



Rail Accident Investigation Branch

Rail Accident Report



Collision at Plymouth station 3 April 2016

Report 02/2017
February 2017

This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC;
- the Railways and Transport Safety Act 2003; and
- 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.

The 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 the RAIB has described a factor as being linked to cause and the term is unqualified, this means that the RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident. However, where the RAIB is less confident about the existence of a factor, or its role in the causation of the accident, the RAIB will qualify its findings by use of the words 'probable' or 'possible', as appropriate. Where there is more than one potential explanation the 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 but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, the words '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 event 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 the RAIB, expressed with the sole purpose of improving railway safety.

The 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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3 April 2016

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Summary

At 15:34 hrs on Sunday 3 April 2016, the 13:39 hrs passenger train service from Penzance to Exeter collided with an empty train which was already waiting in platform 6 at Plymouth station. The collision occurred at a speed of about 15 mph (24 km/h) and resulted in injuries to 48 people and damage to both trains.

The signaller intended that both trains should share the platform because the empty train was to form a service to London and some passengers from the Penzance service were expected to join it. Lift refurbishment work meant that without platform sharing, passengers would have needed to use the stairs and a subway when changing trains. Permissive signalling arrangements were in place at Plymouth to permit two trains to share the same platform.

The signaller misjudged the amount of space available behind the London train and wrongly believed there was room for the Penzance train. He was aware that the platform sharing arrangement required an unusual form of permissive working, but did not communicate this to the Penzance train driver, and the rules did not require him to do so.

The Penzance train driver incorrectly believed he would not be sharing a platform with the London train. There was insufficient distance to stop his train by the time he realised his mistake and had applied the emergency brake.

Great Western Railway, the operator of both trains, and Network Rail the owner of the infrastructure, had not identified the risk of a collision due to the combination of an unusual form of permissive working, the track alignment on the approach to Plymouth station, and an inexperienced driver.

The RAIB has made three recommendations. The first, addressed to Great Western Railway and possibly also relevant to other train operators, seeks improvements to the training and assessment of new drivers. The second, also addressed to Great Western Railway and possibly relevant to other train operators, arises from difficulties encountered during passenger evacuation and seeks improvements to emergency door release controls. The third recommendation, addressed to Network Rail and to be undertaken with the assistance of appropriate train operating companies, seeks a review of permissive working arrangements at stations.

Two learning points stress the care needed by drivers when undertaking permissive moves, and the value of preventing passengers boarding or alighting from trains when permissive movements are taking place in the same platform.

Introduction

Key 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 technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B. Sources of evidence used in the investigation are listed in appendix C.

The accident

Summary of the accident

- 3 At 15:34 hrs on Sunday 3 April 2016, the 13:39 hrs passenger train service from Penzance to Exeter, reporting number 2E68, was entering platform 6 at Plymouth station when it collided with a stationary train, reporting number 1A91, that was already in the platform (figures 1 and 2). Train 2E68 was travelling at around 15 mph (24 km/h) when the collision occurred. During the collision around 48 people were injured and both trains were damaged.
- 4 The two trains were both using platform 6 to allow a convenient transfer of passengers from train 2E68 to train 1A91. This was a change to the timetabled arrangements, made to allow for platform lift refurbishment work and the need to restock the buffet vehicle on train 1A91.
- 5 As train 2E68 approached Plymouth station the signaller set the route into platform 6, and this platform number was displayed at the last signal passed by the train. However, the driver was not expecting to go into the same platform as train 1A91 and, until shortly before the collision, he believed he was going into an adjacent platform. When he realised he was approaching train 1A91, he applied the emergency brake, but this was too late to avoid the collision.

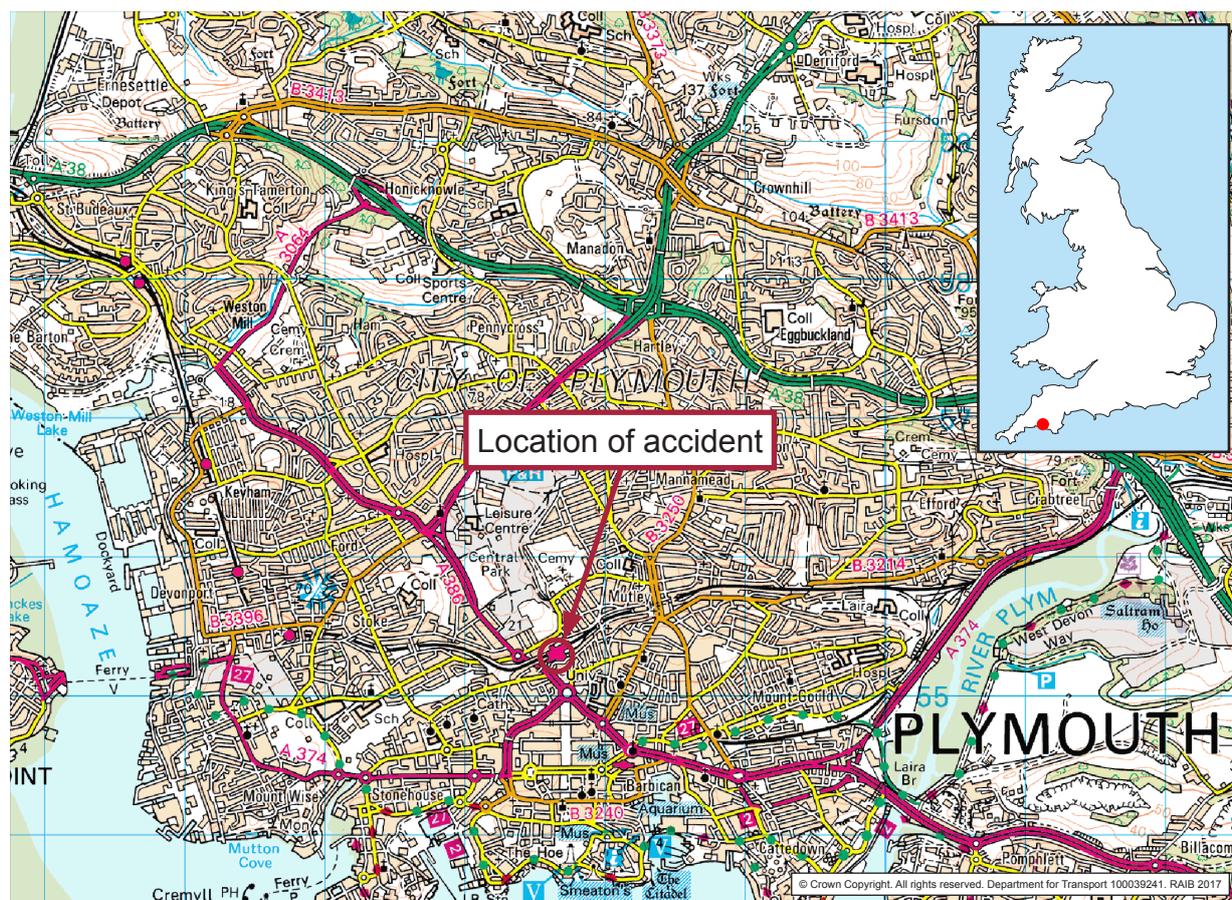


Figure 1: Extract from Ordnance Survey map showing location of accident



Figure 2: Damage to train 2E68 (left image) and train 1A91 (right image)

Context

Location

- 6 Plymouth station is located on the Great Western main line from London Paddington to Penzance. It is 245 miles and 75 chains¹ measured from a datum at London Paddington station along the route via Bristol Temple Meads. The station has six operational platforms comprising five *through platforms* (numbered 4, 5, 6, 7 and 8) and one *bay platform* (number 3).
- 7 A maximum permitted speed of 25 mph (40 km/h) applies to trains approaching platforms 4, 5, 6, 7 and 8 from the west. Trains approaching from this direction have to negotiate an uphill gradient (about 1 in 80 at its steepest) and a left-hand curve, this becomes a right-hand curve as trains enter platforms 6, 7 and 8 (figure 3).
- 8 Drivers' views of the station when approaching from the west are limited by the curvature of the track, vegetation, and a railway building. As a result, the western ends of platforms 3, 4, 5 and 6 are not all visible together until a train is about 135 metres away from the station. The western ends of platforms 7 and 8 are not fully visible until a train is about 70 metres from the station (figure 4). A long train (such as train 1A91) standing in platform 6 can obstruct an approaching driver's view of the middle and far end of platform 7. Station buildings between platforms 7 and 8 restrict an approaching driver's view along platform 8.
- 9 Plymouth signal box controls train movements in and out of Plymouth station. It is located near the end of platform 3 (figure 4). From this position, the signallers can see part of the western end of all the platforms through the signal box windows (figure 9).

Organisations involved

- 10 Great Western Railway (GWR) was the operator of trains 2E68 and 1A91. It was also the operator of Plymouth station through a lease agreement with Network Rail. GWR employed the staff who were working trains 2E68 and 1A91, and the station staff at Plymouth.
- 11 Network Rail owns the railway infrastructure, including Plymouth station, the track, and the signalling. It also employed the signaller involved in the accident.

¹ One chain is 22 yards or approximately 20 metres.

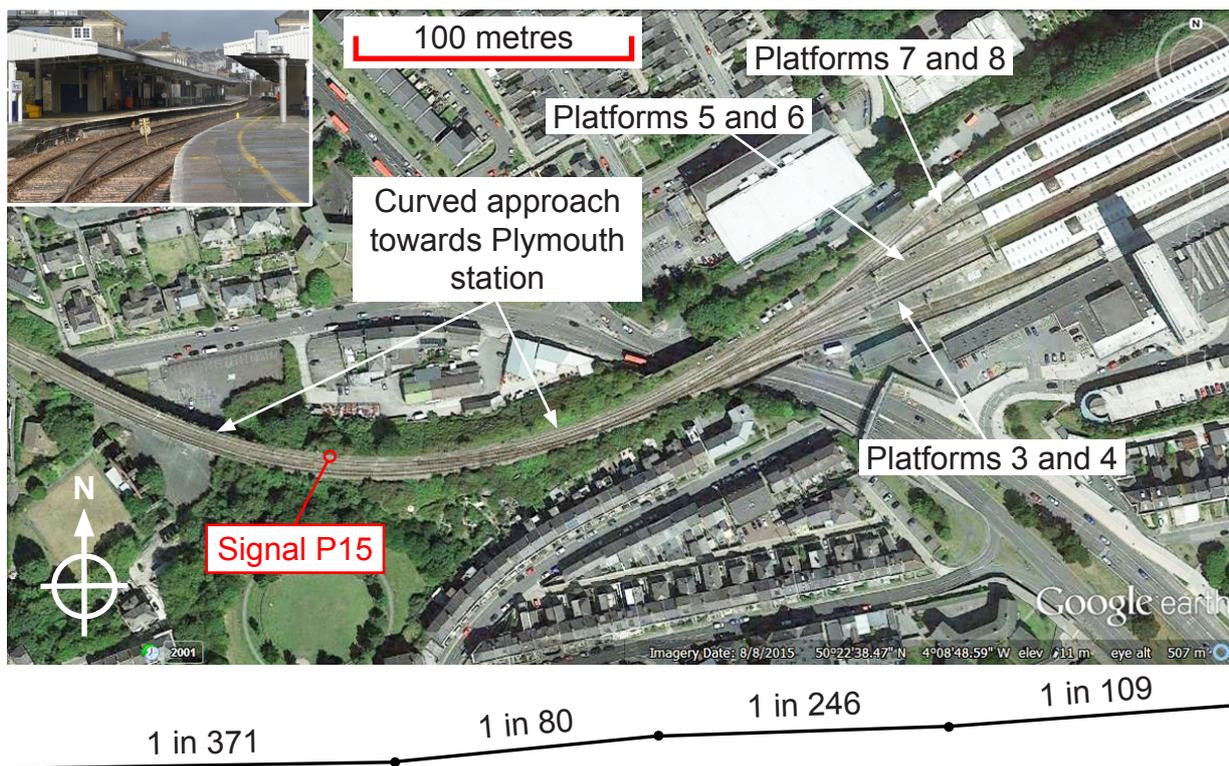


Figure 3: Plymouth station approach showing track curvature, gradients and platform curvature (inset image)

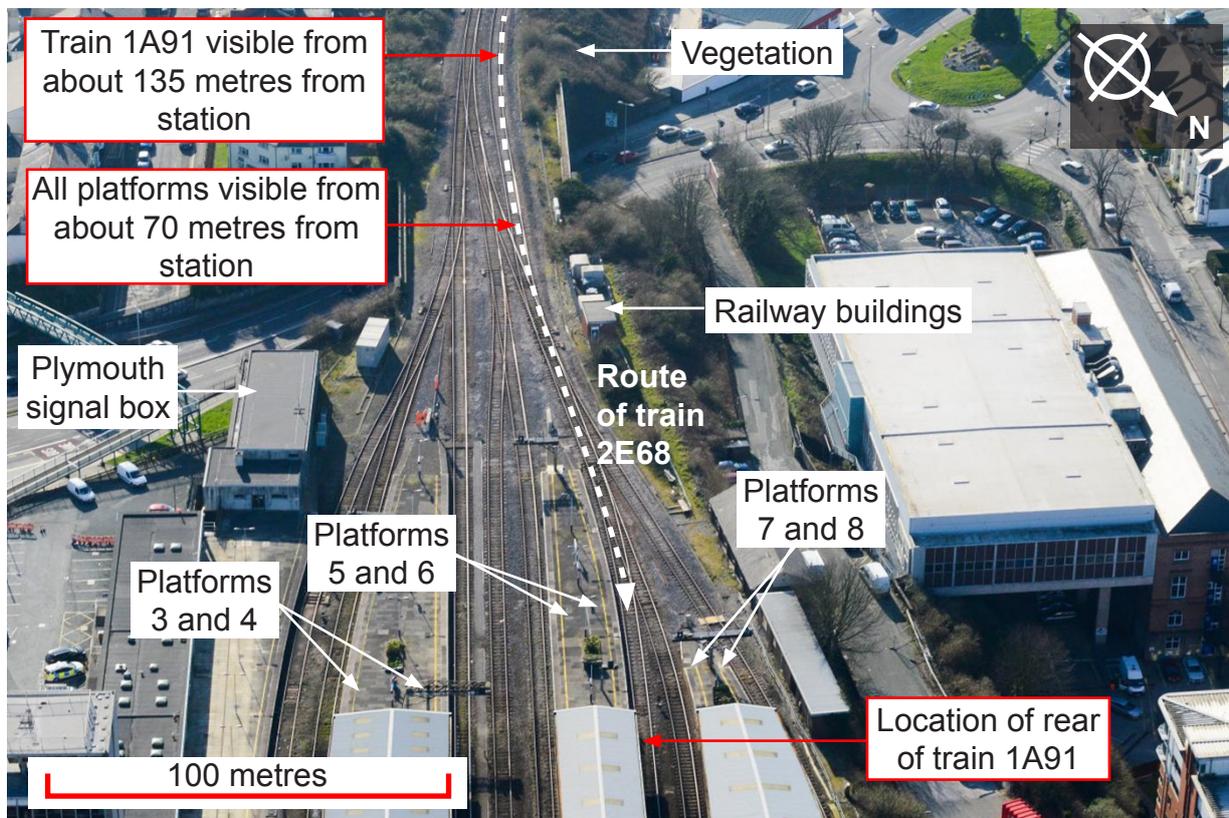


Figure 4: Features obscuring an approaching driver's view of platforms 6, 7 and 8 (image courtesy of Network Rail)

12 Both organisations freely co-operated with the investigation.

Trains involved

- 13 Train 2E68 was the 13:39 hrs service from Penzance to Exeter. It was formed by a pair of two-car class 150 *diesel multiple unit* trains. This four-car formation was 81 metres long and weighed 144 tonnes. This class of train was built between 1984 and 1987. The train was fitted with forward-facing and internal closed-circuit television (CCTV) equipment.
- 14 Train 1A91 was the 15:42 hrs Plymouth to Paddington service. Although described as train 1A91 throughout this report, it had arrived into platform 6 as train 5A91, an out of service empty passenger train. It was formed by a class 253/254 high speed train (HST) and comprised eight passenger coaches with a power car (locomotive) at each end. This class of train was built between 1975 and 1982. The train was 223 metres long and weighed 415 tonnes.

Rail equipment/systems involved

- 15 Train movements approaching Plymouth station from the west (the route followed by train 2E68) are controlled by signal P15. This signal is located 270 metres from the western end of platform 6. It moved to its current position in the late 1980s and the signal's head (displaying the coloured lights) was replaced in 2007² with a light emitting diode type signal head (known as LED). Signal P15 is capable of signalling trains into any of the platforms at Plymouth. When displaying a proceed indication, the appropriate platform number is displayed adjacent to the signal head (figure 5).
- 16 If a platform is already occupied, another train can be signalled into the same platform under permissive working arrangements (paragraph 32). In these circumstances signal P15 will display two white lights (known as position lights), at an angle of 45° adjacent to the red aspect.



Figure 5: Signal P15 showing a stop indication (left image) and a permissive working authority towards platform 6 (right image)

² When the signal head was replaced in 2007, Issue 1 of RGS GK/RT0044 issue 1 (February 2000) applied and it stated that 'The total distance from the signal controlling the movement of the second train to the commencement of the platform used for platform sharing purposes shall not be greater than 400 metres'.

- 17 There is no evidence that the functioning of signal P15 was a factor in the accident. Although the signal was re-positioned before the current Railway Group standard was introduced, the distance of 270 metres between the signal and the platform is compatible with Railway Group standard GK/RT0044 'Controls for signalling a train onto an occupied line'. The December 2014 version of this standard required the distance to be 'minimised, as far as reasonably practicable', and the previous version (February 2000) required that the spacing 'shall not be greater than 400 metres'.
- 18 Around 46 metres after passing signal P15, trains pass over a set of *facing points* which provide routes to platforms 3, 4, and 5. A second set of *points*, located around 32 metres before the western end of platform 6, provide a left-hand route to platform 8 or a straight-ahead route towards platforms 6 and 7. A third set of points, located at the start of platform 6, provides a straight-ahead route into platform 7, or a right-hand route into platform 6 (figure 6).

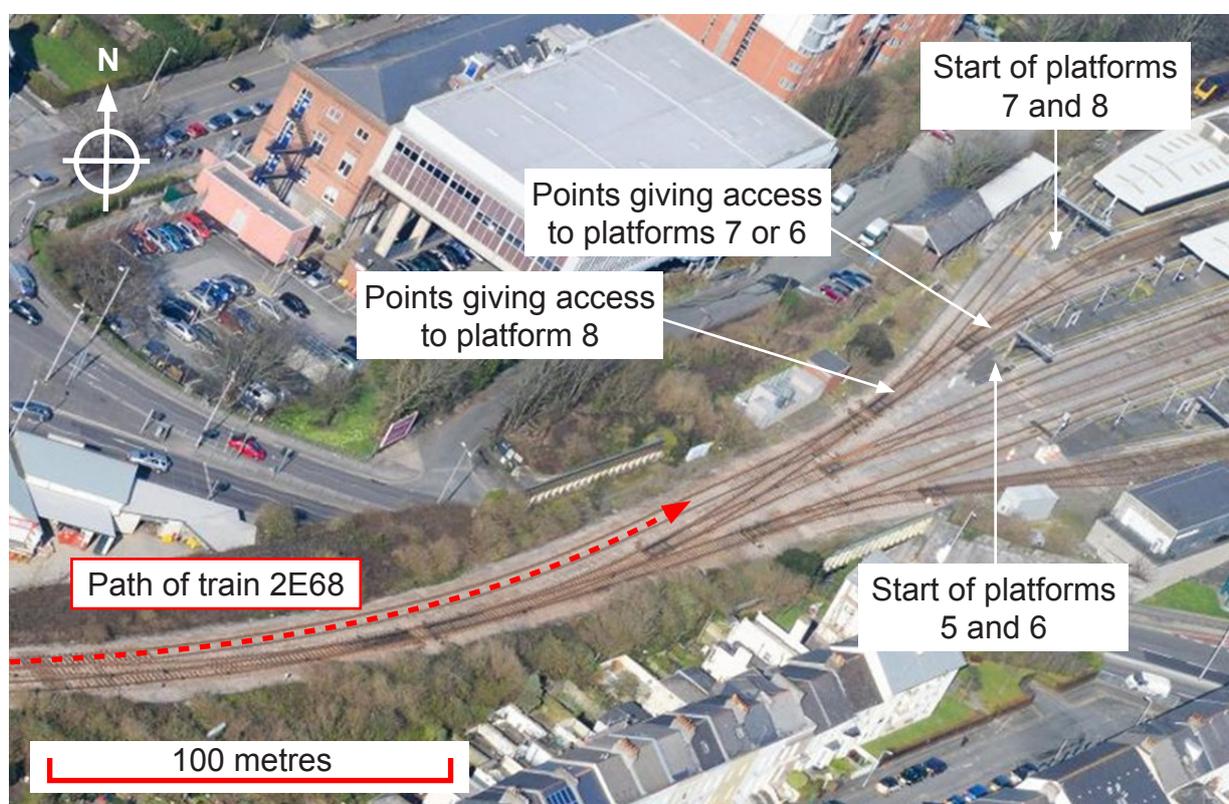


Figure 6: The points giving access to platform 8, and platforms 7 and 6 (image courtesy of Network Rail)

- 19 Signs are provided on each platform to indicate to drivers where to stop the front of their train. Because trains of different length serve the station, each platform has several of these signs; these are referred to as *car stop signs* in this report. The signs relevant to the accident are listed below (figures 7 and 8):
- A 10-car stop sign on platform 6 applicable to trains from the east (the direction train 1A91 came from). This is located adjacent to signal P46, about 47 metres from the western end of the platform.
 - 4-car stop signs applicable to trains from the west (the direction train 2E68 came from). These are located approximately midway along platforms 8, 7, and 6, with the sign on platform 6 being around 165 metres from the western end of the platform.



Figure 7: 10-car and 4-car stop signs relevant to the accident

- 20 Platforms 5 and 6, and platforms 7 and 8, are known as ‘island’ platforms and allow a direct cross-platform transfer to an adjacent train. Cross-platform transfer is also possible between platforms 3 and 4. Where a cross-platform transfer is not possible, passengers need to use either stairs or lifts to access a subway running beneath the platforms.

Staff involved

- 21 The driver of train 2E68 qualified to drive trains for GWR in May 2015. He was based at GWR’s Penzance depot. The driver’s competence assessments were up to date and no concerns about his competence had been identified. His training, experience and actions are discussed further at paragraphs 61 to 85.
- 22 The signaller involved in the accident had been a signaller at Plymouth signal box for over 30 years. All the signaller’s relevant competence assessments were up to date and no concerns had been identified relevant to the accident.

External circumstances

- 23 The accident occurred on a clear, dry day. There was no evidence that any external factors influenced the accident.

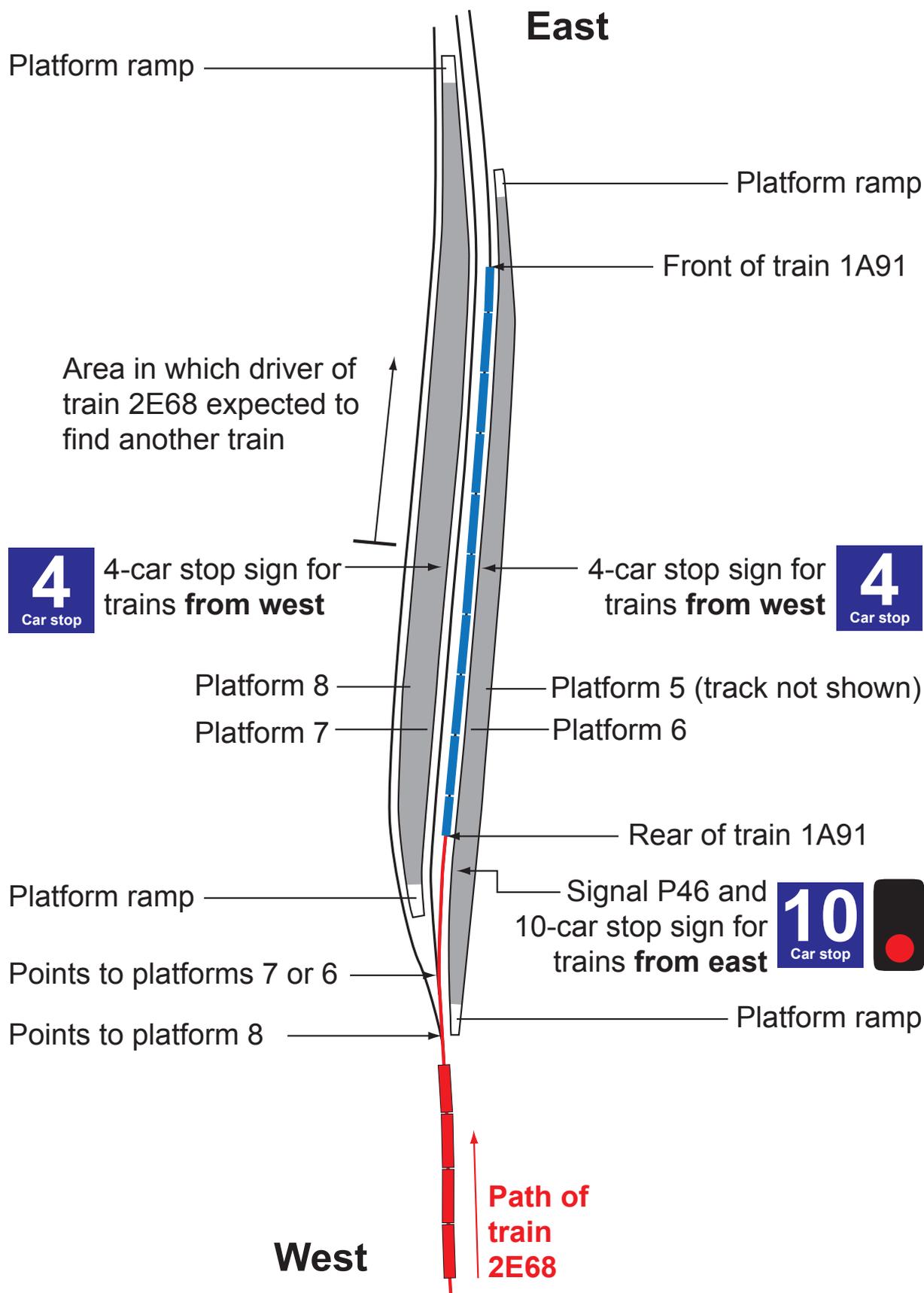


Figure 8: The location of the signs on platform 6 (note: not all tracks, platforms or platform curvature shown)

The sequence of events

Events preceding the accident

- 24 At 13:25 hrs the driver of train 2E68 booked on duty at Penzance. There were no reported issues with the train and it departed Penzance on time at 13:39 hrs. Information from the on-train data recorder (OTDR) indicated that the journey to the outskirts of Plymouth was uneventful.
- 25 Train 1A91 was timetabled to use platform 7 but, before the train arrived at Plymouth, the GWR duty station manager telephoned the signaller at 14:58 hrs requesting that the train use a different platform because it needed catering supplies and the lifts on platform 7 were unavailable due to renewal work. The signaller decided that the train could use platform 6 instead. The driver brought train 1A91 into platform 6, stopping it 11 metres before the front of the train reached the 10-car stop sign near the western end of the platform (figures 7 and 8). This left around 58 metres of platform length between the train and the western end of the platform. The driver stopped train 1A91 at that location because the 10-car stop sign is adjacent to signal P46 and the signal was displaying a red stop aspect. In such circumstances, GWR train driving policy requires that drivers approach platform stop signs cautiously, and stop their trains no closer to a red signal aspect than is necessary to ensure the train is fully within the platform.
- 26 After this move had been completed, the signaller noticed that train 2E68 was timetabled to use platform 8 and was a booked connecting service for train 1A91. As he believed that it was likely that some passengers on train 2E68 would want to join train 1A91, he looked at the position of train 1A91 in platform 6 through the signal box window, and decided to put train 2E68 into the unoccupied western end of platform 6. This would allow its passengers to walk along the platform to train 1A91 instead of using the stairs and subway from platform 8.

Events during the accident

- 27 At 15:33 hrs train 2E68 slowed to around 8 mph (13 km/h) as it approached signal P15, which was displaying a red (stop) aspect. Around 45 metres from the signal the driver stated that he applied power in response to seeing the position light signal illuminate (a proceed indication; paragraph 16, figure 5), together with a number '6' platform indication.
- 28 The driver of train 2E68 then accelerated to 22 mph (35 km/h) and, not realising that his train was being routed behind train 1A91, maintained this speed until he reached the west end of platform 6. He then saw that the points were set towards train 1A91 (figure 6) and applied the emergency brake. This was unable to stop the train before reaching train 1A91 but had reduced the speed of train 2E68 to 15 mph (24 km/h) when the collision occurred. The impact pushed train 1A91 around 3 metres along the platform.

- 29 Many people who were standing up waiting to get off train 2E68 were thrown into each other, into the train's fixtures, and onto the floor. The collision resulted in injuries to 42 passengers and 4 members of staff on train 2E68, including one passenger who was seriously injured³. Two members of GWR staff on train 1A91 were also injured during the collision. Both trains were damaged.

Events following the accident

- 30 Staff on train 2E68 and on the platform, along with officers of the British Transport Police who were also on the platform, helped evacuate passengers from train 2E68 and gave first aid until the ambulance, and fire and rescue services arrived.
- 31 Following on-site accident investigation by RAIB, both trains were recovered to a nearby GWR depot for further inspection. Platform 6 was reopened for service from 04:34 hrs the following day.

³ As defined in the Railways (Accident Investigation and Reporting) Regulations 2005.

Key facts and analysis

Background information

- 32 Train 2E68 was being signalled into a platform already partly occupied by train 1A91. This is known as permissive working and it happens many times each day on the national rail network. The operational benefits of doing this include allowing passengers to transfer onto connecting trains without the need to use stairs or bridges, allowing more trains to use a station at once, and coupling trains into longer formations. The locations where permissive working is authorised are shown in the *Sectional Appendix*, and in the signal box special instructions issued by Network Rail. Train drivers also know from their route knowledge which platforms are authorised for permissive working.
- 33 Where permissive working is authorised, distinctive signals are provided. Signal P15 approaching Plymouth is of this type (paragraph 16, figure 5). When the position lights illuminate at this type of signal, a train is allowed to proceed past the red *main aspect*. In these circumstances, the railway rulebook⁴ states that 'The driver must be prepared to stop short of any train, vehicle or obstruction'.

Identification of the immediate cause

- 34 **The driver did not apply the brakes early enough to stop train 2E68 before it collided with the stationary train in the platform.**
- 35 The on-train data recorder (OTDR) fitted to train 2E68 recorded that the train's power controller was shut off around 6 seconds before the collision, and that the emergency brake was applied 2 seconds later at a speed of around 21 mph (34 km/h). This was around 31 metres from train 1A91, which had been visible to the driver for around 13 seconds before this.
- 36 The train's emergency brake operated in accordance with the relevant braking specification⁵ but was not able to stop train 2E68 before the collision occurred. The specified braking distance from 21 mph (34 km/h), allowing for the 1 in 246 gradient, is around 84 metres.

Identification of causal factors

- 37 The accident occurred due to a combination of the following causal factors:
- the signaller routed train 2E68 into a platform that had insufficient room for it (paragraph 38);
 - the signaller did not tell the driver that an unusual move was intended (paragraph 54); and

⁴ Railway Group rule book handbook RS521 'Signals, handsignals, indicators and signs' issue 4 dated December 2016. Rail industry documents, including standards and the rule book are available at www.rssb.co.uk.

⁵ Table B1 in appendix B of Railway Group standard GK/RT0075 'Lineside signal spacing and speed signage' issue 4 dated September 2015.

- the driver of train 2E68 did not expect his train to be going into the same platform as train 1A91 (paragraph 61).

Each of these factors is now considered in turn.

The actions of the signaller

38 The signaller routed train 2E68 into a platform that had insufficient room for it.

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

- the signaller put train 2E68 into the same platform as train 1A91 so that passengers could transfer between the two trains without using the stairs and subway (paragraph 40); and
- the signaller incorrectly believed train 2E68 would fit in the platform behind train 1A91 (paragraph 44).

Each of these factors is now considered in turn.

The signaller's decision

40 The signaller's intention was to allow an easier transfer of passengers from train 2E68 to train 1A91.

- 41 The signaller intended that trains 2E68 and 1A91 share platform 6 so that the passengers could transfer between the two trains without using the stairs and subway.
- 42 When the national rail timetables are produced, each train is allocated a platform at the stations it calls at. On the day of the accident, train 1A91 was timetabled to use platform 7 and train 2E68 was timetabled to use platform 8. Train 2E68 was a booked connecting service with train 1A91, with 7 minutes provided in the timetable between the arrival of train 2E68 and the departure of train 1A91. The timetabled arrangements allowed for the planned cross-platform transfer from train 2E68 to train 1A91. However, lift renewal work meant there were no working lifts on platforms 7 and 8 from 18 January 2016 to 12 April 2016. On the day of the accident, train 1A91 required its buffet vehicle to be restocked so the train used platform 6 where a lift was available to allow this (paragraph 25).
- 43 The signaller noticed that putting train 2E68 into platform 8 as timetabled, would require passengers transferring onto train 1A91 in platform 6 to use the stairs and the subway. Mindful that some passengers may have difficulty with this (eg mobility impaired passengers, and passengers with pushchairs and suitcases), the signaller looked to see if train 2E68 could use platform 5 where they could transfer to train 1A91 by crossing the platform. However, another train service was already scheduled to use that platform. The signaller therefore considered whether train 2E68 could share platform 6 with train 1A91.

The signaller's awareness of the available space in platform 6

44 The signaller misjudged the available platform space behind train 1A91.

- 45 When considering whether he could put train 2E68 into platform 6, the signaller looked through the signal box window and judged that there was enough room for train 2E68, which he knew to be four vehicles long, to fit between the rear of train 1A91 and the end of the platform (figure 9). This would require a permissive movement by train 2E68 (paragraph 32).

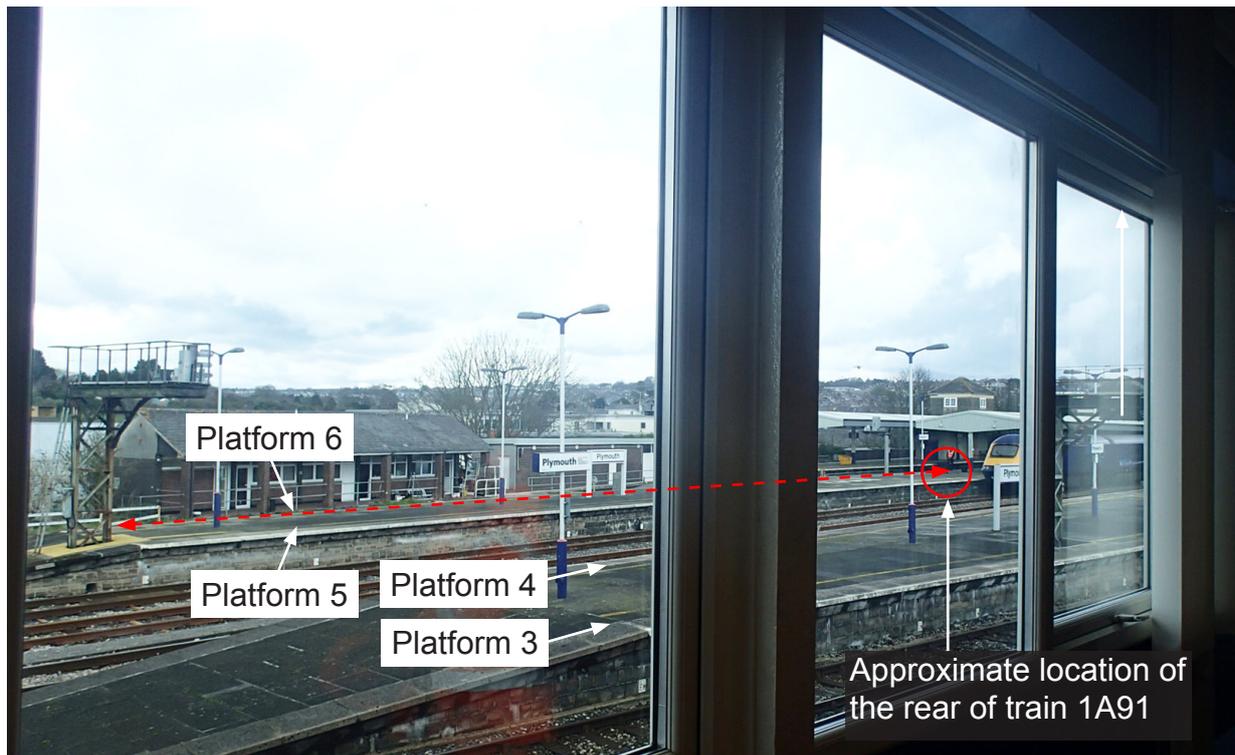


Figure 9: View of platform 6 through the signal box window

- 46 Before arranging a permissive movement, signallers are required to follow the requirements of rule book module TS2 'Track circuit block regulations'. These regulations require signallers to get confirmation from the person in charge of the platform that there is room for the second train, before signalling the movement, in circumstances where the signaller is not sure whether there will be enough room for the second train. The signaller did not seek this confirmation because he believed there was enough room.
- 47 Before signalling train 2E68 into platform 6 behind train 1A91, the signaller phoned the GWR duty station manager and explained his intention. The GWR duty station manager reminded the signaller that train 2E68 was formed of two class 150 trains, four vehicles in total. The signaller told the GWR duty station manager that train 2E68 should fit, but that its position would prevent other trains using platforms 7 and 8 because the signalling system would prevent movement of the points needed to access these platforms. This was not considered to be an issue as no other trains were expected to need these platforms while train 2E68 was in platform 6.
- 48 Train 2E68 was 81 metres long and rule book module TW1 'Preparation and movement of trains' states that drivers must stop their train 'at least 2 metres short of the train in front'. A total of 83 metres of platform space was therefore required for train 2E68 to fit behind train 1A91.
- 49 The actual length of platform available to accommodate train 2E68 was about 61 metres, around 20 metres less than needed. GWR considered that part of this 61 metres was unsuitable for boarding and alighting passengers (paragraph 53).



Figure 10: Gap between the third vehicle of train 2E68 and the platform edge

Information about available platform occupancy

- 50 In Plymouth signal box the position of trains is shown on a signaller's display (figure 11) which includes all the platforms at Plymouth station. When a train is occupying a section of track a series of red lights illuminate on the corresponding platform line on the signaller's display. When a train occupies any part of a platform at Plymouth station, the display shows a series of red lights illuminate along the whole length of that platform. This means that the platform will look fully occupied by a train no matter how long the train is. When train 1A91 was in platform 6 before the collision, the signaller's panel indication showed the whole length of the platform was occupied, even though the signaller could see through the signal box windows that there was a length of platform available behind train 1A91 (figure 9).
- 51 At some locations signalling systems are configured to measure if a second train will fit in the platform or not before the controlling signal permits the second train to enter the platform (known as Lime Street controls). This arrangement is only practicable at locations where trains comprise units of similar length. This is not the case at Plymouth.
- 52 Network Rail had not formally provided the signallers at Plymouth with information about the combinations of trains that could be safely accommodated in each platform. However, the signallers had produced their own document, based on information from the Western Route Sectional Appendix that showed the length of each platform and the length of typical trains that use the station. This document showed that platform 6 had a useable length of 260 metres, and that the combined length of trains 1A91 and 2E68 was 301 metres. Use of this document was not mandated and it was little used by the Plymouth signallers. On the day of the accident the signaller had not referred to the document because he had relied on his visualisation of the length of train 2E68, and his judgement of the available length of platform 6 (paragraph 45).

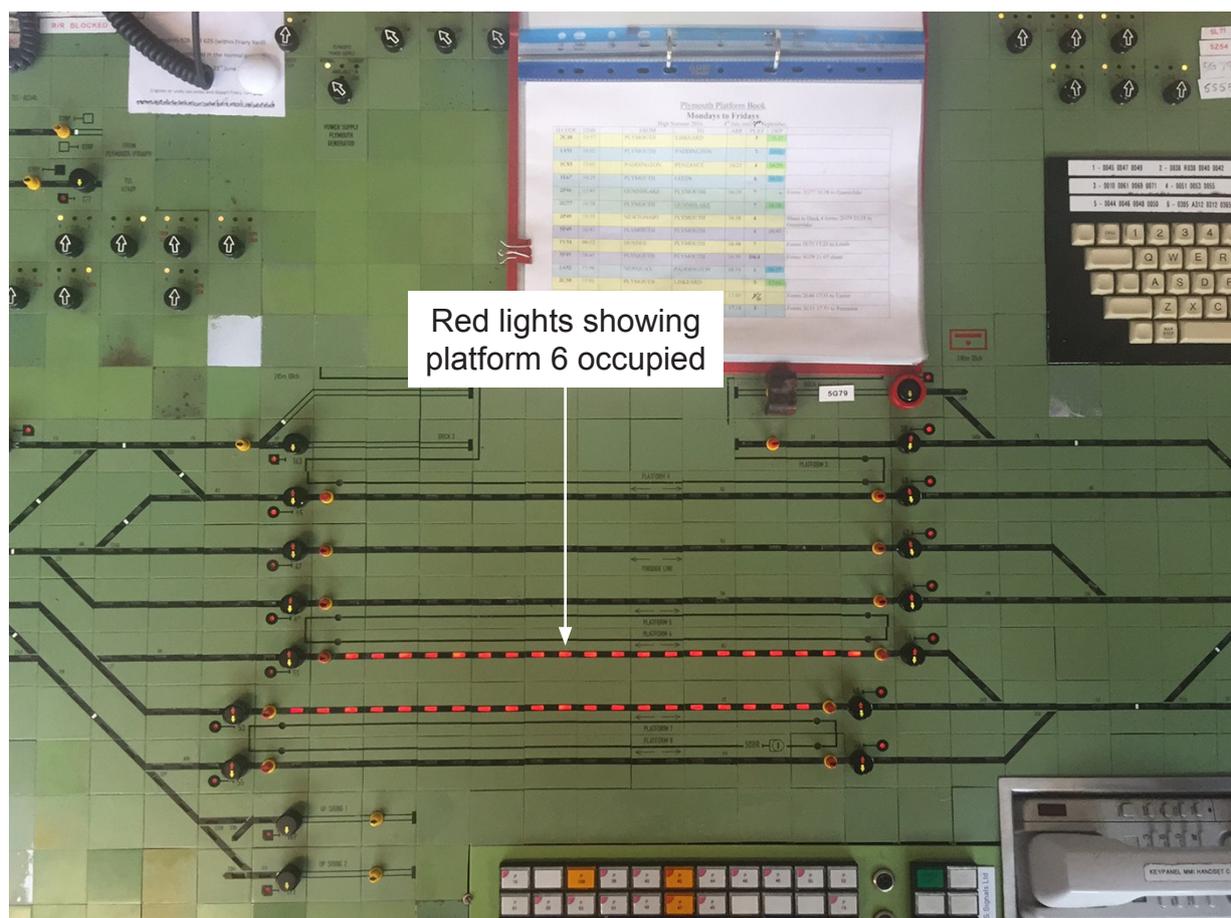


Figure 11: The signaller's panel display at Plymouth signal box

53 When assessing the space available for train 2E68, the signaller believed that passenger trains could use the full length of platform 6. This was consistent with the information given in both the sectional appendix and the document prepared by signallers. However, GWR considered that the length of platform, between the western end of platform 6 and signal P46, was not useable because of the large gap between the platform edge and trains. This was due to the curvature of the platform and track in this area. The gap was apparent when train 2E68 occupied that part of the platform on the day of the accident (figure 10). The signal box instructions for Plymouth station did not include information about unsafe gaps at the platforms.

Telling the driver of train 2E68 about the permissive move

54 The signaller did not tell the driver that an unusual move was intended.

55 At Plymouth station it was unusual for a train formed of two class 150 units, to share a platform with a long passenger train such as 1A91. In this situation train 2E68 needed to stop sooner than in the more usual permissive moves where a relatively short train would be encountered further along the platform.

- 56 This permissive move was considered unusual by Network Rail's operations manager for the Plymouth area, and by GWR driver managers who had operated trains in the Plymouth area for many years. The driver managers confirmed that a few GWR drivers had carried out similar permissive moves, but had been told in advance by the signaller what was going to happen. This was confirmed by some of the signallers at Plymouth who stated that this had been done occasionally while the lift refurbishment work was in progress.
- 57 Even though it was an unusual permissive movement, the signaller did not tell the driver of train 2E68 that he would be going into a platform that was occupied by a long train, and there was no rule book or local instruction requiring him to do so. Had the signaller told the driver about the intended move before it started, it is almost certain that the driver would have controlled the train with the intention of stopping before reaching the rear of train 1A91, rather than initially rejecting the possibility that the intended route for his train was towards train 1A91 (paragraph 66).
- 58 The signaller acknowledged that it was unusual for a train like 1A91 (ie a long passenger train) and a train like 2E68 to share the same platform. In over 30 years as a signaller at Plymouth he could not recall arranging this type of permissive movement before the day of the accident.
- 59 The signaller stated that the main reason he had not contacted the driver of train 2E68 before setting the route into platform 6 was that he expected that the driver would see train 1A91 in platform 6 ahead, and would approach it cautiously, as required by the rules for permissive working (paragraph 33).

Other factors influencing the signaller

- 60 There was no evidence that the signaller was distracted by other events, either personal or work related, or was fatigued.

The actions of the driver

61 The driver of train 2E68 did not expect his train to be going into the same platform as train 1A91.

- 62 This causal factor arose due to a combination of the following:
- the driver believed that his train could safely proceed to a 4-car stop sign located approximately midway along the platform he would use and lacked the experience to quickly recognise the identity of the platform occupied by train 1A91 (paragraph 63);
 - the training and assessments undertaken by the driver had not resulted in a correct understanding of permissive working (paragraph 73); and
 - the driver of train 2E68 had not previously experienced the type of permissive move arranged on the day of the accident (paragraph 79).

Each of these factors is now considered in turn.

The driver's understanding about the routing of train 2E68

- 63 The driver believed that his train could safely proceed to a 4-car stop sign located approximately midway along the platform he would use and lacked the experience to quickly recognise the identity of the platform occupied by train 1A91.
- 64 The driver stated that when he saw the position lights illuminate as train 2E68 approached signal P15 he believed that, based on conversations with other drivers when he was being trained, his train was being permissively signalled into platform 6 because there may be a train in that platform that needed to go to the depot at Exeter. Typically this type of move is not planned in the railway timetable. The driver stated that he thought that this other train would be standing beyond the 4-car stop sign that would apply to train 2E68 (ie the sign about 165 metres beyond the western end of the platform).
- 65 The driver also stated that he believed that the signaller would tell him if his train would have to stop before reaching the relevant car stop sign. This belief was based on an incorrect understanding that stopping short of the appropriate car stop sign would mean that the rear part of his train would not be safely accommodated in the platform and he would need to take appropriate action, by contacting the train's guard, to prevent passengers from using doors not safely accommodated at the platform. Platform car stop signs are usually positioned so that distances between train doors and the platform entrance/exit are minimised. This means they are frequently located further along the platform than the actual length of the train to which they apply. For example, the 4-car sign on platform 4 at Plymouth is located around 165 metres along the platform, while a 4-car class 150 train, the formation of train 2E68, is only about 81 metres long.
- 66 The driver further stated that as his train rounded the curve on the approach to Plymouth station, he saw train 1A91 in a platform ahead. He immediately thought that his train would not be going into the same platform because train 1A91 looked as though it was occupying nearly the whole length of platform and there was no room for his train to fit behind it. At this time platforms 7 and 8 were not visible to the driver because of track curvature and the position of nearby railway buildings (figure 12). This meant that he did not realise that train 1A91 was actually standing in platform 6, the same platform that his train was to use.



Figure 12: Platforms 3, 4, 5 and 6 become visible from about 135 metres from the station (image courtesy of GWR)

- 67 Train 2E68 continued towards Plymouth station with the driver's attention divided between looking forward, looking at the train's speedometer in the driving cab, and adjusting the power settings as the train negotiated the inclined and curved approach. When platforms 8 and 7 came into view to the left of train 1A91, the driver of train 2E68 continued to discount the possibility that his train was proceeding towards the same platform that train 1A91 was occupying because he firmly believed he was proceeding into one of the platforms to the left of train 1A91. His view along these platforms was partly obscured by train 1A91 and station buildings and so he could not see that there were no trains standing further along these platforms (paragraph 64, figure 13) where he would have expected a shorter train to be.

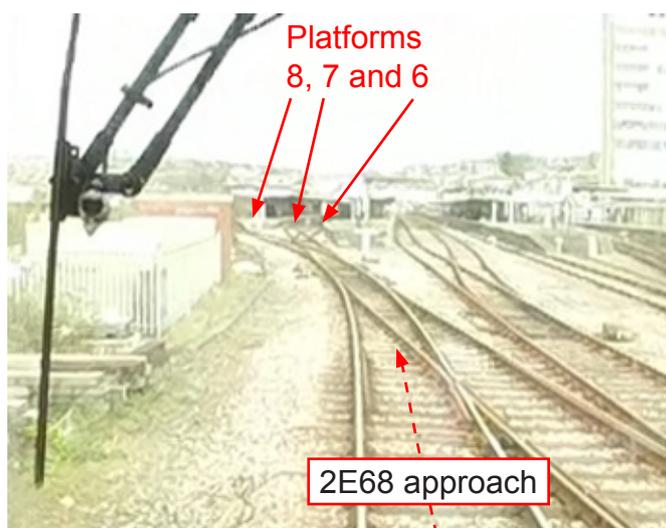


Figure 13: All platforms visible from about 70 metres from the station (image courtesy of GWR)

- 68 About 10 seconds (91 metres) before the collision, train 2E68 approached the points giving access to platform 8 (figures 6 and 14). The driver stated he looked at the points and saw that they were set for the straight ahead route, and continued to believe that his train was not going into the platform occupied by train 1A91.

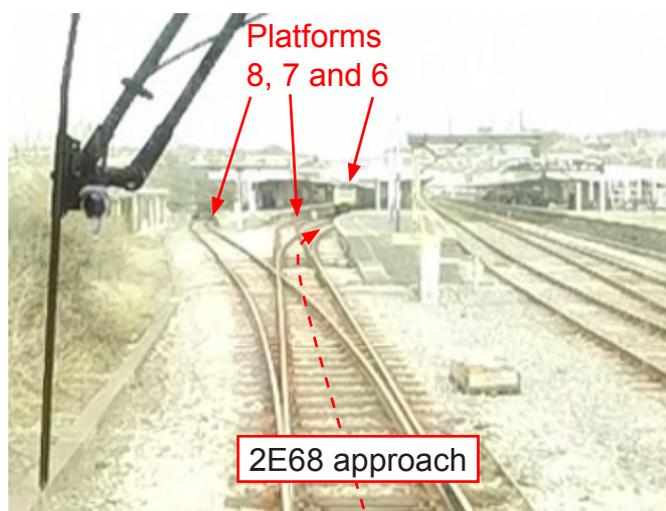


Figure 14: Approaching the points giving access to platform 8 about 91 metres from where train 1A91 was standing in platform 6 (image courtesy of GWR)

- 69 About 7 seconds (62 metres) before the collision, the train approached the start of platform 6 and the driver shut off power in preparation to stop in the station. At about the same time the driver looked at the final set of points which are located at the start of platform 6. This set of points permits a straight ahead movement into platform 7, or a route to the right into platform 6 (figure 15). On the final approach to this set of points the driver saw they were set towards train 1A91. The driver stated that, in disbelief, he counted the platforms across from 8 to 6, and on realising train 1A91 was in platform 6, he made an emergency brake application. The OTDR shows that the emergency brake was applied about 4 seconds (31 metres) before the collision.



Figure 15: The points giving access to platforms 7 or 6 located near the start of platform 6 (image courtesy of GWR)

- 70 The presence of track curvature, vegetation and railway buildings (figures 3, 4 and 12) meant that the driver of 2E68 could not see platforms 7 and 8, and so could not establish the location of platform 6 by counting across from platform 8, until about 13 seconds (125 metres) before the collision. Counting at this stage would have revealed that train 1A91 was in platform 6 and would have given the driver sufficient time to stop his train safely. He did not count platforms at this stage because he had concluded that there was insufficient room for his train to share the platform occupied by train 1A91, and so had discounted the possibility of his train being routed into this platform. Although the driver of train 2E68 was competent to drive the route to Plymouth, he was still gaining practical experience driving it. It is possible that a more experienced driver would have recognised that train 1A91 was occupying platform 6 in time to prevent a collision (paragraphs 66 and 67).

- 71 The final set of points (figure 15) were visible from approximately 33 metres before the train reached them. At that point the train was about 96 metres from the rear of train 1A91. There was no requirement for the driver to check the position of these points because he was undertaking a signalled movement and the signalling arrangements mean that he could not receive a proceed aspect at signal P15 unless all the relevant sets of points were in the correct position for the intended route of the train. There are occasions when drivers must check the position of points, for example during a signalling system failure. However, many drivers develop a routine practice of checking the position of points as their trains approach them. The driver of train 2E68 had developed such a routine, undertaking the check when his train was closer to the points, rather than when they first became visible to him.
- 72 The rules about permissive working (paragraph 33) state that drivers must proceed with caution so that they can stop the train within the distance they can see to be clear ahead of them. The driver of train 2E68 did not perceive that train 1A91 was an obstruction on his route until he was in the vicinity of the last set of points at the start of platform 6 (figure 15). Until this point, the driver was expecting to go as far a 4-car stop sign located nearly half way along one of the platforms to the left of the platform occupied by train 1A91. Analysis of the OTDR data and the braking performance of the train indicated that, if driving into platforms 7 or 8, the driver would have been able to stop normally at the 4-car stop signs on these platforms. He could also have stopped normally at the 4-car stop sign in platform 6 if the platform had been unoccupied to that point. The way train 2E68 was driven into Plymouth station was consistent with the driver's belief he would be going into a platform that was unoccupied at least as far as the 4-car stop sign. If doing this, the train could have stopped within the distance the driver could see to be clear.

The driver's understanding of permissive working

73 The training and assessments undertaken by the driver had not resulted in a correct understanding of permissive working.

- 74 The driver of train 2E68 believed that if a train was to be signalled into a platform such that it could not reach its normal stopping point (ie the appropriate car stop sign) the signaller would tell the driver (paragraph 65). Because the signaller had not told him about this particular intended permissive movement (paragraph 54), the driver assumed the route would be clear as far as a 4-car stop sign.
- 75 The driver of train 2E68 was trained by GWR at its driver training school between June 2014 and December 2014. During this time the driver was trained in the rules and regulations concerning train driving, including rules about permissive working and working trains in stations. GWR also uses a train driving simulator as part of its driver training course but, when the driver of train 2E68 was trained, the simulator training did not include sessions related to permissive working.
- 76 GWR trainers and assessors considered the driver to be a competent trainee and he passed all his assessments. This included assessments testing his understanding of permissive working and the working of trains in stations.

- 77 RAIB examined the GWR driver training syllabus, and the assessment records of the driver to understand if the way the driver was trained and/or assessed had led to the driver misunderstanding permissive working. The following was noted:
- The sessions about permissive working did not mention that, when entering a permissive platform, drivers may encounter another train before reaching the car stop sign that would normally apply to their train.
 - When diagrams accompanying the learning sessions on permissive working showed a train already in the platform, this train was always located at the far end of the platform.
 - The sessions about working trains in stations did not make it clear that car stop signs in platforms can be positioned further along the platform than the actual length of the train to which they apply (paragraph 65).
- 78 RAIB noted that while the assessment of drivers' knowledge of permissive working and working trains in stations included the relevant principles, the questions did not probe drivers' understanding of the practical application of these principles. For example, there were no questions about the risks associated with the positions of car stop signs in platforms, short and long passenger trains sharing platforms, and assuming the extent of a permissive movement. It is possible that deeper questioning would have identified that the driver of train 2E68 had misunderstood some elements of these methods of working.

The driver's practical experience of permissive working

79 The driver of train 2E68 had not previously experienced the type of permissive move arranged as he approached Plymouth on the day of the accident.

- 80 In contrast to the driver's normal experience of permissive working, the movement on the day of the accident was both unplanned and unusual. The driver was not expecting to be put into the same platform as a long train and had no forewarning of this (paragraphs 54 and 61).
- 81 The driver of train 2E68 began learning to drive trains with a GWR instructor driver in December 2014. Over the following six months the driver gained practical experience over a variety of routes, and in May 2015 he qualified to drive trains unaccompanied. Although he had been driving unaccompanied since May 2015, he did not drive trains between 26 November 2015 and 20 January 2016 for a medical reason which had no relevance to the accident. The driver had therefore gained around nine months solo driving experience at the time of the accident. GWR has stated that this included driving to Plymouth typically two or three times per four week period. He used a through platform (rather than the bay platform 3) on at least some occasions as he continued beyond Plymouth to Exeter on about one out of three of those occasions. Before the day of the accident he had last driven a train from Penzance to Plymouth on 23 March 2016, 11 days before the accident.

- 82 Since he qualified in May 2015, the driver had been directly observed driving trains on seven occasions. During these assessments he had worked into bay platforms, and had undertaken permissive moves to couple to other trains in these platforms. There is no record of him being observed driving into a through-platform under permissive working arrangements, or driving into a platform partially occupied by an unusually long or unusually positioned train. The driver had also attended two simulator sessions, but these focused on 'out of course' events and did not include simulation of permissive working. Two OTDR reviews were also undertaken but the journeys reviewed did not include permissive working.
- 83 During his training and solo driving experience the driver had carried out many permissive movements. However, these did not include unplanned movements that differed significantly from the intended timetabled permissive movements. The majority of the permissive working experienced by the driver involved booked timetabled movements and, importantly, did not include any movements like that on the day of the accident. The only permissive movements undertaken by the driver at Plymouth were into platform 3, the bay platform, towards trains of a similar length to train 2E68.
- 84 The driver's work included operating many 'branch line' services consisting of trips off the main line to coastal towns. This type of work included permissive movements towards stationary trains in bay platforms. In these circumstances, trains tend to be driven at much slower speed towards the platform because there is a protection system fitted to the track and trains that is intended to apply the train's brakes if it approaches buffer stops too fast⁶. Also, the limit of the permissive movement would normally be a train that is standing towards the far end of the platform, with sufficient room for both trains; the situation expected by the driver as he approached Plymouth station (paragraphs 64 and 77).

Other possible factors influencing the driver

- 85 The RAIB found no evidence that the driver of train 2E68 was distracted by events inside or outside the driving cab, was suffering from fatigue or any relevant health issues, or was preoccupied with personal or work related issues.

Identification of a possible underlying factor

Understanding of the risks of permissive working

- 86 **Neither Network Rail nor Great Western Railway had identified the risk of an accident during permissive working at Plymouth due to a combination of driver inexperience and a signaller arranging an unusual permissive move. It is possible that this was an underlying factor.**
- 87 Although Network Rail and GWR were aware that permissive working includes a risk of collision, neither organisation had identified specific issues likely to increase the risk of a collision during permissive working at Plymouth station.

⁶ The Train Protection and Warning System (TPWS). This system will apply the train's brakes if it is exceeding 10 mph (16 km/h) at a defined position on the approach to the buffer stops.

Network Rail's actions

- 88 Network Rail's operations manager for the Plymouth area had identified local hazards at Plymouth by ticking applicable hazards from a list given in an appendix to Network Rail company standard NR/L2/OCS/085. The hazards he identified included the gradient on approach to the station, that the view along platforms was obstructed by the effects of stationary trains and platform curvature, and the variance in the stopping position of stationary trains in the platforms (paragraphs 66 and 67). However, there is no evidence that Network Rail had worked with train operators to fully understand the effect of these hazards, or identified suitable control measures that may have reduced the likelihood of a collision between trains during permissive working.
- 89 Network Rail company standard NR/L2/OCS/085 'Permissive platform working' dated March 2011, defines the requirements to control the risk of train collisions during permissive working movements. These include requirements to allow the continuation of existing permissive working arrangements, the situation relevant to the accident at Plymouth. In these instances, Network Rail's operations managers, who are responsible for operational aspects of Network Rail's infrastructure, are required to review the current arrangements and develop an action plan for the 'implementation of reasonably practicable control measures for each location'.
- 90 The operations manager covering the Plymouth area had carried out detailed risk assessments in accordance with standard NR/L2/OCS/085 at locations where the introduction of permissive working was being considered, but had not done so at locations where permissive working was already permitted. This was because he believed the assessments in the standard only applied to locations where permissive working was to be introduced or extended, and not at locations where historic arrangements continued to operate. At locations such as Plymouth where historic arrangements continued to operate, he had used a list provided in an appendix to standard NR/L2/OCS/085 to record risk factors, but had not assessed these and thus had not identified any risk control measures.
- 91 In August 2014, Network Rail's headquarters staff sent an email to its operations managers asking them if they had any concerns relating to locations authorised for permissive working arrangements. This was in response to an RAIB recommendation following a permissive working collision at Norwich station on 21 July 2013 (see paragraph 116). The operations manager for the Plymouth area had no particular concerns with permissive working at Plymouth because it had been used there regularly for many years without incident, there had not been any significant changes to the timetable, the number of permissive movements had not increased in recent years, and the signallers' application of permissive working was checked as part of the signallers competence assessment process.
- 92 Although the operations manager for the Plymouth area had reviewed permissive working arrangements at Plymouth (paragraph 90), and Network Rail had asked its operations managers to review locations where they had concerns about permissive working (paragraph 91), no instructions or guidance had been issued to the signallers about the operational risks to be considered when arranging permissive movements at Plymouth station (paragraph 52).

Great Western Railway's actions

- 93 At the time of the accident at Plymouth, GWR had no process in place to assess permissive working at the stations it serves, and thus did not fully understand the risks associated with this method of working. However, GWR had, as part of its safety management system requirement to identify its operational risks, identified that a collision between passenger trains in a station was a risk. GWR believed that this risk was being managed through processes such as driver training and assessment.
- 94 GWR stated that it had reviewed the RAIB report into the collision at Norwich (paragraph 110) and had identified that it had no process in place to assess permissive working risk. In 2015 GWR requested copies of Network Rail's permissive risk assessments (although these were mainly lists of hazards rather than risk assessments – paragraph 90) and was in the process of reviewing these when the accident at Plymouth occurred.
- 95 GWR provides its drivers with route maps and route risk briefings when they learn routes. The information used in the route risk briefings and route maps includes risks that have been identified through route risk assessments. However, GWR had not identified hazards on the western approach to Plymouth station such as:
- the uphill gradient when approaching from the west, which increases the risk of drivers becoming preoccupied in managing the train's speed;
 - the curved approach into the station, which means that not all platforms are visible when the station first comes into view, making it difficult to identify the train's intended platform; and
 - the curved platforms, which mean that trains standing in the station can prevent drivers seeing trains standing in some parts of other platforms.
- 96 It is possible that identification of these risks, possibly informed by a permissive working risk assessment (paragraphs 89, 90 and 94) would have led GWR to advise or instruct its drivers to approach Plymouth station at reduced speed when undertaking permissive movements (paragraph 124 and Recommendation 2). Had such advice or instruction been provided, it is likely to have either prevented the accident on 4 April 2016, or have resulted in a lower-speed collision with fewer, or less serious, injuries and damage.

The lift renewal work

- 97 The work to refurbish the lifts at Plymouth station began in January 2016. The work affecting platforms 7 and 8 started in mid-January 2016, and was due for completion in mid-April 2016. Before the lift renewal programme began, GWR carried out a risk assessment on the effect the work would have on the operation of the station. The risk assessment was focussed on the risks of injury to passengers and staff directly caused by the construction work, and on the increased risk of accidents on stairs when the lifts were out of use.

- 98 One of the hazards identified by the lift refurbishment risk assessment was the transfer between platforms of passengers with reduced mobility, and passengers with pushchairs, wheelchairs, bicycles, and luggage. One of the measures identified to control this hazard was altering the timetabled platforms for trains where possible. However, because the risk assessment was focused on hazards associated with the station environment itself, and not the operational arrangements for train movements, the possibility that additional permissive moves may arise, for example to restock buffet vehicles, was not considered.
- 99 The signallers at Plymouth, with assistance from GWR's station staff, had produced a station 'simplifier' showing details of how trains would be managed during the period of the lift renewals. This document was sent to Network Rail headquarters staff who in turn updated the national timetable plan to reflect the re-allocation of platforms during the renewal work. Because this amended plan did not increase the number of booked permissive movements, the requirement to carry out a risk assessment in accordance with Network Rail company standard NR/L2/OCS/085 was not triggered.

Factors affecting the severity of consequences

The performance of the trains during the collision

100 The trains' performance was as expected for trains designed before the introduction of modern crashworthiness standards.

- 101 Both trains were designed and built at a time when crashworthiness was an important consideration, but before the introduction of crashworthiness specifications for energy absorption or controlled structural deformation.
- 102 The collision forces were high enough to cause people to be thrown off their feet, and many of the injuries were caused through secondary impacts with other people. The extent of injuries, shown in appendix D, was probably increased because many passengers had got out of their seats ready to alight at Plymouth, and so were standing up when the collision occurred.
- 103 Some passengers were injured when they made contact with the glass draught screens (figure 16). One passenger was injured when the draught screen broke because their head struck it. Other passengers were injured when they struck their heads against the screens, but the screens did not break. The draught screens on train 2E68 were made of toughened glass as their installation predates the requirement in the current Railway Group standard⁷ to fit laminated glass. This accident does not provide sufficient evidence to justify a recommendation for retro-fitting laminated glass to class 150 trains.
- 104 Although both driving cabs were damaged, there was no significant damage to the main structural components of the carriages. This meant that passengers and staff were protected from injury caused by structural deformation of the carriages. The driver's desk of train 2E68 showed no signs of movement, and in the passenger compartments the fixtures and fittings remained largely secured, intact and undamaged. This meant that passengers and staff were not exposed to the risk of injury from train components dislodged during the accident.

⁷ GM/RT2100 'Requirements for rail vehicle structures' Issue 5 dated June 2012, section 6.5.2.

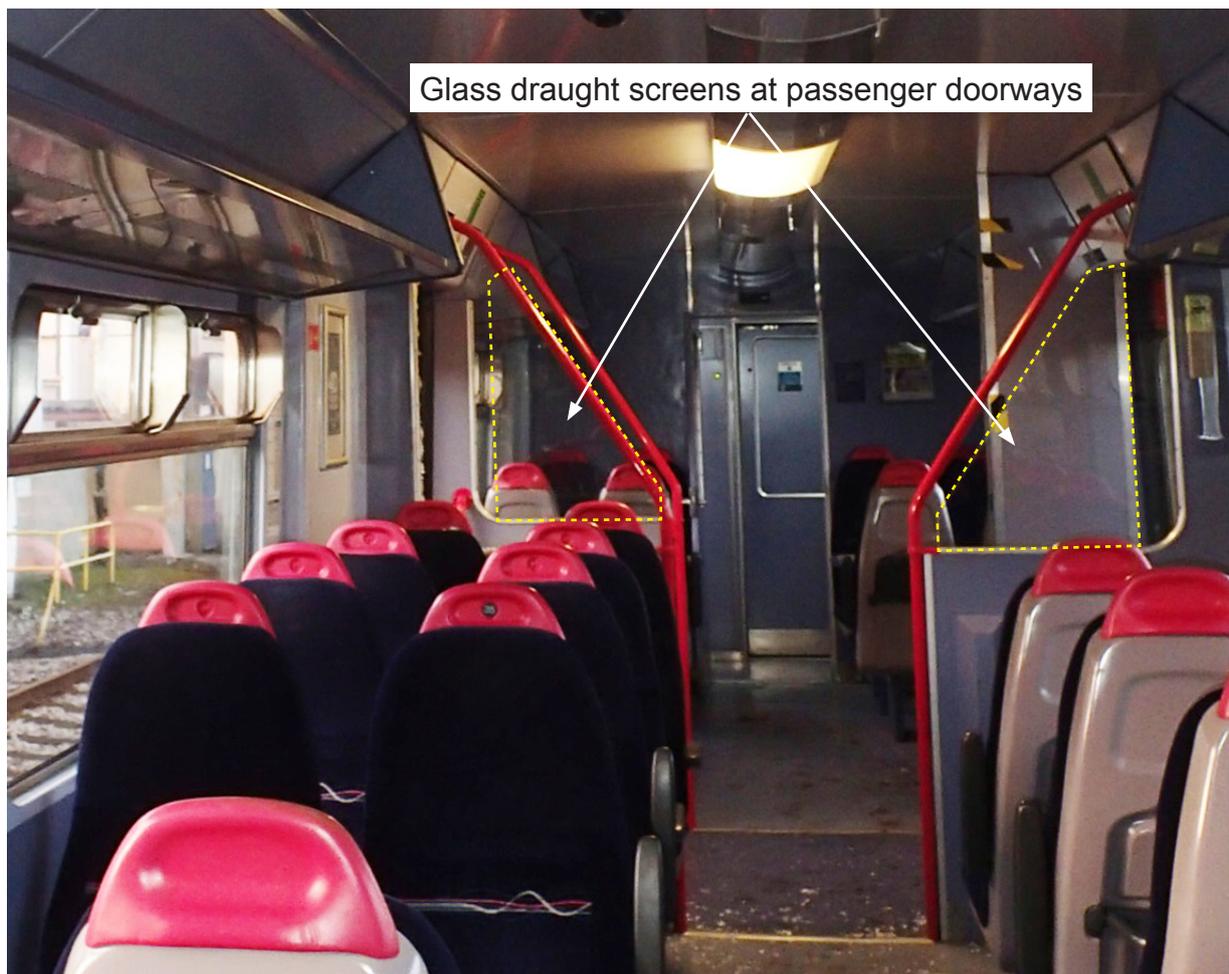


Figure 16: Glass draught screens

Train boarding arrangements

105 Keeping the doors locked on train 1A91 during the permissive movement meant that there were no passengers on it when the collision occurred.

106 A factor that probably reduced the number of injuries was that no passengers had boarded train 1A91. Around 40 passengers were on the platform waiting to join this train but its doors had not been released because of a GWR instruction that doors are to be kept locked on empty passenger train when permissive working is undertaken. Had the doors been released, it is likely that some passengers would have boarded before the collision and then probably been injured during the impact.

Train door emergency release

107 One passenger and a member of GWR staff were injured when they broke the protective covers in order to operate the emergency door release handles. Other passengers said they were afraid to break the covers in case they injured themselves.

108 An emergency door release device is provided adjacent to each passenger doorway on trains where the door locks are operated remotely by train crew. Operating this device allows the adjacent train door to be opened in an emergency situation. On class 150 trains the emergency release device is operated by a lever which cannot be used until a protective cover is broken. The cover is intended to prevent misuse of the lever. The sign next to each emergency door release lever says 'break cover' and shows an image of a closed fist (figure 17).



Figure 17: Emergency door release

109 One passenger and one member of GWR staff reported cutting themselves when breaking the covers while attempting to open the doors to enable evacuation of the train following the accident. Some passengers told RAIB they were afraid to break the covers because they thought the cover was glass and would cause them injury. Figure 17 shows that, even though they are not made of glass, the hard plastic cover can leave sharp edges when broken.

Previous occurrences of a similar character

110 Despite a large number of permissive train movements each day on the UK rail network, relatively few permissive working accidents occur. Data compiled by RSSB shows 19 collisions, not including minor irregularities, during permissive train movements in stations since October 2003. The majority of these were at low speed, typically below 5 mph (8 km/h), with no reported injuries or damage to the trains involved. However, there have been some more serious accidents involving permissive passenger train movements on the British railway network, and some of the more recent ones are summarised below:

- Norwich station, 21 July 2013: A passenger train operated by Greater Anglia carrying 35 passengers collided at 8 mph (13 km/h) with a stationary train in platform 6 at Norwich station. As a result of the collision, eight injured passengers were taken to hospital. RAIB investigated the accident⁸ ([RAIB report 09/2014](#)) and concluded that it occurred because, during the last 20 seconds of the driver's approach to the station, he either had a lapse in concentration or a microsleep. RAIB also found that the driver had an operational history suggesting that he was prone to lapses in concentration.
- Exeter, 4 January 2010: At around 19:25 hrs, a passenger train operated by First Great Western (now GWR) arriving in platform 1 at Exeter St Davids station collided at 11 mph (18 km/h) with the rear of another passenger train which was stationary in the platform. The collision caused injuries to six passengers and three members of staff. The subsequent RAIB investigation ([RAIB report 10/2010](#)) concluded that the accident occurred because, on the approach to platform 1, the train slid for over 100 metres on a length of track that was affected by low rail adhesion. A contributing factor was that the train was not fitted with sanding equipment that would have increased the amount of rail adhesion. At the time of this accident the class of train involved was specifically excluded by Railway Group standard GM/RT 2461 'Sanding Equipment Fitted to Multiple Units and On-Track Machines' from being equipped with sanders.
- London Waterloo, 10 March 2000: At around 13:50 hrs, a passenger train collided at about 15 mph (24 km/h) with an empty passenger train in platform 5 at London Waterloo station. 35 people were injured. The cause of the accident was identified as a loss of concentration by the driver.
- Newton Abbot, 25 March 1994: An incoming passenger train collided with the rear of another train that was standing in the platform. As a result, 31 people were injured, with 2 suffering serious injuries. The cause given in Her Majesty's Railway Inspectorate's annual report for 1993/94 was the driver failing to control the train, either through some cause of distraction on the platform, or because he anticipated that the stationary train was about to move off.
- Leeds, 23 July 1993: An incoming passenger train collided with the rear of another train that was standing in the platform. This resulted in the injury of 21 people, including one person suffering serious injuries. Her Majesty's Railway Inspectorate's annual report again describes the cause as the driver failing to control the train, either through some cause of distraction on the platform, or because he anticipated that the stationary train was about to move off.

⁸ Details of RAIB investigations, including investigation reports are available at www.raib.gov.uk.

111 While all these accidents occurred during permissive working, only the collision at Norwich is directly relevant to events at Plymouth. This is because the lack of assessment of risks from permissive working is a possible factor in both accidents. Paragraph 116 reproduces the relevant recommendation from the Norwich investigation.

Summary of conclusions

Immediate cause

112 The driver did not apply the brakes early enough to stop train 2E68 before it collided with the stationary train in the platform (paragraph 34).

Causal factors

113 The causal factors were:

- a. The signaller routed train 2E68 into a platform that had insufficient room for it (paragraph 38) due to a combination of:
 - i. his intention to allow an easier transfer of passengers from train 2E68 to train (paragraph 40, no recommendation); and
 - ii. his misjudgement of the available platform space behind train 1A91 (paragraph 43, **Recommendation 2**).
- b. The signaller did not tell the driver that an unusual move was intended (paragraph 54, **Recommendation 2**).
- c. The driver of train 2E68 did not expect his train to be going into the same platform as train 1A91 (paragraph 61) because:
 - i. the driver believed that his train could safely proceed to a 4-car stop sign located approximately midway along the platform he would use and lacked the experience to quickly recognise the identity of the platform occupied by train 1A91 (paragraph 63, **Recommendations 1 and 2, Learning point 1**);
 - ii. the training and assessments undertaken by the driver had not ensured a correct understanding of permissive working (paragraph 73, **Recommendation 1, Learning point 1**); and
 - iii. the driver had not previously experienced the type of permissive move arranged as he approached Plymouth on the day of the accident (paragraph 79, **Recommendation 1**)

Underlying factor

114 A possible underlying factor was that neither Network Rail nor Great Western Railway had identified the risk of an accident during permissive working at Plymouth due to a combination of driver inexperience and a signaller arranging an unusual permissive move (paragraph 86, **Recommendation 2**).

Factors affecting the severity of consequences

115 The following factors affected the consequences of the accident:

- a. the trains' performance was as expected for trains designed before the introduction of modern crashworthiness standards (paragraph 100, no recommendation);
- b. keeping the doors locked on train 1A91 during the permissive movement meant that there were no passengers on it when the collision occurred (paragraph 105, **Learning point 2**); and
- c. one passenger and a member of GWR staff were injured when they broke the protective covers in order to operate the emergency door release handles (paragraph 107, **Recommendation 3**).

Previous RAIB recommendations relevant to this investigation

Accident at Norwich on 21 July 2013, RAIB report 09/2014, Recommendation 5

116 This recommendation read as follows:

Network Rail should assess the risk associated with permissive working at Norwich station. Greater Anglia should support Network Rail by providing an understanding of the current constraints and processes for short-term alterations to platform allocations. Network Rail should take these into account when assessing the risk and determining any necessary risk control measures.

Network Rail and Greater Anglia should implement any required risk control measures and brief their staff accordingly

117 In response to this recommendation, Network Rail and Abellio Greater Anglia held a workshop in November 2013 to review permissive working at Norwich station. Following this meeting the organisations reported to the Office of Rail and Road (ORR) that they had identified suitable control measures. ORR reported to RAIB in March 2015 that these control measures were yet to be implemented.

118 In October 2016 ORR told RAIB that the status of Norwich recommendation 5 was still 'open'.

119 Although Norwich recommendation 5 was specific to Norwich station, it resulted in Network Rail taking action to look at permissive working risk at other locations (paragraph 91).

120 GWR had also begun taking action in response to this recommendation, although neither it, nor a station served by it, were mentioned in the recommendation (paragraph 93).

121 There is some overlap between recommendation 5 of the Norwich investigation, and recommendation 2 made in the Plymouth investigation (paragraph 126). Similarities between the two accidents mean that RAIB consider that a nationwide recommendation is justified.

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

- 122 Following the accident at Plymouth, ORR served improvement notices⁹ on Network Rail and GWR saying both organisations had not carried out suitable and sufficient assessments of the risks of permissive working at Plymouth station, in breach of the Management of Health and Safety at Work Regulations 1999, and The Railways and Other Guided Transport Systems (Safety) Regulations 2006.
- 123 The accompanying letter sent to Network Rail in May 2016 required it to review, along with relevant train operating companies, all risk assessments at stations where permissive working is undertaken, and to ensure that ‘any control measures identified are implemented’. ORR also wrote to GWR saying it ‘should cooperate and collaborate with Network Rail to ensure the risks are suitably and sufficiently assessed’ at the stations it operates. RAIB recommendation 2 (paragraph 126) seeks to build on this work by improving the operational arrangements for permissive working at stations through joint assessments between Network Rail and train operating companies.
- 124 Network Rail and GWR have completed a risk assessment for permissive working at Plymouth station and implemented additional control measures including:
- briefing drivers about local risks such as track curvature that can restrict sighting, gradients, and the difficulty of identifying what platforms trains are standing in;
 - instructing drivers to restrict the train’s power setting, and thus limiting the train’s acceleration, when proceeding under permissive working arrangements, and not to exceed 10 mph (16 km/h) at the start of the platform (GWR has also required its drivers to apply this instruction at all stations); and
 - prohibiting permissive working in platform 6 when the stationary train is formed of HST stock.
- 125 Network Rail has begun a programme to assess the risks from permissive working nationally. This was a requirement of the ORR’s improvement notice and letter (paragraphs 122 and 123). Network Rail reported to RAIB that it commenced this work following the accident at Plymouth, but before it was required to do so by the ORR improvement notice.

⁹ Improvement Notices served by ORR are available at www.orr.gov.uk.

Recommendations and learning points

Recommendations

126 The following recommendations are made¹⁰:

- 1 *The intent of this recommendation is to reduce the risk of drivers misunderstanding the concept and application of permissive working.*

Great Western Railway should review its driver training and assessment processes that relate to permissive working with the overall objective of ensuring that new drivers have the knowledge and skills that are needed to address the hazards they may encounter when entering an occupied platform. The review should include consideration of how best to:

- discourage drivers from making any assumptions about the length of platform that is clear, and to avoid presuming that the line is clear to a car stop sign; and
- provide practical experience in a variety of permissive platform working situations, for example, at through platforms, into bay platforms, in track circuit block areas and under absolute block arrangements.

Great Western Railway should implement any enhancements to its existing training and assessment processes that have been identified (paragraph 113c).

This recommendation may apply to other train operators.

¹⁰ 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 and train operating companies to better understand and manage the local operational risks that can affect permissive working train movements.*

Network Rail, with the assistance of the relevant train operating companies, should review and, where necessary, enhance the following aspects of operating arrangements at stations where permissive working for passenger and ECS trains is authorised:

- the means by which signallers should establish the combinations of trains which can be safely accommodated at platforms (to include considering provision of simple look-up tables, whether particular processes should be mandated, and the safe useable length of platforms) (paragraph 113a);
- defining any particular circumstances in which the signaller should speak to the driver in order to provide details of an intended movement into an occupied platform (paragraphs 113b and 114); and
- speed restrictions applicable to trains entering platforms during permissive working (paragraph 113c).

- 3 *The intent of this recommendation is to reduce the risk of injury when operating emergency door release handles.*

Great Western Railway should modify the emergency door release arrangements on class 150 trains so that passengers are not put at risk of injury when using them. It should also review emergency door release arrangements on other trains it operates to determine whether, and when, a similar modification is required (paragraph 115c).

This recommendation may apply to other train operators.

Learning points

127 The RAIB has identified the following key learning points¹¹:

- 1 Train drivers undertaking permissive moves should not presume the extent of the movement permitted by the signalling system, for example, assuming a train will proceed as far as the relevant platform car stop sign. Train drivers must always check carefully the route ahead and be prepared to stop short of any obstruction, taking account of any sighting limitations.
- 2 Train operators should consider reducing risk to passengers by preventing them from boarding or alighting while a second train is entering the same platform under permissive working arrangements.

¹¹ 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when the RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where the 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

CCTV	Closed-circuit Television
GWR	Great Western Railway
OTDR	On-train Data Recorder
ORR	Office of Rail and Road
RAIB	Rail Accident Investigation Branch

Appendix B - Glossary of terms

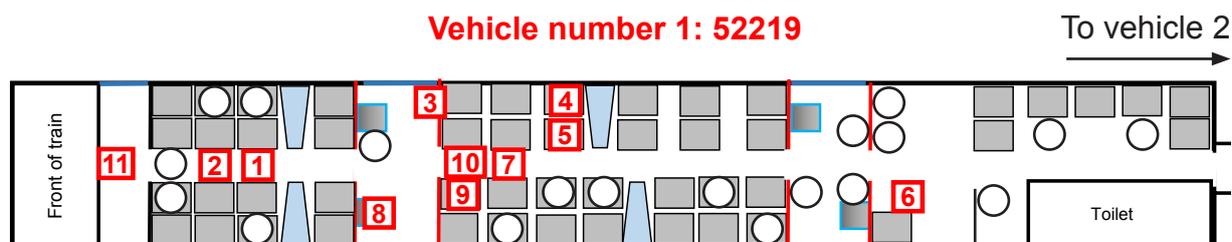
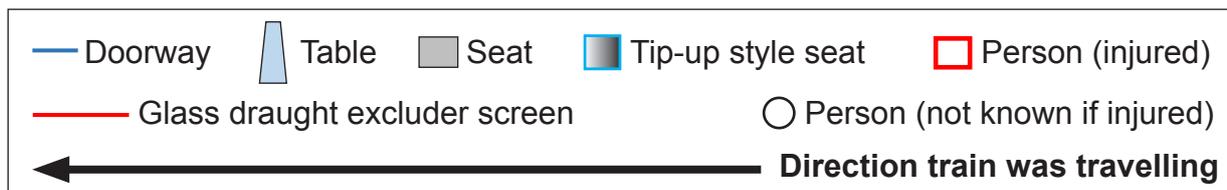
Bay platform	A platform where the line terminates at a set of stop blocks.
Car stop sign	A sign provided on a platform to indicate to drivers where to stop the front of their train.
Diesel multiple unit	A diesel powered train consisting of one or more coaches, including at least one powered vehicle, with driving cabs at each end, which can be coupled to other units and operated as a single train.
Facing points	Points positioned so that routes for trains passing over them diverge in the normal direction of travel.
Main Aspect	The red, yellow and green coloured lights that form a typical signal.
Points	A section of track with moveable rails that can divert a train from one track to another.
RSSB	A not-for-profit company owned and funded by major stakeholders in the railway industry, and which provides support and facilitation for a wide range of cross-industry activities. The company is registered as 'Rail Safety and Standards Board', but trades as 'RSSB'.
Sectional Appendix	A Network Rail document containing details of the rail network such as station locations, line names and line speeds. It also contains local rules and instructions.
Through platform	A platform that can be accessed from either end.

Appendix C - Investigation details

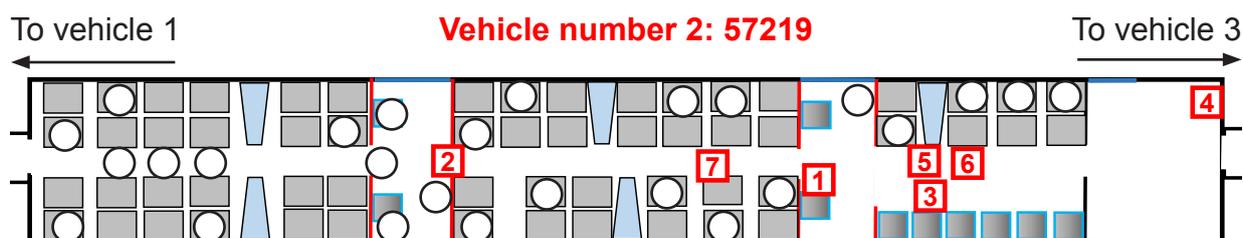
The RAIB used the following sources of evidence in this investigation:

- information provided by witnesses;
- information taken from the on-train data recorders (OTDR) fitted to trains 2E68 and 1A91;
- closed circuit television (CCTV) recordings taken from train 2E68 and Plymouth station;
- telephone voice recordings;
- passenger questionnaires (sent by RAIB to passengers reporting injuries);
- site photographs and measurements;
- weather reports and observations at the site;
- driver and signaller training and competence records, permissive working assessments, and relevant safety management system documents from the organisations involved in the accident.
- a review of previous reported accidents and incidents; and
- a review of previous RAIB investigations that had relevance to this accident.

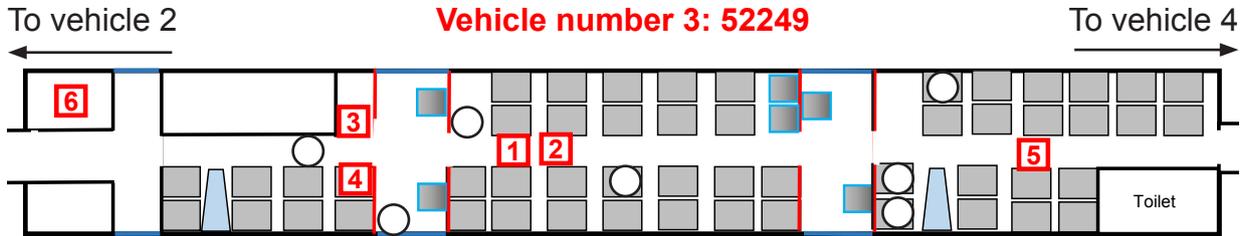
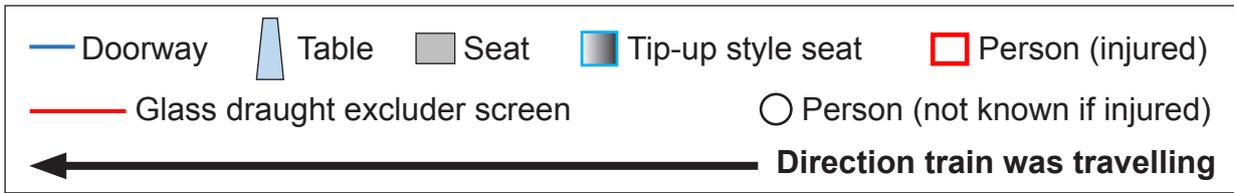
Appendix D - Passenger locations and injuries on train 2E68



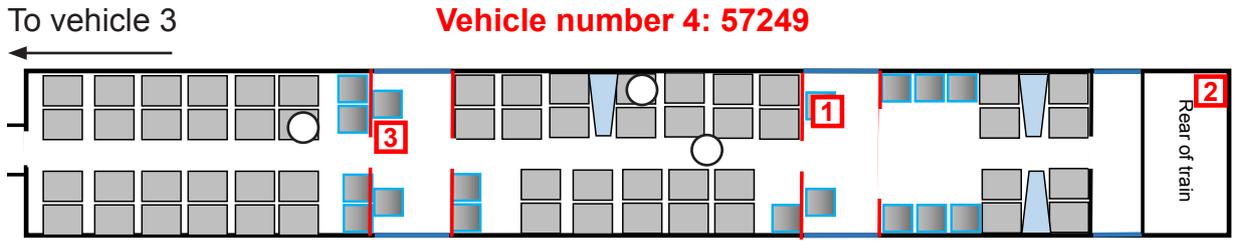
Identifier	Seated/standing	Cause
1	Standing	Fall to floor
2	Standing	Elbow possibly struck door handle. Other passengers falling on them caused other injuries.
3	Standing	Impact with glass partition
4	Seated	Movement during collision
5	Seated	Movement during collision
6	Standing	Impact with pole they were holding and overhead luggage falling on them
7	Standing	Hit arm rest and floor
8	Standing	Possibly hit head on floor
9	Seated	Possible impact with glass panel. Also other passenger contact.
10	Standing	Impact with other passengers
11	Standing	Impact with door frame



Identifier	Seated/standing	Cause
1	Standing	Fall to floor. Secondary impacts from other passengers.
2	Standing	Hit head on lower partition (not glass part)
3	Standing	Impact with glass partition
4	Standing	Impact with partition wall between driving cab and vestibule
5	Standing	Impact with floor
6	Standing	Impact with floor
7	Standing	Impact with seat



Identifier	Seated/standing	Cause
1	Standing	Impact with other passenger
2	Standing	Impact with other passengers
3	Standing	Impact with vehicle interior
4	Seated	Impact with seat in front and being thrown to the floor
5	Standing	Thrown to the floor
6	Standing	Hit head on door frame



Identifier	Seated/standing	Cause
1	Standing	Impact (and shattering) with glass internal panel
2	Standing	Impact with bulkhead wall in rear cab
3	Standing	Impact with arm rest

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