Sam Doecke and Jeremy Woolley

Post impact travel and secondary impacts following urban intersection collisions

Background

- Issue of secondary impacts noticed during rural at-scene in-depth crash investigations
- Minor initial collision resulted in serious secondary impact with a roadside hazard
- No guidance available to designers on the issue
- Study of the issue at rural intersections completed

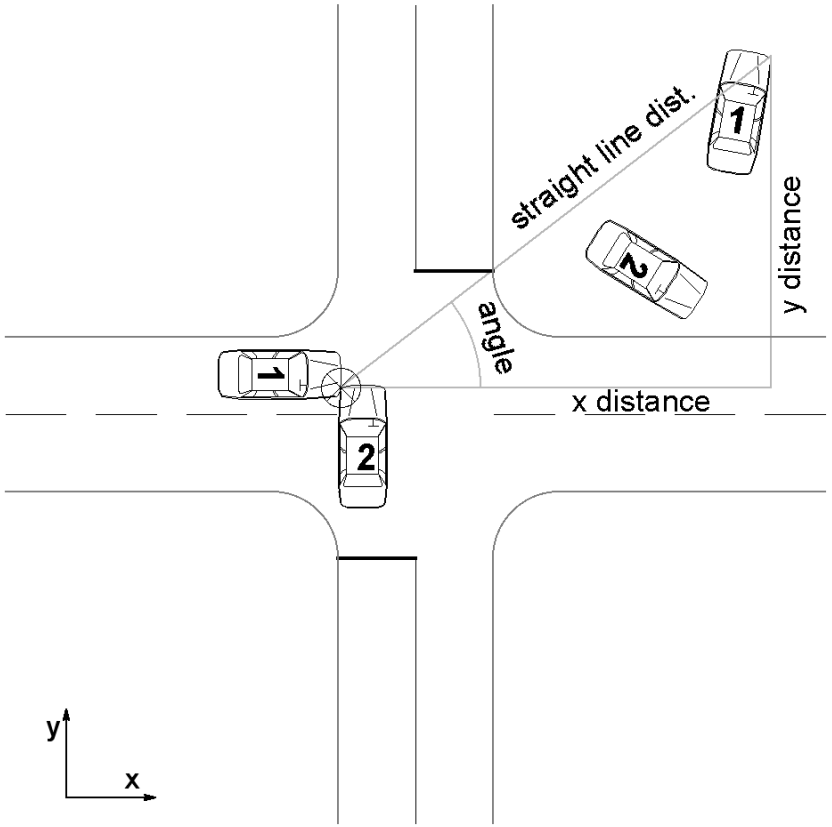
Current Study

- Replicate previous rural study for urban intersections
- Differences between urban and rural intersections:
  - Lower speeds
  - More roadside furniture
  - Traffic signals
  - Pedestrians
  - Intersections geometry

Method

At-scene in-depth crash investigation data includes detailed site diagram

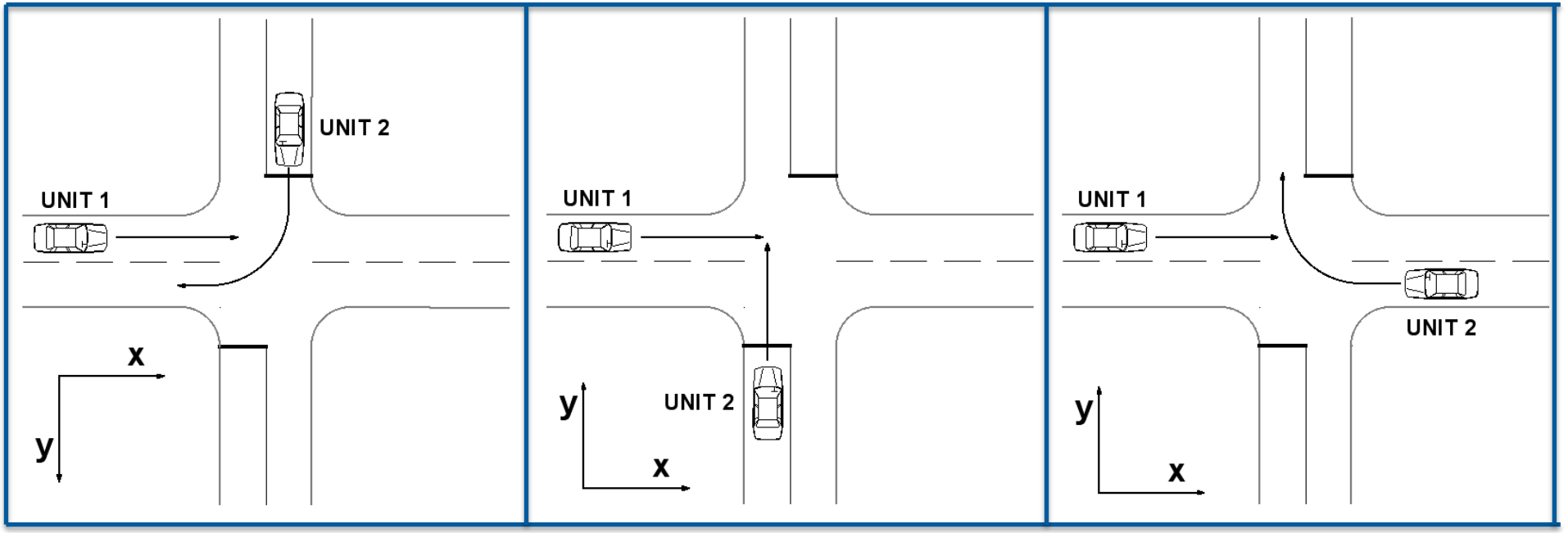
- Travel path data relative to impact point
  - straight line distance
  - x distance
  - y distance
  - Angle
- Database also contains many other crash, vehicle and site variables



Method

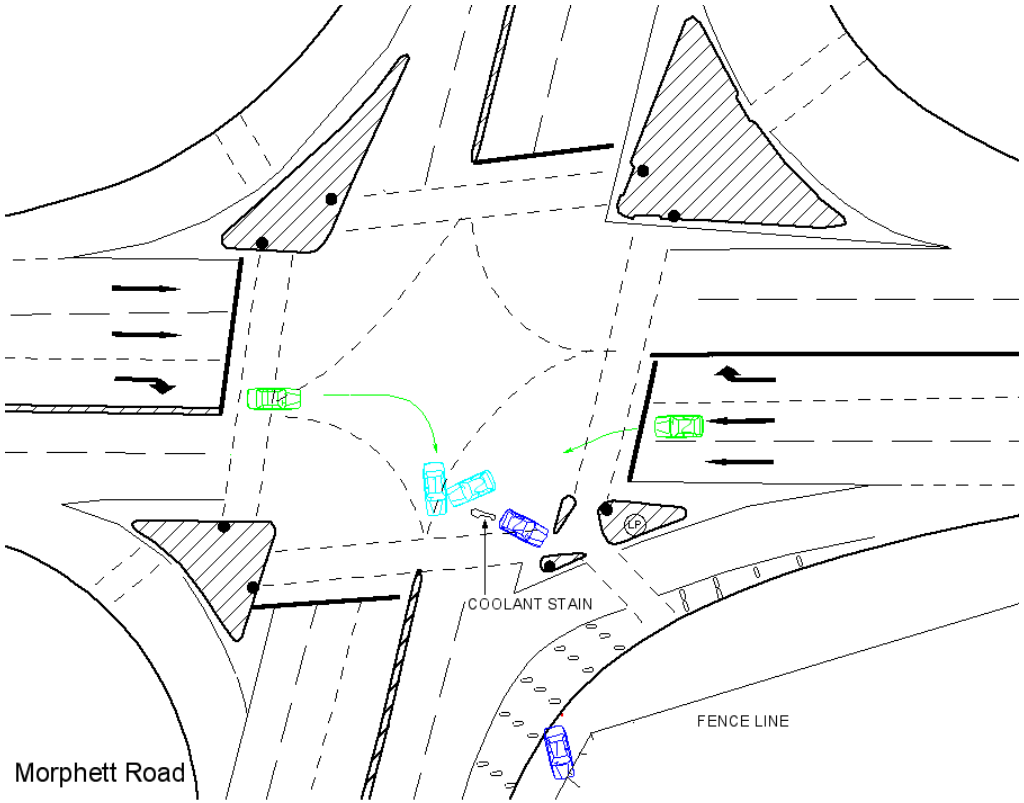
Unit and sign conventions

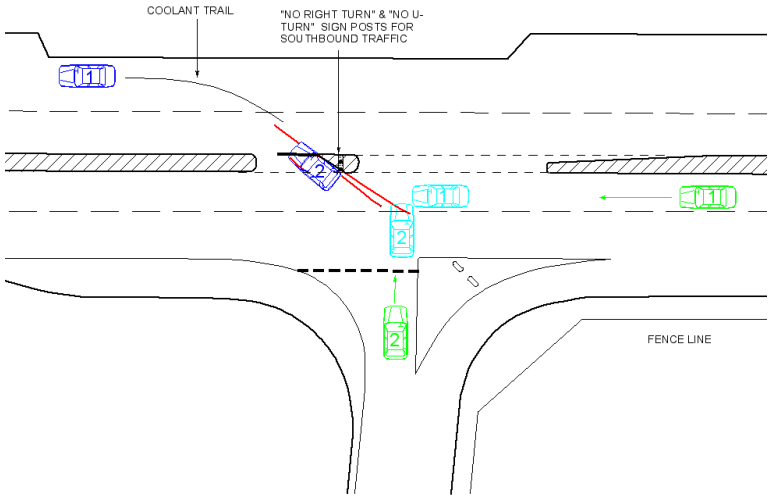
- Positive x is defined as the direction of travel of unit 1
- Unit 1 is the through vehicle, or if both vehicles meet this criterion, the vehicle with right of way



Method

Signalised and non-signalised analysed separately





Results

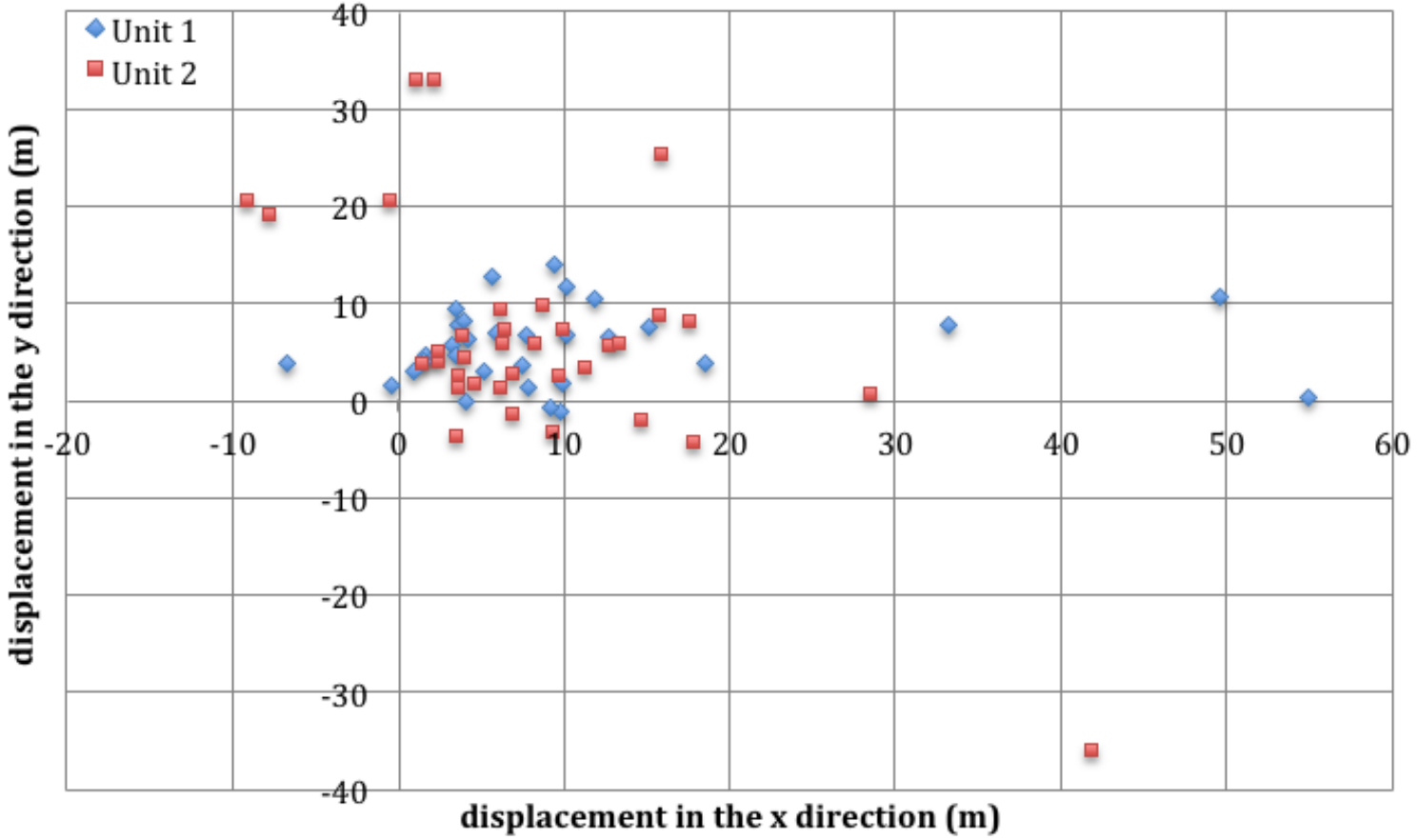
Overview of the cases

- 35 signalised, 43 unsignalised
- Signalised - majority cross roads
- Unsignalised – majority T-junctions (uncontrolled)

Geometry	Traffic Control				
	Traffic signals	Stop sign	Give way sign	Uncontrolled	Total
Cross road	22	8	5	2	37
T-Junction	9	1	2	25	37
Y-Junction	1	0	0	0	1
Multi-leg junction	3	0	0	0	3
Total	35	9	7	27	78

Results – signalised intersections

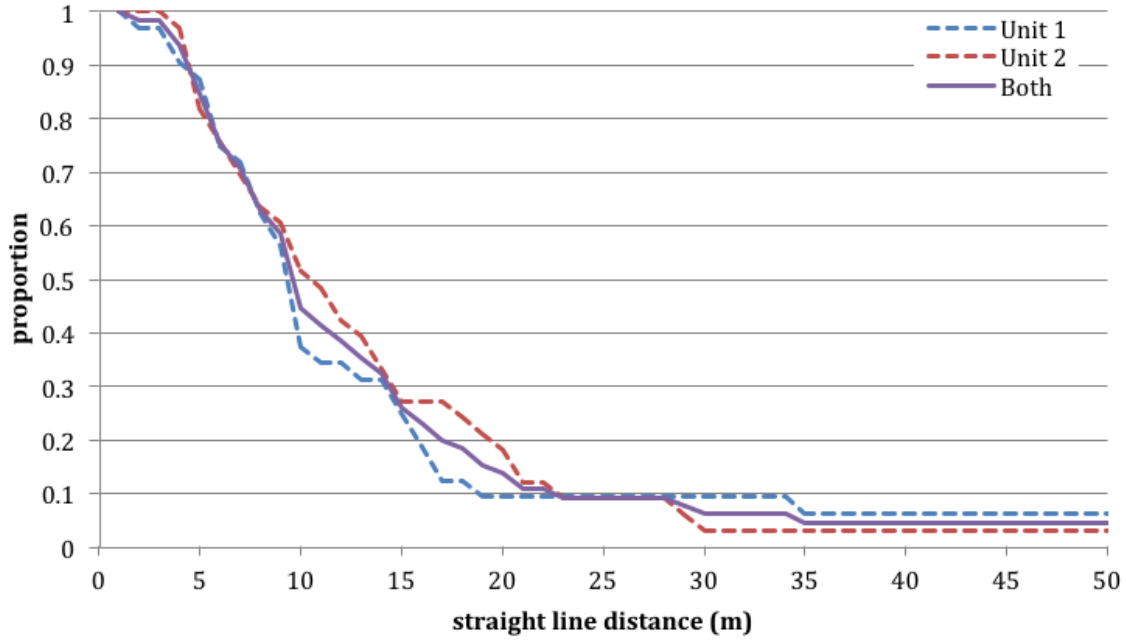
Raw results – final positions relative to impact point



Results - signalised intersections

Proportion of vehicles that travel a given distance post impact

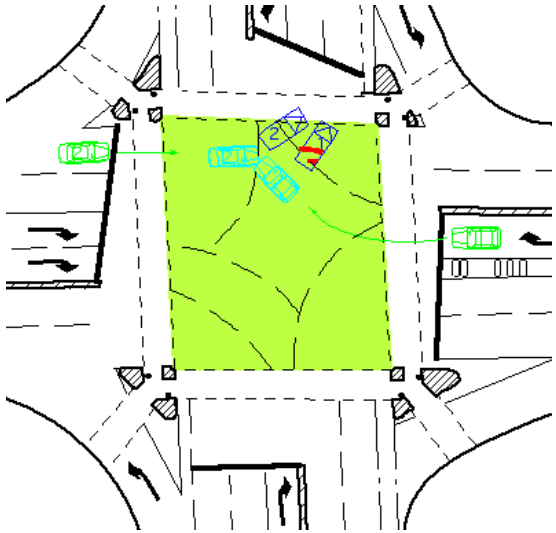
- 50% travel further than ≈ 10m
- 25% travel further than ≈ 15m
- 15% travel further than ≈ 20m



Results - signalised intersections

Departures from the intersection and roadway

- Intersection defined by pedestrian crossings or traffic control lines
- Edge of roadway defined by curb



	Unit 1		Unit 2	
Intersection departure	Number	Percent	Number	Percent
No	21	60.0%	21	60.0%
Yes	14	40.0%	14	40.0%
Roadway departure				
No	33	94.3%	27	77.1%
Yes	2	5.7%	8	22.9%

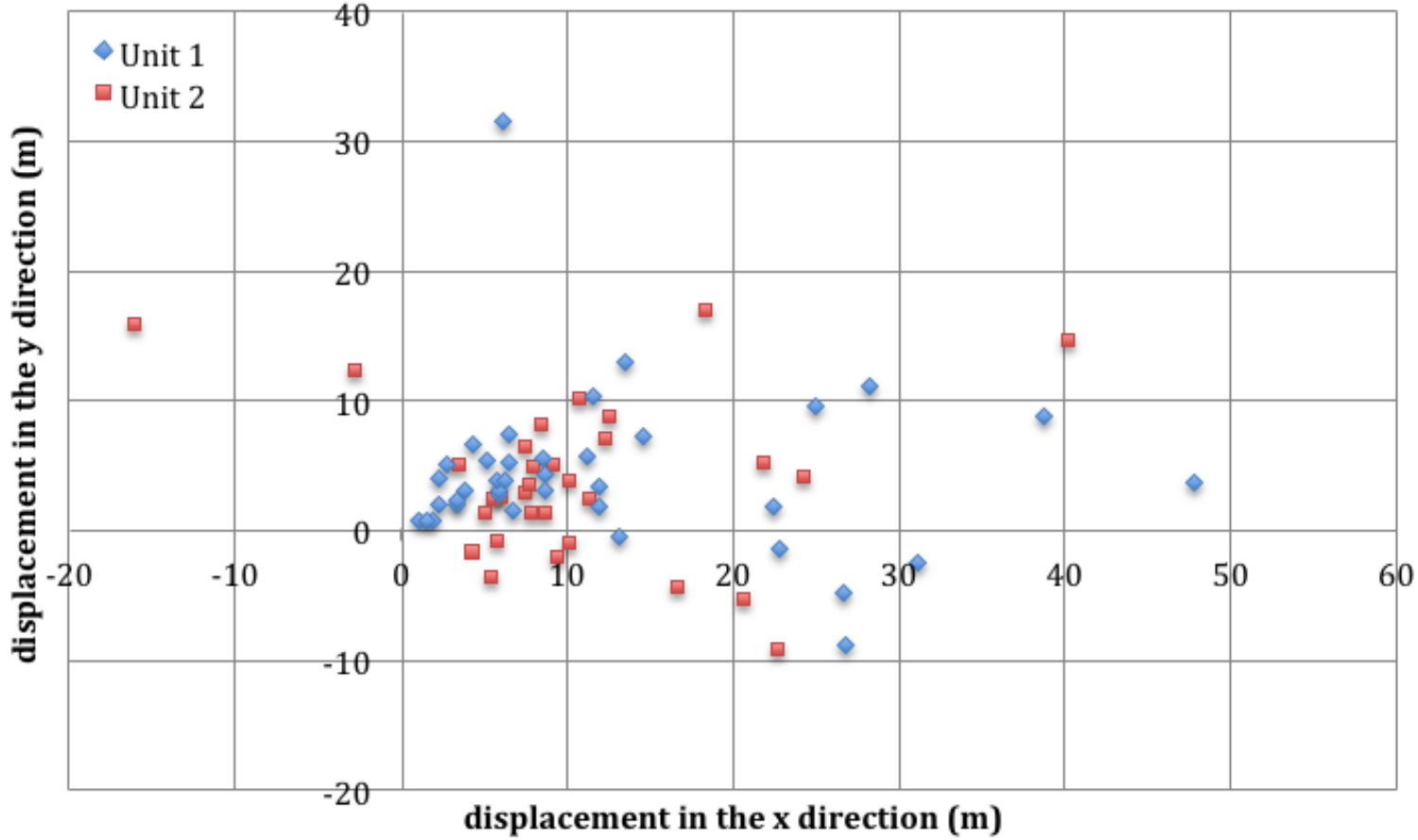
Results - signalised intersections

Secondary collisions and most severe collision

Secondary collision	Unit 1		Unit 2	
	Number	Percent	Number	Percent
None	29	82.9%	25	71.4%
Traffic light pole	3	8.6%	5	14.3%
Building	0	0.0%	1	2.9%
Fence	0	0.0%	1	2.9%
Vehicle – stationary	2	5.7%	4	11.4%
Vehicle – moving	0	0.0%	1	2.9%
Vehicle - parked	1	2.9%	0	0.0%
Most severe collision	**Unit 1**		**Unit 2**	
	Number	Percent	Number	Percent
Initial	32	91.4%	35	100.0%
Traffic light pole	2	5.7%	0	0.0%
Vehicle - parked	1	2.9%	0	0.0%
Total	35	100.0%	35	100.0%

Results – unsignalised intersections

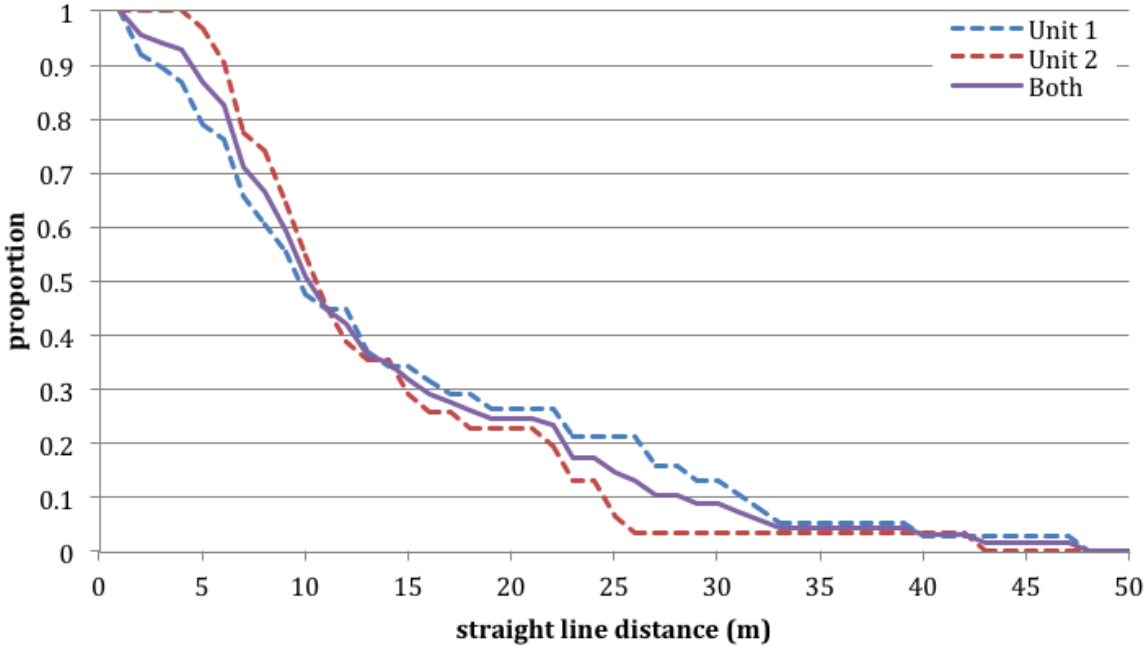
Raw results – final positions relative to impact point



Results - unsignalised intersections

Proportion of vehicles that travel a given distance post impact

- 50% travel further than ≈ 10m
- 25% travel further than ≈ 19m
- 15% travel further than ≈ 25m



Results - unsignalised intersections

Departures from the intersection and roadway

- Intersection defined by curb taper and traffic control lines
- Edge of roadway defined by curb

	Unit 1		Unit 2	
Intersection departure	Number	Percent	Number	Percent
No	17	39.5%	27	62.8%
Yes	26	60.5%	16	37.2%
Roadway departure				
No	29	67.4%	34	79.1%
Yes	14	32.6%	9	20.9%

Results - unsignalised intersections

Secondary collisions

Secondary collision	Unit 1		Unit 2	
	Number	Percent	Number	Percent
None	34	79.1%	36	83.7%
Stobie pole	2	4.7%	1	2.3%
Tree	2	4.7%	2	4.7%
Fence	2	4.7%	2	4.7%
Fire hydrant	1	2.3%	1	2.3%
Sign	3	7.0%	1	2.3%
Pedestrian handrail	0	0.0%	1	2.3%
Vehicle - stationary	0	0.0%	1	2.3%
Vehicle - parked	1	2.3%	0	0.0%

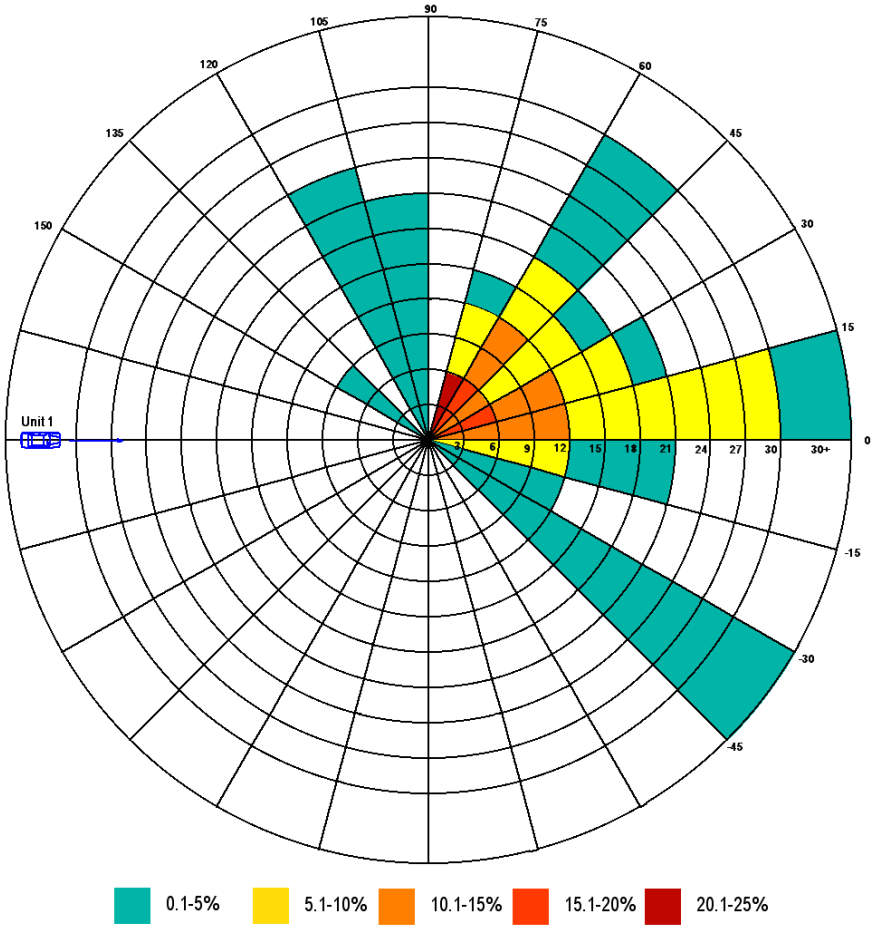
Results - unsignalised intersections

Most severe collision

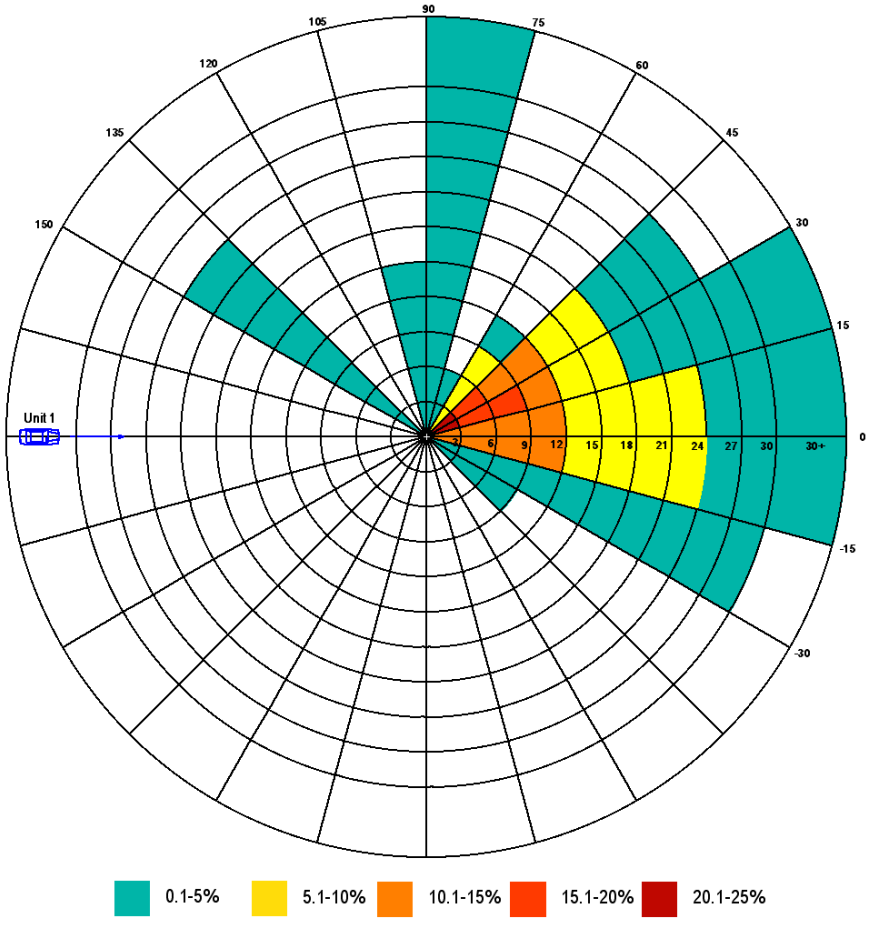
Most severe collision	Unit 1		Unit 2	
	Number	Percent	Number	Percent
Initial	39	90.7%	41	95.3%
Stobie pole	2	4.7%	1	2.3%
Tree	1	2.3%	0	0.0%
Pedestrian handrail	0	0.0%	1	2.3%
Vehicle - parked	1	2.3%	0	0.0%
Total	43	100.0%	43	100.0%

Results – post impact travel diagrams

Signalised



Unsignalised



Limitations

- Post crash travel path assumed to be linear
- Representativeness of sample
  - Bias towards daytime, business hours, higher injury severity
- Stratification difficult given sample size

Discussion

- Raise awareness of the issue for road design
  - Designers should be aware that a variety of post impact travel paths are possible
  - Worst case scenario is often Unit 1 being struck on side
  - Consider the worst case scenarios for safe system design
  - How does the road environment contribute to severity?
- Provides some guidance on
  - Prioritisation of hazard treatment at intersections
  - Where to locate roadside furniture, e.g. traffic controls, signs, bus stops, fences etc.

Acknowledgements and Disclaimer

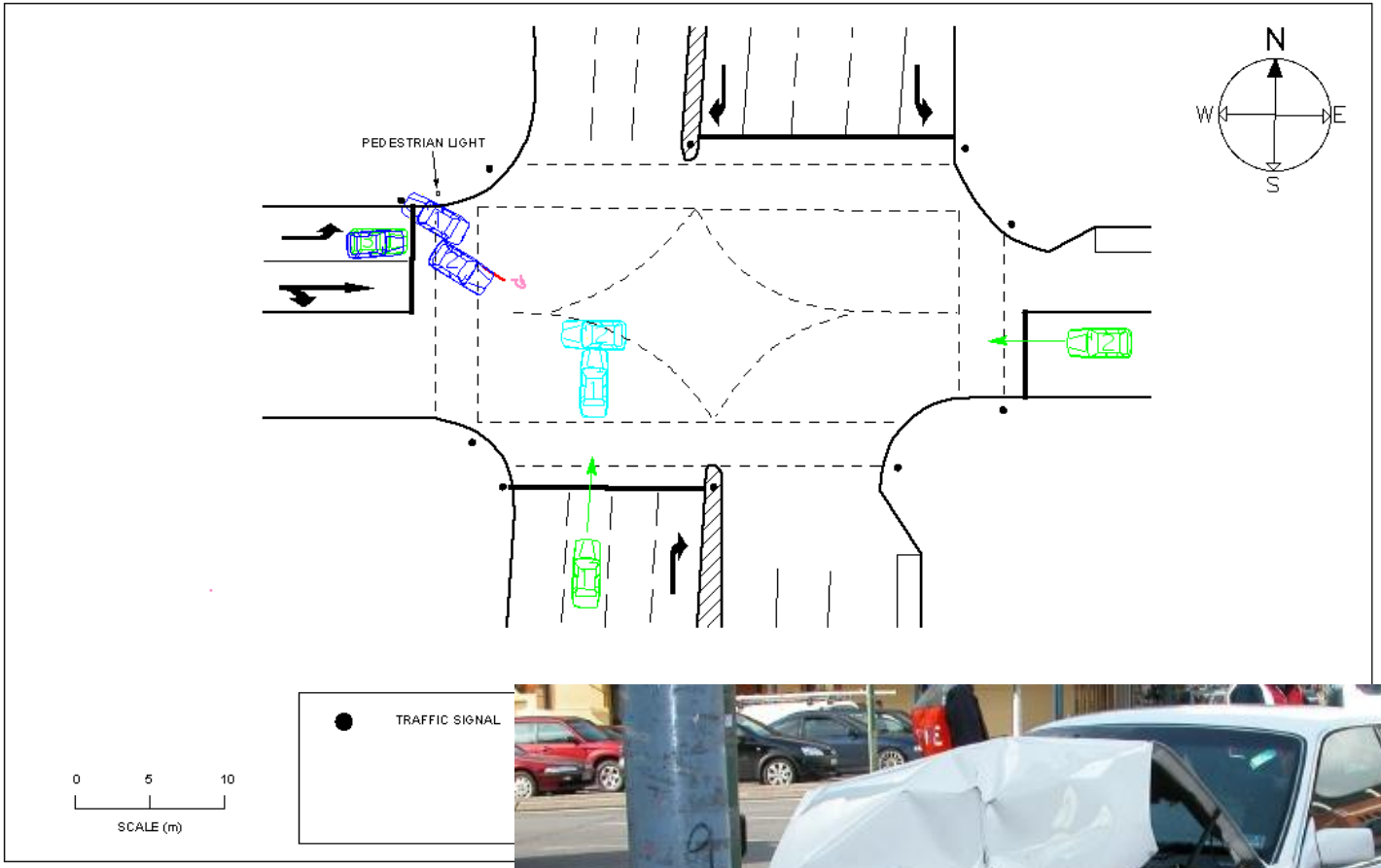
- This project was funded the South Australian Department for Transport Energy and Infrastructure
- The Centre for Automotive Safety Research receives supporting funding from the South Australian Department for Transport, Energy and Infrastructure and the Motor Accident Commission

- The views expressed in this report are those of the presenter and do not necessarily represent those of the University of Adelaide or the funding organisations
- For further information go to

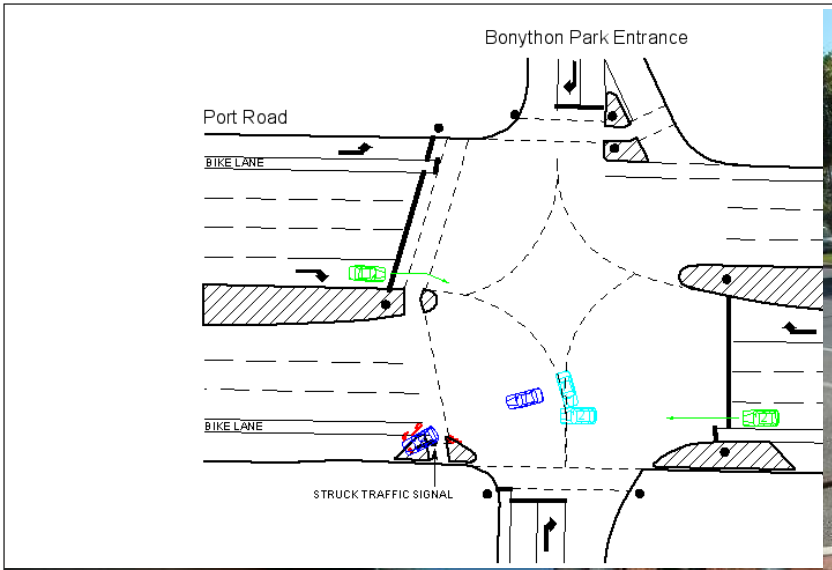
www.casr.adelaide.edu.au

Government of South Australia
Department of Planning, Transport and Infrastructure

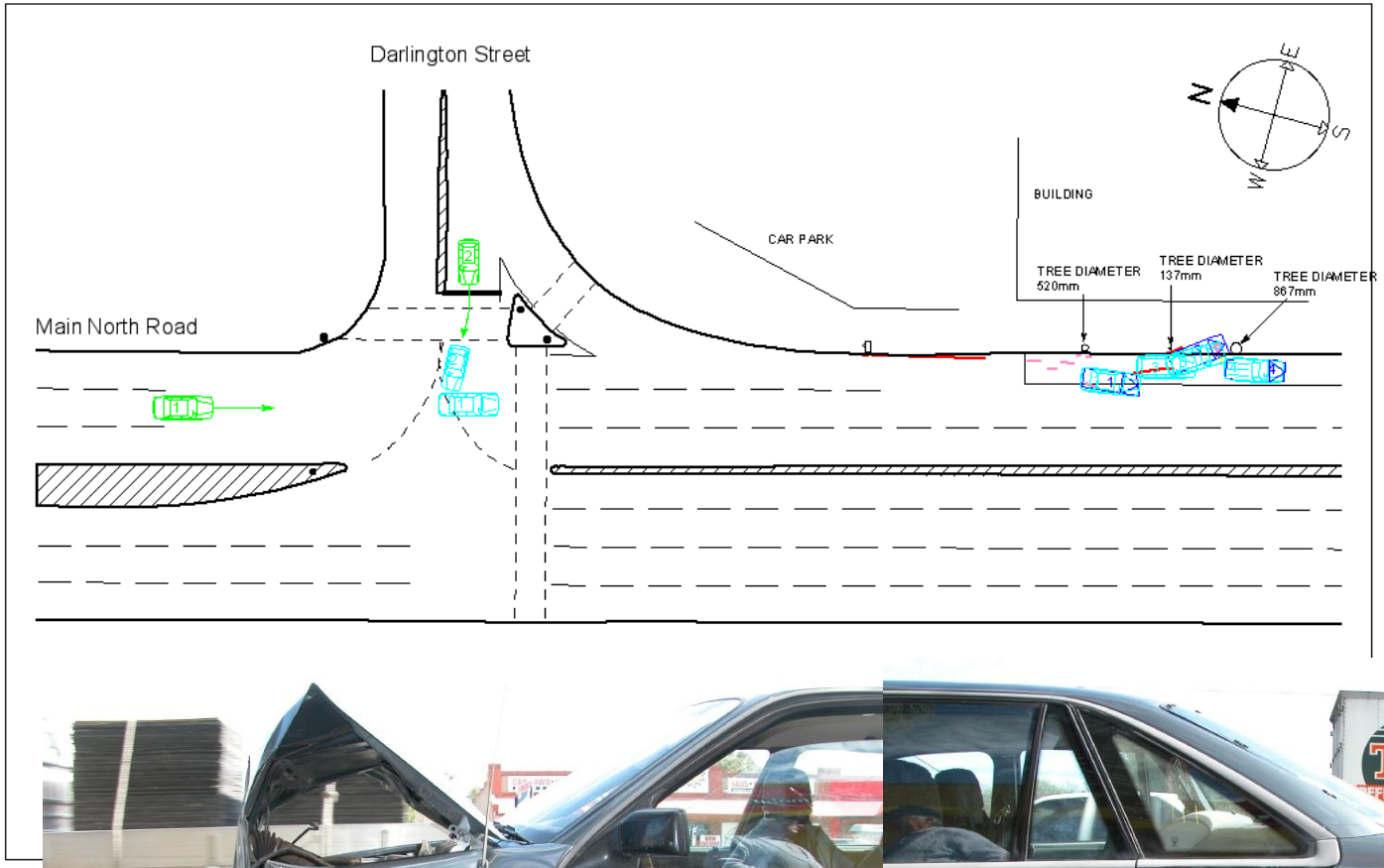
MAC
Motor Accident Commission


PEDESTRIAN LIGHT
N
W
E
S
TRAFFIC SIGNAL
0
5
10
SCALE (m)

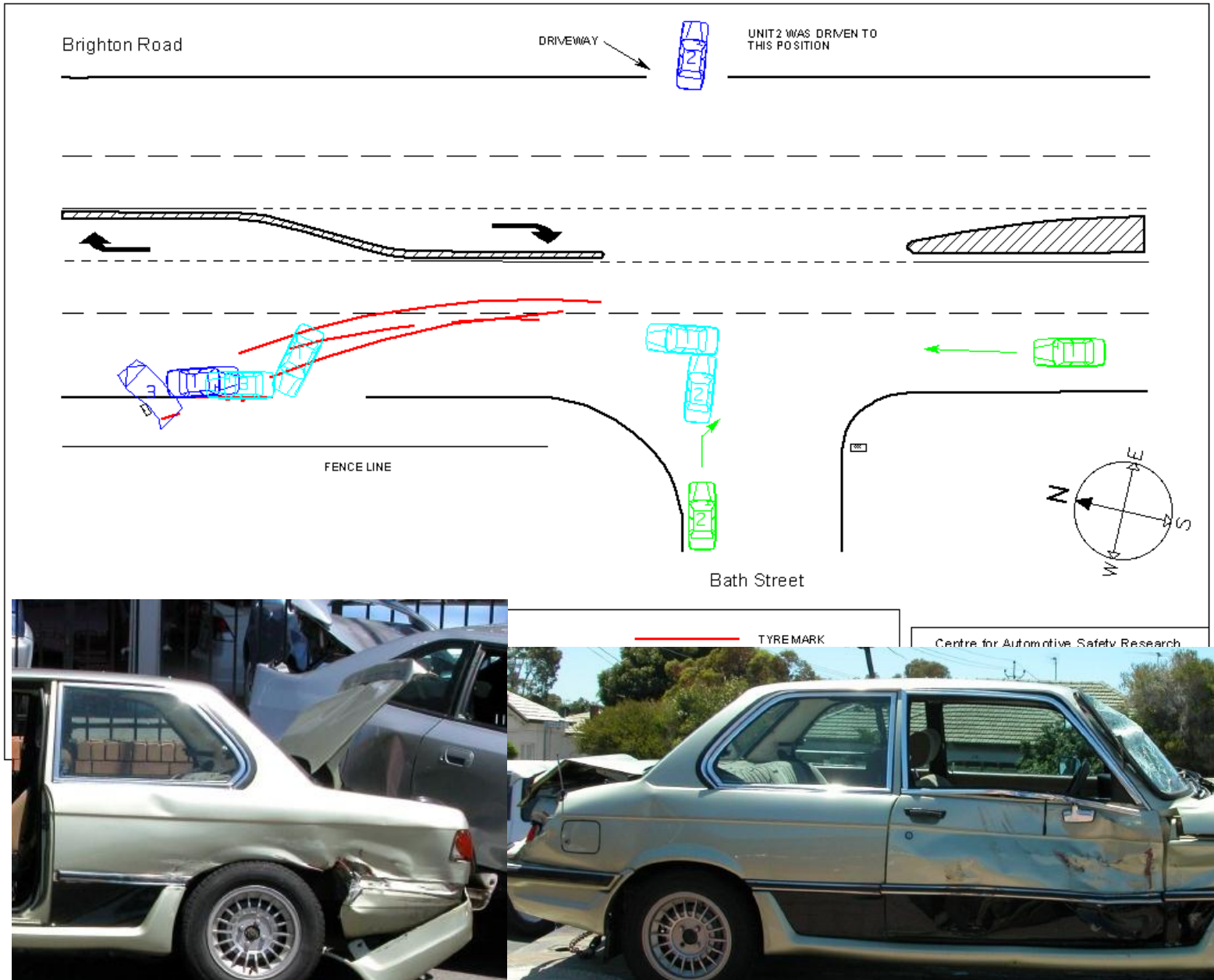

YGG

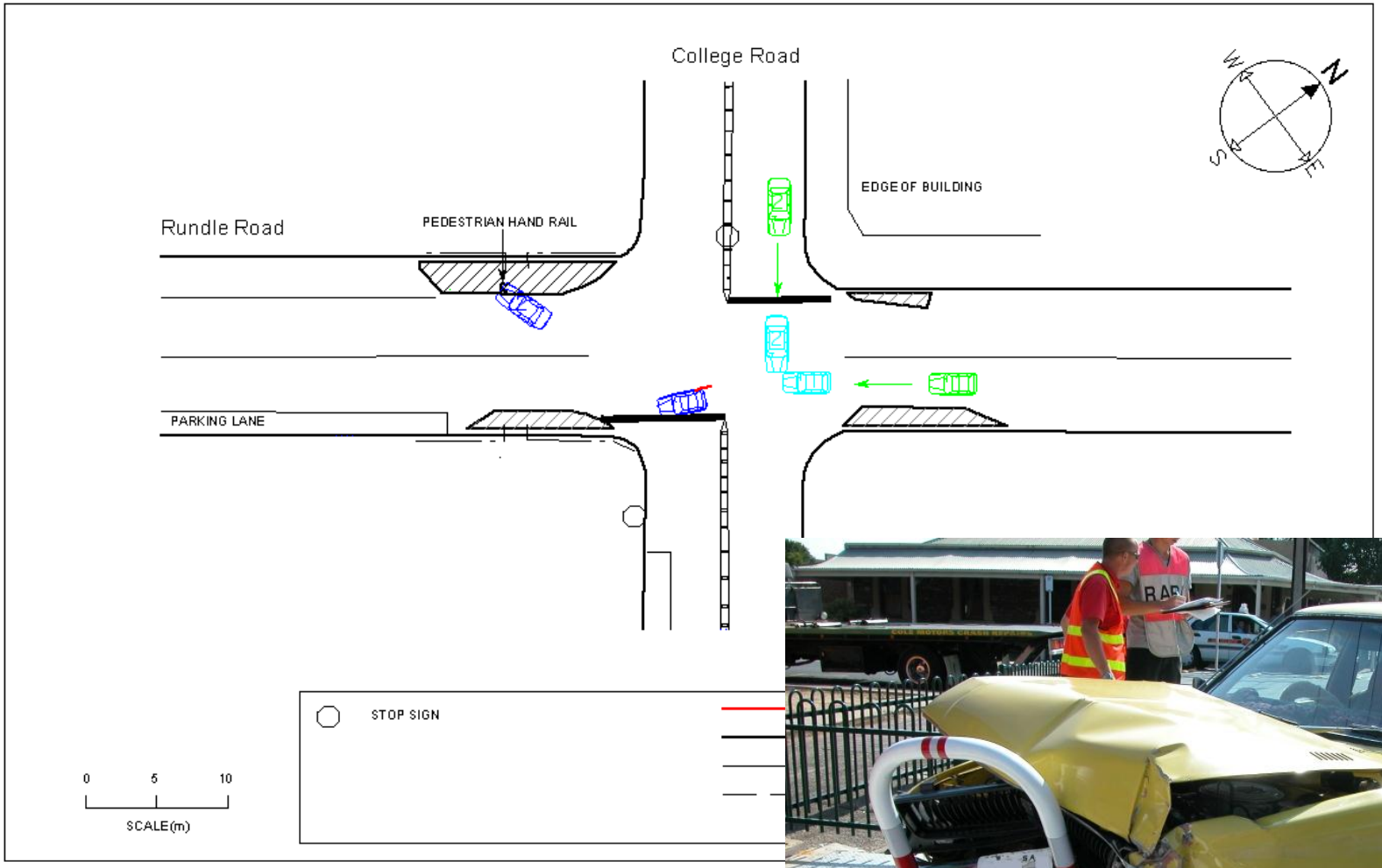

Bonython Park Entrance
Port Road
BIKE LANE
BIKE LANE
STRUCK TRAFFIC SIGNAL

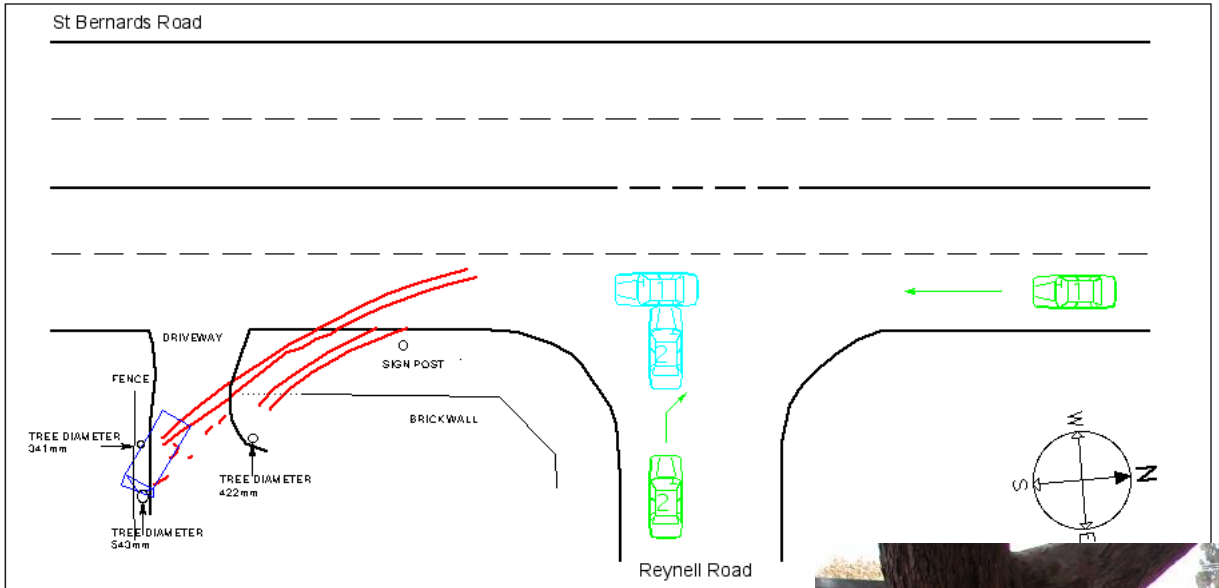

EMERGENCY
000


Darlington Street
Main North Road
CAR PARK
BUILDING
TREE DIAMETER
520mm
TREE DIAMETER
137mm
TREE DIAMETER
867mm
N
E
S
W

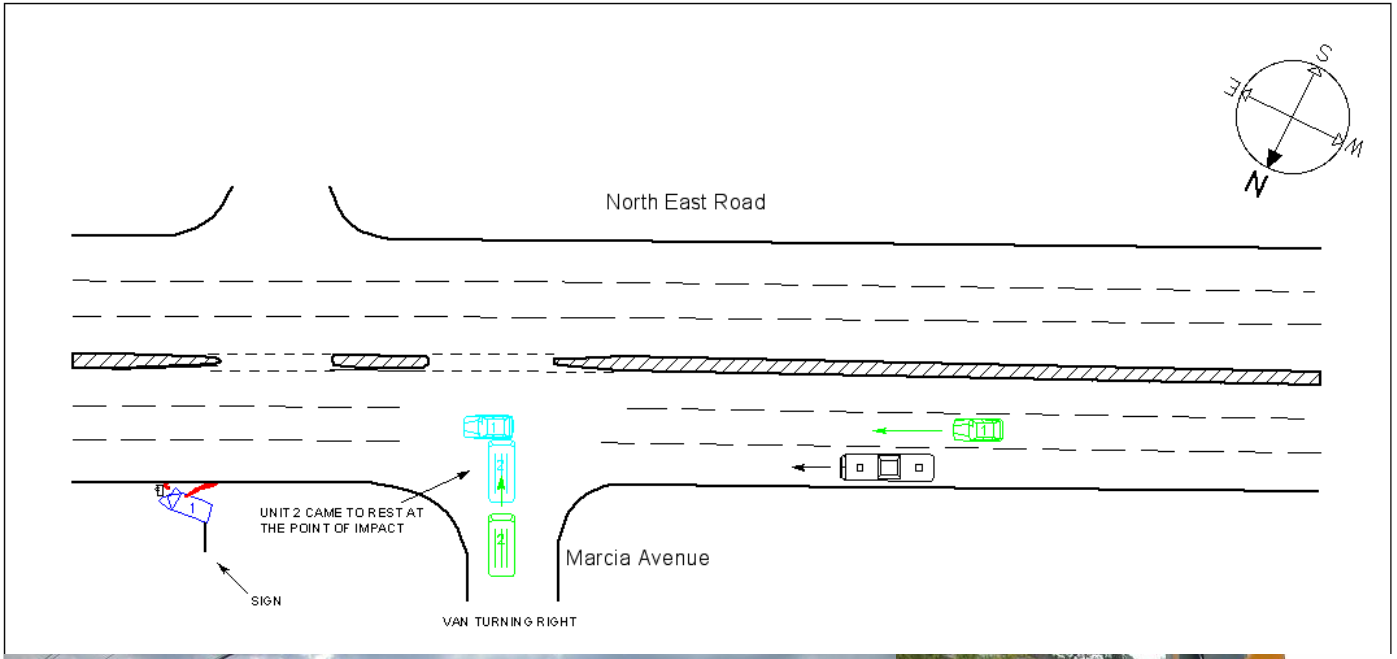

T&H
'The Fresh Food People'
WOOLWORTHS


Brighton Road
DRIVEWAY
UNIT 2 WAS DRIVEN TO THIS POSITION
FENCE LINE
Bath Street
TYRE MARK
Centre for Automotive Safety Research
N
E
S
W

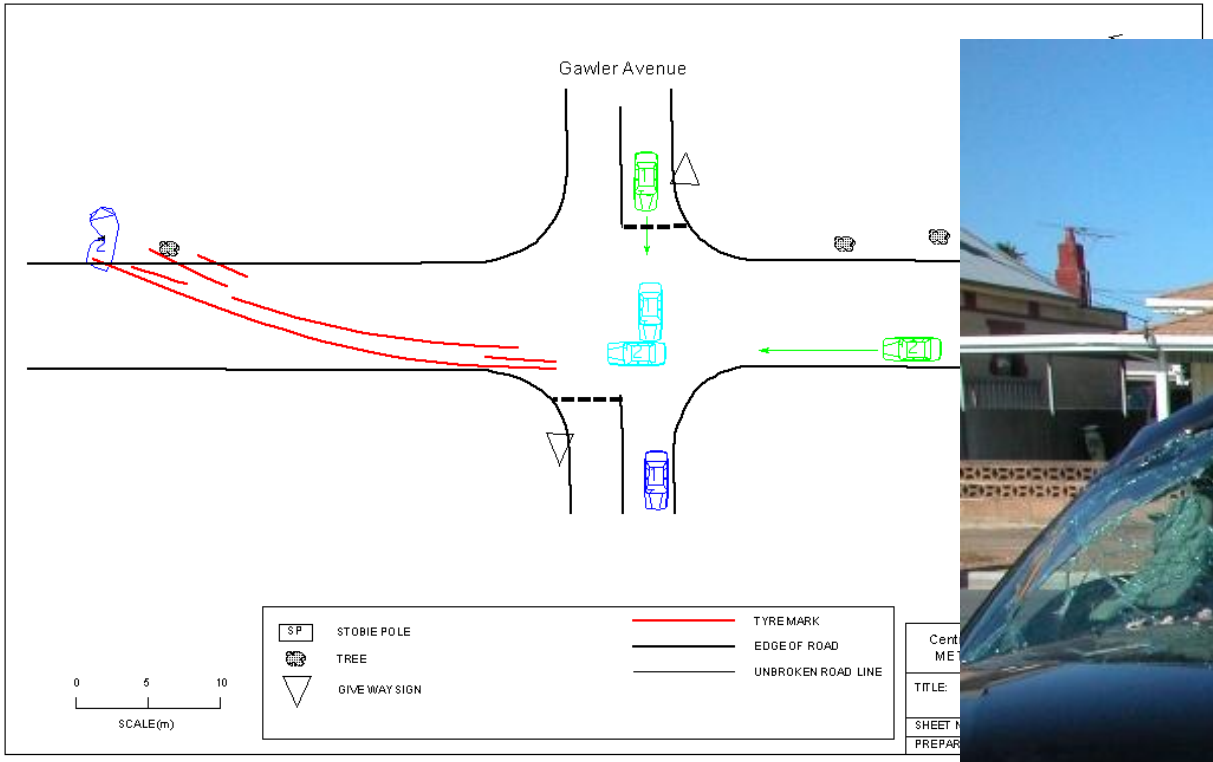

College Road
Rundle Road
PEDESTRIAN HAND RAIL
EDGE OF BUILDING
PARKING LANE
STOP SIGN
0
5
10
SCALE(m)

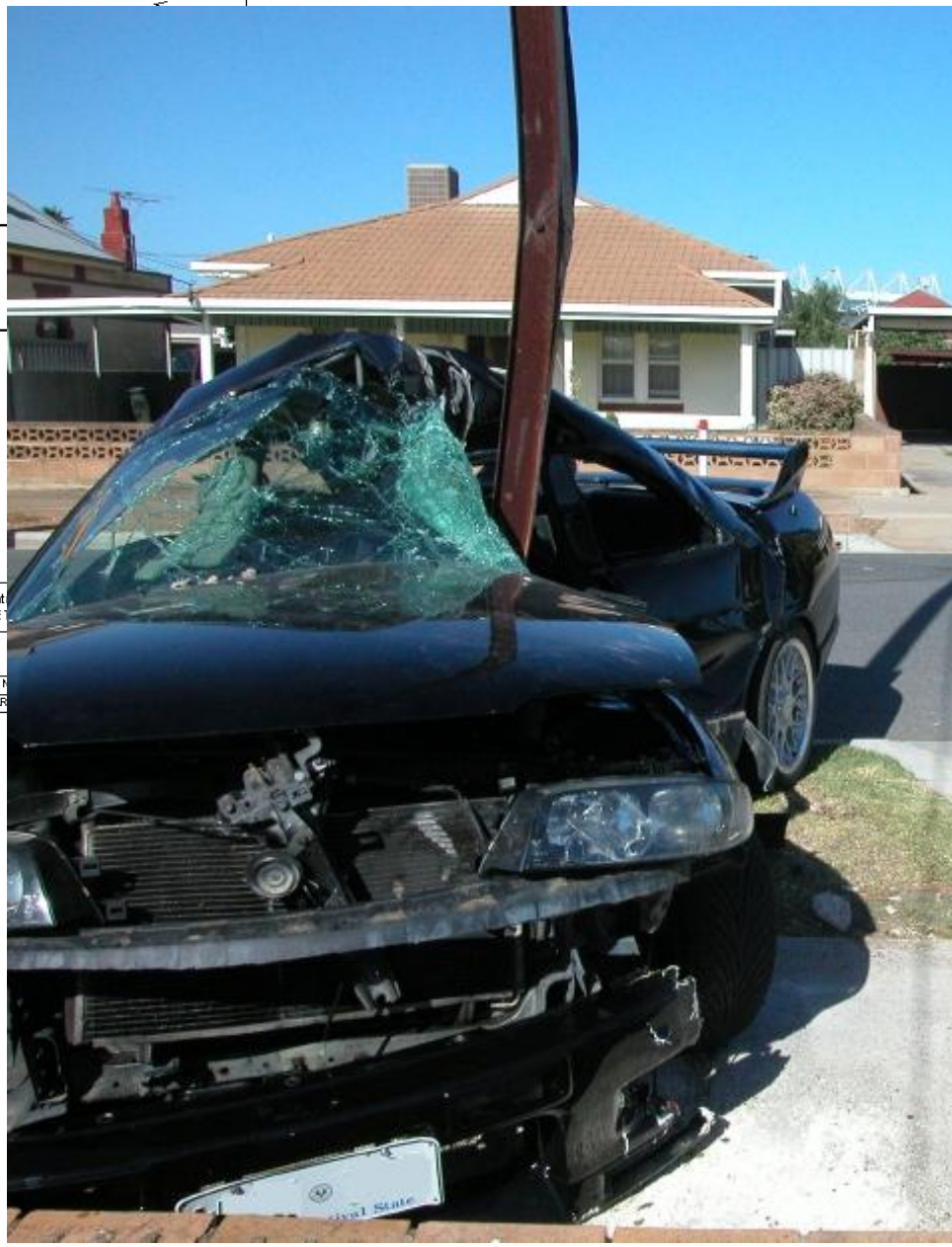

St Bernards Road
DRIVEWAY
FENCE
SIGN POST
BRICK WALL
TREE DIAMETER
341mm
TREE DIAMETER
422mm
TREE DIAMETER
543mm
Reynell Road
W
S
N

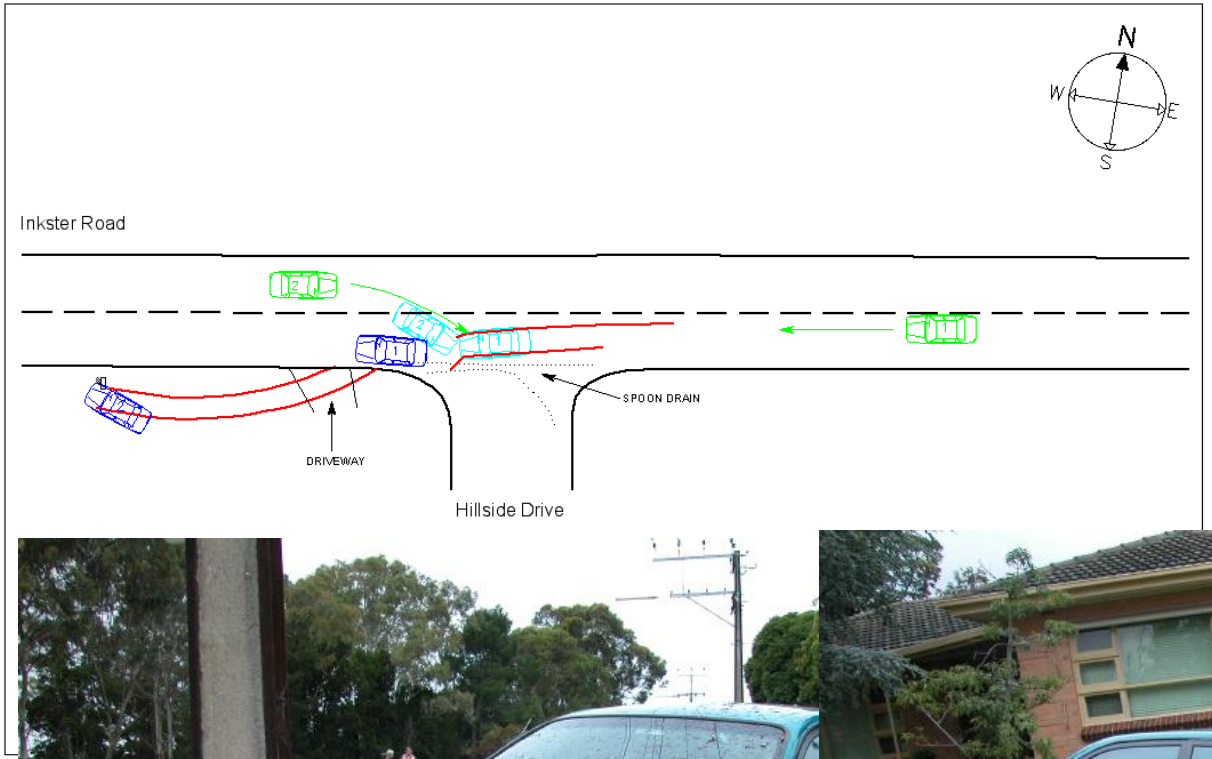

2.6


S
E
W
N
North East Road
UNIT 2 CAME TO REST AT
THE POINT OF IMPACT
SIGN
Marcia Avenue
VAN TURNING RIGHT


HOLDEN


Gawler Avenue
SP
STOBIE POLE
TREE
GIVE WAY SIGN
TYRE MARK
EDGE OF ROAD
UNBROKEN ROAD LINE
0
5
10
SCALE(m)
TITLE:




N
W
E
S
Inkster Road
SPOON DRAIN
DRIVEWAY
Hillside Drive