RAIB

Rail Accident Investigation Branch

Rail Accident Report

Derailment of a passenger train at Ealing Broadway
2 March 2016

Report 24/2016
December 2016

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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Derailment of a passenger train at Ealing Broadway, 2 March 2016

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Summary

At 01:29 hrs on 2 March 2016, the leading bogie of a London Underground District line train derailed just outside Ealing Broadway station.

The train was travelling at less than 5 mph (8 km/h) when it derailed. There were 19 passengers and two members of staff on board the train at the time of the accident. There were no injuries.

The train had been held at a red signal since 00:35 hrs as a result of a track circuit failure. During that time, staff had been establishing which points needed to be secured in order for the train to safely pass the signal at danger and proceed to Ealing Broadway platform 7, where it could terminate.

Due to the inadequate level of information available to the service control staff, the poor relationship between the two control rooms involved, and a lack of understanding of the way in which the type of points involved were shown on the various available diagrams, the operational control staff did not identify the correct positions of all the sets of points that needed to be secured in the route. Consequently, the train was authorised to pass the signal at danger with a set of points in the wrong position for the route the train was due to follow.

The service control staff were not completely clear, from the information available to them within the control rooms, which points they needed to set in which positions and so they asked the maintenance team for assistance. The two teams did not communicate effectively and did not reach a complete understanding of the requirements for the route.

The RAIB has made three recommendations to London Underground Limited. The first covers possible ways of improving the quality and amount of information provided to control room staff to help them make decisions. The second relates to ensuring that a complete and full understanding is reached when passing messages, and ensuring that all those who may need to provide information for operational purposes are appropriately trained; and the third involves ensuring control room staff are able to respond appropriately in the event of conflict or confusion, to enhance team working and effective decision making.

The RAIB has also identified two learning points, relating to the importance of having proper arrangements for safety in place if work needs to be done near live electrical conductors, and avoiding confusion when passing messages by keeping the chain of communication short.

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 01:29 hrs on 2 March 2016, all wheels of the leading *bogie* of a London Underground District line train became derailed on *points* just outside Ealing Broadway station, London (figure 1). The train was travelling at less than 5 mph (8 km/h) at the time of the derailment.

Figure 1: Image from Google Earth showing Ealing Broadway station and the approximate location of the point of derailment

4 There were 19 passengers and two members of staff on board the train at the time of the accident. No one was hurt.

5 There was only minor damage to the train as a result of the derailment; the points were badly damaged and most of the components had to be replaced. This work was undertaken on the night shift of 5-6 March.

6 A *track circuit* failure had caused a signal to remain at danger. In these circumstances London Underground Limited's (LUL) operating rules require that the points in the route that the train needs to travel over, beyond the signal, must be *secured* in the correct position before the train operator can be authorised to pass the signal. The derailment occurred because one of the sets of points needed for the train to travel from signal WP17 into platform 7 (figure 3) had not been identified as being in the route and had not been secured in the correct position for the passage of the train.

Context

Location

7 The derailment occurred at 39A points, about 74 metres east of platform 7 at Ealing Broadway station, which is an above-ground station, and is the western terminus of the District line.

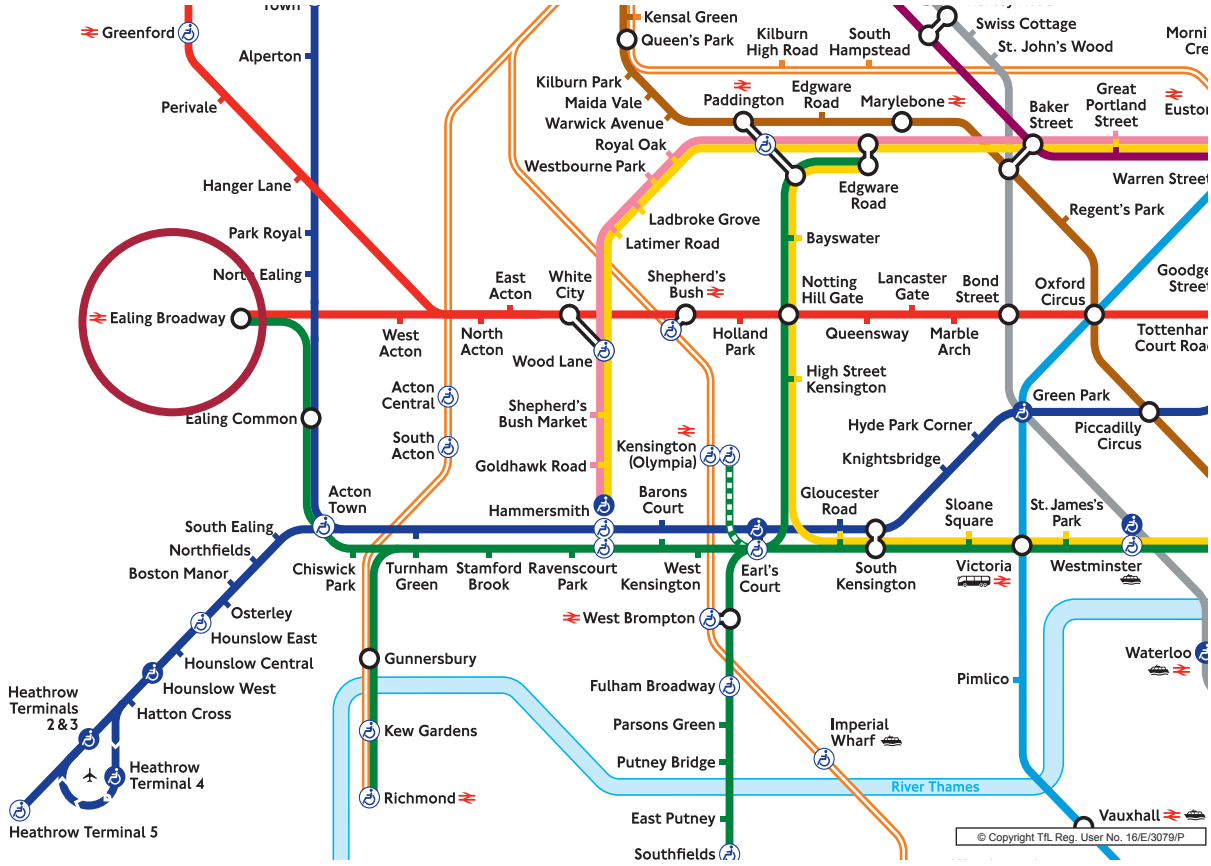

Figure 2: Extract from the London Underground map showing Ealing Broadway station

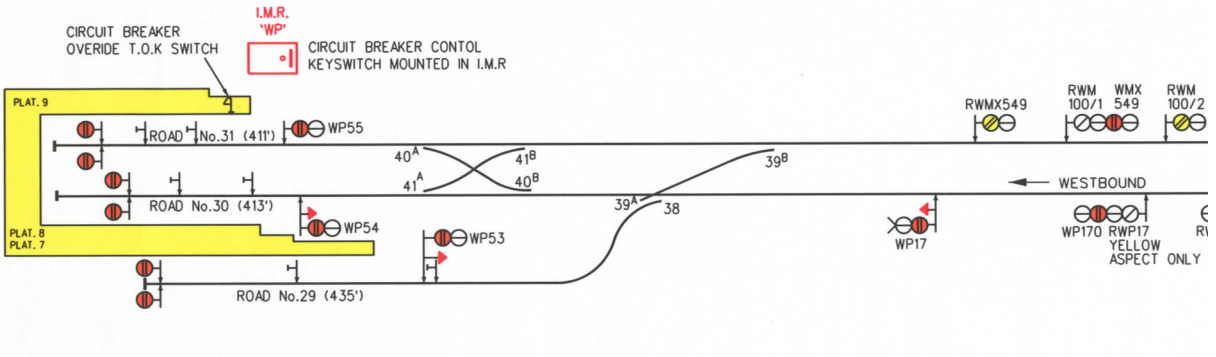

Figure 3: Extract from the Traffic Controller's Diagram showing the track layout at Ealing Broadway

Organisations involved

8 LUL is the infrastructure owner, maintainer, operator and employer of all the staff involved in the accident.

9 LUL freely co-operated with the investigation.

Train involved

10 The train was District line train 011, the 23:27½ hrs service from Barking to Ealing Broadway, and was formed of two D stock electric *multiple units*. The leading vehicle, which derailed, was unit 7036. D Stock units first entered service in 1980. These trains are currently being replaced, and unit 7036 was withdrawn from service after the accident.

11 There is no evidence that the condition of the train contributed to the accident.

Rail equipment/systems involved

12 Ealing Broadway is a terminus for Central and District line Underground trains. It is adjacent to a station of the same name on the Network Rail system, but the tracks of the two stations are not connected. In late October 2015 there was a significant alteration to the track layout at the LUL station as part of a project to reduce maintenance costs. This mainly involved the removal of redundant sidings and the former connection between the District and Central lines.

13 The section of track which links platform 7 at Ealing Broadway with the eastbound line has a set of points at each end, numbered 39A and 39B (figure 3). 39A points make up a *single slip* formation with 38 points (figures 4 and 5). The *toes* of 39A points are 74.1 metres from the top of the platform ramp at the east end of platform 7 at Ealing Broadway station.

Figure 4: Showing the track layout from the east end of 38 points looking towards Ealing Broadway station. The train to the left is at platform 7 and the one to the right is at platform 9.

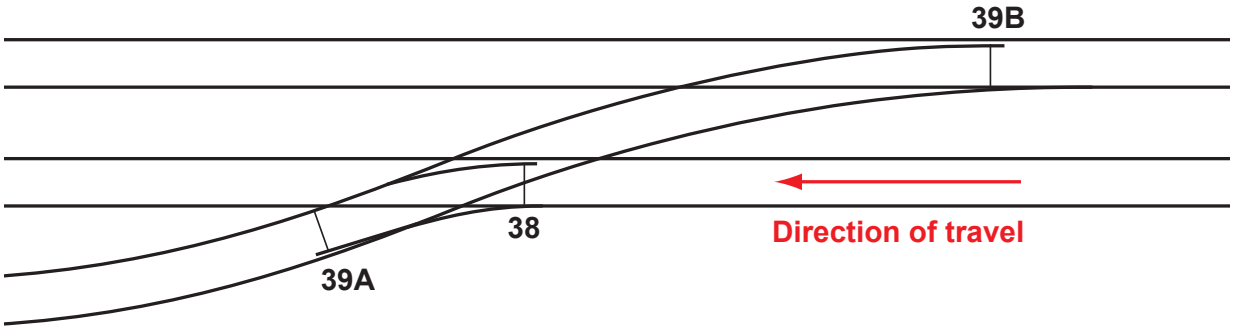

Figure 5: Diagram to show the track layout at 38, 39A and 39B points (points shown in normal position)

14 Both sets of points were locked in the *reverse* position during the accident. For the train to have been successfully routed to platform 7, 38 points needed to be in the reverse position, but 39A points should have been in the *normal* position.

15 Line control within LUL is organised so that *service operators*, who will be referred to from this point onwards as signallers, are responsible for the automatic or manual selection of routes, which involves the operation of points and signals within an area of the line. They are required to ensure that the trains running within that area are correctly routed and any delays are minimised.

16 *Service controllers* have no direct control of points and signals but oversee the operation of the whole line, ensuring that the overall service is maintained as closely as possible to the timetable and any incidents are managed swiftly and efficiently. *Service managers* are responsible for the day to day line management of the signallers and service controllers, and also liaise with senior management and the senior operating officer during incidents to keep them informed of events and decisions made within the control room.

17 District line trains share track with the Piccadilly line from Hanger Lane Junction, a short distance outside Ealing Broadway, as far as Acton Town[1]. Because of this, the Ealing Broadway station area is operated by the Piccadilly line signaller (who is located in the control room at Earl's Court). The District line service controllers and service managers are based in a control room near Baker Street.

Staff involved

18 The train operator joined LUL in 2007 and became a train operator in September 2013.

19 The District line service controller who managed the incident had over 40 years' service with LUL. He became a service controller for the District line in 2006.

20 The District line service controller who was responsible for the rest of the train service during the incident, had been with LUL since 1990 and became a service controller in 2010. He has been a service controller on both the Piccadilly and District lines.

21 The District line service manager joined LUL in 2002, qualified in his current role in December 2014 and began full-time work in the role in July 2015.

[1] It is also possible for Piccadilly and District line trains to run over the tracks normally used by the other line from Acton Town to Hammersmith.

22 The Piccadilly line service manager also joined LUL in 2002 and first became a service manager in 2014, transferring to the Piccadilly line in April 2015.

23 The signaller commenced his employment in 2002 and reached level four[2] in 2007. He started working at Earl's Court in 2013.

24 The station supervisor at Ealing Broadway joined LUL in 2007 and was promoted to station supervisor in 2013. He has been at Ealing Broadway station for two years.

25 The duty signal incident manager has 18 years' service with LUL and was employed as a duty signal incident manager from 2012, although he had been working at this higher grade for 12 months before he was made permanent in the role.

26 The signal operations manager started his career with LUL in 1980, took on the role of signal operations manager in 2013 and retired in May 2016.

27 All the staff involved had current licences and were up to date in the relevant sections of LUL's competence management system.

External circumstances

28 Although it was not raining at the time of the derailment, it had been raining earlier in the evening, and there was heavy rain during the detrainment of the passengers. The temperature was about 8°C at the time of the accident, though with the wind chill, it would have felt more like 4°C. The weather was not a factor in this accident.

29 It was dark at the time of this accident and this may have been a factor as it would have made it more difficult to see how the points were set.

[2] The signalling operations of a line or part of a line have a level which LUL determines by the complexity of the operations at the locations being operated. Level four is the most complex.

The sequence of events

Background information

30 During the late 1960s, signalling and control functions for the District and Piccadilly lines of what was then London Transport Railways were concentrated into a single control room at Earl's Court.

31 The increase in services on both lines over the next 30 years meant that the facilities in the control room became stretched. The room became overcrowded and this started to affect the operators' concentration and communication. The company identified a risk that messages could be mixed or confused between the District and Piccadilly service control staff.

32 The District line service controllers moved to a new facility at Baker Street in the early 2000s. However, the operators (signallers) who worked the signalling desks for both lines remained at Earl's Court. The diagram below shows the line reporting and command and control reporting structure for the two teams.

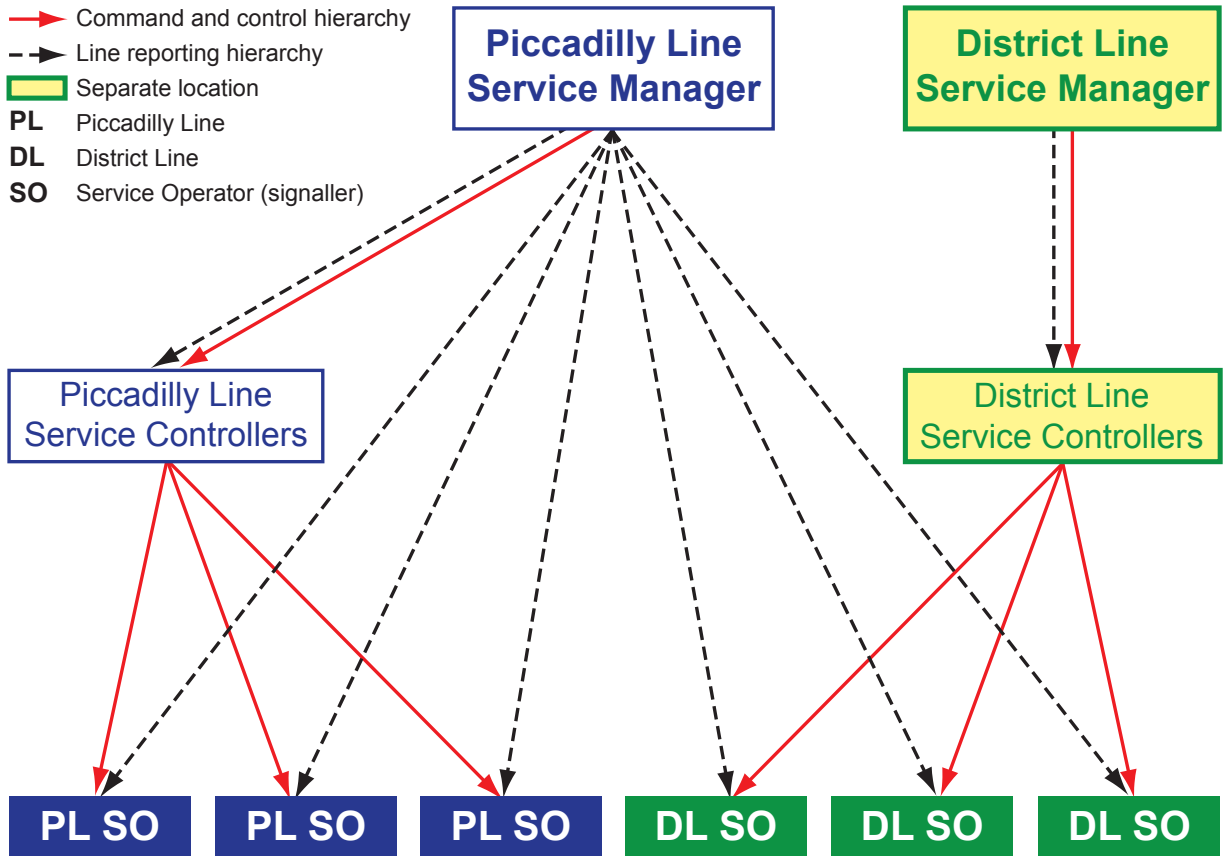

Figure 6: Simplified diagram to show the command and control and line management structure of the District and Piccadilly service control staff

Staffing arrangements within service control at Baker Street

33 LUL has two service controllers on duty for the District line at Baker Street. During normal operations the two controllers split the workload between them.

34 During an incident one of the service controllers takes responsibility for managing the incident and the other manages the train service on the rest of the line. Occasionally, due to workload, they may get involved with the other's area of responsibility, but as they sit next to each other this information is easily shared and communicated.

35 The service controllers may request the service manager to assist them in making decisions. Although the service manager may come into the control room during an incident, they are usually involved in disseminating information to the network operations centre or others who may be involved with managing or overseeing the incident.

36 When this accident occurred, there were two District line service controllers in the Baker Street control room, and both of them were involved in various aspects of the accident. In this report the District line service controller who took the leading part in the events is referred to as the service controller. The only signaller involved in the events was the Piccadilly line signaller, who is referred to as the signaller. All other parties involved are referred to using their full titles, and where appropriate the line they work on.

37 The following extracts are from the LUL rule book.

Rule book 5 section 9.1, extract from the information applying to the train operator:

The signaller is the only person who can authorise you to pass a semi-automatic signal at danger.

Rule book 5 section 9.5 (relevant sections) applying to the signaller:

When it is safe to do so, you must give authority to pass the signal at danger. If you cannot communicate directly with the train operator, you must give this authority through the controller, customer service supervisor/manager or the duty manager.

If points are involved, you must tell the train operator:

- *They have been secured, or*
- *That a method of proving is being used*

Rule book 5 section 13.5 applying to the signaller and service controller (relevant section only):

Securing Points by scotch and clip

Agreeing the arrangements

You must both agree:

- *Which points need to be secured, and in what position*
- *Whether or not traction current needs to be switched off.*

You (service controller) must tell the person securing the points the details.

Events preceding the accident

38 On 1 March 2016, the District line train service ran normally through the day until soon after midnight. At 00:31 hrs on 2 March, track circuit CB failed to revert to unoccupied after the passage of train 064 from platform 7 at Ealing Broadway to the eastbound line (figure 7). This movement required 39A and 39B points to be in the reverse position, and the failure of the track circuit meant that the points remained in this position.

39 The train operator of train 010 brought the signaller's attention to the failure when he reported the fact that the *platform starter* signal WP54 was not cleared for his train to depart from platform 8.

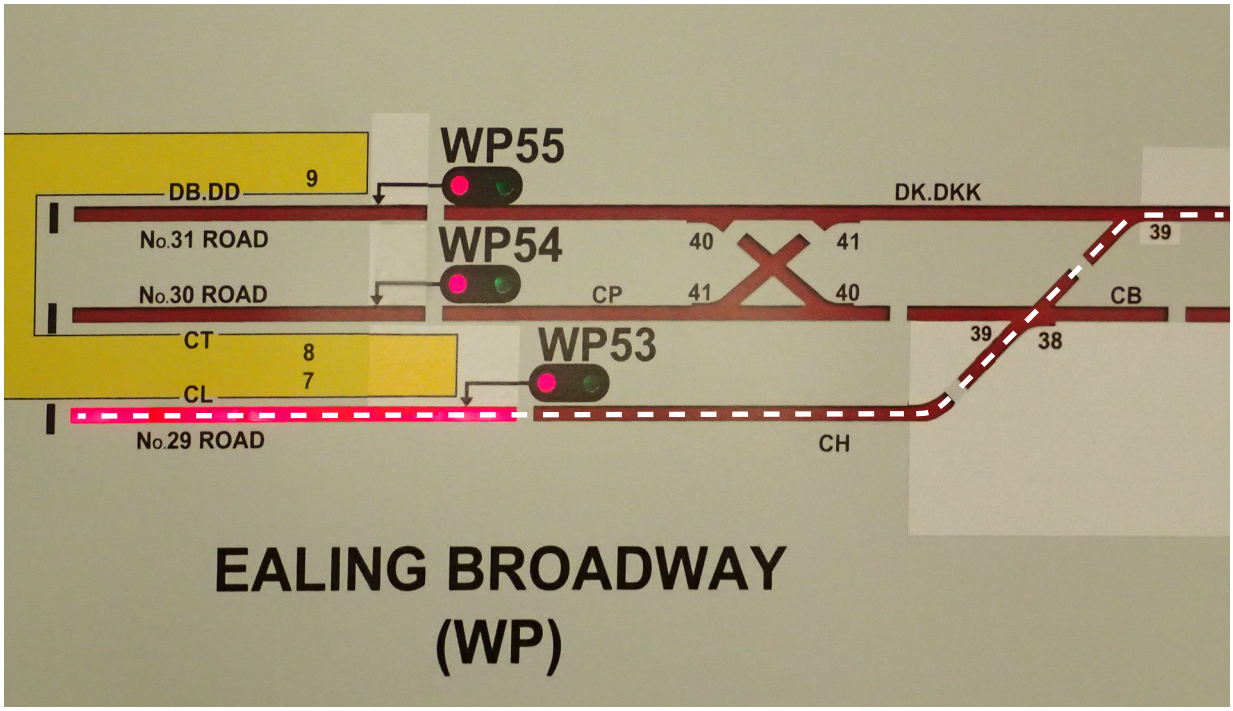

Figure 7: The signaller's overview panel showing the route train 064 took from platform 7 to eastbound line, the location of CB track circuit and signal WP54

40 The signaller contacted the service controller to report the failure, and the consequence that it appeared that it was not possible to get any trains into or out of Ealing Broadway. The signaller then attempted, unsuccessfully, to reset the route for train 010 from platform 8, a process known as taking a release. He then tried taking a release for signals WP53 and WP55 to see if any of the routes from Ealing Broadway would clear, and then attempted to reset the route from signal WP17, none of which was successful. The signaller reported to the service controller that train 011 was approaching signal WP17 and would need to be held at the signal.

41 The service controller contacted the train operator of train 011 to inform him that there had been a signal failure and train 011 might be held at signal WP17 (see figure 3) for a while. The service controller contacted the train operator four times over the next ten minutes in connection with making arrangements for the Ealing Broadway station supervisor to secure 38 points in order to permit the train to travel to the platform.

42 During this time, at the request of the service controllers, the District line service manager assisted with managing the incident. He contacted the station supervisor at Ealing Broadway to request that he go onto the track to confirm the position of 38 points and be prepared to secure[3] them if necessary. The service manager then reminded the station supervisor that the traction current was on, and asked whether he required it to be switched off.

43 The station supervisor replied that he knew that traction current was on, and that he did not require it to be switched off.

44 The District line service manager then contacted the Piccadilly line service manager to ask him to inform the signaller that the station supervisor was going to check that 38 points were in the reverse position (the reverse position of 38 points was with the right-hand switch rail closed, the position needed to route train 011 into platform 7). He did this because the service controller had been unable to contact the signaller directly, because the signaller was busy with signalling the other areas of the line for which he was responsible.

45 The District line service managers and the service controllers discussed the route that would be required and dismissed 39A points as not being in the route, although witness evidence indicates they were not completely sure of this decision (see paragraphs 82 to 89).

46 At 01:10 hrs, the station supervisor contacted the service controller to inform him that he was at 39 points. Just as he said where he was, he realised that he was not at the set of points he had been asked to check and secure. He rang off and rang back less than a minute later, this time when he was standing at 38 points, as requested.

47 The station supervisor confirmed to the service controller that 38 points were in the reverse position, and the service controller requested that the station supervisor *scotch* and *clip* those points.

48 The service controller contacted the signaller to explain that 38 points were being secured, and then asked if securing 38 points in the reverse position would bring the train from WP17 into platform 7. The signaller hesitated for some time and then finally confirmed that it would.

49 About a minute later, the signaller rang the service controller back to explain that he could not in fact confirm that 38 points in the reverse position would bring the train into platform 7 as he had no indication of the position the points were in, nor was he certain which position was normal and which was reverse.

50 The service controller did not understand that the signaller had no means of knowing the positions of any of the points under his control, and the conversation between the two became heated. The signaller tried to explain, unsuccessfully, that he could not confirm in which direction the points would need to be set. The signaller stated he would terminate the conversation, which he then did.

[3] Securing points involves inserting a scotch on the open side of the points between the stock and switch rails to prevent the switch rail moving up to the stock rail and clipping the other switch rail which is closed against the other stock rail, preventing these from splitting.

51 The District line service manager contacted the Piccadilly line service manager to ask if he could provide some assistance to his signaller, who seemed to be struggling to confirm which sets of points were required for the route, and also to ask the signaller to contact the service controller if the points required for the route were anything other than 38 points reversed.

52 The District line service manager was concerned that he was not being given definite information. Because of this and because there was no better information available to the service controllers or to the service manager, the service manager telephoned the duty signal incident manager, the most senior member of signalling maintenance staff on duty at the time.

53 The service manager explained that he wanted to get the train from WP17 into platform 7 and asked whether 'it was just, the one set of points, 38 points, reversed' required for the route.

54 The duty signal incident manager was travelling in a car with a colleague, and did not have the appropriate information with him to be able to conclusively answer the question, and so he contacted the signals operations manager.

55 The signals operations manager was able to confirm from the signalling design plan and the *book wiring diagram* that the points required to get a train from WP17 to platform 7 were 39A points normal and 38 points reversed.

56 The duty signal incident manager then rang the District line service manager and stated 'it is just that one set of points reverse you need'.

57 Having received this assurance, confirmed that 38 points were secured, and that the station supervisor was in the cab of train 011, the District line service manager told his service controllers to ask the signaller to give authority to the train operator to pass WP17 at danger. None of the staff involved had checked with the station supervisor in which position 39A points had been when he passed them, and the station supervisor himself did not realise the significance of 39A points for the route the train had to take.

58 At 01:16 hrs, the service controller contacted the train operator and asked him to contact the signaller for authority to pass WP17.

Events during the accident

59 At 01:22 hrs, the service controller again contacted the train operator to ask him to contact the signaller for authority to pass the signal at danger. The train operator had been unsuccessful in his attempts to contact the signaller on the radio. The service controller said that when authority was given the train operator would need to proceed with extreme caution and ensure that the points were set for the route. The train operator confirmed he would check the points carefully and he and the station supervisor, who was now in the cab with him, would use a torch to check the position of the points.

60 The signaller contacted the train operator and authorised him to pass the signal using the form of words required by the rule book. However, he then requested the train operator to stop when he got to the points and ring him back. The train operator repeated back the standard message to the signaller, but did not repeat back the request to stop and call back, and so the signaller repeated the second part of the message. This time the train operator repeated back the message, but instead of repeating back that he would stop before the points he said he would stop when he was clear of the points.

61 Almost immediately the train operator had finished speaking to the signaller, the service controller contacted the train operator to find out whether he had yet had authority to pass the signal. The train operator confirmed that he now had authority, and the service controller repeated this and reiterated the need to proceed with extreme caution as the junction was complicated.

62 The train operator informed the passengers of what would happen as the train passed the signal, and warned them that there would be a sharp jolt[4] and that they should remain seated.

63 After going through the actions associated with passing signal WP17 at danger, the train operator drove the train forward towards the junction. He stopped before reaching 38 points, and with the assistance of the station supervisor he used a lamp to assure himself that they were set correctly. The train operator then drove his train onto the junction. The train derailed on reaching 39A points, which were still set reverse. The train operator immediately sent an emergency message to service control to report that the train had been derailed.

Events following the accident

64 The train operator used the train's public address system to ask the passengers to pull an emergency alarm if anyone was hurt. No one did, and so he then asked them to proceed forward to the front carriage so that they could be detrained.

65 The duty reliability manager, who had arrived at the station with other technical staff to try and resolve the track circuit failure, requested that traction current be discharged and put down a *short circuiting device* in front of the train. The train operator also placed one at the rear of the train.

66 Staff escorted the passengers safely off the train to the platform.

67 Following an examination by the RAIB, the train was re-railed and recovered to Ealing Common depot. The District line train service to Ealing Broadway was restored on the evening of 3 March, with the exception of platform 7. The damaged points were replaced overnight on 5 March and full services resumed on 6 March.

[4] LUL's signalling system uses tripcock apparatus to enforce a brake application if an associated signal is passed at danger. Each signal has an associated trainstop arm which is raised when the signal is at danger. In this position it will come into contact with a tripcock fitted to each train, which is an externally mounted brake valve with a protruding arm which is actuated by contacting the raised trainstop. When the train's tripcock is pushed back, the brakes are automatically applied. In order to pass a signal at danger a train operator must drive over the tripcock and wait for the train to be tripped. Following this operation, which stops the train abruptly, the train operator must reset the tripcock, and then release the brakes and proceed.

Key facts and analysis

Identification of the immediate cause

68 39A points were set in the wrong position for the passage of the train, which derailed as it travelled over them.

Identification of causal factors

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

a. track circuit CB failed, locking points 39 in the reverse position (paragraph 70);

b. the train operator of train 011 was authorised to pass signal WP17 at danger despite the route beyond the signal being incorrectly set for the train (paragraph 73);

c. the availability and quality of the information available to the service control staff was insufficient (paragraph 82);

d. staff misunderstood the track layout at Ealing Broadway (paragraph 90);

e. the training of the service control staff on Traffic Controller's Diagrams did not include recognising slip points (paragraph 96);

f. the duty signal incident manager did not pass on the full information regarding which sets of points were required to be in which position for the route (paragraph 99); and

g. the working relationship between the Piccadilly signaller and the District service controller was poor (paragraph 107).

Each of these factors is now considered in turn.

The track circuit

70 **Track circuit CB failed, locking points 39 in the reverse position.**

71 Track circuit CB failed to clear after the passage of the eastbound train 064 at 00:31:04 hrs. Track circuit failures are not uncommon on the railway and there are systems and processes in place to mitigate their effect on railway operations. In this case the consequences of the failure included points 39A remaining locked in the position they had been in when the previous train passed over them, and signal WP17 being held at danger.

72 Due to the derailment and the resulting damage caused to 39A points, it was not possible to determine why CB track circuit failed. Despite tests, the failure could not be recreated once the points and the mechanism had been repaired.

The actions of service control staff

73 **The train operator of train 011 was authorised to pass signal WP17 at danger despite the route beyond the signal being incorrectly set for the train.**

74 The failure of track circuit CB meant that signal WP17 could not be cleared for train 011. The Piccadilly line service manager informed the signaller that he should authorise the train operator to pass the signal at danger. In doing this he was passing on a message from the District line service manager, who also stated that the route into platform 7 had been secured.

75 At no point did the signaller and the service controller come to an agreement (as required by rule book 5 section 13.5) about which points were required to be set in which position for train 011 to get from WP17 to platform 7.

76 The District line service manager, and not the service controller as required by rule book 5, section 13, asked the station supervisor to secure the points. Once the points were secured, the station supervisor should, according to the rule book, have contacted the signaller to confirm the points were secured and that he was in a place of safety. Instead, he contacted the service controller, because he had been requested to do so.

77 Rather than challenge the service controller regarding the decision that the route was set and secure, the signaller chose to give an unconventional message to the train operator after passing the standard 'authority to pass a signal at danger' message. He did this because he was unsure about the situation.

78 It is not normal practice, having given authority to pass a signal at danger, to ask a train operator to stop part way through the route. The 'authority' message informs a train operator that the route is set and secure for the train to travel as far as the next signal. The 'authority' message includes warnings to travel at caution speed and stop short of any obstruction, but there is no normal expectation that a train operator should be prepared to stop at incorrectly set points.

79 The train operator initially repeated the message back to the signaller, but omitted the unusual instruction. The words the train operator used when he repeated the message back suggest that he may not have understood the message he was given. The signaller repeated his unusual request and this time the train operator repeated back that he would contact the signaller when he was clear of 38 points.

80 The train operator stopped briefly at 38 points, but he did not contact the signaller. The train operator forgot that he had been asked by the signaller to contact him before reaching platform 7. This may have been because, immediately he had finished speaking to the signaller, the train operator received a call from the service controller to establish whether the signaller had given authority to pass the signal. The service controller then repeated the 'authority to pass' message and went on to caution the train operator to proceed with extreme caution 'as the junction is complicated'.

81 It is not clear why the signaller and the service controller added these elements to the laid down authorisation message, but it strongly suggests that they were uncertain about the setting of the route.

Factors affecting decision making

82 The availability and quality of the information available to the service control staff was insufficient.

83 The signaller had the overview panel (figure 8), the centralised train following system screen (figure 9) and an out of date A4 version of the Traffic Controller's Diagram (figure 10) available to assist him with understanding the track layout at Ealing Broadway. Neither of the first two gave any indication of the position the points were in, and only the Traffic Controller's Diagram gave any information about which point positions were normal and which reverse. There was an up to date version of the Traffic Controller's Diagram at the front of the signaller's log book, but he was not aware of its presence.

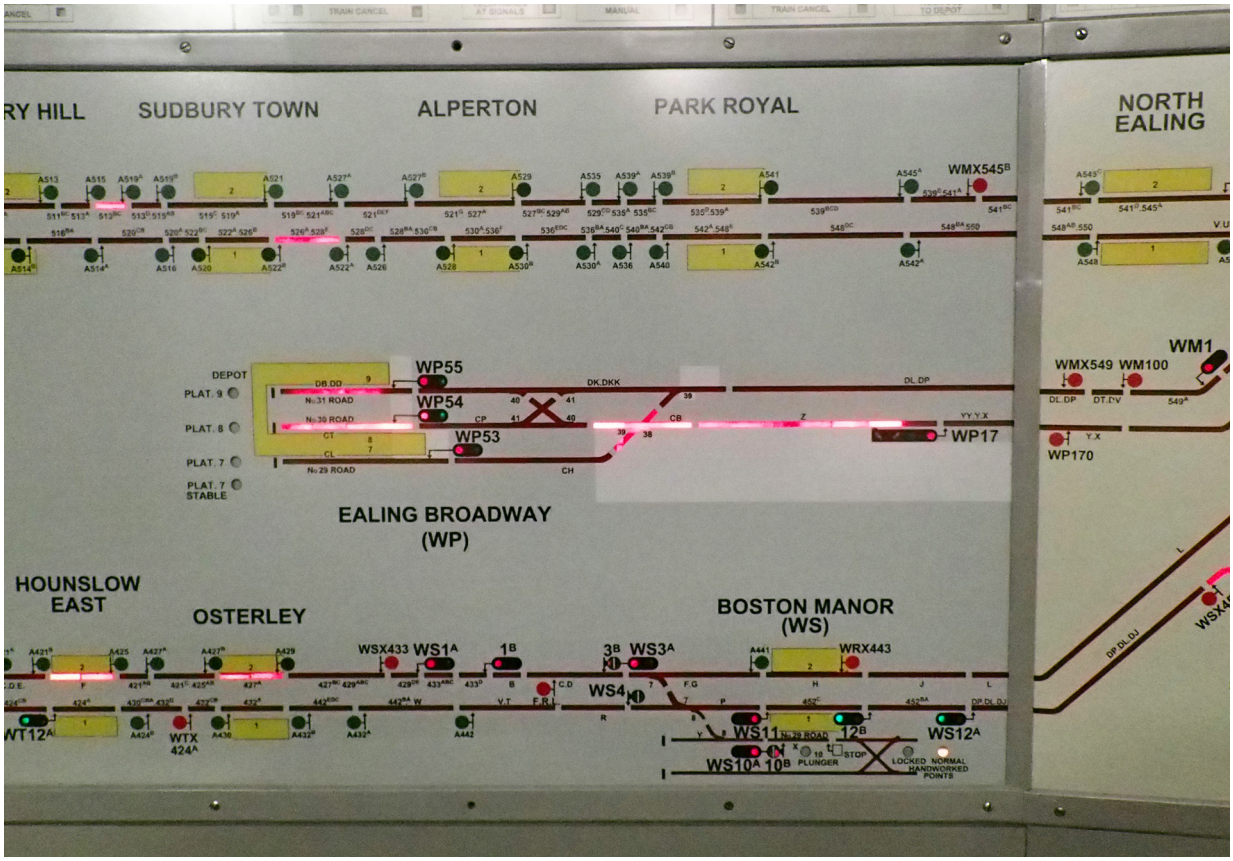

Figure 8: Signaller's overview panel in Earl's Court signal control centre

84 The overview panels in the Earl's Court control room do not show which position of the points is normal, and which reverse, and they do not indicate which position the points are actually in. Most railway signalling displays include information on normal/reverse position, and more modern displays allow the signaller to identify the position the points are lying. The former practice of LUL and its predecessors was not to include this information. However, the signalling of LUL's sub-surface railway, including the District line, is to be completely renewed in the near future, and this will include the provision of better information and displays for control room staff.

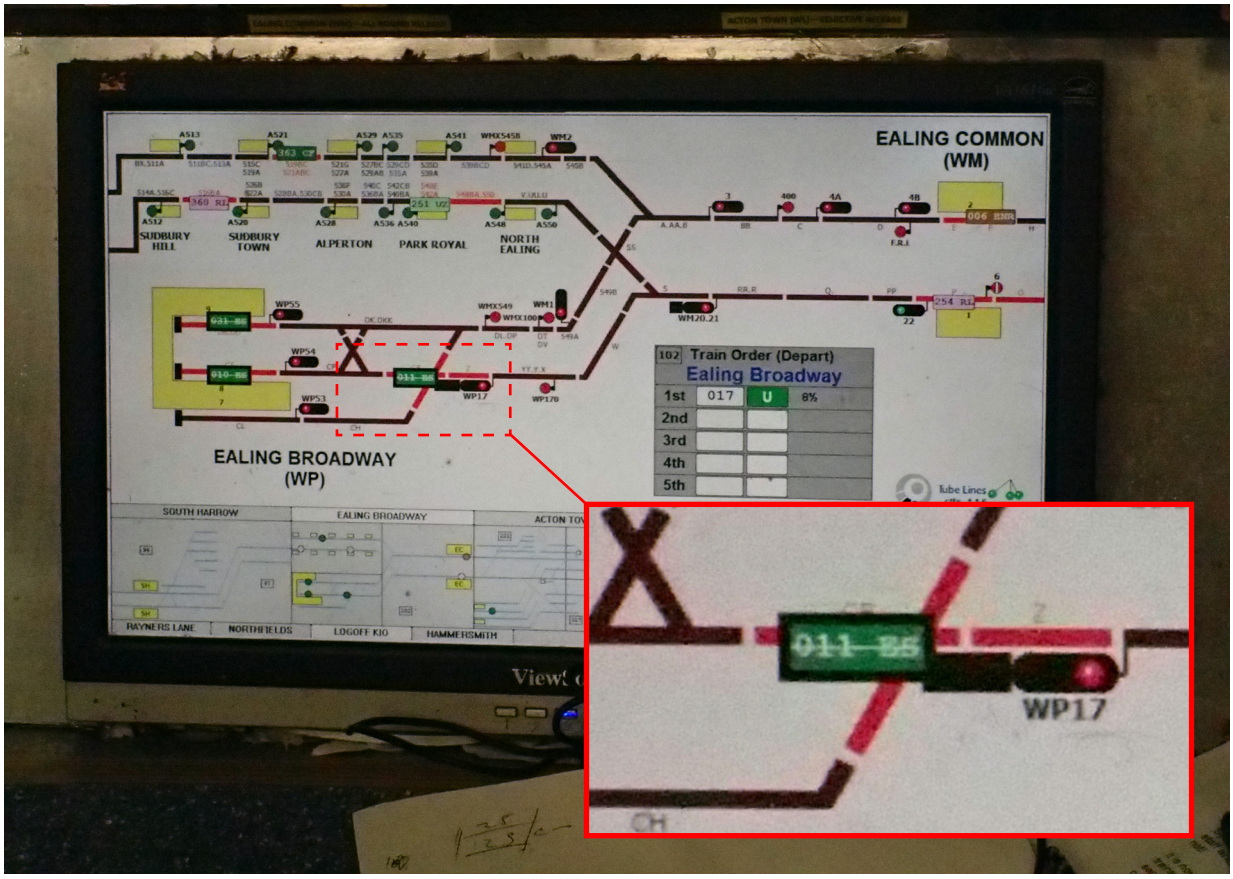

Figure 9: Signaller's centralised train following system screen with insert showing the detail of train 011 on the crossover

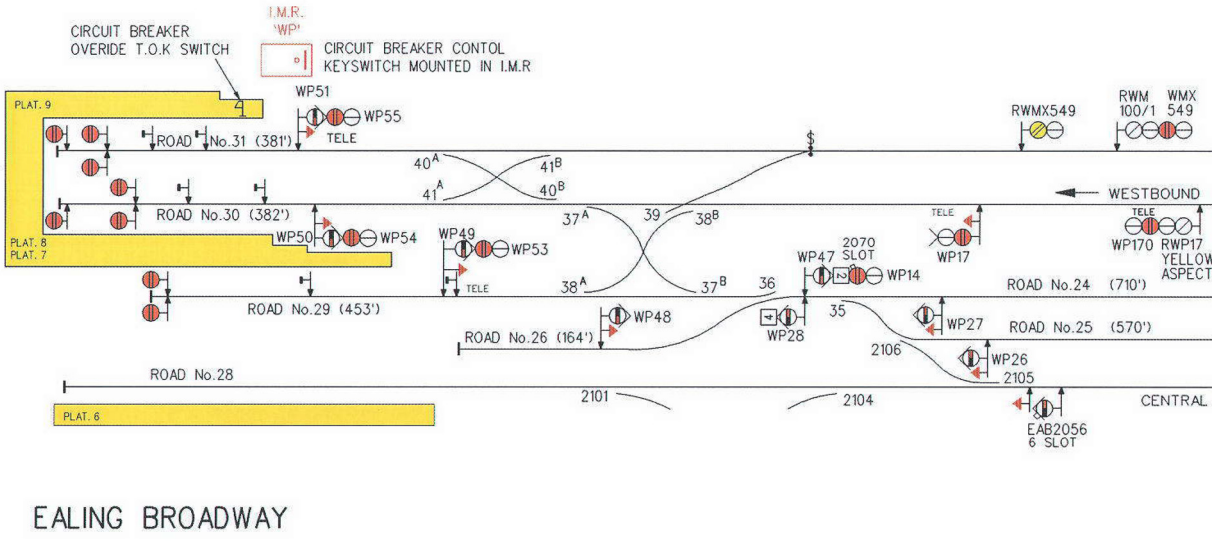

Figure 10: Out of date Traffic Controller's Diagram available to the signaller

85 The diagram available to the signaller (figure 10) was inconsistent with the overview and the centralised train following system in that it showed an extra crossover, point ends numbered differently and some sidings. The centralised train following system and the overview panel did not give the signaller sufficient information about the points or their positions, and so he became confused.

86 The District line service controllers had a later version of the diagram (figure 11) and *Trackernet* (figure 12) to inform their decision making (although LUL company standards state that the Trackernet system must not be used as the basis of safety critical decisions).

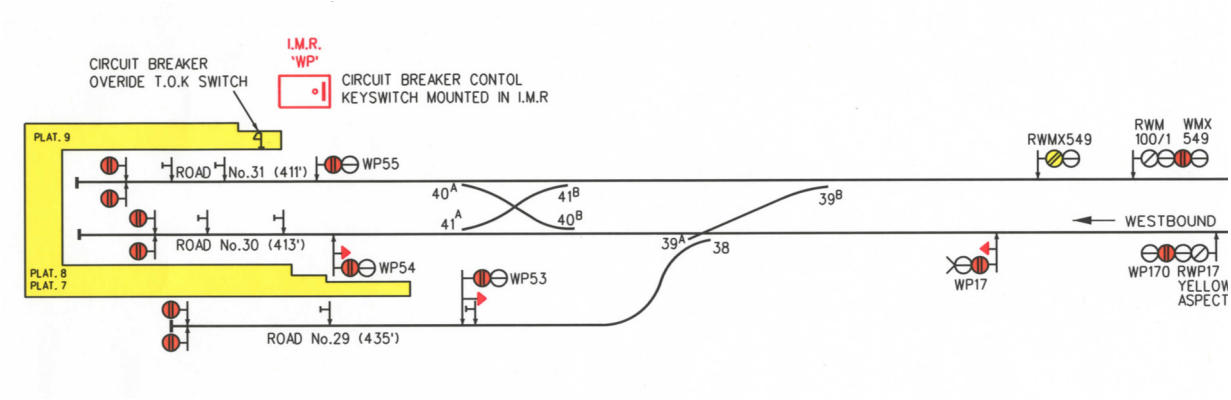

Figure 11: Version of the Traffic Controller's Diagram available to the District line service controllers

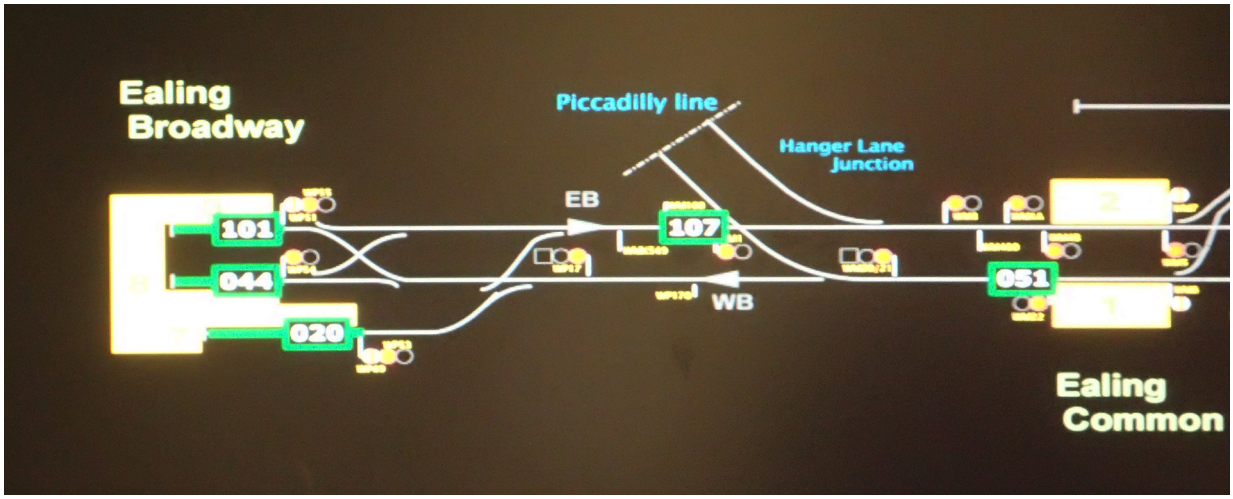

Figure 12: Trackernet overview available to the service controllers

87 The service manager found a signalling diagram on the LUL intranet, but he dismissed this as it showed a track layout he knew was no longer in place. It was the same layout as shown on the diagram the signaller had used.

88 None of the information available to the service control staff was sufficiently clear for them to be able to establish which points were required in which positions to set the correct route for the train from signal WP17 into platform 7.

89 The fact that both the signaller at Earl's Court and the District line service manager had access to documents which were out of date, may have added to the confusion.

90 **Staff misunderstood the track layout at Ealing Broadway.**

91 Work to significantly change the track layout at Ealing Broadway was carried out between 27 and 30 October 2015. The aim was to minimise maintenance costs and remove redundant assets. It involved the removal of sidings and the crossover linking the District line and the Central line. The Traffic Controller's Diagrams for the area had been updated regularly over this period.

92 LUL had informed staff of the changes through the *Traffic Circular*, which is issued weekly to all operational staff, who are required to make themselves familiar with the sections which are relevant to their roles.

93 All the service control staff were aware that there had been changes to the layout, but none of them were aware of what the layout looked like on the ground. They relied on the diagrams and overviews available within their respective control rooms to inform their decisions.

94 Station supervisors and some other staff are trained to read points (to recognise whether points are set normal or reverse) and to scotch and clip them safely. On LUL the normal position of points is indicated by an N and an arrow secured to the sleeper supporting the switch ends, with the arrow pointing to the switch rail which is against the stock rail when the points are normal. Currently, this training does not include how to read a route (determining where a train will go based on the lie of points). These staff are only expected to be able to follow the instruction to read in which direction a set of points is lying and secure them if requested.

95 In this case the station supervisor was standing at 39A points when he first rang the service controller in error. Had he been trained to read routes, he might have been able to identify that 39A points would be required to be set in the normal position for the route the train needed to take.

96 **The training of the service control staff on Traffic Controller's Diagrams did not include recognising slip points.**

97 LUL has a competence management system for service control staff, which includes training and regular assessment. Initial training includes reading the Traffic Controller's Diagrams. Ongoing assessment, however, only covers staff's ability to read the diagrams should they choose to use them to tackle the operational issue they are given as a part of a table top exercise.

98 The initial and on-going training provided to service control staff only covers plain line, and none of the staff involved in the decision making process during this accident recognised the slip points or understood how they were shown on the diagram.

99 **The duty signal incident manager did not pass on the full information about which sets of points were required to be in which position for the route.**

100 The service manager decided to contact the duty signal incident manager, because he thought the duty signal incident manager was the person on duty most likely to be able to confirm exactly which set or sets of points were required to get the train from signal WP17 to platform 7. This was a highly unusual action, and witness evidence indicates that he did it because the service control staff were unsure about their decision.

101 There were two conversations between the duty signal incident manager and the service manager. The first was mostly informal, although the service manager did formalise the question and ask what points would be needed in what position to get the train from WP17 into platform 7. The second conversation was extremely brief.

102 The first conversation was led by the service manager, and he acknowledged clearly that the duty signal incident manager was not in a position to be able to provide him immediately with the information he required. The conversation was very focused on the service manager's understanding of the layout and his belief that it was just the one set of points in the reverse position that was required.

103 The way in which the conversation was conducted may have led the duty signal incident manager to believe that the service manager wanted confirmation of which set of points should be in the reverse position, rather than how many points in which positions were required for the whole route.

104 The duty signal incident manager was provided with the correct information by the signals operations manager, but there was no repeating back of the message between the signals operations manager and the duty signal incident manager to confirm understanding. The duty signal incident manager then immediately contacted the service manager.

105 Despite the signals operations manager saying that 39A points needed to be normal and 38 points reverse, when the duty signal incident manager contacted the service manager, he said 'it is just that one set of points you need reverse'. In the strictest sense this statement was correct, but it does not convey all the essential information that was necessary for the decision regarding the securing of points to be made. The conversation did not follow safety critical communications procedures, and in particular the message containing the important information was not repeated back to confirm that it had been understood.

106 Safety critical communications protocols were not followed during the second conversation between the service manager and the duty signal incident manager. Had they been, it might have prompted the duty signal incident manager to repeat back all of the information he was given by the signals operations manager rather than just the information about 38 points.

107 **The working relationship between the Piccadilly signaller and the District service controller was poor.**

108 The signaller and the service controller, having agreed to terminate their conversation about whether 38 points in the reverse position would bring the train into platform 7, did not speak again. There was no attempt by those two members of staff to come to an agreement regarding the move that was to be done, and all communication between the Baker Street service control centre and the Earl's Court signalling centre was by the two service managers from that point onwards.

109 There is conflicting evidence about the relationship between the District and Piccadilly line control rooms. However, there is substantial witness evidence which indicates that this breakdown in communication between staff of the two lines was not an isolated example, and that there was a lack of trust between the staff of the two control rooms.

Identification of underlying factors

Safety critical document control

110 **The management of information for operating staff was inadequate.**

111 In LUL's service control centres, one of the service controllers is usually made responsible for ensuring that the controlled diagrams and documents within the control room are maintained and kept up to date as part of their designated duties. However, this responsibility is not defined in LUL's processes.

112 In both the District line service control centre at Baker Street and the signalling control centre at Earl's Court, one of the service controllers took responsibility for maintaining the Traffic Controller's Diagrams for the service controllers. In both control centres, the diagrams used by the service controllers were up to date.

113 At the Earl's Court signalling control centre, there were two copies of diagrams available to the signallers. One of them was included in the signalling desk log book, the document which is used by the signallers to record shift changes and abnormal operational events. The log books last around three to four months and during this time, should the diagrams be revised, the copy in the desk log book would not be changed until a new log book was needed, at which point the new diagram would be included.

114 At the time of the accident, the signaller was unaware that there was a diagram in the front of the desk log book. The diagram in this book was up to date.

115 The other copy of the diagram available to the signaller was in a folder which contained support materials for the signallers. The diagram used by the signaller on the night of the accident was from this folder, and this version of the diagram was out of date, as shown in figure 10. No one was allocated the task of ensuring the diagrams in the folder were up to date.

116 The RAIB issued urgent safety advice to the railway industry on 16 March 2016 to make infrastructure managers aware of the need to ensure that only current versions of documentation for making safety critical decisions are available to service control staff (appendix D).

Observations

Securing points with traction current on

117 **The station supervisor secured the points while the traction current was on, despite there being no local arrangement to allow this.**

118 LUL rule book 5 section 13.4, applies to the person securing points:

> *Traction current to be switched off*
>
> *Except where local arrangements apply, you must arrange for traction current to be switched off while points are secured and unsecured using scotches and clips.*

119 The service manager asked the station supervisor to go trackside and confirm the position of 38 points and be prepared to secure them if necessary. He reminded the station supervisor that traction current was on, and if he needed it to be switched off he should contact the service controller.

120 The service controller again reminded the station supervisor that traction current was on when he confirmed that he would like the station supervisor to secure the points in the reverse position.

121 The station supervisor confirmed on both occasions that he was aware that the traction current was on and that he felt he had sufficient space and access to secure the points without the need to isolate traction current. There is no local arrangement in place at Ealing Broadway to allow this.

Roles within the rule book

122 **The LUL rule book allocates tasks to certain people. In several cases during this accident, others carried out these roles.**

123 Rule book 5 section 13.5 states (relevant sections only):

Securing Points by scotch and clip

You (service controller) *must tell the person securing the points the details.*

Securing the points (applies to the person securing the points)

If you require traction current to be switched off, you must ask the controller to do this and confirm when this has been done.

You must check the points are in the correct position and tell the signaller if this is not so.

When the points have been secured

When you are clear of the track, you must:

- *Tell the signaller you have secured the points.*

Rule book 5 section 9.5, applies to signaller (relevant section only):

If points need to be manually secured, you must not give authority for a train to pass a semi-automatic signal at danger until you have received confirmation that all staff are in a place of safety.

Rule book 5 section 13.4, applies to signaller (relevant section only):

You must not authorise movement over any points which have been secured until the person securing the points tells you to do so.

124 The District line service manager asked the station supervisor to confirm the position of 38 points and to be prepared to scotch and clip the points. The station supervisor told the service controller he had scotched and clipped the points and was in a place of safety, but this confirmation was not passed to the signaller.

125 The staff in the control centres stated that they did not adhere to the requirements of the rule book, due to their workload and pressures brought about by managing the incident.

126 It is important that a signaller knows that points are secured in the correct position and that everyone is in a place of safety, before authorising a train to pass a signal at danger. In this instance, the signaller did not get this assurance directly from the station supervisor, but instead from the Piccadilly service manager via the District service manager and the District service controller. This introduced a high risk of miscommunication.

127 The LUL rule book requires the person securing points to receive their instructions from the service controller, yet confirm that the required action is complete and that they are in a place of safety to the signaller. This requirement to speak to different people is potentially confusing.

Summary of conclusions

Immediate cause

128 39A points were set in the wrong position for the passage of the train, which derailed as it travelled over them (paragraph 68).

Causal factors

129 The causal factors were:

a. track circuit CB failed, locking points 39A in the reverse position (paragraph 70, no recommendation);

b. the train operator of train 011 was authorised to pass signal WP17 at danger despite the route being incorrectly set for the train (paragraph 73, **Recommendation 3**);

c. the availability and quality of the information available to service control staff was insufficient (paragraph 82, **Recommendation 1**);

d. staff misunderstood the track layout at Ealing Broadway (paragraph 90, no recommendation);

e. the training of the service control staff on Traffic Controller's Diagrams did not include recognising slip points (paragraph 96, no recommendation);

f. the duty signal incident manager did not pass on the full information regarding which set of points were required to be in which position for the route (paragraph 99, **Recommendation 2**); and

g. the working relationship between the Piccadilly line signaller and the District line service controller was poor (paragraph 107, **Recommendation 3**).

Underlying factors

130 An underlying factor was that the management of information for operating staff is inadequate (paragraph 110, Urgent Safety Advice (appendix D)).

Additional observations

131 Although not linked to the accident on 2 March 2016, the RAIB observes that:

a. the station supervisor secured the points while the traction current was on, despite there being no local arrangement to allow this (paragraph 117, **Learning point 1**); and

b. the LUL rule book allocates tasks to certain people. In several cases during the accident others carried out these roles (paragraph 122, **Learning point 2**).

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

132 The RAIB issued urgent safety advice, on 16 March 2016 (appendix D), relating to the need for adequate processes being in place to cover the issue, management and control of safety critical documentation for signallers, service controllers and other staff with responsibility for the safe movement of trains (paragraph 116).

133 In response to the RAIB's urgent safety advice, LUL confirmed on 21 March 2016 that all staff who rely on Traffic Controller's Diagrams to make safety critical decisions were using the most up to date revision available and had disposed of any out of date versions.

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

134 LUL has included a section on reading a route in the training and refresher training of people who may be required to secure points. This is to enable the staff to check on the ground that the route being secured is correct for a train to pass over any points being secured.

135 LUL has arranged to provide, by the end of December 2016, training or briefing to all staff who use Traffic Controller's Diagrams, to include recognising slip points and other unusual or complex layouts.

Recommendations and learning points

Recommendations

136 The following recommendations are made[5]:

1 *The intent of this recommendation is to improve the presentation of information to service control staff so that they can comply with the LUL rule book requirement to come to a complete agreement on the actions to allow a train past a signal at danger.*

London Underground Limited should provide signallers and, as appropriate, service control staff with adequate means of determining the position of points and a clear method of identifying the required points and their positions in order to be able to come to a complete understanding and agreement of the actions necessary to set a route in order to pass a signal at danger (paragraph 129c).

2 *The intent of this recommendation is to ensure that all staff who may be called on to provide information for safety critical decisions are aware of the need, and are able, to pass complete messages.*

London Underground Limited should review its safety critical communications training and revise it to include the provision of training to staff members who may need to provide information to operational staff, in order to ensure adequate, accurate and complete information is conveyed and full understanding reached (paragraph 129 f).

continued

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

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

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

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

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

3 *The intent of this recommendation is to improve the quality of team working to avoid conflict and promote improved decision making during periods of degraded working.*

To promote and enhance team working, and to facilitate effective decision making in degraded working situations, London Underground should identify barriers to good decision making by service control staff, particularly where there are interfaces between lines and take action to develop the capability of these staff to:

i. communicate effectively;

ii. challenge decisions where there is doubt or uncertainty;

iii. be aware of information gaps and the risk that assumptions may fill knowledge gaps; and

iv. to be aware of how some behaviours may adversely influence the behaviours of others, and how to deal with this.

(paragraphs 129b, 129g)

Learning points

137 The RAIB has identified the following learning points[6]:

1 Where procedures require a specific local arrangement to be in place to address risks from working close to live conductors, staff should not put themselves at risk by doing such work without an authorised arrangement or other appropriate and approved mitigation.

2 Where operating rules require messages to be passed between individuals in named roles, other staff should respect this requirement and not create potential for confusion by modifying the message or becoming involved in the chain of transmission.

[6] '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 and acronyms

LUL	London Underground Limited
ORR	Office of Rail and Road
RAIB	Rail Accident Investigation Branch

Appendix B - Glossary of terms

All definitions marked with an asterisk, thus (*), have been taken from Ellis's British Railway Engineering Encyclopaedia © Iain Ellis. www.iainellis.com.

Bogie	A metal frame equipped with two or three wheelsets and able to freely rotate in plan, used in pairs under rail vehicles to improve ride quality and better distribute forces to the track.*
Book wiring diagram	The name LUL uses for signalling circuit diagrams showing individual relay contacts.
Clip	A device resembling a carpenter's G-clamp, used to render a switch inoperable and to secure a set of points (set of switches) in the closed position.*
Multiple unit	A train consisting of one or two or more vehicles semi-permanently coupled together, that can marshalled with other similar trains to make a formation that has a driving cab at both ends. All the traction power and brakes on all vehicles can be controlled from either cab. Some or all the vehicles may be equipped with powered axles.*
Normal	For a set of points or set of switches, this is the default position, decided generally as being the position which permits the passage of trains on the most used route. This position is depicted on the signalling plan. The opposite is reverse.*
Platform starter	A stop signal located at the departure end of a station platform or within 200 yards or one train length of it.*
Points	An assembly of switches and crossings (S&C) designed to divert trains from one line to another. Another name for a set of switches.*
Reverse	For a set of points or lever this is the "wrong" position, either permitting the passage of trains on the least used route or pulled fully forward in the lever frame respectively. The opposite is normal.*
Scotch	A wedge shaped piece of timber that is placed between switch rail and stock rail to ensure an open switch remains so.*
Secure (points)	To prevent points from moving inadvertently from the position in which they are intended to be, usually by using a scotch and a clip.
Service Controller	A member of staff in overall control of a line, on London Underground.
Service Manager	Shift manager responsible for service controllers and service operators.

Service Operator (Signaller)	A member of staff controlling and supervising the movement of trains over a section of route within a line under the direction of the service controller.
Single slip	A track formation which incorporates a diamond crossing of two lines, with a connection between the two lines in a single direction via two sets of points.
Short circuiting device	An insulated metal bar which is placed on to the conductor rails in order to prevent accidental recharge of traction current to protect people and equipment which may be on the track.
Toe	The movable end of a switch rail.*
Track circuit	An electrical device using rails in an electric circuit which detects the absence of trains on a defined section of line.
Trackernet	A system used by LUL staff that gives an indication of the position of trains on the network. It cannot be used for making safety critical decisions.
Traffic Circular	A weekly publication by London Underground Limited that provides details of train service and other operating information, including changes to the timetable.*

Appendix C - Investigation details

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

- Information provided by witnesses;
- Site photographs and measurements;
- Weather reports and observations at the site;
- Voice communications;
- LUL documents including the rule book and a review of operating staff training material.

Appendix D - Urgent Safety Advice

1. Incident Description			
Lead / Inspector		Contact Tel. No.	
Incident Report No	839	Date of Incident	2 March 2016
Incident Name	Derailment at Ealing Broadway		
Type of Incident	Derailment of D78 stock over a set of points just outside Ealing Broadway station		
Incident Description	District Line train in passenger service derailed on a set of points which had not been identified as being in the route over which the train needed to travel in order to get to platform 7 at Ealing Broadway, and the points were in the wrong position for the train to pass over them.		
Supporting References			

2. Urgent Safety Advice	
USA Date:	16 March 2016
Title:	Availability and control of accurate and current safety critical documentation
System / Equipment:	Traffic Control Diagrams
Safety Issue Description:	In dealing with an incident it is essential that all members of staff involved in making safety critical decisions are working from the same accurate and current versions of documentation in order for safe and correct decisions to be made. It is clear that during this incident at least one of the decision makers had out of date and inaccurate drawings to work from.
Circumstances:	In establishing how many sets of points required securing and in what positions, the signal operator was unable to appropriately take part in the discussion regarding which points the train would traverse, because he only had out of date drawings to refer to, other than the signalling panel in the cabin which did not clearly indicate the position or extent of the points.
Consequences	This was among the factors that caused other people involved in determining which points needed to be secured to dismiss the signal operator's concerns. As a result only one set of points was secured in the correct position, although two sets should have been. This resulted in the derailment of a passenger train after it was authorised to pass the protecting signal at danger.
Safety Advice:	London Underground Ltd is advised to take urgent steps to ensure that there is an adequate process in place covering the issue, management and control of safety critical documentation for signal operators, line controllers and other staff with responsibility for the safe movement of trains.

USA Sign-off*			
Inspector Name:		CI / DCI Name:	Simon French
Inspector Signature:	ELECTRONIC COPY	CI / DCI Signature:	ELECTRONIC COPY
Date:	16/03/2016	Date	16/03/2016

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