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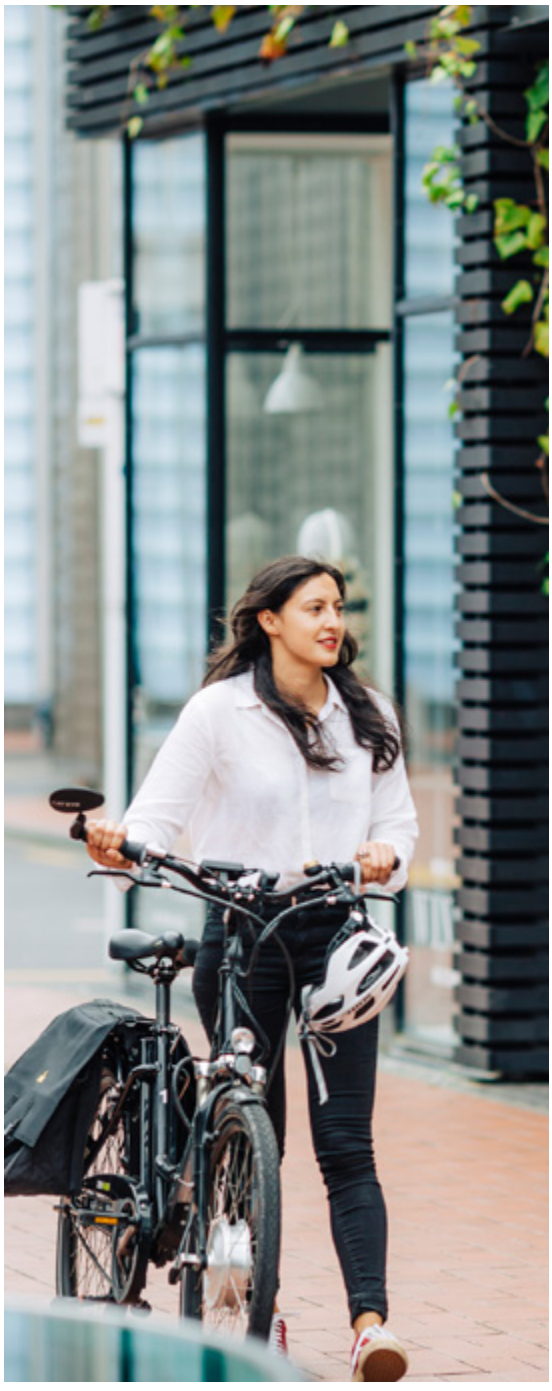

MAKING THE MOST OF LOW-POWERED VEHICLES

Regulations are needed for electric bikes (e-bikes) and other low-powered vehicles in New Zealand, to ensure their significant potential health benefits are not offset by safety concerns.

The use of e-bikes and other low-powered vehicles is on the rise, within New Zealand and internationally, bringing with them health, social and environmental benefits.

Technological advances and lower prices are making e-bikes, mobility scooters, Segways, self-balancing devices, e-skateboards and e-scooters increasingly popular and common on New Zealand roads and footpaths. Market analysis suggests that e-bike sales alone will continue to climb rapidly, with over 35,000 (and potentially as many as 65,000) sales predicted for 2026 (compared with 13,000 in 2016).

Unlike most other countries, however, New Zealand does not limit the maximum motor-assisted speed that low-powered vehicles can travel. With technological advances increasingly blurring the lines between conventional and low-powered motor vehicles, the need for regulations to categorise low-powered vehicles, and set safety and usage constraints for them has become apparent.

Research by ViaStrada has looked at international approaches and local concerns to assess the various regulatory and non-regulatory options for improving the safety of low-powered vehicles, while at the same time supporting technological innovation and attractiveness of low-powered vehicles as a travel option in New Zealand.

LOW-POWERED VEHICLE USE IN NEW ZEALAND

The research focused on electric-powered devices with a continuous power rating of no more than 2,000 W. Such devices may or may not include means of human propulsion.

In New Zealand, these vehicles fall into one of the following classes:

- power-assisted pedal cycles (bicycle-style e-bikes)
- mopeds, including motor scooters with a maximum speed of 50 km/h and low-powered scooters (also known as power cycles or scooter-style e-bikes with pedals)

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- wheeled recreational devices, which may have a motor of no more than 300 W
- mobility devices, including power chairs and mobility scooters, which may have a motor up to 1,500 W
- devices or vehicles with power above 300 W and up to 600 W, officially declared to not be a motor vehicle.

Some of the vehicles reviewed in the research do not fall into any existing class of vehicle regulated in New Zealand.

A full consideration of the potential benefits of these vehicles was beyond the scope of the research. However, a scan of studies conducted overseas established that such devices can have economic, environmental and personal health benefits, require less road space and consume less fossil fuels, than more traditional vehicle modes.

A safety analysis of low-powered vehicles, conducted as part of the research, returned inconclusive results. Consultation with stakeholders also revealed a wide range of often conflicting views on safety-related matters, such as whether devices should be ridden on footpaths or allowed throttles. Although many manufacturers included features in their vehicles to improve their safety, users could often over-ride these by tampering with their motors, sensors or software, or using more powerful batteries.

Internationally, safety-related research has focused on e-bikes, which have both increased safety risks and safety benefits associated with their use when compared with unpowered bicycles. The higher average speeds and typically greater mass of e-bikes may increase the likelihood and injury severity of crashes. On the other hand, e-bikes helped address many barriers to cycling and therefore are likely to support the 'safety in numbers' effect. If e-bikes replace car trips, then they may reduce the social cost of crashes as they cause less damage and injury to others than motor vehicles.

Of the other low-powered vehicles, data showed that mobility scooters had the highest involvement in fatal crashes, although most non-fatal incidents involving mobility scooters were falls or collisions with stationary objects, rather than collisions with motor vehicles. Safety data for the other low-powered vehicles was scant. Modelling of crashes between self-balancing scooters and cars indicated a reduced injury severity compared with crashes between pedestrians and cars.

REGULATORY OPTIONS

The research looked at the various regulatory approaches used overseas to suggest a suitable approach for New Zealand, including the potential classes and rules that could be introduced.

In their report, the researchers conclude, 'The degree and nature of existing legislation varies greatly between the different devices and different countries. Aligning New Zealand legislation with that of other countries will clarify rules for the industry, the public, regulators and the police. Australia and the UK are generally adopting the EU standard for e-bikes, but we could also adopt a framework that comprises the most appropriate components from various overseas rules. As no reviewed countries have rules covering the full range of other low-powered vehicles, the pros and cons outlined in this report may serve as a basis to create a regulatory framework that simplifies the process of approving or rejecting new low-powered vehicles.'

The three main criteria suggested by the researchers as a basis for future classification of low-powered vehicles in New Zealand were:

- maximum continuous power output – this was considered a useful regulatory criterion to:
  - › differentiate low-powered vehicles from other motor vehicle classes
  - › limit acceleration to a level compatible with other path and cycle lane users
  - › reduce the incentive for owners to tamper with speed restrictions set in the vehicle's system
  - › ensure high-power and weight systems are not fitted to bicycles that are not designed to cope with such additions
- maximum power-assisted speed – this criterion was referred to in the legislation of all the other countries reviewed; three maximum motor-assisted speeds commonly used overseas were assessed for e-bikes (25, 32 and 45 km/h), and for other low-powered vehicles (10, 15 and 25 km/h)
- throttles – throttles were one of the most contested components of low-powered vehicles. Their inclusion was considered to increase the safety risks and reduce the health benefits associated with use of these vehicles. The researchers noted, while most major e-bike brands are now moving away from including throttles in their systems, there is some concern that prohibiting throttles may increase the average costs of e-bikes and therefore reduce their uptake and the potential safety-in-numbers effect from their more prevalent use.

The research report sets out an indicative regulatory framework for low-powered vehicles in New Zealand, based on the international experience. In summary this framework recommends:

- including any low-powered vehicles intended for or primarily used by mobility impaired users within the definition of a mobility device
- classifying e-bikes and other low-powered vehicles based on their speed capability
- setting a maximum power-assisted speed and size for vehicles using footpaths
- relaxing the maximum power limits for e-bikes and other low-powered vehicles designed for road use
- introducing minimum age limits and driver licensing for higher speed e-bikes and low-powered vehicles
- using existing road user rules to promote user behaviours that minimise conflict with existing path users.

The authors recommend that the next step could be to consider the proposed framework, and issues and recommendations included in the research report, as a basis for developing government policy on low-powered vehicle use in New Zealand. This policy-making exercise could then be followed by rule making.

Regulations and safety for electric bicycles and other low-powered vehicles, NZ Transport Agency research report 621

Available online at **www.nzta.govt.nz/resources/research/reports/621**

THE VALUE OF INDIVIDUAL SERVICES TO THE PUBLIC TRANSPORT NETWORK

Developing a more comprehensive approach for measuring the value of individual services within the public transport network was the aim behind recent research.

Conducted by Abley Transportation Consultants in Christchurch, the study sought to understand and appraise the additional incremental value that is added to a public transport network by services that in isolation may be comparatively inefficient.

'Through identifying and understanding the elements that influence the value of public transport, the research aimed to develop a more comprehensive approach to quantifying the broader economic and social impact of the removal or addition of network services,' the report says.

Having access to this information will enable practitioners to measure more consistently the broader social and accessibility value of public transport, in addition to economic value. It will also enable them to compare the benefits and costs of making changes to the network, taking into account the many trade-offs that any such change inevitably involves.

'Developing a comprehensive mechanism for measuring the value of public transport is important to gain a greater understanding of existing networks and plan optimal future networks,' the report says.

THE RESEARCH

The New Zealand Government has a key strategic goal of improving the effectiveness and efficiency of public transport, and in recent years has made substantial investment in systems and infrastructure designed to improve network efficiency. While peak services on high-frequency corridors with high patronage are generally operating efficiently, other services, such as evening or feeder services, typically have low fare-box recovery, and as such are perceived as having low efficiency. However, these services are likely to be contributing to higher passenger numbers elsewhere across the network and in doing so, adding value to the network as a whole.

At present, mechanisms for measuring the value of public transport in New Zealand are limited and generally only consider the financial aspects of service provision. The research project aimed to address this situation by developing an approach for appraising public transport provision that assessed the tangible economic value, based on revenue and operating costs, as well as reflecting the social impacts of a public transport service. In particular, the research set out to:

- determine the best method for appraising the value of isolated services, considering their contribution to the wider network, and the economic and social value of the service to the community
- improve clarity around the links and synergies between individual services, the community and the public transport network as a whole
- develop a framework to help network planners understand and value the contributions of individual services, and to assess the impact that reducing or increasing low-patronage services will have on the value of the public transport network as a whole.

The research drew on literature reviews and stakeholder consultation to understand the elements that contribute to, or impact on, the value of public transport. These elements fell into eight broad impact categories, as shown in the table below.

ELEMENTS THAT IMPACT ON THE VALUE OF PUBLIC TRANSPORT

IMPACT	BENEFIT/DIS-BENEFIT
Cost	Change in development cost due to parking supply/demand
	Traffic enforcement variation resulting from change in traffic volume
Land use	Relationship with property value
	Land use accessibility/integration
	Accessibility, connectivity and coverage of transport network
User/social	Travel and vehicle ownership cost savings
	Social inclusion – accessibility to jobs, education and other facilities
	Community cohesion
Health	Access to healthcare
Mobility	Low cost, affordable transport option
Environmental	Pollution (air, noise) through change in private vehicle use
	Energy efficiency or resource cost change in per capita vehicle mileage
Road safety	Improve general road safety through reduced traffic crashes
	Crash reduction through congestion relief
Mode shift	Patronage change

The research then drew on data from several data sets, including Auckland Transport HOP Card and General Transit Feed Specification data, within a geographic information system environment, to evaluate an isolated component of a transport network. From this process, a proposed framework was developed.

THE FRAMEWORK

The framework presents an integrated network approach for considering the economic and social implications of a change in service provision, which can be used to support investment decisions and funding applications and assessments. The approach modifies one of the simplified procedures in the NZ Transport Agency's Economic evaluation manual (EEM) to take into account the additional contribution to the network of a spatial or temporal change in service provision, through considering the value of a service to the network as a whole, and supplements this by addressing the social value of the change.

Two case studies are presented in the research report, one in Auckland and a second in Hamilton, to demonstrate the application of the approach and how it modifies the EEM simplified procedure. A proof of concept, developed as part of the research, provides guidance, and using the case studies as examples, demonstrates the ability to develop an understanding of the value of a service, and the additional value it adds to the network and the community it serves.

The report also contains recommendations for how the findings of the research could now be built on and implemented, including the development of an assessment tool for practitioners. The aim will be to develop a tool that closely aligns with, and complements existing economic evaluation tools provided by the Transport Agency, to inform assessments of public transport service reviews in the future.

Assessing the value of public transport as a network, NZ Transport Agency research report 616

Available online at **www.nzta.govt.nz/resources/research/reports/616**

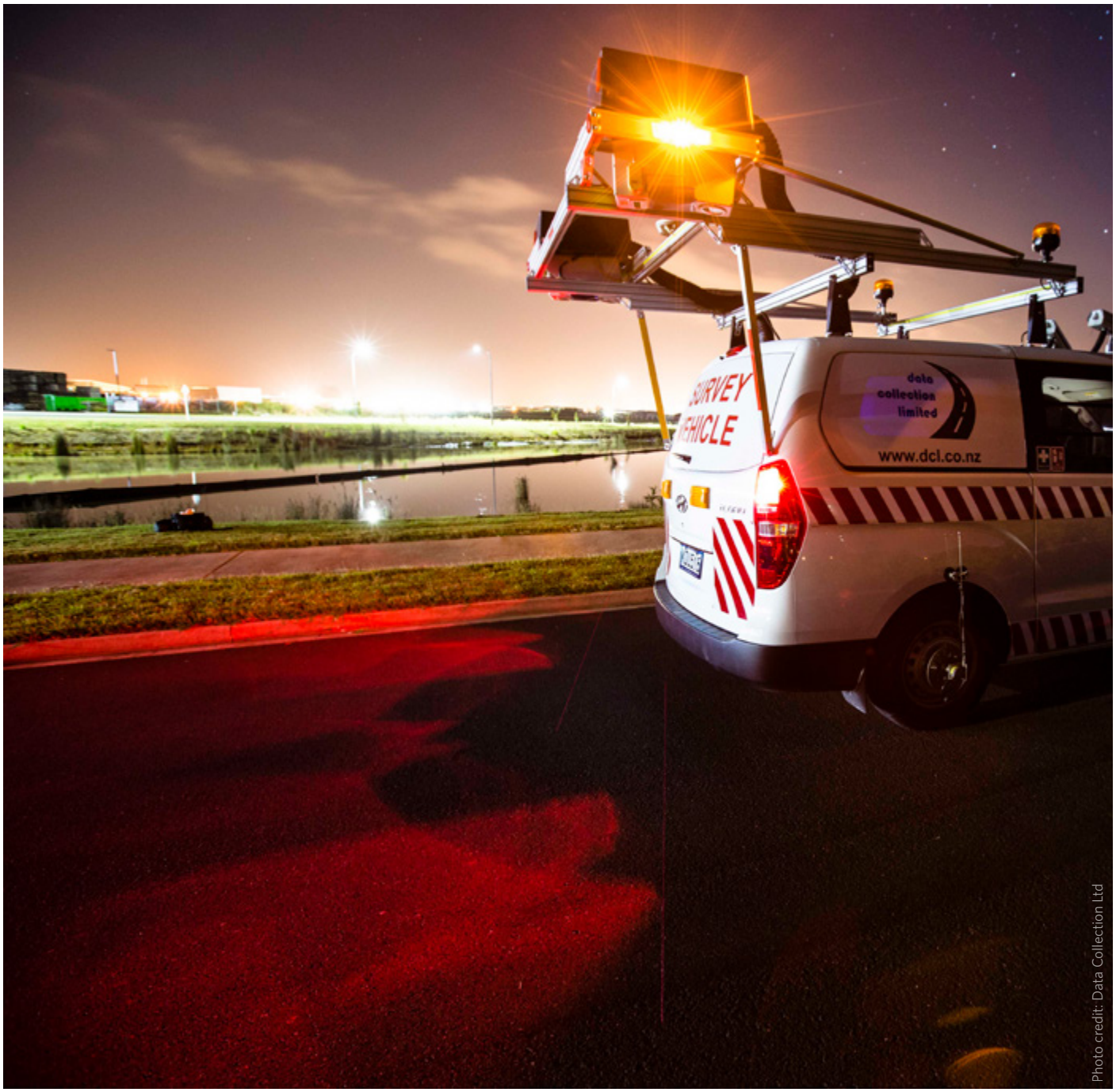


Photo credit: Data Collection Ltd

IS NEW ZEALAND READY FOR AUTOMATED PAVEMENT DEFECT DETECTION?

New research recommends that road authorities should, where practicable, adopt laser scanning technologies to detect road defects. However, further work is needed before this can occur.

At present, road authorities use road asset maintenance management (RAMM) survey data to inform their asset management processes. The RAMM survey method was developed in the 1980s to provide data to inform treatment selection algorithms. Over time, the data has come to be used for more sophisticated asset management processes, including deterioration modelling and advanced trend modelling, raising doubts about its suitability for this purpose. Both field inspectors and researchers have highlighted shortcomings in the quality and repeatability of the manually recorded RAMM data.

Overseas, automated defect data collection systems have been used successfully for over 20 years. Although early systems were well-suited to asphalt and concrete motorways, they proved less reliable when it came to providing robust data about chipseal surfaces; the main type of road surfacing used in New Zealand. However, advancements in technology have largely overcome these limitations. Automated defect data collection systems now rely solely on laser scanning, returning comprehensive 3D images of road profiles.

The research focused on the laser crack measurement system, as the most widely used parameter for maintenance planning in New Zealand. Earlier research had shown laser scanning to be capable of measuring cracks in chipseal pavements with satisfactory robustness. The technology is also currently available in New Zealand, with three operators capable of conducting laser crack measurement system surveys.

Adopting laser scanning technologies offers several benefits for the transport sector, and researchers from the University of Auckland and Opus enumerate several in this report. In contrast to manual surveys, automated detection and data collection systems:

- enable surveys of the entire road (as opposed to the 20 percent of the treatment length sample size covered by the RAMM surveys)
- capture all aspects of the surface condition data simultaneously
- take measurements at high speed (60 to 80 km/h), with clear benefits for safety and traffic management on the roads being surveyed
- enable repeatable and reproducible measurements of the same stretches of road over time.

Despite these benefits, there were areas of the technologies' suitability for New Zealand conditions that needed examining further.

Researcher, Theuns Henning, from the University of Auckland explains, 'Before a wide-spread adoption of the scanning technology is possible, we had to prove the accuracy of the measurements and determine the impact of new data items in the asset management processes. This research addressed both these items and has concluded the technology is ready for adoption in New Zealand.'

A WORK IN PROGRESS

During the project, the research focus shifted slightly to look at how ready the technology in its current state is for wider adoption into New Zealand. Although several international projects had confirmed the accuracy of the measurements collected by the laser scanner, the algorithms then used to interpret the data and identify defects were returning less accurate results.

The major shortfall was that the laser technology tended to identify a number of 'false positives' from the data: identifying defects in the road surface where none existed. Shoving, in particular, proved difficult to identify accurately. (Shoving is the permanent deflection and bulging of the road surface, or horizontal displacement of surfacing materials, usually caused by braking, turning and accelerating vehicles.)

A more detailed investigation into shoving, during the research, identified a number of road features that appear to trigger a finding of shoving, according to the defined algorithm used by the automated technology, where in reality a completely different road feature was being measured. There were also a number of instances where the rating simply 'missed the shove' as it was not very apparent for a number of reasons.

The research team developed and introduced a new algorithm for detecting shoving. They also recommended that, although automated scanning surveys were now sufficiently accurate for adoption in New Zealand, they should be supplemented, at least initially, by appropriate manual quality assurance processes. In their report, they caution:

'The laser technology, despite its accuracy, cannot be applied as a 100 percent automated process. The computer algorithms that analyse the data still need significant "learning" that can only be achieved if the technology is supplemented by manual validation of the outcome. Someone needs to work through the digital images to find erroneous identifications and feed this knowledge back to the algorithms. Once this is completed, business as normal survey contracts should include calibration procedures, validation and quality assurance protocols.'

Despite this need for further refinement, the researchers make a clear recommendation that all road agencies should, where practicable, adopt laser scanning for detecting road defects.

'This recommendation is made on the basis of the significant benefits that can be realised from more accurate assessment, and more repeatable and greater coverage of the road network,' they say.

The report sets out an implementation plan, detailing other areas where laser technologies, and the data and algorithms underpinning them, will require strengthening if and when they are adopted here. These include:

- a new definition of 'defect' – the current definition of defect needs to be updated and universally accepted by the industry, to maximise the potential benefits to be gained from laser scanning
- additional calibration of the algorithm for shoving data, as detailed above, followed by measures to make it freely and publicly available
- the inclusion of ravelling measurements in the surveys – ravelling is an important surface defect in New Zealand, and the ravelling identification algorithm needs to be calibrated to the different chipseals used here
- new data standards – industry consensus is needed in new data standards, for incorporation in best practice guidelines
- updated procurement processes – agreements with survey suppliers should specify the need for quality assurance validation and calibration.

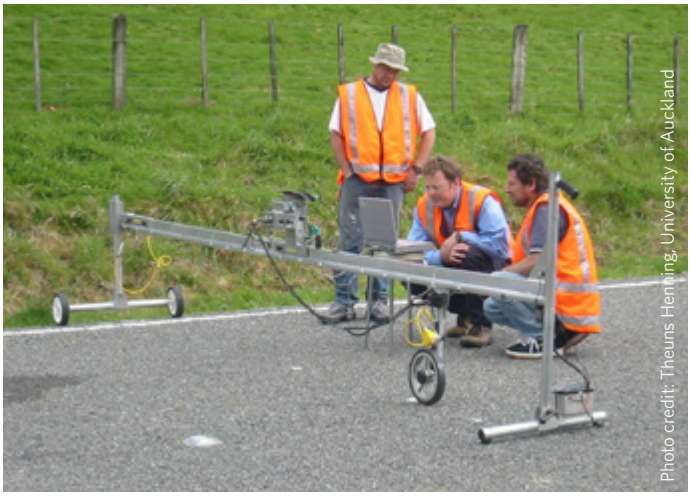


Photo credit: Theuns Henning, University of Auckland

Transition from visual condition rating of cracking, shoving and ravelling to automatic data collection, NZ Transport Agency research report 617

Available online at **www.nzta.govt.nz/resources/research/reports/617**

NOVEL APPROACH DEVELOPED FOR CREATING REGIONAL INPUT-OUTPUT TABLES

A Transport Agency-funded project has developed a method to produce regional input-output tables for New Zealand, which can then be used to assess the impact of transport and transportation industries on regional economies.

Input-output tables are a statistical summary of the flow of industry inputs into production and the subsequent use of the outputs of that production.

Tables can be produced at both a national and regional level. National input-output tables are used to give greater granularity to the national accounts by providing an understanding of the technology of production. Regional input-output tables are about regional variation in that technology and about providing an understanding of the role of inter-regional trade in an economy. With regional tables the focus is on the technology of production and on trade.

Building national-level input-output tables is highly resource intensive, requiring extensive surveying and data examination. In New Zealand, national tables are produced every five years. Regional tables are more effort to produce and require more surveying than national tables. Although some countries do produce them, it is generally not feasible to do so. As a result, one of the central issues in developing regional input-output tables is how to use the data that is already available (including the survey data collected for the national-level table) to estimate inter-regional trade and regional variations in production technology.

To this end, a number of methods have been developed internationally to estimate regional input-output tables based on previously developed national tables. However, the statistical data that New Zealand currently collects about production, consumption and trade is not sufficient to use any of these commonly adopted approaches.

The Transport Agency's research project, conducted by Holt Data Science, has developed a new method for producing the most general form of regional input-output tables for New Zealand from the data that is available here. The method provides estimates of uncertainty for the entries of the table, allows the incorporation of third-party data, and makes best use of available data, be that official statistics, third-party data, or subject matter expertise. It contains a novel approach to estimating bi-lateral regional trade, allowing for cross-hauling (concurrent import and export of the same goods).

Several elements will be required in order to run the model, including a data set, which could be assembled from Statistics New Zealand and possibly the Longitudinal Business Database. Ideally, assembly of the data set should be automated, so the tables can easily be updated in the future. Once built, however, the regional input-output model could be made available as a public resource and automatically refreshed every year or even more frequently if required.

Official statistical data is not the only data that might be useful for creating regional input-output tables, and the project also explored other third-party data sources the model might be able to draw on.

John Holt from Holt Data Science explains, 'We take the view that a regional input-output table is both a set of accounts, giving amounts of inputs and amounts of production and consumption, and also a description of the trade, production and consumption dynamic that is the New Zealand economy. Data describing systems which are influenced by that dynamic can be statistically modelled in terms of any regional input-output table we developed using the official statistical data – if the data can be made representative of the business population, then the results of the model can be used to improve the accuracy of the regional input-output table.'

Four sources of third-party data were looked at as part of the project and, although a couple are promising, all will require significant work to make them usable.

ASSESSING THE IMPACT OF TRANSPORT

The project also sought to understand how a regional input-output table could be used to understand the economic impact of transport and transportation industries.

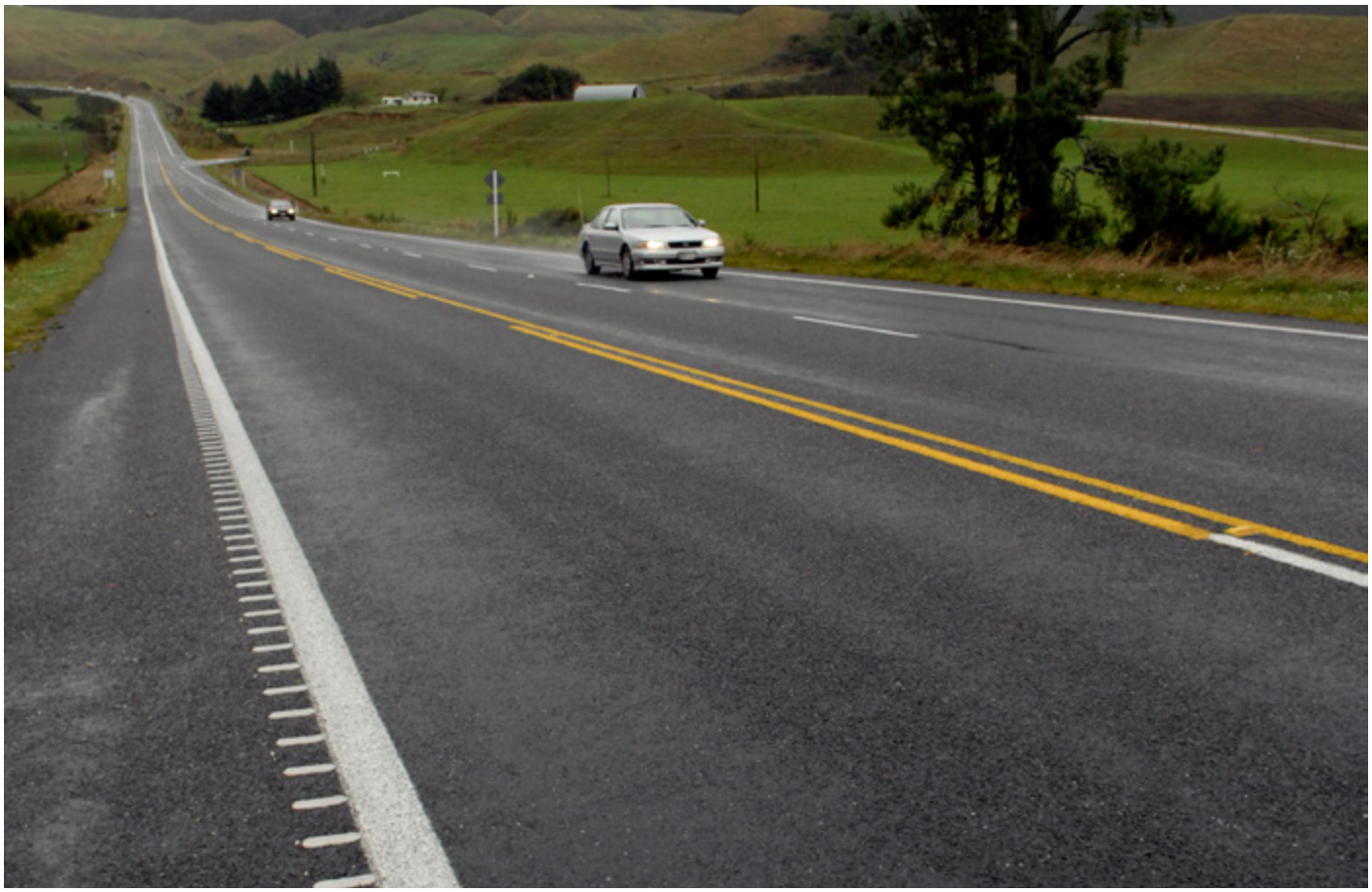
Overall, the conclusion was reached that it was not feasible to measure the direct economic impact of transport using a single regional input-output table. However, indirect effects can be measured and would provide useful input into transport planning at a regional level.

Three main measures were identified – each drawing on the information in the input-output tables to indicate aspects of the economic impact of transportation.

- The efficiency of a regional transport industry can be measured in terms of how much added value it provides as a proportion of the output of the purchasing industries. In this measure, large amounts would be interpreted as inefficiency, though it is likely this measure is very coarse.
- Transport industry inter-dependencies can be quantified using regional input-output tables to understand how air, sea and road transport cooperate to deliver regional transport. This is not an absolute measure of impact, but a measure of the impact one regional transport industry has on another regional transport industry.
- The use of transport is in the movement of people and things. Thus an indirect impact is in how transport facilitates trade. In this measure, the importance of a region to another region is measured in terms of how much added value flows through the region into the other region's production. Transport or value-chain links between a region and another region of high importance should be prioritised, so this measure provides a quantification of importance that informs resource allocation.

Approaches to estimating regional input-output tables, NZ Transport Agency research report 619

Available online at **www.nzta.govt.nz/resources/research/reports/619**



REPORT PROMOTES CLOSER MANAGEMENT AND MONITORING OF ATP ROADMARKINGS

Research has looked into approaches for maintaining audio tactile profiled (ATP) roadmarkings, and proposed an approach for monitoring and managing their ongoing effectiveness.

ATP roadmarkings in New Zealand are typically of a raised-rib design, made from thermoplastic or two-part reactive cold-hardening material (cold plastic). The roadmarkings are generally laid longitudinally on the edge-lines or centrelines of roads.

The effective life of ATP roadmarkings is now considered to be six to eight years (up from four years in the 1990s). Although there are still instances where earlier failure occurs, these situations are now better understood, and as a result are becoming less common.

Most roads in New Zealand are chipseal, although ATP roadmarkings are also used on asphaltic surfaces, such as those found on motorways and expressways. The effective life of chipseal surfaces is estimated to be 8 to 10 years, while asphaltic surfaces can last in the order of 10 to 15 years.

This makes the effective life of ATP roadmarkings comparable to those of the surfaces they are laid on. However, there are instances where ATP roadmarkings still have effective life left in them when roads need surfacing. This may be due to premature failure of the pavement or surface, or because the roadmarkings have been laid partway into the surface's life.

A lack of formal advice about what to do in these situations led the Transport Agency to commission research into how to retain ATP roadmarkings through reseal cycles. The research, by Opus International Consultants, also looked at how to maintain ATP roadmarkings and monitor their ongoing effectiveness. The research took the approach that ATP roadmarkings should be treated and managed as an asset, and their performance monitored accordingly.

MAINTAINING THE EFFECTIVENESS OF ROADMARKINGS

The research found little literature on maintaining or retaining ATP roadmarkings when roads are resealed that was relevant to the New Zealand context. However, two main techniques are being used at a local level, and local industry practitioners were contacted for their input and experience.

The two approaches are:

- in-lane resealing, where the road surface of the trafficked lane adjacent to ATP roadmarkings is resealed, but the non-trafficked shoulder and the ATP roadmarking itself are left without being resealed
- sealing over the ATP roadmarking, with the intention that its audio tactile effects will be retained through the reseal layer.

The research examined the effectiveness of both techniques, and recommended that, in situations where a road surface is to be resealed and the ATP roadmarkings on it are still working effectively, then in-lane resealing should be considered as the preferred method.

Of the two practices, in-lane resealing offered more certainty that the residual audio and tactile life of the roadmarkings would be unimpaired. Although with good practice, some of the audio tactile effects of roadmarkings could be retained where over-sealing was used, the success of this approach was variable.

At a general level, the research determined that maintenance of ATP roadmarkings needed to independently consider their visual, audio and tactile effects.

Visual effects should be monitored during day, night and wet conditions where practicable. Visibility during night conditions is provided by different mechanisms or properties than visibility during daylight, so visibility during night should not be inferred from performance in daylight, nor vice versa. If possible, the visual effects of the roadmarkings should be measured objectively, for example by using a mobile retroreflectometer. Where this is not possible, subjective monitoring of visual performance can be used, and is better than no visibility monitoring at all.

Various techniques are available to refresh roadmarking visibility, including cleaning the roadmarking or recoating it with paint or other roadmarking material, including beads or other optical features to increase the retroreflectivity.

With respect to the audio tactile effects, the research used a car instrumented with a sound level meter and sound recording device to capture the audio effects from roadmarking ribs of various heights and spacings (a strong correlation between audio and tactile effects having previously been established). The captured sounds were then used in a driving-load stimulator to test how noticeable the differing sounds were.

An interesting finding from this aspect of the research was that the height of the ribs needed for drivers to notice and respond to ATP roadmarking on some surface types was far less than previously thought.

An earlier research project had indicated that on chipseal a minimum rib height of 4 mm height was needed before ATP markings provided sufficient audio tactile effects for drivers to notice them. However, this research found that on asphalt surfaces around 80 percent of participants detected ribs with a height of 1.8 mm, and 98 percent detected the next thickness of 2.8 mm, both far less than the 4 mm indicated by the earlier research.

The research also found that at the rib heights required by current New Zealand ATP roadmarking specifications (between 4 mm and 9 mm) there was no significant difference in audio tactile noticeability between 250 mm rib spacing and 500 mm rib spacing.

This disparity in the results was identified as an area where further research was needed. It was recognised that the current project had used different testing methods and road surfaces than the previous project, and as a result it was still unclear what threshold levels were necessary for the audio tactile stimuli provided by ATP roadmarkings to be noticed by drivers.

ASSET MANAGEMENT FOR ROADMARKINGS

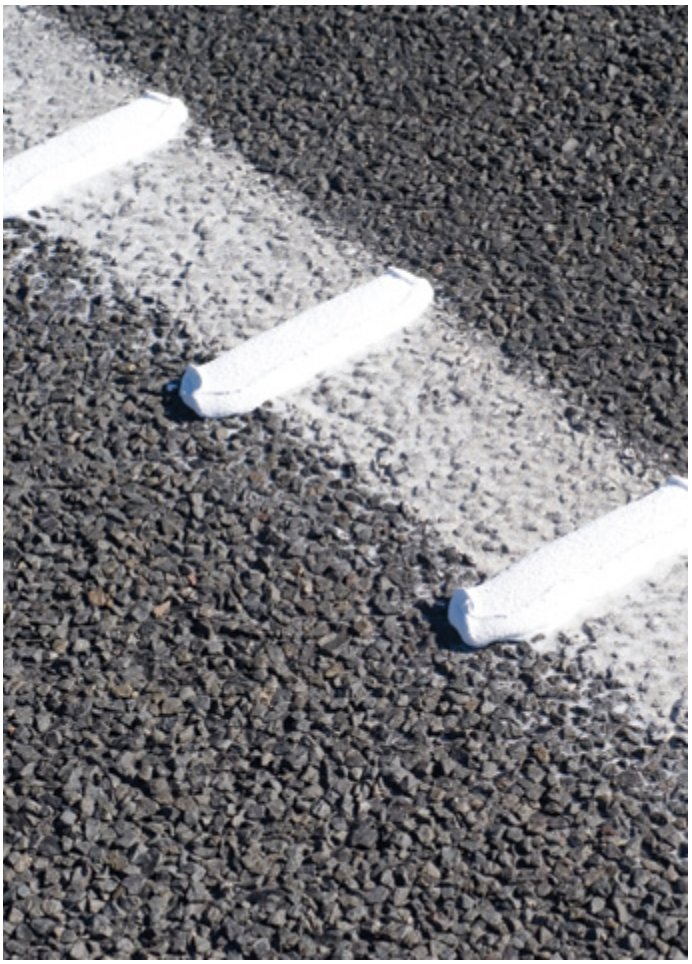
Other recommendations of the research were that ATP roadmarkings should be considered an asset and their performance monitored accordingly. Although there was some evidence that ATP roadmarkings are starting to be treated as assets, the project found that, in general, they were still not being managed to the same extent as other assets.

The research report details suggested best-practice management approaches for ATP roadmarkings. These include regular objective measurement of roadmarkings' visual effects, possibly using a mobile retroreflectometer, and audio tactile effects, possibly with a sound level meter mounted inside the vehicle. Where such an approach is not yet feasible, the report sets out a subjective rating system that can be used for monitoring, either as a complement to objective measurements or until an objective measurement method is developed.

The report concludes that, 'Future research should develop criteria and methods for objective measurements of the ATP marking as the primary goal, or a method for subjective rating of the ATP marking as the secondary goal. Either approach, objective or subjective, needs to account for audio, tactile and visual effects of ATP roadmarkings.'

Maintaining the effectiveness of audio tactile profiled road markings for their full life cycle, NZ Transport Agency research report 615

Available online at **www.nzta.govt.nz/resources/research/reports/615**



RECENTLY PUBLISHED RESEARCH REPORT ABSTRACTS

Benefits and costs of different road expenditure activities

NZ Transport Agency research report 631

Freely available online at www.nzta.govt.nz/resources/research/reports/631

This research report examines how benefit and cost appraisals for road operations, maintenance and renewal, and minor work improvements could be undertaken in a manner comparable with the appraisal framework for capital investments.

In addition, this research seeks to answer what the target level of service should be for each classification of road across the entire network; what the marginal benefits and costs of changes are to the network-wide target level of service for a classification of road; and what the optimal split is between resilience improvements, safety improvements and operational improvements, particularly for minor work improvements.

Framework for review and prioritisation of rail safety risks in New Zealand

NZ Transport Agency research report 632

Freely available online at www.nzta.govt.nz/resources/research/reports/632

The Transport Agency commissioned Navigatus Consulting to undertake this research project to identify and provide evidence-based recommendations for managing priority safety risks for New Zealand rail operations.

The project was carried out in 2015/16 in New Zealand.

The primary purpose of the project was to provide a reliable foundation for future risk reduction activities by carrying out research on best and current risk practice, undertaking a risk assessment to identify priority safety risks, and identifying potential mitigation options to reduce these priority risks to an acceptable level.

A number of recommendations were made relating to the research undertaken.

Analysis and interpretation of New Zealand long-term pavement performance data

NZ Transport Agency research report 633

Freely available online at www.nzta.govt.nz/resources/research/reports/633

A comprehensive statistical analysis and review of the dataset was undertaken on the March 2015 long-term pavement performance database, including application of transformations on the skewed raw data.

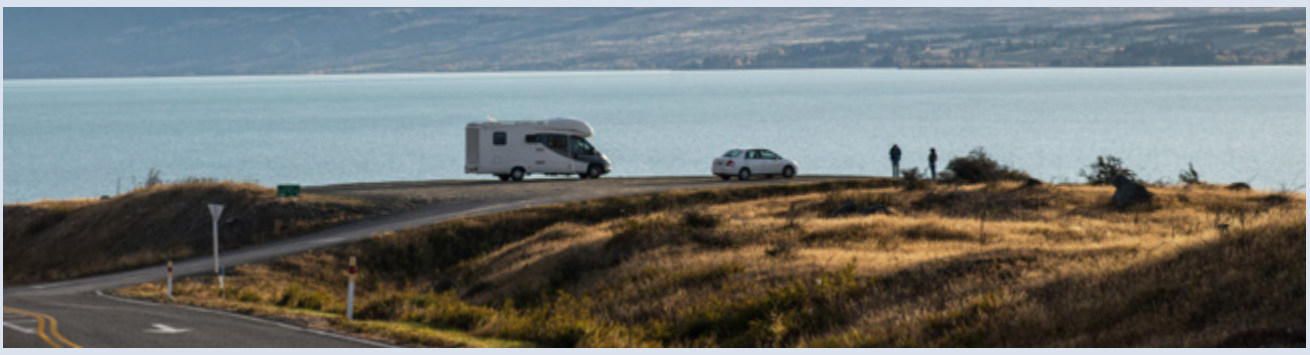
Following a detailed analysis, it was found the numerical data available to undertake a statistical analysis to identify factors that need to be present for accelerated condition trending was not sufficiently robust. It is not possible to find useful or significant correlations with this data set as it stands.

A manual investigation was undertaken by a person with extensive experience in road engineering and maintenance. This investigated engineering explanations for the sites highlighted by the statistical analysis, which involved interpreting site photographs, notes and construction records.

This review was unable to identify any reliable data to show pavements displaying cracking are at a higher risk of failure. It did suggest, however, that the current selection of maintenance treatment type and the quality of maintenance and reconstruction practices might assist in making the level of service worse after maintenance, compared with sterilised sites where maintenance is restricted to emergency repair work only.

The maintenance practice of water cutting also needs to be carefully considered, as this may contribute to a more rapid condition deterioration.

Recommendations are provided on how the dataset could be restructured to provide additional benefit.



Effect of road seal type on resistance to traffic stresses

NZ Transport Agency research report 634

Freely available online at www.nzta.govt.nz/resources/research/reports/634

This report details research carried out from 2016 to 2017 as the preparatory stage of a larger programme to understand how chipseals might be improved to withstand increases in horizontal shear forces imposed by traffic loadings. The research aimed to develop an understanding of mechanisms and factors that lead to chip loss resulting from surface shear stresses, and to develop a methodology for testing seal performance under realistic but controlled laboratory conditions.

The report commences with a literature review to collate and examine existing data and experience on seal selection and chip loss processes from New Zealand and overseas. Physical mechanisms, site and vehicle factors that contribute to seal damage are also investigated. Finally, an experimental test method and plan is developed to quantitatively compare and evaluate the effect of seal and binder type on overall seal performance in the laboratory, but under realistic loading and temperature conditions. The experimental plan is to be undertaken as the next stage of this project.

Pavement maintenance patch trials

NZ Transport Agency research report 635

Freely available online at www.nzta.govt.nz/resources/research/reports/635

There is anecdotal evidence that pavement maintenance patches fail within a few years and research was undertaken to develop a framework for predicting the life of patches to enable asset managers to choose the right treatment to give the life required with the lowest whole-of-life costs.

A total of 12 maintenance patches were constructed consisting of cement stabilisation (two cement contents 1.5 percent and 3 percent); mill and asphaltic concrete inlay; and full depth granular reconstruction replicated on three different state highways.

These maintenance patches were treated as full pavement renewals in terms of testing and investigation prior to their construction.

This information allowed basic pavement characteristics, such as the impact of traffic; pavement depth (adequate, inadequate or very inadequate); aggregate quality (good, average or poor); and pavement deflection (high, medium or low), to be determined prior to patching.

The patches were monitored for three years and during this period most failed.

The monitoring allowed the creation of algorithms based on the basic pavement characteristics to predict the life of the patch treatments.

A tool was developed to allow designers and asset managers to make informed choices on the type of patch treatment based on predicted life, and so prevent early failure of the patches.

The future of employment and economic activity and its transport and land use implications

NZ Transport Agency research report 637

Freely available online at www.nzta.govt.nz/resources/research/reports/637

This report reviewed literature relating to the potential effects that automation and new technologies will have on the type, nature and characteristics of employment in the industrial, service and commercial sectors. The findings of that review were then supplemented with interviews of key sector representatives from large New Zealand companies and organisations. This took place between October 2016 and February 2017.

Together the literature review and stakeholder interviews were used to confirm a methodology and define the parameters and assumptions of scenarios to test possible future employment and land use requirements. These requirements were assessed for four scenarios and a business as usual baseline to explain the potential effects that automation and new technologies will have on the type, nature and characteristics of employment and land use in the industrial, service and commercial sectors. This work took place between February and July 2017.

OBTAINING TRANSPORT AGENCY RESEARCH REPORTS

All research reports published since 2005 are available free of cost for downloading from the Transport Agency's website www.nzta.govt.nz/planning/programming/research

PDF scans of research reports published prior to 2005 are available by emailing NZTAresearch@nzta.govt.nz

A NOTE FOR READERS

NZTA research newsletter

The *NZTA research* newsletter is published quarterly by the NZ Transport Agency. Its purpose is to profile research funded through the Transport Agency'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 Transport Agency's Research Programme, see www.nzta.govt.nz/planning/programming/research.html.

Advertisements of forthcoming conferences and workshops, that are within the newsletter's field of interest, may be published free of charge when space permits.

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All general correspondence, queries related to conference notices, and requests for additions or amendments to the mailing list, should be made to NZTAresearch@nzta.govt.nz .

Disclaimer

The views expressed in the *NZTA research* newsletter are the outcome of research and should not be regarded as being the opinion, responsibility or policy of the Transport Agency or of any agency of the New Zealand Government.

Availability of *NZTA research*

The current edition of the *NZTA research* newsletter is available in hard copy or on the Transport Agency website, along with all previous editions of the newsletter, at www.nzta.govt.nz/resources/nzta-research/.

Email alerts of newly published research reports

Email notifications are provided when new issues of the *NZTA research* newsletter are published. Notification is also provided when new Transport Agency research reports are published on the Transport Agency's website at www.nzta.govt.nz/planning/programming/research.html. Please email NZTAresearch@nzta.govt.nz if you would like to receive these email alerts.

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- receive the *NZTA research* newsletter in hard copy format
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- alter the number of *NZTA research* newsletter hard copies you receive.

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DID YOU KNOW...

That there is a spreadsheet on the Transport Agency website listing all published Transport Agency research reports?

The spreadsheet is searchable by several criteria and can be found at **www.nzta.govt.nz/planning-and-investment/learning-and-resources/research-programme/**

The spreadsheet has two worksheets; the first worksheet lists research reports with associated key words and the second lists research reports with the report abstracts.

NZ TRANSPORT AGENCY WAKA KOTAHI

New Zealand Government