



Rail Accident Investigation Branch

Rail Accident Report



**Fatal accident at Gipsy Lane footpath crossing,
Needham Market, Suffolk
24 August 2011**

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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Fatal accident at Gypsy Lane footpath crossing, Needham Market, Suffolk, 24 August 2011

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Summary

At about 13:52 hrs on 24 August 2011, a pedestrian was struck and fatally injured by a train on Gypsy Lane footpath crossing, near Needham Market in Suffolk. The train driver said that he had seen a person on the crossing, on or near to the adjacent line, as the train approached and that when the train's warning horn was sounded the pedestrian continued to cross and was struck.

Although it is not possible to be certain why the pedestrian continued to cross, the RAIB considers that she either did not see the approaching train, she misjudged the speed of the train, or she believed that the train was approaching her on the line she was standing on.

The RAIB has made four recommendations to Network Rail. These relate to improving the safety of pedestrians crossing the railway at Gypsy Lane, making sure level crossing data is collected accurately and consistently, developing guidance on short-term mitigation measures at level crossings that have insufficient sighting or warning of trains, and making enhancements to the cost-benefit tool that is used to assess level crossing risk mitigation measures.

Introduction

Preface

- 1 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.
- 2 The RAIB does not establish blame or liability, or carry out prosecutions.

Key definitions

- 3 All dimensions and speeds in this report are given in metric units, except speed and locations which are given in imperial units, in accordance with normal railway practice. Where appropriate the equivalent metric value is also given.
- 4 The up direction refers to trains travelling towards London Liverpool Street. The down direction refers to trains travelling towards Norwich.
- 5 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. Footnotes are used where a brief explanation of an element of the main text is needed.

The accident

Summary of the accident

- 6 At about 13:52 hrs on 24 August 2011, train 1P28, the 12:30 hrs service from London Liverpool Street to Norwich, struck a pedestrian on Gipsy Lane footpath crossing (figure 1).
- 7 The pedestrian was fatally injured in the accident.

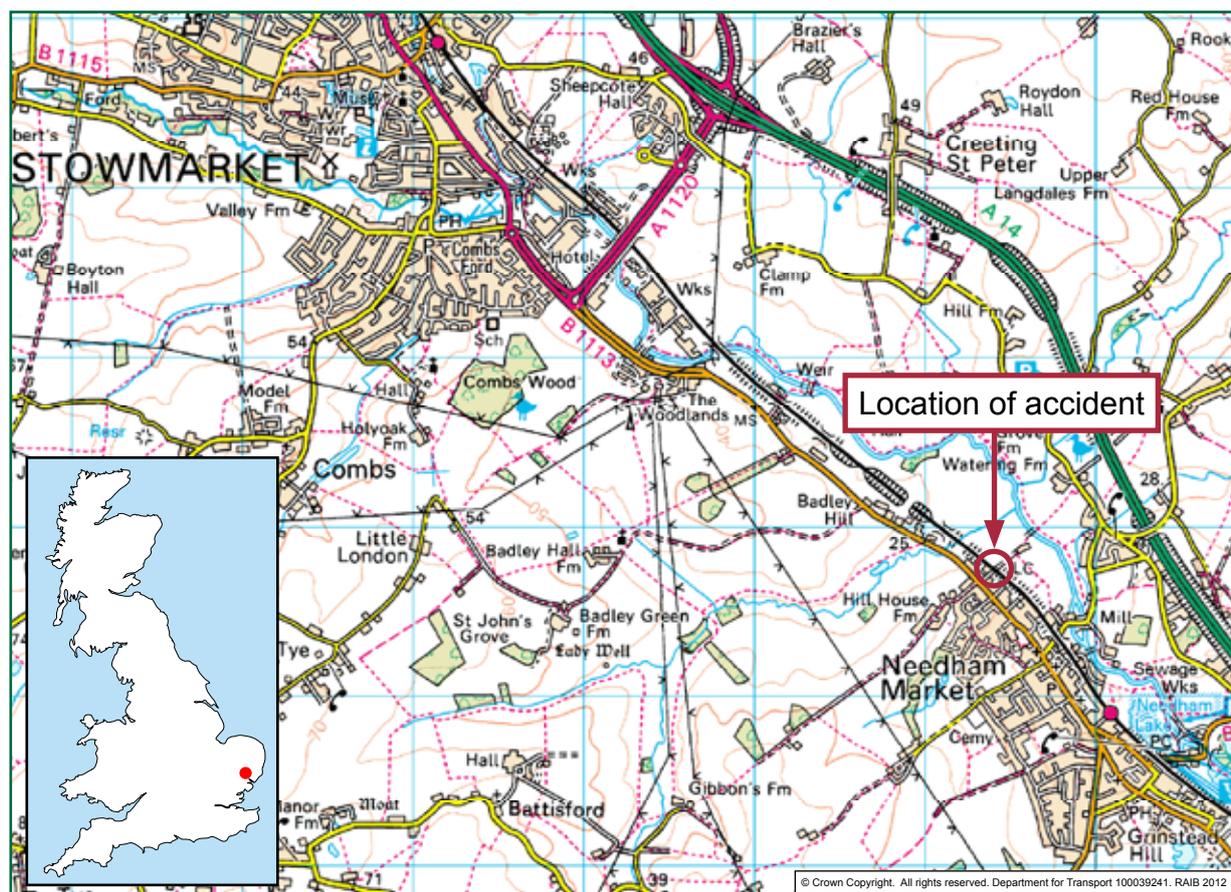


Figure 1: Extract from Ordnance Survey map showing location of accident

Context

Location

- 8 Gipsy Lane footpath crossing is located at 77 miles 64 chains¹ from London Liverpool Street station, on the northern outskirts of Needham Market, Suffolk. A residential area is located on one side of the crossing, and farmland on the other (figure 2).
- 9 The general layout of the crossing and key dimensions are given in figure 3. There are two railway tracks at the crossing and the maximum permitted speed for trains travelling in either direction is 100 mph (161 km/h).

¹ There are 80 chains in one mile. A chain is 22 yards (approximately 20 metres).



Figure 2: Overview of Gipsy Lane footpath crossing and its immediate surroundings (courtesy of Google Earth)

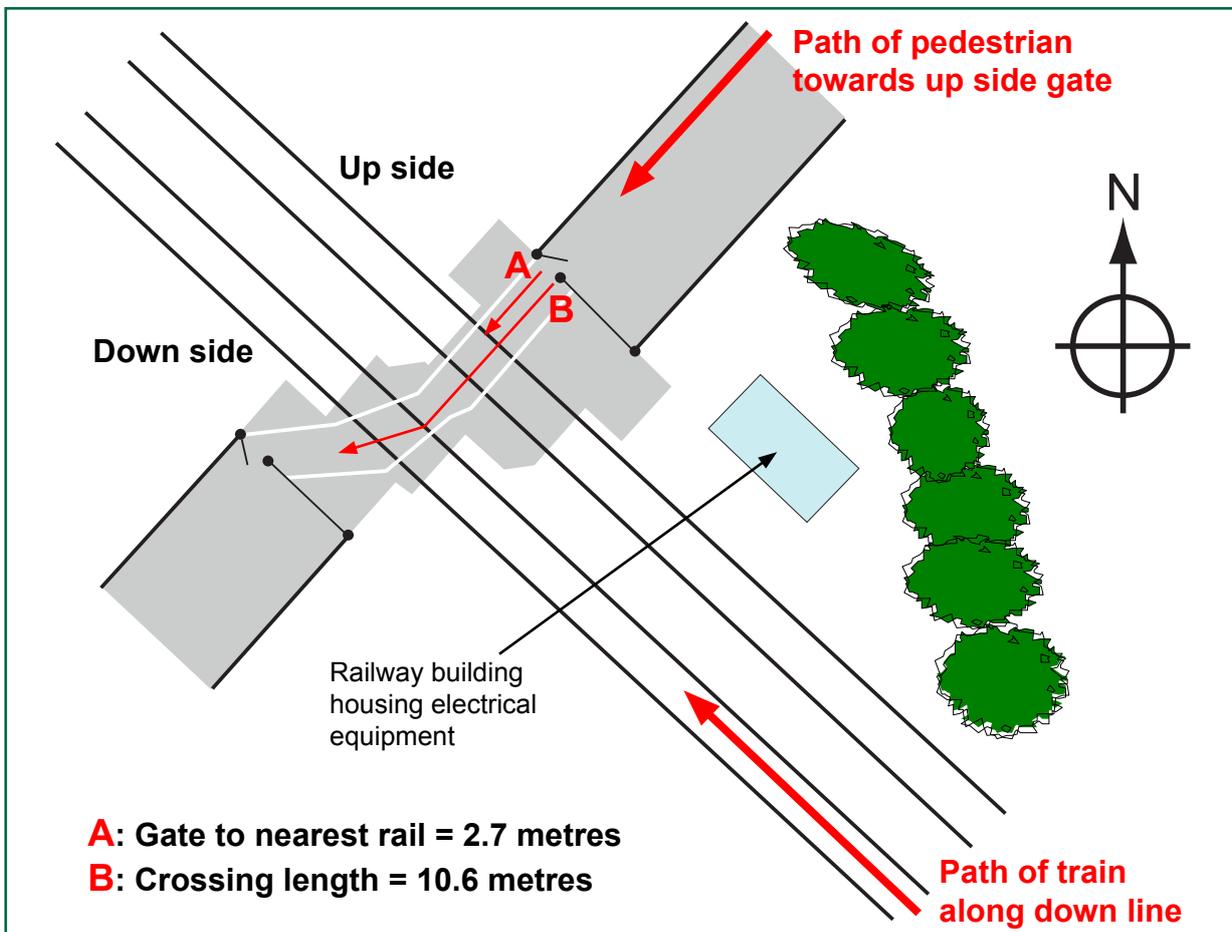


Figure 3: Layout of Gipsy Lane footpath crossing

- 10 Pedestrians have a restricted view of trains approaching along the down line (ie from the London direction) due to line curvature and seasonal vegetation growth. For this reason, a *whistle board* is provided to warn pedestrians of an approaching down train. This is located 396 metres from the crossing.

Organisations involved

- 11 Network Rail is the owner and maintainer of the infrastructure at Gipsy Lane footpath crossing. It also employed the staff who undertook site visits to gather data about the crossing for periodic risk assessments and the staff responsible for managing level crossing risk.
- 12 National Express East Anglia operated train 1P28 and employed the driver of the train. From 5 February 2012, Abellio Transport Holdings, trading as Greater Anglia, took over the rail franchise from National Express.
- 13 Network Rail, National Express East Anglia and Greater Anglia freely co-operated with the RAIB investigation.

Train involved

- 14 Train 1P28 was formed of a *Driving Van Trailer (DVT)* leading a *rake* of ten Mark 3 coaches being powered by a class 90 locomotive attached to the rear of the train (figure 4).
- 15 The RAIB found no evidence to link the condition of the train with the cause of the accident.



Figure 4: A DVT leading a train formed of Mark 3 coaching stock. A class 90 locomotive is attached at the rear of the formation (not the train involved or the location of accident) (image courtesy of Kev Gregory/Railway Herald)



Figure 5: Sign at the crossing gate (view taken from the up side of the crossing - the side from which the pedestrian approached)

Level crossing infrastructure

- 16 The crossing was fitted with wooden gates on both approaches which opened outwards (ie away from the railway). Signs instructing pedestrians to stop, look, listen and beware of approaching trains were attached to each gate (figure 5).
- 17 The crossing surface comprised rubber panels and asphalt strips. The condition of the crossing surface was not a factor in the accident.

External circumstances

- 18 Around the time of the accident the weather was overcast and dry. Weather data obtained by the RAIB from a weather station located approximately 8 miles (13 km) from Needham Market indicated visibility was clear. There was a gentle breeze from a southerly direction of around 9 mph (4 m/s). This would not have adversely affected the audibility of the warning horn of train 1P28 approaching along the down line (in a similar direction to the southerly breeze).

Events preceding the accident

- 19 Train 1P28 departed from London Liverpool Street at 12:30 hrs and from Ipswich at 13:44 hrs.
- 20 The driver of train 1P28 stated that he sounded the train's warning horn shortly after passing through Needham Market station, at the whistle board associated with Gipsy Lane footpath crossing (paragraph 10).

Events during the accident

- 21 As the train approached Gipsy Lane footpath crossing it was travelling at 97 mph (156 km/h), slightly under the maximum permitted speed of 100 mph (161 km/h). The driver stated that as his train rounded a left-hand curve he saw a pedestrian on the crossing in the vicinity of the up line (ie the line adjacent to the one on which train 1P28 was travelling).
- 22 The driver stated that he sounded the train's warning horn to alert the pedestrian of the train's approach, but rather than stopping or moving back, the pedestrian began to run across the crossing in front of the train. When the train was about two seconds (around 88 metres) from the crossing the driver realised the pedestrian was attempting to out-run the train and he applied the train's brakes.
- 23 The train struck the pedestrian before she was able to move clear of the track. She suffered fatal injuries.

Events following the accident

- 24 The train stopped around 960 metres beyond the crossing. The train driver contacted the signaller to report the accident, and the emergency services were called.

The investigation

Sources of evidence

25 The following sources of evidence were used:

- witness statements;
- data from the train's On Train Data Recorder (OTDR);
- site photographs and measurements;
- weather reports and observations at the site;
- Network Rail's file on the level crossing;
- a review of previous reported occurrences at the crossing; and
- a review of previous RAIB investigations that had relevance to this accident.

Key facts and analysis

Background information

The pedestrian

26 The pedestrian was 82 years old and was a resident in a care home located around 10 miles from Needham Market. However, she used Gipsy Lane crossing most weekdays as part of a journey, by bus and on foot, to visit a farm some two miles north of the railway. Her eyesight was classed as poor by staff at her care home and, although she needed to wear corrective glasses, they had been broken some time before the accident, and she had not replaced them. The RAIB has been unable to locate details of the pedestrian's eyesight prescription to confirm her visual acuity. The pedestrian had visited an audiologist for a hearing test in the weeks leading up to the accident and was advised that a hearing aid would improve her hearing. The audiologist had diagnosed that she was suffering from 'moderate hearing loss, average for her age'. However, since the accident he has stated the view that, theoretically, she would have been able to hear a train's warning horn and that her condition was more likely to affect her ability to hear another person in a conversation, such as on a telephone. At the time of the accident she had not purchased a hearing aid. The pedestrian was deemed by staff at the care home to be able to look after herself, and they had no concerns over her ability to travel to and from the farm unassisted. Witness evidence (independent of the care home staff) confirmed that the pedestrian appeared to be able to get around on her own without obvious difficulty.

History of Gipsy Lane footpath crossing

- 27 Gipsy Lane crossing was created when the railway was built, under the Ipswich and Bury St Edmunds Railway Act of 1845. Until 2006, the crossing functioned as a User Worked Crossing² (UWC) with vehicular gates and telephones (for use by road vehicle users).
- 28 In November 1993 there was a collision between a train and a car on the crossing. The car driver was killed in the accident. The investigation into the 1993 accident found that the car driver had not called the signaller for permission to cross as was required. There was a collision between a train and a van on the crossing in December 1998. The rail industry investigation into the accident identified that the van driver had contacted the signaller for permission to cross and that the van driver may have mistakenly believed that this permission also applied to his return trip over the crossing. It is likely that the van driver had stopped his vehicle on the crossing, whilst either opening or closing one of the gates. Fortunately he was out of the vehicle when it was struck by the train.
- 29 At some point between January 1999 and June 2002 whistle boards were installed on both approaches to Gipsy Lane crossing after Railtrack (the predecessor to Network Rail) identified that sighting of trains approaching on the down line was difficult for pedestrians (who were not required to use the telephone) because of track curvature and seasonal vegetation growth.

² UWCs are level crossings where railways intersect with private roads, or minor public roads, where road users are responsible for operating gates or barriers when crossing the railway. In some cases there is no additional equipment to warn of approaching trains, and the user has to look, listen and decide for themselves whether it is safe to cross. In other cases there are telephones and/or warning lights provided to assist users.

- 30 In 2002, Railtrack identified several UWCs (including Gipsy Lane) to be equipped with Miniature Stop Lights³ (MSLs). Work to design and install MSLs proceeded slowly over the next four years and eventually stalled because of problems with the contractual arrangements between Network Rail and its contractors and problems with funding the project.
- 31 In 2003 the crossing surface at Gipsy Lane was renewed. However, the new wooden panels warped, and in September 2003 they were replaced with rubberised panels. The method by which these panels were installed created a staggered crossing, so the crossing gates were relocated longitudinally to provide a straighter route for pedestrians using the footpath element of the crossing.
- 32 In 2006, the sole *authorised user* of Gipsy Lane UWC relinquished his right to use the crossing. Network Rail closed the crossing to vehicles on 30 June 2006 and the telephones were decommissioned sometime between June and November 2006. Following this Gipsy Lane was, and remains, solely a footpath crossing for public users, although the gates remained in place to allow access for railway maintenance vehicles.

Network Rail's procedures for managing level crossing risk

- 33 Network Rail's operations manual includes its process and requirements for level crossing risk assessment and mitigation. The operations manual identifies the roles and responsibilities of those persons involved in this process:
- Route General Managers (RGM) are responsible for the management of risk reduction at level crossings.
 - Operations Risk Advisors (ORA) ensure that all completed level crossing risk assessments are reviewed by a competent person; they also review and approve proposals for level crossing closures and review risk reduction and mitigation recommendations proposed by the Operations Risk Control Co-ordinators (ORCC).
 - Operations Managers are responsible for appointing trained personnel to carry out level crossing site visits, including a census at the level crossing and review recommendations on risk reduction and mitigation proposed by the ORCCs.
 - ORCCs are responsible for:
 - managing the programme of level crossing risk assessment;
 - identifying and analysing risk mitigation measures;
 - providing advice on level crossing matters; and
 - maintaining level crossing records.
 - Mobile Operations Managers (MOM) are required to complete level crossing site visits to gather data and to complete a census in accordance with an agreed programme; this information is used as an input to level crossing risk assessments.

³ MSLs consist of red and green lights for road users, with the red light being displayed when a train approaches, automatically triggered by the train. They are sometimes referred to as Miniature Warning Lights.

- 34 Network Rail's operations manual requires that a risk assessment of each footpath crossing on its network is carried out at least every three years. Additional risk assessments are required when there has been an accident or incident (such as a near-miss) or where a concern about the level crossing has been raised by Network Rail, a train operating company or relevant authority (such as a local council or highways authority).
- 35 Network Rail uses the *All Level Crossing Risk Model (ALCRM)* as part of the level crossing risk assessment process. The ALCRM provides an estimate of risk which it classifies in the following ways:
- individual risk of fatality (identified by a letter A (high) to M (low)), which relates to the risk of death for an individual using the crossing on a frequent basis (500 times per year); and
 - collective risk (identified by a number 1 (high) to 13 (low)), which relates to the total risk generated by the crossing. This takes into account the overall risk of death and injury for crossing users, train crew and passengers.
- 36 Factors which can influence the predicted risk include the number of trains, the number and type of crossing users, poor sighting and glare from the sun at certain times of day. Other factors that are mandated for consideration in a qualitative way are:
- previous occurrences, near-misses and accidents; and
 - level of misuse.
- 37 Once an ALCRM assessment has been undertaken, Network Rail uses a web-based system known as the Level Crossing Risk Management Toolkit (LXRMTK)⁴ to identify relevant factors that may influence human behaviour and possible risk mitigation measures. It provides a listing of options for consideration and indicative costs for each one. The list can be filtered to include only those measures that are relevant to specific crossing types. The principal factors that should be considered when assessing the potential benefits of a risk mitigation proposal are the effectiveness and longevity of risk reduction against the cost of the measure proposed.

Guidance on level crossings provided by the Office of Rail Regulation

- 38 Guidance on all types of level crossing is provided by the Office of Rail Regulation (ORR)⁵, the independent safety and economic regulator for Britain's railways. The guidance was originally created by Her Majesty's Railway Inspectorate when it was part of the Health and Safety Executive. The following extracts from this guidance are relevant to the accident at Gipsy Lane crossing on 24 August 2011. The paragraph numbers [in square brackets] refer to the relevant paragraph in the guidance document:
- *Users are expected to use reasonable vigilance to satisfy themselves that no trains are approaching before they start to cross the line. They should cross quickly and remain alert while crossing. Users should have sufficient time from first seeing, or being warned of an approaching train, to cross safely [paragraph 138].*

⁴ The Level Crossing Risk Management Toolkit is managed by RSSB and is available to view at www.lxrmtk.com.

⁵ Level crossings: A guide for managers, designers and operators. Available from www.rail-reg.gov.uk.

- A sign should be displayed at the decision point⁶ facing the user on either side of each type of crossing explaining the way to proceed safely over the crossing [paragraph 142]. The decision point is a point where guidance on crossing safely is visible and at which a decision to cross or wait can be made in safety. For footpath crossings, this should be not less than 2 metres from the nearest running rails [Appendix E].
- The warning time should be greater than the time required by users to cross between the decision points at either end of a crossing [paragraph 147].
- A speed of 1.2 m/s should be used where the surface is at or near to rail level and 1m/s where the surface is at the standard profile of the ballast. The calculated time in traversing the crossing should be increased to take account of foreseeable circumstances such as impaired mobility of users, numbers of prams and bicycles or where there is a slope or step up from the decision point [paragraph 148]. Network Rail's practice is to increase traverse time by 50% where there are a 'higher than usual' number of vulnerable people⁷ using the crossing, although Network Rail does not clarify what constitutes a 'higher than usual' number.
- Where the warning time is insufficient, additional protective equipment may be provided as follows:
 - (a) audible warnings from trains – whistle boards positioned not more than 400 metres from the crossing [paragraph 149].

39 In August 2011⁸, the ORR updated the guidance on level crossings, publishing 'a guide for managers designers and operators'. One of the principal changes was an amendment to the section on audible warnings provided by whistle boards. The new guidance states [at paragraph 162] that '*where the warning time is insufficient, additional protective equipment should be provided and may include audible warnings of trains (preferably generated at the crossing itself). Where train speeds are low and the service infrequent, whistle boards positioned not more than 400 m from the crossing may help give warning of a train's approach.*'

Warning of approaching down line trains for pedestrians at Gipsy Lane footpath crossing

- 40 The pedestrian who was struck was crossing from the up side gate to the down side. The train was travelling on the down line (figure 3).
- 41 A sign is provided on the up side gate, which instructs users to stop, look, listen and beware of trains. Measurements taken at the crossing recorded that the gate and sign were positioned 2.7 metres from the nearest rail (figure 5).

⁶ The guidance defines the decision point as 'a point where guidance on crossing safely is visible and at which a decision to cross or wait can be made in safety'. For footpath crossings the guidance indicates this should be a minimum of two metres from the nearest rail where the line speed is 100 mph or less and a minimum of 3 metres from the nearest rail where the line speed is greater than 100 mph.

⁷ Network Rail's guidance refers to children, elderly, disabled, vision impaired, pushchair users and those with learning difficulties as being examples of vulnerable people.

⁸ The guidance was also re-issued in December 2011.

- 42 The view from the up side gate towards trains approaching on the down line is restricted by line curvature and vegetation. On the day of the accident the *sighting distance*⁹ was recorded as 348 metres using the up side gate as the decision point - see figure 6. In June 2011, Network Rail had assessed that the required sighting distance needed to be a minimum of 448 metres if users were to rely on sighting alone when judging whether it was safe to cross (at this time vulnerable crossing users (see footnote 7) had not been identified and no additional traverse time had been allowed for).



Figure 6: Sighting of down line trains from the up side gate

- 43 A whistle board is provided 396 metres before the crossing for trains approaching in the down direction. When passing a whistle board train drivers are required to sound the train's warning horn between 07:00 hrs and 23:00 hrs. During the period from 23:00 hrs to 07:00 hrs train drivers are not required to sound the warning horn when passing a whistle board except in an emergency, or when anyone is seen on or near the line. In 2011, the ORA for Network Rail's Anglia route commissioned an audit of all whistle boards associated with level crossings on the route. The purpose of the audit was to identify level crossings with whistle boards that were not providing an effective warning to crossing users. In May 2011, the ORCC for the Anglia route identified that the whistle board on the down line approaching Gypsy Lane did not provide sufficient warning to crossing users (based on data gathered in May 2009). The optimum position of the whistle board was calculated as greater than 400 metres from the crossing, which exceeds the maximum value recommended in ORR's guidance on level crossings (paragraph 38).

⁹ Network Rail considers the sighting distance to be the point at which the majority of the front of the train (including the headlight) is visible to the crossing user.

- 44 In June 2011, a Mobile Operations Manager (MOM) undertook a site visit and quick census¹⁰ of the number and types of persons using Gipsy Lane footpath crossing. The data from this was entered into the ALCRM. The key data was:
- Traverse distance: 10.6 metres using the decision point as the up side gate, located 2.7 metres from the nearest rail. The use of this location is consistent with ORR guidance (paragraph 38); the sign indicating how to use the crossing safely was visible at a point where the crossing user could also view trains approaching from either direction.
 - Traverse time: 10 seconds (using a chart provided as an appendix on the data collection form). No vulnerable users were seen during the census and no additional traverse time was added.
 - Sighting distance of trains approaching along the down line: 390 metres (the MOM used a measuring wheel to establish the distance). The MOM recorded that vegetation restricted the sighting distance on the down line.
 - Required sighting distance on the down line, based on the traverse time and line speed: 448 metres. The available sighting distance at Gipsy Lane footpath crossing was therefore deficient by 58 metres.
 - The location of the whistle board on the down line: 391 metres from the crossing (following the accident it was established that the whistle board was actually 396 metres from the crossing).

Walking speed of crossing users

- 45 Network Rail has used walking speeds of between 1.1 m/s and 1.2 m/s when calculating crossing traverse time. Where vulnerable users have been identified (footnote 7) the base traverse time is increased by 50% (equivalent to about 0.8 m/s). This is broadly consistent with guidance issued by the ORR (paragraph 38) and with the findings from research into pedestrian road crossing use (discussed at paragraphs 48 and 49). The provision for a 50% increase in traverse time originates from the mid-1990s. Railway Group Standard GO/OT0011 'Protection at footpath and bridleway crossings (issue 1 dated October 1993 but withdrawn on 2 October 2004)) stated at paragraph 29:
- 'The calculated crossing time should be increased by 50% if the crossing is frequently used by persons with 'buggy' type push chairs which have swivel wheels and there is a risk of the small wheels becoming caught between the crossing timbers and running rail'.
- 46 The Group Standard therefore implicitly established the principle of increasing traverse time in the presence of vulnerable users, although at this point the term 'vulnerable users' was not used.
- 47 United States Transportation Research Board research¹¹ into pedestrian walking speeds at road crossings undertaken in 1996 identified appropriate design values for road crossings based on the research findings to be:
- for younger pedestrians (less than 65 years old) a crossing speed of 1.22 m/s; and
 - for older pedestrians (65+ years old) a crossing speed of 0.91 m/s.

¹⁰ Network Rail's operations manual describes a 'quick census' as being of 30-60 minutes duration and undertaken between 09:30 hrs and 16:30 hrs on a Monday to Friday.

¹¹ Research abstract available at www.trb.org.

- 48 In 2005, the Department for Transport (DfT) published a traffic advisory leaflet on pedestrian facilities at signal-controlled junctions¹². Part 4 of this publication indicates that pedestrian crossing times are based on 85% of pedestrians having a walking speed of 1.2 m/s. Where crossing users include the young or elderly or where the crossing is close to a school, 3 seconds is considered reasonable to be added to the crossing time where necessary.
- 49 More recent research¹³ to compare the walking speed in the United Kingdom's older population with the speed required to utilise road pedestrian crossings suggests that for persons aged 65 years and older, the average walking speed was 0.9 m/s in men and 0.8 m/s in women.
- 50 There are some important differences between road and rail crossings that would suggest a conservative estimate of traverse time for vulnerable users is more important for the railway:
- road vehicles, in many cases, are able to slow down, stop or swerve to avoid a pedestrian on a road crossing;
 - generally, the speed of approaching road vehicles is much slower than that of an approaching train; and
 - generally, road surfaces are less variable than level crossing surfaces.

The operation of train 1P28

- 51 The RAIB has reviewed the data from the train's OTDR, video images¹⁴ of a train approaching Gipsy Lane footpath crossing (from the train driving cab and from the crossing), and statements from witnesses who heard the train as it approached the crossing immediately before the accident. The video showed that Gipsy Lane footpath crossing became visible about 8 seconds before the train reached the crossing. The OTDR from train 1P28 recorded that, at this point, the train was travelling at around 97 mph (156 km/h). The train's OTDR data also recorded that the train driver applied the train's brakes around 7 seconds after Gipsy Lane footpath crossing was first visible.
- 52 The train driver's first reaction to seeing the pedestrian on the crossing was to sound the train's warning horn¹⁵. This is a requirement of the railway rulebook¹⁶, (module TW1 section 10.2). The railway rulebook does not contain any rule that states that train drivers must first apply the emergency brake if they see anyone on the line at a level crossing. It is left to the train driver's own judgement to decide at what point the emergency brake should be applied. The driver stated that he was not expecting the pedestrian to continue to cross; he expected the pedestrian to stop, or step back (see paragraph 59). In many situations, sounding the train's warning horn in preference to applying the brakes is instinctive and provides an immediate warning to the pedestrian of the train's approach.

¹² Available at <http://www.dft.gov.uk/publications/tal-5-05/>.

¹³ Available at <http://ageing.oxfordjournals.org/content/early/2012/06/08/ageing.afs076.short?rss=1>.

¹⁴ The British Transport Police (BTP) undertook a train driving cab and level crossing video exercise following the accident.

¹⁵ The OTDR fitted to the DVT was not designed to record the operation of the train's warning horn. However, witnesses living near to Gipsy Lane footpath crossing recalled hearing a train warning horn shortly before the accident.

¹⁶ The modules of the railway rulebook are available at www.rgsonline.co.uk.

- 53 Published research¹⁷ indicates that reaction times vary from person to person and situation to situation. The first of the two references in footnote 17 makes a distinction between reaction times for expected hazards (0.5 seconds perception time, plus 0.2 seconds action time, ie move hand or foot to sound horn or apply brake), unexpected hazards (1 second perception time plus 0.2 seconds action time) and surprise hazards (1.2 seconds perception time plus 0.3 seconds action time). The research published by the Transport Research Laboratory examines road vehicle driver reaction times to various hazards and concludes that most road vehicle drivers will respond within 1.5 seconds of the appearance of a familiar but unexpected hazard. The same research also indicates that where a driver has a choice in their response (such as sound the warning horn or apply the brakes), this will increase the reaction time.
- 54 Analysis of the train's OTDR data indicated that had the train driver applied the train's brakes at the point he identified the pedestrian on the crossing (allowing for the driver's reaction time), rather than sounding the train's warning horn, the train would have arrived at the crossing approximately 0.5 seconds later than it actually did. Because it cannot be established at what speed the pedestrian was moving immediately prior to the train's arrival on the crossing, it is not possible to determine whether this additional time would have allowed the pedestrian to reach the other side of the crossing safely.
- 55 The sounding of the warning horn was an instinctive reaction by the driver to the situation ahead of him, and provided an immediate opportunity to alert the pedestrian.
- 56 The RAIB has seen similar reactions by pedestrians in other level crossing fatal accidents (paragraph 64). It is unfortunate that in such circumstances the pedestrian will sometimes respond by attempting to cross before the train arrives, rather than to stop or turn back (paragraph 62 identifies some reasons why this may be).

Identification of the immediate cause¹⁸

57 **The immediate cause of the accident was that the pedestrian continued to cross when she became aware of the approaching train.**

- 58 The train driver's evidence was that the pedestrian was already on the crossing, on or near to the up line, when the crossing first came into his view as the train rounded a bend (see paragraph 21). This would put the pedestrian around 2.7 metres from the up side gate (see paragraph 40). At a nominal walking speed of 1.2 metres/second she would have passed through the up side gate 2 to 3 seconds before the train came into view. The train driver's evidence was that the warning horn was sounded at the whistle board (around 1 to 2 seconds before the train would be visible from the crossing). It is therefore likely that the pedestrian had made her decision to cross before the train horn was sounded.

¹⁷ See <http://www.visualexpert.com/Resources/reactiontime.html> and research published by the Transport Research Laboratory, http://www.trl.co.uk/online_store/reports_publications/trl_reports/cat_road_user_safety/report_driver_reaction_times_to_familiar_but_unexpected_events.htm.

¹⁸ The condition, event or behaviour that directly resulted in the occurrence.

- 59 Although she was not on the line on which the train was travelling, she was on or near to the adjacent up line. When the train driver sounded the train's warning horn he expected the pedestrian to stop, or to step back. The pedestrian's actions in starting to run suggest that she had become aware of the approaching train.
- 60 The RAIB was not able to establish with certainty exactly when the warning horn was operated as train 1P28 approached the crossing. The train driver said that the warning horn was operated at the whistle board approaching Gipsy Lane footpath crossing and again when the driver saw the pedestrian. The train data recorder fitted to the train was not designed to record the operation of the warning horn. Witnesses living close to Gipsy Lane footpath crossing recalled hearing a train horn shortly before the accident. It is not clear whether this was as the train was near the whistle board or when the train driver saw the pedestrian on the crossing. One witness recalled a train horn sounding "louder than normal". This is likely to have been the warning sounded by the driver when he became aware of the pedestrian on the crossing.

Identification of causal¹⁹ and contributory²⁰ factors

The actions of the pedestrian immediately before the accident

- 61 **The pedestrian moved from the adjacent line into the path of the train because she either did not see the approaching train, she misjudged the speed of the train, or she believed that the train was approaching her on the line she was standing on. This is a causal factor.**
- 62 Paragraphs 58 and 59 describe how the pedestrian moved into the path of the train as it approached Gipsy Lane crossing. It cannot be established with certainty why she did this. It may have been that she did not see the train because she was not wearing the glasses that she had originally been prescribed. It is also possible that she may have looked to her left first, without the train being in view, and then looked right. She may have then begun to cross and was not aware of the train approaching from her left until the driver sounded the horn.
- 63 It is also possible that she may have seen the train but misjudged its speed and believed she could get across to the other side by running. Information on the LXRMT website (footnote 4) indicates that the speeds at which trains travel, and the distance it takes for a train to stop, are underestimated by the general public. It asserts that features that may increase the likelihood of decision-making errors at level crossings are:
- Large objects appear to move more slowly than smaller objects travelling at the same speed.

¹⁹ Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

²⁰ 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.

- When looking head-on at an approaching train, the rate at which the train's size on the retina increases is slow and it is not until the train is much closer (and therefore larger in size on the retina) that it becomes easier to determine its actual speed and distance accurately. This distance (referred to as the looming distance²¹) under good daylight conditions is around 128 metres to 69 metres. Looming distances will be shorter in low contrast conditions such as fog and dim light.
 - Crossing users often make the mistake of using their knowledge of road vehicle movement for estimating train speed, distance travelled over time and potential stopping distances.
- 64 The RAIB has undertaken other investigations²² of fatal accidents – at Mexico footpath crossing (RAIB report 10/2012) and Johnson's footpath crossing (investigation on-going) where the reaction of a pedestrian to the train's warning horn was to move from a position of safety into the path of a train.
- 65 It is also possible that the pedestrian believed that the train was approaching on the up line (the same line that she was either approaching or crossing) and that she needed to get out of its way. The curvature of the line would have made it more difficult for the pedestrian to identify on which line the train was approaching.
- 66 However, although the pedestrian was familiar with the crossing, her level of attention and any distractions affecting her immediately before the accident are unknown. It is possible, although not certain, that the pedestrian was familiar with the direction of trains on the two tracks.
- 67 The pedestrian had been prescribed spectacles to correct short-sightedness, but was not wearing them (paragraph 26). This may have had a significant effect on her ability to see the approaching train and to judge its speed and position.

Warning of approaching trains

- 68 For vulnerable users, the warning of an approaching down line train was not sufficient to enable them to use the crossing safely. This was a causal factor.**

Visibility of approaching trains

- 69 The sighting distance for down trains at Gipsy Lane crossing was measured by the RAIB to be 348 metres before the vegetation was cut back following the accident (paragraph 42). This measurement was taken from the up side gate. The maximum permitted speed for trains on the down line is 100 mph (161 km/h). A train travelling at that speed (equivalent to 44.7 metres/second) would first come into view around 7.8 seconds before it arrived at the crossing. This is confirmed by video evidence obtained by the BTP (footnote 14).

²¹ Green, M. et al (2008). *Forensic Vision: With applications to highway safety*. Tucson: Lawyers and Judges publishing.

²² RAIB investigation reports and a list of current investigations can be found at www.raib.gov.uk.

- 70 In June 2011, the Network Rail MOM recorded a traverse distance of 10.6 metres from the up side gate and calculated a traverse time of 11.89 seconds. An appendix to the data collection form showed that a traverse distance of 10.6 metres equated to a traverse time of 10 seconds. The ORCC spotted this discrepancy, amended the form and entered 10 seconds as the traverse time in the ALCRM. The traverse time exceeded the sighting time (7.8 seconds) and therefore the sighting time was insufficient for all types of user at the crossing for trains approaching in the down direction.

Audibility of approaching trains

- 71 That insufficient sighting distance was available at Gipsy Lane had been known since at least 2002 (paragraph 29) and a whistle board was situated 396 metres on the approach to the crossing to give crossing users an additional warning of an approaching train. At 100 mph (161 km/h) a train would arrive at the crossing around 8.9 seconds after the sounding of the train's horn (if the train driver sounded the horn in the immediate vicinity of the whistle board). This was less than the required traverse time of 10 seconds (paragraph 70). However, the RAIB understands that it is not uncommon for train drivers to sound the warning horn just before the train passes the whistle board, which may slightly increase the warning time available for crossing users, provided that the sound of the horn is audible at the crossing.
- 72 In June 2011, Network Rail calculated that the required traverse time at Gipsy Lane was at least 15 seconds when allowance was made for vulnerable users (paragraph 94). The warning horn sounded by approaching trains provided around 9 seconds warning of the approach of a train on the down line.
- 73 From a pedestrian's perspective, a train would come into view around 1 to 2 seconds after the warning horn had been sounded. The driver of train 1P28 stated that when the crossing came into view the pedestrian was on or near to the up line. This meant that when the driver sounded the warning horn as the train passed the whistle board, the pedestrian had probably already made her decision to cross (paragraph 58). Once on the crossing it is possible, in addition to the factors discussed at paragraphs 62 to 65, that the pedestrian's level of alertness to approaching trains was lower than it was prior to making her decision to cross.

Risk management at Gipsy Lane footpath crossing

Risk management until December 2010

- 74 In the period up to December 2010 no action was taken to address the risk to vulnerable users. This was a causal factor in the accident.**
- 75 The level crossing file for Gipsy Lane footpath crossing contains records relating to site visits and risk assessments at the crossing dating from November 2003 and general correspondence dating from 1990. It is clear from the information in the file that sighting for users of the footpath crossing at Gipsy Lane had been a long-standing issue.

76 Whistle boards were installed sometime between January 1999 and June 2002 (paragraph 29) in response to general concerns with sighting distances for trains approaching on the down line. From the time of their installation until a whistle board audit was undertaken in 2011 (discussed at paragraph 84) the whistle boards were seen as mitigating the sub-standard sighting distance for down trains. Table 1 provides the different measurements of crossing length and whistle board location that have been recorded over the years. There are no records of the whistle boards having been moved since their installation. The inconsistent and often inaccurate data meant that assessing the effectiveness of the warning provided by the down line whistle board was difficult.

Crossing length (metres)	Whistle board location (metres)	Census	Date data was collected	Data collected by
10.66	392 metres	No data recorded	Crossing inspection on 23-11-2003	Level crossing inspector
10.36	775 metres	No data recorded	Crossing inspection on 19-03-2004	Level crossing inspector
8.5	440 metres	60 minute 'quick census' – adult pedestrians and cycle users once or twice per day, Child pedestrians once per week	High-risk visit on 10-06-2008	ORCC
9.5	372 metres	Estimated census – one or two pedestrians per day	Data collection on 19-05-2009	MOM
9.3	391 metres	Not undertaken	Sighting time check on 26-06-2009	MOM
10.6	391 metres	40 minute 'quick census' – six adult pedestrians	Data collection on 15-06-2011	MOM

Table 1: Sample of data gathered at Gipsy Lane footpath crossing over the years

77 There are a number of possible reasons why the information on the level crossing file was inaccurate and inconsistent:

- the point at which each data collector takes measurements may vary from person to person – thus the calculated sighting, warning and traverse times may also vary;
- measurements may be taken using laser distance rangefinders, tape measures or using known reference points giving rise to slightly different, inconsistent readings;
- data collection site visits at user worked and footpath crossing typically take place three-yearly, which means that it is not uncommon for site visits to be completed by different individuals;
- the training received by those appointed to undertake level crossing assessments was variable;
- inconsistent data was often not challenged and the individuals not given guidance on where errors were being made;

- the approach to gathering level crossing data had changed over the years with subtle changes to standards and forms occasionally leading to different interpretations by level crossing data collectors; and
 - there were problems within the Anglia route level crossing management team between 2006 and 2009 (see paragraph 82).
- 78 The RAIB has found no evidence that when the user worked crossing element of Gypsy Lane crossing was removed in 2006 (see paragraph 32), an assessment of the safety of the footpath element of the crossing was made, or was required. For example, the gates and signage could have been repositioned to shorten the length of the crossing (and thus the traverse time).
- 79 Network Rail's risk management process for level crossings requires a census of crossing usage to be undertaken. For footpath crossings, this is done every three years at the time of the data collection visit. It is permissible for the census to be estimated if no users are seen during the period of the site visit. Network Rail specifies that the census must be done on a weekday between the hours of 09:30 hrs and 16:30 hrs. Normally a 'quick' census is undertaken, typically for a period of 30 to 60 minutes. The number and type of user is recorded. For Gypsy Lane, the number of crossing users recorded during the quick census varied from one or two users, to six users. The use of the quick census is not always an effective means of gauging crossing usage, particularly where a crossing may see increased usage at weekends, or at other times outside of those prescribed by Network Rail. The RAIB has identified issues regarding the effectiveness of Network Rail's level crossing quick census in the following investigations²³:
- fatal accident at UWC no.451 (RAIB bulletin 07/2010);
 - fatal accident at Halkirk level crossing (RAIB report 16/2010);
 - collision between an articulated tanker and a train at Sewage Works Lane (RAIB report 14/2011); and
 - fatal accident at Mexico footpath crossing (RAIB report 10/2012).
- 80 Vulnerable users were seen using Gypsy Lane footpath crossing during censuses taken in August 2006 and June 2008 but not in the May 2009 census. Network Rail's risk management processes require that action is taken to address the risk if a 'higher than usual' number of vulnerable users are seen during a census and this has an effect on sighting or warning times. No definition is given of the meaning of the term 'higher than usual'.

²³ RAIB reports are available at: www.raib.gov.uk.

- 81 Recommendations were made by the ORCC in 2006 and 2008 for audible warning devices (sirens placed at the level crossing that sound a warning tone when a train is approaching) to be fitted at Gipsy Lane footpath crossing. The ORCC had recommended the installation of audible warning devices because although the UWC was now closed the footpath that remained was seen as being popular with dog-walkers and children and that sighting of trains was “impaired due to track curvature”. The RAIB could find no documentary or other evidence to indicate why the recommendation was not progressed. The most likely reasons why the audible warning devices were not installed are:
- Although at the time of the recommendation, the LXRMT indicated that the cost of fitting audible warning devices was around £10,000, Network Rail staff involved with the management of Gipsy Lane at that time considered that the actual costs would be nearer to £100,000 because equipment necessary to detect the approach of trains would have to be installed. Other factors which led to an incorrect assessment of the safety benefits and costs of installing the audible warning devices were:
 - the data on the level crossing file was inconsistent (paragraph 77);
 - no risk assessment was undertaken following closure of the user worked crossing element of the crossing in 2006 (paragraph 78); and
 - the level crossing team were falling behind with the processing of level crossing data (paragraph 82).
 - Audible warning devices would increase noise levels for the residents who live close to Gipsy Lane footpath crossing. Between 2004 and 2006 a significant number of complaints had been received from residents of newly built flats close to the whistle board for Gipsy Lane and nearby Willow Walk crossings (Willow Walk crossing was closed a few weeks before the accident at Gipsy Lane). It was believed that audible warning devices situated at the level crossing would lead to more complaints from the residents living close to the crossing.
- 82 Another factor which may have influenced the lack of action in response to deficient warning times at Gipsy Lane in the period 2006-2009 was that the Operational Risk team in Network Rail’s Anglia Route had been falling behind with its processing of level crossing risk data. This issue is referred to in greater detail in the RAIB’s investigation into the collision between a train and an articulated tanker at Sewage Works Lane in August 2010²⁴.

²⁴ RAIB report 14/2011. Available at www.raib.gov.uk.

83 No short-term mitigation measures were implemented when it was identified, in May 2011 during the whistle board audit, that the down line whistle board was not providing adequate warning to the users of Gipsy Lane footpath crossing. This was a causal factor.

Actions following the whistle board audit in May 2011

- 84 In early 2011 a whistle board audit was initiated at the request of the Anglia Route ORA (paragraph 43) after she had identified that no such audit had been done previously on the Anglia Route. In May 2011, the ORCC reviewed the level crossing file for Gipsy Lane footpath crossing and established from the records of a site visit completed in May 2009, that the whistle board on the down line needed to be positioned further away from the crossing than 'its current position at 372 metres from the crossing'²⁵. A whistle board at 372 metres from the crossing provided a warning time of 8.3 seconds which was less than the warning time needed for non-vulnerable users.
- 85 Having identified that the down line whistle board was not providing an effective warning for pedestrians at Gipsy Lane footpath crossing, the ORCC stated that she did not recommend any immediate mitigation because:
- Gipsy Lane was one of over 50 level crossings in Anglia Route identified by the audit that had sub-optimally positioned whistle boards.
 - The information on the level crossing file was from 2009 and new data was due to be gathered the following month (June 2011- see paragraph 87).
 - Based on the May 2009 data, the whistle boards were only marginally sub-optimal (Network Rail estimated that the optimal range for the down line whistle board was between 394 metres and 415 metres).
 - The ORCC was not aware that vulnerable users were using Gipsy Lane footpath crossing, and she had not referred to documents within the level crossing file that would have indicated past use by vulnerable users. However, for the reasons discussed at paragraphs 77 and 82, it is unlikely the ORCC would have had complete faith in the census data within the level crossing file.

Actions following the risk assessment in June 2011

86 No action was implemented to reduce the risk to pedestrians at Gipsy Lane footpath crossing when the ORCC identified in June 2011 that the warning time for the approach of down trains was insufficient. This was a causal factor in the accident.

- 87 On 15 June 2011 a MOM visited Gipsy Lane crossing to gather data and take key measurements at the request of the ORCC as part of the three-yearly risk assessment process. The ORCC entered the data into the ALCRM on 21 June 2011. The result of the ALCRM risk assessment for Gipsy Lane footpath crossing was:
- Individual risk (the risk to a crossing user): **C**; and
 - Collective risk (the risk to crossing users, traincrew and passengers): **2**.

²⁵ The data gathered in May 2009 was incorrect. The warning board is actually located 396 metres from Gipsy Lane footpath crossing.

- 88 In view of this outcome, which placed Gipsy Lane footpath crossing in the 'high risk' category, the ORCC planned a further visit to the crossing for 3 August 2011 to conduct a review of the situation on site. In the meantime, the ORCC undertook a cost-benefit analysis (CBA) for the provision of a footbridge to replace Gipsy Lane footpath crossing, and obtained a positive benefit to cost ratio. The cost of installing a footbridge was justified because the nearby Willow Walk footpath crossing was in the process of being closed and the footpath over it was to be diverted to Gipsy Lane footpath crossing. As the installation of a footbridge was a long-term solution, the ORCC sent a proposal to the Network Rail principal programme planner (within the national level crossings team) on 7 July 2011 requesting that the crossing deck be straightened and the crossing signage relocated.
- 89 This would have had the effect of marginally increasing the sighting distance available along the down line from the down side, but would marginally decrease the sighting distance available along the down line from the up side (due to the curvature of the track (see figure 6)). However, the shorter traverse distance created by moving the crossing signage closer to the tracks would compensate for the marginal decrease in sighting distance on the up side. The main reason for straightening the crossing deck and relocating the signage was to allow the easement of a planned speed restriction (paragraph 91) on the down line because the traverse time would be shortened. The proposal also included a request for closure of Gipsy Lane footpath crossing and funding of a footbridge following the positive cost benefit analysis result.
- 90 The National Level Crossing Team informed the ORCC that because a nearby footpath crossing (Willow Walk) had also been recently closed they would be prepared to fund an underpass²⁶ at Gipsy Lane as this would allow better access for all types of user.
- 91 The ORCC sent an email to the RGM on 15 July 2011 outlining the issues at the crossing (paragraphs 44, 84 and 87) and advised him that, in the interim, an 80 mph (129 km/h) speed restriction was needed on the down line. Witness evidence indicates that a combination of causes led to the delay between the ORCC identifying the need for a speed restriction on the down line (21 June 2011) and the email to the RGM (on 15 July 2011). The causes were:
- the ORCC's workload;
 - planned leave; and
 - the ORCC having to leave a meeting on 7 July 2011 early at which she said she had planned to discuss Gipsy Lane footpath crossing with the RGM.
- 92 The RGM replied to the ORCC's email on 25 July 2011 stating that he would delay imposing a speed restriction on the down line until the ORCC had undertaken the high-risk visit planned for 3 August 2011. The RGM considered that delaying the imposition of a speed restriction for a short time was acceptable pending the better understanding of the circumstances at the crossing that would be obtained from the planned high-risk visit.

²⁶ The proposal to fund an underpass was later found to be impracticable due to the ground levels at Gipsy Lane. Network Rail proposed that a stepped footbridge be provided instead.

Actions following the high-risk site visit in August 2011

- 93 **No action was implemented to reduce the risk to pedestrians at Gipsy Lane footpath crossing after the ORCC confirmed in August 2011 that the warning time for the approach of down trains was insufficient and that there were vulnerable users at the crossing. This was a causal factor in the accident.**
- 94 The ORCC duly undertook a high-risk visit to Gipsy Lane footpath crossing on 3 August 2011. During the visit to the crossing (paragraph 87) the ORCC saw vulnerable users (old persons and children with bicycles) using the crossing. In line with Network Rail guidance (see footnote 7), the ORCC increased the traverse time from 10 to 15 seconds (ie by 50%). The following day the ORCC sent another email to the RGM informing him of the vulnerable users and advised him that the speed restriction on the down line would now need to be 55 mph (89 km/h) to allow vulnerable users enough time to cross safely.
- 95 The RGM replied to the ORCC's email the same day. He asked to meet to discuss the findings and to review the data on the level crossing. The RGM requested the ORCC to get the decision points moved (by relocating the crossing signage - paragraph 38) and the crossing deck straightened as a matter of urgency. The ORCC advised the RGM that a request for this to be done had already been made on 7 July 2011 (paragraph 88) and that she was going on leave from the following day. The ORCC did not state in the email when she was due to return from leave. When the ORCC returned from leave the RGM was on leave himself and the accident occurred before their meeting could take place.
- 96 The RGM has stated that he did not impose the speed restrictions advised by the ORCC immediately because:
- he had applied guidance produced by Network Rail's national level crossing team that had led him to decide to take no immediate action (discussed at paragraphs 97 to 105);
 - since he had assumed the RGM's role in August 2009, there had been no recorded misuse or near-miss incidents at Gipsy Lane (unlike a number of other crossings on Anglia route), and it did not therefore immediately register with him as a 'high-risk' location;
 - he did not have sufficient faith in the data presented to him because he had received requests for speed restrictions in June 2011 for which the sighting distance data had been incorrect and the requested speed restriction had therefore either been inaccurate or unnecessary;
 - he believed that an interim solution had been agreed and was being progressed (moving the decision points and straightening the crossing deck) and that this would further reduce risk at the crossing (this is discussed further at paragraph 110);
 - he believed the risk of immediately imposing a speed restriction was possibly greater than that of not doing so (the RGM believed that there was a risk to those staff who would be required to place equipment and signage on the railway to alert drivers to the presence of the emergency speed restriction);

- he believed that as some trains that called at Needham Market station would not be travelling at line speed on the approach to Gipsy Lane crossing, the overall risk to crossing users was reduced (ie the warning time available for those trains was sufficient); and
- he wanted to form his own impression of the risk at the crossing and undertook a cab ride through the area; as a result of his own observations and feedback from the driver he was accompanying, he was not unduly concerned with the arrangements at the crossing.

Identification of underlying factors²⁷

Guidance provided by Network Rail to the level crossing route teams

- 97 **Guidance, in the form of a decision flowchart provided by Network Rail's national level crossings team, sometimes discouraged those involved in level crossing risk management from making short-term changes to reduce risk at crossings such as Gipsy Lane. This was an underlying factor.**
- 98 Network Rail's national level crossings team is a headquarters based function and provides a national lead on level crossing and risk management to the level crossing teams at route level. At the time of the accident at Gipsy Lane there were nine such route-based level crossing teams, each responsible for a discrete geographical section of the network. The Anglia route was responsible for the infrastructure at Gipsy Lane.
- 99 From April 2010 Network Rail began a national programme of reviewing passive level crossings²⁸ that had deficient sighting. The national level crossings team identified that at many crossings solutions were being progressed that could take 12 to 18 months to implement and often no short-term mitigation measures were in place to manage the risk in the interim. They also questioned, from a business perspective, the cost effectiveness of expensive solutions at crossings where the sighting deficiency was very small.
- 100 In July 2010, the national level crossings team produced a decision flowchart that would provide the route level crossing teams with guidance when determining how to manage the risk at passive level crossings with deficient sighting (see figure 6). The concept of the decision flowchart was discussed at a national ORA group meeting later that month. Following some minor revisions, the decision flowchart was trialled in Scotland during August and September 2010.
- 101 The feedback from the Scotland route level crossing team who carried out the trial was that in using the flowchart, they had never been able to reach a point where an interim solution was required. The national level crossings team believed that this was because in the Scotland route the crossings where the sighting deficiency was greater than 10% either had a line speed below 40 mph (64 km/h) or did not have a history of misuse. However, the national level crossings team said that it would expect the level crossing route teams to consider an interim solution, even where the flowchart did not lead them to do so.

²⁷ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

²⁸ Passive level crossings rely on the crossing user to identify for themselves if it is safe to cross by looking and listening for approaching trains.

- 102 The decision flowchart was sent out to all level crossing route teams in October 2010 as a guidance document. The national level crossings team intended the decision flowchart to be used to support judgements about whether interim measures should be considered at passive crossings with deficient sighting. Its use was not mandated or prescribed in the operations manual or in any Network Rail standard or procedure.
- 103 The Anglia route level crossing team and the RGM began using the decision flowchart as part of the overall risk management process for level crossings. The RGM stated that he recalled applying the decision flowchart to Gipsy Lane footpath crossing at a meeting at which the ORA and ORCC were present in early July 2011. Neither the ORA nor the ORCC could recall for certain when Gipsy Lane footpath crossing was discussed but it is most likely that at some point before the accident the decision flowchart was applied as the RGM, ORA and ORCC said it was being used consistently by the Anglia route level crossing team at that time.
- 104 The RGM recalled that when the decision flowchart was applied to Gipsy Lane, it did not merit interim mitigation. The crossing had not met the criterion on high usage (figure 6) because the team considered that the June census had shown usage to be low. The quick census at the crossing identified 6 adult users. Using a standard conversion factor the ALCRM calculated that over a 24-hour period 122 pedestrians would use the crossing and that this level of usage was 'large'. However, when the decision flowchart was applied to Gipsy Lane the team defined usage at the crossing as 'low'. Rather than discount interim mitigation at that stage, the assessment was continued, but it was still not possible to reach the 'implement interim decision' box because there was no recent history of misuse at the crossing. For this reason, and for the reasons described at paragraph 96, the RGM stated he did not impose a speed restriction on the down line on the approach to Gipsy Lane footpath crossing.
- 105 The construction of the flowchart made it difficult for users to justify applying short-term mitigation measures. By asking a qualitative question about usage ('is usage high?') there was a risk that the flowchart would be applied inconsistently throughout the nine routes.

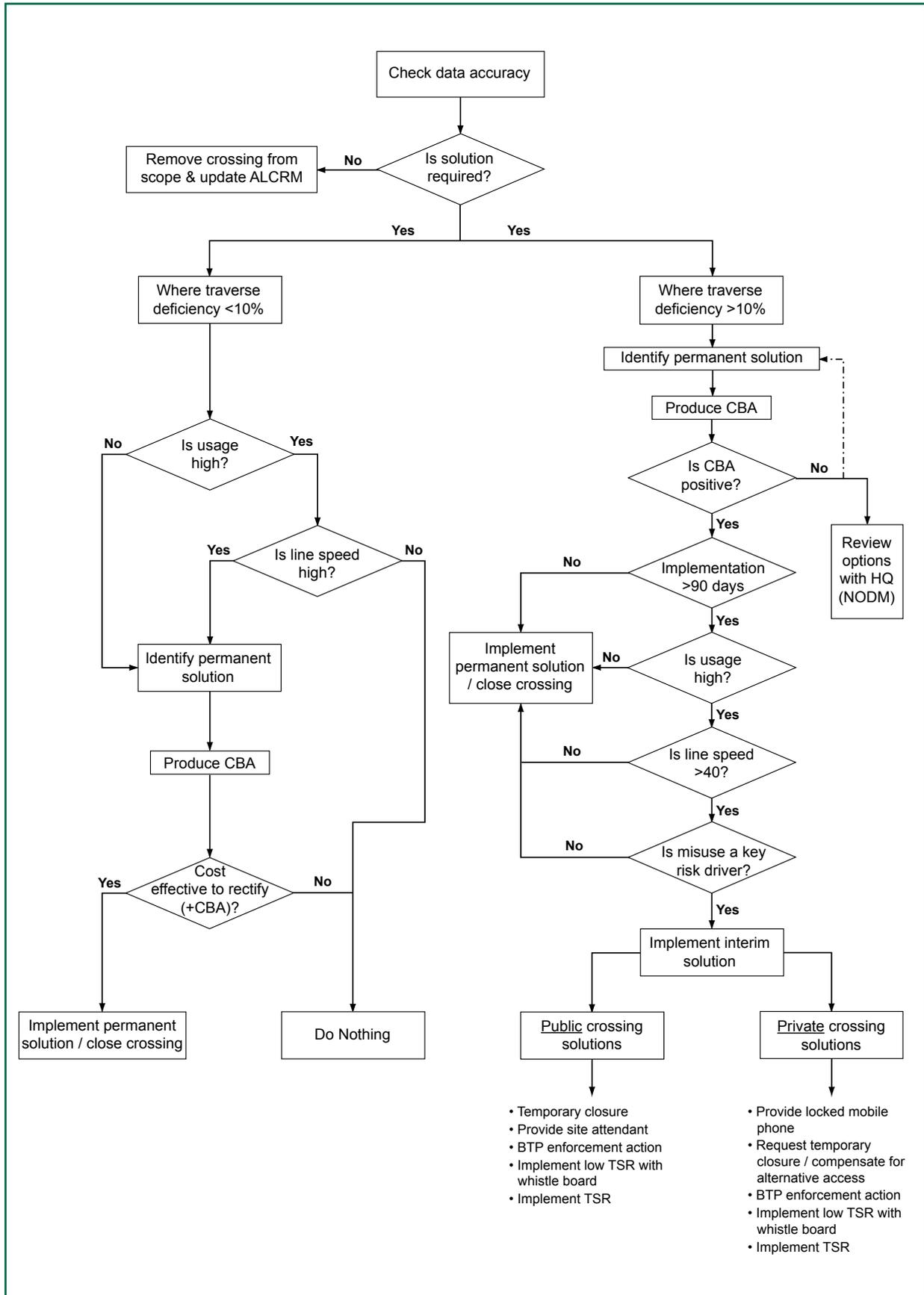


Figure 7: Level crossing decision flowchart devised by the national level crossings team

106 After the accident Network Rail commissioned a 48-hour census at Gipsy Lane footpath crossing. The results of this census were broadly comparable to the figure derived from the quick census undertaken by the MOM in June 2011 (paragraph 43). However, two crossing users (walking dogs) were observed using the crossing during the night-time 'quiet period' (paragraph 43). Prior to the 48-hour census, Network Rail was not aware that the crossing was being used by pedestrians in the 'quiet period'.

Observations²⁹

Network Rail's approach to understanding crossing usage

107 The quick census used by Network Rail to gauge crossing usage is not always an effective measure of the actual number of crossing users and the periods during which the crossing is used (paragraphs 79 and 106).

Network Rail's approach to cost-benefit analysis

108 The ALCRM contains a cost-benefit analysis tool for use during the risk mitigation stage of a level crossing risk assessment. Another cost-benefit analysis tool (independent of the ALCRM) has recently been developed and is used within Network Rail. The new cost-benefit analysis tool was used by the ORCC to get a positive benefit/cost ratio for a footbridge to replace Gipsy Lane footpath crossing (paragraph 88). A positive cost-benefit result is more likely when the new cost-benefit analysis tool is used, partly because the tool factors in detailed non-safety benefits, such as reputational risk, effect on stakeholders and insurance costs, which the ALCRM does not.

109 Although the new cost-benefit analysis tool is in widespread use within Network Rail, its use is not mandated or recommended in Network Rail's operations manual. The new cost-benefit tool is referred to within Network Rail investment regulations which are themselves referenced in a procedure relating to risk assessment of level crossings. However, there is no direct reference to the use of the new cost-benefit analysis tool within that procedure.

Awareness of refused funding proposals

110 The RGM, ORA and ORCC were unaware that funding for the interim solution to move the crossing signage and straighten the crossing deck at Gipsy Lane footpath crossing that had been requested by the ORCC on 7 July 2011 (paragraph 88) had been refused.

111 The programme planning manager had begun the process of applying for the closure of Gipsy Lane footpath crossing and arranging for the provision of an underpass to replace the crossing. He was not prepared to fund the interim mitigation works requested because he had interpreted the ORCC's email to mean that the purpose of the interim mitigation work was to ease the expected 80 mph (129 km/h) speed restriction (paragraph 88); an operational benefit rather than a safety benefit.

²⁹ 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.

112 The programme planning manager stated that he told the ORCC verbally (probably by telephone) that the interim mitigation work would not be funded by the national level crossings team. The ORCC could not recall any such conversation with the programme planning manager prior to the accident.

Clarification of vulnerable crossing users

113 The form used by persons carrying out data collection site visits at level crossings includes a section to record details of any vulnerable population in proximity to the crossing. Within this section of the form the data collector is asked if there is a 'higher than usual number' of vulnerable people using the crossing. The form indicates that vulnerable people includes children, the elderly, disabled and pushchair users. The data collector is required to tick yes or no on the form. No guidance is given on the form, or within Network Rail's operations manual or standards, on what constitutes a 'higher than usual number' of such crossing users.

Previous occurrences of a similar character

114 The RAIB has investigated nine accidents involving pedestrians at level crossings on Britain's main line railways since it became operational in October 2005:

- a pedestrian was fatally injured on Barratt's Lane No.1 footpath crossing near Attenborough on 21 November 2005 (RAIB report 13/2006);
- two pedestrians were struck and fatally injured on Elsenham station crossing on 3 December 2005 (RAIB report 23/2006);
- a cyclist was struck and seriously injured on Scate Moor bridleway crossing between York and Harrogate on 8 January 2006 (RAIB report 06/2006);
- a pedestrian was struck and fatally injured on West Lodge user worked crossing, Haltwhistle, on 22 January 2008 (RAIB report 01/2009);
- a pedestrian was struck and fatally injured on Tackley station crossing on 31 March 2008 (RAIB report 09/2009);
- a pedestrian was struck and fatally injured on Moor Lane footpath crossing, Staines, on 16 April 2008 (RAIB report 27/2008);
- two pedestrians were struck and fatally injured on Bayles and Wylies footpath crossing, Bestwood, on 22 November 2008 (RAIB report 32/2009);
- a pedestrian was struck and fatally injured at Fairfield footpath crossing, Bedwyn, on 6 May 2009 (RAIB report 08/2008); and
- a pedestrian was fatally injured on Mexico footpath crossing, near Penzance on 3 October 2011 (RAIB report 10/2012).

115 The RAIB is currently investigating an accident where a pedestrian was fatally injured on Johnson's footpath crossing, near Bishops Stortford on 28 January 2012 and a fatal accident that occurred on Kings Mill No.1 bridleway crossing, Mansfield, Nottinghamshire, on 2 May 2012.

Summary of conclusions

Immediate cause

116 The pedestrian continued to cross when she became aware of the approaching train (**paragraph 57**).

Causal factors

117 The causal factors were:

- a. The pedestrian moved from the adjacent line into the path of the train because she either did not see the approaching train, she misjudged the speed of the train, or she believed that the train was approaching her on the line she was standing on (**paragraph 61, Recommendation 1**).
- b. For vulnerable users, the warning of an approaching down line train was not sufficient to enable them to use the crossing safely (**paragraph 68, Recommendation 1**).
- c. In the period up to December 2010 no action was taken to address the risk to vulnerable users (**paragraph 74, Recommendation 2**).
- d. No short-term mitigation measures were implemented when it was identified, in May 2011 during the whistle board audit, that the down line whistle board was not providing adequate warning to the users of Gipsy Lane footpath crossing (**paragraph 83, Recommendations 2 and 3**).
- e. No action was implemented to reduce the risk to pedestrians at Gipsy Lane footpath crossing when the ORCC identified that the warning time for the approach of down trains was insufficient in June 2011 (**paragraph 86, Recommendation 2**).
- f. No action was implemented to reduce the risk to pedestrians at Gipsy Lane footpath crossing after the ORCC confirmed in August 2011 that the warning time for the approach of down trains was insufficient and that there were vulnerable users at the crossing (**paragraph 93, Recommendations 2 and 3**).

Underlying factor

118 Guidance, in the form of a decision flowchart provided by Network Rail's national level crossings team, sometimes discouraged those involved in level crossing risk management from making short-term changes to reduce risk at crossings such as Gipsy Lane (**paragraph 97, Recommendation 3**).

Additional observations

119 Although not linked to the accident on 24 August 2011, the RAIB observes that:

- a. The quick census used by Network Rail to gauge crossing usage is not always an effective measure of the actual number of users of the crossing and the periods during which the crossing is used (**paragraph 107, Recommendation 2**).
- b. Network Rail currently uses two cost-benefit analysis tools when reviewing possible level crossing mitigation options. One of these tools is not mandated, recommended or referred to in any Network Rail standard or procedure, although its use is widespread within the organisation and it considers non-safety benefits in greater detail (**paragraph 108, Recommendation 4**).
- c. Although funding for interim mitigation measures had been refused, the RGM, ORA and ORCC were unaware of this despite a procedure being in place to indicate the current status of funding proposals (**paragraph 110, Learning point 1**).
- d. Network Rail requires 50% to be added to the traverse time where a 'higher than usual' number of vulnerable users are seen using a level crossing. No clarification is given on what constitutes a 'higher than usual' number of vulnerable crossing users (**paragraph 113, Recommendation 3**).

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

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

- 120 Prior to the accident at Gipsy Lane, Network Rail had started populating a national list of crossings at which sighting is deficient, and had begun a programme of identifying improvements to them (paragraph 99).
- 121 Traverse time is the subject of current RSSB³⁰ research topic T936 'Enhancing the accuracy and functionality of the ALCRM'³¹, which is considering 54 different aspects of research underpinning the ALCRM. Each aspect has been selected by RSSB from questions raised by rail industry stakeholders about the ALCRM. This includes a review of the justification for the current rationale of increasing traverse time by 50% for vulnerable users.

³⁰ The company is registered as 'Rail Safety and Standards Board', but trades as 'RSSB'.

³¹ RSSB research project brief available at: http://www.rssb.co.uk/RESEARCH/Lists/DispForm_Custom.aspx?ID=1019.

Learning point

122 The RAIB has identified one learning point³² for the railway industry:

Learning point 1

It is important that funding decisions, both agreed and refused, are made known to the person(s) making the funding request. A record of the decision should be given to the person(s) making such funding requests (paragraph 119c).

³² An issue which the RAIB wishes to draw to the attention of industry bodies and railway staff so that they can take appropriate action at their own discretion.

Recommendations

123 The following recommendations are made³³:

- 1 *The intent of this recommendation is for Network Rail to improve the safety of pedestrians at Gipsy Lane crossing.*

Network Rail should arrange for the closure of Gipsy Lane footpath crossing. If Network Rail is not granted permission by the local council to close Gipsy Lane footpath crossing, it should take appropriate risk-reduction measures so that pedestrians have sufficient time to cross safely, and are adequately warned of approaching trains (paragraphs 117a and 117b).

- 2 *The intent of this recommendation is for Network Rail to improve the accuracy and consistency of data collected at level crossings during site visits and make certain that any changes to previous data are fully understood.*

Network Rail should have effective systems in place for accurate information gathering during data collection visits at level crossings. Any changes from previous data collected should be clearly understood and feedback given to the relevant person where data is incorrect (paragraphs 117c, 117d, 117e, 117f and 119a). This includes data relating to:

- the number of crossing users where the quick census is undertaken;
- the use of whistle board protected crossings during the night-time quiet period;
- use of the crossing by vulnerable users;
- location of whistle boards;
- crossing length;
- traverse distance; and
- distance from each crossing gate and decision point to the nearest rail.

continued

³³ 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 200 to 203) can be found on RAIB's website www.raib.go.uk.

- 3 *The intent of this recommendation is for Network Rail to develop guidance for use by the level crossing teams on the circumstances under which short-term mitigation measures are to be implemented at level crossings that have insufficient sighting or warning of approaching trains (paragraphs 117d, 117f, 118 and 119d).*

Network Rail should develop its guidance for use by level crossing teams to include:

- a clear definition of what constitutes a 'higher than usual' number of vulnerable users;
- implementing risk-reduction measures at crossings that have deficient sighting or warning times; and
- when speed restrictions must be imposed, what type of speed restriction is to be used (emergency, temporary or permanent) and the timescales for imposing speed restrictions.

- 4 *The intent of this recommendation is for Network Rail to enhance the cost-benefit analysis function within the ALCRM so that all benefits are properly considered.*

Network Rail should combine within the ALCRM the two different cost-benefit analysis tools currently used by the level crossing risk management teams so that all benefits are properly considered as part of the cost-benefit analysis of risk reduction measures (paragraph 119b).

Appendices

Appendix A - Glossary of abbreviations and acronyms

ALCRM	All Level Crossing Risk Model
BTP	British Transport Police
DfT	Department for Transport
DVT	Driving Van Trailer
LXRMT	Level Crossing Risk Management Toolkit
ORA	Operations Risk Advisor
ORCC	Operations Risk Control Co-ordinator
ORR	Office of Rail Regulation
OTDR	On Train Data Recorder
RAIB	Rail Accident Investigation Branch
RGM	Route General Manager
TfL	Transport for London

Appendix B - Glossary of terms

All Level Crossing Risk Model	A model used by Network Rail to evaluate the risk at level crossings.
Authorised User	A person or persons registered with Network Rail as a user of its level crossings where a private road crosses the railway at those crossings.
Driving Van Trailer	An un-powered rail vehicle with a driving cab at one end. When at the front of a train the DVT allows the train driver to control a locomotive that is attached to the rear of the train. The rear locomotive provides traction power to push the train along.
Rake	A number of vehicles joined together to form a train.
Whistle board	A lineside sign provided to inform train drivers to sound the train's warning horn.

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