ACC – CAS Analysis of incidents associated with roadworks, roundabouts and road surface features

Evaluation of the role that roadworks, roundabouts and road surface features play in motorcycle/moped incidents

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1 Acknowledgements

The authors of this report would first like to acknowledge the input of the Motorcycle Safety Advisory Council in the funding and development of this research. The concept for this project was designed by the Motorcycle Safety Advisory Council.
2 Executive summary

At the beginning of 2015 the ‘Making Roads Motorcycle Friendly’ guide was released and accompanied by a series of seminars around New Zealand (Motorcycle Safety Advisory Council, 2014). This guide was aimed at educating roading asset owners, designers and maintenance contractors about the various road features and issues that can impact on motorcycle/moped safety. Three main aspects of keeping roads safe for riders were at the heart of this guide:

- Roading design/construction
- Road maintenance/reinstatement
- Road work sites

While it is known that factors related to these three aspects have the potential to increase the risk of an incident when riding on New Zealand roads, it is not currently known how prevalent certain roading issues are in relation to motorcycle/moped incidents. To this end, the Motorcycle Safety Advisory Council (MSAC) is interested in the level of risk posed by different road surface features as identified in historical Police summary reports for crash incidents involving motorcycles and mopeds in New Zealand.

This research report presents the findings of an exploratory analysis of incidents reported in the NZ Transport Agency’s Crash Analysis System (CAS) from 2005 to the time of writing in 2015. The research focused on three core areas (at the direction the MSAC):

- Road work sites;
- Roundabout, aprons and islands; and
- Road surface features including: animal waste, service covers, slippery road patches, and loose aggregate.

The research identified two road surface contributors to motorcycle crashes in New Zealand that may warrant further exploration. These are detritus on the road (such as loose aggregate) at road work sites, and flushing (bitumen rising to the surface of the road) on the network. Both of these are related to road maintenance practices, road work sites in particular are environments under the direct control of network managers. Flushing is a maintenance issue that can be remedied through addressing identified problems before they contribute to a crash.

The following recommendations are made based on the findings of this report:

- Both loose road surfaces and flushing appear to be a significant factor in motorcycle/moped incidents. While the current Network Outcomes Contracts do have standards around the acceptable level of flushing and detritus (NZ Transport Agency, 2015), it may pay to examine whether the standards need adjusting; for example, greater consideration as to where the flushing is occurring.
- Since the Network Outcome Contracts apply only to state highways, it is recommended that local Road Controlling Authorities’ also examine their standards in relation to flushing and detritus. This could be facilitated by the NZ Transport Agency through the Road Controlling Authority forum.
- There should be extra emphasis placed on the effects of flushing and detritus in the ‘Making Roads Motorcycle Friendly’ guide and seminar series. This message is especially important for roading maintenance contractors.
- Investigate the feasibility and worth of conducting a review of the ACC database for similar incidents that do not appear to be recorded in the CAS database.
3  Background

Riding a motorcycle carries substantially more risk than driving a car on New Zealand roads. This is evidenced by the fact that a motorcyclist is 21 times more likely to suffer a serious or fatal injury travelling the same distance as a car driver (MoT, 2015).

Due to this increased likelihood of injury, reducing the risk to motorcyclists is a key priority of the Accident Compensation Corporation (ACC). To this end, the Minister for the ACC has tasked the Motorcycle Safety Advisory Council (MSAC) with identifying initiatives for the investment of Motorcycle Safety Levy funds, and to make recommendations to the ACC for programme initiatives that have the potential to prevent or minimise the severity of injuries where incidents involve a motorcyclist.

At the recommendation of the MSAC, motorcycle/moped crashes involving roadworks, roundabouts and road surface features such as animal effluent would be reviewed to determine how much of an issue these road features currently pose to those riding on New Zealand roads.

The results of this review would then be used to generate a set of recommendations as to how the effect of these road features could be mitigated if they were indeed an issue for riders.
4 Method

There were three key areas for motorcycle safety on New Zealand roads of interest for this research (at the direction of the MSAC), they were:

- Road work sites;
- Roundabout aprons and islands; and
- Road surface features such as animal effluent, service covers, road patching and loose aggregate.

Within each research area crashes recorded in the Crash Analysis System (CAS) database were the primary source of information for identifying potential areas of risk for motorcycle riders, and establishing long-term trends. The study period is slightly over 10 years, from 2005 to mid-November 2015. This period was chosen to ensure a full 10 years of data was included for analysis, as well as information for the current calendar year.

All crash records extracted for analysis included a motorcycle (M) or moped (P) as one of the vehicles involved in a crash. This does not denote rider or driver fault but purely crash involvement and potential factors contributing to the crash as identified in the Police summary of events.

The role of motorcycle and moped riders, and that of other road users involved in crashes, is determined by these contributing factors and can be used to assign a level of ‘fault’ to each party involved in a crash. These factors are presented as a set of three digit numerical codes that identify reasons why the crash occurred. They are grouped into relative categories, as described in the following sections of this report, and are based on the explanation of what happened in the drivers’/riders’, the witnesses’, and any other involved party’s statements, and the Police description and comments (NZ Transport Agency, 2014).

Because more than one contributing factor may be assigned to each vehicle involved in a crash it was common for multiple driver control factors to be present. This also means that the count of reported crash factors presented in the following charts can exceed the actual number of crashes across the study period. Vehicle at fault information is contained in CAS reporting and these were used for reporting in this research.

This research used counts of crash incidents between 2005 and 2015 and did not attempt to create rates based on registrations of motorcycles and mopeds across the period. This is because registrations are insufficient to infer how many riders actually travel on the road surfaces of interest for the research. For example: if a relatively small percentage of riders travel on roads where they are likely to encounter road work sites then a crash rate based on all riders in New Zealand would underestimate the actual risk posed by these surfaces.

Qualitative analysis of Police summary reports was undertaken for the road surface features research area. The road surface features of interest for this research are not readily identifiable based on the factor and environmental codes in CAS, so manual evaluation on a case by case basis was required to identify if these surface features had a role in motorcycle crashes in the database. Where there were significant enough numbers, a long-term trend for motorcycle crashes related to different road surface features and environments has been presented. For each of these graphs please note:

- There is consistent evidence of an increase in crash counts and the number of fatalities and injuries resulting from motorcycle and moped crashes for the period 2005 to 2008. This finding is aligned with official Ministry of Transport figures and is likely associated with the increase in registered motorcycle and moped type vehicles on the road during this time (NZ Transport Agency, 2014).
• The 2015 year is incomplete; hence the reduction in counts compared to the previous year is likely to be driven by a lack of data for the warmer spring and summer months at the end of the year. This report includes these counts in the long-term trends as they are included in all of the additional analyses and charts in this report.

The social costs reported for crashes in this report are based on the Ministry of Transport’s official 2014 figures (Ministry of Transport, 2014). These are:

• $3,981,700 per fatality,
• $724,000 per reported serious injury, and
• $70,000 per reported minor injury.¹

The Ministry of Transport defines the social cost of a road crash or road injury as “the total cost that occurs as a result of the road crash or injury.” It is based on components that can be measured or estimated in dollar terms, and uses a willingness to pay technique to express pain and suffering in dollar terms.

The social cost of a road crash or injury includes the following components:

• Loss of life and life quality
• Loss of output due to temporary incapacitation
• Medical costs
• Legal costs
• Vehicle damage costs

¹ Not all serious and minor crashes are reported to Police, so these values are rounded up to account for under-reporting. The base social cost values are $419,300 and $22,400 for serious and minor injuries respectively.
5 Results

5.1 Road work sites

5.1.1 Introduction

Road work sites pose a potentially hazardous environment for motorcycle riders where there is:

- A temporary surface with loose seal or a granulation
- Uneven transitions between surfaces
- Obstructions in the roadway such as vehicles and cones
- Inadequate signage that does not give enough time to respond
- Temporary delineation that may increase the risk of vehicle conflicts

These physical conditions at road work sites may be direct causes of motorcycle crashes, or they may contribute to crashes by amplifying riders’ behaviours and mistakes, leading to a loss of control that may otherwise not have occurred on a better surface.

This research area explores the road and rider factors that probably contributed to motorcycle crashes at road work sites for the period 2005-2015.

5.1.2 Research findings

For the period 2005-2015 there were six recorded crashes in CAS where motorcycle or moped riders struck ‘road work signs or drums, holes and excavations, etc’ (CAS objects struck code R).

Two of these crashes were attributed to a combination of alcohol and speed, three to riders being inattentive or having their attention diverted by scenery or other persons outside the vehicle and losing control. Just one crash, where ‘road work signs or drums, holes and excavations, etc’ were cited as objects struck, was attributed to the road surface being potholed at a site under construction or maintenance.

The analysis of crash records for motorcycles and mopeds was expanded to focus on factors probably contributing to crashes at road work sites. Of an initially wider set of CAS cause factor codes, the following were present in the extracted dataset for 2005-2015:

- Driver too fast for conditions at temporary speed limit (CAS causes code 116)
- Driver inattentive: failed to notice road-works signs (CAS causes code 339)
- Road surface: under construction of maintenance (CAS causes code 817)
- Road obstructed: road works not adequately signposted (CAS causes code 825)
- Road visibility limited: temporary obstruction, dust or smoke (CAS causes code 838)

The number of individual crashes at road work sites with one or more of the above factors cited as potential causes over time are presented in Figure 1. In total there were 178 reported crashes for the period 2005-2015 (note that 2015 year crashes include CAS records as at the 6th of November 2015). Total crashes during the period were highest for 2007, 2008 and 2010, with fewer recorded crashes at road works before and after these years. There is no clear evidence of an increasing or decreasing trend in the total number of motorcycle and moped crashes at road work sites.
Similarly, the number of fatal, serious injury, minor injury and non-injury crashes that occurred at road work sites for the period 2005-2015 have fluctuated with no clear increasing or decreasing trend (Figure 1). Note that these are crash counts, not counts of individual persons of which there may be more than one by injury severity for each crash.

The CAS database records the distribution of fatalities and injuries between drivers and passengers of different vehicles. The split of fatalities and injuries between persons travelling on motorcycles and mopeds with other vehicles in crashes at road work sites is:

<table>
<thead>
<tr>
<th>Motorcycle/Moped</th>
<th>Other vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatalities</td>
<td>4</td>
</tr>
<tr>
<td>Serious injuries</td>
<td>50</td>
</tr>
<tr>
<td>Minor injuries</td>
<td>102</td>
</tr>
<tr>
<td>Non-injury</td>
<td>46</td>
</tr>
</tbody>
</table>

The social costs of fatalities and injuries to all road users in reported motorcycle crashes at road work sites are:

<table>
<thead>
<tr>
<th>Social cost 2005-2015</th>
<th>Average annual social cost 2005-2014*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>$15,926,800 (n=4)</td>
</tr>
<tr>
<td></td>
<td>$1,194,510</td>
</tr>
<tr>
<td>Serious</td>
<td>$38,372,000 (n=53)</td>
</tr>
<tr>
<td></td>
<td>$3,547,600</td>
</tr>
<tr>
<td>Minor</td>
<td>$7,490,000 (n=107)</td>
</tr>
<tr>
<td></td>
<td>$70,000</td>
</tr>
<tr>
<td>Total</td>
<td>$61,788,800</td>
</tr>
<tr>
<td></td>
<td>$5,442,110</td>
</tr>
</tbody>
</table>

NB: The average annual social cost presented here is for the full calendar years of data 2005-2014 only.
For the entire period 2005-2015, 50% (n=89) of motorcycle and moped crashes at road work sites were single vehicle crashes where rider error played some role (Figure 2). This includes crashes where road factors, such as the road surface, were cited as contributing to the cause of the crash. A further 22% (n=40) of crashes at road work sites were multi vehicle crashes where the motorcyclist was assigned primary responsibility, and 6% (n=11) some responsibility. 20% (n=36) of multi vehicle and 1% (n=2) of single vehicle crashes involving motorcycles and mopeds at road works were not attributed to rider fault.

The above figure should be interpreted with care, the majority of factors relating to motorcyclist or driver responsibility at road work sites are due to a loss of control. Because a road surface factor must be present in the crash information for particular loss of control incidents, ‘fault’ does not necessarily mean that intentional or poor behaviour has led to the crash. Rather, there needs to be a focus on interventions and treatments that have merit for reducing the role of the road surface at road work sites on rider behaviours and reactions that result in crashes.

Road surface and the relationship with rider behaviour in crashes at road work sites is emphasised in Figure 3. This figure presents the breakdown of road and rider factors in crashes that are related only to the physical features of the environment at road work sites. For single vehicle crashes, and multi vehicle crashes where the motorcyclist was assigned primary or some responsibility, the road surface being under construction of maintenance was a potential factor in 135 crashes between 2005 and 2015 (Figure 3).

Crashes where the road surface and rider behaviour in direct response to the road surface were not cited make up just 10% of recorded crashes at road work sites from 2005-2015. Physical factors cited as potential
causes were: rider too fast at temporary speed limit (4%, n=6); rider failed to notice road work signs (3%, n=5); road visibility limited from dust or smoke (2%, n=3); and road works not adequately signposted (1%, n=1).

It should be noted that CAS factor codes 804 (loose material on seal), 808 (recently graded) and 817 (road surface under construction or maintenance) have been put into one group in Figure 3 due to the similar environment they describe, and the frequency of their appearance in conjunction with each other.

As stated, motorcycle riders were assigned primary responsibility for a number of single and multi vehicle crashes during the period 2005-2015. Figure 4 presents the full range of rider related factors in crashes at road work sites, as would be expected based on the previous Figure 3, loss of control due is the predominant potential cause of crashes (47%, n=96).

Rider behaviours including: inattention (23%, n=47); speed (16%, n=32); inexperience (7%, n=15); and the influence of alcohol or drugs (6%, n=13) were cited in a number of motorcycle crashes at road work sites.
5.2 Roundabout aprons and islands

5.2.1 Introduction

Roundabout aprons and islands are a potential hazard for motorcyclists where:

- The camber forces riders to transfer their weight and body position towards the outside of the curve as they navigate the roundabout;
- Paint markings on aprons and islands cause a slip hazard;
- Kerbs with a flat, rather than an angled, face are used at the edge of the roundabout; and
- Roadside furniture, safety barriers and vegetation obstruct lines of sight and create a hazard when placed close to the carriageway.

5.2.2 Research findings

In total there were 1,070 crashes involving motorcycles at roundabouts (CAS junction code R) recorded in CAS for the period 2005-2015. There is some evidence of an increasing number of crashes from 2005-2008, before levelling off across the remainder of the study period. The most recent crash recorded for 2015 is in September so there is potentially three months of data yet to be recorded this year.

Similarly, fatalities and injuries resulting from crashes involving motorcycles at roundabouts have remained relatively static over time with some year to year fluctuation.
The split of fatalities and injuries between persons travelling on motorcycles and mopeds with other vehicles in crashes at roundabouts was:

<table>
<thead>
<tr>
<th></th>
<th>Motorcycle/Moped</th>
<th>Other vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatalities</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Serious injuries</td>
<td>147</td>
<td>2</td>
</tr>
<tr>
<td>Minor injuries</td>
<td>560</td>
<td>29</td>
</tr>
<tr>
<td>Non-injury</td>
<td>396</td>
<td>866</td>
</tr>
</tbody>
</table>

The social costs of fatalities and injuries to all road users in reported motorcycle crashes at roundabouts are:

<table>
<thead>
<tr>
<th></th>
<th>Social cost 2005-2015</th>
<th>Average annual social cost 2005-2014*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>$3,981,000 (n=1)</td>
<td>$398,170</td>
</tr>
<tr>
<td>Serious</td>
<td>$57,920,000 (n=80)</td>
<td>$5,574,800</td>
</tr>
<tr>
<td>Minor</td>
<td>$24,710,000 (n=353)</td>
<td>$2,289,000</td>
</tr>
<tr>
<td>Total</td>
<td>$86,611,700</td>
<td>$8,261,970</td>
</tr>
</tbody>
</table>

NB: The average annual social cost presented here is for the full calendar years of data 2005-2014 only.

As shown in Figure 6, the majority of motorcycle crashes at roundabouts are multi vehicle incidents where no motorcyclist fault has been identified (57%, n=481), a comparatively small proportion of multi vehicle incidents were attributed to motorcyclist’s primary (15%, n=122) or some (4%, n=36) responsibility. For single vehicle crashes motorcyclists were most often attributed with fault, this makes up 23% (n=189) of all crashes at roundabouts, while single vehicle crashes with no motorcyclist fault are relatively uncommon (1%, n=10).
The majority of crashes at roundabouts were due to vehicle conflict factors (69%), followed by driver control and the road environment (16% and 8% respectively) (Figure 7). A more detailed breakdown of vehicle conflicts where motorcycle riders were at fault, road factors and rider control factors is provided in Figures 7 and 8.
Vehicle conflicts attributed to motorcycle and moped riders at roundabouts were largely a result of failing to give way, and not seeing or looking for another party until too late (Figure 8). Often these two crash factor codes appeared together in the data. The frequency of these vehicle conflict codes for crashes recorded as single vehicle suggests that while another vehicle was not recorded in CAS, they were present at the time of the crash.
During the period 2005-2015 there were 99 motorcycle and moped crashes at roundabouts recorded in CAS where road factors were probably a contributing factor. These crashes contributed to 24 severe and 59 minor injuries in total, and 20 incidents resulted in no reported injuries.

The reported CAS factors presented in Figure 9 are:

- Slippery road – 800 (e.g., rain, frost, snow, loose material, mud, paint markings)
- Road surface in poor condition – 810 (e.g., potholes, uneven, loose material, under construction or maintenance)
- Visibility limited – 830 (e.g., curve, building, trees, parked vehicle, temporary obstruction)
- Signs and signals – 840 (e.g., damaged, badly located, inadequate, turned off)
- Street lighting – 860 (e.g., failed, inadequate, creating glare)
- Raised islands and roundabouts – 870 (e.g., difficult to see, ineffective, badly located or designed)

Slippery surfaces were most commonly cited as contributing crash factors, and this mainly related to rain and oil/diesel/fuel on the surface causing a loss of traction. For many of these incidents speed was also a factor with riders entering roundabouts too fast and subsequently braking hard on a slippery surface.

The roundabout design at most of these crash locations was classified as a ‘raised roundabout island’ as opposed to a ‘painted island’. Ineffective, badly located or designed roundabouts were cited as a factor for only one crash during the period 2005-2015. In this case a rider slid and crashed into the back of a vehicle as they exited the intersection. A pedestrian crossing was located immediately off the roundabout and the vehicle was stopped to let pedestrians cross, the rider did not see this in time as they were looking out for
other vehicles as they negotiated the roundabout and their exit from it. The rider sustained minor scrape injuries and there was superficial damage to the bike and vehicle.

Rider loss of control (30%, n=60) when turning and under heavy braking are the main contributing factors for crashes, some loss of control is also associated with the road conditions presented in (Figure 10). Merging and following maneuvers in a line of traffic (28%, n=56) was also a significant component of rider loss of control in roundabout crashes. These two factors often appeared together in police reports as a loss of control under heavy braking was a common outcome of sudden actions forced upon the rider when travelling in a line of traffic.

As stated, more than one factor may be attributed to the same road user in a crash. In particular, crashes involving alcohol or drugs (13%, n=27) were often associated with riders travelling too fast for the conditions (12%, n=25) and losing control. There was a small number of Police pursuit or Police evasion related incidents included in these crash reports.
5.3 Road surface features

5.3.1 Introduction

The third research area of this report focuses on other road surface features that likely contributed to motorcycle and moped crashes in New Zealand between 2005 and 2015. These features are not explicitly coded as crash factors in the CAS dataset, so each extraction involved qualitative analysis of handwritten Police summary reports to find features of interest.

5.3.2 Research findings

5.3.2.1 Animal effluent or waste

At present there is not a crash factor in CAS that relates explicitly to animal effluent or waste on the road so ‘road slippery - mud’ (CAS factor code 805) was used as a proxy to try and identify crashes.

For the period 2005-2015 there were 15 motorcycle and moped crashes where mud was a potential factor. An in-depth examination of each Police report for these crashes found no references to animal effluent or waste on the road.
5.3.2.2 Service covers

To identify crashes where service covers on the road surface were a potential factor all Police summary reports where ‘road surface – uneven’ (CAS factor code 812) was cited were examined. This query produced 120 individual records for motorcycle and moped crashes between 2005 and 2015, but none of the Police summary reports made mention of service covers.

A wider query of CAS was subsequently undertaken to look at all crash records where ‘driver lost control – under heavy braking’ (CAS factor code 132) was cited. Of the 480 individual records, one Police summary report cited a ‘manhole’ cover as a potential factor in the crash; however, this was not included in the coded summary report. The recorded potential factors were:

- Driver lost control – under heavy braking (132)
- Driver in line of traffic – following too closely (181)
- Driver sudden action – braked (191)

This crash involved a rider following a car that braked for a pedestrian at a crossing, the rider was travelling too fast and swerved while braking to avoid the rear of the car eventually skidding and crashing on the road. The statement given by the motorcycle rider made mention of the service cover and rain possibly contributing to their skid.

In total, 600 Police summary reports were manually examined to identify the potential risk posed by service covers for motorcycle and moped crashes between 2005 and 2015. Based on the CAS factor codes used here there was little evidence of officers noting the presence of service covers, or any other type of relevant surface feature, in the road environment at crash sites.

5.3.2.3 Slippery road patches

For this research area crashes where ‘road slippery - surface bleeding/defective’ (CAS factor code 809) was cited as a potentially contributing factor were extracted. This resulted in identification of 82 individual crashes for the period 2005-2015, the Police summary reports were subsequently examined to identify crashes where road patching, or patches of flushing on the road surface, were present at the crash site.

Flushing on the road surface was cited for all of these crashes, and six made mention of a recent repair patch on the road surface having significant flushing compared to the older road surface surrounding it. Out of the 82 identified crashes, 54 (66%) were on the state highway network, and just five were in sub 100km/h speed limited zones. Rain or a wet road surface appears to compound the risk posed by flushing patches and was cited in 18 of these crashes. So too does flushing on corners where the force of the riders movement is naturally pushing the wheels out from underneath them.

Comments similar to the road surface being ‘slippery even to stand and walk on’ at spots of significant flushing were common in the Police summary reports.
The social costs for reported motorcycle crashes on patches of slippery roads are:

<table>
<thead>
<tr>
<th></th>
<th>Social cost 2005-2015</th>
<th>Average annual social cost 2005-2014*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>$27,871,900 (n=7)</td>
<td>$2,787,190</td>
</tr>
<tr>
<td>Serious</td>
<td>$7,240,000 (n=10)</td>
<td>$724,000</td>
</tr>
<tr>
<td>Minor</td>
<td>$2,660,000 (n=38)</td>
<td>$238,000</td>
</tr>
<tr>
<td>Total</td>
<td>$37,771,900</td>
<td>$3,749,190</td>
</tr>
</tbody>
</table>

NB: The average annual social cost presented here is for the full calendar years of data 2005-2014 only.

5.3.2.4 Loose aggregate

To identify motorcycle and moped crashes that occurred on loose aggregate surfaces the following factor codes were included for the CAS extraction:

- Loose material on seal (804)
- Recently graded (808)
- Deep loose material (813)

This extraction identified 396 individual crashes involving motorcycle and moped riders in New Zealand, just 28 of these were multi vehicle crashes with six of these involving multiple motorcycles. The long term trend of a marked increase in counts between 2005 and 2008 is again present, though since 2008 there is evidence of a declining numbers of motorcycle crashes on loose aggregate (Figure 11).

There has been two fatalities resulting from a crash on loose aggregate during the study period, both in 2013. One of these was attributed to excessive speed and the wrong line through a corner, the other to alcohol and speed on an unregistered motor-cross bike without a helmet. Post 2007-2008 the number of serious and minor injuries from reported crashes on loose surfaces has been in decline.

Just 34 of the crashes included for these analyses were attributed to loose aggregate on roads under construction or maintenance (CAS factor code 817).
The split of fatalities and injuries between persons travelling on motorcycles and mopeds with other vehicles in crashes on loose aggregate was:

Table 6: Fatality and injury severity counts for motorcycle and moped crashes on loose aggregate

<table>
<thead>
<tr>
<th></th>
<th>Motorcycle/Moped</th>
<th>Other vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatalities</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Serious injuries</td>
<td>134</td>
<td>0</td>
</tr>
<tr>
<td>Minor injuries</td>
<td>241</td>
<td>0</td>
</tr>
<tr>
<td>Non-injury</td>
<td>57</td>
<td>20</td>
</tr>
</tbody>
</table>

The social costs of fatalities and injuries to all road users in reported motorcycle crashes on loose aggregate surfaces are:

Table 7: Social cost of motorcycle and moped crashes on loose aggregate surfaces

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>$7,963,400 (n=2)</td>
<td>$796,340</td>
</tr>
<tr>
<td>Serious</td>
<td>$97,016,000 (n=134)</td>
<td>$9,629,200</td>
</tr>
<tr>
<td>Minor</td>
<td>$16,870,000 (n=241)</td>
<td>$1,610,000</td>
</tr>
<tr>
<td>Total</td>
<td>$121,849,400</td>
<td>$12,035,540</td>
</tr>
</tbody>
</table>

NB: The average annual social cost presented here is for the full calendar years of data 2005-2014 only.

Figure 12 presents the breakdown of the three factor codes of interest for motorcycle crashes on loose aggregate. The majority were coded as loose material on seal (86%, n=341), followed by deep loose material (12%, n=49). A small number of crashes were attributed to a recently graded surface (2%, n=6).
As expected for crashes on a loose surface, the majority of driver related factors were loss of control probably caused by the road surface itself (76%, n=386). Roughly one quarter of driver factors were potential faults of the rider, namely: impairment from alcohol or drugs (8%, n=41); riding too fast for the conditions (8%, n=40); failure to keep left (6%, n=28); and sudden actions such as braking or swerving (3%, n=13).
Figure 13: Rider control factors in motorcycle and moped crashes on loose aggregate and crash severity (2005-2015)
6 Summary of findings

6.1 Road work sites

For the period 2005-2015 178 reported motorcycle and moped crashes at road works in New Zealand were identified. These crashes contributed to four fatalities, 53 serious injuries and 107 minor injuries with annual rates remaining relatively stable with some annual fluctuations.

Motorcycle and moped riders had some level of fault attributed to them in over three quarters of all crashes at road work sites. In single vehicle crashes a rider fault was cited in 96% of crashes, and in multi vehicle crashes riders were attributed at least some responsibility in 65% of reports.

As stated in this research report, care should be taken when interpreting these figures as over half of all crashes at road work cites cited rider loss of control as at least one of the contributing factors. ‘Fault’ therefore may be attributed to a motorcyclist when in fact the loss of control may have been caused, or at least exacerbated, by the road surface that is under construction or maintenance.

Alongside a loss of control the two main contributing crash factors on the part of riders were inattention or distraction and riding too fast for the conditions. These were the main causes of a loss of control; however, the road surface itself or signage around road works are likely to contribute to these rider errors, meaning it cannot be stated that all are the result of intentional or poor riding behaviours. A small number of motorcycle and moped crashes at road work sites were attributed to inexperience (n=15) and riders being under the influence of alcohol or drugs (n=13).

6.2 Roundabout aprons and islands

There were 1,070 reported crashes involving motorcycles and mopeds at roundabouts for the period 2005-2015, of these 93% were single vehicle crashes with the majority attributed to rider fault (97%). Vehicle conflicts caused by riders appear most frequently in the crash records, in particular riders who failed to give way or did not see or look for another party until too late. This suggests that while the majority of incidents were coded as single vehicle crashes there was generally another vehicle present at the time of the crash even if they were not involved in a collision.

In 99 (9%) of the reported motorcycle and moped crashes at roundabouts, the road surface or environment were cited as probable contributing factors. A slippery surface was reported in 89 (80%) of these, while roundabout design was considered to be a contributing factor for just one crash. Note that the roundabout apron or island itself was not explicitly identified as contributing to the slip hazard for any crashes in the dataset.

Rider control factors were cited in 202 (19%) of roundabout crashes, a loss of control due to heavy braking and factors associated with following too closely or attempting to merge in a line of traffic were the most commonly reported rider faults. Riders under the influence of alcohol or drugs (n=27) and riding too fast for the conditions (n=25) were relatively minor contributors to the overall sample of crashes at roundabouts.
6.3 Road surface features

An examination of crash factor codes potentially relating to slippery patches on the road surface uncovered a number of references to poor surface conditions due to flushing. In total, 54 Police summary reports explicitly commented on the level of flushing on the road surface between 2005 and 2015. Some of these called for urgent maintenance attention required to prevent further risk and others described difficulty walking on the surface highlighting the risk to riders. Flushing posed an increased risk when the surface was also wet, and/or when it was present on a corner and riders’ natural forces are already trying to push their wheels out from underneath them. Patches of flushing on the road surface contributed to seven fatalities, ten serious injuries and 38 minor injuries during the period of interest.

Loose aggregate on the road surface was identified as a factor in 396 motorcycle and moped crashes for the study period. Annually the number of crashes related to these conditions has been in decline since 2008, so too have fatalities, and serious and minor injuries of which there were two, 134 and 241 respectively between 2005 and 2015.

There appeared to be no evidence of risk posed by two of the road surface features of interest examined in this research, these are: animal effluent or waste and service covers. This does not mean that there is not risk posed to motorcycle or moped riders in New Zealand by these road features; however, based on the crash reports extracted by the research team and manual analysis of each of the corresponding Police summary reports, no mention of either road feature in the crash history for the study period came to light.
7 Conclusions

The findings of the exploratory analysis of reported motorcycle and moped crashes in the CAS database presented in this report suggest two specific road surface features that are of interest for rider safety, they are:

- Loose aggregate including surfaces under maintenance at road work sites, and
- Patches of flushing on the road surface.

Loose aggregate was the most common contributor to motorcycle and moped crashes for the period 2005-2015 compared to the other road surface features of interest for this research with 396 reported crashes in total. Flushing on the road surface was cited in 82 individual crashes during the same period. Given the Police summaries for these crashes it is apparent that a high level of risk is posed to riders on defective road surfaces patches like these.

While there was a relatively large number of reported crashes at roundabouts, 1,070 for 2005-2015, a relatively small number were attributed to the road surface factors that were a focus of this research. Other features such as animal effluent or waste and service covers which have previously been cited as potentially high risk environments were not identified as contributing factors in reported crashes in New Zealand.

Most roading incidents that result in injury (and all cases that result in a fatality) should have a record in the CAS database. However, previous research has shown there are cases where a motor vehicle crash requiring hospitalisation have no corresponding police report (Alsop & Langley, 2001). It is also easy to imagine there are motorcycle/moped incidents resulting in non-hospitalised injuries, such as a rider slipping and hurting their wrist but riding straight off, not having a corresponding CAS report.

Given that there are likely to be records in the ACC claims database that have no corresponding CAS report it may be worthwhile investigating whether these claims would add to the findings of this report. Such an analysis should only be undertaken though once the following points have been taken into consideration:

- What is the possibility that those incidents that have no CAS reports will significantly alter the findings of the CAS analysis?
- Such a review would require interviewing ACC claimants as well as site visits
- Great care would need to be taken to make sure that there was indeed no CAS report for the ACC claim in question in order to avoid double counting.
8 Recommendations

The following recommendations are made based on the findings of this report:

- Both loose road surfaces and flushing appear to be a significant factor in motorcycle/moped incidents. While the current Network Outcomes Contracts do have standards around the acceptable level of flushing and detritus (NZ Transport Agency, 2015), it may pay to examine whether the standards need adjusting; for example, greater consideration as to where the flushing is occurring.
- Since the Network Outcome Contracts apply only to state highways, it is recommended that local Road Controlling Authorities also examine their standards in relation to flushing and detritus. This could be facilitated by the NZ Transport Agency through the Road Controlling Authority forum.
- There should be extra emphasis placed on the effects of flushing and detritus in the ‘Making Roads Motorcycle Friendly’ guide and seminar series. This message is especially important for roading maintenance contractors.
- Investigate the feasibility and worth of conducting a review of the ACC database for similar incidents that do not appear to be recorded in the CAS database.
9 References


