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Designing Safe System Roads

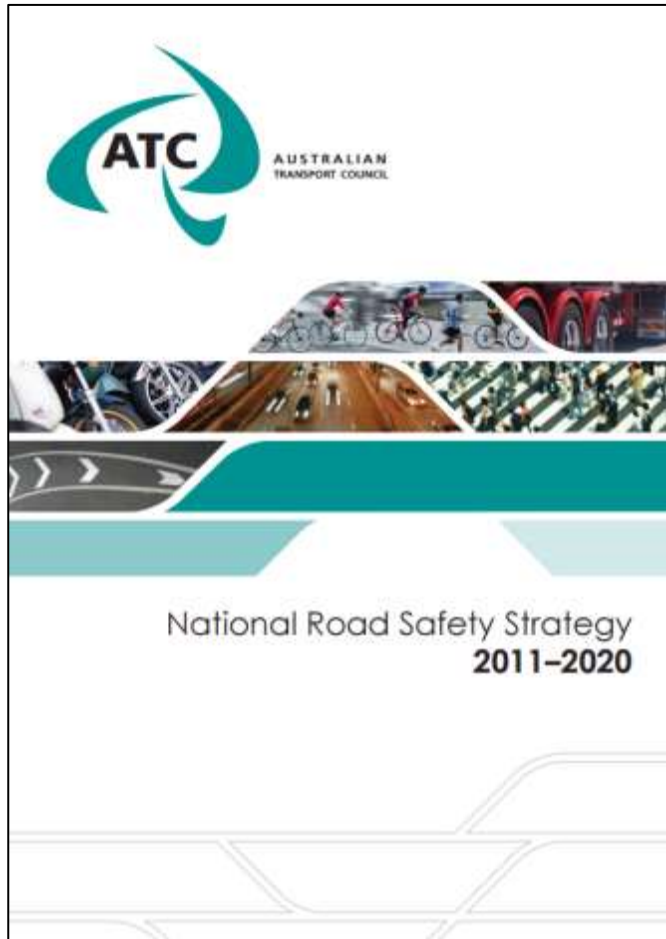
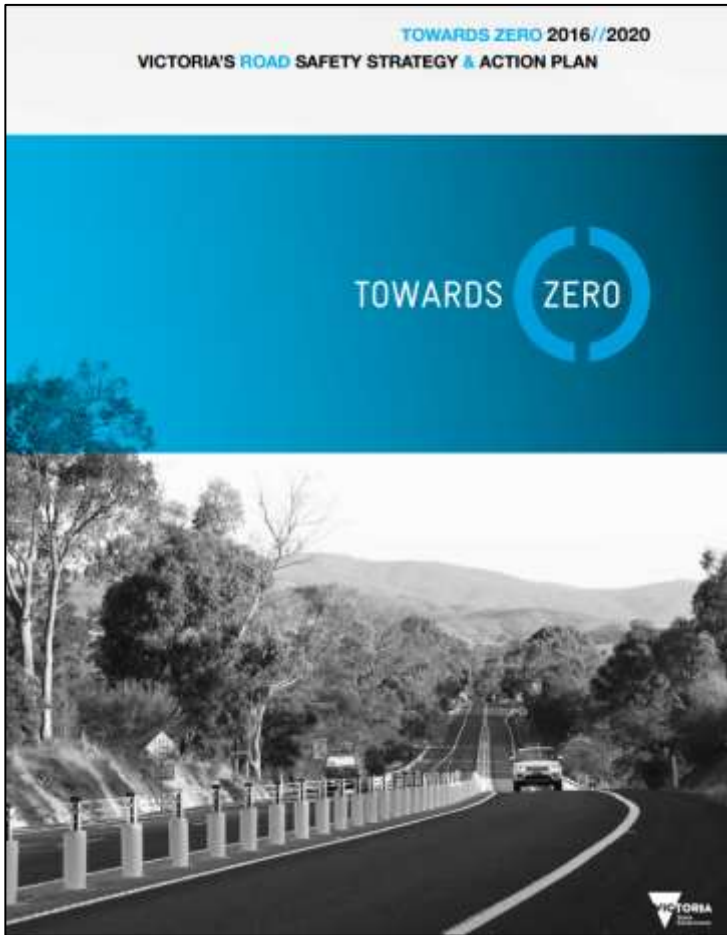
Towards Zero Road Trauma



ROAD SAFETY

ENGINEERING | RISK MANAGEMENT | FACILITATION AND TRAINING







What is the Safe System?

Key Principles

No death or serious injury

People make mistakes

Shared responsibility

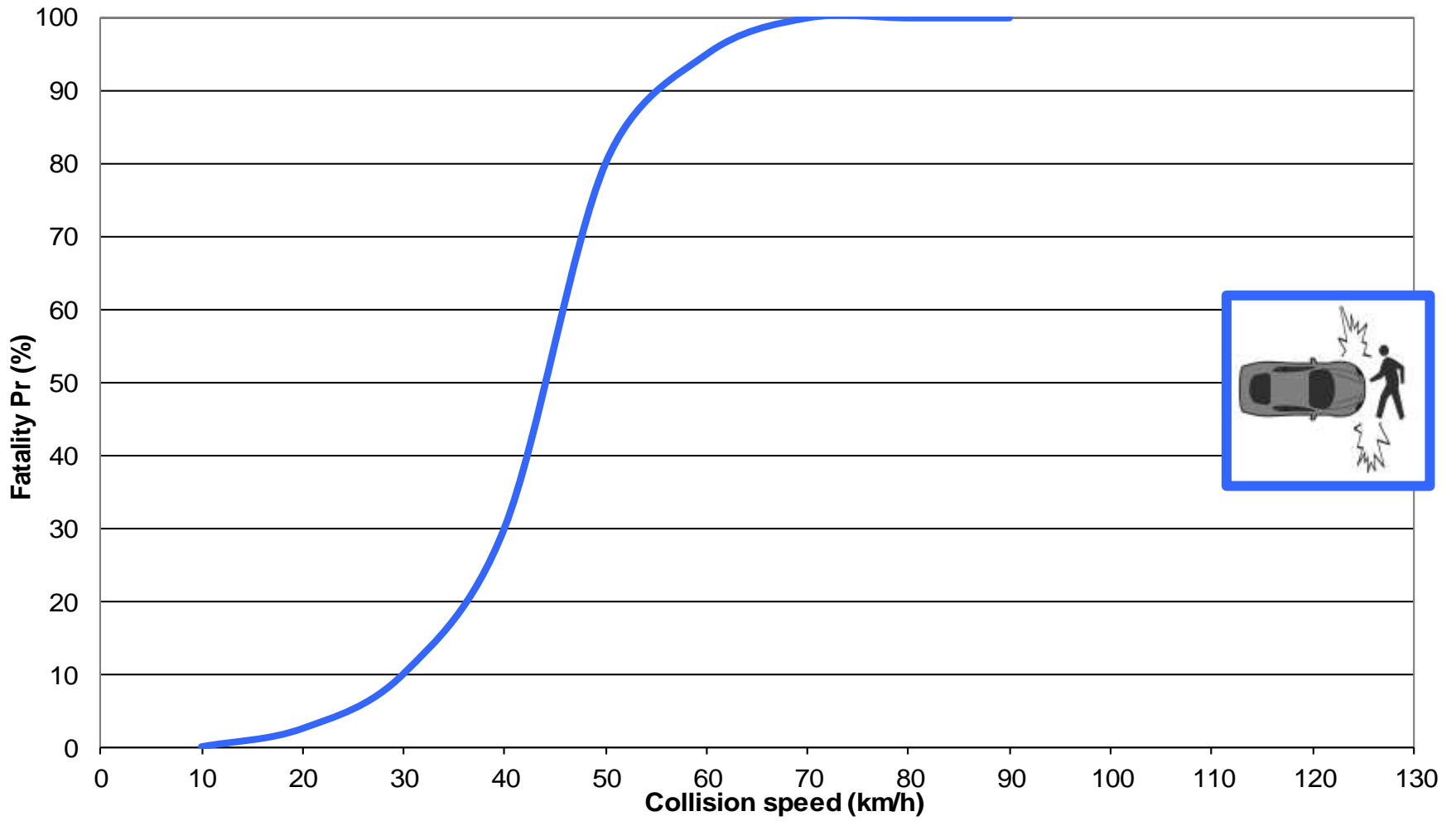
People are vulnerable

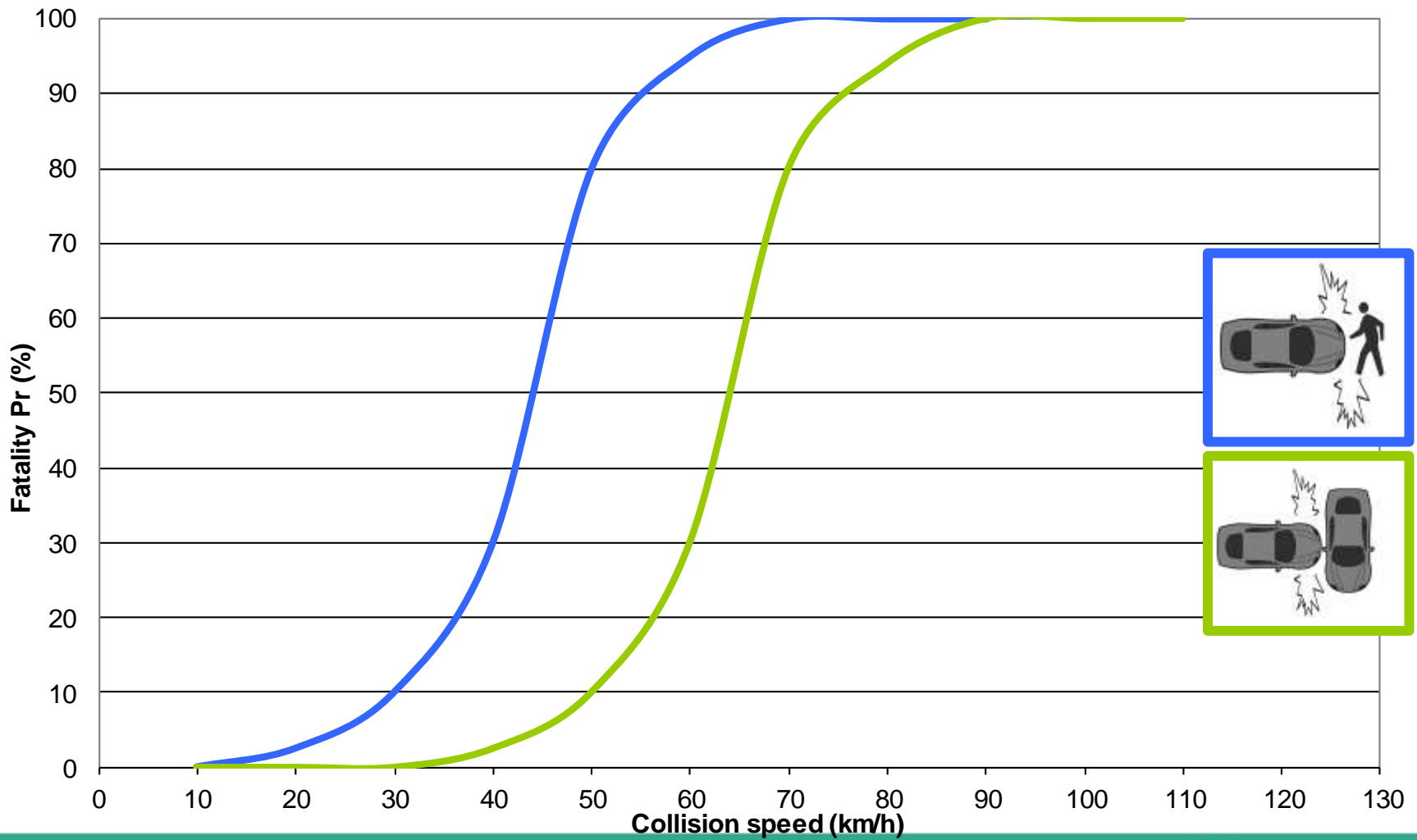
Energy management in the system

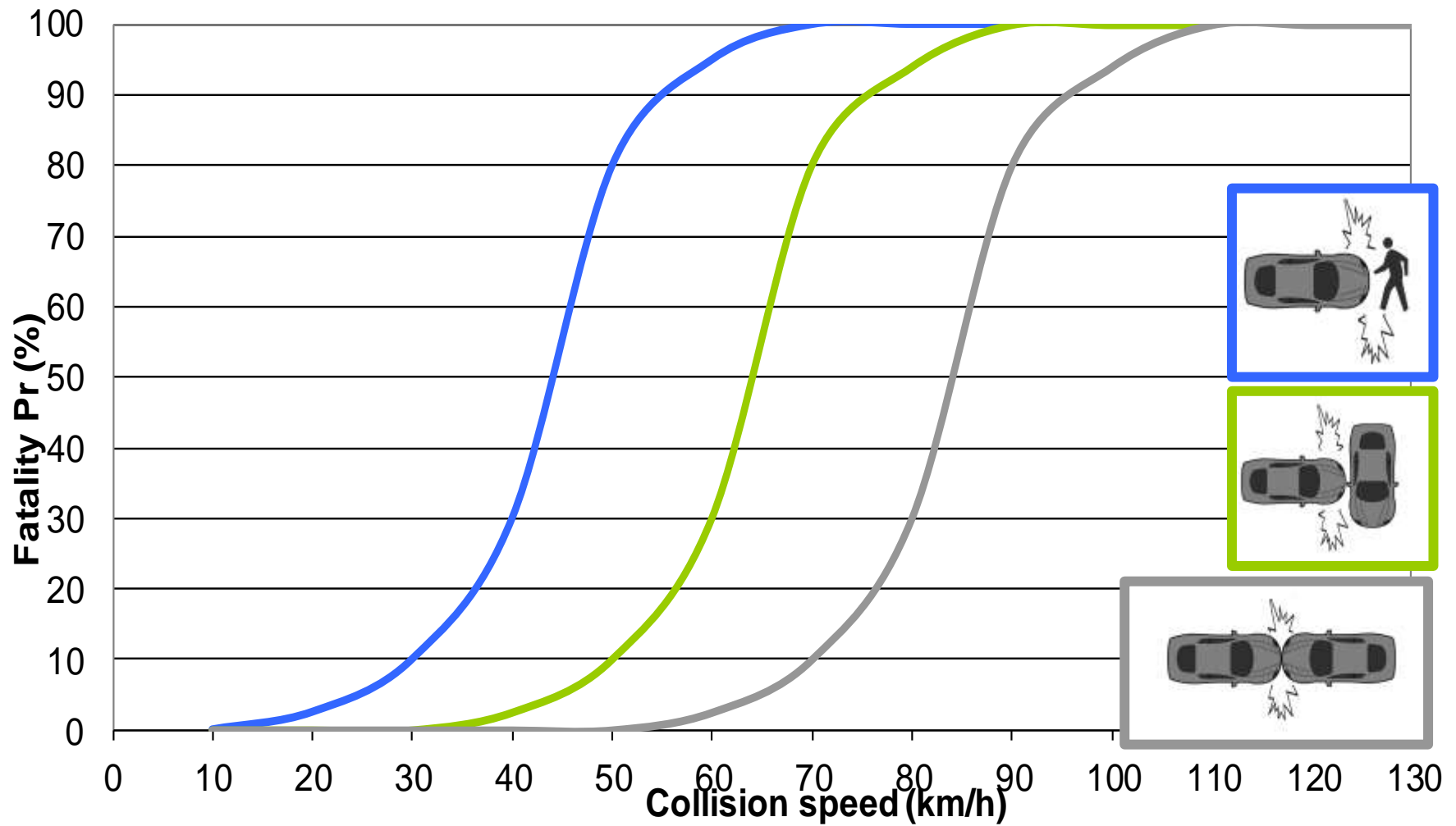


The Safe System











The Safe System

We know the theory

Do we know how to apply it?

What does the Safe System look like in practice?



Some Statistics:

Recent Outer Suburban Arterial Road Upgrades (2011/12 Duplications):

Duplication	Length	Serious Injuries after upgrade (5 years)	Est. trauma cost to the community since upgrade
Hallam Road Duplication - Pound Road to Ormond Road, Hampton Park	2.9 km	9 Serious Injuries	\$7.5M
Plenty Road Duplication - Gordons Road to Hawkestone Parade, South Morang	2.4 km	15 Serious Injuries	\$12.6M
Kings Road Duplication - Melton Highway to Palmerston Crescent, Taylors Lakes	0.9 km	4 Serious Injuries	\$3.4M



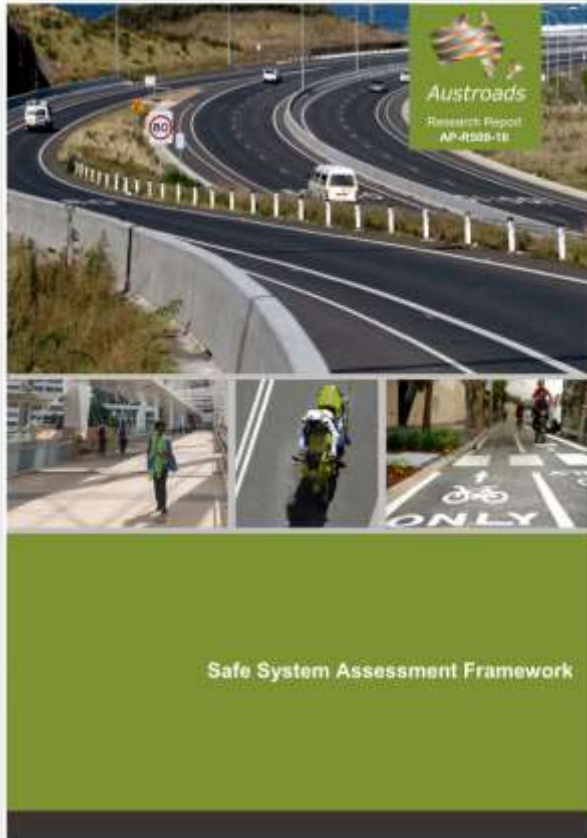


Are you always in confusion?

Hang on help is on its way

Safe System Assessments Framework

Published 2016



Scores infrastructure on alignment with Safe System principles

Existing conditions are scored, designs are scored, improved designs are scored

Scores are based on key crash types

Full Safe System = a score of zero

Key is to move towards zero

Requires answers to key questions associated with road users, vehicles, post-crash care and maintenance.



The Framework

Assess objectives

- Purpose
- Scale
- Depth

Project context

- Project objectives
- Road function
- Speed environment
- Road users
- Vehicles

Safe System Matrix

- Exposure, likelihood, severity
- Other Safe System pillars

Treatment hierarchy

- Primary / transformational
- Supporting
- Other considerations



Objectives Identification

Typical assessment objectives may be:

- To identify if a project / design will produce a Safe System outcome
- To identify the extent to which a project / design aligns with the Safe System objectives
- To compare how project / design options align with Safe System objectives
- To identify and document issues that cause mis-alignment with Safe System objectives
- To consider and recommend changes to a project / design that would move it closer towards achieving Safe System objectives



Setting the Context

Prompts	Comments
What is the reason for the project ? Is there a specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, maintenance/asset renewal, etc.	
What is the function of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)? What alternative routes exist?	
What is the speed environment? What is the current speed limit? Has it changed recently? Is it similar to other roads of this type? How does it compare to Safe System speeds? What is the acceptability of lowering the speed limit at this location?	
What road users are present? Consider the presence of elderly, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school zone speed limits, etc.).	
What is the vehicle composition? Consider the presence of heavy vehicles (and what type), motorcyclists and other vehicles using the roadway.	



The Assessment Matrix

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	AADT; length of road segment	AADT; length of road segment	AADT for each approach; intersection size	AADT; length of road segment	AADT; pedestrian numbers; crossing width; length of road segment	AADT; cyclist numbers; pedestrians	AADT; motorcycle numbers; length of road segment
Likelihood	Speed; geometry; shoulders; barriers; hazard offset; guidance and delineation	Geometry; separation; guidance and delineation; speed	Type of control; speed; design; visibility; conflict points	Speed; sight distance; number of lanes; surface friction	Design of facilities; separation; number of conflicting directions; speed	Design of facilities; separation; speed	Design of facilities; separation; speed
Severity	Speed; roadside features and design (e.g. flexible barriers)	Speed	Impact angles; speed	Speed	Speed	Speed	Speed



The Scoring System

Road user exposure	Crash likelihood	Crash severity
<p>0 = there is no exposure to a certain crash type. This might mean there is no side flow or intersecting roads, no cyclists, no pedestrians, or motorcyclists).</p>	<p>0 = there is only minimal chance that a given crash type can occur for an individual road user given the infrastructure in place. Only extreme behaviour or substantial vehicle failure could lead to a crash. This may mean, for example, that two traffic streams do not cross at grade, or that pedestrians do not cross the road.</p>	<p>0 = should a crash occur, there is only minimal chance that it will result in a fatality or serious injury to the relevant road user involved. This might mean that kinetic energies transferred during the crash are low enough not to cause a fatal or serious injury (FSI), or that excessive kinetic energies are effectively redirected/dissipated before being transferred to the road user.</p> <p>Users may refer to Safe System-critical impact speeds for different crash types, while considering impact angles, and types of roadside hazards/barriers present.</p>
<p>4 = volumes of vehicles that may be involved in a particular crash type are very high, or the road is very long, and therefore exposure is very high.</p> <p>For run-of-road, head-on, intersection and 'other' crash types, AADT is > 10 000 per day.</p> <p>For cyclist, pedestrian and motorcycle crash types, volumes are > 100 units per day.</p>	<p>4 = the likelihood of individual road user errors leading to a crash is high given the infrastructure in place (e.g. high approach speed to a sharp curve, priority movement control, filtering right turn across several opposing lanes, high speed).</p>	<p>4 = should a crash occur, it is highly likely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are high enough to cause an FSI crash, and it is unlikely that the forces will be dissipated before reaching the road user.</p>



The Scoring System

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist	
Exposure	/4	/4	/4	/4	/4	/4	/4	
Likelihood	/4	/4	/4	/4	/4	/4	/4	
Severity	/4	/4	/4	/4	/4	/4	/4	
Product	/64	/64	/64	/64	/64	/64	/64	/448



Other Safe System Components

Additional Safe System components		
Pillar	Prompts	Comments
Road user	<p>Are road users likely to be alert and compliant? Are there factors that might influence this?</p> <p>What are the expected compliance and enforcement levels (alcohol/drugs, speed, road rules, and driving hours)? What is the likelihood of driver fatigue? Can enforcement of these issues be conducted safely?</p> <p>Are there special road uses (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism), or risk-taking behaviours?</p>	



Other Safe System Components

Additional Safe System components		
Pillar	Prompts	Comments
Vehicle	<p>What level of alignment is there with the ideal of safer vehicles?</p> <p>Are there factors which might attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed/existing road design? Is this route used by recreational motorcyclists?</p> <p>Are there enforcement resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement of these issues be conducted safely?</p> <p>Has vehicle breakdown been catered for?</p>	



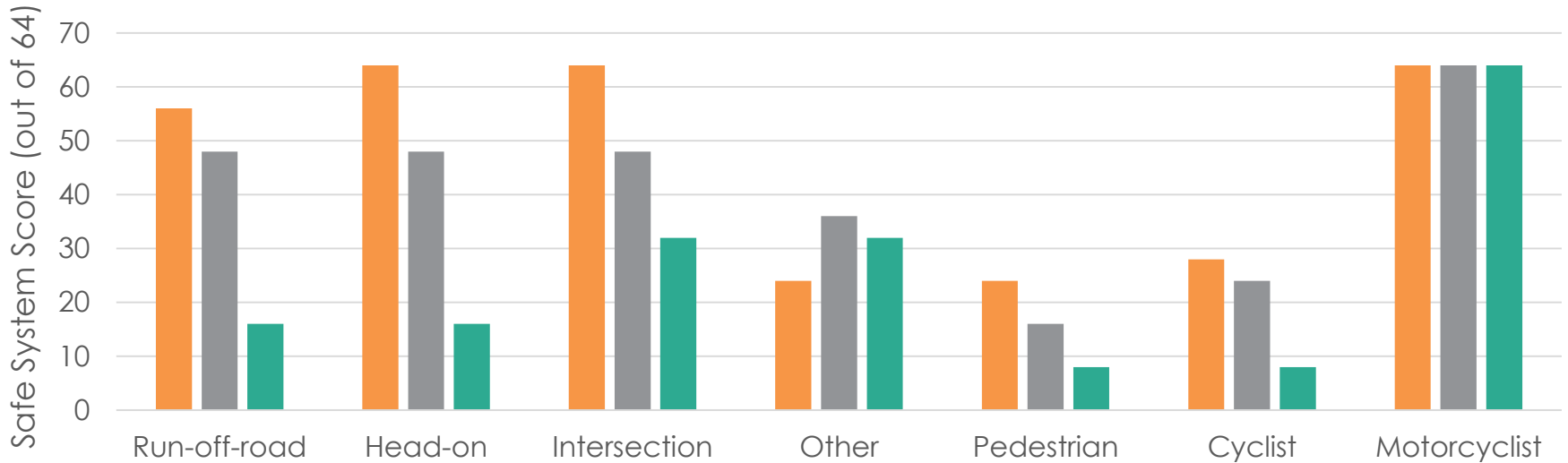
Other Safe System Components




Additional Safe System components		
Pillar	Prompts	Comments
Post-crash care	<p>Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access stopping space)?</p> <p>Do emergency and medical services operate as efficiently and rapidly as possible?</p> <p>Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc.</p> <p>Is there provision for e-safety (i.e. safety systems based on modern information and communication technologies, C-ITS)?</p>	



Results Presentation

Year Year Road



		Safe System Assessment Score	Improvement	Estimated Cost
	Existing conditions	324 / 448		-
	Original design	284 / 448	12%	\$130M
	After Safe System Assessment	176 / 448	45% (38% improvement from original design)	\$130M



Scope	Road Safety Audit	Safe System Assessment
Identifies issues that impact the likelihood of crashes	✓	✓
Identifies issues that impact the severity of crashes	sometimes	✓
Identifies issues that impact the exposure to crashes	x	✓
Provides recommendations for improved road safety outcomes	✓	✓
Considers all road users	✓	✓
Focuses on fatal and serious injuries only	x	✓
Focuses on all crashes (fatal, serious injury and other injury)	✓	x
Investigates safer vehicles	x	✓
Investigates safer people	sometimes	✓
Investigates the impact on maintenance	sometimes	✓
Investigates the impact on post-crash care	x	✓
Makes recommendations to redesign the project if required	x	✓



Safe System Principles

22 August 2017 at VicRoads, Burwood

17 October 2017 at VicRoads, Sunshine

Safe System Applications

23 August 2017 at VicRoads, Burwood

18 October 2017 at VicRoads, Sunshine

Enquiries

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