NZTA research

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WAKA KOTAHI

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Hold that thought: driving while conversing

Studies have shown that talking on a cellphone when driving can adversely affect our driving behaviour and increases our chances of a crash. But is it only cellphone calls that are the culprit or are all conversations in cars dangerous? A recent NZ Transport Agency research project finds out.

According to several studies, the heightened risk of being involved in a car crash when using a cellphone while driving is severe. Three studies have found that just one hour of cellphone use while driving per month could increase your chances of having a crash by 400 to 900 percent, while another found that the risk to drivers of using a cellphone behind the wheel was the same as driving at the maximum legal limit of alcohol intoxication.

Several factors account for the increased risk. Drivers who are talking on the phone take longer to react when vehicles in front of them brake. They also are not so adept at judging gaps, drive too close to the car in front, take curves at higher speeds, have impaired control over their vehicles, look less often in their rear view mirrors, commit more traffic violations and hit more pedestrians.

The exact reasons for this reduced performance, however, have been unclear. While the physical demands of using a hand-held cellphone can certainly interfere with a driver's control actions, this interference is not the cause of many of the negative effects associated with cellphone use. Added to this is the finding that hands-free cellphones can be as detrimental as held-held ones, suggesting that the cellphone interference comes from the cognitive demands of the conversation, as opposed to the physical ones.

Which leads into the question of whether it is specifically cellphone conversations that create the problem, or whether all conversations while driving are dangerous?

Dr Samuel Charlton, Senior Human Factors Scientist at Ternz Ltd and an Associate Professor at the University of Waikato, led a recent NZTA funded research project to shed some light on the issue. He says, 'Although many people are willing to accept the fact that driving while conversing on a cellphone is a dangerous distraction for others, they often fail to see it as a problem for their own driving. Part of the resistance to restricting the use of cellphones by drivers has also been the argument that it is impractical, because it is just one of many distractions that drivers have to contend with, including conversations with passengers. This line of reasoning goes on to maintain that because conversations between drivers and passengers can not be reasonably restricted, then neither can drivers' use of cellphones.

'What we set out to identify was whether there is any difference between drivers' cellphone conversations and their conversations with passengers in terms of their effects on driving performance. We were particularly interested in whether the cognitive demands of a cellphone conversation, and the consequent changes in visual attention, situation awareness and mental workload, are unique to cellphones, or if they result whenever drivers are conversing as they drive.'

So what's the difference?

There are several logical reasons why drivers' conversations with passengers may not be as cognitively demanding or impair their driving ability to the same extent as conversations conducted over a cellphone.

Drivers talking with passengers have access to a number of non-verbal speech cues, making the conversation smoother and simpler to understand, so that less mental effort is required. Similarly the quality of the speech is clearer and easier to understand.

The form and contents of passenger conversations are also believed to be fundamentally different from phone ones. Because passengers can see what the driver sees they can modify their conversation accordingly, matching the timing and complexity of their speech to driving conditions. Passengers may reduce their rate of speech or stop talking altogether in demanding driving situations, whereas this suppression does not occur in cellphone conversations.

In addition, the content of conversations with in-car passengers includes more turn taking and more references to the driving situation than cellphone conversations, and may actually help drivers maintain awareness of their situation.

Taking the test

Two experiments were set up to test issues around driving, conversing and cellphones.

In the first, the performance of 112 participants was tested in four driving conditions:

- Drivers talking with in-car passengers.
- Drivers talking over a hands-free cellphone.
- Drivers talking with remote passengers (who were not actually in the car but could see the driver's situation) by means of a hands-free cellphone.
- A no-conversation control group.

Participants in the experiments drove a 25 km section of New Zealand state highway in a high-fidelity driving simulator. During the drive they encountered five typical hazards and one overtaking situation. Several aspects of their driving performance were measured including speed, deceleration and braking reactions as they approached hazardous road situations. The pace and content of the conversations were also recorded, as were the drivers' ratings of the driving difficulty of the route and how much the conversations interfered with their driving.

Samuel Charlton explains, 'The reason we included the remote passenger condition was to test the difference between a converser being able to see what the driver was experiencing versus actually being present in the car next to the driver. What we found was that drivers talking to in-car passengers were much safer than drivers talking on hands-free cellphones, regardless of whether or not the person on the other end of the cellphone could see what the driver was doing.'

Drivers talking on cellphones often failed to reduce their speeds as they approached hazardous situations, and failed to increase their speeds appropriately when overtaking. The result was they had a significantly higher rate of crashes, ranging from head-on collisions to minor scrapes on bridge rails. Drivers with passengers, on the other hand, were more likely to anticipate hazards and reduce their speed, performing almost as well as the drivers with no conversation to distract them.

The form and content of the conversations gave some insight into why the in-car passenger condition was so much safer. In-car passengers usually stopped talking when drivers approached a hazard, and sometimes remarked on the hazards ahead or other aspects of the driving situation. Cellphone conversers took fewer pauses, made longer utterances (which require more effort to understand), and didn't mention approaching hazards in the same manner as their in-car counterparts, regardless of whether or not they could see the driver's situation.

Samuel says, 'At the beginning of the research we'd posed the question whether driving while talking with passengers was different from driving while talking on a cellphone. What the study showed was that passenger conversations are indeed different, and safer, and that this is due at least as much to what passengers don't say, as to what they do say to drivers.

'Reacting to the driving situation, as the driver is experiencing it, by suppressing conversation when hazards arise allows the driver to concentrate on the job at hand, and is a determining factor in how well the driver handles the situation. The person on the other end of a cellphone typically doesn't know there's a hazard, doesn't stop talking, and the result is that drivers aren't able to redirect their attention to the hazard.

'Having found that these types of driver conversation were indeed different, we then asked ourselves what was the key to the higher safety associated with in-car passengers – was it because the passengers knew when to suppress their conversation or because they could alert drivers to hazards ahead?'

The second experiment investigated whether a cellphone modified to emit warning tones, audible to both the driver and the person they were talking to, could alleviate some of the adverse effects of cellphone conversations. Technologies such as radio frequency tags placed on hazard warning signs or GPS-capable cellphones programmed with maps of known road hazards could be used to trigger cellphones to emit warning beeps as drivers approached them.

Results from the simulation experiment showed that drivers with alerting cellphones performed almost as well as those in the no-conversation control group. Drivers decelerated sooner, and their conversations had shorter utterances, more pauses and more references to the hazard than was usual in cellphone users.

Samuel says, 'The alerting cellphone produced beneficial interruptions to the conversations and tended to focus the driver's attention on the approaching hazard, even though the converser couldn't see the driver's situation. The finding that drivers performed so well with this type of phone suggested that the combination of conversational pauses and alerting is what makes passenger conversations so much safer than cellphone conversations. The alerting tones also demonstrated an appealing technological possibility for making cellphone use while driving safer, with respect to certain types of hazards. The beeping cellphone was just one option that we came up with, and further research into different ways of alerting drivers would be needed before any one technological solution is pursued.'

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Distractive effects of cellphone use, Land Transport NZ research report 349 Freely available online at www.landtransport.govt.nz/research Hard copy $20.00 – email research@nzta.govt.nz to order.

Corrosion finding sparks wider investigation

The discovery of corrosion during a routine inspection of a state highway bridge in 2004 led to a detailed investigation into prestressing steel corrosion in bridges. By understanding the current and future risks, cost-effective decisions can be made for managing the corrosion of prestressing and reinforcing steel in bridges in the future.

Between 1958 and 1971, some 117 state highway bridges were built in New Zealand using prestressed concrete I-beams of standard Ministry of Works design. Some are in exposed coastal locations and others are in sheltered inland environments. Although not designed for a specific service life, they are now approximately halfway through the 100 year service life that new state highway bridges are designed to achieve. The condition of these bridge beams today gives an insight into their likely durability over the next 50 years. It also indicates the probable durability of more recent bridge beam designs.

In 2004 an inspection of one of these early prestressed bridges, the Hamanatua Stream Bridge near Gisborne, revealed corrosion of the prestressing steel in a few of the bridge's beams. Although the steel prestressing strands had not yet broken, the corrosion had cracked and spalled the cover concrete.

The consequences of prestressing steel failure in bridges can be severe. In addition to the immediate safety risks for users and surrounding property, there are longer term economic implications. If not remedied, damage can affect the bridge's load-carrying capacity and long-term durability, reducing its service life.

The prestressing steel corrosion on Hamanatua Stream Bridge was one of the first cases reported of prestressed concrete beams deteriorating under normal service conditions on New Zealand road bridges. Concerns were raised that other prestressed concrete bridges may be affected, leading Land Transport NZ to commission research to determine the extent of the problem.

The investigation focused on bridges built in the 1960s and 1970s to two standard

Research aims

- To identify the factors that contributed to the deterioration of the prestressed concrete beams on the Hamanatua Stream Bridge.
- To ascertain whether this sort of deterioration is widespread, by identifying the current condition and future risk of corrosion, for both prestressing and conventional reinforcement, on other bridges of similar age and design, in a range of exposure environments.
- To assess the variability in materials and workmanship for this type of bridge beam.
- To develop recommendations for managing these bridges in the future, in order to optimise the economic life of the bridge stock and the remaining life of individual bridges.
- To find out whether the risk of corrosion had been reduced by changes to design standards for prestressed concrete beams.

design loadings. These two standard designs were of particular concern because they do not have stirrups that fully confine the prestressing strand. Specifications for prestressed bridge beams have since changed. Nevertheless, by understanding the factors leading to the corrosion on Hamanatua Stream Bridge, and gauging whether prestressing steel was corroding on other bridges of the same designs, the risks posed by steel corrosion on bridge beams of various designs can be managed for the future.

Around the bridges

In addition to Hamanatua Stream Bridge, site assessments were carried on 28 other prestressed concrete bridges in the central North Island. All the bridges had beams of similar design loadings, although their ages and exposure conditions varied.

On Hamanatua Stream Bridge, which is located in a 'coastal frontage exposure zone' close to a surf beach, the corrosion was found to have been caused by chloride ions from sea spray. The chloride ions had penetrated the cover concrete and their concentration at the steel's surface was high enough to cause the steel to corrode.

None of the other bridges inspected showed signs of corrosion in their prestressing steel, although subsequent testing showed that similar bridges in similar coastal locations could be vulnerable to chloride-induced corrosion. Such bridges are unlikely to achieve a 100-year service life without some corrosion damage, and intervention will be required to ensure they remain safe and serviceable. Further work is needed to determine what the best means of that intervention will be.

Most bridges in less aggressive exposure zones ('inland' and 'coastal perimeter') were not considered to be at risk, because they are not exposed to external sources of chloride contamination. In some bridges, however, calcium chloride was added to the fresh concrete to reduce its setting time, which increases the risk of corrosion in these bridges.

Also of note was that the concrete cover depths over the prestressing steel on the Hamanatua Stream Bridge were substantially less than is required under current standards. At the time the bridge was built, standards required a cover depth of 1 inch or 25 mm (although in places it was found to be less). Current specifications (as set out in NZS 3101: 2006 and Transit's bridge manual) require cover depths ranging from 35 mm to 65 mm for coastal frontage exposure zones. Corrosion initiation models showed that beams made to current specifications, using similar concrete and in similar locations to the Hamanatua Stream Bridge, would probably achieve their 100-year service life without corrosion damage.

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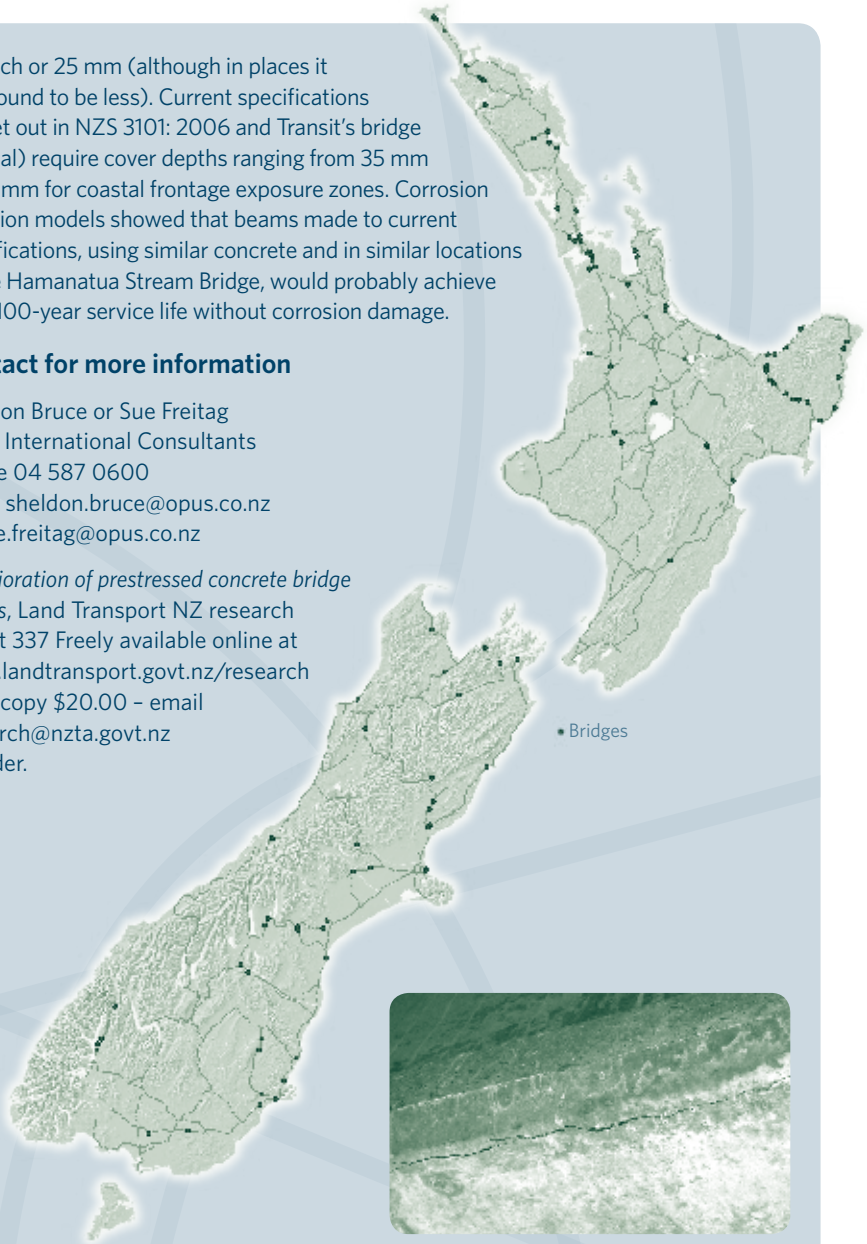
Deterioration of prestressed concrete bridge beams, Land Transport NZ research report 337 Freely available online at www.landtransport.govt.nz/research Hard copy $20.00 – email research@nzta.govt.nz to order.



Corrosion of prestressing steel

Corrosion of prestressing steel is relatively rare. Where it does occur, the following factors, which also determine the risk to conventional reinforcing steel, have been found to contribute:

- Service conditions (have the greatest influence on corrosion resistance).
- Depth and quality of the cover concrete (has significant influence).
- Metal properties (has least influence).

Where corrosion does occur, it can happen without any outward signs on the cover concrete, such as rust staining, spalling or cracking. As a result prestressing wires or strands may de-bond from the concrete or break without warning, and once broken may burst through the covering concrete.

Once a wire or strand is broken, its load is redistributed to the remaining strands, which may not have the capacity to carry the extra stress. The result is that structural capacity is reduced, with attendant risks to users and to the structure's useful life.

Lights and cameras may spell action for greater public transport use

Encouraging more frequent use of public transport may be as easy as turning on the light. A recent Land Transport NZ research report has found that better lighting, information and environmental design are all straightforward ways to make passengers feel safer, and hence more inclined to use public transport.

Passengers' concerns about their personal safety are acknowledged as a major barrier in encouraging people to make greater use of public transport. Even people who already use public transport are discouraged from using it more often by perceived threats to their safety, especially after dark.

While there is some evidence to suggest that perceptions of the risks involved may be exaggerated, understanding exactly what people's concerns are, will enable more effective policies to be developed to address them.

The research, carried out by Booz and Company, explored people's perceptions of safety in Auckland, Wellington and Christchurch (chosen because of their significant public transport patronage levels). In addition to looking at the factors driving people's concerns, the research examined which security measures people wanted and noticed, and drew conclusions about the influence that security measures might have on public transport patronage.

Richard Hancy, Senior Associate at Booz and Company, says that the research found that the 'target market' for any enhanced security measures was diverse. 'Concerns are not limited to a particular gender or age group. Men and women of all ages, from youth right through to the elderly, can have quite specific and varied concerns about their safety, and it will be important for agencies to bear this diversity in mind when developing and marketing any new measures.'

What the research did enable the report to recommend was where these measures should be targeted. Richard says, 'Security measures are going to be more effective if they are targeting at existing patrons, with the aim of encouraging them to use public transport more often. They will be less effective for persuading people who don't currently use public transport to become users, as their reasons for not being patrons may hinge on more diverse concerns than solely security.'

Addressing the fear

One of the biggest challenges that the public transport industry will face in addressing security concerns is how to make patrons better aware of security measures, without causing alarm.

While much of the research focused on the security measures that people would like to see in place, it also made apparent the very low awareness that patrons have of measures that are already operating.

Richard says, 'This was particularly the case with respect to trains. While the New Zealand train system already has large numbers of CCTV cameras in operation, only one in six train users were aware of this, which is consistent with findings overseas. An element of patrons' security concerns may be caused purely by lack of awareness of the security measures in operation, and a relatively easy way to ameliorate those concerns is to improve information and communication about security.'

With respect to the specific features or situations that made people feel unsafe when using public transport, and what could be done to address these, several main areas emerged.

Satisfactory lighting, around stops and waiting areas, and onboard transport at night, was a popular suggestion, and overall would be one of the cheaper and more straightforward measures for authorities to implement. One in seven respondents said that they felt very unsafe or uneasy if travelling on a dark bus, with similar results found for trains.

Another relatively straightforward area to address was providing better information about when buses and trains are due to arrive. One in six users said that arrival uncertainty caused them to have unsafe or uneasy feelings, which could be easily remedied through real-time signs on-board showing up to date journey information.

At a broader level, authorities would do well to draw on the *Crime prevention through environmental design* principles in designing transport stops and stations. *Crime prevention through environmental design* seeks to reduce the incidence and fear of crime by changing the built environment to reduce opportunities for crime to occur and foster positive social interaction. It is already being successfully used in several New Zealand cities.

Transport authorities are not the only ones affected though, as there is also a need for the physical environments immediately adjacent to where people wait for or walk to catch public transport to be safe and to be perceived to be so.

Richard explains, 'Particularly at night, people are deterred by stop or station designs that make them feel enclosed or otherwise vulnerable. They also dislike dark areas, alleyways, and isolated or secluded pathways and streets leading away from or to their stop.

'These are more general concerns that people have about walking around urban areas, both day and night, and councils need to consider these when setting policies and agreeing specific designs. Improved street lighting around public transport stops was a popular measure suggested by survey respondents, as was regular security or police patrols.'

Packages of security measures specifically for bus or train travel also emerged from the research. For buses, there was strong support for the tripartite package of better lighting, security cameras, and emergency alarms or panic buttons to alert guards at bus stops.

With respect to trains, random security guard patrols, emergency alarms and security cameras were also popular, as

were having open kiosks or cafes on stations to provide a human presence.

The latter suggestion was particularly notable, as it was a potentially low cost way to make people feel safer, without introducing the tensions associated with more authoritative figures such as security guards. Whether it was a guard, or a cafe or kiosk, there was overwhelming support among survey respondents for the human presence approach, consistent with findings overseas where such a presence is considered preferable in terms of perceived safety to automated measures such as cameras.

The approach

Carried out in 2007, the research was structured into three distinct phases – an international literature review, qualitative research with focus groups and an online survey. Although the first two stages produced interesting information in their own right, their main purpose was to inform the development of the survey.

The survey's main objective was to 'obtain a general impression of the extent to which concerns about personal security are a deterrent to greater use of public transport in New Zealand', with secondary objectives of identifying the causes of people's personal safety concerns, and exploring potential solutions in terms of security measures.

Three key avenues were put forward as warranting further research – regression analysis and market segmentation analysis, further surveys of participants in the online survey, and further surveys using probability-based methods. Between them, these enquiries would build a clearer picture of the packages of measures that would be most effective for building public transport patronage, test what patrons felt about new measures once in place and examine how perceptions of personal safety were effected.

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Personal security in public transport travel in New Zealand: problems, issues and solutions, Land Transport NZ research report 344 Freely available online at www.landtransport.govt.nz/research
Hard copy $45.00 – email research@nzta.govt.nz to order.

What's happening now?

An interesting insight provided by the report is into how New Zealand's bus and train industries currently address personal safety and security. The outcome of informal discussions with people working in the industries was that the information was not intended as a definitive statement, but none-the-less is a valuable record of the type of issues that the industries presently face.

On buses, two of the main issues are attacks on drivers and vandalism. Robberies and assaults on bus drivers occurred in all three of the cities, with a couple of Auckland companies introducing measures such as protective screens for drivers and CCTVs on board buses to protect drivers from attack.

Christchurch transport authorities had gone one step further by introducing high-level strategies to address social disorder on buses. A recently introduced code of conduct for bus users will establish expected standards of behaviour for patrons, while a complementary media campaign will encourage patrons to take ownership of the public transport system and stand up to disruptive behaviour. Another innovative measure is an after-midnight service, with buses deviating from main routes to deliver people home and waiting until they are safely inside their front doors before continuing on.

With respect to rail, the feeling was that current personal safety issues around rail services are proving detrimental to patronage growth. Stations, car parks and the trains themselves were all identified as potentially unsafe areas, with people threatened by vandalism, tagging, rubbish, 'strange people' and groups of youths. The physical characteristics of railways stations, which tended to be geographically isolated and enclosed with a limited number of exits, added to people's feelings of unease.

In Wellington, Toll has introduced a suite of measures to try and improve patrons' actual and perceived safety, including security guards and Maori wardens on trains, CCTV cameras on trains and at stations, improved lighting, signs and urban design, fostering community ownership of stations through school murals in subways, and encouraging small businesses to locate in stations by charging cheap rent. Similar measures are being introduced in Auckland, and a drop-off in crime in both cities was reported after CCTVs were installed at stations.

New research publications

Using road profile variance to identify sites that promote poor truck ride quality

Research report 352

Neil Jameson, Opus Central Laboratories – $30.00

The relationships between measured truck response data and road profile variance values derived from raw road profiles for short, long and medium wavelengths were examined. Profile variance is a measure of the difference between the actual road profile and its moving average over selected moving average lengths. The effects of geometry and roughness were also investigated, particularly the effects of geometry, curvature and cross fall on the calculation of the profile variance data. Relationships derived from this study were used to generate a methodology for interpreting profile variance data in New Zealand conditions and to establish threshold levels for wavelength content, so that potential sites for truck ride improvement works can be selected and prioritised.

National travel profiles Part A: Descriptions of daily travel patterns

Research report 353

Steve Abley and Michael Chou, Abley Transportation Engineers; Malcolm Douglass, Douglass Consulting Services – $30.00

Gaining a thorough understanding of daily travel for all trip purposes and by all modes of travel is essential to policy and planning. The Ministry of Transport's New Zealand household travel surveys (NZHTS) have, since 2003, been undertaken as continuous ongoing surveys. The dataset resulting from these years of survey include 13,000 people from 6000 households. This large database is a valuable resource covering accidents and safety issues as well as travel profiles. The national statistics are broken down into major and secondary urban areas and also rural areas as the basis of reporting and presentation.

This report makes this information more readily available to researchers and practitioners involved with transportation. The report provides a wide range of tables and graphs relating to modes, purposes and trip legs for weekdays and weekend travel. It concludes with recommendations that the research should continue to provide more detailed investigation of trips, travel trends and regional comparisons. It also recommends that the variables surveyed in the NZHTS be further assessed for use in the development of transportation models for future travel projection.

Better integration of land use and transport at a regional level: Scoping of regional guidelines

Research report 354

Paula Hunter and Sylvia Allan, MWH New Zealand Ltd; Viv Heslop, Vivacity Consulting Ltd; Peter Winefield, Participate; and Terry McDavitt, Pathway Consultancy – $20.00

The integration of land use and transport is considered to be a key priority in delivering a sustainable transport system, yet its implementation remains problematic. The Integrated Approach to Planning (IAP) project has identified both the barriers to implementation and a range of approaches that seek to achieve better integration of land use and transport. This report contributes to the IAP project by scoping the contents of a toolbox specifically designed to assist regions to better integrate land use and transport and by recommending to the NZTA the content for the toolbox and how it should be developed.

A toolbox approach recognises that New Zealand's regions vary greatly in size, complexity and the issues that they have to deal with, and as such 'one size does not fit all'. The approach to scoping the toolbox was to research a range of tools across the spectrum of six key action areas developed by the IAP project: legislation; policy (non-legislative); institutional frameworks; funding; planning practice (implementation); and capacity and capability. These tools were discussed with members of a steering group who provided a breadth of knowledge and experience from across New Zealand, and assisted in the refinement of the tools and prioritisation of the elements of a regional toolbox that form the recommendations in this report.

Engineering lifelines and transport: should New Zealand be doing it better?

Part one: Situation scan and NZ risk exposure

Part two: Gap analysis and solution development

Research reports 355A and 355B

M. Gordon and S. Matheson, Maunsell Ltd – $35.00

This project examined New Zealand engineering lifelines activity, its level of integration in road controlling authority management practices, and its relationship to the resilience of roading networks to natural hazards.

It examined and compared lifelines practice at three levels – international, New Zealand regions and individual road controlling authorities. Relative risk exposures arising from natural hazards and their impacts on regions were assessed at a qualitative level, highlighting the importance of a comprehensive lifelines approach throughout much of the country.

The project found there were many gaps in practice and that it was difficult to align the effectiveness of expenditure with measures of increased resilience.

These gaps present opportunities for improvement, which are described with recommended actions. These include further development of asset management plans, establishing resilience measures, better use of technology for associating hazard events with infrastructural assets, more comprehensive risk management practice and a more proactive approach to funding risk-based investment.

Walkability research tools: Summary report

Research report 356

Steve Abley, Abley Transportation Engineers – $10.00

NZ Transport Agency commissioned Abley Transportation Engineers Limited (ATEL) to:

- facilitate the collection of community street review (CSR) data, and
- develop a methodology for the collection of physical and operational variables related to CSR routes, and
- collect physical and operational data on the CSR routes.

The purpose of the research was to link physical and operational variables in the walking environment to perception surveys undertaken using the CSR methodology. These tasks were undertaken as part of the Walkability Tools Research project.

CSRs were developed as part of a separate commission between Living Streets Aotearoa Inc and ATEL for the Heath Sponsorship Council. The Health Sponsorship Council has since handed over responsibility for the ongoing success of CSR to the NZTA.

The Walkability Tools Research project involved defining appropriate physical and operational variables related to walkability and developing a methodology for the collection of these variables. The next stage involved collecting data, refining the methodology and ensuring it was entered and securely stored in an electronic database.

The survey data will be used by the NZTA for the development of a later mathematical model whereby walkability perceptions can be inferred by physical and operational measurements. The database is currently stored and accessed via www.levelofservice.com.

This report provides a summary of the data collected to date, the reports issued for this project and recommendations for data enhancement and analysis.

Managing transport challenges when oil prices rise

Research report 357

S. Donovan, J. Genter, B. Petrenas and N. Mumby, McCormick Rankin Cagney; T. Hazledine, University of Auckland; T. Litman - Victoria Transport Policy Institute; G. Hewison, T. Guidera, L. O'Reilly and A. Green, Brookfields Lawyers; G. Leyland, Incremental – $25.00

This report provides practical guidance to central, regional, and local government agencies on how to manage the transport challenges associated with rising oil prices. The three main sections of the report are:

- Modeling prices for transport fuels – several oil price forecasts are combined to develop a view on future oil prices. This shows annual average oil prices staying around $110 USD/barrel in 2008, before accelerating rapidly to reach approximately $150 USD/barrel in 2012. After this point prices may stabilise or even decline. Retail prices for petrol and diesel are expected to peak at approximately $2.80 and $2.50 NZD/litre respectively in 2011. Upside and downside risks to these price forecasts exist, particularly in relation to economic growth.
- Modeling future travel demands – travel demand elasticities and cross-elasticities are used to model future travel demands. This considered the effects of fuel prices, economic growth, vehicle ownership, workforce participation, and disposable income on vehicle kilometres travelled (VKT). Under the average fuel price scenario total VKT falls below current levels until approximately 2016, after which the combined effects of economic growth, increases in income, and population growth become dominant.
- Responses to rising oil prices – a range of responses are identified in the areas of land use management, direct and efficient pricing, infrastructure management, behaviour change and education, and freight management. These responses are cumulatively expected to shift travel demands from passenger vehicles to alternative modes, such that total VKT remains at or below current levels. It is recommended that the focus of infrastructure investment shift from peak hour capacity expansion and instead prioritise investment in road network maintenance and alternative transport modes. Both these measures are likely to deliver a transport system that is more energy efficient, as well as realising a range of wider economic benefits.

Obtaining our research reports

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NZTA research

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Contributed articles are welcome, and should be typed in double spacing and not exceed 1000 words. Illustrations may be either black and white or colour, and must be of high quality. *NZTA research* reserves the right to edit, abridge or decline any article.

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