RAIU

Railway Accident Investigation Unit

Investigation Report 2012–R001

Car Strike at Morrough Level Crossing, XG173,

County Galway,

14th February 2011

Document History

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Purpose of an investigation by the 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 European railway safety directive 2004/49/EC.

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Summary

At approximately 12:00 on Monday 14th February a waste collection vehicle crew, who regularly used the Morrough level crossing (XG173) to collect waste from the private residence, Murrough House, opened the gates of the level crossing and passed over the level crossing. The crew left the level crossing gates open while they collected waste, a task that usually took only a few minutes. At approximately 12:13 a Volkswagen Bora car approached the level crossing with the gates still open. The car slowly drove onto the level crossing. At approximately the same time, the 09:30 passenger service from Heuston to Galway approached the level crossing. On seeing the car, the train driver sounded the horn twice and applied the emergency brake. The train struck the car as the car's driver was attempting to reverse off the level crossing. Both occupants of the car were treated for their injuries at the local hospital and released later the same day.

The immediate cause of the accident was that:

- The car stopped at the level crossing in a position that encroached into the path of the approaching train, and was then struck by the train while attempting to reverse off the level crossing.

The contributory factors were:

- The level crossing gates, which provide a barrier to the railway, were open when the car arrived at the level crossing;
- The signage present at the Level Crossing was not successful in communicating to the car driver that he was approaching a Level Crossing or in conveying any of the dangers associated with level crossings;
- There were no warning signs on the approach to the level crossing to alert the car driver that he was approaching a level crossing.

The underlying factors were:

- Iarnród Éireann did not comply with their own internal standard for the certification of changes to infrastructure on the network;
- Iarnród Éireann independently developed the new style signage, without proper consultation with the Railway Safety Commission or other parties;
- The Railway Safety Commission adopted an informal approach to the oversight of Iarnród Éireann's signage design.

As a result of the Railway Accident Investigation Unit investigation the following new safety recommendations, relating to the occurrence, have been made:

- Iarnród Éireann should review the suitability of the signage at user worked crossings on public and private roads, ensuring that human factors issues are identified and addressed.
- Iarnród Éireann should liaise with local authorities where private road level crossings can be accessed from a public road to ensure there is advance warning to road users.
- Iarnród Éireann should ensure that they adopt their own standards in relation to design changes to any plant, equipment, infrastructure or operations that have the potential to affect safety.
- The Railway Safety Commission should ensure that they adopt a formal approach to submissions made by IÉ in relation to design changes to any plant, equipment, infrastructure or operations that has the potential to affect safety.

1 Factual information

1.1 Relevant parties

1.1.1 Parties involved in the occurrence

Iarnród Éireann (IÉ)[1] is the *railway undertaking*[2] that owns and operates mainline railway services in Ireland. IÉ is also the railway *infrastructure manager*, managing the design, installation, testing, inspection, maintenance and renewal of the railway's physical assets. The IÉ departments associated with this *accident* are the:

- Intercity and Commuter Network Department – responsible for the supervision and operation of trains on the mainline, excluding the Dublin Urban Network. This includes the supervision of train drivers and the control of train movements through Centralised Traffic Control in Dublin and regional controlling signal cabins;
- Chief Civil Engineer's Department – responsible for the design, inspection, maintenance and renewal of the railway's structural infrastructure, including level crossings, and the management of risks relating to the use of *passive level crossings* that are operated by the level crossing user.

The Galway-Mayo Institute of Technology (GMIT) are the owners of Murrough House and the land to the Galway Bay side of the railway line. GMIT have contracted Barna Waste Disposal & Recycling Company to collect and depose of waste from Murrough House.

The roles associated with this accident are the:

- Train Driver – The train driver was an IÉ employee, passed as competent to drive trains on the 4th February 2010, he was classed as a trainee driver at the time of the accident and was therefore accompanied by a mentor train driver;
- Mentor Train Driver – A mentor train driver was accompanying the Train Driver at the time of the accident and was acting in a supervisory capacity;
- Car Driver – The driver of the road vehicle struck by the train. He had a full United Kingdom driving licence. He was unfamiliar with the area and the level crossing;
- Barna Waste Disposal & Recycling Company Crew – Driver and one other employee of the waste collection vehicle that drove across the level crossing prior to the car approaching. The driver had a full driving licence and was familiar with the level crossing.

[1] All abbreviations are explained in the list of abbreviations section of this report.

[2] All terms in italics are explained in the glossary of terms section of this report.

1.1.2 Other relevant parties

The Railway Safety Commission (RSC) is the *national safety authority*, which is responsible for the regulatory oversight of railway safety in Ireland in accordance with the Railway Safety Act 2005 and European railway safety directive.

The Department of Transport[3] (DoT) is responsible for implementing an integrated transport policy for Ireland, including road traffic signage regulation.

Galway City Council, as a local authority, is responsible for the management of planning, public roads (including road signage), water, waste and housing in the Galway City area.

The Health and Safety Authority (HSA) is the national statutory body with responsibility for enforcing occupational safety and health law, promoting and encouraging accident prevention, and providing information and advice to all companies, organisations and individuals on safety.

1.2 The accident

At approximately 12:00 on Monday 14th February 2011 a waste collection vehicle owned by Barna Waste Disposal & Recycling approached the Morrough Level Crossing (which will now be referred to as the Level Crossing for the remainder of the report) from the direction of the R338, see Figure 1.

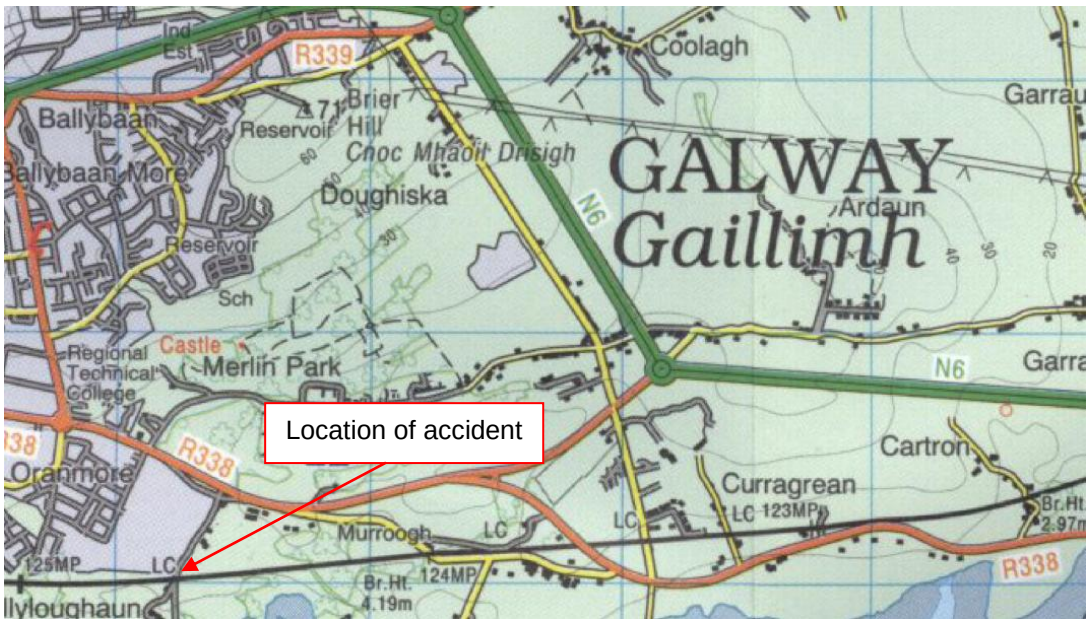

Figure 1 – Location Map (Ordnance Survey Ireland, 2003)

[3] At the time of the accident the Department of Transport, Tourism and Sport was known as the Department of Transport and will referred to as the Department of Transport for this report.

They were driving to Murrough House to collect refuse, which was a routine task undertaken approximately every six weeks when requested by GMIT. On their approach to the Level Crossing, the gates of the Level Crossing were closed to road traffic. The waste collection vehicle crew stopped and opened them on both sides of the railway to allow for access to Murrough House. Although the crew were aware of their obligation to close the gates, they did not close the gates on this occasion, as they were going to cross back over the Level Crossing within a few minutes, when they collected the refuse.

At approximately 12:13, the 09:30 passenger service from Heuston to Galway (which will be referred to as the Train in the remainder of the report) approached the Level Crossing. The Train Driver noticed a car on the *Upside* of the Level Crossing, but not encroaching onto the Level Crossing, and sounded the horn as a precaution at approximately 554 metres (m) before the Level Crossing. He then saw that the car was continuing slowly onto the Level Crossing; he sounded the horn again at 138 m before the Level Crossing and applied the emergency brake. As the Train passed through the Level Crossing it struck the car. The Train's approach to the Level Crossing was recorded on the Train's forward facing closed circuit television (CCTV). Four snapshots, illustrated below, show the last two seconds before the car strike (See Figure 2).

1: Car approaching Level Crossing

2: Car arriving onto Level Crossing

3: Car driving onto the Level Crossing

4: Car position immediately before strike

Figure 2 – CCTV snapshots of the Train's approach to the Level Crossing

The Train came to a stop approximately 342 m beyond the Level Crossing. The Mentor Train Driver went back to the Level Crossing to check the occupants of the car; while the Train Driver remained onboard the Train and carried out his post accident procedures.

The car was driven by a male who was accompanied by a female sitting in the front passenger seat. Both occupants of the car were treated for their injuries at the local hospital and released later the same day. The car suffered substantial frontal damage, rendering it undriveable.

The car's occupants informed the RAIU that they had been staying in a nearby local hotel on a short holiday and having left the hotel it was their intention to go sightseeing along the shore at Galway Bay. As they approached the Level Crossing the gates were open and the Car Driver could see straight ahead towards the shore line. He noticed signage on his approach but the only sign that stood out as noticeable to him was the Stop sign to his left-hand side, he moved his vehicle towards the Stop sign presuming he was at a road junction. He then continued slowly past the Stop sign to cross over what he thought was a road and it was at this point, while still looking for cars to his left, that he saw the Train approaching. He attempted to engage reverse gear but was unable to reverse clear of the Level Crossing. The Car Driver was up until this moment in time unaware that he was approaching a level crossing and neither he nor his passenger heard the Train horn sounding during its approach. The passenger did not notice the train until the moment of impact, she had noticed a 'No Dumping' sign and the Irish Warning sign and assumed they were passing by a refuse facility or building site, but she did not communicate this to the driver.

The weather at the time of the accident was dry and sunny. Met Éireann recorded a maximum temperature of 7.3 degrees Celsius, and an average wind speed of 16.6 km/h. There was good visibility at the time of the accident.

1.3 Infrastructure

1.3.1 General description

The Level Crossing is located on the Athlone to Galway Line at 124 miles 1024 yards from Broadstone Station, Dublin. The line 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.

1.3.2 Morrough Level Crossing

Morrough Level Crossing is identified as asset number (no.) XG173 and is designated, by IÉ as an 'Occupational' (O) type crossing. It is unattended with the gates normally closed to the public and road traffic, see Photograph 1. O type level crossings are unattended level crossings where the level

crossing gates are normally closed to private road traffic, where the private road is solely for access to a private residence. They are user worked crossings, meaning that they require the user to open and close the level crossing gates in order to cross the railway.

Photograph 1 – Morrough Level Crossing, approaching the Up side with the gates closed

In the case of this Level Crossing, the private road, which runs from the R338 approaching Galway, leads into Murrough House which is a private residence owned by GMIT. The approach road to the Level Crossing is a straight, flat road with an unsealed surface, with some potholes. The Level Crossing is fitted with four ornamental wrought iron gates, which can be opened both outwards and inwards, from and towards the railway line, mounted on ornate concrete pillars. The Level Crossing gates are private residence gates adapted for the Level Crossing, and are not similar to other level crossing gates on the network such as Knockaphunta Level Crossing in County Mayo, see Photograph 2, which would be typical of a user worked level crossing on the IÉ network.

Photograph 2 – Typical user worked level crossing on the IÉ network

1.3.3 Operation of the Level Crossing

Gates are provided at level crossings to ensure that the railway is segregated from the road way and the gates must be closed at all times when the crossing is not in use to ensure the safety of both rail and road users as prescribed in Part 14 (Section 13.1) of the Railway Safety Act 2005.

The safe use of user worked crossings is reliant on the gates being kept closed across the approaching road. IÉ provides information to the Level Crossing users through the signage present at the Level Crossing. This means that unfamiliar Level Crossing users must stop at the Level Crossing and read the signage for instructions on how to operate the Level Crossings.

IÉ provides additional information to level crossing users through a booklet entitled 'The Safe use of Unattended Railway Level Crossings Booklet'. This booklet is available from IÉ by request or it can be accessed through their website. At the time of the accident four known users of the crossing had been sent a copy the booklet by recorded delivery. GMIT, the owner of Murrough House, or the Barna Waste Disposal & Recycling Company, were not on the register as a known users by IÉ and therefore did not receive copies of the booklet. However, in the case of this accident, the crew of the waste collection vehicle had opened the Level Crossing gates, passed through the Level Crossing and continued without closing the gates, with the intention of closing the gates on their return.

IÉ have recorded daily usage of the crossing as being 3 cars/vans, 1 tractor and 10 pedestrians per day; it was noted by the caretaker of Murrough House that it is not uncommon that members of the public attempt to cross over the Level Crossing to access the beach.

There is no recorded history of misuse at the crossing, and in the twelve months prior to the accident, IÉ reported the gates being left open on two separate occasions.

1.3.4 Signage

1.3.4.1 Signage at the Level Crossing

The signage present at the time of the accident was installed at the Level Crossing in a date between August and September 2010 (a definite date could not be established by IÉ), which included an English language version of IÉ's instructional sign displayed on the right of the crossing with an Irish language version on the left, see Photographs 3 and 4. A 'Keep these gates shut' sign with dual language bye-laws information is present under the English language sign, see Photograph 3. A reminder 'Have you shut the crossing gates?' sign is on the rear of these signs, see Photograph 5.

Photograph 3 – English language instructional sign

Photograph 4 – Irish language instructional sign

Photograph 5 – 'Have you shut the crossing gates?' sign

A 'Stop' sign was erected by IÉ on the left approach of the level crossing, positioned inside the gates, twelve feet (3.65 m) from the nearest rail on the crossing, as one of the suite of signage to be erected at level crossings as is normal practice for IÉ. The 'Stop' sign at the Level Crossing is as prescribed by the Department of Transport's 'Traffic Signs Manual' 2010, (Section 6.15.9). However there was no continuous white line, sometimes associated with the Stop sign, present at the Level Crossing. There were no other road markings accompanying the 'Stop' sign or indicating the *decision point.* There is a 'No Dumping' sign to the left of the Irish Language sign, see Photograph 6. "Private" is painted vertically down the left hand pillar in dark paint which is faded due to weathering, see Photograph 6; and "Property" is painted vertically down the right hand pillar.

Photograph 6 – Instructional signage, 'no dumping' signage and Stop sign

However, the “Private” and “Property” text on the pillars would have been obscured as the Car Driver approached the Level Crossing as the gates were open, see Photograph 7.

Photograph 7 – Level Crossing approach with the gates opened outwards

As the Level Crossing is located on a private road there is no obligation on the Local Authority (in this case Galway City Council) to erect warning signs in advance of the Level Crossing as would be required on a public road. This is discussed further in Section 1.3.5.3, Signage Regulation, of this report.

1.3.4.2 IÉ signage design

IÉ conducted a review of signage at user worked crossing between October 2008 and May 2010, the objective for the review was to give the level crossing users a clear message that they are approaching a level crossing and what actions are required to be taken to cross the level crossing safely. Legal advice was also sought on the compulsory text that should be displayed on the sign.

A number of designs were looked at by IÉ with the final design completed in January 2010. The signage was based on the *workplace* signage, which is set out in the Safety, Health and Welfare at Work (Safety Signs) Regulations, 1995. These Regulations implement EC Directive 92/58/EEC which because of the increasing mobility of labour within the European Community, established a uniform system of signs and signals intended to be immediately understood by all whatever their linguistic backgrounds. However, it should be noted that Article 1 (3) of this EC Directive states that 'This Directive shall not apply to signs used for regulating road, rail, inland waterway, sea or air transport’, and continues to state in Article 3 (2), that transport signs should be used 'Without prejudice to the provisions of Annex V, the signs used for road, rail, inland waterway, sea and air transport shall be installed, wherever appropriate for such forms of transport, inside undertakings and/or firms.

The system for signs is based on the familiar traffic light colours: red for prohibition, yellow for caution; green for positive action, with an additional blue colour for mandatory signs or to convey information. The shapes of the signs are also standardised: discs for prohibitions and instruction, triangles for warnings, squares and rectangles for emergency and informative signs. These colours and shapes are then generally incorporated into one sign to communicate the hazards in the workplace.

IÉ, in adopting this approach to the signage, also incorporated their own existing signage to the design of the sign. For example, IÉ used the "Puffin' Billy" symbol (see Figure 3) from IÉ's technical information sheet, MW50, 'Accommodation level crossings' (MW50), which requires that the "Puffin' Billy" triangle should be 780 millimetres (mm) in width. The "Puffin' Billy" in the new signage is now 100 mm, when incorporated into the instructional signage.

Figure 3 – Puffin' Billy

Also, in relation to the 'Level Crossing Ahead' sign (See Figure 4). The DoT's 'Traffic Signs Manual' requires the side size of the sign be a minimum of 600 mm. However, when the sign is incorporated into the new style of signage, the side size is now 90 mm. It should be noted however, that Galway City Council is responsible for the erection of this larger size sign on public roads; and as this road is a private road the sign has not been erected.

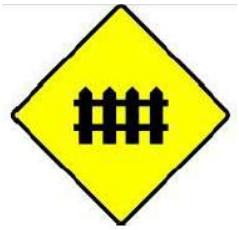

Figure 4 – Level Crossing Ahead

Photograph 8 and 9 show the similar design layout and concept to health and safety workplace signage at a construction site.

Photograph 8 - Workplace sign

Photograph 9 –Level Crossing sign

Although the uniform system of these signs are intended to be immediately understood by all, whatever their linguistic backgrounds, it is recognised that there should be some information provided with this signage to ensure that these signs are understood at the workplace, with the HSA stating that "Employees must be provided with information and instruction on the meaning of safety signs and signals used and be consulted on the measures taken to comply with these Regulations" (Health & Safety Authority, 2004).

1.3.5 Internal IÉ signage approval

IÉ's 'Company Safety Standard No. 6', 'Standard for the Safety Validation of Changes in Plant, Equipment, Infrastructure or Operations (PEIO)', (which will now be referred to as Company Standard 6 for the remainder of this report) has been operative since June 2003 and was operative at the time of the accident. It sets down the mandatory requirements for the safety validation of changes in plant, equipment, infrastructure or operations (PEIO), which apply throughout IÉ, enforcing a process of validation for safety, whereby certification is necessary before the various stages of development and implementation can proceed.

Although, Company Standard 6 does not identify level crossing signage specifically as an item that is required to undergoes this process, the standard does state: "A broad view must be taken of the concept of 'change' in PEIO. The spirit of this Safety Standard is that anything, which is new or being changed has a potential to improve or worsen safety and therefore any change has to be considered from that point of view at the outset". As a result of this statement, the level crossing signage should have undergone the outlined processes; and given that IÉ consider the signage to be the main form of communication between the general public and IÉ in terms of safe use of the level crossing, this further emphasises the fact that the signage should have gone through this process.

IÉ's 'Railway Safety Standard No. 56', 'Safety Validation of Changes in Plant, Equipment, Infrastructure or Operations (PEIO)', (which will be referred to as Railway Standard 56 for the remainder of the report) has been operative since May 2006 and was operative at the time of the accident. It describes the activities that IÉ undertakes to ensure that it delivers its policy and principles regarding the safety validation of changes in PEIO described in Company Standard 6. It sets out a mandatory process of safety validation to ensure that planned PEIO changes are implemented in a consistent, demonstrable and safe manner. The purpose, responsibilities, implementation (including risk assessment requirements and preparation and assessment of safety validation of the application of safety validation), review and audit requirements are outlined in this standard. Railway Standard 56 also provides guidance notes on how to complete the entire process.

The processes outlined in Company Standard 6 and Railway Standard 56 were not applied at any stage to the new design of level crossing signage, with the signage being rolled out in June 2010

accompanied by a nationwide publicity campaign coinciding with International Level Crossing Safety Week which ran from 21st – 28th June 2010.

1.3.6 RSC signage correspondence

On the 9th March 2010 IÉ submitted their signage design to the RSC for comment. Although the RSC were not required to comment of the signage design the RSC did informally reply to this submission on the 18th and 19th March 2010, with some suggestions for the consideration of IÉ. IÉ noted the suggestions and replied to the RSC that their comments would be considered in the future but made no changes to the signage design.

1.3.7 Road signage regulation

In relation to the management of the road signs present on the approach to, and at the Level Crossing, IÉ and Galway City Council are required to adhere to any requirements made by the DoT, in their 'Traffic Signs Manual' (The 'Traffic Signs Manual' available at the time of the signage design was published in 2008; with the latest revision being published in 2010). In relation to sign size and location the manual states the following:

- Section 1.2.1, Sign Size: Legibility - "A sign must be capable of transmitting its message clearly and at the right time to road users travelling at the normal speed for the road during day and night. To achieve this, a sign must have correct legibility distance, appropriate target value, simple content and layout, and effective reflectorisation. Signs must also be adequate in design and construction." (Department of Transport, 2010);
- Section 1.3.1, Sign Location: General Principles - "In order to perform the function for which it is intended, a sign must be capable of transmitting its message clearly and in good time. The clarity of the message is dependent on the design of the sign." (Department of Transport, 2010);
- Section 1.3.6, Sign Location: Siting - "Drivers must be able to read and understand a sign in sufficient time for them to react safely to its message. In order to achieve this, signs should be sited at the correct distances before the junction, hazard or other feature to which they relate. It is also essential to ensure that signs are visible from these distances and are not obscured by intervening obstructions." (Department of Transport, 2010);
- Section 1.3.12 - "Drivers are accustomed to signs being on the left-hand side and such positioning should be the norm." (Department of Transport, 2010). However, the manual does state that right-hand position is appropriate in certain circumstances, for example where there is difficulties positioning signage on the left.

In relation to each approach to the level crossing on a public road, Section 6 of the manual requires that, on a public road:

- Three appropriate yellow diamond 'Level Crossing Ahead' signs shall be erected, see Figure 5. These signs should normally be positioned on the left-hand verge, but may be repeated on the opposite verge for greater emphasis or where the road is on a left-hand curve;
- At crossings with gates, a Stop sign (Figure 6) 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;
- Supplementary Plates (Figure 7) showing the distance to the crossing, or Countdown Markers (Figure 8), should be mounted below the level crossing warning signs, unless Countdown Markers are used instead.

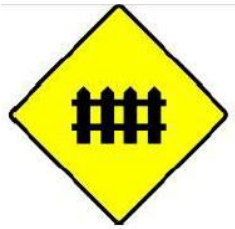

Figure 5 – Level Crossing Ahead

Figure 6 – Stop sign

Figure 7 – Supplementary Plates with distance

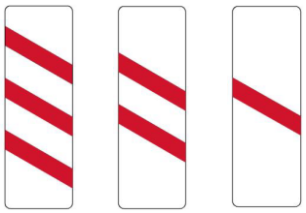

Figure 8 – Countdown Markers

The manual also indicates the responsibilities of the road and railway authorities, stating:

- The road authority shall consult with the railway authority to ascertain the operational details of the crossing and agree the signs and road markings required;
- At all level crossings, the railway authority shall be responsible for providing, operating and maintaining the barriers, gates, Level Crossing Signals. They shall also be responsible for providing and maintaining Stop signs, fixed to the barriers or gates;
- All other signs and road markings at the crossing shall be provided and maintained by the road authority.

Given that the Level Crossing, in the case of the accident, is on a private road, there was no requirement to erect all the above signage. However, it should be noted that the road is openly accessible to the public, as it is off the R338 (Dublin Road).

1.4 Traction and rolling stock

The Train involved was the 09:30 hrs passenger service from Heuston to Galway, train identification A702. The service was operated by a three carriage Class 22000 *Diesel Multiple Unit* (DMU), consisting of carriages 22217, 22317 and 22417. Carriage 22317 was the leading carriage at the time of the accident. The three carriage unit is 70 m long and has a mass of 189 tonnes. The maximum allowable speed of the DMU is 160 km/h.

The event recorder, fitted to the leading carriage, recorded that the Train horn had been sounded at 554 m and 138 m on approach to the Level Crossing. From the event recorder and the CCTV, it can be established that the Train Driver sounded the horn one second after the car is seen approaching the Level Crossing, and applied the emergency brake three seconds later, striking the car approximately five seconds after the application of the emergency brake. The train was travelling at 96.8 km/h when the driver applied the emergency brake, and it took twenty-three seconds to come to a stop. The train stopped 342 m beyond the Level Crossing.

No factors in relation to the condition of the Train contributed to the accident.

1.5 Signalling and communications

The single track route from Ballinasloe to Galway is signalled using two and three *aspect colour light signals*, controlled by the Galway Line Signalman based in Athlone. *Track Circuit Block* (TCB) regulations apply to this route.

The means of communication between the train drivers and the Galway Line Signalman on this route is via train radio.

1.6 Operations

The Train Driver was a recently qualified driver who was under the instruction of an experienced mentor driver. Train movements on this section of track are controlled by the Galway Line Signalman. The line speed limit was 110 km/h.

1.7 Fatalities, injuries and material damage

1.7.1 Fatalities and injuries

There were no fatalities or injuries as a result of this accident. Both occupants of the car were treated for their injuries at the local hospital and released later the same day.

1.7.2 Infrastructure damage

There was no damage to the Level Crossing or any other infrastructure connected with the level crossing.

1.7.3 Traction and rolling stock damage

The leading carriage, 22317, sustained damage to a vertical damper and some light damage to the secondary suspension.

1.7.4 Damage to the car

The Volkswagen Bora was severely damaged from the front bulkhead and engine compartment forward. Both forward chassis members were bent and the engine and gear box unit was dislodged from its mountings.

1.8 History of similar accidents and incidents

IÉ have recorded two similar occurrences at this Level Crossing prior to this accident. Details of these accidents are summarised below:

- 08/04/1975 – A works train collided with a trailer drawn by a Land Rover vehicle. There were no fatalities or injuries as a result of this accident;
- 03/02/1999 – An empty ballast train collided with a car at the level crossing. There were no fatalities or injuries as a result of this accident;

There have been two near miss *incidents* at this level crossing. Details of these near misses are summarised below:

- 22/02/2008 – A train driver reported a car crossed the level crossing close to his train;
- 18/09/2010 – A train driver reported a near miss with a tractor at the level crossing.

Between 2002 and the time of the accident, on the remainder of the IÉ network, at O type level crossings, there have been two recorded car strikes and 111 recorded near miss incidents. There have been an additional eight near misses occurring at O type level crossings since this accident until the publication of this report.

2 Analysis

2.1 Signage

2.1.1 Signage at the Level Crossing

The Level Crossing is situated on a private road and is generally only accessed by familiar users. However, the road can be accessed by members of the public, with the caretaker of Murrough House stating that it is not uncommon that members of the public attempt to cross over the Level Crossing to access the beach. There is no signage present to indicate that the road is private. The first indication that the road is for access to a private residence is the "private property" written on the gate's pillars, which is not visible when the gates are open, as was the case when the Car Driver approached the Level Crossing. The only other signage erected at the Level Crossing is the signage erected by IÉ. In relation to the positioning of the signage, IÉ have only erected signage at the Level Crossing, as they are not required to erect signage on the approaches to Level Crossings.

The DoT 'Traffic Signs Manual' states that the left-hand verge is the norm for sign position on roads. In the case of this Level Crossing the Stop sign and the Irish language instructional sign are in the left-hand verge and the English language instructional sign was in the right-hand verge. As the car occupants were unfamiliar with the Irish language, they may not have been prompted to look at the English language sign on the right-hand side.

IÉ provides information to the Level Crossing users through the signage present at the Level Crossing. For this to be effective, this means that unfamiliar Level Crossing users must stop at the Level Crossing and read the signage for instructions on how to operate the Level Crossings. However, in the case of the accident, the gates were open on the car's approach to the Level Crossing. As a result, the driver approached the Stop sign, which is positioned after the instructional signage, without reading the instructional signage present at the Level Crossing. He assumed he was approaching a road junction, and was slowly proceeding onto the Level Crossing, looking for oncoming road traffic, when the Train approached.

2.1.2 Signage design

IÉ's new signage attempts to communicate to the level crossing users, using the established "traffic light colours" system already adopted in the workplace. This signage is intended to be immediately understood by all, whatever the level crossing user's linguistic background. However, in the workplace, employees are briefed on this type of signage to ensure that these signs are understood by the employees. However, given that this signage is erected by IÉ and there is no additional information on how the sign should be used, there is some doubt as to the efficiency of displaying the information in this manner.

IÉ have also adopted a smaller version of the 'Level Crossing Ahead' sign into their sign, which is inconsistent with the requirements of the 'Traffic Signs Manual' in that the legibility of these signs and their capability of transmitting its message clearly is not achieved through the use of a smaller sign.

It is also evident that in attempting to adopt this "traffic light colours" system, IÉ have failed to meet their own requirements, set out in MW50, on the size of the "Puffin' Billy".

2.1.3 Signage design approval and correspondence

IÉ did not implement their requirements under IÉ's Company Standard 6 or Railway Standard 56. As a result, IÉ did not undergo the changes in a consistent, demonstrable and safe manner as described in Company Standard 6. The purpose of changes, responsibilities, implementation of safety validation, review and audit requirements, outlined in Railway Standard 56 were also not conducted. As a result, IÉ adopted a new style of signage without applying their own mandatory requirements for changes to PEIO, resulting in no internal certification being approved for the updated signage.

The RSC adopted an informal approach to IÉ's submission which resulted in the RSC's comments not being incorporated by IÉ and there was no further action by the RSC in relation to their comments.

2.1.4 Road signage regulation

The only signage erected at the Level Crossing is the signage that IÉ erected, as there is no requirement on Galway City Council, or any other local authorities, to erect road warning signs on private roads under the DoT's 'Traffic Signs Manual'. As a result of this, the yellow diamond 'Level Crossing Ahead' sign, the three appropriate yellow diamond 'Level Crossing Ahead' signs, normally erected on public roads, were not erected. The Supplementary Plates showing the distance to the crossing, or Countdown Markers associated with the 'Level Crossing Ahead', were also not erected at the Level Crossing. As a result of there being no approach signage at the Level Crossing there is not sufficient warning to the driver for them to react safely to the upcoming hazard, the Level Crossing.

2.2 Operation of the Level Crossing

IÉ signage is present at the Level Crossing in relation to the operation of the Level Crossing and the closure of Level Crossing gates after use. The gates at the Level Crossing provide a barrier segregating the railway from the road and stopping cars clear of the railway prior to users of the level crossing operating the gates to cross the railway.

However, in the case of the accident, the gates had been left open by the waste collection vehicle crew. Therefore the initial barrier to stop in front of the instructional signage was removed, resulting in the Car Driver continuing past the signage and onto the Level Crossing.

3 Conclusion

Section 2.1.1 of the analysis identifies that the Level Crossing is situated on a private road and is generally only accessed by familiar users, but is, on occasion accessed by other members of the public attempting to access the nearby beach from the R338 (Dublin Road). The signage also deviated from the norm, in that the English language instructional signage was not erected on the left-hand side of the Level Crossing, with the Irish language sign in its place. Both the driver and the passenger were not familiar with the Irish language.

Section 2.1.2 on signage design discusses the design of signage adopted by IÉ, where the new signage attempts to communicate to the level crossing users, using the workplace "traffic light colours" system, where all the information in is one location. However, it has already been established that not all road users are familiar with this type of signage, as there is normally a briefing conducted on how to use this signage in the workplace.

Also, in adopting this system, IÉ have made their own signs and the DoT's signs smaller to fit onto the one sign. In doing this, IÉ have affected the legibility of the individual signs, resulting in diminishing the signs capability of transmitting its message clearly. This was the case in this accident, where the Car Driver continued past the instruction signage, without recognising the dangers associated with the use of the Level Crossing from the erected signage.

Section 2.1.3 of the analysis identifies that IÉ adopted an informal process for the approval of the new signage and no internal certification of signage was issued based on Company Standard 6 or Railway Standard 56. IÉ also independently designed the signage without proper consultation with the RSC or other relevant parties. While the RSC did comment on the new signage design, the RSC did not ensure that IÉ adequately considered their comments.

Section 2.1.4 in relation to road signage regulation, discusses the fact that unlike public roads, there is no requirement for local authorities to erect the prescribed road warning signs on the approach to level crossings on private roads under the DoT's 'Traffic Signs Manual'. Therefore, as a result of this Level Crossing being situated on a private road, all the relevant Level Crossing signs were not erected on the approach to or at the Level Crossing. As there was no signage on the approach to the Level Crossing, this resulted in the first warning of the Level Crossing, being at the Level Crossing itself, which does not give road users sufficient to react safely, especially in the case where the gates are open.

Section 2.2 of the analysis, shows that the Car Driver approached the Level Crossing with the gates open which resulted in the initial barrier segregating the railway from the road being lost. With the initial barrier removed, this allowed the Car Driver to continue onto the Level Crossing without noticing the warning signage, which provided instructions on the operation of the Level Crossing.

The *immediate cause* of the accident was that:

- The car stopped at the Level Crossing in a position that encroached into the path of the approaching train, and was then struck by the train while attempting to reverse off the Level Crossing.

The *contributory factors* (CoF) were:

- CoF-01 – The Level Crossing gates, which provide a barrier to the railway, were open when the car arrived at the Level Crossing;
- CoF-02 – The signage present at the Level Crossing was not successful in communicating to the Car Driver that he was approaching a Level Crossing or in conveying any of the dangers associated with level crossings;
- CoF-03 – There were no warning signs on the approach to the Level Crossing to alert the Car Driver that he was approaching a level crossing.

The *underlying factors* (UF) were:

- UF-01 – IÉ did not comply with their own internal standard for the certification of changes to infrastructure on the network;
- UF-02 – IÉ independently developed the new style signage, without proper consultation with the RSC or other parties;
- UF-03 – The Railway Safety Commission adopted an informal approach to the oversight of IÉ's signage design.

4 Relevant actions already taken or in progress

4.1 Actions taken by IÉ

IÉ are currently specifying a project for the fitting of a second 'Stop' sign and a 300 mm 'Stop' line 2000 mm back from the running edge on both approach roads at all 'O' type and *'OP'* type level crossings.

4.2 Actions taken by the RSC

In a joint workshop with IÉ on user worked level crossings on the 19th August 2011, the RSC informed IÉ that the use of statutory health and safety signs was not permitted for use at user worked level crossings.

5 Recommendations

5.1 General description

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, the RSC. The party responsible for implementing each recommendation is identified in the recommendation.

As a result of the RAIU investigation, four new safety recommendations have been made in relation to the occurrence.

5.2 New recommendations relating to the occurrence

The Car Driver approached and drove onto the Level Crossing thinking that it was a road junction. This maybe as a result of there not being any approach signage to Level Crossing and the signage at the Level Crossing not communicating effectively the instructions required to operate the Level Crossing. Based on CoF-02 and CoF-03, the RAIU make the following safety recommendations:

IÉ should review the suitability of the signage at user worked crossings on public and private roads, ensuring that human factors issues are identified and addressed.

IÉ should liaise with local authorities where private road level crossings can be accessed from a public road to ensure there is advance warning to road users.

As a result of the informal approaches taken by IÉ and the RSC in relation to the certification and approval of the changes to signage at user worked level crossing, this allowed IÉ to introduce updated signage without adhering to their own mandatory requirements in relation to changes to PEIO. This may have resulted in a more informal approach to be taken by the RSC in relation to approving the signage. Therefore based on UF-01 and UF-02 the RAIU make the following safety recommendations:

IÉ should ensure that they adopt their own standards in relation to design changes to any PEIO that has the potential to affect safety.

The RSC should ensure that they adopt a formal approach to submissions made by IÉ in relation to design changes to any PEIO that has the potential to affect safety.

6 Additional information

6.1 List of abbreviations and acronyms

ALARP	As low as reasonably practicable
CCTV	Closed circuit television
CWR	Continuous Welded Rail
DMU	Diesel Multiple Unit
DoT	Department of Transport
HSA	Health and Safety Authority
km/h	kilometres per hour
m	metre
mm	millimetres
PEIO	Plant, Equipment, Infrastructure or Operations
RAIU	Railway Accident Investigation Unit
RSC	Railway Safety Commission

6.2 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.
Causal factors	Any factor(s) necessary for an occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.
Colour light signals	Signals which convey movement authorities to train drivers by means of coloured lights.
Continuous Welded Rail	Rails welded together to form one continuous rail that may be several kilometres long.
Contributory factors	Any factor(s) that affects, sustains or exacerbates the outcome of an occurrence. Eliminating one or more of these factor(s) would not have prevented the occurrence but their presence made it more likely, or changed the outcome.
Decision point	A point where level crossing users stop clear of the railway line and at which a decision to cross or wait can be made safely.
Diesel Multiple Unit	A train powered by diesel with the engines distributed along its length under the carriages.
Event Recorder	A device fitted to trains to store key train parameters and driver actions.
Horn	A compressed air warning device fitted to trains.
Infrastructure	Organisation that is responsible for the establishment and maintenance of

Manager	railway infrastructure, including the management of infrastructure control and safety systems.
Immediate cause	The situation, event or behaviour that directly results in the occurrence.
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.
O type level crossing	Unattended level crossings where the level crossing gates are normally closed to private road traffic, where the private road is solely for access to a private residences.
OP type level crossing	A level crossing situated on a public road and has manually operated gates that are opened and closed by the level crossing user, and are normally kept closed across the road.
Passive level crossing	Level crossings that have no warning system and/or protection, that activates either automatically or manually, when it is unsafe for the user to traverse the level crossing.
Railway Undertaking	Organisation that operates trains.
Up side	The left side of the track when travelling in the Up direction.
Single track	A line with a single track on which trains normally run in both directions.
Validation panel	A panel of company or departmental experts that meet monthly to evaluation and discuss questionnaires in relation to Company Safety Standard No. 6
Workplace	From the Health and Safety at Work Act, a workplace means a place of work intended to house workstations on the premises of an undertaking and any other place within the area of the undertaking to which an employee has access in the course of his or her employment.

6.3 References

Department of Transport (2008) Traffic Signs Manual.

Department of Transport (2010), Traffic Signs Manual.

Health and Safety Authority (Amended May 2010), Guide to the Safety, Health and Welfare at Work (General Application) Regulations.

Health and Safety Authority (1995), Safety, Health and Welfare at Work (Safety Signs) Regulations.

Safety, Health and Welfare at Work (Safety Signs) Regulations, 1995

Iarnród Éireann (2003), Company Safety Standard No. 6, Standard for the Safety Validation of Changes in Plant, Equipment, Infrastructure or Operations (PEIO).

Iarnród Éireann (1983), Maintenance of Way Technical Information Sheet MW50 Accommodation Level Crossing.

Iarnród Éireann (2006), Railway Safety Standard No. 56, Safety Validation of Changes in Plant, Equipment, Infrastructure or Operations (PEIO).

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