THE MANAGEMENT OF SKID RESISTANCE IN AUSTRALIA – A NATIONAL, STATE OR LOCAL TASK?

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ABSTRACT

It is widely recognised that providing appropriate levels of skid resistance and surface texture across a road network can make a valuable contribution in securing positive road safety outcomes. Yet, the proactive management of skid resistance is often viewed within Australia as being within the domain and achievability of state road authorities only, despite knowledge and experience from other countries (e.g. United Kingdom and New Zealand) that a number of local road authorities (local councils) procure skid resistance testing and are actively using the data.

This paper starts by introducing (and comparing) the highway network in Australia, before looking at current published guidance / good practice concerning the management of skid resistance. The many reasons for, and challenges to, the development and implementation of a skid resistance management strategy at national, state and local levels are then identified.

1. INTRODUCTION – 'THE LUCKY COUNTRY' AND ITS HIGHWAY NETWORK

Australia is a vast country. Figure 1 and Figure 2 show a comparison of its size against USA and Europe respectively.

Figure 1 – Map showing a general comparison of the size (area) of USA and Australia

Figure 2 – Map showing a general comparison of the size (area) of Europe and Australia

Table 1 provides statistical comparisons for Australia and USA, including road networks:

Table 1 – a statistical comparison between USA and Australian road networks

Characteristic / Parameter	Australia	United States
Population	22.8 million (at Jan 2012)	312.8 million (at Jan 2012)
Population Density	7 persons per sq.mile	84 persons per sq.mile
Number of States/Territories	8	56
GDP (in $US millions in 2011)	1,507,402	15,064,816
No. of motor vehicles	16.4 million (2011)	255.9 million (2008)
No. of motor vehicles / 1000 population	730 (2011)	828 (2008)
Road Length (km)	815,074 (2007)	6,506,204 (CIA World FactBook)
Sealed Road Length (km)	331,199 (2003)	unknown
Unsealed Road Length (km)	478,823 (2003)	unknown
% of Roads Sealed	40.89%	unknown
Road Density (metres of road per sq.km)	105	668
Road Fatalities per annum per 100,000 population	7.7 (2007)	12.3 (2009)
Road Fatalities in 2011	1,616	33,808

Figure 3 shows how the vast majority of the population in Australia reside on the coastal plains of the Eastern and Western seaboards.

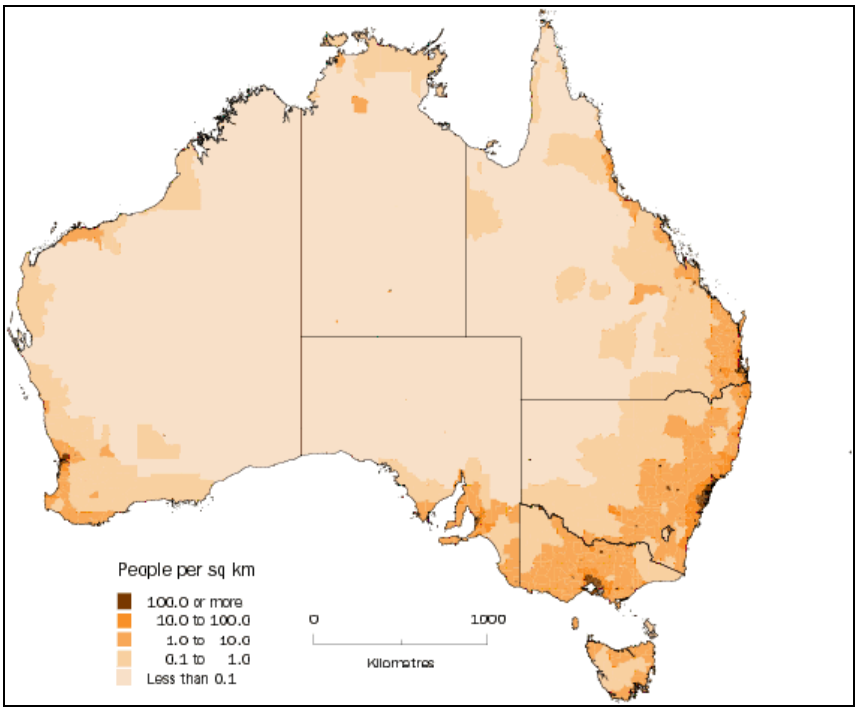

Figure 3 – Map showing the population distribution within Australia

Figure 4 shows the 8 (eight) state and territories of Australia, along with the positions of the major cities.

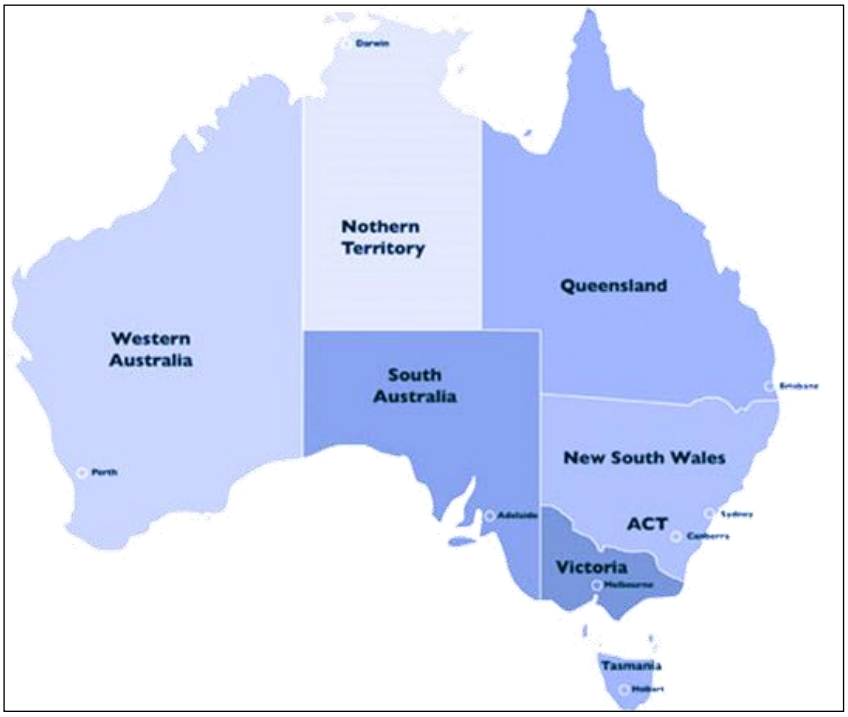

Figure 4 – Map showing the states and territories of Australia

In very basic terms, the highway network in Australia is managed at three levels: national (federal), state and local; with the national and state highway networks (i.e. the most strategic roads carrying the highest traffic volumes) being managed by the 8 (eight) state road authorities and the local road network managed by a large number (hundreds) of local councils. Importantly, the local councils fulfil a range of public services, in addition to acting as the local road authority.

The state and territory road authorities established a kindred technical body, Austroads, to identify and manage a program of highways related research for the common good. In addition, Austroads is responsible for the development of national guidance documents on key highway disciplines / themes, e.g. road safety, traffic management, asset management.

Like USA, the climate of Australia can be extreme and diverse. Much of Australia's land mass is desert, yet many other regions follow a 'warm and wet' and 'cold and dry' weather pattern, rather than having a largely rigid and predictable seasonal structure such as experienced by New Zealand and UK, where 'cold and wet' and 'warm and dry' seasons predominate.

Distribution of average annual rainfall in USA and Australia are included as Figure 5 and Figure 6 respectively.

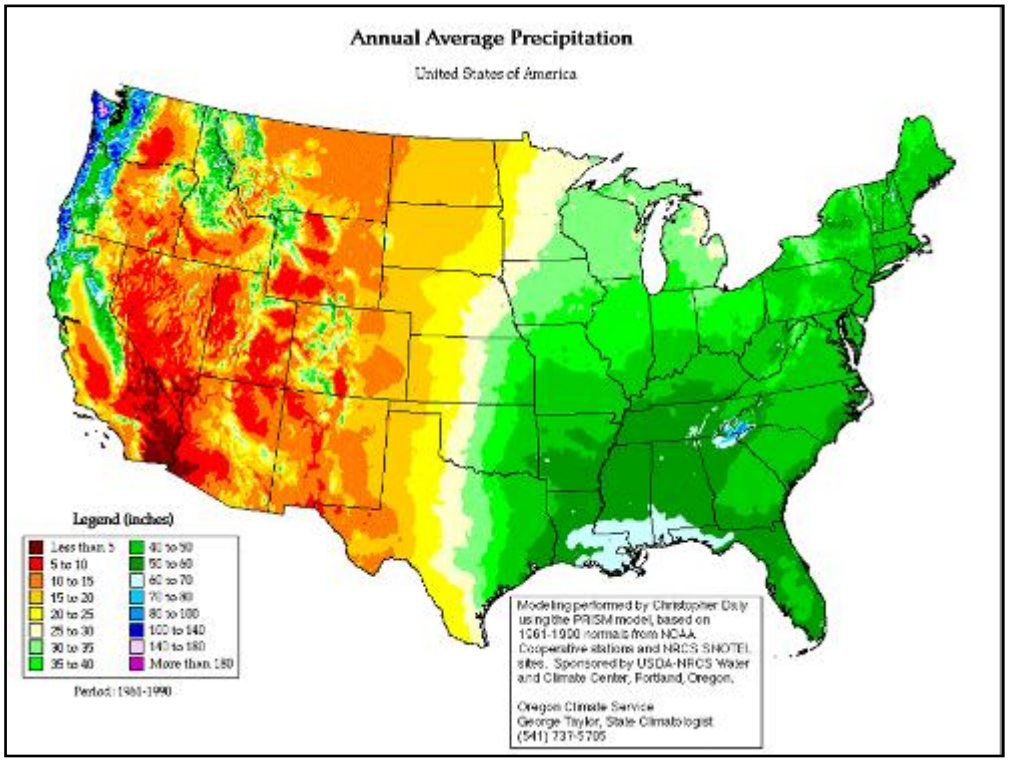

Figure 5 – Map showing the rainfall distribution in USA

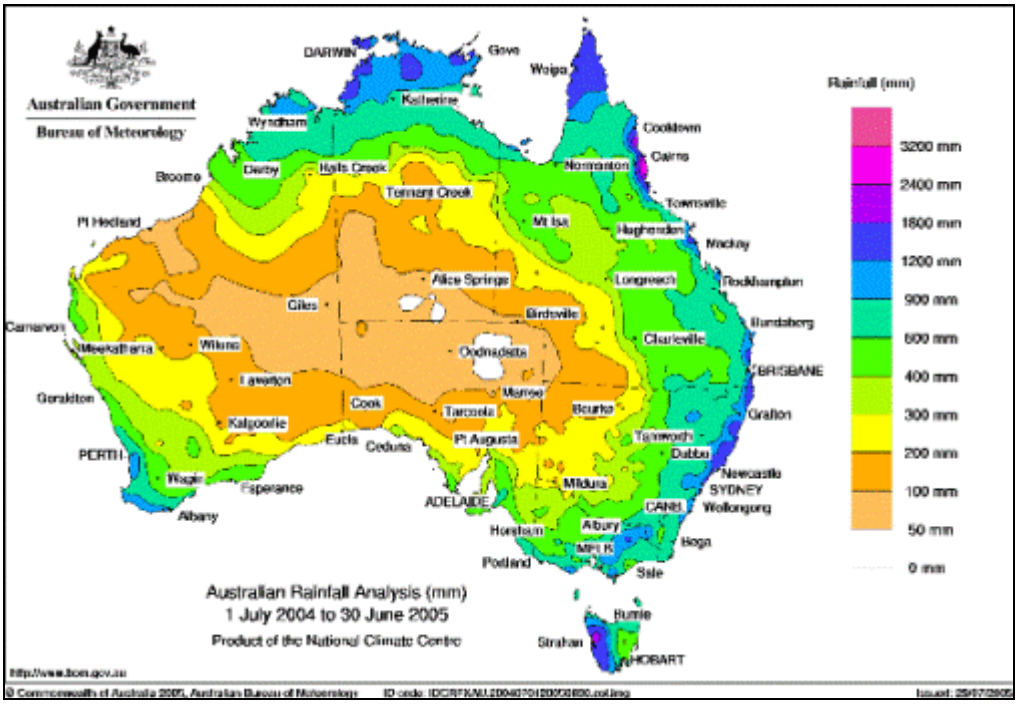

Figure 6 – Map showing the rainfall distribution in Australia

The implications of local climate on the management of skid resistance in Australia receive further discussion later in this paper.

2. INTRODUCTION – THE MANAGEMENT OF SKID RESISTANCE IN AUSTRALIA

There is no specific, mandatory requirement for Australian road authorities to manage skid resistance at a network level. However, road authorities do owe a generic 'duty of care' to the public in managing and maintaining the highway network for which it is responsible.

The potential road safety benefits that can be accrued by effectively managing skid resistance and surface texture are obvious and have been recognised around the world for some time now (e.g. in the UK[1], embryonic measurement of skid resistance commenced in the 1930's, and network level skid resistance management strategies taking shape in the late 1970's). Indeed, the state road authorities of New South Wales and Victoria started to actively measure and manage skid resistance and surface texture in the mid 1980's.

However, it was not until January 2005 that definitive national guidance on managing skid resistance across a road network (rather than just on a project or site by site basis) was published and disseminated [1]. A dedicated program of research on skid resistance issues and the development of further guidance followed and is on-going today. The most recent guidance documents on skid resistance data collection and management were issued in July 2009 and February 2011 [2] [3] [4].

[1] The total road length in Australia is approximately twice that of UK

It is important to note that the Australian Local Government Association is represented on Austroads and therefore, guidance produced is developed with all road authorities in Australia in mind. For example, the specific guidance developed for skid resistance management is not just for state road authorities, it encourages all road authorities (i.e including local road authorities / councils) to develop a local strategy to manage skid resistance across their network, based on consideration and application of a suggested framework of sixteen key building blocks (under five broad headings), as shown in Figure 7.

The guidance recognises that 'one size does not fit all' and that a strategy developed by a state road authority with a significant network of high volume, high speed roads will be somewhat different and by necessity less involved and resource hungry than the strategy developed by a small, local road authority. Nonetheless, the principle is that all road authorities can use the framework and the sixteen building blocks introduced to come up with a useful local response that contributes to securing positive road safety outcomes.

The author is aware that the concepts and principles within the Austroads guidance documents have received some support and have been referenced in recent skid resistance management guidance documents prepared in USA.

Australia[2] hosted the 3rd International Road Surface Friction Conference in May 2011, which was attended by over 240 delegates from 14 different countries. As well as being a forum for networking and over 60 high quality technical papers, the conference program included a demonstration day at a local test track and driver training facility. The proceedings can be found on www.saferroads.org.uk. It was certainly hoped that the successful conference will act as a catalyst to further interest and research into skid resistance issues locally.

[2] The conference was hosted by ARRB Group, in association with the New Zealand Transport Agency (NZTA) and WDM Limited, UK, and with the considerable assistance of the Queensland Department of Transport and Main Roads (TMR).

Figure 7 – Graphic illustrating the sixteen key building blocks (and their five headings) of a skid resistance management strategy introduced in Austroads 2005 as jigsaw pieces

3. BARRIERS TO IMPLEMENTATION?

It is the author's opinion that the greatest barrier to further activity in this field in Australia is a widely held perception that managing skid resistance is currently only (or should ever only be) within the domain of state road authorities. This is accentuated by the urban myth that a road authority must collect test data to be able to manage skid resistance, when the collection of data is of course only one of the key building blocks of a strategy. It is often concluded that collecting data (and hence managing skid resistance) is 'an expensive business', only within the reach of state road authorities and their larger budgets. The author is concerned that this has led to, and perpetuates, an attitude of 'it's all or nothing' within practitioners and their road authorities, i.e. if we do not formally measure skid

resistance and/or surface texture then there is no point in having (or we cannot develop) a skid resistance management strategy.

In August 2011 the author presented on this very issue at a national public works conference held in Canberra and the accompanying paper [5] presents in detail the main arguments for and against the management of skid resistance. It is, of course, necessary to state that some of the 'for' and 'against' points made within that previous paper (and as summarised below) will have a unique level of significance / importance for each individual road authority.

In summary, the author believes that the most compelling arguments **for** the management of skid resistance at local network level are:

- road users lose their lives on public roads in skidding related (wet weather) crashes
- it can be shown that effective skid resistance management strategies contribute to positive road safety outcomes;
- national guidance has been available in Australia since January 2005 which is applicable to local road authorities and state road authorities. If an Australian road authority does not have a local strategy (a local response) in place it can only be benchmarked (and in some cases, judged) against national best practice and the practices of peers (locally, nationally and internationally);
- examples from UK, NZ and within Australia show that local road authorities are able to develop effective, fit for purpose strategies that are commensurate with available conditions and resource levels;
- road authorities have a generic 'duty of care' (and in some cases statutory obligations) to fulfil, and as a result inherit a vulnerability (and often liability) to legal action (civil claims) brought by third parties alleging that 'defective infrastructure' has been a factor in the causation and/or severity of an incident in which they have been involved.

The primary arguments **against** (or constraints to) the management of skid resistance at local level tend to be related to:

- there is no statutory duty for Australian road authorities to manage skid resistance;
- not all of the national highway network is subject to testing, so why test local roads?;
- lack of knowledge and understanding of the issue/s and/or how to analyse and use any test data secured;
- a perception that the national guidance document is not written for local road authorities[3];

[3] The author is aware that in UK, the County Surveyors' Society (now known as ADEPT) produced a document to assist local road authorities (councils) in applying the UK's national guidance document (HD28)

- the extent and remoteness of the local road network to be maintained;
- the expense of procuring, operating and maintaining test equipment in-house and/or the availability and cost of procuring testing from other road authorities / commercial providers;
- competing needs for finite resources, e.g. testing is 'one more thing' to finance[4];
- that this strategy may well identify further sites requiring remedial treatment, i.e. the road authority has even more sites to address;
- 'true' skidding related crashes are extremely rare and are difficult to identify and when compared to other crash causation / contributory factors are extremely low, and hence investment in other areas provides better returns[5].

While the author recognises that some of the arguments immediately above do have some basis, he is nonetheless keen to encourage and promote a mindset that all road authorities can do something worthwhile and useful in this field. It is not just about testing and indeed, it is for this very reason that the Austroads guidance (Austroads 2005) deliberately identifies a range of strategy approaches, which include: Proactive, Reactive or Hybrid.

In its simplest form, a Proactive strategy involves a regime of visual inspections and/or the routine testing of roads within a defined network to identify road sections requiring further investigation to determine whether they require some form of remedial action to improve skid resistance levels (e.g. the placement of a reseal) or to mitigate the risk of falling skid resistance levels (e.g. the placement of warning signage).

A Reactive strategy involves the testing and/or assessment of sites when an issue has been identified, e.g. from a visual inspection or at a site where a skidding related crash may have occurred.

A Hybrid strategy includes elements of both a Proactive and Reactive strategy and such an approach is favoured by the majority of state road authorities within Australia.

4. 'FIT FOR PURPOSE' AND CONSISTENTLY ACHIEVABLE

It is essential that a local skid resistance management strategy (and its underpinning policies, procedures and practices) is consistent with the road authority's corporate objectives. This is especially true for those objectives that are related to Safer Roads outcomes within a Safe System approach and/or are documented within the authority's Road Safety Strategy.

[4] [6] identifies that a large number of local road authorities (councils) in Australia are reliant upon a population of less than 2000 for their core funding

[5] [6] identifies that 88% of all fatal crashes in Australia occur on state highways, and of the remaining 12% of fatal crashes that do occur on local roads: 68% of these occur on straight level sections, 91% occur in 'clear' weather, and 81% occur on dry roads.

Importantly, the strategy developed must be consistently achievable within the resource levels available (in both dollar and resource terms) as well as optimising the returns gained from that level of investment.

The recent Austroads guidance [1][4] explains and promotes an 'equalisation of network risk' approach (based on a suite of Site Categories and Investigation Levels), given that such an approach has been used extensively and successfully around the world to ensure that an appropriate level of skid resistance is identified and provided at **all** locations on a network (and the highest levels of skid resistance are provided where they are most needed, e.g. at the immediate approach to intersections and tight radius curves).

In summary, managing skid resistance across a network is not about providing a uniformly high level of skid resistance across that network – this simply cannot be achieved within existing resource and materials constraints.

In promoting the development of skid resistance management strategies, the author has been able to work with a number of Australian road authorities in 'busting' a few urban myths and allaying some of the fears of road authority officers by explaining that:

- this should not be seen as daunting - there is no right or wrong answer in identifying and addressing the individual elements (e.g. the Austroads key building blocks) of a local management strategy – ensuring the strategy is consistently effective in reducing crashes on the local road network must be the primary concern.
- a local skid resistance management strategy must be fit for purpose, consistently achievable and commensurate with the level of resources available. There is simply no point in 'setting the bar too high' and failing to achieve. Additionally, over-reliance upon what other authorities are doing and / or overcomplicating a strategy can be counterproductive. The latter is particularly important, as it will seriously endanger the consistent implementation of the strategy and achievement in the field
- it is unlikely that road authorities will reach the best possible strategy first time round. Therefore, a continual improvement approach towards the optimisation of safety outcomes has been found to be by far the best approach. Piloting and evaluation of a new strategy is an important consideration and is recommended.
- the best strategy documents accurately reflect what is to be done currently, as well as mapping out future development areas. The strategy must be dynamic and continually improved.
- robustness in the keeping and archiving of inspections, test data (if collected) and operational records is also necessary to allow a road authority to demonstrate consistent application of the strategy for routine management and performance measurement purposes and whenever skid resistance becomes an issue debated by politicians and / or the media, or under scrutiny through legal proceedings.
- every road network is subtly different in terms of its characteristics and issues faced and the challenge is to identify and understand the key local issues and 'tune' the elements of the strategy so that they can provide assistance and solutions to engineers.

- it is often found that an authority has a number of fit for purpose, policies, protocols and operational practices either in place or under development, which do (and will) contribute to the management of network skid resistance and help achieve positive road safety outcomes. Some of these are not always routinely recognised or their direct returns may be hard or impossible to quantify, but they should nonetheless be promoted and documented so that recognition can be gained.

5. ON-GOING ISSUES AND OPPORTUNITIES

The following text identifies (in no particular order or priority) the main on-going issues and opportunities in the management of skid resistance in Australia. The majority of these issues are being addressed in current Austroads and/or state road authority commissioned projects. Further Austroads outputs and guidance are planned for publication in 2011 and beyond.

5.1 Test equipment availability, equipment calibration and the cost of testing

There is a distinct lack of testing equipment available in Australia that is capable of measuring skid resistance at a network level. At the time of writing, the position of the state road authorities within the states of Australia is as follows:

- New South Wales (NSW) – owns and operates two SCRIMs (one main machine, one back up)
- Victoria – owns and operates one SCRIM
- Queensland – owns and operates one ViaFriction device
- South Australia – owns and operates two GripTesters

The state road authorities of Queensland, Tasmania and ACT currently procure SCRIM testing from a third party provider (e.g. WDM Limited, UK).

In terms of static test equipment, all of the state road authorities (and some local authorities) have access to at least one British Pendulum Tester, for project level / spot testing.

One of the more recent emerging issues is the calibration of SCRIMs used in Australia. The WDM Limited SCRIM that comes into Australia is linked back to the UK SCRIM calibration trials at TRL UK, but no formal calibration trial exists in Australia at the present time. However, some local comparisons between the NSW and Victorian SCRIMs are periodically taking place. The latest Austroads research project on skid resistance measurement is examining the possibility of, and necessary protocols for, the undertaking of a national calibration trial in the future.

The cost of securing road condition test data does concern a number of Australian road authorities, especially those that perhaps do not utilise the data to its full value. Data collection budgets can also often be seen as easy targets when belt tightening exercises occur.

The collection of skid resistance and surface texture data, while advisable, is beyond some authorities, and hence there has been much support for test devices that can collect a number of data sets concurrently, rather than having to procure two separate tests.

5.2 Post-crash testing

There has been much recent discussion, prompted largely by high profile incidents, regarding the methods and outputs of skid testing undertaken by the Police at crash scenes, and how this relates to the network level testing of road authorities. As a result, many state road authorities have tried to foster an improved relationship with their local Police crash investigation units and a greater understanding of each party's test methods and objectives (e.g. work towards a common post-crash test method has been highly successful in Queensland). Much of the Police testing is undertaken using in-car tri-axial accelerometers (e.g. Vericom) and the state road authorities of Queensland and Western Australia have invested in their own units to be used in fatal crash investigations and other, more proactive research.

5.3 Post-lay (QA) testing

The 'skid resistance' testing of a recently laid road surface has traditionally been limited to sand patch (sand circle) testing, i.e. the focus has been on determining macrotexture as a surrogate for skid resistance. However, there has been some recent interest in Queensland towards the identification and establishment of a post lay skid test protocol. However, this will not be an easy nut to crack, given the limited test equipment available in Australia and consideration of early life skid resistance issues with some material types. The Vericom accelerometer device has been mooted as a possible option, but much research will need to be done before a solution is found that is agreeable to both road authorities and the aggregate industry.

5.4 Macrotexture as a surrogate, rainfall patterns and the need to test?

There has been some research into the desirability of using surface texture measurement (basically laser measured macrotexture) as a surrogate for skid resistance measurement. In such an approach, locations with the lowest macrotexture readings are flagged for further investigation to decide whether the undertaking of additional, skid resistance testing (e.g. SCRIM) is desired. The main argument for this approach is that the roads that would be selected for this approach are typically high volume and high speed, and hence, it could be argued that microtexture is less important. Notwithstanding, the main attraction is that the road authority needs only to procure one network level measurement, of surface texture, which can also easily be combined with the collection of other parameters such as roughness and rutting.

It is also argued by many road authority officers that much of the Australian road network does not warrant skid resistance testing given that large tracts are predominantly dry by nature (very low annual rainfalls, with the rain that does fall typically being in short, high intensity events) and also especially dry due to localised conditions (e.g. some areas of NSW had been in drought for 5 years up to the start of 2011). The argument is on the basis that if roads are rarely wet then the risk of skidding related crashes in negligible (or certainly, a low risk, when compared to other causation factors). Similarly, the cost of 'largely unnecessary' skid resistance testing has also been raised. This is significant in Australia not just in dollar terms, but also in water usage. Much of Australia has been on long-term and intensive water restrictions and to the lay person; the sight of a test vehicle spraying 'vital, precious' water onto a road surface has understandably led to some adverse commentary.

In response to this argument the latest Austroads guidance document [4] has considered Australia's rainfall distribution and a range of other factors (e.g. population and traffic densities) in identifying national zones of skid resistance demand (as shown in Figure 8 below). This is a risk management approach and each demand zone can then have applied a different skid resistance / surface texture testing regime applied.

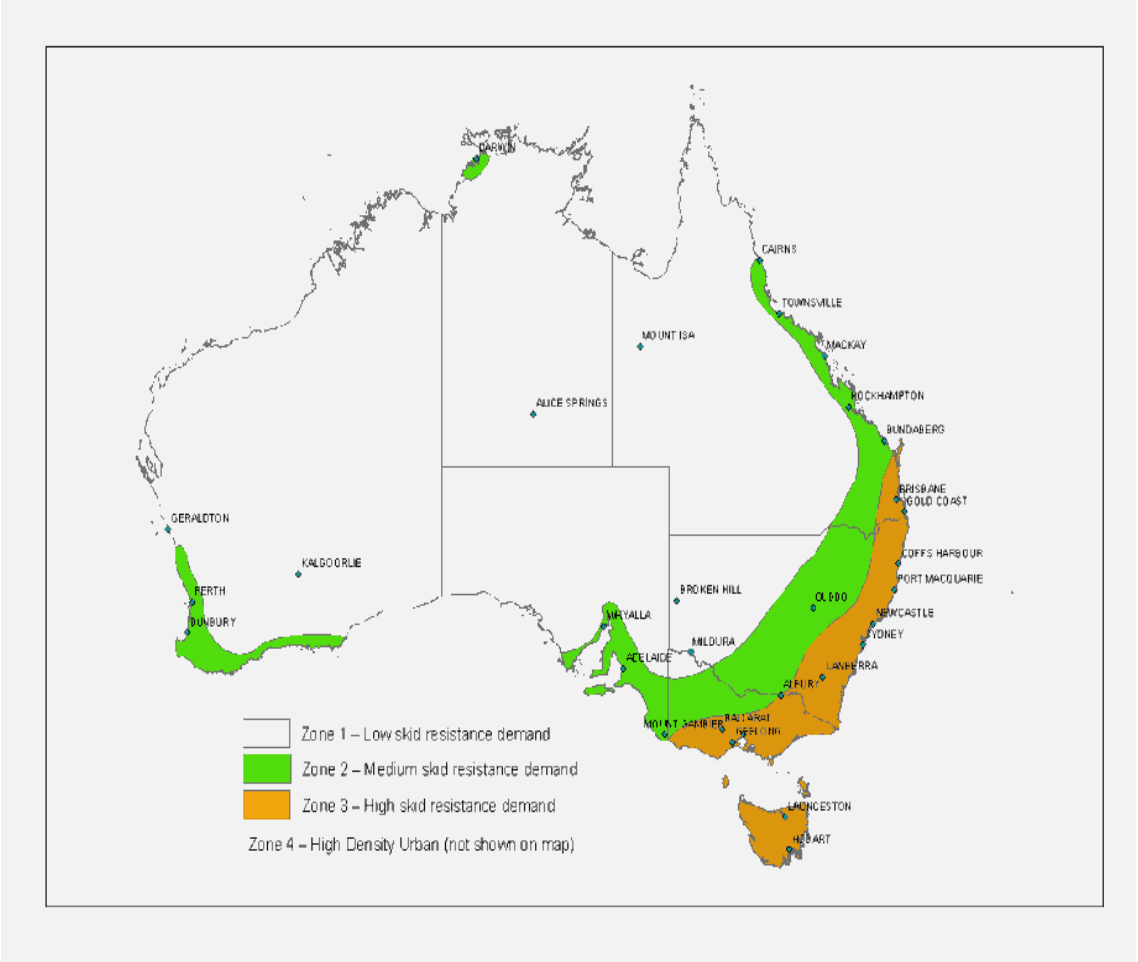

Figure 8 – Map showing national zones of skid resistance demand for Australia

5.5 First Rainfall Skidding Accidents (FRSA)

Following on from the discussion above on rainfall and wet skidding, the author is a 'believer' in the principle of FRSA, having seen data on crash clusters from a short time period after heavy rainfall events on Australian roads that had previously experienced prolonged dry conditions. Therefore, the author believes that this is a phenomenon that cannot be ignored; and it must receive consideration and ideally local management[6].

[6] The author was particularly impressed by a presentation given by Shimon Nesichi of the Israel National Roads Company (INRC) at the 3rd International Road Surface Friction Conference regarding the development of a mitigation regime for FRSA being adopted in Israel utilising pressure road cleaning techniques

5.6 Availability and quality of aggregates

Throughout Australia road authorities are grappling with an ever reducing availability of high quality road surfacing aggregates. This has led authorities to either accept the financial consequences of hauling aggregates a greater distance than ever before (or in some cases importing them), and/or compromising, through approaches such as aggregate blending, relaxing specifications (which also means taking on additional risk) or increasing the frequency of resurfacing with materials using lower quality aggregates.

The 'great aggregates debate' also includes much discussion regarding the on-going suitability and reliability of the standard PSV and PAFV tests in predicting the in-service performance of surfacing aggregates in Australian conditions. This issue is being considered within a current Austroads project, with the most likely outcome at the time of writing being the development of an extended polishing version of the current test methods.

5.7 The flushing (bleeding) of spray seals and the performance of remedial treatments

When Australian road authority officers gather it seldom takes long for discussion to turn to the seemingly perennial problem of managing flushing (bleeding) spray sealed road surfaces, and the risks associated with reductions in / loss of skid resistance and/or surface texture. This is largely due to the harsh climatic and environmental conditions rather than any limitations of practitioners and the Australian spray seal industry, which is one of the most technically advanced anywhere in the world. Remedial treatments (e.g. water jetting, mechanical retexturing) are undertaken and can be successful, but the jury is still 'out' on the longevity and cost effectiveness of some of the treatments adopted.

5.8 Data processing and analysis

A current Austroads project is also examining the following aspects of data processing and analysis:

- improving the positional accuracy and referencing of test data (including the practicalities and difficulties in supplementing current linear referencing protocols with GPS position reckoning)
- standardising the averaging and display of test data (across all test devices)
- seasonal variation in data (determining the extent and significance of this variation and how to manage it)

5.9 Determining a suite of Investigatory Levels

In many cases, Australian state road authorities have historically adopted in full, or fine-tuned, the suites of Investigation Levels for skid resistance adopted by its kindred road authorities or international road authorities (e.g. as used on the UK national highway network). While this has provided an initial position, the latest Austroads guidance document [4] introduces a method using local crash data and other parameters in the determination of Investigation Levels. The next step is to provide practitioners with a case study of the method's implementation and this is being addressed under a current Austroads project, with a view to publication during 2012.

6. CONCLUSION

The author firmly believes that the management of skid resistance and surface texture on Australian road networks (or any road network) should not be solely the domain of the larger, state road authorities.

National guidance published in Australia specifically recognises that 'one size does not fit all' and encourages road authorities at all levels to develop a local strategy to manage skid resistance on their road network. The strategy framework and associated practical guidance and examples provided within the guidance have been deliberately developed to help road authorities to come up with a strategy that addresses local issues and is commensurate with local conditions and available resources.

While the existence of national guidance and the on-going commitment to research are considered important factors, perhaps the bottom line is more stark and hopefully, compelling - as practitioners we can always do more to prevent road users having skidding related (wet weather) crashes on our roads!

The views expressed in this paper are those of the author and do not necessarily reflect the views of the ARRB Group or Austroads

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