability, and they were able to demonstrate that the risk of staff not fully applying handbrakes was very low. RAIB has continued to raise its concerns that no actions had been taken in response to this recommendation in the summary list of recommendations published each year with the RAIB's annual report (Index of recommendations 2019).

130 The present investigation has found that, when the ground staff applied the handbrake on wagon VTG10601, it did not provide sufficient brake force to hold the wagon in place (paragraph 52). Had some form of pull test been carried out with the air brake released when wagon VTG10601 was stabled, as this recommendation proposed, then this would have found that the wagon's handbrake was not fully effective. RAIB also found that the assessment of risk for stabling wagons at the cement works in Clitheroe was inadequate, and that the controls identified to reduce the risk of a runaway wagon were either inadequate or not implemented (paragraph 96).

131 RAIB believes that these findings show that the concerns it raised when this recommendation was not implemented remain valid, and that freight operating companies therefore need to carry out further work to control the risks associated with stabling vehicles on gradients using handbrakes, particularly when a vehicle is stabled on its own (Recommendation 3).

Actions reported as already taken or in progress relevant to this report

Actions reported that address factors which otherwise would have resulted in a RAIB recommendation

132 The Network Rail level crossing manager who manages safety at the level crossings on Network Rail's infrastructure in the Clitheroe area has added the Johnson Matthey level crossing to the portfolio of level crossings that he is responsible for. He has arranged for this level crossing to be added to Network Rail's list of assets, so that the required routine inspections, assessments and maintenance work will take place.

133 The level crossing manager also carried out a site visit to assess the level crossing. The information gathered during this visit was used in Network Rail's level crossing risk modelling process, to understand its risk score. Network Rail intends to assess any non-standard features at the level crossing and is planning to establish contact with Johnson Matthey (which installed the equipment and signage at the crossing, and whose employees and visitors are the users of the level crossing) so that it can be consulted about any proposed changes to the level crossing.

Other reported actions

134 Both GB Railfreight and Dents have changed the practices they follow for stabling wagons in the long and short sidings. When stabling a single wagon in either siding when the siding is empty, the wagon must now be left at the end, two metres from the buffer stop. The wagon's handbrake must be applied, and wheel scotches must also be used to secure it. When stabling a wagon in either siding when it is already occupied, the wagon must be coupled to any wagons that are already stabled in the siding. The handbrakes must be applied on all stabled wagons, and the wagon furthest from the buffer stop must also be secured with wheel scotches.

135 GB Railfreight has recommended fitting a derailer[12] within the cement works, on the single line between the points for the sidings and the loading silo (figure 5). This will derail any vehicle that runs away from either the short or long sidings, containing it within the cement works. Hanson UK has agreed to implement this recommendation and is currently determining the most suitable location for the derailer to be fitted. In the meantime, Dents has instructed its ground staff to ensure that after they have completed any shunting movements, the points to the maintenance siding are set so that any vehicle that runs away from the short or long siding will be contained within the maintenance siding.

136 VTG has reminded DB Cargo Maintenance and Sabre Rail of the importance of correctly labelling and handling components removed from wagons when they are the subject of a safety investigation. VTG has also amended its form that accompanies any components which are removed from its wagons. The form now includes a specific entry to identify that the removed component is quarantined.

[12] A ramp shaped device that is mounted on top of the rail to derail a vehicle making an unauthorised movement. They are used in places where speeds are low, and space is limited.

Recommendations and learning points

Recommendations

137 The following recommendations are made:[13]

1 *The intent of this recommendation is to reduce the risk of a stabled vehicle running away from industrial premises.*

GB Railfreight, working in conjunction with the owners of industrial premises that it operates trains to or within, should improve its risk assessment process for runaway vehicles so that it considers:

a. any factors that could increase the likelihood of a runaway vehicle occurring (such as loading condition, the prevailing gradients at stabling locations or reliance on the handbrake on a single vehicle)

b. any factors that could increase the severity of consequence should a vehicle run away, both within and beyond the boundary of the industrial premises (such as areas where employees or members of the public could come into contact with a runaway vehicle).

It should use these assessments to identify appropriate risk control measures and ensure that these controls are implemented. It should also implement a robust assurance process to check that these risk assessments are updated following any changes and that any control measures identified within them continue to be implemented successfully (paragraphs 120a, 120b, 120c and 122).

This recommendation may apply to other freight operating companies and the owners of industrial premises which trains operate to and within.

2 *The intent of this recommendation is to reduce the risks related to rail operations on railway infrastructure owned by Hanson UK.*

Hanson UK, working with its contractors, should assure itself that suitable and sufficient risk assessment has been undertaken for all rail operations taking place on the railway infrastructure it is responsible for (paragraphs 122 and 123a).

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[13] Those identified in the recommendations have a general and ongoing obligation to comply with health and safety legislation, and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Accident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail and Road to enable it to carry out its duties under regulation 12(2) to:

(a) ensure that recommendations are duly considered and where appropriate acted upon; and

(b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 200 to 203) can be found on RAIB's website www.gov.uk/raib.

3 *The intent of this recommendation is to reduce the risk of a vehicle stabled on a gradient from running away.*

Freight operating companies should review the adequacy of the processes documented in industry standards and company local instructions for stabling vehicles on a gradient using handbrakes, particularly if a laden vehicle is to be left on its own. The review should consider:

a. how the effectiveness of the vehicle's handbrake on the gradient is assured if it is applied at the same time as the air brake, and over time as the air brake releases (for example as air leaks out of the braking system)

b. how the risk of a vehicle running away while being stabled on a gradient, and the associated risks to staff working around a vehicle, are managed if the vehicle's air brake is released before its handbrake is applied.

Freight operating companies should address any inadequacies that are found in these processes by making changes to their local instructions and/or by proposing changes to industry standards (paragraphs 120d and 124).

Learning points

138 The RAIB has identified the following important learning points:[14]

1 Entities in charge of maintenance, and their contractors, are reminded of the importance of scheduled examinations of wagons taking place on or before their due dates. Wagons that remain in service beyond their examination due dates can have undiscovered failure conditions that could affect safety. Wagons that continue to remain in service until operating restrictions are imposed, which then require them to be taken out of service at very short notice, can cause staff to work outside normal working practices (paragraphs 120b, 120c and 121).

2 Entities in charge of maintenance, and their contractors, are reminded of the importance of preserving any items of evidence required for a safety investigation. Items such as components removed from vehicles need to be clearly marked and quarantined as soon as possible after they are identified as evidence. It is also important that any documentation accompanying such items clearly shows that they are quarantined and should not be disturbed or altered without permission (paragraph 123c).

[14] 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

Appendices

Appendix A - Glossary of abbreviations and acronyms

CCTV	Closed-Circuit Television
ORR	Office of Rail and Road
PPM	Planned preventative maintenance
RAIB	Rail Accident Investigation Branch
TOPS	Total Operations Processing System
VIBT	Vehicle inspection and brake test

Appendix B - Investigation details

The RAIB used the following sources of evidence in this investigation:

- information provided by witnesses
- information taken from the location recording equipment fitted to the wagon
- CCTV recordings taken from the entrance to the Johnson Matthey site
- site photographs and measurements of the wagon's brake equipment
- surveys to capture the gradient from the sidings in the cement works through to Horrocksford Junction
- findings from RAIB inspections and tests carried out on wagon VTG10601
- maintenance procedures for the PCA wagon fleet and maintenance records for wagon VTG10601
- drawings and specifications for the PCA wagon's brake equipment
- documentation for managing train movements into, out of, and within the cement works, including risk assessments and control measures
- rail industry standards for freight trains, Rule Book modules and GB Railfreight's general operating appendix modules
- records from TOPS for the wagon and the trains it was part of
- voice communication recordings
- results of searches for previous similar occurrences on rail industry systems
- weather reports and observations at the site
- a review of previous RAIB investigations that had relevance to this accident.

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