Transport Infrastructure Ireland

M7 (Junctions 21 to 28)

Report on the Analysis of Historical Collisions (2014 to 2017)

P·M·C·E

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Executive Summary

This report results from an analysis of collisions that have occurred on the M7 Motorway between Junctions 21 and 28 (Study Area) carried out at the request of the Road Safety Section of Transport Infrastructure Ireland (TII). The purpose of the analysis is to compare the frequency of collision occurrence within the Study Area with other similar sections of road between January 2014 and December 2017, to identify patterns or trends in the historical collisions which have occurred within the Study Area and, where possible, to identify any common causation factors which may be contributing to the collision occurrence.

The data used included Historical Collision Records as reported to/by An Garda Síochána for the national motorway network, Motorway Maintenance and Renewals Contract (MMaRC) incident records, As-built drawings of the M7 motorway within the Study Area, TII's HD15 Reports, vehicle make and model data, vehicle speed data and weather condition data. The analysis concludes that within the Study Area: -

- collision frequency is just below the average on the national motorway network;
- the number of fatal and serious injury collisions, although higher and lower respectively, does not deviate from the average on the national motorway network to a statistically significant degree;
- the number of collisions occurring during wet weather and wet or frosty/icy road conditions (including 'hail') are higher than expected when compared with collisions on the national motorway network;
- the number of collisions occurring during 'hail' events are higher within the Study Area when compared with the average on the MMaRC network;
- twelve incidents occurred within the Study Area which involved secondary collisions, two of which resulted in fatalities and most of which occurred during adverse weather conditions;
- collisions occurring in February, during the hours commencing 3am, 8pm and during the five-hour period 7pm to 12am are higher than expected when compared with collisions on the national motorway network (this possibly relates to weather condition related issues referenced above);
- no locations were identified where the road layout is considered to contribute to collision occurrence (Note: some sections of road within the Study Area were modified prior to the study being undertaken to address safety concerns);
- rear wheel drive vehicles appear to be over-represented, in particular in single vehicle only collisions;
- vehicle speeds are high, with a significant proportion of drivers travelling in excess of the speed limit; and
- vehicle speeds are not being moderated sufficiently, or at all, during adverse weather conditions.

The following measures are suggested to reduce collision occurrence and/or injury severity outcomes within the Study Area: -

1. Measures (e.g. variable message signs) within the Study Area to advise drivers of the risks/hazards associated with adverse weather and the need to moderate their speeds accordingly;

2. Liaison with the national weather services to obtain prior notification of potential adverse weather so that the measures in the above recommendation can be implemented;

3. A national public awareness campaign specifically targeting: -

    - driver behaviour in adverse weather, particularly on the motorway network;

    - vehicle occupant behaviour when involved in a collision on a high-speed road or motorway (e.g. stay in vehicle);

4. Expand the weather & road condition categories on the Garda Collision Report Forms to include 'Hail' as an option to assist in future collision analysis;

5. Agree a common approach to weather and road condition categorisation between An Garda Síochána and maintenance contractors/operatives; and

6. Provide collision data and analysis to An Garda Síochána to permit identification of locations or behaviours that may be amendable to targeted enforcement interventions.

7. Further investigation to assess if rear wheel drive vehicles are more likely to be involved in collisions, particularly during adverse weather;

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1 Introduction

1.1 Purpose

This report results from an analysis of collisions that have occurred on the M7 Motorway between Junctions 21 and 28 (the Study Area) carried out at the request of the Road Safety Section of Transport Infrastructure Ireland (TII).

The purpose of this report is to compare the frequency of collision occurrence within the Study Area with other similar sections of road between January 2014 and December 2017 (the Study Period), to identify patterns or trends in the historical collisions which have occurred within the Study Area and, where possible, to identify any common causation factors which may be contributing to the collision occurrence.

1.2 Review Team

The review was undertaken by a five person team consisting of: -

- [redacted] (Team Leader)
- [redacted] (Forensic Collision Investigator)
- [redacted] (Team Member)
- [redacted] (Team Member)
- [redacted] (Team Member)

1.3 Study Area

The M7 Motorway is the main route between Dublin and Limerick. It has a speed limit of 120 kph and is approximately 166km in length, extending between its intersection with the N7 at Junction 9 (Naas North) and its intersection with the M18 and the M20 at Junction 30 (Limerick).

The Study Area consists of a 75km section of the M7 between Junction 21 (Borris-in-Ossory, Co. Laois) and Junction 28 (Castletroy, Co. Limerick). This section of the M7 was originally constructed as two separate schemes, namely the M7 Nenagh to Limerick Motorway (Junctions 24 to 28) which opened to traffic in September 2010 and the M7 Castletown to Nenagh Road Improvement Scheme (Junctions 21 to 24) which opened to traffic in December 2010.

The main junctions within the Study Area are: -

- Junction 21 – Borris-in-Ossory (County Laois)
- Junction 22 – Roscrea (County Tipperary)
- Junction 23 – Moneygall (County Offaly)
- Junction 24 – Toomevara (County Tipperary)
- Junction 25 – Nenagh Centre (County Tipperary)
- Junction 26 – Nenagh West (County Tipperary)
- Junction 27 – Birdhill (County Tipperary)
- Junction 28 – Castletroy (County Limerick)

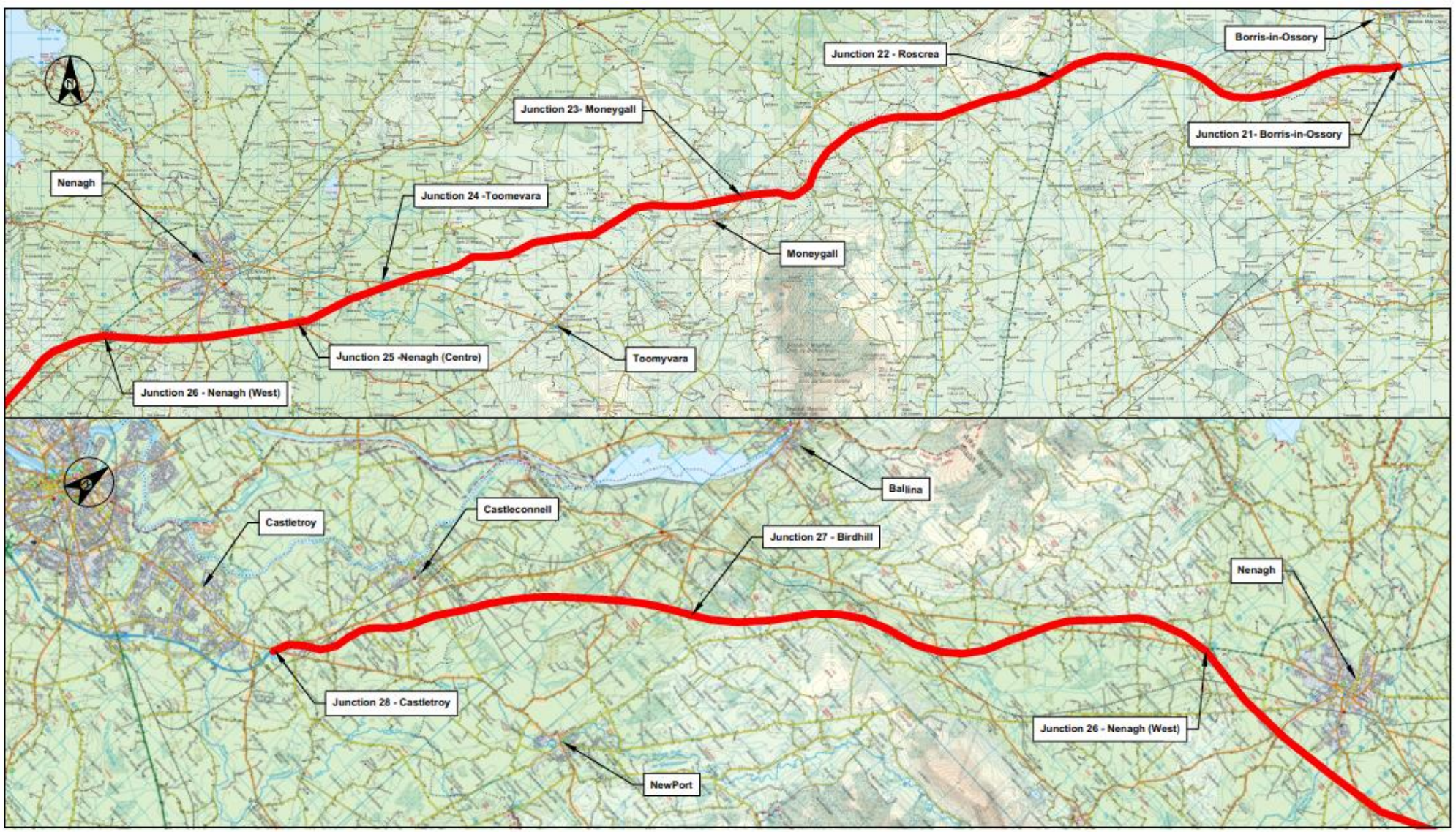

FIGURE 1.1 STUDY AREA EXTENTS

Traffic volumes, in terms of Annual Average Daily Traffic (AADT), on the M7 within the Study Area are shown in Table 1.1 for the years 2016 and 2017.

TABLE 1.1 TRAFFIC VOLUMES (AADT)

Section	Length (km)	2016	2017
M7 Junction 21 – 22	11.5	12,253	12,786
M7 Junction 22 – 23	11.5	12,349	12,881
M7 Junction 23 – 24	12.5	13,488	14,065
M7 Junction 24 – 25	3.0	12,743	13,516
M7 Junction 25 – 26	6.0	13,852	14,604
M7 Junction 26 – 27	15.0	17,890	18,902
M7 Junction 27 – 28	12.0	19,954	20,825

1.4 Previous Interventions within Study Area

Interventions and countermeasures have been introduced on the M7 Motorway in the period since opening to address issues, including perceived safety issues, including the provision of rolling crowns & slot drainage and alterations to the layout at some diverges.

The rolling crown & slot drainage interventions were related primarily to drainage and geometric design elements and reflected updated and additional requirements which were included in revisions to the Geometric Design Standard DN-GEO-03031 (formerly TD9). Amendments to the diverge arrangements at Junction 22 Roscrea and Junction 23 Moneygall involved extending the length of the deceleration lanes and enhanced junction signage.

FIGURE 1.2: IMPROVED SIGNAGE AT JUNCTION 23 – MONEYGALL

In total twelve interventions were implemented within the Study Area between 2014 and 2017. These included six locations where rolling crowns were introduced, four locations where slot drainage was introduced and two locations where improvements to slip lanes were implemented, at Junctions 22 (Roscrea) and 23 (Moneygall). Information regarding the location, date of completion and historical collisions at the ten locations where rolling crowns and slot drainage interventions were undertaken are given in Appendix C.

The number of interventions within the Study Area is consistent with those undertaken on similar roads constructed at the same time, and reflect the ongoing efforts to identify and address potential safety issues on the national road network.

In addition to the interventions described above, a national road boundary fence retrofit programme commenced in 2017 to replace timber or concrete 'post & rail' fencing with 'tensioned wire mesh' fencing which is intended to reduce injury severity outcomes for collisions with roadside fencing. The section of the M7 Motorway within the Study Area has been one of the first sections of national road to have this retrofit treatment applied.

2 Methodology

The methodology for the collision analysis exercise is outlined below and consisted of a structured approach to understanding the Study Area, identifying any environmental or road layout aspects that may contribute to collisions, identifying sites where collisions are grouped and providing report findings and recommendations.

STEP ONE

Collation and Review of Assessment Data

- The study required data from a number of sources including, TII, An Garda Síochana, MMaRC Contractor, Designers and Online sources.
- Once the data was collated, a review was conducted to ensure there were no duplications and all data sources were relevant to the Study Period and Study Area.

STEP TWO

Analysis

- The collated data was analysed to determine if any collision patterns could be identified based on the information provided. A number of individual analyses were conducted including: -
    - Analysis of the individual collisions within the Study Area compared to collisions on the entire motorway network by time of day, day of week, month of year, season, weather conditions, road conditions and collision location;
    - Analysis of vehicle speeds;
    - Review of skid resistance (SCRIM) records;
    - Analysis of Front Wheel and Rear Wheel vehicles in collision records; and
    - Analysis of areas within the Study Area where multiple collisions occurred.

STEP THREE

Site Visit

- From the analyses conducted, the Review Team identified a number of locations that required further investigation, with a site visit being undertaken to close out any specific queries.

STEP FOUR

Conclusions and Recommendations

- Key findings from the analyses were collated and summarised and recommendations were developed.

3 Analysis of Historical Collisions

3.1 General

A common definition is that *"a collision is a rare, random, multi-factor event preceded by a situation in which one or more road users have failed to cope with their environment."* The factors which can contribute to collision occurrence include human, vehicle, road & environmental factors. Any one factor, or a combination of factors, can be involved in a collision occurrence.

The analyses undertaken as part of this study have sought to determine if the collision occurrence within the Study Area demonstrate any non-random trends or patterns which could point to human, vehicle, road or environmental factors that are contributing to these collisions occurring.

To achieve this, historical collision records for the Study Area and the wider national motorway network have been compared, to determine if: -

- there are a higher number of collisions within the Study Area than would be expected;
- there are a higher number of Fatal or Serious Injury collisions within the Study Area than would be expected;
- there are any patterns or trends in the collision occurrence within the Study Area by time of day, day of week, month of year, weather conditions, etc.; and
- there are any patterns or trends in collision occurrence by location (e.g. High Collision Locations).

Arising from the results of these analyses additional factors were also reviewed, as follows: -

- analysis of vehicle speeds during adverse weather; and
- analysis of proportion of front wheel and rear wheel drive vehicles involved in recorded collisions.

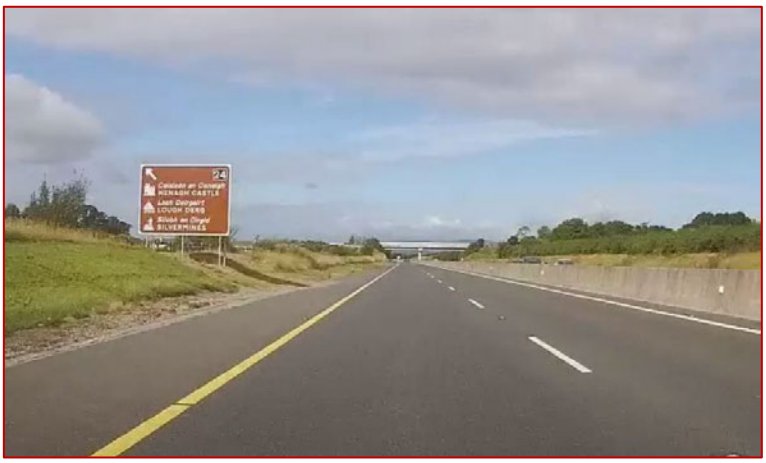

FIGURE 3.1 JUNCTION 24 NORTHBOUND APPROACH

3.2 Available Records/Data

The analysis was undertaken using the following sets of data: -

1) Historical Collision Records: -
    a) Reported to/by An Garda Síochána Collision Records for the national motorway network, including the Study Area; and
    b) Motorway Maintenance and Renewals Contract (MMaRC) incident records.
2) As-built drawings of the M7 motorway within the Study Area;
3) TII's HD15 (High Collision Location) Reports;
4) Previous interventions (changes to road layout) within the Study Area since opening;
5) Skid Resistance (SCRIM) data;
6) Vehicle make and model data including: -
    a) Vehicles involved in collisions; and
    b) CSO data on private vehicles licensed for the first time in Ireland between the years of 2014 and 2017.
7) Vehicle speed data within the Study Area; and
8) Weather conditions during the Study Period.

3.3 Collision Data Sources

3.3.1 An Garda Síochána Collision Records

Historical collision records, as reported to/by An Garda Síochána (AGS), for the Study Period were supplied by TII for the national motorway network. The data supplied did not include any personally identifiable information and consisted of a summary of location, road condition, environmental conditions and vehicle manoeuvre data for each collision.

The AGS collision records for incidents within the Study Area were extracted from the overall national motorway network data for analysis and consisted of records for 203 collisions, a summary of which is given in Appendix A. Of these, three collisions were Fatal, one collision resulted in a Serious Injury, 21 collisions resulted in Minor Injuries and 178 resulted in material damage only.

The overall AGS national motorway collision records were used as control data for the statistical analysis of collision occurrence within the Study Area.

Injury collisions are defined as follows: -

1) A “fatal” collision is defined as one where at least one person is killed as a result of the collision and death occurs within 30 days of the date of the collision from which injuries were sustained.

2) A “serious injury” is defined as an injury for which the person is detained in hospital as an ‘in-patient’, or any of the following injuries whether or not detained in hospital: -

- fractures;
- concussion;
- internal injuries;
- crushings;
- severe cuts and lacerations; or
- severe general shock requiring medical treatment.

3) A “minor injury” is an injury of a minor character such as a sprain or bruise.

All other collisions are “Material Damage” collisions, where no deaths or injuries occur but damage is caused to a vehicle and/or property.

Some information for individual collisions reported to/by AGS may be incomplete (e.g. weather conditions, time of occurrence, etc.). In addition, the AGS collision data does not include ‘hail’ as a weather condition, which is used in the MMaRC data referred to in Section 3.3.2. Where there was hail at the time of occurrence it is likely to have been classified as either ‘Wet’ or ‘Snow’ by AGS.

3.3.2 MMaRC Collision Records

The section of the M7 within the Study Area is operated, from a routine maintenance and incident response perspective, by a Motorway Maintenance and Renewals Contractor (MMaRC) appointed by TII.

The MMaRC Contractor is required to attend incidents on the network and provide support and assistance to AGS and other emergency services.

FIGURE 3.2: EXISTING VARIABLE MESSAGE SIGN ON NORTHBOUND APPROACH TO JUNCTION 21 BORRIS-IN-OSSORY

The MMaRC contractor maintains records of incidents, including collisions, occurring on the roads and junctions within its area of operations. TII provided copies of the MMaRC incident records for the Study Area, a summary of which is included in Appendix B.

3.3.3 Combined Collision Data

The MMaRC data includes records which correspond to collisions within the AGS records. Both data sets were cross-referenced to identify duplicate entries. The remaining MMaRC records, which do not have a corresponding record within the AGS data, are considered likely to relate to collisions which occurred but which were not reported to An Garda Síochána. The MMaRC records include 140 records that do not have a corresponding record within the AGS data, and these were combined with the AGS data to create a combined collision data set.

Where appropriate the combined collision data set has been used in the analysis, however in some instances only the AGS data has been used, for example because the national control data consists only of AGS records and in making comparisons similar records are required, or because the information being assessed is not recorded within the MMaRC records (e.g. collision type), recording of which is beyond the scope of the MMaRC duties and/or competence.

Table 3.1 gives the number of collisions which have occurred between each junction within the Study Area. Collisions are distributed across the Study Area with the number of collisions occurring broadly proportional to the length of motorway between the junctions.

TABLE 3.1 COLLISIONS BY LOCATION WITHIN STUDY AREA

Study Area Section	Approximate Marker Post Chainage (km)			Collision Records		
	From	To	Length	An Garda Síochána	MMaRC Records *	Combined Records
Jn 21 Approach	104.5	107	2.5	3	0 (0)	3
Jn 21 to 22	107	118.5	11.5	24	12 (27)	36
Jn 22 to 23	118.5	130	11.5	32	23 (40)	55
Jn 23 to 24	130	142.5	12.5	36	26 (48)	62
Jn 24 to 25	142.5	145.5	3	6	4 (7)	10
Jn 25 to 26	145.5	151.5	6	13	8 (18)	21
Jn 26 to 27	151.5	166.5	15	40	37 (59)	77
Jn 27 to 28	166.5	178.5	12	43	28 (47)	71
Jn 28 Approach	178.5	179.5	1	6	2 (7)	8
		Total	**75**	**203**	**140 (253)**	**343**

* ***Number of MMaRC collisions within each section is included in the Combined Collision Data Set, with the total number of MMaRC collisions for that section shown in brackets***

3.4 Collision Frequency

TII routinely assess safety issues on the national road network as part of its Network Safety Ranking process (as outlined in GE-STY-01022) to determine the potential for safety development and accident cost savings on sections of the national road network (EU RISM Directive). The process identifies 'High Collision Locations' (HCLs) based on collision rates for each 1km (approximately) long section as compared with the national average for a similar section of road. The collision rate is expressed as collisions per 100 million vehicle kilometres, taking account of the section length and the average traffic volumes for each section.

The HD15 analysis conducted for period 2015 to 2017 calculated an average collision rate of 14.345 per 100 million vehicle kilometres for the national motorway network for all collision types (Material Damage and Injury collisions). A collision rate of 1.943 per 100 million vehicle kilometres was calculated for Injury collisions (Fatal, Serious Injury and Minor Injury). These rates are calculated from AGS data.

Using these average collision rates the expected number of collisions within the Study Area for the Study Period, calculated using 2016 traffic flow data, are 225 collisions including 31 injury collisions. The number of recorded collisions, 203 collisions of which 26 were injury collisions, is slightly lower than the expected number of collisions. This indicates that the section of the M7 within the Study Area had fewer collisions than would be expected based on national averages.

3.5 Statistical (Chi²) Analysis of Collision Injury Severity Outcomes

A comparison has been undertaken comparing the injury severity outcomes of collisions within the Study Area with collisions occurring within the Control Data to ascertain if there are statistically significant differences in the injury outcomes within the Study Area.

A Chi² analysis was undertaken comparing the number of Fatal, Serious Injury and KSI (Killed or Seriously Injured) collisions to determine whether the number of collisions of each type is 'significantly' different from the norm, or average. The results of the Chi² analysis can be interpreted as follows: -

- If Chi² > 2.71 – the result is significant at 10%
  (e.g. 90% confidence that there is a statistically significant deviation in collision occurrence when compared with the Control Data)
- If Chi² > 3.84 – the result is significant at 5%
  (e.g. 95% confidence that there is a statistically significant deviation in collision occurrence when compared with the Control Data)
- If Chi² > 6.635 – the result is significant at 1%
  (e.g. 99% confidence that there is a statistically significant deviation in collision occurrence when compared with the Control Data)
- If Chi² > 10.83 – the result is significant at 0.1%
  (e.g. 99.9% confidence that there is a statistically significant deviation in collision occurrence when compared with the Control Data)

TABLE 3.2 CHI² ANALYSIS RESULTS FOR INJURY OUTCOMES

Injury Severity	Chi²	Significance Level	Comment
Fatal	1.29	Not Significant	Fatal collisions within the Study Area accounted for 1.48% of collisions compared with 0.57% of collisions within the Control Data.
Serious Injury	0.34	Not Significant	Serious Injury collisions within the Study Area accounted for 0.49% of collisions compared with 1.2% of collisions within the Control Data.
KSI	0.01	Not Significant	KSI collisions within the Study Area accounted for 1.97% of collisions compared with 1.78% of collisions within the Control Data.

The results of this analysis indicate that while the percentage of fatal collisions within the Study Area is higher than within the Control Data (1.48% compared with 0.57%), and that the percentage of Serious Injury collisions is lower within the Study Area than within the Control Data (0.49% compared with 1.2%), neither is statistically significant when compared with the Control Data.

3.6 Statistical (Chi²) Analysis of Collision Occurrence by Environmental Conditions and Time of Occurrence

A comparison has been undertaken between the collision occurrence within the Study Area with collisions occurring within the Control Data to ascertain if there are statistically significant collision patterns within the Study Area. (Refer to Appendix D)

TABLE 3.3 CHI² ANALYSIS RESULTS FOR ENVIRONMENTAL CONDITIONS AND TIME OF OCCURRENCE

Category	Parameter	Chi²	Significance Level	Comment
Month & Day	Tuesday	4.47	95%	Collisions on Tuesdays accounted for 9.9% of collisions compared with 15.6% of collisions within the Control Data.
	February	7.64	99%	Collisions in February accounted for 15.3% of collisions compared with 9.2% of collisions within the Control Data.
Adverse Weather & Road Surface	Weather - Wet	51.94	99.9%	Collisions in wet weather accounted for 47.8% of collisions compared with 24.7% of collisions within the Control Data.
	Road Surface – Wet	17.8	99.9%	Collisions in wet road surface conditions accounted for 52.2 % of collisions compared with 37.2% of collisions within the Control Data.
	Weather - Snow	10.38	99%	Collisions in snow weather accounted for 5.4% of collisions compared with 1.9% of collisions within the Control Data.
	Road Surface – Snow	5.83	95%	Collisions in snow covered road surface conditions accounted for 4.4 % of collisions compared with 1.8% of collisions within the Control Data.
	Road Surface – Frost/Ice	6.56	95%	Collisions in frost/ice road surface conditions accounted for 6.9% of collisions compared with 3.3% of collisions within the Control Data.
Dry Weather & Road Surface	Weather – Dry	59.17	99.9%	Collisions dry weather accounted for 42.9% of collisions compared with 69.1% of collisions within the Control Data.
	Road Surface – Dry	34.13	99.9%	Collisions in dry road surface conditions accounted for 36% of collisions compared with 57.1% of collisions within the Control Data.
Time	4pm to 7pm	9.09	99%	Collisions between the hours of 4pm and 7pm accounted for 16.7% of collisions compared with 26.5% of collisions within the Control Data.
	7pm to 12am	11.11	99.9%	Collisions between the hours of 7pm and 12pm accounted for 25.1% of collisions compared with 16% of collisions within the Control Data.
	3am	7.0	99%	Collisions between the hours of 3am and 4am accounted for 3.6% of collisions compared with 1.1% of collisions within the Control Data.
	6pm	5.91	95%	Collisions between the hours of 6pm and 7pm accounted for 4.1% of collisions compared with 10.1% of collisions within the Control Data
	8pm	5.94	95%	Collisions between the hours of 8pm and 9pm accounted for 8.0% of collisions compared with 3.9% of collisions within the Control Data

A Chi² analysis was undertaken for the various collision parameters, such as environmental and timing factors, to determine the statistical significance of any emerging trends, and to determine whether the number of collisions of that type is 'significantly' different from the norm, or average.

The analysis indicates that collisions within Study Area are higher than expected during the month of February and during the hours commencing at 3am and 8pm, and during the period between 7pm to 12am.

Fourteen of the comparison tests yielded results indicating a statistically significant deviation in the pattern of collision occurrence within the Study Area from that within the Control Data. The results are given in Table 3.3 and indicate that collisions occurring during wet weather is higher in the Study Area than expected from the Control Data. Conversely collisions during dry weather are lower than expected when compared with the Control Data. In addition, collisions during wet and frosty/icy road surface conditions are higher than expected.

3.7 Collisions during Adverse Weather Events

The statistical analysis of collisions highlighted that collisions during adverse weather are significantly higher than expected within the Study Area, and the records for these incidents were reviewed to ascertain if any pattern could be identified.

While the MMaRC collision records include a weather category of 'Hail', this category is not an option for An Garda Síochána when recording a collision, whose options are either 'Wet', 'Frost/Ice' or 'Snow'.

Of the twelve MMaRC records which recorded the weather conditions as 'Hail', and which had corresponding records within the AGS data, the AGS weather categories for these were 'Wet' for nine collisions, 'Frost/Ice' for two collisions and 'Snow' for one collision.

Of the eleven AGS collision records which recorded the weather conditions as 'Frost/Ice', and which had corresponding records within the MMaRC data, the MMaRC weather categories for these were 'Sleet' for four collisions, 'Wet' for four collisions, 'Hail' for two collisions and 'Dry' for one collision.

Of the six AGS collision records which recorded the weather conditions as 'Snow', and which had corresponding records within the MMaRC data, the MMaRC weather categories for these were 'Wet' for three collisions, 'Sleet' for two collisions and 'Hail' for one collision.

It is noted that following short-duration hail events the road conditions can turn to 'Wet' very quickly, thus complicating the recording of weather and road condition data. Nevertheless, the absence of a common categorisation for weather conditions means that a rigorous statistical analysis for 'hail' events cannot be undertaken. Even so, a review of the twelve collisions which occurred during 'Hail' weather conditions as categorised by the MMaRC has been undertaken.

It was found that two resulted in fatalities (16.7%), none resulted in Serious Injuries, one resulted in Minor Injuries (8.3%) and the remaining nine resulted in Material Damage.

The MMaRC records for the national motorway network were examined specifically from the perspective of 'Hail' events to ascertain if there were significantly more of these events within the Study Area. Figure 3.3 (supplied by TII) shows graphically the location of recorded incidents on the MMaRC network associated with 'Hail' weather conditions for the period November 2013 to March 2018. By inspection it can be seen that most of the incidents occur along the N/M18 and the M7 within the Study Area.

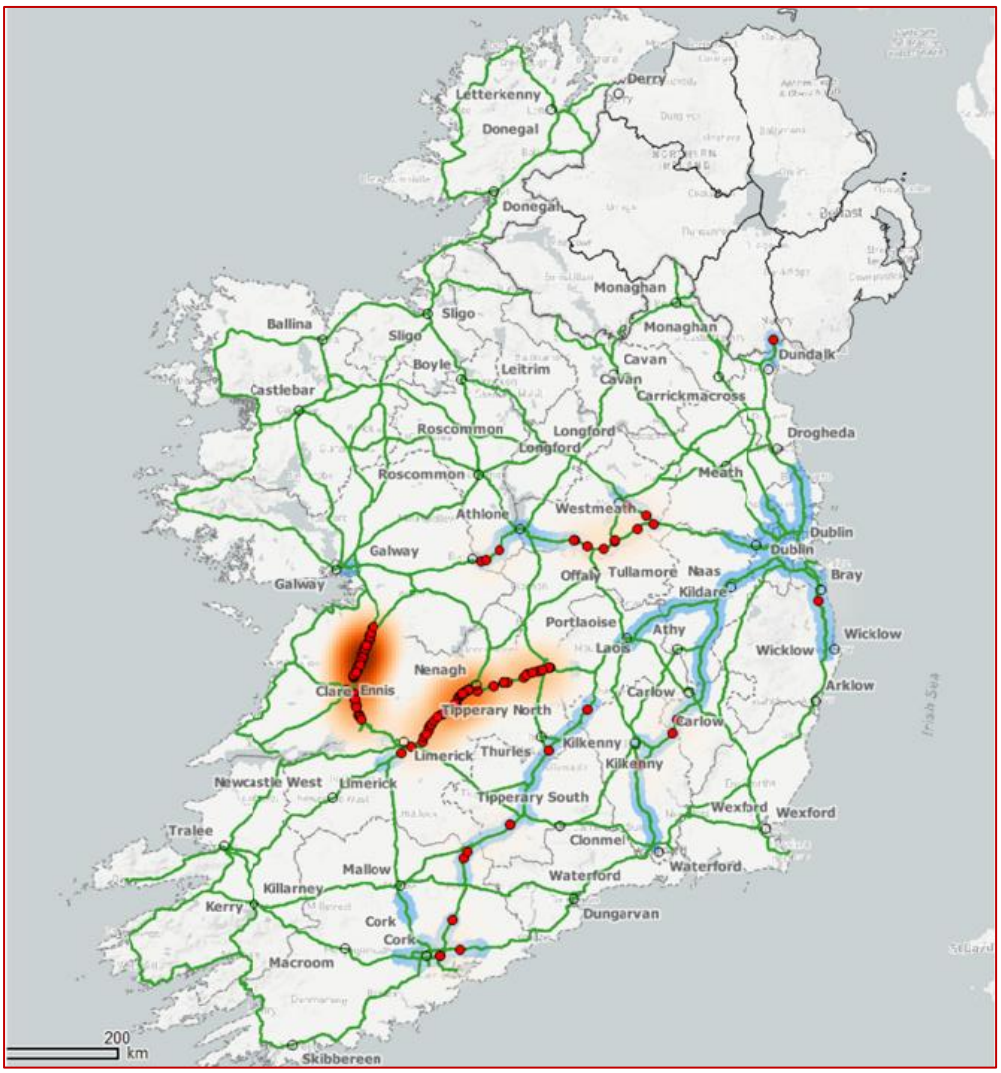

FIGURE 3.3: 'HAIL' EVENTS ON MMARC CONTRACT AREAS

Within the Study Period the number of Hail, Sleet or Snow events within the MMaRC 'B' area for the: -

- M7 was 35,
- N/M18 was 29, and
- M6 was 13.

3.8 Collisions by Location

3.8.1 Collision Groups

The collision data received as part of this analysis included 203 collisions from An Garda Síochána with an additional 140 collisions identified by the MMaRC contractor.

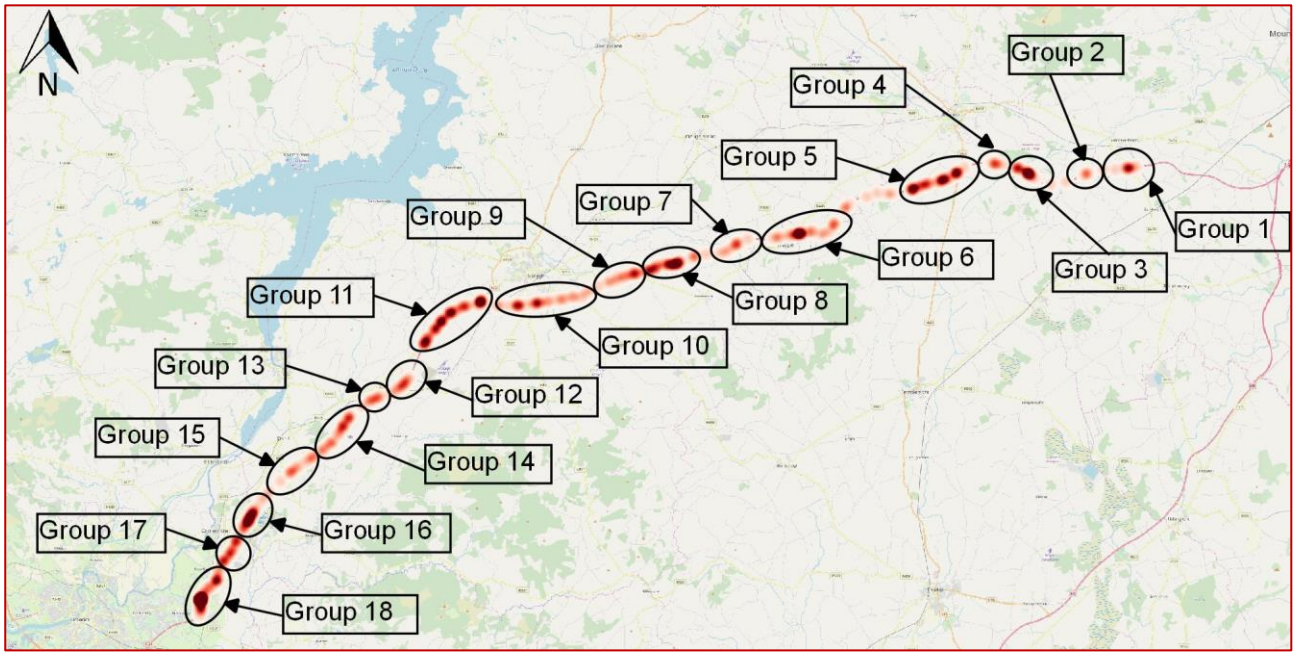

FIGURE 3.4 COLLISION GROUP LOCATIONS

An analysis was conducted to identify locations where the number and density of collisions was higher than the surrounding network (collision groups) and a more focussed review of these potential problem sites/areas was then undertaken where the collision records for each site was reviewed to identify any patterns or trends. Figure 3.4 shows the collision groups identified as part of this analysis

To identify if there were any design elements or pavement issues that may contribute to, or help explain, any emerging collision trend/pattern 'As Built' drawings for the Study Area and 'Skid Resistance' data (in the form of SCRIM results for the northbound carriageway from 2017 and the southbound carriageway from 2018) were obtained and inspected (Ref: Appendices G & H). None of the SCRIM Survey results fell below the investigatory level of 0.35, indicating that the surface skid resistance within the Study Area, in both directions, is satisfactory.

Two locations were noted where the SCRIM values, whilst above the investigatory level, were nevertheless below the levels recorded elsewhere within the Study Area. These locations were compared with the collision locations and were found not to lie within any of the identified collision groups.

A total of 18 potential collision groups were identified. Information regarding the locations and types of collisions within each group are provided in Appendix E, including: -

- A collision map;
- A geometric/engineering assessment of the motorway alignment;
- Assessment of the collision type (rear-end-shunt, side-on collision, single vehicle only, etc.);
- Environmental Factors; and
- Site Observations.

The collisions shown on the sheets within Appendix E use symbols and colours to differentiate between the collision record origin (e.g. An Garda Síochana or MMaRC) and the severity of the collision (Minor, Serious and Fatal).

3.8.2 Secondary Collision Events

The collision data was reviewed to identify collisions which occurred on the same section of road, on the same date and at approximately the same time. Thirty-four collision records were identified from this review, relating to twelve separate events. In these twelve instances it appears that one, or more, secondary collisions arose following a primary collision.

Two of the three fatal collisions recorded within the Study Area are associated with these multiple collision events. Ten of the twelve events were associated with adverse weather conditions, of which five were recorded as ‘Hail’ and two as ‘Sleet’ events by the MMaRC.

3.8.3 Site Visit

The Review Team discussed each collision group site during a workshop and it was concluded that a site visit was required for nine locations to further investigate possible issues identified or queries arising. The site visit was undertaken on the 14th of June 2018 by two members of the Review Team. Weather conditions during the site visit were predominantly dry and the road surface was dry. Traffic volumes at the time of the site visit were low to moderate. The site visit was recorded using a ‘Roadhawk’ windscreen-mounted video camera and observations from the site visit were then discussed with the other Review Team members at a second workshop.

Where additional findings/observations were noted during the site visit, these are included in Appendix E. The primary observation arising from the site visit was that vehicle speeds were high relative to the speed of the Review Team’s vehicle, which was travelling at a speed consistent with the posted speed limit.

Should these speeds be maintained during times of adverse weather or adverse road surface conditions there is an increased risk that drivers may find it difficult to control their vehicle, or safely react to unforeseen events on the motorway.

It is preferable to visit the site during conditions which have been shown to be statistically significant (e.g. adverse weather), however this is often difficult to arrange. The two members of the Review Team who undertook the site visit had, however, travelled along the section of the M7 within the Study Area during a heavy hail event and they had noted that the prevailing vehicle speeds during the hail shower remained high, and in many cases higher than the Review Team thought was appropriate for the prevailing weather conditions.

3.8.4 Findings

The analysis of the collision locations did not identify any clear patterns or trends in collision occurrence relating to the road alignment or geometry.

However, the analysis did find that a higher than expected number of collisions occurred either during wet weather or wet road surface conditions, consistent with the earlier statistical analysis, and there was an increase in collision occurrence at compact grade separated junctions, though this is not unusual at junctions, even motorway junctions.

3.9 Collisions by Vehicle Type

Information regarding vehicle types involved in the recorded collisions was obtained and the make and model of vehicles was used to classify the vehicles as either Front Wheel Drive, Rear Wheel Drive or All Wheel Drive based on online data for vehicle make and models.

Data from the Central Statistics Office (CSO) database on new private cars licensed for the first time between 2014 and 2017 was used to create a Control Data set for comparison.

The analysis showed that 6.0% of new private cars licensed for the first time between 2014 and 2017 were Rear Wheel Drive vehicles, compared with 9.3% of vehicles involved in collisions within the Study Area and during the Study Period for which vehicle make/model data was available.

This indicates that Rear Wheel Drive vehicles may be over-represented in the collisions within the Study Area. To better understand whether rear wheel drive vehicles are more likely to be involved in a collision, the records for single vehicle only collisions were reviewed. A total of 144 single vehicle only collisions were recorded, of which 12.6% involved Rear Wheel Drive vehicles. This again indicates that Rear Wheel Drive vehicles may, indeed, be over-represented in collisions within the Study Area.

This comparison, however, does not take account of exposure data (e.g. whether rear-wheel drive vehicles travel greater distances per annum on average than front-wheel drive vehicles, and are therefore more likely to be involved in collisions).

There may also be other factors that contribute to this result which warrant further analysis, in particular if the over-representation of rear wheel drive vehicles in the collision records, coupled with the higher than expected number of collisions during wet weather, are in some way related.

3.10 Vehicle Speeds & Weather Conditions

3.10.1 General

Following from the site visit observation that vehicle speeds on the M7 appeared to be high, information on average vehicle speeds at four locations within the Study Area, on different dates during the Study Period, were obtained. The data provided vehicle speeds and flows in five-minute intervals over a 24-hour period.

Information on the weather conditions on the dates in question was also obtained from TII weather stations within the Study Area. The weather data included the precipitation intensity in ten-minute intervals during the 24-hour period. The locations/sources of the speed and weather data are given in Table 3.4.

TABLE 3.4 SPEED & WEATHER MEASUREMENT LOCATIONS

Reference	Location	Date
TMU M07 150.0 W	Jn25 Nenagh (Central) and Jn26 Nenagh (West)	09/02/2016
TMU M07 125.0 E	Jn22 Roscrea and Jn23 Moneygall	10/03/2014
TMU M07 170.0 W	Jn26 Nenagh (West) and Jn27 Birdhill	01/03/2017
TMU M07 110.0 W	Jn21 Borris-in-Ossory and Jn22 Roscrea	13/06/2016

3.10.2 Vehicle Speeds

TABLE 3.5 VEHICLE SPEEDS AS PERCENTAGE OVER SPEED LIMIT

Location	Time Frame	% of Vehicles exceeding speed limit by:			
		0%	5%	10%	15%
Jn25 Nenagh (Central) and Jn26 Nenagh (West)	24 Hour Period	22.5	15.2	6.8	3.1
	AM Peak	30.6	21.9	13.9	11.7
	PM Peak	31.6	21.5	18.5	11.4
Jn22 Roscrea and Jn23 Moneygall	24 Hour Period	33.8	24.6	14.0	6.9
	AM Peak	61.7	50.2	42.2	25.8
	PM Peak	37.2	27.7	16.5	8.7
Jn26 Nenagh (West) and Jn27 Birdhill	24 Hour Period	26.2	18.3	9.4	4.3
	AM Peak	37.4	27.5	16.6	12.6
	PM Peak	29.8	19.7	9.9	4.5
Jn21 Borris-in-Ossory and Jn22 Roscrea	24 Hour Period	38.0	27.8	15.5	7.8
	AM Peak	Not Available			
	PM Peak	44.8	37.4	21.4	12.2

The posted speed limit on the M7 within the Study Area is 120 kph. Table 3.5 provides a summary of the vehicle speeds at each location by reference to the percentage of vehicles travelling above the speed limit for all traffic lanes over the 24-hour period reviewed, and during the morning and evening.

The results show that a significant proportion of drivers travel above the posted speed limit with 61.7% of drivers travelling in excess of 120km/h during the morning peak between Junction 22 Roscrea and Junction 23 Moneygall.

The Safe Systems approach to road safety adopted by the United Nations (UN) includes a number of assumptions: -

- Fallibility - humans are fallible and collisions will occur from time to time;
- Frailty - there is a limit to the amount of energy the human body can absorb before sustaining serious injury or death;
- Designers (e.g. of roads and of vehicles) accept responsibility for the safety of the system; and
- Road Users accept responsibility for complying with the rules and constraints of the system.

Vehicle speeds correlate to the energy dissipated during a collision, and therefore directly correlate with the injury severity arising from any collision that occurs.

3.10.3 Adverse Weather

The weather data obtained included precipitation intensity (mm/h). The rainfall intensities recorded were compared to the 85th percentile speeds at the locations reviewed. The 85th percentile speed is the speed exceeded by 15 percent of vehicles.

Table 3.6 gives the 85th percentile speed of vehicles at the four locations reviewed during varying intensities of rainfall. This review was confined to the hours between 7am and 7pm, which represents in excess of 80% of the traffic flows at each location.

TABLE 3.6 85TH PERCENTILE SPEED VS RAINFALL INTENSITIES

	Rainfall Intensity			
	None (0 mm/h)	Light (0-2 mm/h)	Medium (2-4mm/h)	Heavy (>4mm/h)
85th Percentile Speed (kph)	128	128	133	132

The results indicate that vehicle speeds do not change during periods of rain which may increase the risk of a collision during wet weather and road surface conditions.

This indicates that driver behaviour does not change sufficiently to account for adverse weather, which is best demonstrated by the average vehicle speeds being approximately the same in both fair and poor weather. This issue is exacerbated by the significant percentage of drivers driving in excess of the speed limit. The reasons for this are unclear, but drivers may have too much confidence in their vehicle and the motorway network.

3.11 TII Report – 'Analysis of Traffic Speeds on the M7'

In order to obtain a more accurate understanding of vehicle speeds within the Study Area a more detailed analysis of vehicular speeds within the Study Area was prepared by the TII Road & Tunnel Safety section (Appendix F) in November 2018.

The analysis examined traffic data collected within the Study Area by TII's roadside Traffic Monitoring Units (TMUs) for 2017. This encompassed data collected at seven TMU sites, giving a total of approximately 34.5 million records analysed. For the weather data, information from the Nenagh Weather Station was utilised which provided data in 10-minute intervals, giving a total of 49,230 records, and included the air & ground/surface temperature; wind speed; rain intensity; 24-hour precipitation; relative humidity and water film thickness.

This analysis focussed on 'Excessive Speeds' which was taken speeds in excess of 135kph, based on the UK speed enforcement threshold of "10% plus 2mph" over the speed limit, which was converted to "10% plus 3kph" for Irish motorways. Tables 3.6 to 3.9 summarise the analysis findings for vehicle speeds for time of day, month of year, risk of ice and rain state.

TABLE 3.7: VEHICLE SPEEDS BY TIME OF DAY

Hour Beginning	Mean Speed (kph)	Proportion of Vehicle Speeds Over Limit	Proportion of Excessive Vehicle Speeds
0	120.7	35 %	12 %
1	121.0	36 %	13 %
2	120.3	36 %	13 %
3	120.9	41 %	16 %
4	121.1	43 %	17 %
5	122.8	49 %	19 %
6	122.8	45 %	16 %
7	121.6	41 %	13 %
8	120.7	39 %	11 %
9	120.7	38 %	11 %
10	120.5	37 %	11 %
11	120.1	36 %	10 %
12	120.1	36 %	11 %
13	120.1	36 %	11 %
14	120.0	36 %	11 %
15	120.0	37 %	10 %
16	119.9	37 %	10 %
17	119.6	35 %	10 %
18	120.3	36 %	10 %
19	120.7	37 %	11 %
20	120.7	36 %	11 %
21	120.0	34 %	10 %
22	120.0	32 %	10 %
23	120.7	33 %	11 %

TABLE 3.8: VEHICLE SPEEDS BY MONTH OF YEAR

Month	Mean Speed (kph)	Proportion of Vehicle Speeds Over Limit	Proportion of Excessive Vehicle Speeds
Jan	120	35 %	10 %
Feb	121	36 %	11 %
Mar	121	38 %	11 %
Apr	122	40 %	12 %
May	121	38 %	11 %
Jun	121	37 %	11 %
Jul	122	39 %	12 %
Aug	121	37 %	11 %
Sep	121	38 %	11 %
Oct	120	36 %	10 %
Nov	120	34 %	9 %
Dec	119	33 %	9 %

TABLE 3.9: VEHICLE SPEEDS BY RAIN STATE

Rain State	Mean Speed (kph)	Proportion of Vehicle Speeds Over Limit	Proportion of Excessive Vehicle Speeds
None	121	43 %	13 %
Light	120	41 %	12 %
Medium	119	39 %	11 %
Heavy	119	39 %	11 %

TABLE 3.10: VEHICLE SPEEDS BY RISK OF ICE FORMING

Risk of Ice	Mean Speed (kph)	Proportion of Vehicle Speeds Over Limit	Proportion of Excessive Vehicle Speeds
High (< 0°C)	118	37 %	10 %
Low (0°C to 4°C)	119	38 %	11 %
None (> 4°C)	121	42 %	13 %

The analysis indicates that 8% to 10% of traffic consistently travelled at excessive speeds no matter what the weather conditions, and that in terms of weather conditions low ground temperatures and high wind speeds had the greatest impact on the proportion of excessive speeds, however heavy rainfall had a lesser affect.

Overall it found that traffic volumes had the greatest impact on mean traffic speeds and the proportion of excessive speeds within the Study Area, and that excessive speeding is more common during the hours of 3:00am to 6:00am and more common on weekends than weekdays or public holidays.

4 Conclusions

Following the analysis, the following issues are considered relevant to the historical collision occurrence within the Study Area and Study Period: -

- collision frequency is just below the average on the national motorway network;
- the number of fatal and serious injury collisions, although higher and lower respectively, does not deviate from the average on the national motorway network to a statistically significant degree;
- the number of collisions occurring during wet weather and wet or frosty/icy road conditions (including 'hail') are higher than expected when compared with collisions on the national motorway network;
- the number of collisions occurring during 'hail' events are higher within the Study Area when compared with the average on the MMaRC network;
- twelve incidents occurred within the Study Area which involved secondary collisions, two of which resulted in fatalities and most of which occurred during adverse weather conditions;
- collisions occurring in February, during the hours commencing 3am, 8pm and during the five-hour period 7pm to 12am are higher than expected when compared with collisions on the national motorway network (this possibly relates to weather condition related issues referenced above);
- no locations were identified where the road layout is considered to contribute to collision occurrence (Note: some sections of road within the Study Area were modified prior to the study being undertaken to address safety concerns);
- rear wheel drive vehicles appear to be over-represented, in particular in single vehicle only collisions;
- vehicle speeds are high, with a significant proportion of drivers travelling in excess of the speed limit; and
- vehicle speeds are not being moderated sufficiently, or at all, during adverse weather conditions.

5 Recommendations

The following are the measures suggested to reduce collision occurrence and/or injury severity outcomes within the Study Area: -

1. Measures (e.g. variable message signs) within the Study Area to advise drivers of the risks/hazards associated with adverse weather and the need to moderate their speeds accordingly;

2. Liaison with the national weather services to obtain prior notification of potential adverse weather so that the measures in the above recommendation can be implemented;

3. A national public awareness campaign specifically targeting: -

    - driver behaviour in adverse weather, particularly on the motorway network;

    - vehicle occupant behaviour when involved in a collision on a high-speed road or motorway (e.g. stay in vehicle);

4. Expand the weather & road condition categories on the Garda Collision Report Forms to include 'Hail' as an option to assist in future collision analysis;

5. Agree a common approach to weather and road condition categorisation between An Garda Síochána and maintenance contractors/operatives; and

6. Provide collision data and analysis to An Garda Síochána to permit identification of locations or behaviours that may be amendable to targeted enforcement interventions.

7. Further investigation to assess if rear wheel drive vehicles are more likely to be involved in collisions, particularly during adverse weather;