



FORECASTING DEMAND FOR INFRASTRUCTURE

**WHAT TYPE OF INFRASTRUCTURE
SHOULD WE BUILD AND WHERE?
IF WE BUILD IT, WILL PEOPLE USE IT?
WHO WILL THE USERS BE?**

These are fundamental and critical questions for those involved in infrastructure development.

We have recently completed a project for the Wellington City Council on forecasting demand for proposed new cycle routes. Our new methodology is relatively simple to apply, and has produced very similar results to complex and more expensive demand forecasting models.

In addition to cycle routes, there are obviously a multitude of applications for this forecasting tool where we could better understand latent demand. Read more about the Wellington City Council project on page 2.

In this Issue of In-Touch we also feature a range of other projects we have recently been working on. This includes two pavement research stories, highlighting how we are contributing to improved road network performance, as well as an introduction to our new Pavement Research Manager, Kym Neaylon, who has joined us from a similar role at the Australian Road Research Board. We undertake a significant amount of R&D and laboratory services relating to road performance and design, with our New Zealand clients including the NZ Transport Agency, Ministry of Business, Innovation & Employment, Callaghan Innovation, local authorities and commercial companies.

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Jean Beetham and Jared Thomas

INNOVATIVE CYCLE DEMAND FORECASTING TOOL DEVELOPED

DECISION-MAKERS OFTEN ASK SIMILAR QUESTIONS WHEN DECIDING WHETHER/WHERE/HOW TO CREATE CYCLE ROUTES FOR THEIR COMMUNITIES:

IF WE BUILD IT WILL THEY COME?

WHO'S 'THEY'?

WHAT TYPE OF INFRASTRUCTURE SHOULD WE BUILD, AND ON WHAT ROUTE/S?

Opus Research has recently completed a cycle route demand forecasting project for Wellington City, which was very well received by the client, Wellington City Council. This project involved forecasting future demand for cycle routes and cycle route infrastructure using a novel surveying methodology developed and refined in-house by Opus' Petone-based researchers.

The new forecasting method utilises simple survey data from people's current cycling behaviour, along with data generated from the way respondents indicate their behaviour might change in

a range of different cycling scenarios. Our researchers then modified these inputs in line with numerous studies which have identified replicable patterns in observed differences between what people say they will do and what they are actually likely to do in any given situation.

Tangible benefits of the improved forecasting methodology include:

- The necessary data can easily be collected as part of an existing resident perception survey (or similar)
- Questions can be tailored appropriately to take account of local context and test local solutions
- Results can forecast the potential demand and mode share for different cycle routes and characteristics, and different infrastructure types and users
- The method is simple-to-use and inexpensive, making it accessible for any community
- The method has produced very similar results to complex demand forecasting models
- The method has the ability to test demand for new cycle infrastructure and determine which options will encourage the most people to cycle.

The survey can significantly improve the outputs gained from more traditional forecast survey methods to determine the

best investment solution.

Based on feedback to date, this new approach is being welcomed by infrastructure demand forecasting practitioners.

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"Opus Research was an exceptional research partner in the cycling demand forecasting project we completed early this year. Having a capable, independent research partner perform a complimentary method of assessment to our own was essential to the success of our project."

- Tom Pettit, Research Analyst at WCC

OZCANDRIVE OLDER DRIVER STUDY

OVER THE PAST 4 YEARS, OPUS RESEARCHERS GRACE RIVE, KATE MORA AND ABIGAIL HARDING HAVE BEEN CONDUCTING ASSESSMENTS WITH OLDER NEW ZEALAND DRIVERS AND TRACKING THEIR MOVEMENTS VIA GPS. THIS RESEARCH IS PART OF A WIDER STUDY BEING CONDUCTED IN CANADA, AUSTRALIA AND NEW ZEALAND TO HELP DEVELOP AN OBJECTIVE SCREENING TOOL FOR HEALTHCARE PROFESSIONALS TO IDENTIFY AT-RISK OLDER DRIVERS.

With populations ageing globally, older drivers have become increasingly common in many countries, including across New Zealand's roading network. This changing trend has resulted in an identified need to better understand and manage driving behaviours, travel patterns and crash risk for these travellers. The Candrive study (called Ozcandrive in Australia and New Zealand) aims to fill this knowledge gap by examining how driving behaviour alters as people age and as driver health and functional ability changes.

The Candrive/Ozcandrive study, which commenced in 2011, is the largest longitudinal study of older drivers ever undertaken, and involves a partnership with universities in Australia and Canada. Around 1000 participants over 70 years of age were recruited in Canada, with a



further 300 participants aged over 75 in Australia and 45 in New Zealand. The sample size for the New Zealand portion of the study was relatively small as the results will be used to test the relevance of findings from the larger samples for our own population.

Opus Research has conducted biannual in-depth assessments with the sample, along with shorter follow-up assessments. The in-depth assessments required participants to complete a battery of physical and mental functioning tests, including assessment of mobility levels, problem solving, recall and memory, balance, reaction time, strength, eye sight and hearing. Medical histories and driving

behaviour were also recorded. In addition, GPS devices fitted to participants' vehicles logged actual trips taken, including speeds, distances and locations travelled to better understand actual travel behaviour over time.

Data collection is now complete in New Zealand (and is ongoing overseas), and number crunching is underway. Findings from the study will be released in 2015, and from there practical actions will be developed to help prolong the quality of life for our older citizens.

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“We are delighted with the outcomes that our partners have achieved in the development of this innovative new long life surface. Opus Research provided a rigorous science lead for this project from its very beginnings with the OECD, giving the NZTA confidence that we were on the right track. Combined with Fulton Hogan’s “can do” approach to the technical detail of getting the product made and on the ground, our partners have broken down the barriers to innovation that are all too often encountered in introducing new materials. The project has progressed very well so far, with tenders to lay the new material on public roads having already been let. We are keen to eventually use this new material as our standard material-of-choice for all future state highway low noise road surfacing projects.”

- Dave Alabaster, NZ Transport Agency

DEVELOPMENT OF IMPROVED EPOXY-MODIFIED ASPHALT

THE PAVEMENTS TEAM AT OPUS RESEARCH HAS BEEN WORKING WITH THE NZ TRANSPORT AGENCY AND FULTON HOGAN TO DEVELOP AN INNOVATIVE NEW PAVEMENT SURFACING MATERIAL – AN EPOXY-MODIFIED OPEN-GRADED POROUS ASPHALT (OGPA).

The aim of the initiative is to produce a long-life (30 years plus) surfacing material with low maintenance requirements and low noise generation to minimise auditory impacts for road users and neighbouring residents. In addition to its user benefits, the new surfacing material also has the potential to achieve significant cost-savings for the national roading budget.

The OGPA development project forms part of a larger collaborative research programme conducted under the auspices of the OECD/ECMT (European Conference of Ministers of Transport) Joint Transport Research Centre, which is focused on the economic evaluation of long-life pavements.

The New Zealand OGPA surfacing development project has been a collaborative effort between Opus Research, who are leading the NZ input into the OECD/ECMT programme and laboratory studies, Fulton Hogan, who are focused on resolving the surfacing manufacturing and laying issues, and the Transport Agency, who are providing project funding and assisting with accelerated pavement testing at CAPTIF (Canterbury Accelerated Pavement Testing Indoor Facility) and trial sites.

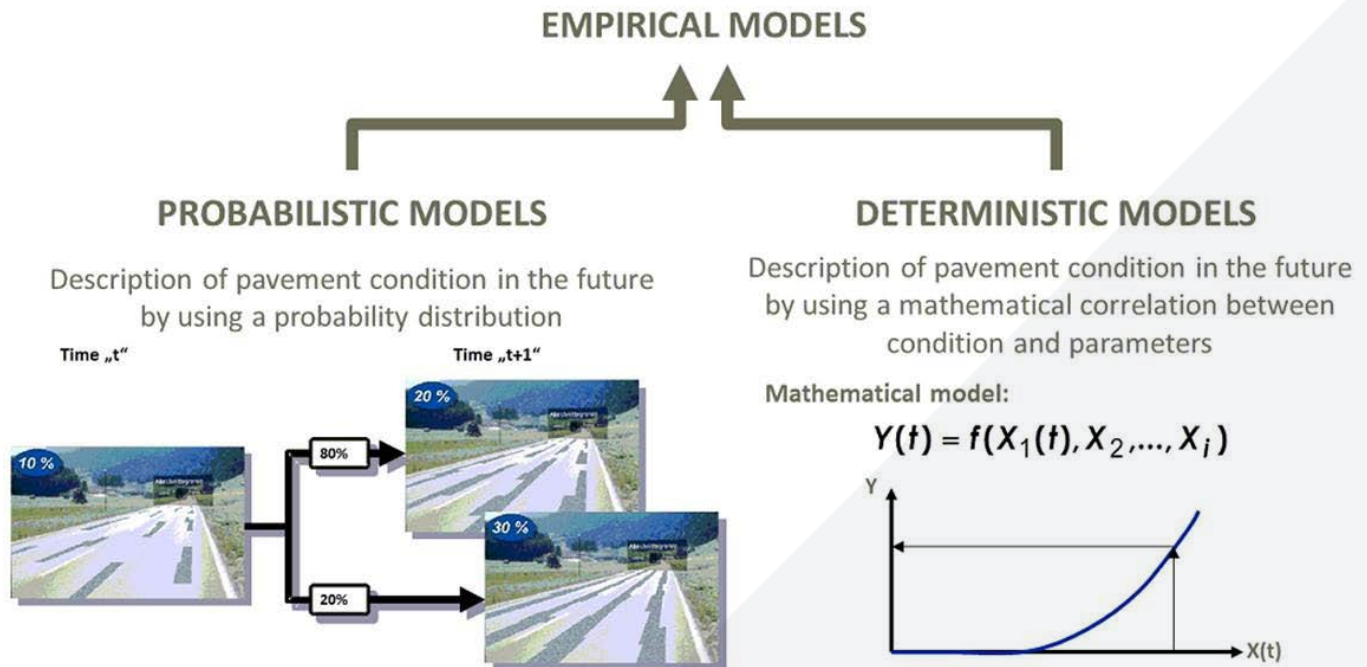
Previous field trials of epoxy-modified surfacings have proven the success of this trialling system. In 2006, five tonnes of epoxy-modified asphalt was produced and laid at CAPTIF, and in 2007, 100 tonnes was laid on SH1 near Christchurch. Both trial sections have now been in place for over seven years and are still performing well. The success of the Christchurch trial also demonstrated that full-scale manufacture through a standard continuous-mix asphalt plant and construction using a standard paver could be achieved without any significant modification to plant or operating procedures.

Recent work in New Zealand has resulted in an EMOGPA (epoxy-modified open-grade porous asphalt) material using a Bitumen Extended Epoxy Binder which is similar to conventional OGPA to manufacture and lay. Resurfacing with the 2012 version of EMOGPA is expected to cost only 30% more than routine resurfacing operations using standard OGPA in the long term, and has the potential to reduce the the Transport Agency’s annual OGPA budget to one half of its current value. The 2012 version of EMOGPA becomes cost neutral at about 13 years’ life, with every year after that a saving to the Transport Agency.

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STOCHASTIC MODELLING DEVELOPMENT TO IMPROVE WHOLE-OF-LIFE ASSET MANAGEMENT



STOCHASTIC MODELLING OFFERS A SUPERIOR ALTERNATIVE TO DETERMINISTIC MODELLING FOR CLIENTS WISHING TO CONSIDER HOW BEST TO MODEL BUSINESS CASE OPTIONS FOR MAINTENANCE AND RENEWAL OF KEY ASSETS SUCH AS HIGHWAY PAVEMENTS, DRAINAGE ASSETS, STREETLIGHTS AND SIGNS.

Stochastic modelling differs significantly in both approach and benefits from the more traditional deterministic modelling method. Both methods are used to predict an asset's anticipated maintenance requirements throughout its lifetime; however the stochastic method enables the user to consider how highway assets

will perform over time based on historical relationships between input variables and either budget or performance outcomes constraints.

Opus Research has been working alongside key technical specialists Elke Beca and Paul Anderson from Opus Tauranga to develop three leading-edge stochastic models to enhance the NZ Transport Agency's pavement maintenance and development plans for the New Zealand state highway network. The focus for these plans has been around three key performance indices: pavement rutting, surfacing renewal and skid resistance.

The stochastic models Opus has developed are based on the Highways Maintenance Efficiency Programme (HMEP) framework developed by a team of researchers from Birmingham University in the UK, with adaptations to capture specific deterioration and treatment logic unique to the New Zealand state highway network. More recently, consideration has been extended to the modelling of maintenance and renewals works in support of highway drainage.

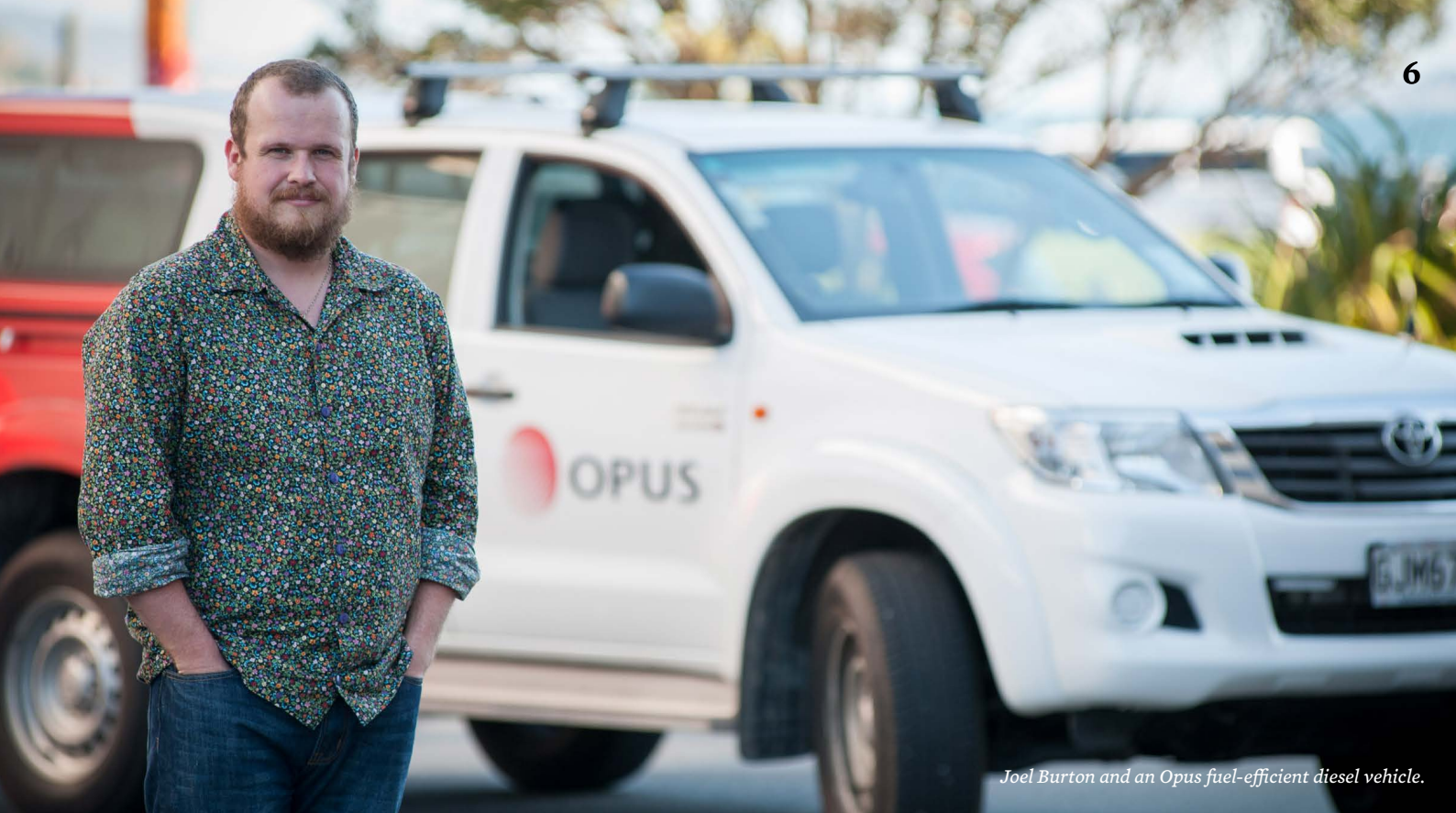
Drainage works have previously been treated as an add-on to the pavement rehabilitation decision-making process. Ideally, drainage works should be considered in advance of pavement works to maximise pavement and surfacing performance.

The stochastic modelling project also includes development of a smartphone-based decision-making tool for use by contractors and asset managers when out in the field.

Next on the agenda for the Opus Research team is to incorporate these innovative stochastic models within the optimisation tools already available within the dTIMS asset management framework. The aim is to assist the Transport Agency to achieve more effective, joined-up business decisions for maintenance and renewal works across critical asset groups throughout New Zealand's state highway network.

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Joel Burton and an Opus fuel-efficient diesel vehicle.

OPUS LEADING THE WAY IN SAFETY AND SUSTAINABILITY

THE FLEET SUSTAINABILITY SURVEY, WHICH IS SPONSORED FROM OPUS' INTERNAL TECHNICAL INVESTMENT FUND, HAS INVOLVED THE OPUS RESEARCH BEHAVIOURAL AND ENGINEERING SCIENCES TEAMS IN INVESTIGATING PRACTICAL MECHANISMS TO IMPROVE FLEET SAFETY, SUSTAINABILITY, AND FUEL EFFICIENCY WITHIN THE COMPANY'S LEASED VEHICLE FLEET. PRELIMINARY FINDINGS INDICATE THAT OPUS STAFF RATE SAFETY AS THEIR MAIN CONSIDERATION WHEN CHOOSING A NEW VEHICLE.

Driver safety and fuel efficiency go hand-in-hand. This is a key finding of our NZ Opus fleet survey, where we surveyed over 215 drivers of our company vehicles in addition to looking at our fleet data.

Opus staff pride themselves on the energy they bring to projects; however, in the context of driver safety, this could be a real area for improvement, with more moderate driving styles proving to be much safer.

Studies show that drivers with an 'energetic' driving style are three times more likely to be in an at-fault accident compared with those drivers that had a 'moderate' driving style.

Our people are passionate about safety, and this is their main focus when selecting a vehicle. We believe this safety focus can be used to encourage more of our drivers to use a smoother, more moderate driving style. Eco-driver training and providing real-time feedback on fuel-efficiency, particularly if combined with a driver reward system, could be just the ticket to change behaviour in the long-term.

The fleet survey examined factors that each individual driver considers important when choosing a company vehicle, both as a work vehicle and as a personal vehicle.

Results of the study showed that, when ranked by importance, the top three characteristics when choosing a new company vehicle were: safety rating, cargo capacity and ride comfort, respectively. The lowest three were (in order of least importance): vehicles off-road ability, the manufacturer, and finally, vehicle prestige.

Findings of the study showed that the Opus vehicles selected were strong on vehicle safety and fuel efficiency ratings, but that there was room to investigate improvements around reliability and cargo space.

The project team has recommended that Opus look into improving driver behaviour by ensuring feedback on driving performance, pushing towards incentivised, real-time feedback on fuel efficiency as a mechanism for long-term safer driving. Recommendations also include implementing a driver training programme, with a strong focus on fuel efficient driving (as the existing company fleet is already very safe). The team has further recommended that Opus consider improving our central database to better monitor vehicle fuel use and other relevant data.

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STRUCTURAL TESTING WITH A GALLIC TOUCH

OPUS HAS ESTABLISHED A COMPREHENSIVE STRUCTURAL TESTING FACILITY AT OUR NEW PREMISES IN PETONE, HEADED BY FRENCH EXPAT GUILLAUME ROUX, WHO RECENTLY CELEBRATED HIS FIRST YEAR ANNIVERSARY WITH US.

Guillaume is a Structural Performance Technologist with impressive professional qualifications and on-the-job experience.

In addition to a Master's degree in Mechanical and Industrial Engineering from the Ecole Nationale Supérieure d'Arts et Métiers (ENSAM) in Paris, Guillaume has also completed a post-graduate certificate from the same engineering school in Innovation Management.

Prior to joining Opus, Guillaume held a range of project management, process engineering and technical design roles with industrial companies in France, including Hologram Industries, which develops anti-counterfeiting solutions including holographic laminates and authentication system software.

Guillaume's professional experience also includes mechanical design for the automobile and special machinery industries.

Under Guillaume's leadership, Opus' structural research team undertakes a very wide variety of analysis and monitoring projects, including strength and failure testing of nuts, bolts and other structurally-critical fasteners, standards compliance testing for large elastic/plastic reverse-loading simulation of large-scale earthquakes, in-situ shear strength testing of masonry mortar joints, and carbon-fibre-reinforced polymer testing. We also calibrate load cells, dynamometers, hydraulic jack systems, pull-out testers and other technical equipment to ensure ongoing accuracy and compliance.

Guillaume has a strong focus on ensuring that all projects have a rigorous grounding in the relevant standards and the most appropriate equipment for the task at hand. He also takes a customer-first approach to all projects he undertakes, and particularly enjoys carrying out on-site testing which helps him to more fully appreciate the intricacies and specific requirements for individual projects and clients.

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PROJECT CASE STUDY

Reid™ Construction System provides a suite of engineering-based innovative reinforcing components that are well-known among construction professions throughout New Zealand. When Reid™ decided to renew one of their critical products – the ReidBar™ coupler, the company approached Opus Research to undertake the most complicated qualification tests required by the ISO standards, to confirm the component would meet all loading scenarios likely to be applied to it throughout its in-service life.

The Opus structural research team began by testing a reference coupler component, the ReidBar™ coupler RB25C – which is one of many couplers Reid™ manufactures – on the most demanding standards compliance test. The 'low cycle reverse elastic-plastic loading test' enables researchers to assess the performance of couplers under alternating large tension and compression deformations, simulating a violent earthquake (Category S2 in ISO 15835-2:2009(E) §5.6.2). The Reid™ reference coupler passed the test easily.

The entire Reid™ product range was subsequently tested according to the same testing conditions, and all components demonstrated full compliance with the international standards.

Several months later, Reid™ asked Opus Research to perform an additional 'high cycle fatigue test' on the same newly designed coupler product, in order to complete the product's qualifications assessment process. This test consists of applying two million cycles at 60% of the elastic range of the steel bar. For this demanding testing regime, we use the full performance of our Universal Testing Machine to achieve a maximum frequency of 20Hz. Each test lasts three-and-a-half days.

Our work with Reid™ to ensure their newly developed components meet applicable structural integrity and high-performance compliance standards has been satisfying for everyone involved.



INTRODUCING... KYM NEAYLON

KYM HAS JOINED OPUS RESEARCH TO LEAD OUR PAVEMENTS RESEARCH AND LABORATORY TEAM.

Over the past 24 years Kym has specialised in bituminous road surfacings, and prior to that his civil engineering career encompassed open cut mining, contract supervision and rural road construction project work. Kym has also lectured on bituminous road surfacings at the University of South Australia.

Kym Neaylon has joined Opus Research following seven years with the road and transport industry research organisation ARRB Group in Australia. Most recently Kym was National Technical Leader – Bituminous Materials with ARRB Group, and he earlier held the position of principal research engineer with the organisation. During that time he provided surfacings advisory expertise for clients throughout Australia, and technical support for a sprayed sealing practice review project in Ethiopia.

Between 2007 and 2014, Kym led Austroads research programmes into sprayed sealing and skid resistance initiatives. He is Chairman of the Australian Standards committee for 'bitumen and related materials for road making purposes', and he is currently leading the revision of the Australian Standard for bitumen.



In addition to his work commitments, Kym is completing a PhD part-time through the University of Swinburne in Melbourne. His research investigates the effects of heavy vehicles on sprayed seal design.

RECENT RADIO NEW ZEALAND NATIONAL INTERVIEWS WITH OPUS RESEARCH

If you missed them the first time, check out these recent interviews featuring some of our transportation research:

- Optimising rumble strips – Jared Thomas
<http://www.radionz.co.nz/national/programmes/ourchangingworld/audio/20152949/rumble-strips>

- Pavement research for better roads – Steve Bagshaw and Phil Herrington
<http://www.radionz.co.nz/national/programmes/ourchangingworld/audio/20152463/pavement-research-for-better-roads>

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