

Rail Accident Report



Derailment at Windsor and Eton Riverside station 11 October 2009

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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Derailment at Windsor and Eton Riverside station, 11 October 2009

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Preface

- 1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.
- 2 The RAIB does not establish blame, liability or carry out prosecutions.

Key Definitions

- 3 This derailment occurred at Windsor and Eton Riverside station, which is located at the end of a branch line. The branch line diverges from the London Waterloo to Reading line at Staines. All mileages in this report are measured from a zero datum at London Waterloo station.
- 4 Appendices at the rear of the report contain the following:
 - abbreviations are explained in appendix A; and
 - technical terms (shown in *italics* the first time they appear in the report) are explained in appendix B.

The Derailment

- 5 The derailment occurred at 14:35 hrs on Sunday 11 October 2009 as train 1Z75, the 13:30 hrs charter service from London Waterloo, arrived at Windsor and Eton Riverside station. The train was formed of a class 73 locomotive leading a five-car Class 201 *Diesel Electric Multiple Unit* (DEMU), with two further class 73 locomotives on the rear.
- 6 The derailment occurred as the train approached the buffer stops at 4.3 mph (6.9 km/h) on platform 1. Wheels on the leading axle of both *bogies* on the first carriage of the DEMU derailed.
- 7 Twelve members of staff (including the train crew and other personnel involved in the organisation of the service) and 120 passengers were on board the train. There were no reported injuries. The normal train service to Windsor and Eton Riverside station was suspended until 19:58 hrs.

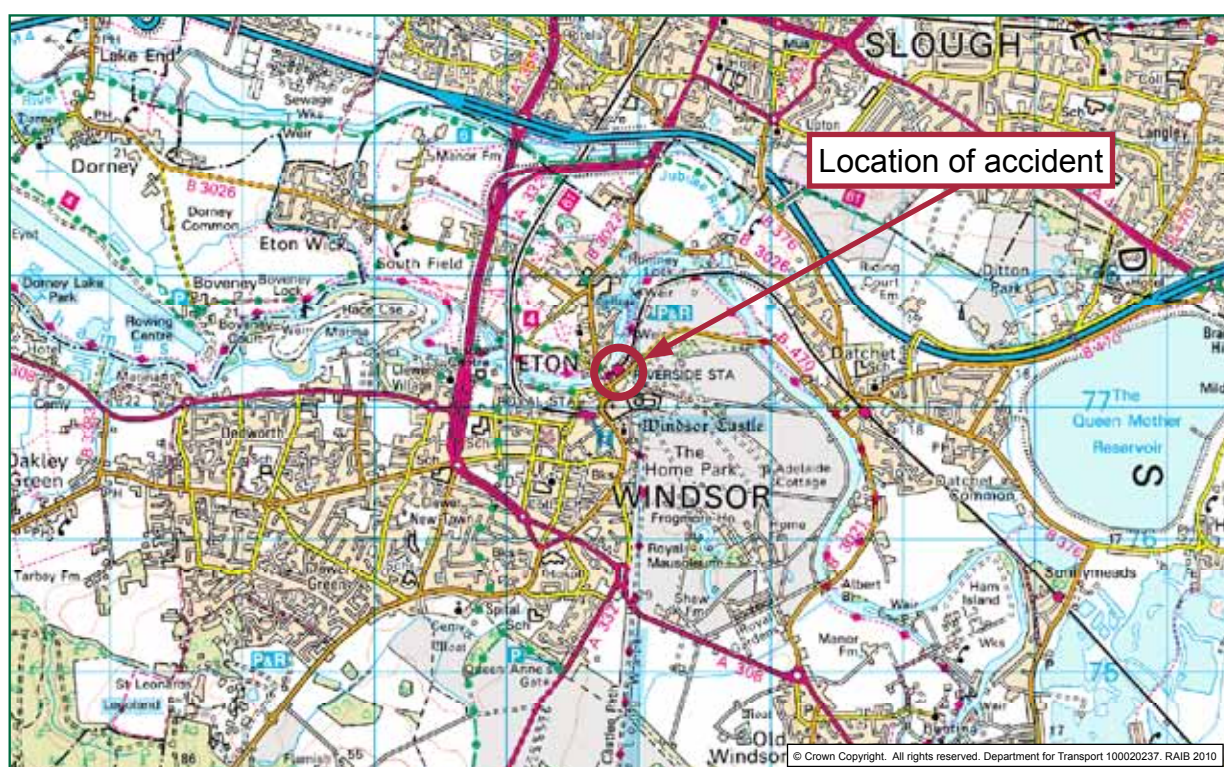


Figure 1: Extract from Ordnance Survey map showing location of the derailment

Organisations involved

- 8 Network Rail was the owner and maintainer of the infrastructure at Windsor and Eton Riverside.
- 9 First Group chartered the train.
- 10 First GBRf was the owner and operator of the locomotives.
- 11 St Leonards Railway Engineering Ltd owned the Class 201 DEMU.
- 12 Network Rail, First Group, First GBRf and St Leonards Railway Engineering Ltd all freely co-operated with the investigation.

Location

- 13 Windsor and Eton Riverside is a terminus station with two platforms (figure 2).
- 14 The derailment occurred on a 1 in 400 radius right hand curve (for arriving trains) on platform 1. Platform 1 has a mixture of *flat bottom* and *bull head jointed rail*, with the transition from one to the other occurring a short distance before the point of derailment. The rails are secured on timber *sleepers*. The *Route Availability* category on the Windsor branch is 8, which allows a maximum load of 24.1 tonnes per axle for trains using the branch.
- 15 Trains are signalled under the *track circuit block* regulations using three-aspect colour light signals, controlled by Feltham Power Signal Box. The route is electrified, using the third rail DC system.

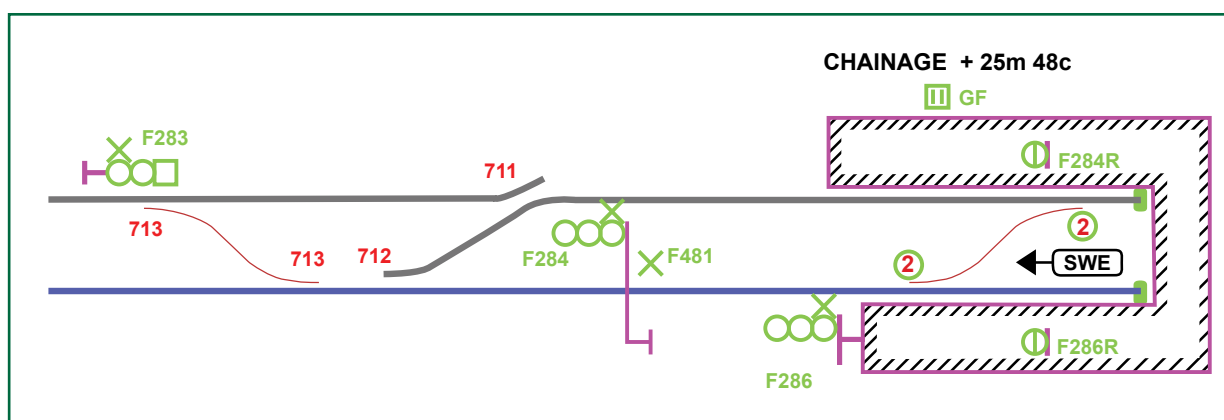


Figure 2: Track layout of platform 1 and 2 at Windsor and Eton Riverside station

Train(s) involved

- 16 The train was formed of a leading Class 73 locomotive (73141) with a total weight of 75 tonnes (19 tonnes per axle, equivalent to Route Availability category 6). The locomotive was attached to a preserved 'Hastings Line' Class 201 unit of five vehicles, with a maximum weight of 55 tonnes in the carriage which conveys the diesel engine. Two class 73 locomotives (73212 and 73213) were on the rear of the train.
- 17 The RAIB found no causal or contributory factors that could be attributed to the design, maintenance or operation of the train.

Staff involved

Infrastructure Maintenance Delivery Manager, Clapham

- 18 The Infrastructure Maintenance Delivery Manager (IMDM) at Clapham was appointed to the post in 2008. The main function of the post is to formulate strategies for maintenance and renewals work and inspections, estimate budgetary requirements and monitor performance. The IMDM reports to the Route Infrastructure Maintenance Director.



Figure 3: Locomotive and derailed Hastings unit at Windsor and Eton Riverside station platform 1

Track Maintenance Engineer, Feltham and Wimbledon

- 19 The Track Maintenance Engineer (TME) was appointed to the post in November 2005. The Track Maintenance Engineer's role is to ensure the safety of the line and develop plans for the short- and long-term management of maintenance. The Track Maintenance Engineer reports to the Infrastructure Maintenance Engineer.

Track Section Manager

- 20 The Track Section Manager joined British Rail in 1977 as a patroller and had worked at Feltham since 1997. He had visited Windsor and Eton Riverside on a number of occasions between 2005 and 2009. The Track Section Manager's role is to implement the Track Maintenance Engineer's plans and to manage the activities of the patrollers on the section. The Track Section Manager reports to the Track Maintenance Engineer.

Assistant Track Section Manager (ATSM)

- 21 The Track Section Manager at Feltham has two assistants, designated Assistant Track Section Managers. The actions of only one of them are referred to in the report. The relevant Assistant Track Section Manager had experience of working as a patroller. In his capacity as an Assistant Track Section Manager, he had visited Windsor and Eton Riverside on a number of occasions between 2005 and 2009. The Assistant Track Section Manager reports to the Track Section Manager and supports the Track Section Manager in meeting his objectives.

Patrollers

- 22 In the four years before the derailment, two patrollers had been responsible for weekly inspections of the track at Windsor and Eton Riverside station. The first patroller had 6 years' experience. His involvement with the branch ended in June 2009 when he handed over patrolling responsibility to a colleague. The handover process involved participation in routine track patrols over a period of four weeks, including Windsor and Eton Riverside station.
- 23 The second patroller qualified in the role in 2007, taking over responsibility for the Windsor and Eton Riverside branch from June 2009. The patrollers report to the Track Section Manager.

Section Planner (Ellipse Administrator)

- 24 The Section Planner assumed his current role in March 2009. Amongst his duties is administration of the *Ellipse* system, Network Rail's database of infrastructure maintenance tasks. As this part of his duties is relevant to the accident at Windsor and Eton Riverside, he is referred to as the 'Ellipse Administrator' in the remainder of this report.
- 25 The Ellipse Administrator reports to the Track Section Manager. His role is to administer work for the section and assist with work planning, completing the *Work Arising Instruction Forms* (WAIF) and *Track Engineering Forms* (TEF) submitted by the patrollers to the Track Section Manager. The Administrator enters data onto the Ellipse database system (see paragraphs 42 to 47).
- 26 The Ellipse Administrator is also involved in the *Plan, Do, Review* (PDR) weekly meetings with the Track Section Manager to discuss resources for planned work and for reprioritising work within the Ellipse database.

Events preceding the derailment

- 27 Network Rail's *Track Recording Vehicle* (TRV) measured various track parameters on the Windsor and Eton Riverside branch on 6 October 2009. Network Rail did not consider that the output from the vehicle when travelling below a speed of 20 mph (32 km/h) could be guaranteed, and it only measured up to 712/713 points on the approach to Windsor and Eton Riverside station (see figure 2). The TRV identified a track *twist* fault near the station which required remedial action to be taken.
- 28 On 8 October 2009 the Track Section Manager and his assistant inspected the twist fault. When they had completed their assessment they walked along the track towards the buffer stops at Windsor and Eton Riverside station. As they walked on the track at platform 1 they saw a number of rotten sleepers in the vicinity of 25 miles 46 *chains*. The rotten sleepers were marked by the Track Section Manager using spray paint and the fault was entered onto the Ellipse database later that day. Resources and equipment were then allocated to replace the sleepers in week commencing 12 October 2009.



Figure 4 (left): Track in platform 1 looking towards the buffer stops

Figure 5 (right): Track in platform 1 looking towards London showing condition of sleepers (both photographs taken by Network Rail staff on 8 October 2009, three days before the derailment)

Events during the derailment

- 29 On Sunday 11 October 2009, all trains using Windsor and Eton Riverside station were routed into platform 1.
- 30 As train 1Z75 approached the buffer stops on platform 1 the rails moved sufficiently apart under the load to permit wheels on the leading axle of the first bogie on the leading carriage of the DEMU to derail. A member of staff on the train noticed a rough ride and pulled the emergency cord to stop the train. The leading axle of the second bogie then began to derail as the train stopped.

Events following the derailment

- 31 No injuries were reported and all passengers were able to leave the train safely via platform 1. The station staff contacted the signaller.
- 32 Platform 2 was used to enable a passenger service to operate.
- 33 Damage had been caused to the derailed wheel sets on the DEMU. After the re-railing operation the rolling stock engineer completed a safety check and the train was then authorised to travel back to the depot.
- 34 Although only superficial track damage was caused by the derailment, the pre-existing condition of the track required *chairs* and sleepers to be replaced and *tie bars* to be fitted. This necessitated the closure of platform 1 until 03:20 hrs on Monday 12 October 2009.



Figure 6 (main): 'Swarf' debris and derailment marks on the rail from the derailed wheel

Figure 7 (inset): Decaying sleepers and wheel set of the DEMU

The Investigation

Sources of evidence

35 The following sources of evidence were used:

- witness statements;
- site examination;
- train examination;
- On Train Data Recorder;
- the Ellipse database;
- patrolling and inspection records;
- local processes for recording, escalation and prioritisation of faults;
- Network Rail company standards;
- the CIRAS database; and
- previous relevant RAIB reports.

Key facts and analysis

Identification of the immediate cause¹

- 36 **The immediate cause of the derailment was that the track was unable to maintain the correct gauge as train 1Z75 passed over.**
- 37 The location of the fault was at 25 miles and 46 chains. The area in the vicinity of the point of derailment showed signs of chair shuffle. Chair shuffle is a mark or indentation on the sleeper or *bearer* which has been generated by the load of the train causing the chair to move. This movement can cause the distance between the rails to deviate from the designed gauge. The wooden sleepers at the location of the derailment were either degrading or rotten and unable to retain the gauge under the load of the train.
- 38 Network Rail Standard NR/L2/TRK/001 states that the static (unloaded) track gauge for plain and curved track over 200 metres radius should be 1435 mm. Maintenance limits for tight and wide gauge on track with a line speed below 20 mph (32km/h) are 1426 mm to 1455 mm (figure 8).
- 39 The track was examined after the derailment. The gauge was found to be 1469 mm at the point of derailment and between 1471 mm and 1478 mm at various locations beyond the point of derailment.
- 40 An examination of the rail head after the derailment confirmed that *dynamic widening of the track gauge* had been occurring. The position of the *running band* of the wheel tread was close to the *gauge corner*, indicating that the weight of trains entering the platform was widening the gauge (figure 8).

Identification of causal², contributory³ and underlying factors⁴

- 41 Factors relevant to the cause of this derailment have been grouped under the following headings:
- aspects of the administration associated with the track fault at Windsor and Eton Riverside station;
 - identification and management of the fault at Windsor and Eton Riverside station; and
 - Network Rail's strategy for the measurement and recording of track geometry.

¹ The condition, event or behaviour that directly resulted in the occurrence.

² Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

³ Any condition, event or behaviour that affected or sustained the occurrence, or exacerbated the outcome. Eliminating one or more of these factors would not have prevented the occurrence but their presence made it more likely, or changed the outcome.

⁴ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

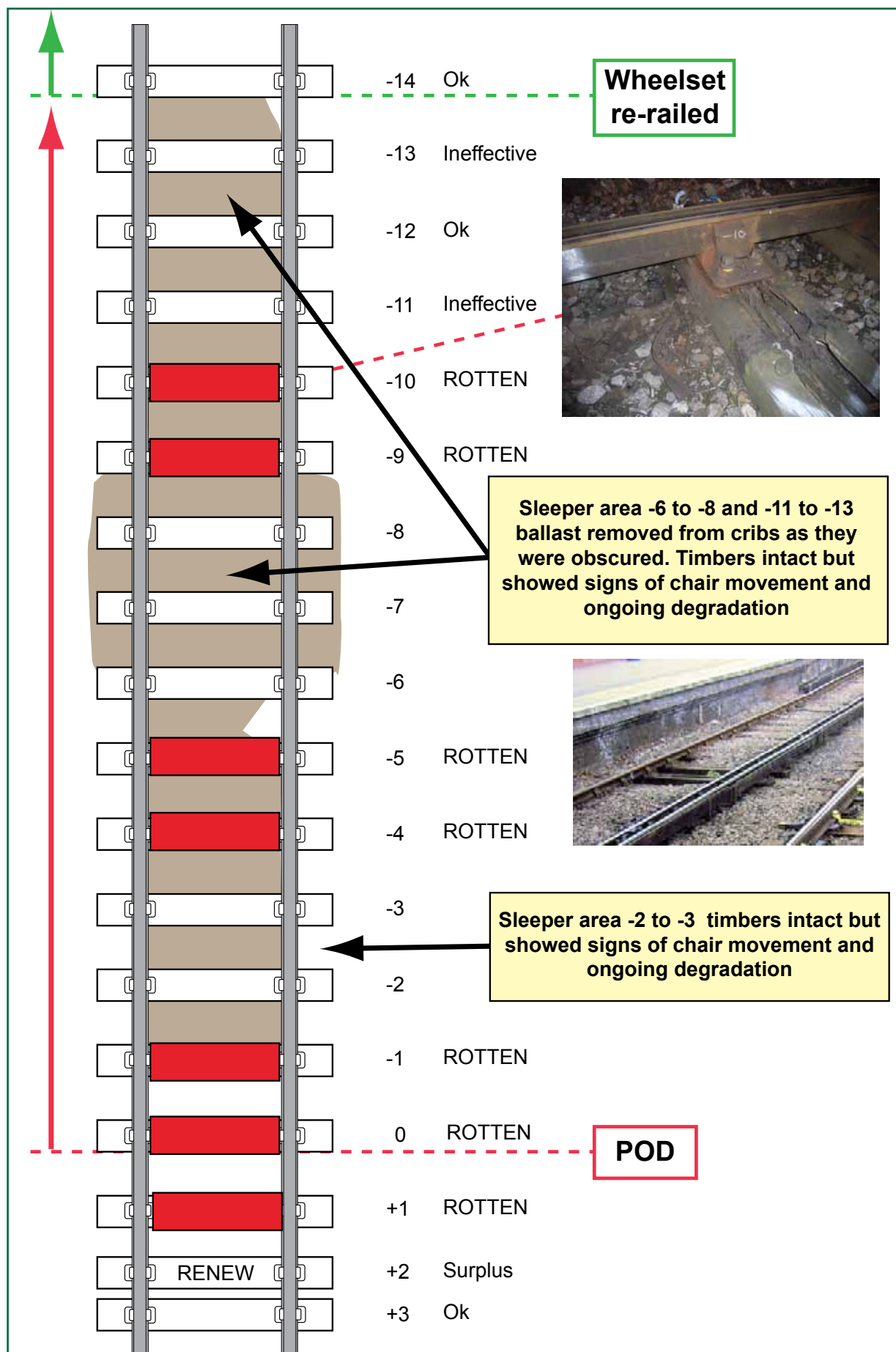


Figure 8: Track survey diagram of the derailment site (inset: image showing running band)

Administration associated with the track fault at Windsor and Eton Riverside station
Error in identifying the location of the fault in the Ellipse database

- 42 **The poor condition of the sleepers at 25 miles 46 chains had been identified four years before the derailment occurred, but the location of the fault had been incorrectly entered into Network Rail's track management database, Ellipse, as 25 miles 31 chains to 25 miles 41 chains (referred to as 25 miles 31 chains in the remainder of this report). While the mistake in identifying the location of the fault did not cause the derailment, it did result in the actual fault at 25 miles 46 chains being subject to a lower level of surveillance by the Track Section Manager (see paragraphs 70 to 71 and 81 to 84). The discrepancy between the actual location of the fault at Windsor and Eton Riverside station and its recorded location on Ellipse was a contributory factor in this derailment.**
- 43 The scheduling of track maintenance is managed by the Track Maintenance Engineer and Track Section Manager using data in the Ellipse database. The Ellipse business process is mandated in Network Rail's company standard NR/L3/MTC/MC0176/02, 'Ellipse work management handbook'. Notification that maintenance work on the infrastructure is required may arise from routine inspections (patrols), management inspections or incidents. Ellipse also identifies maintenance work that is recurring in nature.
- 44 Patrollers conducting basic visual inspection are required to identify new faults and monitor existing faults. Where new work is required, the patroller prepares a Track Engineering Form (TEF). The Track Section Manager considers the contents of the TEF and identifies what work is to be undertaken and the relevant timescales. The Track Section Manager passes details of any work arising to an administrator on a Work Arising Instruction Form (WAIF) for the details to be input to the Ellipse database. Ellipse creates a work order and a unique serial number for new work.
- 45 All of the outstanding work on a section is referred to as the 'work bank'. The Track Section Manager and his assistants are required by NR/L2/TRK/001 to continually review the work bank and the items that are, or will soon become, overdue.
- 46 A WAIF was generated for '16 rotten sleepers' at 25 miles 31 chains in April 2005 and subsequently entered onto the Ellipse database. There was no such fault at this location and it is likely that the fault was actually in the vicinity of 25 miles 46 chains where the derailment occurred. The fault was reprioritised on eight separate occasions between April 2005 and August 2009 by the Track Section Manager or his assistant (see paragraphs 49 to 52). It is likely that on at least some of these occasions, the re-prioritisation was based on their assessment of the condition of the sleepers at 25 miles 31 chains (where there was no fault).
- 47 It has not been possible to ascertain why the mileage on the original WAIF was wrongly recorded as being at 25 miles 31 chains. The error was corrected in the immediate aftermath of the derailment and no remedial work was necessary at 25 miles 31 chains.

- 48 There are two possible reasons why this error was not corrected earlier:
- witness evidence indicates there was reluctance to close any fault recorded in Ellipse without first effecting a repair because it was assumed that there must be a reason why a fault had been recorded in Ellipse in the first place; and
 - the format and presentation of the Ellipse material was confusing and made it difficult for the Track Maintenance Engineer and Track Section Manager to identify the mileage discrepancy without detailed scrutiny (see paragraphs 53-56).

Reprioritising work

- 49 **The fault recorded at 25 miles 31 chains was reprioritised on eight occasions between April 2005 and August 2009. When a fault has been reprioritised six times, the Ellipse Administrator is required to bring this to the attention of the Track Section Manager so that a more detailed review can be undertaken. The Administrator and Track Section Manager were generally competent in using Ellipse, but not aware of the requirement to conduct such a review after a sixth reprioritisation. Consequently, the fault recorded at 25 miles 31 chains was not subject to detailed scrutiny. The Track Section Manager and Ellipse Administrator not following the process for reviewing the fault recorded at 25 miles 31 chains after its sixth reprioritisation is a possible causal factor in this derailment.**
- 50 Network Rail standard NR/L3/MTC/MG0176/02 (Section 2.3) and Maintenance Planning Handbook NR/L3/PL0175 (Sections 7 and 8) outline the responsibilities of staff and processes to be followed in relation to reprioritising work. It is permissible for a Track Section Manager, or his assistant, to reprioritise items of work, which in their judgement may safely be deferred to a later date for rectification, if there are higher priorities elsewhere. This may be done following a visual inspection by the Track Section Manager, Assistant Track Section Manager or Track Maintenance Engineer, or as a desk-based decision taking account of their own experience. In each case the revised timescale is entered onto Ellipse. Where there is doubt about the appropriateness of the decision, the Track Section Manager may either revise the data or refer it to the Track Maintenance Engineer.
- 51 Ellipse includes a facility for 'counting down' to the scheduled date for work to be completed. Faults can be reprioritised, but subject to detailed scrutiny when they have been reprioritised on 6, 12, 18 or 24 occasions. The reprioritisation of work should be monitored by the Track Section Manager and discussed with the Ellipse Administrator to identify milestones being reached. When milestones were reached, the Track Section Manager should discuss the current status of the fault with the Track Maintenance Engineer at the weekly PDR meeting and agree on the plan of action. However, there was no effective system in place at Feltham to do this.
- 52 There is no evidence that the fault recorded at 25 miles 31 chains was ever discussed in a PDR meeting by the Track Section Manager or the Track Maintenance Engineer.

Quantity and format of Ellipse Material

- 53 **The presentation of material from the Ellipse database used by the Track Section Manager when he did his three-monthly inspections was not conducive to the easy identification of longstanding faults. This was an underlying factor in the derailment.**
- 54 The Ellipse Administrator can produce a specific report to assist the Track Section Manager in his three-monthly supervisory inspection of the track. The Ellipse Administrator at Feltham produced a complete 'work bank' print out for the section of track to be reviewed rather than a bespoke report for the Track Section Manager. The fault code and locations are shown on the work bank print out. The date of the initial report, next scheduled date and number of reprioritisations of the fault are shown in separate columns on the spreadsheet.
- 55 The columns on the Ellipse print out were not aligned to highlight the dates and history of the fault. Had the original WAIF details and reprioritisation date columns on the spread sheet been adjacent to each other it may have:
- alerted the Track Section Manager or the Track Maintenance Engineer to the history of the fault as it was being reviewed; and/or
 - alerted them to the degradation that could be occurring because of the length of time that the fault had been present (4 years).
- 56 The Ellipse system is capable of producing bespoke reports for a Track Section Manager and Track Maintenance Engineer but the Ellipse Administrator had not been trained to do so. On occasions this resulted in the Track Maintenance Engineer and Track Section Manager using a filtered version of the work bank report in Excel format, which contained only a limited subset of the data in Ellipse.

Identification and management of the fault at Windsor and Eton Riverside station

The actions of the patroller

- 57 **The patroller did not report the condition of the sleepers at Windsor and Eton Riverside station on a weekly basis. Had he done so, it is more likely that action would have been taken to rectify the fault. It is possible that the patroller not reporting the condition of the sleepers was a causal factor in the derailment.**
- 58 Network Rail Standard NR/L3/TRK/1015 describes how faults are identified during patrolling and Standard NR/L2/TRK/001 mandates that patrollers should report all faults seen during their inspection, irrespective of whether they are new faults or existing faults. The patroller responsible for the section of track including Windsor and Eton Riverside station did not do this and it was not the practice at Feltham for any patroller to do so. The only way in which the patroller was likely to bring this fault to the attention of his Track Section Manager was if he became concerned about the deterioration of the sleepers at 25 miles 46 chains.
- 59 Network Rail standard NR/SP/CTM/011 states that a patroller should be competent in identifying an unsafe condition of the track or gauge (for example, loose or missing keys/clips, wide gauge and chair shuffle). However, the patroller is not expected to identify the position of the running band (paragraph 40) if he observes chair shuffle. Chair shuffle could therefore be observed and identified as a problem, but the associated derailment risk that may require immediate action would not be identified.

- 60 Standard NR/L2/TRK/001 (Section 9.3) mandates that the patroller should look for broken, cracked or ineffective sleepers and vertical or lateral movement of chairs or baseplates. The patroller was aware of this requirement but took no action regarding the condition of the sleepers at 25 miles 46 chains because he did not consider the track to be unsafe. This may have been a factor in the condition of the sleepers not being identified. In addition, the rotten sleepers had at some stage been marked with spray paint and this led the patroller to believe that his Track Section Manager was already aware of the fault (see paragraph 98).
- 61 For the reasons described above, neither patroller at Windsor and Eton Riverside submitted WAIF's or TEF's on a weekly basis between 2005 and the date of the derailment. As a result, no special attention was paid to the rotten sleepers.

Actions of the Track Section Manager

Management of the patrolling and reporting process

- 62 **The Track Section Manager did not encourage patrollers to submit TEFs for existing faults. This was because of the adverse impact that it would have had on his workload. This meant that the Track Section Manager was not being constantly reminded of the fault at 25 miles 46 chains. Had he been reminded on a weekly basis of the fault, it is more likely that action would have been taken to rectify it. It is possible that the non-enforcement of the requirement for patrollers to report all faults on a weekly basis was a causal factor in this derailment.**
- 63 Network Rail standards NR/L2/TRK/001 and NR/L3/TRK/002/A02 outline the role and responsibilities of the Track Section Manager in ensuring that the track remains safe for operational use and in managing the activities of patrollers. The Track Section Manager must identify, assess and review the status of faults and plan corrective action with the assistance of the Ellipse system. The Track Section Manager should also ensure that TEFs are submitted by patrollers for all faults (new and repeat) and that these forms are reviewed and countersigned for input onto the Ellipse system, as appropriate.

Replacement of the sleepers at Windsor and Eton Riverside

- 64 **Although the condition of the sleepers at 25 miles 46 chains was not regularly brought to the attention of the Track Section Manager, this did not mean that he was unaware of the issue. The fact that action was not taken by the Track Section Manager to replace the decaying sleepers was a causal factor in this derailment.**

- 65 Network Rail's company standard NR/SP/TRK/029 (Section 13.11) states that no wet or dry rot or other decay or fungal growth in sleepers is permitted. This is a subjective assessment and therefore a sleeper may show signs of degradation, but still be considered as effective. However, post-derailment examination identified that a number of sleepers were rotten. It cannot be determined with certainty for how long the sleepers had been in a condition that allowed gauge-widening to occur. However, the initial WAIF entry in 2005 described the fault (at 25 miles 31 chains) as 'rotten sleepers' and photographic evidence from a previous (unrelated) derailment at Windsor and Eton Riverside in May 2008 showed sleepers in the vicinity of 25 miles 46 chains to be visibly rotten with vegetation growing through the centre of some of them. The sleepers visible in figures 9 and 10 show signs of the area being examined (removal of *ballast* between the sleepers). It has not been possible to identify who conducted this examination. The ballast between the sleepers should have been replaced after the examination (in accordance with Network Rail's standards).



Figures 9 and 10 (inset): Condition of the sleepers at Windsor and Eton Riverside in May 2009 showing that some ballast has been removed in one area

- 66 Standard NR/L2/TRK/001 mandates that up to six sleepers can be ineffective (not able to support or retain the gauge) within a 60 feet section (18 metres). No more than two consecutive ineffective sleepers are permitted. Each group of two ineffective sleepers must be separated by at least two other effective sleepers that are capable of maintaining gauge.

- 67 The post-derailment examination of the track at Windsor and Eton Riverside showed that there was one group of three consecutive ineffective sleepers and there were four ineffective sleepers within another group of seven. Both sections of track were not compliant with NR/L2/TRK/001.
- 68 The ballast extended over some of the sleepers as well. The covering of the sleepers with ballast was contrary to the requirements of NR/L2/TRK/001 and prevented the patroller and Track Section Manager from inspecting the track to ensure its compliance and safe condition.
- 69 Standard NR/L2/TRK/001 requires the Track Section Manager or his assistant to conduct a visual inspection of the track every three months to assess, review and plan new work.
- 70 The Ellipse database shows that the Track Section Manager and/or his assistant had visited Windsor and Eton Riverside at three-monthly intervals since April 2005. When the fault recorded in Ellipse at 25 miles 31 chains had been scheduled for review, it had always been reprioritised. When the Assistant Track Section Manager reviewed the fault on 27 August 2009 he scheduled the next review for 24 months, but this was amended by the Track Section Manager to April 2010 (8 months). The condition of the fault was recorded on several occasions as 'as expected' or 'no degradation'.
- 71 There are four possible reasons why repairs to the sleepers at 25 miles 46 chains were not actioned by the Track Section Manager:
- On some occasions, the Track Section Manager and/or his assistant may have visited the track at 25 miles 31 chains when reviewing the fault. This is likely to have been the case in August 2009 when the Assistant Track Section Manager scheduled the next review for 24 months later.
 - When they did visit the right location, the presence of a train may have obscured the relevant section of track on occasions.
 - The presence of ballast over some of the sleepers may have obscured the extent of the problem.
 - There was a perception that the condition posed a low risk (see paragraphs 81-84).

Actions of the Track Maintenance Engineer

- 72 **When the Track Maintenance Engineer visited Windsor and Eton Riverside station in May 2008, he observed the condition of the sleepers in platform 1 and asked for the fault to be rectified. No such action was undertaken by the Track Section Manager and the Track Maintenance Engineer did not follow-up his own request. The Track Maintenance Engineer not following up his request for the work to be undertaken was a causal factor in the derailment.**
- 73 Network Rail's standards NR/L2/TRK/001, NR/L3/TRK/1011 and NR/L3/TRK/002/A03 mandate the role, responsibilities and required competence of the Track Maintenance Engineer. A Track Maintenance Engineer conducts a track inspection by foot every two years, supplemented with cab riding. The remit of the inspection includes track condition, trends, proposals for renewal of work and quality of maintenance. It also encompasses a check on the performance and effectiveness of those conducting basic visual and supervisory track inspections.

- 74 The Track Maintenance Engineer visited Windsor and Eton Riverside in May 2008. He documented the 'poor condition' of the sleepers at 25 miles 46 chains and requested that a proposal be made to replace them. This proposal would have been discussed between the Track Maintenance Engineer and the Track Section Manager to ensure the fault was managed.
- 75 The Track Maintenance Engineer's visual inspection form was countersigned by the Track Section Manager. There was no evidence of a discussion about the fault at 25 miles 46 chains between the Track Maintenance Engineer and the Track Section Manager, and the Track Maintenance Engineer did not develop any proposal for the work to be undertaken.
- 76 The Track Maintenance Engineer's visual inspection form is the only item of documentation prepared between April 2005 and October 2009 that specifically refers to the condition of the track at the correct location of 25 miles 46 chains. No subsequent action was taken because the Track Maintenance Engineer assumed that the Track Section Manager would respond to his report and the Track Section Manager did not consider that this particular fault changed his priorities. It was nonetheless evident that the Track Section Manager had taken a conscious decision not to deal with the fault at 25 miles 46 chains. In part, this is likely to have been for the reasons described in paragraphs 81-84.

Visual identification of widening gauge

- 77 **Although there were no mandated methods for measuring dynamic gauge in parts of the network not covered by the track recording vehicle (see paragraphs 85 to 89), close inspection of the running band in the vicinity of the point of derailment would have indicated that the gauge was widening. The non-identification of the widening gauge in platform 1 at Windsor and Eton Riverside was a causal factor in the derailment.**
- 78 The three-monthly supervisory inspections undertaken by the Track Section Manager or his assistant and the two-yearly inspection by the TME could have included scrutiny of the running band in the vicinity of the track fault at Windsor and Eton Riverside station as there were visible signs of chair shuffle and degradation in the condition of the sleepers. The reasons why this did not happen are identified in paragraph 71. There was evidence of dynamic gauge widening and chair shuffle when the Track Section Manager and his assistant visited Windsor and Eton Riverside station on 8 October 2009. Although both were competent in identifying the implication of the position of the running band and the associated risk of derailment, they did not observe it on this occasion. They took no immediate action other than planning to deal with the fault the following week.

Non-application of tie bars

- 79 **Standard NR/L2/TRK/001 mandates that where there is evidence of gauge widening, a tie bar may be fitted as a temporary measure and the necessary work planned and completed within six months of the fitting of the tie bar to rectify the fault. The condition of the sleepers at 25 miles 46 chains (paragraph 67) was such that tie bars should have been fitted on, or before, 8 October 2009. The non-application of tie-bars was a causal factor in the derailment.**

- 80 Standard NR/L2/TRK/001, Section 10.1.1. mandates that a tie bar register must be retained at local level to record when tie bars are fitted. A review of the tie bar register at Feltham shows that no tie bars were ever fitted or removed at 25 miles 31 chains or 25 miles 46 chains. The reasons why tie-bars were not applied are the same as the reasons why the defective sleepers were not replaced (paragraph 71).

Attitude to risk at Windsor and Eton Riverside station

- 81 **Although at various times they were explicitly aware of the condition of the sleepers at 25 miles 46 chains, managers at Feltham took no immediate action to deal with the risk such as application of tie-bars or replacement of the defective sleepers. Their actions were influenced by a consideration that the risk at terminus stations was small. This view was an underlying factor in the derailment.**
- 82 When the Track Maintenance Engineer asked for proposals for the rotten sleepers to be replaced in May 2008 (paragraph 74), he did not ask for tie-bars to be applied pending the undertaking of repair work, although it has not been possible to establish definitively if tie bars were required in May 2008.
- 83 When the Track Section Manager and his assistant observed the fault at 25 miles 46 chains on 8 October 2009, they applied spray paint to indicate that the sleepers were ineffective and required replacement. The track gauge was measured in several locations as being 1455 mm, right on the upper maintenance limit. A decision to fit tie-bars would have prevented the derailment on 11 October 2009, but the Track Section Manager made a conscious decision not to do so as he believed the fault could be dealt with the following week and considered that the risk was small.
- 84 The RAIB found that the belief that the risk was low at a terminus station common to many staff in the Feltham area, including patrollers, the Track Section Manager and his assistant and the Track Maintenance Engineer. They based this view on the low speed of trains as they entered and departed from the station and the limited consequences arising from derailment.

Measurement and recording of track geometry

- 85 **Network Rail's TRVs record track geometry and are capable of identifying dynamic gauge widening, but the TRV does not cover the track at Windsor and Eton Riverside station. There is no other systematic process of assessing a change in the track gauge under dynamic conditions mandated by Network Rail. The absence of a mandated means of measuring or assessing the track gauge under dynamic conditions at Windsor and Eton Riverside station was an underlying factor in this derailment.**
- 86 This non-measurement of dynamic gauge by the TRV in terminus platforms is normal practice. Network Rail standard NR/L2/TRK/001 (Section 11.4.2) mandates that track measurements are taken at all locations except on lines with permitted speeds of less than 20 mph (32 km/h). The standard stipulates that manual methods of recording the track geometry in other areas should be implemented and approved by the Principal Maintenance Support Engineer.

- 87 As a result of recommendations arising from a derailment at Newcastle in March 2008 (paragraph 101), Network Rail circulated a letter of instruction mandating that all Network Rail areas must conduct a review of non-recorded sections of track. An action plan was generated and an amended register was produced and implemented in conjunction with the Ellipse system.
- 88 The Wessex area register had been approved by the Track Maintenance Engineer and Infrastructure Maintenance Delivery Manager and signed off by the Principal Maintenance Support Engineer (Track) in June 2009. Under the management of the Assistant Track maintenance Engineer, the Feltham Technical Team was scheduled to undertake its first review of the platform lines at Windsor and Eton Riverside station using the manual track trolley to record static gauge and twist on 13 October 2009, 2 days after the derailment.
- 89 The manual method of measuring track gauge normally involves measurement of static gauge only. The onus is placed upon the individual to identify visual evidence (which was present at Windsor) of gauge spread under dynamic load and associated derailment risk in areas not covered by Network Rail's TRVs.

Previous occurrences of a similar character

Broxbourne: 27 April 2006

- 90 On 27th April 2006 six wagons on a freight train sidings derailed as the train travelled over the crossing from the main line into the sidings at Broxbourne. Two of the wagons turned onto their side, causing extensive damage to both wagons and track. No persons were injured.
- 91 The causal factor was identified as a deterioration of several sleepers, allowing the gauge to widen to a point where derailment could occur.
- 92 Some of the underlying causes, with some relevance to the accident at Windsor, were identified by Network Rail as:
 - inspections were not carried out with the required level of diligence and failed to detect the deterioration in the track;
 - the judgement of those carrying out patrolling and inspection may have been affected by their perceptions of the general condition of the track and the traffic flow at the location;
 - persons carrying out the inspections had used the maintenance limits specified in track standards as a target on which to decide when action should be taken and had not attempted to identify the underlying cause of the wide gauge; and
 - there was no monitoring of the inspections by the TSM or the TME.
- 93 The RAIB did not investigate the accident as the derailment occurred in sidings and did not affect the adjacent main line.

- 94 Network Rail's investigation highlighted a number of local actions, which only applied to its East Anglia region:
- take action to ensure that a robust process exists for the monitoring of non-recorded track;
 - arrange for TMEs, TSMs and ATSMs within East Anglia to be briefed on the circumstances of the accident and the lessons to be learned; and
 - arrange for a reassessment of the competence of the TME, TSM and ATSM in track inspection.

Liverpool Central: 26 October 2005 (RAIB report 14/2006)

- 95 A Merseyrail passenger train derailed in a tunnel near to Liverpool Central station. The immediate cause of the derailment was the widening of the track gauge during the passage of the train because the track was in poor condition with limited use of tie bars to mitigate the risk.
- 96 Causal factors identified included:
- deficiencies in the system of track inspection; and
 - inadequate maintenance of the track pending a planned renewal that should ideally have been carried out earlier in the asset's life.
- 97 The RAIB made recommendations on the competence of track maintenance staff which were accepted and implemented (see paragraph 118).

Epsom: 12 September 2006 (RAIB report 34/2007)

- 98 A passenger train derailed as it approached Epsom station as a result of excessive side wear in a section of track. The investigation identified a lack of proper maintenance attention to the track at the point of derailment to mitigate the risk of derailment. The requirement for the section of track where the derailment occurred to be renewed was in the work bank, but had been repeatedly re-prioritised over a four-year period. The patroller had not been reporting the fault on a weekly basis.
- 99 The section of track had not been measured using the TRV because of a weak bridge on the route.
- 100 The RAIB recommended that Network Rail should revise its instructions to staff to ensure that patrollers and local track managers have clear and specific instruction and guidance on the identification of, and response to, alignment faults and localised poor rail condition. This recommendation was rejected by Network Rail on the basis that the enhanced Track Maintenance Handbook (NR/L3/TRK/003) already mandated the requirements to meet the recommendation.

Newcastle, King Edward Bridge: 10 May 2007(RAIB report 02/2008)

- 101 A freight train derailed just outside Newcastle station. The cause of the derailment was poor track geometry on a section of line which had not been measured by the TRV.
- 102 The RAIB recommended that Network Rail include guidance in the Track Inspection Handbook on track measurement in areas not covered by the TRV. This was to ensure that additional consideration was given to the monitoring, frequency and methodology of measuring the track in locations where the dynamic track geometry is likely to deteriorate and exceed maintenance limits without otherwise being detected.

- 103 Network Rail accepted the recommendation and issued a letter of instruction in March 2009 in relation to capturing track data in areas which were not recorded by the track recording vehicle. This is referred to in paragraph 87.

Observations⁵

Internal audit

- 104 Network Rail's internal audit in 2007 of the Wessex route identified a number of concerns in relation to the management of track maintenance. The audits covered four Track Section Managers and four Track Maintenance Engineers. Not all of the issues identified applied to every Track Section Manager or Track Maintenance Engineer, but some applied to more than one:
- Patrolling reports were sometimes not reviewed within 3 days of the inspection.
 - Some Track Section Managers were not undertaking track inspections.
 - Faults found during the Track Maintenance Engineer's inspection had no reference numbers on the TEF forms to reconcile those defects to the work in the Ellipse system and therefore had not been acted upon.
 - Reports were not always passed to the Track Section Manager or entered into the Ellipse system.
 - Faults found during 'non-recorded track' inspections were not always dealt with as required and some areas were found to be non compliant as bay platforms were not being recorded.
 - Some locations not visited by the TRV were overdue for inspection, in contravention of the requirements of standard NR/L2/TRK/001.
- 105 The 2009 audit of the Feltham section (undertaken before the derailment) identified similar areas of non compliance. The following areas were identified:
- Inconsistencies in the identification and reporting of defects from basic visual inspection.
 - Supervisors did not take a *walk out report* with them on all occasions and if it was used, the report was not always passed to the Ellipse Administrator for review and sign off (paragraph 56).
 - The Track Section Manager's visual track inspection reports were not consistently countersigned by the Track Maintenance Engineer.
 - There was no documented evidence to confirm approval of the manual methods of track measurement to be used for lines not visited by TRV. There were 20 locations within the register without a date for the last inspection. It could not be confirmed if inspections had been completed.
- 106 Network Rail's internal audit process in 2009 did not identify where issues that had been raised during previous audits had recurred, despite being reported as accepted and completed. Had it done so, it may have focused on issues relevant to Network Rail's knowledge of the condition of the track at Windsor and Eton Riverside station.

⁵ An element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the accident but does deserve scrutiny.

Conclusions

Immediate cause

107 The immediate cause of the derailment was that the track was unable to maintain the correct gauge as train 1Z75 passed over (paragraph 36).

Causal factors

108 The causal factors were:

- a) action was not taken by the Track Section Manager to replace the decaying sleepers at 25 miles 46 chains (paragraph 64, **no recommendation is made**);
- b) the Track Maintenance Engineer did not follow-up his proposal for the replacement of the decaying sleepers in May 2008 (paragraph 72, **no recommendation is made**);
- c) the non-identification of the widening gauge in platform 1 at Windsor and Eton Riverside station (paragraph 77, see **Recommendation 1**); and
- d) tie bars were not applied to the defective section of track (paragraph 79, **no recommendation is made**).

109 It is possible that the following factors were also causal:

- a) the Track Section Manager and Ellipse Administrator did not follow the process for discussing faults after they had been re-prioritised six times (paragraph 49, see paragraph 117);
- b) the patrollers did not report the condition of the sleepers to the Track Section Manager on a weekly basis (paragraph 57, see paragraph 118); and
- c) the Track Section Manager did not enforce the requirement for patrollers to report all faults on a weekly basis (paragraph 62, see paragraph 118).

Contributory factor

110 A contributory factor was:

- a) a discrepancy between the actual location of the fault at Windsor and Eton Riverside station and its recorded location on Ellipse (paragraph 42, see paragraph 116).

Underlying factors

111 The underlying factors were:

- a) the presentation of material in Ellipse that was used by the Track Section Manager when he did his three-monthly inspections was not conducive to the easy identification of longstanding faults (paragraphs 53, see paragraph 117);
- b) the view held by managers at Feltham depot that the risk from track faults at terminus stations was low (paragraph 81, **no recommendation is made**); and
- c) the absence of a mandated means of measuring or assessing the track gauge under dynamic conditions at Windsor and Eton Riverside station (paragraph 85, see **Recommendation 2**).

Observation

112 Network Rail's internal audit process in 2009 did not identify where issues that had been raised during the previous audit in 2007 had recurred, despite being reported as accepted and completed (paragraph 106, see **Recommendation 3**).

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

Network Rail

Wessex area

113 The Ellipse Administrators/Section Planners and Track Section Managers have been re-briefed on the requirements of the Ellipse handbook.

Feltham depot

114 Patrollers and Track Section Managers have been re-briefed to identify both static and dynamic gauge faults.

115 Tie bar registers have been linked to the Ellipse database to ensure all work is held within Ellipse and overdue work can be identified.

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

- 116 The Track Maintenance Engineer has instructed the Ellipse Administrator to check all current entries within his area to ensure accuracy of the data. In the light of this action addressing the factor identified in paragraph 110a, the RAIB has decided not to issue a recommendation.
- 117 Network Rail has changed the reprioritisation report on Ellipse so that the initial date, number of reprioritisations and the dates pre- and post- reprioritisation all appear in adjacent columns. Re-prioritisations are now monitored and reviewed at the weekly PDR meetings with a hardcopy file produced to provide an audit trail from the original WAIF. The Clapham Ellipse manager has amended an Excel spreadsheet produced from the Ellipse database to highlight and colour code items which are re-prioritised more than six times. In the light of these actions addressing the factor identified in paragraphs 109a and 111a, the RAIB has decided not to issue a recommendation.
- 118 Patrollers and Track Section Managers have been briefed to positively report all existing faults on a weekly basis. In the light of this action addressing the factor identified in paragraphs 109b and 109c, the RAIB has decided not to issue a recommendation.

Recommendations

119 The following recommendations are made:⁶

- 1 *The purpose of this recommendation is to improve the skills of all staff involved in track inspection (including managers and supervisors) in identifying excessive dynamic gauge widening. Taken in conjunction with their existing competence in identifying chair shuffle the enhanced skills should increase the ability and confidence of staff in deciding if a dynamic derailment risk is evident.*

Network Rail should revise its current competency training programme for all staff involved in track inspection to include reference to the visual identification of abnormal running band and its relationship with chair shuffle and wide gauge as an indication of dynamic gauge problems and potential risk of derailment (paragraph 108c).

- 2 *The purpose of this recommendation is for Network Rail to consider how potentially vulnerable parts of the network that are not covered by track recording vehicles can be subject to dynamic gauge measurement.*

Network Rail should develop a proposal for the periodic measurement of dynamic gauge at potentially vulnerable locations not covered by a track recording vehicle, and implement the identified measures, as appropriate (paragraph 111c).

- 3 *The purpose of this recommendation is to ensure that Network Rail auditors are aware of findings from previous relevant audits to determine whether appropriate action has been taken and to enable them to understand the reasons why issues have recurred after they had been reported as closed.*

Network Rail should ensure that its procedures for planning audits are amended to include a requirement for those undertaking audits of infrastructure maintenance activities to include as an input to the development of the audit plan a review of the findings from previous relevant audits and action taken, irrespective of whether the associated action is open or closed (paragraph 112).

⁶ 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 Regulation 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 167 to 171) can be found on RAIB's web site www.raib.gov.uk

Appendices

Appendix A - Glossary of abbreviations and acronyms

IMDM	Infrastructure Maintenance Delivery Manager
OTDR	On-train data recorder
PDR	Plan, Do and Review meeting
RAIB	Rail Accident Investigation Branch
SWT	South West Trains
TEF	Track Engineering Form
TRV	Track recording vehicle
WAIF	Work arising instruction form

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.

Ballast	Crushed stone, used to support track both vertically and laterally.*
Baseplate	A steel support for flat bottom rails to hold the rails within gauge.
Bearer	A wooden or concrete beam used to support the track.*
Bogie	A metal frame equipped with two or three wheel sets and able to rotate freely in plan, used in pairs under rail vehicles to improve ride quality and better distribute forces to the track.*
Bull Head Rail	The former standard rail section in Britain. It has a rail head and rail foot that are similarly shaped.*
Chain	A unit of length, being 66 feet or 22 yards (approximately 20117 mm). There are 80 chains in one mile.*
Chair	A cast or fabricated support for Bull Head rail.*
Dynamic (widening the) track gauge	The gauge of the track, measured as a train passes over it. It of can be estimated by applying a predefined load to the gauge faces of the rails to force them apart, and measuring the resulting displacement.*
Diesel electric multiple unit	A train whose source of power is an integral diesel engine and whose transmission is electrical, typically a generator and motor pair. It can consist of one or more vehicles with a driving cab at the two extremities.*
Ellipse (database)	Network Rail system to manage track maintenance activities.
Flat bottom rail	A rail section having a flat based rail Foot or flange.*
Gauge corner	The curved profile of the rail head between running surface and running edge*
Jointed Rail	Rail constructed from lengths shorter than 36.576m (120 feet) drilled with bolt holes and intended to be connected together using fish plated rail joints allowing the rail to freely expand.*
Keys	A shaped wedge of spring steel, oak or teak that secures a Bull Head Rail in a Chair*
Plan-Do-Review Meeting	A weekly meeting involving the Track Section Manager and his/her staff to review work undertaken, consider new and existing faults and plan remedial actions.
Possession	A period of time during which one or more tracks are blocked to trains to permit work to be safely carried out on or near the line.*

Route Availability	A number which describes the effective loading a rail vehicle applies to the track, ranging from 1 (least) to 10 (most). The Route Availability of a rail vehicle must not exceed the lowest Route Availability value of any structure along its journey.*
Running band	The visible contact or wear band between the wheel and rail head. Dynamic gauge issues may be identified with the running band seen close to the gauge corner.
Tie bar	An adjustable metal bar normally constructed with an insulated section in the middle, fixed between running rails to restore and maintain track gauge.*
Track circuit block	A signalling system where the line is proved clear to the end of the overlap beyond the next signal using track circuits or axle counters.*
Track Engineering Form (TEF)	Form submitted by maintenance staff to report faults and repeat faults for submission onto the Ellipse database.
Track Recording Vehicle	A passenger coach converted to be used as a means of gathering track coach/train geometry data automatically, or the train containing such a vehicle which runs regularly over all lines on the network.*
Twist	A rapid change in the level of the two rails relative to one another. Twist is calculated by measuring the cross-level at two points a short distance apart, and then expressing the difference as a 1 in x gradient over the interval.
Walk out report	Report generated by the Ellipse system to assist supervisors conducting a track inspection in assessing the current workload shown on the system against the actual condition of the track during their assessment.
Work Arising Instruction Form (WAIF)	Form used to generate new work or update work already recorded on the Ellipse system.

Appendix C - Key standards current at the time

NR/L2/TRK/001	Track Inspection and Maintenance of permanent way.
NR/SP/TRK/029	Wooden sleepers and longitudinal timbers
NR/L3/TRK/002/F24	Changing sleepers
NR/SP/TRK102	Track construction standards
NR/L3/MTC/MC0176/02	Ellipse handbook
NR/L3/TRK/PL0175	Maintenance Planning Handbook
NR/L3/TRK/002/A01	Track patrol v.4
NR/SP/CTM/011	Competence and Training in Track Engineering.
NR/L3/TRK/003	Track Inspection Handbook
NR/L3/TRK/002/A02	Track Inspection-Supervisor v.3
NR/L3/TRK/002/A03	Track Inspection –Engineer v.2
NR/L3/TRK/1011	Management of permanent way inspections.
NR/L3/TRK/1015	Management of patrolling activities.
NR/L3/TRK/002/C01	Fit and remove tie bars
NR/L2/TRK/038 V5.	Track geometry management of recording and action to be taken.
NR/L3/TRK/1013	Maintenance of track assets

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