RAIB

Rail Accident Investigation Branch

Rail Accident Report

Buffer stop collision at Enfield Town station 12 October 2021

Report 13/2022
November 2022

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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Buffer stop collision at Enfield Town station, 12 October 2021

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Summary

At 08:21 hrs on Tuesday 12 October 2021, an Arriva Rail London (ARL) train hit the buffer stop at Enfield Town station in North London at 7.7 mph (12 km/h). The train struck the buffer stop, which was damaged in the collision, and rode up on it, coming to a rest with its leading wheels about 800 mm above the rails. No serious injuries resulted from the accident. The train had been travelling at 10 mph (16 km/h) when it was 69 metres from the buffer stop. After briefly applying the brakes, the driver made no further control actions for just over seven seconds, until he made an emergency brake application just before the train hit the buffer stop. This occurred too late to prevent the collision.

The accident occurred because the driver of the train did not apply the brakes in time, as a result of him losing awareness of the driving task. The loss of awareness was probably a result of him being significantly fatigued at the time. Post-accident drug and alcohol tests of the driver also yielded a positive result for a recreational drug.

The driver had not reported his fatigue to his employer, who in turn had not identified his fatigue when he signed on duty, or that his personal circumstances made him vulnerable to fatigue. There was also a potential conflict between his employer's processes for ensuring that staff attended for duty and for managing levels of staff fatigue.

None of the engineered systems provided automatically applied the train's brakes, as the conditions for their intervention were not met. In particular, the Train Protection and Warning System did not activate because the train was travelling below the speed at which the system would be triggered on approach to the buffer stop. This system was installed in compliance with the relevant standards but did not protect against the conditions leading to this accident.

RAIB has made two recommendations. The first is addressed to ARL and relates to encouraging staff to report fatigue that could affect their ability to do their jobs safely. The second, addressed to Network Rail in conjunction with RSSB, seeks to improve the risk assessment process for collisions with buffer stops at terminal platforms.

RAIB also identified three learning points. The first reminds Network Rail and train companies that engineered safeguards do not protect against all events, and that operational controls may also be required to manage risk. The second reminds train staff of the importance of reporting fatigue when it affects their ability to work safely. The third reminds staff of the need to comply with their employer's drug and alcohol policies.

Introduction

Definitions

1 Metric units are used in this report, except when it is normal railway 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 explained in appendix A. Sources of evidence used in the investigation are listed in appendix B.

The accident

Summary of the accident

3 At 08:21 hrs on Tuesday 12 October 2021, a passenger train hit the buffer stop at Enfield Town station in North London (figure 1). The train was travelling at 7.7 mph (12 km/h) when the collision occurred, and it rode up over the buffer stop before coming to a rest with its leading wheels about 800 mm above the rails (figure 2). The train involved, reporting number 2U14, was the 07:45 hrs London Liverpool Street to Enfield Town service, operated by Arriva Rail London (ARL).

4 The train's speed had been reduced by the driver as it approached the station, and it was travelling at about 10 mph (16 km/h) when it was within the length of the platform and 69 metres on approach to the buffer stop. After this point, the driver briefly applied the brakes to reduce the speed, before releasing them, but then made no further control actions for just over seven seconds as the train continued to coast towards the buffer stop. Just before the train struck the buffer stop, the driver made an emergency brake application, but it was too late to prevent the collision.

5 Of the estimated 75 passengers on the train, one reported suffering a minor leg injury and the effects of traumatic shock, while another reported that they were also suffering from traumatic shock. Neither required hospital attendance after being seen by ambulance staff at the station.

6 The train's front end was damaged, but this was largely confined to the replaceable front nose assembly (figure 3). There was no structural damage to the train's body that required major repair. The buffer stop was destroyed in the collision.

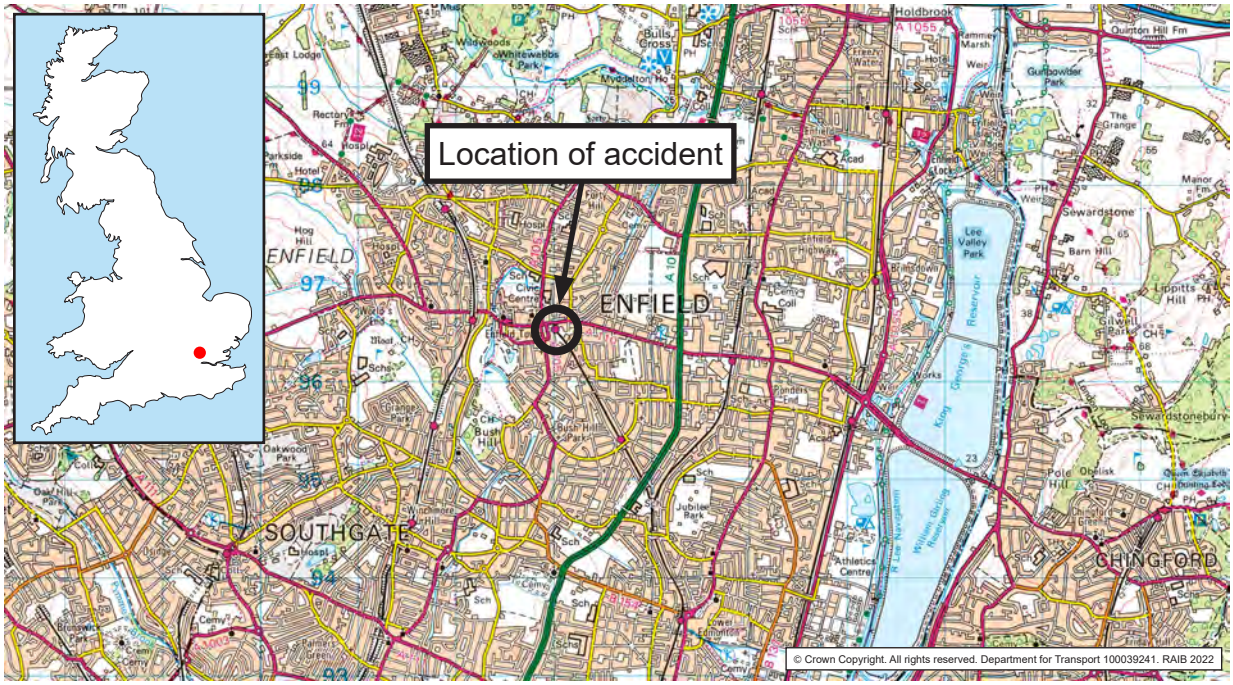

Figure 1: Extract from Ordnance Survey map showing location of accident

Figure 2: Position of the train after the collision

Figure 3: Damage to the front of the train

Context

Location

7 The accident occurred at the buffer stop at the end of platform 2 at Enfield Town station (figure 4). The buffer stop was a fixed, non-energy-absorbing type.

Figure 4: Type of buffer stop at Enfield Town station (platform 3 shown)

8 Enfield Town station is at the end of a two-track branch line, and consists of three terminal platforms (figure 5). Signalling is controlled from London Liverpool Street Signalling Centre. The line is electrified using 25 kV overhead line controlled from Romford Rail Operating Centre. The maximum permitted speed on the approach to the station is 50 mph (80 km/h), reducing to 15 mph (24 km/h) in the station area. Trains enter the station on an uphill gradient of 1 in 121 before running into level platforms.

9 The station area is protected by the Train Protection and Warning System (TPWS). At Enfield, this is designed to apply the brakes on approaching trains if they pass the fixed overspeed sensor system (OSS) transmitter loops above their designated 'set speed'. There are two sets of TPWS OSS loops at Enfield Town station. An OSS on approach to the station area is configured to trigger a brake application if a train is travelling faster than its 33.5 mph (54 km/h) set speed when signal L1365 is showing a danger (red) aspect. A further OSS part way along the platform (69 metres from the buffer stop) is set to trigger a train's brakes if it is travelling faster than 13.5 mph (22 km/h).

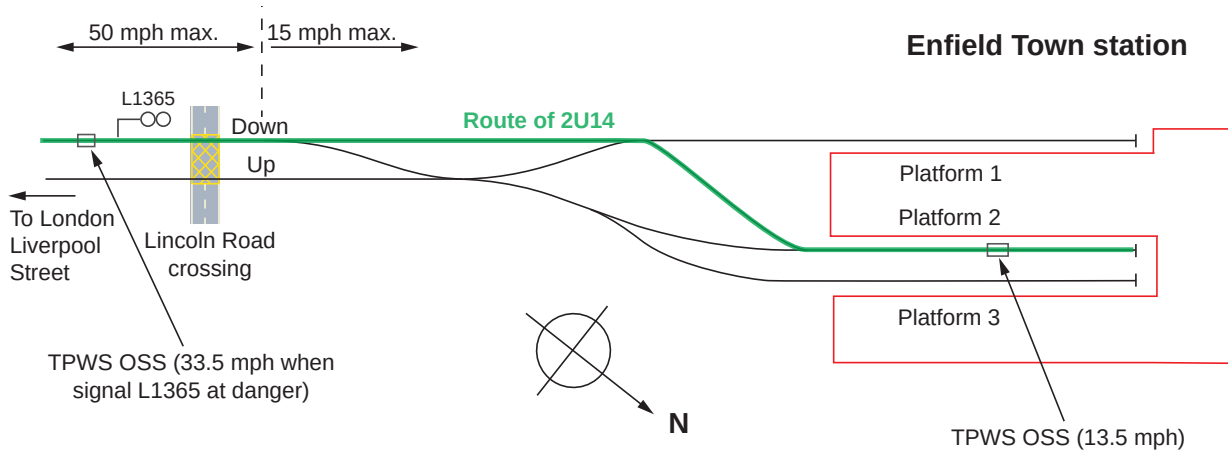

Figure 5: Track layout at Enfield Town station, showing the route of train 2U14

Organisations involved

10 Network Rail owns and maintains the infrastructure at Enfield Town station, which is on its Anglia route.

11 ARL operated the train involved in the accident as part of Transport for London's Overground system. It was the employer of the driver and the operator of Enfield Town station.

12 Both Network Rail and ARL freely co-operated with the investigation.

Train involved

13 The train involved in the collision consisted of two four-car, class 710 electric multiple units (figure 6). Class 710 units were introduced onto Enfield Town services during 2020.

Figure 6: Class 710 electric multiple unit

14 Post-accident testing of the train found no faults in the train's braking. The maintainer's records for the units involved showed that all the scheduled maintenance was up to date. RAIB found no evidence to suggest that the condition of the train contributed to the accident.

Staff involved

15 The driver of the train involved in the accident had been driving trains for ARL, and the preceding franchisees, for 13 years. The driver had always been based at Chingford depot and was very familiar with the routes between London Liverpool Street, Chingford, Cheshunt, Enfield Town and Ilford depot. The driver was also familiar with the class 710 units, having driven them since August 2020.

16 The driver had been involved in three previous safety incidents. These consisted of an incident where a train was stopped short of the platform and the train's doors were released, an acceptance of an incorrectly signalled route and a signal passed at danger. ARL found that the driver was not at fault for the last incident.

External circumstances

17 At the time of the accident, it was daylight and there was good visibility. There was light cloud, although it was not raining, and the sun's position would have been behind the train. There was no evidence of any abnormal environmental noise being present or that other external circumstances influenced the accident.

18 Network Rail took routine post-incident samples from the railhead and confirmed that there was no sign of any abnormal contamination that could have led to the wheels sliding on the rails when braking. However, because data from the train's on-train data recorder (OTDR) later confirmed that the driver had not applied the brakes for most of the final approach to the buffer stop, the level of adhesion between the train's wheels and the railhead is not considered relevant to this accident.

The sequence of events

Events preceding the accident

19 On the day before the accident (11 October), the driver worked from 06:14 hrs to 14:20 hrs. This was his first shift at work after having nine days off. The driver reported that, after this shift, he had gone to bed at around 21:30 hrs in preparation for his early shift the next day, but that he had only been able to get about one hour's sleep during the night (see paragraph 40).

20 On the day of the accident (12 October), the driver got up at around 04:00 hrs, having been awake before his alarm went off. After drinking a coffee, he drove by car for approximately 20 minutes to Chingford depot, where he signed on duty and spoke to the supervisor staffing the desk. He then went to his train and drove it as empty coaching stock to London Liverpool Street station, arriving at 05:57 hrs.

21 At Liverpool Street the driver bought some food and a non-caffeinated drink and took them back to the train to consume in the cab. He then drove the 06:15 hrs service to Cheshunt. After arriving at 06:46 hrs, he remained in the leading cab for three minutes, before changing ends. The driver then drove the 06:52 hrs service back to London Liverpool Street, leaving two minutes late, and arriving on time at 07:31 hrs. He again changed ends and waited in the cab ready to drive the 07:45 hrs service to Enfield Town, the service involved in the accident. The driver departed from London Liverpool Street on time, with the service calling at the required booked stops before arriving at Bush Hill Park, the last stop before Enfield Town.

22 Data from the train's OTDR shows that the driver departed from Bush Hill Park towards Enfield Town at 08:11:46 hrs, reaching a speed of 44 mph (71 km/h). At 08:12:20 hrs, the driver acknowledged the automatic warning system (AWS – see paragraph 82) alarm that indicated signal L1365 was showing a caution (single yellow) aspect for the approach to the station, and then sounded the horn for Lincoln Road level crossing. The single yellow caution aspect at signal L1365 meant that the associated OSS loop for the signal was not active (paragraph 9). At 08:12:43 hrs, after passing the level crossing, the driver braked the train to 18 mph (29 km/h), anticipating further speed loss due to the ascending gradient on the approach to the permanent 15 mph (24 km/h) speed restriction for the station area.

23 The train then coasted into the station and across the points towards platform 2. At 08:13:33 hrs, while travelling at 12 mph (19 km/h), the driver briefly applied power to maintain the train's speed on the gradient approaching the platform. At 08:13:51 hrs, the driver applied the brake for two seconds to bring the speed down to 9.8 mph (16 km/h) for the OSS loop located in the platform area, and 69 metres from the buffer stop. Although this OSS loop was set to trigger at 13.5 mph (22 km/h), the driver had been trained to treat it as being set to 10 mph (16 km/h).

24 After passing the OSS loop in the platform, the driver made two further brake applications, each of two seconds duration and one second apart. The first of these was at 08:14:03 hrs, and these brought the train's speed down to 8.1 mph (13 km/h).

Events during the accident

25 At 08:14:08 hrs, the driver returned the combined traction and brake handle to the coast position. He then made no further control actions until the train was virtually at the buffer stop.

26 Around seven seconds later, at 08:14:15 hrs, the train struck the buffer stop while travelling at 7.7 mph (12 km/h). OTDR data shows that the driver applied the emergency brake about 0.5 seconds before the collision, when the train was approximately two metres from the buffer stop. This was too late to have any noticeable effect on the train's speed.

27 The buffer stop detached from its fixings and became trapped under the leading end of the train. The remains of the buffer stop then pivoted backwards due to the force of the collision and lifted the front of the train into the air. The train stopped with its leading wheels about 800 mm above the rails, and with its front end about one metre from the station concourse wall.

Events following the accident

28 The train was protected from other train movements by the normal operation of the signalling system, while station staff ran onto the platform to see what had happened, and to assist passengers.

29 The train driver called the signaller to report the collision. The driver did not release the doors immediately after the collision, but passengers in the leading unit operated an emergency egress handle in the fourth coach and started to disembark onto the platform. Passengers on the trailing unit started to disembark after a short delay, also after an emergency egress handle was operated. British Transport Police (BTP) and London Ambulance Service were at the site of the accident by 08:35 hrs.

Analysis

Identification of the immediate cause

30 Having controlled the train's speed into the platform and through the overspeed protection, the driver did not subsequently brake the train to a stop before it collided with the buffer stop.

Identification of causal factors

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

a. The driver lost awareness of the driving task as the train approached the buffer stop (paragraph 32).

b. None of the engineered protection systems fitted to the train intervened to prevent the collision (paragraph 78).

Each of these factors is now considered in turn.

Driving of the train

32 The driver lost awareness of the driving task as the train approached the buffer stop.

33 OTDR data shows that the driver applied the emergency brake about 0.5 seconds (approximately two metres) before the train collided with the buffer stop. No control actions were recorded in the seven seconds before the driver applied the emergency brake (figure 7).

34 Before this emergency brake application, the last recorded actions by the driver were two brake applications starting about 12.5 seconds before the collision (about 46 metres from the buffer stop), and ending 7.7 seconds before the collision (about 27 metres from the buffer stop).

35 The driver had also appropriately controlled the train speed into the 15 mph (23 km/h) limit for the station and towards the OSS loop positioned 69 metres from the buffer stop. Comparison of the speed profile of the train entering the station with that of a train driven by another driver showed that the approach was similar until the point that the train involved in the accident passed this OSS loop.

36 Immediately after the accident, the driver reported to the signaller that he had fallen asleep for the last few seconds on the approach to the buffers. He also reported that he woke just before the buffers and applied the emergency brake. This is consistent with the data recorded by the OTDR which showed that he performed no control actions for the majority of this period when the train was approaching the buffers.

37 The driver shared his mobile phone records with his employer. These showed no evidence of any calls being made in the period immediately before the collision. BTP also examined the mobile phone and reported that this showed no evidence of any use immediately before the collision.

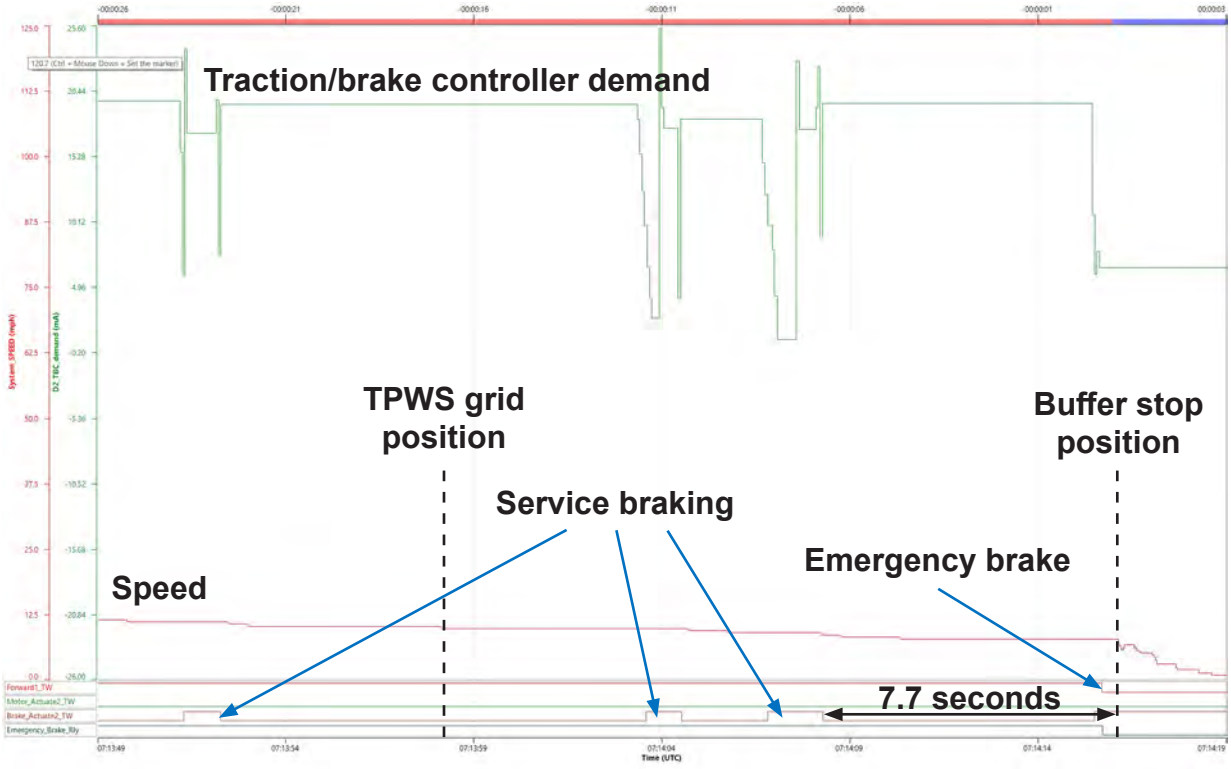

Figure 7: Train data showing driver control actions before the collision

38 The driver's loss of awareness arose due to the following, either singularly or in combination:

a. The driver was driving the train while significantly fatigued, probably affecting his awareness (paragraph 39).

b. The driver tested positive for a recreational drug, and it is possible that its presence affected his situational awareness (paragraph 72).

Each of these factors is now considered in turn.

Driver fatigue

39 The driver was driving the train while significantly fatigued, probably affecting his awareness.

40 The driver stated that he was tired before booking on to his shift due to a lack of sleep. This was his second early morning shift at work after returning from nine days off. There is no evidence that his roster pattern created an exceptional risk of fatigue on the day of the accident.

41 ARL's risk assessment for the operation of trains had identified that drivers signing on to their shifts while fatigued was a hazard that could lead to an accident. It noted that the primary mitigations were appropriate driver training and guidance to allow them to manage fatigue arising from their home lives, and good rostering practice to manage fatigue arising from work patterns. It also identified the provision of engineered systems as providing extra protection (see paragraph 79).

42 This probable causal factor arose due to a combination of the following:

a. The driver had insufficient sleep before starting his shift (paragraph 43).

b. The driver did not declare that he felt too tired to work before starting his shift (paragraph 47).

c. Arriva Rail London did not identify that the driver was fatigued when he started his shift (paragraph 63).

d. Arriva Rail London did not realise that the driver's home circumstances meant that he may have been at an elevated risk of being fatigued when at work (paragraph 68).

Each of these sub-factors is now considered in turn.

The driver's sleep

43 The driver had insufficient sleep before starting his shift.

44 The driver stated that he had settled in bed by 21:30 hrs on the evening before, but that he lay awake most of the night due to his partner having a long-term health condition. He reported that, as a result, he had only had about an hour of sleep before his shift, and that he had experienced similar sleep patterns on previous nights.

45 The driver also reported that he was aware of being tired on the drive to work as well as when driving his train before the accident, and that at one point his eyes were stinging and that he just wanted to close them.

46 Comparison of the OTDR data with records of the driver's previous assessments showed that, before the collision, there were no significant differences from his normal driving practice.

Declaration of fatigue by the driver

47 The driver did not declare that he felt too tired to work before starting his shift.

48 The driver booked on duty at Chingford by signing a sheet in the presence of a supervisor and the two of them spoke briefly. Chingford is the only sign-on point on ARL's Anglia routes where a supervisor is present. At other locations, drivers sign on to duty using unstaffed electronic terminals or by telephone.

49 The driver stated that he was familiar with his employer's fatigue management procedures and guidance (see paragraph 51) and knew that he was supposed to report if he felt too tired to carry out his driving duties. He did not do so on this occasion, despite acknowledging that he was very tired and probably not completely fit to work. The driver stated that this was because he did not want to be a further burden to his employer, having already taken significant time off work for other reasons. He was also conscious that his absences were being monitored as part of ARL's 'Managing for Attendance' (MFA) process (see paragraph 58) and was concerned that declaring he felt too tired to work would have worsened both his employer's and his work colleagues' perceptions of him.

50 The driver reported that he believed that his employer knew about the issues at home related to his partner's illness and the consequent needs for time off, having disclosed them as part of the MFA interview (see paragraph 71). He also stated that, despite this, he did not feel that his employer would have been sympathetic if he had reported another absence. As a result, he continued with his shift in the belief that he would be able to safely get through the day.

Fatigue management

51 ARL has a number of procedures which address staff fatigue by managing shift rosters and providing drivers with guidance on managing their lifestyles to fit in with these shifts. These procedures include references to the importance of staff reporting when they consider themselves to be sufficiently fatigued that they are unable to carry out their duties.

52 ARL's 'Drivers attending for duty' procedure (SQE 08.25 - Issue 1) states that drivers are supervised at Chingford to ensure that they sign a declaration confirming that they are *'in a fit state of health'* and that they *'are not reporting for duty under the influence of alcohol or any drugs which might impair my proper performance of my duties'*. A similar declaration is made at other sign-on locations. The driver signed this declaration on the day of the accident.

53 The 'Managing fatigue' procedure (SQE 12.02 - Issue 1) covers the overall management of the risk of fatigue to employees and the effect this can have on the individual and on the safe operation of the network. Most of its focus is on the management of shift rosters, so that they '*prevent or minimise the build up of fatigue*' due to excessive hours or adverse shift patterns. Although this procedure does acknowledge the need to ensure that '*safety critical workers are not affected by fatigue either at the start of the shift or in the course of their work*', the detail of how this is done is contained in other procedures.

54 ARL also has a procedure titled 'The 24/7 Railway and fatigue management' (SQE 20.7 - Issue 1), which is targeted at drivers and other safety-critical staff. This provides guidance to staff on how shift patterns can interact with their lifestyle and health, and how they can manage the effects to ensure that they are able to carry out duties safely. This document includes a number of statements relating to self-reporting of fatigue, as follows:

- *There is no absolute cut-off point between being fatigued or just tired, but it is an individual decision you must make based on whether you believe you can perform your duties safely and consistently to the required standard.*
- *Both you and Arriva Rail London have obligations; You must ensure to the best of your ability that you are not fatigued when you attend for duty, and Arriva Rail London will ensure that work requirements and patterns do not contribute to fatigue.*
- *You have a personal responsibility to ensure you manage your lifestyle and other personal factors in such a way that you are fit for duty when you attend and for the duration of your shift.*
- *If before coming to work, or whilst at work, you believe that you cannot carry out your duties because of fatigue then you must report this immediately to your line manager or to Control, so the necessary support can be provided.*

55 Similar guidance was contained in the older ‘Drivestyle’ booklet (Issue 2), dated April 2011, that had been issued to drivers by National Express, the operator of services to Enfield Town before February 2012. This document stated:

- *There are a whole range of issues that can impact on performance at work. For example, sleep, medication and home life. It is important to remember because of your role, you have a personal responsibility to come to work in fit state, both physical and mentally. If you do not, the likelihood of error through fatigue or lack of focus on-the-job greatly increases.*
- *Typical errors and factors that can lead to incidents - Failing to advise your line manager of personal issues/major life events which may impact on your ability at work to concentrate.*
- *Ensure you are well rested both physical and mentally. If you believe your fitness could be affected for whatever reason, speak to your Duty Traincrew Manager (DTM).*
- *Should anything outside work be seriously affecting your concentration levels such as bereavement / family illness / divorce or financial problems, contact your Driver Manager in confidence.*
- *If you feel that you may be affected by drowsiness or fatigue, which you are unable to deal with yourself, advise your DTM or Driver Manager.*

56 This guidance was refreshed to drivers in summer 2021, in a booklet titled ‘Summer Brief’. This detailed the lifestyle management tips and emphasised the need for drivers to be fit to undertake their duties. Similar guidance was also given to drivers in a post-COVID briefing, titled ‘Stay on Track 2021’. Examples of the guidance include:

- *If you are suffering from stress or worry, or even just a lack of sleep, please contact a Driver Manager or ARL Employee Assistance Programme (EAP) it may just help to prevent you from having an operating incident.*
- *If you feel that you may be affected by drowsiness or fatigue, which you are unable to deal with yourself, advise a suitable manager.*

57 The driver had been issued with the 2011 ‘Drivestyle’ guidance, and with the 2021 ‘Stay on Track’ and ‘Summer Brief’ guidance. Although ARL was unable to demonstrate that the driver had been issued a copy of the 2017 ‘24/7 Railway and fatigue management’ guidance, the driver reported that he knew, from his training, that he was supposed to report if he believed that he was too tired to safely undertake his duties.

Managing attendance

58 To control levels of absenteeism on its Anglia services, ARL's human resources department operates a 'Managing for Attendance' (MFA) procedure. This procedure originated on these routes in the 1990s and aims to ensure that staff who are fit to work attend when rostered, while taking account of the welfare of staff who are not fit to work. This procedure monitors the attendance of staff when rostered and seeks to identify the reasons for non-attendance so that any underlying issues can be identified and jointly addressed by the employee and by their managers. This states that:

- *Employee welfare is an imperative and ARL will promote and support employee health and well-being. ARL aims to take a balanced approach between welfare concerns and absence control. The well-being of our employees depends on taking adequate time off when they are unfit through sickness or injury. Arriva Rail London will operate most successfully and cost-effectively when all tasks are fully staffed.*
- *Managers must balance their concern about employees who are sick or injured with the responsibility towards ensuring that all employees who are fit to work are at work.*

59 The procedure consists of four stages, each of which is independent, and are triggered by defined numbers of absences and lost days over a defined period:

- *2 separate absence periods or 5 days total absence over 13 weeks; or*
- *5 separate absence periods or 10 days total absence over 52 weeks*

60 Once a stage is triggered, there is a monitoring period of up to 52 weeks where managers expect to see improved attendance. The managers also talk to the individual to understand what the causes of the absence are and to discuss how these causes can be addressed or accommodated. If sufficient improvement is observed, then the process ends. If improvement is not observed, using the same trigger levels, then the process proceeds to the next stage, where the discussions involve more senior levels of management.

61 The driver had had a number of absences from work since the start of 2018. In 2018 he had been signed off as sick for seven weeks due to an injury. This did not result in the MFA procedure being triggered. A four-week absence in 2019 resulted in stage one of the MFA process being triggered, but his attendance was deemed to have improved, and the process was ended. He was also off work for 14 weeks in 2020 due to a combination of furlough and COVID-19, but this did not trigger the MFA process.

62 In 2021, before the accident, the driver was off work for a total of 16 weeks, due to a combination of his employer signing him of as unfit for duty (see paragraph 69) and a subsequent illness. His managers offered him support on several occasions during this absence; this was carried out by letter as they were unable to reliably contact him by telephone. The MFA process was again triggered when he returned to work in May 2021, and the resulting monitoring process was still in place at the time of the accident.

Identification of fatigue by Arriva Rail London

63 Arriva Rail London did not identify that the driver was fatigued when he started his shift.

64 A supervisor was present when the driver signed on for his shift at Chingford on the morning of the accident (paragraph 20). Although the supervisor chatted with the driver on the morning of the accident, he did not detect that the driver was significantly fatigued or otherwise unfit for duty.

65 Part of the supervisor's role was to ensure that drivers sign the declaration of fitness when they start their shift. They also have a desk-based role managing any roster issues that arise on the day due to drivers being delayed, or not being available, and arranging for alternative cover.

66 The supervisor's job description states that they should '*as far as practicable ensure through personal observation, that traincrew are fit for duty at the time of booking on and that they present themselves in full uniform and are in possession of the required equipment and documentation*'. As a result, there was no requirement for the supervisor to carry out a formal fatigue assessment at sign-on, such as questioning drivers about their sleep pattern. ARL's risk assessment also did not identify the supervisor role as a mitigation against driver fatigue (paragraph 41). However, supervisors were expected to raise any obvious signs that a driver was not fit for duty.

67 Where a driver is obviously under the influence of alcohol, or other substances, it is possible that a supervisor would be able to detect this. However, it would be much more difficult for a supervisor to detect that a driver was excessively tired or fatigued and, in this case, the supervisor did not. This difficulty is reflected in ARL's processes for managing fatigue through the driver booking on process. These were largely reliant on drivers themselves being able to identify when fatigue was going to affect their ability to undertake their duties, and reporting this, rather than the onus being on a supervisor to detect it.

Arriva Rail London's awareness of the driver's home circumstances

68 Arriva Rail London did not realise that the driver's home circumstances meant that he may have been at an elevated risk of being fatigued when at work.

69 The driver had been off work a number of times in the years preceding the accident (paragraph 61). In addition, a medical assessment in February 2021 resulted in him being signed off work with a condition related to his home circumstances. A further assessment in April 2021 confirmed that he was fit to resume duties on a managed, gradual basis.

70 On his return to work, ARL initiated the MFA process (paragraph 58) and this resulted in a discussion between the driver and his manager regarding his attendance record and the reasons for the absences. There was a further such discussion in September 2021 after a three-week sickness-related absence.

71 Discussions during the fitness assessment, and during the subsequent return to work and MFA meetings, meant that ARL was aware of the issues that the driver was having at home. This was recorded by ARL as being a cause for the driver's absences. There is no evidence that, during these discussions, the driver specifically highlighted the effect that these factors were having on his level of fatigue at work or the effect that this was having on his ability to stay alert. However, the driver assumed that his employer would be aware that he may be more likely to be fatigued at work because of what had been reported about his home circumstances. This meant that ARL did not realise that the driver was likely to be fatigued when arriving at work and hence at risk of not always being able to to carry out his duties safely.

The presence of recreational drugs

72 The driver tested positive for a recreational drug, and it is possible that its presence affected his situational awareness.

73 ARL operates a random drug and alcohol testing policy. Samples are typically taken from 5% of safety-critical staff every year. Additional testing is also undertaken for new staff at appointment, and after incidents or accidents (known as 'for cause' testing). The driver had last been randomly tested in July 2019 with the result being negative for the presence of both drugs and alcohol.

74 Immediately after the accident, ARL arranged for the driver to be 'for cause' tested for alcohol and drugs. Although he passed the alcohol test, the urine test for drugs showed positive for a breakdown product of cocaine. A hair test taken by BTP five weeks after the accident also tested positive for signs of cocaine.

75 RAIB commissioned a toxicology expert to interpret the drug test results. They concluded that the urine test indicated that it was likely that the driver had taken cocaine within the one or two days immediately before the accident. They also stated that the hair analysis confirmed that there had been historical use of cocaine over an undefined period, and that it was not possible to determine whether this usage was over the long or short term.

76 The toxicology expert stated that the use of cocaine can lead to acute psychological effects which can increase an individual's alertness and attentiveness. It can also affect cognitive behaviour, including an individual's ability to drive a vehicle, and this could have affected the driver's situational awareness and judgement at the time of the accident.

77 The toxicology expert also stated that there can be a rebound effect following cocaine use that can result in profound tiredness. This could have been exacerbated by the driver's lack of sleep, resulting in an effect on his alertness.

Engineered protection systems

78 None of the engineered protection systems fitted to the train intervened to prevent the collision.

79 ARL's generic risk assessment for train operations recognises the risk of collisions with buffer stops at terminal stations. The primary mitigations identified are driver training and assessments, and the implementation of an appropriate driving technique. It also recognises the provision of TPWS as delivering further mitigation. The risk assessment acknowledges that the assessment of the buffer stop design and configuration is an activity that is primarily led by Network Rail.

80 ARL has also undertaken route-specific risk assessments, including one for the route to Enfield Town. However, these assessments focus on the sighting of signals and areas of potential low adhesion, and other area-specific hazards. These route assessments do not separately address the generic buffer stop hazard, unless there are specific concerns at a given location. No such concern was highlighted in the assessment for Enfield Town.

81 The train was fitted with a driver vigilance device (DVD). This requires the driver to keep a pedal depressed while driving, and to periodically release and depress the pedal. On the class 710 trains an alarm sounds every 60 seconds, to prompt the driver to release the pedal, unless they have operated other train controls in that period. Failure to release the pedal when the alarm sounds will result in the train brakes being applied automatically. Because the driver had been operating the controls on the approach into Enfield Town station, the 60-second timeout would not have been triggered as he approached the buffer stop. Consequently, the DVD was not able to detect the driver falling asleep immediately before the collision.

82 The train was also fitted with AWS (paragraph 22). This sounds an electronic bell in the cab when approaching a signal showing a green proceed aspect, and an electronic horn warning when the train approaches a signal that is not showing a green proceed aspect. If the driver does not acknowledge a horn warning, then the train's brakes are applied automatically. The last AWS operation before the collision was when the driver acknowledged the horn for the single yellow caution aspect approaching signal L1365 before the station platforms. Consequently, AWS could not have provided any warnings to alert the driver during the final approach to the buffer stop.

83 The station was also fitted with the TPWS system (paragraph 9), with an OSS with a set speed of 13.5 mph (22 km/h) located 69 metres from the buffer stop. This was in line with Network Rail standard NR/SP/SIG/10138 Issue 3 (Train Protection & Warning System – Transmitter Loop Requirements and Positioning). At buffer stops, this configuration is intended to provide protection from trains colliding with them where they pass the OSS above the set speed and below 20 mph (32 km/h). TPWS, however, provides no protection from a buffer stop collision where trains pass an overspeed sensor below the set speed. The standard assumes that drivers adopt a defensive driving approach when approaching buffer stops, thus managing the risk of collision. However, the standard also implies that any train moving at below the set speed when passing the OSS is likely to result in a low consequence collision, if the driver does not stop in time. The train involved in this collision collided with the buffers at a speed that, in this instance, did not result in any significant injuries.

Identification of underlying factors

Arriva Rail London's fatigue reporting culture

84 Arriva Rail London had not fully embedded a culture to support the self-reporting of driver fatigue.

85 The driver was aware that he was tired when he started his shift (paragraph 45) and that he was supposed to report this if it was likely to affect his ability to undertake his duties (paragraph 57). The driver was also conscious that he was subject to the MFA procedure due to the amount of time he had taken off in the months before the collision (paragraph 62) and was concerned about his managers' and his colleagues' perception of him (paragraph 49).

86 ARL reported that, after the accident, it had become aware that many of its staff perceived the MFA procedure to be a first step towards disciplinary action, whereas it was intended, and written, to be a means of addressing factors that lead to absence. This meant that there was a potential conflict between the requirement for drivers to report when they were fatigued and their perception that not being on shift when rostered could lead to disciplinary action through the MFA procedure.

87 Although ARL had processes in place to encourage self-reporting of fatigue, it had not identified that these were not fully effective. It had not collected any statistics on how many reports of fatigue were being made, nor had it identified any thresholds that would demonstrate that the processes were working. As a result, ARL was unaware that drivers may not have been self-reporting instances of fatigue and, therefore, it had not taken steps to improve such reporting.

Observations

Buffer stop risk assessment

88 There were deficiencies within the buffer stop risk assessment process and its implementation by Network Rail.

89 Railway Industry Standard RIS-7016-INS Issue 1.2 ('Interface between Station Platforms, Track, Trains and Buffer Stops') governs the provision of buffer stops at stations. Although this standard contains detailed requirements for new buffer stop installations, the only requirement relating to existing buffer stops is that '*buffer stops shall be provided at terminal or bay platforms*'.

90 Guidance in RIS-7106-INS requires that buffer stops have a current risk assessment and directs the user to Rail Industry guidance note GIGN5633 Issue 1 ('Recommendations for the Risk Assessment of Buffer Stops and End Impact Walls'). GIGN5633 provides a methodology for undertaking this risk assessment, which can be facilitated by a spreadsheet-based 'buffer stop risk assessment' tool that is available from RSSB.[1]

[1] RSSB is a not-for-profit body whose members are the companies making up the railway industry, and is registered as Rail Safety and Standards Board Ltd, but trades as RSSB.

91 The assessment models inputs such as the number of train approaches, the number of passengers per train, approach speeds, normal stopping position, infrastructure configuration and occupancy of the station areas ahead of approaching trains. It also considers any history of previous collisions in the five years before the assessment.

92 The output of the assessment is an indicative risk level expressed in terms of the number of '*fatalities and weighted injuries (FWI) per 100 years*'. RSSB defines a 'specified' injury (legally requiring reporting to the Health and Safety Executive) as being equivalent to 0.125 fatalities and a 'non-severe' injury (not requiring hospital attendance, or seven days off work) as equivalent to 0.001 fatalities when calculating FWI.

93 Network Rail's maintenance standard (NR/L2/TRK/001 'Inspection and maintenance of permanent way' - Module 18 Issue 6 'Buffer stops') requires assessments to be reviewed at least every 10 years. GIGN5633 additionally requires these to be reviewed when there is a significant change of circumstances. Such triggers include changing the type of train, changing the infrastructure layout, increasing traffic levels or changing train approach speeds.

94 Network Rail's Anglia route carried out a risk assessment of the buffer stops at Enfield Town in June 2021, in response to the change of rolling stock on the line from the older class 315 and 317 units to the class 710 units. This risk assessment calculated the buffer stop collision risk at platform 2 to be 2.032 FWI per 100 years. This is equivalent to one of the following:

- one fatality every 49 years
- one 'specified' injury every 6.1 years
- about 20 'non-severe' injuries per year.

95 There has only been one recent buffer stop collision at Enfield Town station, in 2002. This was also at low speed, but the cause was attributed to low adhesion, and no one was injured in this event. Looking further back, RAIB has found records of two previous buffer stop collisions at Enfield Town station, the last of which occurred in 1893. There is no evidence that anyone was seriously injured or killed in either of these accidents. Even considering this small sample size and that the station layout, mitigation provision and usage will have changed over time, the low consequences of these three collisions suggest that the risk figure calculated by the risk assessment may be too high and not a true indication of the actual risk.

96 Network Rail took no action to either verify the accuracy of the calculated risk value, or to further reduce the buffer stop risk at Enfield Town, even though the assessment had returned a value that was much higher than the apparent historical risk.

97 There are no prescribed thresholds in either RIS-7016-INS or GIGN5633 to define whether the calculated risk at a buffer stop is acceptable. It is left to the assessing organisation to determine whether the risk requires further reduction. As with all transport operators, assessing organisations have a legal duty to ensure that risks are reduced so far as is reasonably practicable.

98 Network Rail's Anglia route had developed its own informal thresholds. This was to allow it to effectively rank buffer stop locations by risk level, and to prioritise any improvements where they would deliver the best value for money in terms of risk reduction. At the time of the assessment, Anglia route was using a threshold for immediate action of 3.7 FWI per 100 years, and the threshold below which no action was considered necessary was 2.0 FWI per 100 years. Anglia route considered that a risk between the two thresholds would require renewal work to be planned into the next budget control period. These Anglia route thresholds were under review, with input from route management, when the accident occurred.

99 A few days before the collision, Network Rail's Anglia route had raised a 'request for help' query to RSSB in relation to the buffer stop risk assessment process described in RIS-7016-INS and GIGN5633. This request included questioning the sensitivity of the buffer stop risk assessment output to passenger numbers, and how the process addressed the interaction between different train types and different types of buffers. Network Rail had not received a response to this request by the time of the collision.

100 The calculated risk figure of 2.032 FWI per 100 years calculated for Enfield Town in June 2021 was less than the Anglia informal reactive threshold of 3.7, and so no immediate work to change the buffer stop arrangement was triggered. It was just at the lower threshold of 2.0, above which the buffer stop arrangement would be considered for possible future upgrade. No upgrade work had been initiated or planned in the three-month period between the assessment and the collision.

101 Even though there are no thresholds in GIGN5633, the standard does state that '*the estimated risk calculated … may indicate that risk mitigation measures are required*' and provides some examples of potential mitigation measures that could be considered in such a situation. However, many of these are likely to already exist at locations like Enfield Town or may be impracticable without costly rebuilding of parts of the station and railway infrastructure. This means that they are likely only to be reasonably practicable when major infrastructure changes are to be undertaken. There is no guidance for what alternative actions should be taken when the process indicates that a risk is high enough to require mitigation, but when it is not reasonably practicable to implement any of the suggested measures in GIGN5633.

102 These issues were not causal for the accident at Enfield Town, nor did they have a significant effect on the severity of the outcome because the consequences of the collision were relatively minor.

Previous occurrences of a similar character

103 RAIB has previously investigated accidents and incidents where trains have collided with buffer stops. These include collisions at the following locations:

- Sudbury on 27 January 2006 – RAIB report 26/2006 (see paragraph 111)
- Chester on 20 November 2013 – RAIB report 26/2014
- King's Cross on 17 September 2015 – RAIB report 15/2016
- Preston on 1 April 2017 – RAIB safety digest 10/2017
- King's Cross on 15 August 2017 – RAIB safety digest 15/2017
- Bromsgrove on 23 March 2020 – RAIB report 14/2020
- Kirkby on 13 March 2021 – RAIB report 07/2022 (see paragraph 114).

104 Only the investigations into the collisions at Sudbury and Kirkby resulted in recommendations that were directly relevant to this accident.

105 RAIB is also aware of a collision that occurred at New Cross station on 10 April 2022, involving a different type of train operated by ARL. The train collided with a buffer stop at a similar speed to the accident at Enfield Town. This buffer stop was of a more modern design than that at Enfield Town. It was intended to be compatible with the coupler of trains using the platform and to absorb energy by sliding along the rails in a collision (figure 8). In this collision, the train's kinetic energy was absorbed in a controlled fashion by the buffer stop, rather than by the buffer stop collapsing and lifting the train into the air. The result was that the train suffered no damage and was able to return to service the next day, demonstrating the benefits of an energy absorbing buffer stop that is designed to be compatible with the rolling stock.

Figure 8: Collision at New Cross on 10 April 2022, showing energy absorbing buffer stop (image courtesy of Arriva Rail London)

Summary of conclusions

Immediate cause

106 Having controlled the train's speed into the platform and through the overspeed protection, the driver did not subsequently brake the train to a stop before it collided with the buffer stop (paragraph 30).

Causal factors

107 The causal factors were:

a. The driver lost awareness of the driving task as the train approached the buffer stop (paragraph 32). This causal factor arose due to a combination of the following:

   i. The driver was driving the train while significantly fatigued, probably affecting his awareness (paragraph 39, **Recommendation 1** and **Learning Point 2**). This probable causal factor arose due to a combination of the following:

      1. The driver had insufficient sleep before starting his shift (paragraph 43).
      2. The driver did not declare that he felt too tired to work before starting his shift (paragraph 47).
      3. Arriva Rail London did not identify that the driver was fatigued when he started his shift (paragraph 63).
      4. Arriva Rail London did not realise that the driver's home circumstances meant that he may have been at an elevated risk of being fatigued when at work (paragraph 68).

   ii. The driver tested positive for a recreational drug, and it is possible that its presence affected his situational awareness (paragraph 72, **Learning Point 3**).

b. None of the engineered protection systems fitted to the train intervened to prevent the collision (paragraph 78, **Learning point 1**, but linked to Kirkby Recommendation 1 – see paragraph 115).

Underlying factors

108 An underlying factor was that Arriva Rail London had not fully embedded a culture to support the self-reporting of driver fatigue (paragraph 84, **Recommendation 1**).

Additional observation

109 Although not directly linked to the cause of the collision on 21 October 2021, RAIB observes that there were deficiencies within the buffer stop risk assessment process and its implementation by Network Rail (paragraph 88, **Recommendation 2**).

Previous RAIB recommendations relevant to this investigation

110 The following recommendations, which were made by RAIB as a result of previous investigations, have relevance to this investigation.

Collision between train and buffer stops at Sudbury, 27 January 2006

111 RAIB investigated the collision of a passenger train with a buffer stop at Sudbury station, in Suffolk (RAIB report 26/2006). The collision occurred because the driver misjudged the braking on the approach to the station. The investigation commented on the design of the buffer stop and the practicability of replacing it with a different type.

112 Following the accident, RAIB made the following recommendation:

Recommendation 2

Network Rail should:

- *carry out a review, including cost benefit analysis, into the practicability of providing energy absorbing buffer stops at terminal platforms;*
- *provide a copy of the review to the safety authority;*
- *develop a programme to fit energy absorbing buffer stops to terminal platforms where it is reasonably practicable to do so.*

113 The Office of Rail and Road reported to RAIB that this recommendation had been implemented by Network Rail.

Buffer stop collision at Kirkby, Merseyside, 13 March 2021

114 RAIB investigated the collision of a passenger train with a buffer stop at Kirkby station, in Merseyside (RAIB report 07/2022). The collision occurred because the driver was distracted on the approach to the station by using his mobile phone and by leaving his driving position to retrieve the contents of his bag. In addition, no engineered system intervened to automatically apply the train's brakes before the collision occurred.

115 Following the accident, RAIB made the following recommendation that is relevant to the collision at Enfield Town:

Recommendation 1

RSSB, in consultation with relevant stakeholders and bodies representing staff, should undertake further research into how the detection and mitigation of a loss of alertness or attention in train drivers can be improved. This research should build on work already completed, such as the functional specification and proposed trials set out in the T1193 research report. It should also take into account relevant practice from other transport systems.

116 This recommendation had just been made at the time of this report, and RSSB is in the process of considering it.

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

117 ARL has rebriefed its drivers about its procedures for self-reporting of fatigue and the importance of doing so when this means that they are unable to safely carry out their duties. It is also refreshing its guidance documents for drivers to reinforce the importance of such reporting.

118 ARL has contacted other train operators to gain knowledge about how the wider industry manages driver fatigue and how they encourage self-reporting of fatigue.

119 Network Rail has replaced all the platform buffer stops at Enfield Town with an energy absorbing type that is compatible with the class 710 rolling stock and that fits in the limited platform space currently available. It has also reduced the maximum allowable speed for trains approaching the platforms to 10 mph (16 km/h). Network Rail has assessed that these measures will reduce the calculated risk value to less than 1 FWI per 100 years.

120 As a result of a number of historic railway accidents that have highlighted the limitations of driver vigilance systems, the rail industry is monitoring developments in technology that could assist with managing driver alertness. In 2014, RSSB prepared a knowledge search report to understand currently available and developing technologies that could be relevant for use in 'Driver alertness monitoring systems' (Report S184). More recently, RSSB has undertaken a research project 'Understanding the Functional Requirements for Train Driver Attention and Alertness Monitoring Devices' (T1193). This was aimed at developing the mainline railway's understanding of technology that was already being trialled on tramways to manage driver alertness.

Recommendations and learning points

Recommendations

121 The following recommendations are made:[2]

1 *The intent of this recommendation is for Arriva Rail London's drivers to declare when they are significantly fatigued so that they do not drive trains when unfit to do so.*

Arriva Rail London should review, and revise as necessary, its procedures for fatigue and attendance management to promote self-reporting by train drivers, and other safety-critical staff, when they feel that they are, or are likely to become, fatigued in a way that may affect their fitness to safely undertake their duties. It should also consider how these arrangements are briefed and implemented so that they proactively develop and maintain an environment where self-reporting of such fatigue is encouraged and considered acceptable, and where staff do not fear that there will be negative consequences if they do declare themselves unfit for duty.

In addition, Arriva Rail London should put in place arrangements to monitor the effectiveness of self-reporting mechanisms for fatigue and identify areas for improvement. The review should consider best practice from other operators and transport systems (paragraphs 107a.i and 108).

This recommendation may also apply to other train and freight operating companies.

[2] 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.

2 *The intent of this recommendation is for Network Rail to better manage the risks of collisions at buffer stops.*

Network Rail, in conjunction with RSSB, should review its process, and associated guidance, for assessing the risks of collisions at buffer stops so that realistic values of risk are derived from it. This review should ensure that the contributions of engineered protection systems, such as TPWS, are correctly modelled as part of this process. Network Rail should also develop guidance for end users of the process so that they are able to determine what further risk reduction measures may be required to ensure that risks are reduced so far as is reasonably practicable (paragraph 109).

Learning points

122 RAIB has identified the following important learning points:[3]

1 Network Rail, train operating companies and freight operating companies should recognise that engineered protection systems, such as TPWS, do not fully protect against all events, such as low speed buffer stop collisions, and that additional operational controls and dependence on human performance are normally necessary to achieve an appropriate level of safety (paragraph 107b).

2 Safety-critical staff, such as train drivers, have a responsibility to manage and recognise fatigue arising from their lifestyle, and to report to the relevant manager or supervisor when they are concerned that their levels of fatigue may impact their performance (paragraph 107a.i).

3 The safe operation of the railway relies on safety-critical staff, such as train drivers, complying with their employer's drug and alcohol policies (paragraph 107a.ii).

[3] '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

ARL	Arriva Rail London
BTP	British Transport Police
DTM	Duty traincrew manager
MFA	Managing for attendance
OSS	Overspeed sensor system
OTDR	On-train data recorder
RAIB	Rail Accident Investigation Branch
RSSB	Rail Safety and Standards Board
TPWS	Train Protection and Warning System

Appendix B - Investigation details

RAIB used the following sources of evidence in this investigation:

- site photographs
- station and train closed-circuit television footage
- data from on-train data recorders
- witness statements
- alcohol and drug test results
- an expert toxicologist analysis of drug test results
- train operator procedures
- train maintenance records
- industry standards
- buffer stop risk assessment records
- weather reports and observations at the site
- a review of previous RAIB investigations that had relevance to this accident.

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