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Transport Infrastructure Ireland

TII Publications

GE PE DN CC OP AM RE

Network Safety Analysis Procedures

GE-STY-01036
December 2017

GE General

Standards

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TII Publications

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Contents

Updates to TII Publications resulting in changes to

Network Safety Analysis Procedures GE-STY-01036

Date:	April 2018
Page No:	8
Section No:	Appendix A

Amendment Details:

The following minor amendment has been incorporated into the December 2017 version of this Standard:

a) Minor updates have been made to the text within the Network Safety Analysis Scheme Development Flowchart within Appendix A for clarity.

Contents Table

1. Introduction

1.1 Scope

The purpose of this document is to further explain the processes used to implement Network Safety Analysis on the national road network. The relevant stages undertaken throughout the analysis are set out in this document.

These procedures should be read in conjunction with GE-STY-01022 Network Safety Analysis, EU Directive on Road Safety Infrastructure Management 2008/96/EC and SI 472 of 2011.

2. Network Safety Analysis

The identification of High Collision Locations (HCL) is a multi-stage process. It follows the steps listed below:

- Identification of HCL sites via desktop analysis;
- Review of HCL Sites; and
- Distribution of sites with summary of the collision problem and possible solution(s) to road operators for scheme development.

This document provides a detailed description of the steps involved in the initial stage of HCL Identification. Further information on the remaining process is detailed in Appendix A Network Safety Analysis Scheme Development Flowchart.

Although the Network Safety Analysis process focuses on site specific locations, this process feeds into other work carried out by TII Road and Tunnel Safety. Examples of this work include the use of material damage collision data for both macro and micro level assessments of the network. Further information on these supplementary outputs can be found in Section 2.2.

2.1 High Collision Location (HCL) Identification Analysis

The initial desktop study is based on spatial data. This includes injury collision data, exposure data, in the form of estimates of vehicle kilometre of travel, and network road link data. This work also includes refining the extent of the Reference Populations (RP) due to changes within the network since the previous analysis. All sites within the same RP are benchmarked against threshold levels (rates and frequency) established for that specific RP.

A HCL is a site on the network which exceeds two thresholds. The first based on collision frequency and a second based on a collision rate.

A HCL is defined as a site where the:

Collision frequency is greater than or equal to 3 or more collisions within the period of analysis (typically 3 years).

And

Collision rate is greater than twice the expected (average) collision rate for a RP.

These thresholds can be adjusted for each individual reference population. To show if collision rates are increasing or decreasing a benchmark rate is used. This rate is an older rate established in a previous period of analysis. The benchmark rate is occasionally updated so that it is within 10 previous study periods. In practice this means that current HCL sites are benchmarked against an older (likely higher) rate. If the benchmark rate for each RP was the current rate then the number of HCL sites would remain high and mask the improvements made to the network though engineering safety interventions. The following sections describe the process of identifying different road types, and the calculations used in identifying HCLs. All HCL sites are then subject to a site assessment. The following sub-sections provide more detail on the data used by TII to calculate these collision rates.

2.1.1 Reference Populations (RP)

PIARC (the World Road Association) consider a RP to be a subset of sites that have similar features and as such, are expected to have similar safety performances. The national road network can be divided into urban and rural sections. These urban and rural sections are typically defined based on the speed limits. The network can then be split/classified into different further subsets including motorway sections, single carriageway sections and dual carriageway sections.

The reference populations are currently defined as follows:

- Rural 2 Lane Roads
- Rural Dual Carriageways
- Urban 2 Lane Roads
- Urban Dual Carriageways
- Urban Motorways
- Rural Motorways

Each segment of the national road network is assigned to one of the six common reference populations. These segments are typically 1 kilometre in length and strive to be homogenous, as far as practicable, taking into account changes such as when county boundaries are crossed. On the assumption that reference populations have a similar safety performance, sites identified as HCLs are those sites where the collision rate and collision frequency are substantially above the average for the reference population.

The following subsections detail the calculations required to establish collision frequency and collision rates at both a site specific and RP level. These in turn are used as thresholds to establish HCL sites within the network.

2.1.2 Collision Frequency (C.F.)

Collision Frequency (C.F.) is used as one of the thresholds within Network Safety Analysis to identify HCLs. This threshold is subject to change as reported collision data improves but is typically defined as a site that has three or more injury collisions within the previous period of three years.

The below equation sets out how to calculate the average collision frequency for each RP:

Equation 1: Average Collision Frequency for the Reference Population

$$f_{rp} = \frac{\sum f_j}{n}$$

Where:

f_{rp} = Average Collision Frequency for the Reference Population

f_j = collision frequency at Site j of a Reference Population

2.1.3 Collision Rate (CR)

Collision Rate (CR) is the ratio between a number of collisions and an exposure measure. Within TII Road and Tunnel Safety, this measure is estimated vehicle kilometres travelled. Benchmark collision rates are used as thresholds that when exceeded identify HCL's.

The below equations set out how to calculate collision rates for individual sites, for RPs as a whole, and to calculate the weighted annual average daily traffic (AADT).

Equation 2: Collision Rate for individual site (j)

$$R_j = \frac{f_j \times 10^8}{365.25 \times PL_jQ_j}$$

R_j = Collision rate of Site j (collisions per 100 Million veh-km)

f_j = Collision frequency at Site j

P = period of analysis (years)

L_j = segment length of Site j (km)

Q_j = average annual daily traffic of Site j (AADT)

Equation 3. Collision Rate for Reference Population

$$R_{rp} = \frac{\sum f_j \times 10^8}{365.25 \times P \times \sum L_j \times Q_w}$$

R_{rp} = Average Collision Rate (collisions per 100 Million veh-km)

f_j = Collision frequency at Site j

P = period of analysis (years)

L_j = segment length of Site j (km)

Q_w = Weighted average annual daily traffic (AADT)

Equation 4. Weighted AADT

$$Q_w = \frac{\sum (Q_j \times L_j)}{\sum L_j}$$

Where:

Q_w = Weighted average annual daily traffic (AADT)

Q_j = AADT of Site j

L_j = segment length of Site j (km)

2.2 Supplementary Data Outputs

While these guidelines document a very specific process around Network Safety Analysis, there are a number of supplementary data outputs from the process that can be used for other purposes.

The ratio of injury collisions to material damage only collisions allows for a deeper insight into the likely severity outcome of a single vehicle collision should it hit, for example, an engineered barrier as opposed to a tree or ditch. An example output of this type of analysis is presented in Appendix B.

In addition, a wider macro view (route scale – typically 100 km) of the network can be compiled from the detail found within individual sites (micro scale – typically 1 km) that the process is built around. For example, displaying the spatial distributions of particular collision types can help highlight any local concentrations within the network that may otherwise have been missed if patterns were only looked for at the micro scale. A typical output of this macro analysis is presented in Appendix C.

3. References

3.1 TII Publications (Standards)

Transport Infrastructure Ireland. GE-STY-01022 Network Safety Analysis. TII Publications.

3.2 Other documents

Association, PIARC - World Road. 2003. Road Safety Manual. S.l. R2Market, 2003. ISBN: 2-84060-158-3.

European Parliament and the Council of the European Union, 2008. Directive 2008/96/EC of the European Parliament and of the Council of 19th November 2008 on Road Infrastructure Safety Management

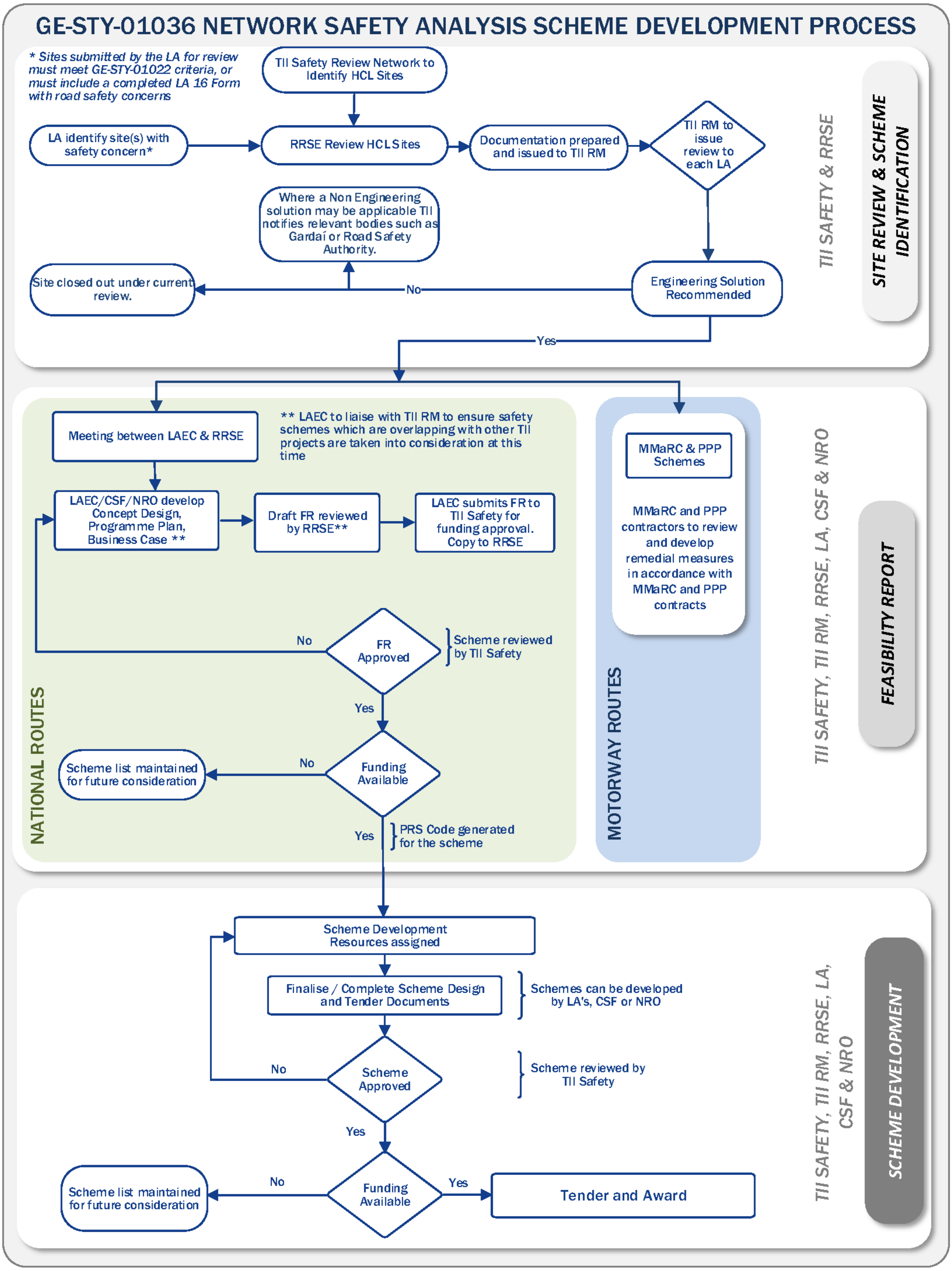
Road Safety Authority. (2012). Road Collision Factbook 2012. Mayo: RSA.

Roads Act 1993. (Order 2012). Classification of National Roads.

S.I. No. 472/2011 - European Communities (Road Infrastructure Safety Management) Regulations 2011.

Appendix A:

Network Safety Analysis Scheme Development Flowchart



Abbreviations

NRO	National Roads Office	HCL	High Collision Locations	CSF	Consultant from TII Safety Framework
RRSE	Regional Road Safety Engineers	LAEC	LA Engineering Contact		
FR	Feasibility Report	TII RM	TII Regional Management Team		

Appendix B:

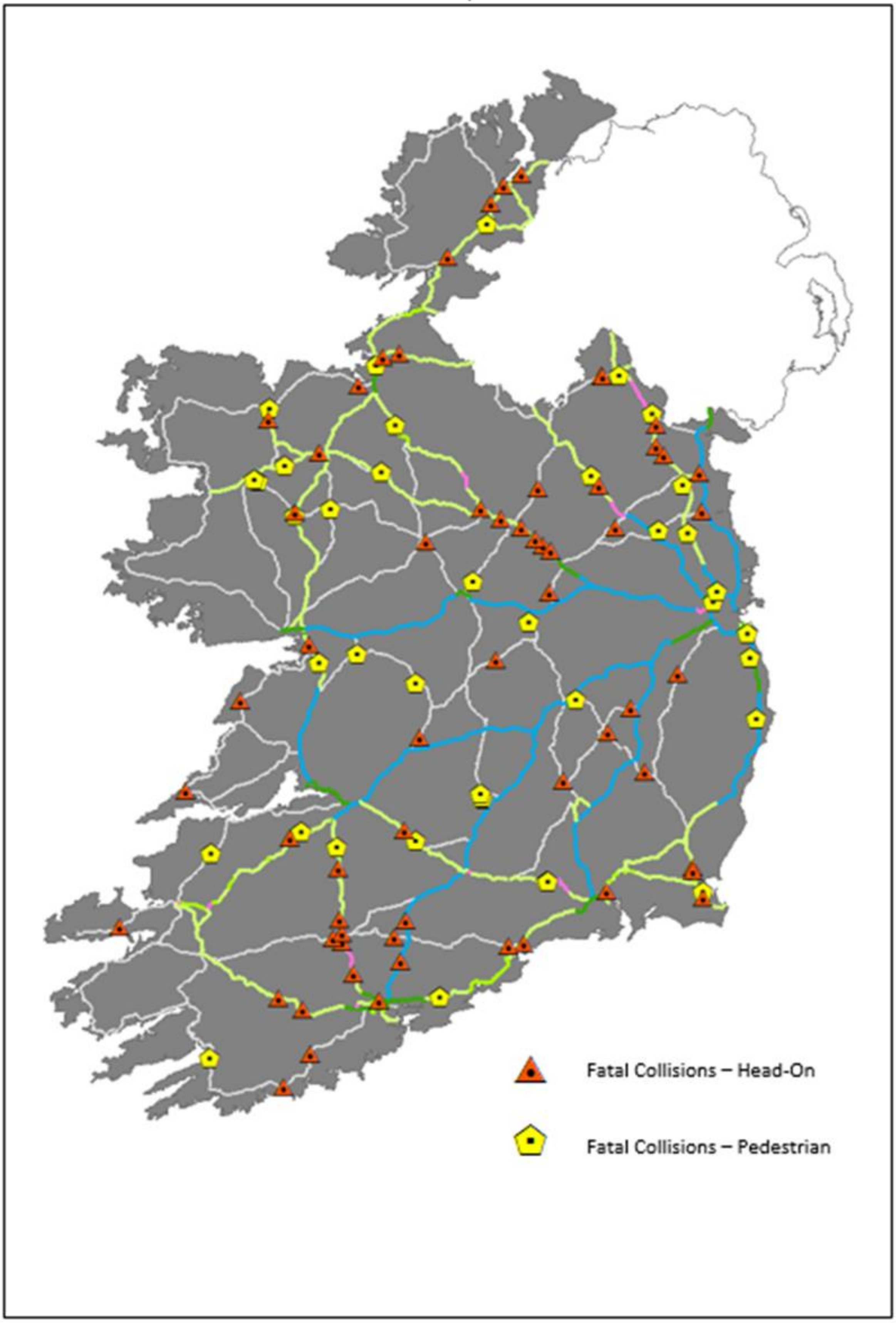
Likely Severity Outcome of all Primary Collision Types

Likely Severity Outcome of all Primary Collision Types on National Roads (Jan 2014 – Sept 2016)				
Primary Collision Type	**Count - Injury**	**Count - MD**	**Count - Total**	**Per Cent Chance of Injury (All NR)**
Pedestrian	280	28	308	91%
Cyclist	164	50	214	77%
Head-On	321	234	555	58%
Parked Trailer/Skip	1	1	2	50%
Tree	63	86	149	42%
Road Edge - Water	4	6	10	40%
Wall - Pillar of Wall	14	25	39	36%
Head-On, Right Turn	41	83	124	33%
Wall - Stone	76	226	302	25%
Fence - Timber	17	53	70	24%
Lighting Pole	21	72	93	23%
Road Verge - Cutting	8	28	36	22%
Angle, Right Turn	118	453	571	21%
Island	9	36	45	20%
Wall - Brick	26	108	134	19%
Pole/Post - Other	45	192	237	19%
Road Verge - Embankment	38	174	212	18%
Road Edge - Ditch	239	1111	1350	18%
Fence - Concrete	7	33	40	18%
Rear End, Right Turn	43	204	247	17%
Fence - Wire Mesh	8	39	47	17%
Angle, Both Straight	94	537	631	15%
Footpath	8	46	54	15%
Barrier - Concrete	37	221	258	14%
Other	295	1805	2100	14%
Hedge	13	98	111	12%
Rear End, Straight	726	5845	6571	11%
Barrier - Steel	79	663	742	11%
Angle, Left Turn	20	173	193	10%
Side Swipe	353	3386	3739	9%
Sign On Post	11	107	118	9%
Rear End, Left Turn	15	146	161	9%
Bollard	5	50	55	9%
Barrier - Wire Rope	13	144	157	8%
Bridge	4	46	50	8%
Debris/Stone	3	44	47	6%
Parked Vehicle	36	531	567	6%
Open Door	1	20	21	5%
Animal - Domestic	4	130	134	3%
Animal - Non Domestic	5	208	213	2%
Shed Load	0	9	9	0%

Appendix C:

Macro View – Spatial Distribution of Fatal Collisions

Spatial distribution of fatal head-on and fatal pedestrian collisions on national road network 2014-2016



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