Safer journeys for motorcycling on New Zealand roads

2nd edition

NZ TRANSPORT AGENCY WAKA KOTAHI

Safer Journeys

New Zealand Government

NZ TRANSPORT AGENCY
WAKA KOTAHI

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Preface

This is the second edition of *Safer journeys for motorcycling*. This updated version has been broadened to cover urban roads as well as rural roads, which is a deliverable set out in the Safer Journeys Action Plan 2016-20.

It is complemented by a map developed in partnership with the Accident Compensation Corporation of the highest motorcycle crash risk parts of the network, overlain with popular open road routes. These maps can be viewed at **www.roadsafetyrisk.co.nz**

Foreword

Motorcycle safety has not shown the improvements made in other areas of concern in the Safer Journeys strategy. Motorcyclists make up an increasing percentage of all crash casualties, and so represent a disproportionate share of ongoing health costs and trauma. Progress on improving motorcycling safety has been minimal since 2010, and the number of deaths and serious injuries has risen since 2013. Deaths and injuries to motorcycle users over the last 15 years have mirrored the size of the motorcycle fleet. Motorcycle ownership has increased with the popularity of recreational motorcycling, and so too have deaths and serious injuries. These statistics, and the level of vulnerability of motorcyclists, show the need for a Safe System response.

This guide was first published in 2012 for use by a variety of audiences, including road controlling authorities, road designers, maintenance crews, motorcyclists and others in the motorcycling sector, and road users not familiar with motorcycling safety. It represents the holistic approach to safety called for in Safer Journeys, with particular emphasis on the safe roads and roadsides element of the Safe System approach. The guidance was tested 'on the ground' in the Coromandel region, with some great work emerging on improvements to a high-risk motorcycling route in that area.

The guide has been updated and is now republished with today's learning in mind. It includes the Motorcycle Safety Advisory Council (MSAC) publication *Making roads motorcycle friendly*, in order to provide all information on motorcycle safety in one place. Significant contribution from Auckland Transport has resulted in a complete new section on urban motorcycling safety.

The guide has developed with tremendous support and input from many others in the sector, including road controlling authorities, ACC, and MSAC. The collaboration among all parties has been instrumental in delivering a safety guide that represents the wide range of perspectives needed in order to result in significant safety gains. We value our relationships with the motorcycling sector and are grateful that the active participation from these groups ensures that all points of view are not only considered, but are fundamental in the development of the guide's recommendations.

A key addition to this 2017 edition of the Safer Journeys for Motorcycling Guide is a new GIS mapping tool, which identifies the riskiest routes on the network. This complements the information on high risk and popular routes developed by ACC, MSAC and the Transport Agency on roadsafetyrisk.co.nz. These mapping tools are intended to help road controlling authorities, the Transport Agency, and ACC prioritise investment decisions that will result in safety improvements which will make the most impact to saving lives.

We trust this guide will be well used and will help to shift how motorcycling safety is approached. The guide will be a dynamic document that continues to be updated over time. Making our roads safer for motorcycling will be an ongoing focus for all of us, and collaboration across the motorcycling sector will continue as we pursue this journey. We continue to welcome suggestions and comments, including about what's been working well and what hasn't.

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ACC
Mike Tulley, Chief Customer Officer

MSAC
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Auckland Transport
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RCA Forum
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Glossary

TERM	DEFINITION
AA	New Zealand Automobile Association
ACC	Accident Compensation Corporation
ATP markings	Audio-tactile profiled markings
CAS	Crash analysis system
Collective risk	A measure of the number of high severity (fatal and serious) crashes, per kilometre of road per year, that have occurred
Delineation	Pavement markings, edge marker or posts, raised pavement markers and/or signage used on and adjacent to the roadway to safely guide traffic over a specific section of roadway during day, night, dry and wet conditions
DSi	Death and serious injury
Favoured motorcycle route	A route identified by motorcycle organisations (such as MSAC) as being a route that motorcyclists frequently choose to ride
Hazard	An object, feature, and/or condition (whether permanent or temporary) present in the road environment that has the potential to cause harm.
High-risk motorcycle route	A route where the motorcycle injury crash density is high or medium-high.
High-severity crashes	Fatal and serious crashes
HRIG	*High-risk intersections guide*
HRRRG	*High-risk rural roads guide*
IAF	Investment Assessment Framework
Impact speed	The speed of travel of an object (usually a vehicle or a person) immediately before striking another object (for example a tree, vehicle or person)
iRAP	International Road Assessment Programme
KiwiRAP	The New Zealand joint agency road assessment programme
Minor injuries	Injuries sustained as a result of a crash that are not likely to require a visit to a hospital for treatment, eg cuts, sprains, bruises.
Moped	Powered two or three wheeled vehicle that has a power output of 2kW or under, and a maximum design speed of 50km/h or under. Refer to: www.nzta.govt.nz/vehicle/your/motorcycles.html
MoT	Ministry of Transport
Motorcycle	Powered two or three wheeled vehicle (with side car) that has a power output of over 2kW or a maximum design speed of over 50km/h.
MSAC	Motorcycle Safety Advisory Council. An organisation established to use the funds gathered from motorcyclists and other riders to make riding safer.
NLTP	National Land Transport Programme
NZTA	NZ Transport Agency
OECD	Organisation for Economic Cooperation and Development

TERM	DEFINITION
Operating speed	The speed at which vehicles travel on a particular section of road. This speed could be greater or less than the posted (legal) speed limit
Personal risk	A measure of the number of high-severity crashes, per 100 million vehicle kilometres of travel on the road, that have occurred
Practitioner	A person who is professionally involved in the investigation, design, and/or construction of measures intended to improve the safety of the roading network for riders of motorcycles/mopeds
RCA	Road controlling authority
Ride Forever	A training programme for motorcycle riders supported by ACC
RoNS	Road of national significance
RTA	Road Transport Association New Zealand
Rural (open) vs urban road	For the purpose of this document, 'urban' and 'rural' may be defined using the Statistics New Zealand classifications, or accepted definitions in regional planning documents (eg Auckland's metropolitan urban limits in the Auckland Plan). For urban areas sub-categories include: main urban areas, satellite urban communities and independent urban communities. For rural areas, sub-categories include: rural areas with high urban influence, rural areas with moderate urban influence, rural areas with low urban influence and highly rural/remote areas. For more information go to www.stats.govt.nz/browse_for_stats/people_and_communities/Geographic-areas/urban-rural-profile/defining-urban-rural-nz.aspx Note that for classifying roads by speed limit, motorways exist in both rural and urban environments. It is recognised that defining Urban and Rural is not always clear cut, particularly in high growth areas undergoing changes in function and use (including land use).
Safe and appropriate speeds	Travel speeds that are appropriate for road function, design, safety and use
Serious injury	Includes injuries (such as broken bones) that are likely to involve a visit to a hospital for treatment
Speed zone	A designated stretch of road where the speed limit has been set for the operating conditions and physical characteristics of the road rather than the standard rural speed limit of 100km/h

1. Introduction and objectives

1.1 PURPOSE

This second edition of *Safer journeys for motorcycling on New Zealand roads* provides practitioners and policy makers with best practice guidance to identify, target and address key road safety issues on high-risk urban and rural motorcycle routes.

It links to a number of road safety resources for planning, funding and evaluating safety projects and programmes. The main aim is to make motorcycling safer through the application of best-practice design and maintenance. However, this document is also intended to provide:

- details of a Safe System approach for motorcycling, covering safe roads and roadsides, safe speeds, safe road use, and safe vehicles
- identification of key crash issues for motorcyclists
- tools to help prioritise high-risk motorcycle routes and motorcycling safety issues
- a range of countermeasures for key crash types to help develop best-value remedial treatments and improve national consistency
- guidance for developing, prioritising and funding road safety infrastructure and speed management programmes
- reference to further tools and resources to evaluate implemented countermeasures.

1.2 SCOPE

This guide refers and directly links to the Austroads guides and to a number of policies, standards and guidelines and trials applicable to New Zealand. It supports and references:

- the third Safer Journeys Action Plan 2016-2020
- the *High-risk rural roads guide*, the *High-risk intersections guide* and the *Speed management guide*
- *Making roads motorcycling friendly*
- New Zealand legislation and, in particular, the Land Transport Act 1998, the Land Transport (Road User) Rule, the Land Transport Rule: Traffic Control Devices, and the Setting of Speed Limits Rule.
- general polices contained in Austroads guides (guides to traffic management, road design, road safety) and other Austroads technical guides
- New Zealand and Australian standards codes of practice and guidelines
- published standards of various organisations and authorities.

This document provides rules, standards and guidance on measures to improve safety on high-risk motorcycling routes. However, practitioners should apply sound judgement when identifying and installing any countermeasures to ensure the best possible safety outcomes.

1.3 TARGET AUDIENCE

The principles underpinning the document are relevant to road controlling authorities (RCAs) for both urban and rural road networks. It is intended to provide guidance to:

- system designers, including, but not limited to RCA planners and policy makers, funders, road system designers, road maintenance staff and road safety coordinators
- system users, including, but not limited to all road users, including those unfamiliar with motorcycle/moped use, riders of motorcycles/mopeds.

1.4 STRUCTURE OF THE DOCUMENT

This document is divided into seven main chapters.

Chapter 2: Strategic context

Outlines the strategic approach and road safety priorities, including the Safer Journeys strategy and the Safe System.

Chapter 3: Crash data

Analyses data on motorcycling crashes in New Zealand.

Chapter 4: Identifying high-risk routes

Describes the process for identifying high-risk and favoured motorcycle routes.

Chapter 5: Key issues and treatments

The key issues for motorcycling safety are listed and information provided on Safe System countermeasures.

Chapter 6: Understand the issues

An overview of matters practitioners should consider to help understand the issues associated with motorcycle crashes.

Chapter 7: Implementation, monitoring and evaluation

Shows how to prioritise and programme, monitor and evaluate countermeasures.

Chapter 8: Other information sources

Provides a list of documents and websites containing useful information for practitioners and motorcyclists.

Chapter 9: Technical summary of treatments

Making roads motorcycling friendly supplement.

2 Strategic context

2.1 SAFER JOURNEYS: NEW ZEALAND'S ROAD SAFETY STRATEGY 2010–2020

Safer Journeys was released in 2010 to guide improvements in road safety over the period 2010-2020. The strategy sets out a long-term vision of 'a safe road system increasingly free of death and serious injury'. To support the vision, Safer Journeys introduces, for the first time in New Zealand, a Safe System approach to road safety. Increasing the safety of motorcycling is one of the high priorities identified in Safer Journeys.

2.2 MOTORCYCLING AND SAFER JOURNEYS ACTION PLAN

Compared to other Safer Journeys high priority areas, there has been little progress in reducing motorcycling deaths and serious injuries (DSIs) since 2010. Motorcyclists still make up a higher percentage of all DSIs and a disproportionate share of ongoing health costs and trauma.

The third Safer Journeys Action Plan 2016-20 refreshes the overarching objective 'to provide a safe environment for motorcycling, educate and inform motorcyclists and leverage emerging technology to reduce the severity of motorcycling injuries'. There are two specific actions and six enabler actions. The two specific actions are to:

- improve awareness of the benefits of Anti-lock Braking Systems (ABS), and vehicle safety features including conspicuity
- investigate mandating ABS on all new motorcycles over 125cc (excl. off-road bikes).

The six enabler actions are to:

- encourage better consumer choice for protective equipment that reduces injury severity when crashes occur
- integrate concepts from the *Making roads motorcycle friendly* guide into this document. Encourage RCAs to follow the guidance, and ensure motorcycle safety is better reflected in transport and activity management plans
- improve motorcycle and moped riders appreciation of the cause and risk of injury and how to reduce those risks through safe and appropriate behaviour and encourage uptake of Ride Forever rider skills training
- continue to work with existing riders to incentivise them to develop their skills
- investigate whether current motorcycling licensing systems are fit for purpose when balanced against the true level of risk and cost to the community
- develop programmes that make road users more aware of motorcyclists.

2.3 INVESTMENT FRAMEWORK

High-risk motorcycling routes are intended to be the starting point for RCAs to consider how to integrate motorcycling safety into their activity management planning. Work is underway to determine safe and appropriate levels of service for motorcycling on roads of different function and class, and this is expected to be completed in 2018.

ACC has a dedicated fund to improve motorcycling safety on high risk, high use routes, to complement RCA investment through the NLTP.

2.4 SAFE SYSTEM

2.4.1 Safe System principles

1. **Human beings make mistakes and crashes are inevitable**	Occasionally people make mistakes and poor decisions, often with tragic consequences. Mistakes, which can be reduced but not removed, include lapses in attention, and skill and performance deficits. Poor decisions include drug or alcohol impairment, fatigue. speeding, and not wearing a helmet.
2. **The human body has a limited ability to withstand crash forces**	Where a crash occurs, the human body has limited ability to withstand crash forces. The response is to design the system to be more forgiving in a crash through technologies and approaches that reduce or absorb crash forces as well as the role of health professionals in post-crash response and care.
3. **System designers and road users must all share responsibility for managing crash forces to a level that does not result in death or serious injury**	System designers will deliver a predictable and forgiving road environment. Responsibility is shared between system designers and road users. Responsibility for what happens in a crash reflects the relationship between road users, system designers, educators, Police, and how well the system protects road users.
4. **It will take a whole-of- system approach to implement the Safe System**	Roads and roadsides, speed, vehicles, and road use are inter-related. The aim is to strengthen all parts of the system, so that if one part is weakened or fails (e.g. a person makes a mistake), the other parts can compensate to prevent DSIs.

The chances of surviving a crash decrease markedly above certain impact speeds. Figure 2-1 shows that for a motorcyclist, a collision with a car has a survivable impact speed of 40km/h.

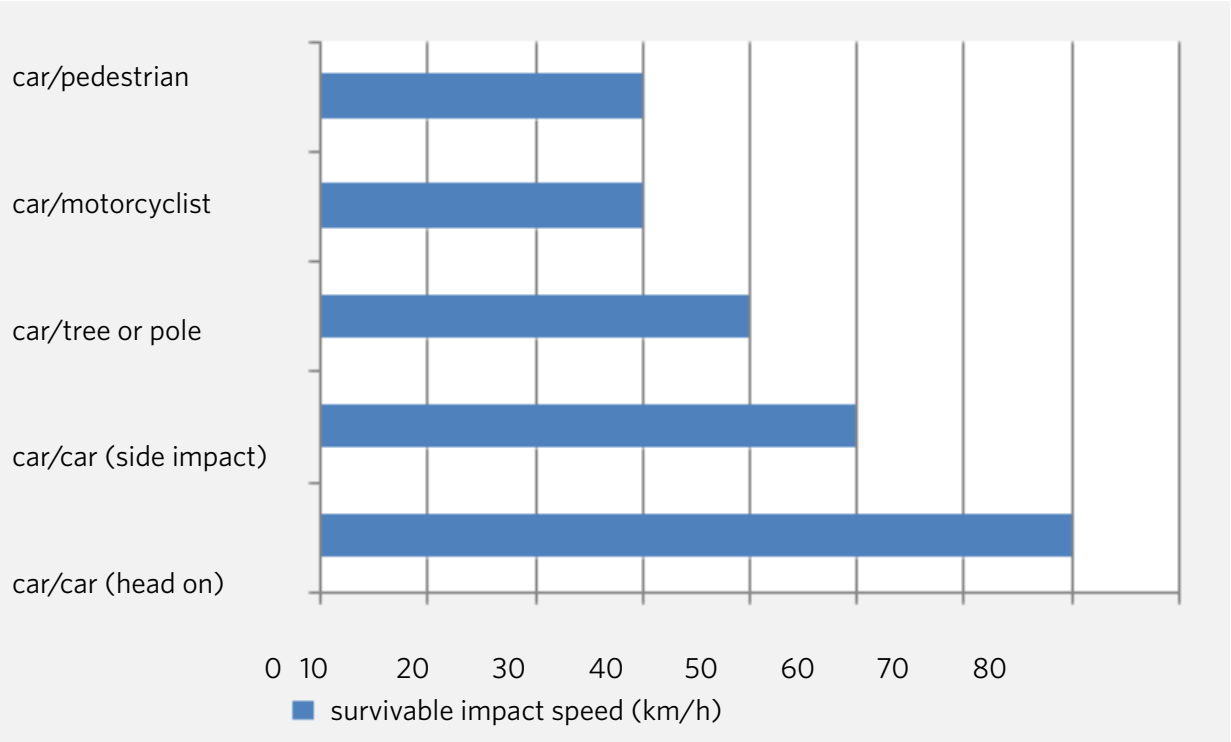


Figure 2-1: Range of survivable impact speeds for different scenarios

Designing for survivable impact speeds is challenging. In addition to considering travel speeds, reducing roadside hazards and finding other ways to protect road users from collisions are needed to reduce trauma, particularly when travel speeds exceed safe system survivable impact speeds.

2.4.2 Safe System elements

The four elements of the Safe System are illustrated in figure 2-2:

- safe roads and roadsides that are predictable and forgiving of mistakes – their design should encourage appropriate road user behaviour and speeds
- safe speeds that suit the function and level of safety of the road – road users understand and comply with speed limits and drive to the conditions
- safe vehicles that help prevent crashes and protect road users from crash forces that cause death and serious injury
- safe road use that ensures road users are skilled, competent, alert and unimpaired and that people comply with road rules, choose safer vehicles, take steps to improve safety, and demand safety improvements.

2.4.3 Safe System in a motorcycling context

A Safe System for motorcycling could be achieved in several ways[1]:

- Manage travel speeds of vehicles and motorcyclists to survivable crash limits
- Improve vehicle protective equipment and roadside performance to increase the travel speed at which collisions are survivable.
- Improve uptake of bike technology so that fewer rider errors result in a crash.
- Educate riders and other road users
- Enforce vehicle and rider standards.

Available technology and community acceptance are constraints on a pure safe system approach, so the focus is on reducing rather than eliminating risk. The Safe System offers a way to understand the problems and derive tools to achieve this risk reduction. A pragmatic approach is required, given New Zealand's roads and the fact that lowering travel speeds to survivable limits may not be acceptable to the community, nor indeed to some motorcyclists.

Figure 2-2: Safe System elements

1. Holgate F. E. Motorcycling and the safer system: an international perspective. Vicroads, 2011

2.5 SAFER JOURNEYS MOTORCYCLING INITIATIVES

2.5.1 Safe roads and roadsides

We know how to make roads safer. Engineering solutions such as median barriers, skid-resistant surfaces, forgiving roadsides, and intersection improvements have a proven track record. Although these measures are not solely related to reducing the number and severity of motorcycle crashes, they still offer significant benefits. The roads and roadsides actions in the Safer Journeys Action Plan that can improve safety for motorcyclists are:

- Target high-risk motorcycle routes and high-risk urban intersections.
- Develop and implement a national programme of safety improvements in high risk local urban arterials that focuses on all modes.
- Develop and implement a national programme of lower cost safety improvements on high risk local rural roads.

A fatal or serious motorcycle crash is equally likely on an urban road as a rural road, but the types of crashes tend to differ. On rural roads 42% of high severity crashes involve loss of control, whereas in urban areas 41% of high severity crashes involve one of three specific intersection movements, namely: (i) right turn off main road, (ii) right turn from a side road and (iii) movements at an intersection where both vehicles are travelling straight through.

RCAs should focus efforts on the high severity movement types to obtain the greatest benefits. Understanding which movement types result in the most crashes helps to determine the most effective interventions for roads and roadsides.

2.5.2 Safe and appropriate speeds

The focus is to help people to drive to the conditions and at safe and appropriate speeds, and to understand how their decisions about travel speeds affect them and others. There are three long-term speed-related objectives in Safer Journeys:

1. People will increasingly understand what travelling at safer speeds means.
2. Speed limits will better reflect the use, function and safety of the network .
3. Travel speeds will support both safety and economic productivity .

The *Speed management guide* gives supports these objectives through two avenues:

- Identifying safe and appropriate speeds across the network, and showing the high benefit opportunities for speed management.[2]
- A set of engagement resources to enable RCAs to have *Better conversations on road risk* with their stakeholders and communities.[3]

Safe and appropriate speeds complement safe roads and roadsides, and there are interventions for other parts of the Safe System, ie safe road use (eg motorcyclist training) and safe vehicles (eg electronic stability control (ESC) which help riders maintain control if a mistake is made).

It should be noted that safe speed does not necessarily mean always travelling at the posted speed limit – the safe travel speed is determined by the road user based on their competency, the road and weather conditions and the standard of vehicle being driven/ridden (see 5.7).

2.5.3 Safe vehicles

Safer Journeys aims to increase public awareness of and demand for safer light vehicles, and promote advanced safety features such as collision avoidance technology. While not specifically provided for increasing safety for motorcyclists, these safety features would help to reduce the overall incidence and severity of crashes.

Safer Journeys outlines the value of promoting existing and new technologies like anti-lock brakes, airbags and advanced protective clothing for motorcyclists. All motorcycle /moped riders (novice, experienced, returning) are encouraged to buy their bikes giving due attention to the safety features of the motorcycle/moped and to keep them well maintained (see 5.6).

2 Speed Management Guide First Edition. www.nzta.govt.nz/safety/speed-management-resources/

3 Ibid

2.5.4 Safe road use

Safe road use is a cornerstone of the Safe System, especially for motorcyclists. Motorcycle riding requires different vehicle control and cognitive skills than those needed to drive a car. Safe road use for motorcyclists also needs other road users to be more aware of motorcyclists.

This document provides guidance for safe road use with a particular focus on:

- implementing regulatory changes and improving motorcycle training
- engaging with the motorcycle/moped community to increase awareness of the cause and risk of injury and how to reduce those risks.
- motorcycle focused enforcement.

Training for motorcycle/moped riders is a key component of safe road use. Ride Forever skills training focuses on improving rider skills as evidence suggests this has the biggest impact on reducing the severity and incidence of crashes. This applies to all types of riders: novice riders, experienced and competent riders, returning riders who may not have travelled by motorcycle/moped for some time and pillion riders.

Training information (or links to the information) is available on websites such as:

- www.rideforever.co.nz
- scootersurvival.co.nz

The 3-step process to getting a full motorcycling licence is set out on the Transport Agency's website[4].

Motorcycle retailers and hirers also have an important role to ensure that a motorcycle/moped is suitable for the rider proposing to use the vehicle.

Safe road use also involves:

- wearing appropriate gear for riding a motorcycle/moped.
- having a legal motorcycle/moped and rider, which includes vehicle warrants of fitness (WOF), current registration, and applicable driver's licence.

ACC and MSAC have developed a Motorcycle Safety Strategy. MSAC have endorsed the investment plan and are fully funding Ride Forever skills training from the Motorcycle Safety Levy. The five priorities in the strategy are[5]:

- **Rider skills**
  - › Enable riders to reduce their chance of crashing by expanding Ride Forever training capacity and accelerating uptake of Ride Forever training.
- **Human factors**
  - › Address driver and rider attitudes and behaviours that contribute to crashes through targeted communications for at-risk groups.
- **Vehicle technology**
  - › Encourage the use of technologies that make riders safer with a specific focus on increasing the uptake of anti-lock braking systems (ABS) on motorcycles.
- **Personal protective equipment**
  - › Increase the uptake of equipment that protects riders from injury by helping to provide better consumer information.
- **Roads and roadsides**
  - › Work with RCAs to improve road design and maintenance with specific focus on helping to make high-risk routes more motorcycle friendly.

4 http://www.nzta.govt.nz/driver-licences/getting-a-licence/licences-by-vehicle-type/motorcycles/

5 https://www.acc.co.nz/preventing-injury/road/

3 Crash data and comparison of road use

There are several data sources available to identify the overall reported issues for motorcyclists. This data can be sourced from the government's crash analysis system (CAS), ACC statistics, motor vehicle registrations, and other national and international research reports. This section describes the CAS recorded crash data in detail.

3.1 REPORTED CRASH DATA

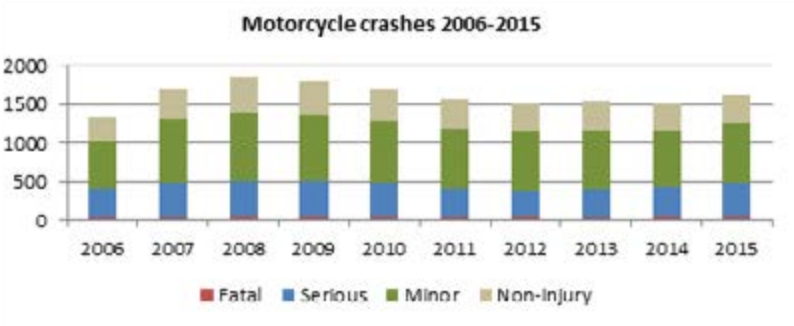
From 2006–15, there were 444 fatal and 4016 serious injury crashes involving motorcycles or mopeds. Those crashes involved 466 deaths and 4269 serious injuries.

Figure 3-1 shows that motorcycle/moped crashes decreased by 7% from the previous five-year period (2006–10) to the next (2011–15).

- 67% of all motorcycle/moped crashes in the 2006-2015 period were in urban areas.
- In the 2006-15 period, 49% of the fatal and serious injury motorcycle/moped crashes were on urban roads, with the remaining 51% on rural roads.
- The fact that only a third of all crashes are on rural roads and half the more serious crashes are on these rural roads reflects the impact of speed on injury severity.

Motorcycle and moped[6] rider injuries accounted for 12% of the total injury crashes and 20% of the fatal and serious injury crashes from 2006-15. The number of motorcyclists killed or seriously injured (per million hours spent travelling) is significantly higher than the injury rate sustained in travel by other modes[7].

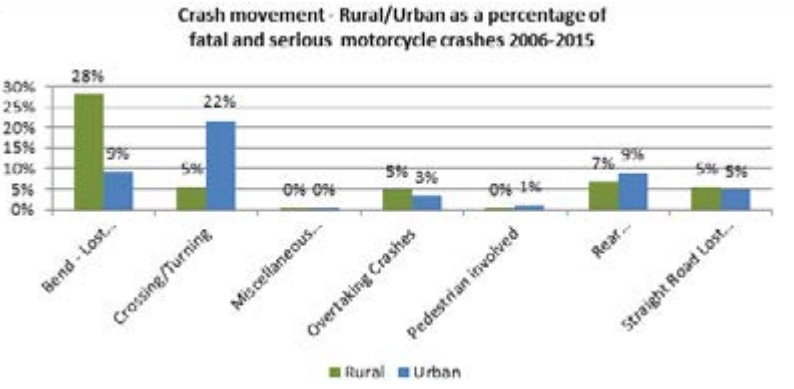
Figure 3-1: Motorcycle crashes by severity 2006–15. Source CAS



- Motorcycle crashes at intersections account for 43% of all motorcycle crashes, 87% of which occurred in urban areas and the majority were at T-junctions.
- Midblock crashes account for 83% of all rural motorcycle crashes and 57% of all motorcycle crashes.

Figure 3-2 shows the most common movement types for fatal and serious crashes involving motorcyclists. This shows that the main rural crash type (bend-lost control/head on) and urban crash type (crossing/turning) are also the main crash types for fatal and serious crashes generally, being the crash movements for 64 percent of fatal and serious motorcycle crashes.

Figure 3-2: Injury crashes by road user type 2006–15. Source CAS



6 A moped is defined as having a power output of 2kW or under, and a maximum design speed of 50km/h or under.

7 Ministry of Transport, 2012. Comparing travel modes, fact sheet related to the New Zealand Household Travel Survey

Table 3-1 shows the crash severity for the main movement types in urban and rural areas and table 3-2 shows the distribution of crashes between intersections and midblocks.

Table 3-1: Main movement types of motorcycle/moped crashes. Source: CAS

AREA	CRASH SEVERITY	CRASH MOVEMENT	% OF MOTORCYCLE CRASH SEVERITY
Urban	All crashes	Crossing/turning	26%
	High severity	Crossing/turning	22%
Rural	All crashes	Bend – lost control/head-on	15%
	High severity	Bend – lost control/head-on	28%

Table 3-2: Distribution of motorcycle/moped crash locations. Source: CAS

PERCENTAGE OF ALL MOTORCYCLE CRASHES 2006–15			
AREA	**INTERSECTION**	**MIDBLOCK**	**ALL CRASHES**
Urban	37%	30%	67%
Rural	6%	27%	33%
Total	**43%**	**57%**	**100%**

- Motorcyclists were attributed to be at either prime or part fault in 37% of urban motorcycle crashes and in 80% of rural crashes[8].
- 61% of those rural motorcyclist at fault crashes were single vehicle crashes, whereas only 48% of those urban crashes were single motorcycle crashes.
- Poor handling[9] is the most common contributing factor for injury crashes where motorcyclists are at fault (including prime fault and part fault); it was a factor in 28% of these crashes in urban areas and 50% in rural areas.

Table 3-3 breaks down at-fault motorcycle/ moped contributing factors, in order of frequency. The numbers in the table show the percentage of injury crashes where a motorcyclist was at fault and these factors contributed to the crash[10]. For injury crashes road factors were a factor in 26 percent of rural crashes and 13 percent of urban crashes. Post Ride Forever skills training, the five greatest areas of self-reported improvement in skill/ competence are in direct correlation with these crash causation factors.

Table 3-3: Percentages where motorcycle/moped riders were at fault

URBAN (%AGE OF CRASHES)	RURAL (%AGE OF CRASHES)
Poor observation (35%)	Poor handling (44%)
Poor handling (28%)	Road factors (27%)
Poor judgement (22%)	Too fast for the conditions (22%)
Incorrect lane/position (19%)	Poor observation (21%)
Failed to give way/stop (17%)	Poor judgement (17%)
Too fast for the conditions (15%)	Incorrect lane/position (17%)
Alcohol (14%)	Alcohol (11%)
Road factors (13%)	

The main road factors identified are described in Table 3-4. The numbers in the table are the percentage of all motorcycle crashes in which each of these factors was identified.

8 At-fault is a data factor obtained from the CAS. However, assigning fault to a particular road user does not preclude that there may have been other factors (for example loose gravel on the road surface) that contrived to the crash.

9 Poor handling includes factors such as poor choice of speed, position on the road, use of controls and not looking through the corner.

10 It is important to note that there can be more than one factor in a crash, therefore, the total percentage of factors can be more than 100%.

Table 3-4: Percentages for motorcycle/moped crashes in New Zealand (2006-15)

URBAN (PERCENTAGE OF CRASHES)	RURAL (PERCENTAGE OF CRASHES)
Road slippery (including general and rain) (3%)	Road slippery (including general and rain) (6%)
Road slippery (loose material on seal) (1%)	Road slippery (loose material on seal) (5%)
Road slippery (oil/diesel/fuel) (>1%)	Road slippery (oil/diesel/fuel) (2%)

3.2 MOPEDS VERSUS MOTORCYCLES

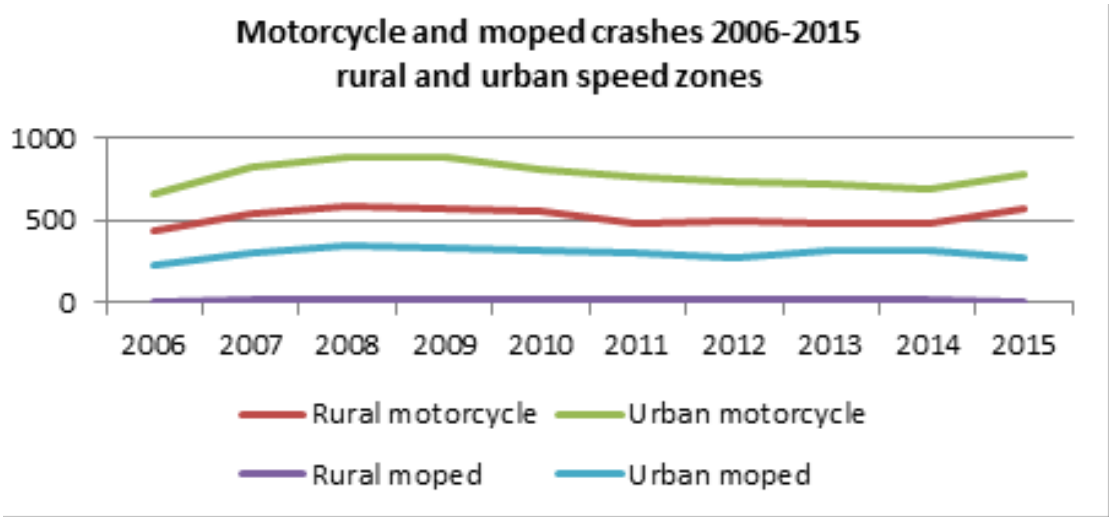
There are some notable differences between motorcycles and mopeds. Mopeds were involved in 28% of all urban motorcycle/moped crashes, and 3% of all rural motorcycle/moped crashes during 2006-15. The proportionally higher use of mopeds in urban areas contributes to the difference in at-fault contributing factors in crashes when factors for moped crashes are compared with those for motorcycles (table 3-5).

Table 3–5: Key at-fault contributing factors to moped crashes versus motorcycle crashes

MOPED		MOTORCYCLE	
Poor observation	41%	Poor handling	37%
Incorrect lane/position	25%	Poor observation	26%
Poor judgement	23%	Too fast	20%
Poor handling	23%	Road factors	20%
Failed give way/stop	19%	Poor judgement	19%
Road factors	16%	Incorrect lane/position	16%

In general, motorcycle/moped crashes in both urban and rural areas (excluding rural moped crashes) have shown an increase over the past 10 years (figure 3-3).

Figure 3-3: Motorcycle versus moped crashes 2006-15. Source: CAS



The main movement types for urban and rural motorcycle and moped crashes are described in the following tables.

Table 3–6: Predominant movement types for each area for all crashes involving a moped/ motorcycle

	MOPEDS	MOTORCYCLES
Urban	• Crossing/turning (42%) • Rear end/obstruction (28%) • Overtaking (10%)	• Crossing/turning (39%) • Rear end/obstruction (27%) • Bend-lost control/Head on (14%)
Rural	• Bend-lost control/head on (25%) • Straight-lost control/head on (23%) • Crossing/turning (23%)	• Bend-lost control/head on (48%) • Rear end/obstruction (17%) • Overtaking (13%)

Table 3-7: Predominant movement types for each area for injury crashes involving a moped/motorcycle

	MOPEDS	MOTORCYCLES
Urban	• Crossing/turning (44%) • Rear end/obstruction (25%) • Bend-lost control/head on (10%) • Straight-lost control/head on (10%)	• Crossing/turning (41%) • Rear end/obstruction (21%) • Bend-lost control/head on (17%)
Rural	• Bend-lost control/head on (27%) • Crossing/turning (23%) • Straight-lost control/head on (22%)	• Bend-lost control/head on (51%) • Rear end/obstruction (15%) • Straight-lost control/head on (12%)

4 Identifying high-risk motorcycle routes

This chapter explains how high-risk motorcycling routes in both urban and rural areas have been identified. The method aligns with other Safe System guides, notably the *High-risk intersections guide, High-risk rural roads guide* and the *Speed management guide*, as well as the third Safer Journeys Action Plan work to identify high-risk local rural roads and urban arterials.

The safety performance of a road is a function of:

- the likelihood of each user on the road being involved in a crash
- the exposure to risk (based on the number of vehicles using the road)
- the severity outcome of any crashes that occur.

There are two types of motorcycling routes identified:

- High-risk routes: lengths of road with a higher than average crash risk. These are roads where deaths and serious injuries are most likely to be observed from crashes involving motorcyclists if recent crash patterns continue.
- Favoured routes: routes that have been identified by rider groups, communities, RCAs and other key stakeholders as being a popular route for motorcycling[11].

ACC has mapped high-risk routes and popular routes nationwide and these can be viewed at www.roadsafetyrisk.co.nz.

The Transport Agency has used these maps as the basis for developing a prioritised listing of the top 100 routes where safety can be improved on both urban and rural roads. This risk map is contained as a layer in the Safer Journeys Risk Assessment Tool, which has been made available to RCAs at https://nzta.ably.com/megamaps/ .

The method by which these routes were prioritised is explained in the following section.

4.1 HIGH-RISK MOTORCYCLING ROUTES DEFINITION

A high-risk motorcycling route in this guide is defined as:

- a road where the death and serious injury casualty equivalent density (collective risk) is classified as high compared with other roads.

High-risk motorcycling routes are identified where the following criteria are satisfied:

- Collective risk = high.
- At least 2 injury crashes in the past 5-years, and
- Minimum route length of 2km.

High-risk motorcycling routes are then prioritised by the proportion that the Collective risk DSi casualty equivalents value exceeds the high-risk threshold. These routes are identified by joining shorter road segments, defined by Infrastructure Risk Rating (IRR) homogeneous sections, with the same road name. Ideally, lengths of road being considered should be corridors or adjoining road sections with similar features, traffic volumes, environment and road-use purpose. However, shorter lengths can also be considered. At the extremes, a very short section of road with two or more injury crashes will be a blackspot with a high crash density, while a very long section may have a low crash density (collective risk) and may only justify lower cost improvements (e.g. delineation). In either case, the process and treatments outlined in this document are relevant.

The process of considering high-risk motorcycle routes and sites will ideally be completed at least every three years to inform maintenance and renewal works proposed for inclusion in the three-year National Land Transport Programme (NLTP).

11 The favoured routes generally do not include urban routes used by commuting riders, in particular moped riders, so are predominantly open road routes.

4.2 CALCULATING COLLECTIVE RISK

Collective risk (also known as crash density) is a measure of the estimated DSi casualty equivalents per kilometre of road per year[12]. As per Urban KiwiRAP risk mapping protocols, the estimated DSi casualty equivalents value for a corridor is determined by applying severity indices to historical crash data.

Collective risk =
Estimated motorcycle DSI equivalents/no. of years of crash data
Length of road section

Unlike Urban KiwiRAP, severity indices differentiate by speed limit to a greater extent than the existing method which splits by low (≤70km/h) and high (≥80km/h) speed environments only. This was done by creating severity indices for 50km/h and 100km/h speed environments and using speed 'scaling factors' to increase or decrease the severity.

Personal risk =
Estimated motorcycle DSI equivalents
Number of years data x 365 x AADT x 10-8

4.3 CALCULATING PERSONAL RISK

Personal risk is a measure of the likelihood an individual road user will be involved in a high-severity crash. Understanding personal risk is important for informing the indicative nature of the treatment intervention that is most likely to be appropriate. Preliminary work[13] has explored the possibility of extending the number of motorcycling risk metrics by:

- investigating the availability of data in order to calculate additional metrics
- calculations of additional metrics for a number of routes as a pilot exercise for possibly similar calculations on a larger scale, and
- considering the role of motorcycle speed data in the future monitoring of motorcycle safety.

These advancements offer an ability to calculate personal risk, although it too relies on the availability of motorcycle volumes. The Personal risk calculation has been established as:

4.4 HOW TO USE THE HIGH-RISK MAPS

It is up to RCAs to determine their investment priorities on their networks, but the high risk maps are designed to show RCAs where they should focus their attention when considering motorcycle safety. If they are considering motorcycle-specific investments or as part of their general investment programme for the NLTP then in principle the high risk motorcycling routes should support the highest level of service for motorcyclists.

The toolbox of safe system interventions contained in Chapter 5 of this guide, and in the Making roads safe for motorcycling supplement in the appendix of this guide, outline not only engineering treatments to improve motorcycle safety but also what can be done to improve rider skills. The current work on safe and appropriate levels of service for motorcyclists across the network will indicate how RCAs can address motorcycle safety on those parts of the network which are not high risk.

12 The method in this chapter was developed in association with Abley Consultants and ACC.

13 This work was undertaken by Opus International Consultants.

5 Key issues and treatments

5.1 CORRIDOR TREATMENT OF HIGH-RISK MOTORCYCLE ROUTES

The next two chapters provide guidance and examples on appropriate treatment strategies. The first step is to determine what type of safety problem exists – whether the current crash patterns are clustered or if there is a common theme. Further analysis and treatments of crash clusters can be found in the New Zealand guide to the treatment of crash locations[14].

5.1.1 Interim safety treatments

Where larger infrastructure works have been identified as the best treatment strategy, they are likely to require detailed investigation and implementation phases given the higher cost of infrastructure-type treatments. So interim safety works could be used if they deliver benefits and don't create problems or increase costs significantly for larger infrastructure works.

For example, if the long-term treatment for motorcyclists for a particular route is to provide roads to a high standard with median barriers and high skid resistance surfaces, then the interim safety treatments could include wide centreline treatments, localised widening on curves, and a prioritised pavement repair programme to produce a consistent surface.

5.1.2 Treatment of non high-risk or popular routes

ACC surveyed motorcycling groups to identify popular routes. If a site or route is defined as a popular route it may not necessarily be high risk but could potentially become one due to its popularity. These routes will be assessed in conjunction with known high-risk routes when it comes to considering appropriate levels of service.

14 https://www.nzta.govt.nz/resources/guide-to-treatment-of-crash-location/

5.2 KEY ISSUES

Austroads Part 15: *Guide to traffic engineering practice – motorcycle safety* describes the safety (and training) needs of motorcyclists. In summary, motorcyclists need to:

- **stay in control and upright on the vehicle and stay on the carriageway**
  - › motorcycles can easily become unstable and topple if braking, accelerating or if the road is slippery or unstable, especially if tyres are worn or brakes are poor
  - › motorcycles tend to have higher power to weight ratios than cars and an increasing number of motorcycles are capable of high speeds and acceleration
  - › the potential for motorcyclists to lose control can be reduced through improved surface conditions, better delineation, pavement markings, geometry and alignment, safe vehicles and speeds, experience, training and education.
- **avoid collisions with other road users**
  - › the visibility of motorcycles to other traffic – motorcyclists are often obscured from the vision of other road users, particularly in congested traffic
  - › rider's visibility can be impacted (particularly peripheral vision) due to their helmet and/or goggles
  - › can be addressed through improvements to intersections and sight distance, safe vehicles and speeds, road user experience, training and education
- **avoid collisions with roadside objects to minimise trauma if fallen from a motorcycle**
  - › motorcyclists are extremely vulnerable to high severity injuries
  - › can be addressed through protecting, removing or mitigating road and roadside hazards, safe speeds, improved rider safety gear, and early intervention by emergency services.

Table 5-1 summarises the key issues. This guide also has a technical supplement 'Making roads motorcycle friendly', aimed specifically at roading engineers and maintenance contractors.

Table 5-1: Summary of key issues that could to reduce the incidence, severity, and/or consequences of motorcycle crashes

ROADS AND ROADSIDES	• Surface conditions • Pavement markings • Delineation • Hazards/roadside furniture • Geometry and alignment • Intersections
ROADS USERS	• Ride Forever training and education • Increasing licencing threshold for BHST • Rider experience, speed, route knowledge and risk taking • Alcohol and drug use • Fatigue • Rider safety gear • Group riding • Rider position on the road
VEHICLES	• Maintenance • Power to weight ratios • Safety features • Headlight performance • Type choice and wear
SPEEDS	• Rider behaviour (too fast for the conditions) • Rider behaviour (following distances) • Posted speed limits
INJURY TREATMENT	• Proximity of helicopter landing area • Available mobile phone coverage • Personal responsibility • Use of personal locator beacons that could be activated to summon help if an incident occurs; particularly in remote areas

A safe road environment should have no surprises in road design or traffic control. It should:

- **warn** the driver or rider of any substandard or unusual features
- **inform** the driver or rider of conditions to be encountered
- **guide** the driver or rider through unusual road sections
- **control** the driver or rider's passage through conflict points or conflict sections
- **forgive** the driver or rider's errant or inappropriate behaviour.

5.3 KEY COUNTERMEASURES

5.3.1 General Safe System treatments

There are five treatment philosophies that have been developed for high-risk rural roads, which can also apply to high-risk motorcycling routes[15]. More details such as application, issues, costs and benefits, and treatment life can be found in the *High-risk rural roads guide.*

15 These treatment philosophies are being used as an input into the work underway to develop levels of service for motorcyclists. When this work is completed it will be integrated into this guide.

Table 5-2: Summary of the key treatment philosophies[16]

TREATMENT PHILOSOPHY	DESCRIPTION
SAFETY MAINTENANCE	Maintain roads to an appropriate standard according to specified standard criteria. Examples include maintaining skid resistance to current specified levels, sweeping, tree trimming, sealing joints, addressing drainage, street lighting and roadworks management.
SAFETY MANAGEMENT	Measures that optimise safety levels through existing road maintenance, such as skid resistance. Generally, high personal risk roads with low traffic volumes will not warrant significant investment. It will therefore be important to consider supplementing safety management on these routes with additional speed management (curve warning signs) education and enforcement measures.
SAFE CORRIDORS	Infrastructure and speed management measures that improve safety, to a lesser extent and usually at a lower cost compared to Safe System transformation works. Examples include delineation, speed activated 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 injury crashes. These include infrastructure measures that physically separate road users and/or speed management that reduce impact speeds to survivable limits. Example infrastructure measures include median and roadside barriers, clear zones and roundabouts. However, unless there are issues along a route that very significantly relate to motorcycle crashes, it is unlikely that transformation works would be undertaken to solely address motorcycle crashes.
SITE-SPECIFIC TREATMENTS	Use these measures where there are crash clusters (blackspots) along a route or at just one site. Depending on where the cluster is located, and to be consistent with other measures along the route, the treatments can be drawn from Safe System transformation works, safer corridors, safety management and safety maintenance.

In many cases, the maintenance and construction measures improve the safety of roads and roadsides for motorcyclists are those that should already be part of normal best practice and complying with contractual obligations; eg. sweeping debris and loose gravel at intersections. While many existing maintenance and construction practices benefit motorcyclists, it is important for practitioners with road maintenance and construction responsibilities to have a greater focus on, and awareness of, motorcycle specific interventions, which in turn can make the roads even safer for other road users as well.

5.4 ISSUES AND TREATMENTS FOR ROADS AND ROADSIDES

Based on a literature search and discussions with motorcycle groups, the key roads and roadsides issues for motorcyclists are those described in sections 5.5.1 to 5.5.6.

Maintenance issues will generally be identified by RCAs and their contractors. However, the potential exists for road users to contribute to safe roads and roadsides by advising RCAs of maintenance issues. Provision of simple and direct methods to allow road users to contact RCAs could help make roads safer for motorcyclists (and all road users).

5.4.1 Surface conditions

Surface conditions are very important from a road maintenance perspective, given that loss of control due to road conditions is one of the most common causes of motorcycle crashes.

Surface conditions including changes to surface texture, skid resistance and loose material on the road surface are critical due to the potential for a motorcycle tyre to have inadequate or inconsistent friction with the road surface. Poor surface conditions on curves are a hazard as motorcycles only have two points of contact with the road surface, so are more at risk than other vehicles. Consistent and suitable surfaces (that can otherwise be affected by a range of issues) are important in all situations. However, they are critical in areas where motorcyclists are braking and in other situations (eg on curves) where the friction demand is increased. These issues and possible treatments described in table 5-3.

Table 5–3: Issues and possible treatments for surface conditions

ISSUE	POSSIBLE TREATMENTS[16]
Slippery conditions (eg rain, frost, diesel spills and bleeding (photo 1)), and surfaces with inadequate skid resistance can cause sudden and unexpected changes to surface texture and lead to loss of control. As for all vehicles, motorcycles also need more distance to stop in wet weather.	• Ride Forever training supports riders to spot and avoid hazards. • Provide appropriate warning signage. • Provide adequate surface drainage to prevent water/loose material washing onto the pavement. • Ensure minimum levels of friction on curves and straight are met and consider improving skid resistance particularly on approach to curves, bridges, intersections or other hazards with high speed approaches. • Improve maintenance response times. • Consider more frequent routine inspections. • Ensure consistent and appropriate standard of skid- resistance on road surfaces.
Surface obstacles (manholes, steel plates, speed humps/judder bars, rail crossing, bridge expansion joints and connection to roads) create sudden changes in available surface friction and can cause loss of traction (photo 2).	• Ensure obstacles located within the road surface (such as manhole covers and steel plates) are flush with respect to the surrounding road surface. Provide skid resistant drain covers/metal road plates. • Position manholes away from braking area or corner apex where practicable. • Provide standard warning signs for obstacles or road features (such as speed humps) that may create loss of control for riders. • Install skid resistant surfacing on steel bridge expansion joints.
Surface debris (eg gravel and other debris, unsealed intersections and driveway accesses) create sudden changes in available friction and can cause loss of traction (photo 3).	• Sealing of intersections where gravel side roads intersect with sealed roads. • Repair and define shoulders – particularly on curves.
Uneven surface conditions (eg corrugations, rutting, flushing, delamination, potholes) can cause motorcycles to temporarily lose contact with the road surface.	• Create suitable and consistent road surfaces free of rutting and uneven surfaces. • Ensure minimum levels of friction on curves and straight are met and consider improving skid resistance for high risk or favoured routes particularly on approach to curves, bridges, intersections or other hazards with high speed approaches. • Improve maintenance standards to identify and repair road surfaces (eg potholes/utility skid resistance improvements, broken road edges and consistent surface levels). • Provide appropriate temporary warning signage if surface defects will not be remedied in the short term.

16 The *Guidelines for the management of road network skid resistance* (AP-G83/05, Jan 2005) describe issues for motorcycles which require specific consideration by maintenance practitioners and designers.

Surfacing transitions, inconsistent frictional properties across road width, surface joins, multiple seal types (photo 4, crack sealing, patchwork repair (photo 5), and treatments (pot holes and edge drop-offs).	• Resurface to provide consistency. • Ensure that when programming resurfacing, the joints are not placed in lean zones, approach to and middle of curves or other locations where there is possibility of a rider losing control. • Maintain shoulder levels and provide a smooth transition.
Roadwork sites (eg loose aggregate and poorly placed signs) can reduce levels of skid resistance; inadequate messages.	• Provide appropriate temporary traffic management layout and warning signage at road worksites. • Provide regular sweeping of surfaces and checking during roadworks and after they have been completed. • Ensure road is back to acceptable condition before temporary signs are removed.
Parallel grooving is often used to restore surface friction. Motorcycle tyres can get trapped in parallel grooves causing loss of stability.	• Avoid parallel grooving. Apply transverse grooving if necessary.
Removal or masking of obsolete line markings can lead to the old markings showing through (Photo 6)	• Markings can appear more noticeable in wet road conditions if they have not been removed properly. Use techniques (such as water cutting or sand blasting) that remove road markings permanently, rather than masking the old markings with black paint, which wears through and creates a hazard in itself.
Poor consideration in roading design and maintenance regarding specific needs of motorcycle/moped users.	• This includes replacing or repairing edge marker posts and barriers, and cleaning signs.

Photo 1: Flushed or slippery section located within wheel track. Source: Opus

Photo 2: Bridge deck expansion joint. In lean zone can cause loss of traction. Source: Transport Agency presentation 2011

Photo 3: Gravel migration located on a curve. Sweep regularly to eliminate.

Photo 4: Avoid seal change located in brake zone. Source: MSAC

Photo 5: Avoid placing patchwork repair zone located on corner.

Photo 6: Remove obsolete road markings rather than painting over or doing nothing. Source: Opus

5.4.1 Pavement marking

Pavement marking should provide consistent, well located and skid resistant applications. In considering the effect on motorcyclists, one rule of thumb is 'if it's not black, it's bad'; ie. motorcyclists want pavement markings minimised. Table 5-4 shows issues and treatments.

Table 5-4: Issues and possible treatments for pavement marking

ISSUE	POSSIBLE TREATMENTS
Absence of pavement markings.	• Apply road markings to current standards where required.
Slippery pavement markings located in the centre of a lane or on curves (eg large head directional arrows, speed control markings, other mid lane markings) can lead to low levels of skid resistance and limit riders' safe position options.	• Apply road markings to current standards. • Restrict markings in the centre of lanes or on curves where not necessary.
The placement of audio tactile or raised markings within lane or centrelines can cause motorcycles to temporarily lose contact with the road surface.	Possible restriction of audio tactile profiled (ATP) markings to edgelines only (not lane or centrelines), while considering the overall safety issues along a route, ie. if there is a high crash rate for other road users for overtaking/head-on type crashes then centreline ATP treatment may be installed to improve the overall safety of the route.
Transverse markings	These types of markings are not standard and have only recently been trialled (photo 9). Where transverse markings are proposed, the needs of motorcyclists should be accommodated. This may involve providing space between markings, within the lane, and not installing transverse markings through curves or at hazards where stopping and deceleration is likely to occur (refer photo 7).
Faded road markings	Increase remarking frequency. New chip seal sites need to have a remark shortly after the initial marking to provide additional build-up of paint.

Pavement marking includes audio tactile profiled (ATP) road markings, reflectorised raised pavement markers (RRPMs), and raised pavement markers (RPMs). Their applications are described in the Traffic control devices (TCD) manual. Before installing any raised pavement markings, the effect on all road users (including motorcycle/moped riders) should be evaluated. For example, if there is a choice between ATP and RPM, the ATP will create fewer issues for motorcyclists than the RPM.[17]

Photo 7: Avoid transverse road markings located across the lane in braking zone.

Photo 8: Transverse markings on approach to hazard with space available in middle of lane to accommodate motorcyclists.

17 http://www.nzta.govt.nz/assets/resources/audio-tactile-profiled-roadmarkings-guidelines/docs/atp-guidelines.pdf

5.4.3 Delineation

Delineation is important for motorcyclists, especially at high-risk locations such as curves, including out-of-context curves and on approaches to hazards. Its effectiveness at night may be reduced for motorcyclists due to the relatively limited range of motorcycle headlights. Issues and possible treatments related to delineation are described in table 5-5.

Table 5-5: Issues and possible treatments for delineation

ISSUE	POSSIBLE TREATMENTS
Inconsistent or absent delineation and signage (eg advance warning signs, chevrons and guideposts/edge marker posts) can make it harder for motorcyclists to 'read' the route. Limited range of motorcycle headlights Inconsistent curve advisory signage	• Apply consistent road and edge delineation and appropriate warning signs, (eg edge and centrelines, including wide centrelines, edge marker posts and curve advisory speeds; (refer to photo 9). • Keep route layouts simple, clearly define vehicle paths. Consider appropriate and/or improved lighting standards (photo 10). • Using ball bank gauge, check curves for need for and consistency of advisory signage.

Photo 9: Delineation, SH2 Waioeka Gorge.
Source: Opus International Consultants

Photo 10: Flag lighting at an intersection.
Source: safety.fgwa.dot.gov/

5.4.4 Hazards/roadside furniture

5.4.4.1 ROADSIDE OBJECTS

The most common objects struck by motorcycles/mopeds in urban areas (2006-15) were parked vehicles, kerbs and fences. In rural areas, ditches, fences cliffs or banks and guardrails were struck in 33 percent of motorcycle crashes that resulted in death or serious injury. For crashes involving death and serious injury, the objects struck most often were:

- fences (rural and urban) in six percent of fatal and serious crashes
- ditches (rural) in five percent of fatal and serious crashes
- cliffs or banks (rural) in four percent of fatal and serious crashes, a further two percent involved going over an embankment.

Figure 5-1: Objects struck in fatal and serious motorcycle crashes – 2006-2015 (Source: CAS)

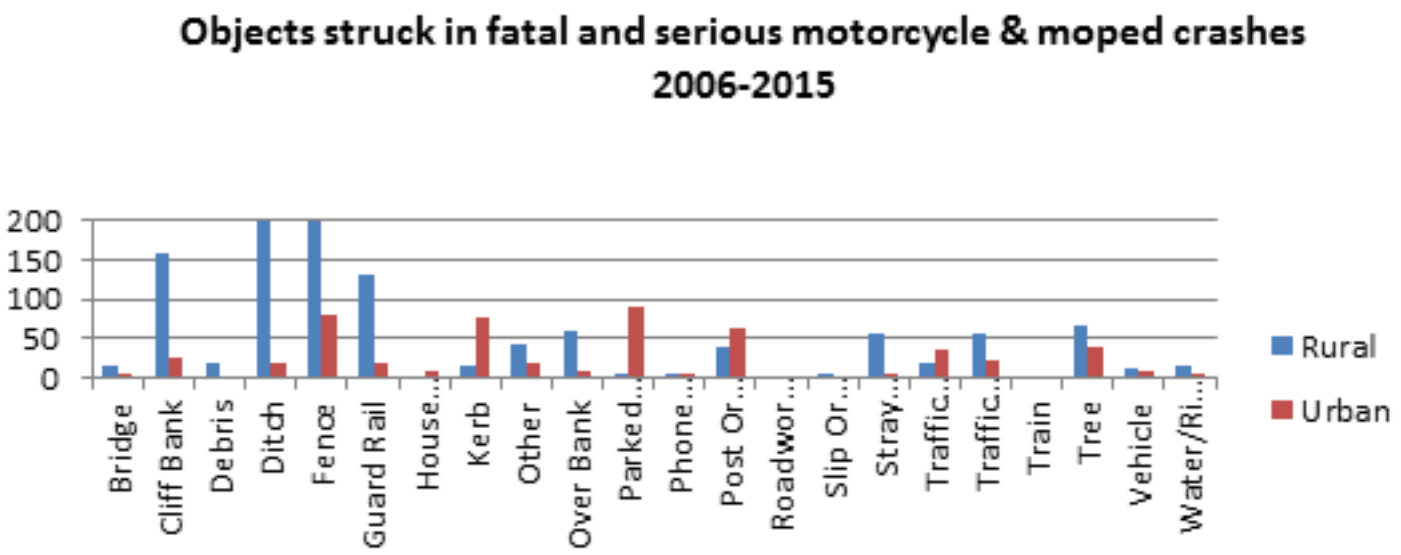


Table 5-6: Issues and possible treatments for roadside objects

ISSUE	POSSIBLE TREATMENTS
Roadside objects (eg culverts, culvert end walls, poles, signs, steep shoulders/ deep drains, trees and vegetation) in clear zones. (photo 11 and photo 12)	• Provide a forgiving environment by removing or relocating roadside hazards (ie. clear zones adjacent to the road that are unobstructed, relatively flat areas beyond the road edge to allow a rider to stop safely or regain control if their bike leaves the road). • If roadside hazards cannot be removed or relocated, or otherwise treated to reduce the risk to an acceptable level, install appropriate barriers, flexible signage and poles. • Consider providing frangible sign supports where signs near the road and there is a risk of a vehicle colliding with a post or pole. Information relating to impact performance, frangibility and breakaway designs can be found in the *Traffic control devices manual* part 1[18], the *Performance based specification for traffic signs*, the *State highway geometric design manual*, the RSMA *Compliance standard for traffic signs* and the Austroads *Guide to traffic management* part 10. • Consider sealing currently unsealed shoulders to assist in recovery and/ or avoidance manoeuvres.
Presence of crash barriers (eg concrete, W-beam and wire ropes can be hazardous with the posts presenting the greatest potential for injury for motorcyclists. With wire rope barriers, there is a risk of motorcyclists striking the posts and/or the wire cable.	• Crash barrier types should take into account vehicle types and location characteristics. A motorcyclist is usually separated from their motorcycle before they hit a crash barrier and it is usually the crash barrier posts that can cause most injury. • Barrier surfaces needs to be as smooth as possible avoiding obstructions and indentations to reduce risk of snagging. • Wire rope barriers should desirably be installed well away from traffic lanes, however, standards must be adhered to for maximum performance for all road users. • Repairs to barriers must be carried out promptly to protect motorcyclists and other road users.
Collisions with animals such as wandering stock.	• Install appropriate hazard warning signs. • A programme could be developed for construction of stock underpasses on high volume motorcycle routes. • Revision of stock droving bylaws.
Motorcyclist sight distance can be more easily reduced by parked vehicles than for other road users.	• Restrict and manage parking where it can obstruct sight distances.

18 NZ Transport Agency *Traffic control devices manual* – part 1: General guidance.

Photo 11: Place collision protection around poles in clear zones.

Photo 12: Place run-off protection when steep slopes and open drains located in clear zones.

5.4.4.2 BARRIERS

Median barriers protect all road users from roadside hazards and from opposing vehicles crossing the centreline. However, crashes into (both roadside and median) are a concern to motorcyclists. Their use and type of installation has been widely researched and discussed. It is important to put the use of these barriers into both the rider and a Safe System perspective.

Three main types of barriers are used in various locations nationally. These are:

- concrete barriers, which have no flexibility and tend to be used in medians for high speed locations such as motorways (photo 13)
- W-beam barriers are considered to be semi-rigid and are used both in the median and roadside locations, (photo 14)
- wire rope barriers are considered flexible and are also used in both median and roadside locations (photo 15 and photo 16).

Roads and roadsides should be predictable and forgiving of mistakes. Barriers protect road users from colliding with hazards (such as oncoming traffic, roadside poles, trees and slopes) that may cause a death or serious injury. Barriers need to be safer for all road users.

There is significant research regarding barriers and the implications for motorcyclists[19]. While concerns have been raised about the use of wire rope barriers ... recent evidence from Sweden suggests that median wire rope barriers may produce sizeable reductions in fatalities and serious injuries for motorcyclists[20].

It is important to note that:

- a motorcyclist who hits a barrier (or any other roadside or median object) is at risk of injury or death, regardless of the type of barrier they hit
- RCAs have a number of factors to weigh up when determining whether or not to install a barrier and the type of barrier to be installed
- RCAs should consider options to improve road safety for all road users. This includes evaluation of the type of barrier that is most appropriate to improve safety for all road users and take into account the specific needs of motorcyclists.

19 *Motorcycle crashes into roadside barriers* stage 1, stage 2 reports, 2010, University of NSW; Berg, F. A., Rucker, P., Gartner, M., Konig, J., Grzebieta, R., & Zou, R. (2005). *Motorcycle impact into roadside barrier- real-world accidents studies, crash tests and simulations carried out in Germany and Australia*. In Proceedings of the 19th International Conference on the ESV, Washington, USA. pp.1–13; *Evaluation of the safety impact of centre-of-the-road wire rope barrier (WRB) on undivided rural roads.* (Austroads Project No. STT1344, Austroads Publication No. AP-T135/09). https://www.nzta.govt.nz/assets/resources/untangling-wire-rope-barriers/Untangling-wire-rope-barriers-leaflet.pdf

20 Grzebieta, R., et al (2010). *Motorcycle crashes into roadside barriers*-Stage 1. University of New South Wales, p 6 and 8.

Photo 13 Concrete barriers.

Photo 14 W-beam or steel barriers.

Photo 15 Median wire rope barrier.

Photo 17 Roadside wire rope barrier.

5.4.5 Geometry and alignment

Motorcycles and mopeds are vulnerable to collisions on bends and curves, where acceleration or deceleration occurs, or where the stability of the motorcycle/moped is compromised and loss of control is more likely[21]. Disproportionately more impacts happen on slip roads (ie. roads with a tight radius) and on roundabouts. These are precisely the areas where barriers are installed and where care is needed to ensure that adequate protection is provided. Issues and possible treatments related to geometry and alignment are described in table 5–7.

ISSUE	POSSIBLE TREATMENTS
Changes in alignment (vertical, horizontal, variable radius curves). Motorcyclists are vulnerable on bends and curves where there is a higher risk of loss of control.	• Design new roads and realignments to ensure consistent and appropriate design standards for alignment on approach to and through curves. • Provide delineation where there are unpredictable changes in alignment.
Lack of sightlines (eg through intersections, roundabouts, splitter islands) and visibility through curves in rural areas.	Have clear sight lines through intersections and design route to be consistent and predictable. Ensure visibility through curves where possible so that full curve can be 'read' by approaching motorcyclist.
Adverse camber (super elevation).	Provide super elevation improvements/cross section consistency commensurate with design speed of road and radius of curve..

21 Berg, F. A., Rucker, P., Gartner, M., Konig, J., Grzebieta, R., & Zou, R. (2005). *Motorcycle impact into roadside barriers: real-world accidents studies, crash tests and simulations carried out in Germany and Australia*. In Proceedings of the 19th International Conference on the ESV, Washington, USA. pp. 1 – 13.

5.4.6 Intersections

Motorcycle crashes at intersections account for 44% of all motorcycle crashes; 86% of those occurred in urban areas and the majority at T-junctions. The main contributing factors attributable to the parties involved in the crashes at both urban and rural intersections were 'failing to give way or stop' and 'did not look or see another party until too late'. Intersection improvements that improve safety for all road users will generally benefit motorcycle/moped users too. Table 5-8 shows intersection issues and possible treatments.

Table 5-8: Issues and possible treatments for intersections

ISSUE	POSSIBLE TREATMENTS
Inadequate quality and/ or quantity of lighting at intersections.	Install and/or improve existing lighting at high risk or high volume intersections.
Lack of sight distance.	Improve sight distance through intersections for all road users, either through redesign, or removal or relocation of obstacles that restrict vertical and/ or horizontal sight lines and approach visibility (eg vegetation (photo 17 and photo 19) parking, and roadside advertising.
Obstacles in lean zones on curves. Motorcycles overhang their wheel track by about 0.5m on each side[22].	Remove or relocate hazards in lean zones; ie. those close to the kerb or edge of seal. The designer should allow for angles of lean of 45 degrees (photo 20).
Form of intersection, ie roundabout/T-junction/ crossroads.	Restrict some movements to reduce conflict where necessary (photo 18).

22 Vicroads. Motorcycle notes no. 6;

Photo 17: Remove sightline obstructions at intersection. Source: Opus

Photo 18: Intersection with the right turn out movement restricted to limit conflict. Source: Google Maps

Photo 19 Ensure sightlines through a roundabout obstructed by vegetation. Source: Austroads Part 15.

Photo 20: Remove hazards located in lean zone. Source: NZ Transport Agency presentation. R. Bullick 2011

5.5 ISSUES AND TREATMENTS FOR ROAD USERS (MOTORCYCLISTS)

Motorcyclists need different skills to other road users when braking, cornering[23] and swerving (crash avoidance); they also need a very good sense of balance. A road user operating within a Safe System is skilled and knowledgeable, alert and compliant, and in the case of motorcycle/ moped riders, is wearing appropriate safety gear.

Victoria's Strategic Action Plan for Two Wheelers reported that in 10% of all fatalities the rider did not have a valid licence, while 10% were riding an unregistered motorcycle. New Zealand is similar, with 10% of fatalities and 6% of all injury crashes involving riders who were either never licensed or were disqualified or had an expired licence. Unregistered statistics cannot be easily obtained for crash data in New Zealand. However, it is notable that 23% of fatal motorcycle/moped crashes in rural areas and 32% of fatal motorcycle/ moped crashes in urban areas involved motorcycles/mopeds with no warrant of fitness. While the legality of a motorcycle/moped for use on the road is an enforcement issue, it is important that riders made aware of the importance of safe vehicles as well as safe road use.

Training and education are necessary components to ensure motorcyclists develop the necessary skills and have equipment appropriate for their level of experience (Table 5-9).

23 Refer to www.rideforever.co.nz/skills-and-technique/cornering/.

Table 5-9: Issues and possible treatments for training and education

ISSUE	POSSIBLE TREATMENTS
The current motorcycle theory test mainly focuses on general road rules (25 of the 35 questions).	Redevelop the theory test to place more emphasis on motorcycle-specific requirements.
The practical riding assessment standards for novice riders do not adequately test the rider ability.	A tougher basic handling skills test and competency-based training and assessment courses have been introduced for novice riders.
An increase in motorcycle use recreationally, particularly in the riders over the age of 25 years.	Motorcycle awareness campaigns targeting older recreational motorcyclists. Refresher training for returning riders[24].
An increase in crashes involving mopeds. Moped riders are only required to hold a car driver licence and are not required to pass any handling skills test before they can legally ride a moped on the road.	Awareness campaigns targeting moped users[25].
Understanding of general road rules (all road users).	Encourage motorcycle dealers to provide information to moped riders about suitable safety gear and have it available.
Understanding specific motorcycle issues (all road users).	Education/motorcycle awareness campaigns targeted at all road users. Develop campaigns that outline/focus on specific motorcycle issues such as lean zones, leaning across the centreline, visibility of motorcyclists by drivers, rider fatigue, user responsibility for maintenance (tyre pressure etc), overloading (especially for mopeds).

Many RCAs provide motorcycle skills training and some have developed regional motorcycle strategies that focus on the motorcyclist and their skills.

5.5.1 Rider experience, speed, route knowledge and risk taking

Table 5-10 describes issues and possible treatments related to rider experience, speed, route knowledge and risk taking.

24 Refer to www.rideforever.co.nz/returning-to-riding/.

25 Refer to: scootersurvival.co.nz/.

ISSUE	POSSIBLE TREATMENTS
Inexperienced riders	Ride forever training and licensing improvements. Incentives to attend Ride Forever training courses.
Speed choice of rider	Install speed management and perceptual countermeasures (eg speed advisory signage, chevron indicators, edge marker posts). Ensure travel speeds are safe and appropriate along high risk or favoured routes. Enforcement and education.
Lack of route knowledge and new route locations.	Education on route knowledge and event based promotion. Provide a consistent environment for all road users including good delineation and identification of hazards; a no surprises forgiving environment.
Lack of knowledge of route conditions.	Provide and promote information regarding current conditions on routes via websites such as: maps.aa.co.nz/traffic/roadwatch and www.nzta.govt.nz/traffic/current-conditions/highway- info/index.html.
Risk taking (seeking a thrill and riding beyond their capabilities).	Provide targeted enforcement along high risk and favoured routes and develop education campaigns.

Safe road use also includes road users informing RCAs about hazards on the roads.

5.5.2 Alcohol and drug use

The use of alcohol is a significant factor in motorcycle crashes, particular in urban areas where it is the most common contributing factor for injury crashes. Issues and possible treatments related to rider alcohol and drug use are described in table 5–11.

ISSUE	POSSIBLE TREATMENTS
Alcohol and drug use	• Blood alcohol/drug content testing. • Random breath testing. • Drug impairment tests. (CIT[26]) • Ride Forever skills training addresses safe choices including alcohol and drug advice. • Post-crash breath testing education. • Alcohol interlocks.

Motorcyclists are subject to the same compulsory breath test requirements (photo 21 and photo 22) as other road users. Testing for alcohol content includes testing for blood alcohol content (BAC), which can arise from a random stop or may be carried out following a crash.

26 CIT = compulsory impairment test.

Photo 21: Compulsory breath testing activity is supported by booze buses.
Source: Opus International Consultants: Swears, R S

Photo 22: All road users, including motorcyclists are subject to compulsory breath testing.
Source: Opus International Consultants: Swears, R S

While police enforcement of road use by motorcyclists is generally conducted in the same way as for other road users, there are some motorcycle-specific enforcement activities, eg special operations in relation to outlaw motorcycle gangs.

5.5.3 Fatigue[27]

Measures can be applied across all four elements of the Safe System to reduce the adverse impact of fatigue on road safety. Fatigue can affect a rider's reaction time, their ability to concentrate and their understanding of the road and traffic around them.

5.5.4 Rider safety gear

Wearing protective gear helps to reduce injuries should a crash occur as well as enhancing the visibility of motorcyclists to other road users. Suitable safety gear also protects the rider from the elements and reduces the chances of exposure related conditions such as hypothermia.

New Zealand research[28] has shown that 'low conspicuity may increase the risk of motorcycle crash related injury. Increasing the use of reflective or fluorescent clothing, white or light coloured helmets, and daytime headlights are simple, cheap interventions that could markedly reduce motorcycle crash related injury and death.' In summary the research noted that:

- 'riders wearing reflective or fluorescent clothing had a 37% lower risk than those who were not wearing such materials...'
- 'compared with wearing a black helmet, use of a white helmet was associated with a 24% lower risk...'
- 'self-reported light coloured helmet versus dark coloured helmet was associated with a 19% lower risk'
- 'three quarters of motorcycle riders had their headlights turned on during the day, and this was associated with a 27% lower risk ...'.

It is important to recognise that the improved safety associated with more conspicuous clothing may also be a function of the safety attitude of the motorcyclist wearing the clothing.

Issues and possible treatments related to rider safety gear are described in table 5-12. The responsibility for addressing these treatments lies with a range of organisations, agencies and motorcycle groups with an interest in improving safety for motorcyclists.

27 Material in this section is predominantly taken from the Safer Journeys strategy.

28 British Medical Journal April 2004, 328:857. *Motorcycle rider conspicuity and crash related injury: case-control study*

Table 5-12: Issues and possible treatments for rider safety gear

ISSUE	POSSIBLE TREATMENTS
Use of protective clothing	• Promotion and education of the importance of protective clothing (figure 5-2, 5–3 and figure 5-4).
Promotion of new technology (eg air bag technology, neck protection).	• Promotion and education of new technology to both sellers and buyers.
Use and quality of helmet design (eg age, size, fit and type).	• Promotion and education of the importance of appropriate equipment to both sellers and buyers. Refer to www.rideforever.co.nz/gear/safety- approved-gear/.

Also refer to:

- www.rideforever.co.nz/gear/
- www.infrastructure.gov.au/roads/safety/publications/2009/good_gear_guide.aspx

While motorcycle/moped riders have the primary responsibility for ensuring they are safely equipped, motorcycle retailers and hirers have an obligation to ensure they have appropriate protective gear for motorcycle/moped riders. This includes making available:

- a range of helmets
- a range of protective clothing, including a much wider range of coloured clothing to balance the predominant availability of black clothing
- a range of boots
- information regarding the need for stocking a range of suitable protective clothing.

Figure 5-2: Protective gear for motorcyclists: Source: The official NZ road code for motorcyclists

Examples of education campaigns for motorcycle/moped road users are illustrated in figure 5-3 and figure 5-4 below:

Figure 5-3: Education campaign to wear protective clothing
Source: www.reducetherisk.co.nz

Figure 5-4: Successful rider training
Source: www.scootersurvival.co.nz

5.5.5 Group riding

Many recreational motorcyclists enjoy the social opportunities of group riding. However, it can have its own issues (Table 5-13). More information on group riding can be found at:

- Scooter Survival (Accident Compensation Corporation, www.scootersurvival.co.nz).
- Ride Forever (Accident Compensation Corporation, www.rideforever.co.nz).
- *The official New Zealand road code for motorcyclists* (www.nzta.govt.nz).

Table 5-13: Issues and possible treatments for group riding

ISSUE	POSSIBLE TREATMENTS
In group riding situations there can be perceived or actual peer pressure for motorcyclists to ride above their abilities to keep up with the bunch.	• Offer education as part of training packages and other campaigns. • Talk to tour group facilitators.
Lack of communication between riders.	• Each riding group should have a set of basic hand signals so they can communicate with each other.
Keeping the group together (stopping and leaving intersections, passing vehicles etc).	• Group leader takes responsibility. • If you are at the front of the group leave enough room for others to join.
Inexperienced riders failing to keep up with the rest of the group may feel pressured to ride with the group and so ride outside of their comfort zone and experience.	• Provide designated stopping or meeting places. • Allow inexperienced riders to set the pace in group rides.
Inappropriate riding formation can reduce safety for all road users.	• Riders should ride in a staggered formation (photo 23 and photo 24), with less experienced riders in the left hand wheel track of the lane. Lead rider should take responsibility. • Single file formation should be considered in locations where it may be safer than staggered formation; such as when the group are turning, using off-ramps, passing slower vehicles, riding in areas of narrow lane widths or areas with parked cars[29].

Photo 23: Group riding.
Source: www.rideforever.co.nz

Photo 24: Staggered formation.
Source: *The official NZ road code for motorcyclists*

29 www.motorcyclebasics.com/group-riding.html.

Motorcyclists tend to position themselves in the vehicle wheel track. At curves, this can be potentially hazardous as the wheel tracks will be the higher loaded areas of the road (especially by trucks) and might have more damage to the road surface and pavement. On curves, motorcyclists may cross from one wheel track to the other.	• Provide wider shoulders where needed such as on approach to out of context curves (photo 25). • Consider appropriate speed management treatments or perceptual countermeasures (photo 26). • Reduce head-on risk where exposure is high through appropriate treatments such as wide centrelines and median barriers. • Ride Forever skills training provides coaching on lane approach and positioning for safety. • Carry out appropriate maintenance to ensure motorcyclist riding lines are in good condition. Recognise that on curves motorcyclists may cross from one wheel track to the other.

Photo 25: Shoulder widening.

Photo 26: Speed threshold treatments.

30 www.scootersurvival.co.nz/videos/how-to-ride/ ; www.rideforever.co.nz/skills-and-technique/cornering/cornering-lines/

31 www.scooter-survival.co.nz/videos/how-to-ride

5.6 ISSUE AND TREATMENTS FOR VEHICLES (THE MOTORCYCLE)

Safe vehicle technology for motorcycles/mopeds is developing and in the future there will be improvements to the safety features available on motorcycles/mopeds.

5.6.1 Maintenance

Table 5–15 describes issues and possible treatments related to maintenance of motorcycles.

Table 5–15: Issues and possible treatments for maintenance of motorcycles

ISSUE	POSSIBLE TREATMENTS
Poor vehicle maintenance (eg inadequate tyre tread and pressure, bearings, lights, brakes).	• Education and information campaigns to show riders the importance of vehicle maintenance. • Vehicle inspections on popular motorcycle routes.

5.6.2 Power-to-weight ratios

A higher proportion of crashes involving large motorcycles (500cc or larger) result in death rather than injury – riders of large motorcycles make up 41% of all casualties but 60% of deaths[32]. This is partly a result of riding patterns and in particular inappropriate speeds. The highest number of injury crashes are among 15-24 year-olds with learner/restricted licences, on small bikes on urban roads[33] . Issues and possible treatments related to power-to-weight ratios of motorcycles are described in Table 5-16.

Table 5-16: Issues and possible treatments for motorcycle power-to-weight ratios

ISSUE	POSSIBLE TREATMENTS
Limited capabilities in handling more powerful vehicles than experienced or trained in.	• The Land Transport (Driver Licensing) Amendment Rule 2011 introduced a power-to-weight restriction for novice motorcycle riders. Learner motorcycle licence holders can only ride motorcycles which do not exceed a power-to-weight ratio of 150 kilowatts per tonne. • Training and education for riders about their choice and use of a motorcycle/moped suitable for their level of capability.

5.6.3 Motorcycle conspicuity

'Enhancement of ' conspicuously can make a critical contribution to the safety of ...' motorcycles/mopeds[34] . The relative lack of motorcycle/ moped conspicuity is one of the most important factors associated with motorcycle/moped crashes. However, the conspicuity advantage obtained from headlights (for daytime and night-time) on motorcycles/ mopeds has been hampered by the increased daytime use of headlights by other road users[35]. The results of a study into four light configurations for motorcycles found that[36]:

- a triangular lighting configuration on a motorcycle was not significantly more detectable than a standard lighting configuration
- motorcycles, where the standard headlight and a helmet mounted light were used were ' globally better detected than those equipped with the standard headlights'

32 As a percentage of all casualties and deaths for motorcycle/moped riders

33 ACC pers.comm. 2017.

34 Pinto, M, and Cavallo, V Influence of headlight design on sensory conspicuity of powered two wheelers, proceedings of the sixth international driving symposium on human factors in driver assessment training and vehicle design, 2011, p373.

35 Ibid page 86

36 Ibid, page 377.

- motorcycles equipped with a yellow headlight 'were globally better detected...than with a standard one'.

While some of these differences were not statistically significant other research has shown that non-standard lighting configurations on motorcycles/mopeds can make motorcycles/mopeds more conspicuous in a traffic stream. Results[37] show that motorcycles/mopeds with a T light configuration (across the handlebars and down the front forks) are seen a lot sooner than motorcycle/mopeds with a conventional front headlight only.

5.6.4 Features

Issues and possible treatments related to motorcycle features are described in Table 5-17.

Table 5-17: Issues and possible treatments for motorcycle features

ISSUE	POSSIBLE TREATMENTS
Availability of new safety technology (eg ABS, stability control, linked brakes, traction control and airbags).	• Promotion of new safety technology. • Enhance rules regarding safety features required on imported motorcycles in New Zealand.
Lack of conspicuity associated with motorcycles.	• Daytime headlights. As required by law[38]. • Additional running lights.
Buyers and importers knowledge of safety features.	• Provide information for buyers and importers on what safety features they should be looking for such as anti-lock brakes and stability control features.

5.7 ISSUES AND TREATMENTS FOR SPEEDS

Safe speeds are a fundamental issue for motorcycling safety. Riding to the conditions reduces the risk of loss-of-control. Good speed management can help avoid a crash and reduce injury severity when crashes occur. Table 5-18 summarises issues and possible treatments.

Table 5–18: Issues and possible treatments for speeds

ISSUE	POSSIBLE TREATMENTS
Travelling too fast for the conditions.	• Self-explaining roads, appropriate signs and markings for hazards, eg curve signs and edge marker posts to highlight design of curves (particularly those that are out of context).
Speeding (that is over the speed limit).	• Visible and targeted enforcement.
Posted speed limits are not safe.	• Refer to the NZ Transport Agency's *Speed management guide.*
Following distances.	• Enforcement and education.
Lack of rider awareness of speed limit.	• Provide additional cues, particularly in areas subject to speed zoning and/or where speed limit is not obvious.

37 Rössger L, Hagen K, Krzywinski J, Schlag B *Recognisability of different configurations of front lights on motorcycles,* Accident Analysis and Prevention 44 (2012) 82-87.

38 It is a legal requirement to turn on either your moped or motorcycle's headlight or daytime running lights during daylight hours if your motorcycle or moped was manufactured on or after 1 January 1980. Refer to www.nzta.govt.nz/resources/roadcode/motorcycle-road-code/about-riding/night-riding.html.

Speed management measures described in the Speed Management Guide Toolbox[39], include:

- speed activated warning signs (SAWS)
- speed thresholds
- lowering the posted and operating speed.

5.8 ISSUE AND TREATMENTS FOR INJURIES

All road users should be aware of general crash scene and first aid procedures. Immediate first aid for riders injured in crashes can reduce the severity of the outcome.

Appropriate gear reduces the severity of motorcyclists' injuries and in some cases can prevent injury. For example a heavy jacket (leather, Kevlar, etc) would reduce the severity of injuries in 92% of motorcycle crashes, whereas a light or medium weight one (cotton, denim, etc) would do this in only 69% of crashes; light footwear reduces the severity of injuries in 46% of crashes, whereas motorcycle boots achieve this in 93% of crashes[40]. In the 2007–10 four-year period nearly 5000 people had ACC claims for broken limbs that resulted from motorcycle crashes[41].

Information on choosing the right gear for riding a motorcycle/moped can be found on the ACC Ride Forever website (www.rideforever.co.nz). A summary of the issues and possible treatments related to motorcyclist injuries are described in table 5-19.

Table 5-19: Issues and possible treatments for injuries

ISSUE	POSSIBLE TREATMENTS
Personal responsibility.	• Knowledge of first aid and general crash scene procedures.
Proximity of helicopter landing.	• First responder needs (golden hour).
Available mobile phone coverage.	• Increased coverage in lower population areas. • Use of personal locator beacons could be activated to summon assistance if a crash occurs, particularly in remote areas where mobile phone coverage may be poor.
Inadequate safety gear.	• Wearing suitable safety gear to reduce the potential for injury if a crash occurs.

5.9 GENERAL CRASH REDUCTION RESULTS

While this document does not go into detail about specific crash reduction percentages, a summary of the effectiveness of some treatments to reduce the potential motorcycle casualties has been developed by iRAP (International Road Assessment Programme)[42] – examples of these treatments, their relative costs and potential for casualty reduction are described in Table 5-20. Further information and detailed crash reduction percentages for all road users can be found in the *High-risk rural roads guide* and the *High-risk intersections guide.*

39 https://www.pikb.co.nz/assets/Uploads/Documents/SpeedManagementToolboxandAppendicescombinedFinalNovember2016.pdf

40 ACEM, European Motorcycle Industry, www.acem.eu/cms/ppe.php.

41 Accident Compensation Corporation.

42 www.toolkit.irap.org/default.asp?page=roaduser&id=6

Table 5-20: Possible casualty reduction for motorcycle crash treatments

TREATMENT (COST)	CASUALTY REDUCTION %	TREATMENT (COST)	CASUALTY REDUCTION %
Delineation (L[43])	10–25	Intersection-delineation (L)	10–25
Central turning lane full length	10–25	Intersection-turn lanes (signalised) Intersection – turn lanes (unsignalised (L-M)	1 10–25
Roadside safety hazard removal (L-M)	25–40	Intersection - turn lanes (unsignalised) (L-M)	10–25
Parking improvements (L-M)	10–25	Motorcycle lanes (M)	25–40
Shoulder sealing (M)	25–40	Intersection-signalise (M)	25–40
Road surface upgrades (M)	25–40	One way network (M)	25–40
Speed reducing treatments (M)	25–40	Restrict/combine direct access points (M-H)	25–40
Traffic calming (M–H)	25–40	Realignment – horizontal (H)	25–40
Intersection grade separation (H)	25–40	Realignment – vertical (H)	10–24

43 L = low estimated cost, M = medium estimated cost, H = high estimated cost

6 Understanding the issues

Analysing all crash data and other factors helps to determine the safety problem and the most appropriate countermeasures to be adopted for the treatment strategy.

6.1 ANALYSING THE DATA

Crash analysis is essential before choosing countermeasures. Using all the crash data rather than just data for the high-severity crashes provides a larger sample size to make more informed decisions on what type of countermeasures may be suitable for any given route/site[44].

Risk analysis uses the crash prediction tools to supplement any detailed analysis of:

- all crashes (the inclusion of minor and non-injury crashes will better highlight spatial, temporal and crash movement commonalities or factor patterns)
- the spatial location of crashes – whether they are clustered or distributed
- key risk factors such as lengths, proximity to other road users and to roadside hazards
- consistency of expectation and provision of road features and roadside infrastructure.

Other data that could help develop treatments includes consideration of changes to land use, traffic volumes, and key stakeholder and community concerns.

6.2 DETAILED CRASH ANALYSIS

Although the CAS plain English and coded reports are a good starting point, the original traffic crash reports should be reviewed and analysed, preferably by someone with a good understanding of motorcycle dynamics, as they contain information not available in the summary reports. In some cases, discussing a specific crash with the police officer involved may help to better understand the details of the crash.

The general factors that should understood are crash movement types, midblock versus intersections, direction of travel, temporal factors (day of week, time of day, month of year) and ambient light (day or night).

The roads and roadside factors are straights versus curves, wet or dry conditions, objects struck, and other road factors (such as surface material, sight distance, roadside features). These include consistency and readability of alignment, signage and delineation, carriageway width, skid resistance, median treatments, and hazard removal, protection or mitigation.

The speed factors that should be studied include if drivers were travelling too fast for the conditions, or exceeding the posted speed limit, and time of day and traffic conditions.

The road user factors that should be taken into consideration include (but are not limited to) driver/rider age, sex, licence status, recent motorcycling experience on actual motorcycle that was crashed, and if alcohol, speed, fatigue or inattention was involved.

The vehicle factors to consider are the age, type and condition of the vehicle.

If crash analysis or community and key stakeholder feedback has identified that a significant number of motorcyclists use a route, then considering appropriate facilities for these types of road users is important when developing any treatment.

Further information and analysis on environmental factors (for example, wet and dark crashes) and other vulnerable road users (pedestrian and cyclists) can be found within the *High-risk rural roads guide*, the *Pedestrian planning and design guide*, www.nzta.govt.nz, and cycling aspects of Austroads guidelines.

While use of a route by a significant number of motorcyclists does not necessarily equate with a safety issue, high levels of motorcycle usage demonstrate a greater need for RCAs (and their consultants and contractors) to ensure that construction and maintenance practices are appropriate for all road users.

44 See also the NZ Transport Agency's *New Zealand guide to the treatment of crash locations* and Austroads: Part 8 *Treatment of crash locations*

7 Programme implementation, monitoring and evaluation

Monitoring targets for motorcyclists in the Third Safer Journeys Action Plan are:

- the treatments recommended in this guide are increasingly applied to high-risk motorcycling routes
- increased consumer awareness of ABS benefits
- increased percentage of ABS is recorded in the motorcycle fleet
- reduced number of motorcyclist deaths and serious injuries.
- reduced severity of injuries (as measured by ACC claims data.

Once countermeasures have been determined for high-risk routes and sites, the next step is a suitable implementation programme and a system to monitor its effectiveness, in particular to:

- identify the benefits and the effectiveness of the various treatments
- identify the most effective packages of treatments
- assess required levels of investment to achieve various levels of crash reduction
- prove that funding has been invested wisely.

This chapter describes the development of a programme of treatments, and how to establish the appropriate interventions.

7.1 PROGRAMME DEVELOPMENT

It is important to remember that even though Safe System transformation works[45] can produce significant safety benefits, low-cost safety management treatments are still relevant for many situations including high-risk motorcycling routes.

In some regions there will be no rural road sections that have long term larger infrastructure or corridor improvements planned, therefore, a programme of ongoing safety improvements should be considered and tailored to fit the desired outcome.

For more information on programme prioritisation, programme implementation and challenges to implementation, refer to the *High-risk rural roads guide.*

7.1.1 Focus on incremental improvements across networks

Having identified that larger infrastructure/ capital projects may be planned for a route to produce a Safe System transformation, the end result has to some degree been confirmed. However, given there may be long lead times until the major project is constructed, doing nothing until that project eventuates continues to place motorcyclists at risk of death or injury.

Incremental improvements are viable if they:

- contribute to a reduction in the cost of the final project, that is providing incremental benefit and costs, or
- return an economic road safety benefit over the intervening period, that is between now and the realistic date for delivery of the major project.

7.1.2 Consistency and road classification

The road environment should give the road user a strong indication of what to expect, how to behave and the appropriate speed. The consistency of road environment messages along the road corridor is important. These are delivered through the carriageway width, alignment, access management, signs and markings standards and other traffic control devices.

Service levels for motorcyclists are currently being considered as part of the overall levels of service work for the One Network Road Classification.

7.1.3 Driver awareness measures/self-explaining roads

Driver awareness measures for self-explaining roads provide clear direction and unambiguous information to all road users which drivers can use to make decisions and modify their behaviour depending on the design and function of a road and the associated risks, including the nature and consistency of the road surface. These measures are more likely on routes where there are higher levels of personal risk but low to medium levels of collective risk.

45 Safe System transformation works are likely to be the most effective in producing a significant step change in the safety profile for a section of road. Safe System transformation works are generally the higher cost infrastructure countermeasures and are developed and implemented over a long term.

7.2 KEY STAKEHOLDER ENGAGEMENT

7.2.1 General consultation and engagement

It is vital to engage with key stakeholders (community, affected and interested parties) when developing projects in order to create a common sense of purpose, draw on and learn from other's perspectives, make better decisions, align mutual interests, identify and mitigate risks, and find shared solutions to challenges.

Good relationships are important for effective engagement. However, many of the hallmarks of good relationships – trust, mutual respect and understanding – are intangibles that develop and evolve over time. Early engagement provides a valuable opportunity to set a positive tone with stakeholders from the outset of a project. The absence of established relationships and communication channels can put your project at an immediate disadvantage.

Effective engagement and communication will ultimately ensure the project's success. Some new resources have been developed to help RCAs engage with their stakeholders and communities and have better conversations on road risk[46].

7.3 ROAD SAFETY ACTION PLANNING

Road safety action planning is a process for planning and implementing road safety interventions at the local level and is an important avenue for delivering the Safer Journeys strategy. Effective road safety action planning is based on a collaborative approach from participating partners to provide focus, commitment and urgency in order to address and mitigate road safety risks.

Partners may include regional and local authorities, the Transport Agency, Police, ACC and other road safety stakeholders according to local enthusiasm and existing relationships. The partners agree on regional and/or local road safety risks, identify objectives, set targets, undertake road safety actions, and monitor and review progress towards road safety targets.

Road safety action planning is an excellent way to coordinate a Safe System approach to road safety problems at sub-regional levels and could be a key opportunity for all road safety partners to identify their motorcycle improvement projects.

7.4 MONITORING AND EVALUATION

Monitoring and evaluation of Safe System treatments is important to gauge the effectiveness of different treatments and rider training, tests and assessments. Specifically:

- monitoring involves an assessment of progress and collecting information through the course of a project or training programme, this can be before, during and after implementation to gather results from which to do an evaluation (see section 7.5.1)
- an evaluation analyses the results of monitoring and determines the results and effectiveness of the types of treatments used (see section 7.5.2).

7.4.1 Monitoring

Monitoring and collection of data for evaluation will help to identify if road safety has been improved. 'Systematic recording of data and analysis of trends from which the performance measures can be calculated allows the most recent values of measures and their trends to be compared with target levels[47].' The Transport Agency website (www.nzta.govt.nz/resources/road-safety-outcomes/) contains quarterly outcome reports that indicate actual road safety progress compared with the Safer Journeys areas of concern. These reports provide an overall picture of road safety from a national, regional, and police district perspective.

7.4.2 Evaluation

The role of evaluation is to:

- ensure that recently delivered programmes are effective and enable remedial action if they are not
- build up a reliable knowledge base about the effectiveness of different interventions, which will allow more effective future programmes to be developed.

46 https://www.nzta.govt.nz/safety/speed-management-resources/

47 Austroads, 2006, *Guide to road safety part 2: road safety strategy and evaluation*, AGRS02/06, page 30

There are effectively two levels of monitoring and evaluation:

- Strategic monitoring and then evaluating the effectiveness of the overall programme or strategy, which is made up of various projects or initiatives.
- Individual monitoring and evaluating of specific projects or initiatives that combined make up the overall programme or strategy.

In the following sections the monitoring and evaluation of individual initiatives or projects are described, followed by the monitoring of the overall strategy.

For further information of evaluation of treatments, evaluation methods refer to the *High-risk rural roads guide*.

7.4.3 Monitoring and evaluation performance measures

Monitoring and evaluation performance measures can be split into primary and secondary:

- Primary outcomes – for example, the reduction in the number of motorcyclists killed or seriously injured on high-risk routes.
- Secondary performance measures, such as reductions in collective risk. These can be measured in terms of reported crash numbers and patterns of crash types and factors.

Lead performance indicators or intermediate measures describing the improvements to the road, road environment, speed or other features that have a known impact on road safety; for example, increasing skid resistance investigatory levels to reduce loss of control crashes. These output measures are known to directly impact safety outcomes. These intermediate measures are particularly important[48].

'Within a Safe System approach there is a need to switch from injury based data (final outcomes) to performance data (intermediate outcomes). Some countries already have systems which give them an opportunity to address road safety problems without needing to wait to measure final outcomes in terms of fatalities and injuries. Focusing on this intermediate data and its measurement builds awareness that, for a Safe System, 100% achievement of safety performance in various sub-target areas is required.'

7.4.3.1 PRIMARY OUTCOMES

The primary outcome target is the reduction in deaths and serious injuries over the highest-risk routes and intersections that contribute most to the total across the network.

7.4.3.2 SECONDARY PERFORMANCE MEASURES

Secondary performance measures (refer to table 7-1) relate to reducing the crash risks on the network and on each high-risk rural route. Indicators could be reductions in all recorded crash types or particular subgroups.

48 OECD, 2008, *The Safe System approach: Towards zero ambitious road safety targets and the safe system*. OECD International Transport Forum, Transport Research Centre, 2008, page 12.

Table 7-1: Key secondary performance measures

KEY SECONDARY PERFORMANCE MEASURES BASED ON ACTUAL RISK (CRASH DATA) COULD INCLUDE A REDUCTION IN:	KEY SECONDARY PERFORMANCE MEASURES BASED ON PREDICTIVE RISK ANALYSIS MAY INCLUDE A REDUCTION IN:
• overall collective risk • number and severity of loss of control crashes • number and severity of intersection crashes • number and proportion of crashes in the wet • injuries to motorcyclists	• the length of route (through realignment).

7.4.3.3 LEAD PERFORMANCE INDICATORS

The most relevant lead performance indicators will directly relate to the change in collective crash risk associated with improvements in the feature being assessed. Key lead performance indicators may include:

- proportion of highway (or travel on highways) with roadside barriers or hazard reduction
- proportion of highway (or travel on highways) with sealed shoulder widths of at least 1m
- the length of routes subject to speed zoning below the default limit or under active speed management
- the change in mean operating speed
- the change in centre line or edge line encroachments.

The primary outcomes all relate to the nationally reported targets for motorcycling safety:

- ACC entitlement claims from motorcyclists.
- Motorcycle/moped riders killed per 100,000 population per year.
- The percentage of motorcycle/mopeds with a non-current warrant of fitness (WOF) involved in crashes.
- Motorcycle/mopeds riders hospitalised for more than one day per 100,000 population per year.

Goals could also be set for one or more lead indicators, provided they pertain to:

- crash patterns for both
- high-severity crashes, that is, those resulting in death or serious injury, as they may differ from lower- severity crashes
- all crashes (the inclusion of minor and non-injury crashes will better highlight spatial, temporal and crash movement commonalities or factor patterns)
- the spatial location of crashes – whether they are clustered or distributed
- key risk factors such as length, proximity to road users, and severity of hazardous roadsides
- consistency of expectation and provision of road features and roadside infrastructure.

7.4.4 Responsibilities for monitoring and evaluation

The Ministry of Transport monitors the national trends in the numbers of road users killed or seriously injured – the primary outcomes. However, RCAs should also be monitoring these primary outcomes for their respective networks.

RCAs should also be monitoring the secondary outcomes, related to collective and personal risk, patterns of crash types and factors, and changes in the risk profile of the routes and intersections being targeted.

RCAs should also focus on lead performance indicators as the measure of the work they are performing towards Safe System goals.

7.5 CASE STUDY: AUCKLAND MOTORCYCLE/MOPED DEMONSTRATION PROJECT

This case study[49] is a good example of how to address high risk motorcycling routes taking a whole of Safe System approach. While mainly focused on urban road environments, the process is still applicable to high risk rural motorcycle routes.

Motorcycle/moped use is increasingly popular in Auckland both as a form of recreation and as an efficient means of transport. Auckland motorcycle/moped use grew 22% from 32,079 in 2011 to 39,274 in 2015. Despite making up only 3% of the Auckland vehicle fleet in 2015, motorcycle/moped DSI made up 20% of all Auckland DSI from 2011 to 2015. 79% of this occurred on urban roads. The social cost of motorcycle/moped crashes in Auckland in 2015 was estimated at $158 million. Moped crashes are a significant part of urban motorcycle/ moped DSI, making up 22% of Auckland urban motorcycle/moped DSI from 2011-2015.

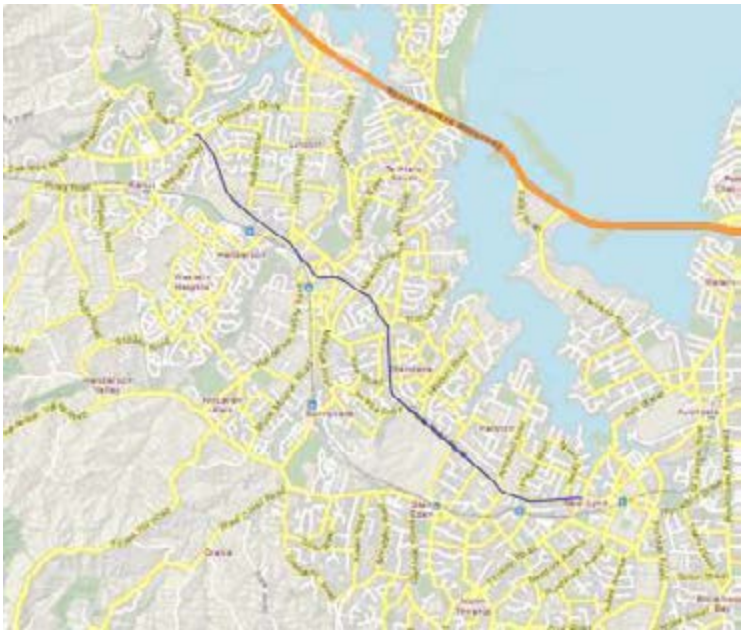
An urban motorcycle crash reduction study team was formed for the project including Road Safety Action Plan partners. The team identified a list of key motorcycle/moped Safe system issues on two high risk routes.

The methods below were used on two high-risk routes, Great North Road and West Coast Road:

- Crash Analysis (Motorcycle/moped)
- Road Infrastructure Audit (All road users)
- Road User Audit (Motorcycle)
- Motorcycle Safety Audit Review (Motorcycle)

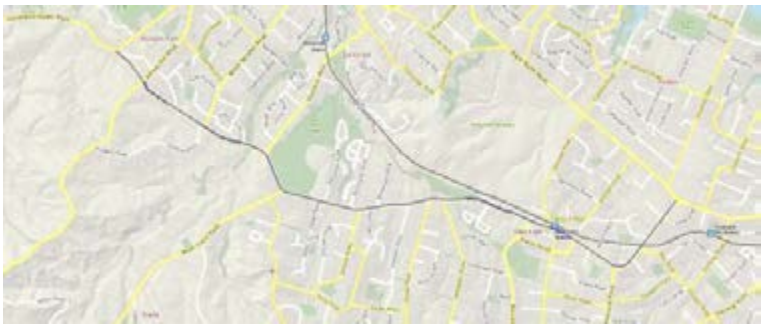
Route description – Great North Road

The Great North Road Route starts at the intersection of Titirangi Road and Rata Street in New Lynn, then continues along Great North Road and Swanson Road before ending at Universal Drive Roundabout. Great North Road is an urban arterial carrying between 11,500 to 26,000 vehicles per day. There are different lane combinations along the route. The main land use is residential with a few small town centre hubs along the route.



Route description – West Coast Road

The West Coast Road Route begins at its intersection with Great North Road, then proceeds west to Parrs Park, and changes to Parrs Cross Road and then Pine Avenue. It ends at the intersection of Henderson Valley Road. West Coast Road is a mix of single and double lane sections, over its first few kilometres. The lanes appear before intersections and disappear after them. There are right turn bays marked in the flush median for all of the minor side roads.



Road infrastructure audit (all road users)

The first step to grasping the issues was a road infrastructure audit to identify all deficiencies on the routes from a motorcyclists/moped perspective. It can be hard to determine if a hazard or deficiency an issue for motorcyclists, but not for other road users.

The following issues were assessed:

- Placement of roadside furniture especially at intersections where it may restrict visibility between vehicles and motorcyclists.

49 Content for this case study was provided by Auckland Transport.

- Roadside hazard, ie guardrails.
- Consistency of road marking/roading layout.
- Street lighting conditions.
- Visibility requirements at all crossing facility along the routes.
- Level of utility services covers.
- Appropriate signage.

Road user audit (motorcycle)

A road user audit was undertaken by motorcyclists with video cameras mounted on their bikes. As part of the drive-over, the motorcyclists provided commentary as they rode.

ROAD USER AUDIT RESULTS – GREAT NORTH ROAD

- **Road condition**: There are a few of places where the road condition is deteriorating, eg. large holes, a large hump on the outside lane of a roundabout and poor surface condition in places.
- **Visibility**: Height of planting in places, which could potentially affect the visibility of oncoming vehicles to motorcyclists should they grow higher.
- **Utility/services covers**: Numerous utility/service covers are not flush with the road surface, and some are indented into the road by approximately 20 – 40 mm. Indented utility/service covers could lead to loss of traction and loss of control, especially when wet. While utility/services cover is a potential safety issues the auditor commented that riders would generally avoid riding over utility/service covers.
- **Signage**: Lack of advance warning signage at certain locations along the route to warn motorcyclists and other road users of approaching changes.
- S**peed limit**: There is lack of speed limit or speed advisory signs along the length of the Road. Great North Road does not 'look' like a road with a 50km/h speed limit. There is no signage advising the speed limit on some sections.
- **Parking**: The location of some parking spaces is not ideal and there is a risk of collisions with vehicles pulling out of parking spaces due to limited visibility.

ROAD USER AUDIT RESULTS – WEST COAST ROAD

- **Utility/services covers**: numerous utility/service covers were indented.
- **Signage**: Lack of signage at a roundabout regarding direction. Riders could get lost.
- **Road condition**: Uneven road surfacing and loose gravel was found along a few parts of the road. Following the road user audit, remedial work was undertaken in 2014/15.

Motorcycle safety audit review (motorcycle)

This was a 2016 desktop review based on the 2014 Road Infrastructure Audit. It examined both routes from a motorcyclist's perspective. Hazards were split into five categories; surface, strike (roadside hazards), sightlines, signage (and delineation) and speed. Each category was ranked from minor to serious using the same method as the Road Infrastructure Audit.

RESULTS – GREAT NORTH ROAD

- **Surface**: Moderate surface concerns included low skid resistance surfaces, rough surfaces, patches not full width, oil/fuel spills and pit lids/service covers. A minor concern was raised pavement at pedestrian crossings.
- **Strike (roadside hazards)**: Power poles/cabinets adjacent to carriageway were identified as a moderate concern.
- **Sightlines**: Sight lines along Great North Road are reasonable for a 50 km/h road. Some utility poles at junctions may inhibit drivers waiting to turn from seeing motorcycles.
- **Signage (and delineation)**: A moderate concern is the lack of speed signs. A minor concern is the bus bay marking.
- **Speed**: A moderate concern is the wide carriageway which encourages speeding. A significant concern is confusion over the speed limit.

RESULTS – WEST COAST ROAD

- **Surface**: Moderate surface concerns included low skid resistance surfaces, rough surfaces, patches not full width, and pit lids/service covers.
- **Strike (roadside hazards)**: Power poles / cabinets adjacent to carriageway were identified as a minor concern.
- **Sightlines**: The sight lines along West Coast Road were considered reasonable for a 50 km/h road. Some utility poles at junctions may hamper driver's ability to see motorcycles.

- **Signage (and delineation)**: Lack of speed signs was a minor concern. Bus bay marking was a moderate concern.
- **Speed**: A moderate concern was the wide carriageway which encourages speeding. A minor concern was confusion over the speed limit.

A number of the crash types identified might be better addressed by changing behaviour rather than engineering or speed management. These include intersection crashes where drivers did not seen a motorcyclist approaching on a main road, speed related crashes particularly when a motorcyclist is overtaking, and collisions with other vehicles such as when a motorcyclist cuts in front of another vehicle. The next section summarises the education and training activities delivered in Auckland in response the lessons learned from the project.

Auckland motorcycle/moped road safety education and training

The Road Safety Action Plan partners work together with key stakeholders such as MSAC on motorcycle education and training towards common goals of skills training, wearing high visibility and protective clothing and bike maintenance. The following actions are part of Auckland motorcycle road safety education and training activities:

TRAINING

The main focus of Auckland's education programme is ACC's Ride Forever full –day skills courses, which AT promotes via advertising, events and its website. AT delivers 4 hour classroom based courses to complement ACC courses that include bike maintenance, bus lane riding, hazard perception and winter riding gear. The AT course includes training on special vehicle lanes regulations for motorcycles/mopeds in T2, T3, bus and cycle lanes.

HIGH VISIBILITY AND PROTECTIVE GEAR

The other education focus is to increase uptake of high-vis and protective clothing, including high vis vests, full face helmets, gloves, boots, trousers and jackets. These are promoted through training courses, police checkpoints, campaigns and events. Free high-vis vests can be ordered on AT's website.

POLICE CHECKPOINTS

Police checkpoints are an effective opportunity to engage with riders. AT supports Police at checkpoints with conversations about laws, training courses and safety gear. High-vis vests are distributed and fitted immediately if the rider agrees.

SUPPORTING PEER TO PEER EDUCATION

The motorcyclist community is well organised with many voluntary clubs and annual events. AT works through these community structures because peer education and encouragement is one of the most effective methods to achieve behavioural change.

ADVERTISING CAMPAIGNS AND EVENTS

In 2015/2016 the AT regional campaign targeted car drivers and the high risk group of 30-59 year old riders in several parts of the region. Road Safety Action Plan partners deliver several events such as a Winter Motorcycle breakfast. Safety videos supported campaigns such as the 'Gear Up! You can Ride through Winter!' motorcycle video and the 'Ride for the unexpected, especially in bus lanes' moped video.

REPORTING ROAD MAINTENANCE PROBLEMS

The AT motorcycle safety webpage has link to reporting pothole, loose gravel or other road maintenance problem to AT.

ENGAGING MOPED RIDERS

Unlike motorcyclists, moped riders do not gather at moped specific events and clubs. Successful ways of reaching moped riders in Auckland include stands at tertiary institute orientations, working with Auckland University's Motorcycle and Moped club, using social media and providing online ordering of free high visibility vests through the AT website.

IMPLEMENTATION PLAN

Following this study, Auckland Transport plans to implement the following actions:

SHORT TERM – GREAT NORTH ROAD AND WEST COAST ROAD ACTIONS

- **Utility/services covers** – carry out work to adjust utility covers at high risk locations.
- **Posted speed limit** – determine the need for improved cues and signage
- **Monitor routes** to ensure oil / fuel spill is removed from pavement surface.
- **Awareness campaign** – Target motorcyclists along these routes to raise awareness of safety. Note: Two billboards were erected on West Coast Road in May 2016.
- **Request** a motorcycle Police checkpoint and offer education and high-vis vests there.

MEDIUM TERM – AUCKLAND WIDE ACTIONS

- Develop best practice strategy for road patching on Auckland Transport network.
- Develop best practice strategy for utility providers and road maintenance contractor on level of tolerance for the level of utility cover in relation to the road surface.
- Develop best practise strategy for utility providers to guide them on the positioning of their asset on Auckland Transport road network.
- Engage key motorcycle stakeholders via the Road Safety Actions Planning process.

LONG TERM – AUCKLAND WIDE ACTIONS

Several of the actions below will be developed for the Auckland context, but they may be useful to other RCAs too:

- Continue to focus resources and investment on high risk routes and locations.
- Continue to use the toolbox of motorcycle safety improvement and design guidelines in particular self-explaining and forgiving roads with motorcyclist friendly infrastructure and appropriate speed environments for both urban and rural roads.
- Use and promote this motorcycling guide to ensure that all possible motorcycle safety issues are considered during the design process, eg. surfacing, road marking, placement of signage, drainage, visibility, landscaping and clear / run off zones. All these principles could be incorporated into the AT Code of Practice.
- Undertake further research on how to improve visibility and heighten the awareness of motorcyclists. This includes measures to address emerging issues such as lane-splitting on multilane arterials and motorways.
- Explore ways to incorporate the needs of the motorcyclists into AT's Network management plans to strengthen the provision of acceptable road condition and appropriate maintenance response time and level of services.
- Encourage the inclusion of a motorcyclist perspective into AT's road user audit process
- Consider whether safety management plans should specifically mention motorcycles/ mopeds rather than saying all road users need to be considered.

7.6 CASE STUDY: COROMANDEL LOOP MOTORCYCLE/MOPED DEMONSTRATION PROJECT

The Southern Coromandel Safer Rides project is a pilot aimed at identifying and implementing suitable road safety improvements for motorcyclists along a 130km loop of State Highways popular among recreational motorcyclists. Figure 7-1 shows the route. The crash data shows that between 2009-2013 motorcyclists were involved in 42 percent of the fatal and serious crashes along this stretch of highway, yet the make up only 2 percent of the road users.

The project involves partners (including the Motorcycle Safety Advisory Council, ACC, Police, Waikato Regional Council, Thames-Coromandel and Hauraki district councils) working with the Transport Agency. At the start of the project motorcycle groups were consulted both regionally and nationally and were encouraged to join a ride over of the route and provide input to the project. An instrumented motorcycle was used to record features of the route from a motorcyclist's perspective.

In addition to the key stakeholders, maintenance teams, local road safety coordinators and a number of international motorcycling experts from VicRoads and Monash University were invited to join and help to identify safety issues and recommend suitable interventions.

Figure 7.1 Southern Coromandel Loop

The project has three main areas of focus:

- Helping to keep riders on their bikes with innovative road markings (Photo 27) and upgraded signage around some deceptive corners, improved surface conditions as well as work to improve visibility.
- Creating a more forgiving environment by removing or modifying various roadside hazards to help reduce the severity of potential injuries if riders do crash (Photos 28 and 29).
- Getting medical treatment to injured riders as quickly as possible via four new rescue helicopter landing areas (Photo 30).

A series of safety improvements are being trialled, aimed at reducing the number and severity of crashes involving motorcyclists on this route. These include:

- Drains reshaped and filled in to remove steep drop-offs
- Property entrances sealed to remove the amount of loose material on the road
- Guardrails installed on bridges and approaches
- Upgraded signs and chevrons to provide consistency and improve curve readability
- Banks removed to improve rider visibility through corners
- Road surface resealed or treated to create a more consistent surface
- Large concrete roadside drainage pipes replaced with more forgiving structures
- Delineation improved by doubling the width of edgelines to 200mm
- More guardrails at steep drop-offs installed.

The innovative road markings are designed to reduce the rider's speed on the approach to deceptive corners and improve their lane positioning. This is a good example of perceptual countermeasures because it changes the way the road looks or is perceived by motorcyclists.

The project has been well received by riders and there are plans to extend the initiative to include the northern half of the Coromandel Peninsula.

More information on the Southern Coromandel Safer Rides project can be found at the links below.

- http://www.nzta.govt.nz/assets/Safety/docs/safer-rides-leaflet.pdf
- http://www.nzta.govt.nz/safety/driving-safely/motorcycling/motorcycle-safety-projects/safer-rides-southern-coromandel/resources-and-links/

Photo 27: innovative road markings.

Photo 28: hazard protection

Photo 29: hazard protection.

Photo 30: rescue helicopter landing area.

8 Other information sources

DOCUMENT/REFERENCE	WEBSITE
Speed management guide.	• https://www.pikb.co.nz/assets/Uploads/Documents/Speed-management-guide-first-edition-Nov2016a.pdf • https://www.pikb.co.nz/assets/Uploads/Documents/SpeedManagementToolboxandAppendicescombinedFinalNovember2016.pdf
High risk rural roads guide.	https://www.nzta.govt.nz/resources/high-risk-rural-roads-guide/
High risk intersection guide.	https://www.nzta.govt.nz/resources/high-risk-intersections-guide/
Traffic control devices manual. NZ Transport Agency.	www.nzta.govt.nz/resources/traffic-control-devices-manual/index.html
Traffic Control Devices Rule and Traffic note. NZ Transport Agency.	www.nzta.govt.nz/resources/results.html?catid=2
Kiwi Road Assessment Programme (KiwiRAP). New Zealand Joint Agency.	www.kiwirap.co.nz
The handbook of road safety measures. Elvik, 2004.	http://books.google.com/books/about/The_handbook_of_road_safety_measures.html?id=f4NUAAAAMAAJ
Towards zero: Ambitious targets and safe system approach. OECD, 2008.	www.internationaltransportforum.org/jtrc/safety/targets/08TargetsSummary.pdf
Motorcycle crashes into roadside barriers stage 1 and stage 2 reports. (Monash University Study).	
Berg, FA, Rucker, P, Gartner, M, Konig, J, Grzebieta, R, & Zou, R. (2005). *Motorcycle impact into roadside barrier- real-world accidents studies, crash tests and simulations carried out in Germany and Australia* in Proceedings of the 19th International Conference on the ESV, Washington: USA. pp.1–13.	
Evaluation of the safety impact of centre-of-the-road wire rope barrier (WRB) on undivided rural roads. (Austroads AP-T135/09).	
Scooter survival (Accident Compensation Corporation).	www. scootersurvival.co.nz
Ride forever (Accident Compensation Corporation).	www.rideforever.co.nz
The official New Zealand road code for motorcyclists. NZ Transport Agency.	www.nzta.govt.nz
Motor vehicle crashes in New Zealand, 2010. Ministry of Transport.	www.transport.govt.nz/research/Pages/MotorVehicleCrashesinNewZealand2010.aspx

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