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research

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Three steps help keep the environment safe

Recycled or alternative materials are often seen as a good way to reduce demands on scarce (and expensive) resources and help the environment.

So it makes sense that road authorities are keen to include these materials in their construction work. But how are authorities to judge whether a particular recycled material is safe to use? Nobody wants to see a situation where recycled or previously untested materials inadvertently cause more harm to the environment than good.

Help is at hand though, through a Land Transport NZ-funded project that has developed a three-stage process that authorities can use to evaluate materials.

Phil Herrington of Opus Central Laboratories, who led the research, says, 'Incorporating alternative materials in road construction, whether they're new materials that an authority hasn't used before or recycled waste materials, can have obvious benefits, both in terms of improving surface or pavement performance and in terms of reducing costs.

'However, it's essential that making innovations in construction doesn't have long-term negative impacts for the environment, for example through leaching of chemicals or other contaminants from the materials into surrounding land or waterways. What we set out to provide through the research was a set of logical, straightforward guidelines that road authorities, contractors and suppliers can use when they're deciding whether to make use of new or recycled materials in their work.'

In New Zealand, the drive to incorporate recycled materials into road construction is coming from high-level government policy and strategy. In particular, the Ministry for the Environment's national waste strategy seeks to reduce the volume of waste going to a landfill by encouraging waste producers to reduce the amount of waste they make and to find ways that their waste materials can be recycled or reused.

Phil says, 'Reusing building and demolition waste, slags, fly ashes, etc in road construction can provide an attractive alternative means of disposal, provided, of course, that engineering performance is not compromised.

'At present, the main recycled materials used in New Zealand roads are waste rock, concrete and asphalt millings. An even greater range of materials is used overseas, and it's likely that more of these materials will start being considered for use here in the near future. What we foresaw would be needed was an effective procedure so that, as these materials came on line, road authorities could use it to assess whether they were environmentally safe. That's where the guidelines come in.'

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Your views

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

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What might we use?

- Waste rock – used in the same way as conventional aggregates in the base, sub-base and sub-grade layers. Needs careful screening to ensure geochemistry and physical characteristics are favourable.
- Reclaimed (crushed) concrete – can be used as aggregate in base course and sub-base layers once foreign debris and reinforcing steel have been removed. Alkalai leachate may be a problem.
- Reclaimed asphalt – once crushed and screened, can be used as aggregate in base, sub-base and sub-grade layers. Contaminants generally come from vehicle emissions deposited on the surface and then mixed in through crushing, although subsequent leaching of these contaminants has been shown to be insignificant.
- Reclaimed chip seal – fragments can be used in the base course as aggregates. Should not pose any environmental risks.
- Crushed bricks – used as an alternative to aggregates in the sub-surface layers. Should not create environmental problems unless the materials the bricks were made from were contaminated or recycled.
- Coal fly ash – used in Europe and the United States as embankment or structural fill material, although can also be used in building base or sub-base layers. The composition of fly ash can vary considerably, and certain minerals and metals, if present, can pose a leaching hazard.
- Spent foundry sands – generally clean, high-quality sand but can contain leachable contaminants, such as heavy metals and phenols that are absorbed by the sand when it is used to make moulds for casting.
- Scrap tyres – used to build pavements and surfaces. While the rubber itself is inert, additives used during tyre manufacture may be potentially environmentally harmful.
- Glass – can be used in aggregate applications, eg a small amount can be successfully added into base course aggregates. Should not release any chemicals into land or water, provided the glass itself was not contaminated, such as from storing hazardous chemicals.
- Waste motor oil – used as a dust suppressant on unsealed roads, although this practice is now less frequent. Contains high concentrations of engine wear metals and polyaromatic hydrocarbons, which can be leached or spread airborne on dust.
- Waste plastic – can be chopped or shredded and added to asphalt as part of the aggregate component or the bitumen component of the mixture. Can also be used in the sub-base and base course layers. Although most common plastics are inert, additives to them may leach.

Guidelines

The guidelines set out a three-stage process that will allow Transit New Zealand, local authorities and contractors to evaluate the possible adverse environmental effects of new and recycled materials against the background of how and where they are proposed to be used.

Using the guidelines, authorities can evaluate the risk of longer-term environmental effects caused by gradual leaching of contaminants (into soil, surface water or groundwater, either during or immediately after rain).

'Leaching is the main way that contaminants from road materials can enter the environment,' says Phil, 'so a focus of the research was on the efficacy of various leaching tests and leachate analysis methods. What we found is that there are many factors that can influence the leaching process, including chemical processes, physical factors and external factors, and it is very hard to reproduce these under laboratory conditions. As a result, an important feature of the guidelines is the need for a comprehensive environmental impact assessment if there is any indication in the earlier stages that materials contain contaminants that may leach.'

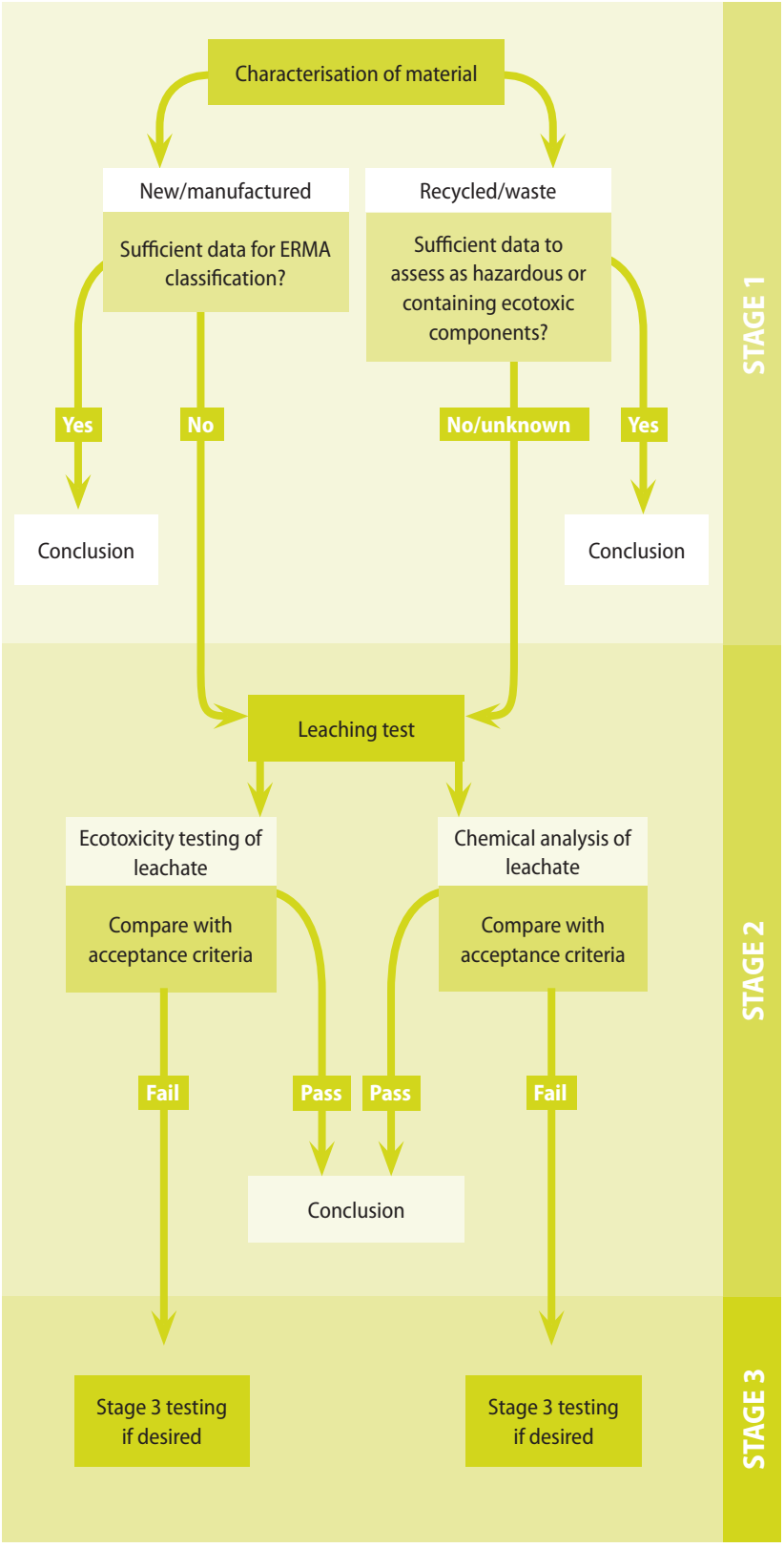
What the guidelines don't cover are environmental impacts, such as sediment runoff, that are associated with the construction work itself. Phil says, 'Comprehensive guidelines have already been published for these situations, and they will apply equally whether the materials are new or recycled ones, or the standard materials that the authority always uses.'

What the guidelines do provide is a comprehensive step-by-step process that road authorities can use when faced with the decision of whether or not to make use of the growing range of new and recycled materials that are becoming available for road construction.

The three steps

- Stage 1: Initial assessment – this stage of the process is about gathering information to decide (based on what is already known) whether the material is considered hazardous to the environment. This will include looking at all the relevant legislation, regulations and guidelines, and asking whether a) the material is hazardous and b) it needs approval from the Environmental Risk Management Authority (ERMA). Where insufficient information is available, the material will need to go to stage 2.
- Stage 2: Material screening tests – this stage involves a conservative screening test to decide if the material contains environmentally harmful contaminants in a leachable form. Leachate tests and assessment procedures are recommended. If this stage indicates that the material contains potentially harmful leachable contaminants in significant concentrations, then the material needs to go to stage 3.
- Stage 3: Comprehensive environment impact assessment – this stage involves a more comprehensive environmental impact assessment using data from less conservative (more realistic) leaching tests. The tests will include site parameters (such as geometry and hydrology) to model the release, transport and fate of the contaminants over time. The report suggests how this assessment could be made, but does not go into a detailed process.

Process diagram – environmental evaluation of road constriction materials



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Assessing the environmental effects of new and recycled materials in road construction,
Land Transport NZ research report 306, $20.00.
See page 11 for details about buying reports.

And on a similar topic …

A second Land Transport NZ-funded research project, completed during 2005 and 2006, looked at the local and international literature around using industrial by-products in road construction and the potential environmental issues that such use may raise.

The impetus for the research has been the same – the need to conserve natural resources, reduce the volume of waste going to a landfill, reduce costs and promote New Zealand's clean green image.

Potentially useful industrial by-products include crushed concrete, recycled asphalt pavement, smelter slag, steel slag, crushed glass, fly ash, scrap rubber, bag-house fines, kiln dusts, paper-making residues, waste incinerator ash and waste plastic granules and fibres. There is increasing interest in all of these products from Transit New Zealand and local authorities who are keen to innovate but, at the same time, want to make sure the environment is protected.

The outcome of the literature review has been a new process for assessing by-products to enable them to be categorised as inert, notifiable or assessable, depending on their composition, intended use and track record. Under the process, the onus for testing and categorising the by-products would be with the supplier, with it then left up to the road authority to decide whether or not they were suitable and safe to use.

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Environmental impact of industrial by-products in road construction – a literature review,
Land Transport NZ research report 308, $20.00.
See page 11 for details about buying reports.

Research builds a clearer picture of tolls

As the number of motorists and vehicles on New Zealand's roads grows, road controlling authorities are looking with renewed interest at tolls as a means of funding the extra infrastructure required. The removal in 2001 of the tolls from Tauranga Harbour Bridge provided a rare opportunity to examine exactly how New Zealand drivers react to tolls and to understand how well patronised toll roads will be, if and when they are built. It also offered an opportunity to understand any traffic demand management effects associated with tolls.

In 1988, a new harbour bridge was built between central Tauranga and Mount Maunganui. A toll of $1 for light vehicles and $4 for heavy vehicles applied between 6 am and 11 pm for motorists wanting to use the bridge.

Thirteen years later, the toll was removed. During that time, daily traffic flow over the bridge had increased from 10,000 to 27,200 vehicles per day. Six years later, traffic flow has increased again, with nearly 40,000 vehicles per day (the bridge's capacity) using the bridge at peak times.

Work is currently underway to widen and improve approaches to the bridge, and the government has considered imposing a toll once again to help pay for this work.

Andrew Murray of Beca Infrastructure says that the removal of the toll from the bridge presented a valuable opportunity to examine in greater depth how New Zealand drivers respond to tolls. 'Tolls are in common use internationally and, as a result, overseas countries have well-established procedures for forecasting how toll roads will be patronised. What we didn't know is how this knowledge would translate to a New Zealand context. Drivers here are not used to tolls, many may never have encountered them, so we needed to understand how tolls would affect people's driving behaviours before we went ahead and built a host of new toll roads. There is also uncertainty about how tolls affect the total number of trips being made, as opposed to drivers just diverting to alternative routes.'

The recently released Land Transport NZ-funded report on the research contains information to provide a benchmark and improve forecasting about traffic flows on proposed new toll facilities. Specifically, it provides data on how traffic responded to toll removal, both in terms of route diversion and also in terms of total traffic using the corridor. While it does not represent a comprehensive analysis of travellers' behaviour choice, it does imply information about the parameters and elasticities of drivers' behaviour when faced with tolls, which will help authorities to develop more accurate (in the New Zealand context) models for forecasting.

The study

Andrew says that the study, which took place in 2004, had three main purposes. 'Our primary purpose was to observe how traffic flows over the bridge changed after the toll was removed. From this, we hoped to better understand the parameters that affected whether or not motorists chose to use the bridge and the level of change associated with the $1 toll cost. We also looked at how total trip making in the corridor altered and, subsequently, the level of induced traffic associated with the toll removal. Finally, we wanted to be able to compare what we had modelled for toll removal against what in fact happened, and from that improve our traffic-modelling techniques.'

Before the completion of the harbour bridge in 1988, only one other main route linked the western side of Tauranga harbour to its eastern side, including Mount Maunganui, Papamoa and the wider eastern Bay of Plenty. This route, which has remained popular with motorists, goes along State Highway 2 and State Highway 29, at one point crossing the Maungatapu Bridge. Other routes were too rural or remote to be considered as real alternatives to the harbour bridge crossing.

The existence of this one alternative major route was useful, as it enabled the study to trace more clearly how travel behaviours changed after the toll was removed. The study started by collating all available traffic count data on both routes, from both before and after toll removal. The data was then analysed to work out how traffic flow patterns changed and to understand whether the toll worked to divert drivers and whether drivers were induced to use the harbour bridge when the toll was removed.

Initial traffic usage models were run for use of the bridge, both with and without the toll, and the predicted changes in use from these were compared with the actual observed changes. 'This enabled us to run alternative models to see if we could develop one that would have given a more accurate predication', says Andrew. 'It also enabled us to use observed changes in the traffic flows and journey costs to estimate the value that motorists applied to the toll.'

The findings

Initial effects on traffic flows from the toll removal were quite significant. On the Tauranga Harbour Bridge, daily flows increased by 26 percent, while, on Maungatapu Bridge, they initially reduced by 10 percent, but returned to normal levels after 14 weeks. Overall, the combined daily flows on both routes increased by 15 percent, demonstrating that the toll's removal induced significantly more traffic to use these routes.

The effect on heavy commercial vehicles was even more pronounced, with an increase of 74 percent, or 1000 more trucks each day, using the harbour bridge, while only 150 fewer per day used the alternative Maungatapu Bridge route.

The study also found that the original traffic model had over-predicted how much the traffic would increase once the flows were removed. Tests of different models and parameters showed that the parameter that would most influence how accurate the model proved to be was the weight applied to tolls. People's value of time had to be doubled if the model was to replicate the actual changes in flow. The study also found that the increase in traffic during non-peak periods was significantly greater than during the peak periods, and the original model structure did not reflect this well.

Andrew says that, from the observations and modelling, the study was able to draw some important implications for future forecasting of road toll projects. 'What became clear is that tolls can have a much greater effect than simply encouraging people to divert to alternative routes. Tolls can have the effect of suppressing or redistributing trips, and this has important implications for travel demand management, particularly in urban areas or for projects where the new tolled route may provide significant savings in terms of travel times and distances.'

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Effects of toll removal on Tauranga Harbour Bridge, New Zealand, Land Transport NZ research report 313, $20.00. See page 11 for details about buying reports.

To seal or not to seal – only part of the question

Unsealed roads are a familiar part of New Zealand's rural landscape, but would accident rates reduce if these roads were all to be sealed? Or might the opposite be true? A recent Land Transport NZ-funded study set out to answer this question.

A significant proportion of New Zealand's road network is currently unsealed – approximately 33,000 km of the total 93,000 km (around 35 percent). These roads range from main roads to access roads, and are located on all types of terrain, from flat and straight to winding and mountainous.

Accidents happen on all types of roads, but questions existed around whether these could be reduced by sealing roads – or whether, in fact, the opposite was true. Certainly, previous reports had commented on an increase in the accident rate following seal extensions, noting that the new seal could encourage higher speeds.

Peter Bradshaw from Beca Infrastructure, which carried out the new research in 2005 and 2006, says there were two areas they wanted to explore through the research.

'Our first challenge was to determine whether there were benefits or disadvantages associated with sealing unsealed roads. To do this, we collected data, through a pilot study then later a more detailed study, about roads that had recently been sealed and accident statistics on these roads before and after sealing.

'The second step was to have been to develop a procedure that road authorities could use to calculate the accident benefits (or disadvantages) of sealing a particular road. In the event, this didn't prove necessary, as we found no evidence to suggest that sealing had any significant effect on accident rates.'

The data

The initial pilot study for the research used existing data about accident rates on recently sealed roads. The accident benefits (or disadvantages) were evaluated based on a terrain classification (flat, rolling, hilly or mountainous) and the location of the road (North Island or South Island).

The analysis of the entire dataset (for all terrains and locations) for the pilot study showed an increase in accidents after sealing of approximately 0.1 accidents/year/vehicle-km. Similar results were shown for flat South Island roads, but there was insufficient data for North Island roads.

The detailed study set out to fill these gaps with data collected from throughout the North Island about roads that had received seal extensions between 1994 and 2001. Accident data for these roads was then collated for the four years on either side of when the extension happened. Data on at least 68 sites for each terrain classification (flat, rolling, hilly or mountainous) was collected. Flat sites were split into North Island and South Island sites to determine whether there was a difference in effect between the two regions.

The site groupings were then analysed to see whether the sealing had made any difference to crash rates. The conclusions reached for each grouping are set out in the table on the page opposite.






Outcome of the statistical analysis

Classification	Sites	Mean difference	95% confidence interval	Conclusion
Overall (all road lengths)	393	0.0840	–0.268, 0.436	No statistical change in the accident rate
North Island flat	80	–0.0253	–0.530, 0.479	No statistical change in the accident rate
South Island flat	98	1.006	0.401, 1.611	Statistical evidence of an increase in the accident rate
All flat	178	0.542	0.311, 0.773	Statistical evidence of an increase in the accident rate
Rolling	65	–0.0295	–0.362, 0.303	No statistical change in the accident rate
Hilly	91	–0.721	–1.956, 0.514	No statistical change in the accident rate
Mountainous	59	0.0686	–0.316, 0.453	No statistical change in the accident rate

Overall, the research concluded that there was no statistically significant benefit (or disadvantage) associated with sealing unsealed roads. This, in effect, validated the current funding procedures in Land Transport NZ's *Economic evaluation manual*.

Peter says, 'What the research also shows is that, for specific roads within the groupings, there were quite pronounced changes in accident rates after sealing. There were both increases and decreases, depending on the road.

'We recommended that local authorities look at these roads to see if there was a common hazard, other than sealing, that might be the cause.

'The only other grouping to show a statistically significant increase after sealing was South Island flat roads, and again we recommended that a proportion of these sites should be looked at to work out why this should be.'

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Accident benefits of sealing unsealed roads, Land Transport NZ research report 314, $20.00. See page 11 for details about buying reports.

Walking and cycling – who is ready to do more?

A recent Land Transport NZ-funded research project has used data from the extensive Obstacles to Action database to shed new light on New Zealanders' readiness to take up cycling and walking.

The research was also able to draw conclusions about the readiness to change of specific population groups, making it easier for promotional activities to correctly target their audiences.

In reaching its conclusions, the project accessed a larger quantity of data than has previously been available about people's motivation with respect to walking and cycling. In 2003, Sport and Recreation New Zealand (SPARC) and the Cancer Society of New Zealand commissioned a nationwide survey about the physical activity and eating habits of adult New Zealanders. The resulting Obstacles to Action database contains responses to a questionnaire from more than 8000 people aged 16 or over.

The questionnaire contained several transport-related questions, which the current project analysed with respect to cycling and walking. Key questions included:

- how often people did these activities
- how ready people were to take them up as forms of transport
- differences in use and readiness between population groups.

Readiness to change

For both cycling and walking, the research analysed people's responses to questions about how likely or willing they were to use these forms of transport in certain circumstances. From their responses, people were placed into one of six categories of readiness to change, ranging from 'pre-contemplation' (the respondents would not even consider walking or cycling as an option) to 'maintenance 2' (the respondents would almost always cycle or walk in this situation).

Readiness to change statistics are particularly important for active transport strategies and initiatives because they highlight that different types of initiatives may be needed to influence different groups of people, depending on how ready they are to walk or cycle. They are also important for monitoring the success of campaigns, because they measure changes in people's attitudes (ie people becoming more ready to contemplate an activity in the future), rather than just changes in actual current behaviour.

Cycling stages of change

The following table shows how respondents completed this question about cycling:
For a short journey when the weather was fine and you have nothing to carry, would you ...

Stage of change	%
Not even consider using a bicycle (Pre-contemplation)	41.1
Realise that you could use a bicycle but wouldn't actually do it (Contemplation)	13.6
Think seriously about the pros and cons of cycling but rarely do it (Ready for action/Preparation)	8.0
Try cycling on some occasions (Action)	17.6
Cycle quite often (Maintenance 1)	9.8
Almost always cycle (Maintenance 2)	4.7
Not answered	5.2
Total (n = 8163)	100.0

Walking stages of change

The following table shows how respondents completed this question about walking:
For a journey of 1.5 km (about 15 minutes walk at normal walking speed), when the weather was fine and you have nothing heavy to carry, would you ...

Stage of change	%
Not even consider walking (Pre-contemplation)	5.8
Realise that you could walk but wouldn't actually do it (Contemplation)	6.0
Think seriously about the pros and cons of walking but rarely do it (Ready for action)	4.2
Walk on some occasions (Action)	26.8
Walk quite often (Maintenance 1)	21.6
Almost always walk (Maintenance 2)	25.0
Not answered	10.5
Total (n = 8163) (rounded)	100.0

Promotions to encourage people to walk or cycle are best targeted at people in the 'ready for action' and 'action' categories, as these people have at least contemplated the possibility of using these transport modes but may need encouragement or incentives to start using them regularly. People in the 'pre-contemplation' stage are less susceptible to targeted encouragement, as they do not even see walking and cycling as possible options.

Replacing car trips

Also of interest from the responses was how ready people were to use walking or cycling in place of car trips. Thirty-seven percent of respondents agreed that they could replace a car trip by cycling or walking at least two days most weeks, without too much difficulty.

People were more likely to agree that they could walk instead of drive, rather than cycle. This reflects the fact that more of the respondents already walked than cycled.

Not surprisingly, people in the 'pre-contemplation' stage were less likely than people in other stages to agree that they could replace car trips. For example, only 18 percent of people in the walking 'pre-contemplation' stage said they could walk instead of drive, compared with 46 percent in the 'maintenance 2' stage (those people who almost always walk).

Cycling

Most respondents to the survey were non-cyclists (69 percent), with only 11 percent saying that they cycled regularly (once a week or more often).

More men than women cycled, and cycling decreased with age. The large sample size enabled the research to detect that cycling was also much less common among Asian and Pacific people than it was among New Zealand Europeans and Māori. Cycling decreased with increasing obesity. It also tended to stop for women who had young children.

Overall, 5.8 percent of respondents said they had 'never learned to ride properly', although there were large variations between ethnic groups (17 percent and 21 percent for Pacific peoples and Asian peoples respectively, compared with 4 percent for New Zealand Europeans and 6 percent for Māori). Given that children's cycling is known to have declined in recent years, the project report highlighted that this was an important area to monitor in the future and that Pacific and Asian children might require special initiatives. Clearly, the impact of initiatives that aim to increase cycling will be undermined if fewer people are learning to ride in the first place.

With respect to the stages of change, respondents in the two groups that would be most fruitfully targeted by cycling promotion campaigns ('ready for action' and 'action') were fairly evenly balanced between the genders.

This result differed noticeably from the clear gender difference in people who were currently cycling (around twice as many men as women regularly cycle). Around half of the respondents in these two stages of change categories were aged between 35 and 64.

Recognising that many cycling promotion initiatives are regional and that cycling is more strongly linked than walking to demographics and hilliness, the research reported on people's stages of change with respect to cycling for 12 different regions around the country.

Walking

From a transport perspective, the data on walking in the Obstacles to Action database has a rather narrow focus on brisk walking (resulting from SPARC's and the Cancer Society's focus on health benefits).

Respondents were asked how much time they spent walking briskly each week. This probably excludes a lot of walking done as a mode of transport (as opposed to a purposeful exercise activity). There was also no distinction between walking for leisure and for more utilitarian purposes.

The number of people who walked briskly was much greater than those who cycled, with only 22.6 percent of respondents saying they didn't walk (compared with 69 percent non-cyclists) and nearly 31 percent of respondents saying they had walked briskly for at least 2½ hours (often more) in the past week.

Walking was shown to be less related than cycling to external variables such as demographics, work status and urbanisation. This is important as it means that campaigns aimed at increasing walking do not need to take these things into account but can concentrate instead on other factors, such as targeting people in specific stages of readiness to change.

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Substantially fewer people (5.8 percent) fell into the 'pre-contemplation' stage for walking readiness to change (eg they would not even consider walking) than for cycling (where the figure was 41.1 percent). This highlights that walking is seen as a more accessible and popular form of alternative transport. The fact that so many respondents already walk, combined with there being no need for any specific equipment, confirms that walking should be concentrated on in active transport strategies.

Taking the environment into account

Several recent studies have borne out the importance of environmental factors in influencing how prepared people are to walk and cycle. The Obstacles to Action questionnaire asked people about a list of possible barriers that would deter them from physical activity, with the most common response being not enough street lighting, heavy traffic, not enough cycle lanes and paths, and dog nuisance.

However, the list was somewhat limited and the research concluded that local authorities should look not only at the concrete environmental issues that may discourage cycling and walking (such as lighting and dogs) but also at broader issues of urban design (such as encouraging mixed land use or increasing the amount of public open space).

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Increasing cycling and walking: An analysis of readiness to change, Land Transport NZ research report 294, $40.00. See page 11 for details about buying reports.

New research publications

Light/medium commercial vehicle use in four urban centres
Research report 316
C O'Fallon, Pinnacle Research and Policy Ltd; C Sullivan, Capital Research Ltd
$30.00

This study, undertaken in 2004–2005, explores light to medium commercial vehicle trip patterns in urban areas. We selected four case study corridors: two in the heart of the central business district of a major city (Queen Street, Auckland, and Lambton Quay, Wellington) and two in the main business area of a secondary city (central Takapuna, North Shore City and central Lower Hutt).

We conducted face-to-face interviews with key informants from organisations located within each corridor. Approximately 50 such organisations were interviewed. Given the extensive use of couriers in all four corridors, we also interviewed one non-urgent and one urgent courier company operating in the Wellington region.

The project had four main purposes:

- to qualitatively clarify the nature, as well as the driving factors (eg consumer preference, inventory requirements), of urban-based light and medium commercial vehicle movements
- to categorise the types of movements and usage of transport services by organisational purpose (eg goods vs services, perishables vs non-perishables) to the extent feasible within a case study approach
- to comment on the impact different policy tools might have on such movements, based on key informant interviews
- to discuss the implications for modelling such movements (eg for forecasting).

ITS environmental monitoring and forecasting: International trends and experiences
Research report 317
Rod James, Hyder Consulting (NZ) Ltd
$35.00

The purpose of this project was to review the use overseas of environmental monitoring and forecasting systems as a component of wider-integrated ITS facilities, in particular those linked to transport and traffic management, and to consider their potential for New Zealand. It also aimed to provide direction from overseas best practice on the use of these systems to monitor, forecast and manage the adverse environmental effects of New Zealand traffic.

Through evaluation of these systems, this research intended to highlight the benefits that could be achieved through an improved ability to plan and manage traffic on the basis of accurate and reliable environmental data. It also planned to provide better information on the adverse effects of traffic on the environment, especially through air and noise pollution, leading to better-targeted mitigation strategies (short and longer term).

Clay mineralogy of modified marginal aggregates
Research report 318
FG Bartley, Bartley Consultants Ltd; CC Harvey and G Bignall, Institute of Geological and Nuclear Sciences Ltd, Wairakei; AB Christie, A Reyes, R Soong and K Faure, Institute of Geological and Nuclear Sciences Ltd, Lower Hutt
$25.00

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This study, undertaken in 2003–2004, aimed to:

1 study changes produced when additives are mixed with roading aggregates containing swelling clay minerals

2 identify the most suitable chemical to use for a particular rock type and the quantity required to achieve particular effects, namely:
   - conversion of the clay to a better form
   - establishment of bonds between particles
   - strength that is insensitive to water content
   - minimal drying shrinkage
   - permanence.

Samples of fresh, partly weathered and weathered rocks of three rock types were taken from four quarries. Cement, lime or Durabind™ was added to the partly weathered samples at two levels.

The untreated and treated samples were analysed. Proctor Needle and CBR testing was performed on the partly weathered samples.

Volcanic rocks contained a higher proportion of more readily weathered minerals than greywacke. Drury greywacke was more intensively sheared than Otaika greywacke. All partly weathered materials treated with 3 percent of additive had satisfactory CBR values.

Methylene Blue tests and X-ray diffraction analysis confirmed that 3 percent of additive almost eliminated swelling tendencies.

Geochemical studies identified that additives reversed the trends of changing fluid composition caused by weathering.

Cement stability was investigated by suspending crushed treated samples in water. Swelling tendency increased over time, but in alkaline conditions, the aggregates returned to 30–70 percent of their original values after four days.

Benchmarking pavement performance between Transit's LTPP and CAPTIF programmes
Research report 319
TFP Henning, DC Roux and D Alabaster, MWH New Zealand Ltd
$35.00

This report details the findings from research conducted on the long-term pavement performance (LTPP) programme and on the Transit New Zealand CAPTIF programme for accelerated pavement testing. The research was aimed at delivering a complete new model format to predict rut progression on New Zealand roads. It was based on earlier findings that suggested some limitations with the current approach using the World Bank's HDM rutting models.

A three-stage modelling approach is recommended:

- firstly, a simpler model is proposed to predict the initial rutting or densification
- average progression rates are proposed for the annual increase of rutting during the normal life of the pavement since no satisfactory model could yield any results that were more accurate
- lastly, a probabilistic model is proposed to predict the probability or risk of a pavement undergoing accelerated rut progression caused by weak layers or overloading.

One benefit that the new proposed model promises is its simplistic format, which makes it easy to adopt into a modelling system. Another is it is based on improved accurate pavement condition data. Further work in this area is recommended, mostly on the practical implications of these research findings, and on developing remaining models based on the LTPP programme and CAPTIF experiments.

Obtaining research publications

Research reports are freely available online at www.landtransport.govt.nz/research. They can also be purchased in hard copy. To order any of these reports, or for questions regarding Land Transport NZ's research programme, please email research@landtransport.govt.nz.

Carolyn Marslin – the new Research Programme Analyst

Land Transport NZ was delighted to welcome Carolyn in April this year to a key role within the Research Programme Team. Based at Land Transport NZ's national office in Wellington, Carolyn works alongside Patricia McAloon, Manager, and Nigel Curran, Senior Analyst, to coordinate and develop the Research Programme. She is the first point of call for Research Programme matters, and many readers will have already contacted her by telephone (04) 931 8772 or email carolyn.marslin@landtransport.govt.nz. Originally from Central Otago, Carolyn moved to Wellington after completing her OE and worked at Parliament as a Hansard Reporter/ Editor prior to joining Land Transport NZ.

Timing alert for 2008/09 Research Programme

From now on, the Research Programme's application and assessment process will run about a month earlier than in previous years. This means that Expressions of Interest for the 2008/09 Research Programme will need to be lodged with Land Transport NZ by Wednesday 21 November 2007. View the new timetable and updated documentation on our website at www.landtransport.govt.nz/research/funding-process.html.

Land Transport Research

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

Land Transport Research is published quarterly by Land Transport NZ. Its purpose is to report the results of research funded through the Land Transport NZ research programme, to act as a forum for passing on national and international information, and to aid collaboration between all those involved. It also aims to stimulate inquiry, discussion and solutions concerning land transport and Land Transport New Zealand's areas of research focus – namely, environmental effects, sustainability, travel behaviour, safety and personal security, and risk, network and asset management.

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. *Land Transport Research* reserves the right to edit, abridge or decline any article.

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

Inquiries on specific articles should be made to the author. Otherwise, all general correspondence and queries related to conference notices and mailing list requests should be made to: research@landtransport.govt.nz.

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