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Low Cost Safety Measures and Road Safety Audit

Steve Proctor, TMS Consultancy

Topics to cover

- Safe Systems and Road Safety Targets
- Scale of the Problem
- Collision Causation
- Collision Investigation
- Cost Benefit Analysis
- Case Studies
- Road Safety Audit and Inspection
- European Directive on Road Safety Infrastructure Management

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Steve Proctor/ TMS Consultancy

- 35 years' international experience
- Written guidelines for national governments and local road authorities
- Director of national Road Safety Audit training programmes in UK and Ireland
- Undertaken collision studies, Road Safety Audits, Road Safety Inspections throughout Europe

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024 7669 0900

About Us

Together we can save millions of lives.

DECADE OF ACTION FOR ROAD SAFETY 2011-2020

www.decadeofaction.org

About Us

TMS provides practical expertise to improve road safety and traffic management by offering audit, consultancy and training services. Our driving principle is to deliver services and solutions that make roads safer and ultimately reduce casualties.

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Safe Systems approach and Road Safety Targets

A global catastrophe….

- 1.25 million people killed every year
- Half of these are pedestrians, cyclists or motor cyclists
- A further 50 million people are seriously injured, many of whom have life changing injuries

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Vision Zero Origins in Sweden

- In October 1997, the Road Traffic Safety Bill founded on Vision Zero was passed by a large majority in the Swedish parliament
- The Vision is an expression of the ethical imperative that:
  - *"It can never be ethically acceptable that people are killed or seriously injured when moving within the road transport system"*[1]

    Prof Claes Tingvall, Swedish Road Administration

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Safe Systems Approach

- Now implemented in Sweden, The Netherlands, Finland, Norway, South Africa and New Zealand
- Advocated by the World Health Organisation
- Focuses around Vision Zero:
  "***No loss of life is acceptable***"
- Based on the simple fact that we are human and make mistakes
- Therefore the road system must be designed to protect us at every turn

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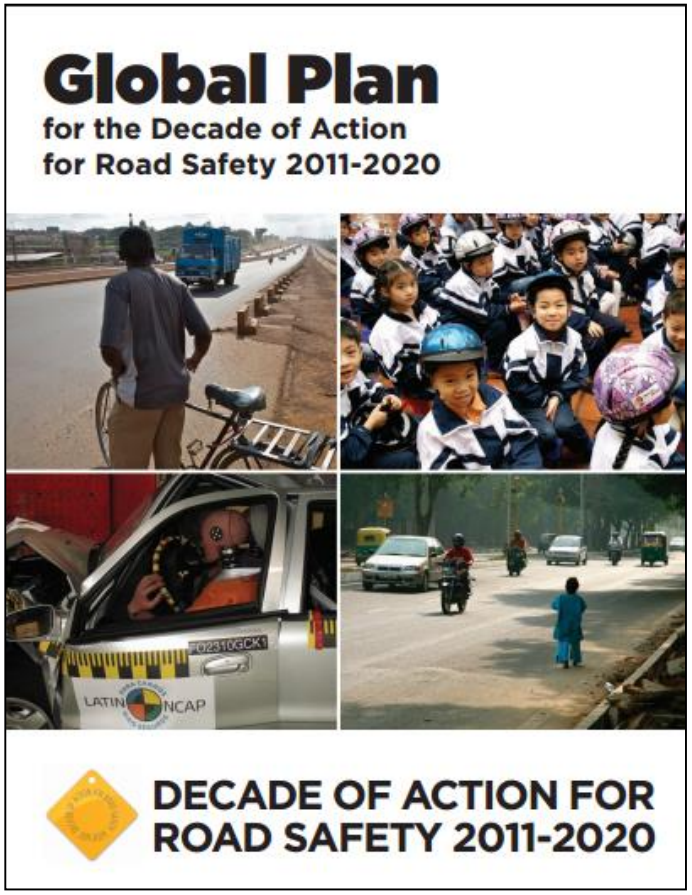
UN Fatal Road Casualty Reduction Target



- Official goal of “stabilising and then reducing” global road traffic fatalities by 2020 compared to 2010
- Plan is a tool to support the development of national and local plans of action

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Road Safety Targets

- EU target to reduce road deaths by 50% by 2020 (compared to 2010)
- Scotland target (2020)
  - to reduce deaths by 40%
  - child deaths by 50%
  - serious injuries by 55%
  - child serious injuries by 65%

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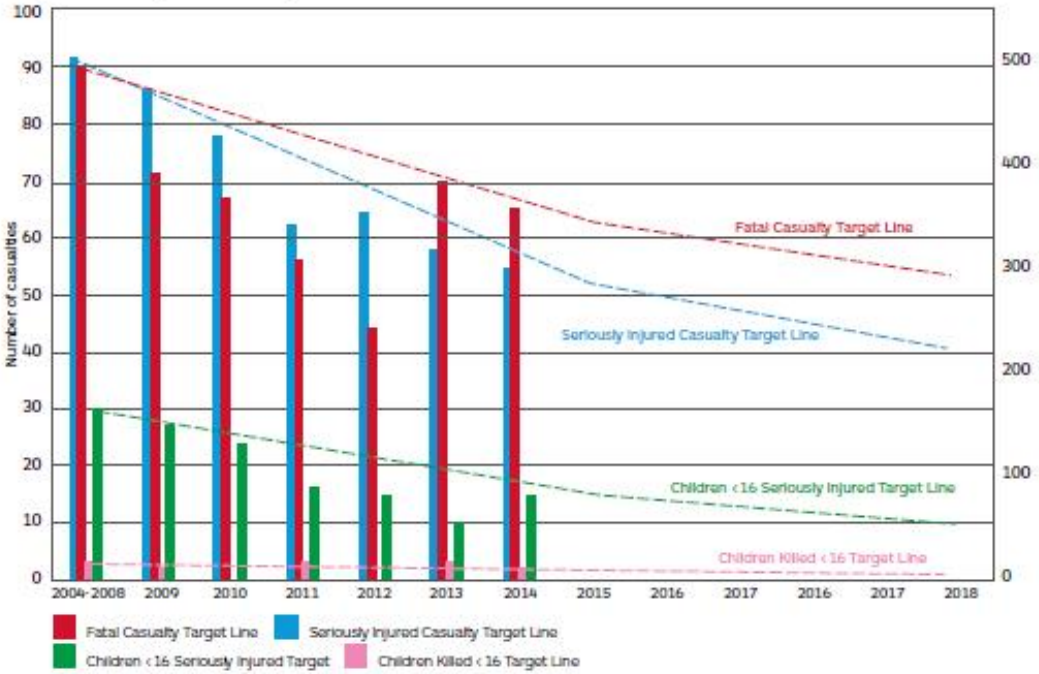
7. ANALYSIS OF ACCIDENTS AND CASUALTIES

Accident data is at the heart of understanding, delivering and improving road safety, and is central to the work of the Strategic Road Safety Team, as it provides a means to gauge not only those areas in need of safety improvement measures but also allow monitoring of the effectiveness of such measures. This also allows decisions regarding investment to be evidence led and targeted.

2015/2020 Casualty Reduction Targets



PERFORMANCE AGAINST TARGETS

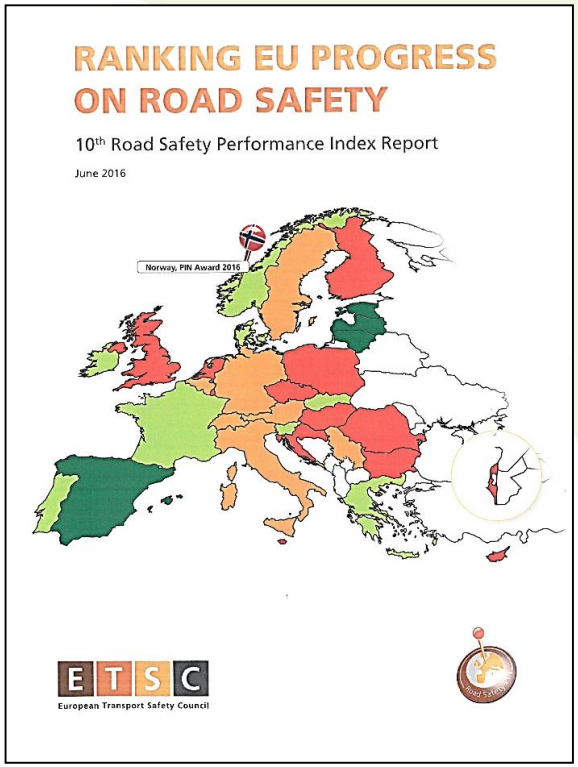
The Scottish Government casualty reduction targets for 2020 are being met on the Scottish trunk road network, with reductions consistently below the current pro-rata target year on year in terms of 'Killed and Serious Casualties', 'Killed and Serious Child Casualties'.

Summary

- We are on track to m **Framework** targets
- Further action is nee
- The use of evidence decisions that are we as possible

EU Road fatalities in 2015

- "***EU road safety progress has come to a standstill***"
- 26,313 reported road fatalities in 2015 (25,970 in 2014)
  - 1% increase compared to 2014
- Target to reduce road deaths by 50% by 2020 requires an 9.7% reduction every year between 2016-2020
- Recommendation to provide funds to allow target oriented setting of measures



Source: 10th EU Road Safety Performance Index Report June 2016

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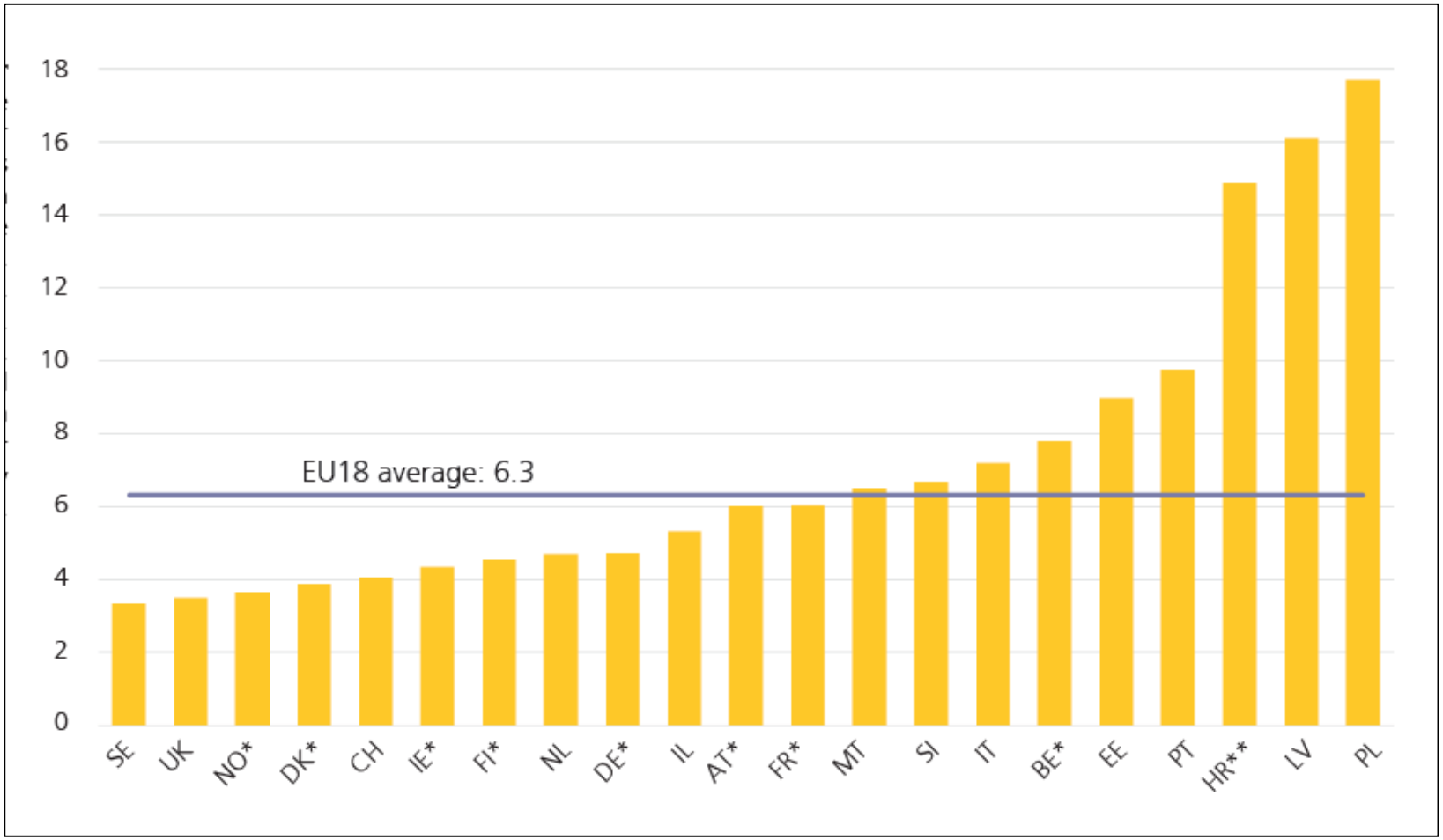
EU Road fatalities in 2015



Road Deaths per billion vehicle kilometres in 2015

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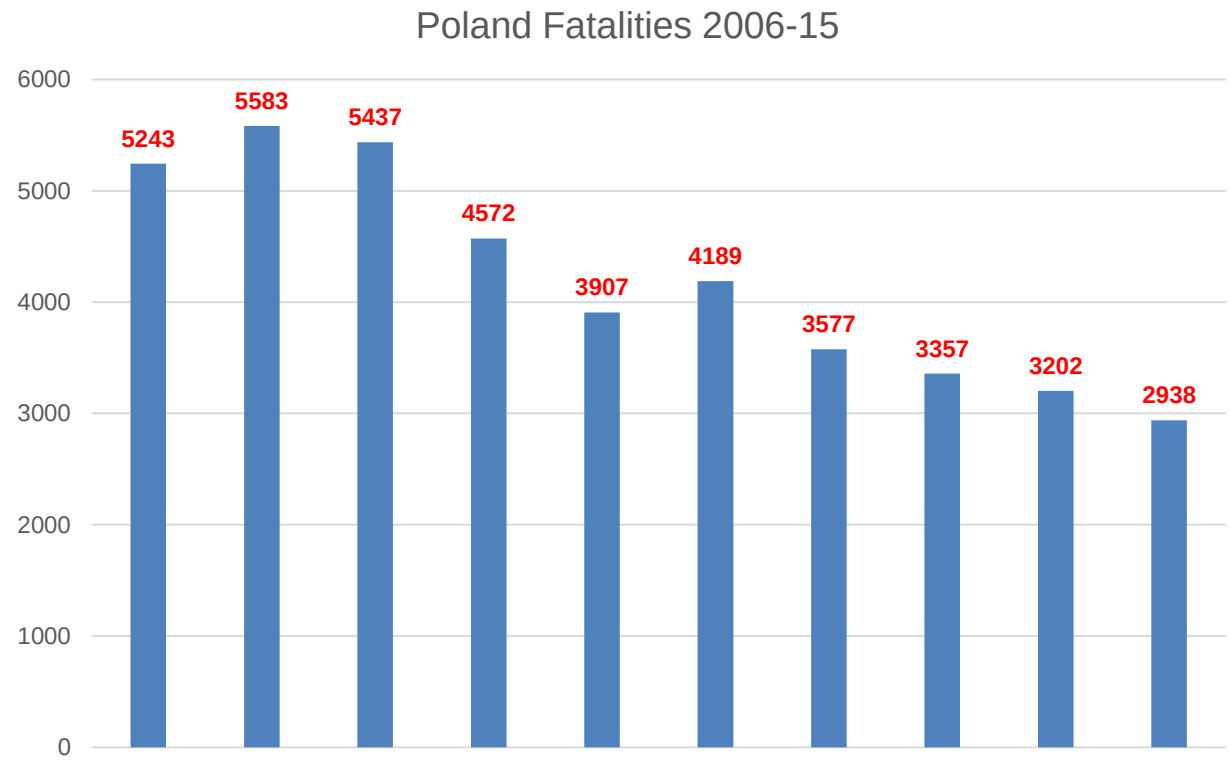
Scale of the Problem

Scale of the problem - Poland



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Collision Causation

Road Collision Definition

An unintentional energy exchange, which occurs when energy of any type reaches a susceptible structure in amounts, and at rates, in excess of those that can be tolerated without damage

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Road Collision Definitions

- road collisions are :-
  - **rare** –1 in 330 people in UK injured in 2014
  - **random** - impossible to predict where and when the next collision will happen
  - **multi-factor** - combination of behavioural, vehicle and highway factors
  - **“How did this road user fail to cope with the road environment?”**

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Multi-factor ...

Behavioural Factors

Vehicle Factors

Highway Factors

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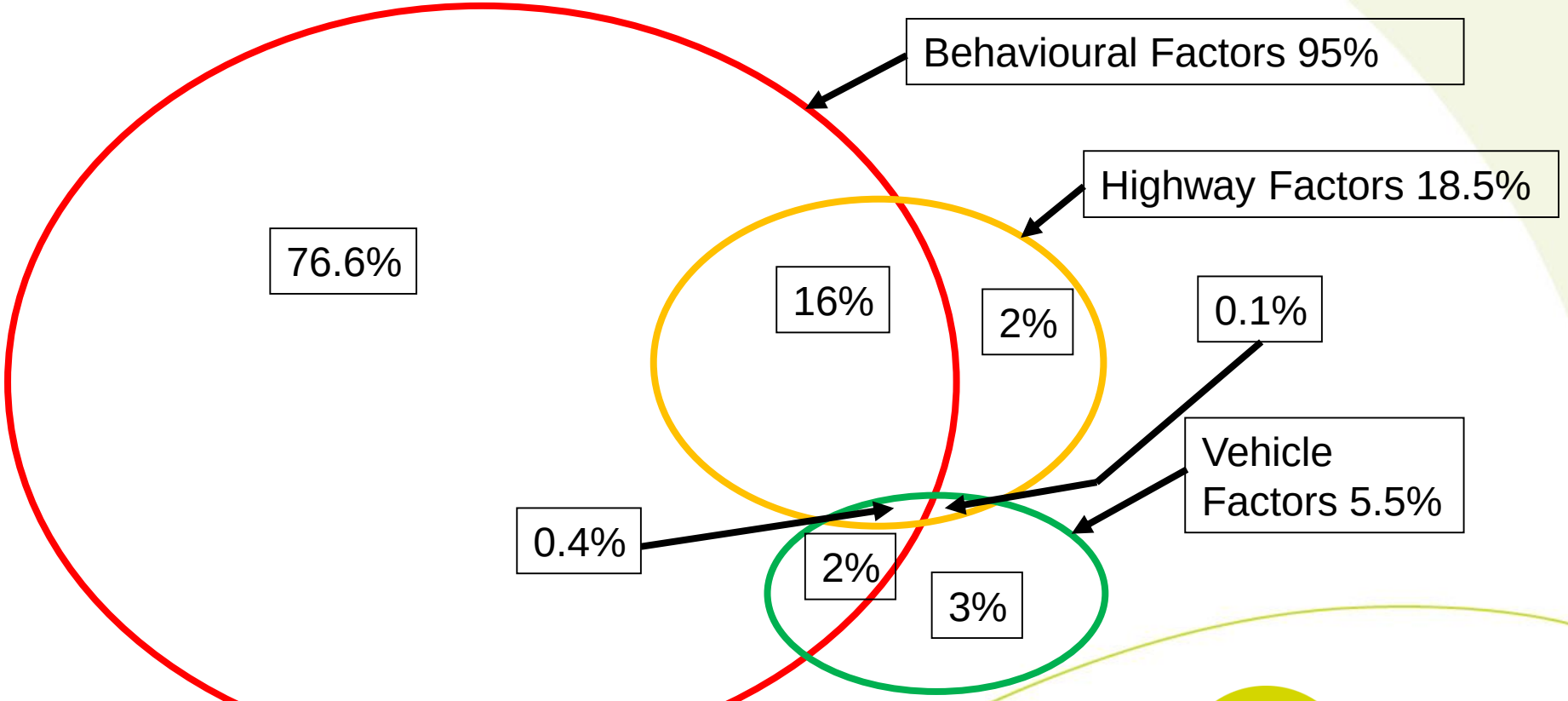
Factors involved in a collision



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Collision causation workshop

- Work in groups of 4 to review the handout
- What were the main highway factors involved in the collision
- Why did this road user “fail to cope” with the road environment
- Which of the various parties involved in this incident would you consider to be liable, and by how much (%)

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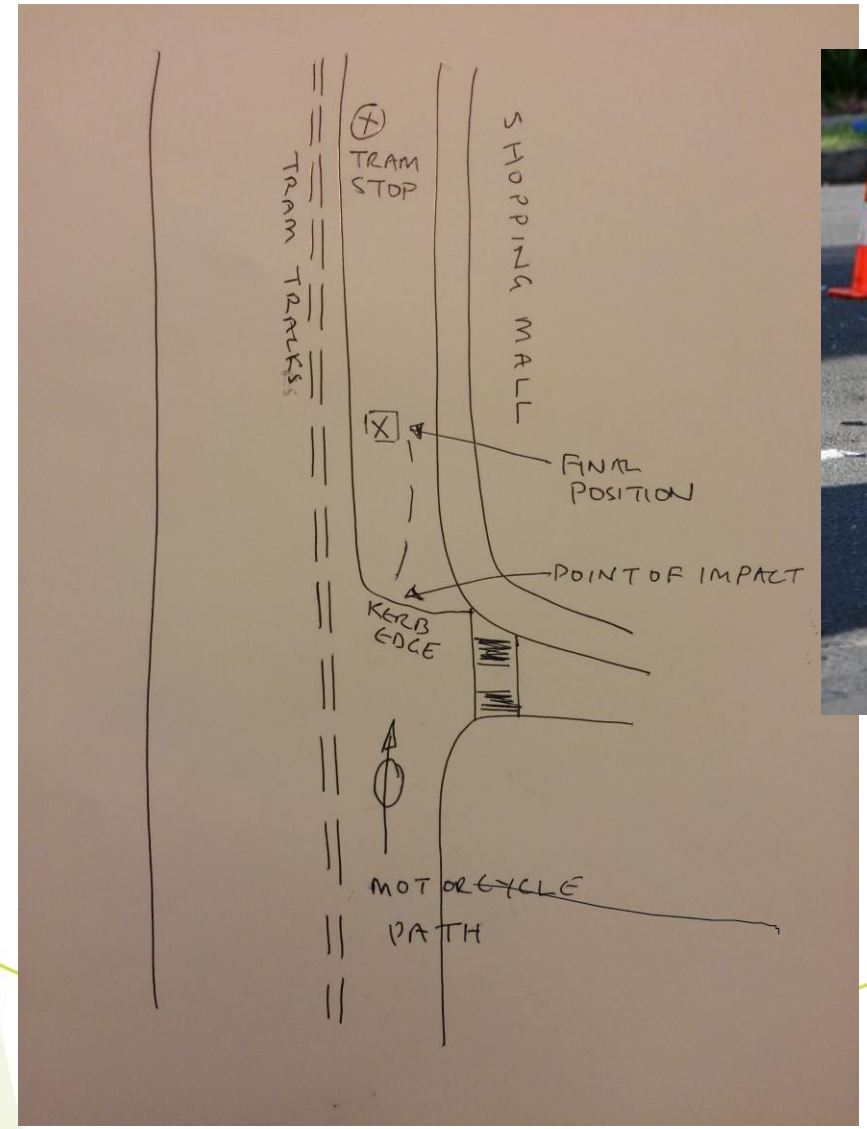
Collision causation workshop



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Collision Investigation

Collision Investigation – high risk sites

- Based on police collision data
- “A high number of collisions with a dominant crash pattern can indicate a problem related to the road
- collisions of this type will continue to occur unless the problem is treated
- making changes to the road environment can influence the way a driver behaves and reduce road collisions”

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Collision Investigation Workshop

- Work in pairs
- Examine the handout
- Analyse the collision grid and define the collision problem at this location

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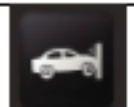
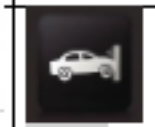
FIVE YEAR COLLISION HISTORY 2011 – 2015: dangerous bend on rural road – speed limit 100kph

	1	2	3	4	5	6	7	8	9	10
	FRI	TUES	MON	SAT	SAT	THURS	SUN	WED	TUES	THURS
	Aug 2011	Feb 2011	April 2012	June 2013	July 2014	Jan 2014	Oct 2015	Nov 2015	March 2015	Nov 2015
	2300	1000	0900	0100	2300	1100	2000	1300	2000	1800
										
										
										
Vehicle 1										
Vehicle 2										
											
	Loss of control	Head on	Pedestrian hit by car	Loss of control	Head on	Loss of control	Loss of control	Head on	Loss of control	Loss of control
Human factor										

Collision Analysis from Grid

1. Trends

	All collisions			
2011	2	1	1	1
2012	1	0	0	0
2013	1	0	1	1
2014	2	2	1	2
2015	4	3	3	4
	10	6	6	8
✓	85% confident of increase in 2015	88% confident of increase in 2015	88% confident of increase in 2015	92% confident of increase in 2015

2. Comparison with controls

				
Bend	60%	60%	60%	75%
Control	28%	33%	25%	25%
✓	95% confident of high site risk	95% confident of high site risk	99% confident of high site risk	99.9% confident of high site risk

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Collision Investigation - summary

- Indication of a recent increase in collisions
- Significant increase in wet road/ night time and loss of control/ head on crashes, also a site based risk compared to control data
- Site observations: poor road surface, getting worse, speeds approaching bend at 100kph, braking late

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Cost Benefit Analysis

Cost Benefit Analysis

- Average cost of an injury collision is derived from estimates based on:
  - Loss of earnings/ production
  - Personal loss
  - Cost to emergency services
  - Cost to health service

- Eg Ireland average cost of collision = 125,000 EUROS

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Collision Savings

- **Collision savings can be estimated by:-**
  - looking at collision reduction achieved by similar schemes elsewhere (control data)

  OR
  - looking at the collision record and estimating how many collisions would have been saved if a safety scheme had been implemented at the start of the period being studied

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Collision Reduction Single Sites UK RoSPA Manual, 2007

Collision Reduction Schemes in Oxfordshire			
Treatment		Reduction	No of sites
URBAN	Pelican crossing	25%	39
	Traffic signals	50%	12
	Mini-roundabout	40%	34
	Road humps	50%	49
	Speed cameras	25%	46
RURAL	Right turn lane	60%	10
	Signing	30%	103
	Anti-skid at junction	30%	11
	Visibility improvement at junction	20%	18
	Visibility improvement on bend	40%	13
	Bend signing	30%	140
	Anti-skid on bend	50%	13
	30 mph village speed limits	25%	180
	Speed cameras	15%	16

TAG – UK Collision Cost Values

Table A 4.1.4: Average value of prevention per road accident by severity & road class £(2010 prices and 2010 values)				
Accident Severity	**Road Class**			
	Built-up	Non Built-up	Motorway	All
Fatal	1,766,781	1,897,359	1,962,139	1,841,455
Serious	201,721	227,468	240,389	210,089
Slight	20,965	25,303	30,426	22,174
All Injury	56,230	114,619	81,781	69,342
Damage only	1,858	2,718	2,611	1,964
Average cost per injury accident	89,118	135,816	101,626	99,300

TAG - Transport Analysis Guidelines
Autumn 2015 release v1.4b

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First Year Rate of Return (FYRR)

FYRR (%) =

$$\frac{\text{annual collisions saved} \times \text{collision cost} \times 100\%}{\text{scheme cost}}$$

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Cost Benefit Analysis Workshop

- In pairs
- Consider options for treatment at the “dangerous” bend
- Estimate the cost of treatment
- Estimate collision savings to be made
- Calculate FYRR

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Low cost treatment mitigation:

Option 1: Chevron signs, Advance bend warning signs, rumble strips on the approach

Option 2: As above, plus high friction road surface around the bend

Major scheme treatment mitigation:

Option 3: Re-align the bend

Economic Assessment:

	Option 1	Option 2	Option 3
€ scheme cost	10,000	20,000	500,000
crash savings	50% dry loss of control/ head-on plus 30% wet loss of control / head-on	50% dry loss of control/ head-on plus 50% wet loss of control / head-on	75% loss of control plus 33% head-on
savings/year	0.56	0.8	1.03
€ crash cost	0.56 x 125,000 = 70,000	0.8 x 125,000 = 100,000	1.03 x 125,000 = 128,750
FYRR	70,000/10,000 x 100% = 700%	100,000/20,000 x 100% = 500%	128,750/500,000 x 100% = 26%

FYRR = First Year Rate of return = (crash savings/ year) / (scheme cost) x 100%

Cost of injury crash = 125,000 EUROS (Republic of Ireland figure)

Scheme Prioritisation

Scheme	AccSavings £	Scheme Cost £	FYRR %	Cumulative Cost £
1	50,000	8,000	**625**	**8,000**
2	20,000	4,000	**500**	**12,000**
3	64,000	20,000	**320**	**32,000**
4	24,000	16,000	**150**	**48,000**
5	30,000	24,000	**125**	**72,000**
6	42,000	34,000	**124**	**106,000**
7	44,000	40,000	**110**	**146,000**
8	20,000	20,000	**100**	**166,000**
9	24,000	30,000	**80**	**196,000**
10	16,000	26,000	**62**	**222,000**

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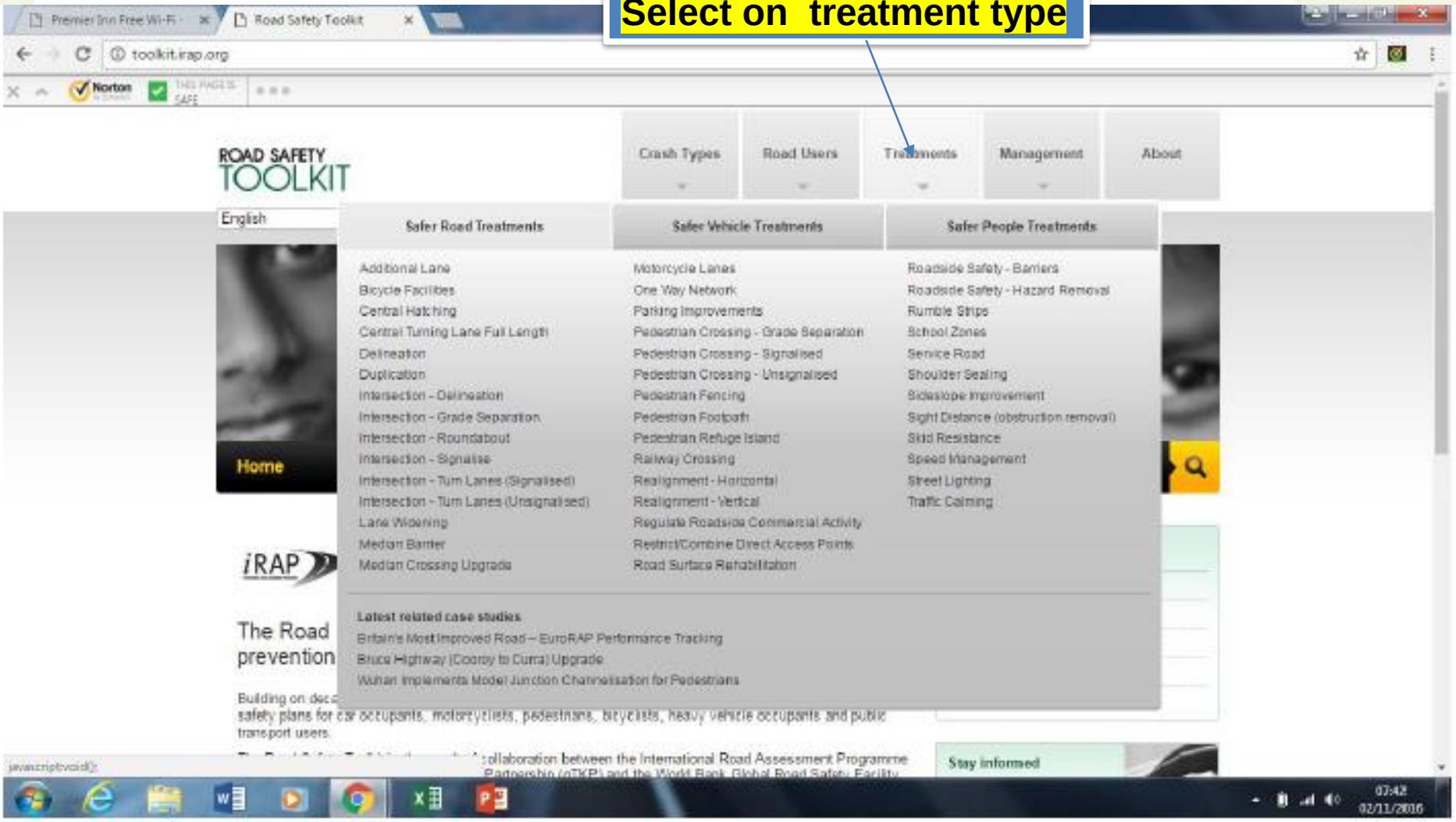
Case Studies

toolkit.irap.org



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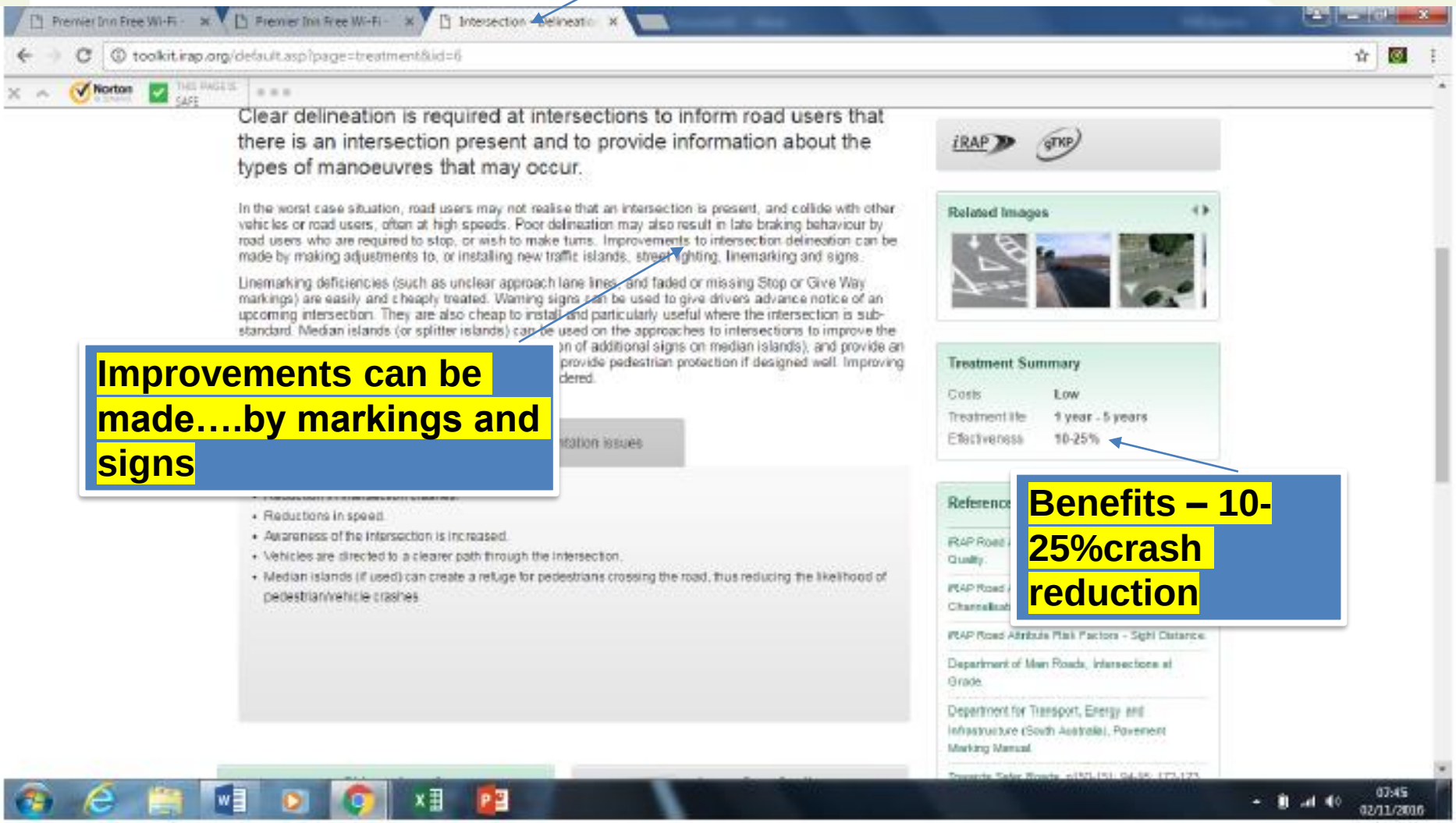
Treatment type - delineation



Improvements can be made….by markings and signs

Benefits – 10-25%crash reduction

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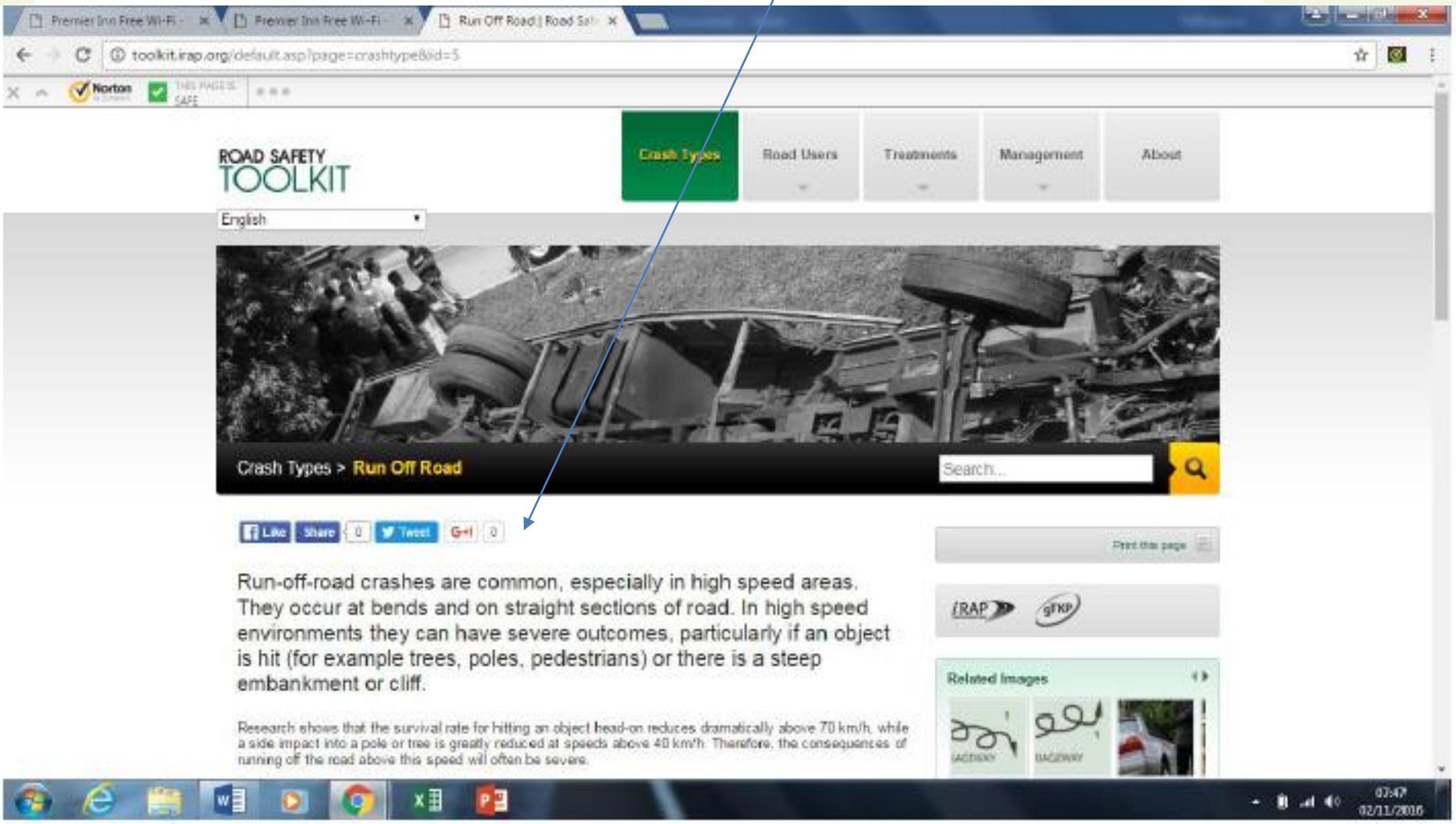
Crash type – loss of control



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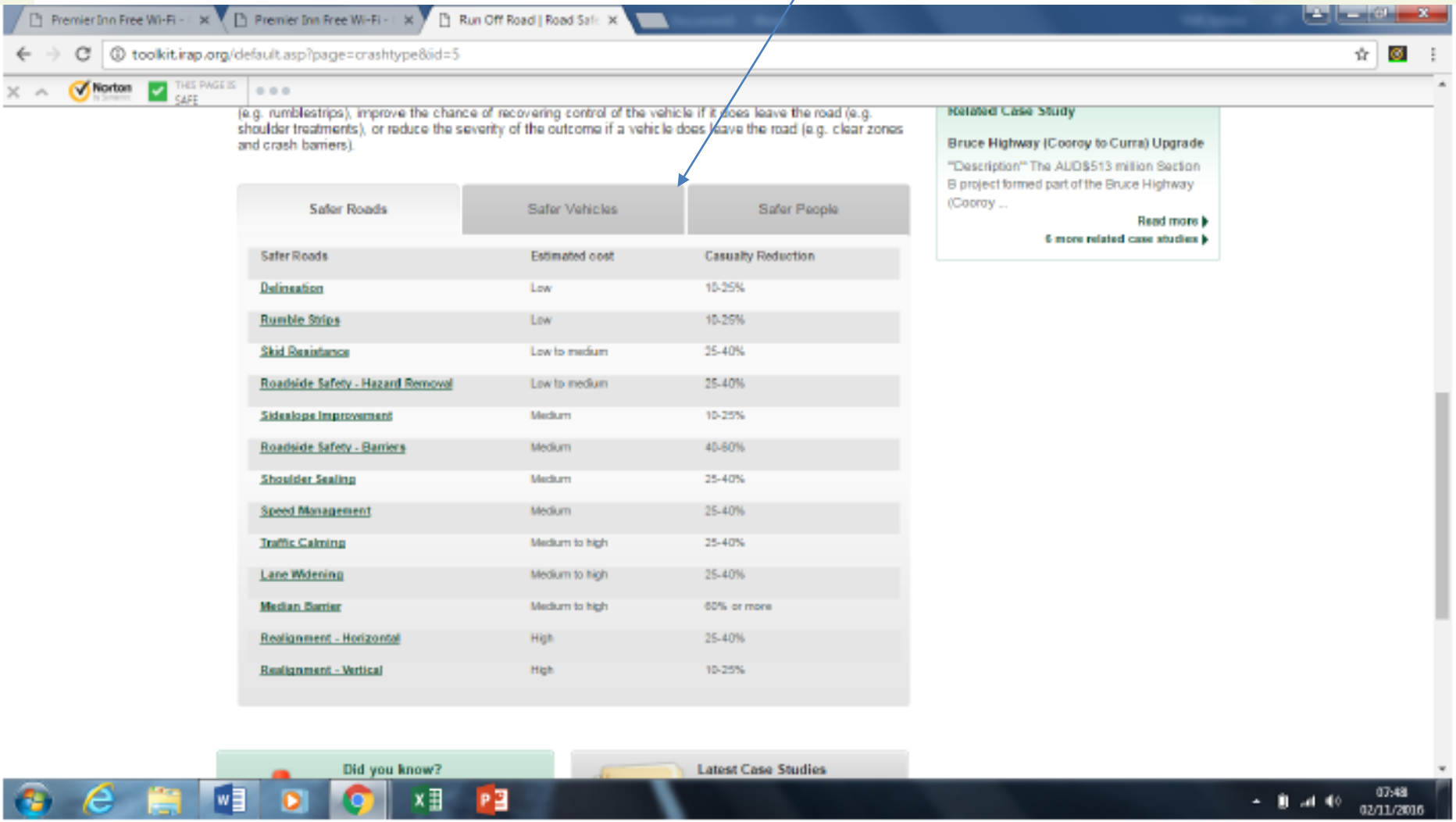
Treatment types – for loss of control



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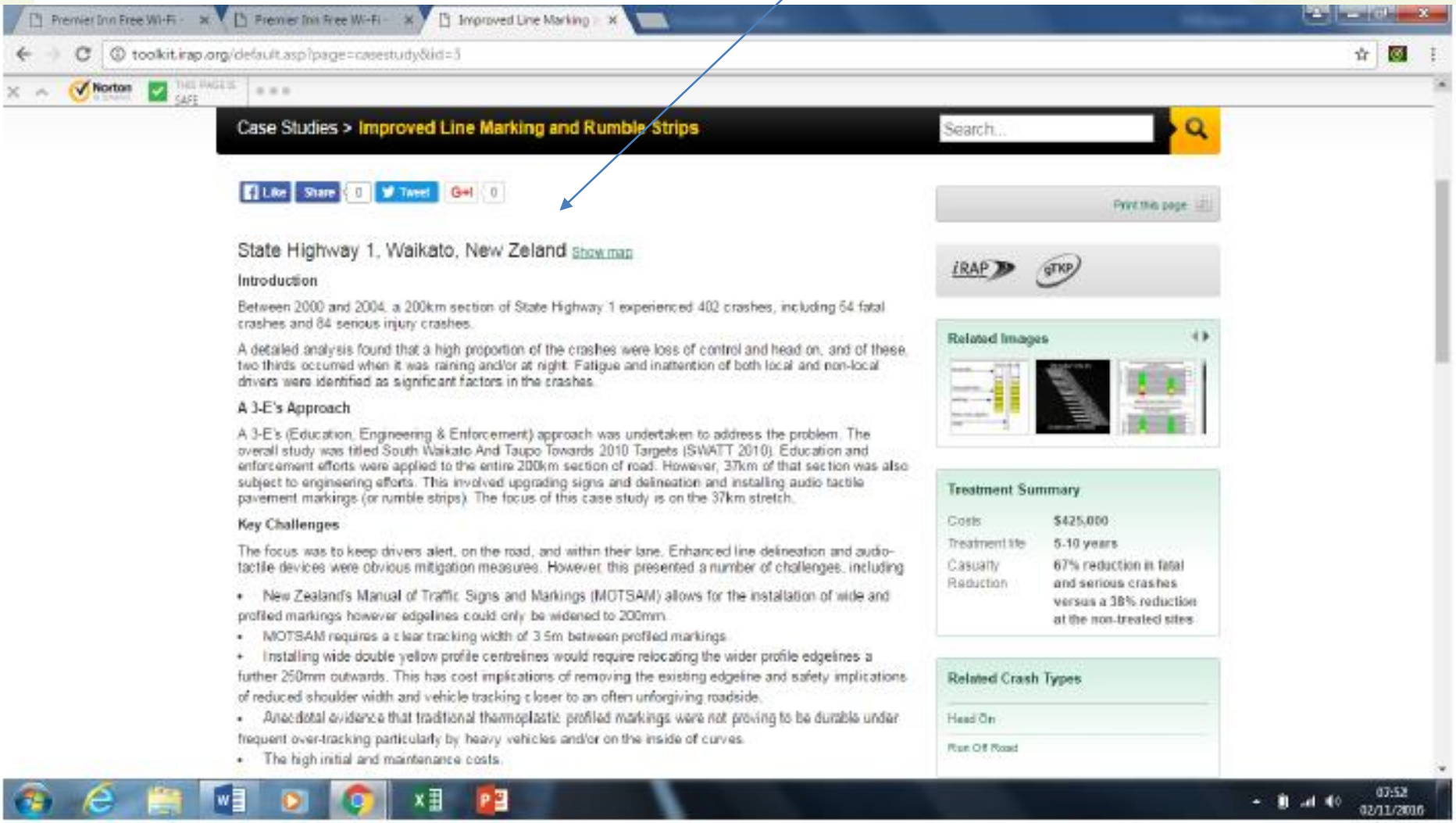
Case studies of effective treatments



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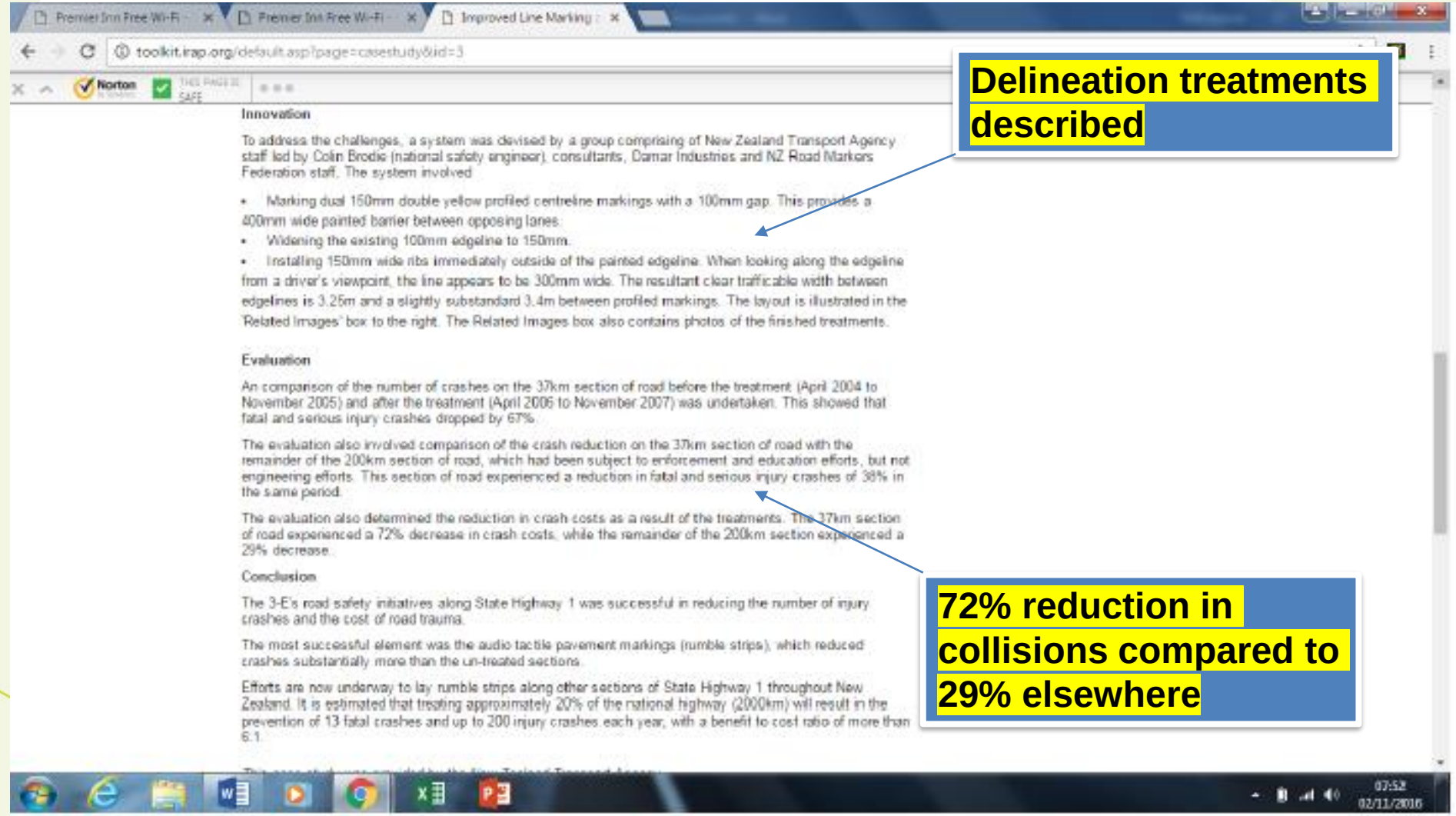

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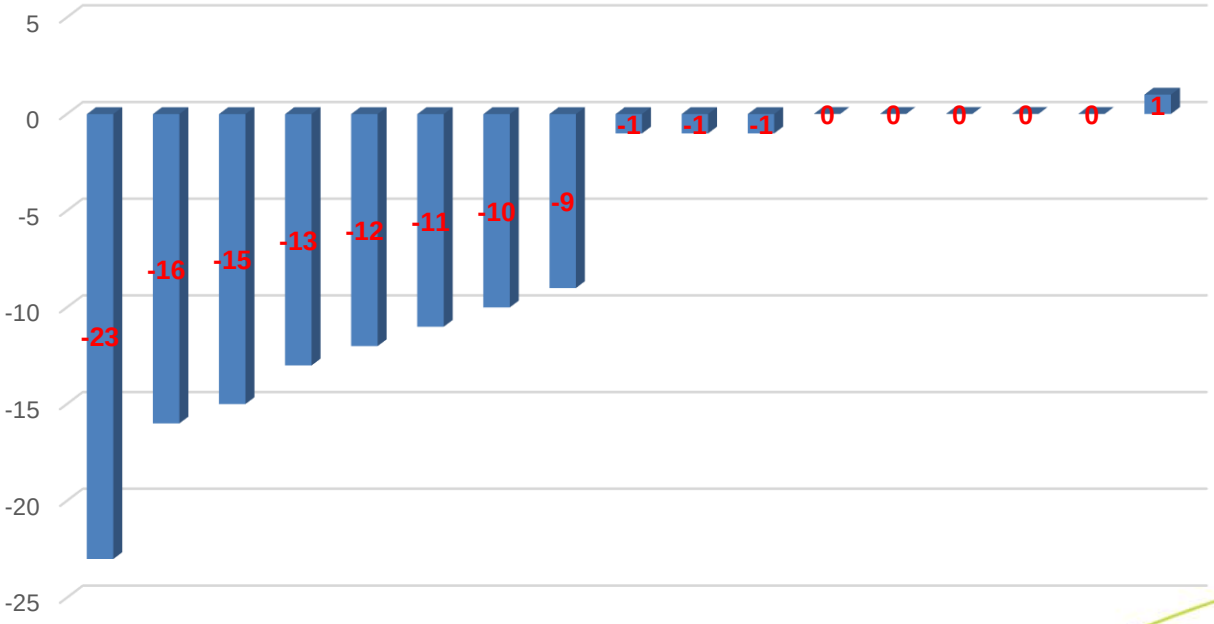
Ireland Control Data

Table H: Percentage Collision Reduction by Solution Type 1998-2004 with 5yr before and after data.

Urban/Rural Area	Short Solution Description	Number of schemes	TotalCost (yr 2002)	% Reduction on Collisions			
				All	Fatal	Serious	Minor
Urban	Antiskid plus other	15	€534,493	26%	100%	12%	26%
Urban	Pedestrian Facilities	29	€594,090	-17%	44%	18%	-34%
Urban	RTL	12	€480,818	-16%	86%	74%	-84%
Urban	Signing & Lining	47	€905,067	11%	51%	24%	6%
Rural	Crash Barrier plus other	11	€378,200	50%	69%	10%	61%
Rural	Lighting plus other	14	€688,841	67%	100%	69%	56%
Rural	Right Turn Lane plus other	57	€2,537,147	44%	37%	72%	32%
Rural	Sight Distance	30	€852,463	24%	63%	35%	13%
Rural	Sign & line	182	€3,005,985	15%	48%	22%	6%
Rural	Surfacing & Sign & line	24	€1,068,215	34%	39%	25%	36%
Total		**421**	**€11,045,319**	**20%**	**52%**	**32%**	**10%**

TMS research mid-1990s

Percentage reduction in 85%ile speed at locations treated with FDG signs



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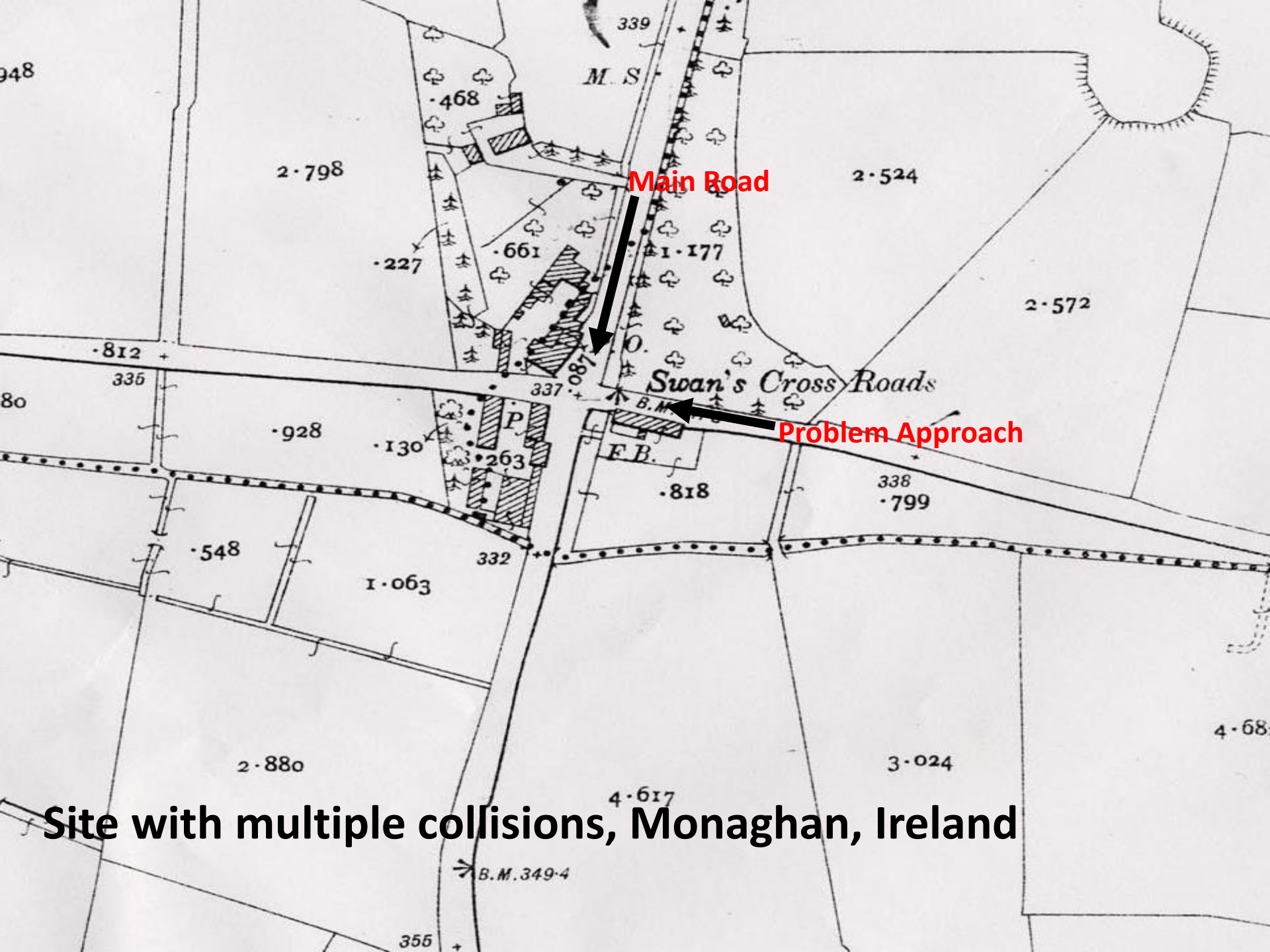

Site with multiple collisions, Monaghan, Ireland


100m


STOP
STOP
40m


STOP
STOP
20m

Low cost treatment

Low cost treatment

Major Scheme


83 Lios Darach
NEWBLISS
Muinchille
COOTEHILL
uneachan
ONAGHAN R188
100m
100m

Signing as part of a package of measures

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Road Safety Audit (UK & Ireland HD 19) and Road Safety Inspection (Ireland HD 17)

Road Safety Audit Definitions and Ethos

- “independent detailed systematic and technical safety check relating to design characteristics of a road infrastructure project covering all stages from planning to early operation”
- “who can be hurt here and why?”
- “Prevention is better than cure”

- to minimise collision numbers and severity
- to consider the safety of all road users - especially vulnerable road users

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Who should carry out Audits?

- independent of the design team
- at least two people with Road Safety Engineering “expertise”
- Certificate of Competency on TERN road schemes
- Competent team appointed by the employer

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Format of Safety Audit report

- list audit team members and others involved
- list safety issues - problem followed by recommendation stating the safety problem as clearly as possible
- list all plans and other information
- sign and date the report
- report requires a **response**

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Road Safety Audit and “enforcing” Regulations

- The Road Safety Auditor is NOT there to ensure conformity of signs and markings to regulatory requirements

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Road Safety Audit and "enforcing" Regulations

- **However**, if road user safety is compromised in relation to
  - Size of sign and speed of road
  - Reflectivity of sign
  - Width of markings
  - Consistency of signage
  - Road user understanding of signs and markings
- **Then the Audit should comment….**

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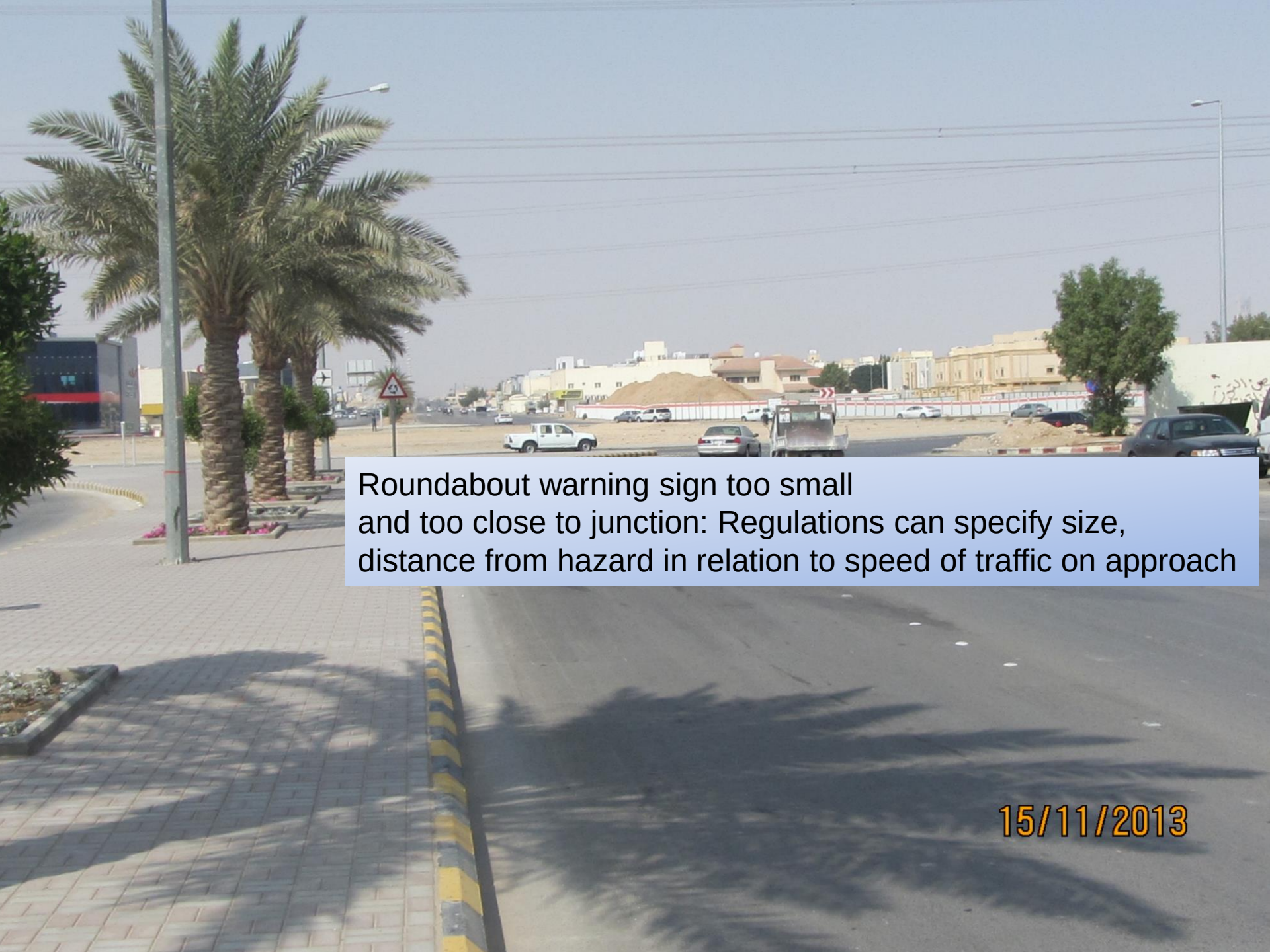
Inappropriate and misleading Direction Sign for roundabout junction – Regulations can specify Format of sign required


Roundabout warning sign too small
and too close to junction: Regulations can specify size,
distance from hazard in relation to speed of traffic on approach
15/11/2013


Roundabout chevron too small, not reflective.
Again, Regulations can specify appropriate requirements
15/11/2013


camping
4000 m
BUINI LEGNAMI
"ORA" FIAT
PIZZA al TAGLIO
da CICCIO
TRATTORIA
da Elide
LOS ANGELES
trattoria
"SANTUCCI"
PowerTech
Agriturismo IL GIRASOLE
DIREZ. ASSISI di ILVEA CIANETTI
RISTORANTE - PIZZERIA
LA TAVOLA ROTONDA
RISTORANTE • PIZZERIA
Hotel Bellavista
VISCONTI
ELETTRONICA
CENTRO TIM
Castello di Petrata
Country House
Le Colombe
iron
UMBRIA MARKET
PRODOTTI TIPICI • ERBORISTERIA
ARREDAMENTI
SPAZIOTRE
HENRY
LGM
UmbriaGas
DUE T SPORT
IL MANIERO
GOMMISTA
LASA
ABACUS HOTEL
PERLA
ARREDAMENTI
UmbriaGas
OFFICINA RIPARAZIONI AUTO
EZIO GAMBACORTA
INDUMENTI
SICUREZZA
SUL LAVORO
ARREDO INN.
TRATTORIA
DAL CACCIATORE
RISTORANTE - PIZZERIA
La Basilica
HOTEL
LE MUSE
La Mora
AGRITURISMO
McDonald's
ALBERGO DONNINI
TRATTORIA DEGLI ANGELI
IL RISTORO
RESIDENCE SERENA
HOTEL
CRISTALLO
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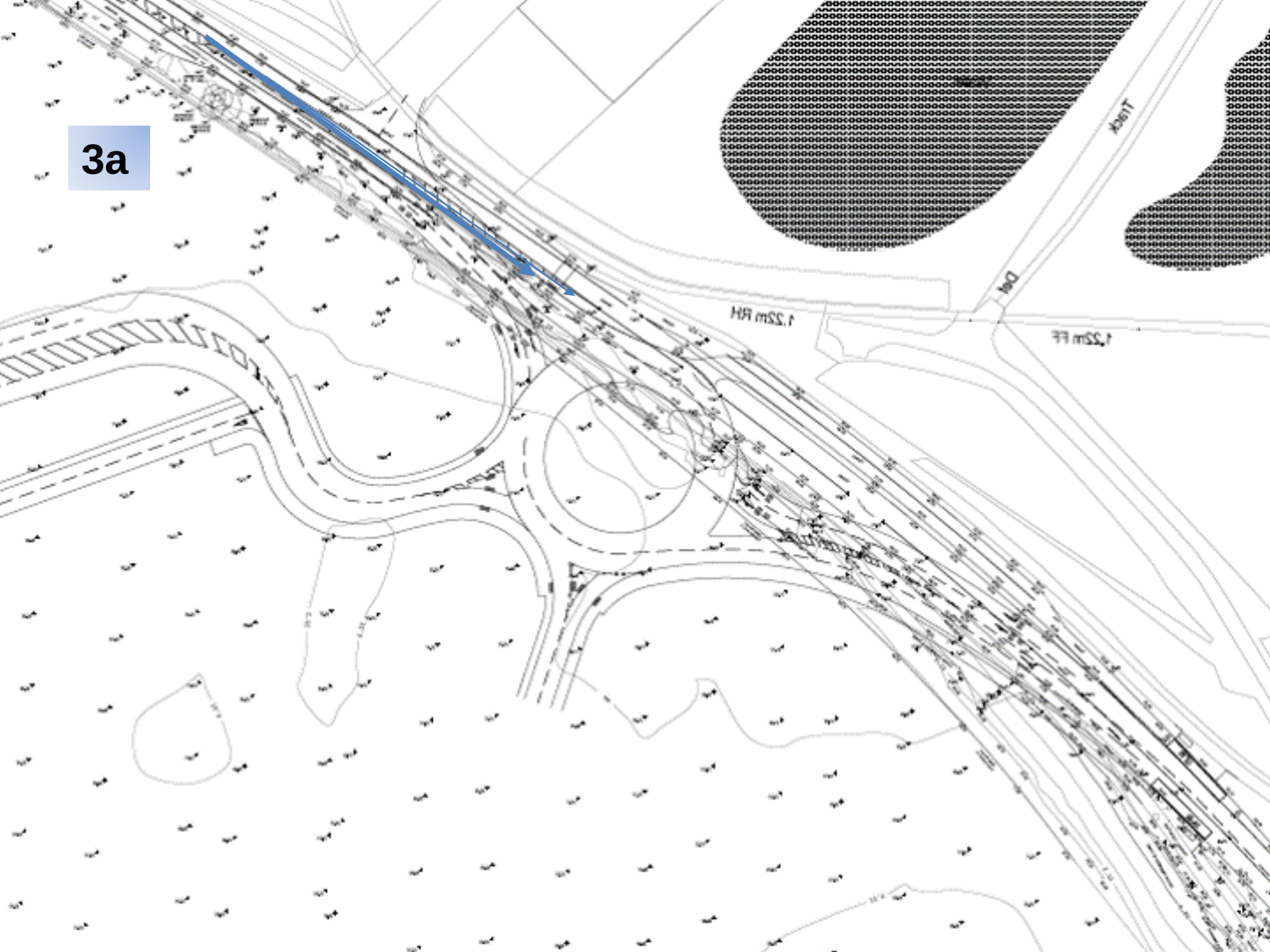
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3b


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5
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Neighbourhood
Centre
Humps


JINDŘIŠSKÁ


POZOR
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22/11/2012


Gabh sa Lána
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Gabh sa Lána
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REDUCE SPEED


eToll
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MAX HEIGHT 5.0m / 16'4"
16'4"
eToll
VEHICLES WITH TAGS ONLY
ALL VEHICLES


M6
E
15.5
3
Ath Cliath
DUBLIN
M6
R400
Droichead
Chaisleán Laoise
ROCHFORTBRIDGE
Beatach Bhaile
an Mhuilinn
MILLTOWNPASS
Rod
RHODE
500m


TRAVEL TIME MINS
M4 J7 MAYNOOTH 24
N4 J1 (M50) 34


M6
Níl aon seirbhisi ar
line ar fáil romhat
Seirbhisi as line romhat
30km - 45km - 60km - 90km
M6
W
7.5


P


M6
W
17


120
120


e an Chláir
ESBOROUGH
1km


١٢٠
22/11/2012


22/11/2012


مخرج
الخرج ٦٥
الدمام ٤٠
وسط المدينة
TOYOTA
22/11/2012


24/11/2012

Table 5.1: Summary of public understanding of prohibitory traffic signs

Traffic Sign					
	No motor vehicles	No vehicles	No pedestrians	Height restrictions	Weight restrictions
% of respondents demonstrating correct comprehension	88%	84%	83%	94%	96%

Signs installed according to appropriate Regulations are understood by the majority of road users: UK DfT

Road Safety Inspections

- Ordinary periodical verification of the characteristics and defects of an operational road that require maintenance work for reasons of safety
- “Safety Audit of an existing road”
- Can be undertaken using IRAP “star rating” procedures
- Requires similar independent, qualified, audit team

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Road Safety Audit workshop

- Examine the photos in small groups
  - What is it here that could hurt someone?
  - Who can be hurt?
  - What sort of collision could occur?
  - What could you do to prevent it?

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Summary – Road Safety Management in Europe

European Directive - EC Directive 2008/96/EC

Application to Trans European Road Network (TERN)

“Existing” roads

- Network Management (Collision Investigation/ Cost Benefit Analysis)
- Road Safety Inspections

New roads and road improvements

- Road Safety Impact Assessment
- Road Safety Audit

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The words of the UK Coroner following the first fatal crash

“This must never happen again”

1.25 million lives per year….