"Hands-on"
As a naturalistic data collection method

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- Background: Monitoring road safety
  - Reactive vs Proactive measurement
  - Intermediate outcome measures
- The "Hands-on" measure
  - Reliability of the measure
  - Recent applications - Delineation
- Potential implications for road safety
  - Self-explaining roads
- Real-time speed feedback and driver behaviour
  - Intelligent Speed Adaptation

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Overview

- Intermediate outcome measures
  - Offer timely feedback on road safety solutions
- Speed most recognised
  - Sensitive to changes in driving environment
- Steering wheel grasp links to emergency control over the vehicle
  - e.g. Tyre blowout simulation (Sanders, 1981; Kline, 2001)

Naturalistic measure examples
Speed
Headway (to next vehicle)
Steering wheel reversals
Lane position maintenance
Gap size acceptance (when pulling into traffic)
Overtaking frequency
Lane changing frequency
Conversation with passengers
Cell phone use
Other activity use (e.g. Food/drink)
Seat position
Seat belt use
Child restraint use

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Background: Naturalistic observations

- The recommended driving position is the 10/2 o'clock hand alignment
- However drivers often deviate from this position. Why?
  - Task complexity of driving a particular section of road
  - Drivers perception of the risk
- Use as an evaluation tool

Key reference:
Walton, D., & Thomas, J.A. (2005). Naturalistic observations of driver hand positions. *Transportation Research Part F. Traffic Psychology and Behaviour, 8*, 229-238.

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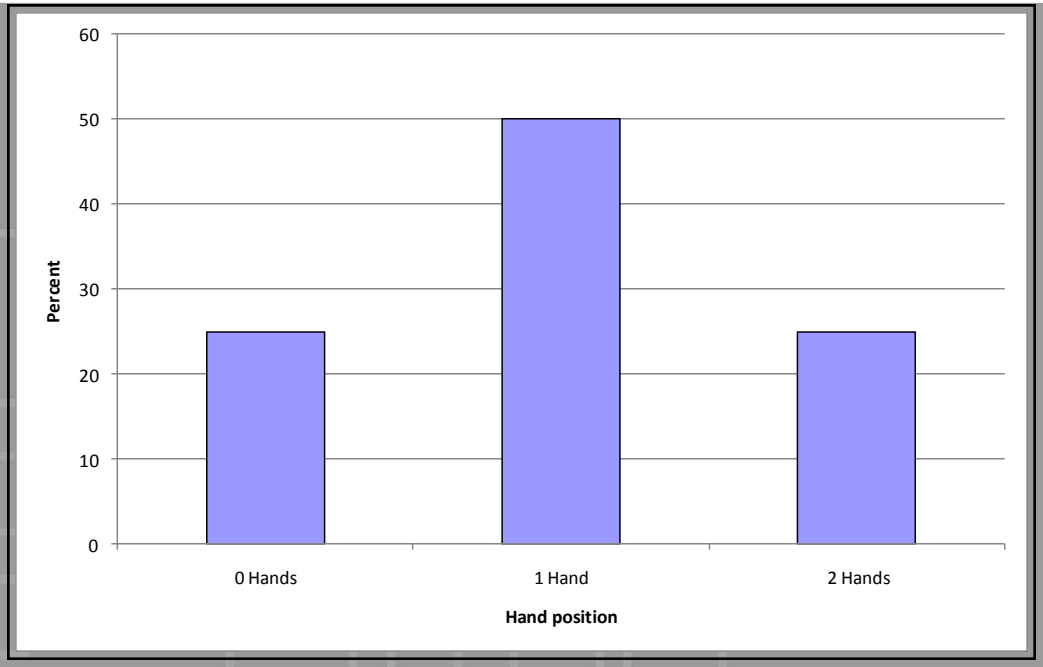
The "Hands-on" Technique



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Hand positions

			Number of hands on the top half of the steering wheel					
			Zero		One		Two	
		N	%	AR[a]	%	AR[a]	%	AR[a]
Individual Factors								
Gender	Male	1225	18%	0.2	**64%**	8.3	**19%**	-9.6
	Female	828	17%	-0.2	**45%**	-8.3	**38%**	9.6
	Total	2053						
Age	Under 60 years	592	**33%**	3.22	**48%**	2.41	**19%**	-6.32
	60 years and over	126	**18%**	-3.22	**37%**	-2.41	**45%**	6.32
	Total	718						
Vehicle Factors								
Vehicle type	Car	578	27%	0.6	**49%**	2.3	**24%**	-3.1
	SUV	618	25%	-0.6	**42%**	-2.3	**32%**	3.1
	Total	1196						
Environmental Factors								
Speed zone	50kph	1161	25%	-0.1	**55%**	4.3	**20%**	-4.8
	100kph	3643	25%	0.1	**48%**	-4.3	**27%**	4.8
	Total	4804						
Lanes	2-lane highway	3214	**26%**	4.2	48%	0.2	**26%**	-4.2
	6-lane motorway	429	**17%**	-4.2	48%	-0.2	**36%**	4.2
	Total	3643						

(a) Adjusted residuals (AR) over 2 indicate a significant finding and are highlighted in bold.

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Hand position findings

Examined driver hand positions over time

- Matched driver hand position within drivers at two points on SH1 that were10km apart
- 42% changed hand positions
- No evidence of habit or fatigue effects

Hand position change from top half of steering wheel	Percent
Removed two hands	2.2
Removed one hand	18.3
Stayed the same	57.6
Added one hand	20.1
Added two hands	1.7

Self-report regarding hand positions

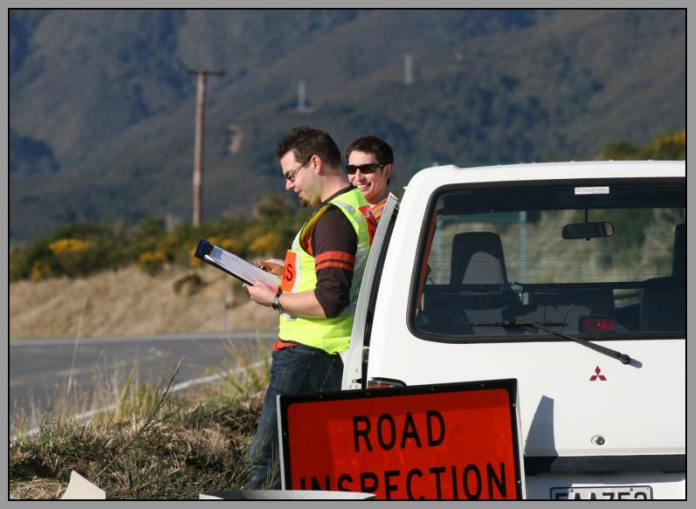
Item	N	Mean	Median	Mode	SD
Actual observed hand positions	1196	1.02	1	1	0.74
Your hand positions when relaxed	542	1.27	1	1	0.69
The most natural hand positions when driving	543	1.51	2	2	0.65
Your typical hand positions when driving	544	1.71	2	2	0.50
Your typical hand positions when tense	542	1.92	2	2	0.32
The hand positions that give you most control over the vehicle	547	1.94	2	2	0.24

Temporal and Contextual Reliability

		N	Number of hands on the top half of the steering wheel					
			Zero		One		Two	
			%	AR	%	AR	%	AR
Temporal reliability								
Day 1		324	23%	0.32	47%	0.78	30%	-1.12
Day 2		344	22%	-0.32	44%	-0.78	34%	1.12
	Total	668						
Contextual reliability								
Northbound		331	22%	-0.15	45%	-0.49	33%	0.66
Southbound		337	22%	0.15	46%	0.49	32%	-0.66
	Total	668						

Inter-rater reliability

- 92-97%
- Higher in slow speed zones



Improvements in the method:

- Observer elevation
- Typically at least 2 hours of data collection
- Use of naked eye preferable (over technology options)
- Use of paper and pen (over Dictaphone)
- Making rules to deal with:
  - A platoon of vehicles
  - Drivers shifting their hand positions
  - Hands loose vs hands gripping the steering wheel

Road Delineation Experiment

Conditions:

- Bright vs faded linemarkings
- Wet vs dry delineation

Key driver behaviour measures:

- Speed and Headway (TIRTL)
- "Hands-on" (with observers)

Methodological issues

- Night measurement
- Wet condition measurement

Key question:

Can improved markings demonstrate a shift to the pattern of driving seen in dry, daytime conditions?

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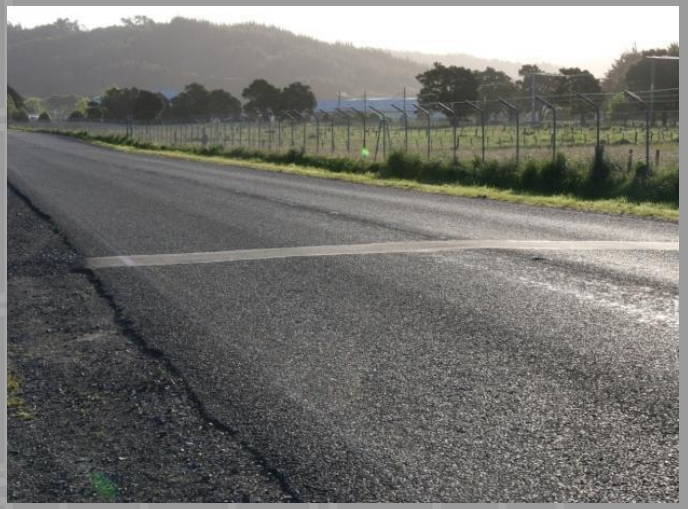
Recent experiment: Application to delineation

Generation 2 Night Vision Goggles

Hand-held infrared spotlight

Methodological Issues: Adapting to Night Conditions



Road markings before (38RI)

Road markings after (142RI)

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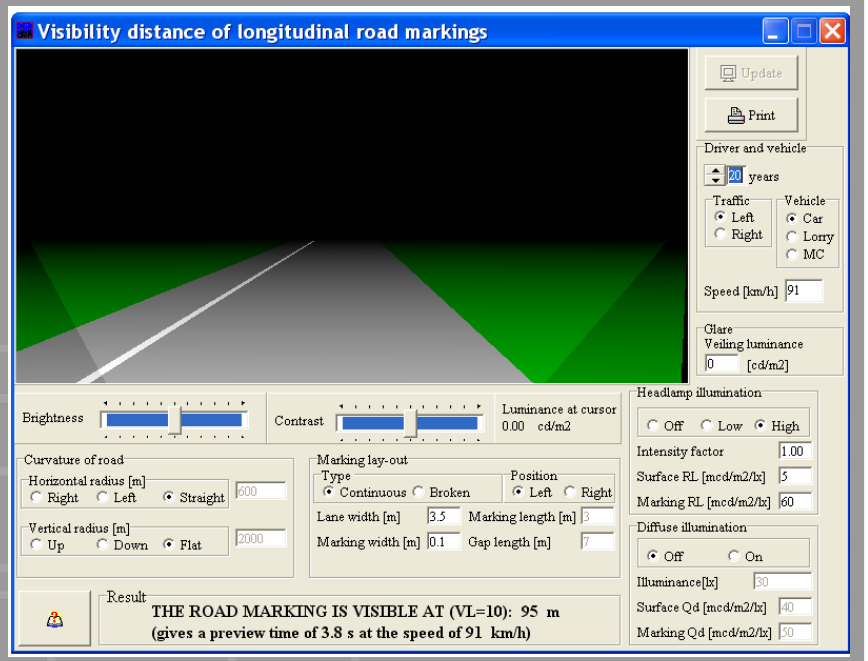
Brighter road marking intervention

Average sight distance improvement of 1.6 seconds (or about 35m)

		Alexander Rd (vehicles travelling at 71kph)			
		Before upgrade (38RI)		After upgrade (142RI)	
Headlight condition	Driver age group	Preview time (s)	Sight distance (m)	Preview time (s)	Sight distance (m)
Dipped headlights	16-25	2.8	65	4.1	91
	26-35	2.8	62	4.1	90
	36-45	2.8	62	4.0	89
	46-55	2.7	60	4.0	88
	56-65	2.6	58	3.9	86
	66-75	2.3	51	3.6	79
	76-85	1.8	39	2.9	64
Full headlights	16-25	3.1	68	5.3	117
	26-35	3.0	66	5.1	114
	36-45	2.9	65	5.0	112
	46-55	2.8	62	4.8	107
	56-65	2.7	60	4.6	102
	66-75	2.3	52	4.0	89
	76-85	1.8	39	3.0	66



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Visibility Distance Improvement

Hand positions at night

- Before and after results detected a change towards more comfortable driving conditions.
- 37% improvement towards daytime driving conditions

Speed and headway at night: No detectable statistical change

Measure sensitivity

- "Hands-on" may be a more sensitive measure (relative to speed or headway)
- For example, speed externally monitored

			Before upgrade (38RI)		After upgrade (142RI)	
		N	%	AR[a]	%	AR[a]
Hand Position	Other	146	69%	-2.07	84%	2.07
	Two hands	113	31%	2.07	19%	-2.07
	Total	259				
		N	Mean	SD	Mean	SD
Speed		281	75.50	9.61	74.20	9.63
Headway		29	2.00	0.87	1.90	0.64

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Brighter road marking results

Wet Conditions

- Site location 100kph speed zone (SH2)
- Rainfall was very heavy (10.2mm/hr)
- Limitations in wet conditions
  - Inter-rater reliability was lower in wet conditions (84.5%)
  - Wet night condition was not tested (night vision limitation)
  - Headway measurement accuracy issues
  - Dictaphones used to record instead of pen and paper

Wet weather delineation presents a challenging driving environment:

- 53% of drivers with two hands on the top half of the steering wheel
- Average vehicle speeds were significantly lower (by about 9kph)
- Wet delineation is the most difficult driving environment where roadmarking solutions could play a critical role

Dry conditions

Wet conditions

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Evaluation of any before-after design

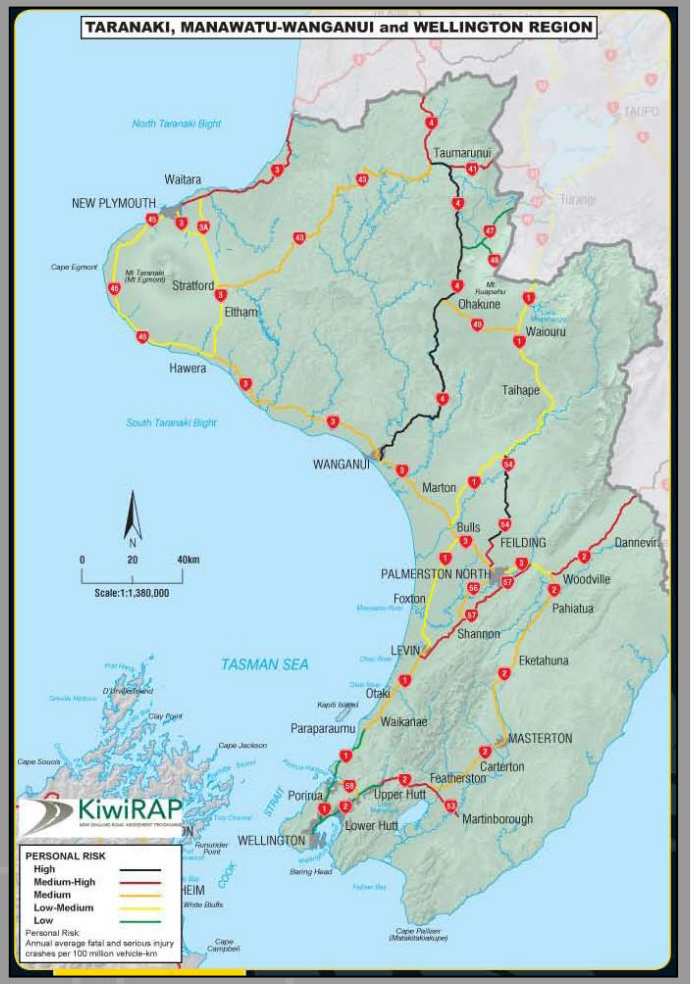
Especially any visual or tactile environmental feature in the road corridor, including:

- **Perceptual countermeasures** e.g. roadmarking narrowing and other perceptual speed interventions
- **Alterations to sight lines** e.g. edge marker posts or cats eyes
- **VMS Signs** e.g. effectiveness of safety messages

Transverse road markings – Before and after
Andrew Martindale

- Map the intuitive performance of different sections of the road network using hands-on
- Develop a baseline profile of "typical" behaviour
- Ability to prioritise problem areas:
  - Sections where actual risk is high (e.g KiwiRAP or crash prediction models) AND...
  - Drivers are more relaxed than typical

Percieved risk	Actual risk	
	Low	High
Low	✓	✗
High		✓



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Driver evaluation of self-explaining roads

Intelligent Speed Adaptation (ISA)

Research Purpose

- To encourage safe speeds and reduce crashes
- To investigate the issues associated with the deployment of ISA in a New Zealand context

Potential Benefits

- e.g. 8.4% reduction in fatalities and a 5.9% reduction in injuries (NSW Centre for Road Safety)
- Noise pollution and emissions reductions

Research Team

- MWH New Zealand Ltd, Opus, Institute for Transport Studies, University of Leeds
- NZTA

Field Trial

- Advisory ISA system to asses potential user compliance with ISA and the impact of ISA on driving

An example of an ISA device.

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An Investigation into the Deployment of an Advisory ISA System in NZ

ISA Typologies

- **Advisory:** displaying the speed limit and reminding the driver of changes in the speed limit

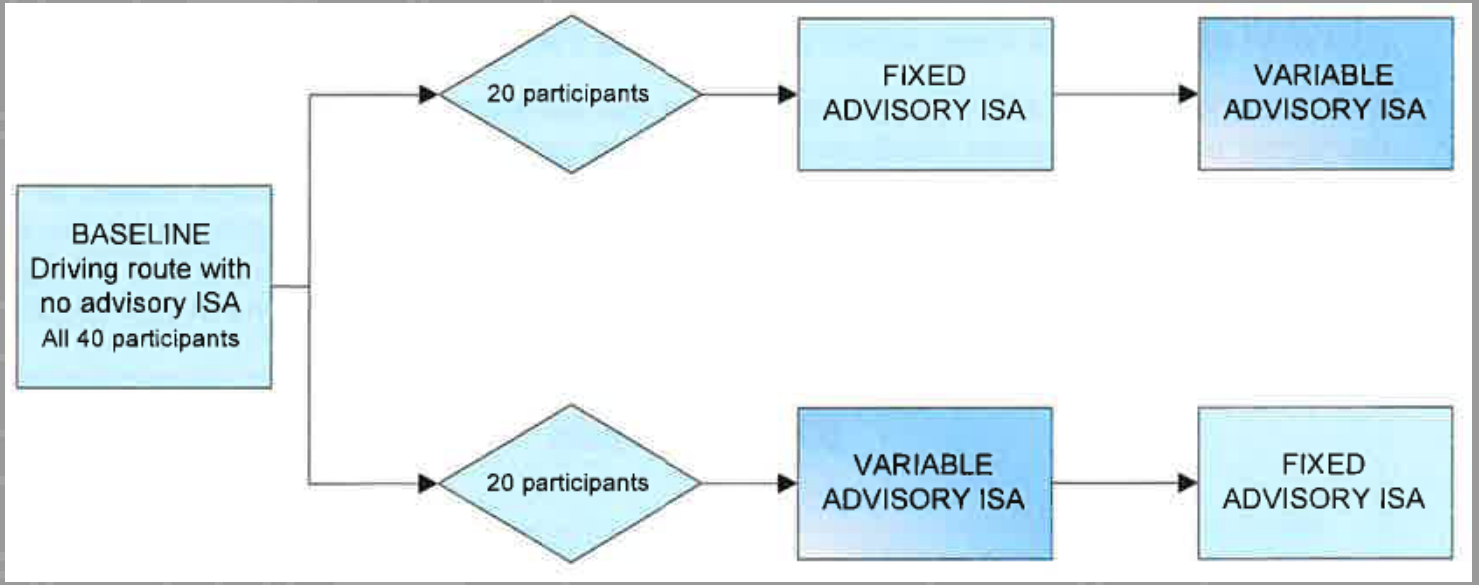
ISA Speed Limit Information

- **Fixed:** The vehicle is informed of the posted speed
- **Variable:** The vehicle is additionally informed of where a lower speed limit or advice is recommended (e.g. advisory curves)

How does it work?

- A portable ISA device can be plugged into your vehicle to provide real-time visual and audio feedback (beeps).

- The field trial looks at the impact of ISA on driving behaviour and the perceptions of users
- Test subjects will complete a questionnaire and then drive a pre determined route three times, with further questions to be answered following each run



- Driver's speed profiles are recorded and sent back to the Smart Car Technologies server

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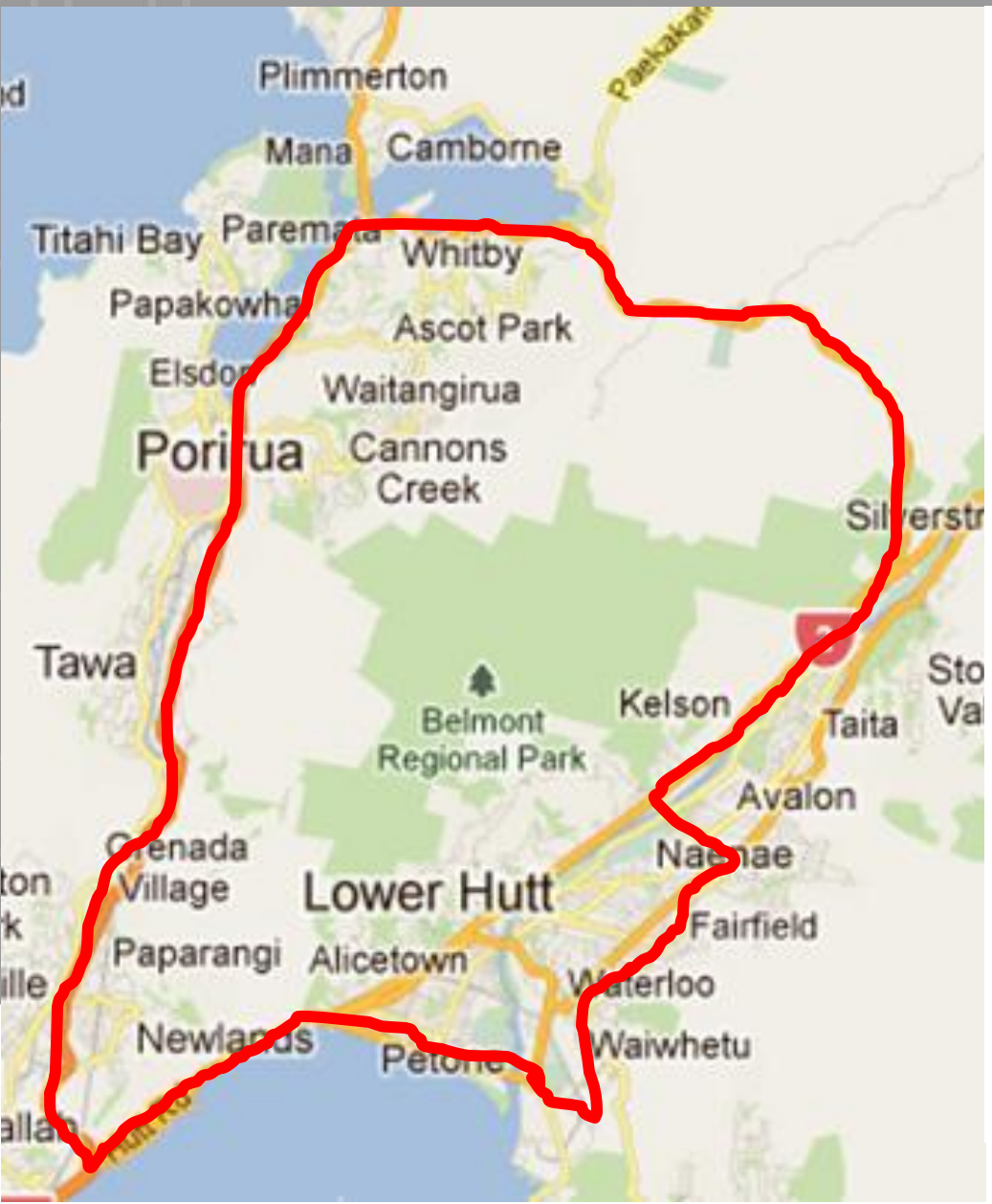
Field Trial Methodology

Proposed Survey Route



Opus Central Labs in Hutt Park Rd
→ Gracefield Rd
→ Bell Rd → Waiwhetu Rd
→ Naenae Rd → Daysh St
→ Fairway Dr → SH2
→ SH58 → SH1
→ SH2 → The Esplanade
→ Waione St → Seaview Rd
→ Parkside Rd → Opus Central Labs

- 56km long
- Mixture of roads, urban and rural, from local roads to motorway
- 10 speed limit changes
- 23 advisory speed limit signs, including one urban advisory on Waiwhetu Rd
- 2 rail crossings
- Speed humps on Bell Rd

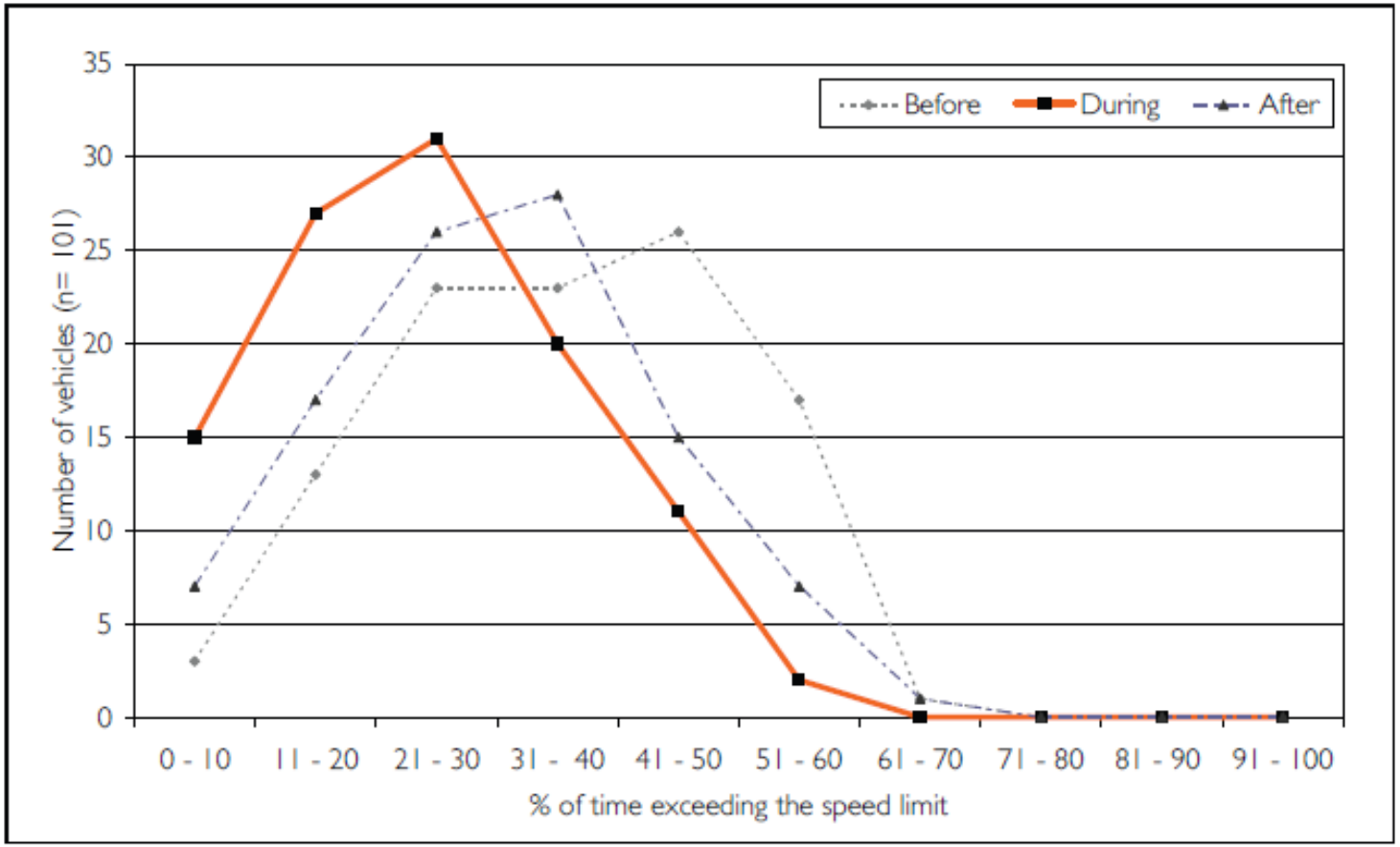


Figure 21: Number of vehicles by percentage of time spent exceeding the speed limit 'Before ISA', 'During ISA' and 'After ISA'

Source: http://www.rta.nsw.gov.au/roadsafety/downloads/isa_trial/isa_trial_final_results.pdf

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Potential benefits of ISA

Overview

- Hand positions
  - Reliable naturalistic measure
  - Examines how drivers naturally perceive adapt to different driving conditions
  - Potentially more sensitive than speed or headway
  - Combined measurement provides a stronger monitoring tool to examine design improvements

- Driver feedback systems (e.g. ISA Trials)
  - Technology to alert drivers to real-time changes in the driving environment
  - Possibility of rewarding speed-compliant behaviour