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CRICOS PROVIDER 00123M

Centre for Automotive Safety Research  
Associate Professor Jeremy Woolley

# How can we have a better road safety response?

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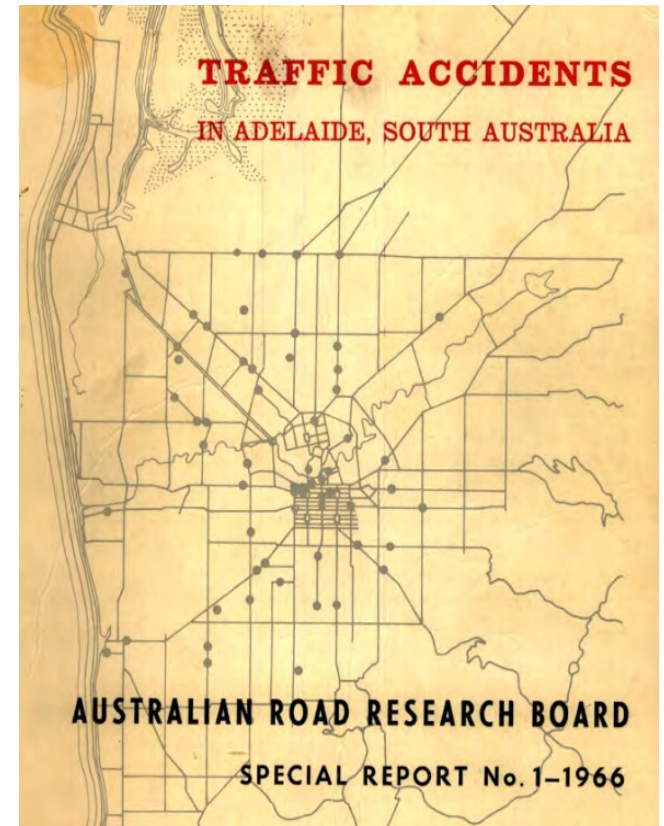
*seek* LIGHT

# CASR Crash investigation since the 1960s



# Crashes through the decades

- 1960s
  - 1970s
  - 1980s
  - 1990s
  - 2000s
- 
- Intersection crashes
  - Road departure crashes
  - Head on collisions
- 
- *What is the constant?*
  - *What will we build tomorrow?*



# Forrest Hwy, WA

- 2009 \$760m
- 50-60m wide Xsect
- At grade intersections
- Clear zone principles
  
- 51 F+SI
- 21 RoR

*A missed opportunity*



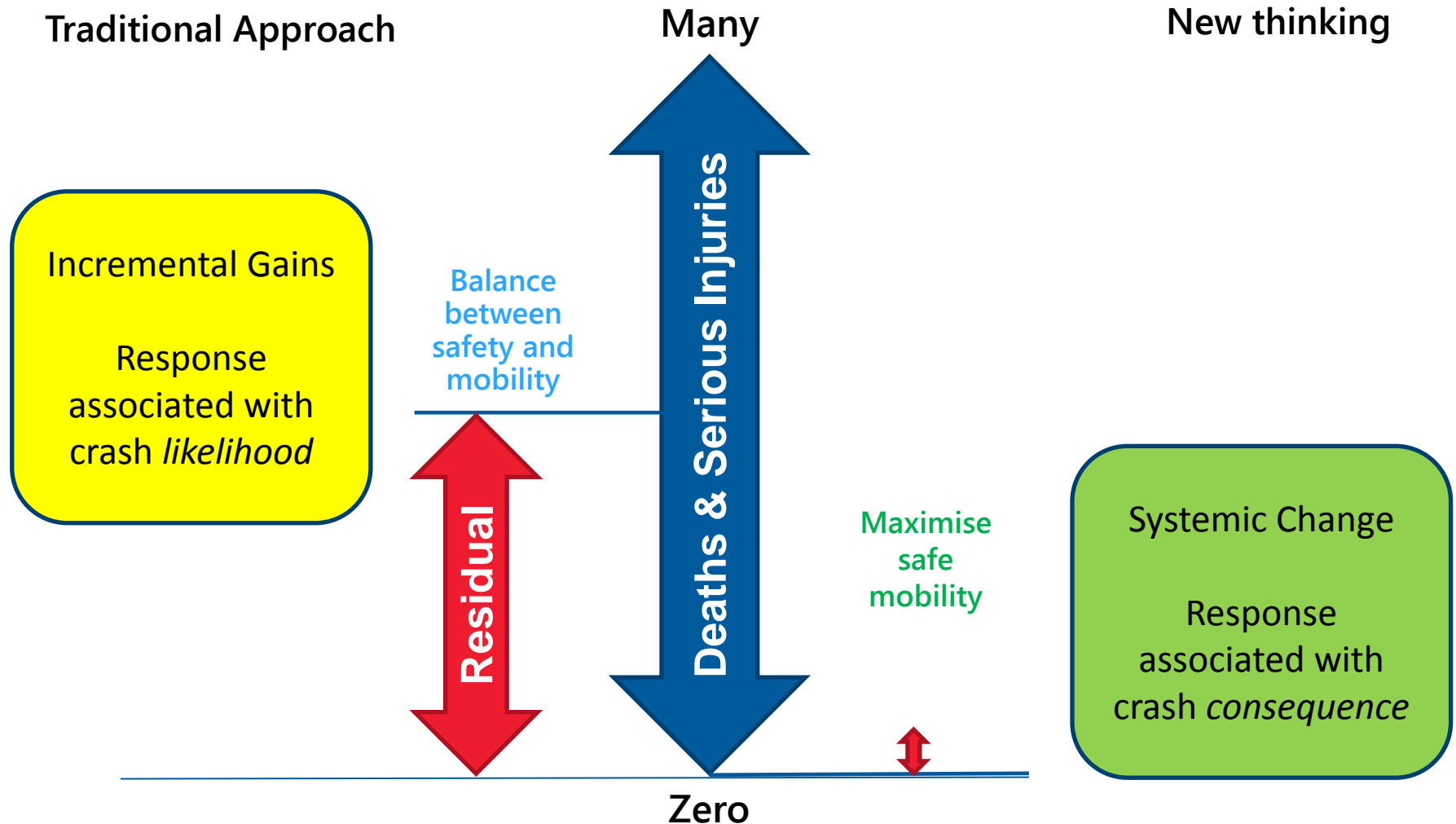
# Road Users are set up for failure



# The philosophical shift

Traditional Approach

New thinking



# What is the Safe System?

- Interacting Pillars

- People
- Roads
- Vehicles
- Speed
- (Post Crash Response)



- Core Principles

- People will make errors
- System forgiving of errors and their consequences
- Shared responsibility

# 1980s Pacific Hwy bus crashes - Grafton





# 1980s Pacific Hwy bus crashes - Kempsey



# Yet another rural road fatality today ...



# The breakdown – Harm elimination

- The physics of the system
  - Energy management
  - Forces on the human body
  - The physics we allow to occur in the system
- Expectations of road users
  - Understanding more about errors
  - The reliance placed on human decision making in safety critical situations
  - Our system can be viewed as “*setting people up for failure*”

# Vehicle occupant protection

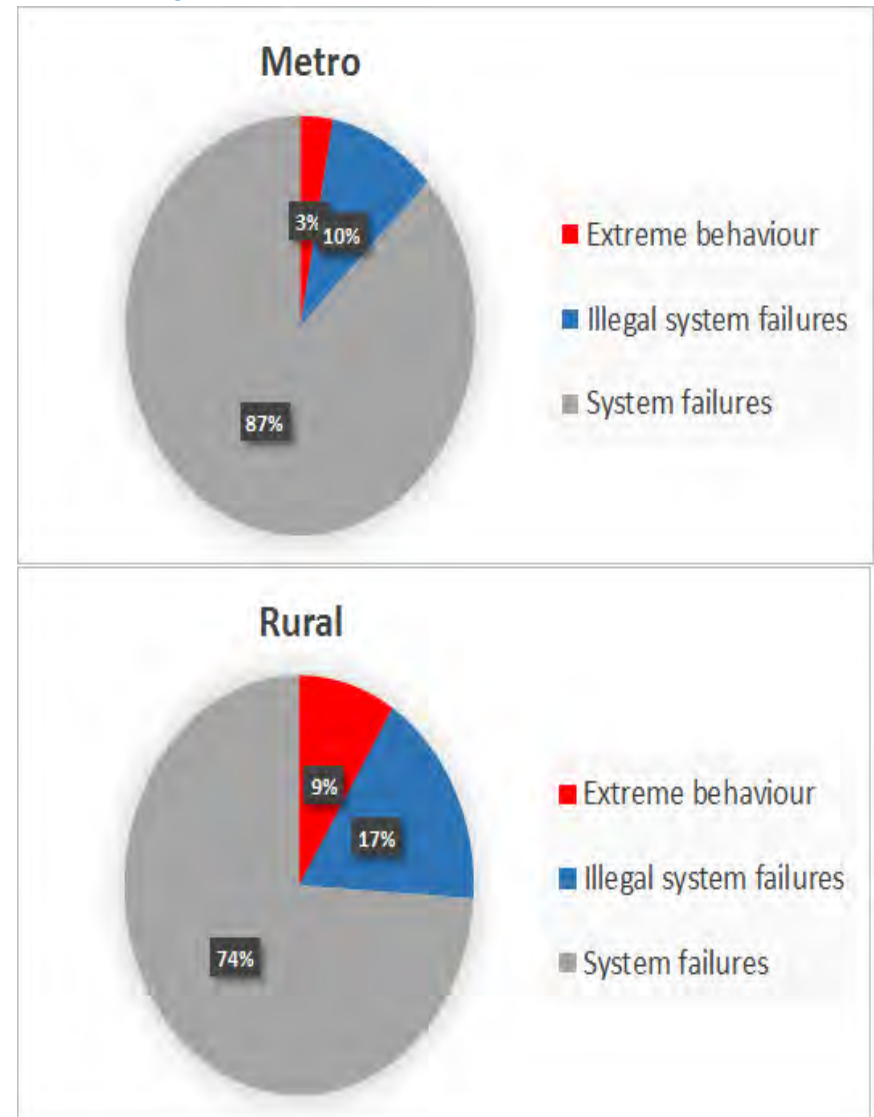


# The reality



# Extreme behaviour or System Failure?

- Wundersitz et al. (2011)
  - <10% of non-fatal injury crashes involved extreme behaviour
  - 46% of fatal crashes involved extreme behaviours
- Stigson (2009)
  - Interaction of the system pillars
  - Most potential to prevent harm still lies with road infrastructure
  - Divided roads a key explanatory variable of safety
  - Different perspective if look at crash causation rather than what is causing the injury

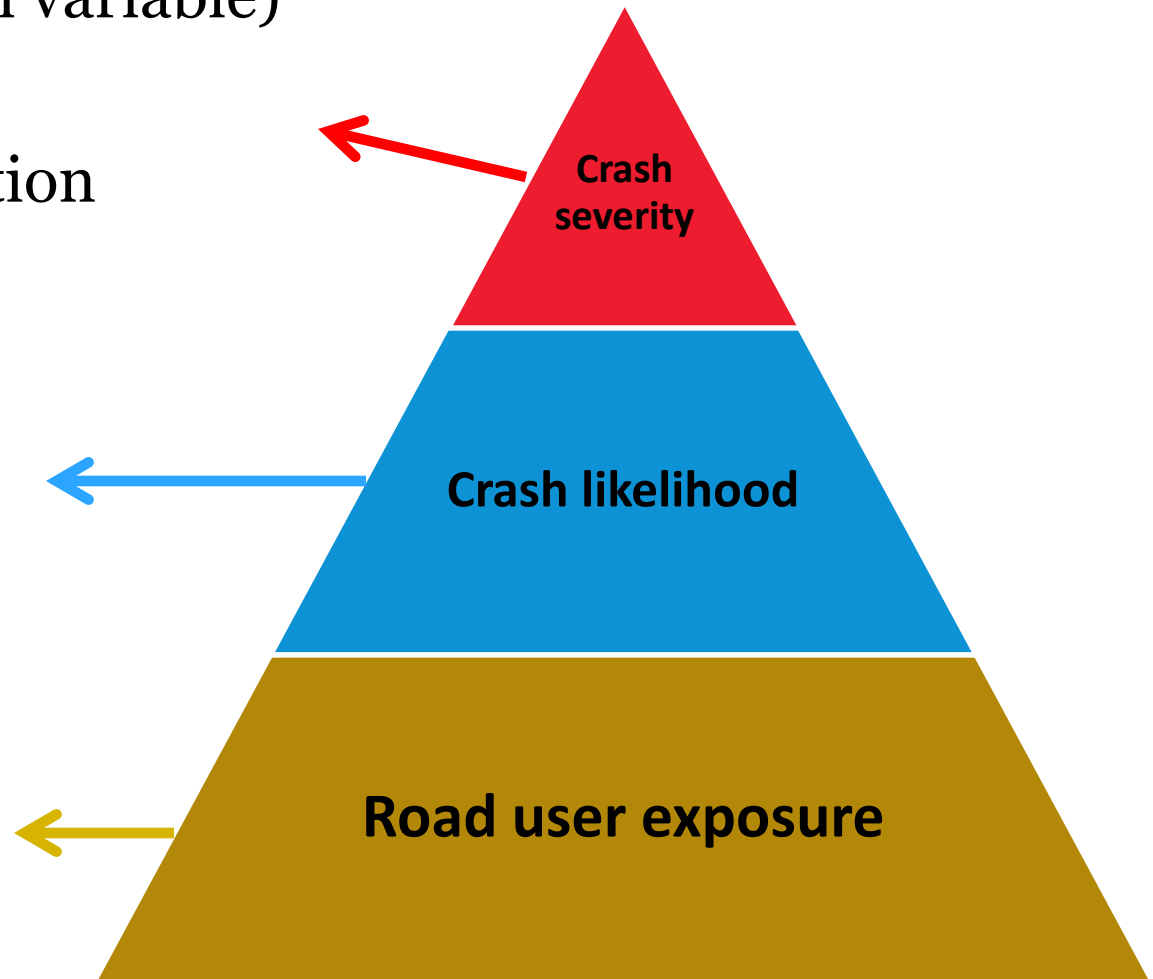


# Many opportunities, so what are the traps?

- Safety is assumed
  - We do not manage for the best outcomes
- We have unrealistic expectations of road users
  - Still many things we do not really know about regarding complexity of the driving task
  - Even non-compliant and risky behaviour is “normal” in society – design still has a role to play
- Guidelines + Standards  $\neq$  the best safety outcomes
  - Also if cannot meet them do nothing at all
- We do not focus on the consequence of crashes

# Key Safe System Considerations

- Speed (as a design variable)
- Mass
- Impact configuration
  
- Redundancy
  
  
  
  
  
  
  
  
  
- Why the risk?





# Redundancy



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# How should we regard treatments?

## Primary Treatment

- Road planning, design and management considerations that **virtually eliminate** the potential of fatal and serious injuries occurring in association with the foreseeable crash types

## Supporting (step towards)

- Road planning, design and management considerations that **improve** the overall level of safety associated with foreseeable crash types, but not expected to virtually eliminate the potential of fatal and serious injuries occurring
- Improves the ability for a Primary Treatment to be implemented in the future

## Supporting Treatment

- Road planning, design and management considerations that **improve** the overall level of safety associated with foreseeable crash types, but not expected to virtually eliminate the potential of fatal and serious injuries occurring
- Does not change the ability for a Primary Treatment to be implemented in the future

## Non-Safe System Treatment

- Road planning, design and management considerations that are **not expected to achieve an overall improvement in the level of safety** associated with foreseeable crash types occurring
- Reduces the ability for a Primary Treatment to be implemented in the future

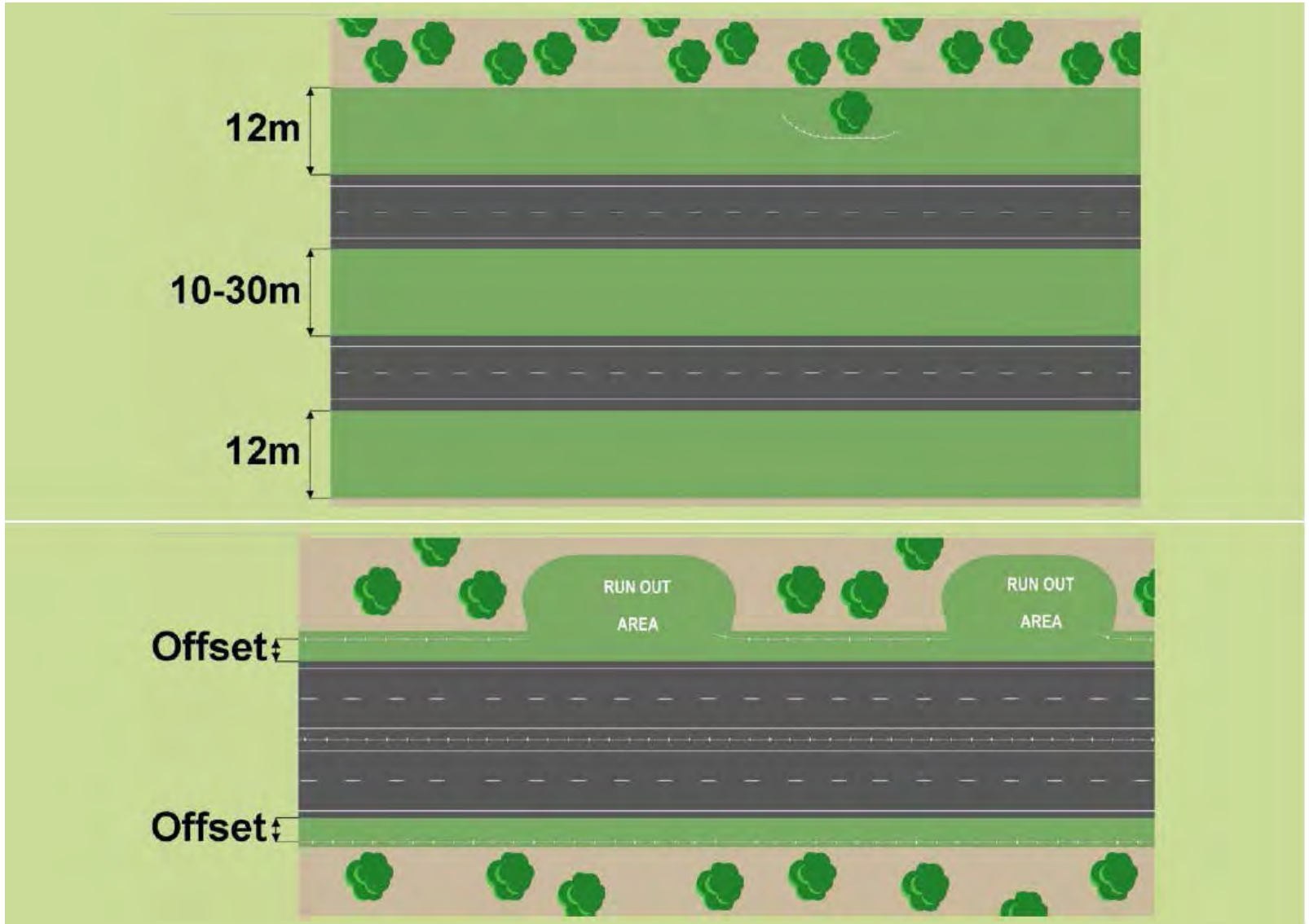
# Treatments

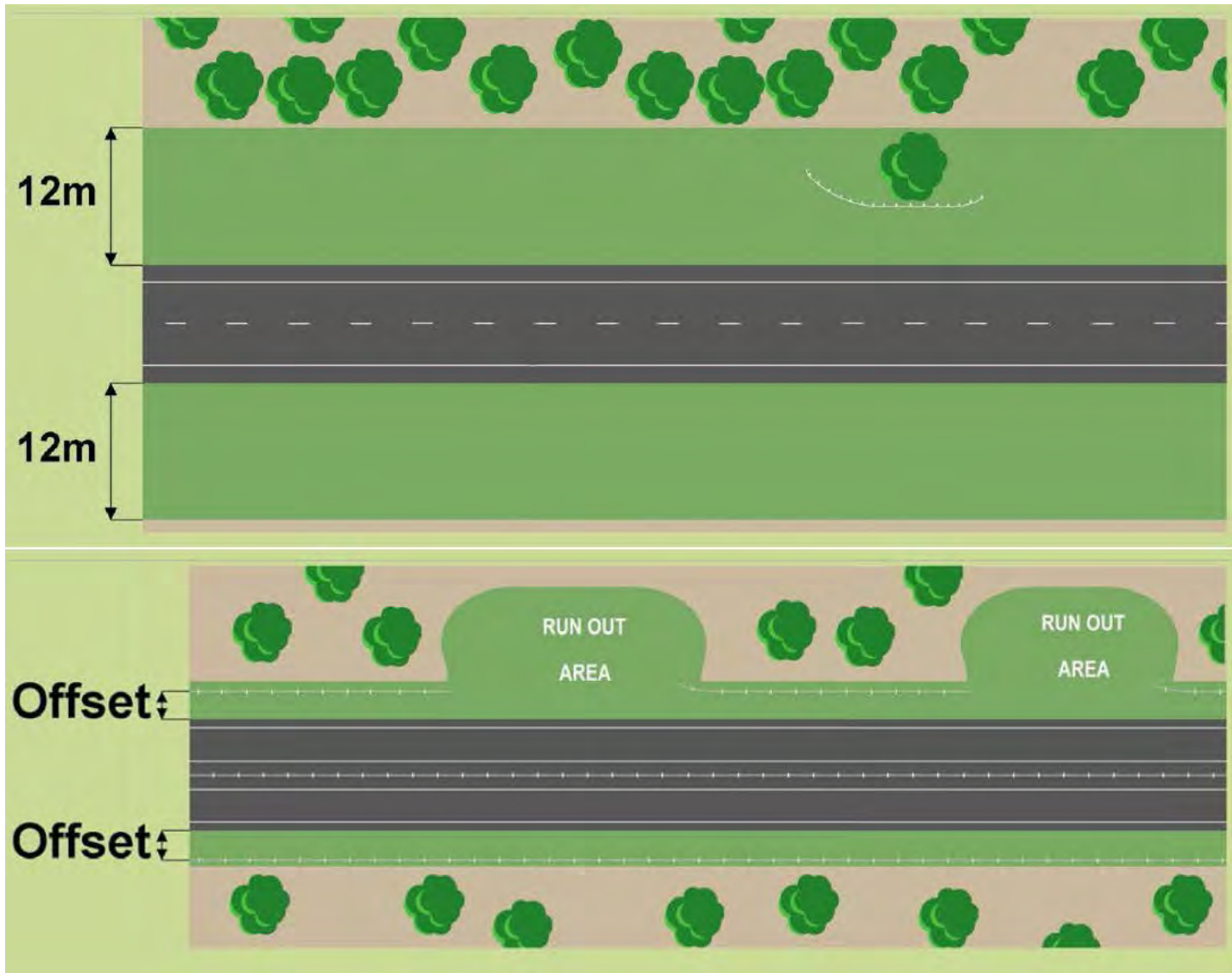
- Primary
  - Roundabouts
  - Signalised Roundabouts
  - Median treatments
  - Continuous barrier systems
  - Safe System Speeds
  - Segregation
  - Grade Separation
  - Removal of points of conflict
  - Reducing exposure
- Supporting
  - Wide Centrelines
  - Sealed shoulders
  - Audio tactile linemarking
  - Safety tables
  - Constraining geometry
  - Speed limit reductions
  
  - Multiple redundancy

# Key Approaches – Rural Roads

- **Continuous lengths of (flexible) barriers** along corridors
  - Wire rope is proven
  - Other systems with emerging potential
  - High levels of DSI safety performance
- **Wide centre lines** are a good interim measure
- **Clear zone is also a hazard**
  - Departures can have large lateral displacements
  - Rollover not managed well







# Key Approaches - Intersections

- **Manipulate impact angles**
  - Utilise the best features of roundabout design
  - Avoid 90 degree configurations unless speed is low
- **Guarantee safe interaction speeds**
  - Use fit for purpose vertical deflection
  - Constraining geometry (narrow lanes etc)
  - Radial designs
- **Mass**
  - Is segregation possible?

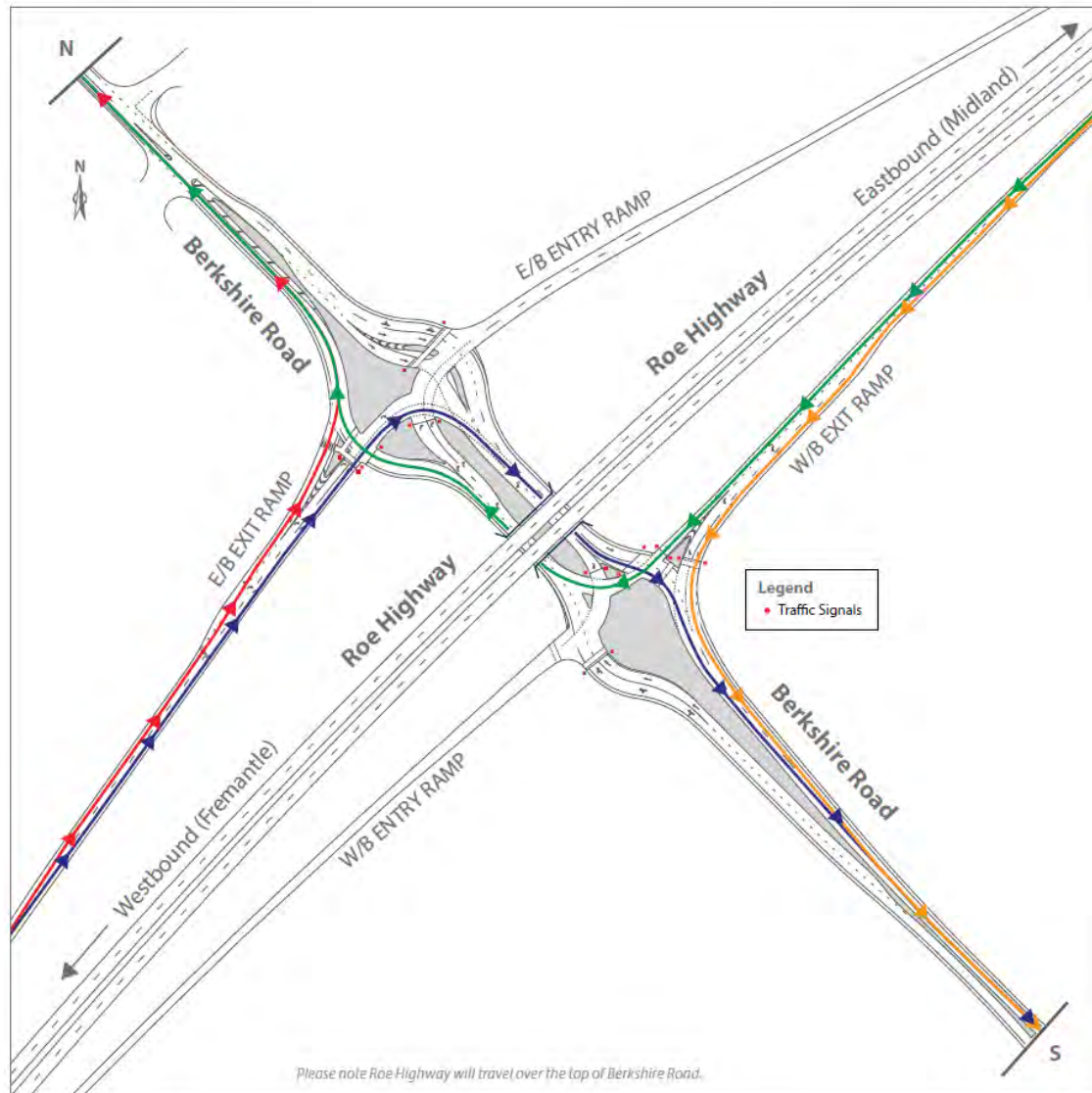
*Consider dynamic visual obstruction*

*Consider inattentive blindness (“looked but did not see”)*





# “Tennis Ball”, WA







# Key Approaches – Residential areas

- Place making
- Self-explaining roads
- Good European practices to latch on to
  
- Holistic benefits
  - Safety
  - Emissions and Noise
  - Active Travel and community health benefits
  - Traffic calming
  - Shared ownership of the problem and solutions





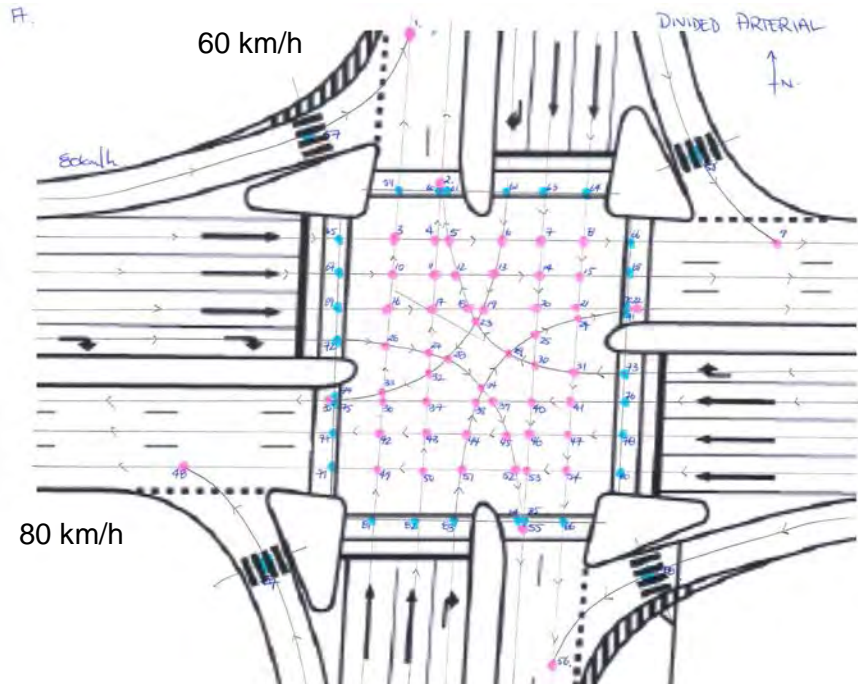
# Assessing Safe System alignment

Table 4.2: Safe System assessment framework for infrastructure projects

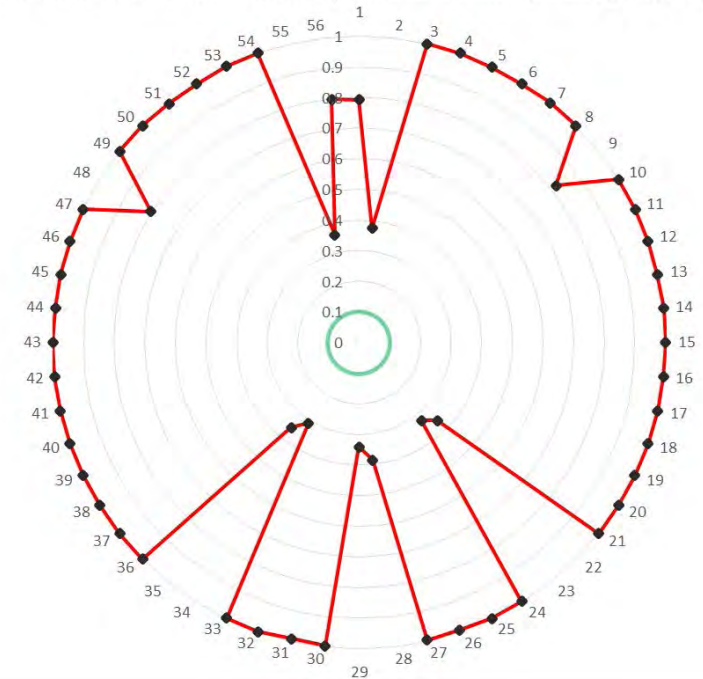
	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	AADT; length of road segment	AADT; length of road segment	AADT for each approach; intersection size	AADT; length of road segment	AADT; pedestrian numbers; crossing width; length of road segment	AADT; cyclist numbers; pedestrians	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



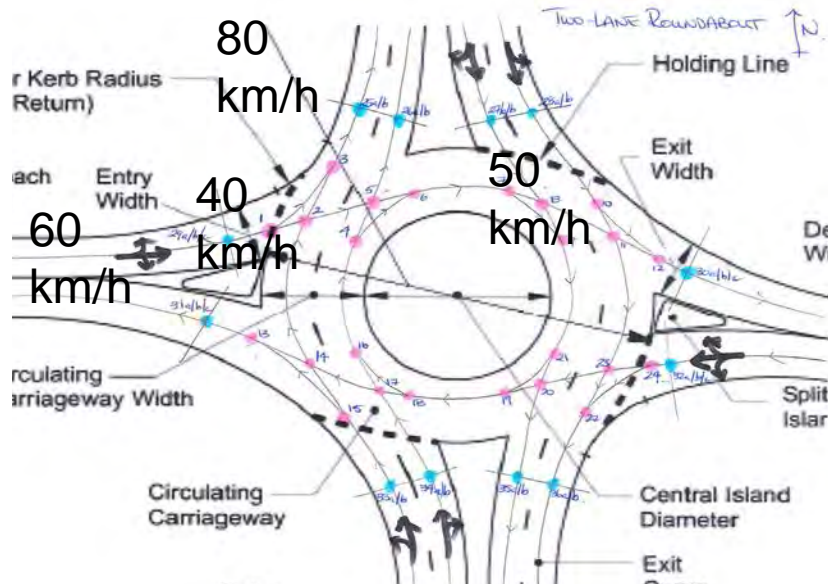
# Conventional + intersection



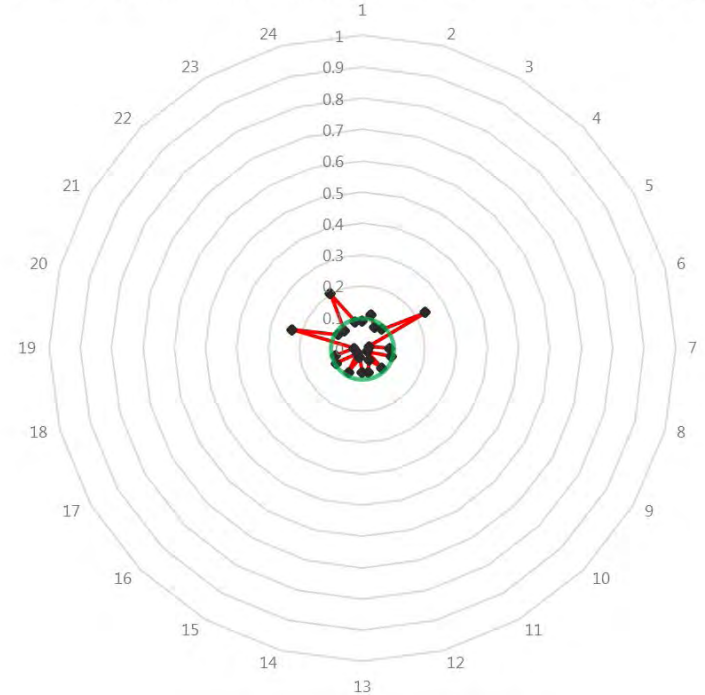
Divided Arterial Int - Conflict points and corresponding Pr(FSI)



# Roundabout



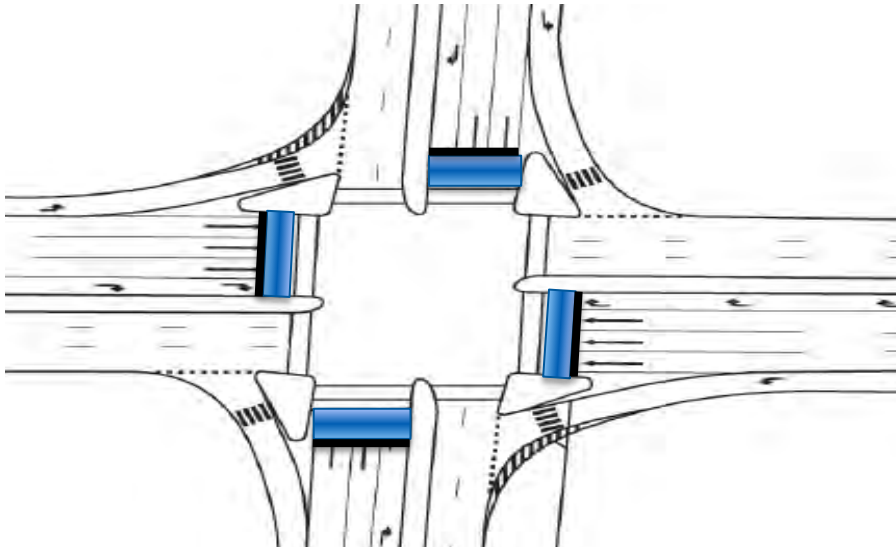
Two-Lane Roundabout - Conflict points and corresponding Pr(FSI)



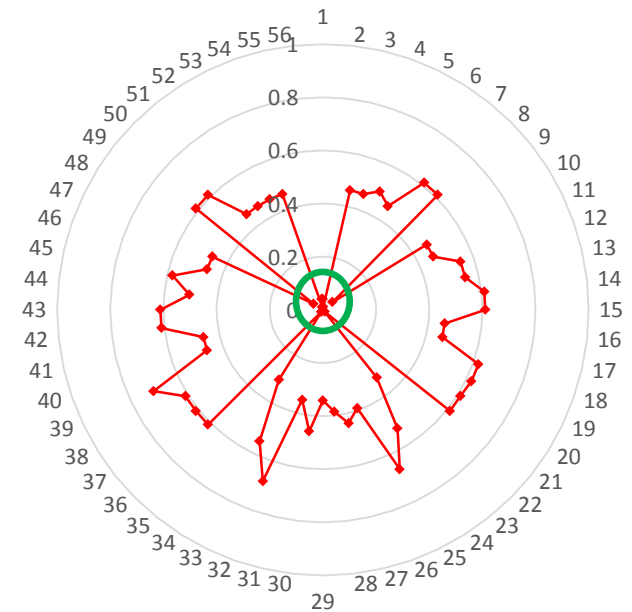
# Hybrid solution

80 km/h Speed Zone

All entry speeds 40 km/h

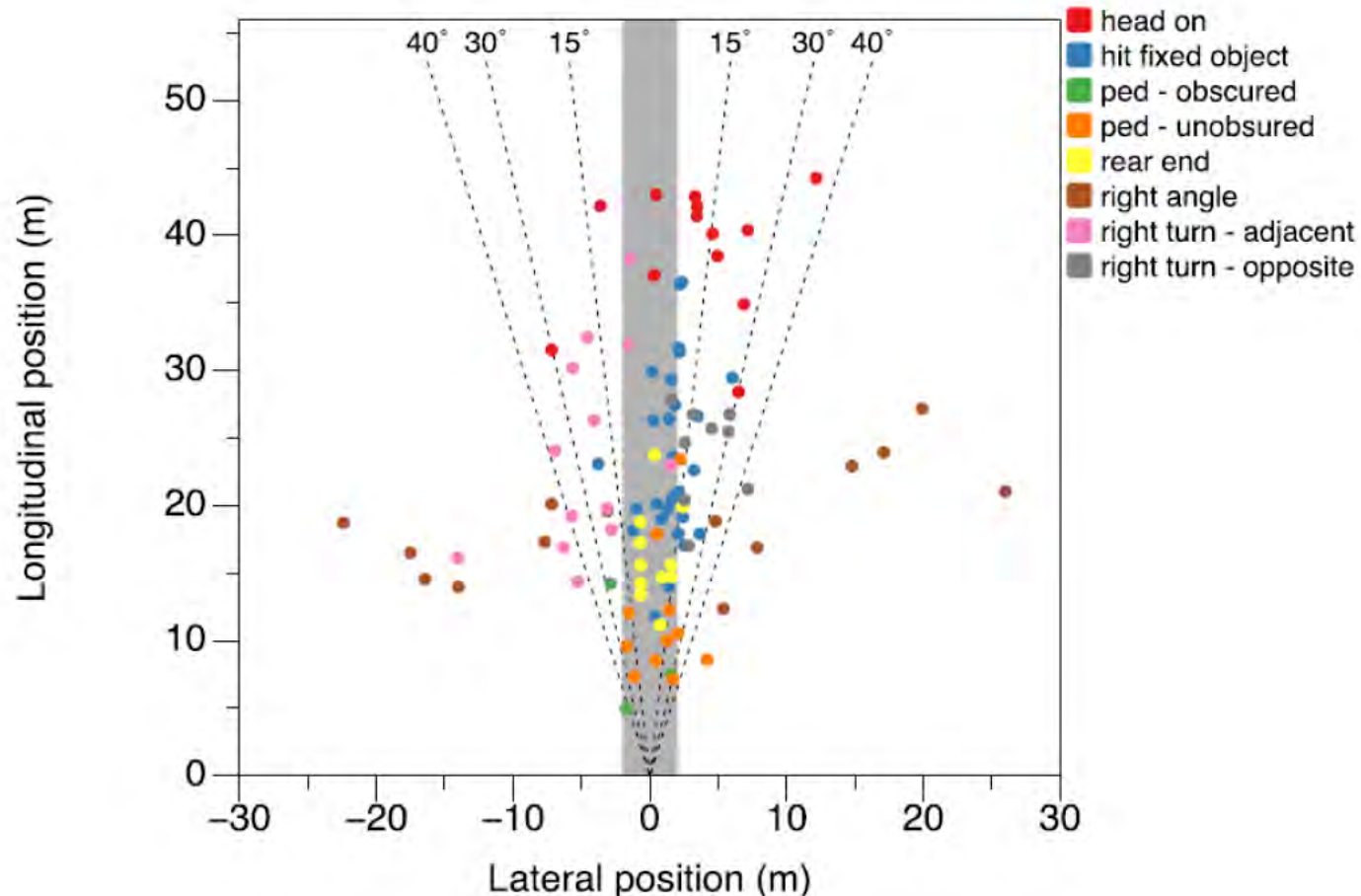


Divided Arterial Int (40km/h) - conflict points and corresponding Pr(FSI)



# Vehicle technology to the rescue (AEB)?

Figure 8.1. Location of crash partner one second from collision by crash type (Doecke et al 2012)



# Take home messages

- We are not making the most of our opportunities
  - Safety outcomes need to be managed not assumed
- Safe System = Harm reduction
  - Use this as the starting point
  - Manipulate speed/mass/orientation to influence crash consequence
  - Back up with redundancy features
  - Expect errors
- Consider the Safe System treatment hierarchy
  - Primary treatments
  - Supporting treatments
  - Non Safe System treatments
  - Tools now exist to assist
- Consider safety by default
  - Go to aspirational Safe System design stereotypes and principles first
  - Put effort into justifying variations that make a scheme less safe
  - (at the moment we do the opposite)
  - Are we sincere about “safe mobility” or “mobility vs safety”?

# Austroads publication bringing current Safe System knowledge together



[jeremy@casr.adelaide.edu.au](mailto:jeremy@casr.adelaide.edu.au)