

50 years of progress

With 2010 drawing to a close, so is ARRB's 50th birthday 'year of celebrations'. From one temporary office and a handful of staff, the organisation has grown to more than 268 staff spread over 5 Australian offices and in Dubai, Abu Dhabi and China (see page 2 for a description of our 50th year).

Our expertise has grown from a focus on road design, materials and traffic engineering to coverage of diverse areas including parking, heavy vehicles, collection of road condition data, asset management, network management, transport planning and policy, transport economics, and traffic management and safety at mining sites.

A feature of the year has been the second Sprayed Sealing and the 24th ARRB Conferences (see pages 2 and 3 for reports on both Conferences).

ARRB's Board, management and staff wish to extend their gratitude to the many organisations and individuals that have contributed during the last 50 years.



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50th year celebrations drawing to a close



In March, staff across ARRB's offices celebrated the organisation's official birthday (28 March) with a party. At ARRB's Head Office in Melbourne, Board Chairman Don Larkin presented awards to employees, including Peter Witt for 44 years with the organisation.

During the year, work commenced on the preparation of ARRB's official history. Based upon available records and the recollections of current and former staff, work is progressing and the book will be available in early 2011.

ARRB also released updated products, including the Roughometer III, a new laser profiler and the Hawkeye Duo portable laser profiler and imaging system. ARRB's products often stem from decades of engineering and scientific research into surfacings and pavement performance. Development work continues to ensure that

the products evolve to meet the changing needs of network managers.

During 2010, three publications of national and international standing published summaries of ARRB's history, namely, Highway Engineering in Australia, World Highways and the Journal of the Australasian College of Road Safety.

In October, ARRB held the 2nd International Sprayed Sealing Conference and 24th ARRB Conference in Melbourne. Summaries of both events are on pages 2 and 3.

At the ARRB Conference, a breakfast of former Board Members was held, and ARRB Alumni were invited to join ARRB's Board and Conference delegates at the Conference dinner held at the National Gallery of Victoria.

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Sprayed Sealing Conference report

The 2nd International Sprayed Sealing Conference (held in October) involved over 240 participants from 19 countries. The theme was 'Sustaining sprayed sealing practice'. It featured a technical tour, 3 paper sessions (involving 15 refereed papers) and 3 special sessions. The Conference keynote address was delivered by Mr Dennis Rossmann (South African National Roads Agency) on *Imperatives in sustaining sprayed sealing practice*.

Themes emerging from the conference included:

Technical

- Surface preparation and flushing seals are key issues for many countries.
- How can the sealing season be extended?
- Sprayed seals cannot be designed solely in the office.
- Some of the design manuals need to be questioned.
- The heavy vehicle fleet is changing.
- There have been some early failures of SBS modified binders.
- There is a need to replace technology such as the sliding plate viscometer.

Knowledge

- There is a skills shortage although training courses do exist.

- There is low interest in practical application.
- Knowledge sharing is a problem.
- Spraying high bitumen content emulsion (HBCE) requires a new set of skills.

Funding

- Our networks are insufficiently funded and maintained.

Southern hemisphere sprayed sealing society

It was resolved to form a southern hemisphere sprayed sealing society to coordinate resolution of sprayed sealing issues common to Australia, New Zealand and South Africa – the three countries that are pre-eminent in the field of sprayed sealing.

Kym Neaylon from ARRB is drafting a terms of reference, which will then be circulated for comment to those attending the inception meeting. It is envisaged that the next society meeting will be held adjacent to the CAPSA conference in September 2011 in South Africa.

For those wishing to obtain a copy of the Conference proceedings, see page 18.

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24th ARRB Conference report

The 24th ARRB Conference held in Melbourne in October was an outstanding success. There were over 500 participants from 28 countries. The theme was 'Building on 50 years of road and transport research'. It featured two technical tours, a keynote address, 3 plenary sessions, 31 technical sessions (where 121 refereed papers were presented), and 8 workshops.

Keynote address

His Excellency Dr Kenneth Michael, AC, Governor of Western Australia opened the conference with keynote address on Building on 50 years of road and transport research, which tied together the past and looked to the future of road and transport research. A transcript of the address is available on ARRB's website (www.arrb.com.au).

The plenary sessions

The three Plenary sessions tackled key topics of interest from a broad range of perspectives addressed by panels of national and international speakers.

Towards a sustainable road system

The first plenary examined the meaning of sustainability in the roads and transport context, and considered sustainable network capacity, fuel/ power/ emissions futures, resource consumption and infrastructure provision, and human resources and capability.

The Plenary was chaired by Mr Peter Mitchem (VicRoads), and featured Professor Eiichi Taniguchi (Kyoto University), Dr Luke Reedman (CSIRO) and Mr Jon Oxford (Department of Transport and Main Roads Queensland).

Maximising network productivity and the case for road pricing

The second plenary focused on factors that influence current and emerging network demand and possible responses, particularly road pricing.

The Plenary was chaired by Mr Neil Doyle (ARRB Director), and featured Mr Stephen Perkins (OECD/ITF), Mr Neil Aplin (Council of Australian Governments Road Reform Plan) and Ms Marj Morrissey (Department of Planning and Infrastructure, Northern Territory).

Integrating safety outcomes

The final Plenary explored an integrated approach to planning and managing road assets whilst delivering improved road safety outcomes.

The Plenary was chaired by Mr Robert Klein (Global Road Safety Partnership), and featured Mr Iain Cameron (Office of Road Safety, Western Australia), Ms Kathy Martin (Main Roads Western Australia), Mr Russell Henk (Texas Transportation Institute) and Mr Michael de Roos (Roads and Traffic Authority NSW).

Workshops

The conference featured nine workshops covering:

- Designing an Australian Low Carbon Transport Forum (ALCTF)
- Regulatory telematics
- Outcome-based maintenance
- Project appraisal: Current state and future direction
- Skid resistance: Scoping the future

- The road safety decade of action: How can Australia respond?
- Foamed bitumen stabilisation
- Moving towards road freight efficiency
- Round Table on road condition data collection.

Technical program

The conference technical program featured 31 paper sessions with 121 peer reviewed papers covering the conference technical themes.

Technical Tours

The two Technical Tours were popular with conference delegates. One focused on network operations and safety issues, and featured the M1 Upgrade intelligent Freeway Management System along the Monash-CityLink-West Gate (M1) corridor. The second tour focused on asset management and pavement research issues, and showcased aspects of the construction and operation of the Eastlink tollway, as well as a visit to the ARRB full scale pavement testing research laboratory. Both tours also featured a visit to ARRB's research facilities in Vermont South.

ARRB Academy Young Researchers Award

The ARRB Academy awarded the inaugural Young Researchers Award for the paper titled: *Travel time reliability and the bi-modal travel time distribution for an arterial road* submitted by Ms Susi Susilawati of the University of South Australia.

For those wishing to obtain a copy of the Conference proceedings, see page 18.



Local government and the Safe System approach to road safety



The theme for the recent Australasian Road Safety Research, Policing and Education Conference held in Canberra was ***Safe System From Knowledge to Action***. With this in mind ARRB Group, together with the Western Australia Local Government Association (WALGA), facilitated a workshop titled 'Local Government and a Safe System Approach'.

It is evident that many in local government are not aware what a Safe System approach means to local road users and their councils, as road authorities. The aim of the workshop was to engage local government practitioners in discussion about the Safe System approach – outlining what it is, how it can contribute to road safety on local roads, and importantly where it has been applied by councils.

Representing the National Road Safety Council was Ms Ann Bunnell, former Deputy Mayor of Townsville City Council. Ann introduced the topic and speakers and at the conclusion of the workshop provided a summary about the importance of councils in achieving national and state objectives.

Delegates listened to four presentations after which they were provided an opportunity to discuss their views and issues concerning local government road safety and the Safe System approach.

The presentations were given by ARRB's David McTiernan and Blair Turner who provided a background on the Safe System approach framework and a snapshot of road safety issues across Australia on local government managed roads.

WALGA's Ruth Wernham outlined the approach that has been adopted in Western Australia and is being implemented across councils in that state under the auspices of WALGA.

Ross Gregory from Mornington Peninsula Shire Council in Victoria, provided an interesting overview of how that council has taken the Safe System concept and applied it to the strategic planning and operational levels.

Both Ruth and Ross provided an important perspective to delegates, showing how the theory and knowledge can be turned into positive road safety action by local councils.

Present at the workshop were representatives from a range of Australian government and non-government agencies. Overseas road agencies including New Zealand's Transport Agency and Indonesia's Department of Public Works were also in attendance.

The open forum discussion session proved to be interesting and useful with issues raised including the role of local government in contributing to national and state road safety objectives, the yet to be released National Road Safety Strategy and funding models for ensuring adequate action on local roads to improve safety.

The outcome of the workshop is a report, ARR375 ***Local Government and the Safe System Approach to Road Safety***. The report summarises the presentations and the open forum discussion and is freely available via the ARRB website at <http://www.arrb.com.au/Information-services/Publications/Reports-Manuals/Safe-Systems-publication-list.aspx>

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Improving traffic safety at mining operations

Australia's burgeoning and vibrant mining and resources industry is a major global player that is heavily relied upon by world economies, particularly those from the Asia-Pacific region, for their continuing growth.

The industry has a world-wide reputation for excellent safety standards and for continually striving to improve its safety record under the long-term vision of achieving the 'Zero Harm' aspirations.

The Australian mining and resources industry relies on an extensive road and railway network to transport products and goods both within and between operations as well as to their national or international customers via one of numerous industrial ports.

Given the challenges resulting from the remoteness of its operations, long working hours, unique vehicle fleet and growing demand for experienced operators it is not a surprise that road safety is considered by the industry as one of the key risk areas which has a significant impact on safety and productivity outcomes.

An additional challenge is the lack of skills and expertise required to deal with traffic safety and management issues on mining and resource processing operations. For this reason ARRB Group has established itself as a recognised expert provider to the industry.

In this period ARRB has worked with all major mining organisations throughout Australia and provided relevant and practical advice on improving traffic safety and traffic management issues.

The most common and effective approach taken by ARRB to address these issues is to carry out industry-specific road safety audits. These audits are based on the principles laid out in relevant Austroads Guides but certain aspects have been modified to better match the issues, circumstances and requirements relating to mining fleets.

Some of the issues that are usually covered by the audits include:

- traffic signage and delineation
- speed management

- interaction between vehicles and pedestrians
- segregation between incompatible vehicles
- traffic flows
- parking.

The audits are documented in reports that provide a comprehensive record of findings together with practical improvement recommendations.

The application of the recommended actions can assist organisations to meet their health and safety obligations but often also to, as an indirect consequence, improve productivity and efficiency of their operations.

In order to further assist the industry in increasing its internal expertise in this area, ARRB has developed a technical Mining Roads Safety and Design workshop which has been running successfully throughout this year.

See page 19 for scheduled workshop dates in 2011.

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Half a century of achievement in road safety



The early years

Much of the research program in this period was focused on a number of specialised facilities and pieces of equipment. Experiments on lighting and sign legibility were conducted in a 'dark tunnel' which used mercury vapour lighting to simulate natural daylight.

Overtaking behaviour was measured by video cameras mounted on an articulated truck which ARRB owned and operated. A 'tilt deck' was used to tilt articulated trucks until one wheel lost contact with the deck surface. Two generations of instrumented cars were used to test driver curve negotiation behaviour with different delineation treatments.

ARRB also funded some substantial projects at universities. This included

work at the University of Melbourne on crashes with utility poles, on traffic signal and sign visibility, and on delineation. A major in-depth crash study was carried out at the University of Adelaide.

The main safety benefit of early ARRB research was to provide Australia with a body of standards and guidelines for roads and traffic management that matched or exceeded best practice elsewhere in the world, or were specially developed for Australia's unique conditions. These covered road lighting; lane and shoulder width; traffic signal displays and siting; traffic sign legibility, reflectivity and comprehension; overtaking lanes; truck stability and suspension matching of prime mover and trailer; skid resistance management guidelines; roundabout design; and local area traffic management standards and guidelines.

Changing opportunities and methods

Research methods have changed in response to evolving needs and the opportunities created by new technologies. Reliance on formal experiments using specialised laboratory equipment has diminished. The principal growth area has been the collection of information about roads, roadsides and road surfaces which can be linked to crash records using Global Positioning technology.



Austroads Guides

The ARRB team has undertaken the bulk of the work in drafting the nine volumes in the Austroads Guide to Road Safety. The Austroads Guide to Road Design and the Austroads Guide to Traffic Management also have substantial safety content. The Austroads Guides are acknowledged as leaders in their field, and have influenced similar publications in other countries, particularly in the Asian region.

Risk management

ARRB has taken a leading role in developing a risk management approach to road safety engineering in Australia. This has been principally through a six-year project for Austroads which examined the risk associated with different road stereotypes and features, and the risk reduction which could be expected from a range of remedial measures.

Software tools

ARRB has developed software to assist road safety practitioners in their decision-making. Experience was originally gained with the X-LIMITS set of programs to assist with speed limit selection. Road Safety Risk Manager provides guidance regarding the extent to which different treatments will reduce crash risk in different situations. Road Safety Toolbox provides guidance as to which treatment is most appropriate in different situations. Both these products are used in conjunction with the road survey products described below and are widely accessed by practitioners across the globe.

Safe System

Safe System was adopted by the Australian Transport Council as a guiding





principle in the 2005-2006 *National Road Safety Action Plan*. Since that time, ARRB has been among the leading contributors to the interpretation and development of the doctrine. Workshops have been held to explore the implications for infrastructure provision, the management of speed, the management of road users, and the implications for local government. Projects are underway to help road authorities and local government come to grips with the practical implications.

AusRap and iRAP

In culmination of many years' research and development, ARRB had by 2005 produced a network survey vehicle which could create a three-dimensional map of the road along which it travelled while recording road and shoulder cross-section, offset to roadside objects, and the presence of signs and road markings.

These vehicles were used to conduct the Australian Road Assessment Program (AusRAP) surveys which allocated star ratings to major roads according to the level of safety the road offered. Since then, the ARRB Hawkeye system has been widely used in the International Road Assessment Program (iRAP), with surveys conducted in several countries using this equipment.

Behavioural research

ARRB has continued to conduct behavioural research in a number of areas. The safety of young drivers has been an ongoing theme, including monitoring the accumulation of supervised driving experience by learner



permit holders; redevelopment of a computer-based hazard perception test; contributions to the development of practical on-road tests and investigations of factors contributing to risk-taking by novice drivers.

With the assistance of sub-contractors, ARRB developed an educational program to reduce recidivism among convicted drink drivers; an independent evaluation found the program to be of high quality and much more effective than other programs with similar aims. Motorcycle safety has also been a continuing theme, with work on crash analysis, training and licensing requirements and rider's views and acceptance of new technologies.

Work with road signing has examined new conventions for complex direction signing and issues relating to variable message signs and changeable speed limit signs. ARRB has also been active in community and local government road safety, principally at the level of developing and reviewing programs.

Other areas

ARRB has contributed to other areas of road safety. These include road surfacing, where the ability to assess aspects of surface condition using low-cost laser measurements has raised fundamental questions about the best strategies to manage networks.

Work to ensure stability and other aspects of safe performance of new heavy vehicle designs continues. Acceleration and braking of heavy



vehicles at railway crossings has been a particular concern, as part of a wider body of work on railway level crossings, including an assessment of the ALCAM model currently used to assess the safety of individual crossings.

ARRB has also carried out work related to the safety benefits of different types of intelligent transport systems (ITS) technologies – both in-vehicle and roadside – in Australia.

The future - substantial change, major challenges

The land transport system is faced with substantial changes and enormous challenges. Major changes in the way road travel is powered seem imminent, with as yet unknown effects on the mix of vehicles using the network. Efforts to achieve sustainability and shortages of some traditional road-building materials are forcing changes in the way roads are built and managed, while climate change has implications for drainage and the resilience of structures and roadside furniture.

The implementation of Safe System principles with limited budgets requires careful consideration. Rapid motorisation confronts developing countries with the prospect of an enormous casualty toll, the containment of which requires knowledge transfer on a very large scale.

ARRB's team looks forward to the challenge of the next fifty years. For the Safe System team in particular, the challenge will be to assist progress towards Safe System goals, while addressing these other factors and constraints.

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Photo: D. Best





The road safety decade of action

Worldwide, it is estimated that around 1.2 million people die in road crashes every year, and a further 50 million are injured. This represents a major burden on health systems, as well as inflicting a massive amount of pain and suffering on individuals, families and communities.

The young are particularly at risk, and road injuries are the leading cause of death in the 15 to 29 year age group and rank in the top three in the 4 to 44 year age group. Around 90% of road deaths and injuries occur in low and middle-income countries, many of them right on Australia's doorstep.

The situation is set to worsen, with estimates that by 2030 road crashes will be the fifth leading cause of death, topping 2.4 million fatalities per year unless significant action is taken.

Next year will mark the start of the Decade of Action for Road Safety. This initiative was instigated by a UN

resolution, and was co-sponsored by more than 90 countries, including Australia. The goal of this global initiative is to halt or reverse the increasing trend in road traffic deaths and injuries around the world.

As part of the 24th ARRB Conference (held in October 2010), a workshop was held in association with the Road Engineering Association of Asia and Australasia (REAAA) to provide background information on the Decade of Action. A further aim of the workshop was to discuss how those based in Australia can usefully contribute to this new initiative, both in Australia and globally.

Presenters from the Global Road Safety Partnership (GRSP), International Road Assessment Program (iRAP), Eric Howard and Associates, ARRB and AusAID provided background on the Decade of Action and current activities relating to it. Over 50 attendees

contributed to discussions on Australia's involvement.

Some of the key discussion points were that Australian individuals and organisations have a lot to contribute to



global road safety, having been active in this area for a number of years. However, there is a need to better coordinate these activities in the future, and it was suggested that a coordinating body was required. A number of useful suggestions were made about how knowledge and experience can be transferred to other countries.

It was also suggested that the draft Australian Road Safety Strategy be assessed for consistency with this new global initiative, and that opportunities should be sought through this strategy to actively engage in activities that will help achieve the Decade of Action outcomes.

A summary report from this event has been prepared and is available for download from the ARRB website (www.arrb.com.au).

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Photo: D.Best

ARRB Journal: special issue on bicycle research

The June issue of ARRB's peer reviewed journal, *Road and Transport Research*, brought together several papers relating to research into the promotion, operation and safety of cycling in Australia and New Zealand.

Bicycle usage and surrounding issues have not been thoroughly researched to date. The subject sits uneasily between bicycle lobbying and user groups, traffic engineering and safety literature, sustainability programs, 'smart travel' initiatives, health studies and other areas of public policy and action.

The papers demonstrate a range of research interests, from safety analysis and travel behaviour change to the fundamental question of priorities, both on the roads and in transport policy. They cover such topics as:

- International literature on bicycle lanes through roundabouts, and implications for applicability in Australia, in the context of the Austroads *Guide to Traffic Management*.
- Studies aimed at understanding and reducing the risk of cycle crashes.

The research provides some support for the 'safety in numbers' effect, i.e. that individual risk decreases the more people cycle.

- A study that used helmet-mounted cameras to observe behaviour of on-road commuter cyclists and their interactions with other road users in urban areas.
- A discussion of the difficult policy question of the relative priorities given to motor vehicles and cyclists in the road system. The authors argue that cycleways, by removing cyclists from road space rather than acknowledging the place of cycling within the traffic space, perpetuate the lower priority given to cycling in transport policy.
- Various aspects of identifying and overcoming barriers to cycling.
- Technical notes, one of which argues that the term 'cyclist' should be avoided in communications promoting cycling to the non-cycling public and motorists, and the other summarising factors to be considered when planning to retrofit bicycle provisions into road space.



The papers demonstrate that a wide range of skills and research interests can (and need to be) brought to bear on studies aimed at creating more amenable, functional and acceptable bicycle provisions. The papers illustrate the potential for greater research effort that moves beyond simple case studies and campaigning to providing a solid evidence base for transport policy that gives a proper place to cycling.

For information on journal subscriptions or to purchase a specific paper or issue, please contact the ARRB publication sales team on +61 3 9881 1555 or e-mail info@arrb.com.au

Ray Brindle, Editor
Road and Transport Research

Report from BAST



Adam Ritzinger's secondment from ARRB to Germany's Federal Highway Research Institute (BAST) is continuing to provide benefits for both organisations. While mainly focusing on undertaking research work for BAST, Adam has also spent some time investigating how road research is coordinated and managed in Europe, by attending the recent ERA-NET ROAD II Plenary meeting in Brussels.

ERA-NET stands for 'European Research Area Network', and is simply a consortium of stakeholders engaged in a similar research field. The aims of these consortiums are to strengthen the European scientific knowledge base, to support the structure of the European Research Area, and to conduct strategically planned and funded trans-national research programs. The ERA-NET concept was launched in 2002, and now

there are more than 80 different ERA-NETs in operation, such as ERA-NET ROAD II.

A good example of the effectiveness of such programs is the recent 'Road Safety' program call, launched under ERA-NET ROAD II in 2009. It received €1.6 million in funding from the National Road Authorities of 11 countries within the consortium, and from that 5 projects were awarded and are presently being jointly conducted by members of the consortium. The benefits of such work are improved quality and reduced duplication of research, better exchange of knowledge, and more value for money (access to more research per dollar spent).

Adam has also worked to further develop ARRB's international relations by attending the International Conference of Heavy Vehicles, Road Trains and



Urban Transport in Minsk, Belarus. Adam presented the results of recent heavy vehicle simulation studies undertaken by ARRB as part of the joint OECD/ITF Transport Research Centre (ITRC) Research Working Group, and discussed opportunities for collaboration on heavy vehicle safety related issues with local transport engineers and policy makers.

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Fine grained marginal materials
 Bitumen stabilised crushed rock
 Bitumen/cement stabilised crushed rock
 Crushed rock axle load equivalency
 Crushed rock moisture/compaction
 (Beerburum, QLD)

February 1992 – June 1993



Crushed rock
 axle load equivalency
 (Dandenong, VIC)
 March 1996 – May 1996

Heavy duty unbound pavement
 with sprayed seal surface
 (Benalla, VIC)

June 1985 – February 1986



Unbound and stabilised
 blast furnace slag
 (Prospect, NSW)

July 1987 – May 1988

Lateritic gravel bases & subbases
 (Beerburum, QLD)

June 1993 – March 1994

Pavement heating system
 commissioning
 (Beerburum, QLD)

October 1994 – January 1995

In situ stabilisation of
 marginal sandstone
 (Dandenong, VIC)

May 1996 – March 1997

Rut-resistance of asphalt: II
 (Beerburum, QLD)

January 1995 – April 1995

Stabilised fly ash
 (Eraring, NSW)

May 1995 – December 1995

Fatigue of asphalt and
 cement treated crushed rock
 (Mulgrave, VIC)

November 1989 – March 1991



Cement treated bases
 and subbases
 (Beerburum, QLD)

February 1986 – February 1987

Geotextile reinforced seals
 on expansive clays
 (Brewarrina, NSW)

July 1991 – December 1991

Fatigue of asphalt: I & II
 (Dandenong, VIC)

September 1996 – July 1997

Heavy duty unbound pavement
 with thin asphalt surface
 (Somersby, NSW)

July 1984 – April 1985



Asphalt rehabilitation
 treatments
 (Callington, SA)

July 1988 – October 1989



Rut resistance of asphalt: I
 (Beerburum, QLD)

November 1993 – March 1994

Deep lift in situ recycling
 (Cooma, NSW)

May 1994 – October 1994

Granite sett
 (Dandenong, VIC)

July 1997 – October 1997



1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998

ALF since 1984

The Accelerated Loading Facility (ALF) is used to simulate heavy vehicle trafficking on pavement structures under controlled conditions. This allows pavement performance to be evaluated in a very short time compared with test sites under normal traffic.

This timeline shows that, in over 25 years of hard work, ALF has been used to help explore a wide range of issues relevant to pavement technologists and practitioners.

The 35th test program, which is currently underway, aims to assess the effects of multiple axle load types on the performance of unbound granular pavements. The goal is to produce better procedures for assessing the impact of a spectrum of axle group types and load levels on Australian road pavement types.

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Failure of asphalt: III
(Dandenong, VIC)
 September 1998 – September 1998



Maintenance intervention: I
(Avenel, VIC)
 September 1998

Rigid pavements: II
(Goulburn, NSW)
 October 1999 – March 2000

Rigid pavements: I
(Goulburn, NSW)
 October 1998 – December 1998



Maintenance intervention: II
(Ruffy, VIC)
 March 1999 – May 1999

& II
 July 1997

pavements
(VIC)
 October 1997



Maintenance intervention: III
(Dandenong VIC, in shed)
 July 2000 – August 2000



Maintenance intervention: IV
(Dandenong, VIC, in shed)
 February 2001 – June 2001

Large format pavers
(Dandenong, VIC)
 June 2002 – September 2002

Axle load equivalence for
sprayed sealed
unbound granular pavements
(Dandenong, VIC, in shed)
 October 2002 – August 2003



Effect of wide single tyres
on a sprayed sealed
unbound granular pavement
(Dandenong, VIC, in shed)
 January 2004 – August 2004



Fatigue of cemented bases
(Dandenong, VIC, in shed)
 July 2005 – January 2007

Deformation of
sprayed sealed
unbound granular
pavements
(Dandenong, VIC, in shed)
 July 2007 – June 2008



Effect of ultra-wide single tyre
on sprayed sealed
unbound granular pavement
(Dandenong, VIC, in shed)
 February 2008 – March 2008

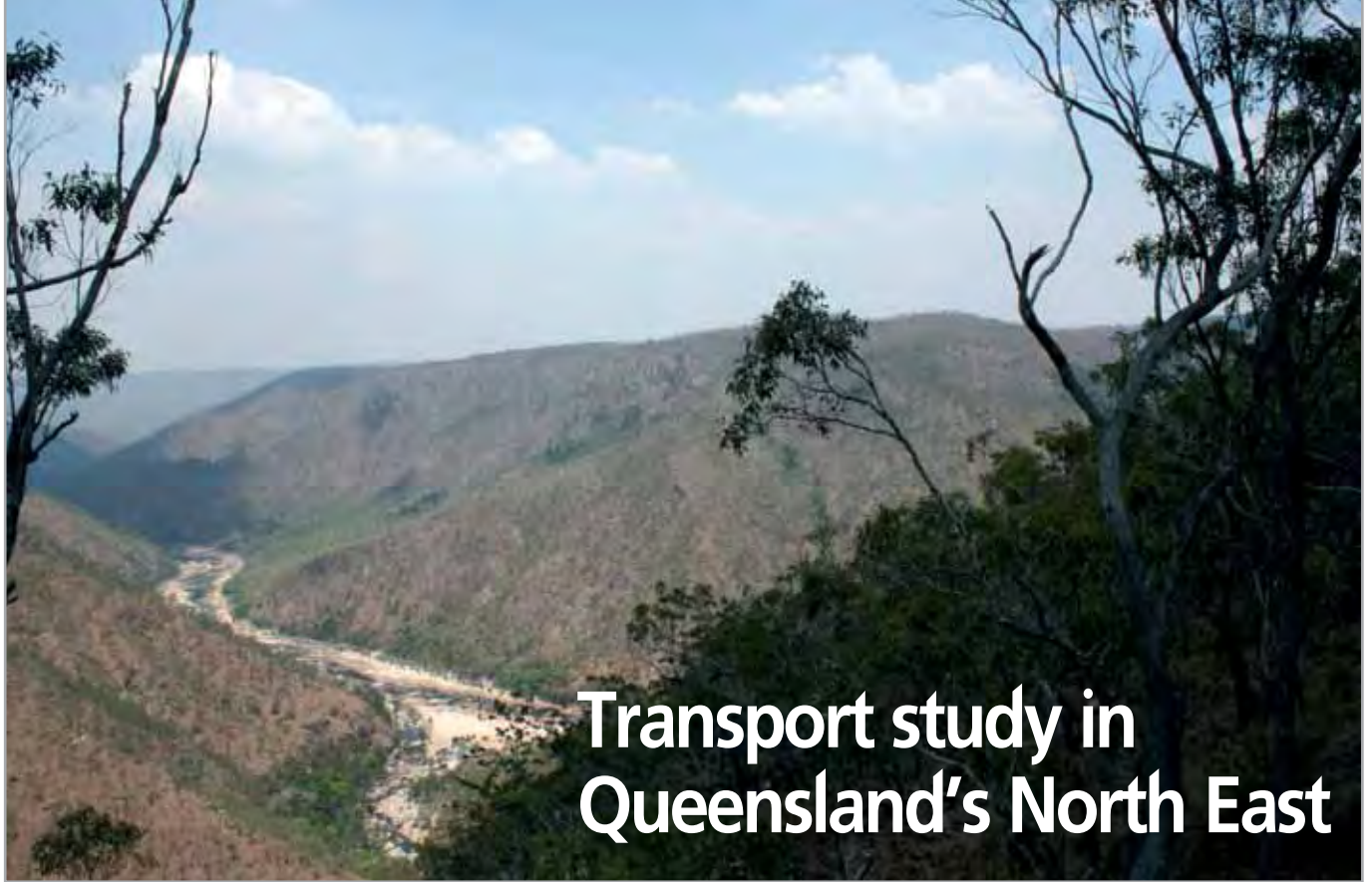
Multiple axle assemblies
commissioning
(Dandenong, VIC)
 September 2008 – September 2009



Effect of multiple axle loads on
sprayed sealed
unbound granular pavement
(Dandenong, VIC, in shed)
 October 2009 – June 2011



1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012



Transport study in Queensland's North East

ARRB recently collaborated with CRU Strategies in a freight task study on behalf of the Department of Transport and Main Roads in Queensland. CRU Strategies is the management consulting arm of CRU Group, one of the world's leading providers of information, research, forecasting and business advisory services to the global metals, mining and fertiliser industries.

The study involved:

- Defining the boundaries of the North East Mineral Province (NEMP) - Where? How big? This was influenced by geology and existing transport infrastructure.
- Policy - What does government want and intend?
- Current status - What infrastructure is in place now?

- Freight task - How much freight will there be? Where?
- Freight cost - How much will it cost to transport?
- Funding - Who will pay and how?

The NEMP covers about 75,000 square kilometres in a triangle between Cooktown, Georgetown and Charters Towers. Its mining potential is comparable to Mt Isa, but spread over a vast area, mainly west of the Great Dividing Range.

TMR's challenge, and that of industry and councils, is how to minimise the transport costs associated with mining operations in circumstances where many roads are of low standard, including a mix of sealed and unsealed roads (having evolved from the 'Beef Roads' of the 1950s), and deposits are modest in size and widely dispersed – often requiring trucking to a central mill for processing..

Remnants of a once-extensive railway network exist, but few lines operate today away from the major coastal and Townsville – Mount Isa lines, with a major hub at Townsville. The area is, however, well served with ports, providing capacity for the inward supply of goods and export of ore and concentrate.

ARRB's role was to convert CRU's estimates of mine inputs and outputs into a transport task, and to assess the impacts on the network and likely development needs, including both road- and rail-intensive solutions.

Among the most significant findings are:

- Increased mining activity resulting from NEMP development could significantly increase road use on 40% of the network.
- Infrastructure needs improvement. Acting early could provide a win-win for both TMR and road users: it saves money, benefits current and future users (non-mine/mine), and significantly reduces load-wear costs.
- Cherry-picking would help reduce costs and so maximise benefits. A road-intensive solution is most likely, but the potential exists for some rail development.
- The final scale and extent of the potential development is uncertain, as is its impact on fragile existing infrastructure.

Subsidiary studies have also been implemented at a detailed level, addressing such issues as wet season closures, localised rail-intensive solutions and the potential for major road upgrades in specific locations.

The partnership with CRU is an example of ARRB's multidisciplinary ability to address the needs of government and industry.

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First global iRAP Centre of Excellence at ARRB



The International Road Assessment Programme (iRAP) and ARRB launched the first iRAP Centre of Excellence at the 24th ARRB conference in Melbourne in October. Rob McInerney, iRAP's Chief Executive Officer and ARRB's Managing Director, Gerard Waldron, were present to launch the Centre of Excellence.

The creation of the iRAP Centres of Excellence

around the world is designed to focus expertise, ownership and leadership for the iRAP programs at a technical level and to help iRAP achieve its vision for a world free of high risk roads. iRAP Centres of Excellence will only be offered to a single peak organisation in each global region – those that have a demonstrated excellence in road safety engineering and are focused on activities for the public good. ARRB will cover the region of

Australasia and the Pacific but also have input at a global level.

ARRB has been involved with iRAP and many other RAP programs since their inception. This includes involvement in the development of the iRAP model and protocols, the development of the iRAP Road Safety Toolkit, establishment of several country pilot programs, and the conduct of a substantial portion of the research underpinning the assessment processes. In addition, much of the iRAP video data used in the assessments throughout the world is now collected with ARRB's Hawkeye technology.

Mr McInerney said 'The Centre of Excellence will work to prevent the more than 3,500 deaths that occur every day on the world's roads during the United Nations Decade of Action for Road Safety (2011-2020). A major focus of the Centre will be on road infrastructure safety in low- and middle-income countries, where 9 out of 10 road deaths occur. We are very pleased to be creating this partnership with ARRB - a world leader in

road research - for the benefit of global road safety.'

The Centre of Excellence will support development and delivery of new road assessment programs throughout the Asia Pacific region and established programs, including in Australia (AusRAP), New Zealand (KiwiRAP), Korea, Malaysia and Vietnam. It will also support organisations licensed to apply RAP programs, provide a focal point for iRAP expertise, assist with the communication of the iRAP vision and supporting protocols in key forums, assist with building relationships and partnerships with other Centres, and assist with capacity building and training activities to build an effective delivery network.

Further details on iRAP and the Centre of Excellence can be found at www.irap.org and at www.arrb.com.au/Home/News.aspx?newsID=44

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Annual GRSP Asia Seminar and iRAP Asia Pacific Workshop

The third iRAP Asia Pacific Workshop was held on 5 November in Siem Reap, Cambodia. The workshop was held in conjunction with the Global Road Safety Partnership (GRSP) Asia annual seminar held on 3-4 November, hosted by the National Road Safety Council and Government of Cambodia. Over 200 delegates attended the GRSP seminar on the first two days with a smaller focus group of 50 delegates from 15 countries

attending the iRAP Workshop on the third day.

This year a major focus of the events was on what organisations can do to promote the Road Safety Decade of Action, which will be officially launched by the United Nations on 11 May 2011.

ARRB played a major role in both events including:

Blair Turner gave a keynote address on ***Taking a benefit cost approach to road safety***, facilitated a road safety initiatives workshop entitled ***Planning for effective evaluations of road safety initiatives*** and presented in another workshop addressing road safety data management.

Peter Damen presented on how ARRB, as the first iRAP Centre of Excellence in

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the world, plans to assist iRAP program leaders with support for country programs, research and development, and capacity building activities. He also presented on the establishment of other regional centres, and facilitated a discussion on what ongoing support was needed. In conjunction with Peter Daly of the RACV, he also presented on the latest

developments in infrastructure road safety in Australia.

This year the iRAP star performer award was awarded to the NZ Automobile Association and the NZ Transport Agency for the very successful development of the KiwiRAP program and the partnering model used in New Zealand. ARRB has been a key contributor to

the development of KiwiRAP since its inception.

Further details on the iRAP workshop can be found at <http://irap.org/3rd-annual-asia-pacific-workshop.aspx>.

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International Rural Roads Convention in China

The IRF, the Global Transport Knowledge Partnership and the China Highway and Transportation Society collaborated to hold the 2nd International Rural Roads Convention in October 2010 in Jinan City, Shandong Province.

The Convention followed last year's successful event in Tanzania, and addressed the need for socio-economic development of rural areas in the context of poverty reduction and social cohesion.

Well in excess of 300 delegates attended with over 100 drawn from neighbouring countries in East and South Asia, Africa and further afield. The event showcased the PRC's massive program and achievements in rural road development in recent years, with this being one of the country's topmost priorities.

It drew leading figures from the worldwide network on rural transport development. Session topics embraced:

- The socio-economic role of roads
- Planning and managing rural roads

- Building and maintaining rural roads
- Safe rural roads
- Financing of rural roads.

A pre-conference on *Urban Mobility and Environment* was also held.

ARRB was represented by Tyrone Toole who contributed on *Rural roads management: Achieving community-oriented outcomes and value for money*. Tyrone also initiated a user survey on decision support tools to aid rural road planning and management.

To ensure continuation of innovation and knowledge sharing, IRF and its partners are looking into the opportunity to form an Asian Community of Practice for Rural Mobility, Access and Transport. This would allow regional practitioners and decision makers to continuously exchange, update and improve their working knowledge for



the development and management of sustainable rural mobility, access and transport.

For more details visit www.gtgp.com

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Library news

ARRB Group takes a leading role in national land transport information services through the National Interest Services (NIS) program funded by our federal, state and territory member organisations. Aiming to maximise resources and minimise duplication, services supplied through NIS include:

- Australian Transport Index (ATRI)
- Transport and Road Update (TARU) RSS feeds
- Road Research Register
- Research Coordination Group
- Road Safety Contacts Register
- Leadership of the Tranzinfo network of Australasian transport libraries

- International liaison to maintain Australasian involvement in global transport information developments.

In order to continue the relevance of NIS to our members' current and future land transport information needs, ARRB is convening sessions with stakeholders. Andrew Meier, Library Manager, and Damien Hense, Project Leader have already held discussions with DLP and DCI in Darwin, DTEL in Adelaide and DIER in Tasmania, with further member sessions scheduled during the remainder of 2010.

In September Andrew Meier also met with Tranzinfo network New Zealand library members, NZTA, Ministry of Transport, and Opus, whilst in Wellington to help launch the Rail Knowledge Bank (www.railknowledgebank.com). ARRB Group was commissioned to develop this



online resource for the rail sector by the CRC for Rail Innovation.

You can find more information on NIS, and access services like the Road Research Register and TARU RSS feeds, via the Library pages on the ARRB website: <http://www.arrb.com.au/Information-services/MG-Lay-Library.aspx>

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Got a problem? Need some testing?

ARRB's bitumen, asphalt, pavements and concrete laboratories undertake testing for Austroads, road authorities, materials producers and the construction industry. The laboratory facility is NATA accredited and has assisted in the development of many national test methods.

ARRB provides laboratory services that are independent. This appeals to organisations that may not be able to afford to operate their own laboratory, but need occasional access to specialised testing facilities and testing procedures not provided by commercial operators.

The laboratories are supported by ARRB's scientific, engineering and technical staff. The laboratories are fundamental to many of the research projects being delivered by ARRB.

The range of tests which can be undertaken is vast.

Aggregates and cement treated tests include:

- Particle size distribution by sieving
- Material finer than 75 µm in aggregates (by washing)
- Particle density and water adsorption of coarse and fine aggregates
- Apparent density of filler
- Voids in dry compacted filler
- Sand degradation by dry and wet rolling
- Repeat load triaxial determination of deformation and modulus characteristics of unbound materials
- Modulus and fatigue flexural beam testing.

Physical asphalt tests include:

- Design of asphalt mixes by Marshall and Gyropac methods

- Bulk and Maximum density
- Resilient modulus
- Dynamic creep
- Deformation resistance (wheel tracking)
- Fatigue life - four point flexural beam
- Stripping potential (tensile strength)
- Marshall and gyratory compaction methods
- Marshall stability and flow
- Voids and density relationships of asphalt materials
- Preparation of asphalt slabs
- Bitumen Content and aggregate grading
- Asphalt binder drain off testing
- Asphalt particle loss
- Marshall test properties for asphalt mixes for airports
- Determination of field core properties.

Bituminous binder tests include:

- Consistency, stiffness, elastic recovery and tensile modulus of PMBs
- Apparent dynamic viscosity
- Capillary and Brookfield viscometry
- RTFO (Rolling Thin Film Oven) treatment of binders
- Analytical determination of asphaltenes, resins, saturates and aromatics
- Penetration
- Softening point
- Torsional recovery
- N-Heptane insolubles
- Determination of rheological properties of binder
- Extraction of binder from seal and asphalt samples.

Sprayed seal physical tests include:

- Seal behaviour
- Viscosity of recovered binder.

Concrete physical tests include:

- Preparation of concrete mixes
- Alkali aggregate reactivity testing (Mortar Bar)

- Determination of compressive strength and splitting tensile strength of concrete cylinders
- Water absorption and apparent volume of permeable voids
- Indirect tensile testing
- Dry shrinkage determination
- Accelerated chloride penetration analysis
- Length change due to alkali-silica reaction.

Skid resistance physical tests include:

- Calibration of portable British pendulum skid resistance testers
- Field testing of new and existing surfaces.

Applications include:

- asphalt mix design and performance testing
- bridge inspections for signs of fatigue
- visual and physical assessment of sprayed seal condition
- chemical and physical assessment of bituminous binders
- forensic investigations into bituminous surfacing failures.

The laboratories are lead by Shannon Malone. Shannon has extensive experience in road surfacing research and development, NATA accreditation assessments, design of asphalt and slurry mixes, test methods and procedures for compliance and research into new products that have some commercial advantage.

Independent technical expertise is provided by Allan Alderson, Geoff Jameson, Kym Nealyon, Dr John Oliver, Dr Ahmad Shayan, Dr Robert Urquhart and others.

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100,000 km and still going...



Australia has the greatest length of road per capita of all the OECD countries. Managing these vast assets with such a small population base is a difficult balancing act for the various levels of government around Australia. In order to make informed decisions, governments are increasingly using technology to obtain objective quality measures of road condition.

ARRB plays a major role in collecting this data and for the year to date has completed over 100,000 km of survey across the length and breadth of Australia using our fleet of Hawkeye Network Survey Vehicles (NSV). These vehicles provide a wide range of information on road condition from which maintenance and other planning decisions can be confidently made. This length equates

to nearly one-third of Australia's paved network being surveyed by an ARRB vehicle in the past twelve months.

ARRB currently operates a pool of six complete Network Survey Vehicles and has over 50 fully trained staff across Australia, making us the leading provider of automated road data collection services. ARRB not only holds key contracts with all the relevant state and territory road authorities, these services are also provided to many local governments and private contractors.

As well as celebrating ARRB's 50th anniversary this year, ARRB also celebrated its 20th year of data collection service provision. As part of planning for the future it held a special Round Table as part of the 24th ARRB conference. The Round Table was attended by all State and Territory road authorities.

ARRB staff presented a preview of some proposed new developments and the road authorities provided valuable feedback and suggestions on how our services could be further improved.

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ARRB and IRE Bandung join forces

ARRB has signed a Memorandum of Understanding with IRE Bandung. IRE (Institute of Road Engineering) is a research centre managed under the Agency for Research and Development, Ministry of Public Works in the Republic of Indonesia. The Institute assists the Ministry in the development of national, provincial and local roads.

The MOU is focused on research cooperation and targets:

- mutual exchange of technical information
- staff exchanges to provide development opportunities and enhance expertise available within both organisations
- cooperation in agreed research programs.

The signing ceremony took place at IRE's headquarters in Bandung Indonesia on

8 November 2010 and was attended by ARRB Group's Managing Director, Mr. Gerard Waldron and Senior Business Manager, Mr. Barry Jan. Dr Jawali Marbun, Director of IRE Bandung, signed on behalf of the Institute.

At the signing, Mr. Waldron said that 'the similarities in the goals and responsibilities of both of our organisations provide the ideal forum for cooperation activities which will be mutually beneficial'. He added that the MOU should also enhance the strong relationships already in place between ARRB and many Indonesian agencies over the past decade.

The first formal meetings under the MOU will get underway in Melbourne in early 2011.

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Dr. Jawali Marbun and Gerard Waldron at the signing ceremony.

ARRB appoints new distributor in Russia

ARRB has appointed LLC Monitoring as our business partners in Russia. Based in St. Petersburg, LLC Monitoring have been involved in the roads and transport industry for more than 10 years, with their main focus on equipment for material testing and road construction quality surveys.

LLC Monitoring recently took part in the 'Roads. Bridges. Tunnels.' exhibition held in St. Petersburg in September and 'Roads of Russia XXI' held in Chelyabinsk in October. LLC Monitoring showcased ARRB's product range and received a number of enquiries from

interested organisations from Russia and surrounding countries.

This month, LLC Monitoring will be exhibiting at 'The Road' exhibition in Moscow, which is one of Russia's largest road and transport related trade fairs.

Prior to appointing LLC in Russia, ARRB developed Russian language versions of its Hawkeye software. The list of languages supported in Hawkeye now includes Chinese, Japanese and Spanish.

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LLC Monitoring Brand Manager, Marina Malieva, at the 'Roads.Bridges.Tunnels' exhibition.

Elastometer redeveloped

The ARRB Elastometer has been the instrument of choice for determining polymer modified bitumen (PMB) properties for over 20 years and is the basis for the Australian PMB specifications. ARRB has recently completed a redevelopment of the Elastometer to ensure it remains the instrument of choice for this important test.

Various hardware availability issues were the impetus for the redevelopment of the Elastometer, which has resulted in the following updates:

- upgraded data acquisition module
- new software program enabling operation in a Windows 7 environment
- calibration, diagnostics and reporting programs included in software

- operates on current PCs, which guarantees availability of spare parts.

Pricing for the updated Elastometer is now available, as well as an upgrade option for owners of existing units.

Please contact productinfo@arrb.com.au for further information.



3rd International
Road Surface Friction Conference
Safer Road Surfaces – Saving Lives

15-18 May 2011, Hyatt Regency Sanctuary Cove, Gold Coast QLD



Registrations now open

ARRB Group is hosting the 3rd International Road Surface Friction Conference (15 – 18 May 2011) on the Gold Coast, Australia in association with the New Zealand Transport Agency and WDM®.

The theme of the Conference is Safer Road Surfaces – Saving Lives reflecting the undoubted contribution that effectively managing road surface friction can make to achieving positive road safety outcomes.

The Conference will provide opportunities for delegates to network, share industry knowledge and exchange research information.

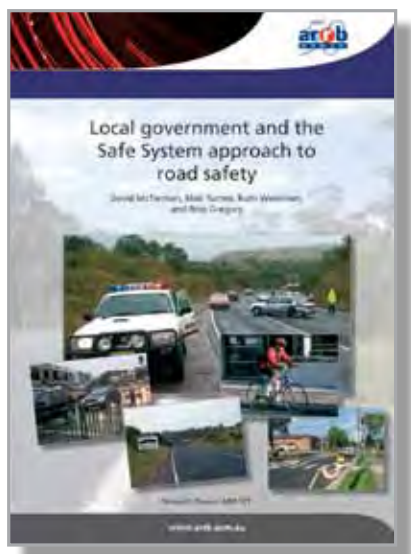
One of the highlights of the conference will be held at Queensland Government's Mount Cotton test track on Day 3 of the Conference. Delegates will be able to witness and, in a number of cases, experience some of the key concepts and underlying principles of road surface friction, across a range of different vehicle types.

For further information please contact
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THE 3RD INTERNATIONAL ROAD
SURFACE FRICTION CONFERENCE IS
BEING RUN IN ASSOCIATION WITH:



Early Bird closes 31 March 2011 - Register online at www.friction2011.com.au



Local government and the Safe System approach to road safety

D. McTiernan, B Turner, R. Wernham, R Gregory

Research Report ARR 375

Understanding of the Safe System approach and its application by local government is low. This report collates material presented at a workshop facilitated by ARRB

New publications from ARRB

Group and the Western Australian Local Government Association and summarises discussion. It provides an appreciation of the Safe System approach and issues for local government road safety initiatives and action.

This publication is available as a free downloadable PDF file from ARRB's website: www.arrb.com.au or for hard copies contact booksales@arrb.com.au +61 3 9881 1561

2nd Sprayed Sealing and 24th ARRB Conference Proceedings

The Proceedings for both conferences are published on CD by ARRB Group and may be purchased together at a cost of \$77 plus \$7.50 delivery within Australia (GST incl.), \$10 to New Zealand, and \$15 to all other places.

ARRB is intending to publish the proceedings online in the coming months.

The Sprayed Sealing Proceedings include 15 papers. The ARRB Conference Proceedings



include 121 refereed papers from the conference technical sessions.

Presentations from Plenary, technical and special sessions during the conferences are available for download from www.arrb.com.au.

For more information, contact us on + 61 3 9881 1561 or email booksales@arrb.com.au

New staff



Dr Hanson Ngo has joined the Structures team in Brisbane as a Senior Engineer (Bridges). Hanson has over 14 years experience in structural engineering and civil infrastructure

industries in Vietnam. His research interests are in the area of inelastic structural behaviours and bridge engineering. He has a BEng, an MSc in Bridge Engineering from Vietnam and a Doctorate in Structural Engineering from University of New South Wales - Australia.

pavement design and asphalt technology and a Master of Engineering (Civil, majoring in transport infrastructure engineering). Laszlo has experience in road construction, quality control and materials testing.

Prior to joining ARRB Laszlo led and managed research projects on asphalt performance and pavement performance enhancement at the Budapest University of Technology and was also the Hungarian representative on several PIARC committees.



Ganesh Vengadasalam joins our NSW office in the Safe Systems group. Ganesh commenced his traffic engineering career in the UK and brings to ARRB his extensive technical expertise acquired

over the last nine years. His core skills are in the area of road safety and crash investigation where he has completed

and provided advice on key road safety projects for both private and public sector clients. He is also a qualified and experienced road safety auditor.

Ganesh has a BSc Civil Engineering (USA), MSc Traffic Engineering (UK), MBA (UK) and Masters in Project Management (Aust).



Dr Robert Urquhart has joined the Sustainable Infrastructure Sciences team in Melbourne. Robert was previously Australian bitumen technology manager at BP Bitumen. He

is a specialist in bituminous sciences and has a total of 20 years post-doctoral experience in universities, CSIRO and industry. He has a chemistry background with particular expertise in bitumens, polymer modified binders and bitumen emulsions.

Dr Urquhart will join the materials group in binders related research projects, and

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Dr Lazlo Petho has joined ARRB Queensland as an asset management engineer, specialising in pavement structures and asphalt technology. Laszlo has a PhD in

participate in appropriate industry and road authority committees and panels. Together with Dr John Oliver, Dr Urquhart will assist in mentoring less experienced research staff and laboratory staff.



Lauren Yarrow has joined our Brisbane Office as a Consultant with Luxmoore Parking. Lauren has a vast amount of experience as a traffic engineer/transport planner

specialising in the parking field. Lauren's recent roles include lecturing with the University of Southern Queensland and as a traffic/transport engineer with the Ipswich City Council. Most recently Lauren ran her own consultancy business where she was sub-consulting to Luxmoore on parking projects.

Knowledge transfer program

We would like to thank all those who responded to our Client Feedback Survey, which was designed to help establish the degree to which we are meeting the training needs of our clients. You can still leave feedback by emailing training@arrb.com.au

A big thank you also to our workshop presenters and facilitators for collaborating with us, and helping ensure the success of the workshop program.

The 2011 Program

Look at what is coming to your region:

NEW SOUTH WALES

- Managed freeways 15-16 March, Sydney
- Traffic theory and applications 28-29 March, Sydney
- Planning and design of parking facilities 21-22 June, Sydney
- Local area traffic management 6-7 July, Sydney
- Level 1 bridge inspection early 2011, 4-5 May 2011, Sydney
- Basic geometric road design mid 2011, Sydney
- Unsealed local roads mid-late 2011, (location TBC)
- Legal issues facing road authorities mid 2011, Sydney

VICTORIA

- Managed freeways 3-4 May, Melbourne
- Unsealed local roads early 2011, (location TBC)
- Level 1 bridge inspection mid 2011, 1-2 June 2011, Melbourne

QUEENSLAND

- Managed freeways 8-9 February, Brisbane
- Traffic theory and applications 31 March – 1 April, Brisbane



- Planning and design of parking facilities 19-20 May, Brisbane
- Local area traffic management 8-9 September, Brisbane
- Basic geometric road design mid 2011, Brisbane
- An introduction to geotechnical investigation and design mid 2011, Brisbane
- Unsealed local roads mid 2011, (location TBC)

WESTERN AUSTRALIA

- Managed freeways 1-2 March, Perth
- Basic geometric road design 15-17 March, Perth
- Level 1 bridge inspection 22-23 June 2011, Perth
- Unsealed local roads early-mid 2011, (location TBC)
- Mining roads – safety and design mid-late 2011, (location TBC)

SOUTH AUSTRALIA

- Fundamentals of transport modelling 5-6 April, Adelaide
- Managed freeways 24-25 May, Adelaide

TASMANIA

- Basic geometric road design 22-24 February, Hobart
- Fundamentals of transport modelling 10-11 May, Hobart

AUSTRALIAN CAPITAL TERRITORY

- Fundamentals of transport modelling 8-9 March, Canberra

NEW ZEALAND

- Fundamentals of transport modelling 8-9 February, Auckland
- Planning and design of parking facilities 23-24 March, Auckland
- Managed freeways 4-5 April, Auckland
- Managed freeways 7-8 April, Christchurch
- An introduction to geotechnical investigation and design 12 April, Auckland
- An introduction to geotechnical investigation and design 14 April, Christchurch
- Basic geometric road design early 2011, Auckland
- Basic geometric road design early 2011, Christchurch
- Treatment of crash locations early 2011, (location TBC)

Unsealed local roads: The latest practices in the management of unsealed roads based on the popular ARRB *Unsealed Roads Manual*. It will cover recent research findings, best maintenance techniques and case studies demonstrating how to get greater value from available funding. The workshop will be a practical hands-on presentation with group participation, worked examples, case studies and a field inspection of unsealed road sites.

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Knowledge transfer program

Treatment of crash locations: A two day training workshop on the *Guide to Road Safety Part 8: Treatment of Crash Locations*. It will cover provision of a Safe System, road safety engineering, human factors, police investigations, identifying crash locations, diagnosing the crash problem at the site, selecting an effective solution, crash costs and economic appraisal.

An introduction to geotechnical investigation and design: Aims to familiarise participants with current best practice in geotechnical design considerations in road design, and to participate in case studies to learn how to identify important geotechnical issues that have an impact on various road design elements.

Mining roads: safety and design: Meets the need for formalised training of mining personnel involved in planning, design, construction, maintenance or review of mining roads. This workshop is structured to provide participants with practical and applicable knowledge in the areas of traffic safety/management and mining road design.

Planning and design of parking facilities: Will be based on the Austroads *Guide to Traffic Management Part 11: Parking and Australian Standard AS2890.1-5*. It will cover best practice techniques, available resources, design principles, on and off-street requirements, special needs of different users, architectural and urban design considerations, and a case study syndicate exercise to provide hands-on experience applying latest practice.

Traffic theory and applications: Analyses of traffic behaviour are essential to both traffic management and road design, and also have application in the broader transport planning field. Such analyses draw upon many aspects of

traffic theory, an appreciation of which greatly enhances the technical insights and capabilities of traffic engineers, road designers and transport planners. This workshop will present and explain the key areas of traffic theory, illustrate their application to various types of traffic analysis and provide participants with hands-on practice in identifying and undertaking the analyses appropriate to different situations.

Basic geometric road design: Good road design will achieve operational efficiency, be safe and cost-effective, and minimise the environmental impact. The role of the road designer is to produce the most appropriate design that achieves the specified functionality using the design inputs from all relevant disciplines. The design must provide for a safe and efficient road facility that takes into account all inputs from stakeholders and road users. This workshop will cover these principles so that delegates will obtain a clear understanding of the key geometric design requirements for road design.

Legal issues facing road authorities: The two-day workshop provides a comprehensive appreciation of current and emerging issues associated with, the liability of road authorities, as well as a useful toolkit for any practitioner that has been, or may potentially become, involved in legal proceedings. The aim is to ensure that those attending are prepared in the event of future representation of their organisation. The two day workshop is considered of particular relevance to those just starting a career with a road authority.

Level 1 bridge inspection: A two-day workshop for those involved with the routine maintenance inspection of bridge structures and culverts. The workshop aims to assist participants develop skills to conduct the Level 1 inspection and

complete the Level 1 inspection report form, on which to base the required maintenance intervention. Also the workshop will enable delegates to recognise and assess bridge condition problems essential for Level 2 inspections.

Managed freeways: In Australia and New Zealand over recent years the term managed freeways has emerged describing an innovative way of using integrated tools and technologies to manage congested urban freeways in order to bring about a high level of traffic throughput, reduced travel times, improved reliability and increased safety. This two day workshop will cover all aspects of managed freeway systems, including best practice for freeway ramp metering.

Local area traffic management: Will be based on Austroads *Guide to Traffic Management Part 8: Local Area Traffic Management*. It will cover material relating to best practice techniques, available resources, design principles, device selection, special needs of different road users, legal issues and a case study syndicate exercise to provide hands-on experience applying latest practice.

Fundamentals of transport modelling: This two day workshop will focus on providing delegates with an understanding of the fundamentals of transport modelling. Estimates of future demand are essential to the formulation of transport plans and policies. Transport demand modelling is therefore one of the core skills of a transport planner. This workshop aims to provide participants with a background on the four-step demand model.

For further information:

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