Contributory factors analysis for road traffic collisions

A report for the National Roads Authority of Ireland

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Executive Summary

As part of its contribution to the new Road Safety Strategy, the National Roads Authority (NRA) is currently reviewing how road collision data collection and analysis could be improved. One area of focus is to better understand how an analysis of contributory factors recorded for past collisions can be used to identify priorities for action to further improve road safety.

This report describes the contributory factors data analysis carried out by Risk Solutions. We have looked at the collision database maintained by the Road Safety Authority, which captures the road collisions reported to the Garda, and the separate database of fatal collision LA16 forms maintained by the NRA.

Our analysis of the Garda opinion recorded in the RSA dataset suggests that road factors contributed to around 3.4% of all personal injury collisions on National roads between 2007 and 2010 (on their own or in combination with other factors). This is a small fraction of all collisions, and it must also be borne in mind that the Garda expressed no opinion on the main contributory factors in over 30% of personal injury collisions on national roads.

We therefore also looked at other fields in the database where some contribution from road infrastructure could be inferred, even if the Garda officer hadn't explicitly cited it as a factor. We found from this analysis that looking at one contributory factor at a time was only part of the story, but there are some combinations of pairs of contributory factors that, if they occur together, result in much higher average consequences per collision. Some of the most frequent pairs of factors with high average consequences include:

- Head-on collisions on single carriageway undivided roads
- Collisions with pedestrians at night where there is no lighting
- Single vehicles losing control and running into ditches, trees, walls etc

This pattern of contributory factors is typical of what you might expect on a network with significant amounts of rural undivided roads. The scope for hard engineering measures to fully mitigate risk is therefore always going to be limited.

However, there is an important role for Road Safety Inspection (RSI) to educate the population on the types of hazard present and to help local authorities prioritise expenditure. The results of this contributory factors analysis could be used to highlight some of the most important combinations of features for the RSI inspectors to look out for as they complete their inspections over the coming months.

In support of the move towards route based road safety assessments (such as RSI), we have also attempted to look at collision risk at the route level (collisions per million vehicle kilometres along each National route). We found significant differences between two available estimates of exposure data (vehicle kilometres) that emphasise the need to improve the quality of vehicle flow data on the network.

Recommendations

In order to improve NRA's capability to perform contributory factor analysis in the future, we make the following recommendations:

1. The NRA should investigate the feasibility of gaining access to the collision records recorded by the Garda much more quickly than is currently possible. We suggest that one way of doing this would be for them to receive un-validated data downloads from PULSE every six months, on the understanding that the 'official' dataset would still be provided by RSA some time later after the completion of their data validation checks.
2. The data downloads from PULSE should include the free text fields relating to the Garda's opinion on contributory factors and the summary collision description, where

data protection guidelines allow. This information should be analysed in parallel to basic collision count data to provide a fuller picture of the root causes of incidents to help inform the Irish authorities on driver behaviour and enforcement activities as well as road infrastructure issues.

3. If revisions to PULSE replace the free text fields with more ‘drop down menus’ this would make the analysis of contributory factors easier, and would hopefully decrease the number of fields left blank. It would also enable the data protection issues to be addressed unambiguously as it would be clear which database fields could and could not be released. However, any move to ‘drop down’ fields should be done in consultation with the main users of the data to ensure that important information is not lost.
4. The Forensic Collision Investigation reports prepared by the Garda are also a potential source of additional information on the root causes of fatal collisions. The NRA should investigate whether this information could be made available for analysis in a suitably anonymous form, to supplement the information captured in PULSE.
5. We used Fatalities plus Weighted Injuries as a convenient measure of average collision severity in our analysis. We would encourage the NRA to consider using it in future work as well (for example the RSI programme), as it gives a complimentary picture to statistics based on collision frequency.
6. Better exposure data (vehicle kilometres travelled) is essential if collision risk is to be assessed on a route basis. The information contained in the NTpM shape files offers some additional analysis options compared to what was possible previously, but it is based on the same underlying 2004 survey data and we found considerable differences in our re-analysis of the NTpM data on some routes compared to the existing estimates used by NRA. Also, the NTpM is currently a high level planning tool so the AADT values used in it are not sufficiently detailed to analyse (for example) different levels of exposure during day and night. We recommend that NRA investigates the cost and practicality of measuring vehicle flow data more regularly and at more locations than is done at present, and considers whether the NTpM would be the most appropriate system to use to analyse such data in the future. The driver for installing traffic counters is usually to monitor congestion and provide traffic growth forecasts, but there is also scope for installing traffic counters on routes identified as high risk to see if this can be correlated with unusual traffic patterns, e.g. a high proportion of traffic at night, or an unusual mix of vehicle types. There is also a potential source of traffic flow data not currently being used – the data captured by mobile cameras at enforcement sites.
7. The LA16 form is potentially useful for contributory factors analysis as it especially focuses on a visual inspection of road features. Local Authorities should be encouraged to improve the return rate, and the scheme would benefit from being extended to cover serious injuries as well as deaths. This would require additional resources to be made available however, as between January 2007 and December 2010 there were 956 serious injuries on National roads compared to 439 fatalities.
8. The LA engineer and Garda officer, when they meet, should be encouraged to discuss the contributory factors in the collision. When there are road infrastructure related features that contributed to the collision, these could be recorded on the LA16 form.
9. The results of this analysis could be shared with the inspectors contracted to perform Road Safety Inspections. An important message to impart to them is that some combinations of contributory factors result in significantly worse average collision consequences than others, so it is worthwhile paying special attention to locations where these factors are likely to be present.

Table of Contents

1 INTRODUCTION

1.1 The Department of Transport, Tourism and Sport (DTTaS) is responsible for road safety in Ireland. The current Road Safety Strategy 2007-12 is coming to an end, so later this year the Road Safety Strategy for the next seven years will be published.

1.2 As part of its contribution to the new Strategy, the National Roads Authority (NRA) is currently reviewing how road collision data collection and analysis could be improved. One area of focus is to better understand how an analysis of contributory factors recorded for past collisions can be used to identify priorities for action to further improve road safety.

1.3 This report describes the contributory factors data analysis carried out by Risk Solutions. It complements our separate report on the data collection processes used in Ireland and benchmarked against international practice in selected European countries[1]. We have looked at the collision database maintained by the Road Safety Authority (which captures the road collisions reported to the Garda, where someone was injured) and the separate database of fatal collision LA16 forms maintained by the NRA. Most of our analysis is for the National road network and on contributory factors that are within the remit of the NRA (i.e. relating principally to road infrastructure).

1.4 The contents of this report are as follows:

Section 2: Data sources and previous analysis. A description of the databases supplied to us for this project and a summary of the type of analysis that has been done to date by the RSA and NRA.

Section 3: Contributory factors. An analysis of the relative importance of different types of contributory factor (vehicle, road infrastructure, driver behaviour etc) recorded by the Garda.

Section 4: Road infrastructure related contributory factors. An analysis of the road infrastructure related contributory factors (which the NRA might have some influence over), that have contributed to the most serious and frequent collisions on the National road network. A repeat of this analysis for the Regional and Local road network, for comparative purposes.

Section 5: Complementary analysis of LA16 reports. An examination of the LA16 reports for those collisions identified in Section 4 as the most serious or most frequent.

Section 6: Risk exposure and collision risk analysis. Options for estimating risk exposure (vehicle kilometres etc) and an analysis of the collision risk on National routes.

Section 7: Conclusions and recommendations. A discussion of the analysis that has been possible, conclusions drawn and recommendations for the future.

[1] Road Collision Data Collection in Ireland and International Benchmarking, Risk Solutions report, September 2012

2 DATA SOURCES AND PREVIOUS ANALYSIS

Data sources

2.1 A Garda officer should be called to all road collisions where someone has been injured. Details of the collisions are summarised on 'PC16' forms, generated by the PULSE incident management system. The Garda submit these forms to the RSA in paper and electronic form, as the RSA have primary responsibility for collating and reporting road collision statistics in Ireland.

2.2 An electronic download of this collision data is provided annually to the NRA by the RSA, although resource constraints and the time taken to 'cleanse' the dataset mean that its release can be up to 18 months after the end of the year. Consequently, the most recent data available for this analysis was for the calendar year ending 31 December 2010. This was combined with the datasets for the three previous years, which was judged to be a reasonable compromise between (i) collision information representing current road conditions and (ii) having enough data to generate meaningful statistics.

2.3 The RSA data was split into two populations, depending on whether the collisions occurred on National roads or on Regional and Local roads (abbreviated as RAL roads). Basic statistics are shown in Table 1 and Table 2 below.

Table 1: RSA database of Garda PC16 forms.
National roads - collisions between 1 Jan 2007 and 31 Dec 2010

Number of collisions	6,934
Total fatalities	439
Total serious injuries	956
Total minor injuries	9,199
Total unknown injuries	403
Fatalities plus (known) weighted injuries	627

Table 2: RSA database of Garda PC16 forms.
RAL roads - collisions between 1 Jan 2007 and 31 Dec 2010

Number of collisions	17,664
Total fatalities	628
Total serious injuries	1,939
Total minor injuries	22,679
Total unknown injuries	400
Fatalities plus (known) weighted injuries	1,049

2.4 Road safety statistics are often based on an analysis of fatalities or KSIs (killed and seriously injured). In order to increase the size of the available dataset, the NRA also includes minor injuries in many of their statistics. However, there are advantages in using a combined measure of the overall severity of a collision so for this analysis we have used the concept of Fatalities plus Weighted Injuries (FWI)[2]. This is defined as follows:

FWI = Fatalities + (0.1 x serious injuries) + (0.01 x minor injuries)

2.5 Every collision recorded in the RSA database has a field for the total number of fatalities, serious injuries, minor injuries and unknown injuries that occurred, so we were able to calculate the FWI value for each. We took the decision to exclude the unknown injuries from this calculation as it would be potentially misleading to make any assumptions about how these should be distributed between the other three categories.

2.6 In addition to the RSA dataset, we were also provided with electronic copies of around 450 LA16 forms spanning the period January 2008 to December 2010. We were able to map approximately 390 of these to records in the RSA database, based on matching the unique PULSE identification number and/or the date and time of the incident. Of these 390, approximately 150 were for collisions occurring on National roads.

2.7 The LA16 forms are for fatal collisions only. This system was implemented nationally as part of the previous Road Safety Strategy, to speed up the process of gathering intelligence on the most serious collisions and to promote good relations between the Garda and the Local Authority Area Engineers. The percentage rate of return of LA16 forms for fatal collisions has been rather low to date unfortunately, although it does vary considerably from region to region. For this analysis therefore, we have treated the LA16 data as supplementary information that might help to further inform the contributory factors analysis, especially as it contains a narrative description of the incident that is missing from the RSA database and also has more detail on some of the road infrastructure related features present at the collision site.

Previous contributory factors analysis

2.8 There has been a limited amount of contributory factors analysis done prior to this research. The 2007-2009 RSA Road Strategy document includes one pie chart that shows the distribution of different types of contributory factor for fatal collisions, reproduced below as Figure 1.

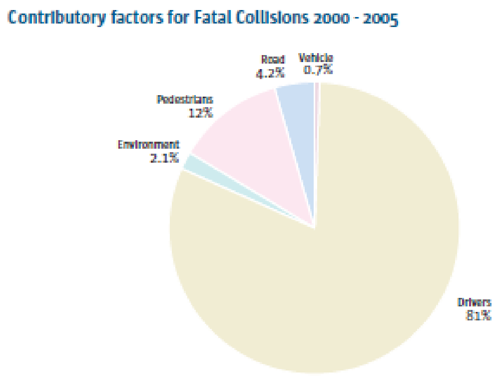

Figure 1: Reproduction of Figure 5 from the RSA Road Safety Strategy 2007-2012

2.9 The RSA also produces an annual 'fact book' of road safety statistics[3]. The 2009 and 2010 versions contain pie charts similar to the above for fatal collisions within the year; a breakdown of the major causes of two-vehicle fatal collisions; and some supporting tabular data.

[2] This concept was introduced by the railway industry in the UK, and is now widely used. See www.rssb.co.uk for more details.

[3] Available on-line at http://www.rsa.ie/en/RSA/Road-Safety/Our-Research/Collision-Statistics/

2.10 There is no specific analysis of road infrastructure related contributory factors in the RSA documents and to date the main focus of the NRA's data analysis has been to map collision locations as accurately as possible using geo-spatial tools in order to identify particular sections of road with higher than average historical collision rates (collisions per million vehicle kilometres). The NRA analysis has been very useful at identifying priority locations for action, taking into account the level of risk exposure, but we understand that this analysis has already identified the most obvious collision clusters. If further reductions in casualties are to be achieved, the new Road Safety Strategy will need to look beyond historical collision cluster analysis and become more pro-active at preventing collisions before they occur. The planned programme of Road Safety Inspections should be at the heart of the new strategy for this reason, but there is also the potential for collision data analysis to go beyond identifying collision clusters by seeking to identify contributory factors that, if they occur, result in more severe collisions. It is therefore important to look at the **average consequences** of different types of collision as well as their **frequency.**

2.11 If certain road infrastructure features can be identified that are correlated with an increase in the severity of road collisions then this would be valuable information. Exploring this would be consistent with the NRA's current thinking with regards to the future road safety strategy; that is to explore the extent that forgiving roadsides and self explaining roads can be encouraged.

3 CONTRIBUTORY FACTORS

3.1 The Garda's opinion of the main contributory factors in a collision can be found on page 3 of the PC16 form[4] (an example PC16 is included in Appendix 1). There is a Yes/No field for whether there is single principal cause which precipitated the collision and a table underneath where several factors can be listed as having contributed to a Large Extent, to Some Extent or Not At All. The corresponding fields in the RSA database are as follows:

Field name	Description
PED1, PED2	Pedestrian (1 or 2) actions contributed to the collision
DR1, DR2	Driver (1 or 2) actions contributed to the collision
ROAD	Road factors contributed to the collision
ENVIR	Environmental factors contributed to the collision
VEHICLE	Vehicle factors contributed to the collision

3.2 We analysed the RSA database for collision records where these fields were set to "L" or "S" (Large Extent or Some Extent respectively). The results are summarised in the Venn diagram below.

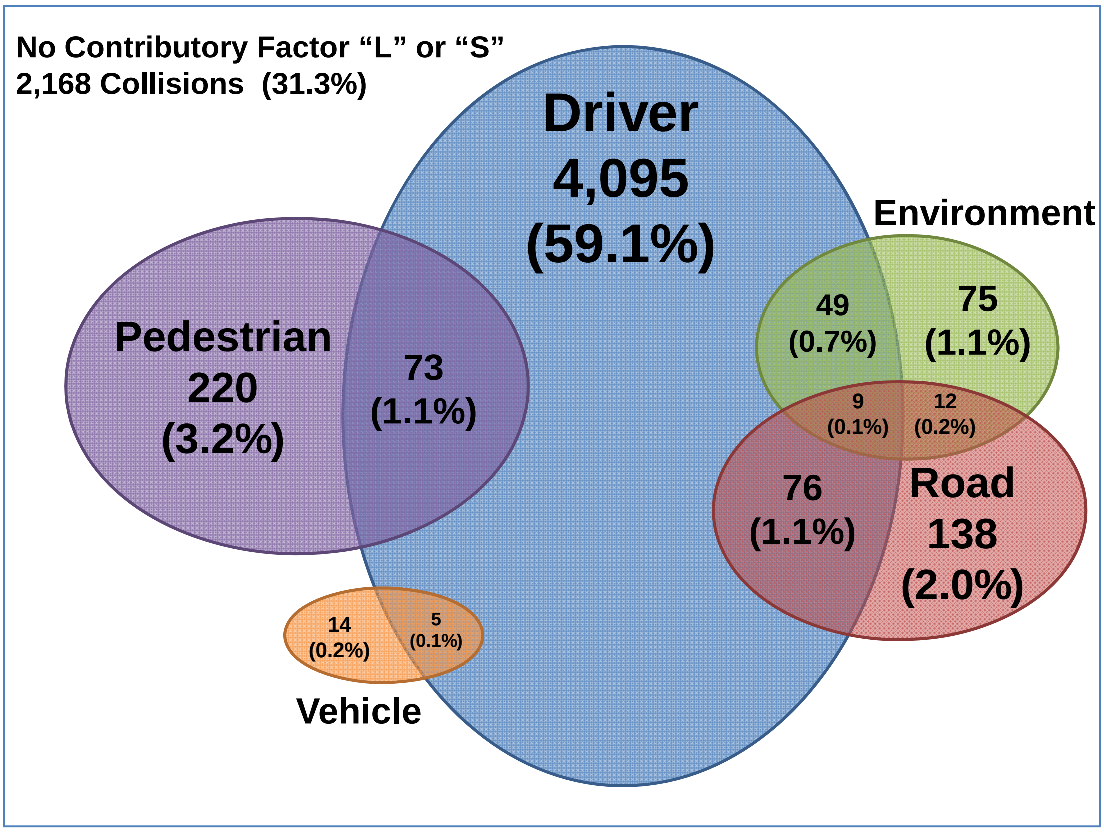

Figure 2: Venn diagram showing Garda opinion of factors that contributed to a Large Extent or to Some Extent in collisions on National roads between 1 Jan 2007 and 31 Dec 2010

[4] The Garda still refer widely to the road collision data collection form as the 'CT68' form. In this report the terms PC16 and CT68 can be used interchangeably.

3.3 From Table 1, there were a total of 6,934 collisions in the NRA database on National roads between 1 January 2007 and 31 December 2010. Out of this population, 31.3% had no contributory factor flagged as to a Large Extent or to Some Extent responsible for the incident. This might indicate the reluctance of police officers to identify contributory factors if they are not certain.

3.4 The most common response is for driver actions to be cited as a contributory factor, with fields DR1 and/or DR2 flagged in 59.1% of the collisions on their own and in a further 3.1% of collisions with one or more of the other factors.

3.5 The next most common response is for pedestrian actions to be cited as a contributory factor, with fields PED1 and/or PED2 flagged in 3.2% of collisions on their own and a further 1.1% of collisions with both pedestrian and driver fields flagged.

3.6 Road factors are cited as a contributory factor on their own in only 2.0% of collisions. A further 1.1% of collisions cite road and driver factors together; 0.2% of collisions cite road and environment factors together; and 0.1% of collisions cite road, driver and environment factors. Pedestrian actions and vehicle defects do not appear to occur in conjunction with road factors according to this set of data (Garda opinion), although other fields in the database may reveal more interconnections (see Section 5 below).

3.7 Overall, the Garda opinion recorded in the RSA database suggests that road factors contributed to around 3.4% of all personal injury collisions (on their own or in combination with other factors) between 2007 and 2010. This compares with a published value of 4.2% for fatal collisions between 2000 and 2005[5] and 3% for fatal collisions in 2009[6], although both of these analyses use pie charts rather than Venn diagrams so don't refer to the possibility of different types of contributory factor occurring together.

Comparison with studies in the USA and UK

3.8 The Venn diagram analysis presented above is similar to that done by Treat et al[7] in their seminal work in this field. Table 3 maps the results from our analysis onto the closest match to Treat's categories for the USA. Also shown is some comparable data from the Highways Agency in the UK.

[5] Road Safety Strategy 2007-2012, Road Safety Authority

[6] Road Collision Facts 2009, Road Safety Authority

[7] Treat, J. R., Tumbas, N. S., McDonald, S. T., Shinar, D., Hume, R. D., Mayer, R. E., Stansifer, R. L., Castellan, N. J., 1979, Tri-Level Study of the Causes of Accidents, Indiana University, Bloomington, Institute for Research in Public Safety

Table 3: Comparison of Garda opinion of contributory factors with that reported by Treat at al for the USA and comparable data from the UK Highways Agency

Ireland[1] NRA National roads, 2007-2010	% of collisions	USA[2] All roads, 1971-1975	% of collisions	UK[3] Highways Agency single carriageway roads, 2007 to 2010	% of collisions
No contributory factor	31.27%	No contributory factor	0%	No contributory factor	4.91%
Driver only, Pedestrian only, or both	63.28%	Human only	57.1%	Driver only	70.18%
Environment only, Road only, or both	3.24%	Environment only	3.3%	Road/Environment only	5.17%
Vehicle only	0.20%	Vehicle only	2.4%	Vehicle only	0.54%
Driver & Environment or Driver & Road or all three	1.94%	Human & Environment	26.4%	Driver & Road/Environment	14.51%
Driver & Vehicle	0.07%	Human & Vehicle	6.2%	Driver & Vehicle	1.52%
Vehicle & Environment or Vehicle & Road	0%	Vehicle & Environment	1.2%	Vehicle & Road/Environment	2.87%
Driver/Pedestrian, Environment/Road and Vehicle	0%	Human, Environment & Vehicle	2.9%	Driver, Road/Environment & Vehicle	0.30%

Notes:

1 - Garda opinion of factors that contributed to collisions on National roads between Jan 2007 and Dec 2010. Data taken from Figure 2. Note that the Environment and Road categories have been merged and the Driver and Pedestrian categories have been merged, to best match the three categories used by Treat et al.

2 - Results of the Tri-Level study conducted by Treat et al. Published in 1979 for collisions occurring between 1971 and 1975. The data is very old now, but the study is still widely quoted. Figures don't add to 100% - presumably due to rounding errors.

3 - UK data taken from the Highways Agency Safety Risk Model. Data covers the period Jan 2007 to Dec 2010, restricted to single carriageway roads within the Highways Agency network as the best available comparison to Irish roads.

3.9 Treat used an expert team to determine collision contributory factors, so 100% of the collisions in his dataset were attributed to Human, Environment or Vehicle causes.[8] The Highways Agency data has been similarly processed to allocate all but approximately 5% of collisions to one or more category. However, only 69% of the Irish collisions were flagged with an "L" or an "S" by the Garda (see Figure 2). The percentages for Human factors only and Road/Environmental factors only are quite similar between the USA data and the Garda opinion data and are consistent with the UK data, but there is a large difference in the percentage figure for collisions where Human factors and Road/Environmental factors both contributed – 26% for the USA, 15% for the UK and 2% for Ireland. We could speculate that the large number of collisions in the Garda dataset with no contributory factors recorded has distorted the results, and many of these collisions would perhaps fall into the Human and Road/Environment category, but it is impossible to say more without access to the underlying collision description information.

3.10 The percentage figure for collisions where road infrastructure related factors were clearly responsible is small in all the datasets however, so one might argue that there is limited opportunity for the NRA to make a real difference to total casualty numbers within their sole area of responsibility. Furthermore, because police officers often do not complete these contributory factor fields, it is clear that we need to dig deeper into the RSA database and LA16 database to see what information can be inferred from the other database fields. The analysis that we have done is presented in the remaining sections of this report.

[8] 100% allocation at the "probable" level of certainty. Around 90% of collisions were allocated to the three categories at the "definite" level of certainty.

4 ROAD INFRASTRUCTURE RELATED CONTRIBUTORY FACTORS

Analysis of the ‘Contributory Road Factors’ database field

4.1 The database contains a ROAD field where the Garda officer can express an opinion as to whether road infrastructure factors were to a Large Extent or Some Extent responsible for a collision, see Section 3. However, there is also a separate ‘Contributory Road Factors’ database field (CTRDFCTR) on the PC16 form that can be completed to indicate which type of road infrastructure related features contributed to the collision. We saw from Section 3 that in over 30% of collisions, the Garda officer does not express an opinion on any contributory factors, so it is possible that the CTRDFCTR field contains additional information. Table 4 and Table 5 summarise the correlation between these two database fields.

Table 4: National roads. Values of CTRDFCTR field when ROAD field indicates Garda opinion that road factors contributed to the collision.

CTRDFCTR field: Category of contributory road factor	Total collisions 2007 to 2010	Total FWIs 2007 to 2010	Average FWIs per collision
Blank or None	205	5.04	0.025
Layout	12	1.23	0.103
Skid resistance	11	0.37	0.034
Surface evenness	6	0.26	0.043
Traffic signs	1	0.01	0.010

Table 5: National roads. Values of CTRDFCTR field when ROAD field is blank.

CTRDFCTR field: Category of contributory road factor	Total collisions 2007 to 2010	Total FWIs 2007 to 2010	Average FWIs per collision
Crossfall/camber	4	1.27	0.318
Layout	99	12.77	0.129
Lighting	42	10.14	0.241
Road markings	9	1.82	0.202
Road signs	14	2.35	0.168
Sight distance	21	2.35	0.112
Skid resistance	65	6.74	0.104
Surface evenness	11	0.26	0.024
Traffic signs	20	2.65	0.133

4.2 Table 4 shows that, when the ROAD field is used to indicate road factors contributed to the collision, it is very rare for the CTRDFCTR field to also be completed. Based on the format of the PC16 form (see Appendix 1) there is a free text description field that the Garda officer can also use associated with the ROAD field, so it is possible that some officers use this field instead of CTRDFCTR. Unfortunately we were unable to check this as the RSA database doesn't contain any of the free text fields.

4.3 Table 5 shows that the CTRDFCTR field is more often completed when the ROAD field is left blank. There are an additional 285 collisions where some contribution of road factors could be inferred (i.e. 285 of the 2,168 unallocated collisions identified in Figure 2). Of these, road layout, lighting and skid resistance appear to be the most important issues, though as noted above unfortunately there are no free text field descriptions in the RSA database to examine these collisions in more detail.

Analysis of other contributory factor database fields

4.4 As noted above, the two database fields that directly relate to road infrastructure contributory factors are ROAD and CTRDFCTR. However, there are a number of other fields that could also indirectly indicate some involvement of road factors. Table 6 below summarises a list of database fields and field values which we examined as potentially relevant.

Table 6: Database fields and field values containing potentially relevant contributory factor information

Database field	Relevant field values	Comments
CONTACT1, CONTACT2	All values	Driver contributory action such as speeding, improper overtaking, failing to stop at traffic signs etc, but some of these could also be partially down to road layout, sight lines etc.
CTRDFCTR	All values	Main road contributory factor field analysed above (layout, skid resistance etc)
JNCNTRL	All values	Junction control type (traffic lights, road markings etc)
JNTYPE	All values	Junction type (T junction, cross roads etc)
LIGHT	4, 5, 6 or 7	Field values of 4, 5, and 6 represent collisions where it was dark with poor lighting, unlit lighting, or no lighting respectively. A field value of 7 represents unknown lighting.
PEDACT1, PEDACT2	All values	Pedestrian actions such as crossing the road, walking in the road etc could be made unsafe by road features
PRCOLTYP	All values	Primary collision type (head on etc)
RDCHAR1, RDCHAR2	All values	Road character (straight, bend etc)
RDMARK1, RDMARK2	All values	Road markings (centre lines etc)
RDWKS	Y	Incident at or close to roadworks
SKIDD	Y	Evidence of skidding
SVCW	All values	Single vehicle collision with various object types (tree, gate etc) that might indicate an unforgiving road side.

4.5 We have colour coded the fields in Table 6 to make it clear which ones are the most significant in the analysis that follows.

Table 7: National roads. Individual contributory factors where road infrastructure features are potentially relevant

Database field	Field value	Total Collisions 2007 to 2010	Total FWIs 2007 to 2010	Average severity[1] (FWIs per collision)
Pedestrian Action	Walking against traffic	33	13.72	0.416
Contributory Road Factors	Crossfall/camber	4	1.27	0.318
Single vehicle collision with:	Tree	87	22.88	0.263
Light Conditions	Unknown	26	6.83	0.263
Pedestrian Action	Lying in roadway	5	1.22	0.244
Contributory Road Factors	Lighting	42	10.14	0.241
Primary collision type	Head-on conflict	698	165.90	0.238
Pedestrian Action	Standing in roadway	46	10.20	0.222
Driver Action	Went to wrong side of road	381	82.90	0.218
Light Conditions	Dark-Unlit Lighting	62	12.91	0.208
Contributory Road Factors	Road markings	9	1.82	0.202
Pedestrian Action	Walking on traffic	45	9.00	0.200
Contributory Road Factors	Road signs	14	2.35	0.168
Light Conditions	Dark-No Lighting	881	147.05	0.167
Road Markings	Double continuous centre line	263	42.60	0.162
Single vehicle collision with:	Pole	117	18.74	0.160
Road Characteristics	Some gradient	157	23.29	0.148
Primary collision type	Pedestrian	758	105.41	0.139
Single vehicle collision with:	Wall/gate	291	40.41	0.139
Pedestrian Action	Otherwise crossing	271	34.88	0.129
Contributory Road Factors	Traffic signs	21	2.66	0.127
Contributory Road Factors	Layout	111	14.00	0.126
Road Characteristics	Hillcrest	86	10.50	0.122
Road Characteristics	Bend	958	114.77	0.120
Single vehicle collision with:	Other	1128	133.44	0.118

Note 1 – where numbers are small, the estimate of average FWI per collision cannot be treated as reliable. The ranking is indicative only.

4.6 The simplest analysis is to look at each database field and each field value individually. For the period 2007 to 2010, we counted the number of collisions on National roads where each field value was flagged and then calculated the average FWIs per collision. This is a measure of the average severity of collision when each factor is present on its own or in combination with any others. The top 25 results are shown in Table 7, ranked in descending order of severity. Note that the contributory factors listed are only those where road infrastructure has the potential to influence the collision, so for the example the pure human behaviour contributory factors such as seat belt wearing and alcohol are excluded.

4.7 Table 7 shows that the factor that results in the highest average collision severity, where there is arguably some degree of contribution from road features, is vehicle collision with a pedestrian walking against the traffic. There were 33 such collisions between 2007 and 2010. As the average FWI per collision is greater than 0.1, on average each collision of this type results in a major injury of worse.

4.8 The main road contributory factor field CTRDFCTR occupies six of the top 20 places, although some field values have very few collisions so the average severity is going to be heavily influenced by one or two bad incidents. From the table it appears that street lighting is potentially an issue, with Lighting cited as a contributory factor in CTRDFCTR 42 times. In addition, the conditions of unlit or no lighting also appear in the top 20 list. Another collision type appearing several times in the list with arguably a road features contribution, is single vehicle collisions with solid objects such as trees, poles, walls and gates.

4.9 It is difficult to extract much more information from an analysis of single contributory factors, due to the lack of free text fields in the RSA database to add context to the collisions. Although the Garda do record narrative descriptions for collisions in their PULSE system, this information is removed for data protection purposes before the database is passed on to RSA.

4.10 There is also insufficient data to perform a full multi-variate analysis, but a worthwhile intermediate step is to consider pairs of contributory factors that occur together. This is considered in the next section.

Analysis of paired contributory factors

4.11 There are over 2,000 different combinations of pairs of contributory factors from Table 6 that could be cited together on a PC16 road collision report form. We found that there are some pairs of contributory factors that, if they occur together, result in much higher average consequences per collision than the typical single factor averages listed in Table 7. In order to ensure the averages are not biased by small numbers of collisions we set the following threshold criteria:

- A minimum of four collisions occurred on National roads with that combination of contributory factors present over the period 2007 to 2010
- The average number of fatalities and weighted injuries (FWIs) per collision was greater than 0.4.

4.12 The collisions that ‘pass’ these threshold criteria are shown by the purple box in Figure 3 below.

4.13 43 contributory factor combinations resulted in an average frequency and average severity that met the threshold criteria. We have given each of these an identifier in the format ‘IDn’. All these combinations are shown in Table 8 and Table 9. The Top 10 incident types by FWI per collision, and by frequency, are discussed in more detail below.

4.14 The objective of this analysis is not necessarily to pinpoint locations on the network that require remedial action, but rather it is to identify conditions that occur more often than not in high average consequence collisions. These conditions can then be highlighted for special attention during the programme of Road Safety Inspections. If NRA wish to extend the analysis further, it might be useful to look next at those collisions with an average frequency of ten or more per year and an average severity of greater than 0.2 FWIs.

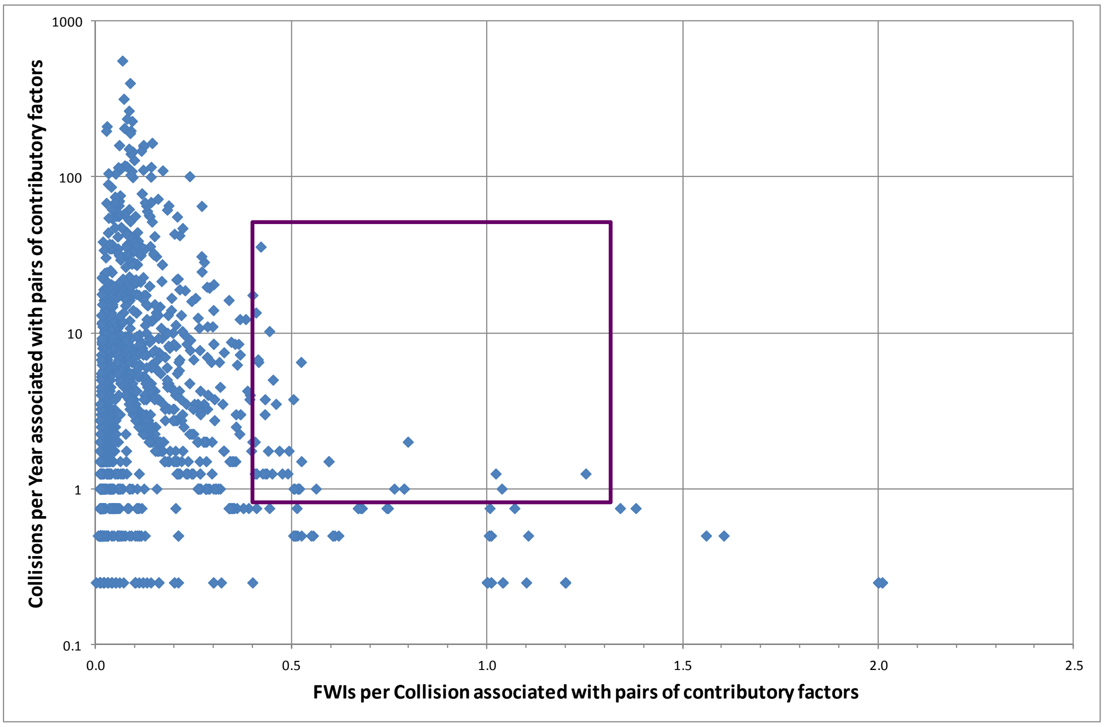

Figure 3: Collisions on National roads, 2007 to 2010. The purple box represents combinations of contributory factors that had at least one collision per year on average and at least 0.4 FWIs per collision on average.

Top ten incidents with the highest FWIs per collision, with an average of one or more collisions per year. National roads.

4.15 **ID1**: At the top of the list are collisions in darkness (where lighting is not lit), and where there is a double continuous centre line, as contributory factors. Five such collisions occurred in the last four years, and the average FWI per incident is 1.252. Looking in detail at these five incidents shows that in three cases the collision involved a driver attempting to overtake, and in one case the safe speed was also exceeded. Clearly driver actions were implicated in some of these incidents, but if it was dark and lighting should have been lit then the road conditions are also potentially implicated.

4.16 **ID2**: The next on the list are those collisions where one driver in a collision between vehicles exceeded the safe speed and where the collision happened on a bend. Four of these occurred over the last four years, three of them in 2009. Again, while driver action is the key contributory factor, road characteristics may have enabled or encouraged excessive speed.

4.17 **ID3:** Five incidents with more than 1.0 FWI per incident involved a pedestrian walking against the traffic and evidence of skidding. Two of these occurred in daylight, but the remaining three occurred in darkness with either no or poor lighting. In three cases the driver attempted avoiding action, but was unable to avoid the collision – this, together with the evidence of skidding may suggest that the road was potentially partly at fault. Additionally, if pedestrians are walking in the road there may be some problem with insufficient separation.

4.18 **ID4:** Eight incidents with an average of 0.80 FWI per incident are attributed to combinations of road layout and double continuous centre line. In four of these drivers attempted to take avoiding actions. Four of the incidents were during hours of darkness in unlit areas – one where lighting was unlit, and three where no lighting was available. It therefore seems possible that visibility played a part in half of these incidents, as well as the road layout.

4.19 **ID5**: Four incidents occurred with an average of 0.79 FWI per incident, where a single vehicle hit a tree, with some gradient on the road. The relatively severe consequences of a single vehicle hitting a tree are also reflected in the analysis of the individual contributory factors, however in these cases where a gradient was involved the collision severity was increased. Therefore the road layout may have contributed to increased severity.

4.20 **ID6**: There were four incidents where one of the drivers involved carried out an overtaking manoeuvre where a double continuous centre line would have indicated that overtaking was dangerous. These incidents had an average FWI of 0.76.

4.21 **ID7**: Six incidents involved single vehicles leaving the road and hitting a wall or gate, at a location where there was a double continuous centre line – perhaps indicating that they lost control at a particularly hazardous location. These incidents had an average FWI of 0.59.

4.22 **ID8**: Four incidents occurred where one of the two drivers involved exceeded the safe speed in the dark, in an unlit area. These incidents had an average FWI of 0.56.

4.23 **ID9**: In six incidents, one of the two drivers involved went onto the wrong side of the road where there was a skid-resistant surface in place. It is possible that the skid-resistant surface may not have been as effective as necessary in these incidents, which had an average FWI of 0.53.

4.24 **ID10**: There were 26 incidents where a driver exceeded the safe speed at a location with a double continuous centre line, resulting in an average of 0.52 FWI per incident. These are the most numerous of the top ten FWI/collision incident types.

4.25 Many of the contributory factors present in this list are typical of the types of issues that arise on largely rural road networks. For example, the lack of lighting, limited separation between vehicles and pedestrians, collisions with objects at the side of the road, and drivers overtaking or losing control and colliding with on-coming vehicles.

Top ten most frequent incidents with an average FWI per collision of 0.4 or greater. National roads

4.26 **ID32**: The most frequent incidents with a relatively high FWI per collision (0.421) are head-on collisions that take place where there is a broken centre line – an average of 35.75 incidents of this type occurred each year – a total of 143 over the period. The vast majority of these (119) were on two-way single carriageway roads. This suggests that people are overtaking, in a permitted area, but for some reason are misjudging or are unable to see enough to carry out the manoeuvre safely.

4.27 **ID42**: The second most frequent combination of contributory factors is collisions with pedestrians at night where there is no lighting. There were 17.5 incidents of this type per year, with an average FWI per collision of 0.4. This could suggest that there are places on the network where pedestrians are able to walk on the road (perhaps without pavements) but where lack of lighting makes this a particularly dangerous activity.

4.28 **ID39**: The third most frequent type of incident is where a driver exceeds the safe speed and is the only vehicle involved in the collision. In these cases cars have run into ditches, bollards, walls, gates, trees and parked cars. While the driver has primary responsibility for these collisions, there may be some reason in terms of the layout or signage of particular roads that may encourage excessive speed.

4.29 **ID25**: The fourth most frequent incidents are those where one of the two drivers involved is on the wrong side of the road where there is a broken centre line. These incidents had an average FWI of 0.44.

4.30 **D34**: The fifth most common type of incident is where a single vehicle hits a tree, in the dark, where there is no lighting. These incidents result in an average of 0.41 FWI.

4.31 **ID10**: This is the only combination of factors that appears in both lists. There were 26 incidents where a driver exceeded the safe speed at a location with a double continuous centre line, resulting in an average of 0.52 FWI per incident. These are the most numerous of the top ten FWI/collision incident types and the most severe of the top ten most frequent incidents.

4.32 **ID33**: There were an average of 6.5 incidents per year where a driver went onto the wrong side of the road in the dark in an area with no lighting.

4.33 **ID23**: These incidents, resulting in an average of 0.45 FWI, involved a single vehicle being driven too fast into an unspecified object (not one of the standard types, such as tree, wall etc).

4.34 **ID17**: The ninth most common type of higher-risk incident involves a driver exceeding the safe speed, when it was dark and where there is no lighting. These had an average of 0.5 FWI per collision.

4.35 **ID29**: Fifteen incidents over the four year period were simply attributed to 'Lighting' with a single vehicle colliding with an object classed as 'other'.

4.36 The contributory factors identified in this list are very similar to the previous list. Features common on many rural roads such as head-on collisions, lack of separation between vehicles and roadside objects or between vehicles and pedestrians, lack of lighting, are again especially prominent.

Table 8: National roads. Pairs of contributory factors where road infrastructure features are potentially relevant. One or more collisions per year with average FWIs per collision greater than 0.4, ordered by severity

ID	Database field 1	Field 1 value	Database field 2	Field 2 value	Total Collisions 2007 to 2010	Total FWIs 2007 to 2010	Average severity (FWIs per collision)
1	Lighting Conditions	Dark-Unlit Lighting	Road Markings	Double continuous centre line	5	6.26	1.252
2	Driver 2 Actions	Exceeded safe speed	Road Characteristics	Bend	4	4.15	1.038
3	Collision involved skidding	Collision involved skidding	Pedestrian Action	Walking against traffic	5	5.11	1.022
4	Contributory Road Factors	Layout	Road Markings	Double continuous centre line	8	6.38	0.798
5	Single vehicle collision with	Tree	Road Characteristics	Some gradient	4	3.15	0.788
6	Driver 2 Actions	Improper overtaking	Road Markings	Double continuous centre line	4	3.05	0.763
7	Single vehicle collision with	Wall/gate	Road Markings	Double continuous centre line	6	3.57	0.595
8	Driver 2 Actions	Exceeded safe speed	Lighting Conditions	Dark-No Lighting	4	2.25	0.563
9	Contributory Road Factors	Skid resistance	Driver 2 Actions	Went to wrong side of road	6	3.15	0.525
10	Driver 1 Actions	Exceeded safe speed	Road Markings	Continuous centre line	26	13.63	0.524
11	Road Characteristics	Other	Primary Collision Type	Rear end, right turn	4	2.08	0.520
12	Driver 1 Actions	Went to wrong side of road	Road Characteristics	Other	4	2.07	0.518
13	Driver 1 Actions	Went to wrong side of road	Single vehicle collision with	Pole	4	2.07	0.518
14	Driver 2 Actions	Other action	Primary Collision Type	Head-on right turn	4	2.06	0.515
15	Single vehicle collision with	Bollard/island	Road Characteristics	Other	4	2.03	0.508
16	Driver 1 Actions	Went to wrong side of road	Road Markings	No markings	4	2.02	0.505
17	Driver 1 Actions	Exceeded safe speed	Lighting Conditions	Dark-No Lighting	15	7.57	0.505
18	Driver 1 Actions	Went to wrong side of road	Lighting Conditions	Dark-Poor Lighting	7	3.45	0.493
19	Lighting Conditions	Dark-Poor Lighting	Road Characteristics	Hillcrest	5	2.45	0.490
20	Road Markings	Edge markings	Primary Collision Type	Head-on conflict	5	2.38	0.476
21	Driver 1 Actions	Went to wrong side of road	Junction Control	Stop sign	7	3.28	0.469

ID	Database field 1	Field 1 value	Database field 2	Field 2 value	Total Collisions 2007 to 2010	Total FWIs 2007 to 2010	Average severity (FWIs per collision)
22	Lighting Conditions	Dark-Unlit Lighting	Road Characteristics	Bend	14	6.44	0.460
23	Driver 1 Actions	Exceeded safe speed	Single vehicle collision with	Other	20	9.05	0.453
24	Driver 1 Actions	Drove through stop/yield	Road Markings	Edge markings	5	2.25	0.450
25	Driver 2 Actions	Went to wrong side of road	Road Markings	Broken centre line	41	18.17	0.443
26	Driver 2 Actions	Improper overtaking	Primary Collision Type	Head-on conflict	7	3.08	0.440
27	Single vehicle collision with	Tree	Road Markings	Double continuous centre line	5	2.18	0.436
28	Driver 1 Actions	Exceeded safe speed	Single vehicle collision with	Bollard/island	5	2.16	0.432
29	Contributory Road Factors	Lighting	Single vehicle collision with	Other	15	6.48	0.432
30	Driver 1 Actions	Exceeded safe speed	Single vehicle collision with	Wall/gate	12	5.18	0.432
31	Driver 1 Actions	Exceeded safe speed	Road Markings	Lane markings	5	2.13	0.426
32	Road Markings	Broken centre line	Primary Collision Type	Head-on conflict	143	60.23	0.421
33	Driver 2 Actions	Went to wrong side of road	Lighting Conditions	Dark-No Lighting	26	10.8	0.415
34	Lighting Conditions	Dark-No Lighting	Single vehicle collision with	Tree	27	11.18	0.414
35	Contributory Road Factors	Road signs	Road Characteristics	Straight	5	2.05	0.410
36	Driver 1 Actions	Exceeded safe speed	Road Characteristics	Other	5	2.05	0.410
37	Driver 1 Actions	Improper overtaking	Road Markings	Continuous centre line	5	2.05	0.410
38	Single vehicle collision with	Bollard/island	Road Markings	Continuous centre line	5	2.05	0.410
39	Driver 1 Actions	Exceeded safe speed	Primary Collision Type	Single vehicle only	54	22.08	0.409
40	Collision involved skidding	Collision involved skidding	Pedestrian Action	Standing in roadway	8	3.25	0.406
41	Lighting Conditions	Day-Poor Visibility	Single vehicle collision with	Tree	5	2.03	0.406
42	Lighting Conditions	Dark-No Lighting	Primary Collision Type	Pedestrian	70	28.02	0.400
43	Contributory Road Factors	Lighting	Road Markings	Broken centre line	8	3.2	0.400

Table 9: National roads. Pairs of contributory factors where road infrastructure features are potentially relevant. One or more collisions per year with average FWIs per collision greater than 0.4, ordered by collision frequency

ID	Database field 1	Field 1 value	Database field 2	Field 2 value	Total Collisions 2007 to 2010	Total FWIs 2007 to 2010	Average severity (FWIs per collision)
32	Road Markings	Broken centre line	Primary Collision Type	Head-on conflict	143	60.23	0.421
42	Lighting Conditions	Dark-No Lighting	Primary Collision Type	Pedestrian	70	28.02	0.400
39	Driver 1 Actions	Exceeded safe speed	Primary Collision Type	Single vehicle only	54	22.08	0.409
25	Driver 2 Actions	Went to wrong side of road	Road Markings	Broken centre line	41	18.17	0.443
34	Lighting Conditions	Dark-No Lighting	Single vehicle collision with	Tree	27	11.18	0.414
10	Driver 1 Actions	Exceeded safe speed	Road Markings	Continuous centre line	26	13.63	0.524
33	Driver 2 Actions	Went to wrong side of road	Lighting Conditions	Dark-No Lighting	26	10.8	0.415
23	Driver 1 Actions	Exceeded safe speed	Single vehicle collision with	Other	20	9.05	0.453
17	Driver 1 Actions	Exceeded safe speed	Lighting Conditions	Dark-No Lighting	15	7.57	0.505
29	Contributory Road Factors	Lighting	Single vehicle collision with	Other	15	6.48	0.432
22	Lighting Conditions	Dark-Unlit Lighting	Road Characteristics	Bend	14	6.44	0.460
30	Driver 1 Actions	Exceeded safe speed	Single vehicle collision with	Wall/gate	12	5.18	0.432
4	Contributory Road Factors	Layout	Road Markings	Double continuous centre line	8	6.38	0.798
40	Collision involved skidding	Collision involved skidding	Pedestrian Action	Standing in roadway	8	3.25	0.406
43	Contributory Road Factors	Lighting	Road Markings	Broken centre line	8	3.2	0.400
18	Driver 1 Actions	Went to wrong side of road	Lighting Conditions	Dark-Poor Lighting	7	3.45	0.493
21	Driver 1 Actions	Went to wrong side of road	Junction Control	Stop sign	7	3.28	0.469
26	Driver 2 Actions	Improper overtaking	Primary Collision Type	Head-on conflict	7	3.08	0.440
7	Single vehicle collision with	Wall/gate	Road Markings	Double continuous centre line	6	3.57	0.595
9	Contributory Road Factors	Skid resistance	Driver 2 Actions	Went to wrong side of road	6	3.15	0.525
1	Lighting Conditions	Dark-Unlit Lighting	Road Markings	Double continuous centre line	5	6.26	1.252

ID	Database field 1	Field 1 value	Database field 2	Field 2 value	Total Collisions 2007 to 2010	Total FWIs 2007 to 2010	Average severity (FWIs per collision)
3	Collision involved skidding	Collision involved skidding	Pedestrian Action	Walking against traffic	5	5.11	1.022
19	Lighting Conditions	Dark-Poor Lighting	Road Characteristics	Hillcrest	5	2.45	0.490
20	Road Markings	Edge markings	Primary Collision Type	Head-on conflict	5	2.38	0.476
24	Driver 1 Actions	Drove through stop/yield	Road Markings	Edge markings	5	2.25	0.450
27	Single vehicle collision with	Tree	Road Markings	Double continuous centre line	5	2.18	0.436
28	Driver 1 Actions	Exceeded safe speed	Single vehicle collision with	Bollard/island	5	2.16	0.432
31	Driver 1 Actions	Exceeded safe speed	Road Markings	Lane markings	5	2.13	0.426
35	Contributory Road Factors	Road signs	Road Characteristics	Straight	5	2.05	0.410
36	Driver 1 Actions	Exceeded safe speed	Road Characteristics	Other	5	2.05	0.410
37	Driver 1 Actions	Improper overtaking	Road Markings	Continuous centre line	5	2.05	0.410
38	Single vehicle collision with	Bollard/island	Road Markings	Continuous centre line	5	2.05	0.410
41	Lighting Conditions	Day-Poor Visibility	Single vehicle collision with	Tree	5	2.03	0.406
2	Driver 2 Actions	Exceeded safe speed	Road Characteristics	Bend	4	4.15	1.038
5	Single vehicle collision with	Tree	Road Characteristics	Some gradient	4	3.15	0.788
6	Driver 2 Actions	Improper overtaking	Road Markings	Double continuous centre line	4	3.05	0.763
8	Driver 2 Actions	Exceeded safe speed	Lighting Conditions	Dark-No Lighting	4	2.25	0.563
11	Road Characterstics	Other	Primary Collision Type	Rear end, right turn	4	2.08	0.520
12	Driver 1 Actions	Went to wrong side of road	Road Characteristics	Other	4	2.07	0.518
13	Driver 1 Actions	Went to wrong side of road	Single vehicle collision with	Pole	4	2.07	0.518
14	Driver 2 Actions	Other action	Primary Collision Type	Head-on right turn	4	2.06	0.515
15	Single vehicle collision with	Bollard/island	Road Characteristics	Other	4	2.03	0.508
16	Driver 1 Actions	Went to wrong side of road	Road Markings	No markings	4	2.02	0.505

Infrastructure related contributory factors for Regional and Local roads

4.37 For comparative purposes, we have repeated some of the analysis presented above for the Regional and Local (RAL) road network. Table 10 and Table 11 summarise the correlation between the ROAD field and CTRDFCTR field for RAL roads.

Table 10: RAL roads. Values of CTRDFCTR field when ROAD field indicates Garda opinion that road factors contributed to the collision.

CTRDFCTR field: Category of contributory road factor	Total collisions 2007 to 2010	Total FWIs 2007 to 2010	Average FWIs per collision
Blank or None	581	16.00	0.028
Crossfall/camber	1	0.01	0.010
Layout	23	1.75	0.076
Lighting	5	1.13	0.226
Road markings	3	0.04	0.013
Road signs	3	0.25	0.083
Sight distance	2	0.06	0.030
Skid resistance	22	2.51	0.114
Surface evenness	8	0.10	0.013
Traffic signs	2	0.02	0.010

Table 11: RAL roads. Values of CTRDFCTR field when ROAD field is blank.

CTRDFCTR field: Category of contributory road factor	Total collisions 2007 to 2010	Total FWIs 2007 to 2010	Average FWIs per collision
Crossfall/camber	9	1.31	0.146
Layout	242	22.06	0.091
Lighting	92	6.29	0.068
Road markings	22	1.73	0.079
Road signs	43	2.90	0.067
Sight distance	58	7.70	0.133
Skid resistance	127	10.83	0.085
Surface evenness	47	5.38	0.114
Traffic signs	31	0.42	0.014

4.38 As for the National roads, Table 10 shows that the CTRDFCTR field is very rarely also completed when the ROAD field has been completed (indicating Garda opinion that road factors contributed to the collision). Table 11 shows that the road factor most often cited, and with the highest total FWIs, is road layout, followed by skid resistance and lighting. These three factors are the same as was observed for the National roads (see Table 4).

4.39 We also repeated the paired contributory factors analysis for the RAL roads. Only ten combinations of contributory factors met the threshold criteria for frequency and severity of impact (i.e. a minimum of four collisions from 2007 to 2010 and an average severity of at least 0.4 FWIs per collision), so there is a single 'top ten' list rather than two lists. As before, we have given each of these collision types an identifier in the format 'LIDn'. These combinations are described in more detail below.

RAL roads. Collisions with pairs of contributory factors present. At least 0.4 FWIs per collision and an average of one or more collisions per year.

4.40 **LID1:** There were a total of five collisions over the past four years where the lighting conditions were unknown, and a head-on collision occurred. The average FWI per collision for these incidents was 0.88. Only a small proportion of the total numbers of road collisions have unknown lighting conditions (less than 1%), although it is twice as common for RAL network collisions to have unknown lighting conditions as it is for those recorded on the National network.

4.41 **LID2:** The second most serious combination is for those collisions where the driver went onto the wrong side of the road (perhaps through loss of vehicle control) and collided with a tree. Thirteen of these collisions occurred over the four year period, resulting in an average of 0.8 FWI per collision.

4.42 **LID3:** Nine collisions occurred where one of the drivers involved exceeded the safe speed and where the collision occurred at a hillcrest. These resulted in an average of 0.58 FWI per incident.

4.43 **LID4:** Six collisions with an average of 0.57 FWI per incident occurred with unknown lighting conditions but where there was evidence of skidding.

4.44 **LID5:** 21 incidents occurred where the primary collision type was with a pedestrian, with the pedestrian lying in the roadway. Of these collisions, poor lighting levels were indicated in 12 incidents (over half) which occurred when it was dark and lighting was either not available, poor, or not illuminated. Good lighting is clearly an important factor in allowing drivers to see pedestrians in the road (lying down or simply walking where no pavement is present).

4.45 **LID6:** Seven incidents occurred at a junction controlled by road markings and signage, where a single vehicle ended up in a ditch – leading to an average FWI of 0.44. Four of these incidents occurred during hours of darkness where no lighting was present.

4.46 **LID7:** In five incidents, sight distances combined with poor lighting conditions at night led to collisions with an average FWI of 0.43 per collision.

4.47 **LID8:** There were five incidents where one of the drivers involved went to the wrong side of the road at a complex junction. This resulted in an average of 0.42 FWI per collision. Junction design is potentially a significant factor in these collisions.

4.48 **LID9:** Five incidents occurred where a driver exceeded the safe speed and collided with an island or bollards, leading to an average of 0.41 FWI. Road design could have contributed to these collisions.

4.49 **LID10:** Six incidents occurred where lighting conditions were recorded as 'unknown' and a single vehicle collided with a wall or gate. These had an average of 0.41 FWI per incident.

4.50 The issues raised by this list are mostly very similar to the previous lists for National roads. One area that is new is that LID6 and LID8 mention junction design as significant for the first time.

5 COMPLEMENTARY ANALYSIS OF LA16 REPORTS

5.1 As we noted several times in the analysis presented above, the RSA database does not contain any of the free text description fields from PULSE which would give greater context to the road infrastructure related collisions. We do however have copies of completed LA16 forms for some fatal collisions. These forms contain a record of the visual examination of the road infrastructure together with a brief description of the incident (an example is reproduced in Appendix 1).

5.2 We therefore extracted the individual incidents from the database that fell within the 'top ten' paired contributory factors lists for National roads, described in Section 4, to identify[9] which of these had a completed LA16 form available as well. The sample of LA16 forms is summarised in Table 12. We analysed the forms qualitatively to try and draw out any useful additional information.

Table 12: Mapping of available LA16 forms to incidents with pairs of contributory factors identified as high risk. National roads.

ID	Contributory factor 1	Contributory factor 2	LA16 forms	PULSE numbers
ID1	Dark-Unlit Lighting	Double continuous centre line	1 Collision	6404971
ID2	Exceeded safe speed	Bend	2 Collisions	5712575 6341619
ID3	Collision involved skidding	Walking against traffic	1 Collision	6683523
ID4	Road layout	Double continuous centre line	3 Collisions	4740390 4605595 6404971
ID5	Tree	Some gradient	1 Collision	6883376
ID6	Improper overtaking	Double continuous centre line	None	
ID7	Wall/gate	Double continuous centre line	1 Collision	4681630
ID8	Exceeded safe speed	Dark-No Lighting	1 Collision	6341619
ID9	Skid resistance	Went to wrong side of road	None	
ID10	Exceeded safe speed	Continuous centre line	2 Collisions	5093457 6372294
ID32	Broken centre line	Head-on conflict	14 Collisions	5136320 5134687 5455161 4954259 4728690 4602949 4646947 5713635 6084797 5915883 6064320 6285407 6297437 6587262

[9] The mapping between RSA database incident and LA16 form was done using the Garda PULSE number, supplemented with a check that the date and time of the incident matched.

ID	Contributory factor 1	Contributory factor 2	LA16 forms	PULSE numbers
ID42	Dark-No Lighting	Pedestrian	9 Collisions	3790656 4740390 4966158 5371675 5449354 5590629 5720436 6603964 7310872
ID39	Exceeded safe speed	Single vehicle only	4 Collisions	5093457 6297017 6648122 7205937
ID25	Went to wrong side of road	Broken centre line	6 Collisions	4947640 4954259 5134687 6297437 6587262 7379220
ID34	Dark-No Lighting	Tree	2 Collisions	5262176 6883376
ID10	Exceeded safe speed	Continuous centre line	2 Collisions	5093457 6372294
ID33	Went to wrong side of road	Dark-No Lighting	4 Collisions	4654672 5291557 6291088 6297437
ID23	Exceeded safe speed	Other	3 Collisions	5093457 5371675 6297017
ID17	Exceeded safe speed	Dark-No Lighting	2 Collisions	5371675 6297017
ID29	Lighting	Other	2 Collisions	3790656 5720436

5.3 Where an individual incident appears more than once, subsequent appearances are greyed out. This resulted in a total of 41 separate fatal collisions, for which LA16 information was, in theory, available. In fact there were three incidents for which we did not have pdf copies of LA16 forms (highlighted in yellow).

Qualitative analysis of LA16 forms

Road-related contributory factors

5.4 Several of the incidents mentioned the contribution made by the roadside conditions or street furniture to the consequences of the collision:

"No hard shoulder so roadside unforgiving"

"Roadway 50mm above verge [which contributed to consequences of collision as the car was deflected by the edge of the road]"

"Single vehicle lost control on bend – veered left into grass margin – collided with tree in hedgeline"

"…roadway between solid boundary walls"

"…spun the car around 180 degrees tight against the precast concrete post and rail fence at the back/ edge of verge"

"…single vehicle struck LHS kerb, then RHS wall and travelled along wall, then crossed road and struck flashing light pole and corner of the wall"

"The car appears to have crossed the white centre line and hit the van which in turn hit the warning sign and turned over"

"Severe bend to north of site and stone flower beds at roadside a hazard"

5.5 In some cases, consideration could be given to altering the roadside furniture, for example officers recommended the removal of the stone flower beds. Trees adjacent to the roadside sometimes present a hazard, with 16 fatal incidents involving single vehicles colliding with trees between 2007 and 2010. In two cases officers recommended improving the signage for the bend in the road, and in one other case warning signs had been put in place subsequent to the collision, where excessive speed associated was associated with a bend. In one case a month of monitoring at the site indicated that the 100kph speed limit was often exceeded by cars.

Road surface - wet or icy conditions

5.6 Many of the incidents occurred in damp or wet conditions:

"Wet and very dark…"

"Surface was wet at time of collision but not raining"

"Dark with light intermittent drizzle"

"Road conditions were damp at the time of the accident"

"Weather conditions at the time were wet…"

"Weather – Dry. Road slightly damp…"

5.7 There are 134 fatal incidents between 2007 and 2010 where the road surface is classified as wet, of which 54 occurred in dark conditions with no or poor lighting. This combination of conditions is particularly high risk. Of the incidents that occurred in the wet, only three indicated that an anti-skid surface was present, although for 29 incidents there was evidence of skidding.

5.8 One incident occurred with snow or icy conditions although the LA16 reports noted that the ice had not contributed to the incident because of recent gritting:

"Road surface not considered a contributing factor [as it had been salted the night before and that morning]*"*

5.9 In total, there are 13 fatal incidents in snow or icy conditions, which is a small number in comparison to the total number of fatal road collisions in the database, possibly suggesting that mitigation against ice risks is working well.

Night time incidents

5.10 A number of incidents occurred in the dark, either where no lighting was available, or where lighting was not lit. Descriptions of these incidents, with implications for the management of roads, were as follows:

"Wet and very dark, no street lighting, road conditions very difficult, no hard shoulder so roadside unforgiving"

"Dark with no public lighting – two vehicles travelling in opposite directions collided"

"Two pedestrians crossing road, stopped at centre line, one misjudged whilst being pulled back by the other and stepped into path of vehicle"

"20/21year old male attempted to cross…shortly after midnight when he was struck… in the middle lane"

"Pedestrian dressed in black striped shirt, black jeans, walking northwards on N59, no street lighting along road on side of impact"

"Bus…impacts with pedestrian…Pedestrian was not wearing high vis/ bright clothing. No street lights"

"This approx 2km stretch of road has had several accidents this year."

"SUV overtaking tractor travelling in hard shoulder… accident car suddenly over white line and collided head-on with SUV. Dark, damp road surface. Possible confusion by fatal driver due to double set of headlights ahead"

"2nd fatality in 6 months, both involved ped crossing road to public house (which serves food) and were during the hours of darkness"

"Weather conditions were fine, it was dark…"

"The weather was dry, road surface dry, no street lighting along road"

5.11 From the collision information it appears that pedestrians are at particular risk in dark conditions. There are 32 fatal incidents in the database where pedestrians were killed during hours of darkness with either poor or no lighting, out of a total of 137 such fatal incidents. Further analysis of these incidents would be worthwhile to determine any lessons that might be learned.

Quality of data

5.12 A large number of incidents did not have a good description of the collision recorded in the LA16 form, so it was difficult to draw any conclusions about the underlying contributory factors for the incident. Some examples of descriptions that provided little useful information:

"Accident between pedestrian + vehicle, pedestrian killed"

"Driver error"

Other observations

5.13 Two incidents involved cars travelling the wrong way on the road. In one case a dual carriageway for four to five km and in another case on the fast lane of a motorway. Unfortunately where drivers are killed it is difficult to identify what it was that caused them to do this, but examining where and how the wrong carriageway was accessed might lead to some useful insight about the junction or slip road design.

5.14 Other cases where there was no obvious cause of the collision, and the driver was killed, are also difficult to get to root causes. In five incidents cars appeared to go out of control and cross into the path of oncoming traffic or other object, during daylight hours with dry conditions and good visibility. In such cases it seems unlikely that there was any contribution to the incident from the road.

6 RISK EXPOSURE AND COLLISION RISK ANALYSIS

Estimates of risk exposure

6.1 So far we have focussed on the average frequency and average severity of collisions at a network level. In order to compare the collision risk at different locations across the network however, it is necessary to normalise for risk exposure.

6.2 The NRA has conducted collision risk analysis since the early 2000s, segmented into different reference populations. The process is now included in the NRA Design Manual for Roads and Bridges[10]. Collisions are mapped to 'sites' along the length of each National route based on their latitude and longitude, and collision risk is calculated as the sum of collisions tagged to that site divided by the estimated annual vehicle kilometres for that site. High risk collision sites are identified where the collision rate is greater than twice the average collision rate.

6.3 This approach relies on a good estimate of exposure data (vehicle kilometres travelled). However, the availability of good quality traffic flow measurements is poor as there are only a limited number of automatic traffic count locations on the network and surveys are conducted infrequently. The NRA process is therefore being severely hampered, and has been forced to 'scale up' an estimate of vehicle kilometres for each year from the last time a dataset was constructed in 2004.

6.4 An additional approach to estimating exposure data is to make use of the recently completed National Transport Model (NTpM). It is important to acknowledge that this is a planning tool, not designed to provide very accurate traffic flow data, and it relies on the same limited network of 140 automatic traffic counters. Nevertheless, the available traffic flow data has been processed using different methods so we have investigated a series of ESRI shape files[11] provided to us by NRA, to see whether they add anything to the analysis that has been possible to date. The details of the shape file mapping process are described in a separate note[12], but in summary:

- Shape files for carriageway data were provided for 2007, 2008, 2009 and 2010. These contain information about the road name, direction of travel and carriageway type.
- Shape files for estimated traffic flow were provided from the NTpM (based on the 2004 traffic census and corrected to reflect 2009 volumes). The traffic flow was mapped to the 2010 carriageway data file as a baseline representation of the network.
- Older shape files from a 1998 'Needs Study' and a 'Speed Limit Register' were used to map other road features such as lighting locations and carriageway widths.

6.5 The data were analysed by National Route number.

6.6 A key task was to check whether the new vehicle kilometre dataset appeared consistent with the dataset used by the NRA for their previous analysis. The pedigree of the data from the NTpM shape files was not very clear to us, for example there were some anomalies in the lengths of individual sections of road on some routes. The correlation between the previous NRA dataset and the NTpM dataset is summarised in Figure 4 below.

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[10] The NRA Design Manual for Roads and Bridges, Volume 5, HD 15 - Network Safety Ranking, available on-line at: http://nrastandards.nra.ie/road-design-construction-standards/dmrb/volume5/nra-hd-15-network-safety-ranking

[11] Private communication from D. O'Connor. Information on the ESRI shape file format can be found at http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf

[12] Shape File Analysis, memo to D. O'Connor from Risk Solutions, September 2012.

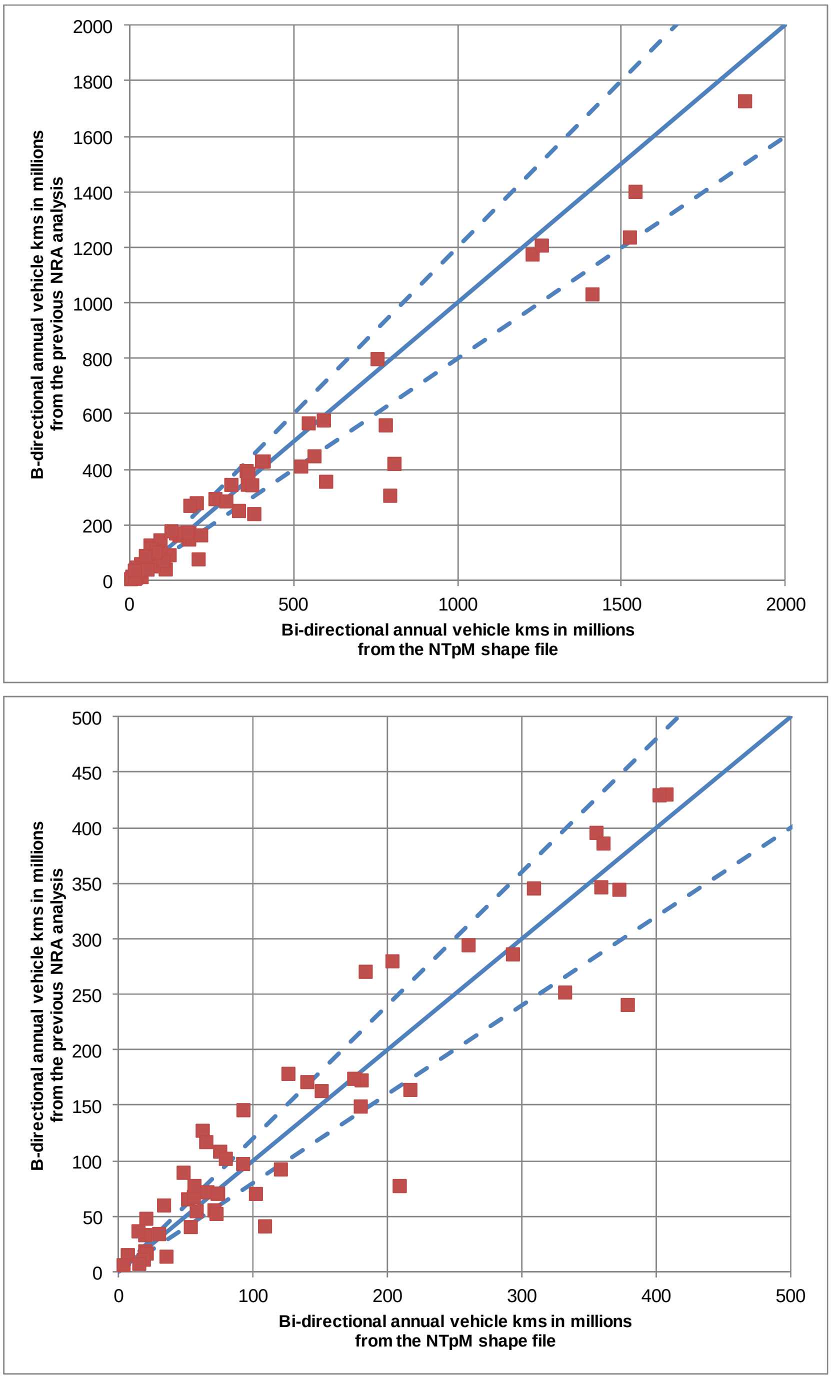


Figure 4: Vehicle kilometres calculated from the NTpM dataset compared to the original NRA dataset at two different X-axis scales

6.7 In Figure 4, each dot represents one National route (N1 to N87 respectively). The dots should fall on the solid line if the two datasets are identical. The dashed lines represent a +/- 20% difference in the Y-axis value for a given X-axis value.

6.8 It can be seen from Figure 4 that there are some significant differences between the two datasets, with many of the dots falling outside the +/- 20% band. For the shorter routes (less than 500 million vehicle kilometres per year) the dots lie equally above and below the line, but for the longer routes many of the dots lie below the line, implying that our re-analysis of the NTpM data has resulted in a higher vehicle flow than used in the previous NRA analysis. Ideally, traffic data should be broken down across the day and across the year into a series of hourly flows but unfortunately the NTpM and NRA datasets only contain an average annual daily flow (AADT) and a rough breakdown into the am peak average flow and inter-peak average flow.

Collision risk for National routes

6.9 The NTpM vehicle kilometres dataset was used to determine the average collision rate along each route (average annual number of collisions mapped to a route divided by the average annual vehicle kilometres). The results are shown in Figure 5 below.

6.10 The highest risk routes from this analysis appear to be the N87, N12, N66 and N16, with over three times the network average rate, although all these routes have relatively low traffic volumes so the collision rate is more sensitive to yearly random variations in collision numbers.

6.11 The RSA 2010 Road Collisions Factbook also contains a collision risk analysis broken down by National route number[13]. These same four routes are identified as some of the highest risk, but the absolute collision rates are different to those shown in Figure 5. Part of the reason for this is that the RSA data is for a single year rather than a four year average. The effect of the uncertainty in the vehicles kilometres exposure data cannot be underestimated however, for example the length of the N87 is 56km in both the NRA and NTpM dataset but the total vehicle kilometres estimated for each differs by a factor of 2.6, which is sufficient to explain all of the difference in estimated collision rate.

6.12 Our conclusion from this is that the available estimates of network exposure are not sufficiently accurate to calculate absolute collision risk values, although they may be more robust for comparing one route with another in a relative sense. The ranking produced using the NTpM data could also be compared to the ranking produced by the NRA’s Network Safety Ranking process (HD15).

[13] Table 51: Fatal and Injury Collisions on National Routes Classified by Route and by Location Type, Page 47, Road Collisions Factbook Ireland 2010, Road Safety Authority www.rsa.ie

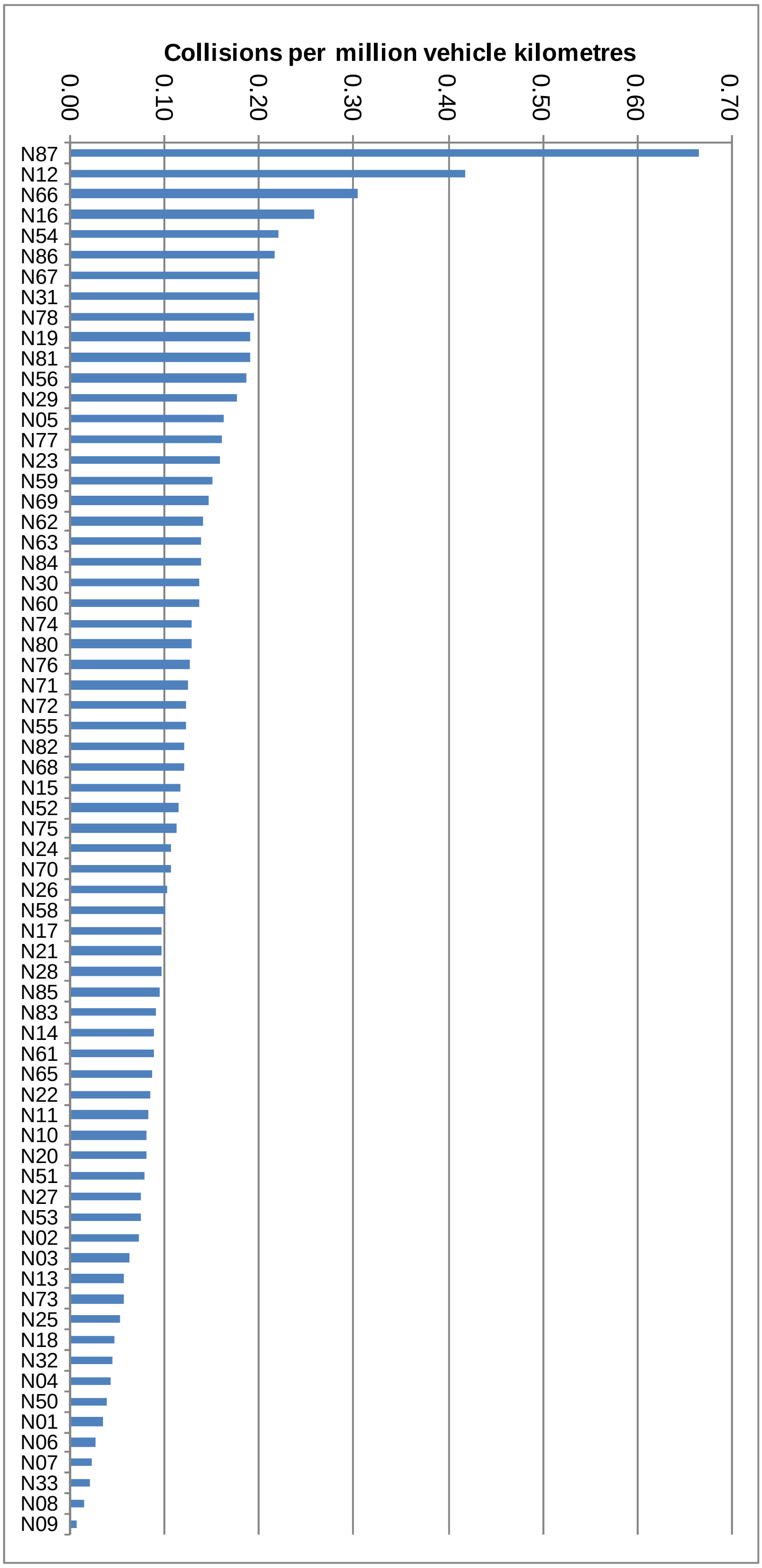


Figure 5: Collision risk (collisions per million vehicle kilometres) for National Routes. 2007 to 2010 average.

6.13 Given the significance of head-on collisions and collisions with pedestrians at night, we also looked at the collision risk on routes with different lane configurations and different amounts of lighting.

6.14 Table 13 shows a summary of the collision risk for different lane configurations.

Table 13: Collision risk for different lane configurations. National roads.

Lane configuration	Millions of vehicle kilometres per year	Total collisions 2007 to 2010	Collisions risk (collisions per million vehicle km)
Undivided two way single carriageway	10,449	4,700	0.11
Undivided '2+1'	476	151	0.08
Dual carriageway	8,761	1,202	0.03
Divided 3-1	45	18	0.10
Divided 3-2	72	14	0.05
Divided 3-3	1,640	179	0.03
Divided 4-2	11	1	0.02
Divided 4-3	27	9	0.08
Divided 4-4	470	11	0.01

6.15 As might be expected a single lane in each direction is much higher risk than two lanes or three lanes in each direction. There is however a significant amount of traffic also being driven on roads with a '2+1' configuration, and this also has quite a high collision risk. The other configurations have much smaller numbers of vehicle kilometres driven each year so the collision risk estimates are likely to be less accurate. These results are consistent with the Irish inter-urban collision rates reported by O'Cinneide et al[14], who identified 2 lane undivided roads as the highest risk followed by 3 lane roads followed by dual carriageways and motorways.

6.16 Figure 6 shows a repeat of the data in Figure 5, but with separate collision rates calculated for those portions of the route with and without lighting present. The two highest risk routes appear to have no lighting along their entire length, but the rest of the data is rather inconclusive. This is potentially because it is only collisions at night that are affected by the presence or absence of lighting. However, because it isn't possible to reliably estimate the vehicle kilometres driven at night compared to during the day, the collision risk is based on total collisions (day and night) occurring on sections of road with and without lighting divided by total vehicle kilometres (day and night) on those road sections.

[14] D O'Cinneide, J C Murphy, T Ryan, 2004, Interurban Accident Rates By Road Type and Geometric Elements, European Transport Conference on-line repository available at: https://etcproceedings.org/

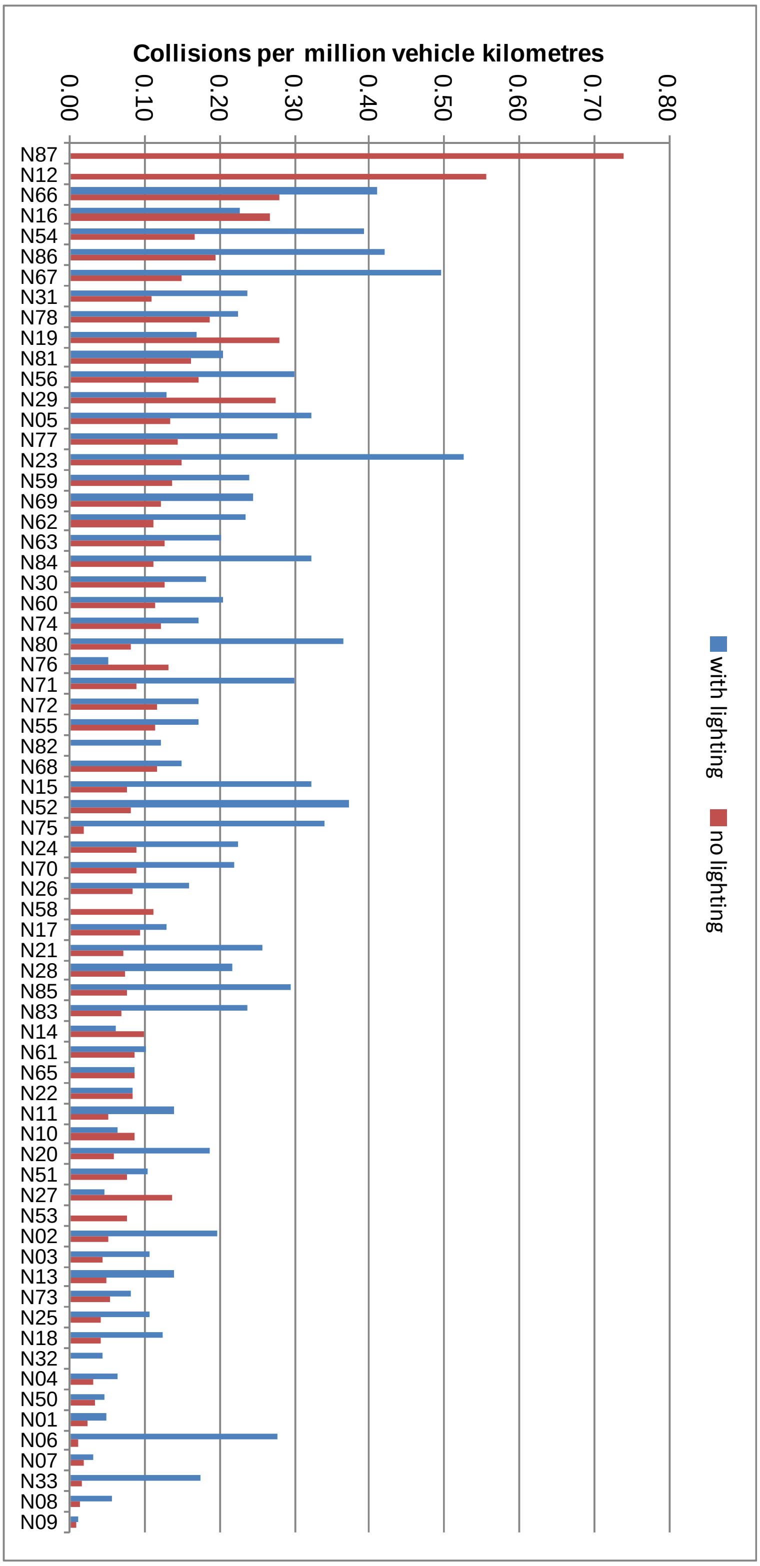


Figure 6: Collision risk (collisions per million vehicle kilometres) for sections of National Routes with and without lighting. 2007 to 2010 average.

7 SUMMARY CONCLUSIONS AND RECOMMENDATIONS

7.1 Under the current Road Safety Strategy, the focus for collision analysis work undertaken by the NRA has been to more accurately map the location of collisions onto GIS maps of the road network. The Garda are now collecting more reliable GPS coordinates for collisions, which has enabled most entries in the national collision database maintained by the RSA to be allocated to individual road segments. This has helped to identify high risk 'black-spots', for example using estimates of vehicle traffic flows at collision sites to calculate collision rates (collisions per million vehicle kilometres travelled).

7.2 However, the amount of time needed for the RSA to process and release collision datasets to the NRA has limited the ability of the NRA to respond to trends in collision data quickly. The LA16 process was designed in part to respond to this problem. It has speeded up the flow of information on the location of fatal collisions, and has improved communication between Local Authority engineers and the Garda, but we are not aware of any concerted effort to analyse the LA16 data centrally in detail.

7.3 The purpose of this analysis has been to build on the location mapping work and look at contributory factors in collisions, especially those collisions where the road infrastructure played a part. Our analysis of the Garda opinion recorded in the RSA dataset suggests that road factors contributed to around 3.4% of all personal injury collisions on national roads between 2007 and 2010 (on their own or in combination with other factors). This is a small fraction of all collisions, and it must also be borne in mind that the Garda expressed no opinion on the main contributory factors in over 30% of personal injury collisions on national roads.

7.4 We therefore looked at other fields in the database where some contribution from road infrastructure could be inferred, even if the Garda officer hadn't explicitly cited it as a factor. We counted the number of collisions that occurred in the four year period when one or more database fields were set to particularly relevant values and calculated the average severity of the consequences. We have used Fatalities plus Weighted Injuries as our measure of collision severity, as this takes into account the large number of minor injuries as well as deaths and serious injuries. We found from this analysis that looking at one contributory factor at a time was only part of the story, but there are some combinations of pairs of contributory factors that, if they occur together, result in much higher average consequences per collision. Some of the most frequent pairs of factors with high average consequences include:

- Head-on collisions on single carriageway undivided roads
- Collisions with pedestrians at night where there is no lighting
- Single vehicles losing control and running into ditches, trees, walls etc

7.5 This pattern of contributory factors is typical of what you might expect on a network with significant amounts of rural, single carriageway, undivided roads. The scope for hard engineering measures to fully mitigate risk is therefore always going to be limited, especially when only a very small fraction of collisions can be blamed on road infrastructure related factors in isolation.

7.6 **Because large scale 'engineering' interventions are likely to be impractical, a greater emphasis needs to be placed on more targeted measures. The results of this contributory factors analysis could therefore be used to highlight some of the most important combinations of features for RSI inspectors to look out for as they complete their inspections over the coming months. Locations where these features are particularly dangerous might often be detectable by simple visual inspection of the road, so it would be worthwhile ensuring that the inspectors pay special attention to the detailed list of contributory factor combinations described in Section 4 of this report.**

7.7 A more in depth analysis of contributory factors would be possible if the RSA dataset also included the various free text fields captured by the Garda officers on their PC16 forms (for example the free text description of the incident and the fields that allow the officer to specify in more detail his opinion on why particular factors contributed to the incident). We understand that some of these free text fields may be replaced with greater use of ‘drop down menus’ in future PULSE upgrades, which would potentially remove some of the data protection concerns and would make analysing this data easier and hopefully increase completion rates of the PC16 forms. The Forensic Collision Investigation reports prepared by the Garda for fatal collisions might also contain very valuable information for contributory factors analysis, although to date this information has not been made available to the RSA or NRA. In the absence of this data, we looked at the free text information captured on the LA16 forms. This provided some useful supporting information but didn’t change our understanding of which road infrastructure related features played a significant part in the collisions.

7.8 In support of the move towards route based road safety assessments (such as RSI), we have also attempted to look at collision risk at the route level. In order to do this, it is necessary to normalise the collision count along a route by the level of exposure (millions of vehicle kilometres driven). Previous attempts by NRA to estimate exposure have relied on limited traffic surveys last done in 2004, so as part of this project we investigated whether the GIS shape files generated for the National Transportation Model (NTpM) could be used to improve exposure estimates. We were able to map NTpM traffic flow data to individual national routes and compared the results with the previous NRA estimates. We found considerable differences between the two datasets that cast doubt on the accuracy of the absolute values of collision risk estimates at the route level, although the data can still be used to rank routes in terms of relative risk.

7.9 The highest risk routes (highest collisions per million vehicle kilometres) appear to be the N87, N12, N66 and N16, with over three times the network average rate, although all these routes have relatively low traffic volumes so the collision rate is more sensitive to yearly random variations in collision numbers. These routes were also some of the highest risk in the RSA Road Collisions Factbook for 2010.

7.10 Given the significance of head-on collisions and collisions with pedestrians at night, we also looked at the collision risk on routes with different lane configurations and different amounts of lighting. The lighting data was inconclusive as it is not possible to say what proportion of vehicle kilometres are driven at night, but we found that routes with a single carriageway in both directions, or a 2+1 arrangement, had significantly higher collision risk levels than routes with two or three lanes in both directions.

Recommendations

7.11 In order to improve NRA’s capability to perform contributory factor analysis in the future, we make the following recommendations:

1. The NRA should investigate the feasibility of gaining access to the collision records recorded by the Garda much more quickly than is currently possible. We suggest that one way of doing this would be for them to receive un-validated data downloads from PULSE every six months, on the understanding that the ‘official’ dataset would still be provided by RSA some time later after the completion of their data validation checks.
2. The data downloads from PULSE should include the free text fields relating to the Garda’s opinion on contributory factors and the summary collision description, where data protection guidelines allow. This information should be analysed in parallel to basic collision count data to provide a fuller picture of the root causes of incidents to help inform the Irish authorities on driver behaviour and enforcement activities as well as road infrastructure issues.
3. If revisions to PULSE replace the free text fields with more ‘drop down menus’ this would make the analysis of contributory factors easier, and would hopefully decrease the number of fields left blank. It would also enable the data protection issues to be

addressed unambiguously as it would be clear which database fields could and could not be released. However, any move to ‘drop down’ fields should be done in consultation with the main users of the data to ensure that important information is not lost.

4. The Forensic Collision Investigation reports prepared by the Garda are also a potential source of additional information on the root causes of fatal collisions. The NRA should investigate whether this information could be made available for analysis in a suitably anonymous form, to supplement the information captured in PULSE.
5. We used Fatalities plus Weighted Injuries as a convenient measure of average collision severity in our analysis. We would encourage the NRA to consider using it in future work as well (for example the RSI programme), as it gives a complimentary picture to statistics based on collision frequency.
6. Better exposure data (vehicle kilometres travelled) is essential if collision risk is to be assessed on a route basis. The information contained in the NTpM shape files offers some additional analysis options compared to what was possible previously, but it is based on the same underlying 2004 survey data and we found considerable differences in our re-analysis of the NTpM data on some routes compared to the existing estimates used by NRA. Also, the NTpM is currently a high level planning tool so the AADT values used in it are not sufficiently detailed to analyse (for example) different levels of exposure during day and night. We recommend that NRA investigates the cost and practicality of measuring vehicle flow data more regularly and at more locations than is done at present, and considers whether the NTpM would be the most appropriate system to use to analyse such data in the future. The driver for installing traffic counters is usually to monitor congestion and provide traffic growth forecasts, but there is also scope for installing traffic counters on routes identified as high risk to see if this can be correlated with unusual traffic patterns, e.g. a high proportion of traffic at night, or an unusual mix of vehicle types. There is also a potential source of traffic flow data not currently being used – the data captured by mobile cameras at enforcement sites.
7. The LA16 form is potentially useful for contributory factors analysis as it especially focuses on a visual inspection of road features. Local Authorities should be encouraged to improve the return rate, and the scheme would benefit from being extended to cover serious injuries as well as deaths. This would require additional resources to be made available however, as between January 2007 and December 2010 there were 956 serious injuries on National roads compared to 439 fatalities.
8. The LA engineer and Garda officer, when they meet, should be encouraged to discuss the contributory factors in the collision. When there are road infrastructure related features that contributed to the collision, these could be recorded on the LA16 form.
9. The results of this analysis could be shared with the inspectors contracted to perform Road Safety Inspections. An important message to impart to them is that some combinations of contributory factors result in significantly worse average collision consequences than others, so it is worthwhile paying special attention to locations where these factors are likely to be present.

APPENDIX 1: EXAMPLE PC16 AND LA16 COLLISION REPORTS

The following images are extracted from a typical Garda PC16 collision report form, showing the information collected on contributory factors. The remaining parts of the form have been redacted to preserve anonymity.

Garda Siochana Road Traffic Accident Report

Station Name:	Ennis	Speed Limit:	120 (km/h)
Accident Involved:	Death	Investigated at Scene:	Yes
Date:	06/10/2009	Number of Vehicles Involved:	2
Day:	Tuesday	Number of Pedestrians Involved:	0
Time:	21:24		

County:	Clare
Local Authority:	
City/Town/Townland:	Ennis
Name Street/Road:	Knockanean

At Intersection With:			
Or if Not at Intersection:	Knockanean, Ennis, Clare	If National/Regional Route/Route No.:	M18
		And if National Route, Metres/Feet:	
Metres/Yards:	200 m	Direction:	
Direction:	South	of Post no.:	
Of:	Exit 13, M18, Ennis, Clare.		

Light Conditions:	Dark-No Lighting		
Weather Conditions:	Dry	Skidding Occurred:	Yes
Surface Conditions:	Dry	Road Works:	No
Junction/Crossing Control:		Road Width:	
Road Character:	Straight	Junction Type:	
Other Road Character:		Road Type:	Motorway

Road Markings

1. Broken Centre Line		5. Lane Markings	X
2. Continuous Centre Line		6. No Markings	
3. Double Continuous Centre Line		7. Centre Line Reflectors	
4. Edge Markings		8. Edge Line Reflectors	

Contributory Factors:

Was there a single principal cause which precipitated this accident: Yes

If Yes, Specify: Driver Error

Factors	Extent	Specify

Primary Collision Type: Other
Other Primary Collision: Side Impact

Single Vehicle Collision With:
Other Single Vehicle Collision:

Pedestrian 1 Action:
If other Action, specify:

Pedestrian 2 Action:
If other Action, specify:

Driver 1 Action: Other
If other Action, specify: Driving Straight

Driver 2 Action: Other
If other Action, specify: Going Wrong Way

Driver 1 Exiting/Entering:
If other Exiting/Entering, specify:

Driver 2 Exiting/Entering:
If other Exiting/Entering, specify:

Contributory Action Driver 1:
If other Action, specify:

Contributory Action Driver 2: Went to Wrong Side of Road
If other Action, specify:

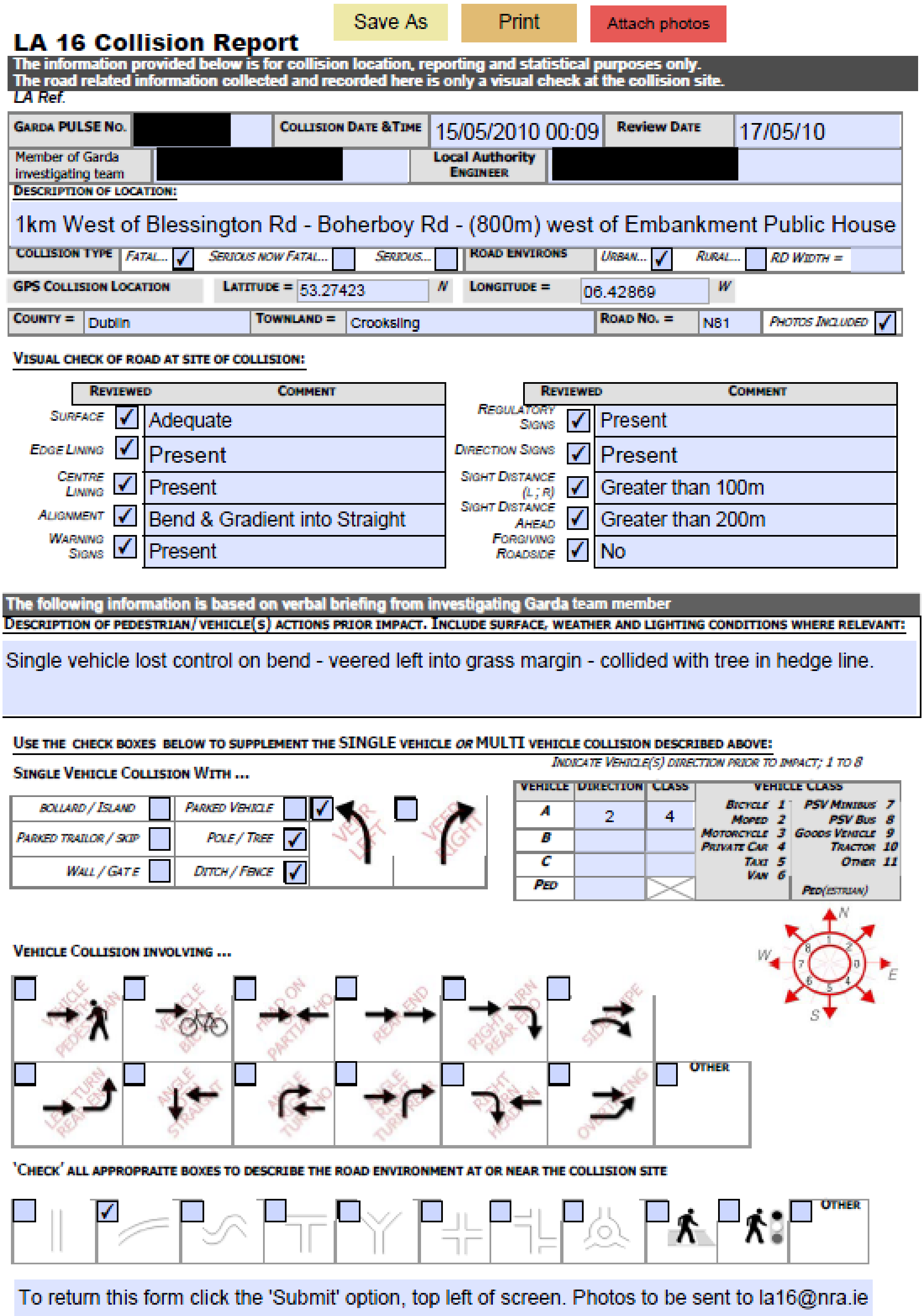
Driver/Cyclist Details

	Driver/Cyclist 1	Driver/Cyclist 2
Driver Resident:		
Driver Learner:		
Driver/Cyclist Familiar W/Location:	Yes	No
Walkman/Hand Held Phone in Use:		

Road Factor Contribution

1. Layout		4. Lighting		7. Sight Distance	
2. Skid Resistance:		5. Surface Resistance		8. Crossfall/Camber	
3. Road Signs	X	6. Road Markings		9. Traffic Signals	
10. Other:					

The following image is a typical example of the most recent electronic version of the LA16 form.



Save As | Print | Attach photos

LA 16 Collision Report

The information provided below is for collision location, reporting and statistical purposes only.
The road related information collected and recorded here is only a visual check at the collision site.

LA Ref.

Garda PULSE No.	[redacted]	Collision Date & Time	15/05/2010 00:09	Review Date	17/05/10
Member of Garda investigating team	[redacted]	Local Authority Engineer	[redacted]		

Description of location:

1km West of Blessington Rd - Boherboy Rd - (800m) west of Embankment Public House

Collision Type: Fatal... ✓ | Serious now Fatal... ☐ | Serious... ☐ | Road Environs: Urban... ✓ | Rural... ☐ | Rd Width =

GPS Collision Location: Latitude = 53.27423 N | Longitude = 06.42869 W

County = Dublin | Townland = Crooksling | Road No. = N81 | Photos Included ✓

Visual check of road at site of collision:

	Reviewed	Comment
Surface	✓	Adequate
Edge Lining	✓	Present
Centre Lining	✓	Present
Alignment	✓	Bend & Gradient into Straight
Warning Signs	✓	Present

	Reviewed	Comment
Regulatory Signs	✓	Present
Direction Signs	✓	Present
Sight Distance (L ; R)	✓	Greater than 100m
Sight Distance Ahead	✓	Greater than 200m
Forgiving Roadside	✓	No

The following information is based on verbal briefing from investigating Garda team member

Description of pedestrian/vehicle(s) actions prior impact. Include surface, weather and lighting conditions where relevant:

Single vehicle lost control on bend - veered left into grass margin - collided with tree in hedge line.

Use the check boxes below to supplement the SINGLE vehicle or MULTI vehicle collision described above:

Single Vehicle Collision With ...

Bollard / Island	☐	Parked Vehicle	☐
Parked Trailor / Skip	☐	Pole / Tree	✓
Wall / Gate	☐	Ditch / Fence	✓

Veer Left ✓ | Veer Right ☐

Indicate vehicle(s) direction prior to impact; 1 to 8

Vehicle	Direction	Class
A	2	4
B		
C		
Ped		

Vehicle Class: Bicycle 1, Moped 2, Motorcycle 3, Private Car 4, Taxi 5, Van 6, PSV Minibus 7, PSV Bus 8, Goods Vehicle 9, Tractor 10, Other 11, Ped(estrian)

N, E, S, W

Vehicle Collision Involving ...

Vehicle Pedestrian | Vehicle Bicycle | Head on Partial | Rear End | Right Turn Rear End | Sideswipe | Left Turn Rear End | Angle Straight | U Turn | Right Turn | Head On | Overtaking | Other

'Check' all appropriate boxes to describe the road environment at or near the collision site

Other

To return this form click the 'Submit' option, top left of screen. Photos to be sent to la16@nra.ie