VIASTRADA

TRAFFIC ENGINEERING AND PLANNING

TRANSPORT NETWORK OPTIMISATION

Think-piece document prepared for

Land Transport New Zealand

ViaStrada Ltd

July 2008

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Quality Assurance Statement			
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Project Number:	234		
Project Name:	Network Optimisation Think Piece		
Status	Final		
Date:	7 July 2008		

Acknowledgements

ViaStrada wishes to acknowledge with gratitude the assistance provided by the following groups and individuals in preparing this document:

- International panel: Tony May (University of Leeds, UK), Todd Litman (Victoria Transport Policy Institute, Canada), Russell Thompson (University of Melbourne, Australia) and Troels Andersen (Technical Traffic Solution, Denmark);
- Network Management Focus Group steering committee: Balt Gregorius, Geoff Mansell and Wayne Osmers;
- Christchurch City Council transportation staff, and staff of related transport agencies;
- External project team members: André Dantas (University of Canterbury) and Paul Roberts (Christchurch City Council); and
- Many individuals from local, regional and national government organisations who have provided information on the New Zealand examples in Section 5.

Summary

This discussion document looks at ways of optimising New Zealand's road transport network. It is assumed that we will not be attempting to build our way out of congestion – instead we are moving towards smarter ways of managing land use (to reduce the need for travel) and more sustainable modes of transport. Better integration of land use and transport planning is recognised as a key requirement through to 2040 and beyond. Increasingly, we will be attempting to get better value for money out of our road network by using existing roads better (for all modes) rather than building more roads.

Nationally, there is an increasing emphasis on sustainability, not just in transport but across all sectors. Fuel price rises, climate change, the health sector's support for more active lifestyles and the desire for improved urban design in our towns and cities are strong reasons for a more sustainable transport future.

Managing land use better to minimise the need for travel will be essential. Travel demand management and other techniques to change attitudes and behaviour will be part of the toolkit for optimising our road network. This optimisation must increasingly include the needs of pedestrians, cyclists and public transport users. These changes will help us improve the quality of life in our urban areas and achieve national targets for reduced emissions, less motor vehicle travel and more travel by sustainable modes.

There is much we can do to improve the operation of the road network itself to better support sustainable travel. This includes traffic signal optimisation, implementation of traffic calming, better management of the quantity and location of parking, bus priority measures, better freight practices and enhancements to our road network to support walking and cycling. A key to better urban design and more walkable, cycle-friendly cities will be reducing traffic volumes and speeds in city centres and on residential streets.

Specific programmes for walking and cycling will be needed, not just for infrastructure, but for marketing and promotion. We need to provide conducive environments in our towns and cities where people feel they have the option to walk or cycle for routine trips to work, school, local shops and for social and recreational purposes – and then choose to do so.

Pricing and charging for roads and parking are increasingly being used overseas to encourage desired transport outcomes and these tools will be needed in New Zealand. The urge to reduce fuel taxes (or not introduce regional fuel taxes) in times of international price rises should be resisted as pricing is a very effective way of forcing change, while at the same time helping manage congestion and raise revenue for more sustainable transport options. Ensuring users pay the full price of travel encourages people to reduce trips and choose the right mode for each trip, thus improving community outcomes.

The discussion document draws inspiration from five international case studies. London (UK), Portland (Oregon, USA), Odense (Denmark), South East Queensland (Australia) and Freiburg (Germany) have been chosen to illustrate a series of measures used to manage transport in cities. They all rely on the use of many interventions, where land use and transport planning is integrated and sustainable travel modes are actively supported.

In addition, some 30 New Zealand examples of good practice are discussed. They typically showcase an innovative solution in one of our towns or cities and are intended to provide inspiration for others to emulate. However, as in the international case studies, we will need to make many changes in our urban areas; no single treatment will be sufficient to achieve our goals.

Finally, the document includes a "shopping list" of actions for local and regional government to consider. They may not all suit every town or city, but there should be something for everyone. Strong leadership at the local and regional level, by both professionals and their elected representatives, will be needed. Change is needed now to achieve the outcomes we desire for this generation and the ones to follow.

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1 Introduction

This document is intended for key transport stakeholders at both regional and local council levels. Other interested parties will include transport user groups and local communities. The document is intended to provide inspiration and practical guidance for local and regional council elected representatives and staff to achieve better outcomes over the next few years.

Transport network optimisation can mean a multitude of things. It may be as practical a concept as managing the traffic signals in a city so that delays to motorists are minimised across the road network. This discussion document takes a broader view of the concept, however. It looks at ways of getting the best or most effective use out of New Zealand's road transport network. This means not just moving cars, but moving people and freight efficiently and sustainably within economic, environmental and social constraints. It assumes that New Zealand will not attempt to build significant additional road capacity.

"Optimisation" in this discussion document means effectively balancing various impacts and objectives to get the best value for society out of the road network, recognising the increasingly pronounced nature of competition for scarce road space. These varied objectives include user convenience and comfort, congestion reduction, road and parking cost savings, consumer savings, accident reductions, improved mobility options for non-drivers, energy conservation and pollution emission reductions. They also include more diverse objectives such as support for increased land use accessibility, community redevelopment, habitat preservation and increased public fitness and health.

Moving people and freight efficiently is critical to economic development, although opportunities to minimise the amount of travel should also be seriously considered. Optimising transport in our towns and cities will also provide opportunities to minimise the transport "footprint" on the urban environment, with reductions in visual pollution, urban sprawl, community "severance" (the effect large roads and motorways have on severing communities) and simply the amount of space devoted to motor vehicles.

Transport network optimisation (in this document) is concerned principally with optimising the road network; it does not attempt to optimise the rail, sea or air networks. These modes are considered only in their capacity to provide alternatives to travel by road and thus help with road network optimisation.

Furthermore, the focus of this document is the urban (rather than rural) components of the road network. Accordingly, the air network has only a small role to play. Rail and sea transport, however, have some significance in the urban environment as alternatives to road travel, both for passenger transport and freight.

The key legislative framework for transport in New Zealand is provided in the Local Government Act, the Resource Management Act and the Land Transport Management Act. Significant progress has been made nationally over recent years on identifying goals and targets for New Zealand's transport system, culminating in "Sustainable Transport", the 2007 draft update to the NZ Transport Strategy [1] (uNZTS). National issues are discussed more fully in Section 2 ("National Context").

There are many different definitions of sustainable transport, the general theme of which is that sustainable transport involves providing short-term, local transportation options without jeopardising long-term, global needs [2]. Truly sustainable transport must balance a variety of objectives, including economic and environmental aspects.

While some options are presented as being sustainable, they only address certain aspects (for example, converting to solar powered cars might be more environmentally sustainable but would not reduce congestion or decrease the road toll). Claiming a new road is sustainable because it uses recycled road materials would be spurious. A

thorough evaluation of the full environmental, social, cultural and economic implications over the life of the road is more likely to conclude that it was not sustainable.

Some people expect mechanical engineers will develop motor vehicles that are fuel-efficient enough to maintain the current levels of transport use at future fuel production levels. While motor vehicle efficiency will improve, these efficiency gains will not be sufficient to maintain current levels of car mobility [3].

Some people do not believe that oil production will decline (under the phenomenon known as "peak oil"); others believe that alternative fuels and technologies such as bio-fuels or hydrogen cells will be able to replace our current level of oil use. It has been shown, however, that global oil reserves and alternative energy sources will not support continued growth in fuel demand [4]. Oil discovery and production rates will not be able to cater for the current and increasing demand for transportation [5, 6, 7] under "business as usual".

Fuel consumption at current levels is causing irreversible climate change through increased carbon dioxide (CO_2) emissions to the atmosphere. Even if motor vehicle energy sources were plentiful and did not emit CO_2 in future years, concerns with the safety records of our current transport systems would require a rethink in favour of safer systems, either by providing physical segregation between faster and slower, more vulnerable road users, or by slowing motor vehicle traffic on urban streets to speeds more compatible with walking and cycling.

In the long run, we are likely to have to change our lifestyles to evolve to a more accessible but less mobile society [3]. Providing people with **access** by a variety of means, rather than motorised **mobility**, will be increasingly important. Besides the "peak oil" and climate change reasons for these changes, there are increasingly well recognised health reasons. Accessibility is a better goal than mobility [8, 9].

Some people believe that road pricing measures and increasing fuel prices based on a diminishing supply and a global increase in demand will diminish the demand for transportation and result in reduced travel, fuel consumption and traffic congestion. Congestion charging on its own will not ensure sustainability and more consideration should be given to land use, equity and mobility issues [10]. Also, China, India and Russia (and many other countries) currently subsidise fuel heavily so that consumers are not paying the full costs of motorised travel. In this environment, global demand seems unlikely to diminish in the foreseeable future.

At the core of this document is a growing understanding that various demographic and economic trends are fundamentally changing future transport demands, so a number of structural changes are needed now in land transport policy and planning practices to prepare for the future. Specifically, a more diverse and efficient transport system will better meet the needs of an aging population, reduce the exposure of individual consumers and the overall economy to risks of rising fuel costs and climate change, help increase safety and health, and respond to changing consumer preferences. "Business as usual" is unlikely to lead to optimal outcomes. The changes needed to meet future demands will require new approaches and institutional relationships.

With the national legislative and policy framework mostly in place, implementation is now needed at the local and regional level. The New Zealand Transport Agency is convinced that a strong partnership is needed between central government and regional and local government to effect the changes that are necessary.

Accordingly, this document attempts to provide practical examples of how change might be implemented locally and regionally in the short term (see Section 5). It is expected to encourage dialogue with key stakeholders on specific projects or packages that will help implement national directions in ways that are seen as beneficial, locally, regionally and nationally.

In practice, this is likely to mean a variety of complementary initiatives that collectively improve travel options, encourage use of efficient modes, and create more accessible land use patterns to help create a more economically and resource efficient transport system.

These initiatives are likely to need strong leadership at the local and regional level. “It is government that determines, explicitly or implicitly, how much the car will be used”, says Enrique Peñalosa, former mayor of the Colombian capital Bogotá, speaking in Brisbane in February 2008. According to Peñalosa, governments must resist the temptation to build more roads and highways; their leadership in reducing space for cars can force travel behaviour change. [11]

The document discusses the national context first (Section 2), then international trends (Section 3) and five overseas case studies where land use and transport integration and a variety of interventions are features (Section 4). Section 5 is devoted to about 30 case studies from New Zealand; in contrast to the international case studies, they are typically good examples of an individual treatment to optimise transport rather than an integrated approach. Section 6 identifies potential action for implementation by local and regional councils to help achieve network optimisation and more sustainable transport systems in New Zealand.

2 National Context

There is now a robust legislative and policy framework to support sustainable transport in New Zealand via the Land Transport Management Act (2003) and the New Zealand Transport Strategy (2002). For example, the NZTS has five objectives:

1. Assisting economic development
2. Assisting safety and personal security
3. Improving access and mobility
4. Protecting and promoting public health
5. Ensuring environmental sustainability.

More recently, the uNZTS has proposed targets and indicators for New Zealand which will help to determine whether implementation of the strategy is occurring and at an appropriate rate.

Land Transport NZ has identified 13 trends as indicators of progress towards better transport. These trends cover all aspects of land transport: infrastructure, behaviour, vehicles, links with land use, rules, the private vehicle fleet and the commercial and freight fleet. Land Transport NZ states that it will know that progress is being made towards sustainable and safe land transport when:

- Development patterns of towns and cities reduce the need for people to travel.
- Development of towns and cities, design of networks, and operating rules provide a safe and convenient environment for walking, cycling and other personal travel options.
- More people choose active modes of transport.
- People drive in a way that uses less energy and is safe in the conditions.
- Fatal and serious injury crashes reduce.
- People use private vehicles less at congested times.
- Traffic flows more efficiently with greater reliability on the road network.
- The availability and use of shared transport, passenger transport and services for the transport disadvantaged increases.
- The proportion of business and household expenditure on land transport reduces.
- The commercial and private vehicle fleets become more energy efficient, safer and have improved environmental performance.
- Commercial transport operators adopt management practices that promote safety, use less energy and reduce emissions, noise and vibration.
- A higher proportion of freight is carried on rail and coastal shipping.
- The freight industry productivity improves.

These trends are evident in places, but are not yet widespread in New Zealand. For these trends to take hold, a paradigm shift will be required. A variety of changes will be required to create a truly optimal transport system. Considerable new motor vehicle capacity is currently being provided and planned, making it easy for many people to continue driving for most trips.

The focus will need to shift from building more capacity (through the creation of new roads or the continual “improvement” of individual intersections or corridors) to managing or

reducing demand for travel. In addition, emphasis will need to be placed on managing existing road capacity more efficiently and improving alternative modes, telecommunications and freight delivery systems.

The uNZTS proposes a number of targets. For example, public transport's mode share for peak hour travel in the three main cities (Auckland, Wellington and Christchurch) should increase from the current average level of 9% to 20% by the year 2040. Walking and cycling in urban areas are targeted to nearly double from 17% to 30% by the same date. The distance travelled by single occupant motor vehicles is targeted to reduce by 10% on weekdays by 2015 in an effort to reduce congestion and fuel consumption.

The effects of transportation on the environment are becoming increasingly apparent. The uNZTS notes that transportation currently contributes 18% of the country's greenhouse gas (GHG) emissions and the government proposes to reduce per capita GHG emissions from domestic transport by 50% by the year 2040.

There are many other targets for improving the transport system in the uNZTS, including increasing the proportion of domestic freight tonne kilometres carried by rail from 18% to 25% and by coastal shipping from 15% to 30%. Demand management on the road network can be assisted by better use of these modes, as they can make a meaningful contribution for the transport of both freight and passengers.

The government is working on a "Next Steps Review" project to develop a Government Policy Statement (GPS) on transport and the Land Transport Management Amendment Bill, both targeted for July 2008. In a recent update [12], the Ministry of Transport noted that:

"The work of the project team developing the GPS is focused on the following themes:

- achieving progress on the priorities and targets within the uNZTS and monitoring work to achieve these;
- change in funding allocations will be gradual, recognising the expectations that have been created by past policy decisions and the long lead time for projects;
- the GPS will stress the importance of combining land use with transport development in an efficient and sustainable way;
- with the shift to more targeted regional programme development, there will also need to be a continued focus on our national networks; and
- moving over time to a situation where individual users face the costs of their transport choices more directly."

Transportation systems are already changing, although progress will be incremental rather than sudden. Strategies will need to be developed to reduce private car use and help meet the targets of the uNZTS. New Zealand will need to make better use of existing transport infrastructure and rely less on new capacity than has previously been the case.

Government transportation spending is at record levels, with $24 billion programmed under the National Land Transport Programme (NLTP) over the next 10 years [13]. Current annual NLTP expenditure is $2.1 billion, up by 118% in the past five years (2002 to 2007). Road expenditure in New Zealand is currently increasing at five times the rate of inflation and is predicted to continue outstripping inflation for many years under "business as usual" [14].

Total travel ("vehicle kilometres travelled", or VKT) by motor vehicle is expected to increase as the population increases, but the challenge will be to restrain or even reduce per person VKT. Increases in VKT are likely to put the country's roading network under increasing stress, especially in the more congested cities of Auckland, Wellington, Christchurch and Tauranga.

The Ministry of Transport's Surface Transport Costs and Charges Study of 2005 found that cars, trucks and buses paid between 56% and 68% of their costs, based on analysis of 2001-02 data. There has been some debate about the validity of these figures and further work is underway, but it is fair to say that the full costs of road-based motor vehicle travel are not paid by users.

Other parts of society therefore cross-subsidise motorised travel in New Zealand. Other costs not borne directly by cars, trucks and buses include health, pollution and climate change. Some of these are not paid at all (yet); others are picked up by the health sector and ratepayers (property owners through their property taxes). Reducing or eliminating cross-subsidies to these modes would provide better pricing signals to support more sustainable transport choices.

New Zealand may be able to position itself more competitively in the global market by having smaller cities where walking, cycling and buses provide ample travel choice without the need for much more expensive light or heavy rail systems. Auckland is of such a geographic size and elongated shape that rail is necessary, and Wellington is fortunate in already having significant rail infrastructure.

Other cities may, however, be much better placed with the cheaper and more flexible option of buses, supplemented by comprehensive efforts to support walking and cycling. Christchurch, Tauranga, Hamilton and Dunedin (and other smaller cities) should be able to avoid the considerable investments needed in rail and position themselves competitively compared to Auckland and Wellington, and especially when compared with the large Australian cities. Travel costs for individuals (and their local, regional and national institutions) will be cheaper in these smaller cities as fuel prices continue to increase.

Part of the solution to network optimisation will need to be improvements in the integration between land use and transport planning. Too little consideration of transport implications has historically been taken in land use and development decisions, resulting in low density settlements and urban sprawl that is difficult and expensive to service with the more sustainable travel modes – walking, cycling and public transport.

The population densities of New Zealand's cities vary considerably. Auckland City, which is fully developed, has around 1,200 persons/km^2 while Christchurch City's density is about 240 persons/km^2, reflecting its large hinterland of rural land. Greater Wellington's constituent cities vary from 620 persons/km^2 for Wellington City to about 260 for Lower Hutt and Porirua, and to only 70 for Upper Hutt. Even the most fully-developed of New Zealand's cities have low population densities by international standards, however.

Much work has recently been done at a national level to improve the relationships between land use and planning through the Integrated Approach to Planning [15] and other initiatives. There are now opportunities for action at the local and regional level. These are discussed further in Section 6.

3 International Directions

Many techniques have been tried overseas to help optimise the transport system and its networks. Information in this section comes from an extensive international literature review of research and published papers and advice from the international panel. For the purposes of this project, these techniques have been grouped into seven categories, although there is some overlap amongst the categories.

3.1 Land Use and Transport Planning Integration

Land use has an important relationship with the transportation system. Good towns and cities with effective transportation systems require more accessible land use patterns and more multi-modal transport options, to reduce the amount of travel needed to reach activities and to give residents viable mobility options. A more diverse transportation system can provide many benefits by letting travellers choose the most efficient and appropriate option for each trip. Optimal transport systems result in each mode being used for what it does best, from an individual as well as a societal perspective [16].

Policies need to be developed to combat urban sprawl [17]. In larger cities, land use policy- and decision-makers should encourage higher urban population densities and centralisation of the population and activities around passenger transport hubs [18]. Higher densities give more people more potential destinations and activities within walking and cycling distance and make public transport more accessible. As patronage goes up, bus and train frequencies can increase, improving the level of service for public transport users and further improving patronage levels. Success breeds success!

But mixed use development is perhaps also as important as intensification and higher densities. Mixed use development allows people to find jobs, recreational opportunities and goods and services close to their homes, reducing travel demand and increasing the feasibility of travelling by more sustainable modes.

Smart growth is an urban planning and transportation theory that concentrates growth in the centre of a city to avoid urban sprawl. It advocates compact, transit-oriented, walkable, bicycle-friendly land use, including neighbourhood schools, streets that work for everyone and mixed-use development with a range of housing choices [19]. “New urbanism” is a similar concept with its roots in architecture and urban design.

Smart growth values long-range, regional considerations of sustainability over a short-term focus. Its goals are to achieve a unique sense of community and place; expand the range of transportation, employment and housing choices; equitably distribute the costs and benefits of development; preserve and enhance natural and cultural resources; and promote public health [19].

Changing from minimum parking standards for new developments to maximum standards can reduce the amount of space devoted to parking (and increasing urban densities) while reducing the attractiveness of driving [20]. Such practices often need to be introduced at a regional level to ensure consistency and to prevent one council compromising its parking policies and standards to attract inappropriate, low-density development at the expense of a neighbouring council.

Often the development of transport policies involves parties external to the transport sector. Government intervention will be required to achieve an altruistic outcome and multi-disciplinary, international teams can often add value to the development of policies [21]. Citizen involvement is seen as essential in policy development [22].

3.2 Attitudinal and Behavioural Measures

A number of interventions are available to influence travel behaviour and travel demand [20]. These include individualised marketing to reduce car use (often targeted at the workplace, household or community level), where travel planners visit willing businesses, individuals or households and develop options with them that may include assessing public transport and cycling options and supporting them as they make lifestyle changes. Some people may even consider moving house or changing job location to reduce total travel, with more time to do other more important things than travelling.

School and workplace travel plans are somewhat labour-intensive but effective interventions to influence travel demand and reduce motor vehicle use. Ride sharing has been promoted particularly through workplaces and can provide some reduction in single-occupant motor vehicle trip-making. These interventions do need to be supported over time; left alone they often become less effective as people lapse into earlier patterns. Ride sharing, for example, can diminish over time as key people in an organisation leave to work elsewhere.

Travel demand management (TDM, also called “mobility management”) is a term used to encompass a range of strategies that result in a more efficient use of transportation resources [23]. These strategies generally involve changes in policy emphasis to maximise the capacity of existing roads and minimise travel, especially by private motor vehicle. For example, parking policies may evolve from the provision of parking spaces to the development of workplace travel plans and integrated transport assessments (plans detailing how the traffic requirements of a site will be met using a variety of modes). [24]

TDM proponents note that accessibility (rather than mobility) should be the focus of optimisation processes and that planning should be truly multi-modal, as, when all impacts are taken into account and proper land use planning is applied, private motor vehicle use is less efficient than its alternatives [8, 9]. It has been said that “beyond an optimum level, increased mobility is harmful to consumers because it wastes resources – time, money, land and energy – with more beneficial alternative uses.” [16]

Car clubs allow urban residents to share ownership and other fixed costs of cars, with booking schemes that allow them to pay for cars when they need them. They may then not need to own a car (or a second car). This results in reduced motoring costs for individuals and families and generally reduces total travel by those involved. Car clubs are increasingly common in Europe and North America.

Telecommunications provide options for reducing travel and travel during peak, congested periods. Some people can do some of their work from home, either missing peak period traffic or, if they work at home for a day a week, for example, may reduce their commuting by 20%. Flexible working hours can have similar benefits.

Transport policies are often used to influence travel behaviour. Network optimisation relies partially on changing society’s habits, for example by encouraging less use of private motor vehicles [25]. There are also merits in looking at human needs such as accessibility to influence the function of the transportation system [26].

3.3 Optimising Traffic Operations

Traffic operations are at the core of network optimisation, traffic congestion management and road safety. This includes how individual intersections are managed (and the form of intersection control, such as roundabouts, traffic signals, and Stop and Give Way controls). New Zealand has many practitioners who devote their careers to the “coal face” of traffic operations. Conferences (such as the IPENZ transportation Conference) concentrate on the art and science of optimising traffic operations.

However, the focus of traffic operations practitioners is changing from designing new facilities to managing existing infrastructure better. This means ensuring all roads and intersections are designed to better accommodate pedestrians, cyclists and public transport vehicles.

The concept of a hierarchy of users has been established in the UK for use in traffic planning and design processes. This hierarchy places pedestrians at the top, followed by cyclists, then public transport, then freight, with unaccompanied private car-users last. The objective of such a hierarchy is to ensure that the needs of the most vulnerable and most sustainable road users are fully considered in all schemes, but not necessarily to give priority to pedestrians and cyclists in every location.

Adoption of a hierarchy of users is recommended as one of the elements of good practice in the UK's Local Transport Plans, and is one of the recommendations in the UK Government's Response to the Select Committee on Walking in Towns and Cities. [27]

Intelligent transportation systems (ITS) provides ways in which technology can help improve traffic operations. ITS comes in many different forms. It can be divided into three categories: driver assistance systems, traveller information systems and traffic management systems [28]. Systems that assist drivers of private motor vehicles can include devices that control speed, starting and stopping and lane positioning [29]; these improve the efficiency and safety of individual vehicles and therefore improve the capacity of a network.

Providing information to motorists and empowering them to make decisions based on real-time information can improve the operation of a network. Variable message signs can improve the operation of a network by encouraging drivers to divert to less congested routes, although researchers found that, due to driver behaviour, the benefits were never distributed equally throughout the networks studied [30]. Furthermore, improved real-time knowledge by drivers of traffic conditions on a network may simply allow more users to use the system at peak times, effectively "filling up" more roads to ever higher levels of congestion.

ITS can also be used to improve road pricing operations to help eliminate "pinch-points" in the transportation system and therefore increase its overall capacity. Various technologies are available such as automatic number plate recognition systems, electronic vehicle identification, open road tolling, multi-lane free flow and infra-red vehicle occupancy counters used in the implementation and enforcement of charging systems [31]. ITS is very context sensitive and different systems are not necessarily interchangeable between locations [32]. Research, monitoring and development are required to effectively implement ITS measures.

"Smart growth", "new urbanism" and traffic calming support modifications to conventional urban road design standards to allow narrower roadways and to reduce traffic speeds. Streets can become more conducive to use by pedestrians and cyclists. Streets should be considered to be part of the open space resource of a town or city and available for passive enjoyment. Many streets are so clogged with traffic that they are unpleasant places for these purposes. Implementation of these practices requires technical and political leadership with the courage to challenge existing guidelines and standards, and to rewrite these over time.

Parking management is also a useful component of network optimisation. This includes on-street management, where parking may need to be removed in some locations to provide space for pedestrians, cyclists or public transport, or to help manage motor vehicle travel demand. But off-street parking supply management is also needed to manage travel demand.

3.4 Public Transport

Increasing public transport use improves the capacity of a road network (as buses and trains take up less space per person than private motor vehicles) and is more environmentally sustainable. However, public transport is often seen by potential users as less desirable than car travel so public transport systems have to be carefully designed, managed and promoted to attract and sustain patronage. Road space may need to be re-allocated to favour public transport over other motor vehicles.

Many new technologies and methods are being developed to improve public transport services. Flexible transport systems which offer non-conventional, demand-responsive passenger transport options are also emerging [33]. Integrated ticketing systems allow passengers to transfer between public transport services of different modes and different providers while still using the same payment methods. The introduction of an integrated ticketing system to The Netherlands' has been shown to provide a wide range of socio-economic benefits which exceeds the total cost of implementation [34].

Planners and decision makers are beginning to apply forward planning to public transport projects, for bus rapid transit systems could be designed in anticipation that they would later be converted into light rail transit systems [35]. The efficiency of a railway system can depend on specific regulations which determine whether the focus of the system is passenger or freight transport [36]. The recent decision to buy back the New Zealand rail network into public ownership should help improve co-ordination and implementation of urban rail initiatives.

Improving public transport may require large investments, especially for rail systems. Such investment is most successful when the providers and users are supportive of public transport [37]. Investing in passenger rail usually encourages more intense land development, particularly around the stations, but also along the corridors. Accordingly, such investment decisions should be based on sound land use and transport planning so that development occurs in appropriate places.

A variety of complementary policies and programmes can increase the cost effectiveness of such investments by encouraging ridership and improving operating efficiency [37]. Examples include public transport priority in traffic management, road and parking pricing, public transport oriented development, and improved conditions for walking and cycling around public transport terminals and stations.

Transport policies regulate other elements of the transport system; it has been suggested that the optimal strategies would be those involving higher toll charges and increased public transport frequencies [38].

For large overseas cities, a decentralisation of population and activity locations is expected to occur. Cities will move from being mono-centric to poly-centric, with their centres based around passenger transport hubs [18]. The lesson learnt from previous public rapid transit systems is that it is important to invest in rail but major controlling actions (zoning and road pricing) are required to induce supportive changes in land use.

New Zealand may be able to position itself more competitively in the global market by having smaller cities where walking, cycling and buses provide ample travel choice without the need for much more expensive light or heavy rail systems. Auckland is of such a geographic size and elongated shape that rail is necessary, and Wellington is fortunate in already having significant rail infrastructure. Other cities may, however, be much better placed with the cheaper and more flexible option of buses, supplemented by comprehensive efforts to support walking and cycling. Buses can be more heavily subsidised in central or heavily congested areas to induce mode shift away from car travel.

Accurate data collection and analysis are important when planning public transportation services. Data collected from automatic fare collection systems on public transport services can be analysed so that planners can adapt the services to suit passengers' journey needs [39].

3.5 Walking and Cycling

Walking is important as the original sustainable transport mode. The concept of "walkability" is used to describe the ease with which it is possible to walk in a particular area or city. Walkability is important, not just for people making walking trips, but also as a way for motorists to travel between parking areas and origins and destinations and for bus and train users to access public transport stops and stations.

People walking (or "pedestrians"), in a transportation planning sense, includes a wide variety of people. Those using mobility aids, those with vision impairments and those of limited cognitive ability (including younger children) are all pedestrians and users of walking facilities. Provision and continued maintenance of footpaths, tracks and road crossing facilities are essential for pedestrians. Many other design, infrastructure, information, encouragement and policy provisions can be made to enhance footpaths. [23] But there is more to making towns and cities more walkable than providing good footpaths. A predominance of motor vehicles and higher speeds in a city reduces walkability. Conversely, a culture of restraint in motor vehicle use and speed fosters walkability.

Some European towns and cities are adopting the "naked streets" approach. Traffic control devices, road markings and footpaths are removed in favour of creating shared spaces or slow zones, where motor traffic, cyclists and pedestrians all make use of the entire roadway [40, 41], albeit at slow speeds.

Walking and cycling are the most sustainable transport modes as they do not require external energy inputs. The Netherlands, Denmark and Germany have increased cycling patronage by providing cycle facilities (both on- and off-road), treatments at intersections, implementing traffic calming or area-wide speed limit reduction, giving right of way to cyclists in many locations and providing cycle parking and integrating cycling with public transport. These measures have been complemented with increased education, promotional ventures and restrictions on car ownership and use. Incentives can also be offered by employers, for example businesses providing showers and cycle lockers in workplaces. [42]

3.6 Freight

It is likely that the demand for freight transport will increase in the future. Increases in e-commerce increase the levels of freight transport on the road network [25]. It is predicted that goods movement between countries will increase in the future which will result in the movement of more containers, both at sea and on land (road and rail) [44]. This international trend will have similar effects on New Zealand.

Different methods of accommodating freight on the road network are available. Some researchers suggest that network capacity can be improved by offering financial incentives to freight operators to distribute their goods during off-peak periods [45]. Others suggest that the increases in freight due to increased e-commerce activity can be accommodated by improving freight provisions on the network, for example by using co-operative freight transport systems (where individual vehicles carry goods from several sources), pickup points and consolidated time windows (i.e. freight can only be delivered at certain times) [46].

Similarly, some researchers advocate a system of short term parking spaces for delivery trucks, along with staff at delivery destinations employed specifically to help unload

trucks [47]. Collaborative hub networks, where goods are distributed among modes suited to handling different volumes of freight, can improve freight utilisation and therefore system optimisation [48].

As sustainability becomes more important as a global objective, researchers are also looking at ways of managing transportation to mitigate the environmental effects of freight and thus improve the liveability of surrounding areas. Australian researchers have shown that the best method of reducing emissions from urban freight transport is to increase the vehicle load factors (higher load factors correspond to trucks travelling with a higher proportion of their carrying capacity being used) [49]. However, there is a large hidden cost incurred by increasing load factors. Heavier loads break up the road surfaces (which in some cases have not been designed to take those loads) much quicker. Increased road maintenance costs will probably end up being passed on to taxpayers and ratepayers.

Alternatives to using the land transport network for freight transport exist. Sea shipping can help reduce the congestion of the land transportation network by moving goods off-shore [50]. Therefore, the efficiency of shipping operations also affects the land transport network. A study of shipping in Eastern Asia found that pendulum-direct coastal shipping services (i.e. goods are shipped directly between origin and destination) are more efficient than services that stop at many ports along the route, as they save transhipment costs and reduce transhipment risks [51].

The Alameda Corridor Project in California is an example of major intermodal infrastructure that involves a 20-mile (32 km) grade-separated intermodal freight rail corridor. It links the ports of Long Beach and Los Angeles to the transcontinental rail network near downtown Los Angeles. It is a series of bridges, underpasses, overpasses and street improvements that separate freight trains from street traffic and passenger trains, facilitating a more efficient transportation network. This resulted in 200 railway grade crossings in the urban area being eliminated, resulting in decreased congestion and air and noise pollution.

Pricing measures applied to the road network have significant effects on freight transport. Internalising road user costs such as road wear, congestion and traffic crashes by applying distance-based charges can make road freight transport more expensive and therefore rail and shipping become more commercially attractive modes. Alternatively, if pricing measures are focused on private motor vehicles (especially those with single occupants) the congestion relief on the road network can increase freight transport efficiency. [23].

Network capacity and environmental sustainability can be conflicting goals for the freight industry. Research has concluded that, for the Japanese transport network, rail is more efficient than ship transport in terms of carbon emissions [63]. Japan, while being an island nation of similar size to New Zealand, has much denser development and more extensive rail coverage, however.

Appropriate, enforceable regulations regarding freight access to cities by location, time of day and vehicle type, for example, are seen as important [43]. Freight utilisation can be improved by combining different modes and creating collaborative hub networks where goods are transferred between these modes [48].

3.7 Pricing and Charging Measures

Many existing market distortions, such as private motor vehicle under-pricing, automobile-focused planning practices and automobile-dependant land uses favour private vehicle travel over other modes [52].

An efficient market should have a variety of options available to consumers, competition amongst these options, efficient pricing and economic neutrality (i.e. subsidies and taxes applied consistently between options) [23]. Efficient road pricing schemes are those which

accurately reflect the true costs of travel; implementing these can help optimise the system as trips that are seen to be of higher value to society are prioritised over those of lower value [23].

Road pricing is an economic tool whereby various direct charges are applied for the use of roads. These road charges include fuel taxes, licence fees, parking taxes, tolls and congestion charges, including those which may vary by time of day, by location, or by specific vehicle type. Road pricing has two distinct objectives: revenue generation, usually for road infrastructure financing, and congestion pricing for managing travel demand. Toll roads are an example of revenue generation. Charges for using high-occupancy toll (HOT) lanes or urban tolls for entering a restricted area of a city (such as London) are typical examples of using road pricing for congestion management purposes.

The amount and mix of transport activity that consumers would choose in an efficient market has been studied. Researchers concluded that "in a more optimal market consumers would choose to drive significantly less, use alternative modes more, choose more accessible land use options, and be significantly better off overall as a result." [16]

Different methods of pricing are currently used in schemes throughout the world and include congestion charging, parking pricing, fuel taxes, distance-based insurance measures and subsidies to public transport measures. Pricing and control measures are generally aimed at either creating revenue or deterring traffic in order to reduce congestion and achieve sustainability.

People's perceptions of pricing systems are very important factors in determining the system's success [53]. Some researchers have concluded that a properly devised charging scheme could lead to real differences in future traffic growth and congestion relief, whilst relieving pressure to build new roads and reducing environmental damage [0]. They showed that cities densely concentrated around a single centre tend to achieve larger welfare gains than more dispersed cities with multiple centres, under pricing schemes that involve cordoned areas (generally the central city) which users must pay to enter.

Consistency across modes and locations helps improve the efficiency and public acceptability of pricing schemes. The UK is moving towards a national charging scheme to replace taxes on car ownership and petrol consumption [55]. Some researchers see the need for a consistent pricing scheme that includes rail, air and waterborne transport throughout all the countries in the European Union [56].

A pricing scheme must be reflective of the actual costs imposed on the transportation system by its users [10]. Some researchers have shown that the optimal tolls for a road network are independent of the actual fixed costs (e.g. construction and maintenance) of the roads [57]. Others suggest that the marginal social cost (the additional cost to the network resulting from one new user) would be a more equitable and efficient method of pricing [58]. Some pricing schemes aim to increase equitability between modes by introducing distance-based costs to private vehicle users. By paying for road use, insurance and environmental effects according to the amount of travel, private vehicle owners are encouraged to drive less [59]. Travel patterns and network performance would be better optimised if externality costs were charged [60].

Pricing measures can be applied to encourage use of modes previously considered less desirable than private vehicles. For example, a road user charging system can be implemented to provide higher funding and patronage for the rail system [61]. As well as pricing measures that aim to provide users with disbenefits to travel, some measures offer incentives to other kinds of travel (e.g. a change in mode or route choice). Effecting change in user behaviour requires incentives [62]; such incentives may include subsidy systems to influence shift to other modes by making them more financially attractive [63].

4 International Case Studies

Five case studies have been assembled to illustrate overseas best practice. A common feature of these is that they all rely on a series of measures in combination to improve transport – no one measure in isolation will solve a city's transport problems. While they show a commendable variety of creative and integrated measures to optimise network operations and enhance sustainable travel options, there is room for improvement in all of these cities, nevertheless.

4.1 London, UK

London, home to approximately 7.5 million people with a population density of about 4,800 persons per square kilometre (persons/km^2), has an extensive transport network catering for a wide variety of modes. In 2007 the mode share statistics for journeys to work indicated 3% walked, 10% cycled, 47% used public transport and 37% used private motor vehicles. [64] To manage increasing congestion on the road network, many different measures have been adopted.

A comprehensive **land use plan** underpins London's success including encouragement of mixed development, higher density development and development associated with public transport and restrictive maximum parking standards for new development. [65]..London has made extensive use of public awareness campaigns and requires **workplace travel plans** for new developments.

SCOOT **traffic signal control** co-ordinates and optimises traffic signals throughout most of the city. Extensive on street parking controls apply in central and inner London and outer town centres while some **road space reallocation** has occurred to provide for pedestrians, cyclists and public space.

The Transport for London "**red routes**" network consists of five percent of London's roads which collectively carry a third of its traffic volumes. **Bus priority measures** on these routes (and elsewhere) provide preferential treatment for buses. Parking and stopping is prohibited along these red routes to maintain traffic flow. Traffic wardens, community support officers and CCTV cameras are used to monitor and enforce restrictions. [66]

Bus boarders have been introduced at strategic locations to maintain the place of buses in the traffic stream and reduce the overall time required for buses to stop. The reallocation of road space to include **high occupancy vehicle (HOV) lanes** has also increased the level of service to bus users. [67] Selective vehicle detection (SVD) measures have been introduced to prioritise buses at 1450 signalised intersections throughout London's road network. When a bus is detected near an SVD intersection, the green phase for the bus movement may be called earlier by shortening or skipping the green phases of other movements, or the bus's green phase may be lengthened to allow the bus time to reach and progress through the intersection. In conjunction with SVD, the iBUS system has been introduced. This system tracks all of London's 8,000 buses and can provide **real-time information** to users and operators and can be linked to the SVD intersections to trigger priority. [68, 69] There has been a substantial increase in bus service provision in conjunction with (and subsidised by) the congestion charging system.

London has an extensive **cycling network** consisting of on-road cycle lanes and off-road paths, although variations of widths of cycle lanes and the heavy volumes of surrounding motor traffic have been identified as barriers to cycling in London, especially during peak periods. Various **cycling promotion** schemes such as "BikeIt", "safe routes to schools" and "TravelSmart" are operated in London and throughout the UK aimed at encouraging more people to cycle more often.

In 2003 a **congestion charging** scheme was introduced to reduce congestion and also produce revenue to fund sustainable transport initiatives. Drivers of private vehicles are

charged a fee of £8 (increase in 2005 from an initial value of £5) to drive in the central city during weekdays between the times of 7 am and 6:30 pm. CCTV cameras at the charging area boundaries are used to photograph vehicles entering the area and infrared technology used to identify number plates and therefore charge registered owners. Several payment options are available and drivers can pre-purchase credit but if the charge is not paid on the day it is incurred a further fine is applied.

The congestion charging scheme has been highly controversial, a source of much opposition from private vehicle users and a major political standpoint. However, in its first five years of operation it has reduced traffic entering the zone by 21%, increased cycle traffic within the zone by 43% and produced approximately £10 million in profit (after all operating and capital costs have been paid [67]) which has been invested on bus network improvements, road safety schemes, safe routes to schools programmes, walking and cycling initiatives, distribution and freight measures and road and bridge maintenance and upgrades. [70, 71, 72, 73]

Figure 1: Vehicles entering London's congestion charging zone

The disincentives to private motor travel of congestion charging in London have been countered with incentives for public transport, walking and cycling use. Bus, train and tram services in London operate with an **integrated ticketing system** – known as the Oyster card. This provides a consistent pricing system and payment mechanism between all modes. This improves convenience and usability for passengers and improves travel times by reducing the amount of time required to collect fares when boarding services.

The pricing system that accompanies the Oyster card is intended to entice users by offering discounts over cash fares and fare caps for daily travel. Different payment options and mechanisms are available, including ticket machines, internet payments or automatic transactions. [74, 75, 76] In 2006, some 10 million Oyster cards were issued, with approximately half of these in regular use, equating to approximately 80% of all public transport payment.

The London Lorry Control Scheme (LLCS) consists of controls on the movement of any heavy goods vehicles over 18 tonnes maximum gross weight at night and weekends to help minimise noise pollution in residential areas during unsocial hours. LLCS provides a website with customised trucks maps and free permits. A partnership between the trucking industry and London councils, LLCS provides information for truck drivers and transport managers. The site assists in route planning and route approval. [77]

Transport for London is responsible for virtually all of the above, except for surface rail services and local roads (for which it instructs the London boroughs); it covers much of the travel to work area, but not all of it, which extends throughout South East England; there is an integrated strategy, and congestion charging and bus service improvements particularly demonstrate the principles of integration; the Oyster Card provides integrated fares, except for some surface rail, but there is not much integration of service levels or information. [77] Overall, the London example provides many excellent features.

4.2 Portland, Oregon, USA

Portland, Oregon has approximately 568,000 residents, with a density of about 1,500 persons/km². Recent estimates suggest that 6% of daily trips in Portland are made by cycle; little information is available on the mode share of other modes.

Portland uses **Smart Growth** principles aimed at increasing urban densities and improving the efficiency of land use and transport systems. Urban Growth Boundaries (UGBs) were established in 1973; since then the population has increased by 17 percent, but the UGBs increased only 2 percent [78]. The Smart Growth system has much opposition, with critics claiming that it results in undesirable and expensive housing options, increases suburbanisation, increases congestion and deprives citizens of their preference for automobile dependence. However, it has been shown that Portland residents experience lower congestion time and monetary costs per capita than would be expected given the population of the city and that neighbourhood density has less effect than total metropolitan population. [79, 80]

Portland boasts a comprehensive **public transport** system consisting of bus, light rail, streetcars and an aerial tram; all four of these modes are also equipped to carry bicycles. Services are frequent and operate seven days a week. Fares are paid by purchasing tickets, for which a variety of different plans are available with **integrated ticketing** between the three modes. A large section of downtown Portland is designated as "**Fareless Square**" – where there is no charge for public transport. [81]

Figure 2: A Portland streetcar

Portland also has a high level of provision for cyclists and has international recognition as a cycle-friendly city. It has an extensive **cycle network** of on- and off- road facilities, signage and parking and runs a number of different **cycling promotion programmes** aimed at encouraging more people to cycle and improving safety awareness. [82]

The Portland Office of Transportation coordinates a **car pooling** scheme and gives guidance to employers on how to motivate employees to car pool through provision of facilities and financial incentives [82]. The city is also home to a privately operated **car-sharing** scheme called "Zipcar" whereby members reserve vehicles to travel between specified destinations and pay hourly rates for usage, which includes petrol, insurance, maintenance and mileage costs [83].

A number of different plans are in place to encourage use of sustainable modes and reduce vehicle emissions, Portland has a "**downtown parking lid**" which limits the amount of commuter parking available in the central business district (CBD) and restricts parking ratios for new development. The **business energy tax credits** programme rewards business who enable employees to telework, fund public transport passes or use hybrid vehicles by giving them tax reductions on costs of implementing such projects. A **property tax exemption** is available to new developments in pedestrian and public transport districts. Not all incentives for public transport are financial - the **TriMet public art programme** aims to promote increased public transport use and community pride by integrating temporary and permanent art into the public transport system.

4.3 Odense, Denmark

Odense, the third largest city in Denmark, has approximately 185,000 residents and a population density of about 600 persons/km². In 2001, the mode share in Odense consisted of 34% combined walking and cycling, 8% public transport and 57% private motor vehicle[○][84], however more recent data suggests that cycling itself now comprises 35% of the mode share [85]. 80% of all school children either walk or cycle to school as a result of 30 years ongoing promotion of school routes. 85% of citizens find Odense to be an attractive city for cycling. [86]

The **cycle masterplan** was drawn in 1976 and is now more than 90% complete. Odense now has a total of 510 km of cycle paths which are mainly one-way. All new developments must have cycle facilities built in from the start. Cycle parking facilities are provided in all new workplaces, institutions and other significant destinations. [86]

From 1999 to 2002, Odense was a **cycle demonstration city**, a project aimed at increasing the number of people cycling, the number of cycle trips and the safety of cyclists. A number of **campaigns** were aimed at informing and motivating different groups of people, with the focus being on personal contact between campaign staff and participants rather than provision of informational material. Cycle trailers (for transporting children and goods) with free servicing every three months were provided to 6,000 families.

Figure 3: Cycle parking in Odense

From 2003 to 2006, Odense was part of the European Union's Liveable Cities project which aimed to promote initiatives, development and activity in historical city centres for the benefit of citizens, visitors and commercial traders. As well as focusing on cultural and heritage aspects, this project was concerned with management of movement, regeneration of public spaces and urban design. There was a significant focus on improving amenity to pedestrians. [87]

Cycling has now been identified as perhaps the most important way of tackling health problems in Denmark. Research from Odense University indicates that 50 times as many lives are saved in Denmark due to the health benefits of cycling compared to the number of lives lost cycling.

After 25 years of political discussion the council recently decided to close the main road through Odense's city centre, carrying 35,000 motor vehicles per day. This will boost cycle traffic and public transport will benefit from a planned light rail system. [86]

End-of-trip facilities such as bicycle parking spaces and underground locker rooms were introduced. Maintenance of facilities was improved, ensuring that all bicycle paths were maintained by the same practices applied to the city's largest roads. Road inspectors were required to regularly inspect bike paths by cycling. The operation of the road network was also significantly modified to prioritise cyclists. Green waves between sets of traffic signals were set based on cycling (not driving) speeds. At signalised intersections where cyclists cross roads, road rules were changed to give cyclists right of way over motorists. [88]

Car-sharing initiatives (called "car clubs") have been introduced to give cyclists access to vehicles when required.

Odense also has a focus on improving public transport with many novel initiatives such as the ability to purchase bus tickets by sending text messages from mobile phones. **Bus°priority** is provided in the form of special bus phases at traffic signal controlled intersections. **Real time information** regarding buses is available by mobile phone, internet and at bus stops. [89] The city also plans to install a light rail system in the near future.

Figure 4: Cycling in Odense

4.4 South East Queensland, Australia

South East Queensland has a population of 3.1 million; 90 percent of which is located in Brisbane, the Sunshine Coast and the Gold Coast. This gives a high variation in population density over the region ranging from about 330 persons/km² in the Gold Coast to much lower in other localities, the overall density for the whole region being about 140 persons/km². The region is said to be the fastest growing in Australia, which puts high demand on its transportation system. In 2004 the mode share for Brisbane city was 81% private vehicle, 8% public transport, 2% cycling and 9% walking [90].

One of the aims of the South East Queensland Regional Plan 2005-26 is to integrate land use, transport and economic activity. This is to be achieved by **transit-oriented development**, where a mix of residential (30 to 120 dwellings per hectare) and employment land use is located near high quality public transport facilities. The regional plan offers guidance on the formulation of local growth management strategies to achieve these criteria. The plan defines freight routes that are to be improved to accommodate the predicted doubling of freight volumes by 2020, improve freight efficiency and facilitate economic growth. The plan also aims to coordinate air and sea transport to increase efficacy of both freight and passenger transport.

South East Queensland operates a system of **integrated public transport**, known as TransLink, which includes rail, bus and ferry networks. The switch to integration, as well as making public transport more-user friendly, has had significant operational benefits. TransLink operates under one organisation, rather than multiple individual organisation. There is more co-ordination between services, for example when there are disruptions to rail services (e.g. due to maintenance) operators provide alternative bus services to ensure passengers are not disadvantaged. [91, 92]

A variety of ticket options are available to users of TransLink services based on different durations of travel, as well as the **smart card** “Go card” system. The Go card must be held up to a card reader at the start and end of each journey made on a TransLink service and fares are calculated based on the number of zones travelled. Go cards are pre-paid through a variety of different options and offer discounts after six trips in a week have been made. [93]

Some integration between cycling and public transport is available in South East Queensland, however levels vary between cities. In Brisbane, bikes are allowed on ferries and on trains during off-peak hours at no extra charge. Three Brisbane bus routes also have bike racks.

South East Queensland participates in a **TravelSmart programme** which is aimed at increasing the level of sustainable transport use through individualised marketing. TravelSmart teams meet with communities, workplaces, schools or families to tailor sustainable travel programmes to their needs. A TravelSmart project was conducted in Brisbane North in 2006/07. Of the 75,000 households in the target area approximately 41,000 chose to take part and received information and services aimed at increasing their use of sustainable transport or (for those who were unable or unwilling to use public transport, walking or cycling) make their use of private vehicles more environmentally friendly. For those who participated, overall the combined modal share of walking, cycling and public transport increased from 17 % to 24 %, and that of the car and other motorised private modes decreased from 83 % to 76 %. [94]

4.5 Freiburg, Germany

Freiburg is a city with approximately 220,000 residents on the south-western edge of Germany. The population density is about 1,400 persons/km².

The city is well known for its early decision to move away from car-centric transport planning that was otherwise common in the 1960s. The **transportation master plan** of 1979 favoured environmentally friendly types of traffic. In the overall traffic concept of 1989 a principal purpose was specified to make the so-called environmental group (i.e. the pollution free modes – foot and bicycle traffic as well as public transport) more attractive to offer road users an alternative to the car. The remaining motor traffic was to be accommodated in an environmentally and city-compatible way, minimising noise, exhaust gases and road safety problems. [95]

Figure 5 shows the significant change in model split achieved between 1982 and 1999. Walking (the blue columns) has clearly decreased (this is a country wide trend), while bicycle traffic (green) and public transport (purple) have increased and passenger car transport (yellow) has decreased.

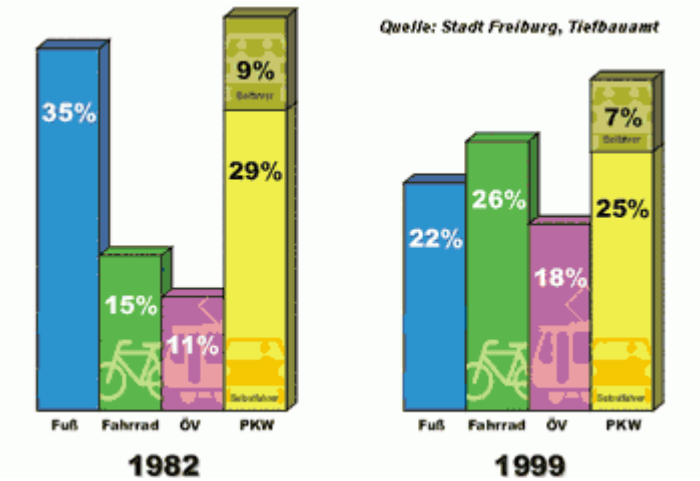

Figure 5: Walking, cycling, public transport and car (driver / passenger) trends in Freiburg [95]

A common German tool of reducing traffic volumes in local street networks is the provision of one-way streets, channelling through traffic onto arterial routes. Freiburg has 120 one-way streets, and based on a change of the German traffic regulations in 1997, which enabled the opening of one-way streets for cycling in a contra-flow direction, has by now opened 50% of its one-way streets for **contra-flow cycling**. [95]

Freiburg received the first European Public Transport Award for its excellent public transport system. In 2006, the public provider carried 71 million people on its four tram and 26 bus routes [96], which given the coverage of the public transport system (which extends slightly beyond the city boundaries) represents 0.8 public transport journeys per person per day. Citywide **integrated ticketing** was introduced in 1984, and by now covers the wider region.

5 A Selection of New Zealand Initiatives

There are many examples of local network optimisation initiatives successfully operating around New Zealand. While they represent often creative solutions to individual transport problems, New Zealand is still in its infancy in terms of applying comprehensive packages of solutions in a town or city.

These local examples are briefly described here. They should be viewed as examples of measures that could form part of a multi-pronged approach to network optimisation. Further information can in many cases be gained by contacting the appropriate local authority or searching its internet website.

5.1 Land Use and Transport Planning Integration

1. Western Bay of Plenty SmartGrowth

The Western Bay of Plenty (including Tauranga City) had a population of about 146,000 in 2006 and is one of the fastest growing regions in New Zealand (29% increase in population between 1996 and 2006). It recently adopted a "SmartGrowth" strategy aimed at managing this growth in a sustainable way. SmartGrowth differs from earlier strategies in that it has a long-term focus on collaboration amongst key agencies and the community. The strategy involves voluntary participation from the Western Bay of Plenty District Council, Tauranga City Council, Environment Bay of Plenty, tangata whenua and local community groups.

The SmartGrowth strategy, which is designed for a time-frame of 50 years, aims to achieve higher residential densities, while protecting and enhancing the natural and cultural environment. The strategy takes an integrated approach across all elements (one of which is transportation) of the region. It is expected that the region will need to provide new roading infrastructure, consider travel demand management (TDM), introduce road charging, and install bus priority measures, park and ride facilities, cycleways and enhanced pedestrian facilities. Rail is likely to be used only for freight in the short term. The strategy aims to achieve a mode share target of 21% of travel by modes alternative to private motor vehicle by 2021.

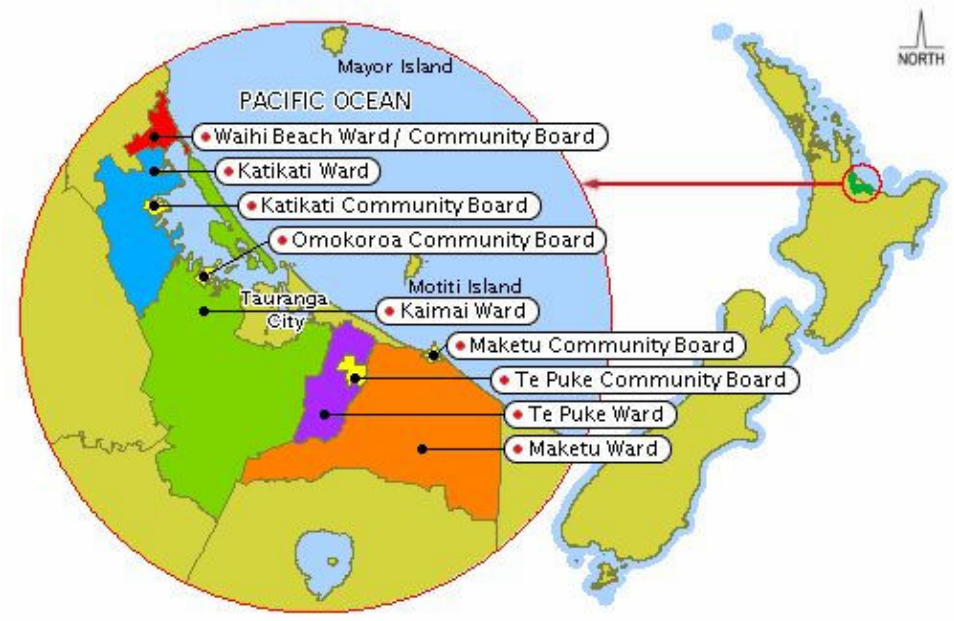

Figure 6: Western Bay of Plenty location

2. Wakatipu Transportation Strategy

Queenstown Lakes District Council, Otago Regional Council and Transit New Zealand developed the Wakatipu Transportation Strategy to deal with the high growth rate and ensure the delivery of an effective long-term integrated transportation system for the Queenstown Lakes District that retains and enhances the unique amenity values of the district. The population of the district increased 61% between 1996 and 2006, to nearly 23,000 people, making it the fastest growing district in New Zealand. It has been predicted that if no changes are made to the district's transportation system, Frankton Road (Queenstown's main arterial) will experience extreme congestion and average travel speeds of 20 km/h by 2026.

The strategy considers four complementary measures – public transport, travel demand management, roading and parking management. These four measures each consist of several elements and are combined in a package approach. A detailed implementation plan for a 20 year period has been developed to ensure delivery of the measures. The achievement of project objectives will be gauged by key indicators and extensive monitoring.

3. The Greater Christchurch Urban Development Strategy

The population of the Greater Christchurch region is expected to grow 14% between 2001 and 2021. With this growth comes increased demand for housing and residential land, increased environmental effects, changes to community identities and more demand for transportation. To counter and mitigate these effects the three local councils and the regional council, as well as Transit New Zealand, developed the Greater Christchurch Urban Development Strategy.

The draft strategy presented three different options for managing growth in terms of how existing urban areas should be redeveloped, how urban densities would change and the amount of spread each urban area should be allowed. The effects on the transportation network, such as congestion, travelling times, vehicle emissions and fuel costs, were key criteria in assessing the three options. The transport requirements of each option, such as improved public transport systems, road widening and walking and cycling facilities were also identified.

The option involving least "greenfield"[1] development and highest urban densities was preferred by the vast majority of residents engaged in the extensive public consultation process. The Greater Christchurch Urban Development Strategy has attempted to integrate land use planning and transportation planning and it shows that other aspects (for example community values and environmental considerations) can also be integrated into the planning process to develop a more holistic solution to growth.

[1] Greenfield development is development on land that has not previously been developed. "Brownfield" development uses land which has previously been used for urban (often industrial) purposes.

5.2 Attitudinal and Behavioural Measures

4. Workplace Travel Plans, Auckland

In 2006 the Auckland Regional Transport Authority (ARTA) began a workplace travel plan programme aimed at encouraging employers to develop plans for employees to use sustainable travel methods of commuting. The programme covers a wide variety of employers, from a single business to a group or cluster of businesses in a particular area or site that have agreed to combine their travel planning activities.

Over 30,000 employees from 31 organisations as well as 50,000 tertiary students and staff are involved in the programme. In the first year a reduction of about 350 vehicles during the morning peak hour was achieved; this is in line with the overall programme target of achieving a 12% reduction in morning peak hour vehicles by 2016.

For workplaces, the programme aims to change travel behaviour through a series of identified actions developed through a five stage process. These actions tend to be localised, including changes to on-site infrastructure and facilities as well as improvements to information, education and awareness that will result in positive behaviour change. For larger, institutional, travel plans ARTA works in partnership with the institution and the relevant territorial local authority. Together they consider changes to facilities, infrastructure, services, ticketing information and marketing, to achieve benefits for all travellers and other commuters going to and around the institution.

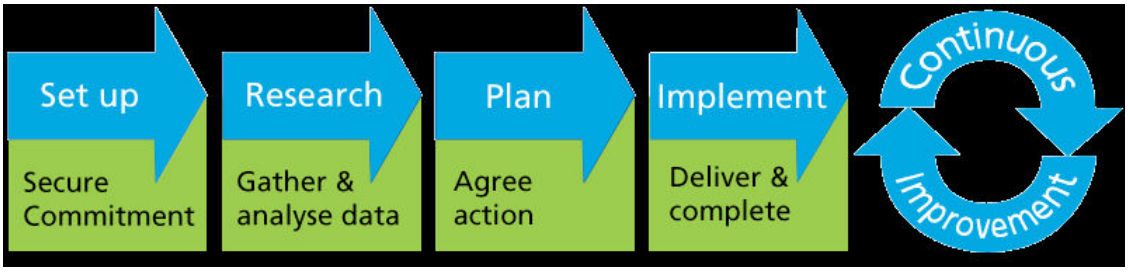

Figure 7: ARTA travel plan 5 steps

5. "Getting Around Wellington" – Travel Demand Management Programme

With funding from the Ministry for the Environment and in partnership with Wellington City Council, the Sustainability Trust is delivering the "Getting Around" project in the southern and eastern wards of the city. The project encourages people to consider the many benefits of getting around without their cars.

One of the main ways of contacting participants for Getting Around Wellington is by delivering free travel behaviour advice sessions to community groups, workplaces and individuals. The programme includes making sure people have all the information and things they need to make travel behaviour changes – like a working bicycle, advice on a safe bike route, or an up-to-date bus timetable.

The 'Getting Around' project was piloted in areas of Lower Hutt in 2006, in a joint initiative with Hutt City Council and Greater Wellington Regional Council. Findings showed that 83% of participants in the project reduced their kilometres travelled by car – an outstanding result!

6. Auckland's Walking School Buses

The walking school bus programme aims to encourage children to walk to school in the hope that they will continue these habits later in life and parents will also re-evaluate their travel choices. A walking school bus is led by one or more adult volunteers, who walk along an official route to school, collecting children along the way at designated locations. After school the children return home using the same process.

The Auckland Regional Transport Authority (ARTA) and/or the relevant local council within the Auckland region provides guidance and support for schools and adult volunteers, undertakes hazard identification of the routes and assists with the implementation of walking school buses. Community and/or private organisations often supply useful items such as fluorescent clothing, flags and maps. Many walking buses now operate throughout Auckland and are seen as a safe and healthy option for travelling to school.

Figure 8: Walking school bus in Auckland

7. Canterbury Active Transport Forum

The Canterbury Active Transport (CAT) Forum first met in early 2007 to encourage information sharing and cross sector action in Canterbury amongst agencies with an interest in active transport. Participants include representatives from the education, environment, health, disability, recreation, sport, tourism and transport sectors. National, regional and local government are represented, as well as consultants, non-profit groups and advocacy groups. The forum has been modelled on successful walking and cycling or active transport forums in Auckland and Wellington. The CAT Forum works in collaboration with the regional Active Transport Working Group (ATWG) which was established by the Regional Land Transport Committee (RLTC). CAT Forums are held quarterly. Agendas, minutes and presentations from the forums are accessible on the Environment Canterbury website:

www.ecan.govt.nz/Our+Environment/Transport/CanterburyActiveTransportForum.htm

Figure 9: Canterbury Active Transport Forum website

5.3 Optimising Traffic Operations

8. Auckland City's Liveable Arterials

Auckland City Council's Liveable Arterials Plan (2007) aims to improve Auckland's arterial roads by developing a systems-based network rather than a conventional hierarchical network. That is, the surrounding network and land use must be considered when determining the function of an arterial road. The plan is underpinned by sustainable transport concepts. Arterial roads are each assigned a particular emphasis – freight, passenger transport, general vehicle or community.

The plan places emphasis on dispersal of traffic throughout the network, rather than road widening (which reduces the amenity to non-motorised modes and lessens the chance of people stopping en-route at small businesses) or bypasses (which require land acquisition and promote urban sprawl).

9. Self Explaining Roads

Transport Engineering Research New Zealand (TERNZ) is carrying out a research project called "Self Explaining Roads". The research is being funded by the Foundation for Research Science and Technology (New Zealand Government) and participating local authorities are funding the physical works required for the research.

The aim of the research is to improve the safety and sustainability of the urban environment by managing driver behaviour through the use of "Self Explaining Roads" (SER). These are road treatments that can be retrofitted to the existing urban road infrastructure. SER design involves the systematic manipulation of perceptual features within the driving environment to control driver behaviour.

SER treatments are being developed for a hierarchy of road functions and their effectiveness will be evaluated through controlled trials in existing urban environments. Effectiveness will be measured by comparing road user behaviour and residents' perceptions (including willingness to use local roads for non-vehicle use) in the trial and associated control areas.

TERNZ is working with Auckland City Council to implement the first SER treatment area, in the suburb of Point England. Baseline monitoring is currently underway and construction of the SER treatments is due to start in October 2008. Preliminary findings from the Point England study are expected by June 2009. Meanwhile pre-implementation planning has begun with the second local authority (Rodney District Council), with construction planned for late 2009.

TERNZ will develop guidelines on the development of SER treatments as well as workshops on "Self Explaining Road Design". These workshops will be aimed at local authorities and their consultants so that the findings of the research can reach the widest possible audience. Auckland City Council is also updating its guidelines for addressing road safety in neighbourhoods using SER principles.

10. T3 lane – Onewa Rd, North Shore

Onewa Road, on Auckland's North shore, connects to the northern motorway. It has two inbound lanes, one of which is specified as a T3 transit lane (meaning that vehicles using this lane must have at least three occupants) and the other remains a "general" lane that can be used by any vehicle. The T3 lane carries approximately two thirds of the inbound commuters on Onewa Road – 28% of the total in high occupancy vehicles and 40% in buses – but accounts for only 27% of all vehicles on Onewa Road. This gives an average of 2.7 people per vehicle across both lanes as opposed to Auckland's overall average of 1.1 people per vehicle.

Enforcement ensures that motorists comply with the T3 regulations. It has been shown that travel times for those using the T3 lane are significantly lower than for those using the general lane and the overall capacity of the road has been increased. The decreased travel times and increased reliability of bus services using Onewa Road have resulted in increasing bus patronage and customer satisfaction.

11. SCATS, Christchurch

SCATS (Sydney Coordinated Adaptive Traffic System) helps optimise traffic flows, reduce delay and minimise fuel consumption and CO_2 emissions. Christchurch City is known to have an active approach to its use of SCATS to coordinate its nearly 250 signalised intersections. SCATS is often used in just a passive or reactive role – for example identifying blockages in the network or defective hardware.

Christchurch, however, has a high degree of coordination amongst intersections based on volume observations. At one point, the city's signals engineer developed a mobile SCATS monitor so that he could move around the city and alter phasing times at intersections based on real-time, first-hand observations.

Christchurch also caters for non-motorised modes using SCATS. Several mid-block cycle crossings, where the crossing phase is called by detections from SCATS cycle loops, are in place throughout the city. Cyclists and pedestrians have their own signal hardware so that the crossing phase can have a shorter duration if only cyclists are present. SCATS monitors have also been used to give information on the demand for pedestrian and cycle crossings at intersections throughout the city.

12. Creyke Road, Christchurch

The environment on Creyke Rd has been changed from a “car” place to more of a “people” place. Initial indications are that road safety has been significantly enhanced. Design and extensive consultation through the Living Streets programme commenced in 2001. Construction occurred during 2004. This project shows that a conventional minor arterial road with 13,000 vehicles per day in a busy urban environment can be transformed to better accommodate pedestrians and cyclists, without reducing functionality for cars.

The project included extensive collaboration with external stakeholders, council staff and consultants on the traffic engineering, traffic calming, sustainable drainage design, urban design and landscape architecture aspects of the project. The design narrows the road, removes a significant amount of on-street parking, and provides cycle lanes, wide footpaths and numerous street trees. Three central islands with trees at significant locations make it easier for pedestrians to cross the road. Traffic speeds are expected to reduce as the trees grow and reduce visibility along the street, improving conditions for non-motorised road users.

Figure 10: Creyke Road has been narrowed and fitted with pedestrian refuges, cycle lanes and numerous new street trees to improve conditions for pedestrians, cyclists and residents.

13. Queen St Redevelopment

A new road user hierarchy has been adopted that aligns with the Auckland City Council's Central Area Access Strategy, prioritising pedestrians and then public transport users over private motor vehicle drivers in Queen Street. The redevelopment of Queen Street reinforces this priority by increasing footpath widths, enhancing the streetscape including art works and other visual features. Facilities such as seating and three new pedestrian crossings have been added and signal phasings have been improved to suit pedestrian travel. A "pedestrian countdown timer clocks" trial has also been introduced that advises pedestrians how many seconds remain for the pedestrian phase of the signals, improving the quality of information for pedestrians. In addition, consultation is under way to authorise reduction of the speed limit for traffic on Queen Street to 30 km/h. The phasing of all traffic signals in Queen St is currently being reviewed to provide pedestrian priority.

For an area such as Queen Street with high pedestrian traffic flows, it is important that motor vehicle speeds should be reduced to more closely match the needs (and speeds) of pedestrians. This reduction in speed limit (and associated signal progression speeds to match pedestrian needs) is expected to make Queen Street more pedestrian-friendly. Lower traffic speeds increase pedestrian safety by reducing the risk and consequences of crashes. Reduced speeds result in less noise and vibration from traffic and therefore also improve pedestrian comfort.

Figure 11: Queen Street pedestrian crossing

5.4 Public Transport

14. New Lynn Transit Oriented Development

A range of inter-related transit orientated development (TOD) initiatives has been pursued by Waitakere City Council since the council's 1995 Greenprint Strategy, reflected in the City's Growth Management Strategy and City Transport Strategy (2006-16). New Lynn was confirmed as a growth centre by the Auckland Regional Growth Strategy (ARGS; and its recent review), by the requirements of the Local Government (Auckland) Amendment Act 2004 and by subsequent changes to the region's regional policy statement. New Lynn is located about 10 km southwest of the Auckland CBD, in Waitakere City.

The focus on New Lynn as a TOD reflects the strategic aims of growth management in Waitakere to integrate land use and transport and to promote urban and rural villages that emphasise thriving town centres for people to "live, work and play". A primary transport aim is to reduce the proportion of people who commute out of Waitakere City from the current 56% to 40%.

Accordingly the city's transport strategy supports land use and transport integration, with features including the use of rail as the backbone of passenger transport for Waitakere, connected to centres of intensified growth.

Figure 12: Artist's impression of future New Lynn station

In line with the growth direction set in the ARGS, New Lynn was identified as a sub-regional centre. Major increases in bus services and the increased train service will make the town centre a major destination and interchange point. Waitakere City Council, ARTA and ONTRACK are working collaboratively to redevelop the public transport system in New Lynn. An integrated rail and bus interchange, new road connections across the rail corridor at Memorial Drive and Hetana Street, new walking and cycling facilities and public circulation spaces and plazas will be developed. This project calls for the railway to be double-tracked and placed (with the station), in a trench; to have a new bus terminal located above, new and upgraded road connections and to include a variety of other improvements to the associated public spaces.

The interchange and integrated ticketing system proposed at New Lynn will encourage greater bus to bus and bus to rail interchanges. This is expected to reduce the vehicle trips to New Lynn that would have otherwise arisen.

15. Northern Busway, North Shore

The Northern Busway opened in December 2007 and now forms the central spine of a bus rapid transit system for the North Shore area and beyond to Rodney District. The busway, a 6 km dedicated two-way roadway for buses, is effectively a train system on rubber wheels – with interconnecting local services linking to the busway stations and the high frequency busway services. Park'n'ride facilities are provided at two stations. In the future, High Occupancy Vehicles (HOVs) with three or more occupants will have southbound access on the busway in the morning peak.

The busway and its stations are complemented by upgraded suburban bus stations and shelters, bus priority lanes on local streets, new bus routes, real-time information signs informing passengers when they can expect the next bus, and improved timetable information.

The busway has made it possible to re-plan the way bus services operate on Auckland's North Shore. This improved public transport network provides a real alternative to private car use. This is particularly useful for people visiting or working in the Auckland CBD where access is congested and parking is becoming more scarce and expensive.

By making bus travel more attractive and efficient it is anticipated that public transport will carry an increasing proportion of travellers. The projected volume of bus passengers will mean that one lane of buses will carry as many people as three lanes of general traffic. The busway is therefore increasing the people-carrying capacity of the SH1 motorway corridor and the Auckland Harbour Bridge. Since opening in December 2007 patronage has increased significantly.

Figure 13: Buses on the Northern Busway

16. Christchurch Bus Priority

Christchurch City Council is currently introducing bus priority measures. Some measures have been in place for some years, including bus, taxi and cycle lanes and bus only traffic signals at strategic locations in the central city where buses can move in a direction unavailable to other traffic. A trial of "bus boarders" along one bus route has also been implemented. The bus boarders allow buses to stop at bus stops in the roadway to pick up or drop off passengers, while other traffic must wait behind the bus. This ensures that the bus is not delayed getting back into the traffic stream and waiting drivers are made aware that bus users are given priority.

The boarder design also accommodates cyclists with a cycle lane by-pass, so that cyclists do not have to wait for a stopped bus in the same way that motorists do. A recent decision has been made to remove the bus boarders and replace them with bus lanes; this will provide even better priority for buses.

Figure 14: Bus stopped at bus boarder on Hills Road, Christchurch

17. Wellington Bus Lanes

Bus lanes have been installed to improve bus service and reliability. The lanes are next to the kerb and allow buses to move past banked-up traffic to the front of the queue, ensuring bus delays are minimised. Bus lanes have been installed on Lambton Quay, Hunter Street, Customhouse Quay, Willis Street, Thorndon Quay, Manners Street, Glenmore Street, Chaytor Street, Adelaide Road and Kaiwharawhara Road progressively since 2002.

Wellington City Council is working with the Wellington Regional Council to expand the bus lane programme. Bus lanes are mainly for buses, but motorcycles and cycles can use them too. Some bus lanes are marked "Buses Only" – motorcycles and cycles are prohibited there. In April 2008, use of the lanes by taxis was authorised on four streets for a year-long trial.

In general, bus lanes should be designed to accommodate cycles too – otherwise there is no safe place for cycling on these routes. In practice, this means that bus lanes should be at least 4.2 m wide. If this width is not available, then bus lanes should be about 3.2 m wide to ensure that cyclists can "hold" the lane and not be squeezed by buses. This option is undesirable and should be accompanied by 30 km/h speed limits to enhance pedestrian and cyclist safety.

5.5 Walking and Cycling

18. Bay of Plenty Regional Walking and Cycling Strategy

The Bay of Plenty Regional Council (Environment BOP) has developed a walking and cycling strategy for the region; the vision of which is “walking and cycling are an integral part of daily life in the Bay of Plenty”. Generally, walking and cycling strategies are provided at a local government level but this regional document enables sharing of knowledge, activity coordination, support and consultation amongst the six Bay of Plenty districts and a variety of other agencies in diverse sectors.

A regional cycle network plan has been proposed. An implementation plan outlines future walking and cycling projects and programmes and the agencies responsible for achieving them. The strategy also calls for continued monitoring and revision so that walking and cycling projects and programmes are kept up to date.

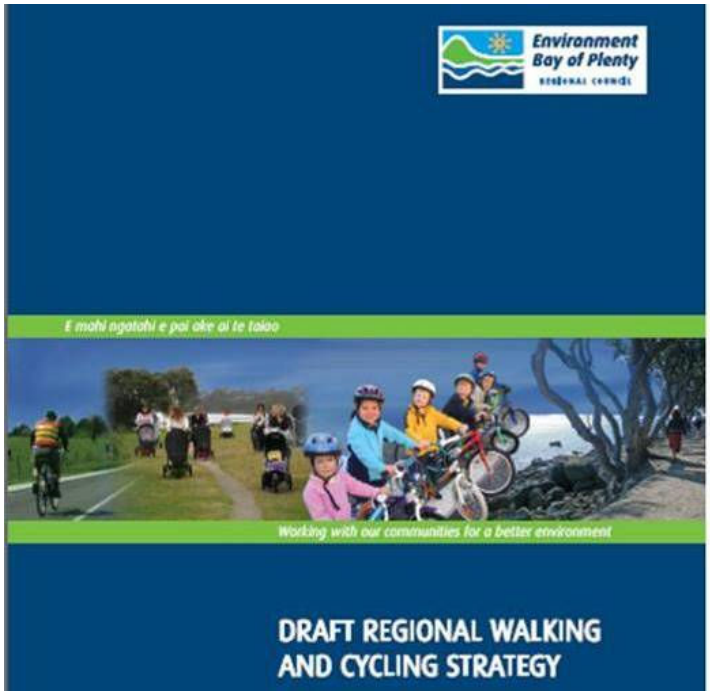

Figure 15: Environment Bay of Plenty’s walking and cycling strategy helps co-ordinate activity across six districts, two health boards and Sport Bay of Plenty, amongst others

19. Bikes on Buses Trial in Canterbury

Bike racks have been fitted to buses on the Christchurch to Lyttelton bus route, helping cyclists get through the Lyttelton tunnel from which they are otherwise prohibited. The project has been authorised as a trial by Land Transport NZ and began operations in November 2007. Initial indications are that the service is popular, safe and easy to use.

The bike racks can hold two bikes and are visible to bus passengers and the driver during travel, allaying fears of theft that would exist if the racks were rear-mounted. There is now demand for bike racks on all bus routes in Christchurch. This would provide opportunities for residents in more distant suburbs of Christchurch to cycle to their local bus stop and travel by bus to the city or other suburb, then continue their journey by bike. Some 50,000 bus trips are done per day in Christchurch (population 340,000) and a similar number of cycle trips is also undertaken.

Figure 16: Bike racks have been installed on Christchurch to Lyttelton buses allowing cyclists to travel through the Lyttelton Tunnel

20. Cycle Lanes, Christchurch

Christchurch City Council provides a comprehensive network of over 130 km of on-road cycle lanes and off-road cycle paths. The network is intended to cater for journeys by providing a connected network. Cycle lanes are designed according to standards from the NZ Supplement to Austroads Guide to Traffic Engineering Practice Part 14: Bicycles, which specifies appropriate widths depending on the speed environment and presence of adjacent car parking. Intersection treatments including coloured surfacing, advanced stop boxes, hook turns and special cycle traffic signals are provided at appropriate locations.

Figure 17: Cycle lanes on Fendalton Rd provide space for cyclists alongside 25,000 motor vehicles per day. The Railway Cycleway, shown here at Fendalton Rd, parallels the railway for more than 6 km through Christchurch's northern suburbs.

21. Contra-flow Cycle Lane, Christchurch

Contra-flow cycle facilities have been provided on Tuam Street and Antigua Street in central Christchurch, along with a walking and cycling bridge across the Avon River. Special features at two sets of traffic signals in the area improve access and safety for cyclists and pedestrians. These facilities improve the "permeability" for walking and cycling relative to cars, making these travel options more favourable.

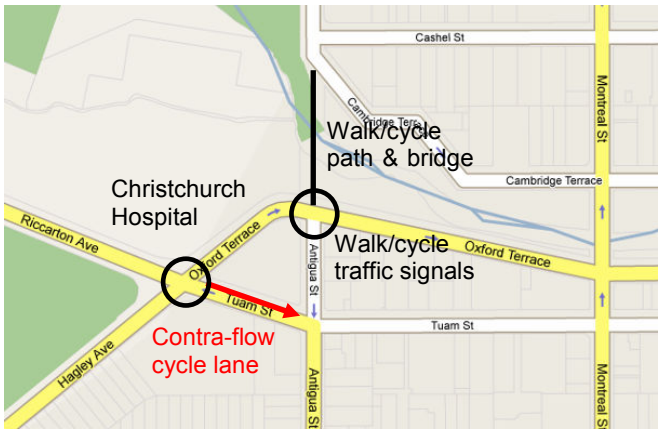

Figure 18: Contra-flow cycle lane allows eastbound cyclists to travel on a short section of Tuam Street which is one-way westbound

Figure 19: Cyclists cross the Oxford Tce/Riccarton Av intersection at protected signal crossing to access contra-flow cycle lane on Tuam Street

22. Shared Use Path, Hawke's Bay

The Napier Rotary Pathway Trust, an organisation formed with the specific intent of developing Napier's shared-use pathways, has been working with the Napier City Council, Transit New Zealand and the Hawke's Bay Regional Council since 2002. The group has raised money from community and corporate organisations and in 2003 began a $2.4°million, 10-year project to build a regional cycle network.

A series of off-road coastal paths and coastal bridges for cycling and walking has been constructed. Mobility-impaired users are also accommodated and the paths include features such as rest areas, rubbish bins, information and route guidance.

The project connects and circumnavigates the two cities of Napier and Hastings. The Rotary club's involvement and motivation of the wider community and technical support from the Napier City Council are seen as key factors in the project's success.

Figure 20: Rotary pathway, Napier

23. Off-road Cycle Path, Christchurch

Matai Street West is a short local street in Christchurch that has been recently redeveloped. Originally the street had a wide carriageway (about 14 m), excessive for its purpose. To reduce traffic volumes and speeds it was decided to reduce the width of carriageway provided to motor vehicles and reallocate road space for cyclists and pedestrians. The street is an important link between the railway cycle path and Straven Road, with many nearby homes, schools and activities.

The street now includes a dual-way cycle path at the same level as the rest of the road but separated by a grass berm and kerb. On the other side of the path is the original footpath, at a higher elevation and separated from the cycle path by a kerb. This gives cyclists increased protection from motor traffic without compromising pedestrian safety.

Figure 21: Matai Street West off-road cycle path

24. Little River Rail Trail, Canterbury

The Little River Rail Trail is a joint initiative between a trust set up specifically for the project and a number of stakeholders, including Christchurch City Council and Selwyn District Council. It is planned to extend from Hornby (10 km southwest of Christchurch) to Little River on Banks Peninsula, some 40 km away. Two sections, comprising over half of the total planned length, have been available for use since the first section was opened in 2006.

The Motukarara to Little River section (20 km) is an off-road path well away from State Highway, the main route from Christchurch to Little River and Akaroa, and offers excellent views of Lake Ellesmere and Banks Peninsula. The Prebbleton to Lincoln section (6 km) is well used as both a commuting route to the university town of Lincoln and as a recreational route. It is also off-road, but is located adjacent to Birchs Road, a main road joining the towns.

The two sections are estimated to carry about 30 cyclists per day and 120 cyclists per day respectively, based on a series of automatic counts undertaken between October 2007 and March 2008, adjusted for seasons over the year. From these counts it has been estimated that about 10,000 and 43,000 cyclists respectively used these path sections between July 2007 and June 2008.

Off-road cycle paths are generally expensive compared to cycle lanes but are well-liked by users as they provide a traffic-free experience. It is expected that the recreational component of the Little River Rail Trail will help to increase people's enjoyment and confidence with cycling and result in more people choosing to commute via cycle.

Figure 22: Little River Rail Trail – Motukarara to Little River section

Figure 23: Bicycle counting on the Prebbleton to Lincoln section

25. BikeCentral Bike Station, Auckland

The BikeCentral station was formed in January 2008 after an investigation by Cycle Action Auckland, the Auckland Regional Transport Authority (ARTA) and the Auckland City Council. BikeCentral is located in Auckland's CBD, near the Britomart public transport station. Cyclists can hire a secure bicycle storage facility as well as shower and locker facilities at daily, weekly or yearly rates. The centre also has a café and a wireless internet connection available for customers. Cycle repairs, maintenance, spare parts and accessories are available on site, as well as bicycle rentals for half-day or full-day hire.

Figure 24: BikeCentral

5.6 Freight

26. Wiri Inland Port, Auckland

Ports of Auckland Ltd (POAL) has recently established an “inland port” on land it owns close to Wiri station on the North Island Main Trunk rail line in South Auckland. Currently container traffic is moved from Wiri to the main port by truck (usually at night) but the port authority has proposed that the bulk of this traffic be transferred to rail. In the early years the use of rail would not be financially viable but the proposal would have “public good” benefits.

The volume moved through Wiri is expected to grow at around 10% annually and as this happens, in the absence of a rail alternative, more trucks would travel by day since there is a limit to the extent of night time operation possible.

Wiri is well suited as the location for this type of facility. It is accessible by road and rail, especially once the SH20 connection to SH1 is complete. The site itself has future growth options and is close to the main industrial area of Auckland (approximately 80% of export and import traffic through the port is from south Auckland) as well as other potential users such as freight forwarders and the airport.

The site has existing rail sidings but these would need to be upgraded if the rail proposal is to go ahead. A hard standing area where containers can be loaded onto trains is also needed. The capital works necessary for this would be funded by Ontrack and the cost recovered from POAL over 15 years.

27. Auckland Freight Strategy

The Auckland Regional Council (ARC) sees freight transport as a vital part of its economy. As population and economic growth are both predicted to increase in the region and environmental concerns are growing, ARC has developed a freight strategy to ensure the efficient and sustainable movement of freight.

The freight strategy covers regional, inter-regional and international freight movements carried via road, rail, sea, air and pipeline transport. It includes six strategic policies: improve information and communications; supportive funding and regulatory framework; relief of congestion; strategic freight network, local area freight management; and a clean, quiet and safe freight system. These policies are to be achieved according to a detailed implementation plan that outlines individual policy components, the required action, organisations responsible for delivery and the time frame for completion. The strategy acknowledges that data acquisition and monitoring is vital in understanding and therefore improving freight transport. Consolidation of goods, hub networks, flexible delivery hours and freight access routes are among the actions to be used and it is recognised that freight transport should be considered in all travel demand management and pricing projects developed for Auckland’s road network.

5.7 Pricing and Charging Measures

28. Tauranga Toll Road

Takitimu Drive (also known as “Route K”) links State Highway 29, south of Tauranga to State Highway 2, which progresses through central Tauranga and links via the harbour bridge to Mount Maunganui. It is a two-lane expressway (with the possibility of being upgraded to a four lanes) and was completed in 2003 as part of a project aimed at catering for the significant growth in the Tauranga region.

It was expected that the benefits of operating Route K as a toll road would be double the costs of provision, however volumes of traffic using the road were significantly lower than predicted and the capital cost of construction was significantly higher, resulting in Route K being identified as an uneconomic project in 2005. It was also identified that Route K gave benefits to users of alternative routes due to reduced congestion on these route but Route K users were effectively double-charged as they paid tolls in addition to road user charges and petrol taxes (which did not contribute to the financing of Route K). This highlights the importance of identifying and using the correct pricing structures in road pricing schemes. Cameras with automatic number recognition technology have been trialled at the Route K toll booths as a replacement for manually operated toll collection.

Figure 25: Tauranga’s Route K toll booth

29. Wellington Inner Residential Parking Management

Wellington operates a parking management scheme within the inner residential areas surrounding the CBD. This is aimed at increasing amenity to local residents and limiting the supply of commuter parking (thus attempting to dissuade commuters from travelling by private motor vehicle). As well as standard parking management techniques such as short-term parking outside dairies and bus stops, two parking regimes are used: residential parking and coupon parking.

Residents can purchase residential permits which allow them to use residential parking. Coupon parking is open to anyone and is free for the first two hours (thus allowing short stays). Residents in the area can purchase coupon exemptions (which are cheaper than residential permits) to allow them to use coupon parks. Other groups who meet certain criteria but do not reside in the area can also purchase the exemptions. Some free coupon exemptions are given to community groups, schools or business owners with special circumstances.

6 Local and Regional Opportunities for Action

A number of possible tools are available to implement desirable changes in New Zealand's transport systems. This list comprises actions mostly available to local and regional councils. There are many other actions for national government agencies to undertake, but that is not the focus of this discussion document and there are other processes in play to identify and advance national initiatives. Typically, the actions identified in this list (see Table 1) will be most successful when implemented with other measures as part of comprehensive, integrated packages.

Strong leadership by elected officials and senior technical staff at the local and regional level will be essential to accomplish change.

Table 1: Tools for influencing travel choices

Actions	By	Comment or explanation
Land Use and Transport Planning Integration		
1. Foster intense land use around public transport hubs and corridors	Local & Regional	While national initiatives such as a National Policy Statement or the Government Policy Statement on transport may reinforce this, local councils can already use their district plans and resource consent processes to implement this.
2. Set the direction for urban growth with outline development plans	Local & Regional	Letting individual subdivisions occur in an ad hoc manner often results in urban sprawl that is hard to service with sustainable transport modes.
3. Require new developments to pay sustainable transport contributions or levies.	Local	This would be analogous to the existing requirement where new developments pay reserve contributions for new parks and playgrounds. The revenue could be used to support public transport, walking or cycling.
4. Change district plan parking requirements from minimums to maximums.	Local	Most councils require minimum numbers of car parking spaces for new developments, typically based on floor area or number of employees. Changing this to maximums would result in less land being consumed by car parking, less car traffic induced, and more intense land use. These trends support sustainable travel modes.
5. Develop and implement regional parking strategies for both off- and on-street parking.	Local & Regional	Development of regional parking strategies with the assistance of local councils will allow consistent approaches to this essential tool to manage car traffic growth. Implementation will usually be a local function, but elected representative leadership at both local and regional levels will be essential.
6. Adopt appropriate uNZTS targets in local plans and strategies	Local & Regional	National and regional targets are being set through the uNZTS targets. Each council should adopt these or better them, where possible.

Attitudinal and Behavioural Measures		
7. Implement travel plans at schools, workplaces and new subdivisions.	Local	Helping users understand their travel options can reduce VKT, especially when people have changed circumstances such as starting a new job or school, or moving to a new location.
8. Start marketing campaigns aimed at reducing urban speeds	Regional	Physical changes (such as traffic calming) will need to be supported by publicity campaigns, changing attitudes towards speed and then driver behaviour.
9. Lead by example	Local & Regional	Introduce staff travel plans targeting walking, cycling and public transport. Achieve a sustainable travel environment for staff, so that their personal experiences can flow into their work.
Optimising Traffic Operations		
10. Optimise traffic operations continuously in towns and cities.	Local	For example, undertaking traffic signal audits or optimisation exercises on 1/3 of a city every three years would provide more traffic capacity, but also provide opportunities to improve conditions for walking, cycling and public transport.
11. Consider the road user hierarchy in all traffic planning, operations and maintenance activities.	Local	Considering pedestrians first (followed by cycles, buses, trucks and cars) in all traffic engineering and planning functions will progressively change the "balance of power" on streets in favour of more sustainable modes of travel.
12. Introduce bus priority measures wherever buses are routinely caught in congestion.	Local & Regional	This will need to be a collaborative approach between both levels of government. Regions are responsible for public transport and local councils are responsible for road and traffic operations.
13. Introduce traffic calming and/or 30 km/h areas in residential and CBD areas.	Local	Reducing motor vehicle speeds in urban areas is a powerful way of encouraging walking and cycling.
14. Protect local roads from through traffic and make the local road network less "permeable" for cars.	Local	Providing opportunities for people to walk and cycle more freely through neighbourhoods and CBDs gives these modes a competitive advantage over cars and helps people choose to walk and cycle.
15. Review and adjust kerb lane widths on all arterial roads to accommodate cyclists, or provide cycle lanes.	Local	Kerb lanes need to be at least 4 m wide to safely accommodate cyclists. A less desirable alternative is to have very narrow kerb lanes so cyclists can "hold" the lane, but this should be accompanied by 30 km/h speed limits and complete parking prohibitions. Widths between 3.0 m and 4.0 m should be avoided. These widths should be increased by 0.2 m if buses or trucks are prevalent.
16. Improve traffic counting systems for all modes	Local	Good traffic data are the foundation of all traffic management systems.

Public Transport		
17. Implement integrated ticketing throughout all metropolitan areas with public passenger transport services.	Regional	A single ticketing system, allowing users of buses, trains, trams and ferries as appropriate to transfer between services run by different operators, improves the level of service for users and allows "seamless" journeys.
18. Ensure there are adequate incentives for public transport drivers and operators to keep to timetable	Regional	Nothing is more dissatisfying for public transport patrons than buses that leave the bus stop early, even by one minute. Conversely, services that run "like clockwork" and provide certainty of arrival time are highly valued. Regional councils can provide strong incentives to reward operators, who can then reward their bus, train and ferry drivers for punctuality.
19. Improve access to real-time information for public transport patrons.	Regional	Access to bus, train and ferry arrival times at the nearest stop can be made available on cell phones, at stops and by internet. This improves service and perceptions of safety for patrons.
20. Require bike racks on buses in all new public transport service contracts.	Regional	Many overseas bus operators provide this option for patrons to cycle to or from a bus route and then take their bikes with them. A recent trial in Christchurch has been successful.
21. Allow bikes to travel free on commuter and long-distance trains.	Regional	Many overseas train operators provide this option for patrons to facilitate longer journeys by cycle and train. Suburban trains in Auckland and Wellington allow off-peak carriage of bikes but charge for the privilege.
22. Enable bus drivers to order taxis to meet passengers at bus stops to complete journeys door to door at night.	Regional	People can be encouraged to use public transport if they are provided surety of door to door service at night. This could work in both directions.
Walking and Cycling		
23. Develop and implement walking and cycling strategies	Local & Regional	District, city and regional councils that don't have a walking, cycling, or combined strategy should be encouraged to develop one. Set measurable targets that correspond to the uNZTS. Include an implementation plan connected to LTCCP.
24. Increase funding for footpath maintenance.	Local	Although not subsidised nationally like other transport projects, footpath maintenance is essential for a good walking environment. Councils should attempt to provide a safe and secure travelling surface for pedestrians, including those in wheelchairs.
25. Implement the model communities project (one of 10 initiatives in the implementation plan for NZ's national walking and cycling strategy	Local & Regional	By being involved in this initiative, councils will have a cost-effective way to get major changes to enhance walking and cycling implemented in their communities.
26. Review public cycle parking provision and implement more at key destinations.	Local	Provision of appropriate parking facilities at key destinations (retail, leisure, school and workplace) encourages cycling.

27. Arrange for arterial roads and cycle lanes to be swept weekly or monthly for broken glass.	Local	Broken glass (especially after Friday and Saturday nights) causes frequent punctures for cyclists and can force them to abandon cycling. Regular sweeping (ideally on Sundays or Monday mornings) helps mitigate this risk for cyclists.
Freight		
28. Improve data collection on freight operations.	National & Regional	Data quality is poor for freight. Data collection at the local or regional level will be imperative to understand the issues and monitor trends before remedial actions can be identified.
29. Encourage use of the voluntary operator rating system for freight carriers.	National, Regional & Local	Data quality is poor for freight. This voluntary system provides much-needed data on freight movements.
Pricing and Charging Measures		
30. Implement regional fuel taxes.	Regional	These can help fund transport improvements (especially sustainable transport facilities and services). They can be made revenue neutral if desired by reducing property taxes ("rates"), as a large proportion of these goes to road maintenance and construction.
31. Co-ordinate off-street and on-street parking charges regionally	Regional & Local	Different charges in neighbouring council areas can undermine a consistent approach to parking charges, encouraging car use instead of more sustainable modes.
32. Introduce road pricing on congested corridors and bridges	Regional	Ensuring users pay the full price of travel encourages people to reduce trips and choose the right mode for each trip, thus improving community outcomes.
33. Improve data collection and analysis from public transport, traffic counts, traffic signal systems and parking systems.	Regional	This will assist with policy and pricing refinements.

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