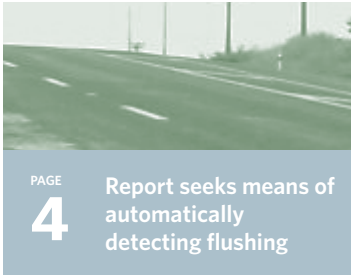




Method keeps tabs on projects' wider impacts



PAGE 4 Report seeks means of automatically detecting flushing



PAGE 5 Cycling infrastructure to attract new cyclists



PAGE 7 Reducing pedestrian delays at urban intersections



PAGE 9 Relationship between chipsealing rates and early pavement failure

A project to develop a method to assess the wider economic impacts of transport projects uses one of New Zealand's largest ever infrastructure projects - the additional Waitemata Harbour crossing - as a case study.

The ability to accurately assess the economic impact of a proposed transport investment is crucial when deciding whether a given project will go ahead. Economic impacts are also used to prioritise funding between different projects, and to retrospectively analyse whether investments have been a good use of public money.

In New Zealand, economic efficiency is one of the three assessment factors that the NZTA uses when assessing whether submitted projects will be funded. The NZTA's approach is described in its *Economic evaluation manual* (2010).

In assessing economic efficiency, a cost-benefit analysis framework is used where a project's impacts, both positive and negative, are converted into monetary units, then summed to provide an estimate of the total value of a project to society. The approach focuses on savings in travel time, operating costs, crash costs and other peripheral benefits.

In 2010 the NZTA commissioned Steer Davies Gleave to develop an appraisal methodology that would capture the wider economic impacts of a project - that is, impacts that are additional to the benefits already captured by the standard appraisal approach.

What is meant by wider economic impacts?

There is no standard definition of economic impacts. Some definitions take it to mean impacts on gross value added or productivity, others as impacts on jobs or employment, and yet others as all impacts that have an economic value.

The current study was primarily interested in impacts on traded sectors, such as productivity gains or expansion in employment. It took a narrow view of economic impacts, excluding any non-market effects even though these may have value to individuals, and concerned itself mainly with long-term equilibrium economic impacts and not short-term effects. (The latter was considered appropriate given the typically long timeframe of transport assessments.)

Direct economic impacts, such as those felt by providers and users of the transport system, are nearly always captured in transport appraisals. The project was intent on capturing the additional, indirect impacts of transport on the economy outside of the transport sector. These impacts are additional to, or in some cases a consequence of, the direct impacts, and can include:

- economies of scale (created by encouraging greater concentration – agglomeration – or specialisation of economic activity)
- mitigation of market failures (through improved access and cross-trade between markets)

- increased output in imperfectly competitive markets (that diminish or augment the cost of persistent externalities)
- increased transfer of knowledge (and other interactions) between economic actors.

Incorporating wider economic impacts

Being able to quantify wider economic impacts enables business case reviewers to form better views about the effect of transport projects.

For larger infrastructure projects, the wider impacts are likely to be substantial – a host of examples from the UK show that wider economic benefits can represent anything from 5% to 56% of the standard economic benefits used to assess projects. When this additional benefit is added to the cost-benefit equation it can influence the overall economic viability and appeal of projects.

The current research used an international literature review to establish an approach for introducing wider economic impacts into New Zealand transport project appraisals. An incremental assessment

framework, developed and used in the UK, was selected as the best option, with stage 2 of the project tailoring this to the New Zealand economic context and its existing appraisal framework.

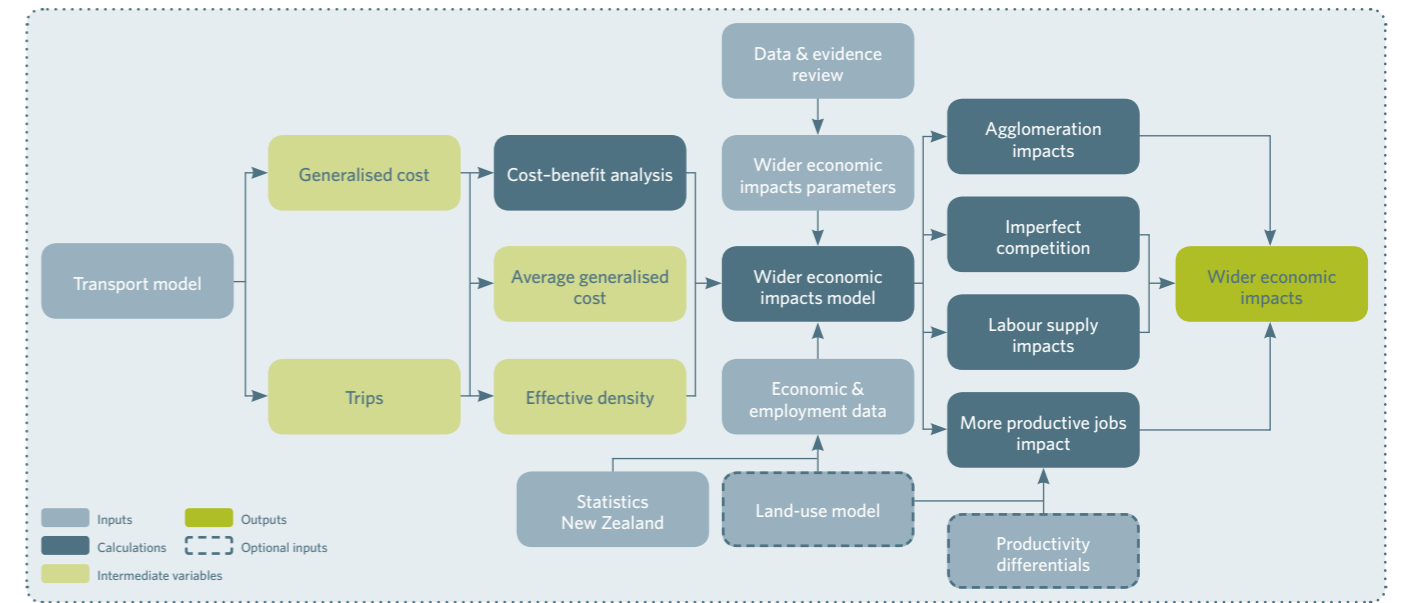
Five main impacts, additional to those included in the current appraisal approach, were assessed:

- agglomeration benefits
- imperfect competition benefits
- increased competition benefits
- labour supply benefits
- job relocation impacts.

The project then derived parameter values for these impacts, to be used in the wider economic impacts estimation methodology developed through the research. The research report includes a full discussion of each of the impacts and the assigned values.

The wider economic impacts estimation methodology created by the project is designed to use standard transport models and economic data. It requires multiple calculations based on the key parameters and inputs. The diagram on the next page provides an overview of the calculation process.

Wider economic impacts model overview



The final stage of the project demonstrated the methodology by applying it to an actual transport project – the additional Waitemata Harbour crossing.

Overall, the wider economic impacts of the additional crossing are expected to uplift the standard cost-benefit analysis of the project by one-third (33.1% or \$106.6m). The table below shows these impacts for each year modelled in the research and across the project's full 30-year appraisal period.

Wider economic impacts summary table (\$m)

	User benefits ¹	Agglomeration	Labour supply	Imperfect competition	Total WEI	WEI uprate %
2026	83.8	18.1	4.4	2.6	25.2	30.0%
2041	127.6	28.4	9.2	5.5	43.1	33.8%
NPV ²	322.4	72.0	21.7	13.0	106.6	33.1%

¹ A discrepancy from the reported benefit in the business case for the additional Waitemata Harbour crossing of \$329m occurs because of averaging errors.
² Net Present Value.

Results of note include significant agglomeration benefits for the North Shore, Rodney, Waitakere and the Auckland central business district in terms of reducing the cost of business interactions and increasing employee productivity. The North Shore will also experience substantial labour market impacts, as a result of more new workers entering the labour force in response to reduced commuting costs, with a flow-on increase in the local tax income base.

Not surprisingly, the greatest impacts will be felt in the areas of high population and employment density close to the new crossing. However, being able to calculate the project's wider economic impacts means that positive impacts from the crossing can be demonstrated much further afield. Positive impacts are estimated for all areas of Auckland, including the more distant, rural areas, where relatively small, but ongoing, positive impacts are anticipated.

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Wider economic impacts of transport investment in New Zealand, NZ Transport Agency research report 448
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Report seeks means of automatically detecting flushing

An on-road measurement programme found that the tyre-road friction of chipseal road surfaces can be reduced by around one-quarter in both wet and dry conditions by the presence of binder rise.

The safety implications for New Zealand's roads are obvious, but what is not so clear is the best way to detect binder rise and quantify its degree and extent.

The research, carried out by a team from Opus Central Laboratories and the Department of Civil and Environmental Engineering at the University of Auckland, focused on the most extreme form of binder rise, when the binder is level with or above the sealing chip. This condition is commonly known as flushing. The visual effect when binder rises to this extent is to create a slick black surface on the road.



The question to be investigated was what effect this degree of binder rise has on the tyre-road friction of chipseal surfaces. The team attempted to answer it by using surface texture profiling (using two-dimensional road surface profiles measured with lasers) and two sets of friction measurements (using locked-wheel-braking with an instrumented vehicle and a dynamic friction tester) on public roads. Tests were also performed on the Manfeild race circuit to find out if the two different methods of measuring friction agree with each other. The race circuit's asphaltic concrete surface has a macrotexture level that is comparable with a flushed chipseal surface.

Chipseal-surfaced sections of the Northland state highway network were also used for a statistical study on how to best detect flushing. Ten metre sections were visually ranked according to the extent that they could be seen to be displaying signs of flushing. Their texture profile was then measured using the laser profilometer and five different statistics calculated – mean profile depth (MPD), MPD based on a shortened 25mm segment length (MPD25), peak count (Pc), material/bearing ratio (RMR), and the difference between MPD and MPD25 (MPD – MPD25).

The statistics were compared with the visual ratings of flushing. The aim was to assess which of the statistics was the most suitable to be used as an indicator of flushing, and to set threshold values for each statistic that would show when flushing had occurred.

The three statistics that gave the best results were MPD – MPD25, MPD and RMR. However, although MPD is already routinely used for this purpose, it only detected half of the road segments that could be seen to be badly flushed, casting doubt on its usefulness as an identifying statistic.

The team's conclusion was that texture-based profiling, on its own, was unlikely to be sufficiently accurate as a way of detecting and predicting flushing. Other information, such as skid resistance and surface reflectance, would be needed to complement the profile measurements.

Both sets of friction tests carried out on public roads confirmed that flushing reduces the skid-resistance of chipseal surfaces. In particular:

- the skid resistance of a flushed chipseal surface reduces by 0.1 units (measured

on the dynamic friction tester) at 40km/h in wet conditions, compared with when the surface is not flushed

- when braking at 30km/h, deceleration on a wet flushed chipseal surface is 0.08g less than on the same surface when it is not flushed
- skid resistance is consistently less on dry chipseal surfaces when they are flushed, compared with the same surface not flushed.

Given the substantial impact that flushing can have on reducing road friction (and hence skid-resistance), the research concluded that it was important that further research effort should be put into identifying an automatic means of detecting flushing, and the extent of flushing, on New Zealand's state highway network. Additional work was also needed to determine whether the main way that flushing reduced the skid-resistance of a surface was by masking its microtexture or the loss of its macrotexture.

Another conclusion was that the dynamic friction tester held considerable promise as a means of measuring the skid resistance of roads in situ. Further tests are needed, however, to establish the tester's sensitivity to road surface macrotexture and surface type.

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The influence of binder rise in reducing tyre-road friction, NZ Transport Agency research report 447
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Reasons to cycle (or not)

What keeps non-cyclists off their bikes? What barriers do they see to cycling, and what facilities could be provided to overcome them? These and other questions were asked by a team from the University of Canterbury looking into ways to attract new cyclists to 'utilitarian' cycling.

Utilitarian, or utility cycling, is where people use a bike for their day-to-day travel, including for travelling to work or study. Distinguished from recreational cycling, utilitarian cycling has declined in many countries in the past half-decade, reflecting the ascendancy of the private motor car as the favoured mode of transport.

But with the environmental, health, time and economic benefits of cycling now widely understood and accepted, both central and local governments in New Zealand are looking to reverse the trend and encourage utilitarian cycling as a means of getting around.

They face a big job, however. Cycling is currently only a minor transport mode in New Zealand: at the 2006 census, only 2.5% of workers cycled to work. Recent research from the University of Canterbury has looked at why this is the case, asking who is and isn't cycling, what motivates or prevents each group, and what facilities could be provided to encourage people to get on their bikes.

The research

The primary aim of the research was to identify the type of cycling infrastructure that would encourage new cyclists to use cycling as transport for their daily activities.

Cycling infrastructure referred to any physical street facilities that assisted cycling, such as cycle lanes and paths, signals and dedicated waiting areas at signals, but not to other related infrastructure such as parking, storage or changing facilities. New cyclists were defined as people who either did not cycle at all, or did cycle but not for utilitarian trips.

Professor Simon Kingham of the Department of Geography at the University of Canterbury says, 'We knew we were exploring fertile ground, because in New Zealand nearly half of all simple work commutes are under 10km in length, while research overseas has shown that trips of anything up to 8 to 10km are generally



perceived as a reasonable distance to cycle. There is also evidence from a couple of studies undertaken here that a large segment of the population that is not currently cycling is either keen, or at least willing, to take it up.'

Identifying people who were potentially interested in cycling was an important first step for the research, as was exploring the various motivations for, and barriers to, cycling.

Simon says, 'It is important to remember that there will always be a section of the population who simply do not wish to cycle. Previous research has suggested that in New Zealand this could be as high as 41%. These are people who would never cycle, even if the conditions were favourable.'

Factors affecting people's decision to cycle are multitudinous and diverse, traversing concerns about the weather and the type of attire required to cycle, to a like or dislike of physical exertion and helmets.

The most significant factors to emerge, however, were safety, fear of cycling, and the type of cycling infrastructure available. It was these that formed the basis for the questions used in the research survey and focus groups.

Simon says, 'Overall, the questionnaires and focus groups showed that safety was the most significant issue for potential cyclists, particularly in relation to vehicle driver behaviour and traffic volume. However, other issues were also significant, including enjoyment and the perception that vehicle drivers are not courteous, both of which can be related to safety, as well as having suitable facilities at destinations for showering and changing.'

Focus group participants were shown images and plans of a variety of cycling infrastructure (subdivided into groups of mid-block, signalised intersection, and roundabout infrastructure) and asked to rate them according to how comfortable they would be cycling on infrastructure of that type during peak-hour traffic.

The preferred infrastructure that emerged was a comprehensive, consistent network of cycle-only paths that were clearly separated from motor vehicles. Throughout the research, participants were clear that some degree of separation from the traffic was safer than no separation, so that even well-delineated cycle lanes would provide a sufficient degree of comfort for a number of potential cyclists.

continued on page 6

Participants were also clear that, alongside consistent infrastructure, education for both motor vehicle drivers and cyclists on how to safely use it would be needed to encourage more people to cycle.

Another interesting finding to emerge was that, contrary to expectations, some cyclists did not cycle because trips weren't long enough.

Simon explains, 'For experienced recreational cyclists, trips, particularly to work and back, weren't long enough. Riders felt they were too short to get much fitness or training benefit out of them, and did not justify the effort of changing clothes, showering and preparing and storing their cycling gear. This was an interesting concept, contrary to what we had assumed, and requires further thought - how we could develop or promote commuting trips as training rides.'



Recommendations to promote utilitarian cycling in New Zealand

- We should invest in cycling facilities throughout the country. Facilities should be chosen based on best-practice guidance and practical considerations.
- Infrastructure that separates cyclists from the traffic is a good idea, with extra safety details at intersections and driveways.
- We should trial a wide variety of cycling infrastructure, and monitor each type's actual safety record (as well as user understanding and attitudes to them).
- We should implement consistent infrastructure for cyclists at intersections (so everyone knows what to expect and do).
- We should improve cycling infrastructure signs and markings, and teach all road users how to best use the infrastructure.
- We should implement more low-speed zones and cycle-friendly traffic management infrastructure country-wide, to make New Zealanders more familiar with them.
- We should improve the continuity and understanding of existing cycle facilities.
- More research is needed on the relationship between the availability of company vehicles and the uptake of utilitarian cycling.
- Practitioners should consider the health benefits of cycling, as well as its safety implications, when planning and designing cycling infrastructure.

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Assessment of the type of cycling infrastructure required to attract new cyclists, NZ Transport Agency research report 449

Freely available online at www.nzta.govt.nz/resources/research/reports/449/index.html



No time to wait: reducing pedestrian delays at urban traffic signals

Traditional approaches to road management, especially when planning changes for traffic signals and other aspects of the road network, have focused on improving vehicle carrying capacity and speed. This emphasis will have to change though, if we are to make urban areas more pedestrian friendly.

Research by Beca Infrastructure has taken a step in the right direction by developing mechanisms to reduce pedestrian delays at traffic signals in central city areas.

The research, carried out between 2007 and 2010, was a response to the government's acknowledgement that, although it wants to promote walking, there are several barriers to overcome before walking becomes more popular.

Delays experienced by pedestrians at urban traffic signals is one of these barriers, and, given that New Zealand pedestrians are estimated to make 2.4 billion road crossings each year, it is a major one. This is compounded by the fact that, as the research found, traffic signal delays tend to cause disproportionate frustration for those getting around on foot, which leads to unsafe crossing behaviour.

The root of the problem

One of the main causes of the excessive delays being experienced by urban pedestrians is that traffic signal cycles are generally set to maximise traffic flows at peak times. While this may be an acceptable strategy during morning and afternoon rush hours, it becomes less so over the midday period, when pedestrian numbers are typically higher and traffic volumes less.

Chris Vallyon of Beca Infrastructure says, 'Like cyclists, pedestrians have often been marginalised in New Zealand road management. The emphasis has been on maximising the speed and throughput of traffic. Where pedestrians have been taken into account, such as at traffic signals, they are often accommodated in ways designed to cause the least disruption to motorised traffic. The result is excessive waiting times, and this becomes particularly evident in our city centres.'



The value of time

The value of time is essentially the value that policy makers place on efforts to reduce delays. In some cases it is derived from the value that people place on their own time; in others it is derived from the public cost or benefit of a project.

The value of time is used in assessing cost-benefit ratios for projects (by weighing the project's financial cost against, among other things, the benefits gained through travel time savings). The value attributed is therefore fundamental to whether pedestrian initiatives will receive funding (a low value of time for pedestrians creates a correspondingly low assessment of benefit).

In New Zealand, the value of time for pedestrians provided in the NZTA's *Economic evaluation manual* is considerably lower than for motorists. (The manual distinguishes between work-related and recreational trips, attributing a higher value to the former.) This is at odds with most other countries, where the value of time for pedestrians is higher than for vehicle occupants (in some countries two or three times higher).

Chris says, 'These higher values attributed to pedestrian time overseas effectively represent a policy decision to prioritise pedestrians over vehicles. There can be good reasons for this - for example, to minimise the amount of time that people are exposed to the elements or pollution, or to promote walking for health reasons.'

'But here in New Zealand, it could be argued that the value of time for pedestrians has steadily eroded over the past 15 years, reflecting the increasing dominance of private motor vehicles over other means of travel. It is unlikely that issues of unreasonable pedestrian delays at intersections will be adequately resolved while this remains the case.'

Added to this is the fact that the value-of-time figures attributed to pedestrians are lower than those for vehicle occupants, which affects benefit-cost ratios, creating a disincentive to investments in walking compared with other transport modes.

The Beca research used micro-simulation models, pedestrian questionnaires and observational surveys to look into the benefits, for all road users, of improving pedestrian travel times and reliability.

Chris says, 'An alternative approach, taken overseas, is to treat pedestrians as road users who are increasing the carrying capacity of our roads through their choice of a sustainable transport mode. This perspective means we should be valuing the travel times of pedestrians at least as highly, if not more so, as that of motor vehicles, particularly within urban areas.'

The research found that actual delays were compounded by pedestrians' perceptions of them; after 20 to 30 seconds delay, pedestrians' frustration levels grew disproportionately to the length of the delay, to the extent that some pedestrians were prompted to cross despite the signals.

This created major safety issues in Auckland and Wellington in particular, where pedestrian delays were often substantially longer than 30 seconds. Two out of three pedestrians surveyed stated that they would cross on a red man if they felt they had been kept waiting too long, while, unsurprisingly, over half felt that pedestrians should be given greater priority at signals.

A fresh look at delay

The research used the concept of per-person delay, which includes delays experienced by both pedestrians and vehicle occupants, to come up with a fair method of allocating time.

Chris explains, 'This provided us with an average delay for people arriving at an intersection, irrespective of the mode they arrived by. Changes to traffic signals can then be assessed in terms of their per-person delay to see how well they have allocated time for all intersection users, not just vehicle occupants.'

The research then went on to identify approaches for reducing delays at signalised intersections in cities. Micro-simulation modelling of these approaches at three major intersections demonstrated that making off-peak improvements to pedestrian

waiting times could significantly reduce per-person delays for all road users.

Changes to per-person delay at stand-alone intersections

Location	Base delay per person (sec)	Effect of optimisation (sec)	Optimisation + other measures (sec)	Improved per-person delay (sec)
Lake Rd, The Strand (North Shore City)	52	-13	-21	31
Albert St & Customs St (Auckland City)	39	-12	-15	24
Taranaki St & Courtenay Place (Wellington City)	36	-10	-14	22

Drawing on international best practice, the research recommended policy and technical mechanisms to improve delays.

The 'most important observation' to come out of the research was that it was possible to reduce pedestrian delays by making relatively simple operational changes, without unfairly disadvantaging other road users. The report recommends three such operational changes:

- Reduce signal cycle times, particularly in high pedestrian areas and especially during the off-peak period.
- Introduce off-peak signal phasing to better use off-peak capacity.
- Introduce per-person optimisation, rather than per vehicle, to more fairly distribute intersection time for all road users.

Other recommendations focused on areas for future policy development and research, including revisiting the value of time allocated to pedestrians in the NZTA's *Economic evaluation manual*, and developing a best-practice guide to reduce pedestrian delays, including a requirement to consider pedestrians when optimising signals or making operational changes.

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Reducing pedestrian delay at traffic signals,
NZ Transport Agency research report 440

Freely available online at www.nzta.govt.nz/resources/research/reports/440/index.html



Laying it on thick not the right approach for chips

The industry will have to agree on lower chip application rates for chipseals in the wake of findings that we are wasting millions of dollars each year by over-applying chips.

Experts around the world have been unable to agree on the optimum amount of chip to apply in order to create durable chipseal pavements. In New Zealand, the standard approach, adopted by both contractors and site engineers, is to apply extra chip, rather than risk leaving gaps in the sealing chip mosaic.

This approach has been based on consensus among road construction practitioners that achieving a complete stone mosaic helps prevent premature pavement failure. Practitioners aim to leave enough loose chips on the surface after construction to complete the chip mosaic during trafficking. The result is an estimated 10% over-application of chips in New Zealand chipseal pavement construction projects.

New research has questioned this standard approach, concluding that it is costing the industry millions of dollars each year, with no appreciable effect on pavement durability.

Chipping away at the chips

In total, 484 different chipseal scenarios were examined as part of the research. Seven different types of chipseals were tested and monitored at a number of different sites, with chip application rates ranging from very, very light to very heavy.

The results of the monitoring represented a significant amount of data, and Jeff Waters of Fulton Hogan Ltd who led the research says that the results were clear.

'The sites were mostly low-stress and, on all of them, the chip application rate did not

directly affect the chipseal's performance over the first two years after they were constructed, which is the period we monitored for. Other factors, such as traffic volumes and distribution, and the condition of the surface before we laid the chipseal, did have an effect. But the amount of chip applied didn't.

'What this means is that the industry is incurring substantial costs each year based on a best-practice approach that isn't backed up by the evidence. There's not just the cost of the extra chip; there's also costs associated with transporting and sweeping chip, disposing of the contaminated wasted chip, and broken windscreens.

'We can now say with confidence that, in low-stress environments, incomplete chip coverage does not cause early chipseal failure, and that contractors and site engineers should reduce their application rates, so that the exact amount of chip needed is used, with no wastage.'

Achieving this will require a tested method or tool for accurately measuring chip application rates, and this, along with a specification containing chip application rate targets for New Zealand, is one of the main recommendations to come out of the research.

Jeff also states that further research will be needed for chipseals in higher-stress environments, including higher traffic ones, to see if the same conclusion applies.

Towards a guideline for chip application rates

Although the majority of New Zealand roads are surfaced with chipseal (90%), there is no simple method to control chip application rates.

Normal practice is to use an estimate of the area covered (in square metres) for the volume or mass of chip used (in cubic metres). However, variations in chip size and shape mean that application rates based on area per square metre will only apply to specific stockpiles of chips, while

using weight or volume as a guide will lead to over-chipping or under-chipping.

Attempts to address these difficulties, by producing visual guides for contractors of what an optimum chip application rate will look like once applied, have also proved unsuccessful. This is mainly due to inadequacies with the chip application devices used by contractors, and inaccuracies in the visual guides. Currently the chip application rates are managed by the visual memory (of the chip runner, foreman, supervisor or consultant) of what has worked in the past, without comparing the result with the actual photo guides.

Jeff says that a secondary purpose of the research was to develop a guideline that contractors can use to determine the appropriate chip application rates.

'A guideline would reduce the cost of laying chipseal by reducing chip use and waste, and improving the success rates of chipseals,' says Jeff. 'Far from minimising the risk of failure, anecdotal evidence from practitioners is that over-application of sealing chips can itself contribute to the early failure of seals.'

Unfortunately, because the research was only funded for two years, the performance of the chipseals in this time did not confirm that over-chipping or under-chipping contributed to the premature failure of the chipseals. Further monitoring on the test sites, five years after construction, has recently been completed. However, the analysis of the results is not yet available.

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Investigating the contribution of sealing chip application rates to the early failure of chipseals, NZ Transport Agency research report 445

Freely available online at www.nzta.govt.nz/resources/research/reports/445/index.html



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Selection of aggregates for skid resistance

Research report 470

PD Cenek, RJ Henderson – Opus International Consultants, Central Laboratories

RB Davies – Statistics Research Associates

Freely available online at www.nzta.govt.nz/resources/research/reports/470/index.html

Statistical modelling was undertaken to develop a means to reliably predict the expected in-service skid resistance of any rural section of the New Zealand state highway network surfaced with chipseal.

The measure of slow-speed skid resistance used was the sideways-force coefficient routine inspection machine (SCRIM) coefficients averaged over a 10m length. The statistical modelling was based on data from the 2006–2007 high-speed condition survey of the entire New Zealand state highway network, which amounts to a sealed length of 23,113 lane km. The resulting database contains a total of 976,338 observations, allowing identification of statistically significant relationships between the dependent variable (the measured in-service skid resistance) and the independent variables (road geometry, traffic characteristics and aggregate characteristics). One aggregate-related variable investigated was a categorical parameter, representing the name of the quarry from which the aggregate was sourced. This parameter inherently encompasses not only polished stone value but all other important influencing factors such as chip shape, chip hardness, mineralogical properties and crusher type.

The major finding was that the categorical variable 'aggregate source' is a better predictor of in-service skid resistance performance than the numeric variable 'polished stone value'.

Company cars and fringe benefit tax – understanding the impacts on strategic transport targets

Research report 474

RA Scott, GV Currie and KJ Tivendale – Booz & Company

Freely available online at www.nzta.govt.nz/resources/research/reports/474/index.html

This report investigates the degree to which current tax policies influence travel behaviour (perhaps unintentionally) in ways that contradict strategic policy objectives. It also evaluates potential tax policy reforms that could help increase efficiency and equity.

Current New Zealand fringe benefit tax policies encourage employers to offer company cars (including associated expenses such as insurance, fuel, tolls and parking) and employee parking

subsidies, since as untaxed benefits they are worth more to employees than their cash wage value. Analysis of New Zealand data concerning vehicle purchase and ownership patterns, commute travel patterns and crash rates, and international research, indicates company cars tend to be larger and less fuel efficient. Employees who receive company cars tend to drive more annual kilometres, are more likely to live in more dispersed, automobile-dependent locations, and have higher crash rates than motorists who own their vehicles. The larger size of company cars appears to increase the overall average size and reduce the fuel efficiency of the future New Zealand vehicle fleet. This research also indicates that employees who receive significant parking subsidies (through fringe benefit tax exemptions) are more likely to drive than use alternative modes of transport.

Data collection and monitoring strategies for asset management of New Zealand road bridges

Research report 475

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T Henning – University of Auckland

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Freely available online at www.nzta.govt.nz/resources/research/reports/475/index.html

This research was undertaken between July 2008 and May 2011 and brings together findings from a review of literature and a survey of New Zealand bridge asset management practices. The review and the survey identified that the type of data that is collected for bridges has to be improved if advanced bridge asset management is to be adopted. Also, techniques of data collection have to change to ensure data reliability.

To achieve these goals, a strategy is proposed that defines the data to be collected (inventory, cost, performance, safety and environmental, and risk) and how the data should be managed. The strategy also recommends changes to current New Zealand data collection practices, including improvements to the visual inspection regime, adoption of non-destructive evaluation and structural health monitoring, adoption of benchmarking data collection, implementation of condition rating, and improved inspector training courses.

The strategy also acknowledges that not all networks have the same requirements. A risk- and criticality-based approach is therefore promoted and outlined. The risk and criticality approach allows bridge asset managers to have flexibility to mould the strategy to their own needs and to maintain a cost-neutral data collection programme.

Modelling crash risk on the New Zealand state highway network

Research report 477

P Cenek and R Henderson – Opus International Consultants, Central Laboratories

R Davies – Statistics Research Associates

Freely available online at www.nzta.govt.nz/resources/research/reports/477/index.html

This report presents an updated statistical analysis of data relating to crash rates on New Zealand roads. The research was carried out during 2007–2009 and it precedes the changes in 2010 to the New Zealand T10 specification. The refinements presented are associated with accounting for differences between the local and the general (ie design) speed environment, crash severity and interactions between curvature and roughness. The addition of these refinements will extend the present model's usefulness for guiding safety initiatives and providing economic justifications.

The regression model used in the analysis assumes that crashes are statistically independent and the number of crashes in each 10m segment of road follows a Poisson distribution. Inputs to the model include the average daily traffic (per side) and is a linear combination of the road characteristics, being transformations of terms that include factors such as gradient, curvature, out-of-context-curve effect, skid site classification, skid resistance, region and an urban/rural classification.

There is still more variability in the data than the Poisson model would predict. However, the results indicate the availability of a robust crash prediction model that takes into account both road condition and road geometry, allowing proactive identification of existing engineering-related road safety deficiencies and, more importantly, the ability to quantify the potential for improvement.

The economic and land use impacts of transformational transport investment

Research report 479

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K Sanderson – Business and Economic Research Ltd (BERL), Wellington

Freely available online at www.nzta.govt.nz/resources/research/reports/479/index.html

The purpose of this research, which was undertaken between July 2010 and June 2011, was to develop, test and recommend additional methodologies that could be used to quantify the economic productivity and land use impacts when assessing transformational or structural transport investments over time. Currently there is a knowledge gap in this area and the intention was to develop a more strategic approach to help gain greater value for money from future transport investments.

We investigated how it might be possible to get a forward-looking view of the productivity and land use changes associated with transformational transport investments. In our view, the retrospective case study approach can be used to provide a predictive tool to assess land use and productivity effects of transformational transport investments.

One key factor that enables this is that the tool is intended to be employed at the project inception phase. It is not designed to precisely quantify productivity effects in the same way that agglomeration effects are quantified in the *Economic evaluation manual*. Instead, it is intended to indicate potential directions of changes to land use and productivity, and through these indications, provide feedback that can be used to better align transport investment with desired land use and economic change, based on what has been observed to happen in similar locations where similar projects have been implemented.

Improved effectiveness and innovation for audio tactile profiled roadmarkings

Research report 478

VK Dravitzki, JA Thomas and K Mora – Opus Central Laboratories

Freely available online at www.nzta.govt.nz/resources/research/reports/478/index.html

The research identified how the physical noise and vibration generated by traversing audio tactile profiled (ATP) roadmarkings was influenced by the properties of the roadmarkings, such as their height, width and pitch, as well as by other factors, such as vehicle speed. The research established the relationship of human response to the noise and vibration generated. The physical effects of traversing ATP roadmarkings were determined by measuring the noise (using sound level meters) and vibration (using accelerometers) inside the vehicle while the vehicle traversed a special test strip of ATP roadmarkings, the profiles of which were machined mainly from wood, or from plastic.

The driver-response was investigated as a threshold effect via a laboratory-based driving simulation. Participants were played noise effects in controlled conditions from a vehicle driving over different ATP block heights between 2mm and 6mm, and from a vehicle on the road only. The accuracy of participants in distinguishing between road-only noise and ATP roadmarking noise was assessed using signal detection theory while the participant completed a distracter task (Stroop task; Stroop 1935) designed to replicate the cognitive demands of driving. The overall threshold block height was found to be between 3mm and 4mm.



Supplementary issues of the NZTA research newsletter

The significant number of research reports published during recent years has resulted in the need for supplementary editions of *NZTA research*, which are in addition to the standard March, June, September and December quarterly editions.

In 2011, three supplementary editions were published in May, August and November.

This is the first of three supplementary editions to be published in 2012. Two further supplementary editions will be published, in August and November, in addition to the standard quarterly editions.



Apology

The article 'Promising news and new issues for vehicle emission levels' in issue 15 of *NZTA research*, profiling research report 441 – *Are the harmful emissions from New Zealand's light duty vehicle fleet improving?*, included two photographs showing equipment used in conducting the research. The photographs should have been credited to NIWA. The NZTA regrets the oversight and acknowledges the photos were provided by NIWA.

Your views

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

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

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.

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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/planning/programming/research.html.

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New Zealand Government