NZ TRANSPORT AGENCY
WAKA KOTAHI

High Risk Rural Roads Guide

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Safer Journeys

New Zealand Government

The *Safer Journeys* Safe System Vision

A safe road system increasingly free of death and serious injury

Why we need a different approach

Our current road transport system is not as safe as it could be.

International research suggests that even if all road users complied with road rules, fatalities would only fall by around 50% and injuries by 30%.

If everybody obeyed the road rules, New Zealand would still have many deaths and serious injuries on the road each year.

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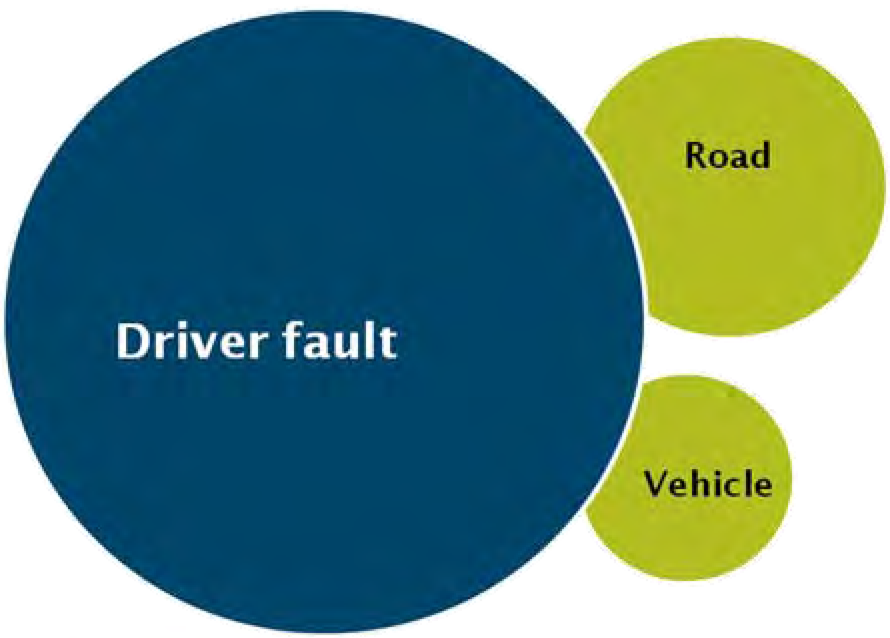
Compliance isn't enough

Traditional approach:
Target driver non compliance



Does not address crashes caused by simple errors

Targeting the driver doesn't protect people when crashes occur

Even when the driver is at fault, death is too high a price to pay

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Why the safe system approach is better

Safe system approach - Strengthen entire system

We aim to prevent serious injury by taking human fallibility and vulnerability into account

A forgiving system will reduce serious injury when a crash occurs

World best practice

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Four Safe System principles

Human fallibility

- 1 - People make mistakes and crashes are inevitable

Human vulnerability

- 2 - The human body has a limited ability to withstand crash forces

Shared responsibility

- 3 - System designers and system users must all share responsibility for managing crash forces to a level that does not result in death or serious injury

All of system approach

- 4 - It will take a whole-of-system approach to implement the Safe System in New Zealand

Principle 1 - Human fallibility

1. People make mistakes and crashes are inevitable

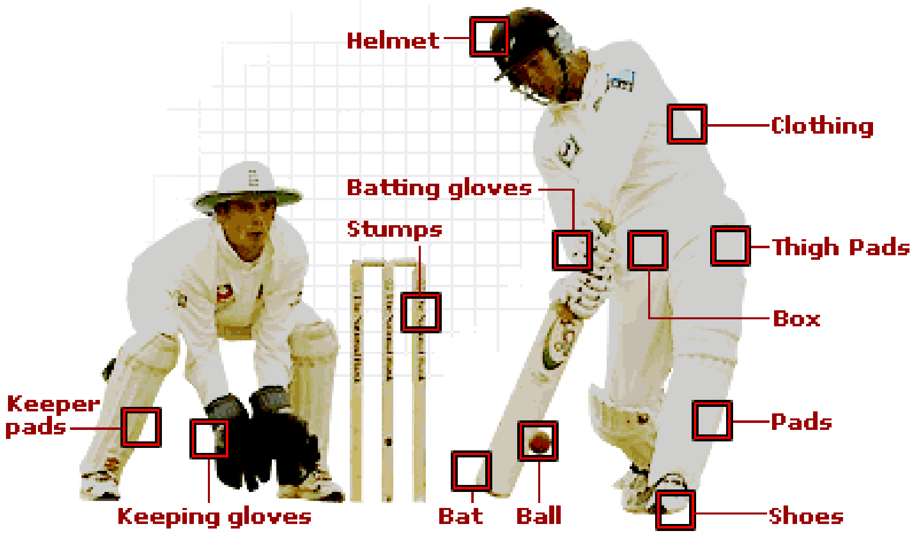
   No one performs perfectly 100% of the time

   No one should pay for a mistake with their life or limb

Principle 2 - Human vulnerability

2. The human body has a limited ability to withstand crash forces

Error may cause crashes, but injury or death is not an inevitable result.
What happens depends on speed at the time of crash and what protection is provided



Even if speed doesn't cause the crash, it affects crash severity
It's all a matter of physics: $k_e = ½m\mathbf{v}^2$

Principle 3 - Shared responsibility

3. System designers and system users must all share responsibility for managing crash forces to a level that does not result in death or serious injury

We need to identify the full set of system designers, both public and private sector

Principle 4 - Whole of system

4. It will take a whole-of-system approach to implement the Safe System in New Zealand

We must improve the performance of all parts of the system

We aim for higher star ratings for Our roads and roadsides, vehicles, operators, and users.

High Risk Rural Roads within Safer Journeys

Safer Journeys Strategy

Priority Area: Safe Roads and Roadsides

FIRST ACTION

Focus safety improvements programmes on high risk rural roads and [high risk urban intersections]
High Strategic fit for funding

Focus on Fatal and Serious Crashes (Head on, run off Road, Intersections)

High Risk Rural Roads Guide

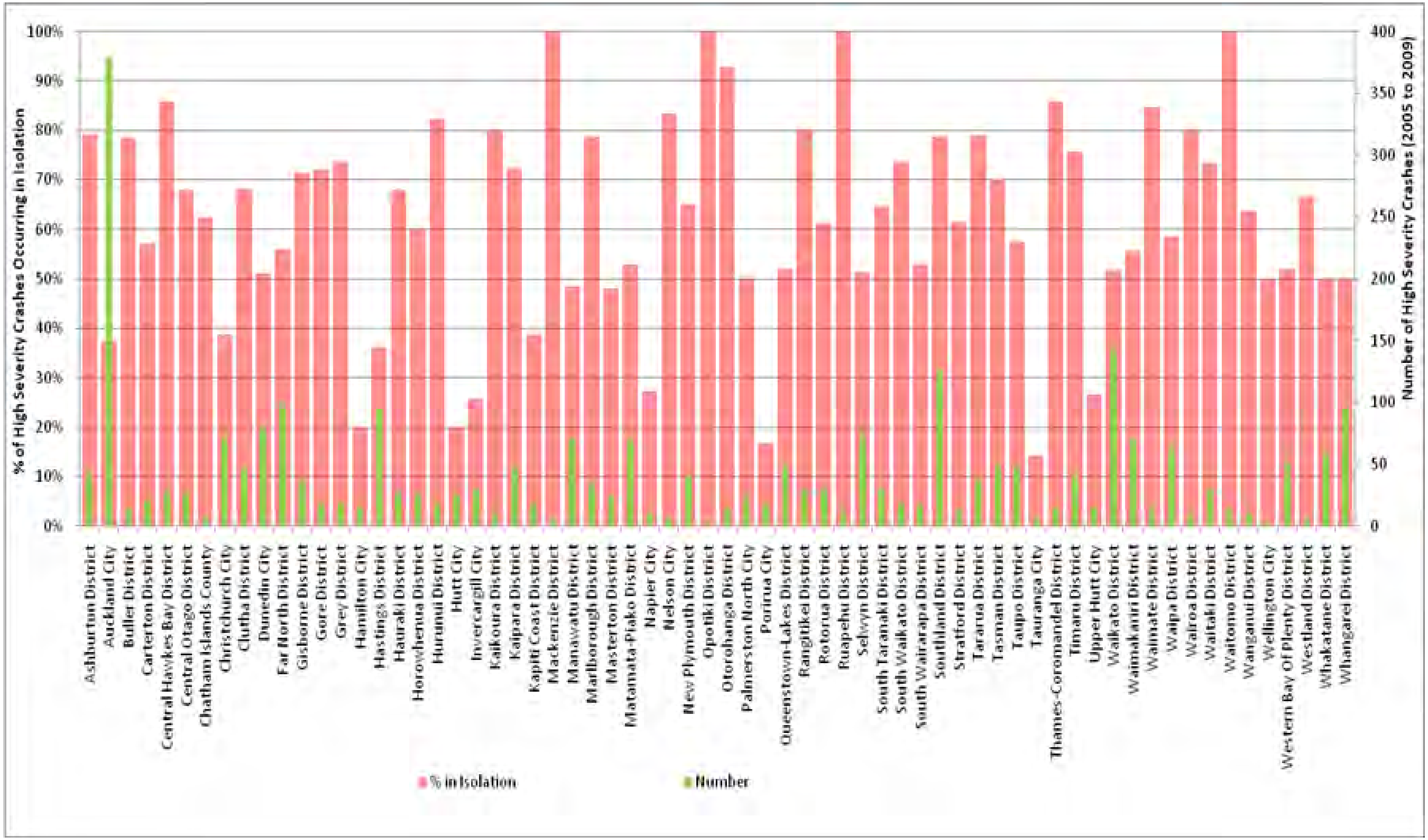
High Risk Intersections Guide (under development)

High Risk Motorcycle Routes Guide (under development)

Priority Area: Safe Speeds

Further Action

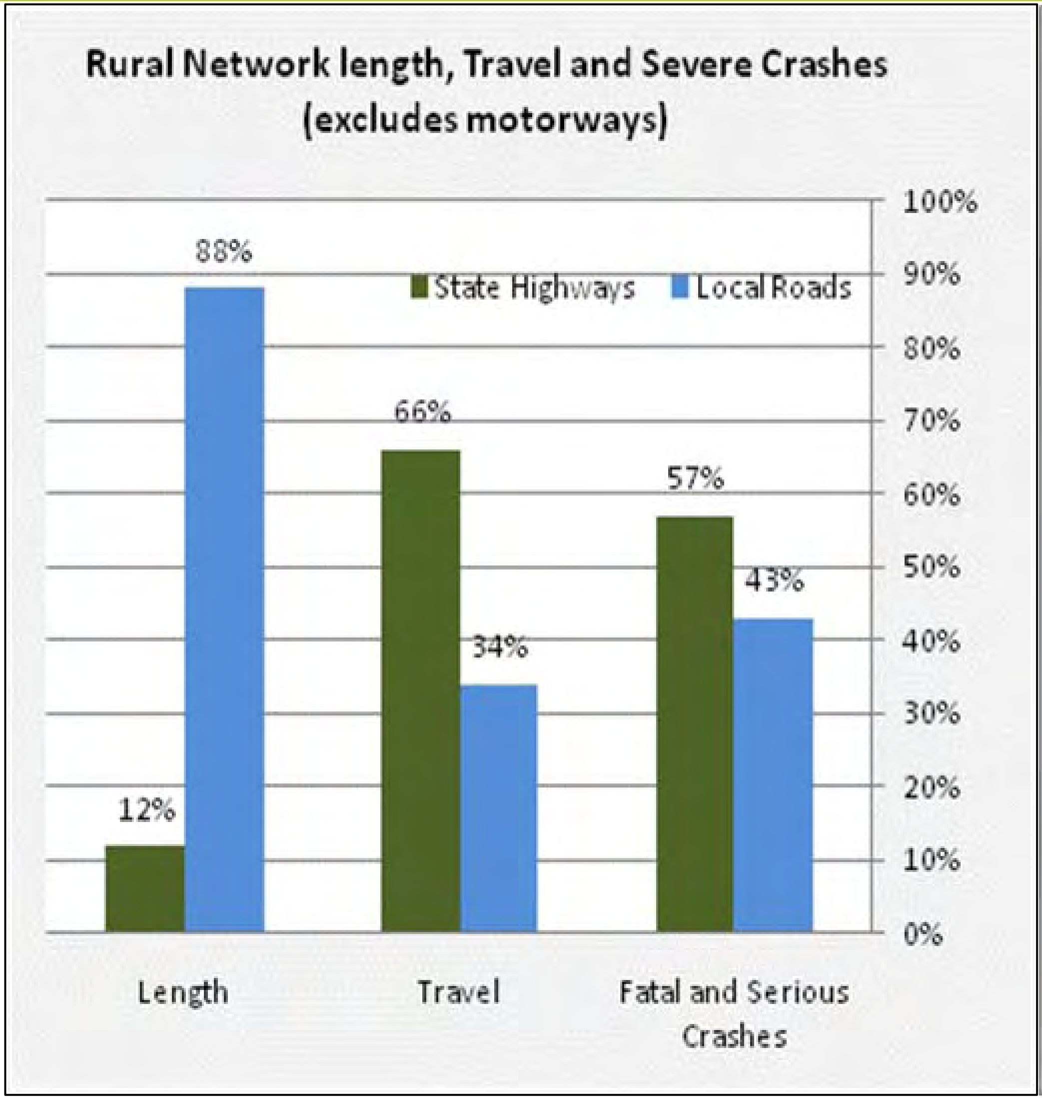
High Severity Crashes occurring in isolation

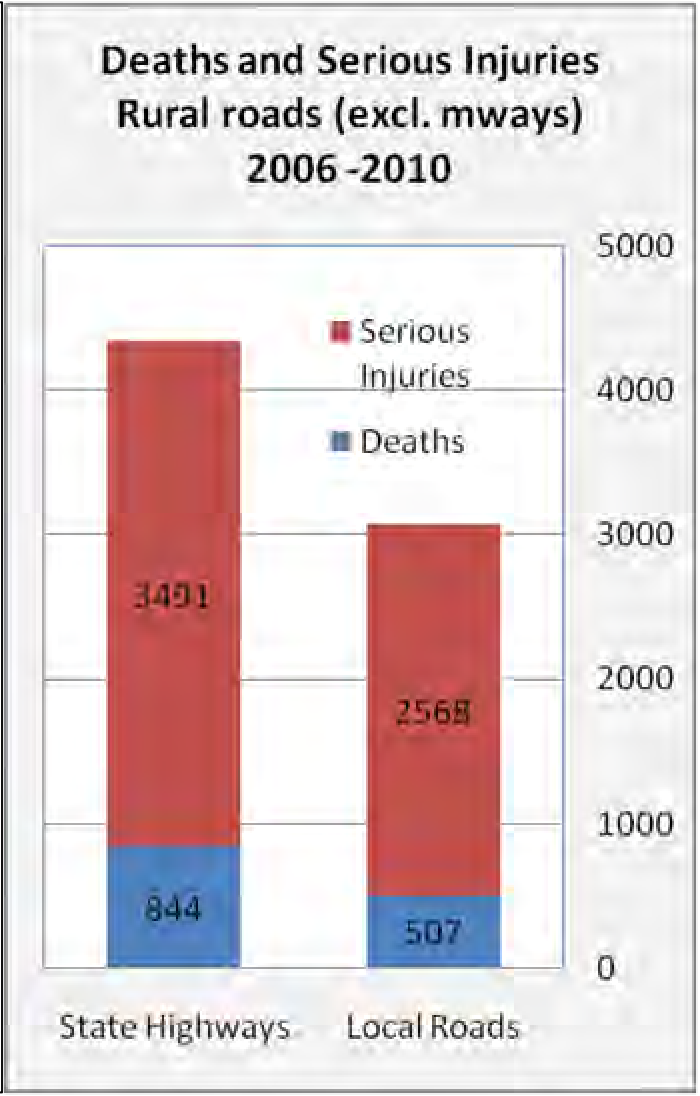


Structure of HRRRG

Section 2	Strategic Context
Section 3	Crash Priorities
Section 4	Identifying HRRR
Section 5	Countermeasures
Section 6	Programme, Monitoring and Evaluation
Section 7	Other references

State Highways and Local Roads





3 key crash types

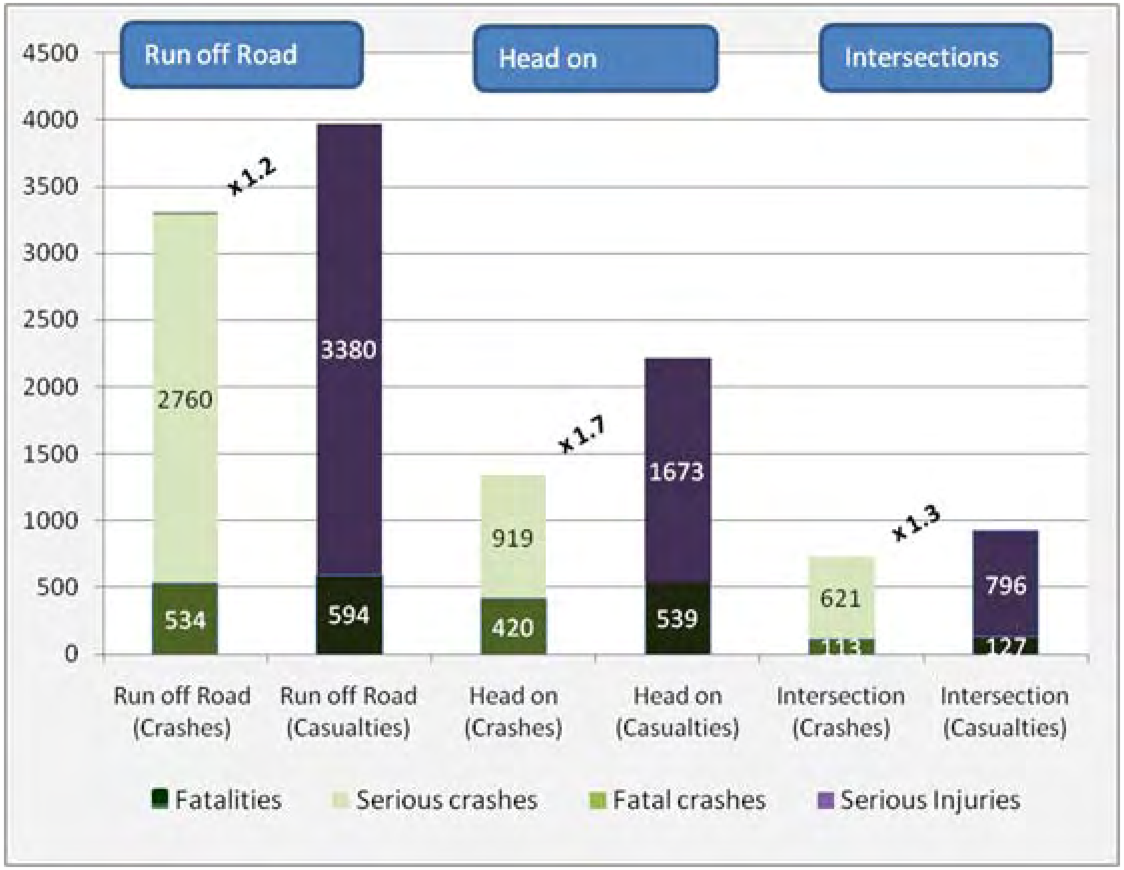


Figure 3-3: Number of deaths and serious injuries on *rural* state highways and local roads (2005–2009), excluding motorways)

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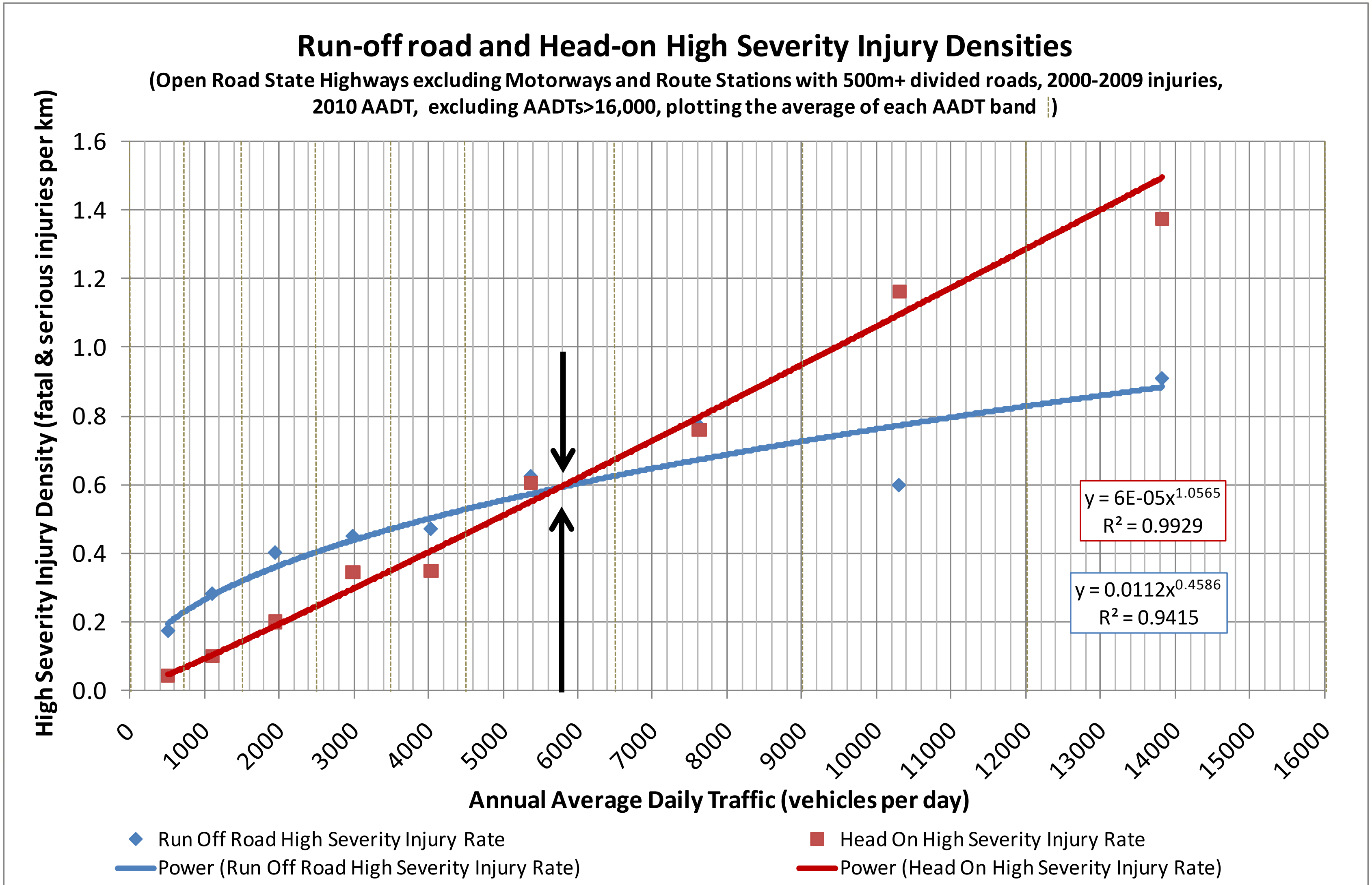
Run off Road / Head On injury density



What constitutes a HRRR

a high-risk rural road is classified as:

- a rural road where the **fatal and serious crash rate** (personal risk) **or crash density** (collective risk) **is high** compared with other roads
- a **high or medium–high collective** or **high or medium-high personal** risk route (as defined by **KiwiRAP**)
- a rural road that has features that are likely to increase the **potential for fatal or serious injury crashes** along a route as determined by the **KiwiRAP star rating** or road protection score (RPS), ie 1 or 2 star road or an Road Protection Score greater than 10
- an equivalent process such as the **Road Safety Infrastructure Assessment (RISA)** where the risk score is greater than say 2.0?

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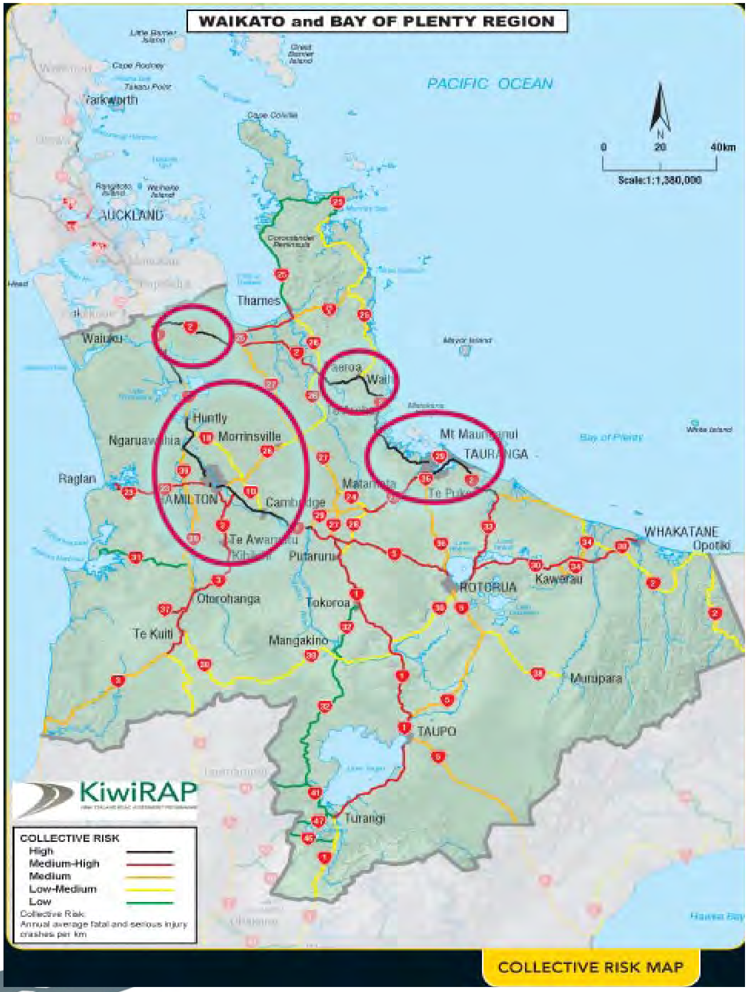
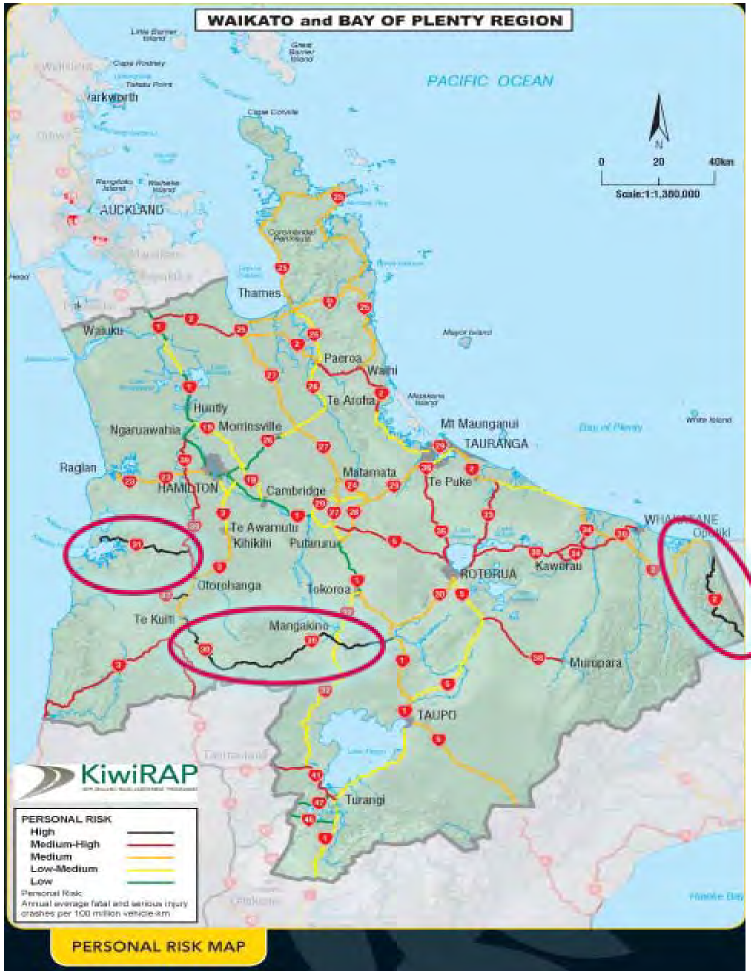
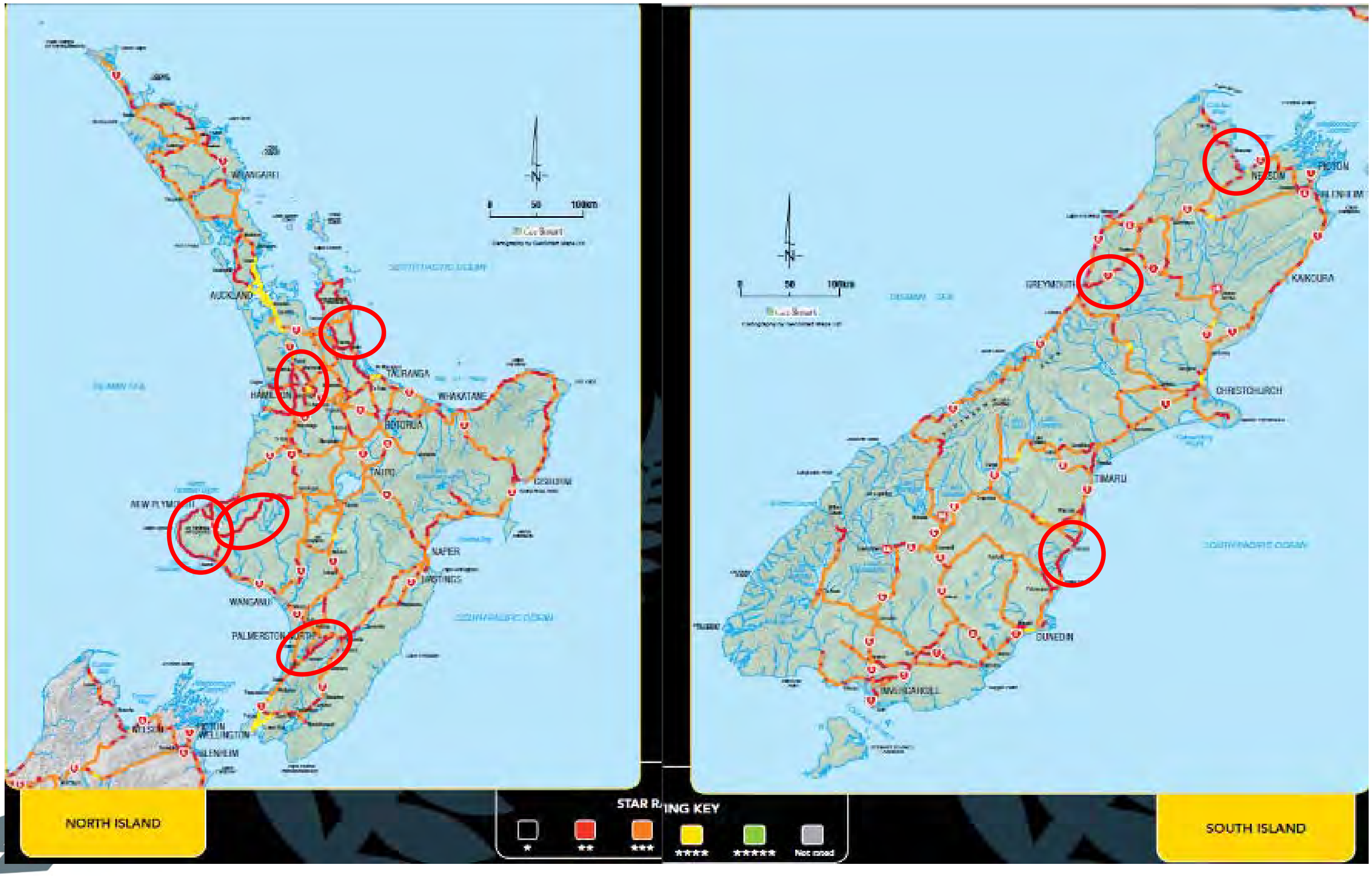
HRRR using KiwiRAP Risk Maps





HRRR using KiwiRAP Star Rating Maps



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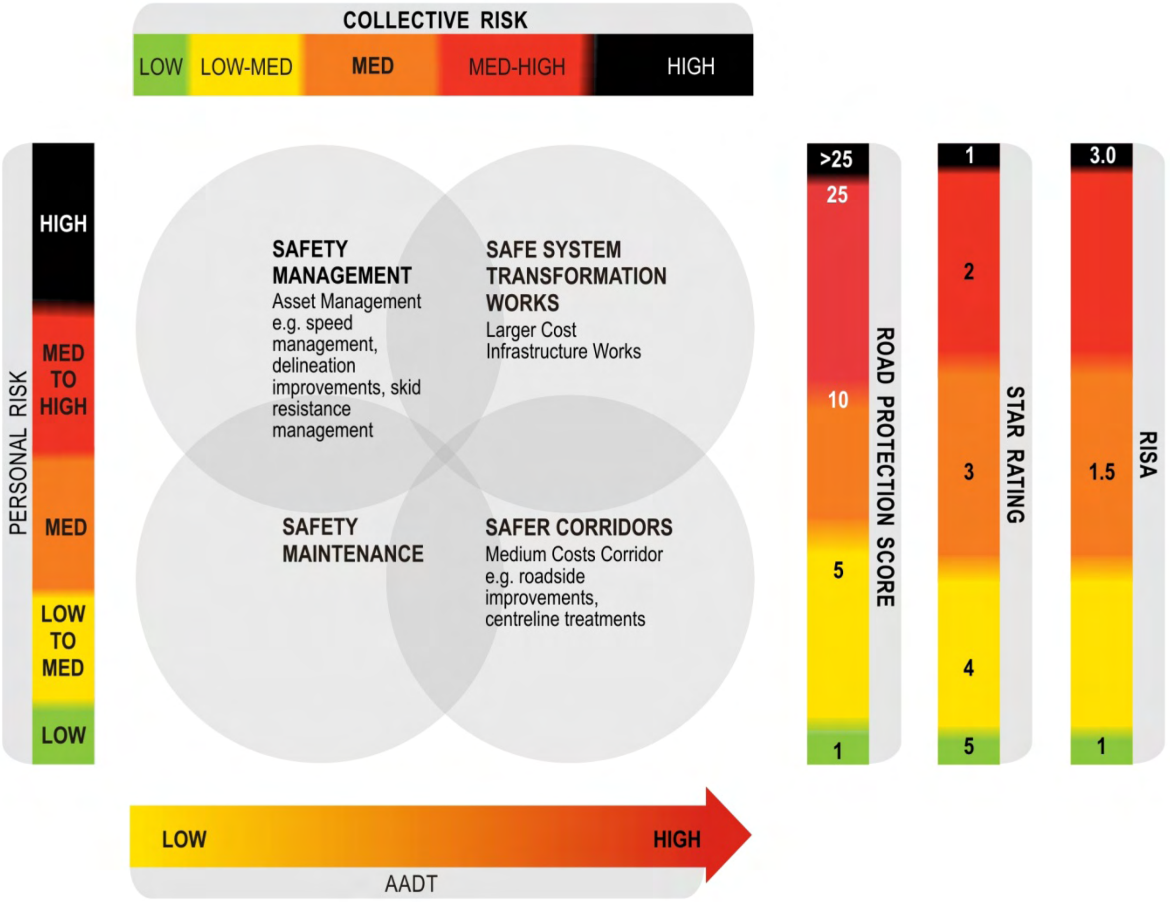
Treatment Philosophy Strategy



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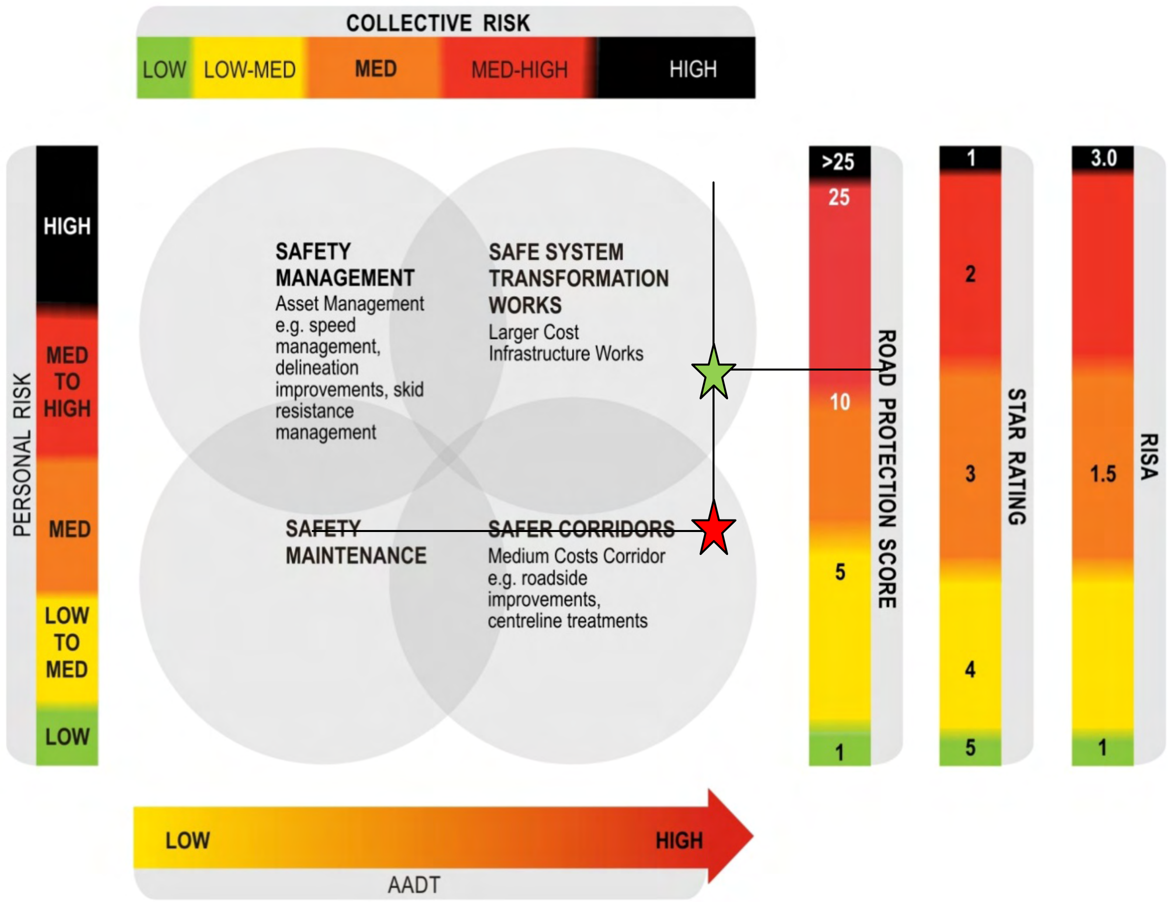
Treatment Examples – State Highway - Tauranga to Katikati

The 2008 KiwiRAP crash risk mapping (based on 2002 to 2006 crash data) identified 32 Black Routes, sections of state highway with the highest collective crash risk.

Using updated data to find collective and personal risk calculations; SH 2 is a Medium Personal Risk and a High Collective Risk.

Using the treatment philosophy strategy shows that this section of highway lies on the boundary between Safe Systems Transformation Works and Safer Corridors treatments (red star). However, using the KiwiRAP star rating of 2.8 (obtained from the KAT tool – figure 4-9) would suggest a greater focus on the road infrastructure improvements (green star).

SH2 Katikati to Tauranga Treatment Philosophy



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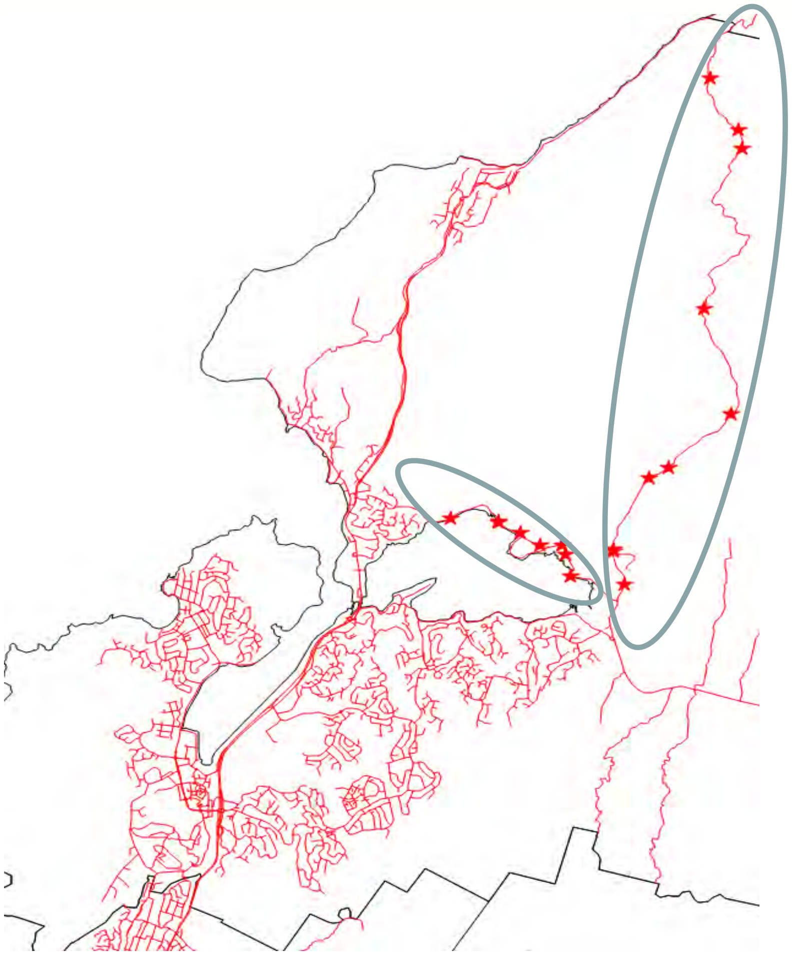
Local Authority Roads– using Collective and Personal Risk

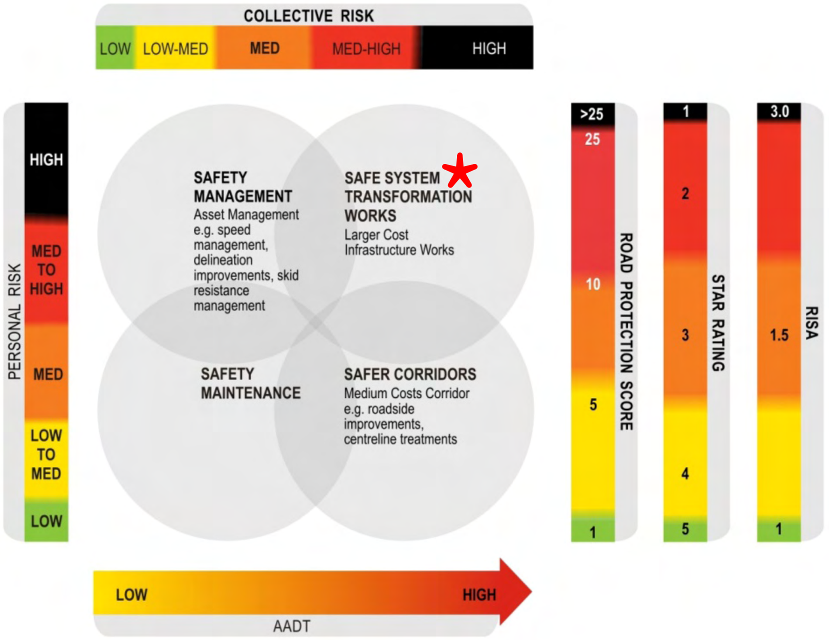
Grays Road is approx 4.8km of 80km/h rural road with eight high-severity crashes in five-year period 2004 to 2009. This rural section is relatively flat, but follows a winding alignment and carries approximately 5800 vehicles per day

Using risk calculations – High Personal and High Collective risk

Using the above risk , then safe transformation works would be the most appropriate (red star)



Local Authority Roads– using Collective and Personal Risk

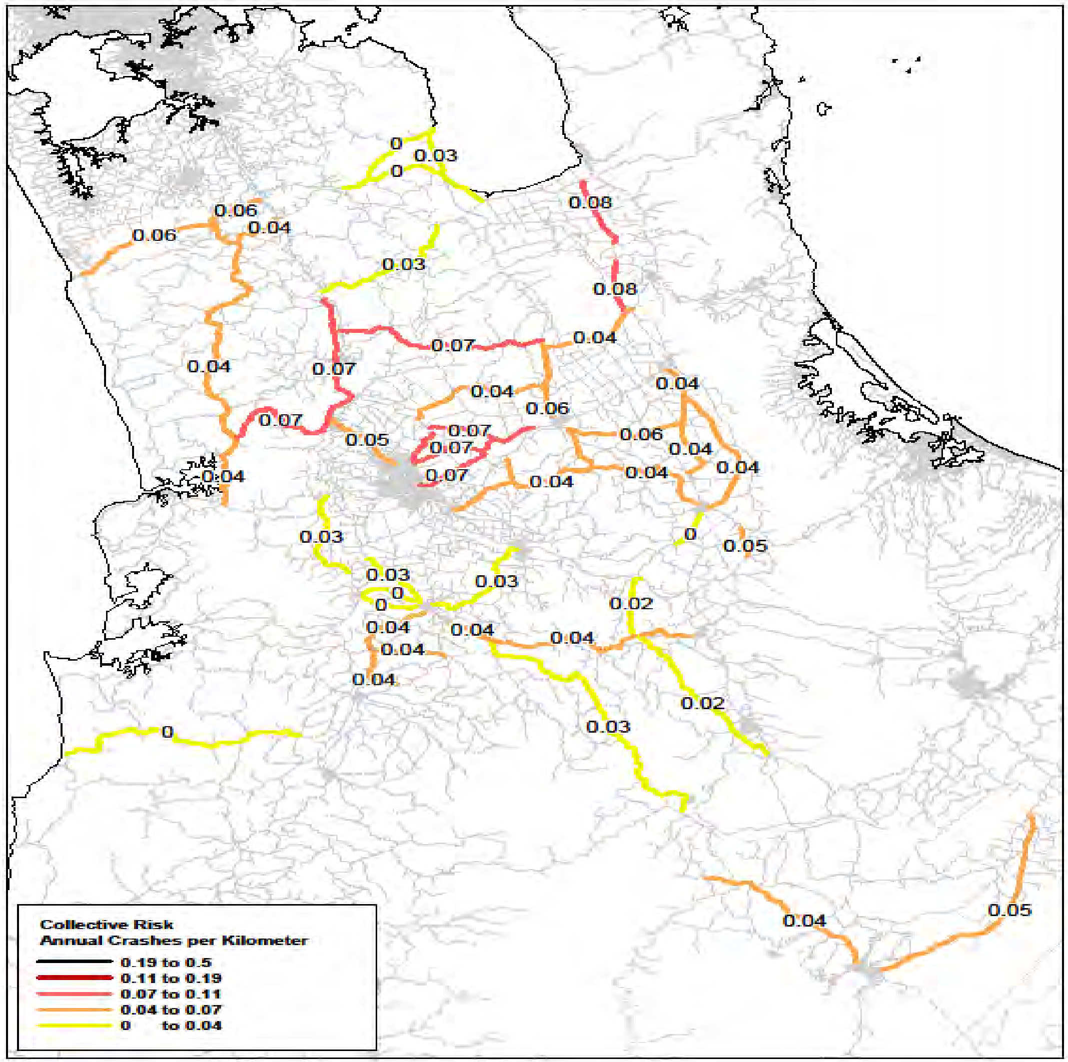


In some cases high cost measures cannot be justified.

The recommendations in the crash report uses safer corridors including improved skid resistance, delineation (signs and edge marker posts – EMPs) and some site-specific engineering measures

Further consideration could be given to determining the gap between the current operating speeds to determine whether a harm reduction speed would improve safety

Local Roads: *KiwiRAP Collective risk map*



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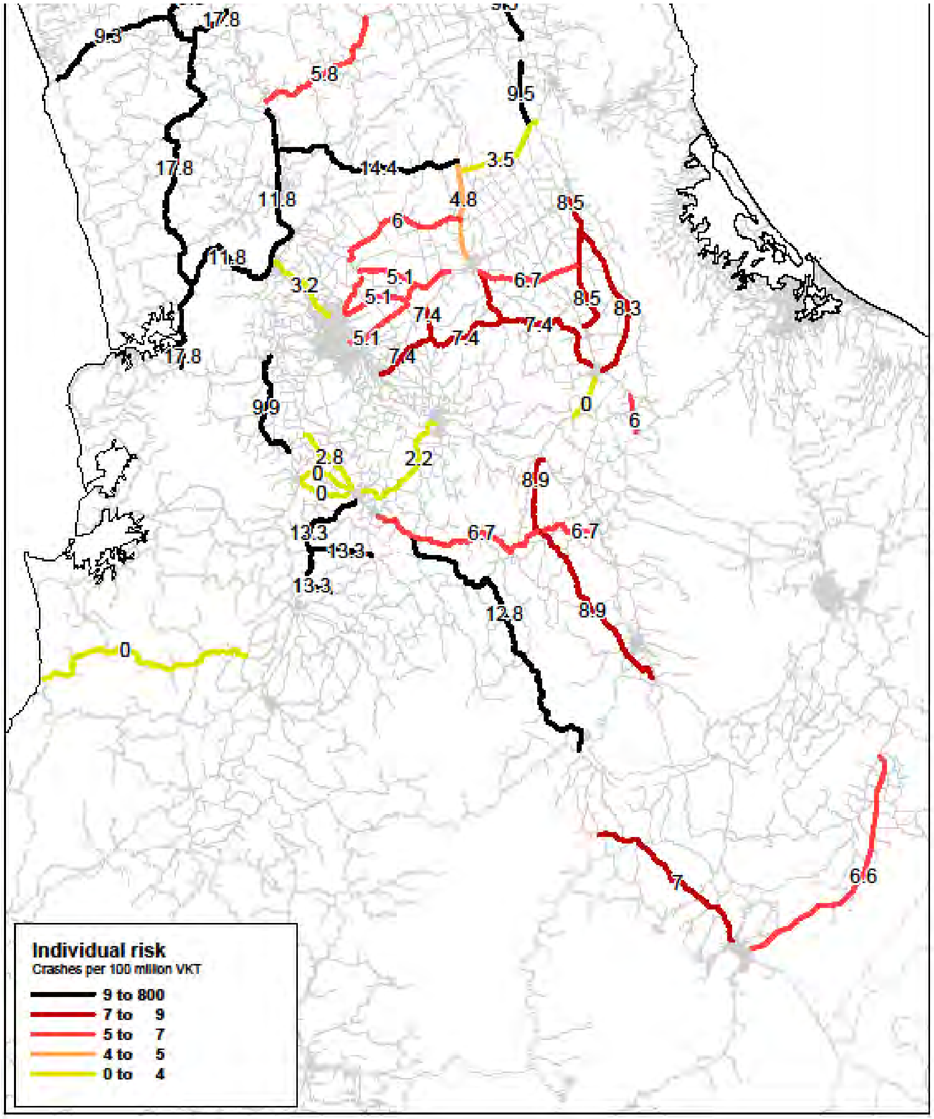
Local Roads: *KiwiRAP Personal risk map*



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Local roads

KiwiRAP Personal and Collective risk maps

Criteria for routes likely to have a High or Medium risk rating;

a. Volume >500 vpd,

b. Length >8km,

c. Fatal & serious injury crashes

3 in five years,

5 in ten years.

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Local Roads

KiwiRAP Personal and Collective risk maps

NZTA is assisting 4 demonstration clusters of RCAs to identify routes that are likely to have high or medium strategic fit for NLTP funding

- Northland
- Waikato & Bay of Plenty
- Mid Canterbury
- Southland & Queenstown

- For more information – Bill Greenwood

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Countermeasures – Treatment Philosophy

Treatment philosophy strategy	Description
Safety Maintenance	Maintaining rural roads to an appropriate standard in accordance with specified standard criteria. Example measures include maintaining skid resistance levels to current specifications.
Safety Management	Measures aimed at optimising safety levels through maintenance of the existing road network such as skid resistance. Generally, high personal risk roads with low traffic volumes will not warrant significant infrastructure investment. It will therefore be important to consider supplementing safety management on these routes with additional speed management (speed activated warning signs, etc), education and enforcement measures.
Safer Corridors	Infrastructure and speed management measures that improve safety, though to a lesser extent and generally at a lower cost compared to Safe System Transformation Works. Example measures include delineation, curve warning signs, seal widening and audio tactile profiled (ATP) markings.
Safe System Transformation Works	Measures that eliminate or significantly reduce the potential for fatal and serious injuries. These include infrastructure measures that physically separate road users and/or speed management measures that reduce impact speeds to survivable human tolerance limits. Example infrastructure measures include median barriers, roadside barriers, clear zones and roundabouts.
Site-specific treatments	Although not included in the treatment philosophy strategy (figure 5-1), these measures are used where you have crash clusters (blackspots) along a route, or just one site. Depending on where the crash cluster is located and to be consistent with other measures along the route, the types of treatments can be from a range of measures covering Safe System Transformation Works, Safer Corridors, Safety Management and Safety Maintenance.

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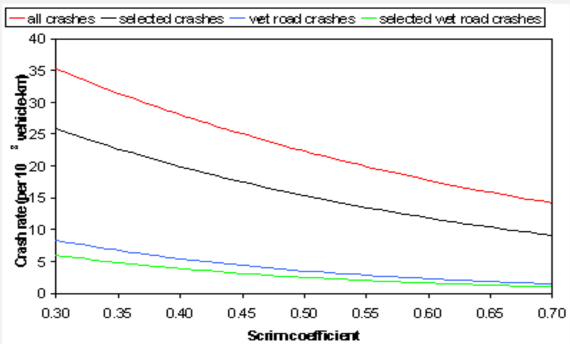
Safety Management Treatments

Skid resistance and intervention levels

Description

Skid resistance is a very complex issue that includes factors such as speed, water and/or detritus, micro texture, stone shape, etc, to name just a few.

A wealth of research demonstrates the strong relationship between skid resistance levels and crash risk. These relationships support skid resistance policies such as NZTA T10/2010. Refer to the Davies, Cenek, Henderson (2005) graph shown below.



Research undertaken in a number of countries consistently indicates that a disproportionately high number of crashes occur on road surfaces that have a low level of skid resistance (particularly below 0.4–0.5) and/or low surface texture (below 1mm in Sand Patch Texture Depth), particularly in higher-speed locations.

The strongest skid resistance/crash relationships are typically found on two-lane undivided roads and at high demand areas such as curves and intersection approaches, which is why higher levels of skid resistance are recommended at these locations in the NZTA T10/2010 specification. However, these areas are also subjected to the highest levels of stress and consequently are often the hardest for which to maintain good skid resistance surfaces.

Due to the large body of evidence supporting the effectiveness of measures to improve skid resistance and their net economic benefits, there can be high confidence in improving skid resistance through a variety of methods.

Application

The measurement of skid resistance can be undertaken via a variety of methods. Refer Austroads Guide to Asset Management Part 5F: Skid Resistance (2009). The NZTA undertakes annual surveys of the entire state highway network using the SCRIM machine. Some other New Zealand RCAs also undertake periodic SCRIM surveys.

As a minimum the levels of skid resistance on the state highway network should be in accordance with the NZTA T10/2010 requirements. Particular attention should be given to the high-demand, high-risk areas and intersection approaches. The KiwiRAP analysis tool can also be used to identify the higher-risk areas, evaluating the run-off road and head-on RPSs, in conjunction with the Curve Risk Rating levels developed by the T10 procedure and held within the RAMM database.

Methods of improving skid resistance include:

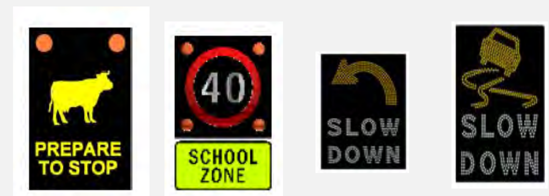
- resurfacing, particularly with a stone capable of providing a high level of skid resistance
- slag surfacing
- high Polished Stone Value surfaces treatments, eg epoxy-based products such as

Active signs (vehicle activated and variable speed)

Description

An active sign is a warning sign that has an electronic display component which becomes active when the activity or hazard described by the sign (eg children on the road, out of context curves, slow down, queues ahead) is likely to be occurring on or close to the road. They can also include:

- vehicle-activated signs
- speed-activated warning signs (SAWS) see section xx
- variable speed signs



Application

Should be restricted to sites where the RCA considers that none of the standard warning signs will provide adequate warning to approaching drivers.

Issues

- Ownership and responsibility – eg is a 'cattle ahead' electronic warning sign or flashing light the farmer's responsibility to operate and maintain or the RCA's responsibility?
- Legal liability in event of power or equipment failure
- Vandalism, especially in rural areas
- Power source (solar-powered signs are available)
- Daylight saving tune adjustment
- Enforcement

Crash reduction

- 35% reduction in all crashes [44]
- 30–35% reduction in crashes at rural curves and intersections [91]

Other benefits

- Reduced traffic speed with speed activated and dynamic speed signs

Cost

Moderate ($20,000 – $50,000)

Treatment life

5–10 years

References and guidelines

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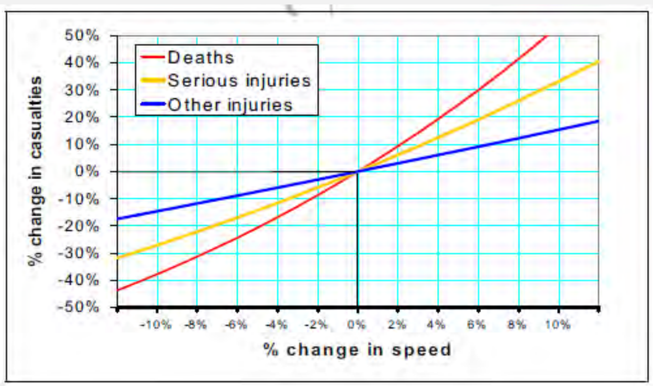
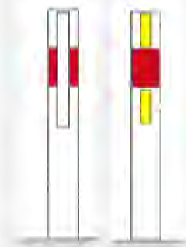
Safer Corridors Treatments

Lower the posted and operating speed

Description	The default posted speed limit on New Zealand open/rural roads is 100km/h and is generally applied to all rural roads with only limited exceptions at the present time (2010). A more suitable speed limit for these roads might be one that more closely matches the design speed and the present safety features, ie a speed that reflects Safe System harm minimisation speeds (section 2.3.2 and 5.2 (d)). 
Application	To lower the posted speed limit, surveys must be undertaken to first determine the current operating speed. This will provide the platform from which to make a decision. If there is already an operating speed limit that is lower than the posted speed limit, then consideration could be given to implementing a speed limit that closely reflects the 85th percentile speed of road users, ie a speed zone. Safe threshold/harm minimisation speeds are discussed in section 2.3.2 and 5.2(d); this type of speed limit should be carefully considered and consulted on prior to implementation as a typical rural road in New Zealand. At-grade intersections and a head-on crash risk would require a 50km/h speed limit to be introduced to eliminate most deaths and serious injuries.
Issues	Where speed limits are introduced on routes where the operating speeds are higher than the limit, then additional measures should be considered to achieve compliance. In most cases a posted lower speed limit where one is not warranted or, where it is not supplemented with engineering measures and enforcement, is unlikely to be complied with.
Crash reduction	• For every 10km/h reduction in operating speed, a 15–40% reduction in head-on, run-off road and intersection crashes [3] • Change in posted and operating speed limit • All reductions in speed limit – 15% reduction in crashes [54] • Change in operating speed 

Edge marker posts

Description	Retro-reflective edge marker posts (EMPs) give guidance to road users of the alignment of the road ahead, especially at horizontal and vertical curves.  
Application	EMPs are to be installed on the side of the road in the shoulder or attached to a guardrail They should be used where other sources of delineation (such as line marking) are not sufficient and cannot be correctly placed Roads with greater than 500 vpd; however, where there are unfavourable conditions they can be applied on any road [89] EMPs shall be installed on all rural state highways [2]
Issues	Maintenance costs can increase due to need for frequent cleaning, weed spraying and repair / replacement of breakages Any gaps in the sequence of EMPs reduces the overall effectiveness of the delineation Speeds may increase at night
Crash reduction	• 32–67% reduction in loss of control crashes at night [89] • 15–18% reduction in total crashes at night [89] • 30% crash effectiveness [16]
Other benefits	Nil
Cost	Low
Treatment life	1–5 years
References and guidelines	[2], [16], **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.**, [89]

Safer Corridor Treatments

Curve warning

Description

This section only relates to standard curve warning signs (including chevron signs), not speed-activated curve warning signs. For information regarding speed-activated warning signs, see section 5.2.2(g).

'Warning signs inform drivers of the nature of a hazard they are approaching. Advisory signs, including advisory speed signs, tell drivers how to navigate the hazard safely, eg hazardous bend signs placed on the approach to the bend can inform the driver of how the road alignment changes. Hazardous bend signs can be mounted above an advisory speed limit sign which states a safe speed for the bend.' [18]

Application

Used on horizontal curves. Specific installation requirements can be found in the NZTA's *Traffic control devices manual*. Note that these are known as Chevron Alignment Markers (CAM) in Australia and other countries.

They should be consistent along a route, ie it is undesirable to have a mixture of colours and styles along a route.

Issues

Vandalism, maintenance (dust on sign etc), correct placement

Visibility of the chevron signs in both directions needs to be considered and a sign for one direction should not be visible to traffic travelling in the opposite direction

Crash reduction

- 25–40% reduction in run-off road, head-on and intersection type crashes [3]
- 30% reduction in crashes [45]
- 40.8% reduction in crashes with the use of both curve warning and chevron signs [103]
- 20–57% reduction in total crashes [11]
- 25% reduction in rural night-time crashes [104]

Other benefits

Potential maintenance benefit as there would be reduced collisions with roadside furniture on the curve due to drivers being better able to read the curve.

Cost

Low

Treatment life

5–10 years

References and guidelines

[3],[11],[18],**Error! Reference source not found.**,**Error! Reference source not found.**,**Error! Reference source not found.**,[45], [104]

Description

This section discusses the impact of no-passing lines and centreline rumble strips. Edgeline rumble strips are discussed above.

No-passing lines are solid yellow and white (dashed centreline trial) lines that indicate to a driver that passing (or overtaking) is not allowed along the road section. No-passing lines are increasingly being supplemented with centreline rumble strips (ATP markings) to assist where there are number of head-on crashes.

Figure Error! No text of specified style in document.-**1: No-passing centreline with rumble strips**

Application

ATP centreline marking may replace or supplement standard centreline markings on sections of road where:

- traffic volumes are not high enough for median barrier treatments
- a significant number of road crashes are attributed to fatigue or driver inattention
- there are specific site problems such as poor visibility, frequent or heavy rain, or night-time crash history.

ATP no-passing lines should be installed as a corridor treatment rather than be site specific and should be used in conjunction with profiled edgelines.

Issues

- May present a hazard to cyclists and motorcyclists if centreline is crossed
- Should be implemented over a continuous length
- The auditory effect is less noticeable for larger vehicles, especially trucks
- May cause noise disturbance for adjoining land users
- Insufficient passing opportunities can increase travel times and frustrate drivers. Consider implementing passing lanes or sign posting upstream passing lanes
- Different types have different effectiveness or wear off more quickly.

Crash reduction

- 21–37% reductions in head-on and sideswipe crashes ranging from 21% to 37% of reported crashes. [41]
- On two-lane rural roads
  - 12% reduction in fatal and injury crashes [108]
  - 44% reduction in fatal and injury head-on and sideswipe (opposite direction) crashes [108]
  - 25% reduction in head-on injury crashes [113]

Other benefits

Nil

Cost

Moderate ($5,000 – $20,000)

Treatment life

1–10 years

References and guidelines

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Safe System Transformation Treatments

Description	Roadside safety barriers include: • flexible barriers (wire rope) • semi-rigid barriers (typically steel beam) • rigid barriers (concrete). Well-designed roadside barriers reduce the severity of crashes involving errant vehicles leaving the road and colliding with more severe roadside hazards.  *Side and central wire rope barrier, SH1 Rangiriri*
Application	Traditionally, safety barriers have been developed for speed environments in excess of 70km/h, where the crash severity without a barrier outweighs the severity associated with colliding with the barrier [16]
Issues	• Safety barriers are roadside hazards. Therefore, all other options for hazard reduction should be examined before choosing to install a barrier. Barriers are designed to reduce the severity of a collision but may also increase the collision frequency because they are closer to the roadside than the hazard being protected and often extend over a longer length than the hazard being protected • Length of need must be adequately calculated and designed for • Adequate end treatments are crucial to ensure the barrier ends do not become significant hazards • Barriers can have significant maintenance costs that need to be compared with expected benefits
Crash reduction	• Side barrier = 45% reduction in run-off road injury crashes [16] • 40% reduction in total crashes [18]
Other benefits	Protection of valuable or dangerous assets on roadside Adds to the delineation of road environment, particularly on curves
Cost	Moderate
Treatment life	10+ years
References and guidelines	**Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.**

Roundabouts

Description	Rural roundabouts are typically high-speed roundabouts.  *Oropi Road, Western Bay of Plenty (source: Google map Pro Licence)*
Application	Roundabouts generally provide a safer alternative to signalised and other unsignalised intersections. Crash reductions at roundabouts are primarily attributed to two factors; reduced traffic speeds and elimination of high-energy conflicts that typically occur at other types of at-grade intersections.
Issues	• Approach volumes and movements should be reasonably balanced to ensure all approaches function efficiently and safely • Can be difficult for heavy commercial vehicles if not appropriately designed • Not appropriate where there are high levels of pedestrians and cyclists; however, this is not usually an issue in a rural location • May require substantial land acquisition when compared with other intersection forms as a result of having to provide appropriate alignments that manage speeds. • They need to be carefully engineered with regards to high approach speeds.
Crash reduction	• Up to 70% reduction of all injury crashes in rural areas [18] • 60% reduction in intersection crashes [3] • Upgrading an intersection from a rural single-lane stop sign (T-junction) to single-lane rural roundabout produces 58% reduction in total crashes and 82% reduction in injury crashes [25] • 50–70% reduction in intersections, head-on, opposing vehicles and U-turn type crashes in high-speed areas [101]
Other benefits	• Can improve traffic flow • Low maintenance requirements • Can act as threshold to complement other speed management measures
Cost	High (over $100,000)
Treatment life	10+ years
References and guidelines	[3],[18],**Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.**,[115]

Programme, monitoring and Evaluation

Once routes and measures have been identified a suitable programme of implementation is important, along with a system to monitor the effectiveness of these countermeasures.

In summary:

1. identify the benefits or rather the effectiveness of the various treatments
2. identify the most effective packages of treatments
3. assess the levels of funding that may be required to achieve various levels of crash reduction
4. ‘prove’ that funding has been spent wisely.

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HRRRG: Consultation

Website:

www.nzta.govt.nz/consultation/high-risk-rural-roads-guide

Includes:

Document

Q & A's

Submissions:

Close 30 May 2010

We need RCAs to work with us to ensure it fully meets the needs of local roads - volunteers please at end.

High Risk Intersections Guide

Being drafted by Beca and TERNZ.

- Expected end of June.
- Covers urban and rural intersections.
- Similar structure to HRRRG.

Seeking more RCAs involved.

- We have CCC, Auckland approached, who else?

At two levels; high level strategic oversight.

Technical working group to ensure:

- Addresses the safety risks for local road intersections
- Countermeasures are appropriate to those needs.

Thank you

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