



**Report into the Fatality at Level Crossing XX 032 between
Ballina and Manulla Junction on the 28th of February 2008**

Function of Railway Accident Investigation Unit

The Railway Accident Investigation Unit (RAIU) is a functionally independent investigation unit within the Railway Safety Commission (RSC). The purpose of an investigation by the RAIU is to improve railway safety by establishing, in so far as possible, the cause or causes of an accident or incident with a view to making recommendations for the avoidance of accidents in the future, or otherwise for the improvement of railway safety. It is not the purpose of an investigation to attribute blame or liability.

The RAIU's investigations are carried out in accordance with the Railway Safety Act 2005 and the Railway Safety Directive 2004/49/EC.

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Executive Summary

On the 28th of February 2008 at approximately 11.07 hours the 10.50 hours service from Ballina to Manulla Junction passenger train collided with a car at user operated level crossing XX 032, which is located on the Ballina branch line, approximately 500 yards beyond the 153 milepost in the townland of Knockshanbally, County Mayo.

The train struck the car on its left hand side. The car became lodged at the front of the train and remained there until the train came to a stop approximately 350 metres (m) from the point of collision. The leading vehicle of the train was damaged but the train was not derailed.

The sole occupant of the car was fatally injured. There was a train driver and one passenger on the train at the time of the collision, neither were injured. The ambulance service, fire services and the An Garda Síochána attended the scene of the accident along with representatives of Iarnród Éireann (IÉ). The passenger was detained and continued the journey by road.

The line remained closed until that evening to allow clearance and preliminary investigation work to be carried out. The train was removed from the scene of the accident to Ballina at 19.10, allowing the line to be reopened.

Immediate cause:

- The immediate cause of the accident was that the vehicle was driven onto crossing XX 032 as the train approached.

Causal factors:

- The gates of the level crossing were open when the car approached the crossing.

Underlying causes:

- XX 032 and other local level crossings were habitually misused, with gates being left open on a regular basis.

Recommendations:

- The RSC should carry out a review of the suitability of this type of level crossing on public roads. This review should include, but not be limited to, factors such as continual misuse, signage, user mobility, environmental and human factors;
- IÉ should, taking into account the close proximity of the three level crossings, close or upgrade some or all of these crossings;
- IÉ must identify crossings that are regularly misused and take proactive action to manage the increased risk created by this misuse;
- IÉ are to put in place procedures that will capture and manage near miss reports.

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1 Factual Information

1.1 Accident description

On the 28th of February 2008 at approximately 11.07 hours (hrs) the 10.50 hrs service from Ballina to Manulla Junction passenger train collided with a car at user operated level crossing XX 032, which is located on the Ballina branch line, approximately 500 yards beyond the 153 milepost in the townland of Knockshanbally, County Mayo (Figure 1 – Location map).

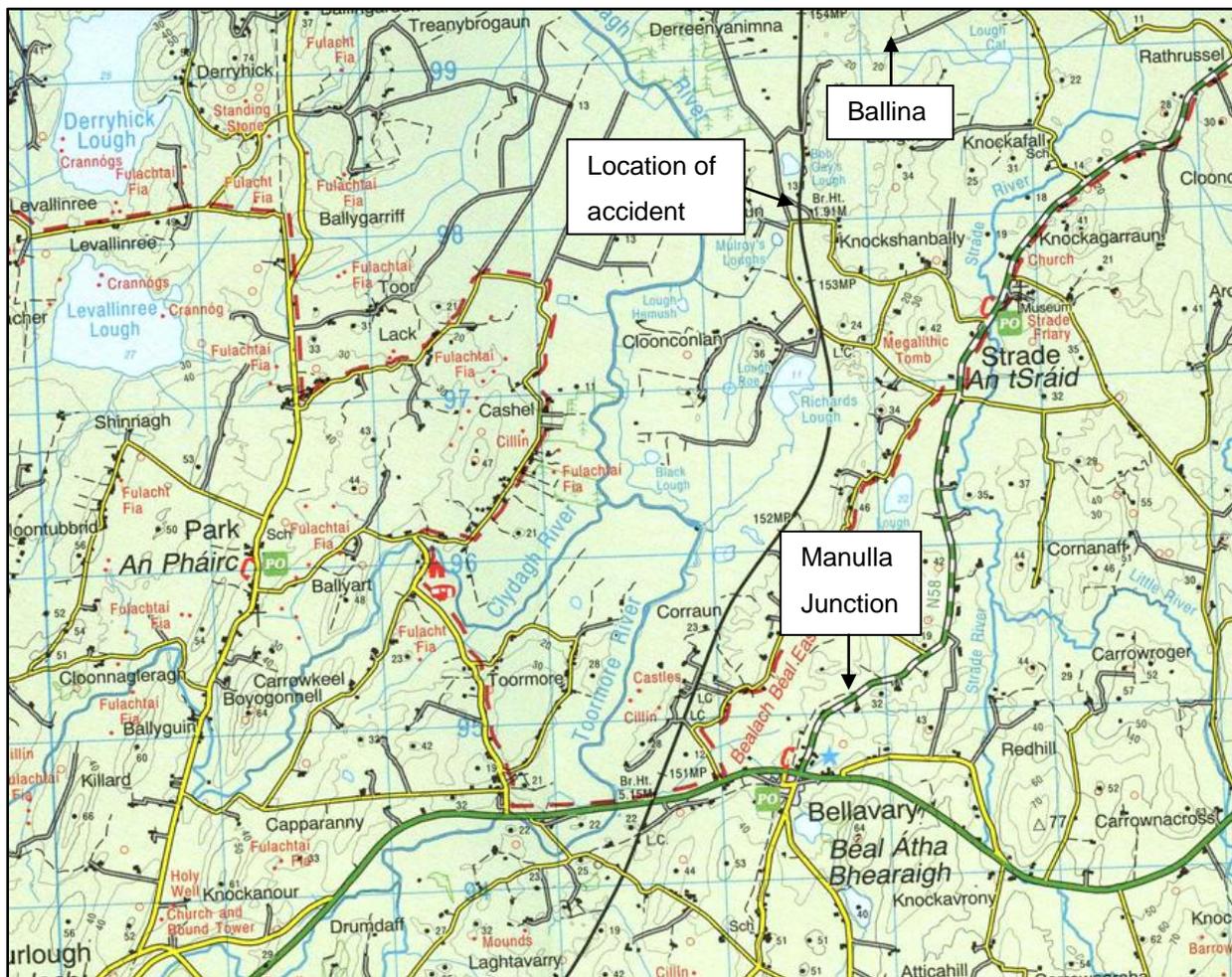


Figure 1 – Location map

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The vehicle driver approached XX 032 from a T junction approximately 110 m from the crossings, on a third class road leading to the N58 (Figure 2 – Site map). As the car crossed XX 032 it was struck by the train on its left hand side. The car became lodged at the front of the train and remained there until the

train came to a stop approximately 350 m from the point of collision. The leading carriage of the train was damaged but the train was not derailed. Following the accident rocks were found to be placed against the gates of the level crossing holding them open.

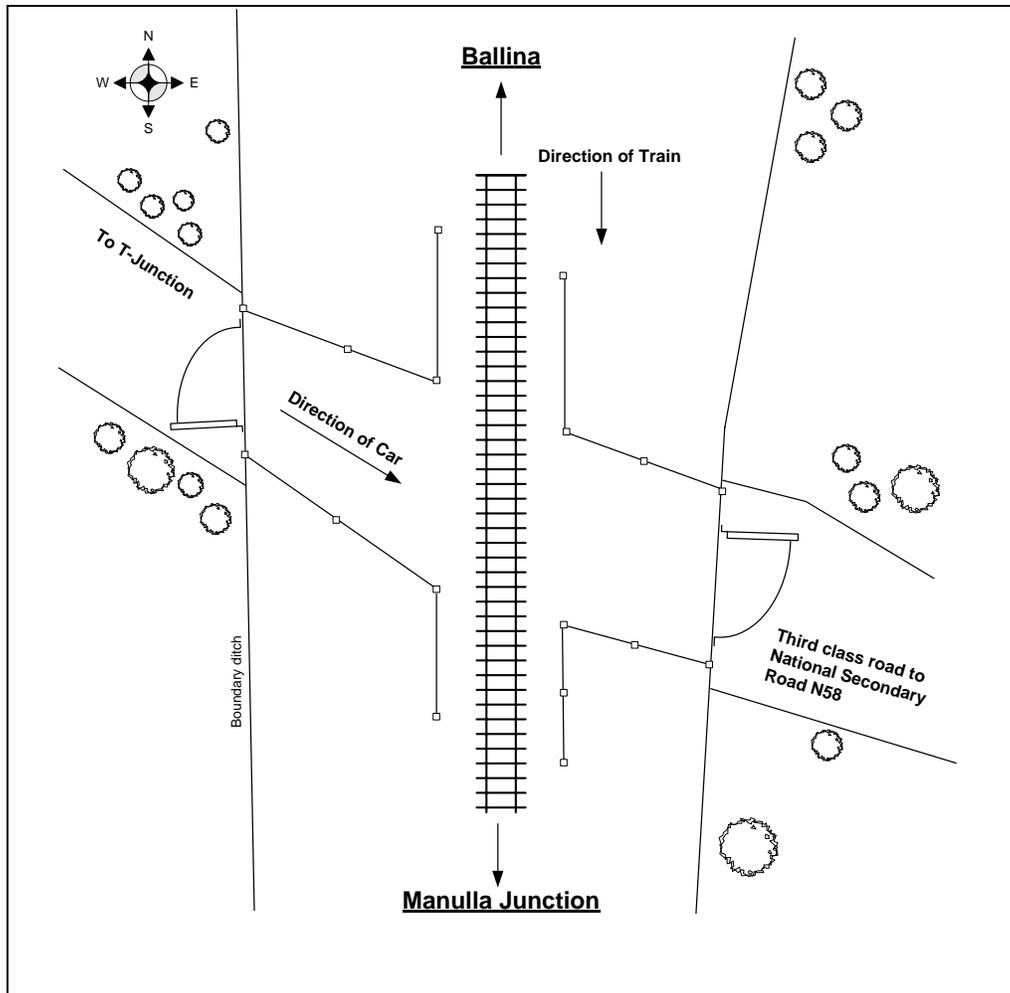


Figure 2 – Site Map

The sole occupant of the car was fatally injured. There was a train driver and one passenger on the train at the time of the collision, neither were injured. The ambulance service, fire services and the An Garda Síochána attended the scene of the accident along with representatives of IÉ. The passenger was detained and continued the journey by road.

The accident occurred during daylight hours. The weather at the time of the accident was dry and mostly cloudy with some bright or sunny intervals, temperatures at the time ranged between 7-8 degrees Celcius (°C) to 10° C. Visibility of the railway line would have been good.

The line remained closed until that evening to allow clearance and preliminary investigation work to be carried out. The train was removed from the scene of the accident to Ballina at 19.10 hrs, allowing the line to be reopened.

The driver of the train had booked on duty at 05.50 hrs and had a rest period of 16 hrs 10 minutes since his last turn of duty. The driver had one day off four days prior to the incident. There were no issues identified of concern regarding the driver's competence to drive trains. As the train driver was breathalysed, by An Garda Síochána, IÉ did not carry out their procedure in relation to drug and alcohol testing post incident.

1.2 Material damage

1.2.1 *Damage to infrastructure*

There was only minor damage to the infrastructure, damage was caused to the cattle grids at the crossing and a railing on the railway bridge was dislodged when struck by the car (Photo 1 – Damage to infrastructure).



Photo 1 - Damage to infrastructure

1.2.2 **Damage to train**

On Unit 2614 the obstacle guard was bent on the non driving side and the windscreen washer bottle and holder was bent. The front of the gangway received impact damage, and the suspension was damaged. There was slight damage to the electrical connection box front cover on the coupler on both sides.

The electrical conduit from the transmission control box to the main engine needed to be repaired. The levelling valve on the non driver side of the motor bogie was broken. The main engine cluster radiator was also damaged. Unit 2617 had no damage caused by the collision.

1.2.3 **Damage to road vehicle**

The road vehicle, a silver Chevrolet Kalos was extensively damaged in the collision, the impact was to the passenger side of the vehicle forcing in both doors and the door sill, the front passenger seat was crushed with the back of the seat forced behind the driver's seat. The centre pillar was over against the driver's seat and the back of which was slightly crushed. The dash was crushed and the roof was forced over the passenger side to the centre of the vehicle (Photo 2 – Damage to road vehicle).



Photo 2 – Damage to road vehicle

1.3 The level crossing

1.3.1 *Description of the crossing*

The level crossing (XX 032), known locally as Dillon's crossing, has manual gates that are operated by the users of the crossing, who are responsible for ensuring that it is safe to cross before they do so.

XX 032 is located on a third class road, leading to the N58 which is the Foxford to Bellavary road. This road starts from a T junction approximately 110m from the crossing. The speed limit on this road is 80km/h. The line runs in a north to south direction, with the road intersecting the line in a north west to south east direction. Three level crossings, including XX 032, and a railway bridge over a road are situated within a mile of each other. The road under the railway bridge is narrow with a steep gradient on the east side.

The iron gates on both sides of the crossing are 3.65 m (twelve feet) wide. There is concrete post and wire fencing between the gate and the cattle grids adjacent to the track on all four sides. The fence is returned behind the cattle grids parallel to the track. Cattle grids are in place between the fencing and the track and also between the rails on the up and down side of the crossing. XX 032 has a Strail rubber crossing surface to give a level surface over the track. Warning signs are erected on the approaches to the crossing at both sides. XX 032 is not protected by signals; there is no direct telephone communication available with the controlling signalman; and there is no lighting at this crossing.

1.3.2 Signage at crossing

Approaching the crossing from the T junction, approximately 55.6m from the railway line on the left hand side, there is a warning sign “BEWARE Railway Crossing Ahead Stop before You Cross the Railway”. On the right hand side approximately 23.8m from the railway line there is a warning sign “BEWARE Railway Crossing STOP LOOK LISTEN before crossing”. There is also a “Have you shut the gates” sign on the back of this sign. The gate is positioned approximately 19m before the railway line. On the left hand side approximately 8.4m from the railway line there is a warning sign “DANGER RAILWAY LEVEL CROSSING” beside this sign is a “STOP” sign with a “Keep These Gates Shut” sign below it (Photo 3 – Signage at crossing XX 032).



Photo 3 – Signage at crossing XX 032

Currently IÉ do not have a standard that clearly identifies the specification and signage required at crossings. A list of signage for user worked crossings was provided to the RAIU by IÉ (see appendix 1). In addition, the Maintenance of Way Technical Information Sheet MW50, dated 01/01/1983 (MW50) (Iarnród Éireann, 1983) identifies a list of signage to be fitted as does the Report of Committee of Inquiry into Accommodation Level Crossing Safety, dated 13/07/1990 (Iarnród Éireann, 1990). The signage at the crossing was consistent with all three lists of required signage for this type of crossing. The KEEP THESE GATES SHUT sign contains a considerable amount of information which may not be easily read by vehicle users (Photo 4 – ‘Keep these gates’ shut sign).



Photo 4 – ‘Keep these gates shut’ sign

1.3.3 *Sighting distances at level crossing*

A viewing distance from the crossing (Photo 5) in excess of 1600 m was recorded on the side that the car approached from, facing the direction from which the train approached the crossing.

MW50 (Iarnród Éireann, 1983) details the viewing requirements of approaching trains for crossing users to cross safely with normal vigilance. These are based Goold's Cross Report 1966¹. MW50 gives the position of measurements for viewing point to be taken at 3.66 m (12 feet) from the nearest running line and at a height of 1.22 m (4 feet) above ground. It also gives a reaction time of 1.5 seconds (s), a crossing speed of 1.34 m/s (3mph), a crossing distance of 5.5 m and a standard vehicle length of 7.3 m based on an agricultural tractor and trailer. Based on the above:

Minimum View (m) = [Safe Crossing Time of 11 s (crossing time + reaction time)] x Speed of train (m/s)

This can be approximated as follows according to MW50 for a single line:

View (m) = [Speed of train (miles per hour)] x 5

For the Ballina to Manulla Junction line this gives a minimum required view at crossings of 300 m for the permanent speed restriction of 95 km/h (60mph).

The crossing was also reviewed against the RSC's guidelines². The guideline identifies conditions for suitability of user worked crossings and states that the viewing time of an approaching train should be the railway company's Safe Crossing Time plus a margin of 5 seconds.

¹ Coras Iompair Éireann's (CIÉ) Report of Committee, Derailment at Goold's Cross on 5th August, 1965, dated February 1966 (Coras Iompair Éireann, 1966)

² RSC's publication 'Guidelines for the Design of Railway Infrastructure and Rolling Stock, Section 5 – Level Crossings', Issue 01, (Railway Safety Commission, 2008)

Using the RSC guidelines, the viewing time prior to the arrival of a train is 16 seconds (Safe Crossing Time of 11 seconds plus 5 second margin). Applying this to IÉ's MW50 formula gives:

$$\text{Minimum View (m)} = \frac{[\text{Safe Crossing Time of 11 s (crossing time + reaction time) + 5 second margin}] \times \text{Speed of train (m/s)}}{1}$$

This gives:

$$\text{Minimum view} = 26.66 \text{ m/s} \times 16 \text{ sec} = 427 \text{ m}$$

This viewing distance (Photo 5) was also in excess of this.



Photo 5 – View from crossing

1.3.4 **Level crossing risk assessment**

In 1999, consultants A D Little developed a level crossing risk assessment model for IÉ. This model was created to identify level crossings judged to need priority investment to reduce risk. XX032 was given a priority score of 14 (priority scores are 1 to 15, 1 being low risk and 15 being high risk). This crossing was one of the 609 Level Crossings that were rated as “Black” in 1999. Black indicated an intolerable risk.

In Section 1 of the model, consideration is given to crossings that IÉ are aware are misused.

Question 1.3: ‘User Characteristics’ asks:

‘Are gates left open a known problem at the crossing?’

There are 3 answers to this question (i) No, (ii) Yes, occasional and (iii) Yes, Frequent.

With regards to XX032 this question was answered “Yes, Frequent”. This crossing was upgraded in 2002 as part of the 1999 – 2003 Railway Safety Programme this include improving viewing distances and putting in Strail units to improve the surface of the crossing. This moved the crossing from the “black” to the “white” category indicating that it is a “crossing currently not requiring mitigation on risk grounds”.

IÉ are currently developing a new level crossing risk model to replace the A D Little model. The new model employs a wider range of inputs than the A D Little model, includes more types of crossing and more types of accidents, it is also calibrated to include more precursor and accident data and, is able to be recalibrated to include more recent incidents, accidents and changes to crossings, timetables, etc.

1.3.5 **Maintenance**

Track and patrolling standards³ were in place at the time of the incident. The track patrolling standard had been briefed to the local patrol gangers in April 2007, but it had not yet been fully implemented and some staff were still reporting based on previous versions of the standards. The infrastructure was last inspected on the 25/02/08 and the only issue reported was that the gates had been left open.

The records for track patrolling show that the gates at XX 032 and the gates at the nearby crossings XX 031 and XX 033 were regularly left open.

³ Standards I-PWY-1107 ‘Track and Structure Inspection Requirements’ (Iarnród Éireann, 2006, I-PWY-1107) and I-PWY-1307 ‘Standard for Track Patrolling’ (Iarnród Éireann, 2006, I-PWY-1307)

1.3.6 *Use of user worked crossings*

Gates are provided at level crossings to segregate the railway from the road and these must be maintained closed across the roadway to ensure safety of level crossing users and railway users as prescribed in Part 14 (Section 13.1) of the Railway Safety Act 2005.

IE publishes a booklet 'The SAFE use of Unattended Railway Level Crossings' (Iarnród Éireann, 2006). The booklet sets out the hazards associated with various types of vehicles, pedestrians and cyclists using the level crossing and the local conditions such as adverse weather or overgrown vegetation which might affect the safety of the user. It highlights factors such as vehicle music systems, headphones, and mobile phones that might affect the user's ability to hear approaching trains. It also advises that "trains cannot stop quickly. A train traveling at 100mph will cover ¼ mile in 9 seconds and a train traveling at 60 mph will cover the same distance in 15 seconds"

The booklet 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. It provides contact details for the controlling signalbox so that a user could telephone the signalman if herding animals or driving a vehicle which is slow, heavy, low slung and cumbersome. It also indicates that when special farm activities take place such as silage making, hay making and harvesting, necessitating repeated movements across the railway, additional arrangements may need to be made.

A normal sequence of events for a road user at a user worked level 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, second, and last, there is a need to check that no train is approaching before the action is undertaken):

- Step 1 - stop vehicle clear of the first gate;
- Step 2 - open the first gate;
- Step 3 - cross the track on foot to the second gate and open it;
- Step 4 - return over the crossing to the vehicle;
- Step 5 - drive and stop vehicle at a safe position were an approaching train could be observed
- Step 6 – if no train is approaching drive vehicle over the crossing and stop on the far side of the crossing gate;
- Step 7 - return over the crossing to the first crossing gate, close and secure it;
- Step 8 - traverse the crossing again to the second crossing gate, close and secure it;
- Step 9 - proceed on journey.

IE's records show correspondence with local users of the crossings in relation to gates being left open and the importance of closing gates after use. The records also show correspondence from the deceased and his family to IE concerning issues relating to safety at the crossings, the hazards of cattle movement, the possible provision of an alternative route and closure of a crossing, and maintenance issues. Correspondence on these matters were also sent to the RSC.

1.4 The railway infrastructure

The line between Ballina and Manulla Junction is a single line, continuously welded rail (CWR) track. The line speed on this section is 95 km/h (60 mph), there were no temporary speed restrictions in effect on the day of the accident.

A whistle board (an upright rectangle bearing black and yellow diagonal stripes) is a sign marking a location where a train driver is required to sound the horn. Whistle boards are erected where the available views of the train are restricted. A whistle board is located approximately 770 m north of XX 032, as a warning for users of XX 033. This is the closest whistle board to XX 032 for trains driving towards Manulla Junction. However, assuming the horn is sounded at a distance of 10 m before to the board, this would sound 34.42 seconds prior to the train arriving at XX 032.

The track was upgraded in 2003 replacing jointed track with continuously welded rail allowing increase in speed from 80 km/h (50 mph) to 95km/h (60 mph).

1.5 Signalling and communications

The line is signalled under a system known as 'Track Circuit Block' system (TCB). Colour light signals are provided throughout the section and are controlled by the Mayo Line Signaller, who is located in Athlone.

On the Ballina to Manulla Junction line there is a discrete train radio system for trains. This gives direct contact on a closed channel between the train driver and the Mayo Line signaller at Athlone and also between the train driver and the traffic regulator based in Central Traffic Control (CTC), Dublin. Lineside telephones are provided at stations and lineside signals. These give a direct connection to the controlling signaller at Athlone.

1.6 The train

1.6.1 General

The train was a two carriage Class 2600 Diesel Multiple Unit (DMU) consisting of units 2614 and 2617. The leading unit was 2614. The Class 2600s entered service in 1994. The train was driver only operated.

The Class 2600 DMUs have a tare weight of 81,400 kg. The maximum service speed is 110 km/h. The maximum service braking rate is 0.88 m/s². The emergency braking rate is 0.96 m/s². The braking system is a two pipe air pressure brake system with wheel mounted disc brakes. The Wheel Slip/Slide Protection (WSP) is a microprocessor controlled system, providing per axle slide correction for the pneumatic brakes. The Class 2600s are fitted with a Teloc event recorder.

The Class 2600 DMUs were introduced to this line in December 2006. In January 2007 Irish Rail wrote to known level crossing users advising them that these trains were quieter than those previously in service.

1.6.2 Event recorder

A download from the event recorder on unit 2617 was taken on the day of the accident for review. Incorrect vehicle identification⁴, wheel size⁵, time⁶ and failure to record brake cylinder pressure⁷ were inaccuracies found in the event recorder; taking these into account analyses was conducted on the data.

The train departed Foxford at approximately 11:03 hrs and was approaching XX 032 at 92km/h when the collision occurred, at this point an emergency brake application was made. The train was brought to rest in a distance of 359 m. There were no issues identified concerning the braking capacity.

The event recorder download data does not show any horn activity at the time of the accident or earlier that day, however, there is horn activity recorded on previous days to the accident. The horn was tested on the site of the accident and sounded correctly. A test was carried out on the 3rd of March 2008, this test confirmed that the horn was operational and that horn activity was being recorded by the event recorder⁸, however, horn activations of less than one second are not recorded. The train driver stated that he sounded the horn as he approached the whistle board.

⁴ Vehicle identification shown on the graphs are 2614 and should read 2617.

⁵ Wheel size had been set for 840mm, the wheel size when measured was found to be 796mm.

⁶ The time recorded on the download was GMT plus one hour and two minutes out of sync.

⁷ The brake cylinder pressure monitoring function of the event recorder did not record the brake cylinder pressure due to a faulty pressure transducer.

⁸ To record a horn activation, a pressure switch in the air line supplying the horn must be activated, this switch is activated when the air pressure exceeds 4 bar.

1.7 Behaviour of users at level crossings

The behaviour of users at level crossings often differs and do not always conform to the prescribed method of safely using the crossing. Findings from the 'Level Crossing' document created by the UK's Rail Industry Advisory Committee's Human Factor Working Group are summarised below:

The diversity of human risk perception, level crossing types and the environments around the crossing raise many human factors issues. The following provides an overview of some of the key themes.

Competence issues

Competence issues relate to the crossing user not being aware of, or failing to understand, the correct rules and procedures for using a level crossing. An example of a competence-related human factors issue is the awareness and application of the Highway Code. It currently contains over 250 rules and guidance for vehicle drivers, including those for level crossings. However, drivers only need to study the Code when learning to drive. This once-only reference, coupled with the depth and complexity of the requirements, means not all vehicle drivers maintain full awareness of the exact procedures for responding correctly to the information at level crossings.

Non-compliance issues

Deliberate non-compliance occurs at level crossings. The user, fully aware of how to use the crossing safely, chooses not to do so. Examples of non-compliance include driving past the flashing red warning lights at a road level crossing or deciding not to telephone the signaller for permission to cross at a user-worked crossing. Many of these behaviours are as a result of the user wanting to save time. Additional factors may increase the likelihood of non-compliance, such as a crossing located on a short-cut route or being held in traffic close to the crossing.

Distraction

Distractions at a level crossing may also result in the users failing to fully take account of the correct crossing rules and procedures. Examples of distraction issues include:

- Noise: noisy surroundings may mean that users cannot hear oncoming trains;
- Groups: level crossing users in groups may behave differently to individuals, for example when trying to keep together;
- Visual distractions: visual distractions, such as shops and advertisements, may draw the user's attention away from the information and warnings at the crossing.

Risk compensation

People adapt their behaviour to compensate for perceived changes in the dangers to which they are exposed. People adopt different strategies for adjusting their behaviour when within risk-exposed

environments. An individual's target risk level changes dependent upon the positive or negative results from undertaking risky behaviour.

For example, if a driver of a large vehicle chooses not to telephone the signaller before crossing, the positive and negative implications he or she weighs up are as follows:

- Positive: by crossing immediately, the driver saves time;
- Negative: crossing without permission from the signaller is dangerous.

If a person does not like taking risks and their perception of risk at a level crossing is high, then that person will behave in a cautious manner. However, if their perception of risk at level crossings is low, that person may behave in a more risky manner.

This issue occurs at footpath crossings. At crossings with a short sighting distance, users may show great vigilance in checking for approaching trains. Users may act less cautiously at crossings with ample sighting distance.

Mental models

People form mental models of situations to help them make sense of, and put structure into, the world around them. However, if the mental model fails to contain all of the correct information or has misinterpretations of the environment, a person who perceives himself or herself to be safe on a crossing may in fact be exposing themselves to danger. Level crossing users tend to base their model of train movement upon road vehicle speed, therefore underestimating train speed and distance. This may result in decision-making errors.

Familiarity

A person's familiarity with a task can influence their behaviour. Habits form over a period of time and to help cope with these common situations and contexts, people adopt behaviours that require minimal thinking. However, this means that people may miss important information and therefore put themselves at increased risk. A low frequency of trains at level crossings also influences user behaviour. A crossing where a regular user very rarely sees a train may lull them into a false sense of security.

IEÉ staff reported that the gates were left open on a regular basis. It was not possible to ascertain when or by whom the gates were last left open before the accident, however, it was evident that the rocks had been in situ for some time. On several occasions after the accident when members of the RAIU visited the site, the crossing gates were found to be left open. The individual involved in the accident was a local resident and would have encountered these gates left open on a regular basis. Some local users have raised their concerns about using the crossings when visibility is poor, at night and in bad weather conditions.

1.8 History of accidents and incidents

XX 031, XX032 and XX 033 are in close proximity, therefore the prior history of accidents and incidents at all three was examined. Both IÉ staff and local residents recall numerous near misses at the crossings; IÉ's record of near misses does not reflect this. Additionally, the existing documentation on near misses does not accurately identify their frequency, causes or severity.

Known accidents and incidents prior to 28th February 2008:

- A train collided with a car at XX 033 on the 8th May 1974 as the car attempted to traverse the crossing. The driver suffered minor injuries. CIÉ's investigation into the accident concluded that the accident be attributed to the driver of the motor car failing to exercise normal precautions in using the crossing;
- A passenger train collided with car on the evening of the 26th October 1999 at level crossing XX 031. The driver was driving through the level crossing from the up side to the down side. Having entered the crossing she turned right onto the track and drove the car approximately 15 feet along the track before stopping. At this time the passenger train was approaching the crossing and the driver abandoned the car. The train struck the car and pushed it ahead of the loco for a distance of approximately 90 yards before coming to a halt. The driver sustained no injuries;
- On the afternoon of 24th December 2007, a local resident driving across level crossing XX 032 at dusk reported a near miss with a train. The resident reported that the gates had been open when he arrived at the crossing and the visibility was poor as it was beginning to get dark;
- On the morning of the 28th February 2008, the morning of the fatality, there was a reported near miss with a vehicle at XX 032.

There were two further near misses with vehicles reported by train drivers, one in 2002 and one in 2006. However, no details were available.

Known accidents and incidents that occurred after 28th February 2008:

- A local resident witnessed and reported a near miss at XX 032 on the 29th March 2008, the resident witnessed a van crossing the level crossing, braking suddenly and reversing off the crossing as a train passed within seconds;

- A near miss was reported on the 8th September 2008, at level crossing XX 032. The vehicle driver reported that it was raining heavily and very windy. She was familiar with the crossing and looked for approaching trains in both directions; she did not see any trains and proceeded across the crossing. As she exited the crossing a train passed within close proximity of the car. She also reported that the gates had been left open when she arrived at the crossing.

2 Analysis

2.1 The level crossing

XX 032, along with XX 031 and XX 033, are within a mile of each other. The signage at the crossing is as per IÉ guidelines. As discussed in section 1.3.2 some of the signage would be difficult to read from the vehicle driver's position, however, this would not have contributed to the accident as the vehicle driver, a local resident, was familiar with the crossing. Local users of the crossings were issued with booklets detailing the safe use of the crossings.

The gate is approximately 19m from the line and if left open, a car approaching the crossing at only 15km/h would cover the distance between the gate and the track in 4.63 seconds. At 50km/h the same distance would be covered in 1.37 seconds. A train approaching the crossing at the permissible speed for this section of line, 95km/h, would cover the minimum viewing distance of 427 m in 16 seconds. These timings demonstrate the necessity for stopping at the crossing to allow the vehicle driver sufficient time to check for an approaching train. The viewing distance was above the minimum views required by IÉ and the RSC and is not likely to have contributed to the accident. From maintenance reports and the risk assessments carried out for this crossing it is evidenced that the crossing was frequently left open. Photographic evidence from the scene of the accident show rocks placed against the gates holding them open.

2.2 The train

The trains introduced in December 2006 would have been quieter than the previous trains. A letter stating this was issued to the local users.

The event recorder shows that the driver was driving the train within the permissible speed limit at the time of the accident. It cannot be confirmed by the event recorder that the horn was activated. Horn activations of less than one second are not recorded. The train driver stated that he sounded the horn as he approached the whistle board for XX 033, there was no whistle board provided for XX 032.

2.3 Behaviour of users at level crossings

The safe working of unattended railway level crossings is critically dependent on the gates remaining closed at all times following use, this draws attention to the presence of the railway for subsequent users, in particular unfamiliar users. The closed gate creates a physical barrier and point from which approach speed to the crossing is controlled, allowing the user to slowly approach the railway line and stop at a safe distance and see if it is safe to cross the crossing.

It is unlikely the accident occurred as a result of a competence issue as the individual was a local resident and should have been aware of the correct procedures for using the crossing safely, non compliance has been identified as an issue as the gates were left open on a regular basis. It is not known if distraction may have been an issue to the cause of the accident, which may have resulted in the user failing to fully take into account the correct crossing procedure.

The gates at XX 032 were habitually left open, as were gates at other level crossings in the local vicinity. This can influence a person's behavior and how they react to what becomes a common situation. The exact extent of misuse of the crossings is difficult to establish but reports from patrol men, who are scheduled to walk the line on a weekly basis would indicate the gates were frequently left open. The reported accidents and incidents support these accounts.

The proximity of the three level crossings means a user may be required to cross more than one crossing to reach their destination. This may affect their risk taking behaviour. The user may become frustrated at being delayed and having to repeat the process of opening and closing the gates. To demonstrate, if a single user was to make 10 return journeys a day using two of the crossings this would entail crossing the level crossing 100 times to cross and secure gates. This may cause a user to be reluctant to open and close gates. Additionally, in poor weather or when accompanied by children, a user may be reluctant to get out of their car.

2.4 History of accidents and incidents

As XX 032 is in close proximity to XX 031 and XX0 33, near misses have been reported for all three crossings. Both IE staff and local residents recall numerous other near misses, this is not reflected in IE's records.

3 Conclusions

It is unlikely the accident occurred as a result of a competence issue as the individual was a local resident and would have been aware of the correct procedures for using the crossing safely. The viewing distances at the crossing were found to be adequate and again unlikely to have been a causal factor.

Familiarity and distraction may have resulted in the user failing to fully take into account the correct crossing procedures on this occasion. Non compliance has been identified as an issue as the gates were left open on a regular basis as was the case on the day of the accident.

Immediate cause, contributory factors, underlying causes

Immediate cause:

- The immediate cause of the accident was that the vehicle was driven onto crossing XX 032 as the train approached.

Causal factors:

- The gates of the level crossing were open when the car approached the crossing.

Underlying causes:

- XX 032 and other local level crossings were habitually misused, with gates being left open on a regular basis.

4 Recommendations

The following safety recommendations⁹ are made:

- The RSC should carry out a review of the suitability of this type of level crossing on public roads. This review should include, but not be limited to, factors such as continual misuse, signage, user mobility, environmental and human factors;
- IÉ should, taking into account the close proximity of the three level crossings, close or upgrade some or all of these crossings;
- IÉ must identify crossings that are regularly misused and take proactive action to manage the increased risk created by this misuse;
- IÉ are to put in place procedures that will capture and manage near miss reports.

⁹ Recommendations shall be addressed to the safety authority and, where needed by reason of the character of the recommendation, to other bodies or authorities in the Member State or to other Member States. Member States and their safety authorities shall take the necessary measures to ensure that the safety recommendations issued by the investigating bodies are duly taken into consideration, and, where appropriate, acted upon. (Railway Safety Directive, 2004/49/EC)

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

IE have developed a plan for the renewal of the existing underbridge (widening and increased headroom) under the railway, the construction of local access roads and drainage works that will, if implemented, enable the closure of three level crossings, XX031, XX032 and XX033. Implementation of the plan requires the agreement of a landowner to make a strip of land available at reasonable cost and is also subject to planning permission. IE lodged the formal application for planning permission in January 2009, consequent on the signed consent of the landowner involved.

IE is continuing its investment programme in the upgrading and closure of level crossings subject to Government funding. A further 39 crossings were closed during 2008.

IE is examining ways of further increasing public awareness to emphasise the risks. This campaign includes:

- The distribution of the unattended level crossing safety booklet 'The safe use of unattended railway level crossings';
- Door to door visits to regular users of unattended level crossings;
- Distribution of a DVD titled 'Your Safety – On the Level';
- Fitting of CCTV cameras to influence user behaviour (12 fitted at present and plans to expand this number);
- Reporting misuse to An Garda Síochána and a small number of prosecutions;
- Review of level crossing signage.

IE, at the request of a family member of the deceased, erected a whistle board on the upside approach to this crossing. The sighting distance is such that a whistle board is not required but in the circumstance IE agreed to carry out the installation.

IE are carrying out a review of maintenance instructions related to data recorders across all rolling stock fleets.

IE are reviewing the engineering design issues pertaining to the recording of all horn activation.

IE have issued an instruction to train drivers and others to enable the categorised recording of Level Crossing near miss reports.

6 Additional information

6.1 Glossary of Terms

Central Traffic Control	Main signalling centre based in Dublin.
Data recorder	A device fitted to trains to store key train parameters and driver actions.
Diesel multiple unit	Self propelling train carriage powered by diesel, which can operate as single units or coupled together.
Down Direction	Direction of travel leading away from Dublin.
Down Side	The left hand side of the track in the direction of travel away from Dublin.
Up Direction	Direction of travel leading towards Dublin.
Up Side	The left hand side of the track in the direction of travel to Dublin.
Railway Safety Act 2005	The Railway Safety Act 2005 puts in place a modern regulatory framework for railway safety. The Act established an independent statutory public body, the Railway Safety Commission (RSC), to regulate railway safety in Ireland. The RSC has wide-ranging powers to monitor and inspect railway infrastructure and to take enforcement action where necessary. The Commission's Railway Accident Investigation Unit investigates serious railway accidents.
Railway Safety Commission (RSC)	The RSC was established under the Railway Safety Act 2005. It has responsibility for matters of railway and cableway safety on passenger carrying systems and freight carrying systems where they interface with public roads. The principal functions of the RSC are to: foster and encourage railway safety; enforce this Act and any other legislation relating to railway safety; and investigate and report on railway incidents.
Track Circuit Block (TCB)	A development of the Absolute Block System, in which track circuiting is applied throughout. A train may proceed to the next stop signal as soon as the line is clear, determined by the operation of the track circuits, provided the overlap beyond that signal is also clear.

6.2 References

Coras Iompair Éireann (1966), Report of Committee Derailment at Goold's Cross on 5th August, 1965, dated February 1966.

Iarnród Éireann (2006), I-PWY-1107 'Track and Structure Inspection Requirements', Issue 1.0, dated 05/09/2006 (I-PWY-1107).

Iarnród Éireann (2006), I-PWY-1307 'Standard for Track Patrolling', Issue 1.1, dated 05/09/2006 (I-PWY-1307).

Iarnród Éireann (2006), The SAFE use of Unattended Railway Level Crossings.

Iarnród Éireann (2002), The SAFE use of Unattended Railway Level Crossings.

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Iarnród Éireann (1990), Report of Committee of Inquiry into Accommodation Level Crossing Safety, dated 13/07/1990.

Ordinance Survey Ireland (2003), Discovery Series 59, Second Edition.

Railway Accident Investigation Unit Report (2008), Report into the collision at level crossing XN 104 between Ballybrophy and Killonan on the 28th of June 2007

Rail Industry Advisory Committee (downloaded 2008), Level Crossings, Office of Rail Regulator

Railway Safety Commission (2002), Guidelines for the Design of Railway Infrastructure and Rolling Stock, Section 5 – Level Crossings', Issue 01.

Directive 2004/49/EC of the European Parliament and of the Council (Railway Safety Directive), 29th of April 2004

Appendix 1 - List of signage for user worked crossings

Nr.	Sign	Drawing No.	Nr. In LC Safety Booklet	Crossing Type		Dimensions (WxH) (All dims in mm)	Position	Remarks
				Field	Occupation			
1	Warning Stop Before You Cross The Railway	W496/124	18.5.1	No	Yes	1200 x 1000 - 2 posts	50 m before LC on LHS	This will be used in advance of Occupation Crossings where no accident has occurred.
2	Warning Accident Black Spot	W496/124	18.5.2	No	Yes	1200 x 1200 - 2 Posts	50 m before LC on LHS	This will be used in advance of Occupation Crossing where an accident has occurred.
3	Puffin Billy	W496/103B	18.5.3	Yes	Yes	Equilateral Triangle 780 each side - 1 Post	1 m before LC Gate on LHS	Above the Danger Railway Level Crossing Sign.
4	Danger Railway Level Crossing	W 496/128	18.5.4	Yes	Yes	730 x 920 - 1 Post	1 m before LC Gate on LHS	Below the Puffing Billy Sign
5	Stop Sign	W 496/133	18.5.5	Yes	Yes	750 x 750 - 1 Post	Directly at LC Gate on LHS	Fix to separate pole. Add white line, where feasible.
6	Stop, Look, Listen	W 496/ 114	18.5.6	Yes	Yes	450 x 600 - 1 Post	1 m before LC on RHS	
7	Keep These Gates Shut	W 496/116	18.5.7	Yes	Yes	450 x 600 - 1 Post	Put on the same pole as the STOP sign	Put on the same pole as the STOP sign
8	Level Crossings Numberplate	W 496 /100	18.5.8	Yes	Yes	560 x 240 - 1 Post	At least 3730 mm from RE of nearest rail so that the views are not obstructed. Fixing it to the fence would eliminate the need for 2 poles.	At least 3730mm for the RE of nearest rail so that the views are not obstructed. Fixing it to the fence would eliminate the need for two poles.
9	Stop Behind the Black and Yellow Markers	W 496/102	18.5.9	At LCs with BYM posts	At LCs with BYM Posts	1200 x 600	Replace STOP sign with this one.	The provision of Black and Yellow Marker (BYM) Posts is at the DE's discretion. Use this sign instead of the STOP sign where BYM Posts are provided.
10	Do Not Trespass on the Railway	W 496 / 106	18.5.10	Yes	Yes	260 x 380 - 1 Post	At the far side of the cattlegrids from the roadway. This sign must not interfere with the views. Outside structure gauge.	At the far side of the cattlegrid from the roadway. This sign must not interfere with the views. Outside structure gauge.
11	Have You Shut The Crossing Gates?	W 496 /127	18.5.11	Yes	Yes	630 x 430 - 1 Post	5 m from LC Gate on LHS	Must not be allowed to obstruct the Stop, Look, Listen sign when coming from the opposite direction.