RAIB

Rail Accident Investigation Branch

Rail Accident Report

Collision between a train and tractor on crossing XL202 near Limavady Junction, Northern Ireland
2 August 2007

Department for Transport

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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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Collision between a train and tractor on crossing XL202 near Limavady Junction, Northern Ireland, 2 August 2007

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Introduction

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.

3 Access was freely given by Northern Ireland Railways (NIR) to their staff, data and records in connection with the investigation.

4 Appendices at the rear of this report contain the following glossaries:

- acronyms and 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.

Summary of the report

Key facts about the accident

5 At approximately 15:22 hrs on 2 August 2007, a passenger train operated by Northern Ireland Railways (NIR) collided with a tractor on crossing XL202, close to the disused station at Limavady Junction on the Londonderry line.

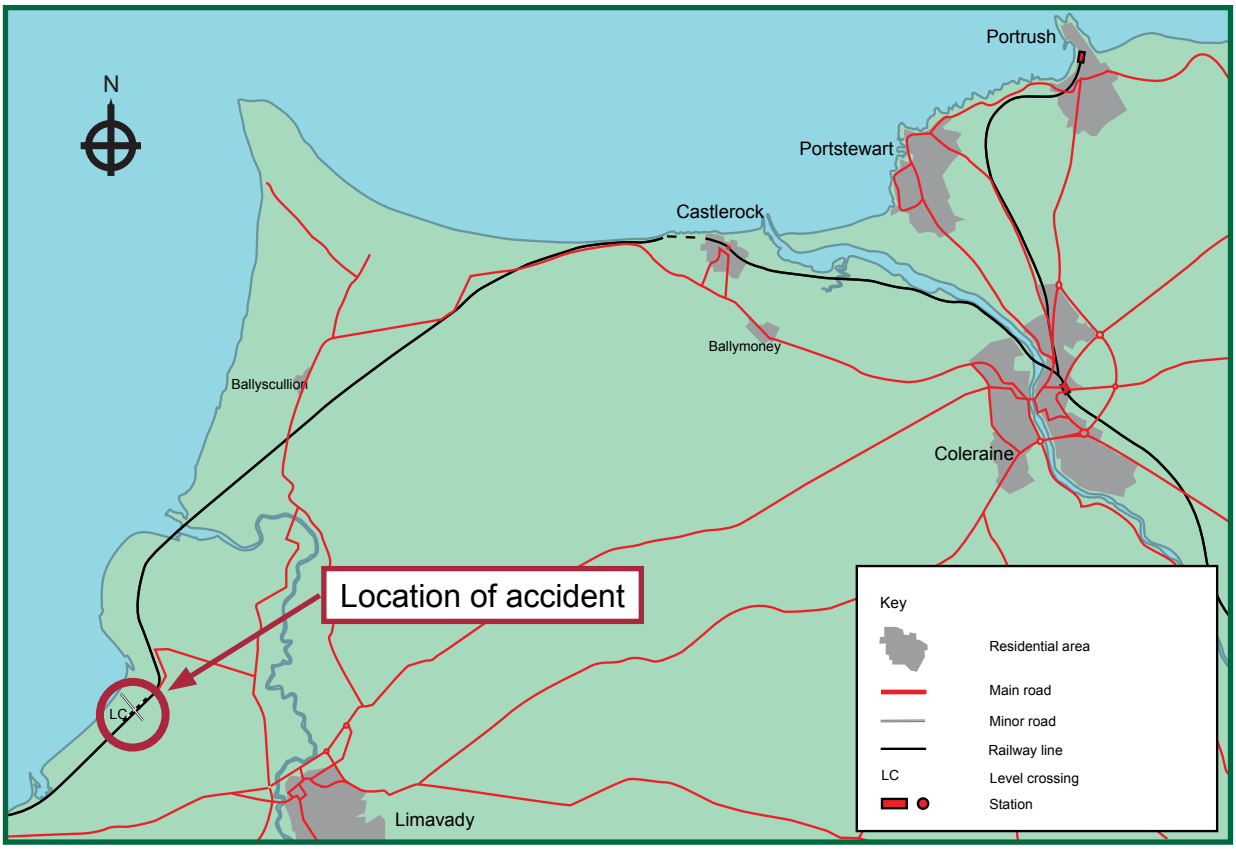

Figure 1: Map showing location of accident

Immediate cause, causal and contributory factors, underlying causes

6 The immediate cause of the accident was that the tractor driver drove his vehicle onto the level crossing as the train approached.

7 The causal factor was that the tractor driver did not see the train approaching. A possible causal factor is that the tractor driver may have been preoccupied with other matters as he approached the crossing, causing a momentary loss of concentration.

8 The following factors were possibly contributory to this accident:

- the position of the sun in relation to the approaching train; and
- the skewed nature of the crossing in conjunction with the position of the tractor's offside roof support pillar which combined to impede the tractor driver's view towards the railway out of the right side of his tractor, preventing him becoming aware of the presence of the train as he approached and negotiated the crossing.

Severity of consequences

9 The tractor driver was killed in the accident and the train driver suffered shock and was taken to hospital. The passengers on the train and the remaining member of staff were uninjured. The train was damaged in the collision and the tractor was destroyed.

Recommendations

10 Recommendations can be found in paragraph 147. They all relate to observations made during the course of the investigation on other matters rather than to causal and contributory factors. They are concerned with the following areas:

- guidance given by NIR to crossing users;
- NIR's crossing risk assessment methodology;
- a safe system of work for taking cattle over crossing XL202;
- the wording on warning signs that are provided at crossings such as XL202; and
- the design of ladders used for evacuating passengers from trains to track.

The Accident

Summary of the accident

11 At approximately 15:22 hrs on 2 August 2007, train B413, the 15:05 hrs Northern Ireland Railways (NIR) service from Londonderry to Belfast Great Victoria Street, collided with a tractor on *User Worked Crossing* XL202, located approximately 700 m south-west of the disused station at Limavady Junction (Figure 1).

12 The tractor driver was thrown from his cab during the collision and died as a result of the injuries he sustained. The driver of train B413 suffered shock and was taken to hospital. He was discharged later the same day. The 65 passengers and conductor on the train were not injured. The train did not derail.

13 The line remained closed for the remainder of the day for clearance and preliminary investigation work to be completed. The train was moved to Belfast York Road depot at approximately 01:30 hrs on the morning of 3 August and the line was reopened to traffic from the start of service on that day.

The parties involved

14 The parties involved in the accident were NIR (owners and operators of the infrastructure and the train) and the owners of the land that adjoins the line at crossing XL202.

Location

15 Crossing XL202 is located on the Coleraine to Londonderry section of NIR. The railway runs generally north-east to south-west at this location, with Bellarena station approximately 5 miles to the north-east and Londonderry approximately 15 miles to the south-west (Figure 1).

16 The railway is a single line at this location. There are 18 passenger train movements each weekday over crossing XL202. There are no freight trains operated over the Londonderry line and the only other train movements through the crossing are occasional engineering trains.

17 Maximum permitted speed of trains through the crossing in both directions is 60 mph (96 km/h).

18 To the north of the crossing there is extensive pasture and arable land, and to the south there are fields and a farm house with outlying buildings including barns and a milking shed.

19 Animal movements over the crossing are necessary in summer when cows are grazing close to the crossing to the north of the line and need to be brought to the farm buildings for milking. An underpass linking north and south sides of the line is provided between the crossing and Limavady Junction approximately 500 m from the crossing, but this is only used if the cows are grazing in the fields adjacent to the underpass.

20 Road vehicles, mainly tractors, tractors with trailers and quad bikes, use the crossing in conjunction with (and in addition to) movement of the cattle for work on crops, to check sheep and to maintain items of equipment such as pumps located on the north side of the line. The use of the crossing increases significantly when crops are being harvested and slurry is being spread.

External circumstances

21 The weather on 2 August 2007 was dry and sunny. At crossing XL202, the sun was above a train approaching from the Londonderry direction at the time of the accident. A weather recording station is located at Eglinton, approximately seven miles west of crossing XL202. For 2 August 2007, it recorded that between 15:00 hrs and 16:00 hrs, the peak windspeed was 12 mph (19 km/h) from a north westerly direction and the temperature was 18 °C.

The train

22 Train B413 was formed of a NIR Class 3000 *diesel multiple unit* (DMU), No. 3014. It comprised three vehicles. It was equipped with a *front-facing closed-circuit television* (FFCCTV) system and an *on-train data recorder* (OTDR). Both of these items of equipment were functioning at the time of the accident and both have provided valuable information regarding the course of events.

Railway infrastructure

23 The railway through XL202 crossing is controlled from Castlerock signal box. The line is operated using the *electric token block system*. Drivers must be in possession of the correct token before they are permitted to enter the 28 mile long single line section at either Castlerock or Londonderry.

24 XL202 crossing provides access between different parts of the landowner's property. The roadway consists of a track, wide enough for a single vehicle, linking the farm buildings on the south side of the crossing with farmland on the north side of the crossing. The crossing surface is compacted stone, both on the approaches to the crossing and between the rails. A cattle guard is provided on both sides of the crossing. There are warning signs, including instructions for using the crossing (Figure 2). On the south side of the line, a single gate with associated wicket gate is provided. At the time of the accident, the crossing gates on the north and south sides of the line were offset from each other (Figure 5). On the north side, three routes converged on the crossing:

- one running parallel with the railway in the Londonderry direction;
- one running at right angles to the railway (this was the route used by the tractor driver involved in the accident); and
- one from a field.

The first two routes were separated from the railway by a double gate with a removable post where the gates met. The field had its own gate leading directly onto the crossing.

Figure 2: Signage at crossing XL202 (3 August 2007)

25 The users of the crossing are responsible for ensuring that it is safe to cross before they do so. Gates are provided to segregate the railway from the farm track (paragraph 24) and these must be maintained closed across the roadway. Failure to close gates after use is an offence under the Railway Safety Act (Northern Ireland) 2002.

26 A normal sequence of events for a road user at the crossing involves them having to traverse the crossing five times. A typical sequence would involve the following steps (note that at every step except the first and last, there is a need to check that no train is approaching before the action is undertaken):

- stop vehicle clear of the first gate;
- open the first gate;
- cross to the second gate and open it;
- return over the crossing to the vehicle;
- drive vehicle over the crossing and stop on the far side of the crossing gate;
- return over the crossing to the first crossing gate, close and secure it;
- traverse the crossing again to the second crossing gate, close and secure it; and
- proceed on journey.

Events preceding the accident

27 During the afternoon of 2 August 2007, the landowner, other family members and employees were engaged in cutting straw. This meant that there were a number of movements over crossing XL202 by tractors and tractors with trailers.

28 Between 15:15 hrs and 15:20 hrs, tractor driver (1), who was also the owner and farmer of the land adjacent to the crossing, approached the crossing from the north side on a tractor at the same time as a tractor and trailer driven by another person (tractor driver (2)) was approaching from the south side. Tractor driver (1) reversed his tractor off the crossing to allow the other tractor to cross first and a conversation ensued between the two men, 20-30 m from the north side of the crossing.

29 On completion of their conversation, tractor driver (1) proceeded towards the crossing in order to return towards the farm house. The crossing gates on both sides were open, having been left in this condition by tractor driver (2) when he crossed a few minutes earlier. Tractor driver (1) approached the crossing shortly after 15:22 hrs.

30 Meanwhile, the driver and conductor of train B413 had signed on duty at Londonderry at 14:50 hrs in order to work the 15:05 hrs departure to Belfast Great Victoria Street. The driver took possession of the relevant token (see paragraph 23) and the train departed from Londonderry on time.

31 The journey towards the first station stop at Bellarena was normal until shortly after 15:22 hrs when train B413, travelling at 57 mph (92 km/h), was approximately 400 m from crossing XL202. At this point, the train driver became aware of a tractor on the north side of the line, moving slowly towards the crossing.

Events during the accident

32 Table 1 lists the key actions and events that occurred during the accident. They have been derived from the FFCCTV and OTDR equipment carried on the train.

Time	Event	Train speed	
		mph	km/h
15:22:02	Tractor intermittently visible from train (trees on left side of line causing an occasional obstruction to the view from the train driver's cab)	57	92
15:22:09	From now, tractor continuously visible from train until collision occurs	57	92
15:22:11	Train passes 'W' board (which is a lineside instruction to the driver to sound the horn); driver does not sound horn	57	92
15:22:16	Train driver applies brake (approximately 75 % of full braking effort)	57	92
15:22:17	Train driver sounds horn for one second	56	90
15:22:21	Train driver applies full service brake (100 % of full braking effort)	51	82
15:22:22	Train driver sounds horn (and continues to do so until leaving cab at the time of impact with tractor)	47	76
15:22:25	Train driver applies emergency brake	43	69
15:22:26	Front of tractor reaches point on crossing where conflict with train inevitable.	41	66
15:22:29	Impact between train and tractor	33	53
15:22:43	Train stops	-	-

Table 1: Time line of events during the accident

33 Throughout the period before the collision occurred, the tractor approached the crossing from the north side without any apparent variation in speed.

34 Approximately 13 seconds before impact occurred, the train driver started braking, subsequently increasing the braking rate until he applied the emergency brake about four seconds before impact. The train driver did not sound the train horn at the 'whistle' board (passed approximately 18 seconds before the train reached the crossing). He did sound the horn when the train was 12 seconds from the crossing and he sounded the horn continuously from seven seconds before the train reached the crossing until immediately before impact occurred.

35 The train was travelling at approximately 33 mph (53 km/h) when it collided with the tractor.

Consequences of the accident

36 The tractor driver was thrown from the tractor on impact and suffered fatal injuries.

37 The train driver suffered shock and was taken to hospital.

38 The conductor and all the passengers were uninjured.

39 The tractor was destroyed in the accident.

40 The train was damaged during the collision (Figure 3). The damage affected the leading vehicle and comprised:

- extensive distortion of the coupler;
- damage to the panels on the front of the train;
- both windscreens smashed (but the glass remained in the frame); and
- various items of equipment dislodged, damaged or disconnected including flexible hoses and lighting boxes.

Figure 3: Damage to the front of unit 3014 (3 August 2007)

41 Following repair, the train returned to traffic on 7 September 2007.

Events following the accident

42 The train stopped 14 seconds after passing over, and approximately 100 m beyond, the crossing. The conductor made contact with operations control and asked for the emergency services to attend. The driver secured the assistance of a trainee nurse on the train to attend to the driver of the tractor pending the arrival of paramedics. The nurse was able to confirm immediately that he had died.

43 The conductor provided information and reassurance to passengers until the arrival of the emergency services. An ambulance and the Police Service of Northern Ireland (PSNI) arrived on site at approximately 15:40 hrs and while the paramedics attended to the tractor driver, the PSNI commenced the process of taking details from passengers on the train.

44 Operations control, in conjunction with the conductor of train B413, arranged for coaches to be available at the disused Limavady Junction station. At 16:50 hrs, the PSNI had completed their work on the train, and passenger evacuation commenced under the supervision of the station supervisor from Coleraine. The passengers were evacuated through the leading passenger doors on the south side of the train, using the emergency ladder provided as part of the train's emergency equipment. Some of the less agile passengers experienced difficulty negotiating the ladder, but the conductor and members of the emergency services assisted them and all were evacuated safely.

45 The passengers were taken in groups of ten along the track to Limavady Junction (a distance of approximately 600 m). The last passenger left the train at 17:10 hrs, and they were taken from Limavady Junction to Coleraine for onward transport to their destinations.

46 The line remained blocked for the remainder of the day. The RAIB gave permission for the train to be moved to Belfast York depot once the OTDR and FFCCTV data had been secured and functional checks made of key items of equipment such as the train horn. NIR made its own safety checks on the train and it was then able to move off site under its own power, but at reduced speed, at 01:30 hrs on 3 August. The line was reopened to traffic from start of service on 3 August.

The Investigation

Investigation process

47 The RAIB was notified by NIR of the accident at approximately 16:15 hrs on 2 August and an *Accredited Agent* (AA) was deployed to preserve and record evidence on behalf of the RAIB pending the arrival of an inspector the following morning. The AA arrived on site at 17:35 hrs and under direction from the RAIB, secured the data from the train's OTDR and FFCCTV equipment. He then recorded key items of evidence including the position of driving controls in the cab of the train.

48 An inspector from the RAIB travelled to Northern Ireland the following day (3 August) and was present when the images from the FFCCTV equipment and the OTDR were downloaded. The inspector also examined the damaged unit in York Road depot and visited the site of the accident.

49 Subsequently the RAIB scrutinised and analysed the data obtained from the FFCCTV and the OTDR in order to provide a comprehensive picture of the sequence of events, before, during and after the accident.

50 The RAIB has conducted meetings with NIR and interviewed, or met with, key witnesses.

51 The RAIB has also held discussions with the Department for Regional Development in Northern Ireland, who are responsible for transport policy and are the *Safety Authority* for railways in Northern Ireland.

Sources of evidence

52 The principal sources of evidence were:

- data from the train's FFCCTV and OTDR equipment;
- photographs and records from the AA and PSNI who attended site in the immediate aftermath of the accident;
- results from tests undertaken by others, e.g. examination of the tractor by the PSNI;
- information provided by those involved in the accident, gathered at interviews and meetings;
- the risk assessment for crossing XL202 prepared by NIR, including measurements of sighting times and distances at the crossing; and
- communications between NIR and UWC users generally and between NIR and the users of crossing XL202 in particular.

Factual Information

The Level Crossing

Railway Safety Principles and Guidance

53 Crossing XL202 is a User Worked Crossing (UWC). Its basic characteristics at the time of the accident are described in paragraph 24.

54 Guidance on the factors to be considered in the arrangements at a UWC is laid down in Part 2, Section E of the *Railway Safety Principles and Guidance* (RSPG). Those factors relevant to the accident that occurred at crossing XL202 are listed in Table 2, together with a commentary on the relevant features of crossing XL202. The guidance contained in RSPG is not, by definition, mandatory and does not need to be applied retrospectively.

RSPG basic guidance	Equivalent condition at crossing XL202
The speed of trains over the crossing should not exceed 100 mph (160 km/h) unless additional protection is provided	The speed of trains at the crossing was restricted to a maximum of 60 mph (96 km/h)
There are no limitations on frequency of rail traffic	-
These crossings should only be used on private roads	The crossing was located on a private road
There should not normally be more than two lines over the crossing	There was one line over the crossing
Where no additional protection is provided, the time required by likely users to traverse the crossing length to be at least 5 seconds less than the available warning time (warning time being the elapsed time between a train becoming visible to a crossing user and the time that the train reaches the crossing)	For a train approaching from Londonderry, the warning time available was 37 seconds. NIR's estimate of traverse time at crossing XL202 for different types of user was: • Pedestrian: 8.5 seconds • Light vehicle: 18.75 seconds • Heavy vehicle: 33.75 seconds

Table 2: Comparison between basic guidance on requirements for UWCs and the characteristics of XL202 UWC

NIR's level crossing risk assessment

55 NIR prepares a risk assessment for all UWCs and footpath crossings. The inputs to the risk assessment include:

- maximum permitted speed for trains through the crossing;
- average daily frequency of use of the crossing and characteristics of the user(s);
- frequency of train service over the crossing (averaged over the eight peak hours);
- estimate of the 'crossing time' for each identified type of user, calculated on the basis of an assumed speed of movement of 1 m/s and the width of the crossing;

- the distance from the crossing where a train first becomes visible in each direction (the sighting distance); and
- estimate of the warning time for the approach of trains as viewed from both sides of the crossing and for each direction from which a train could approach (a total of four values for each crossing), calculated by dividing the sighting distance (in metres) by the maximum permitted speed (in metres/second).

56 The output from the risk assessment is a numeric value which expresses risk in terms of 'potential equivalent fatalities' per year and is based on a computation of the likelihood that a crossing user will be struck by a train based on all of the available input data. The risk assessment is sensitive to a number of factors, but particularly the number of crossing movements (road or rail) per day. It does not provide an indication of the actual level of risk at each crossing, but does allow the risk at similar types of crossing to be compared (i.e. it is a risk ranking process).

57 The risk value derived enables NIR to rank all of their level crossings according to their risk potential.

58 There are three categories of user in NIR's risk assessment methodology:

- pedestrians, including cyclists;
- light vehicles, comprising horse riders, motorbikes, cars, vans and minibuses; and
- heavy vehicles comprising lorries, heavy goods vehicles, farm vehicles and trailers, buses and cattle.

59 NIR's risk assessment for crossing XL202 was last updated at the beginning of August 2006. It classifies all usage of the crossing as being by heavy vehicles. The estimated traverse time for heavy vehicles at crossing XL202 was 33.75 seconds. A movement from the north to the south side of the crossing would meet RSPG criteria if 38.75 seconds warning time was available (33.75 seconds crossing time plus the defined five seconds margin). NIR's risk assessment shows that the actual warning time available was 37 seconds.

Measures to be considered if criteria in RSPG on warning times are not met

60 The RSPG provide further guidance on the additional protective measures that can be provided in a situation where warning times at crossings do not meet the guidance values:

- Audible warnings of the approach of trains (i.e. the provision of 'Whistle' boards as an instruction to drivers to sound the horn). These can be considered where train speeds are low (45 mph (72 km/h) or lower) and should be positioned not more than 400 m from the crossing.
- Telephones connected to a supervising point on both sides of the crossing. This is an option to be considered when:
    - there is known regular use by animals on the hoof;
    - fog is prevalent;
    - the daily road vehicle user exceeds 50;
    - there are more than 2 railway lines; or
    - the line speed exceeds 160 km/h.

- Miniature stop lights on both sides of the crossing. This is an option to be considered where:
    - the minimum warning time of trains cannot be obtained and the actual daily road user exceeds 100; or
    - the provision of a telephone is impractical because it is difficult to provide reliable information concerning the whereabouts of trains, or the information supplied would be so restrictive that it would be likely to cause the user to become unduly impatient and to cross without permission.

61 The only additional protective equipment provided at crossing XL202 is audible warnings; a whistle board is provided on each side of the crossing. The provision of whistle boards did not meet the criteria described in paragraph 60:

- maximum speed of trains through the crossing was 60 mph (96 km/h) as compared with the maximum defined value of 45 mph (72 km/h); and
- one of the boards was located 436 m from the crossing and the other 410 m from the crossing, as compared with the maximum defined value of 400 m.

62 At a speed of 60 mph (96 km/h), the audible warning would be sounded approximately 17 seconds before the train reached the crossing with the board in its current location. For a speed of 45 mph (72 km/h), the audible warning would be sounded approximately 20 seconds before the train reached the crossing with the board positioned 400 m from the crossing.

63 The 'audible' warning time that results from the positioning of the whistle board in either location is less than the 'visual' warning time available for the user of 37 seconds (Table 2).

Communications on the safe use of UWCs

64 NIR has produced a booklet on the safe use of UWCs which it has distributed to all landowners who use such a crossing to gain access to their property. The booklet is occasionally updated and reissued. NIR states that it was last reissued and distributed to landowners on 18 April 2007. At the beginning of May 2007, NIR wrote to landowners at UWCs to advise them of changes to the legislation governing signage at private crossings[1] and that failure to close gates or use telephones, if provided, could lead to a fine of up to £1000. NIR maintains a database of landowners at UWCs. The owner of land adjacent to crossing XL202 received the booklet and other communications.

65 The booklet on safe use of UWCs:

- Sets out the hazards associated with UWCs and the local conditions such as adverse weather or overgrown vegetation which might affect the safety of the user. It highlights factors such as deafness, headphones, vehicle music systems and mobile phones that might affect the user's ability to hear approaching trains.
- Describes the safe method of using the crossing, including the need to obey the instructions on the signs and always to close the gates after use.
- Provides contact details for the controlling signalbox so that a user could telephone the signalman if herding animals or driving a vehicle which is unusually long, wide, low, heavy or slow-moving. Guidance is provided on the meaning of each of these terms, except 'low'. The tractor involved in the accident at crossing XL202 did not fit into any of these categories.

[1] The Private Crossings (Signs and Barriers) Regulations (Northern Ireland) 2007

- Indicates that when special farm activities take place involving moving vehicles back and forth across the railway line, additional arrangements may need to be made. The examples of special farm activities given in the booklet are grass harvesting and slurry spreading. However, NIR advised that if the consequence of any such activity was only greater use of the crossing, this would not generally require additional arrangements. Employment of outside contractors on work that involves them using the crossing is one circumstance that would require special arrangements as might the use of slow-moving machinery. Those arrangements might include the provision by NIR of a *lookout man*. NIR asks that contact regarding special arrangements is made 'well beforehand'. The booklet also says that the user should always contact NIR when herding animals across the line.

66 The landowner at crossing XL202 had, on occasions, contacted the signalman at Castlerock when planning activities involving intensive use of the crossing. On one occasion NIR provided a lookout man to help manage crossing movements safely, but generally no assistance was provided. There are a number of farming activities that involved increased use of the crossing, including slurry-spreading where the crossing might be used every ten minutes for a short period of time. However, while use of crossing XL202 increased during crop-harvesting to an average of one crossing every 45 minutes, the landowner did not consider that it constituted exceptional use and he had not requested assistance from NIR for the activities of 2 August 2007.

67 Written communication occasionally took place between NIR and the landowner at crossing XL202. In May 2005, the landowner requested details of 'work' trains so that he would know when it was safe to move cattle over the crossing. NIR responded that users of UWCs should not 'rely on train times' because they might operate additional trains and trains could run late. A second exchange of correspondence took place in July 2006, containing a request from the landowner for NIR to repair the top surface of the crossing which was being damaged by cattle using the crossing. The correspondence included the commitment by NIR to undertake the repairs and also resulted in the risk assessment for the crossing being revised in August 2006 to take account of its use by cattle.

68 NIR also supplied information indicating that in the weeks after the accident occurred, there were further incidents at crossing XL202. 'Near-misses' were recorded with crossing users on 3 August and 22 August and the gates were recorded as being left open on 6, 7, 8, 13 and 23 August. NIR contacted the Health & Safety Executive (Northern Ireland) (HSE(NI)) on 16 August 2007 to seek their assistance in enforcing the safe use of the crossing, which was provided.

The train

69 The train involved in the accident was a Class 3000 three car DMU. It has a designed maximum speed of 90 mph (145 km/h) and a designed maximum braking rate of 1.1 m/s^2.

70 The data from the OTDR confirms that the driver operated the horn (Table 1). The train horn was tested after the accident and found to be in working order. Witnesses to the event referred to hearing the train horn sound as the train approached the crossing.

71 Photographs taken by the PSNI and the AA show that the marker lights on the front of the train were illuminated. It is normal practice for the lights to be switched on by the driver at the start of the journey.

72 The Class 3000 is designed to be compliant with modern technical standards for *crashworthiness* as specified in *Railway Group Standard* GM/RT2100, 'Structural Requirements for Railway Vehicles'. Compliance with Railway Group Standards is not mandatory in Northern Ireland, but NIR chose to comply with this standard as it represented best practice in the United Kingdom.

73 The damage to the train during the incident was wholly confined to the exterior of the leading vehicle (paragraph 40). The impact with the tractor was borne by the driver's windscreen and the panels below. The glass in the windscreen did not become detached from the frame and infiltrate the driving compartment and the panels provided adequate protection. There was no loss of survival space in the driving cab and the remainder of the train was unaffected.

The tractor

74 The tractor was manufactured by Massey Ferguson, model 6150. An authorised officer from the PSNI undertook a mechanical examination of the tractor after the accident and concluded, to the extent that he was able to given the damage sustained by the vehicle, that the tractor had been well maintained with no apparent mechanical defects. The FFCCTV images indicate that the windows of the tractor were clean enough to permit the driver a reasonable view of an approaching train.

Analysis

Identification of the immediate cause

75 The immediate cause of the accident was that the tractor driver drove his vehicle onto crossing XL202 as train B413 approached.

Identification of causal and contributory factors

The actions of the tractor driver

76 The instructions for the crossing (Figure 2) require that users stop, look and listen before driving onto the crossing. The RAIB has considered why the tractor driver did not stop before reaching the crossing, and why he did not hear or see train B413 approaching.

77 If the crossing had been used in accordance with the instructions (paragraph 26), the tractor driver would have needed to stop to open the gates before proceeding onto the crossing. However, the gates were already open. They were open because another tractor had just passed over the crossing and its driver had seen the tractor approaching from the north side. In those circumstances, it would have been perverse for the driver of the other tractor to have closed the crossing gates.

78 The RAIB has considered whether the fact that the gates were already open might have misled the tractor driver into thinking that the crossing was clear for him to proceed over it. This might be feasible as an explanation if the users of crossing XL202 were always in the habit of opening and closing the crossing gates every time they crossed.

79 NIR has one record of gates being left open at crossing XL202 before the accident. This occurred in 2005. Reference is made in paragraph 68 to a number of incidents that have occurred since the accident involving non-compliance with the guidance on using the crossing. It seems improbable that non-compliance with those rules would have started after the accident and for that reason, it is unlikely that the tractor driver took the fact that the crossing gates were open as an indication that it was safe for him to cross.

80 The tractor might not have stopped if the brakes had failed. The tractor was examined by the PSNI Vehicle Examiner after the accident and no fault was found (paragraph 74).

81 The signs at the crossing make reference to the user listening for approaching trains (Figure 2). This would be feasible for users such as pedestrians where there might be little ambient noise to mask the sound of the approaching train, but for any user in motorised transport, the sound of the engine has the potential to mask that of the train. That potential is increased significantly if the driver is in an enclosed cab of a tractor. For this reason, at crossing XL202 the primary means for drivers of motorised transport to secure their own safety when a train is approaching from Londonderry is the ability to see an approaching train.

82 Although road users at crossing XL202 do have a good view of approaching trains, brief consideration has been given to the factors that would have affected the ability of the tractor driver to hear the warning horn that was sounded as train B413 approached:

- The insulation provided by the tractor's cab. The tractor involved in the accident had a fully enclosed cab and evidence from the FFCCTV indicates that the window on the off-side of the tractor (the side from which the train was approaching) was closed.

- It is understood that the tractor driver enjoyed listening to the radio while driving. It cannot be established whether the radio was switched on or not, but if it was, this would have further diminished the audibility of the train horn. NIR's booklet that it sends to UWC users highlights this hazard (paragraph 65).
- The wind was blowing from north-west to south-east, whereas the tractor was moving in an arc from north-west to north-east of the train. This may have further reduced the audibility of the train horn for the tractor driver.

83 The signs at the crossing make reference to the need for users to look for approaching trains. For a tractor driver approaching the crossing from the north side, the view towards Londonderry is good, with no obstructions (Figure 4). The railway is straight at this point and affords a clear view over a significant distance (at least 1000 m) for a road user. The tree to the right of the line in Figure 4 is approximately 600 m from the crossing and train B413 passed the tree approximately 20 seconds before the collision occurred.

Figure 4: The view towards Londonderry from the north side of crossing XL202 (3 August 2007)

84 Evidence from the FFCCTV shows that the tractor driver looked towards the train two or three seconds before impact occurred. The principal reasons why the tractor driver might have looked for, but not seen the train approaching before that time were either because he had problems with his eyesight or because something prevented him seeing the train.

85 There is no evidence to suggest that the tractor driver had problems with his eyesight. He was not prescribed corrective glasses for distance vision.

86 The visibility of the train was enhanced by high intensity lights on the front of the unit. It is likely that they were operational as the train approached the crossing (paragraph 71). However, the tractor driver would have been looking towards the sun. The other tractor driver who had used the crossing shortly before the accident told the PSNI that the presence of the sun had made looking towards the Londonderry direction difficult when he crossed the line. The position of the sun is a possible contributory factor for this accident.

87 When approaching at right angles to the crossing on the north side, the only vegetation that could obstruct a tractor driver's view towards Londonderry was the tree located at 600 m and 20 seconds running time from the crossing (paragraph 83). Although a tractor driver's view of the train would have been partially obstructed before it passed the tree, the high intensity lights on the front of the train would have helped to improve its visibility to a road user before it reached that point.

88 When the roadway is running at right angles to the crossing, the tractor driver has a good view of trains approaching from the right. However, just before the crossing is reached, the roadway went through a 'dog-leg' (Figure 5). The gates on either side of the crossing were not directly opposite each other and the tractor driver crossed at an angle to the railway.

Figure 5: Aerial photograph of crossing XL202 showing 'dog-leg' (2August 2007) (Photograph courtesy of PSNI)

89 When crossing at an angle, the tractor driver's view to the railway on the right could have been affected by the tractor's roof support pillar when the tractor driver was sitting upright in the seat. This would have started to occur just as the tractor was approaching the railway (approximately three seconds before it reached the point where conflict with the train was inevitable and approximately six seconds before the time when impact occurred) and continued until the time of impact. The presence of the roof support pillar may have impeded the tractor driver's peripheral vision, preventing him becoming aware of the train until it was too late. Even if he had glanced quickly to his right, the presence of the pillar and the bright sunlight coming in through the tractor's right-hand window may have combined to make seeing the approaching train difficult.

90 Figure 6 illustrates the possible problem caused by the roof support pillar when the train is 19 m from the crossing and is based on the design and dimensions of the model of tractor involved in the accident and the dimensions of the Class 3000 DMU. The left-hand graphic shows the position of the tractor driver sitting upright in his seat with the train located 19 m from the crossing, while the right-hand graphic provides an indication of the peripheral vision available to the tractor driver in equivalent circumstances, and shows the roof support pillar obstructing the view of the approaching train The skewed nature of the crossing, in conjunction with the position of the roof support pillar on the off side of the tractor are possible contributory factors for this accident.

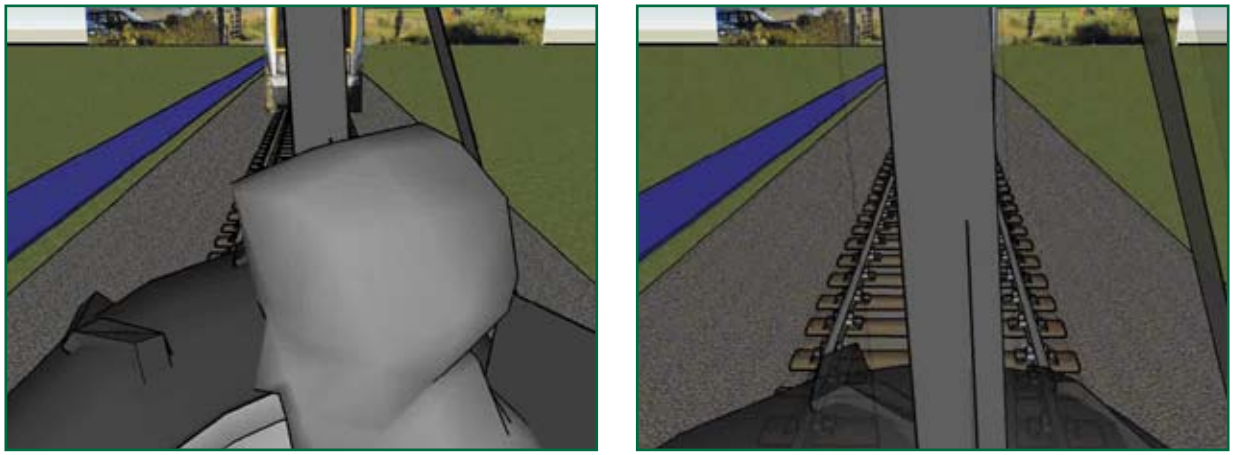

Figure 6: Graphic showing the possible effect of the roof support pillar on a tractor driver's vision at Crossing XL202

91 The position of the sun and the effect of the roof support pillar on the tractor driver's vision may help to explain why he was not alerted to the presence of the train as he drove through the dog-leg. However, the train was clearly in view for at least 20 seconds before the accident occurred. The RAIB considers that the most likely explanation of why the tractor driver did not see the approaching train before he reached the dog-leg at the approach to the crossing is because he did not look for it.

92 On the day of the accident, straw cutting was taking place on the farm which resulted in much more frequent use of the crossing than normal (paragraph 27). In common with the rest of the United Kingdom, Northern Ireland had suffered a wet July and the dry weather at the beginning of August provided an opportunity in which to gather the crops. The work still to be done was the subject of the conversation between the two tractor drivers immediately before the accident occurred. The preoccupation of the tractor driver with other matters as he approached the crossing is a possible causal factor for this accident.

93 Taking all of the factors described in paragraphs 83-92 into account, the tractor driver not seeing the approach of train B413 is considered to be the causal factor for this accident.

94 Although usage of the crossing was greater than normal during the period when the accident occurred, the landowner had not made a request for assistance in managing road vehicle movements over the crossings (paragraph 66). NIR advises that on occasions, other landowners have contacted NIR to advise of a period of intensive use of a UWC. In such circumstances, NIR has either provided a lookout at the crossing or advised the landowner of measures to be taken to enhance the safety of crossing users during this time (e.g. by stationing someone at the crossing to warn road users of approaching trains).

95 However, the guidance provided by NIR did not define the exact circumstances under which additional assistance should be requested. It did not identify who within NIR should be contacted or how long before assistance was needed that it should be requested. As a consequence, there was no consistency in the circumstances under which farmers would make requests for assistance to NIR and no consistency in NIR's response to such requests. For these reasons, the fact that the landowner did not seek assistance with using the crossing on 2 August 2007 is neither causal nor contributory to the accident.

The configuration of crossing XL202 and the risk assessment

96 NIR's risk assessment for crossing XL202 (see paragraphs 55-59) showed that for heavy vehicles, it did not quite meet the guidelines on warning times set out in RSPG for a train approaching the crossing from the Londonderry direction. The guidance in RSPG is not retrospective, and is normally only applied when a new railway or level crossing is constructed, or when a level crossing is upgraded. However, the RSPG are taken as the baseline for good practice. The RAIB has considered whether the disparity between recommended warning times in the RSPG and those assessed as being available for heavy vehicles could have contributed to the accident.

97 NIR's risk assessment assumes that all users at crossing XL202 are in a 'heavy vehicle' category, defined on the risk assessment sheet as embracing lorries, HGVs, farm vehicles and trailers, buses and cattle. It defines a crossing time of 33.75 seconds.

98 NIR provided the following explanation of how this time had been calculated:

- Assumed crossing speed of 1 m/s, which equates to 2.2 mph (3.5 km/h). This is based on the crossing speed for a pedestrian on ballast in RSPG. The crossing width has been measured at 7.5 m, equating to a crossing time of 7.5 seconds at 1 m/s.
- The length of the vehicle using the crossing. A heavy vehicle is assumed to be a maximum of 15 m long. Thus a heavy vehicle will take 22.5 seconds to cross (15 m of vehicle traversing 7.5 m at 1 m/s).
- The presence of special circumstances at a crossing, such as uneven crossing surface or a steep or slippery approach road. If one of these factors is present, the traverse time is increased by 50 %; if two are present, the traverse time is doubled. In the case of crossing XL202, the crossing surface was defined as uneven, resulting in the 22.5 seconds crossing time for a heavy vehicle being increased by 50 %, giving a total crossing time of 33.75 seconds.

99 Adding the five seconds referred to in RSPG (Table 2) to this crossing time results in the required warning time for trains approaching from Londonderry being 38.75 seconds. In practice, the available warning time was calculated to be 37 seconds.

100 Had the crossing assessment for crossing XL202 included tractors within the 'light vehicle' category, a more realistic length of 5 m would have been assumed, resulting in an estimated crossing time of 18.75 seconds (5 m of vehicle crossing 7.5 m of crossing at 1 m/s (12.5 seconds), increased by 50 % for the uneven crossing surface). The warning time available of 37 seconds for trains approaching from Londonderry is significantly higher than the 23.75 seconds needed (18.75 seconds crossing time plus the five seconds defined in the RSPG).

101 The FFCCTV images show that the tractor first impinged upon the crossing approximately 3 seconds before the accident and by the time that impact occurred it was located centrally on the crossing. This means that if the tractor had continued off the crossing, an elapsed time of no more than 10 seconds would have occurred between the time that the vehicle first impinged upon the crossing and the time that it reached a place of safety. This is significantly less than the time of 33.75 seconds allowed in the risk assessment.

102 The RAIB considers that the fact that the actual warning time available for trains approaching from Londonderry was below the value identified as being necessary within NIR's risk assessment for crossing XL202 was neither causal nor contributory to the accident.

103 The figure used in NIR's risk assessment for road vehicle movements over the crossing (average of 1/day) may have led to an under-representation of the risk at the crossing for two reasons:

- When cattle are using the crossing (one week in four between June and September), at least four return journeys over the crossing are necessary for farm personnel, as the cattle are brought in and taken out twice per day.
- The technique of averaging road vehicle usage is questionable when usage increases significantly at certain times of year. Crossing use varies according to the activities that are being undertaken. At the quietest times of year, it may fall to three times per week, but increases when there are specific activities such as slurry spreading and crop-harvesting to be undertaken (paragraph 66). In addition, while regular activities can be scheduled to avoid conflicts with timetabled train movements (although this is not, in itself, a guarantee of absolute safety as trains can run late and additional trains can be operated), special activities such as crop-havesting will result in movements over the crossing taking place on an ad-hoc basis, thereby increasing the potential for conflict.

104 The categorisation of vehicles in the risk model does not include tractors (without trailers) and quad bikes; vehicles which can feature prominently in farm use. Furthermore, the inclusion of cattle in any of the current categories cannot be justified as the time they take to cross the track does not lend itself to quantification. Instead, as suggested by the RSPG, they need to be treated as a special case, requiring suitable arrangements to be agreed between the landowner and the railway infrastructure owner.

105 NIR's risk assessment model does not consider the relative importance of audibility and visibility at crossings in the context of the different types of user. The risk at a crossing with limited sighting times will be higher if there is frequent use by people in motorised transport, because the noise from the vehicle's engine may prevent the driver hearing the approaching train. Although NIR's risk model does include data on warning times (sighting time plus five seconds), it does not explicitly consider the difficulty that some types of user might experience in hearing approaching trains, even if the train driver sounds the warning horn at the correct location.

<u>The performance of the train</u>

106 The performance of the train is described in paragraphs 69-73.

107 The tractor was required to give way to the train at crossing XL202 and there was no requirement for the train to stop. However, the driver did apply the train brakes and the RAIB has considered the braking performance of the train.

108 The OTMR download and FFCCTV allow analysis of the actual braking rate of the train. The braking performance of the train is summarised in Table 3:

Time	Brake applied	Braking rate	Comment
15:22:16	Partial (c.75 %)	0.55 m/s^2	
15:22:21	Full (100 %)	1.04 m/s^2	
15:22:25	Emergency (100 %)	1.11 m/s^2	
15:22:30	Emergency (100 %)	1.00 m/s^2	After impact and affected by oil spilled from tractor onto the rails

Table 3: Analysis of braking performance of train B413

109 It will be seen that the maximum braking rate achieved by the train was 1.11 m/s^2. The designed maximum braking rate for the Class 3000 unit is 1.10 m/s^2. The train achieved its designed maximum braking rate.

110 The Class 3000 unit is equipped with a *wheelslide protection* (WSP) *system* which intervenes when the wheels are skidding on wet or contaminated rail surfaces to release train brakes in a controlled manner and then reapply them. If the train is experiencing severe adhesion problems, the unit also has the capability to lay sand which helps to improve the available rail adhesion.

111 The WSP system became active on train B413 when the train driver first applied the brakes and sand was laid immediately after the train passed over the crossing and encountered severe adhesion problems caused by oil contaminating the surface of the rail. Table 3 shows that low adhesion had minimal impact on the ability of the train to achieve its maximum designed braking rate.

112 There were no issues regarding the crashworthiness performance of the train (paragraphs 72 and 73).

113 The performance of the train was neither causal nor contributory to the accident.

The actions of the train driver

114 The train driver did not sound the warning horn when he passed the whistle board located 436 m from the crossing (Table 1). However, he did commence sounding the horn six seconds later when the train was approximately 285 m from the crossing. At this time, it would still have been possible for the tractor driver to stop had he heard the warning as he would have had an unobstructed view of the approaching train and he was still nine seconds away from reaching the point where a collision between the train and tractor was inevitable. The RAIB does not consider that the train driver not sounding the horn at the whistle board was causal or contributory to the accident.

115 The driver remained at the controls of the train until the moment of impact and sounded the train horn continuously for seven seconds before the train reached the crossing. Had the tractor driver heard the warning horn at any time up to 4-5 seconds before impact, he would have been able to stop before reaching a point of conflict with the train.

116 The train driver started applying the brakes when the train was still approximately 300 m from the crossing and increased the braking effort twice in the period before the collision occurred. This had the effect of reducing the train speed from 57 mph (92 km/h) to 33 mph (53 km/h) by the time of the collision and delaying the arrival of the train on the crossing by approximately one second.

117 Immediately after the accident, the train driver returned to his cab to ensure that the train would not move. He also sought assistance for the tractor driver (paragraph 42).

118 It should be noted that the driver, without regard for his own safety, remained in his cab until the moment of impact in order that he could use the horn to warn the tractor driver of the approach of the train.

Response of others

119 In the immediate aftermath of the accident, the conductor of train B413 contacted the NIR control office to advise them of the accident and make arrangements for the passengers to be taken to their destinations. He provided advice and reassurance to passengers on the train both before and after the arrival of the emergency services. He obtained the assistance of the emergency services in evacuating passengers from the train and remained solicitous of the welfare of the driver, ensuring he was delivered into the care of paramedics.

120 NIR's control office responded quickly in calling the emergency services. They also provided road transport for the evacuated passengers in a prompt and efficient manner so that as soon as the PSNI had completed their duties on the train, the station supervisor from Coleraine, assisted by the conductor, was able to commence the evacuation of passengers to Limavady Junction for their onward journeys.

121 The attendance of the emergency services was timely and they worked effectively with the station supervisor and conductor to secure the evacuation of passengers in a safe and efficient manner.

Other factors for consideration

The evacuation ladder

122 The emergency equipment carried on Class 3000 units includes an emergency ladder. This is a conventional extendable wooden ladder with round rungs. Paragraph 44 describes the evacuation process and the difficulty experienced by some passengers in using the ladder. Ascending and descending ladders can be a difficult and discomfiting experience for those with no experience of so doing and for those with restricted mobility. The requirement to manoeuvre oneself onto the ladder adds to the difficulty.

123 An improved design of ladder or collapsible steps with integral handrail would have provided a slightly more robust means for passengers to exit from train to ground level.

The configuration and use of crossing XL202

124 In assessing the arrangements at crossing XL202, the RAIB has noted a number of other issues about the crossing that, while not relevant to the accident, still need to be considered.

125 Paragraph 59 refers to the fact that the warning time available for a heavy vehicle traversing crossing XL202 was 1.5 seconds less than that required for a train approaching from Londonderry if the guidance in RSPG was to be met. The warning time currently available for users when trains are approaching from Coleraine is 21.47 seconds, which is significantly less than the traverse time of 33.75 seconds for heavy vehicles to cross.

126 NIR has indicated that approximately two thirds of its UWCs have warning times that do not meet the guidance values in RSPG. They use their risk assessment process to identify the higher risk crossings and target the highest risk crossings for further attention. Closure of UWCs is NIR's preferred option and 78 have been closed since February 1999 (a reduction of almost 28 % in the number of UWCs on the NIR network). However, closure is not an option for crossings that are used frequently, or where there is no viable alternative such as removing one or more crossings that exist in close proximity to each other.

127 At the time of the accident, crossing XL202 was ranked 19th out of NIR's remaining 203 UWCs for risk (where the highest risk crossing is classified as first). Further work has been undertaken at Crossing XL202 to reduce the risk since the accident occurred (see paragraph 146).

128 Cattle have been using crossing XL202 since 2005 (paragraph 103). According to the RSPG, telephones are an option to be considered when animals on the hoof use crossings (paragraph 60). The RSPG state that miniature stop lights can be considered if the provision of telephones is impractical, although it is specifically noted in RSPG that they may not be suitable at crossings where movement of cattle takes place. In practice, neither telephones nor miniature stop lights have been provided, but as mentioned already, the RSPG provide guidance and do not need to be applied retrospectively.

129 In 2006 the landowner at crossing XL202 wrote to NIR asking for an improved crossing surface to be provided because his cows were having difficulty crossing the line. NIR improved the crossing surface and adjusted the risk assessment to reflect the change of use. This resulted in the estimated risk at the crossing increasing by a factor of four. This was not the first occasion that NIR could have been aware that cattle were using crossing XL202; another exchange of correspondence had taken place in 2005 regarding train times (see paragraph 67).

130 NIR asserts that the existing underpass (paragraph 19) provides mitigation of the risk from cattle using crossing XL202 (it does not eliminate the risk because the crossing is still used by cattle on some occasions) and it is not practicable to provide further protective measures. The provision of telephones will not enhance safety because the signaller is unable to provide any indication of the whereabouts of a train once it has entered the 28 mile single line between Castlerock and Londonderry. The evaluated risk at crossing XL202 was lower than at 18 other UWCs on the NIR network and risk would be taken into account when allocating resources for safety improvements.

131 NIR has not entered into any discussion with the landowner regarding a safe method of work for crossing cattle. Neither were the signs at the crossing changed to reflect the fact that cattle were using it after NIR became aware that this was the case. The signs in place (Figure 2) make no mention of cattle and the current arrangements for crossing animals safely involve the landowner and his family contacting the signal box using a mobile phone or a phone located in the farmhouse.

132 The existing sign does not include contact details for Castlerock signal box. In the event that a problem was encountered by a person not carrying the relevant telephone number with them, they would not know who to contact. A formal inquiry into a collision between a train and a car on a UWC at Woodtown (located nine miles east of crossing XL 202, between Bellarena and Castlerock) on 11 May 2004 recommended that NIR should review the signs at UWCs with one objective being to provide users with the most appropriate means of contacting the crossing operator.

133 Signage at the crossing is in accordance with The Private Crossings (Signs and Barriers) Regulations (Northern Ireland) 2007, which includes two possible signs for UWCs. The first of these signs (designated 'Diagram 102' in the regulations) makes reference to crossing with animals, but requires users in vehicles also to contact the signaller before crossing. This is unnecessary at crossing XL202 because sighting is good for vehicle users. The second of the signs (designated 'Diagram 103' in the regulations and the variant used at crossing XL202) does not mention animals and, unlike Diagram 102, does not permit the telephone number of the supervising signal box to be affixed. There is no sign available in the regulations that matches the circumstances found at crossing XL202.

Conclusions

Immediate cause

134 The tractor driver drove his vehicle onto crossing XL202 as train B413 approached.

Causal factors

135 The tractor driver did not see train B413 approaching (paragraph 93).

136 The RAIB has made no recommendations to address this causal factor because the circumstances that gave rise to its occurrence do not lend themselves to an enduring solution, or have already been addressed by work undertaken at the crossing (paragraph 146)

Possible causal factors

137 The tractor driver may have been preoccupied with other matters as he approached the crossing, causing a momentary loss of concentration (paragraph 92).

Possible contributory factors

138 The following factors were possibly contributory to this accident:

- the position of the sun (paragraph 86); and
- the skewed nature of the crossing in conjunction with the position of the tractor's offside roof support pillar which may have combined to impede the tractor driver's view towards the railway out of the right side of his tractor, preventing him becoming aware of the presence of the train as he approached and negotiated the crossing (paragraph 90).

139 Changes made at the crossing since the accident have now eliminated the offsetting of the gates (paragraph 146).

Additional observations

140 The information provided by NIR on the circumstances under which landowners should seek assistance from NIR to ensure safe use of UWCs does not include:

- clarity on the exact circumstances that should trigger such a request;
- information on who, within NIR, should be contacted for assistance; and
- how long before the event the request should be made (paragraph 95, Recommendation 1).

141 The risk assessment undertaken for crossing XL202 is inaccurate (paragraphs 97 and 103, Recommendation 2).

142 Some of the parameters within NIR's crossing risk assessment process model for UWCs need to be reconsidered (paragraphs 103-105, Recommendation 3).

143 NIR has not worked with the landowner to develop a safe system of work for crossing cattle at crossing XL202 (paragraph 131, Recommendation 4).

144 The signs at crossing XL202 are inaccurate for the usage of the crossing, but their wording is constrained by current legislation (paragraphs 131 to 133, Recommendation 5).

145 Some of the passengers found the evacuation ladder to be difficult to use (paragraph 122, Recommendation 6).

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

146 NIR, in consultation with the owner of the land adjacent to crossing XL202, has realigned the road approach to the crossing on the north side to remove the 'dog leg' (paragraph 88), which has resulted in the gates on the north and south side now being located opposite each other.

Recommendations

147 The following safety recommendations are made[2]:

Recommendations to address other matters observed during the investigation

1 NIR should reissue its booklet, 'The Safe Use of User Worked Crossings' to enhance the section on special farm activities to include:

- a clearer description of the circumstances that should trigger a request from a landowner for additional assistance in managing movements at the crossing;
- details of who, within NIR, a landowner should contact for assistance in these circumstances; and
- guidance on how long before the event the request should be made.

NIR should use the reissuing of the guidance booklet and the accident at crossing XL202 as the basis for reminding users how to cross UWCs safely and how to consult with NIR regarding the provision of additional risk mitigation measures under the defined circumstances (paragraph 140).

2 NIR should revise the risk assessment for crossing XL202 to ensure that it more accurately reflects usage of the crossing (paragraph 141).

3 NIR should review its crossing risk assessment model in the light of this investigation report to establish whether the model's accuracy could be improved by reclassifying road crossing user types, giving greater significance to peak usage of the crossing, reconsidering how animal movements are treated in the model and considering the relative importance of factors affecting visibility and audibility of approaching trains for different types of crossing user. Consideration should also be given to the effectiveness of mitigation provided (e.g. sounding of train horns at whistle boards) (paragraph 142).

4 NIR should work with the owner of the land adjacent to crossing XL202 to establish a safe system of work for crossing cattle (paragraph 143).

continued

[2] Duty holders, 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 Department for Regional Development in Northern Ireland to enable them to carry out their 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 at www.raib.gov.uk.

5 NIR should work with DRDNI to add a template to the Private Crossings (Signs and Barriers) Regulations (Northern Ireland) 2007 that is appropriate to the circumstances at crossing XL202 and includes a permitted variant to allow the telephone number of the crossing operator to be added (paragraph 144).

6 NIR should review the design of evacuation ladders to determine whether an alternative design incorporating handrails could be adopted to provide a more robust means for passengers to descend from train to track (paragraph 145).

Appendices

Glossary of abbreviations and acronyms — Appendix A

AA	Accredited Agent
DMU	Diesel Multiple Unit
FFCCTV	Front-Facing Closed Circuit Television
NIR	Northern Ireland Railways
HSE(NI)	Health & Safety Executive (Northern Ireland)
OTDR	On-Train Data Recorder
PSNI	Police Service of Northern Ireland
RAIB	Rail Accident Investigation Branch
RSPG	Railway Safety Principles and Guidance
UWC	User Worked Crossing
WSP system	Wheelslide Protection System

Glossary of terms — Appendix B

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

Accredited Agent	A member of railway staff trained and appointed by the Rail Accident Investigation Branch (RAIB) to record perishable evidence pending the arrival of RAIB inspectors.
Crashworthiness	The capacity of a vehicle to protect its occupants during an impact.
Diesel Multiple Unit	A self-contained diesel-powered train comprising one or more vehicles that can be coupled to other compatible diesel multiple units to form longer trains.
Front-facing closed -circuit television	A CCTV system featuring a camera located in the driver's cab which records the view from the front of the train.
Electric Token Block system	A signalling system for single lines based on the issuing of tokens for each section. Only one token may be released at a time and trains may not enter the section without a valid token, ensuring that only one train may occupy each section at any one time.*
Lookout man	A competent person whose duties are to watch for and to give an appropriate warning of approaching trains.
On-train data recorder	An electronic device wired into a train's electrical systems for the purpose of recording with respect to time key control and system conditions.
Railway Group Standard	A document mandating the technical or operating standards required of a particular system, process or procedure to ensure that it interfaces correctly with other systems, process and procedures.*
Railway Safety Principles and Guidance	The documents produced by Her Majesty's Railway Inspectorate (HMRI) providing guidance on the design and operation of light railways, railways and tramways. Although HMRI has no jurisdiction in Northern Ireland, the guidance in RSPG is used as an exemplar of good practice by Northern Ireland Railways and by the Health & Safety Executive (Northern Ireland) who are responsible for safety enforcement on the railways of Northern Ireland.
Safety Authority	A government body that provides a regulatory framework to enable railway safety to be maintained and, where reasonably practicable, continuously improved. In Northern Ireland, the rail safety authority is the Department for Regional Development in Northern Ireland.
User Worked Crossing	A level crossing where the barriers or gates are operated by the user.*
Wheelslide Protection System	A system which, when active during braking, identifies when train wheels have started to slide and releases and reapplies brakes to optimise braking rate to the level of adhesion available and clean the surface of the rail by friction to improve available adhesion.

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