



**Railway Accident
Investigation Unit**

Ireland



INVESTIGATION REPORT
Car strikes train at level crossing XM250,
Knockaphunta, Co Mayo
8th June 2014

RAIU Report No: R2015 – 002R1
Published: 04/06/2015

Report publication

This report is published by the Railway Accident Investigation Unit (RAIU). The copyright in the enclosed report remains with the RAIU by virtue of section 61(5) of the Railway Safety Act, 2005. No person may produce, reproduce or transmit in any form or by any means this report or any part thereof without the express permission of the RAIU. This report may be freely used for educational purposes. For further information, or to contact the RAIU, please see details below:

RAIU
2nd Floor, 2 Leeson Lane
Dublin 2
Ireland

email: info@raiu.ie
website: www.raiu.ie
telephone: + 353 1 604 1241
fax: + 353 1 604 1351

The original publication details are given below:

Title	Car strikes train at level crossing XM250, Knockaphunta, Co Mayo, 8 th June 2014
Document type	Investigation Report
Document number	R2015-R002V1
Document issue date	04/06/2015

Where the report has been altered following its original publication, details on the changes are given below:

Revision number	Revision date	Summary of changes
V1	08/06/2015	Clarification of units, removal of repeated recommendation, correction of typographical errors.

Reader guide

All dimensions and speeds in this report are given using the International System of Units (SI Units). Where the normal railway practice, in some railway organisations, is to use imperial dimensions; imperial dimensions are used and the SI Unit is also given.

All abbreviations and technical terms (which appear in italics the first time they appear in the report) are explained in the glossary.

Descriptions and figures may be simplified in order illustrate concepts to non-technical readers. Paragraphs from the report will be referenced throughout the report for ease of reading.

Report preface

The RAIU is an independent investigation unit within the Department of Transport, Tourism and Sport (DTTAS) which conducts investigations into accidents and incidents on the national railway network, the Dublin Area Rapid Transit network, the LUAS, heritage and industrial railways in Ireland. Investigations are carried out in accordance with the Railway Safety Directive 2004/49/EC and the Railway Safety Act 2005.

The RAIU investigate all serious accidents. A serious accident means any train collision or derailment of trains, resulting in the death of at least one person or *serious injuries* to five or more persons or *extensive damage* to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety.

The RAIU may investigate and report on accidents and incidents which under slightly different conditions might have led to a serious accident.

The purpose of RAIU investigations is to make safety recommendations, based on the findings of investigations, in order to prevent accidents and incidents in the future and improve railway safety. It is not the purpose of an RAIU investigation to attribute blame or liability.

Report summary

At approximately 18:42 hours (hrs) on Sunday the 8th June 2014, the 15:35 hrs passenger service from Heuston Station (Dublin) to Westport (Mayo) was approaching Knockaphunta level crossing (asset number XM250), situated at Knockaphunta, near Castlebar, Co Mayo when a Toyota Auris approached the level crossing from the Castlebar direction.

As the train travelled through the level crossing, the car drove onto the level crossing and into the side of the train. The car was thrown clear by the impact and into the adjacent drainage ditch next to the level crossing.

The single occupant of the car was cut free from the wreckage by the emergency services and conveyed to Mayo General Hospital, Castlebar. The driver of the car was not seriously injured and was released from hospital after treatment.

This is the third accident at this level crossing where a vehicle has come into contact with a train.

The *immediate cause* of the accident was that a car did not stop at the level crossing and drove into the side of the passing train. Contributory factors associated with accident are:

- The gates at the level crossing were open when the car approached the level crossing, allowing the car to enter onto the level crossing without stopping;
- The level crossing was regularly misused by the local users, whereby the gates are regularly left open.

The underlying cause associated with this accident is the fact that the many actions IÉ have taken in response to previous RAIU safety recommendations (2009 and 2011), have not resolved the issue of level crossing users leaving the gates open.

An additional observation to this accident is that the addition and purpose of the 'new Stop Line' on user worked level crossings is not obvious to users of the level crossing and may cause confusion with the statutory Stop Lines used previously at some level crossings.

As a result of the accident, the RAIU has reiterated two safety recommendations associated with the accident:

- IÉ should upgrade the level crossing to ensure that the operation of the Level Crossing is not reliant on any direct action by the level crossing user;
- IÉ should carry out a full review of known misused user worked level crossings on public and private roads and either upgrade the level crossing or introduce measures to minimise their misuse.

The RAIU also reiterate a recommendation related to an additional observation made during the investigation:

- IÉ should ensure that where a Decision Line¹ is present on a user worked level crossing, that the purpose of this Decision Line is conveyed to the level crossing users.

The RAIU have issued one new recommendation in relation to an additional observation made during the investigation:

- The RSC, RSA and IÉ in consultation with any relevant stakeholders should agree a common policy in connection with instructions and warnings related to user worked level crossings.

¹ This is now referred to as the New Stop Line

Contents

THE ACCIDENT	8
SUMMARY OF THE ACCIDENT	8
PARTIES & ROLES ASSOCIATED WITH THE ACCIDENT	11
<i>Parties involved in the accident</i>	<i>11</i>
<i>Roles involved, directly and indirectly, in the accident</i>	<i>11</i>
<i>Parties not directly involved in the accident</i>	<i>11</i>
GENERAL DESCRIPTION OF THE RAILWAY	13
<i>Infrastructure</i>	<i>13</i>
<i>Rolling stock</i>	<i>14</i>
<i>Signalling and communications</i>	<i>14</i>
<i>Operations</i>	<i>15</i>
FATALITIES, INJURIES AND MATERIAL DAMAGE	15
<i>Fatalities and injuries</i>	<i>15</i>
<i>Material damage</i>	<i>15</i>
EXTERNAL CIRCUMSTANCES	17
RAIU INVESTIGATION.....	18
RAIU DECISION TO INVESTIGATE	18
SCOPE OF INVESTIGATION	18
INVESTIGATION AND EVIDENCE	19
EVIDENCE.....	20
LEVEL CROSSING INFRASTRUCTURE	20
<i>General description.....</i>	<i>20</i>
<i>Signage on the approach to Knockaphunta level crossing</i>	<i>21</i>
<i>Signage on Knockaphunta Level Crossing.....</i>	<i>23</i>
<i>Road markings on Knockaphunta Level Crossing</i>	<i>26</i>
<i>Viewing distance at the Level Crossing</i>	<i>28</i>
<i>Inspection and maintenance of Knockaphunta Level Crossing.....</i>	<i>29</i>
OPERATION OF KNOCKAPHUNTA LEVEL CROSSING	29
<i>Introduction to the operation of OP type level crossings.....</i>	<i>29</i>
<i>Operation of unattended level crossings - RSA's Rules of the Road</i>	<i>29</i>
<i>IE's The SAFE use of Unattended Railway Level Crossings.....</i>	<i>32</i>
<i>The RSC's Third Party Guidance on Railway Risk</i>	<i>32</i>
<i>Operation of the Level Crossing by the Car Driver</i>	<i>33</i>
<i>Frequency of use of Knockaphunta level crossing</i>	<i>35</i>

<i>Misuse of Knockaphunta level crossing</i>	36
<i>Risks associated with the level crossing</i>	37
EVENTS BEFORE, DURING AND AFTER THE ACCIDENT	39
<i>General description</i>	39
<i>Events before the accident</i>	39
<i>Events during the accident</i>	39
<i>Events after the accident</i>	39
SIMILAR OCCURRENCES	40
ANALYSIS	42
KNOCKAPHUNTA LEVEL CROSSING	42
<i>Access to the level crossing and frequency of use</i>	42
<i>Signage and road marking on the approach to, and at, the level crossing</i>	42
<i>Viewing distances at the level crossing</i>	43
<i>Inspection and maintenance of the level crossing</i>	43
OPERATION OF OP LEVEL CROSSINGS AND KNOCKAPHUNTA LEVEL CROSSING	43
<i>General description</i>	43
<i>Misuse of the level crossing</i>	44
ACTIONS TAKEN BY PARTIES ON THE DAY OF THE ACCIDENT	44
<i>Actions of the Car Driver</i>	44
<i>Actions of the Train Driver</i>	44
CONCLUSIONS	46
THE LEVEL CROSSING	46
OPERATION OF THE LEVEL CROSSING	46
<i>Actions of the Car Driver</i>	46
<i>Immediate cause, contributory factors and underlying causes, root causes and additional observations.</i> .	47
RELEVANT ACTIONS TAKEN OR IN PROGRESS	48
ACTIONS TAKEN BY IÉ	48
SAFETY RECOMMENDATIONS	50
GENERAL DESCRIPTION	50
NEW SAFETY RECOMMENDATIONS RELATED TO THE ACCIDENT	50
REITERATED SAFETY RECOMMENDATIONS RELATED TO THE ACCIDENT	50
REITERATED SAFETY RECOMMENDATIONS RELATED TO THE ADDITIONAL OBSERVATIONS	51
<i>New safety recommendation</i>	Error! Bookmark not defined.
ADDITIONAL INFORMATION	52

LIST OF ABBREVIATIONS.....	52
GLOSSARY OF TERMS	52
REFERENCES	54

The accident

Summary of the accident

- 1 At approximately 18:42 hrs on Sunday 8th June 2014, the 15:35 hrs passenger service from Heuston Station (Dublin) to Westport (Mayo) was approaching level crossing XM250, at Knockaphunta, County Mayo. See Figure 1 for the location of the level crossing.

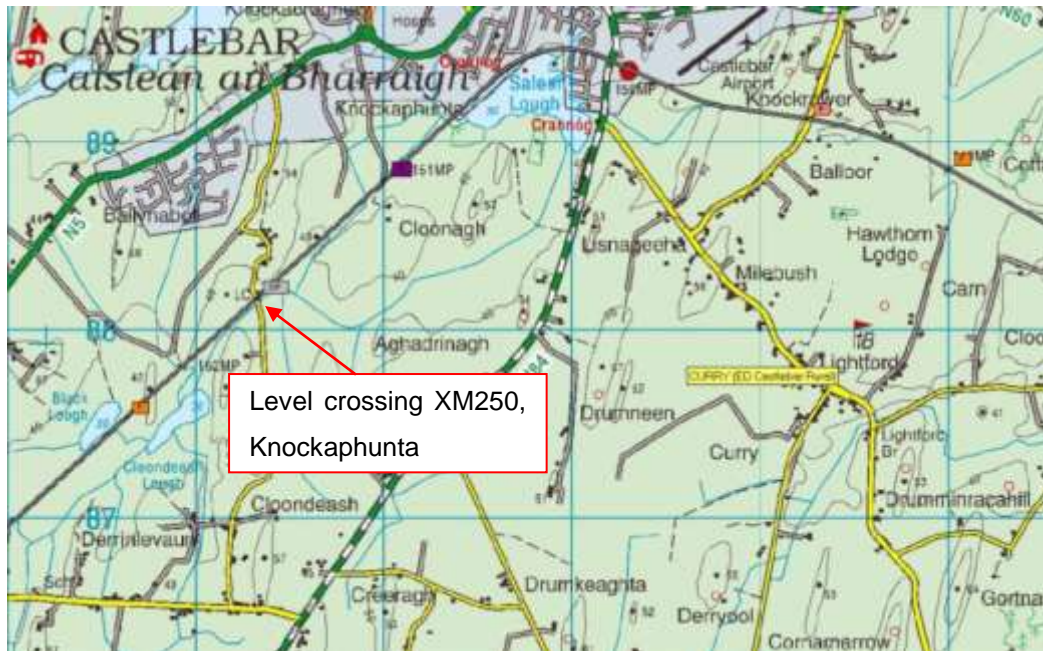


Figure 1 – Location of level crossing

- 2 As the train was travelling through the level crossing, a car approached the level crossing from the direction of Castlebar onto the *up side* of the track (see Closed Circuit Television (CCTV) stills A, B, C of Figure 2 (note: the poor resolution of the CCTV is not weather related but due to a build-up of grime on the camera lens housing). The car did not slow or stop as required on the approach to the level crossing and continued to drive onto the level crossing (see CCTV still D of Figure 2) and into the side of the train (see CCTV still E of Figure 2). The period of time from when the car first came into the view of the train and the impact was 4.46 seconds.



Figure 2 – Car approaching Level Crossing and striking train

- 3 The train driver immediately applied the emergency brake and the train came to a stop beyond the level crossing.
- 4 The car was dragged sideways by the train, breaking through the concrete post and wire fencing and into the ditch adjacent to the level crossing (see CCTV stills G, H of Figure 3).



18:41:51.31 – Car travels through fencing



18:41:51.79 – Car thrown into ditch

Figure 3 – Car clearing the path of the train

- 5 The car came to a stop 10.2 m from the initial point of contact with the train, see Figure 4 (note that the emergency services removed the roof and windscreen of the car to access the car driver).



Figure 4 – Car in drainage ditch adjacent to the level crossing & stopped train

- 6 The front of the train came to a stop 205.8 m from the level crossing and the train driver requested the attendance of the emergency services, which arrived on site approximately ten minutes after the accident.
- 7 The car driver was taken from site to the local hospital for treatment of their minor injuries. There were no injuries to the train driver or any passengers on the train as a result of the accident.

Parties & roles associated with the accident

Parties involved in the accident

- 8 IÉ is the railway *infrastructure manager* (IM), managing the design, installation, testing, inspection, maintenance, renewal and operation of the railway's physical assets. The IÉ department associated with this accident is the Chief Civil Engineer's (CCE) Department – responsible for the design, inspection, maintenance and renewal of the railway's structural infrastructure, including level crossings, and the management of risks associated with these assets.

Roles involved, directly and indirectly, in the accident

- 9 The roles involved in the accident, directly and indirectly are as follows, are the:
 - Car Driver – Local resident with a full driving licence, who was a regular user of the Level Crossing;
 - Train Driver – Qualified, competent and trained in this class of train.

Parties not directly involved in the accident

- 10 RSC – The RSC is the national safety authority, which is responsible for the regulatory oversight of the Safety Management System (SMS) and enforcement of railway safety in the Republic of Ireland in accordance with the Railway Safety Act 2005 and the European Railway Safety Directive. The RSC issues Safety Certificates to Railway Undertaking (RU) and Safety Authorisations to infrastructure managers; and are issued to provide evidence that the railway organisations has established its SMS and can meet the requirements laid down in the national safety laws and European legislation; which is subject to the RSC's regulatory oversight and enforcement of compliance.

- 11 The Road Safety Authority (RSA) – The RSA’s aim is to save lives and prevent injuries by reducing the number and severity of collisions on the road. Some of the ways that the RSA works to improve road safety in Ireland are by:
- Developing and implementing information and education campaigns to increase awareness of road safety and promote safer driving;
 - Undertaking accident and road safety research in order to develop measures and recommendations to improve road safety;
 - Producing road safety strategy documents and monitoring their implementation.
- 12 DTTAS – The role of the DTTAS is to deliver critical aspect of Ireland’s economic activity including further development to the transport infrastructure and services and the support and enhancement of significant tourism and sport sectors.
- 13 NTTX Ltd – External consultant engaged by IÉ to assist the IÉ Signage Review Group in focusing on the human factor aspects of level crossing signage. They were also key to ensuring that the messages conveyed through each of the signs were in alignment with the key safety risks.

General description of the railway

Infrastructure

- 14 The line from Athlone to Westport is a single track *bidirectional line*. The track is plain line with *flat bottom continuously welded rail* (CWR) mounted on concrete sleepers in ballast. No factors in relation to the condition of the track were found to have contributed to the accident.
- 15 Knockaphunta is located within one kilometre (km) from Castlebar town. The level crossing is located on a public regional road which connects the N5 national road (Longford to Westport) to the N84 national road (Castlebar to Galway) see Figure 5. The speed limit for this section of road is 80 kilometres per hour (km/h).



Figure 5 – Knockaphunta Level Crossing, XM250 (with user operated gates open)

- 16 IÉ have designated the level crossing as an OP Type crossing (Occupational on a Public Road) and is identified by IÉ as asset number XM250. OP Type crossings are unattended level crossings, on public roads, where the level crossing gates are normally closed to road traffic. They are *user operated*, meaning they require the user to open and close the level crossing gates in order to cross the railway.

Rolling stock

- 17 The train involved in the accident, was the 15:35 hrs passenger service from Heuston (Dublin) to Westport (Mayo), train identification number A804, which was due to arrive, on time, in Westport at 19:00 hrs.
- 18 The service was operated by a six carriage Class 22000 *Diesel Multiple Unit* (DMU), consisting of carriages 22353, 22453, 22253, 22203, 22403, 22303. Carriage 22353 was the leading carriage at the time of the accident. The six carriage unit is 140 m long and has a mass of 378 tonnes. The maximum allowable speed of the DMU is 160 km/h.
- 19 The *on-train data recorder* (OTDR), fitted to the leading carriage, recorded that the train had been travelling at a speed of 43 mph (68.8 km/h), the speed limit of this section of track is 45 mph (72 km/h). When the train driver applied the emergency brake, and it took 16 seconds to come to a stop.
- 20 The OTDR also recorded that the train horn had been sounded at the location of the *whistle board* and on approach to the level crossing. In addition, the ODTR and the on board CCTV show that the Train Driver sounded the horn one second after seeing the car approaching the level crossing, and applied the emergency brake three seconds later.
- 21 A technical examination of the train found no defects and all warning devices were operating properly.
- 22 No factors in relation to the condition or performance of the train contributed to the accident.

Signalling and communications

- 23 The single track route from Athlone to Westport is signalled using two and three aspect *colour light signals*, controlled by the Mayo Line Signaller, located in Athlone Signalling Centre. *Track Circuit Block* (TCB) regulations apply to this route.
- 24 The means of communication between the train drivers and the Mayo Line Signaller on this route is through train radio.
- 25 No factors in relation to the condition of the signalling and communications systems were found to have contributed to the accident.

Operations

- 26 The train service was a driver only service, meaning that the only crew on the train was the Driver. The movement of trains on the Athlone to Westport line is controlled by the Mayo Line Signalman.
- 27 IÉ have imposed a Temporary Speed Restriction (TSR) of 45 mph (72 km/h) on trains approaching the level crossing, whistle boards are also in place on the approach to the crossing to alert road users to an oncoming train.
- 28 The Train Driver was a qualified driver with all competency documentation up to date.
- 29 No factors in relation to operations were found to have contributed to the accident.

Fatalities, injuries and material damage

Fatalities and injuries

- 30 There were no fatalities as a result of this accident.
- 31 The Car Driver was taken to hospital for minor injuries as a result of the accident.
- 32 The Train Driver or passengers (there were 38 passengers on board) did not suffer any injuries as a result of the accident.

Material damage

- 33 The car, a 2009 registered Toyota Auris, was extensively damaged as a result of the accident, Figure 6. Note that the roof and windscreen were removed by the emergency services.



Figure 6 – Damage to car

- 34 The train was struck on the side damaging the external cabinets and panel, approximately 7 m from the front of the train, see Figure 7.



Figure 7 – Damage to the side of the train

- 35 The concrete post and wire fencing at the level crossing was knocked over by the car, on impact, see Figure 8.

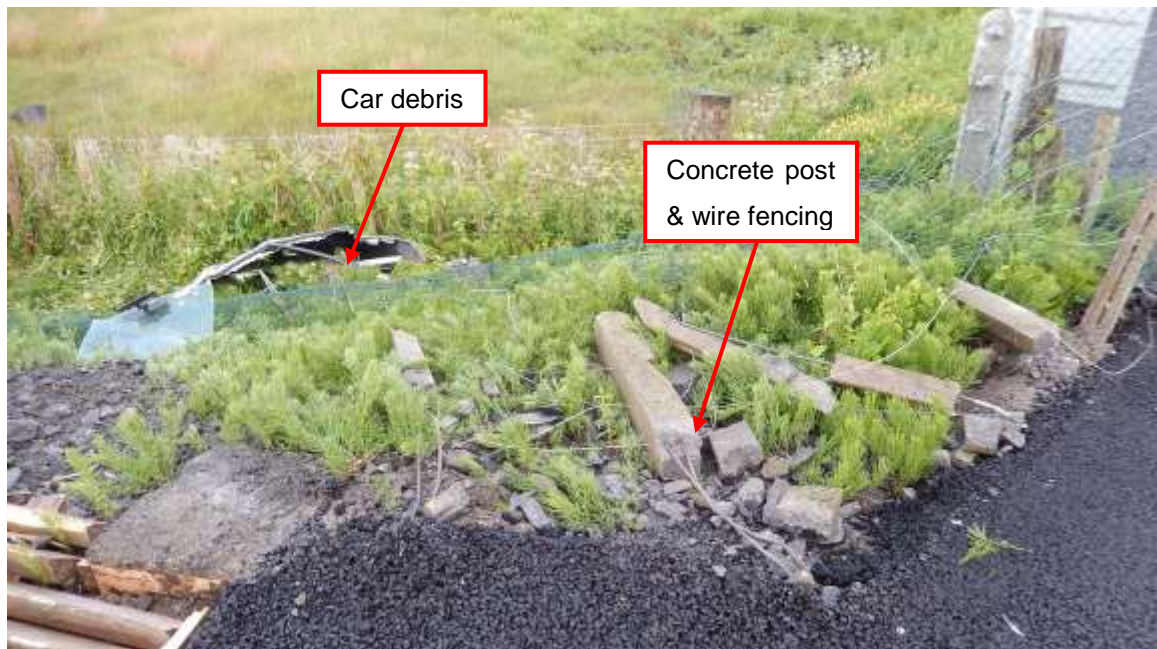


Figure 8 – Damage to level crossing fencing (with debris from car in the background)

External circumstances

- 36 The weather at the time of the accident was fine with good visibility. The weather report from Met Éireann (Claremorris) for the day of the accident recorded that the average temperature was 16 degrees Celsius; the mean wind speed was 7.5 knots and there was 10.8 millimetres (mm) of rainfall recorded for the day.

RAIU Investigation

RAIU decision to investigate

- 37 In accordance with the Railway Safety Act 2005 the RAIU investigate all serious accidents. Given that under slightly different conditions, this accident may have led to a serious accident where there would have been potential for fatalities and serious injuries, to the Car Driver, passengers and IÉ staff due to the possible derailment of the train, a decision was made to investigate under article 19 (2) of the Railway Safety Directive (EC, 2004).

Scope of investigation

- 38 The RAIU must establish the extent of the investigation to ensure that only pertinent information is recovered and reviewed. Therefore, for this accident, the RAIU have defined the following scope:

- Establish the sequence of events;
- Establish, where applicable, the immediate cause, contributory factors and underlying causes and *root causes*;
- Examine the design, inspection and maintenance regime for the level crossing;
- Examine the standards and procedures associated with the inspection and maintenance regime;
- Examine other near misses at the level crossings and other local level crossings;
- Examine any other significant safety deficiencies identified as a result of this investigation.

- 39 A number of RAIU safety recommendations from previous RAIU investigations will also be reviewed as part of this investigation. The scope of this investigation will include a review of the actions taken by IÉ and the RSC as a result of these safety recommendations. The investigations of relevance are as follows:

- Car Strike at Morrough Level Crossing, XG173, County Galway, 14th February 2011;
- Car Strike at Knockaphunta Level Crossing, XM250, County Mayo, 24th October 2010;
- Collision between a train and a road vehicle at level crossing XN125, Cappadine, on the Ballybrophy to Killonan line 31st of July 2008;
- Fatality at Level Crossing XX032 between Ballina and Manulla Junction on the 28th of February 2008.

Investigation and evidence

40 During the on-site and off-site investigation the RAIU collated the following evidence:

- Photographic record of the accident;
- Witness evidence from parties involved in the accident (car and train drivers);
- Other evidence from members of the IM with information pertaining to the accident;
- IÉ Infrastructure standards, procedures and other documentation;
- Standards, procedures and documentation from other relevant bodies;
- RAIU investigation reports related to level crossing accidents;
- Evidence of actions taken by IÉ as a result of the RAIU investigations.

Evidence

Level crossing infrastructure

General description

- 41 Knockaphunta Level Crossing is located on the Mayo Line at 151 miles 1141 yards from Dublin (Broadstone). As mentioned previously IÉ have designated the level crossing as an OP type crossing and is identified as asset number XM250.
- 42 The level crossing gates are 4.3 m wide metal gates positioned on each side of the level crossing, which open away from the railway. The surface of the intersection of the road with the track is stone mastic asphalt, which provides a level surface over the track. *Cattle grids* are installed adjacent, on each side of the roadway, where it crosses the track. There is concrete post and wire fencing running between the gates and the boundary hedges. See Figure 9 for some of the features of the level crossing.



Figure 9 – Features of the level crossing

- 43 A residential dwelling (an old railway building) and shed are located 20 m and 15 m, respectively, from the up side of the Level Crossing, see Figure 10.



Figure 10 – Residential dwelling and shed

Signage on the approach to Knockaphunta level crossing

- 44 On both approaches to the level crossing, the 'Level Crossing with No Flashing Red Signals' (W121) warning signs, as designated in the Traffic Signs Manual 2010, are positioned as count-down signs at 100 m intervals (at 300 m, 200 m and 100 m), see Figure 11.

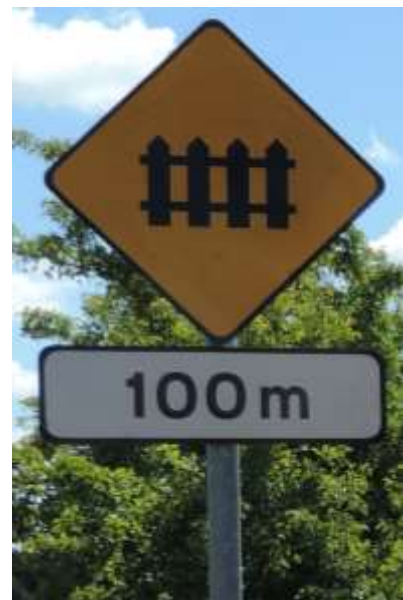


Figure 11 – Level Crossing with No Flashing Red Signals

- 45 Historically, this W121 sign was supplemented with an additional information sign with the word 'Unattended' in black on a white background, giving the road user a reminder that they were approaching an unattended gated user operated level crossing, see Figure 12.



Figure 12 – Signage at Knockaphunta Level Crossing in December 1967

- 46 In addition to the W121 signage, there are two 'Accident Black Spot' signs situated between the 100 m sign and the level crossing on the up side approach, see Figure 13.



Figure 13 – Accident Black Spot signs

Signage on Knockaphunta Level Crossing

47 The Level Crossing is not protected by roadside traffic signals and there is no *lineside telephone* provided at the Level Crossing. Information to the user is provided through signage on the level crossing. The signage at Knockaphunta Level Crossing, was erected in June 2010 and consists of a:

- 'Stop' sign located within the railway boundary;
- IÉ 'Danger' sign, in the English language, including the statements: "unattended railway crossing"; "stop, look both ways, listen, cross safely, shut the gates"; "you must shut the gates – save lives" and penalty notice (Figure 14);
- IÉ 'Danger' sign in the Irish language, including the above statements in Irish;
- IÉ 'Keep these gates shut' sign which includes requirements related to closure of the gates and penalty notices associated with the failure to close gates (Figure 14);
- IÉ 'Have you shut the crossing gates?' signage, which is located on the rear of the IÉ 'Danger' signage (Figure 15).



Figure 14 – 'Danger' & 'Keep these gates shut' signage



Figure 15 – 'Have you shut the crossing gates' signage, exiting the level crossing

48 The signage at the Level Crossing is compliant with IÉ Technical Management Standard CCE-TMS-380, 'Technical Standard for the Management of User Worked Unattended Level Crossings' issued July 2013 (which will be referred to as CCE-TMS-380 for the remainder of the report).

- 49 In addition to the IÉ signage a stop sign is fixed to the centre of the gate and an additional stop sign is located on the left side on the approach to the crossing as stipulated in the DTTAS Traffic Signs Manual (2010) Section 6, see Figure 16. Section 6.15.9 of the Road Signs Manual (2010) states that “At crossings with gates, a stop sign shall be fixed to the gate such that, when the gate is closed, the sign is approximately in the centre of the approaching road traffic lane. However, where the gates are operated by the road user or where attendant operated gates are not interlocked with the railway signals, a stop sign shall also be erected on a post on the verge adjacent to the crossing stop line. This sign is required to ensure that all traffic stops before crossing, as the presence of an open gate does not mean that a train cannot cross”.



Figure 16 – Stop signal on gate

- 50 Although the signage exceeds the requirements set out in CCE-TMS-380, the suitability of this signage was questioned by the RAIU during previous level crossing investigation, namely the ‘Car Strike at Murrough Level Crossing, XG173, County Galway, 14th February 2011’. This investigation report, published in February 2012, recommended that “IÉ should review the suitability of the signage at user worked level crossings on public and private roads, ensuring the human factors issues are identified and addressed”.
- 51 As a result of this safety recommendation, IÉ engaged external human factors consultants, NTTX Ltd, to review and develop new information signage which is currently on trial. In an NTTX Ltd report, published in January 2013, NTTX Ltd found that the older signage, as shown in Figure 16, was “busy and confusing”. IÉ then commissioned NTTX Ltd to develop new signage, an example of this new signage is shown in Figure 17, this signage is currently being trialled at Level Crossing XN240, Kilnageer, Manulla, Co. Mayo.



Figure 17 – New signage being trialled by IÉ

- 52 The new signage gives the user instructions on the safe method of crossing, such as how to use the stop line (discussed in paragraph 58) painted on the road and instructions to open the driver's window and turn off any music.
- 53 At the time of publications of this report, there is no definitive result of the outcome of this trial from IÉ IM.

Road markings on Knockaphunta Level Crossing

- 54 There is no continuous white stop line (referred to as the Stop Line for the remainder of the report) sometimes associated with the 'Stop' sign (referred to as the Stop Sign for the remainder of the report).
- 55 The 2010 Traffic Signs Regulations also specify the design requirements of the line, stating "a 200 mm wide stop line indicates the position of which a vehicle must be brought to a complete halt. At signals for level crossings the stop line shall be 300 mm wide (Section 7.2.2). There is also provision in the 2010 Traffic Signs Regulations for the provision of a longitudinal line projecting from the Stop Line, see Figure 18.

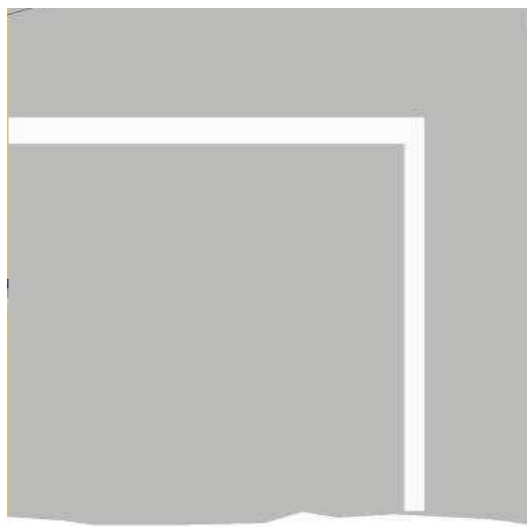


Figure 18 – Longitudinal line

- 56 The Stop Sign should ideally be sited 1.5 m in advance of the Stop Line, but in circumstances where this would lead to impaired visibility of the Stop Sign this may be increased to a distance not exceeding 6 m. Although, IÉ recognise that the Stop Line is the most suitable road marking for level crossings, IÉ do not consider this to be usable on roads with limited road width.
- 57 As a result of this and the RAIU safety recommendation "IÉ should assess the risks relating to road users' behaviour in identifying a safe stopping position at User Worked Level Crossings and based on the outcome of this risk assessment, IÉ should introduce measures to allow safe use of this type of level crossing" made on the 29th July 2009 in the RAIU investigation report 'Collision between a train and a road vehicle at level crossing XN125, Cappadine, on the Ballybrophy to Killonan line 31st of July 2008', IÉ consulted with the DTTAS in relation to a substitute line on roads with limited road widths.

- 58 As a result of this consultation, IÉ have commenced painting a 300 mm white line, in the place of any other Stop Line. These white lines are to indicate, to the level crossing user, the safe distance that a vehicle user can stop without the vehicle encroaching onto the path of trains, this is sometimes referred to as the 'decision point' i.e. the point where the motorist decides to cross if safe to do so, and is referred to in this report as the New Stop Line.



Figure 19 – New Stop Line at the level crossing

- 59 As a result, there is a 300 mm continuous white line is painted from the left edge passed the centre onto the roadway; it continues as a broken white line to the right edge of the roadway. The line is located approximately 2 m from the nearest rail on each of the level crossing road approaches, see Figure 19. There is no longitudinal line projecting from this line.
- 60 This was considered by IÉ as a working compromise to be used on narrow roads and was agreed with the DTTAS. The concept being that where a road was too narrow to facilitate a longitudinal line in the centre of the road the stop line was agreed as solid over two thirds of the road way and the remainder broken, so not to give the impression the road is one way.

Viewing distance at the Level Crossing

61 The level crossing was surveyed on the 8th June 2014 and the viewing distances met the requirement of 'IÉ Technical Standard for the Management of User Worked Unattended Level Crossings, CCE-TMS-380' published in July 2013, in full, the distance required for a line speed of 45 mph (72 km/h) being 225 m. The viewing distances were recorded as:

- Up Side towards Castlebar – 700m;
- Up Side towards Westport – 716m;
- Down Side towards Castlebar – 700m;
- Down Side towards Westport – 1000m.

62 On the approach to the level crossing from the direction of the N5, there is a dwelling house with a wooden shed to the rear of the property. Figure 20 show how the drivers view is obscured by the house and shed on approach to the level crossing. However, the view towards Castlebar from behind the New Stop Line is clear and unobstructed, Figure 21.



Figure 20 – House on the approach to level crossing



Figure 21 – Car Driver's view behind New Stop Line

63 There is an annual inspection of all crossings by IÉ and a vegetation management programme to ensure that all crossings have correct and safe viewing distances for users. The last vegetation control was on the 15th May 2014 this comprised cutting back vegetation for 300m on both sides of the crossing and weed spraying.

Inspection and maintenance of Knockaphunta Level Crossing

- 64 The level crossing is patrolled once per week by a Patrol Ganger in compliance with 'Track and Structures Inspection Requirements' IÉ Technical Management Standard CCE-TMS-361 'Technical Standard for Track Patrolling'.
- 65 The last scheduled work on the crossing was an upgrade carried out during March/April 2014 where railings were upgraded, new concrete posts and resurfacing of the crossing. The New Stop Line as shown in Figure 19 was reapplied and the stop sign relocates to the left hand side on the approach road.

Operation of Knockaphunta level crossing

Introduction to the operation of OP type level crossings

- 66 As an introduction to the use of OP type level crossing, this section of the report will describe three documents related to the safe use of level crossings available to members of the public. The documents in place at the time of the accident, and still current at the time of publication of this report, are as follows:
- The RSA's 'Rules of the Road', last updated in December 2013; (RSA have a Safety at Level Crossings leaflet which summarises safe use of crossings in the Rules of the Road)
 - IÉ's 'The SAFE use of Unattended Railway Level Crossings', last updated in April 2013;
 - The RSC's 'Third Party Guidance on Railway Risk, Volume 3, Crossing the Railway', document number RSC-G-012-A, published in April 2008.
- 67 All three documents are available on their respective websites. However, it should be noted that the 'Rules of the Road' are the only document which is mandatory and on which a driver would be tested as part of the driving test for the provision of a driving licence.

Operation of unattended level crossings - RSA's Rules of the Road

- 68 Pages 85 – 87 of the RSA's 'Rules of the Road' contains guidance on the operation of unattended level crossings with iron gates (including OP type crossings). The document includes an illustration of the approach signage for the level crossing, which is signage W121 (previously mentioned in this report) which according to the Traffic Signs Manual 2010 means 'Level Crossing with No Flashing Red Signals'; and



Figure 22 – W121

according to the Rules of the Road means “Level crossing ahead, guarded by gates or lifting barriers”. The document also provides an illustration depicting an unattended level crossing, see Figure 23.

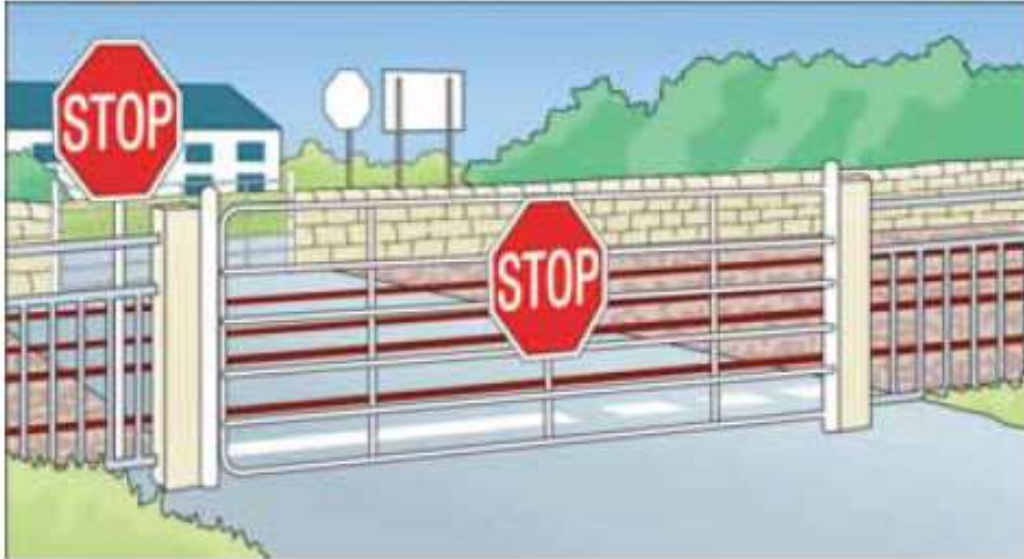


Figure 23 – Unattended level crossing gates as depicted in the Rule of the Road

- 69 The document states that “these unattended level crossings are found on minor roads. The railway is normally guarded by iron gates which must be kept shut – there is no other protection. The user has the responsibility to open and shut the gates”. It continues “these crossings can be dangerous to use and drivers should use all available help to cross safely. It is preferable for drivers to use a bridge or an attended or automated level crossing where one is available”.
- 70 The Rules of the Road describes actions that the driver “should” and “must” do when operating the level crossing, see Figure 24. These include actions related to preparation to cross, crossing and requirements to shut the gates.

Drivers – what you **should** do

Prepare

- STOP clear of the gates
- Switch off phone and music systems
- Open windows on driver and passenger sides
- Read instructions at the crossing
- Get a helper to operate the gates if possible

Drive across safely

- First walk across and open both gates
- Drive forward and STOP two metres clear of the railway line
- Apply your handbrake
- Look right and left and listen
- Drive across quickly when the railway is clear
- Stop well clear of the tracks on the opposite side

Drivers – what you **must** do

Shut gates at unattended level crossings

- You must shut and fasten the gates as soon as you and any person, animal or vehicle under your care has passed through
- Even if the gates are open when you arrive, you must shut and fasten them after you to protect others.
- Failure to shut and fasten the gates is an offence

Figure 24 – Driver requirements set out in the RSA's Rules of the Road

71 The requirement to shut the gates is further highlighted in the document, stating that failure to close to gates is an offence, see Figure 25.



Figure 25 – RSA highlighted information

72 These instructions are simplified in the Rules of the Road documents as the “Rail Cross Code”, see Figure 26. Additionally the RSA have published compact publication ‘Safety at Level Crossings’ which summarises the requirements and dangers for level crossing users (Figure 24).

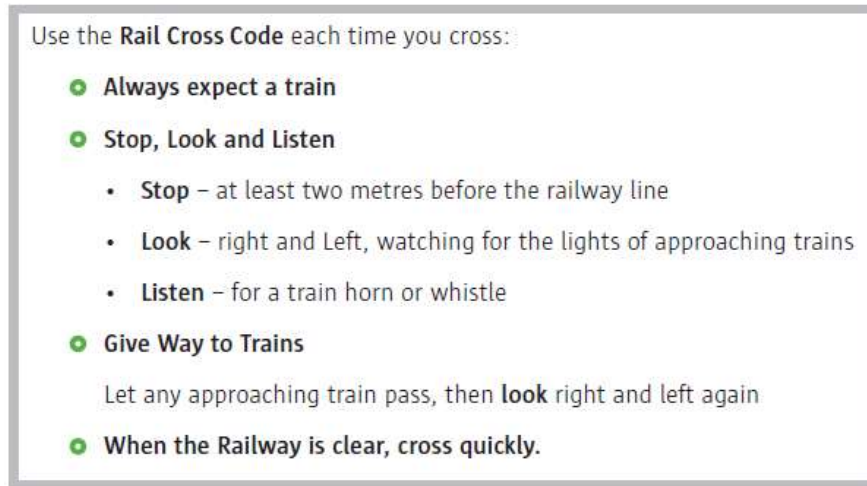


Figure 26 – RSA's Rules of the Road 'Rail Cross Code'

IE's The SAFE use of Unattended Railway Level Crossings

73 IE's booklet 'The SAFE use of Unattended Railway Level Crossings' was first published in July 2001, with the latest edition, published in April 2013, in place at the time of the accident. This booklet is accessible on line and has been issued by IE to twenty-two known users of the level crossing.

The RSC's Third Party Guidance on Railway Risk

74 The RSC's 'Third Party Guidance on Railway Risk, Volume 3 (2008), Crossing the Railway', document number RSC-G-012-A (referred to as RSC-G-012-A for the remainder of the report) identifies the hazards associated with unattended level crossing (such as O/OP crossings), see Figure 27.

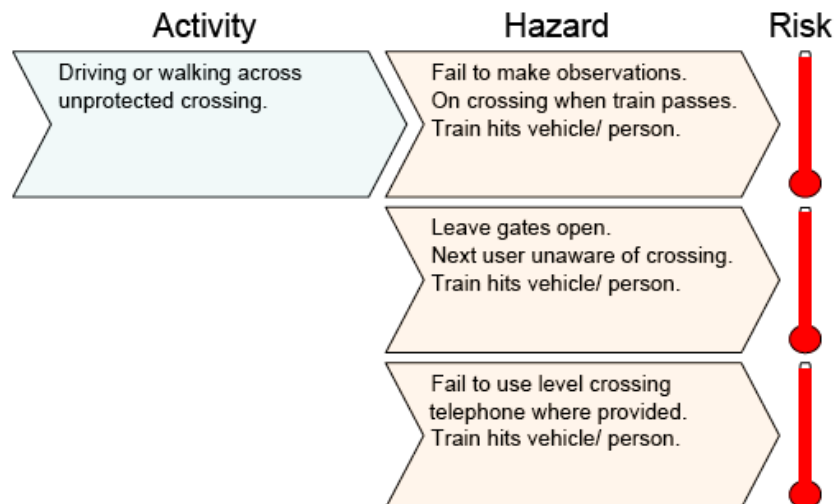


Figure 27 – RSC Hazards associated with unprotected crossings

75 RSC-G-012-A refers to the IÉ booklet 'The Safe Use of Unattended Level Crossings' for comprehensive guidance related to the use of unprotected crossings; RSC-G-012-A does not reference the RSA's Rules of the Roads as the publication pre dated the amended RSA guidance.

Operation of the Level Crossing by the Car Driver

76 On the day of the accident, the Car Driver approached the Level Crossing with the gates open and did not slow or stop at the stop sign on the approach to the Level Crossing but drove onto the Level Crossing without looking for approaching trains.

77 The Car Driver described to the RAIU, their understanding of the safe operation of the Level Crossing, which entailed stopping at the Level Crossing to open the gates (at the point that the road surface changes), opening the gates, looking for trains as the gates were opened and continuing over the Level Crossing. The Car Driver was unaware that they were supposed to then move forward towards the Stop Line at the crossing and look for approaching trains from this position, see Figure 28.



Figure 28 – Car Driver's stopping position and New Stop Line stopping position

78 In should be noted that the stopping position used by the Car Driver is in the same position as the old position of the Stop Sign, see Figure 29. This signage was changed in June 2010.



Figure 29 – Old signage at the Level Crossing (pre 2010)

- 79 In the RAIU investigation report, published in October 2011, 'Car Strike at Knockaphunta Level Crossing (XM250), County Mayo, 24th October 2010' the RAIU identified that "The Car Driver had intended to stop in a safe place prior to crossing the Level Crossing, however, given that the Level Crossing gates were open when he approached the Level Crossing, in conjunction with the absence of any obvious indications for a decision point, the driver miscalculated their stopping distance and position, and encroached into the pathway of the train.
- 80 They were also unaware, given that he had not been issued with IÉ's booklet that the "a train overhangs the rails by a considerable amount". The absence of a decision point in this instance was found to be a contributory factor to the accident "There are no road markings or marker posts at the Level Crossing identify the decision point for users to allow them to stop clear of the railway line and make a decision to cross safely or wait".
- 81 As a result of this IÉ started to mark this point of the crossing with the white stop line.

Frequency of use of Knockaphunta level crossing

- 82 The risk assessment in place at the time of the accident in 2010, which had been last updated in March 2009, recorded the daily vehicle usage (including cars, vans, buses and tractors) at the level crossing as 116, with an additional 20 pedestrians.
- 83 An independent traffic survey on the 7th – 8th May 2011 over a 24 hour period, recorded the daily vehicle usage, with 130 vehicles using the level crossing, while the pedestrian usage remained at 20. This show an increase in the frequency of use of the level crossing.
- 84 Additionally an IÉ survey conducted during the month of April in 2011 during a continuous two week period indicated that 1820 vehicles passed through the crossing during that period.
- 85 It cannot be determined how many of the level crossing users are local users, familiar with the level crossing or unfamiliar users.
- 86 Additionally, Castlebar Rugby Club is located on the public regional road, close to the level crossing which draws additional road users into the area.
- 87 As part of the RAIU investigation, the RAIU investigators found that satellite navigation systems were directing traffic over the level crossing for assess to Castlebar when approaching Castlebar from the Dublin direction.

Misuse of Knockaphunta level crossing

- 88 Misuse is identified as an offence in Part 14, Section 131(1) of the Railway Safety Act 2005, stating that: “Where a person fails to shut and fasten the gate of a level crossing or passage to which this section applies, as soon as he or she or any animal or vehicle under his or her care has passed through the level crossing or passage, he or she is guilty of an offence and is liable on summary conviction in respect of every such offence to a fine not exceeding €1,000.”
- 89 IÉ’s risk assessment at the time of the accident identified that the gates of Knockaphunta level crossing are frequently left open to road traffic and that this misuse of the level crossing. In relation to other level crossings, this was above average.
- 90 Section 20.9 of IÉ’s ‘The SAFE use of Unattended Railway Level Crossings’ booklet states: “Always remember that you are liable to a fine in excess of €600 and/or 6 months imprisonment for failing to shut the level crossing gates.”
- 91 In 2007, four Castlebar residents were brought before the local district court on charges of failing to close the Level Crossing gates at Knockaphunta after travelling across the railway. Two of these users had been issued with IÉ’s ‘The SAFE use of Unattended Railway Level Crossings’ booklet in 2006. The residents were not convicted by the district court for the offence.
- 92 In 2009, the RAIU published investigation report ‘Fatality at Level Crossing XX032 between Ballina and Manulla Junction on the 28th of February 2008’ which recommended that “IÉ must identify crossing that are regularly misused and take proactive action to manage the risk created by this misuse”.
- 93 In 2010, due to the number of incidents reported in connection with misuse, which will be discussed in the ‘Similar Occurrences’ section of this report, IÉ sought planning permission for the construction of a bridge over the level crossing. This planning permission was granted by Mayo County Council in July 2012. However, the permission was on the condition that a much larger bridge be constructed.
- 94 On the 27th January 2015 IÉ-IM representatives met with Mayo County Council representatives and presented them with drawings containing modified proposals for the bridge installation at XM250, Mayo County Council is to this progress with the consultants.
- 95 In 2011, as part of an investigation into an accident at Knockaphunta Level Crossing ‘Car Strike at Knockaphunta Level Crossing, XM250, County Mayo, 24th October 2010’ the RAIU re-iterated the safety recommendation made in 2009 related to identifying and taking action at regularly misused level crossing. The report also recommended that “IÉ should upgrade the Level Crossing to

ensure that the operation of the Level Crossing is not reliant on any action taken by the level crossing user”.

- 96 In December 2012 IÉ wrote to Mayo County Council expressing concern at the speed of road traffic on approach to the level crossing and requested that the Council consider the implementation of traffic calming measures, specifically speed ramps. The Council were opposed to speed ramps and advised IÉ that speed ramps may not be appropriate given the ramps would be in an 80 kph zone and the 1998 Road Traffic (Bollards and Ramps) Regulations (S.I. no 32 of 1988) and the Road Traffic Act 1994 which forms the basic legislation and regulations for the provisions of ramps on public roads refer to this.
- 97 In the month previous to this accident, the gates were reported open to the railway by IÉ staff twenty-four times; there is no record of mis-use number prior to this date. However, it is known to IÉ that these gates are frequently left open. It was also reported that the Level Crossing users generally do not come to a full stop when they approach the Level Crossing when the gates are open. With the speed limit of 80 km/h at the Level Crossing, cars are able to approach the Level Crossing at speed.
- 98 As noted in RAIU investigation report ‘Vehicle struck by train at Corraun level crossing, XX024, Co. Mayo, 12th February 2014’ this misuse can result in frequent users adopting unsafe habits, such as leaving gates open, and taking into account that most users rarely encounter a train; an informal approach by the user of the level crossing has developed over time. Misuse has continued despite a public awareness campaign in April 2013.

Risks associated with the level crossing

- 99 IÉ Senior Track and Structures Engineer maintains a risk register for all level crossings on the network, the risk register shows that there were no outstanding risks on the register at the time of the accident. Risks associated with misuse are included in the Level Crossing Risk Model (LCRM).
- 100 The LCRM is a tool used to calculate the ranking of collective and individual risk at level crossings. This is done by way of a computer programme using a ranking system that establishes the risk at each level crossing based on data specific to each crossing on the network.
- 101 The risk model plays an important part in assisting IÉ in its risk evaluation and decision making process, by allowing a risk evaluation of all crossings it allows decision support for the management of risk both on an on-going day to day basis as well as overall from a strategic point of view.

102 It is used to evaluate the continually changing risk profile at crossings, as this risk profile is always variable, by evaluating risk, including the tolerability of risk at crossings. It also allow IÉ more strategic decision support for the undertaking of other aspects of their overall strategy for managing user worked level crossings.

103 The order of risk is ranked from the highest number 1 to the lowest which at the time of the accident was 1050. The LCRM Model calculates the ranking when new data is inputted and generates a Collective Risk and an Individual Risk:

- *Collective Risk* is the totality of risk to all exposed groups from one or more hazardous events;
- *Individual Risk* is the risk to a typical person exposed to one or more hazardous events.

104 The ranking for the Level Crossing on the day of the accident was a *Collective Risk* Rank 1 and an *Individual Risk* Ranking of 13, XM250 is classed by IÉ as having a high risk but manageable with the mitigation measures in place.

105 The level crossing at Knockaphunta and another similar OP level crossing at Kilnageer (XM240), Mayo, account for 40% of all near miss incidents involving trains and road vehicles on the network.

106 Level crossings, and in particular user worked level crossings, present the biggest infrastructural risk on the rail network. IÉ have over 800 of these type of crossings throughout the network, the challenge's for achieving optimal reductions in risk to level crossing users as well as to IÉ customers and staff are significant.

107 IÉ have stated that in recent years these challenges have been accentuated by major reductions in funding provisions. Whereas previously when greater funding was available elimination of individual crossings may have delivered a positive safety cost benefit, currently the reduced funding has necessitated IÉ spreading funding across the wider asset base to ensure that overall risk levels at individual crossings remains at a tolerable level.

108 This strategy is aimed at utilising funding over a number of high risk crossings and achieving a degree of risk reduction at each, rather than utilising the available expenditure in a single large scale capital investment at a single crossing.

109 This strategy has been shown by IÉ to deliver a greater risk reduction to the network and therefore a greater safety cost benefit.

Events before, during and after the accident

General description

110 This section in the report, outlines the key events before, during and after the accident.

Events before the accident

111 At 18:40 hrs the train departed Castlebar Station and at 18:41hrs was approaching Knockaphunta Level Crossing.

112 The Train Driver sounded the horn twice as the train approached the level crossing, and slowed the train to 43 mph (68.8 km/h) in preparation for the 45 mph (72 km/h) TSR.

113 The front lights of the train were illuminated and found to be working correctly.

114 The gates of the level crossing were open as a car approached from the right hand side of the train (from the Castlebar direction) and did not slow or stop as it approached the level crossing (the CCTV shows that the brake lights of the car did not illuminate as it approached the level crossing).

Events during the accident

115 The Train Driver noticed the car just as he was arriving on the level crossing. As the front of the train passed through the level crossing, the Train Driver felt a slight impact and heard the sound of the vehicle colliding with the train.

116 The car had struck the side of the train (7 m from the front of the train) and took 4.46 seconds from when the car first came into the view of the train until the point of impact.

Events after the accident

117 The Train Driver immediately applied the emergency brakes, and the front of the train came to a stop 205.8 m beyond the level crossing and the car came to rest 10.2 m from the crossing.

118 The Train Driver immediately made an emergency call to the Controlling Signaller in the Athlone Control Centre and then made his way back to the upturned car.

119 The Train Driver was able to ascertain that there was one occupant in the vehicle and this person was conscious.

120 The Emergency Services arrived on the scene within approximately ten minutes. The Car Driver had to be cut from the wreckage by the Fire Service and conveyed to Mayo General Hospital in Castlebar for treatment, the drivers injuries were of a minor nature.

Similar occurrences

121 There have been a number of accidents/near misses at Knockaphunta Level Crossing, starting with the most recent the incidents are as follows:

- 03/04/2014 – Near miss between train and car driven onto the level crossing, no injuries reported;
- 01/04/2014 – Member of the public walked in front of a train, no injuries reported;
- 14/10/2013 – Near miss between a train and van driven onto the level crossing, no injuries reported;
- 07/07/2013 – Near miss car driven across the level crossing in front of an approaching train;
- 01/06/2013 – Near miss between train and a 4x4 driven onto the crossing;
- 10/11/2011 – Near miss between a train and van;
- 29/04/2011 – Near miss with a van;
- 24/10/2010 – Train struck a car which drove onto the crossing no injuries reported;
- 11/06/2009 – Passenger train involved in a near miss with a van which drove across in front of the train.
- 11/02/2004 – Passenger train involved in a near miss with a car which drove across in front of the train;
- 24/06/1998 – Car was struck on the crossing, no injuries reported.
- 23/12/1967 – Four persons fatally injured and three seriously when the Morris Minor van driver drove onto the level crossing, without stopping, and were impacted by a goods train.

122 There has been a history of misuse by users on level crossings on the IÉ network. There have been ten level crossing incidents, on user worked level crossings, reported to the RAIU since 2007, which are as follows (where a full RAIU investigation was conducted, the report number is included:

- XN104 – Roscrea to Birdhill line, 28th June 2007 a tractor and trailer were struck by a train no injuries reported, RAIU Report 07062801;
- XX032 – Dillons Crossing, Ballina to Manulla Junction, 28th February 2008 a tractor was struck by a train, the tractor driver was fatally injured, RAIU Report 08022801;
- XN125 – Cappadine Crossing, Ballybrophy to Killonan line, 31st of July 2008 private car struck by a train no injuries reported, RAIU Report 08073101;
- XE039 – Ennis to Limerick line, 27th June 2010, a farmer was struck by a train and fatally injured herding cattle across the crossing, RAIU Report 2011-R005;
- XM096 – Ballina to Athlone line, 2nd September 2010, a tractor was struck by a train the tractor driver was fatally injured, RAIU Report 2011-R006;
- XM250 – Knockaphunta Crossing, Athlone to Wesport line, 24th October 2010 a private car was struck by a train, no injuries reported, RAIU Report 2011- R007;
- XG173 – Murrough Crossing, Athenry to Galway line, 14th February 2011 a private car was struck by a train, no injuries reported, RAIU Report 2012-R001;
- XE020 – Carrols Crossing, Limerick to Galway line, 20th June 2012 a train was struck by a tractor, no injuries reported, RAIU Report 2013-R002;
- XN125 –Cappadine Crossing, Ballybrophy to Killonan line, 3rd September 2012 a private car was struck by a train, no injuries reported, RAIU Preliminary Report only;
- XX024 – Corraun Crossing, a van was struck by a train and the driver of the van seriously injured. 12 February 2014, RAIU Report 205-001.

Analysis

Knockaphunta Level Crossing

Access to the level crossing and frequency of use

123 The level crossing is situated on a regional public road running between the N5 and N85 (paragraph 15), and the frequency of use recorded in 2011 showed an increase of use of the level crossing (since 2009) with 130 vehicles and twenty pedestrians using the level crossing on a daily basis (paragraph 82 - 83).

124 This increase may be the result of the road being a short cut to Castlebar, with the RAIU's sampling of routes showing that satellite navigation systems directing vehicles over this road (paragraph 87). The presence of Castlebar Rugby Club (paragraph 86) may also account for the increase. Both these factors increase the likelihood of unfamiliar level crossing users approaching the Level Crossing.

Signage and road marking on the approach to, and at, the level crossing

125 The signage on the approach to and on the Level Crossing meets the requirements set out in CCE-TMS-380 (paragraphs 44 - 49). However, this signage may be replaced by signage that is currently on trial at a different location. This change of signage is as a result of a previous recommendation made by the RAIU in relations to signage, which prompted IÉ to engage human factors consultants to review and update the signage (paragraph 51). The results of the trial have not been seen by the RAIU at the time of publication of this report (paragraph 53).

126 The Stop Line road marking was introduced by IÉ to show the level crossing users where to stop to safely look for approaching trains (paragraphs 54 - 59). The signage present at the time of the accident does not describe the purpose of this Stop Line; although it is noted that it is clearly given in the new signage currently being trialled.

127 Although the signage present at the time of accident does not describe the purpose of the New Stop Line; on the day of the accident the Car Driver did not stop at any position on the approach to the Level Crossing and as a result the signage did not contribute to the accident.

Viewing distances at the level crossing

128 The viewing distances exceed the requirements set out in CCE-TMS-380 from the crossing at the marked white line. However as noted in paragraph 43, there is a dwelling and shed on the near side as a motorist approaches the crossing from the N5 direction which obscures the view to the left on approaching the level crossing.

129 Had the Car Driver stopped at a safe distance from the level crossing and looking and listened for approaching trains, the Car Driver would have had a clear view of the train as the viewing distances are good, the visibility at the time of the accident was good and the train had the head lights illuminated. In addition, the train sounded the horn on the approach to the level crossing.

130 As a result of these factors, the viewing distances at the Level Crossing are not thought to have contributed to the accident.

Inspection and maintenance of the level crossing

131 Inspections and routine maintenance were carried out in compliance with CCE-TMS-380 (paragraphs 64 - 65).

132 No aspects of the inspection or maintenance regime are thought to have contributed to the accident.

Operation of OP Level Crossings and Knockaphunta Level Crossing

General description

133 The RSA, RSC and IÉ documents sets out the requirements of how to correctly operate user operated level crossings. The RSA's Rules of the Road does illustrate the New Stop Line but do not explain what to do when approaching it. The RSC documentation does not refer to the New Stop Line (paragraphs 66 - 75), as it was published in 2008.

134 In this accident, none of these published documents are thought to have contributed to the accident as the Car Driver was a familiar user of the Level Crossing.

Misuse of the level crossing

135 The Level Crossing is subject to frequent misuse by those using it, with the gates found open frequently by the Patrol Ganger (paragraph 97). It can also be seen from the CCTV footage that the gates were open as the car approached.

136 The RAIU have previously carried out investigations at this type of user worked level crossing. In all of these investigations, misuse by users of the level crossings in not closing gates or following correct procedures to ensure safe passage was identified.

137 Misuse of the Level Crossing is thought to have contributed to this accident, as the gates were left open prior to the car approaching the crossing and the Car Driver did not use the Level Crossing as directed by signage and the RSA, RSC and IÉ documents.

Actions taken by parties on the day of the accident

Actions of the Car Driver

138 The Car Driver did not operate the Level Crossing as required on the day of the accident, as they did not stop at the Stop Sign/Line to look for approaching trains, their decision not to stop may have been affected by the fact that the gates were open on the approach to the Level Crossing.

139 It should also be noted that the Car Driver did not have a clear understanding of how to operate the Level Crossing and was unaware that they were required to drive up to the Stop Line to look for approaching trains; instead they thought that motorists had to stop in the location of the old Stop Sign, open the gates on both sides and continue over the Level Crossing (paragraphs 77 - 78).

140 The lack of clarity of the decision point was previously identified by the RAIU to have contributed to a similar accident, where the driver was stopped in a position encroaching the path of the train. This has led to IÉ designating the new stop line location at user worked level crossings.

Actions of the Train Driver

141 The Train Driver was travelling within the temporary speed limit on approach on to the crossing, He sounded the horn at the whistle board location on approach to the level crossing (paragraph 20).

142 The Train Driver sounded the horn again for approximately three seconds just as the train came onto the crossing, at this point the driver noticed the car on his peripheral vision and felt a slight impact (paragraph 117).

143 The Train Driver immediately applied the emergency brakes and came to a stop 172 m from the time of application (paragraph 19). He made an emergency call to the controlling signalman at Athlone and made his way back to assist the occupant of the car.

144 The actions of the Train Driver on the day of the accident did not contribute to the accident.

Conclusions

The Level Crossing

145 The Level Crossing can be accessed from the N5 or the N84 and has a frequency of approximately 130 vehicles and twenty pedestrians (as established in 2011). The presence of the local rugby club and the fact that satellite navigations systems direct users over the level crossing means that there may be a high percentage of unfamiliar users of the Level Crossing (paragraph 123).

146 The Level Crossing meets all the requirements of IÉ's Technical Standard CCE-TMS-380 in terms of signage (paragraph 125), viewing distances (paragraphs 128 - 130), inspections and maintenance (paragraph 131).

147 IÉ have adopted the use of a Stop Line 2m from the Level Crossing to assist drivers in identifying a safe location to stop, however, there is no signage present, or any obvious indication, at the Level Crossing to inform users about the purpose of this Stop Line (paragraphs 126 - 127).

Operation of the Level Crossing

148 IÉ, RSC and RSA documentation provide information in relation to the safe use of this type of user worked crossing. The IÉ is the only documentation that describes the purpose to the New Stop Line.

149 The Level Crossing is frequently misused by the users, whereby the gates are frequently left open (paragraphs 135 - 137).

150 There have been four deaths at this level crossing (1967), one previous accident where a car was struck by a train (2010) and ten reported near misses at this Level Crossing, all the result of misuse of the Level Crossing. This Level Crossing and another local level crossing at Kilnageer are accountable for 40% of all the serious near misses on the IÉ network.

Actions of the Car Driver

151 The Car Driver approached the level crossing from the direction of the N5, as can be noted from the on board CCTV footage taken from the approaching train. The vehicle did not stop at the crossing as required or slow down before the crossing and drove straight onto the crossing making contact with the train (paragraphs 138 - 140).

Immediate cause, contributory factors and underlying causes, root causes and additional observations.

152 The immediate cause of the accident was that the car did not stop at the Level Crossing and drove into the side of the passing train.

153 Contributory factors associated with the incident are accident:

- CF-01 – The gates at the Level Crossing were open when the car approached the level crossing, allowing the car to enter onto the Level Crossing without stopping;
- CF-02 – The Level Crossing was regularly misused by the local users, whereby the gates are regularly left open.

154 The underlying causes associated with this accident are:

- UC-01 – The underlying causes associated with this accident is the fact that the many actions IÉ have undertaken in response to previous safety recommendations (2009 and 2011), have not resolved the issue of level crossing users leaving the gates open.

155 An additional observation in this accident is:

- AO-01 – The addition and purpose of the New Stop Line on user worked level crossings is not obvious to users of the Level Crossing and may cause confusion with statutory Stop Lines on the roads network with a longitudinal marking.

Relevant actions taken or in progress

Actions taken by IÉ

156 IÉ are currently undergoing a works programme of erecting advance signage on the approaches to user worked level crossings on private roads.

157 In 2014 IÉ undertook a communications strategy throughout the year around the area of user worked level crossings, these included:

- A number of 'event days' were undertaken with a full day presence at high risk crossings to engage with users about their problems as users and about the dangers of user worked crossings;
- Media events were arranged at key crossings, attended by IÉ senior management, An Garda Síochána, the RSA and the RSC to bring about greater mutual understanding of the issues surrounding user worked crossings;
- Radio advertisement campaigns were run in March and November highlighting the issues around the safe use of level crossings. These adverts were run on sixteen local radio stations which were chosen based on regional proximity to user worked crossings.

158 The detailed communication strategy further involved positive engagement with a range of potential level crossing user's including:

- Local schools;
- Sports clubs;
- Irish Creamery Milk Supplies Association (Membership 12,500);
- An Post;
- Oil delivery companies;
- An Garda Síochána;
- The Civil Defence;
- Irish Farmers Association;
- Teagasc;
- Agricultural suppliers (Glanbia, Devenish Nutrition, Wex. Field Producers);
- Refuse collectors;
- Vets and Doctors.

159 From the infrastructure perspective, IÉ commenced progression of a project involving implementation of technical enhancements at user worked crossings, where it is intended these improvements will be rolled out, on a risk prioritised basis, subject to funding being available.

160 Significant efforts continue to be expended on closing level crossings and a further sixteen crossings have been closed since this accident.

Safety recommendations

General description

161 In accordance with the Railway Safety Act 2005 (Government of Ireland, 2005a) and the European Railway Safety Directive (European Union, 2004), recommendations are addressed to the National Safety Authority (RSC). The recommendation is directed to the party identified in each recommendation.

New safety recommendation related to the accident

162 Due to different publication dates and with the introduction of the Traffic Signs Manual (2010), alongside the recent work undertaken by IÉ on user worked level crossings, the RAIU have made one new safety recommendation (AO-01)

The RSC, RSA and IÉ in consultation with any relevant stakeholders should agree a common policy in connection with instructions and warnings related to user worked level crossings.

Reiterated safety recommendations related to the accident

163 Given the number of accident, serious near misses and regular misuse at this Level Crossing, the RAIU reiterate the safety recommendation made in the RAIU investigation report published in October 2011, 'Car Strike at Knockaphunta Level Crossing (XM250), County Mayo, 24th October 2010'; and given that this recommendation has not been closed, the RAIU suggest that the following recommendation be expedited (CF-01, CF-02 & UC-01):

IÉ should upgrade the Level Crossing to ensure that the operation of the Level Crossing is not reliant on any direct action by the level crossing user.

164 In relation to the misuse at the Level Crossing, the RAIU reiterate the safety recommendation, made in the investigation report 'Vehicle Struck by Train at Corraun Level Crossing, XX024, Co. Mayo, 12th February 2014' and published in April 2015. It should be noted that the RAIU made a similar recommendation in 2009, which has also not been closed, therefore the RAIU suggest that the following recommendation be expedited (CF-02 & UC-01):

IÉ should carry out a full review of known misused user worked level crossings on public and private roads and either upgrade the level crossing or introduce measures to minimise their misuse.

Reiterated safety recommendations related to the additional observations

165 As a result of the confusion associated with the Stop Line applied 2m from the crossing, the RAIU reiterate the safety recommendation made in the investigation report 'Vehicle Struck by Train at Corraun Level Crossing, XX024, Co. Mayo, 12th February 2014' and published in April 2015 (A-01):

IE should ensure that where a Decision Line is present on a user worked level crossing, that the purpose of this Decision Line is conveyed to the level crossing users.

Additional information

List of abbreviations

°C	Degrees Celsius
AO	Additional Observation
CCE	Chief Civil Engineer/ Chief Civil Engineer's Department
CF	Contributory factor
hrs	Hours
IM	Infrastructure Manager
km	kilometres
km/h	Kilometres per hour
IT	Information Technology
M	Metre
MP	Milepost
PII	Post Incident Inspection
PWI	Permanent Way Inspector
RAIU	Railway Accident Investigation Unit
RC	Root cause
RSC	Railway Safety Commission
RU	Railway Undertaking
SI Units	International System of Units
SMS	Safety Management System
STSE	Senior Track & Structures Engineer
UC	Underlying cause

Glossary of terms

Accident	An unwanted or unintended sudden event or a specific chain of such events which have harmful consequences including collisions, derailments, level-crossing accidents, accidents to persons caused by rolling stock in motion, fires and others.
Bi Directional Line	A track on which trains may be worked in either direction under normal signalling arrangements
Cattle grid	An obstacle type structure using to prevent livestock straying onto a piece of land, in this case the railway line.
Colour light signals	Signals that convey movement authority to train drivers by means of coloured lights.
Continuous welded	Sections of rail that are welded together.

rail

Contributory factor Factors relating to actions taken by persons involved or the condition of rolling stock or technical installations.

Controlling
Signalman Competent person designated to control a specific section of track.

Extensive damage Damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.

Incident Any occurrence, other than an accident or serious accident, associated with the operation of trains and affecting the safety of operation.

Infrastructure
Manager Organisation that is responsible for the establishment and maintenance of railway infrastructure, including the management of infrastructure control and safety systems.

National safety
authority The national body entrusted with the tasks regarding railway safety in accordance with European directive 2004/49/EC.

Overbridge A bridge over a railway line.

On train data
recorder Device that records data about the operation of train controls and performance

Railway
Undertaking Train Service Operator

Rolling stock

Railway vehicles.

Root cause Causes related to framework conditions and application of the SMS.

Serious accident Any train collision or derailment of trains, resulting in the death of at least one person or serious injuries to 5 or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety, where extensive damage means damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.

Serious injury Any injury requiring hospitalisation for over 24 hours.

Track circuit block A signalling system that uses track circuits to confirm the absence of trains in order to control the movement of trains.

Underlying cause Causes related to skills, procedures and maintenance.

Up Main Line The line on which trains normally travel in a direction towards Dublin.

Whistle boards Trackside sign which indicates a train driver must sound the horn.

References

European Union (2004), Directive 2004/49/EC of the European Parliament and of the Council of 29 April 2004 on safety on the Community's railways and amending Council Directive 95/18/EC on the licensing of railway undertakings and Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification (Railway Safety Directive), 2004/49/EC, 29th April 2004.

IE (2013) Technical Standard for the Management of User Worked Unattended Level Crossings, CCE-TMS-380.

IE (2013) Track and Structures Inspection Requirements, CCE-TMS-360.

IE (2013) Technical Standard for Track Patrolling, CCE-TMS-361.

IE (2013) The SAFE use of Unattended Railway Level Crossings.

NTTX Ltd (2013) Signage Review: User Worked Level Crossings.

RAIU (2012) Investigation Report 2012-R001, Car Strike at Murrough Level Crossing, XG173, County Galway, 14th February 2011.

RAIU (2009) Fatality at level crossing XX 032 between Manulla and Ballina on the 28th February 2008.

RSC (2008) Third Party Guidance on Railway Risk, Volume 3, Crossing the Railway', RSC-G-012-A.

RSA (2013) Rules of the Road.