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WAKA KOTAHI

An artist's impression of how a slower-speed environment might look outside Warkworth School. Warkworth was one of three schools included in case studies in the full report. (Picture by Dale Projects)

Your views

NZTA research welcomes letters from readers. Letters should be addressed to:

The Editor, NZTA research
NZ Transport Agency
Private Bag 6995
Wellington 6141
New Zealand

www.nzta.govt.nz

Smarter school travel planning takes all factors into account

The benefits of improving school travel systems are manifold, but at present so are the barriers to their development and implementation.

A recent project has looked at the evidence supporting school travel systems, and developed a toolkit for developing plans and systems to suit individual schools. Part of a broader programme of research into school travel needs, the toolkit will be of use to school travel planners nationwide.

Both internationally and here in New Zealand there are issues associated with over-reliance on private vehicles to get children to school and back. Congestion around the school gates, rising obesity, and a reduction in children's road safety awareness and skills can all be linked back, at some level, to the daily commute by car.

Although encouraging results are beginning to filter through from initiatives such as walking school buses, planned safe routes to school, and various road safety education packages, there are still significant barriers to the effective implementation by schools of these, and other initiatives.

Hamish Mackie of TERNZ Transport Research explains, 'We identified what we term a "missing link" in these various initiatives to encourage more children to walk or cycle to school. This link is that there is no national-level strategy or policy that clearly sets out for schools what they should be aiming for in terms of travel outcomes for their school. There is also no guidance about what type of overall system is

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needed if schools are to achieve these outcomes. The result tends to be a fragmented approach to school travel needs, which lacks effectiveness.'

The research project aimed to address this, by first reviewing the evidence to support developing a systematic approach to school travel, and from that developing a comprehensive and user-friendly toolkit that schools could use to assess and address their own travel needs.

Hamish says, 'The international evidence provided clear support for using a system-centred approach. By considering school travel as a system, it becomes less likely that any elements of the system will be neglected or overlooked, and more likely that schools will develop comprehensive plans for addressing their travel needs.'

The international evidence also highlighted the importance of providing clear and detailed explanations for schools about why they need to focus on travel, and of backing those explanations up by specific design guidance on how transport systems around schools can be improved.

'We also consulted extensively with local school travel personnel, to get a clearer picture of the issues and themes that currently surround school travel planning in New Zealand,' says Hamish.

How the toolkit works

The research report sets out a school travel system toolkit that school travel planners can use to supplement and add coherency to their existing travel initiatives.

The toolkit includes a model of an overall school travel system. The elements that make up the system are broken down, so that each can be assessed to see if it needs work or is functioning well. Examples of elements within the system include favoured routes for walking and cycling to school, parental attitudes, existing initiatives, traffic speeds and volumes, road designs around the school, and on-site storage facilities, such as bike racks and sheds.

A simple 'traffic-light' method could be used to identify elements of the system that are working well/where more work might be done/where urgent attention is needed.

Elements within the system are afforded a 'traffic light' coding to show their status: red (dark grey in this example) means the element is high-priority (needs immediate attention); amber (mid grey) indicates it is operating reasonably well, but has some issues; and green means it is functioning well or is well provided for. There is also a neutral coding for elements that may not be able to be addressed in the circumstances of that particular school, for example, walking routes for schools located on high-speed rural roads.

Shared pathways through parks and reserves are important components of a school cycle network.

Each element that the school needs to consider is backed up in the toolkit by good-practice examples and links for accessing more information. Case studies show the toolkit in action at actual urban and rural schools.

A proposed 'status diagram' for defining a school travel system (example only).

Looking at the bigger picture

The toolkit and the project it has flowed out of are part of a broader research programme into school travel needs being carried out by TERNZ on behalf of the NZ Transport Agency and the Road Safety Trust. Other aspects of school travel that are, or have already been, looked at include the barriers that prevent or deter children from cycling to school, school bus signs and their efficacy, and a project that looks at the specific road safety needs of rural schools.

Hamish says, 'Overall, we felt that, although there are some great initiatives happening in some areas, wr strategic importance needs to be given to school travel and that this needs to be led at a government-level. The model and toolkit we've developed in our report are good starting points for putting in place a more comprehensive and user-friendly approach to school travel in New Zealand. However, there are specific areas where more research is needed if we are to develop meaningful guidance. In particular, children's routes to school need more attention to understand the safety and usability issues. For example, there is currently no single position on children cycling on footpaths. Consequently, children and other road users have mixed expectations and there are safety issues. High levels of perceived risk by parents related to school travel is another big problem, although many traffic environments make these perceptions understandable, even if actual school travel casualty statistics are relatively low.'

The strategic placement of bike racks at Kowhai Intermediate School in Auckland, outside the principal's office window, means there are never any problems with the bikes.

Good reasons for improving school travel systems

- There is tangible evidence of a relationship between school travel and congestion; less cars at the school gate means less delays. In New Zealand and overseas there is consistent evidence that 20 to 30% of all morning peak hour traffic congestion is related to school travel, which has significant economic implications.
- Countries with the best child road safety records also have a strong commitment to encouraging walking and cycling.
- There is growing evidence of a link between active transport and better health.
- Shifting to active transport may help address climate-change concerns.
- Improved school travel supports government policies around economic growth and productivity, including improving journey times, making better use of existing transport infrastructure, reducing deaths and injuries through road crashes, providing more transport choices, and reducing the adverse environmental effects of transport.

Contact for more information

Hamish Mackie
TERNZ Ltd
09 337 0542
h.mackie@ternz.co.nz

Improving school travel systems,
NZ Transport Agency research report 420

Freely available online at www.nzta.govt.nz/research/reports/420/index.html

Improving transport options for small towns

Shared transport, in its various forms, shows promising potential to expand the transport choices of people living in New Zealand's non-metropolitan areas.

The transport needs of people living in New Zealand's medium-sized and smaller cities and towns are very different from those living in the nation's larger metropolitan areas. Recent research, headed by Massey University, has sought to build a better understanding of these non-metropolitan transport needs, so that ways can be found to meet them.

Dr Christine Cheyne, from the Resource and Environmental Planning Programme at Massey University, says that in the past a lot of transport research and policy has focused on metropolitan areas (defined in the study as those local government areas that include one of the three main metropolitan cities, namely Wellington, Auckland and Christchurch). However, in New Zealand a significant proportion of the population live in minor urban areas, such as medium or small rural towns, and

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Demand-responsive community transport has proven effective and viable in Bristol in the UK.

there is evidence that, for various reasons such as lifestyle choices and affordability, this proportion is growing.

'Good access to transport is vital to the economic and social wellbeing of these communities, and the households and individuals within them,' says Christine. 'Transport increases people's employment choices, which in turn makes small towns more economically viable. It also increases leisure and social choices, and ease of access to health care, all of which influence where people chose to live.'

For many people, private transport is not option. This may be due to age (the elderly and young), disability, or affordability. In non-metropolitan areas, people without private transport tend to rely on friends and family to get them where they need to go, but if such assistance is not available they can experience severe transport disadvantage.

Christine says, 'Although public transport is recognised as a key component of an affordable, integrated, sustainable transport system, New Zealand's system is, and has historically been, characterised by dependence on private vehicles. This trend has been reinforced by relatively cheap fuel and car prices in past decades, and also to some extent by regional and national transport policy. However, as New Zealand's population ages and international uncertainty around fuel availability increases, viable alternatives to private transport become increasingly important.'

The study sought firstly to build an understanding of people's attitudes and behaviour in relation to shared and public transport in non-metropolitan regions. Three regions were selected – Taranaki, Manawatu–Whanganui, and Hawke's Bay – with the focus narrowed to travel between participants' home towns and their nearest main urban centre. International studies on shared transport were also looked at, to identify the potential for this type of transport to increase non-metropolitan residents' transport choices.

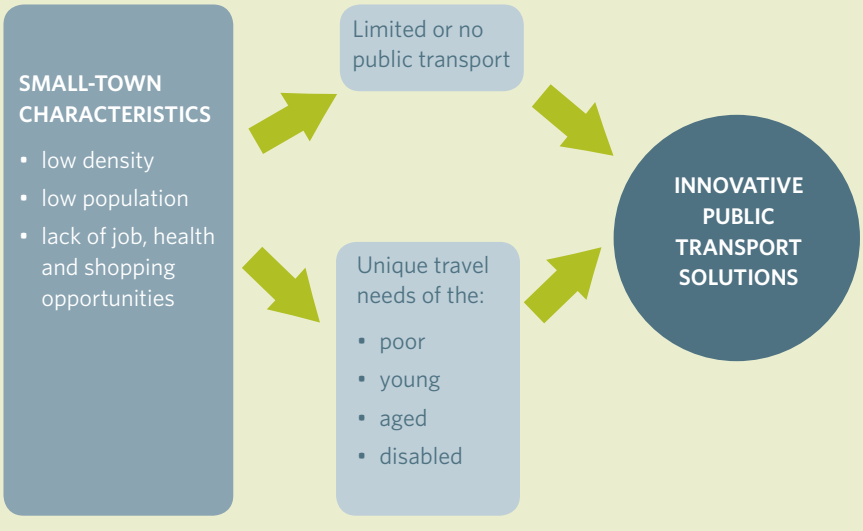
Christine says, 'We were particularly interested in ways to improve access to transport and overcome transport disadvantage that made use of existing infrastructure. This is in line with current government goals to provide more transport choices, lower transport costs, make best use of existing infrastructure, and ensure that land transport investment contributes to economic growth and productivity.

'Overseas, a form of shared transport called demand-responsive transport has successfully increased people's transport choices in low-population areas, and we found that there were considerable opportunities to adopt similar systems here. Not only would shared transport increase non-metropolitan residents' transport choices, but it would also lead to better land use and transport integration. More shared transport means less single-occupant trips, and fewer vehicles coming into large urban centres from surrounding areas. This would ease congestion and benefit the wider land transport system and economy, by making transport networks more effective and better value for money.'

The need for innovation

Providing travel options for socially disadvantaged people and areas has long been recognised as an objective of providing public transport and is a main rationale for government subsidies for these services.

Factors producing innovative public transport solutions



Innovative transport solutions

(adapted from Logan 2007, Raje and Brand 2003, and Currie and Gammie 2005, p54)

TRANSPORT SERVICE	DESCRIPTION	SERVICE EXAMPLES
Community transport services	Services provided by a (not-for-profit) community transport group, or other community group	• Community bus services (group, many-to-one) • Demand-responsive transport (DRT) • Community bus brokerage
Motor vehicle schemes	Schemes to assist with driver training and motor vehicle purchasing	• Car/moped grants/subsidy schemes • Improved training programmes and licence testing
Ride-sharing schemes	Schemes to enable people without motor vehicles to ride share with drivers	• Community car schemes/volunteer driving • Safety car scheme • Hitchhiker licensing and designated pickup points, driver/rider licensing • Police giving young people a ride home • Modify the post delivery bus to include seating for passengers[1]
Telematics	Use of information and communication technologies to inform and facilitate travel	• Internet-based booking system for on-demand transport • Demand-responsive bus schemes and car schemes
Transport subsidies and grants	Subsidies or grants provided for a range of travel options	• Subsidised taxi vouchers, driving lessons, public transport fares • Motorbike repair grants
Outreach	Bring more services to communities	• Mobile libraries and banks • Use of Internet and telephone for access to facilities

However, in lower density areas it can be difficult to make conventional services, such as buses, economically viable, even with subsidies. The problem becomes cyclical, as low-frequency and widely dispersed services lead to falls in patronage.

Innovative solutions are needed to meet the diverse public transport needs of New Zealand's small-town residents, and substantial research in Australia has looked at the various options.

Christine says, 'One of the solutions that showed the most promise from our research was demand-responsive services. Demand-responsive services can be flexible in terms of their route, vehicle allocation, operator, payment type and type of passengers they carry. As such, they fill the gaps between fixed-route services, totally on-demand services (such as taxis), and area-wide networks.

'The overseas research shows that they are particularly effective for connecting rural areas and small towns with employment, shops, and health services, making them a good option for the type of communities we were focusing on. Other options that featured highly were carpools and clubs, which residents often organise informally among themselves, but could potentially be set up more formally within communities.'

Overall the research showed that shifting from single-occupant to flexible and shared transport modes of transport would improve sustainability and result in more effective use of the transport network in non-metropolitan areas. A key principle for success was to recognise the mutual interdependence between provincial cities (and the services they contained) and their outlying smaller towns, then design and plan shared transport that catered to the characteristic travel patterns of that region. In many New Zealand regions, linear groups of settlements outside provincial centres meant that there was good scope for organising shared transport effectively, bringing benefits for both small-town residents and the larger centres.

[1] Post minibuses operate in many rural areas of the UK, taking the mail to rural areas in the same way as New Zealand Post's rural delivery mail service. The minibuses travel to places that regular transport services would not reach, but operate on very limited timetables (Currie and Gammie 2005, p58).

Contact for more information

Dr Christine Cheyne
Massey University
06 356 9099 (ext 2816)
c.m.cheyne@massey.ac.nz

Attitudes and behaviour in relation to public transport in New Zealand's non-metropolitan regions,
NZ Transport Agency research report 419
Freely available online at www.nzta.govt.nz/research/reports/419/index.html

Pavements' performance challenges prediction

Providing objective data about the probability of failure for various pavement construction methods will back up guidelines for calculating failure risk in the Austroads pavement design guide.

A NZ Transport Agency-funded research project has looked in depth at the pavement lives in four areas of New Zealand's state highway network. Taking into account all the variables and unknowns related to pavement design, the project looked at how these factors combined to influence how the pavements actually performed.

John Patrick of Opus Central Laboratories says, 'What we found is that although the 5% risk of a pavement not achieving its design life, given in the Austroads guide, appears to be correct, this is not for the expected reasons. By looking at the actual maintenance and failure data for roads, we were able to add some robustness to statistical methods for estimating the risk and reliability of the various pavement designs.'

A question of risk

The project looked at the long-term performance and probability of early failure (within the first few years) of granular, bound and structural asphalt pavements.

Data from the RAAM Database for three areas of the state highway network was initially looked at – Napier/Gisborne, West Wanganui and Southland. Data from the Auckland region was subsequently added to provide information about structural asphalt pavements (which were scarce in the other regions) and higher traffic volume roads. Data about maintenance costs from 2002 to 2005, and pavement condition in 2005, for each of the four areas (relating to over 4500 road sections in total) was extracted, combined and analysed.

Road pavements in New Zealand are currently designed in accordance with Austroads' *Pavement design: A guide to the structural design of road pavements* (2004). This guide, and earlier pavement design manuals, all use a pavement design system based on the elastic layer theory. The elastic layer theory assumes that a pavement's life is determined by a combination of the traffic loading it is subject to, and the compressive strain on the top of its subgrade and/or the tensile strain at the bottom of its bound layer.

Figure 1: Pavement deterioration model

John says, 'The risk in pavement design is that a pavement's actual life will be materially shorter than its design life. The Austroads guide contains a methodology for allocating probabilities of failure to different types of pavement construction, which pavement designers can use to work out which type of pavement is most appropriate and cost-effective for their area. On state highways a failure probability of 5% is usually used.'

Reasons that a pavement might fail prematurely include:

- inappropriate assumptions about a material's properties
- errors in the design methodology
- inadequate pavement materials
- inadequate pavement construction
- underestimations of traffic volumes and loadings
- inadequate maintenance.

John says, 'Although a theoretical analysis of the variables can be performed, the final proof of the design has to be in the pavement's actual performance. This is what the current project was focused on – getting hard data upon which to base calculations of failure risk. We concentrated in particular on thin-surfaced granular pavements, as these make up over 95% of our state highway network.'

Focus on actual performance

In the research, pavement performance was analysed in terms of the pavement's age, rather than its traffic volume or load.

John explains, 'All of the roads included in the study had a design life of 25 years, so the expectation was that, as the pavements aged, their probability of failure increased. The pavement design methodology modifies the pavement structure depending on the traffic level and, in this way changes in traffic volume are included

in the design. By analysing the pavements' performances in terms of their age, we could draw a direct comparison between that performance and their design life.'

Rut depths and roughness for all of the networks were analysed but, contrary to expectations, none of the networks showed a strong correlation between their age and the degree of rutting or roughness.

John says, 'Those expectations derived from the assumptions behind the design methodology in the Austroads guide, but what we found is that those assumptions are not being borne out in the field. We also found that, although the design life of a typical granular pavement is 25 years, the evidence is that they last much longer, more in the range of 50 years, which is 200% of their design lives.'

Potential reasons for this, discussed in the research report, include the maintenance programmes for minor rutting and roughness that are routinely carried out on New Zealand roads.

'These counteract the classic deterioration patterns,' says John, 'which has the overall effect of extending the pavement's life.'

The traditional idea of a pavement gradually changing in shape over its design life is shown in figure 1. The research suggests that the pattern would be similar to the 'proposed' curve in the figure, where the intervention in resealing and associated pavement repairs approximately every 10 years would result in the pavement never reaching the extreme of roughness or rutting assumed in the design methodology.

However, despite the erroneous assumption about why pavements fail (ie due to rutting or roughness), the research found that the 5% probability of a pavement not achieving its design life, proposed in the Austroads guide, is in fact correct.

'So although the reason for early failure is not correct, the approximate figure is,' says John. 'We found that thin-surfaced granular pavements have a bimodal distribution of life. This means that the first peak of failure typically happens early on, in the first few years of life when shearing or potholing can occur, but after that, the pavements tend to settle down.

'From the data we analysed we found that around 6% of pavements needed significant repairs within the first four years after construction. The size of this early peak failure is likely to be even higher for pavements with high traffic volumes, but more research is needed before we can determine this with any accuracy.'

Contact for more information

John Patrick
Opus Central Laboratories
04 587 0660
john.patrick@opus.co.nz

Failure probability of New Zealand pavements, NZ Transport Agency research report 421 Freely available online at www.nzta.govt.nz/research/reports/421/index.html

What's in a life?

In practice, the end of a pavement's life can be hard to define.

Characteristics that might typically show that a pavement is nearing the end of its life include:

- rutting levels of around 20mm or more
- roughness levels of around 120–150 NAASRA (National Association of Australian State Road Authorities) or more
- fatigue cracking
- higher than average maintenance costs.

However, rutting and roughness can be, and are, addressed through regular maintenance, giving a pavement a new lease of life.

In addition, decisions to replace rather than maintain existing pavements are typically based upon the net present value of carrying out future maintenance (ie where it becomes more cost-effective to replace rather than fix a pavement it can be considered to have reached the end of its life, even if maintenance could effectively extend that life).

Measuring the wave of a rough ride

A project to find alternative ways to measure roughness deterioration in road pavements has returned promising results for using wavelet analysis to understand why pavements fail.

Road roughness affects road users on a daily basis. It influences drivers' perceptions about the condition of the road, and affects vehicle safety, comfort, speed and operating costs. As a result, roughness is one of the main performance indicators of road condition for road engineers and asset managers, and one of the major triggers for pavement maintenance and rehabilitation.

Yet despite this, a comprehensive understanding of the factors that influence roughness and pavement deterioration has not yet been developed in New Zealand.

Bryce Tinkler, formerly of Pavement Management Services Ltd, led a recent research project to address this gap. He says, 'In New Zealand we're lucky to have access to the data from the long-term pavement performance programme, which has been collecting pavement condition data about state highways since 2001. Although the data has already been used to create pavement deterioration models, this analysis can also be used to refine roughness models.

'At present, road roughness deterioration modelling tends to focus on predicting roughness in terms of the International Roughness Index. This has its limitations, mainly because the index is a summary of what a driver feels when driving on a particular pavement. In the mid-1980s the index was based on vehicle technology and hence driver experience, which is vastly different to how modern vehicles feel and operate. Also, because it relies on vehicle response, the index overlooked many of the other factors that make up the roughness profile of a pavement. So while the index might give an indication of a pavement's perceived roughness, it doesn't actually effectively measure how road profiles change over time.'

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The research project used wavelet analysis to analyse the characteristics of the longitudinal profile of road surfaces. Using longitudinal profile data collected from the long-term pavement performance programme over the past eight years, the project team processed it using wavelet decomposition. This involved splitting the longitudinal profiles of the various pavements' sections into a number of wavebands, and then calculating the relative energy within each waveband.

Bryce explains, 'Changes in a pavement's roughness result from a number of distress mechanisms, and this is evidenced in the various modes of deterioration. In general, short wavelength roughness is associated with degradation of the surface or base layer, while long wavelength roughness is often related to deformations or displacements in the subgrade. It follows that, because different types of roughness are associated with different wavelengths, breaking the roughness profile of a pavement down into individual sub-bands of wavelength can help us interpret how and why the pavement is deteriorating.'

The project aimed to use its analysis of pavements' longitudinal profiles to develop a method to calculate roughness deterioration. This method could then be used to work out how much of a particular pavement's roughness could be attributed to factors such as its type, traffic loading, environment and maintenance regime.

Bryce says, 'The objective then became to take the first steps towards developing a model that would predict road deterioration through roughness over time. We feel we've developed a good basis for this.

'Although the research highlighted several issues that need more investigation, the results showed that wavelet analysis will be useful to provide additional information about the deterioration process in pavements. We recommend that the approach should start being trialled on networks as soon as possible to test whether it is feasible to collect and store the necessary data. Once we know this, we can begin to develop a framework for performance reporting, based on wavelength analysis.'

How the research was done

The project developed a procedure to analyse pavement profiles using wavelet analysis of the longitudinal profile data collected on 146 New Zealand calibration sites.

Each pavement profile was analysed and the energy content was spilt into six different wave bands (0.5–1m, 1–2m, 2–4m, 4–8m, 8–16m, and 16–32m). The relative energy within each wave band was calculated for each year of data and trends in the change of energy from year to year and site to site were recorded.

The results obtained were statistically analysed to highlight trends and identify failure modes. A separate review of the physical deterioration – the observed deterioration characteristics noted over the past six to eight years – was also undertaken and these observations were analysed in tandem with, and compared to, the results obtained from the wavelet analysis.

Contact for more information

Diana Scruby
Pavement Management Services Ltd
07 847 0499
dscruby@fugropms.co.nz

Identifying pavement deterioration by enhancing the definition of road roughness,
NZ Transport Agency research report 430
Freely available online at www.nzta.govt.nz/research/reports/430/index.html

Building a national view of travel

A study into the feasibility of developing a national trip-end model for longer-distance New Zealand surface travel has found that, although there is already some data and regional models available, more work is needed before a full national model can be created.

Although New Zealand currently has several transport models for its larger urban areas, these models were developed in isolation from each other and there are difficulties in combining the information from them. For the rest of New Zealand, the information available on travel behaviour is relatively limited. To this end, the feasibility of developing a national trip-end model was the subject of a recent research project and report, which looked at the models and data we already have, and how these might be used and what else might be needed if we are to develop a national model.

A national trip-end model would allow transport issues relating to longer-distance surface travel to be debated and analysed in a more robust and consistent way at a New Zealand-wide level.

Russell Jones of Prism Consulting, who was part of the project team, explains that, 'We were looking at what would be required to create a model that allows travel to be modelled and considered from a national perspective.'

Modelling approaches

The project found that the four-stage model – traditionally used in New Zealand urban areas – has been widely used for modelling travel in larger areas overseas.

Russell says, 'Although there are limitations to this model, the advantages of the four-stage model are that there are already proven software and robust algorithms to support this form of modelling. The disadvantage is that it can be overly complex, leading to excessive data requirements, when applied to non-urban areas.'

In the first stage of the four-stage model, demographic and economic variables are used to generate trips originating and terminating in each zone. This involves

obtaining current data and projecting future numbers of people living and working in the zone, along with other variables, such as real GDP and tourism numbers.

In the next stage, these trip ends are tied together, resulting in a trip (or origin–destination) matrix. In the third stage, each trip is allocated to a transport mode, such as bus, car or train, with the final stage being trip assignment, where the trips are assigned to each network.

Russell says, 'We excluded the fourth assignment stage for longer-distance travel in NZ as there is usually only one route, making this step largely redundant. We also looked in-depth at national and state transport models and techniques that have been used overseas to see how these might inform the development of our own model. During our review we concluded that while there are some special New Zealand issues, such as there being two islands and mountainous terrain, suitable methods exist to deal with these issues.'

Data sources

The only New Zealand-based national model currently available is the Ministry of Tourism's tourism flow model, which provides projections of future travel by domestic and international tourists. The model covers the majority of overnight trips taken in New Zealand, whether by locals or tourists, as well as day trips by New Zealand residents that are longer than 40km.

Other possible sources of data include the ongoing New Zealand Household Travel Survey (which looks at the travel habits of 4600 households over a couple of days every year), and data generated by a number of regional and urban models that either have been, or are in the process of being, developed.

Russell says, 'None of these models or sources provides enough, or consistent enough, information to inform a national model. But any expanded programme to collect national data would be a major and costly undertaking.'

With this in mind, the report recommends a simplified approach for some less-populated areas of New Zealand, with more complex modelling around major urban centres.

Russell says, 'The strength of a modelling approach is that it makes explicit those factors that influence travel growth or change, such as population, employment patterns and impedance of travel. While population growth and changes to the road network are anticipated in certain areas of the country, especially in the upper North Island, in other areas fewer changes are anticipated.

'This might enable us to apply a more limited model to those parts of the country where travel will remain more predictable, which will dramatically reduce the data requirements for the model.'

For the more complex areas, such as around Auckland, Hamilton, and Tauranga, there are already regional models in place that can provide a wealth of trip data.

'A first step towards a national model might therefore be to build a model of vehicle travel in the upper North Island,' says Russell. 'The data surveys needed would be much less than for the whole country, and the model would have its own significance given the economic importance of this area. Once it is in place, we could look at extending a less complex model to other areas, which would give us the bigger nationwide picture for strategic planning purposes.'

Contact for more information

Russell Jones
Prism Consulting
09 575 9788 or 021 180 5544
russell@prismconsult.biz

Feasibility study of a national trip-end model for New Zealand,
NZ Transport Agency research report 413
Freely available online at www.nzta.govt.nz/research/reports/413/index.html

New research publications

Integrated transport and land use: Sylvia Park as a case study

Research report 444

Stuart Donovan, Jenson Varghese, Bonnie Parfitt, Mark Huggins, Neil Mumby

McCormick Rankin Cagney

Freely available online at www.nzta.govt.nz/research/reports/444/index.html

Strategic government documents emphasise the need for more integrated land use and transport planning. This study, undertaken in 2009–2011, considers the Sylvia Park retail centre in Auckland, New Zealand, as a case study of more integrated land use and transport policies. Our analysis of the costs and revenues associated with different transport modes suggests that Sylvia Park is likely to benefit from better integration of walking and cycling facilities, and improved bus services. This analysis indicates that improving alternative modes and more efficient parking management may deliver financial benefits to the retail centre, as well as economic benefits to wider society. To support more integrated outcomes, four key recommended priorities for regulatory reform are identified:

- manage the location of major developments
- remove minimum parking requirements
- levy development contributions using shadow tolls
- replace transport rates with an annual parking levy.

The thrust of these recommendations is to reduce upfront capital costs and risks for the private sector while providing ongoing incentives for managing travel demands. Together, these recommendations are expected to improve the alignment between private and public sector interests greatly, thereby contributing to more integrated transport and land use outcomes.

Investigating the contribution of sealing chip application rates to the early failure of chipseals

Research report 445

J C Waters

Fulton Hogan Ltd

Freely available online at www.nzta.govt.nz/research

Chipsealing is the predominant resurfacing used on the state highway network in New Zealand. An important component of chipseals is the sealing chip layer that is applied to protect the binder layer and provide surface texture and surface friction. There are a number of specifications written to ensure that the sealing chip used is the correct size and shape, and that it has the appropriate 'polished stone value' (PSV), but no specifications on chip application rates exist. Early-life failures of chipseals are generally attributed to the binder, the binder application rate, or the weather; however, the sealing chip application rate may also contribute significantly to these early failures.

The objectives of this research, which was carried out between July 2006 and December 2009, were as follows:

1. To determine the effect of variations in chip application rate by constructing several seals with varied chip application rates, and monitoring the performance of the seals for two years.
2. To assess the effect of the time of sealing (in terms of season and weather) with chip application rates and the success rate of the chipseals.
3. To develop a pictorial and quantitative guideline for the correct application rate for sealing chip in New Zealand.

This report documents the performance, over the first two years after construction, of chipseals that were constructed using different chip application rates.

The influence of binder rise in reducing tyre–road friction

Research report 447

R J Henderson, P D Cenek, N J Jamieson

Opus Central Laboratories

D J Wilson

Department of Civil and Environmental Engineering, University of Auckland

Freely available online at www.nzta.govt.nz/research

This research examined the influence of binder rise in reducing tyre–road friction of chipseal surfaces. The emphasis was on the most extreme form of binder rise when the binder is level or above the sealing chip resulting in the formation of a black, slick surface. This condition is referred to as flushing.

The research involved performing texture profile and friction measurements on chipseal surfaced public roads. Both locked-wheel braking with an instrumented vehicle and the dynamic friction tester were employed for the friction measurements.

The key finding was that the presence of flushing in chipseal surfaces reduced tyre–road friction by about 20% to 25% under both wet and dry conditions. Therefore, a robust means of identifying the presence, degree and extent of binder rise in chipseal road surfaces will be beneficial in improving the safety management of road networks. A secondary finding was that attempts to identify binder rise from texture-based statistics derived from two-dimensional road surface profiles are unlikely to be successful even for the flushing condition unless complemented with other information such as skid resistance or surface reflectance.

The following research publication was notified in issue 12, June 2011 of NZTA research. There has been an amendment to the last paragraph of the abstract to correctly list the five predictor variables.

Next generation of rural roads crash prediction models – pilot study

Research report 437

S Turner and R Singh, Beca Infrastructure Ltd, Christchurch

F Tate, MWH New Zealand Ltd, Wellington

Freely available online at www.nzta.govt.nz/resources/research/reports/437/index.html

The majority of fatal and serious crashes in New Zealand occur on rural two-lane roads. Data on historic crash patterns is not always sufficient to enable a suitable diagnosis of the safety deficiencies of various sections of this rural road network. It also cannot readily identify safety issues on low-volume roads and shorter sections of highway, where the relative scarcity of crashes may mask the considerable potential for safety improvements.

This pilot study covers the second stage of a three-stage research project that aims to quantify the impact of all key road features on the safety of two-lane rural roads. This stage of the study involved the collection of road alignment, roadside environment, traffic flow, and crash data for 200 sections of rural road, each one 400m long, throughout the Waikato region of New Zealand. The data was used to develop preliminary crash prediction models for two-lane rural roads, using generalised linear regression model techniques developed by Beca.

The data collection exercise covered a total of 28 predictor variables used for developing the preliminary model. The preferred model showed that the crash rate was most influenced by five predictor variables – namely, traffic volume, absolute gradient, distance to non-traversable hazards, skid resistance (SCRIM)*, and percentage reduction in the curve-negotiation speed of the section as compared with the preceding 500m section.

* Sideways-force coefficient routine investigation machine.

The following research publication was notified in issue 10, December 2010, of NZTA Research. The name of the principal author, FW Hill, GHD Ltd, Auckland, was inadvertently excluded. The corrected notification is as follows:

Case studies and best-practice guidelines for risk management on road networks

Research report 415

FW Hill, GHD Limited, Auckland

TFP Henning, University of Auckland, Auckland

B Smith, Brian Smith Advisory Services, Christchurch

K Dever-Tod, National Asset Management Steering (NAMS) Group, Wellington

Freely available online at www.nzta.govt.nz/resources/research/reports/415/index.html

The requirements of the 2002 Local Government Act have led to a greater emphasis on local authorities having a holistic approach to risk management. However, it is widely considered that compared with other disciplines, the practical application of risk management is still lacking in the area of transportation.

This research project aimed to establish a comprehensive yet simple best-practice guideline for risk management in the transport area. This was achieved through a literature review and a pilot study across nine representative transport authorities throughout New Zealand in November 2008. These guidelines provide the minimum requirements of an integrated risk framework, and also describe in detail ways to overcome some practical obstacles to the effective use of the risk management process.

Links to NZTA Research Reports

Here is a quick way to find a research report on the NZTA website, if you already know the report number. Just insert the 3 digit report number in place of ### in the following link www.nzta.govt.nz/resources/research/reports/###/index.html. You will be taken straight to the report!

Supplementary issues of the *NZTA research* newsletter

The significant number of research reports recently published has resulted in the need for supplementary issues of *NZTA research*. Supplementary issues were published in May and August 2011. There will be a third supplementary issue published in November 2011.

The supplementary issues are being published in addition to the regular quarterly publication of *NZTA research*.

The NZTA has a number of other publications you might be interested in.

The NZTA's quarterly newsletter *Pathways* keeps the transport sector up to date with what we are doing.

NZTA Connect provides a snapshot of the NZTA's projects and initiatives that are relevant to the work approved organisations are doing in the area of land transport in New Zealand.

Exchange is the Public Transport Leadership Forum's quarterly e-newsletter. It informs transport sector leaders and rail, bus and ferry operators across New Zealand about the forum's vision, synergies, and planned initiatives to improve the effectiveness of public transport in New Zealand.

For more information about these newsletters go to www.nzta.govt.nz/about/newsletters/index.html

NZTA research

NZTA contacts

Karen Johnson
Nigel Curran
Patricia McAloon

For any enquiries, email research@nzta.govt.nz.

NZTA research is published quarterly by the NZ Transport Agency. Its purpose is to report the results of research funded through the NZTA's Research Programme, to act as a forum for passing on national and international information, and to aid collaboration between all those involved. For information about the NZTA's Research Programme, see www.nzta.govt.nz/resources/research/index.html.

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