Median Barriers

Protecting people from serious road trauma: a compendium of current knowledge on median barrier performance and cross-section considerations

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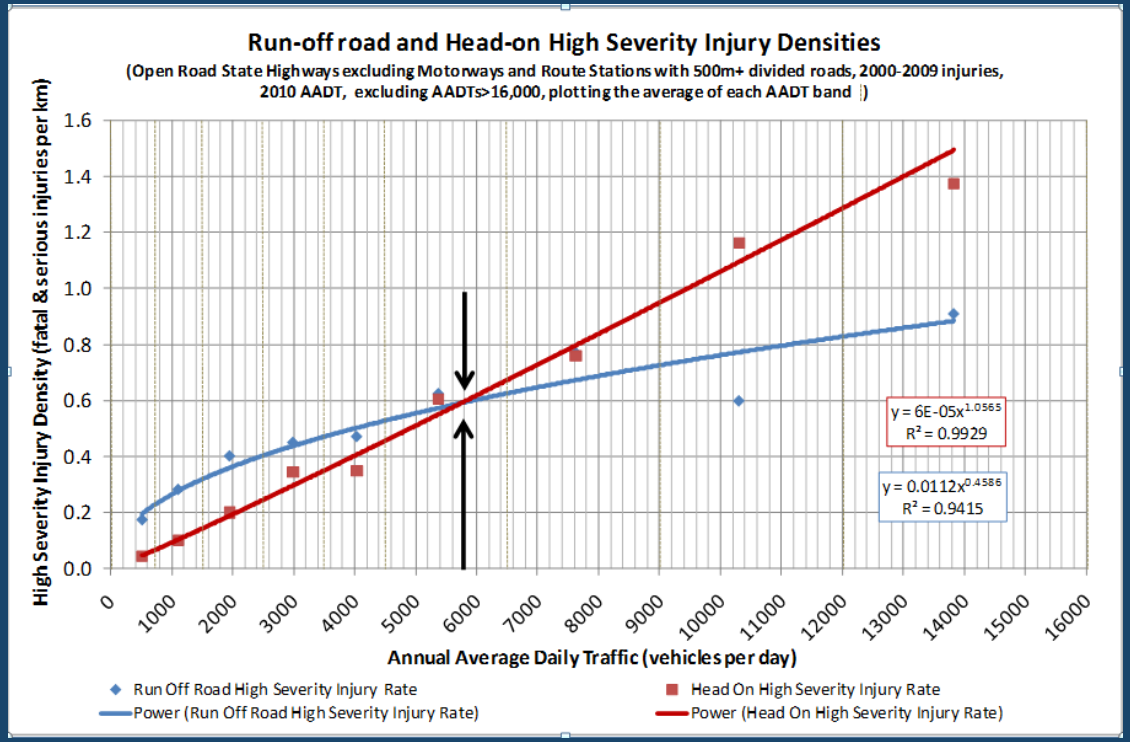
The Problem

On State Highways, more people die in head-on crashes than any other crash type

Half of all NZ road deaths happen on SHs. Half of the deaths on SHs are due to head-on crashes

Head-on crashes become the predominant DSI crash type once traffic volumes rise above about 5,500 vpd



Median barriers save lives

Innovative approaches will be needed to maximise Road to Zero outcomes

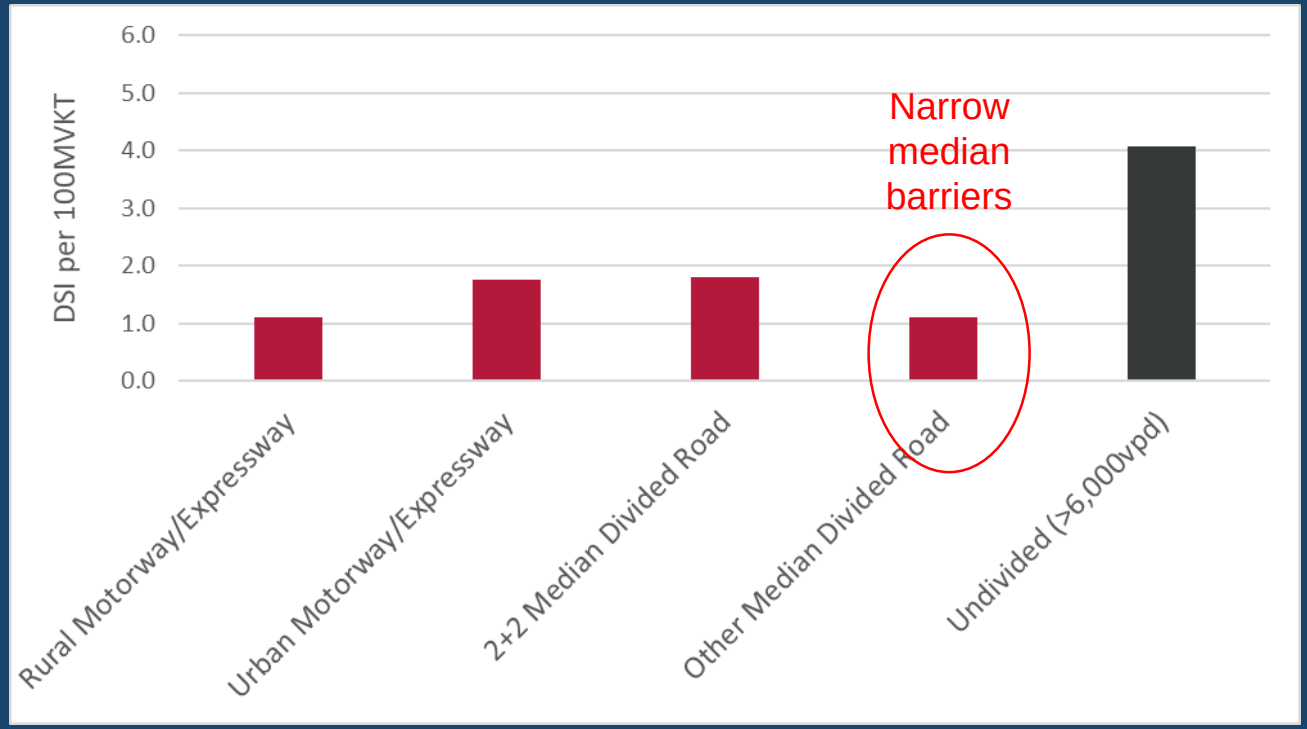
- Johansson (2008) – roads fitted with median and side barriers have been proven to reduce deaths by 85-90% in Sweden

- Roads treated with median barrier typically achieve a DSI reduction of around 65% and are the next level down preferred treatment if 3-rows (median and roadside) cannot be achieved

- As well as virtually eliminating head-on DSIs, median barriers also reduce run-off-road DSIs by around 40-50%

Transport Agency Board feedback on the Road to Zero consultation document - *The Transport Agency is fully committed to playing its part in achieving the trauma reduction target ultimately agreed by Government, whether this is 40 percent, 50 percent or 60 percent. If 40 percent is set, we would welcome opportunities to explore greater levels of ambition as implementation progresses, with for instance, developments in technology that may enable more rapid progress.*

Safety comes from separation of conflicts

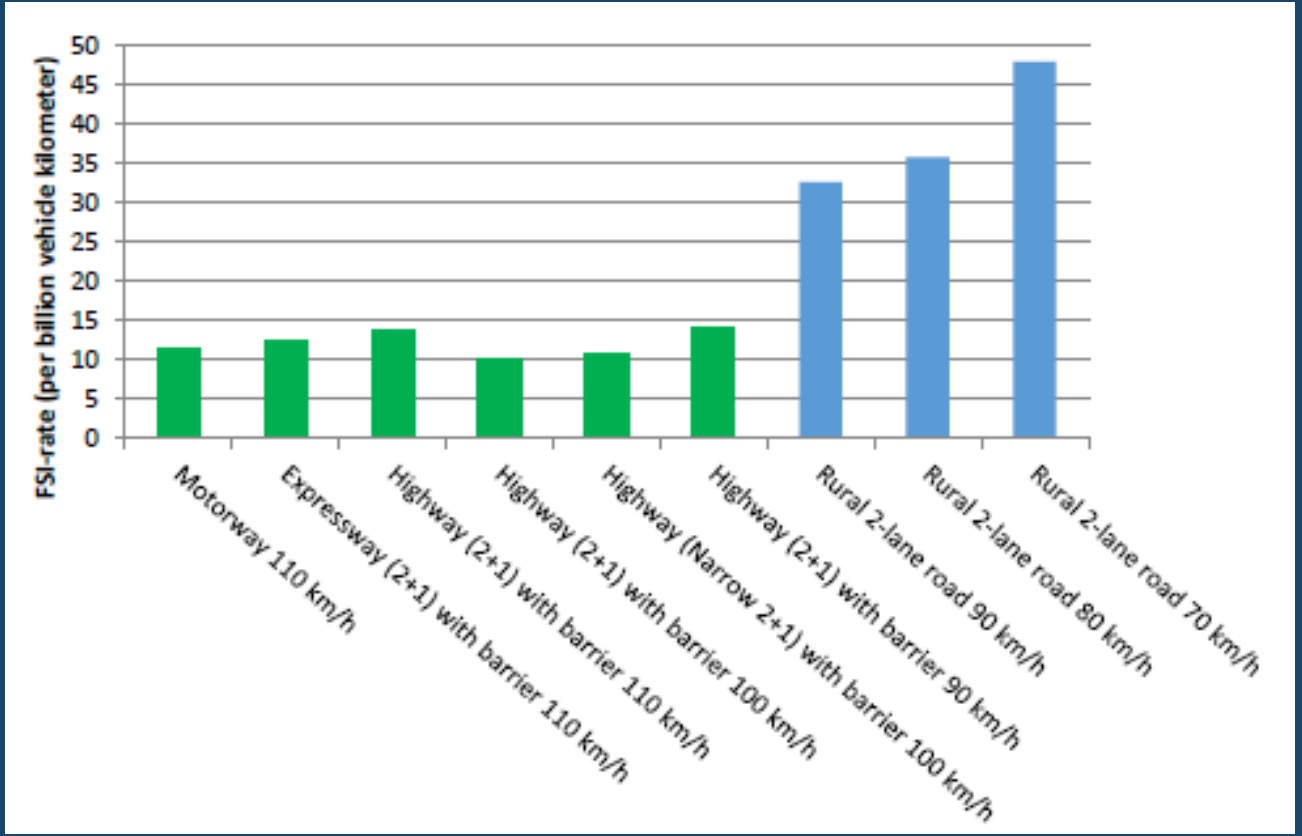


O'Neil and Marsh (2019) – The DSI rate on all roads with median barriers in NZ is less than half that for undivided roads. Narrow median cross-sections perform as well, and in some cases better, than other median barrier layouts. The predominate factor behind the improved safety performance is the separation of conflict through the use of barriers, rather than the number of lanes or cross-section details.

Sweden results are essentially the same

Results in Sweden are very similar to those in NZ (note scale differs by a factor of 10)

Green columns indicate roads fitted with median barriers. Blue columns indicate undivided roads.



Johansson (2008) – roads fitted with median and side barriers have been proven to reduce deaths by 85-90% in Sweden

Median barriers are a primary Safe System intervention

Road to Zero calls for Primary Safe System interventions wherever possible

Austroads recommended Primary Safe System treatments for head-on crashes.

Table 4.6: Head-on treatments

Hierarchy	Treatment	Influence (E = exposure L = likelihood S = severity)
Safe System options ('primary' or 'transformational' treatments)	• One-way traffic • Flexible median barrier • Very wide median • Very low speed environment/speed limit.	L S S L, S
Supporting treatments (compatible with future implementation of Safe System options)	• Wide median • Painted median/wide centrelines.	L L
Supporting treatments (does not affect future implementation of Safe System options)	• Non-flexible barrier provision • Lower speed environment/speed limit • Ban overtaking • Skid resistance improvement • Audio-tactile centreline • Audio-tactile edgeline • Roadside barriers • Consistent design along the route (i.e. no out-of-context curves) • Consistent delineation for route • Overtaking lanes • Improved superelevation.	S L, S L L L L S L L L L
Other considerations	• Speed enforcement • Rest area provision • Lane marking compatible with vehicle-lane-keeping technology.	L, S L L

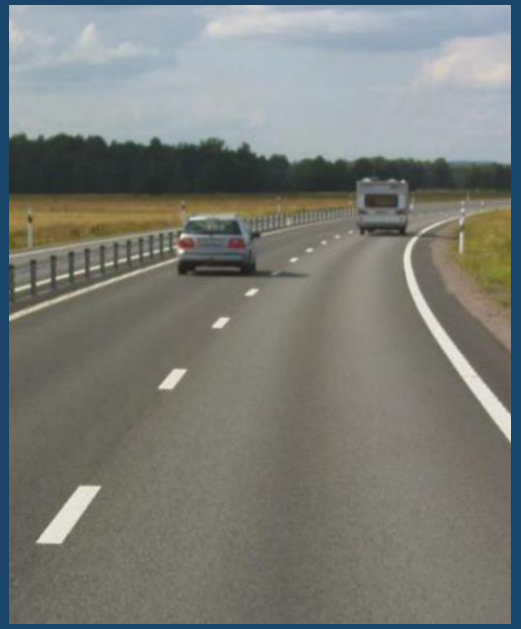
Narrow median barriers in Sweden

1+1 roads are 9-10m wide, to which the medians have been added without widening

Vadeby (2015) - deaths and serious injuries decreased by 63% on narrow 1+1 links treated with a median barrier.

For almost all of the road sections included in the research, the speed limit was also raised from 90 km/h to 100 km/h when the road was treated with median barrier.

Narrow 1+1 road, **width 9-10m**



2+1 road, width 13 m

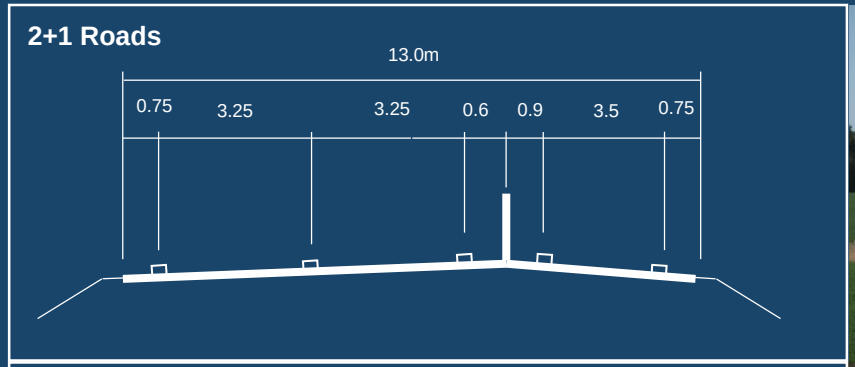
Median barriers in Sweden

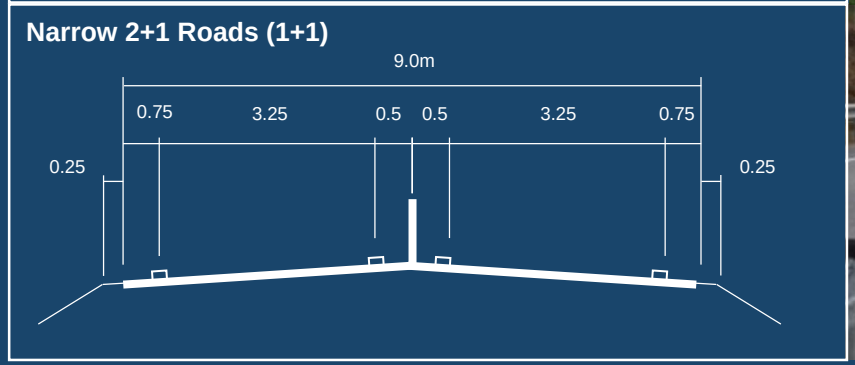
Sweden

- 5,000km median
- 73% travel on >80ph roads with median

NZ

- 350km median
- 20% travel on >80kph roads with median

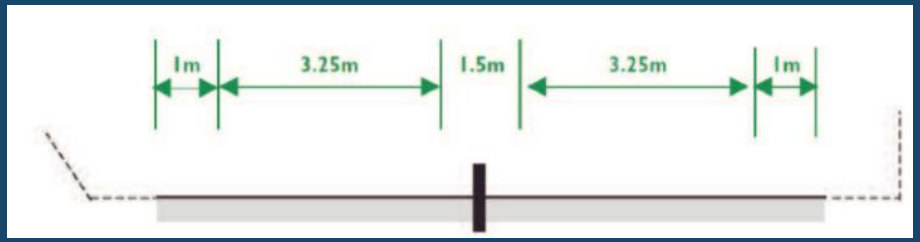




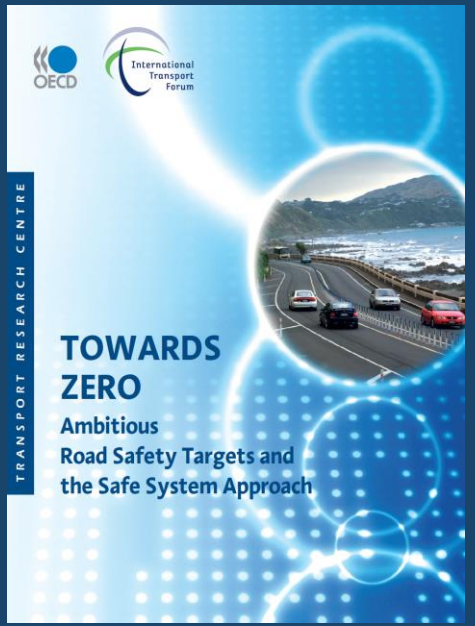
Bergh et al (2016) - emergency stops, break downs, incidents and accidents do not create more delays on 2+1 roads (both 2+1 and narrow 1+1) compared to other cross-sections in terms of total vehicle-kilometres travelled. This is largely attributed to the substantial cut in severe crashes.

Narrow median barriers in New Zealand

Centennial Highway is considered an international best-practice example



Centennial Highway has a 10m standard width



OECD (2008) Safe System Best Practice Guidance with Centennial Highway on cover

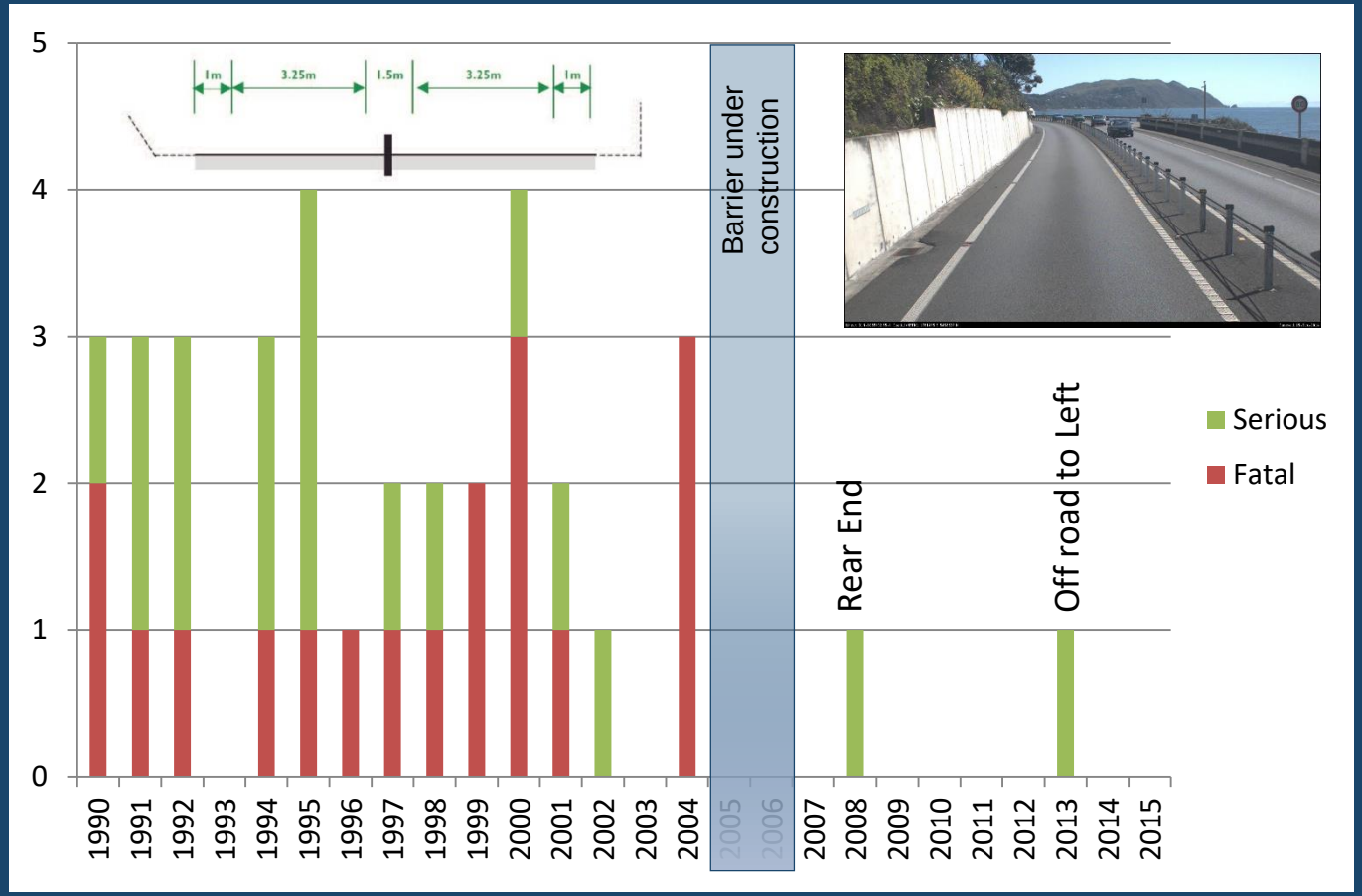
Centennial Highway Safety Performance

100% reduction head-on

95% reduction DSI

Cost of crashes

- Pre- $5.8M / year
- Post- $65k / year



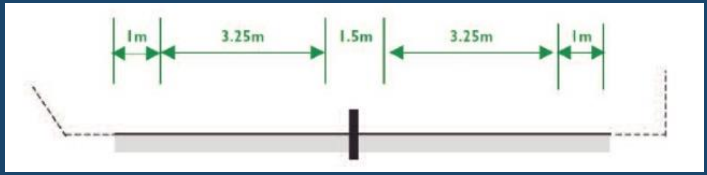
Centennial Highway

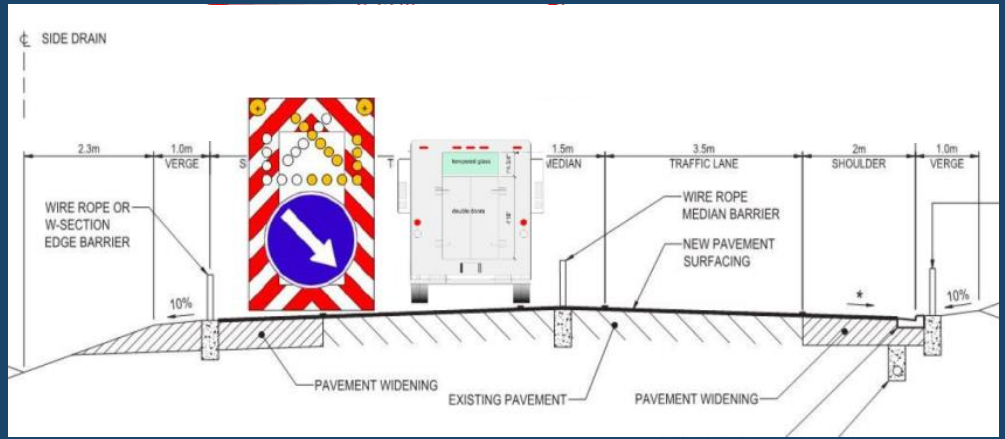
Even in a constrained environment there are often natural places to pullover if necessary

Very constrained section

Approx. 250m downstream

Operations & Maintenance





Centennial Highway and other locations such as Rangiriri have shown to operate successfully through innovative practices such as dropping barriers. There is room for wider capacity-building regarding these practices as well as further innovation.

Operations & Maintenance

Image showing median barrier being dropped on Centennial Highway to facilitate Stop / Go control during maintenance operations.

Operations & Maintenance

Gaps can be left in barriers to accommodate maintenance and some driveways if appropriate / necessary.

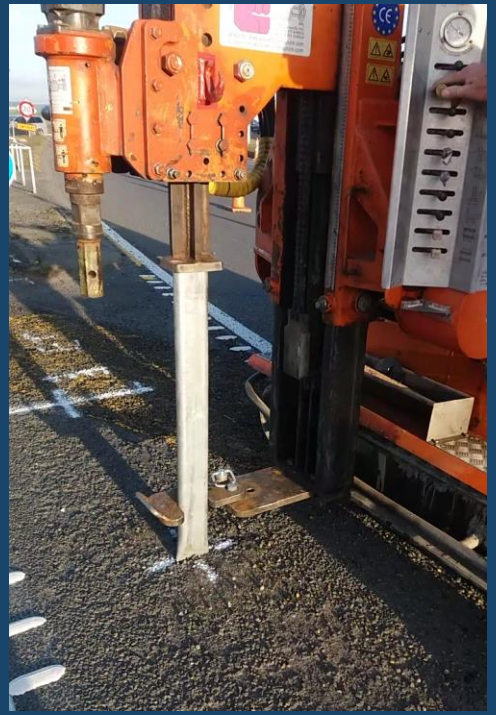
Pull over bays can also be provided if the environment is constrained over long lengths.

Innovations - driven posts

Experiences from Hawkes Bay Expressway

Advantages

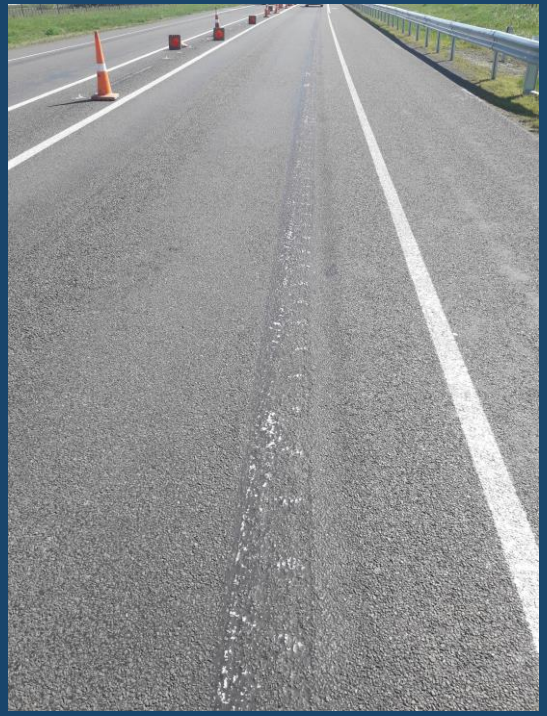
- More efficient installation time and cost
- One socket every 22 seconds (pavement dependent)
- No damage to existing wearing course during travel



Innovations - road marking removal

Experiences from Hawkes Bay Expressway

- Various removal methods have been tested with good results demonstrated



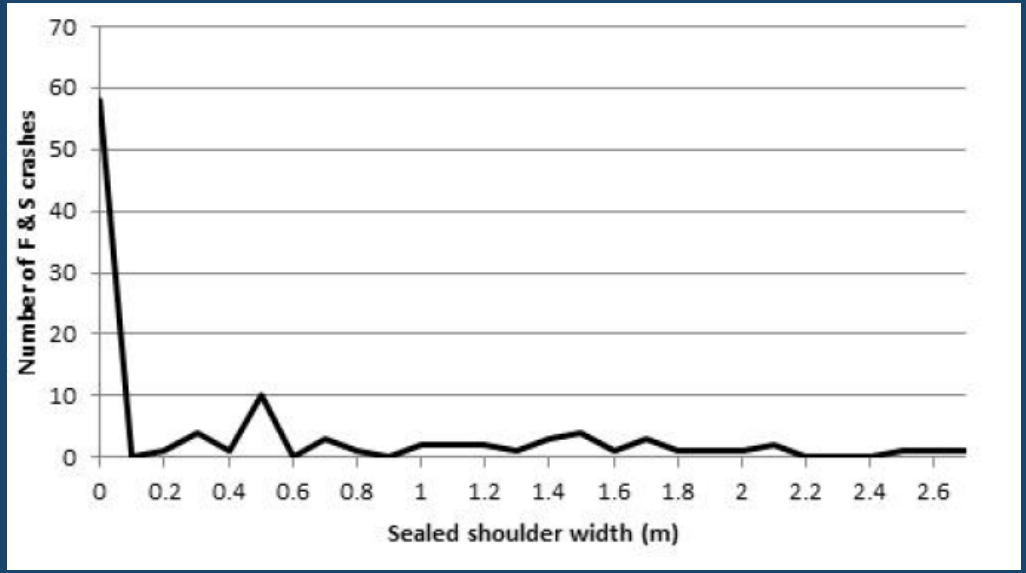
Provision for cyclists

A proposed 10m narrow median barrier cross-section would allow minimum 1m shoulder

Bergh et al (2016) - hard shoulder of 0.75m is considered acceptable for bicyclists and pedestrians on Swedish 2+1 roads.

US FHWA - When providing paved shoulders for bicycle use, a minimum width of 1.2 m (4 ft) is recommended, However, even 0.6 m (2 ft) of shoulder width will benefit more experienced bicyclists.

Additional safety benefits for shoulder widths greater than 0.6m are negligible. If Safe System levels of protection are desired then physical separation is necessary.



Cycling Safety Panel Report (2014) - Same direction rural fatal and serious cyclist crashes by shoulder width 2003-2012

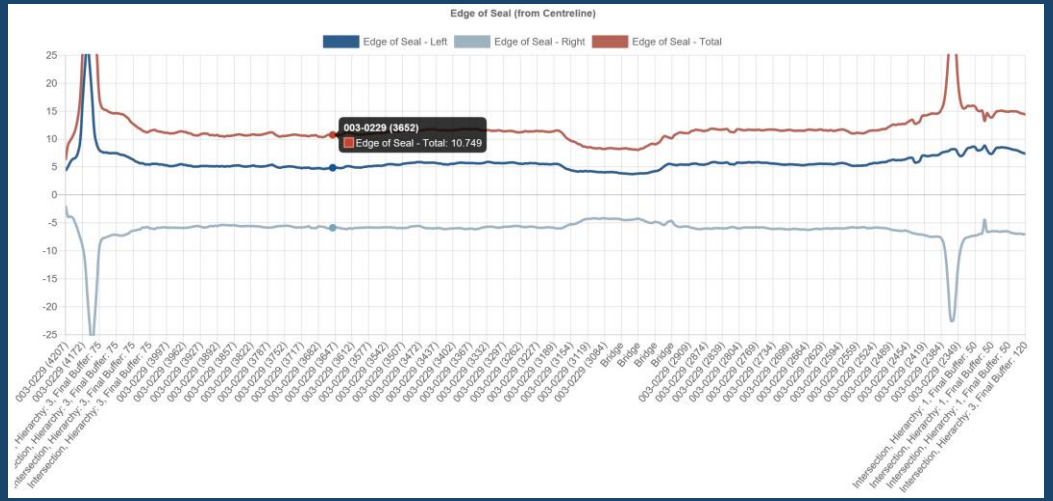
Cost considerations

Achieving same or similar road safety performance with greater cost efficiency

The cost of widening to accommodate median barriers on traditional wider cross-sections (12-13m) can be 5-10 times, or more, the cost of the median barrier - noting that 13m in Sweden would be sufficient to accommodate a 2+1 road.

Installation of median barrier on a 2.4km section of SH1 Cambridge to Pairere without widening was completed at $277k per km including all TTM, P&G etc, and $200k (total) of line marking.

This compares to an SSI cost range of around $1M-$3M per km for median barrier, which can be even higher depending on quantity of widening.



SH3 Waitara to Bellblock for example has >10.5m cross-section over almost the entire length except for the bridge, with significant lengths >11m. A median barrier could be accommodated without costly widening *(image created using output from X-Section tool and Lidar data)*

Median barrier retrofit effectiveness in NZ

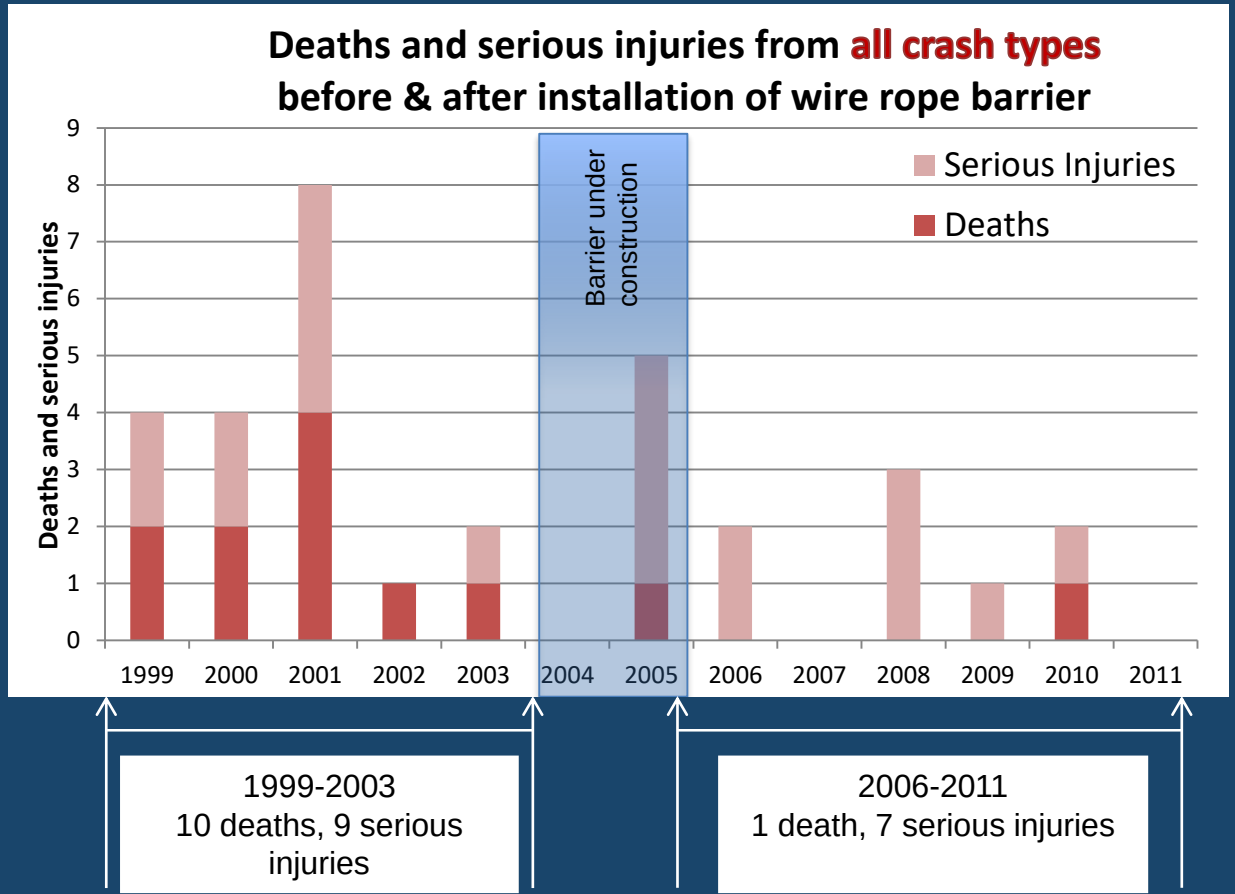
Overall DSI reduction of 67%

4 sites	38km	Before 18 DSI/year	After 6 DSI/year	92% reduction in head-on DSI
		Overall 67% Reduction in DSI		
SH1 Centennial SH1 Rangiriri SH2 Haywards SH58	38km of highway retrofitted with a median barrier	18 deaths and serious injuries per year on the 4 sites before a median was installed	6 deaths and serious injuries per year on the 4 sites after a median was installed	

SH1 Rangiriri

Rangiriri before & after

65% reduction in all deaths and serious injuries
100% reduction in head-on deaths and serious injuries

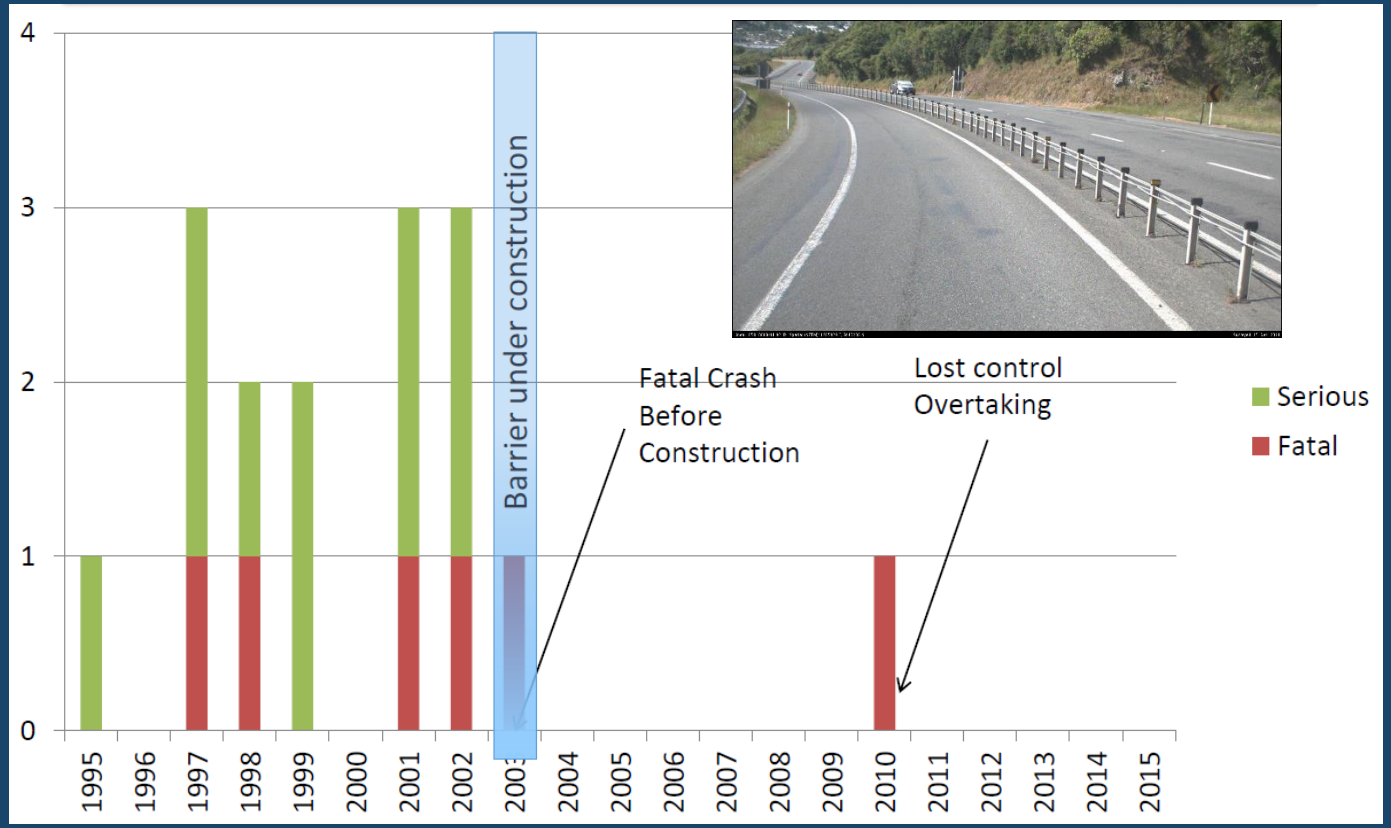


SH58 Haywards Hill

SH58 Haywards before & after

100% reduction head-on

95% reduction DSI



Another good example

SH1 Dunedin to Fairfield

Summary

Narrow median barriers

- Median barriers are a Primary Safety System measure proven to dramatically reduce DSIs compared to undivided roads even if alignment, road width, accesses or intersection arrangements are not ideal.
- Safety benefits are primarily derived from physical separation through barriers rather than the number of lanes or cross section width.
- Available evidence suggests maintenance is manageable and delays are no worse than other parts of the network.
- Narrow cross-sections as low as 10m in New Zealand and 9m in Sweden have proven effective and offer the same or similar level of safety performance to wider sections
- Narrow cross-sections are a cost-effective and innovative approach to achieving greater outcomes and levels of ambition