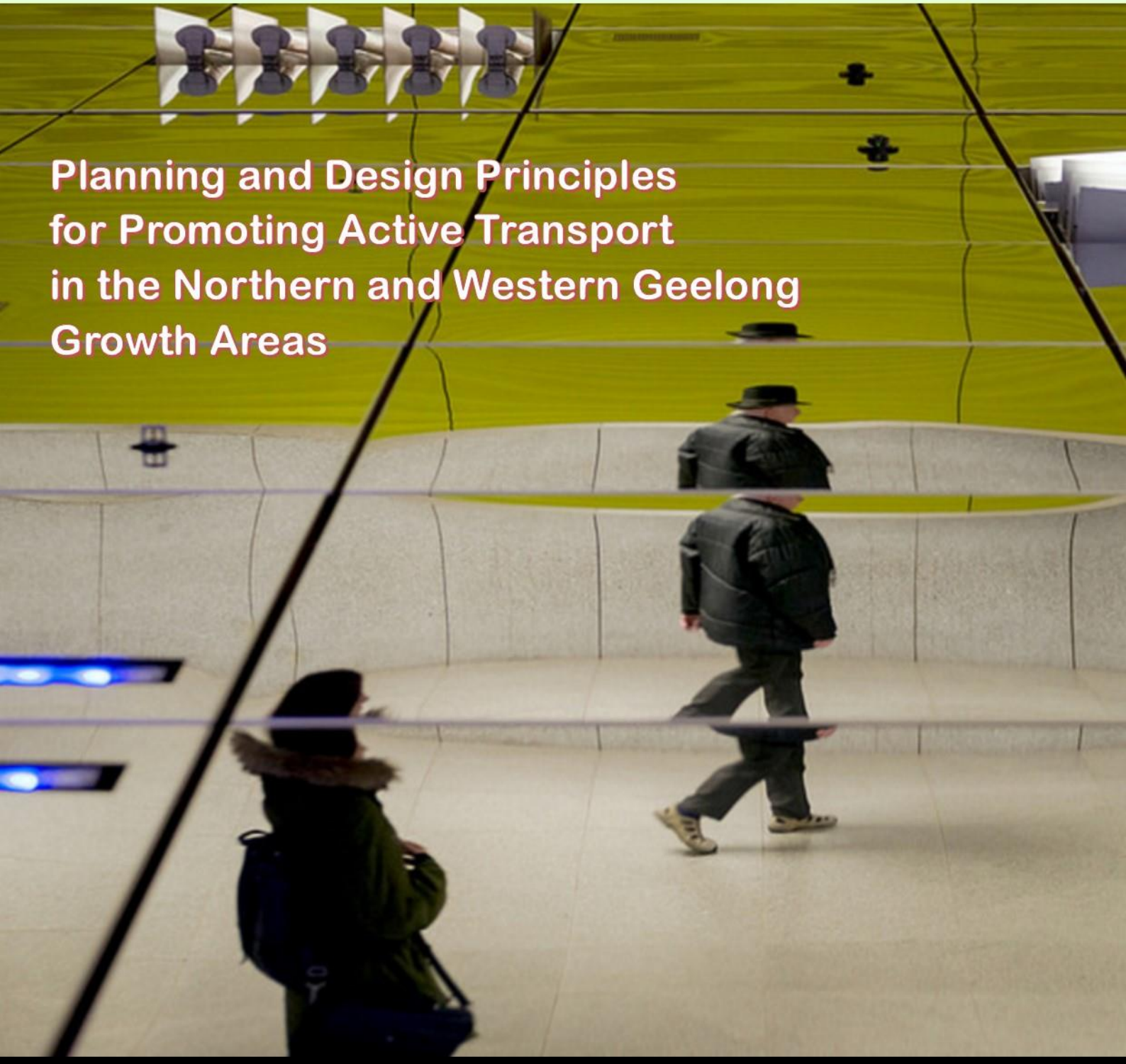

Planning and Design Principles for Promoting Active Transport in the Northern and Western Geelong Growth Areas

Prepared for City of Greater Geelong
24 August 2017

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CONTENTS

1. INTRODUCTION

1.1. CONTEXT

The Northern and Western Geelong Growth Areas project aims to establish a framework for the delivery of sustainable liveable communities in both growth areas. The project builds upon the work undertaken by the G21 Regional Growth Plan, which identified two further investigation areas to accommodate the medium to long term growth of Geelong (see Figure 1).

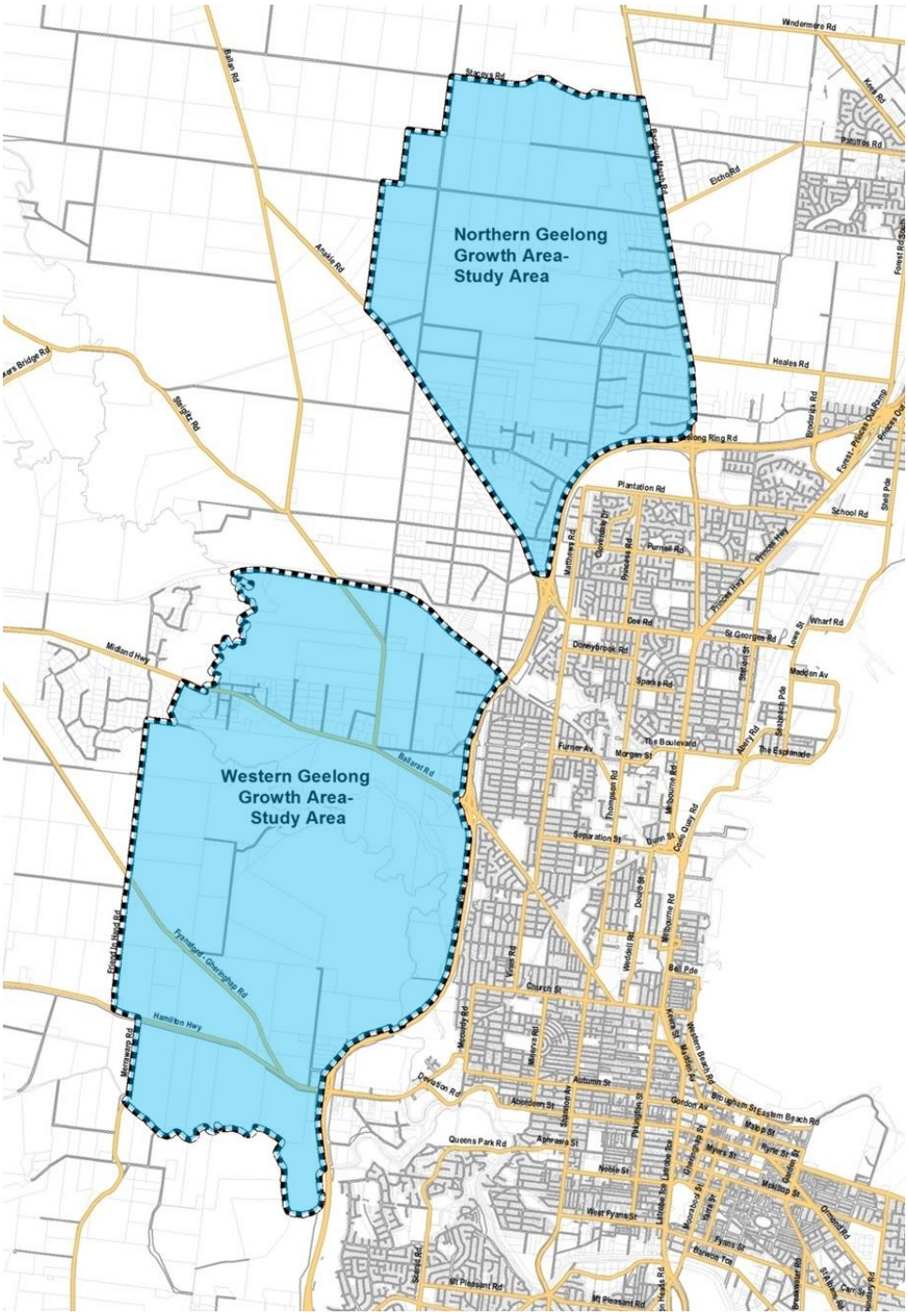


Figure 1: Location of the Northern and Western Geelong Growth Areas

1.2. PURPOSE

This report presents a comprehensive body of evidence that summarises the latest science, research findings and practical guidance for the design of the 'sustainable suburbs of the future', characterised by seamless active transport corridors, high levels of accessibility to a wide range of destinations, and streets as an integral part of the public realm (rather than simply roads for cars). In particular, this report explores aspects that may be of relevance to promoting the desired active transport goals for the Northern and Western Geelong Growth Areas (as presented in the April 2016 Northern and Western Geelong Growth Areas Project – Context Report), namely:

- Provide opportunities for people to walk and cycle within the communities and establish connections to existing shared paths external to growth areas (e.g. Barwon River pathways).
- Identify active (and public) transport corridors to key locations such as the Geelong Ring Road Employment Precinct, Corio Village shopping centre, Lara and North Shore railway stations and Central Geelong.

To achieve the desired goals, this report: (1) presents a detailed summary of all the relevant evidence and scientific knowledge in the community building arena, and (2) defines a set of principles and strategic objectives that provide the foundation for the detailed planning of the Northern and Western Geelong Growth Areas. More specifically, this report summarises information collected through:

- A comprehensive review of Australian and international literature, including peer reviewed papers, best practice urban design and traffic engineering guidance documents, and other technical reports of relevance (such as publications from the Transportation Research Board of the United States National Academies of Science, Engineering and Medicine; the United States National Association of City Transportation Officials; the European Urban Research Association; the European Conference of Transport Research Institutes; and the Canadian Institute of Planners).
- Direct engagement with internationally recognised experts in the fields of urban design, transport planning and behavioural science from leading academic institutions. This is critical since peer reviewed publications are, by the nature of academic approaches and protocols, 'conservative' in the presentation of lessons that can be readily applied in practice. For example, since most studies have relatively small sample sizes, which limit their scientific validity from a purely statistical perspective, the conclusions presented in peer reviewed publications are generally presented as (at best) providing only an initial basis for practical applications. By engaging with the experts directly, this report goes beyond published knowledge and presents 'deeper' knowledge and insights that informed the definition of practical, innovative and scientifically sound active transport guiding principles.

1.3. KEY PRINCIPLES

Nine principles have been developed to help guide the creation of framework for the delivery of sustainable liveable communities in both the Northern and Western growth areas.

- **Principle 1 – Priority for Active Modes**
  Designing neighbourhoods to make walking and cycling to key destinations always shorter than 'driving' alternatives
- **Principle 2 – Land Uses and Distances**
  Identifying desirable distances to support the 5-minute neighbourhood living concept – to give people the ability to 'live locally' – meeting most of their everyday needs within a 5-minute walk, cycle or local public transport trip of their home
- **Principle 3 – Consolidated Residential Parking**
  Provision of communal/consolidated parking facilities to replace on-street and on-site parking
- **Principle 4 – Parking and Schools**
  Creating exclusion zones around schools so that there is no public parking within 500 metres of any entrance – to promote children walking and cycling to school, and enhance road safety for the most vulnerable road users
- **Principle 5 – Accessible Shared Mobility**
  Establishing shared mobility systems within a 5-minute walk of all homes (shared bikes at a maximum of 250 metres and shared cars at a maximum of 500 metres) – to encourage the use of shared vehicles and discourage high levels of vehicle ownership by residents
- **Principle 6 – Day One Public Transport**
  Establishing public transport services, in the form of shuttle bus services that link to/from Geelong CBD in the morning and afternoon peaks seven days a week – to discourage reliance on the use of cars for commuting trips
- **Principle 7 – Road Design and Traffic Management**
  Establishing a network of pedestrian and cycle friendly local roads, in the form of pedestrian-bicycle priority spaces and shared zones – to encourage the use of roads as spaces for people (on foot and bike), create an urban environment where people of all ages and abilities can safely walk and cycle, and discourage the use of cars for local trips
- **Principle 8 – Pedestrian Villages**
  Designing neighbourhoods where the frontages of homes face a network of linear pedestrian/cycle park paths that connect all homes to commercial areas, parks, schools, recreation and other amenities – to provide full separation for pedestrians and cyclists for the majority of their local trips
- **Principle 9 – Local Business Incentives**
  Council will provide financial incentives, in the form of a rebate or concession on rates and charges, to assist the establishment and viability of local businesses that are consistent with the land uses required to encourage active transport (see Principle 2) – to promote the establishment of viable and high-quality local centres and neighbourhood activity centres that allow people to meet most of their daily needs by traveling on foot and by bike

2. PRINCIPLES

2.1. PRINCIPLE 1 – PRIORITY FOR ACTIVE MODES

Designing neighbourhoods to make walking and cycling to key destinations always shorter than 'driving' alternatives. More specifically, walking and cycling trips to grocery stores/supermarkets, open spaces, child care centres, cafes/restaurants, and primary/secondary schools always shorter (in terms of distance) than motorised trips.

Key Supporting Research

1. **In Adelaide, Cerin et al. (2007) found that walking rates for residents for whom active transport was not a predetermined priority were positively affected by destination accessibility. This suggests that part of the effect of the built environment on transport related walking was a direct effect.**
2. **In the United States, Ewing (2017) reviewed 35 regional transportation plans and highlighted recent evidence that destination accessibility and diversity of land uses have a greater impact in promoting active travel than other land use variables (such as density).**
3. **In the United States, Ewing et al. (2008) and Ewing and Cervero (2001) identify destination accessibility (by active travel modes) as a development factor in determining travel behaviour. Destination accessibility has a significant impact on the travel of individuals and households, mostly through its effect on distances travelled and mode of choice.**

Residential Preferences and Public Health in Metro Vancouver:

Promoting Health and Well Being by Meeting the Demand for Walkable Urban Environments

There is strong preference for walkable neighbourhoods in Metro Vancouver

City of Vancouver residents:

64% would *strongly prefer* to live within a 10 minute walk of shops & services

8% would *strongly prefer* to live where housing & commercial areas are kept separate

52% would *strongly prefer* to live where travel distances are <5 km, even if it means a smaller lot

7% would *strongly prefer* to live on a larger lot, even if it means travel distances over 25 km

Residents outside the City of Vancouver:

40% would *strongly prefer* to live in walking distance to a wide range of smaller food stores

15% would *strongly prefer* to live where there are few food stores in walking distance, but several very large supermarkets accessible by car

"Well planned built environments are integral to sustainable communities...aligning consumer demand with principles of good neighbourhood design helps build healthier communities, which benefits everyone."

- Jack Wong, CEO, The Real Estate Foundation of BC

The survey found considerable *unmet demand* for neighbourhoods with a wide range of smaller food stores within walking distance

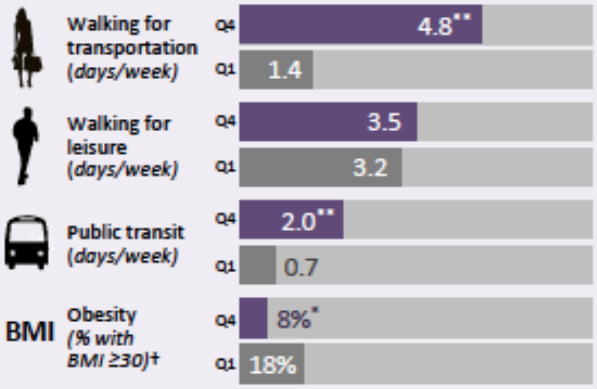
...strong desire was expressed among:

30% of City of Vancouver residents who feel their neighbourhood is very car-oriented

25% of residents outside the City of Vancouver who feel their neighbourhood is very car-oriented

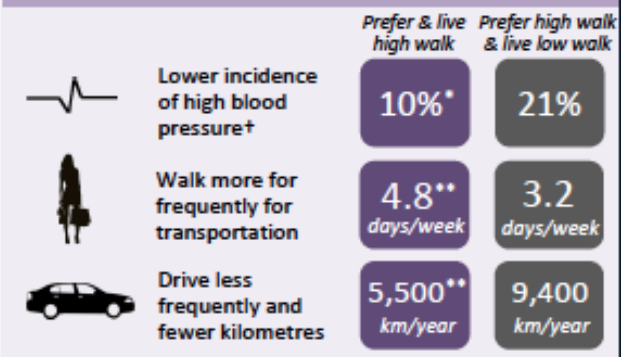
- Dr. Lawrence Frank, UBC (Study Lead)

People living in Metro Vancouver's most walkable neighbourhoods reported walking more often for transportation, using public transit more frequently, and lower incidence of obesity



Q4= highest quartile of neighbourhood walkability | Q1= lowest quartile of neighbourhood walkability

People who prefer and live in a walkable place reported healthier lifestyles than those who prefer a walkable neighbourhood, but do not live in one



**significantly different than the reference group ($p<0.01$)
*significantly different than the reference group ($p<0.05$)
†statistically significant after adjusting for age, sex & income

UBC Health & Community Design Lab

Report funded by the Real Estate Foundation of BC and prepared in partnership with Healthy Canada by Design, an initiative led by the Heart and Stroke Foundation and funded by Health Canada through the Canadian Partnership Against Cancer's CLASP program.

The survey polled 1,223 Metro Vancouver adults age 25 years and older in 2011. Participants indicated their preference for walkable versus auto-oriented neighbourhood design features in a series of illustrated "trade-off" scenarios while holding factors such as cost, job access and school quality equal.

Access the full report at: http://health-design.spph.ubc.ca/publications/reports

Graphic: S. Kershaw | September 2014

2.2. PRINCIPLE 2 – LAND USES AND DISTANCES

Identifying desirable distances to support the 5-minute neighbourhood living concept – to give people the ability to 'live locally' – meeting most of their everyday needs within a 5-minute walk, cycle or local public transport trip of their home. More specifically, distance thresholds (from each home) for the main land uses, as follows:

- *A grocery store or supermarket within 500 metres of every home*
- *Open space within 1 kilometre of every home*
- *Child care within 1 kilometre of each home*
- *Cafes/restaurants, general retail and personal care establishments within 1 kilometre of each home*
- *Primary school within 1.5 kilometres of each home*
- *Secondary school within 2 kilometres of each home*

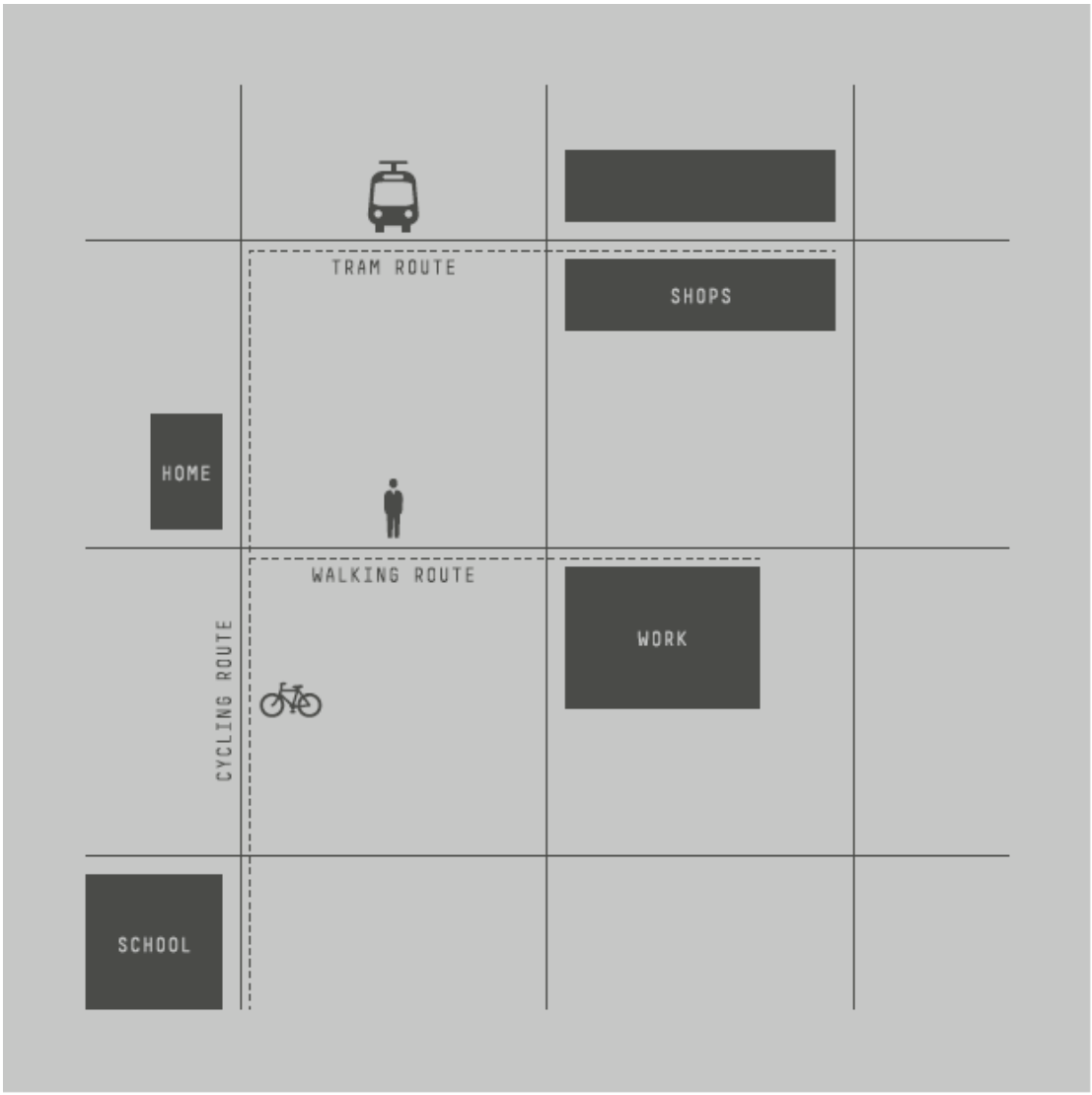
Key Supporting Research

1. **In Perth, Australia, McCormack et al. (2008) found that having convenience stores for daily shopping needs, located within 400 metres of home was associated with greater levels of walking. They also found that having schools, convenience stores, shopping mall, and train stations within 1,500 metres was equally associated with greater levels of walking.**

2. **Australian Bureau of Statistics (ABS) latest Household Expenditure Survey Australia: Summary of Results (2009-10). The table shows that 'food and drink' and 'recreation' are the two categories (aside from 'housing' and 'transport') with the highest level of expenditure. Collectively the 'food and drink' and 'recreation' categories are responsible for around a quarter of the average weekly spend across all 'life stages' reported by the ABS (varying from a low of 24% for '*lone person aged under 35*' to 30% for '*couple with kids – eldest child between 14-24*'). This supports the findings in the literature that grocery stores, supermarkets and food outlets (e.g. cafes and restaurants), and recreational facilities/destinations are likely to be key land uses to promote active travel.**

3. **In Denmark, Heyman and Stahle (2013) concluded that it can generally be said that people are willing to walk about 400 to 500 metres for simple errands or attractions, such as food shopping, personal care and recreation and entertainment.**

Principle 2 is fully consistent with, and supports, Headline Opportunity 1 ('Five Minute Living' Through Compact Urban Form and Mixed Land Uses) of the "Best Practice Sustainability within the Northern and Western Geelong Growth Areas" report. The report highlights the importance of creating communities that fully embrace the 'five-minute living' concept in their urban form and land use and density arrangements, as a mechanism to significantly boost Geelong's future sustainability as a city. 'Five-minute living' is possible in communities that have varied employment opportunities and embrace a diversity of dwelling types within higher density activities centres, and which have access to excellent public and active transport choices.



Principle 2 is also consistent with Plan Melbourne 2017-2050, which aims to make the 20-minute neighbourhood a reality for every Melburnian. The concept of the 20-minute neighbourhood is to give all Melburnians the ability to 'live locally' – meeting most of their everyday needs within a 20-minute walk, cycle or local public transport trip of their home. The everyday needs include schools, shops, meeting places, open spaces, cafes, doctors, childcare and access to public transport. Research undertaken by the Heart Foundation (Victoria) for the Victorian Government identifies hallmarks of a 20-minute neighbourhood. A 20-minute neighbourhood must:

- be safe, accessible and well connected for pedestrians and cyclists to optimise active transport
- offer high-quality public realm and open space
- provide services and destinations that support local living
- facilitate access to quality public transport that connects people to jobs and higher-order services
- deliver housing/population at densities that make local services and transport viable
- facilitate thriving local economies.

If 20-minute neighbourhoods existed across Melbourne, it could reduce travel by nine million passenger kilometres and cut Melbourne's daily greenhouse gas emissions by more than 370,000 tonnes.

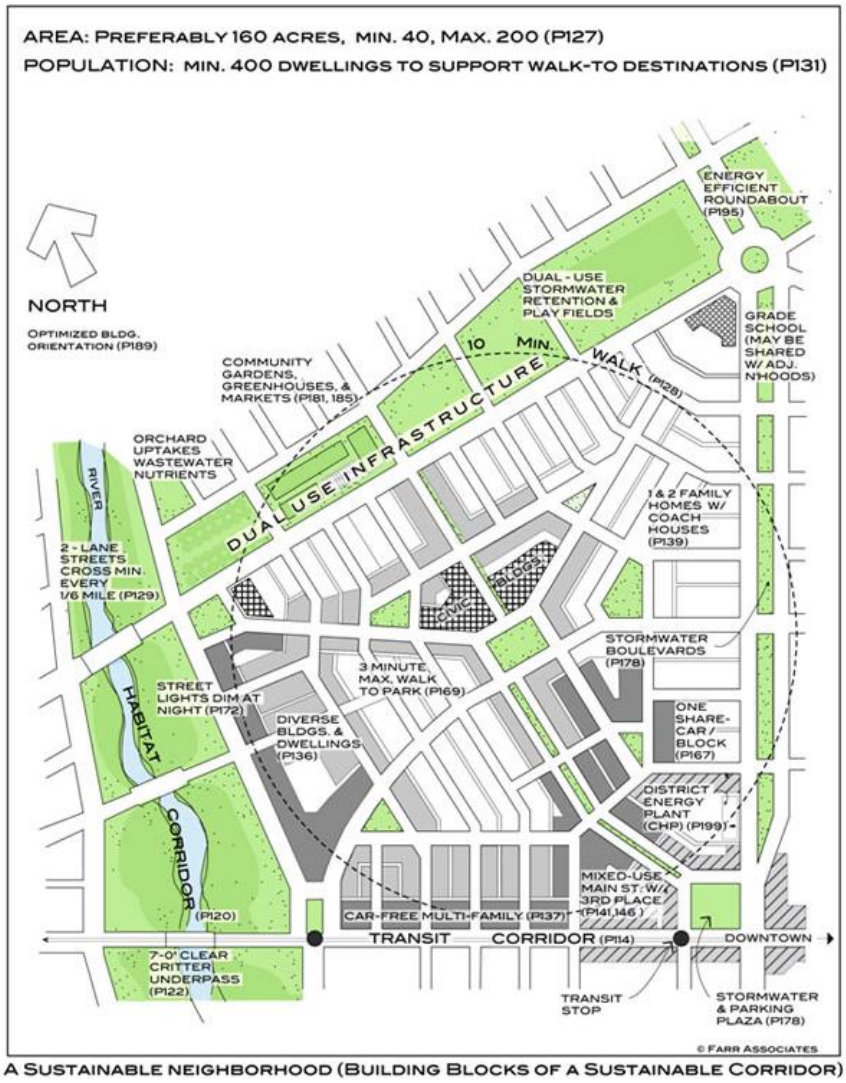


Figure 2: Clarence Perry – Neighbourhood Unit

Clarence Perry published in 1929 a plan for creating new cities comprised of neighbourhood units. The idea was to centre social and civic buildings towards the centre of the new neighbourhood and orientate houses and community around these focal points in order to foster interaction and goodwill between neighbours. Notably, Perry developed the concept of the ¼ mile distance, or radius, forming a comfortable distance residents would be willing to walk to services. The residential unit would be developed within a reasonable commuting distance of a city centre, alongside a highway where the major retail services and regional through traffic would be located, so that they could service a wider community than just that of the new neighbourhood. After its wide spread acceptance into practice and theory, Reginald Isaac presented strong opposition to the idea. His criticism stemmed from the fact that the more neighbourhood unit type places were built the more it became clear that they were being used (by both developers and planning agencies) as socially isolated and racially segregated neighbourhoods.

Some of the elements presented by Perry can be adopted into new designs for the 21st century. Instead of the adjacent regional highway, public transport can be used to connect people into the major employment centres. The idea of creating a central meeting place for residents to commingle has merit; however, the civic and community centres would be better placed near the commercial areas and public transport services. These elements have the potential of working well in concert with one another, creating a cultural centre for the neighbourhood, and creating an active place.

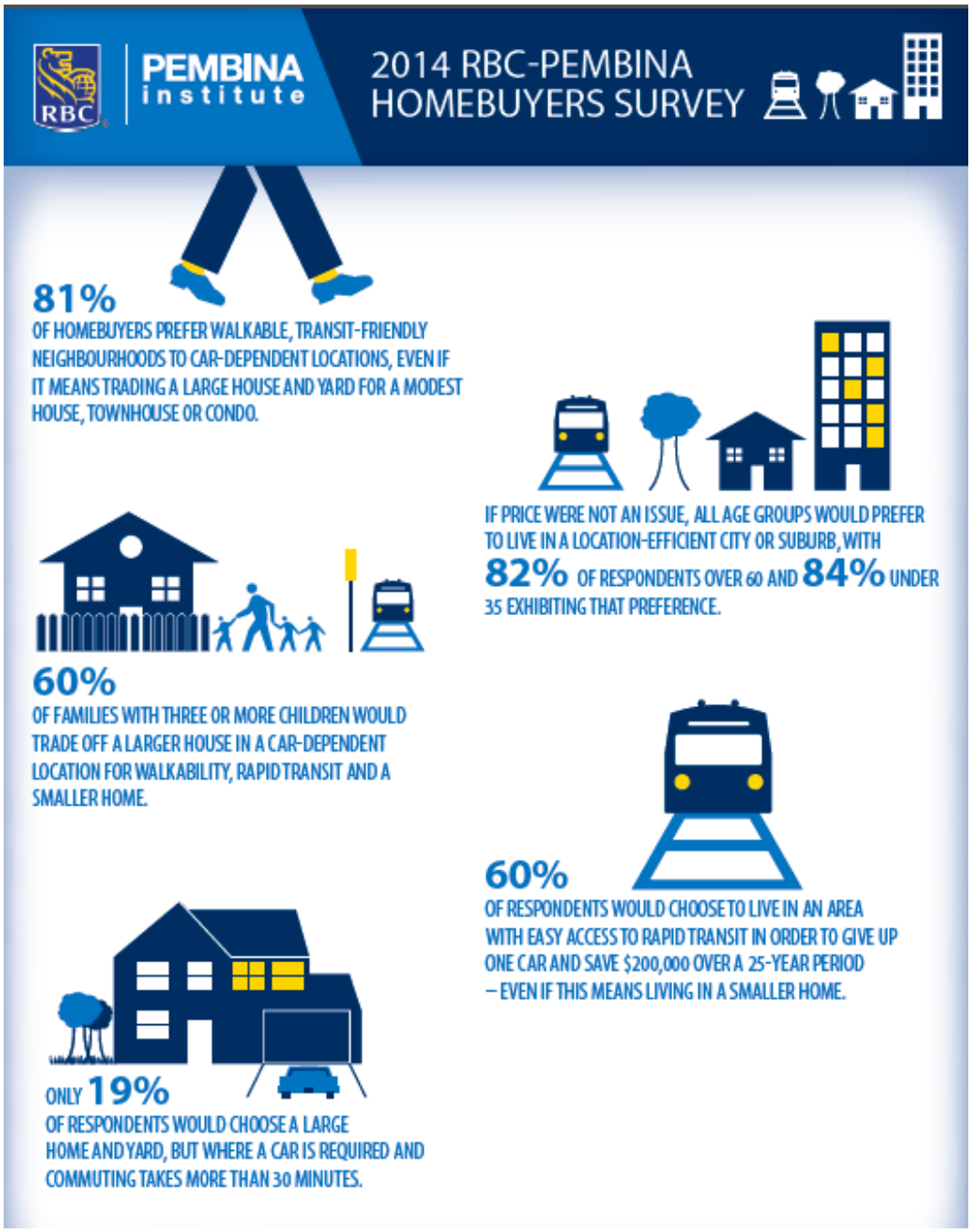
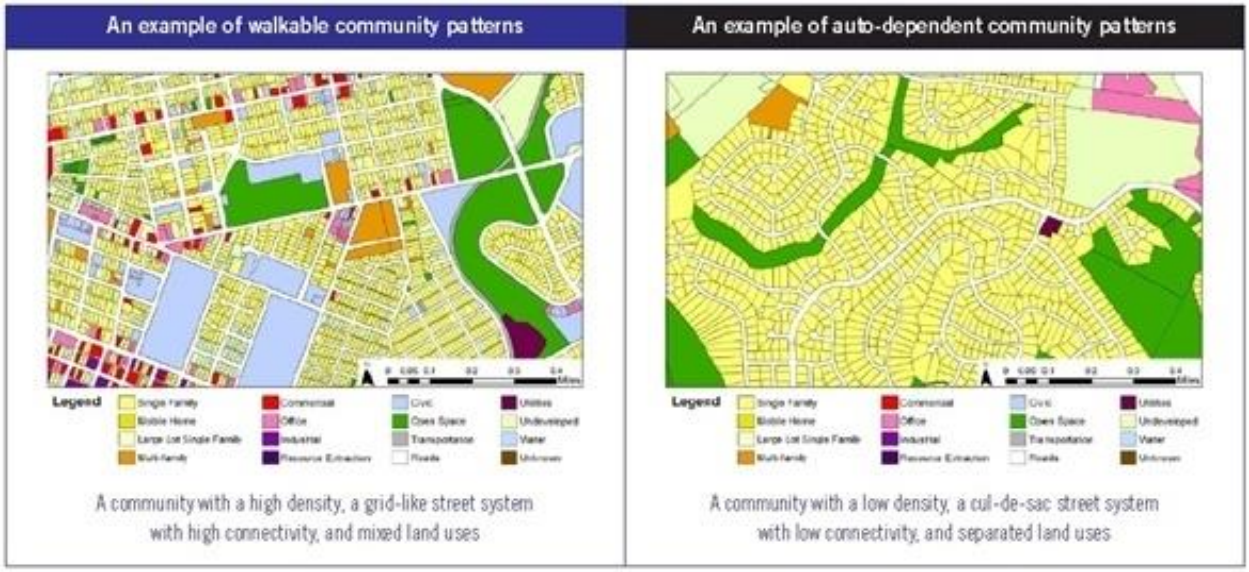


Figure 3: RBC-Pembina Home Location Study – Understanding where Greater Toronto Area residents prefer to live

The two aerial photos are from Colorado Springs. The top image is for a neighbourhood coffee shop in a traditional Pre-WWII neighbourhood, while the bottom image is for a first ring suburban area of Colorado Springs, or conventional suburban development. The traditional neighbourhood has a *well-connected* grid of streets, whereas the other diagram includes an automobile-centric street layout common in suburbs around the world. The traditional neighbourhood has multiple intersections, allowing more access for pedestrians. An area with a great amount of intersections per hectare and short blocks will be better suited for walking than an area with few intersections and long blocks. The conventional suburban neighbourhood is set up with a definitive hierarchy of streets, limiting the accessibility of pedestrians. The two diagrams provided illustrate in a black dashed line actual distances of 400-metres on foot from the centre of the 'circle with 400-metre radius'. In the traditional neighbourhood, a significant proportion of the circle of 400-metre radius is actually within 400 metres of the centre, whereas in the suburban neighbourhood only a small proportion is within that distance.



Examples of walkable and auto-dependent community patterns

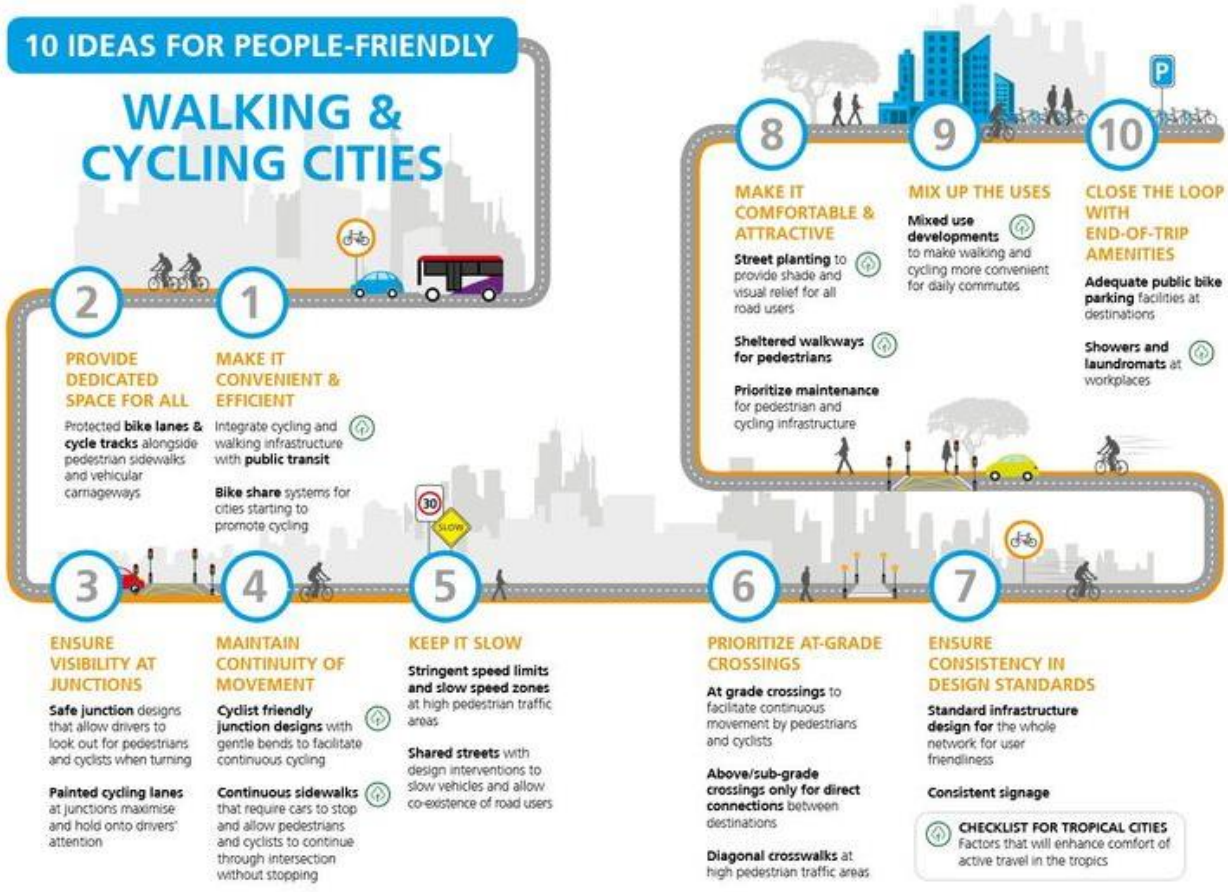


Figure 4: Australian Bureau of Statistics (ABS) latest "Household Expenditure Survey Australia: Summary of Results, 2009-10"

2.3. PRINCIPLE 3 – CONSOLIDATED RESIDENTIAL PARKING

Provision of communal/consolidated parking facilities to replace on-street and on-site parking. More specifically, establishing centralised communal parking on neighbourhood edges, rather than providing car parking on individual residential lots, to discourage excessive reliance on the use of cars.

Key Supporting Research

1. **In New York City, Guo (2013a) investigated the effect of home parking convenience on households' car usage, and the implications to residential parking policies. The study found that households without off-street parking adjacent to the home used cars significantly less and relied more on active modes and public transport. Guo (2013b) showed that parking supply can significantly determine household car ownership decisions – the influence of parking supply was found to be higher than household income and other demographic characteristics.**
2. **In Lisbon (Portugal) Vaconcelos and Farias (2015) found that time spent searching for parking was identified as one of the key aspects that deterred people from driving in areas with limited parking supply for local destinations.**
3. **In Norway, Christiansen et al. (2017) found that reduced access to free workplace parking was the most effective way of reducing car use for work trips. Limited access to parking at home was also identified as strogly linked with car use – the decision to drive decreases with increasing walking distance to parking, especially in relatively dense areas. The study concluded that restricted parking both at home and at the trip destination result in significantly lower levels of car use and higher levels of active transport.**

Figure 5: Collective Resident Parking Compound – Kensington Banks Melbourne

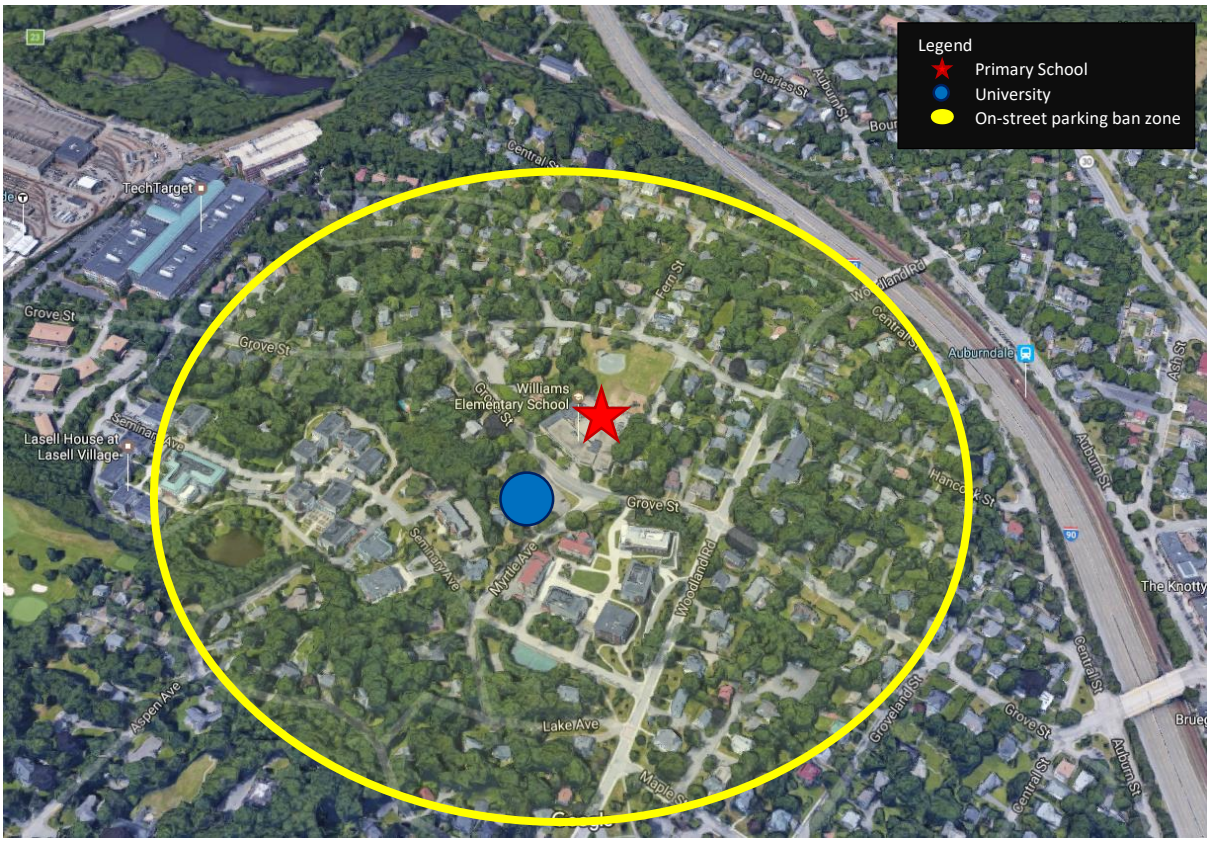

Easy Access to Public Transport
Centralised Car Park
Fenceless Design
Car-less Environment More Conducive for Walking & Cycling
Water Taxi
Bike Sharing

2.4. PRINCIPLE 4 – PARKING AND SCHOOLS

Creating exclusion zones around schools so that there is no public parking within 500 metres of any entrance – to promote children walking and cycling to school, and enhance road safety for the most vulnerable road users.

Key Supporting Research

1. **In Lisbon (Portugal) Vaconcelos and Farias (2015) examined the effect that parking has in terms of neighbourhood accessibility indicators for local services such as pharmacies, groceries, bakeries and primary schools. The study showed that areas with low parking pressure (at the destination) have higher car use than those with higher parking pressures (at the destination), which exhibited higher levels of active transport (for all trip types).**
2. **Numerous schools in the United States have implemented parking restrictions around schools to promote active travel (see case study below).**



Case Study:

Williams Elementary School is a public school located in the town of Newton in Massachusetts (United States), around 20 kilometres west of the Boston CBD. Williams Elementary School is one of many primary schools in the State of Massachusetts that implemented on-street parking bans in the late 1990s, in response to air quality concerns and the impact of idling vehicle emissions on students' health. The parking restriction implemented by Williams Elementary School prohibits on-street parking on all streets surrounding the school, within a radius of around 1,000 feet (roughly 300 metres). All streets within the parking exclusion zone were narrowed to physically prevent on-street parking and enhance the pedestrian (and cycling) environment.

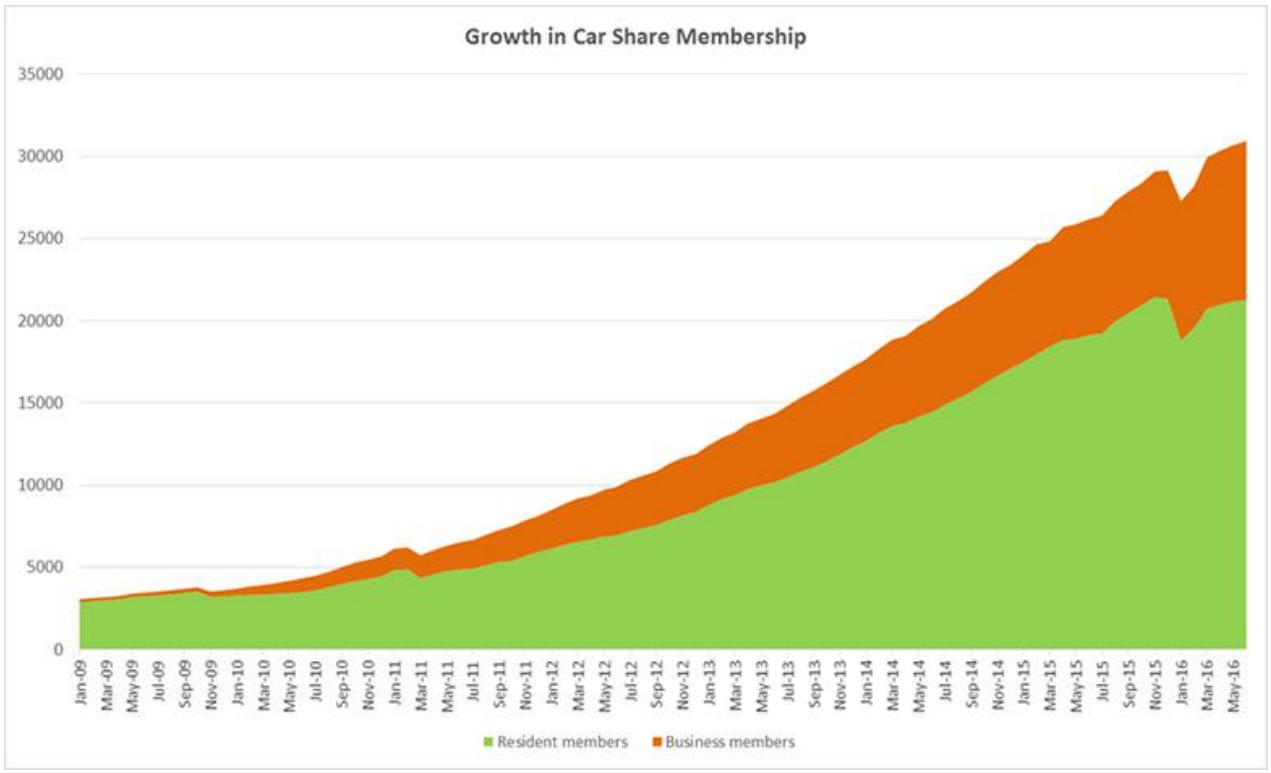
2.5. PRINCIPLE 5 – ACCESSIBLE SHARED MOBILITY

Establishing shared mobility systems within a 5-minute walk of all homes – shared bikes at a maximum of 250 metres and overall provision equivalent to one shared bike per home (on average) and shared cars at a maximum of 500 metres – to encourage the use of shared vehicles and discourage high levels of vehicle ownership by residents.

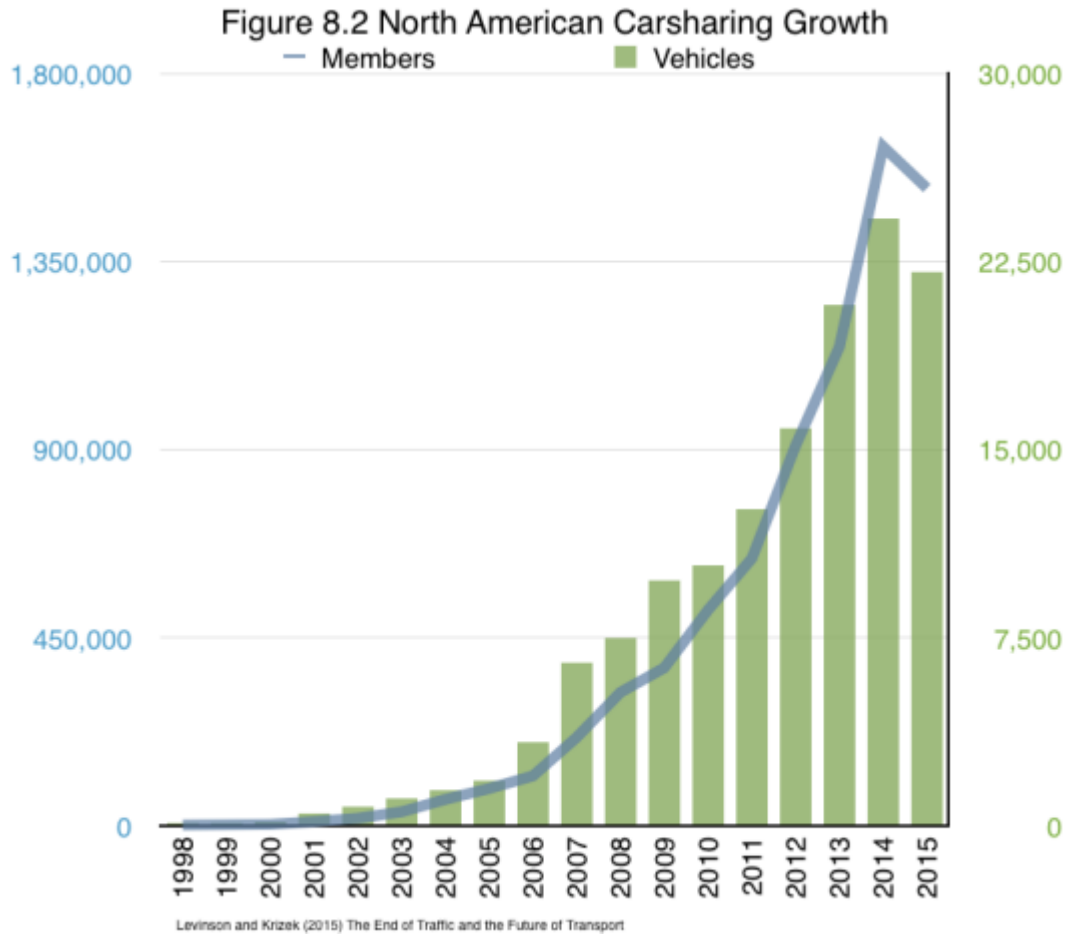
Key Supporting Research

1. **In the Netherlands, Kopp et al. (2015) found that carsharing users have a more sustainable mobility behaviour compared to the general population: own fewer cars per person in their households (one shared vehicle replaces 3-13 private cars), use public transport more and have a higher share of multimodal persons.**
2. **In the United States, Cervero and Tsai (2004) found that carshare members drive less frequently, resulting in a decrease in the distance travelled by car (and person) – the savings are of 40-80%.**
3. **Shaheen et al. (2009) found that the use of car-sharing is associated with a shift of trips to public transport, cycling and walking.**

Bike share systems are the fastest growing "mode" of transport around the world. Today, there are bike share systems in over 700 cities in more than 50 countries, with another 200 cities in the planning stages for implementation. There are currently well over half a million shared bikes around the world – the total number of shared bikes has more than doubled in the last 3 years.



Growth in Car Share – City of Sydney



Growth in Car Share – USA

2.6. PRINCIPLE 6 – DAY ONE PUBLIC TRANSPORT

Establishing public transport services, in the form of shuttle bus services that link to/from Geelong CBD in the morning and afternoon peaks seven days a week – to discourage reliance on the use of cars for commuting trips

Key Supporting Research

1. **VicHealth (2016) determined that the initiatives delivered at Selandra Rise are a positive step towards incorporating social determinants of health into community planning. Early delivery of public transport, a community centre and diverse parks indicate small but positive impacts on residents' health and wellbeing. See case study in Section 6.5 and Appendix A.**

2.7. PRINCIPLE 7 – ROAD DESIGN AND TRAFFIC MANAGEMENT

Establishing a network of pedestrian and cycle friendly local roads, in the form of pedestrian-bicycle priority spaces and shared zones – to encourage the use of roads as spaces for people (on foot and bike), create an urban environment where people of all ages and abilities can safely walk and cycle, and discourage the use of cars for local trips. All road in neighbourhoods should be 'local' roads, comprising a combination of:

1. *Streets designed as shared zones, which primarily service the rear of residential properties and frontages/rear of non-residential land uses. They should be preferably built with flat surfaces and no kerbs.*
2. *Streets designed as pedestrian-bicycle priority spaces, which primarily service the frontage of residential properties (see section 2.8).*

Key Supporting Research

1. **Doi et al. (2016). analysed the empirical relationships among urban structures, travel speeds and traffic fatalities, and suggested that it would be possible to enhance traffic safety by strictly managing urban density levels and travel speeds. The study found causal relationships in which the more dispersed a city was, the higher the average vehicle travel speed and the higher the traffic fatality rate.**
2. **The involvement of road agencies in setting guidelines, standards and criteria for shared zone installations (across multiple jurisdictions worldwide), together with the ongoing expansion of such treatments, in a diversity of environments, reflects that agencies are increasingly comfortable with adoption of shared zone treatments and/or have conducted sufficient due diligence to satisfy themselves of the merits and safety performance of such schemes.**


10
SHARED
ZONE

2.8. PRINCIPLE 8 – PEDESTRIAN VILLAGES

Designing neighbourhoods where the frontages of homes face a network of linear pedestrian/cycle park paths that connect all homes to commercial areas, parks, schools, recreation and other amenities – to provide full separation for pedestrians and cyclists for the majority of their local trips.

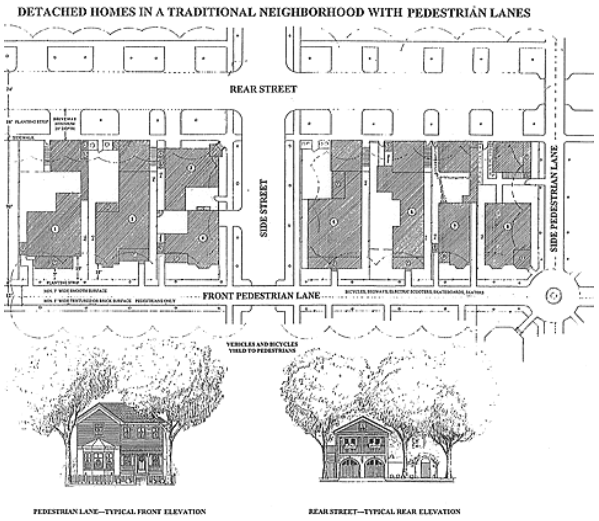
Key Supporting Research

1. **Link and place: a guide to street planning and design (Jones, Boujenko and Marshall 2007). This guide sets out to provide strategic guidance covering the integrated planning and design of the urban street network, by developing a new approach to urban street planning and design, based around the dual function of streets as links (movement conduits) and as places (destinations in their own right).**
2. **Filtered Permeability case studies.**
3. **Seattle Neighbourhood Greenways.**
   Seattle's vision for prioritising streets for walking and biking

Several complementary and sometimes overlapping concepts have been at the heart of a reconsideration in street design approaches:

- The "Link and Place" principle developed by Professor Peter Jones has been used recently for the City of Adelaide's Transport and Movement Strategy 2012-22 – known as Smart Move. Link and Place seeks to create more people-friendly urban streets through street planning and design that acknowledges the range of street functions. Link and Place responds to increasing concern about the dominance of road traffic in urban areas, and the role that conventional street planning and design has played in fostering this. Such concerns have converged from two different directions. First, from traffic planners attempting to encourage use of more sustainable transport modes; and second, from urban designers, developers and others worried about the poor condition of the public realm and the low quality of facilities for social and economic activities.
- "Filtered permeability" – a concept that promotes the design of street layout where bike riders and pedestrians are given preferred direct access through an area while motor vehicles are restricted but can still get through via a slow and/or less direct routes.
- "Seattle Neighbourhood Greenways" – the vision:
  "Imagine your neighbourhood, knitted together with quiet residential streets where children and adults safely walk, ride bicycles, play and run. Imagine these streets are close to where you live and connect you to the places you want to go — the grocery store, your favourite coffee shop, your community centre, your child's school. Imagine traveling along a whole city network of streets designed first for children and adults who are walking and biking. Places where people are alert when they drive, and open their car doors carefully after they park. Welcome to Seattle Neighbourhood Greenways."


1. Primary precinct entry zone
2. Feature "sticks"
3. Pedestrian connections to street
4. Central common access paths
5. Upper lawns
6. Sculptural art centerpiece
7. Open lawn space
8. Picnic shelter
9. Cluster gardens
10. Substation
11. Vehicle slow zones
12. Bioretention basin
13. Shared path to Francis Rd (3m width)
14. Footpath to Bunya Rd (2m width)
15. Vegetation protection area
16. Council park
17. Visitor parking
18. Batten fence
Property Boundary
Francis Road
Bunya Road


DETACHED HOMES IN A TRADITIONAL NEIGHBORHOOD WITH PEDESTRIAN LANES
REAR STREET
SIDE STREET
SIDE PEDESTRIAN LANE
FRONT PEDESTRIAN LANE
VEHICLES AND BICYCLES YIELD TO PEDESTRIANS
PEDESTRIAN LANE—TYPICAL FRONT ELEVATION
REAR STREET—TYPICAL REAR ELEVATION

2.9. PRINCIPLE 9 – LOCAL BUSINESS INCENTIVES

Council will provide financial incentives, in the form of a rebate or concession on rates and charges, to assist the establishment and viability of local businesses that are consistent with the land uses required to encourage active transport (see Principle 2) – to promote the establishment of viable and high-quality local centres and neighbourhood activity centres that allow people to meet most of their daily needs by traveling on foot and by bike.

Key Supporting Research

1. **Victorian legislation (Local Government Act 1989) provides Councils the ability to grant a rebate or concession on rates and charges to "*assist the proper development of the municipal district…or to assist the proper development of part of the municipal district*". 'Proper' development can cover land use, economic development and environmental objectives.**
2. **OECD (2017) recognised the important role that financial incentives (e.g., tax concessions and subsidised rents) can play in promoting the establishment and long-term viability of land uses in growth areas that are consistent with government objectives**

Victorian legislation (Authorised Version No. 109A of the Local Government Act 1989 [No. 11 of 1989], incorporating amendments as at 1 August 2011) provides Councils the ability to grant a rebate or concession on rates and charges to "*assist the proper development of the municipal district…or to assist the proper development of part of the municipal district*". 'Proper' development can cover land use, economic development and environmental objectives.

A Council resolution granting a rebate or concession must specify the benefit to the community as a whole resulting from the rebate or concession. A Council may only grant a rebate or concession— (a) to owners of specified rateable properties not exceeding one third of the rateable properties in the municipal district; or (b) to owners of rateable properties who undertake to satisfy terms that directly relate to the community benefit as are specified by the Council. The Victorian legislation thus provides a direct mechanism to encourage the establishment and viability of land uses that promote Council goals – such as the health (at both the individual and community levels), environmental and other social benefits derived from active transport.

The Banyule City Council developed a Rating Strategy (in 2016) to ensure the Local Government Act rating objectives of equity and efficiency are achieved. The Rating Strategy is intended to be transparent to the community and is reviewed annually as part of the budget process. The 2016 Rating Strategy recognises the ability of Banyule City Council to apply rebates or concessions on rates and charges to promote desirable land use outcomes. Other Councils in Victoria, such as City of Hume, provide financial incentives for new businesses relocating to the municipality (or specific areas within the municipality). Unfortunately, these incentives are generally targeted to businesses with a relatively large number of employees (e.g., 50 in Hume) or that involve significant levels of capital investment (e.g., $50 million in Hume) – as such, these incentives would not apply for the types of businesses of 'interest' for local centres and neighbourhood activity centres in Geelong.

Considerable research, analysis and debate across developed nations, such as the United States, Canada, Australia and Europe, has been undertaken to examine the merits or otherwise of providing incentives to support local businesses and promote land use objectives. A 2017 OECD report (The Governance of Land Use) recognised the important role that financial incentives (e.g., tax concessions and subsidised rents) can play in promoting the establishment and long-term viability of land uses in growth areas that are consistent with government objectives. The report also recognises that the policy and financial instruments, while largely in place in most developed nations, are seldom used to encourage desired outcomes in terms of land use density and mix – as such, examples of successful applications with local government involvement are limited.

The community benefit from providing incentives for 'proper' land uses that increase levels of active transport in the Geelong Northern and Western Growth Areas are expected to be significant – derived from improved health, reduced emissions (air pollutants and greenhouse gases) and enhanced road safety.

The potential benefits can be illustrated by examining the potential reduction in vehicle kilometres travelled (and associated greenhouse gas emissions) related with the establishment of a grocery store or supermarket (identified in Principle 2 as one of the key land uses for promoting active transport). The 2013 Victorian Integrated Survey of Travel and Activity (VISTA) reports that half of all trips in metropolitan Melbourne are less than 4.2km. If we conservatively assume that a shopping trip in Geelong is half that distance, then a return shopping trip would be 4.2km. VISTA also reports that 83.7% of all trips in Geelong are by car.

Combining the mode share and distance (for a return trip to a grocery store) means that each patron visiting a grocery store (that is provided within the local community) effectively results in a reduction in 3.5 vehicle kilometres travelled (as 16.3% of people are assumed to already be using non-car modes). Anecdotal evidence from the United States, Canada and other countries (complemented by informal observations at a number of grocery stores/convenience stores in outer areas in metropolitan Melbourne) shows that a local grocery store in a suburban or outer urban area has an average of one patron entering the store every two minutes. If a local grocery store is open 12 hours each day, the average number of patrons is 360 per day.

The Green Vehicle Guide (http://www.greenvehicleguide.gov.au/pages/Information/VehicleEmissions) from the Australian Government estimates that the average CO_2 emissions for a new light vehicle sold in Australia are 188 grams per kilometre (g/km). Combining these data sources, it is estimated that a local grocery store (by transferring shopping trips from car to walking and/or cycling) can result in a reduction of around 460,000 vehicle kilometres travelled per year, equivalent to 87 tonnes of CO_2. Australia's Chief Scientist (http://www.chiefscientist.gov.au/2009/12/which-plants-store-more-carbon-in-australia-forests-or-grasses/) estimates that forests with continuous canopies take up around 0.5-2 tonnes of CO_2 per year for each hectare. Using the lower end of this range would result in savings in emissions equivalent to planting 174 hectares of forest per year (or around 3.2% of the area covered by the Northern and Western Growth Areas). In simpler terms, 31 local grocery stores can result in land savings per year (that would need to be allocated for carbon sequestration) equivalent to the combined area of the Northern and Western Growth Areas.

The above example illustrates the significant benefits that may be achieved by establishing 'proper' land uses within the Northern and Western Growth Areas, making it feasible for Council to provide financial incentives.

Examples of what has been successfully implemented include:

UNITED KINGDOM

Legislation allows for local government agencies to provide financial support (in the form of subsidised rents and rates) to encourage small businesses to start up in particular areas. While not explicitly established as a land use planning tool, municipalities are using these mechanisms to achieve land use outcomes that promote sustainable transport (and other) behaviour.

UNITED STATES

Partnering with the United Small Business Administration (SBA) and Cuyahoga County, the City of Cleveland has established a performance grant that allows businesses to reduce their equity in a SBA funded project from the required 25% to 10%. In other words, the City of Cleveland provides a grant of 15% which is funded half by the City and half by the County. The goal of this grant is to leverage financing to benefit small businesses in the creation of jobs and opportunities. Projects must create one permanent full-time job for every $35,000 in City funds.

Imperial County in California has established a Micro Lending program to promote the development and expansion of micro businesses (with up to five employees and financing needs of $25,000 or less). To be eligible for this program a business must operate within the Imperial County, be classified as a Sole Proprietorship, and employ no more than 5 people at the time of application. Loans are provided in the maximum amount of $25,000. This program is similar to those being used by municipalities across Victoria, such as Hume, to attract businesses – the primary difference is that the Imperial County program is specifically targeted to micro businesses, which are precisely the type of establishments that are desirable in local neighbourhood settings.

3. CURRENT GROWTH PLANNING / DELIVERY LANDSCAPE WITHIN VICTORIA

3.1. OVERVIEW

Planning for growth across Victoria is jointly managed by the State Government and municipalities. At the State level, the Victorian Planning Authority (VPA) is a State Government statutory authority, that reports to the Minister for Planning, and focuses on the planning of strategically important precincts in inner and middle ring Melbourne, the growth areas and regional cities. The VPA has a specific focus on achieving the State's longer term vision (such as that set out in Plan Melbourne 2017-2050) and for the strategic land use and coordinated infrastructure planning to support the future growth and transformation of Victoria's cities and regions. It works closely with councils and local communities, other government agencies, landowners and developers. Planning aspects involving transport infrastructure and solutions typically involve other agencies such as VicRoads and the Department of Economic Development, Jobs, Transport and Resources (Public Transport Planning).

At the municipal level, Victoria's regional cities such as Greater Geelong are responsible for much of the detailed planning that is required to cater for growth. In particular, regional cities are typically responsible for:

- Identifying a land supply pipeline to facilitate regional growth
- Implementing Regional Growth Plans
- Undertaking master planning for strategic sites

3.2. STANDARDS & GUIDANCE

VPA Precinct Structure Planning and VicRoads guidelines as well as road cross sections and parking requirements specified in the Planning Scheme provide little explicit guidance on how to achieve desired outcomes with respect to active transport. Collectively, statutory requirements in Victoria (such as parking rates, adherence to minimum road cross section standards and satisfaction of VicRoads traffic capacity aspirations) often result in the creation of physical environments that are dominated by excessive road infrastructure and parking supply, and that are thus conducive to motor vehicle travel – thereby making active transport less attractive.

The 'building blocks' provided to planners, engineers and designers by state and local guidance focus primarily on the creation of roads, while the analysis and evaluation tools focus on the relief of traffic congestion. For example, whilst in recent years, significant improvements have been achieved with respect to the provision and implementation of facilities for cyclists (such as on-road bicycle lanes), the extent of guidance available is significantly less detailed than the information and guidance provided for the design of facilities that support motorised traffic.

Councils across the United States have historically faced similar challenges and limitations with respect to the guidance provided for the implementation of infrastructure and policy actions that promote walking and cycling. A recent report (Ewing 2017) of *Best Practices in Metropolitan Land Use and Transportation Planning* reviews 35 long-range transport plans, prepared by metropolitan organisations, to identify and describe conventional and emerging best practices in metropolitan land use and transport planning. Conventional and best practices are outlined for goals and objectives, performance measures, land use and transportation integration, scenario planning, smart growth, highway expansion, highway maintenance, transit expansion, bike and pedestrian improvements, travel demand management, funding shortfalls, public involvement, and other topics. The best practices are designed to achieve broad goals and objectives in the areas of congestion relief, air quality, traffic safety, climate change, energy security, and public health.

The Ewing 2017 report highlights that most regional transport plans focus on the traditional goal of traffic congestion relief, generally at the expense of focus on other areas such as road safety, public health (directly linked to physical activity) and environmental outcomes. The report acknowledges that this is, to some degree, a direct result of the requirement to comply with federal regulations that require metropolitan planning organisations to adopt a 'congestion management process' with which they monitor mobility within the region and make recommendations to correct 'deficiencies'.

The practical result, as identified in the Ewing 2017 report, is that the emphasis on congestion management has the effect of focusing the planning process primarily on road capacity expansion, at the expense of other municipal goals. The report highlights the recent adoption of broad goals and operationalisation of objectives (through quantification) in a number of municipalities across the United States. More specifically, three emerging goals are beginning to appear in progressive plans: 1) promotion of active travel, in the interest of physical activity, obesity prevention and public health; 2) mitigation of greenhouse gas emissions; and 3) energy security. With respect to active travel, places such as San Diego have instituted plans that provide specific and broad guidance (accompanied by the required level of funding) with respect to bicycle and pedestrian facilities.

The Atlanta Regional Transportation Plan, for example, contains hundreds of qualitative objectives and a single quantitative objective, which relates specifically to congestion relief, as measure by the 'travel time index'. As such, there is little surprise that most actions focus on congestion relief; no objective and no performance information is provided with respect to reductions in vehicle kilometres travelled (by, for example, residents of a new community being planned), which is a key determinant of the plan's impact on (directly) greenhouse gas emissions and (indirectly) physical activity associated with utilitarian travel. In contrast, the Portland Regional Transportation Plan contains specific quantitative performance objectives with respect to a number of other aspects, such as active transport. More specifically, the Portland plan specifies that, by 2035, there should be three times as many walking, cycling and public transport trips compared to 2005.

The Ewing 2017 report also highlights that, just as the emphasis in transport plans is on roadway congestion, so is the emphasis in associated land use plans on one aspect of urban form, density. Some examples include:

- St Louis Regional Transportation Plan – 'the dispersion of activities made possible by the automobile has made it an almost absolute necessity to meet their daily needs and actively participate in the community'
- Boston Regional Transportation Plan – 'recent travel demand modelling results for the Boston region suggest that changes in land use that create denser future developments located near existing transportation facilities will have a more positive impact on reducing congestion, increasing mobility, and improving air quality than all the new transportation projects the region can afford to build in the next 23 years'

The report acknowledged the importance of (relatively higher levels of) density as one of the elements needed to promote active travel and reducing motor vehicle use. However, it highlights recent evidence that destination accessibility and diversity of land uses have a greater impact in promoting active travel than density. The exclusive focus on density has resulted in the implementation of plans that focus exclusively on residential density (at the expense of diversity of land uses and destination accessibility); these communities are characterised by higher reliance on the automobile for most trips. In contrast, the Seattle Regional Transportation Plan acknowledges the importance of 'creating places that contain a mix of business, commercial, residential and cultural activity within a compact area; these places promote walking, cycling and public transport use as the preferred and most viable transport options'.

The evidence summarised in the Ewing 2017 report shows that the limitations and challenges faced by Victorian (and, more generally, Australian) Councils with respect to promoting active travel is commonplace in the United States. Importantly, the report highlights extensive examples of municipalities that have shifted the direction of their long-range transport and land use plans to promote the establishment of communities that support active travel (among other goals). Of relevance to the planning for the Northern and Western Growth Areas of Geelong is the fact that most of the 'success' stories have in common the willingness to 'resist' the temptation to follow conventional practice and traditional guidance, instead implementing progressive measures based on a combination of best practice examples from around the world and the latest thinking with respect to ways to achieve desired outcomes (such as increased levels of walking and cycling). In summary, these examples show – put simply – that change can indeed be achieved even in a car-centric society as the United States.

4. ACTIVE TRANSPORT

Mobility is an essential human need, as the ability to move people and goods supports human activity and social interaction, and is almost universally acknowledged as one of the most important prerequisites to achieving improved standards of living. Road transport activity has grown strongly over the past decades and is projected to continue increasing; however, it is associated with deaths, injuries, and physical damage; obesity from lack of physical activity as part of routine travel; congestion; energy consumption; greenhouse gas emissions; air pollution; noise; community and equity effects; and ecosystem impacts. Mobility has thus come at a price economically, environmentally, and socially.

Today, most passenger travel occurs in motor vehicles; in Australian cities, 89.1% of person-km travelled are by private motor vehicle – this is the case not only for long-distance trips where active modes are not competitive, but also for short (and eminently walkable and cyclable) trips. Motor vehicle injuries, obesity, congestion and air pollution are but a few of the significant economic costs that the use of motor vehicles impinges on society and affect, directly and indirectly, the lives of millions of people in Australia. Even though not all costs associated with these aspects are entirely attributable to the use of motor vehicles, such as in the case of obesity, which is related to a wide range of factors and not simply travel choices, the annual cost to society associated with the use of motor vehicles is likely in the tens of billions of dollars and includes:

- Congestion in capital cities: $16.5 billion p.a.
- Road safety – 1,205 road crash deaths in Australia with a cost of $27 billion p.a.
- In 2008, the total annual economic cost of physical inactivity in Australia, including healthcare, productivity and mortality costs, was estimated at $13.8 billion (Medibank 2008).
- Air pollution deaths related to road transportation (2010) – 1,483, with a cost of $5.8 billion
- The road transport sector was responsible for 20% of the total per capita greenhouse gas emissions in Australia in 2015.

Importantly, the cost of these negative externalities to society is in general not reflected in the current market prices in the road transport sector – all or portions of these costs are usually borne by individuals and/or society but not by the road transport sector. Reducing the use of the motor vehicle for personal travel provides a unique opportunity for simultaneously addressing these challenges. Achieving this will, however, require a true 'paradigm shift' at both the individual and societal levels.

The State of Australian Cities report recognises the many benefits of active travel: reduce demand on other modes of transport, promote health benefits to people who walk/cycle, reduce greenhouse gas emissions/air pollution, and provide human-scale activity on city streets. Congestion, crashes, obesity and air pollution are the main costs associated with car use and collectively amount to well over $50 billion p.a. Reducing car use for personal travel will reduce these costs; thus, even small shifts to active modes will result in significant sustainability benefits. As Australians of all ages do not use active travel modes for most short trips, there is enormous behaviour change potential.

4.1. THE IMPORTANCE OF WALKING AND CYCLING

Walking and cycling for transport can generate economic benefits through reductions in transport-related costs – including lower personal expenditure on fuel and vehicle maintenance. These aspects can be critical to disadvantaged communities, who have lower annual incomes and for whom transport costs generally represent a larger component of their expenses.

Wider societal benefits are also associated with increased walking and cycling (and related reduced motor vehicle use), including improved air quality, reduced greenhouse gas emissions, reduced traffic congestion and maintenance costs, and increased community connectedness and liveability (O'Hern and Oxley, 2015). Walking and cycling for transport is also a more socially inclusive form of physical activity than leisure-time activity: while socioeconomically disadvantaged population groups are substantially less likely than advantaged groups to participate in recreational exercise, walking for transport is fairly evenly distributed across the socioeconomic spectrum (Gerrard 2013).

4.2. ACTIVE TRANSPORT AND HEALTH

The growing worldwide awareness of the significant impacts of physical activities on physical and physiological health has aroused great interest in the role of the physical built environment plays in walking and cycling activities. A number of studies have studied the specific elements of the built environment that enhance people's walking and cycling levels (particularly for utilitarian trips). Studies have looked at identifying the barriers to walking and cycling activities, as well as the general and specific characteristics of the major physical built environment attributes within a residential neighbourhood that can help overcome these barriers and enhance the walking and cycling activity levels. Studies have also compared the effectiveness of some individual attributes.

The health benefits of physical activity include increased life expectancy, physical fitness, energy, mental health, cognitive functioning, social connectedness, and independent living for older adults (Garrard 2009). Physically active people are less likely to become overweight or obese, and to develop cardiovascular disease, type 2 diabetes, colon cancer, breast cancer, osteoporosis and depression. Physically active adults in the workforce have lower rates of absenteeism and increased job satisfaction. Despite these benefits, more than a third of Australian adults (34.6%) are classified as sedentary; that is, reporting no exercise (for fitness, recreation or sport) in the two weeks prior to interview (ABS 2009). Physical inactivity is responsible for 6.6% of the total burden of disease and injury in Australia (Begg et al 2007), resulting in an estimated direct gross cost to the Australian health budget of $1.49 billion per annum (Garrard 2009).

Lack of time is consistently reported as a major constraint on participation in physical activity. Among all age groups, lack of time is routinely cited by individuals as one of the main barriers to exercise. When the behaviour is ingrained in daily activities, it requires a lower commitment threshold and behaviour maintenance is achieved. Research shows that incorporating physical activity into routine travel can be a promising strategy for addressing time-related constraints. Walking and cycling as means of daily transport can be a most effective strategy to achieve desired public health gains. The promotion of 'lifestyle' physical activity such as walking and cycling is more cost-effective than structured exercise programs (Garrard 2009), and the regular short trips most people take to get around in their communities are ideal for accumulating the recommended levels of moderate to vigorous physical activity on most days. Frequent short trips can also contribute to low intensity physical activity and reduced periods of sedentary behaviour, both of which have recently been beneficially associated with metabolic risk variables.

HEART FOUNDATION

The Australian Heart Foundation (HF) is dedicated to fighting the single biggest killer of Australians – heart disease. The HF recognises that insufficient physical activity is one of the leading risk factors for global mortality and is on the rise in many countries, adding to the burden of non-communicable diseases and affecting general health worldwide. People who are insufficiently active have a 20% to 30% increased risk of death compared to people who are sufficiently active. Regular physical activity reduces the risk of heart disease, high blood pressure, diabetes, breast and colon cancer, and depression. It also modifies other important risk factors such as blood cholesterol and overweight and obesity. Increasing population levels of physical activity is an important public health objective and we need strategic approaches to health promotion and illness prevention.

HF is working to get Australians moving by supporting individual behaviour change as well as cultural/societal changes that encourage physical activity and a healthy diet; however, the role that the physical environment – both natural and built – can play on how much physical activity people engage in, and the likelihood of developing heart disease, cannot be underestimated. HF recognises that individuals can be more active when they:

- Live close to shops, services, school, and jobs, so they can walk or cycle to them instead of driving
- Have supportive infrastructure such as footpaths, road crossings, cycling paths and public transport
- Have access to quality spaces that improve wellbeing – like plazas, green areas, open space and recreational facilities.

The HF is dedicated to both raising awareness of the importance of a built environment that supports heart health and helping planners, developers and communities work towards creating healthier streets, buildings, towns and cities. The HF has developed evidence-based resources that provide an essential toolbox for those concerned with, or working in the creation of, liveable places and spaces.

The HF works to create healthy neighbourhoods that are planned to promote walking, cycling, physical activity and public life. Healthy and liveable neighbourhoods are places where people can easily walk, or cycle to schools, employment, sports facilities, shops, green spaces, parks, and public transport. This means the residents have opportunities to be socially connected and live in neighbourhoods that provide health, economic and environmental benefits.

The HF has produced a *Healthy Active by Design* website as a practical guide to address the need to build health into the design of our built environment. The built form can support a healthy and physically active community and access to healthy food. In addition, neighbourhood design can positively impact levels of pedestrian activity, safety for cyclists, and use of public transport.

The HF has noted that "how and where we live, work, travel and spend our leisure time" affects our health status. Decisions about how land is used can affect the health of Australians now, and for many generations to come. In the 21st century, town planning decisions can help prevent lifestyle-related diseases through facilitating physical activity, access to healthier food, and positive mental health. In this context, the HF asserts that policy and legislation across all sectors must be oriented to support health and wellbeing. This concept, embedded in the Ottawa Charter for Health Promotion and described by the World Health Organization (WHO) as healthy public policy, recognises that many of the factors that influence health are situated outside the health sector. Sectors, such as education, transport and planning, impact significantly on the health status of the community.

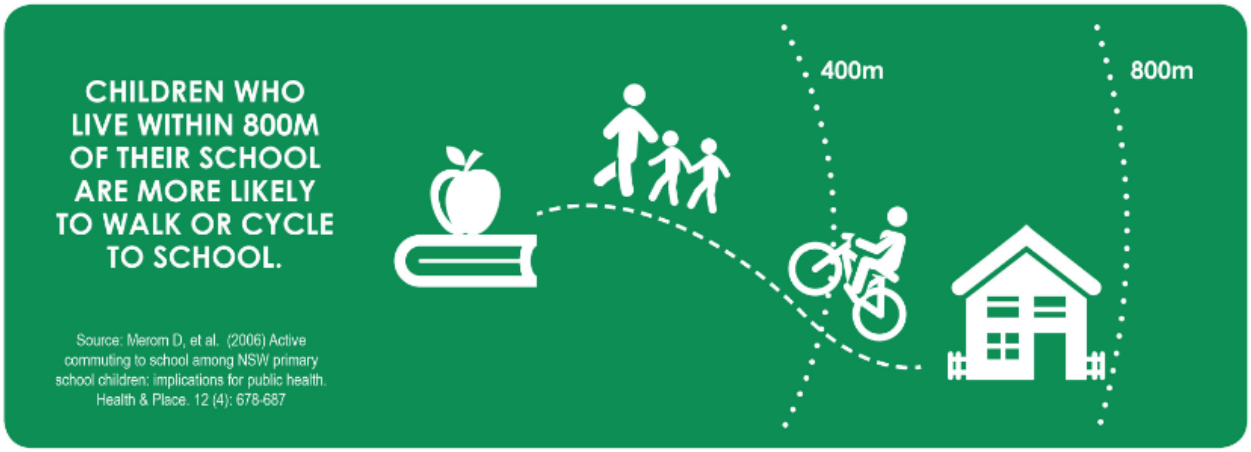
Accordingly, the HF has identified various design and policy directions that can contribute to the creation of healthier neighbourhoods. These cover:

- Public Open Space
- Community Facilities
- Buildings
- Destinations
- Movement Networks
- Housing Diversity
- Sense of Place

Effective movement networks provide safe routes for pedestrians and cyclists to travel on between destinations and encourage active modes of transport and recreation. As most public transport trips begin or end with walking, the provision of these routes and services provide important opportunities for walking to or from the stop.

Shorter travel distances can enable easy access to facilities and services for all people, including the very young, older persons and people with a disability, which can reduce social isolation for these groups. In terms of walking behaviours, greater connectivity reduces the distances between origins and destinations and provides a range of routes to choose from, increasing the likelihood of walking between locations. Traditionally designed neighbourhoods tend to have a grid-style layout with few barriers to direct travel (e.g., dead ends and major intersecting roads), resulting in high levels of connectivity and a choice of routes. In contrast, conventional neighbourhoods are developed around a network of hierarchical roads. Curvilinear roads terminating in cul-de-sacs (i.e., lollipop-shaped dead end roads) feed from large, high speed roads, creating low levels of connectivity. Residents have little or no choice of route, as often there is only one road in and out of the development, and the indirect curvilinear streets increase walking distances between destinations thereby discouraging walking. Walking has been made difficult in conventionally planned developments because of the disconnected street system, lack of footpaths, unsafe routes and long distances to most destinations.

Streets should be designed as places, not just as thoroughfares. They should encourage social interactions and create distinct and inviting spaces that people choose to experience. Streets should be places where people walk, shop, play, relax, sit and talk. Residential streets also provide a setting for informal games (e.g. street cricket/basketball).


CHILDREN WHO LIVE WITHIN 800M OF THEIR SCHOOL ARE MORE LIKELY TO WALK OR CYCLE TO SCHOOL.
Source: Merom D, et al. (2006) Active commuting to school among NSW primary school children: implications for public health. Health & Place. 12 (4): 678-687
400m
800m


+ 30MIN
WALKING
TO & FROM
MORE LIKELY TO ACHIEVE
10,000 STEPS
29% OF PUBLIC TRANSPORT USERS ACHIEVE ≥30 MINUTES OF DAILY PHYSICAL ACTIVITY SOLELY BY WALKING TO AND FROM PUBLIC TRANSPORT.
Source: Besser LM, et al (2005). Walking to Public Transit: Steps to Help Meet Physical Activity Recommendations. American Journal of Preventive Medicine, 29(4): 273-280.


+ 60MIN PER WEEK
THE MORE STREET TREES ALONG THE FOOTPATH NETWORK, THE MORE LIKELY RESIDENTS ARE TO WALK FOR 60 MINUTES EACH WEEK
Source: Hooper, P., et al. (2015). "The building blocks of a 'Liveable Neighbourhood': Identifying the key performance indicators for walking of an operational planning policy in Perth, Western Australia." Health & Place 36: 173-183.

4.3. ACTIVE TRANSPORT – POLICY CONTEXT

Numerous Local, Victorian and Federal Government policies across several sectors, including health, transport, urban planning and the environment recommend a mode shift from car travel to active travel. However, rates of active transport in Australia are low in comparison to many European and Asian countries, particularly for cycling. Encourangingly, the Australian National Cycling Strategy 2011-2016 – *Gearing up for Active and Sustainable Communities* – reported that over 1.9 million people now cycle in Australia on a regular basis and 2008 saw the largest ever increase in people riding their bikes. The overarching vision of the Australian National Cycling Strategy is to realise a step-change in attitudes to cycling and in the numbers of riders in the country. In the short term, the goal was to double the number of people cycling over the next five years.

The Victorian Government has established Active Transport Victoria, a unit within Transport for Victoria, to promote the benefits of walking and cycling in Victoria. Active Transport Victoria is the contact point for all cycling and pedestrian projects. Active Transport Victoria works with local councils and communities right across Victoria to better coordinate the planning of infrastructure, and ensure projects are built where they are need most, and delivered on time. It also puts active modes of transport such as walking and cycling front and centre, better connecting them to the broader transport network. Active Transport Victoria works with VicRoads and the Transport Accident Commission (TAC) to prioritise and invest in infrastructure that keeps cyclists and pedestrians safe through the Victorian Government's $100 million Safer Cyclists and Pedestrians Fund, and is responsible for finalising and implementing Victoria's Cycling Strategy.

At a national level, the Pedestrian Council of Australia (PCA) is active in the promotion of walking and its role is essentially one of education, advocacy and the promotion of a culture of concern and care within the whole community for the rights and responsibilities of pedestrians. PCA is a non-profit organisation whose objectives, as stated in its Memorandum of Association are:

1. The continual improvement of pedestrian safety, amenity and access;
2. The promotion of walking as a legitimate transport mode and an important, healthy, social activity;
3. The encouragement of the inclusion of pedestrian safety, amenity and access provisions in all urban and transport planning;
4. The enhancement of community health and welfare and particularly the enhancement of the health and welfare of those members of the community who are aged, infirm, disabled, young, socially disadvantaged, tourists or included in any other special interest group or group of persons under any kind of handicap or disability; and
5. Research (including experiments and surveys and their publication) into all aspects of the objects set out in 1, 2, 3 and 4.

The PCA's Charter seeks to:

- Create a physical, social, economic, legal and psychological context in which more Australians will be encouraged to walk more often and to walk further.
- Re-assert the rights and freedoms which pedestrians once enjoyed but which are now being usurped and threatened by private motorised traffic and the infrastructure that supports it
- Promote the personal, social and environmental benefits of walking as a safe, healthy, enjoyable and accessible form of transport, exercise and recreation
- Encourage the planning, design and development of neighbourhoods in which safe, attractive and convenient walking conditions are provided as a fundamental right
- Ensure that in the planning of our communities access to basic amenities and services is not dependent on car ownership but is always available to those on foot, bicycle, wheelchair and public transport.

5. TRAVEL STATISTICS – GEELONG TODAY

Any strategy to reduce car-dependency and increase active transport in Geelong's growth areas should acknowledge, as a starting point, the current travel behaviour context, in particular:

- Why people travel (trip purpose)
- How far people travel
- What mode people use to 'get around' (mode share)

To this end, the State Government's 'Victorian Integrated Survey of Travel and Activity' (VISTA) provides a comprehensive insight into the travel behaviour of Geelong residents. VISTA is an ongoing survey of household travel and activity and data from across Greater Melbourne, Geelong and the regional centres of Ballarat, Bendigo, Latrobe and Shepparton. It provides a detailed picture of Victorian travel patterns. The latest available VISTA data was collected in 2012-13 and revealed the following key travel facts for Greater Geelong.

5.1. TRIP PURPOSE

Travel for work and social/recreational activities are the most common trip purposes across Greater Geelong. For residents of Geelong, 25% of weekday trips are work related and 25% are for social/recreational purposes; however, 44% of distance travelled is for work. Residents of Geelong mainly travel to the Melbourne CBD for work (see Figure 6). For education purposes, the higher the level of education, the further the average distance of travel.

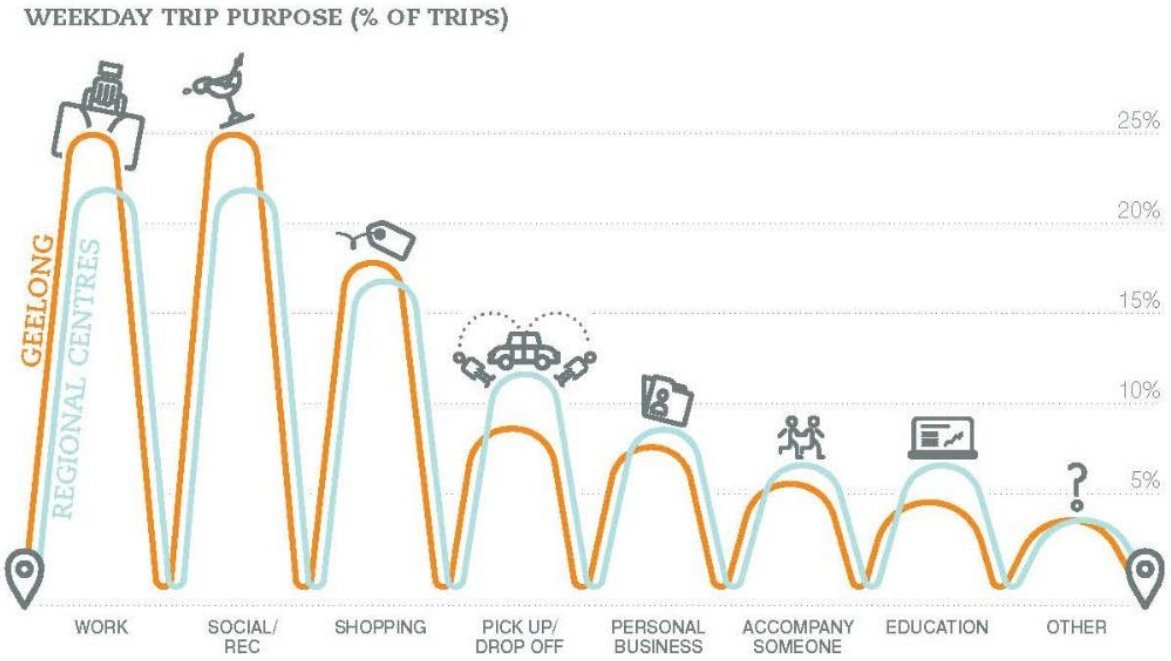


Figure 6: Proportion of Weekday Trips by Trip Purpose for Residents of Geelong

While job-creation in neighbourhood areas remains a challenge (and thus people often travel longer distances for work as confirmed by the VISTA data) the high proportion of social/recreational and shopping trips provides an ideal context to switch many of those trips to active transport modes by providing the requisite social/recreational and shopping land uses within the growth areas.

5.2. TRIP LENGTH, DURATION AND CAR OWNERSHIP

A substantial number of short trips are made on a typical weekday in Geelong. These are the trip types where cars could be readily substituted by active transport options.

- In 2012-13, the average trip distance for Geelong residents was approximately 11.5km. Importantly, half of all trips were less than 3.6km. (3.6km is the median trip distance in Greater Geelong – the midpoint of the data)
- Average trip time for Geelong residents in 2012-13 was 20 minutes. Half of all trips are less than 15 mins.
- The average household in Greater Geelong has 1.7 cars. This is unchanged over the last 5 years.

5.3. MODE SHARE IN GREATER GEELONG

Private vehicle remains the most common mode of travel in Greater Geelong, both in the number of trips taken and total distance travelled by each mode (see Figure 7).

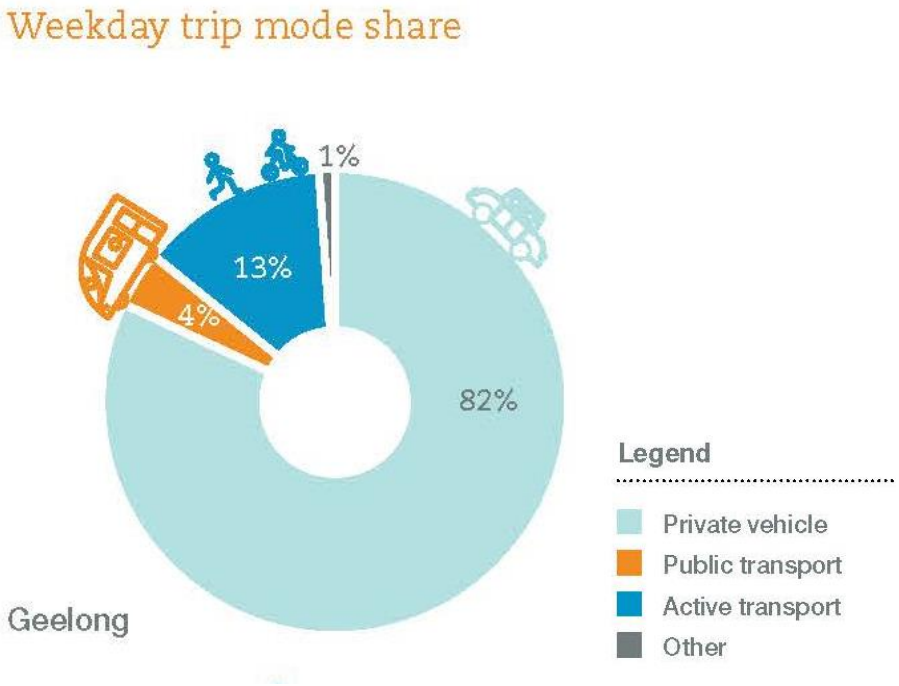


Figure 7: Travel Mode Share for Weekday Trips in Geelong

The 2012-13 VISTA results revealed private vehicle travel accounts for 82 per cent of trips by Geelong residents, while active transport makes up 13 per cent of all trips respectively. Public transport accounts for 4 per cent of trips in Geelong.

In the five years from the 2007-08 VISTA survey there has been a slight shift from private vehicle to active modes, however the share of public transport trips has remained stable. In terms of distance, residents of Geelong are travelling further by public transport than in 2007-08. Public transport now accounts for 16 per cent of total distance travelled. This is in contrast to Victorian regional centres where the percentage of total distance travelled by public transport dropped from 10 per cent to 6 per cent.

6. LITERATURE REVIEW

This section presents a summary of a comprehensive review of Australian and international literature, including peer reviewed papers, best practice urban design and traffic engineering guidance documents, and other technical reports of relevance. It also presents information collected through the direct engagement with Professors Daniel Rodriguez and Robert Cervero of the University of California Berkeley.

An extensive body of scientific and technical guidance literature exists (in Australia and internationally) covering a wide range of land use, policy, infrastructure, technology and other aspects that can promote higher levels of active transport. This decades-long research provides a solid foundation for determining what general aspects may be incorporated in the design of communities to promote the desired active travel outcomes. However, the main shortcoming that has been identified through this comprehensive review of the available literature is that there is a scarcity of in-depth and detailed analysis of the specific components of communities that positively influence travel behaviour.

6.1. URBANISATION AND DEVELOPMENT TRENDS

DECENTRALISATION & IMPACT ON TRAVEL

The rate of urbanisation has increased rapidly in recent decades, especially in the less developed regions of the world (United Nations (UN) 2008). As of 2008, for the first time in history, the majority of the world population lives in urban areas (UN 2008). In 2007, approximately 74% of people in the developed world and 44% in the developing world lived in urban areas. Urbanisation is expected to continue, particularly in the developing regions; by 2050, urban dwellers are projected to account for 86% of the population in the more developed regions and for 67% in the less developed ones. Overall, the world population is expected to be 70% urban in 2050 (UN 2008).

A parallel trend to urbanisation has been the decentralisation of cities, which have spread out faster than they have grown in population as people search to maximise privacy and individual space (Feigon et al. 2003). This dispersed development trend dominated the growth of cities in developed countries such as the United States and Australia during the second half of the twentieth century. It also became a catalyst for greater automobile dependency and construction of the associated road networks to support increased automobile use – this was the result of deliberate planning and became known as 'predict and provide' (predict travel demand and provide infrastructure, generally roads) (Goodwin 1999 and Vigar 2002). Although less deliberate and organised, this pattern is becoming increasingly prevalent in developing countries. Together, urbanisation and decentralisation have created cities planned and built on the assumption that people own automobiles and will use them for most of their travel needs (Ewing et al. 2008). These cities, characterised by relatively low densities and a functional separation of land uses, do not support active travel modes and are not well served by public transport, making alternatives to the automobile inconvenient and often uneconomical (Feigon et al. 2003). Importantly, transport costs for those living in decentralised areas are consistently higher than for those living in more compact developments (Feigon et al. 2003).

As a larger share of the built environment follows this pattern, the mode of travel has changed and trip lengths have significantly increased, resulting in a rapid growth in automobile dependency and a concurrent decline of non-motorised and transit modes as a share of total urban travel (WBCSD 2004). Figure 8 and Figure 9 show the relationship between density and mix of land uses and travel behaviour (in terms of automobile travel and mode choice, respectively) for a collection of globally representative cities.

It is clear that cities with higher population and employment densities (and mix of uses) have lower levels of automobile use and a significantly higher share of non-motorised and public transit modes. For example, the Millennium Cities data shows that even though residents of Melbourne and Barcelona have very similar levels of affluence, Barcelona has a much higher density and diversity (in terms of number of people and jobs per hectare – activity intensity) (Kenworthy and Laube 2002). These and other factors (such as public transit availability, fuel prices and parking costs) have a significant influence on travel mode choice: people in Melbourne drive more than three times as much (and use non-automobile modes half as much) than their counterparts in Barcelona. Similar comparisons can be made for a number of other cities.

Population growth has been responsible for only about one quarter of the increase in automobile travel over the last two decades (Ewing et al. 2008). A larger share has resulted from higher numbers of people travelling exclusively by automobile to meet their travel needs and making longer and more frequent trips as homes are located farther from workplaces, schools, and other destinations, such as shopping and entertainment locations (Feigon et al. 2003, Ewing et al. 2008, and Turcotte 2008).

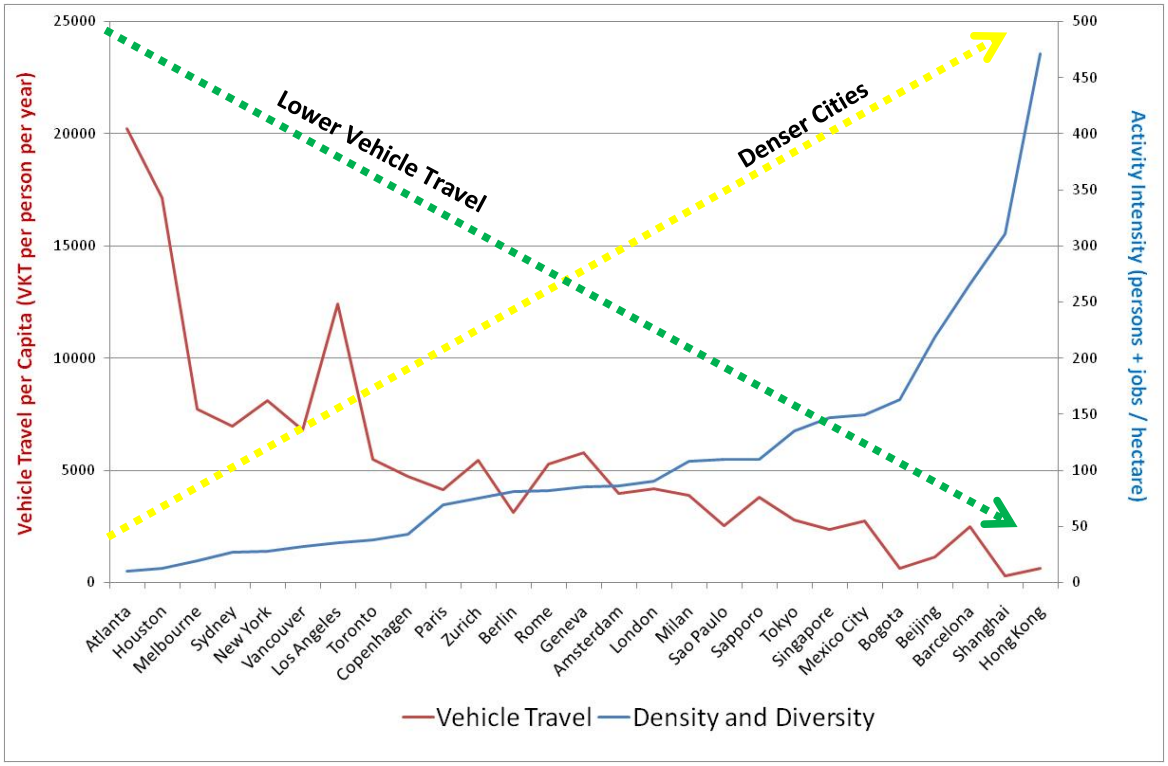


Figure 8: Relationship between Density & Mix of Land Uses and Vehicle Travel
Source: Selected data from the Millennium Cities Database for Sustainable Transport (Kenworthy & Laube 2002)

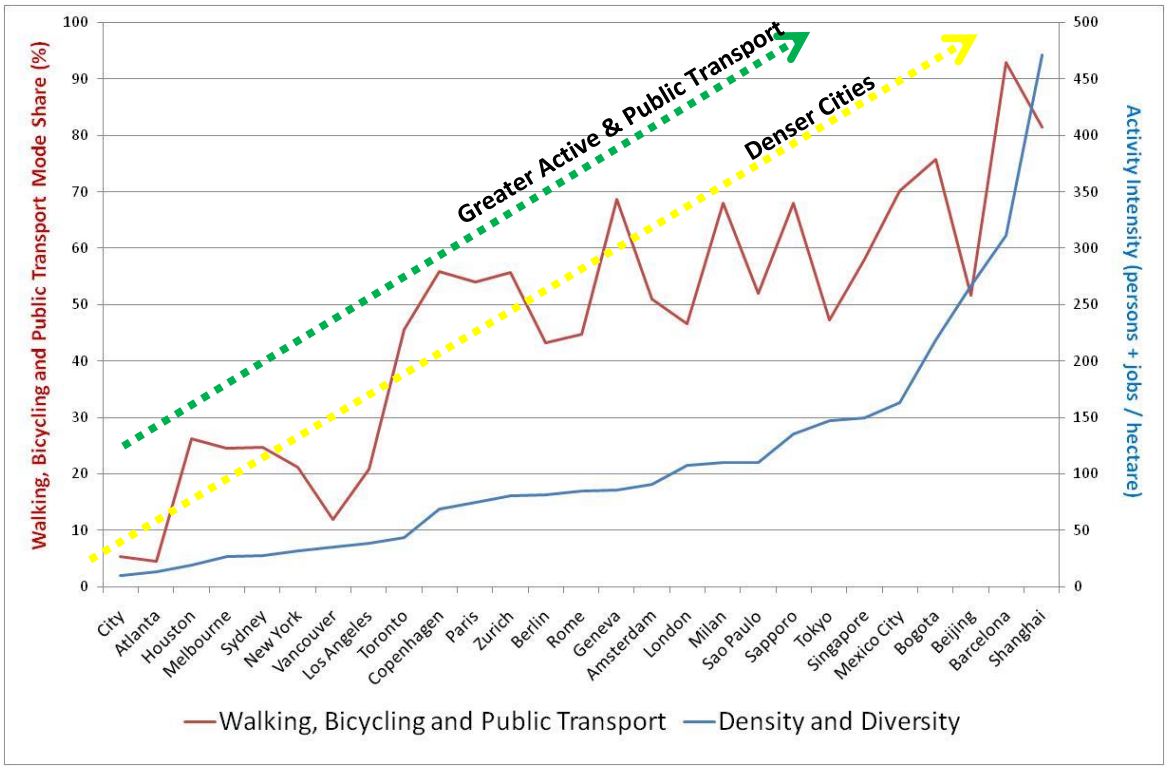


Figure 9: Relationship between Density & Mix of Land Uses and Non-Automobile Mode Share
Source: Selected data from the Millennium Cities Database for Sustainable Transport (Kenworthy & Laube 2002)

WHAT MATTERS MOST?

In terms of urbanisation and development trends, the literature review has identified that cities characterised by relatively low densities and a functional separation of land uses do not support active travel modes and are not well served by public transport, making alternatives to the automobile inconvenient and often uneconomical. In addition, analysis of the relationship between density and mix of land uses and travel behaviour for a collection of globally representative cities shows that cities with higher population and employment densities (and mix of uses) have lower levels of automobile use and a significantly higher share of non-motorised and public transit modes.

6.2. AUTOMOBILE DEPENDENCY

Economic growth has also contributed to changing travel patterns: as incomes have risen, people have shifted from walking and bicycling to public transport to motorised transport, such as motorcycles and automobiles (Schafer 2000 and IPCC 2007). Additionally, the combination of urbanisation and decentralisation has significantly increased the reliance on the automobile in many regions of the world. Automobile travel now accounts for 15-30% of total trips in the developing world, but 50% in Western Europe and 90% in the United States (see Figure 10) (IPCC 2007).

The intensity of car ownership and use varies widely around the world even when differences in income are accounted for. This means that different countries and cities have made different choices as they have developed. For example, people in Western Europe (who are on average wealthier) drive about two times less than people in the United States (IPCC 2007). Figure 11 shows the relationship between income and vehicle ownership for a collection of globally representative cities. It shows clearly that income is not the only (or perhaps even the main) factor in determining vehicle ownership. For example, the Millennium Cities data shows that people in Atlanta (despite being 25% less affluent) own 80% more cars than people in Paris (Kenworthy and Laube 2002).

The evidence is even more telling when considering vehicle use (in terms of annual per capita vehicle-kilometres-travelled) (see Figure 12). Comparing the same two cities, the Millennium Cities data shows that people in Atlanta drive almost five times as much as people in Paris (Kenworthy and Laube 2002). Factors contributing to this difference in travel behaviour include density and mix of land uses, and their combined impact on the distances between origins and destinations. Atlanta is significantly less dense than Paris (in terms of population and employment) and the average work trip for a resident of Atlanta is three times longer than for a Parisian. Distances for other trip types are also significantly larger, promoting reliance on the automobile for most travel needs. Similar comparisons can be made for a number of other cities.

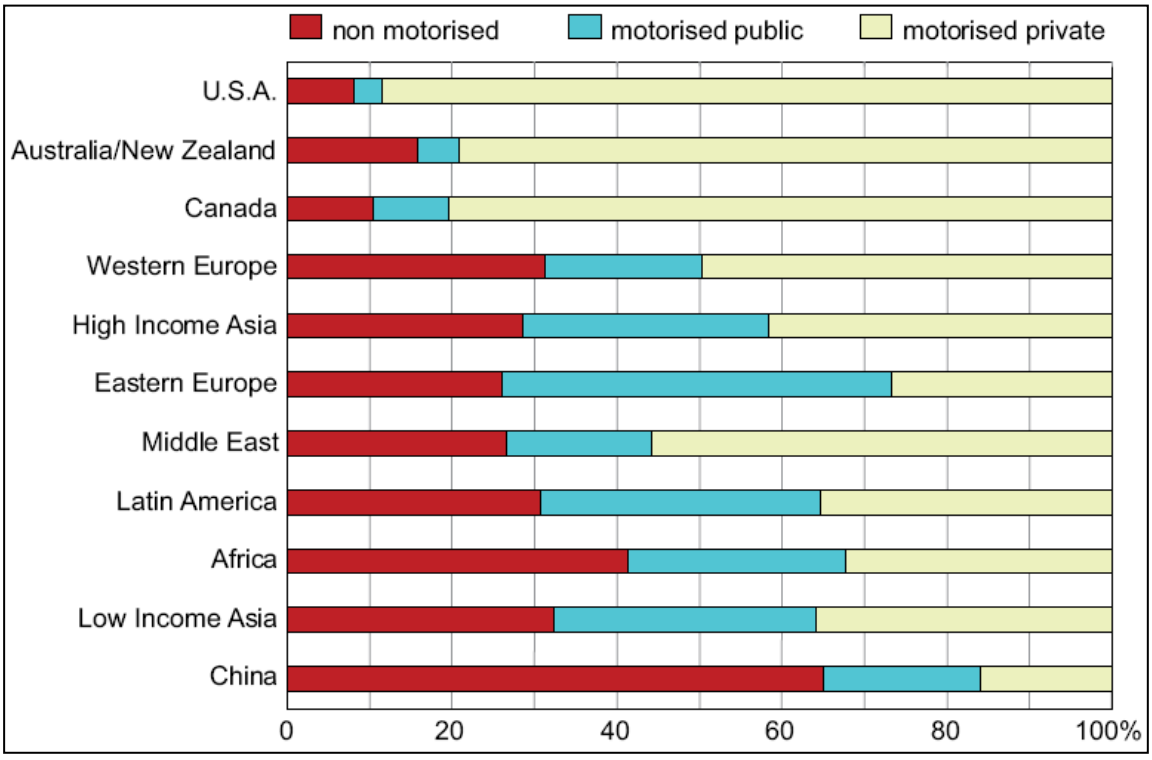


Figure 10: Global Travel Mode Share

Source: IPCC 2007 and Kenworthy and Laube 2002

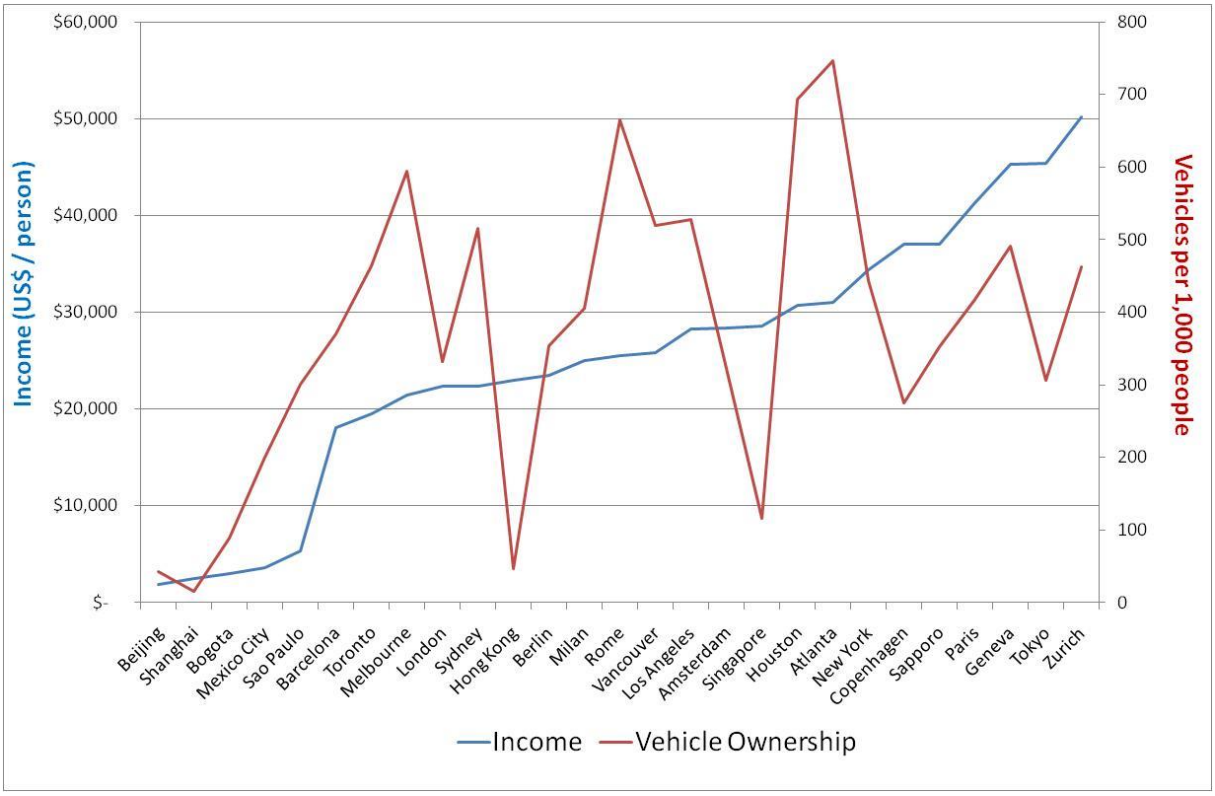


Figure 11: Relationship between Income and Vehicle Ownership

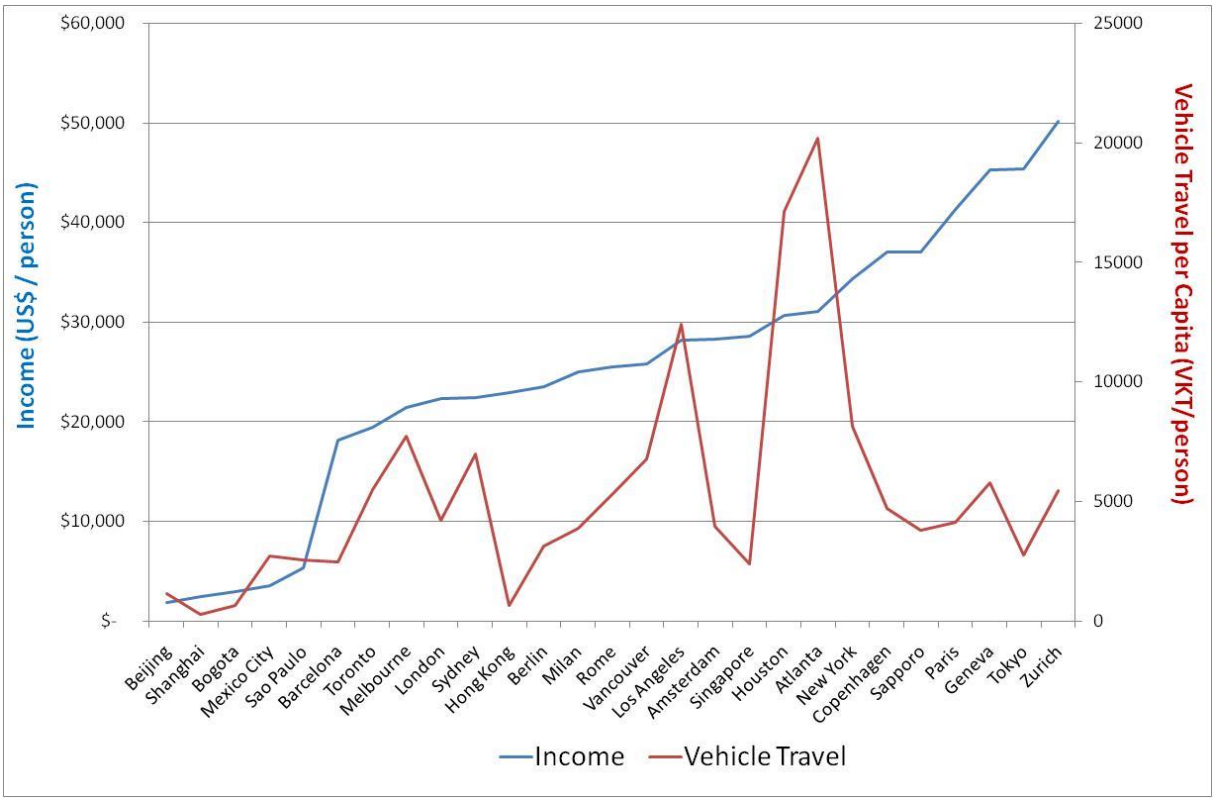


Figure 12: Relationship between Income and Vehicle Travel

Source: Selected data from the Millennium Cities Database for Sustainable Transport (Kenworthy & Laube 2002)

The world automobile fleet grew from about 50 million to 650 million between 1950 and 2005, five times faster than the growth in population, and is projected to grow to 1.4 billion and 2 billion automobiles by 2030 and 2050, respectively (IEA 2008 and IPCC 2007). Relative to the year 2000, the world automobile fleet is expected to double by 2030 and triple by 2050. In the United States, automobile travel has grown three times faster than population since 1980 (United States Environmental Protection Agency 2006).

In China, annual automobile sales have increased threefold from 2001 to 2006 and automobile travel has increased fivefold during the last two decades (Cervero and Day 2008 and WBCSD 2004). In 2006, China became the world's second-largest vehicle market after the United States (Energy Information Administration 2009). Crucially, there is significant scope for continued expansion of China's vehicle fleet, since there are only 30 automobiles per thousand people in China, compared to about 850 automobiles per thousand people in the United States and about 590 automobiles per thousand people in Western Europe (see Figure 13) (Davis et al. 2009).

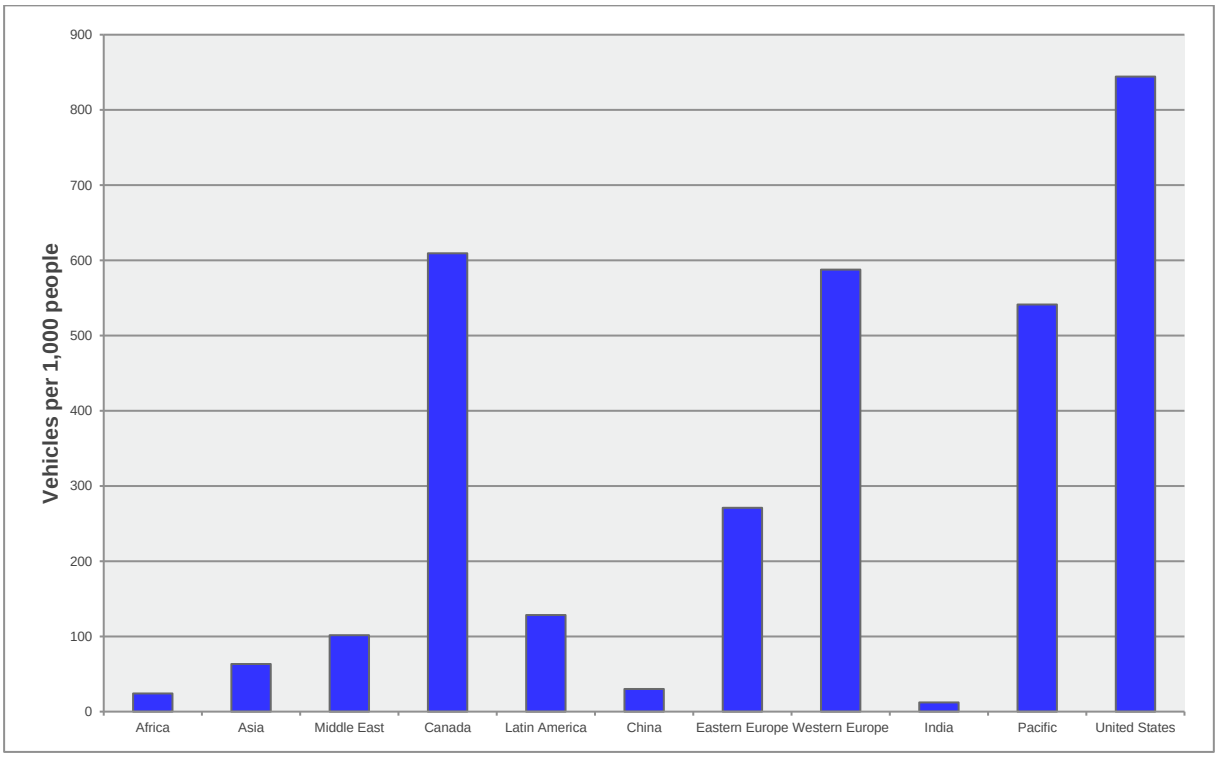


Figure 13: Global Vehicle Ownership
Source: Transportation Energy Data Book: Edition 28 (Davis et al. 2009)

WHAT MATTERS MOST?

While the combination of urbanisation and decentralisation has significantly increased the reliance on the automobile globally, the intensity of car ownership and use varies widely around the world, even when differences in income are accounted for. This means that different countries and cities have made different choices as they have developed. An analysis of travel behaviour for a collection of globally representative cities shows that income is not the only (or perhaps even the main) factor in determining vehicle ownership and use. For example, cities in Western Europe where people are on average wealthier than those from cities in countries such as the United States, drive significantly less than their American counterparts.

6.3. TRAVEL SATURATION

TRIP-MAKING TRENDS IN AUSTRALIA & THE DEVELOPED WORLD

Across Australia, studies such as the Household Travel Behaviour Surveys in Victoria (VISTA) and New South Wales have shown that "the number of trips per person has remained largely stable over recent decades". Specifically, data from the 2012-13 Victorian Integrated Survey of Travel and Activity (VISTA) revealed that in 2013, the typical Melburnian makes 2.9 trips per day, slightly less than the 3.1 trips per day recorded during the 2007-08 VISTA survey. In addition, the Australian Government's Bureau of Infrastructure, Transport and Regional Economics (BITRE) produced an information sheet in 2014 to illustrate the concept of "saturating daily travel" (i.e. natural limits being approached in the amount of personal day-to-day travel), by looking at the historical growth of per person urban travel in the United States and Australia. The BITRE information sheet presents estimates and models for urban daily travel in Australia and the United States using financial year data from 1920-21 through to 2011-12 for Australia, and calendar year data from 1921 to 2010 for the United States. BITRE's analysis shows that, in both countries, urban travel per person is indeed saturating. Figure 14 (an extract from the BITRE fact sheet) shows Australian urban all-modes passenger-kilometres per person since 1921, and the two-phase saturating logistic trend fitted to it. Saturating daily travel as a concept is about the flattening part towards the right of the red curve.

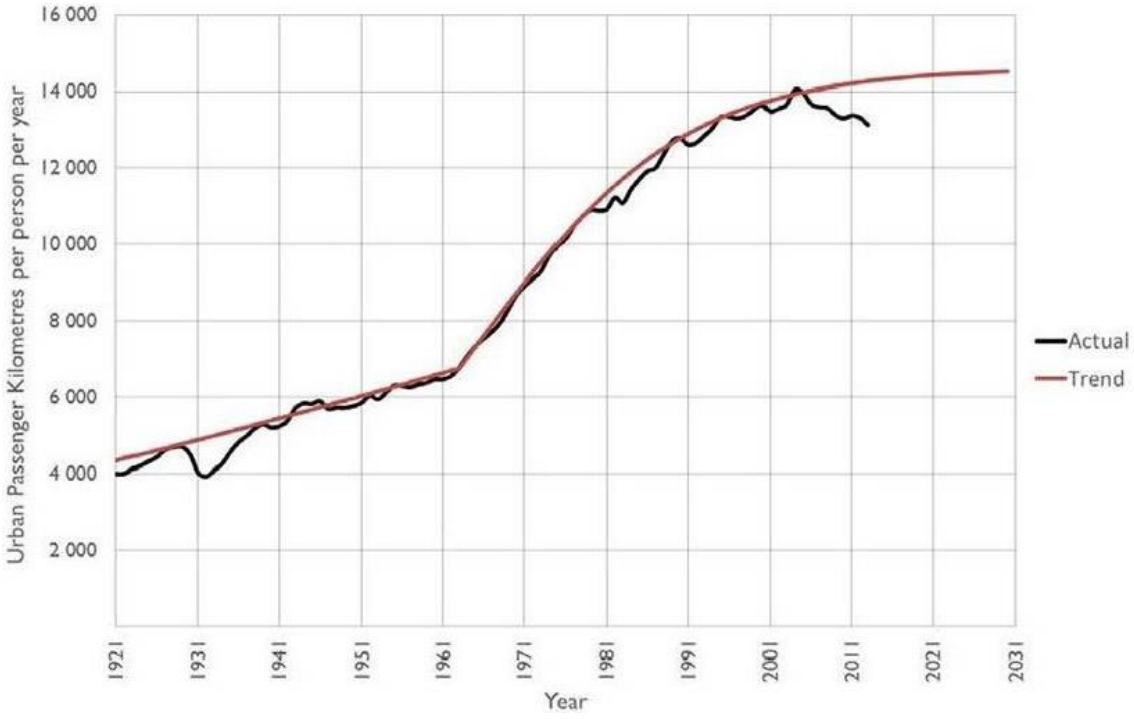


Figure 14: Australia All-Modes Urban Passenger Kilometres per Person
Source: BITRE (2014)

BITRE explained that the perturbations of the actual daily travel per person from the fitted (red line in Figure 14) saturating trends are a function of mainly three things:

1. petrol prices,
2. unemployment, and
3. major economic impacts, in particular the Global Financial Crisis (and the persistent changes in behaviour associated with it).

BITRE concluded that all three of these factors have been exerting downwards pressure on travel levels in recent years, contributing to the considerable gap (shown by the data on the right-side of Figure 14) between current per capita values and the saturation levels implied by the pre-GFC historical trend. Whilst acknowledging these perturbations as short-term, BITRE emphasises that it is the saturating trend in per-person daily travel that is at the heart of the slowing daily travel phenomenon.

In summary, BITRE showed, by the analysis of the two countries, that urban travel per person is tending to saturate (faster in Australia, slower in the United States). The BITRE study provides the foundation for stating that there is strong evidence to suggest that people will not make additional trips throughout the day due to the new road connection. In both countries, a notable halt to per person traffic growth in the period after 2005 is shown to be associated with mostly temporary influences. As such, the period to 2020 is likely to be one of renewed aggregate traffic growth, due mainly to population growth.

BITRE describes 'saturating daily travel' as a saturating (or asymptotically limiting) trend in personal daily travel. As such, the BITRE concept:

1. is of a plateau,
2. refers to daily (short-distance) passenger travel per person,
3. includes all modes of daily passenger transport – i.e. cars, light commercial vehicles, motor cycles and mopeds, walking, cycling, urban public transport (UPT) and (in earlier days) horses and horsedrawn carriages,
4. is better measured in per capita passenger-kilometres (i.e. numbers of passenger trips multiplied by the average length of those trips) than just average number of trips, since passenger-kilometres (pkm) are a better indicator of the time and effort involved in the passenger movement task.

The stabilisation of car use in recent years is also occurring in other developed countries (see Figure 15).

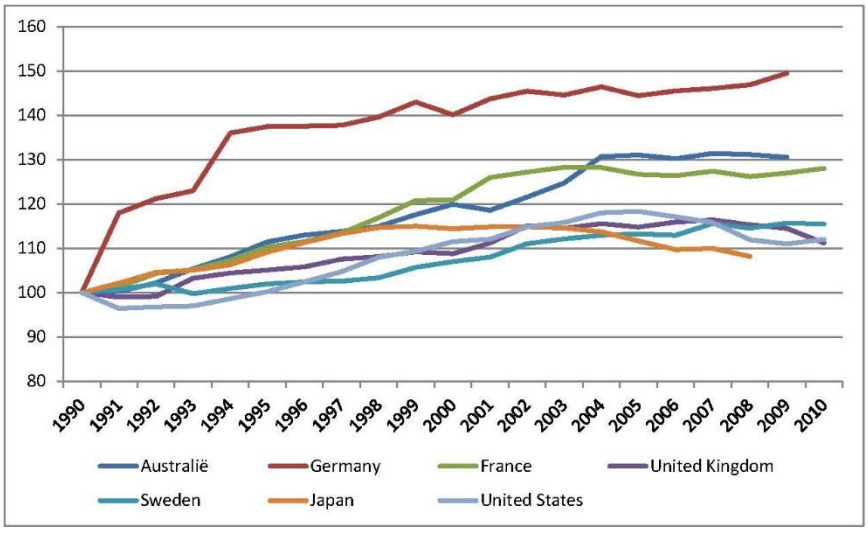


Figure 15: Traveller Kilometres for Cars and Light Trucks, 1990-2009 (Index: 1990 = 100)
Source: International Transport Forum (2012)

WHAT MATTERS MOST?

BITRE has identified that "daily travel" in Australia and the United States is reaching saturation; that is, that the natural limits in the amount of personal day-to-day travel are being approached. The evidence reviewed also shows that the stabilisation of car use in recent years identified for Australia and the United States is also occurring in other developed countries, such as the United Kingdom, Germany, France, Sweden and Japan.

6.4. TRANSPORT AND LAND USE INTERACTIONS

HOW LAND USE AND TRAVEL CHOICES INTERACT

The integration and coordination of land use and transport systems has been proposed in the literature as the catalyst for this shift in travel mode choice. Effective integration will promote sustainability through an urban environment that:

- Advances a reduction in the need for travel (both in terms of number of trips and distances travelled)
- Enhances accessibility to goods, employment and services
- Provides a variety of equitable and affordable travel alternatives
- Preserves or augments the market share of active modes of transport

Urban development patterns were initially characterised in terms of their density, diversity, and design (Cervero and Kockelman 1997). More recently, destination accessibility, distance to transit, and parking supply and cost have been added as important considerations (Ewing et al. 2008). These variables have a significant impact on the travel of individuals and households, mostly through their effect on distances travelled and mode of choice (Ewing and Cervero 2001 and Ewing et al. 2008). In the United States, for example:

> *Trip frequencies appear to be primarily a function of socioeconomic and demographic characteristics, and secondarily a function of the built environment; trip lengths are primarily a function of the built environment and secondarily of socioeconomic and demographic characteristics; and mode choice depends on both.*
> *(Ewing and Cervero 2001 and Ewing et al. 2008)*

Consequently, urban development can play a significant role in promoting active travel when characterised by coordination of land use and transport systems; higher average 'blended' densities; a mix of land uses; ready access to goods and services via a variety of travel modes; strong population and employment centres; interconnection of streets; and the design of spaces at a human scale (Ewing et al. 2008, Cervero et al. 2004, and Arrington and Cervero 2008). Walking and bicycling have similar levels of flexibility (in accessing destinations) to those offered by the automobile. In addition, recent studies suggest that pedestrian and bicycle trips tend to increase in the presence of mixed uses of land, improved street connectivity, and higher employment and population density at the origin and the destination. Therefore, by reducing the distance between destinations (mainly through increased density and mix of land uses), walking and cycling can become the preferred travel options for a large proportion of trips. In this context, it is proposed that *proximity* (a balanced combination of density and diversity measured in terms of the accessibility to destinations by walking or bicycling) can effectively and readily promote active transport.

SOME VICTORIAN EXAMPLES

Southbank, a precinct immediately south of the Melbourne (Australia) CBD, provides a relevant example of the importance of *proximity* in promoting sustainable travel modes. Southbank includes cultural, arts and institutional uses, in addition to extensive leisure and entertainment facilities. It is an important employment, residential and tourist hub and is bounded by some of Melbourne's most significant open spaces. Southbank residents exhibit very high levels of walking compared to other Melbournians from across the metropolitan area. For example, 48% of Southbank residents walk to work and 5% bicycle (Victoria DOT 2008). In addition, a quarter of residents do not own automobiles despite having incomes 20% higher than the average Metropolitan Melbourne resident.

Furthermore, despite 75% of residents owning automobiles, less than 20% drive to work (the vast majority of those residents who own an automobile do not drive to work). At the metropolitan level, 77% of people travel to work by automobile and only 5% travel by bicycle and walking combined. This dramatic difference is the result of a land use pattern that places residents within comfortable walking distance of most employment, shopping and leisure destinations. The main contributing factors are proximity to attractive destinations and relatively high levels of density, particularly since there are significant barriers to pedestrian activity in the precinct and the walking environment in Southbank is generally recognised as being of relatively poor amenity and low connectivity.

OTHER INSIGHTS

The scientific literature strongly suggests that single initiatives tend to have a modest effect on changing travel behaviour and promoting active modes. The synergistic nature of many strategies means that the key to achieving sustainability goals is to cluster a suite of them as a package (IPCC 2007, Greene and Schafer 2003, and Ewing et al. 2008). The integration of land use and transport systems will, therefore, be effective only when supported by a comprehensive set of policy, regulatory, planning, economic, technological, infrastructure, and behaviour-focused elements that make active and public transport use a feasible and desirable mobility option for urban residents to access the services they need and want (Feigon et al. 2003). The set of initiatives to be implemented will vary across regions, depending on each location's demographic, geographic, climatic, economic, political, and cultural conditions.

Many rigorous empirical studies of the link between urban development and travel patterns show that, even after accounting for income and other socioeconomic and demographic differences, residents of communities with relatively high levels of density and mix of land uses drive significantly less and walk, bicycle, and ride public transport more than their counterparts in low-density suburban communities (Arrington and Cervero 2008, Cervero et al. 2004, Ewing et al. 2008, and Feigon et al. 2003). Even though the level of travel reduction and shift to alternative modes is highly dependent on local and regional conditions, such as urban form and accessibility, most of the evidence shows that people in these communities drive 20-40% less (Ewing et al. 2003, Feigon et al. 2003, Ewing et al. 2008, and Bartholomew 2007).

This is mostly attributed to shorter distances between destinations—allowing people to live within walking or cycling distance of some of their destinations, such as work, school, shops, and parks—and easy access to public transport to reach farther destinations. Hence, automobile ownership is lower, automobile trips are shorter and less frequent, and active and public transport have a larger share of the overall travel demand (Arrington and Cervero 2008). Community-oriented travel within neighbourhoods is not dealt with in detail in most studies, and cycling and walking are generally disregarded. As a result, Ewing et al. (2008) suggest that the potential reductions in automobile travel are probably underestimated. However, since single strategies tend to have a relatively minor effect on reducing motor vehicle travel, the integration of land use and transport systems will only yield considerable benefits as part of a comprehensive set of economic, regulatory, planning, technological, infrastructure, and behaviour focused initiatives.

Initiatives to promote sustainable travel behaviour in urban environments

- Integrate land use and transport planning at the local and regional level to promote access to goods and services.
- Enhance access to integrated goods and services (employment, school, health, recreation) within the development to maximise community-oriented travel.
- Manage travel demand, including soft measures to promote voluntary travel behaviour change, and hard measures to lock-in the benefits.
- Implement pedestrian- and bicycle-friendly land use initiatives and facilities that support local, community-oriented travel, such as walkable and safe urban spaces and dedicated bicycle paths.
- Integrate non-motorised transport and public transit to enhance their mutual effectiveness, such as by placing bicycle facilities at transit stations and bicycle racks on buses.
- Provide access to high-quality, frequent, and safe public transport for longer-distance trips.
- Encourage mobility on demand initiatives, such as car and bicycle sharing programs.
- Develop innovative strategies for land acquisition and development.
- Introduce financial incentives and disincentives such as location-efficient mortgages and employee-preference housing.
- Establish market-responsive and flexible zoning for increased densities and mixed uses
- Implement flexible parking policies, such as parking limitations, pricing, adaptive reuse of parking lots, and unbundling of housing and parking costs.
- Provide public transport incentives.
- Expand telecommunications services to facilitate reductions in work and shopping travel.
- Reallocate existing road space for walking, cycling, and public transport facilities.
- Introduce disincentives to automobile use via traffic calming, road user charges, operating restrictions, automobile-free districting, and road design mechanisms.

WHAT MATTERS MOST?

Urban development patterns play a significant role in promoting active travel when characterised by coordination of land use and transport systems; higher average 'blended' densities; a mix of land uses; ready access to goods and services via a variety of travel modes; strong population and employment centres; interconnection of streets; and the design of spaces at a human scale. Even after accounting for income and other socioeconomic and demographic differences, residents of communities with relatively high levels of density and mix of land uses drive significantly less and walk, bicycle, and ride public transport more than their counterparts in low-density suburban communities. This is mostly attributed to shorter distances between destinations—allowing people to live within walking or cycling distance of some of their destinations, such as work, school, shops, and parks—and easy access to public transport to reach farther destinations. Proximity and accessibility to destinations are thus proposed as key factors to promote active transport.

6.5. TRAVEL AND THE BUILT ENVIRONMENT

A large number of studies exist that study the relationship between travel behaviour and what is generally termed the 'built environment'. To date, there are more than 300 studies of the relationship between travel and the built environment (most of them completed since the year 2000). These studies have analysed the effect of land use aspects such as density, mix of uses, urban design elements and distances to destinations. However, little work on this topic to date has generalised across studies or addressed the differences between results in an attempt to provide detailed guidance to the design, planning and engineering communities. Without this, practitioners have glimpses of a large number of potential 'solutions' (albeit mostly at too high a level – not specific enough to allow for meaningful application) rather than a comprehensive and simplified view of what actually 'works' to promote higher levels of walking and cycling for daily travel activities in different types of communities (e.g. based on their size and geographic location).

In fact, even the most detailed and comprehensive meta-analyses 'conclude' by stating that the findings of the international literature on this topic should be viewed with 'caution' and not used as technical guidance when making planning decisions. More specifically, the literature suggests that, since sample sizes of most studies are relatively small (from a statistical perspective) and very few studies control for individual preferences and attitudes (what people would elect to do irrespective of the built environment), it is difficult to generalise from the results and that the findings can, at best, be used as general guidance.

The latter element (self-selection bias) has attracted increasing attention as it has generally engendered doubt with respect to the actual magnitude of travel benefits associated with certain development patterns. Even though recent studies have found conclusive evidence of statistically significant associations between the built environment and travel behaviour, independent of individual preferences, most have found that self-selection attenuates that effects of the built environment.

Lastly, most studies 'stop short' of providing the required level of detail to meaningfully inform practical planning and urban design decisions. For example, there is a large body of evidence that suggests that higher densities and mix of uses will in fact promote a reduction in motor vehicle travel and associated increases in walking and cycling; however, the literature is not conclusive and emphatic in establishing what uses are most relevant to promote active travel. Even those studies that venture into the types of land uses that are most conducive to active travel may identify that 'retail' uses are important elements of 'walkable' communities; however, they do not specify what retail uses should be provided to encourage active travel.

Ewing and Cervero (2010) analysed more than 60 prior studies, and concluded that no individual built form variable had a large impact on travel behaviour. However, they suggested that the cumulative impact of multiple measures could be quite large. Hirsch et al (2013) also supported this view, concluding that the influence of land uses were small and generally not statistically significant because it is likely they act together with other aspects of the built environment and additional influences to effect mode choices. However, Cerin et al. (2007) found walking rates for Adelaide residents for whom active transport was not a priority were positively affected by destination accessibility, which they suggested could meant that part of the effect of the built environment on transport related walking was a direct effect. This suggests that a multi-pronged approach to built environment design should be taken rather than focussing on one or two variables.

In considering the appropriate scale for designing for walkable neighbourhoods, the work of Greenwald and Boarnet (2001) is relevant. They examined non-work trips, finding that impacts of land use on walking operated at the local but not the regional level. This means that detailed design of the local environment will be most important in influencing walking rates rather than aspects such as average densities over a larger area. This is consistent with Ewing and Cervero (2010), who found that population and job densities were only weakly associated with travel behaviour once other variables were controlled for, and also Lee and Moudon (2006), who found that the residential density of the resident's own block was significant, but not the overall density of their neighbourhood as a whole.

Ewing and Cervero (2010) found that walking was most strongly related to distance to a store, intersection and street density and job/housing mix. Public transport usage was related to these variables plus the distance to a public transport stop. More detailed information relating to important land uses is included below. Being near a public transport stop also increased levels of walking, but not by as much as the other factors.

Adams et al. (2016) examined the associations of perceptions of the environment in the workplace 'neighbourhood' and commuter walking. Six hundred and seventy six participants in the baseline survey of the Walking Works intervention study reported perceptions of ten environmental attributes in their workplace neighbourhood, availability of public transport, time spent walking to and from work in the last seven days, their participation in physical activity and socio-demographic characteristics. The study concluded that creating 'pedestrian friendly' environments in workplace surroundings may be important for encouraging walking for the daily commute to work. Such environments would include convenient routes, suitable and maintained pedestrian infrastructure and convenient access to public transport.

Christiansen et al. (2016) undertook an international cross-sectional study to document the strength, shape, and generalisability of relations of objectively measured built environment variables with transport-related walking and cycling. The analyses were conducted on 12,181 adults aged 18–66 years, drawn from 14 cities across 10 countries worldwide. The frequency of transport-related walking and cycling over the last seven days was assessed by questionnaire and four objectively measured built environment variables were calculated. Associations of built environment variables with transport-related walking and cycling variables were estimated – positive associations of walking for transport were found with all the environmental attributes.

Land use mix had a linear relationship with walkability, meaning that the higher the land use mix the higher the walkability recorded. Other environmental variables, such as residential density, intersection density and the number of parks had a nonlinear relationship with walkability, suggesting that there may be optimum values in these attributes, beyond which higher values could have neglibible or even negative impact. Cycling for transport was associated linearly with residential density, intersection density and land use mix, but not with the number of parks. Across 14 diverse cities and countries, living in more densely populated areas, having a well-connected street network, more diverse land uses, and having more parks were positively associated with transport-related walking and/or cycling.

Lee and Moudon (2004) analysed studies relating to cycling and walking in the health literature. Some of the studies reviewed focussed on walking and cycling for transport whereas others focussed on leisure and exercise. They identified environmental barriers to physical activity (shown below in their Table 3), which should be avoided in designing neighbourhoods. Lee and Moudon (2004) also identified factors positively influencing walking and cycling. These included the number of local shops (Corti, 1997) and number of destinations (Craig, 2002). There were also a number of perceived factors that also influenced walking and cycling, including a variety of destinations, presence and continuity of footpaths, traffic control measures and perceived safety.

Lee and Moudon (2006) comprehensively assessed the relationship between rates of walking and over 900 environmental variables in urban and suburban neighbourhoods in America. They found that increased walking was associated with:

- Shorter distances to grocery stores alone
- Shorter distances to grocery stores clustered with restaurants and retail
- Shorter distances to eating and drinking places
- Shorter distances to banks
- Greater distances to uses that take up a large area of land (education and offices)
- Residential density of the resident's own block, but not of the neighbourhood as a whole
- Smaller block sizes
- Greater total length of footpath
- Directness of the route to closest grocery store

Forsyth et al. (2008) found that in addition to presence of footpath and smaller blocks, street lights and traffic calming were also associated with greater amounts of walking. Shay et al. (2006) specifically examined a neo-traditional neighbourhood with a single commercial centre, and found proximity to this centre to be related to walking rates.

Owen et al. (2007) had similar results in Adelaide, finding that street connectivity and proximity to retail and commercial destinations were associated with walking for transport, suggesting that the findings of these American studies may also be applicable in Australia.

In a study that examined changes over time, Hirsch et al. (2014) found street connectivity that initial and improved street connectivity were important in increasing walking. They measured street connectivity as the proportion of a 1 mile radius from a person's house that can be reached by travelling 1 mile on the street network.

Cerin et al. (2013) found that for elderly residents, personal safety and an unchallenging pedestrian environment (lack of sloping streets and path obstructions) were important influences on whether they would walk to local destinations.

Regarding general planning measures, the factors that affect walking the most are intersection density, jobs-housing balance and distance to stores (Ewing and Cervero 2010). Population density and commercial floor area ratio have a positive effect in promoting walking. This is also confirmed by (Saelens et al. 2003) who state that population density and mixed land-use has significant effects on walking. On the lower scale, or the design level, there are three main characters that make a street attract non-residents to walk through it (Jacobs 1961). Firstly, it should be distinctive borders between private space and public space. Secondly, buildings should face the street in order to support residents to be able to watch the street as an issue of safety for those that are using it. Thirdly, the sidewalks should attract the residents to use it.

VICTORIAN CONTEXT

Encouraging regular physical activity is one of five strategic imperatives in the VicHealth Action Agenda for Health Promotion. VicHealth recognises the many health benefits that an active lifestyle can provide and has produced a 'Physical activity and sedentary behaviour' evidence summary, which outlines current physical activity and sedentary behaviour levels in Australia and Victoria. It provides an overview of the impacts of physical activity and sedentary behaviour, as well as barriers to and enablers of active lifestyles. With respect to 'Built environment factors' (parts of environments that are created or modified by humans) VicHealth has noted the following:

- Neighbourhoods that have high 'walkability' (high residential density, mixed land uses and connectivity of streets) support walking and active travel among both adults (Saelens & Handy 2008) and children (Ding et al. 2011).
- Access to footpaths and cycling infrastructure, and the availability of parks and open space are important facilitators of physical activity among children and youth (Ding et al. 2011).
- Long distances between home and school, recreational facilities, parks and shops are a barrier to active travel for children (Wong et al. 2011).

VicHealth has also noted that few studies have examined the influence of neighbourhood environments on sedentary behaviour. It has highlighted the following:

- Australian data indicates that crime and a lack of quality sporting facilities or options close to home is related to higher levels of television viewing in children and adolescents (Timperio et al. 2012).
- Television viewing is higher among adults who live in areas with low walkability (Sugiyama et al. 2007).
- Limited public transport availability, disconnected streets and low population density contribute to time spent sitting in cars (Sugiyama et al. 2012).

CASE STUDY: SELANDRA RISE

In 2016, VicHealth released its "Planning and designing healthy new communities: Selandra Rise Research Summary". The research was also supported by Stockland, the City of Casey, the Metropolitan Planning Authority and RMIT University and aimed to provide recommendations for the design of future residential communities.

Selandra Rise is a new housing development located in Melbourne's south-east growth corridor, 52km from the Melbourne CBD, where residents have bought land and built new houses over a period of several years. This research project aimed to discover how design and planning of a new residential community could improve the health and wellbeing of residents. In partnership with Stockland, the Metropolitan Planning Authority (now Victorian Planning Authority), the City of Casey, the Planning Institute of Australia (Vic) and VicHealth, a key focus of the research was the development of recommendations to inform design and planning of future residential communities.

The research was guided by the social determinants of health directly related to housing and neighbourhood. These are: physical activity, social inclusion, mental health, childhood health, food accessibility and safety. It follows on from research showing that neighbourhood design can contribute to a sense of place and to the health and wellbeing of residents (Frumkin 2003; Giles-Corti et al. 2005).

Selandra Rise's key features include:

- 120 hectare site, 8000m^2 in Clyde North, 52km from the Melbourne CBD
- St Peter's Secondary College established October 2011
- First residents moved in November 2011
- Selandra Community Place Community Centre opened March 2012
- Multi-use parks designed with community consultation
  - Hilltop Park, June 2012
  - Heritage Park, March 2014
  - Youth Park, November 2015 (not complete at time of final study data collection)
- Bus service started June 2014
- Kindergarten opened January 2015
- Town centre & business precinct established July 2015 (not complete at time of final study data collection)
- Community garden established November 2015 (not complete at time of final study data collection)

VicHealth determined that the initiatives delivered at Selandra Rise are a positive step towards incorporating social determinants of health into community planning. Early delivery of public transport, a community centre and diverse parks indicate small but positive impacts on residents' health and wellbeing. On the whole, residents were satisfied with Selandra Rise as a place to live, but long commuting times caused persistent and increasing dissatisfaction. VicHealth concluded that to improve the health and wellbeing of future residential communities in growth areas, integration with regional planning and transport is vital, especially access to employment opportunities closer to areas of affordable housing. This could be facilitated through the decentralisation of employment in Victoria and the development of better and integrated road and public transport infrastructure and services. In addition, VicHealth recommended that early delivery of major services such as public transport, local community services (e.g. shops and schools), well-connected paths and community facilities to coincide with the arrival of the first residents to encourage early adoption and support the health and wellbeing of residents. Key highlights from the research project:

- Early provision of diverse parks and interim measures for creating community, such as Selandra Community Place, encourages social interaction and engagement amongst residents.
- Access to public transport and commute times to work are two of the most important dimensions impacting the health of residents. For example, long commutes to work reduced residents' capacity for physical activity, time spent with family and community engagement, while exacerbating weight gain.
- Provision of continuous walking and cycling paths that connect new communities with public transport, local destinations and community facilities and services, both within and beyond a residential development, are needed to reduce car dependency and support physical activity, active transport, social inclusion and community engagement.

WHAT MATTERS MOST?

In terms of those aspects of the built environment that are of most relevance to this project, the literature review has identified the following as the most important elements in terms of their potential contribution to promoting active travel:

- Provision of specific land uses within walking and cycling distance of homes
- Distance thresholds for relevant land uses
- Parking policies
- Provision of shared mobility alternatives
- Road safety

6.6. PREFERENCE FOR WALKABLE NEIGHBOURHOODS – INTERNATIONAL EVIDENCE

Walkable neighbourhoods (those that encourage walking) are promoted as a normative goal by planners and policy makers, by international bodies such as the World Health Organisation and the United Nations Human Settlements Programme (UN-Habitat), and by influential models of urbanism, especially New Urbanism and Smart Growth (Brookfield 2017). A walkable neighbourhood typically has the following characteristics: medium or high density, compact, mixed use, amenity rich and with easy access to public transport and extensive active transport networks. A number of studies have presented evidence that that this development pattern provides multiple benefits, including increased physical activity, reduced carbon emissions, less congestion, better air quality, less sprawl, a 'richer public domain' and greater social capital.

Historically, the development of walkable neighbourhoods has been criticised as a policy or land use goal because people (in countries like the United States, Canada and Australia) 'do not want to live in them'. Many studies, plus sections of the development industry, have identified amongst residents a strong preference for low density, single use residential environments. While there are aspects of the walkable neighbourhood that consistently resonate with people in these and other countries, such as the availability of schools and higher levels of public safety (Weiss 2004), preference surveys have often shown that people prefer single-family detached housing with green spaces. This seems to imply that density and satisfaction appear to be inversely correlated (Marans and Rodgers 1973). This has traditionally posed a problem for walkable neighbourhood proponents to the extent that density and walkability are correlated – particularly since the relationship between the two is not straightforward and causality is frequently questioned by researchers who argue that self-selection plays an important role in people's choices of neighbourhood and their travel behaviour patterns.

More recently, evidence is accumulating of support for elements of the walkable neighbourhood. With changing demographics, some have argued that these historical preference structures are evolving (Myers 2007), as many residents who prefer low density "could do well without the rest of the suburban package" (Levine and Frank 2007, Leinberger 2007 and Nelson 2013). The Regional Plan Association (RPA), a reputable urban research and advocacy organisation in the United States and chartered with improving the prosperity, infrastructure, sustainability and quality of life of the New York-New Jersey-Connecticut metropolitan region, published a report in 2016 in which it states that "*growing numbers of young and old Americans prefer to live in communities where they can walk to stores, school, services, parks and public transportation*". More specifically, it identifies that 56% of millennials and 46% of baby boomers prefer to live in more walkable, mixed-use neighbourhoods.

A recent study in England (Brookfield 2017) investigated residents' preferences for walkable neighbourhoods. The study focused on a specific type of resident, the members of residents' groups, with the objective of providing insights into how a population which frequently seeks to shape local planning regimes evaluates an urban form increasingly promoted by these regimes. In doing so, this study introduces a critically understudied yet locally vocal perspective into debates on the possibility (or impossibility) of walkable communities. The Brookfield study considered the environmental preferences of 11 diverse residents' groups operating in a variety of environmental settings within the city of Southampton in South-East England. Working in Southampton provided access to a large population of residents' groups operating in more and less walkable environments, creating scope to consider possible associations between an area's walkability and a group's potential amenability to more walkable neighbourhoods.

The study found that residents' groups tended to favour neighbourhoods that encouraged walking and supported physical characteristics and urban design factors commonly associated with walking. Consistent with previous studies, a compact urban form, local amenities, good pedestrian infrastructure and greenspace were favoured. However, in line with many past studies, high density and mixed use development were widely and strongly disliked. Development of this type was thought likely to result in congestion, noise, disturbance and adverse effects on health and wellbeing. Overall, it seems likely that there will continue to be a cognitive dissonance between the desire for walkability and the perceived tensions resulting from living in the kind of heterogenous, high density environment that the walkable neighbourhood implies (Brower 2011).

Numerous studies have investigated the relationship between neighbourhood self-selection (people's preference for living in walkable neighbourhoods) and walkability (physical attributes of the neighbourhood) on walking activity for transport and leisure purposes. A recent study with 240 overweight and obese men in San Diego (California) by Norman et al. (2013) found that neighbourhood walkability was directly and positively related to walking for transport but not related to leisure walking. This is consistent with other studies that have found associations between walkability and walking for transport, even after adjusting for self-selection. However, neighbourhood selection also contributed significantly to walking for transport, providing further evidence that active people do self-select into walkable neighbourhoods and that walkability and selection are both important to walking behaviour.

The study separated self-selection into the '*selection*' of current type of neighbourhood and '*preference*' for ideal neighbourhood type in which to live, and found that both factors made independent contributions to explaining walking for transport. Overall, the study found that walkability, selection, and preference were all independent correlates of walking outcomes. The potential of policies to enhance walkability was indicated by the finding that, among men who preferred suburban neighbourhoods, those living in walkable neighbourhoods walked more. Thus, living in a walkable neighbourhood may "attract" men to walk more, despite their preference.

In the United States, it is estimated that more than half the development 'on the ground' in 2025 (and approximately two thirds of that in 2050) is yet to be built (Nelson 2006). This provides a unique opportunity for the establishment of communities that promote active transport because it involves 'shifting (the nature of) investments that have to be made anyway' (Ewing et al. 2008). However, the RPA study notes that while there is a growing shortage of attached housing in mixed use neighbourhoods, the country's current supply of detached single-family homes is estimated to exceed future demand for at least the next 25 years. The RPA report partly attributes this disconnect to the fact that development projects with the characteristics of walkable communities (which have, by definition, a mix of housing and non-residential uses in settings ranging from high-rise urban neighbourhoods to traditional CBDs to newer suburban activity centres) are ineligible for most federal loan guarantees and financing, and are often unable to attract private financing as a result.

As such, there are a limited number of successful case studies of the establishment of truly walkable neighbourhoods in growth area contexts. The example that follows, from Arlington (Virginia), despite being in an inner/middle urban context with relatively high density, is relevant as it involves the transformation of a formerly car-centric suburb into one of the most walkable areas in the United States.

CASE STUDY: ARLINGTON, VIRGINIA (UNITED STATES)

Arlington County, Virginia has witnessed more mixed-use development along a rail corridor over the past three decades than any other community in the United States. Arlington County has become a textbook example of creating a vision and putting in place appropriate implementation tools to achieve it. Arlington County did not become a pedestrian friendly place overnight. The footpaths are lively today thanks to a series of decisions carried out over several decades. The story of this suburb's rise to become one of the most walk-friendly communities in the United States can offer lessons for communities wanting to promote active transport.

Through a collaborative effort that engaged local stakeholders and an ambitious campaign that targeted supportive infrastructure improvements to rail stops along the corridor, Arlington County managed to transform the Metrorail Orange line into a showcase of public and active transport supportive development, with mid-to-high rise towers and multiple uses today flanking the Rosslyn, Courthouse, Clarendon, Virginia Square, and Ballston Metrorail stations. Borrowing from the experiences of "sustainable transport metropolises" like Copenhagen and Stockholm), Arlington County proceeded to leverage Metrorail's presence and transform once dormant neighbourhoods into vibrant clusters of office, retail and residential development.

Initially, pedestrian activity was limited to the areas in the immediate vicinity of public transport stations, primarily because most of the streets were still designed as roads for moving vehicular traffic in the most efficient way, with little regard for the impact on pedestrians and surrounding neighbourhoods. The county board, spurred on by neighbourhood leaders, adopted an "urban village" approach to planning, which resonated with people – the idea of comfort and community while still being cosmopolitan. "Being both suburban and urban at the same time."

One strong focus of this plan was to make walking more safe and convenient. Footpaths were widened while the pedestrian crossing distances at intersections were narrowed. A task force on traffic calming was launched and the outdated policy of charging homeowners for the cost of building new footpaths – still common throughout the United States – was eliminated. Today, 90% of all residential streets have footpaths and traffic on seven of the county's nine busiest roads has declined up to 23% since 1996. As a result, walking and cycling now account for 17% of all trips (significantly higher than the active transport mode share in most cities in the United States and Australia). The county's population has now climbed to 220,000, and surveys of new residents reveal that the area is attracting many young professionals and families who could afford to live in wealthier suburbs but prefer Arlington's walkability and sense of community. In addition, Arlington is also growing as a regional job centre, with more than 215,000 people working in the county.

Infrastructure improvements to the pedestrian and cycling environment have been extensive, including footpath widening, footpath extensions and medians at intersections, midblock crossings, bicycle lanes (on- and off-road) with appropriate levels of separation from traffic (with buffers or fully separated 'tracks'), road narrowing, lane reduction, traffic calming and zoning changes to promote mixed uses. In addition, a county-sponsored initiative (Walk Arlington) has been implemented to encourage people to 'get back on their feet'. WalkArlington developed 25 walking routes known as Walkabouts around the county, highlighting neighbourhoods' history, community resources and attractions. The WalkArlington Works program helps employers and staff to boost walking in the workplace, both for commuting and trips during the workday. WalkArlington is part the county's Car-Free Diet program, an innovative approach that empowers residents to live without a car.

Arlington's walk friendly environment, plus extensive train and bus service, trails, bike lanes, bikeshare and carshare make this a viable option for a significant number of households. WalkArlington also involves children, by implementing programs at schools – from coordinating Walk to School Day to promoting walking school buses at elementary schools. In the summer, WalkArlington offers walking scavenger hunts at the county fair and collaborates with County-run camps to promote walking. Arlington's 22 elementary schools and five middle schools all run Safe Routes to Schools programs, which seek ways for more children to walk and bike to school.

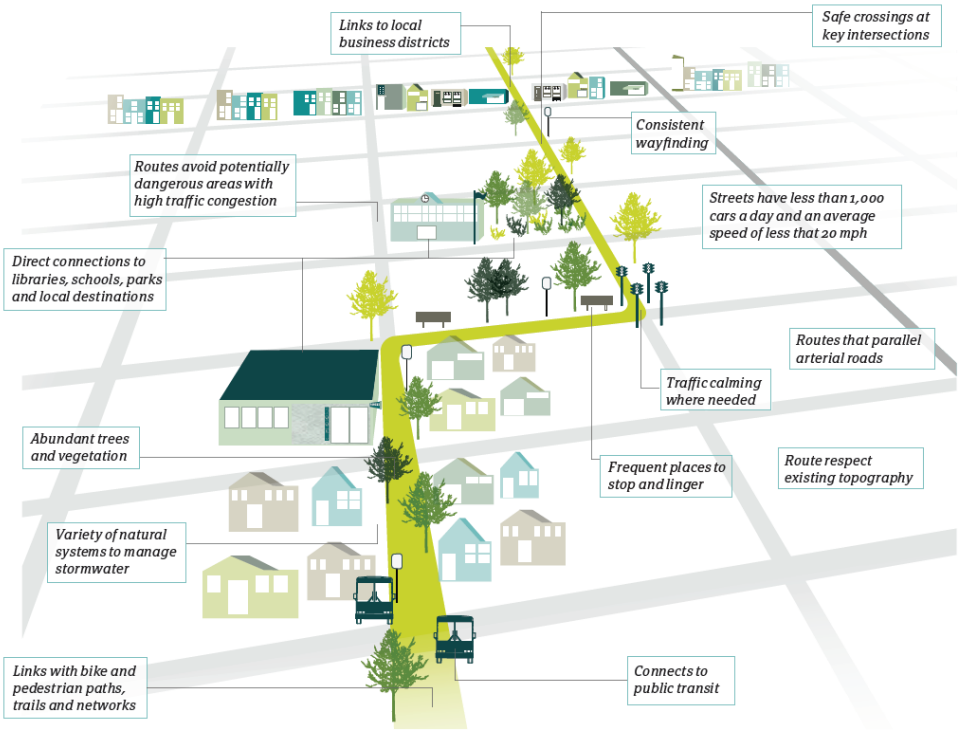
The pedestrian education efforts, coupled with the extensive improvements to the physical environment, have enabled Arlington toward fulfilling the goal of building a community where 8-year-old children can travel alone to most destinations."

CASE STUDY: SEATTLE NEIGHBORHOOD GREENWAYS

"Seattle Neighborhood Greenways" is a safe street advocacy organisation. It is a volunteer coalition representing many neighborhoods across Seattle who plan and advocate for safe, equitable, and comfortable streets.

Neighborhood Greenways are one of the tools used by the group which involves making simple changes to streets to provide for safer streets in residential areas. Greenways are generally found on non-arterial roads with low volumes of cars going slowly enough so that people who walk or ride bicycles feel safe and comfortable. Greenways provide easy access to open space and have many park-like functions. Trees and other landscaping, including public art and rain gardens, are often part of greenway projects.

Cars, delivery, and service vehicles continue to use greenways and parking is allowed. Greenways are signed and engineered to slow traffic on residential streets and help people get safely across busy commercial and arterial streets.



FILTERED PERMEABILITY

The term "filtered permeability" was first coined in Steve Melia (2008 – Senior Lecturer in Transport and Planning, University of the West of England) and subsequently defined in guidance prepared for the Department of Communities and Local Government in the UK as follows:

> "Filtered permeability means separating the sustainable modes from private motor traffic in order to give them an advantage in terms of speed, distance and convenience. There are many ways in which this can be done: separate cycle and walk ways, bus lanes, bus gates, bridges or tunnels solely for sustainable modes."

In practice, filtered permeability has often been deployed to "filter out" car traffic while still letting public transport, pedestrians and those on bikes through. The manner by which this is achieved varies but all implementation examples share a street layout where bike riders, pedestrians and public transport are given preferred direct access through an area while motor vehicles are restricted but can still get through via a slow and/or less direct routes. Examples of cities and neighbourhoods that have filtered permeability include:

Groningen, the Netherlands

Groningen city planners split the centre city into 4 quadrants and made it such that you cannot get from any one quadrant to another in a car. Drivers are forced to use the perimeter road instead. Other transport modes are free to move about the city without restriction.

Strasbourg, France

The "bike capital of France," the central part of Strasbourg is designed to discourage through car traffic by making it difficult to drive through the city, but pleasant for people walking and on bikes. The street network is easy to navigate on foot and bike, but raised bollards restrict car traffic.

De Beauvoir Town (Hackney, London)

De Beauvoir Town features extensive use of "Filtered Permeability" (roads which have been closed for through motor traffic but remain open to pedestrians and cyclists) which reduces motor traffic across much of the area to a very low level.

Figure 16: Strasbourg – Filtered Permeability

LINK AND PLACE

The “Link and Place” principle was first developed by Professor Peter Jones in the UK and has been used recently for the City of Adelaide’s Transport and Movement Strategy 2012-22 – known as Smart Move. Link and Place seeks to create more people-friendly urban streets through street planning and design that acknowledges the range of street functions.

The “Link and Place” principle has been a catalyst for many reports and guidelines being produced by a range of UK organisations in recent years, all encouraging a recognition of streets as being places for people rather than just vehicles. One of the most significant publications has been the Manual for Streets, published by the Department for Transport and the Department for Communities and Local Government, which has signalled a fundamental change in national policy in the UK. This stresses the role of streets as ‘Places’ as well as channels for movement and shows how a more balanced approach to street planning and design can be applied in the case of lightly-trafficked residential roads in new housing developments.

While establishing the principle of adopting a more holistic, people-centred approach to urban street planning and design, the Manual for Streets does not address in any detail the planning of the whole urban street network nor how to design appropriately for competing street uses on the busier sections of street, where space is limited.

Urban streets provide the setting for a wide range of urban street activities, which can be grouped under two broad types of street functions: ‘Link’ and ‘Place’. Link and Place helps to determine the appropriate balance of street space and capacity to be allocated to different street user groups. This, in turn, affects the kinds of design solution appropriate in different contexts.

As a Link, a street provides a conduit for through movement, and forms an integral part of the wider urban street network and other, more specialised, urban transport networks (e.g. on-street light rail network). A Link user may travel by a variety of modes, from private car or truck to bus, bicycle or on foot. Their essential need is to follow a continuous, linear path through the street network, with minimum disruption and a seamless connection from the beginning to the end of their journey. In general they are seeking to minimise travel time along each section of street.

As a Place, a street is a destination in its own right: a location where activities occur on or adjacent to the street. A Place user is someone wishing to make use of some of the features that are on that particular street, and will usually do so on foot. While such people are classified as ‘pedestrians’, they are not passing through the area – they are spending time in the area, and may be carrying out a wide variety of activities (e.g. shopping, talking, waiting, resting, working). They are particularly affected by the noise and air pollution produced by vehicular traffic, and the general severance effect of heavy traffic volumes in inhibiting their movement between places on opposite sides of the street.

However, not all of the traffic and transport-related activity observed on urban streets is part of that street's Link function. There are also some types of Place-related activities that are directly connected with traffic and transport, and occur within and adjacent to the carriageway. For example: loading/unloading; parking by employees, customers, residents, etc.; and buses and trams stopping to drop off/pick up passengers.

The concepts of ‘Link’ and ‘Place’ provide the basis for developing a two-dimensional street classification, into which every kind of urban street can be located. This is shown schematically in Figure 17, where a major city boulevard has both a high Link and high Place status and a local residential street a low Link and low Place status.

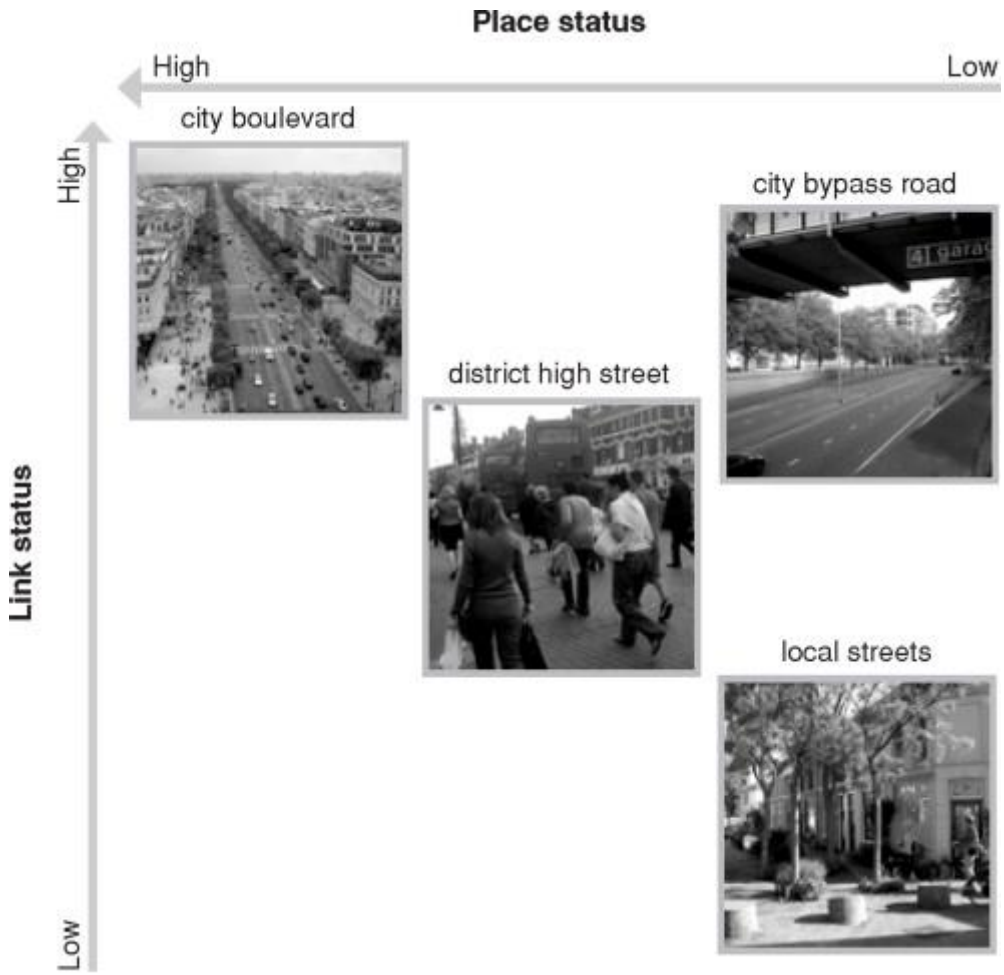


Figure 17: Mapping diverse urban street types into a Link/Place framework

WHAT MATTERS MOST?

The development of walkable neighbourhoods has historically been criticised as a policy or land use goal because people (in countries like the United States, Canada and Australia) 'do not want to live in them'. Many studies, plus sections of the development industry, have identified amongst residents a strong preference for low density, single use residential environments. Recent evidence is accumulating in support for elements of the walkable neighbourhood. With changing demographics, historical preference structures are evolving. In countries like the United States and the United Kingdom, significant and growing numbers of people have been identified as preferring to live in communities where they can walk to stores, school, services, parks and public transport.

Figure 18: "Green display village with no roads" – Armstrong Estate at Mt Duneed (Geelong)

6.7. LAND USE TYPES

There are two ways of examining what type of uses are most important – those that generate a lot of trips, and those uses that have been found to be specifically related to active transport rates. Sallis et al. (2004) found that retail and food outlets were likely to be visited both more often and by a larger number of residents than recreational destinations such as sporting fields and parks.

In a study of residents in Adelaide (Cerin et al., 2007), monthly walking trip rates were analysed for a wide range of land uses and food stores were the most frequent. Cerin et al. (2007) found that the most significant contributor of transport-related walking was proximity to workplace for women, but not for men. In relation to uses, Ewing and Cervero (2010) found that walking was most strongly related to distance to a store and job/housing mix.

Hirsch et al. (2013) found that in New York, proximity to social uses, defined as community centres, religious institutions, schools and gathering places had a positive impact on rates of walking. There was no statistically significant effect for proximity to restaurants, bars, theatres, sports arenas, parks, playgrounds or gyms. They also examined similar data for North Carolina but found no significant relationship between land uses and walking rates. However, in this study walking rates were defined as meeting or not 150 minutes of transportation by walking per week. The use of a discrete variable limits its usefulness. The study also found that lesser distances to beaches and post offices increased the likelihood of walking. There was a weak but positive link between the diversity of uses available and walking rates.

Hirsch et al. (2014) subsequently used a similar data set to examine changes in walking for transport and changes in the built environment over time for residents who remained living in the same location. Increases in walking over time were found to be related to higher initial levels of land zoned for retail, population density and number of social destinations within one mile, number of walking destinations within one mile and street connectivity. Increases in the number of social destinations, number of walking destinations and street connectivity were found to be associated with increases in walking levels over time.

With respect to land uses, Lee and Moudon (2006) found walking rates were influenced by shorter distances to grocery stores, eating and drinking places, banks and centres which included grocery stores, retail and restaurants. This is similar to the results of McConville et al. (2010), who found that proximity to banks, bus stops, fast-food restaurants, grocery stores, rail stations, physical activity uses, recreational facilities, restaurants, social uses and sports facilities were associated with transportation walking. McConville et al. (2010) also found that the numbers of bus stops, grocery stores, offices, and retail stores in participants' neighborhoods were associated with transportation walking, as was land-use diversity. McCormack et al. (2008) found proximity to convenience stores, bus stops, post boxes, shopping malls, newsagents and train stations influenced walking rates of residents in Perth.

It is possible that uses that promote walking may also be culturally influenced. In a study of elderly residents in Hong Kong, Cerin et al. (2013) found that public transport stops, health services, place of worship, retail, grocery store and restaurants were all associated with greater walking for transport, but only where the pedestrian network and destinations were perceived as safe.

Another approach to determine the potential types of land uses that may be most important to provide when planning communities is to examine the expenditure of Australian households. Guidance on such expenditure is found in the Australian Bureau of Statistics (ABS) latest "Household Expenditure Survey Australia: Summary of Results, 2009-10". This major survey of spending characteristics revealed that half the money that Australian households spend on goods and services goes on housing, food and transport.

The Household Expenditure Survey showed the average Australian household spent $1,236 per week on goods and services in 2009–10. The level of weekly expenditure varied across states and territories. Households in the Australian Capital Territory ($1,536) and the Northern Territory ($1,500) recorded the highest average weekly expenditures. The lowest average weekly expenditures were in South Australia ($1,044) and Tasmania ($1,064). The average weekly expenditure of households located in capital cities was $1,310, compared with $1,107 in areas outside of capital cities.

Couple family households with dependent children had much higher average weekly expenditure on goods and services ($1,748) than the national average. Households which were lone persons aged 65 years or over ($446), had much lower weekly expenditure on average.

Table 1 shows the average weekly spend by life stage (age) for Australian households. The table shows that 'food and drink' and 'recreation' are the two categories (aside from 'housing' and 'transport') with the highest level of expenditure. Collectively the 'food and drink' and 'recreation' categories are responsible for around a quarter of the average weekly spend across all 'life stages' reported by the ABS (varying from a low of 24% for '*lone person aged under 35*' to 30% for '*couple with kids – eldest child between 14-24*'). This supports the findings in the literature that grocery stores, supermarkets and food outlets (e.g. cafes and restaurants), and recreational facilities/destinations are likely to be key land uses to promote active travel.

Table 1: Australian Average Weekly Spend by Life Stage

	Lone person aged under 35	Couple only (reference person aged under 35)	Couple with kids (eldest child under 5)	Couple with kids (eldest child between 5-14)	Couple with kids (eldest child between 14-24)
Housing	$278	$360	$364	$325	$242
Fuel & power	$20	$26	$28	$43	$48
Food & drink	$104	$207	$224	$279	$314
Clothing & footwear	$23	$52	$54	$64	$82
Medical & health expenses	$24	$58	$67	$77	$104
Alcohol	$24	$41	$26	$31	$35
Transport	$142	$224	$220	$254	$332
Recreation	$106	$182	$132	$208	$253
TOTAL	**$869**	**$1,429**	**$1,484**	**$1,670**	**$1,900**

Source: https://www.moneysmart.gov.au/managing-your-money/budgeting/spending/australian-spending-habits

WHAT MATTERS MOST?

The literature review has identified that the following are the most important land use types in terms of their potential contribution to active travel on a daily basis (when located within walking and cycling distance of homes):

- Grocery stores or supermarkets
- Open space
- Child care
- Cafes/restaurants
- General retail
- Personal care establishments
- Primary school
- Secondary school

6.8. DISTANCES TO DESTINATIONS

There is surprisingly little research on how far people are willing to walk for transport, with much policy work based on rules of thumb such as 400 (quarter mile) or 800 (half mile) metres that are not grounded in empirical work (Alshalalfah & Shalaby, 2007; Iacono, Krizek & El-Geneidy). Much of the research that has been done into walking distance has focused on walking distance to public transport stops as part of a larger multi-modal journey (Upchurch et al., 2004; Zhao et al., 2003). These studies have shown that as part of the journey to work, commuters are willing to walk further than the 'rules of thumb' used for urban and transport planning in many North American cities (Alshalalfah & Shalaby, 2007).

Knuiman et al. (2011) examined the influence of the spatial geography chosen for GIS studies which measured the relationship between the built environment and walking in Perth. They found that assessing the built environment at a 15 minute walk level was more predictive than using the administrative boundaries of suburbs or census collection districts.

Establishing appropriate walking distances across population groups can be challenging. In research with participants aged over 55 years, Michael et al. (2006) found a wide range in what was considered walking distance for access to local services. Some of their participants currently walked more than 1 mile (1,600 metres) to access shops and services whereas others said that 3 blocks was too far to be considered walkable.

Larsen et al. (2010) examined how far people walked or cycled for different trip purposes in Montreal, Canada. They found walking distances of up to 3.5 kilometres for work and leisure activities (although most were significantly below this amount), with people on average willing to walk further for work than for leisure, school or shopping activities. Cycling trips were generally less than 5 kilometres for work and 3-5 kilometres for leisure. The results of this study are shown in Table 1 below, which provides mean, median and 85% percentile for each trip purpose.

In a study of residents in Perth, McCormack et al. (2008) found that having the following uses within 400 metres of home was associated with greater levels of walking: convenience store, bus stop, post box, shopping mall, newsagent and train stations. They also found that having the following uses within 1,500 metres was associated with greater levels of walking: schools, convenience stores, shopping mall, newsagents and train stations.

Handy & Clifton (2001) found that the average number of food shopping trips within 30 days was 15.2. Residents made the majority of these trips by foot if they lived within a quarter mile (400m) of a store. Rates of walking for quarter mile to half mile and half mile to three quarters of a mile were similar, being under half the rate of trips for closer residents. Walking rates dropped further for three quarters of a mile to one mile, where only an average 1.1 trip per month was made on foot.

Walking distances may also be influenced by cultural preferences. In a study which compared walking in Adelaide with a Japanese neighbourhood, Sugiyama et al. (2015) found that walking rates were associated with the number of destinations within a 10 minute walk in Adelaide. However, in their Japanese city walking rates were associated with the number of destinations within a 6-20 minute walk. Interestingly, the Japanese results are closer to the results of the study in Perth by McCormack et al. (2008), who found that walking for transport was associated with the number of destination types within 400 metres and 1500 metres.

A recent study in Denmark (Heyman and Stahle 2013) concluded that considering all factors that influence pedestrian movements, it can generally be said that people are willing to walk about 400 to 500 metres for simple errands or attractions, such as food shopping, personal care and recreation and entertainment. For other errands or attractions (e.g. work trips), most people are willing to walk about three kilometers and bike around 5 kilometres. Importantly, the larger the cities the longer the distance people are willing to walk and bike.

A 2016 study by VicHealth (Planning and designing healthy new communities: Selandra Rise – Research highlights) identified that to encourage engagement in outdoor physical activity, open space would be provided 300 metres from all dwellings. In addition, a footpath layout to encourage walking or riding to local shops, kindergartens and schools would be critical to promote active transport.

WHAT MATTERS MOST?

There is surprisingly little research on how far people are willing to walk (and bike) for transport, with much policy work based on rules of thumb such as 400 (quarter mile) or 800 (half mile) metres that are not grounded in empirical work. Much of the research that has been done into walking distance has focused on walking distance to public transport stops as part of a larger multi-modal journey. However, the literature review allowed the identification of thresholds for the willingness of people to walk to different destinations, as follows:

- A grocery store or supermarket – 500 metres
- Open space – 1 kilometre
- Child care – 1 kilometre
- Cafes/restaurants, general retail and personal care establishments – 1 kilometre
- Primary school – 1.5 kilometres
- Secondary school – 2 kilometres

6.9. PARKING

A large number of studies undertaken over the last few decades have analysed the impact of parking supply at destinations (in urban centres and commercial areas) on car use and (more generally) travel mode share. However, only a limited number of empirical studies have rigorously analysed the impact of residential parking supply in suburban communities and growth areas on travel behaviour. Some studies have found that parking supply has little or no effect on vehicle ownership and use, while others have found that lower levels of parking supply are correlated with lower levels of vehicle use and higher share for active and public transport modes.

Two recent studies in the New York City region have examined this issue and provide useful guidance in terms of potential parking management strategies that may be implemented to promote active transport. Guo 2013a investigated the effect of home parking convenience on households' car usage, and the implications to residential parking policies. The study included a random sample of 840 households selected from a travel survey in the New York City region The study found that, with the same car ownership level, households without off-street parking adjacent to the home used cars significantly less, and relied more on alternative modes (e.g. active modes and public transport) than those with off-street parking. For households with access to both off-street and on-street parking, those who use off-street parking tend to make more car trips than those who do not. In general, convenient home parking encourages households' car usage.

Guo 2013b investigated the impact of residential parking supply on private car ownership, in order to evaluate the potential for residential parking regulations to be used as demand management strategies to influence travel behaviour. This study analyzed 770 households randomly selected from a household travel survey in the New York City region, and measured off-street parking supply and on-street parking availability. The results from the study showed that parking supply can significantly determine household car ownership decisions, even after controlling for the intrinsic interrelationship between the two. The influence of parking supply was found to be higher than household income and other demographic characteristics that are often assumed as the dominant determinants of car ownership.

A recent study in the city of Lisbon in Portugal examined the effect that parking has in terms of neighbourhood accessibility indicators for local services such as pharmacies, groceries, bakeries and primary schools (Vaconcelos and Farias 2015). The study analysed travel behaviour in two neighbourhoods in Lisbon with different charcateristics with respect to urban planning and parking management: a historical neighborhood in Lisbon, with characteristics of a small village inside the city and a high parking pressure, and a new urban area with a car-oriented development and a low parking pressure. The analysis considered only local trips inside the neighbourhood, since they are more predominant and the most influenced by parking pressure.

The comparison between these two neighbourhoods, with very distinct characteristics regarding parking demand and policies, showed that areas with low parking pressure (at the destination) have higher car use than those with higher parking pressures (at the destination), which exhibited higher levels of active transport. Time spent searching for parking was identified as one of the key aspects that deterred people from driving in areas with limited parking supply for local destinations.

A 2017 study in Norway examined the relationship between parking availability (at both the destination and at home) and car ownership and use (Christiansen et al. 2017). This study used data from the 2013/14 Norwegian National Travel Survey and geographical context data to analyse the impact of parking availability at home and at destinations on car use, while controlling for different urban contexts like housing and job density, and population density.

The analysis examined three different aspects: car use and availability of workplace parking; home parking accessibility and car use; and the combined effect of parking at trip start and the trip end on car use. The study found that reduced access to free workplace parking was the most effective way of reducing car use for work trips. Limited access to parking at home was also identified as strogly linked with car use – the decision to drive decreases with increasing walking distance to parking, especially in relatively dense areas. The study concluded that restricted parking both at home and at the trip destination result in significantly lower levels of car use than those experienced in areas with unrestrained (and generally free) availability of parking. Active transport levels were also found to be higher in areas with parking limitations both at home and the destination, when compared to areas with no parking limitations.

WHAT MATTERS MOST?

Some studies have found that parking supply has little or no effect on vehicle ownership and use, while others have found that lower levels of parking supply are correlated with lower levels of vehicle use and higher share for active and public transport modes. Recent studies provide useful guidance in terms of potential parking management strategies that may be implemented to promote active transport. The most relevant findings include:

- Convenient home parking encourages households' car usage
- Parking supply (number and location) can significantly determine household car ownership decisions
- Areas with low parking pressure (at the destination) have higher car use than those with higher parking pressures (at the destination); the latter exhibit higher levels of active transport
- Time spent searching for parking is one of the key aspects that deters people from driving in areas with limited parking supply for local destinations
- Restricted parking both at home and at the trip destination result in significantly lower levels of car use than those experienced in areas with unrestrained (and generally free) availability of parking
- Active transport levels are higher in areas with parking limitations both at home and the destination, when compared to areas with no parking limitations

6.10. SHARED MOBILITY

Carsharing services began to emerge in the 1980s in Europe and are now prevalent in many cities in Europe, the United States, Canada, New Zealand, Australia and many other countries around the world. Operation and usage of the services were motivated by a mixture of pragmatic reasons such as cost reductions for car use and idealistic reasons such as reducing the environmental effects of travel behaviour (Shaheen et al. 2009). Despite well-documented individual and societal advantages, as well as governmental support (in terms of parking and other 'concessions'), carsharing remains a niche product.

A number of studies indicate that car sharing members use public transport, walk and bicycle at higher rates than the general population. As an alternative to car ownership, car sharing imposes scheduling and accessibility constraints that encourage walking. However, the main aspect that has been identified in the literature as promoting walking is the fact that members pay the full incremental cost when they use car sharing, with itemised bills describing each trip. Walking primarily, and to a lesser extent public transport and cycling are thus encouraged by car sharing membership. Overall, travel indicators showed that carsharing members used active modes and public transport more than the average member of the population.

Numerous studies have investigated travel patterns of station-based car-sharing members, but only a few concentrate on answering question regarding the overall travel patterns of car-sharing members. Overall, carsharing users show different travel behaviour than non-users and the general population: Carsharing members mainly use public transport and private cars are used less frequently (Kopp et al. 2015). Carsharing users have a more sustainable mobility behaviour compared to the general population: own fewer cars per person in their households, use public transport more and have a higher share of multimodal persons. Several studies have determined that one shared vehicle replaces 3–13 private cars, while others have shown a decrease in the frequency of private car use after becoming a car-sharing member (Kopp et al. 2015).

Overall, car trip frequency decreases after joining a carsharing scheme (Pesch 1996; Muheim 1998; Meijkamp 1998; Koss 2002; Cervero and Tsai 2004). This reduction in driving frequency also leads to a decrease in the distance travelled by car (and person), with savings of 40-80%. The use of car-sharing is also associated with a shift of trips to public transport, cycling and walking in a number of studies (Muheim1998; Perner et al. 2000; Haefeli et al. 2006; Shaheen et al. 2009).

In a study of CarSharing Portland in 2000, car sharing members reported a 14% increase in public transit trips, a 10% increase in bicycling trips, and a 26% increase in walking trips since becoming members. The 2000 Portland study also found that members used walking for almost 37% of all trips, compared to using a private or shared automobile for about 32% of all trips. Further, for six of the ten types of trips evaluated in the study (representative of most routine trips), walking had the largest mode share. In a survey of Portland Flexcar members conducted in 2003, 29% of members reported that they walk more often than they did before joining Flexcar. Members also reported that they were somewhat more willing to walk in inclement weather and walk longer distances (for all trip types) after joining Flexcar.

A recent study of free-floating carsharing (whereby – as opposed to station-based systems like Flexicar – users are not required to return the vehicle to its 'pod' but can drop it off 'anywhere' within an approved area) showed higher trip frequency for members and differences in mode choice pattern (Kopp et al. 2015). Free-floaring carsharing members are more intermodal and multimodal in their behaviour. In addition, they exhibit higher shares of cycling and significantly lower shares of car use (in terms of overall number of kilometres travelled compared to non-members).

WHAT MATTERS MOST?

In terms of those aspects of shared mobility that are of most relevance to this project, the literature review has identified the following:

- Car sharing members use public transport, walk and bicycle at higher rates than the general population
- The main aspect that promotes active travel and public transport use is the fact that members pay the full incremental cost when they use car sharing
- Car trip frequency decreases after joining a carsharing scheme
- The reduction in driving frequency also leads to a decrease in the distance travelled by car, with savings of 40-80%

6.11. ACTIVE TRAVEL AND SCHOOLS

VicHealth in 2015 commissioned La Trobe University and the Parenting Research Centre to undertake a research study which included:

- Focus groups with 132 children aged eight to 15 years and 12 parents, to explore their perceptions of independent mobility and the process of becoming independently mobile.
- A survey of more than 2000 parents of children aged nine to 15 from across Victoria, to determine the factors associated with children's independent mobility and parental fear.
- Expert workshops with 47 professionals from a broad range of sectors, to inform the development of evidence-based recommendations for promoting the independent mobility of Victorian primary and secondary school-aged children.

The study was published as "Parental fear: a barrier to the independent mobility of children". The research aimed to develop recommendations and strategies to promote the independent mobility of Victorian children aged nine to 15 years (in partnership with community, government and non-government stakeholders). Workshop group discussions with professionals from a broad range of sectors, including local government, sport and recreation, health, research, urban planning and parent advocacy, informed recommendations across several areas. Those recommendations targeted at policy-makers, state government, local government and urban planners were the following:

- Encourage urban planning that facilitates walking and cycling to local destinations.
- Coordinate state and local planning to develop and maintain high walkability as a shared goal.
- Conduct cost-benefit analyses to compare the cost of upgrading or maintaining safe and accessible walking and cycling spaces, with the alternative cost of an inactive population.
- Increase access to quality green spaces for children to gather and play, and enable unstructured contact with nature through parks, playgrounds, paths and green corridors.
- Use wayfinding and footpath decals to highlight safe routes to local places and spaces.
- Promote and encourage both children and adults to walk to places within neighbourhoods, to have more people being out and about on the streets, and support an improved perception of safety.
- Encourage the safe use of streets for play (e.g. pop up street closures, street parties and meet your neighbour days).
- Engage parents and children in the planning and design of places and spaces, so that perceptions of safety and preferred safe routes to key local destinations such as local schools, parks and libraries are incorporated.
- Map and evaluate current community-wide and school-based programs promoting children's active travel, physical activity and mobility, to support coordination of these initiatives implemented within local councils.
- Consider how existing policies and legislation influence children's independent mobility, active travel behaviour and physical activity levels. In particular, consider those having a risk aversion approach, such as legal implications for parents who allow their children to be independently mobile, compared to an enabling approach.
- Develop and provide evidence-based tools to support parents to make judgements about when their child is ready for staged transition from dependent to independent mobility.

The evidence shows that parents' were more likely to let their children travel and play independently when:

- They valued independent travel and play;
- They felt competent to support their child's independence;
- They perceived less social disapproval from friends, family members, or the school;
- They lived in communities where people knew each-other;
- There were fewer traffic and pedestrian hazards, and more children and adults walking; and
- They had less fear and worry about their child's safety

Participants emphasised the importance of children engaging in non-structured and creative play in their neighbourhoods for overall health, as well as highly structured and supervised school-based activities. They highlighted that children enjoy contact with nature and the social side of independent play, so opportunities for unstructured play are important. Participants could not identify any current programs that aimed to specifically address or promote children's independent mobility more broadly than just active transport to school, such as travel to destinations other than school, or free play.

Other research that focuses exclusively on active travel to schools identified that mode choice for journeys to school is considered to be based on different factors than those influencing other trip purposes (Ewing et al., 2004). Distance from school is a key influence of walking rates (Ewing et al., 2004). McMillan (2003) and Schlossberg et al. (2006) found that those within one mile (1600m) of a school were most likely to walk. In a study of middle school children, Schlossberg et al. (2006) found that walking rates for children living less than 1 mile, between 1 mile and 1.5 miles and greater than 1.5 miles from school were 52%, 36% and 4% respectively. Similarly, Christiansen et al. (2014) found that travelling less than 2km to school was associated with greater levels of active transport.

Additional factors such as lack of tree cover close to the school, perceptions of heavy traffic, and lack of footpaths decreased walking rates (Ewing et al., 2004; Timperio et al., 2004; Boarnet et al., 2005). Intersection density increased rates of walking to school (Schlossberg et al., 2006). A 2016 VicHealth study (Equity Focused Health Impact Assessment – Walk to School Program July 2015-March 2016) further stated that "the large expanses of 'nothingness' through which children would have to walk makes walking less appealing: no trees, shade, seats or protection from the weather."

Gallimore et al. (2011) found that the location of the school was critical – if the school was primarily accessible by a busy arterial road, students were deterred from walking due to lack of pedestrian infrastructure and perceptions of lack of safety. They recommended ensuring that routes to schools could be provided on quieter streets. Having a more permeable street network assists with this.

For cycling, distance from school was also important, although cycling rates were consistent up to approximately 2.5 miles (4km) from school (Schlossberg et al., 2006). In a Danish study, 60.7% of school trips between 3-4 km were made by bike (Christiansen et al., 2014). The authors suggested this high rate was due both to cultural differences and differences in physical environment.

In a study of Australian primary schools students, Trapp et. al (2011) found that parents' confidence of their child's cycling ability was most important in cycling rates. In addition, school proximity, street network connectivity and traffic exposure were associated with cycling rates for boys but not for girls. Christiansen et al. (2014) found that having many paths was positively associated with active transport including cycling, and speeding traffic was negatively associated with active travel.

Faulkner et al. (2010) found that parents made utilitarian decisions on how to travel to school with their children, choosing modes that were quickest and easiest. If parking was restricted around schools, parents reported that this influenced their decision to walk with their children to school because it was time competitive. The authors concluded that limited parking or no vehicle zones around schools may be a useful intervention to encourage more active travel.

In addition to influencing walking rates of school children, living close to a school can also influence walking rates for some adults. In their Adelaide study, Cerin et al. (2007) found that for households with children, proximity to schools was related to walking rates for parents.

WHAT MATTERS MOST?

In terms of active travel and schools, the literature review has identified the following as the most important elements that influence mode choice:

- Distance from school is a key influence of walking and cycling rates by students
- Factors that deter walking to school include perceptions of safety, lack of tree cover close to the school, perceptions of heavy traffic and lack of footpaths
- Intersection density increases rates of walking to school
- The location of the school is critical – if the school is primarily accessible by a busy arterial road, students were deterred from walking due to lack of pedestrian infrastructure and perceptions of lack of safety.
- Parking restrictions around schools influence parents' decision to walk with their children to school

6.12. STREET DESIGN AND ROAD SAFETY

Over the past decade, the Safe System approach has adopted in Australia, through the National Road Safety Action Plans and the strategies of individual states and territories. It is consistent with the approaches adopted by the safest countries in the world. There are several guiding principles to this approach:

- People make mistakes. Humans will continue to make mistakes, and the transport system must accommodate these. The transport system should not result in death or serious injury as a consequence of errors on the roads.
- Human physical frailty. There are known physical limits to the amount of force our bodies can take before we are injured.
- A 'forgiving' road transport system. A Safe System ensures that the forces in collisions do not exceed the limits of human tolerance. Speeds must be managed so that humans are not exposed to impact forces beyond their physical tolerance. System designers and operators need to take into account the limits of the human body in designing and maintaining roads, vehicles and speeds.

The risk of death or serious injury to a pedestrian rises rapidly at impact speeds above 30 km/h. Travel speeds of 30 km/h can reduce the risk of fatal injury to a pedestrian by over 80% compared to travel speeds at 50 km/h.

The 2011 Pedestrian Safety, Urban Space and Health report of the International Transport Forum of the OECD identify traffic-calming policies and generalised 30 km/h zones in city centres, residential areas and other high pedestrian activity areas as one of the key recommendations to promote 'sustainable mobility'. The report states that these policies should be based on a functional classification of urban spaces, streets and road networks, supported by appropriate infrastructure design criteria to create low-risk and amenable urban environments for active transport road users.

A recent study examined traffic safety in the context of an integrated and inclusive design of streets, built environments and land use, and communities (Doi et al. 2016). The study analysed the empirical relationships among urban structures, travel speeds and traffic fatalities, and suggested that it would be possible to enhance traffic safety by strictly managing urban density levels and travel speeds.

The study found that the rate of traffic fatalities increased as urban density decreased. The study focused on motor vehicles only and analysed two conditions: the relationship between population distribution and average vehicle travel speed, and the relationship between average travel speed and traffic fatality rate. The study found causal relationships in which the more dispersed a city was, the higher the average vehicle travel speed and the higher the traffic fatality rate. Designing cities and communities to have higher density levels appears to help reduce traffic fatalities by not only encouraging the use of public transport but also, and more importantly, reducing vehicle travel speeds and providing walkable environments where people interact with each other.

OECD AND PEDESTRIAN SAFETY

The International Transport Forum released the "Pedestrian Safety, Urban Space and Health" report in September 2012. This report presents evidence on the important place of walking in transport policies and provides guidelines for developing a safe environment conducive to walking.

The International Transport Forum at the Organisation for Economic Cooperation and Development (OECD) is an intergovernmental organisation with 52 member countries. It acts as a strategic think tank with the objective of helping shape the transport policy agenda on a global level and ensuring that it contributes to economic growth, environmental protection, social inclusion and the preservation of human life and well-being. The International Transport Forum organizes an annual summit of Ministers along with leading representatives from industry, civil society and academia.

The Members of the Forum are: Albania, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Canada, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, FYROM, Georgia, Germany, Greece, Hungary, Iceland, India, Ireland, Italy, Japan, Korea, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Mexico, Moldova, Montenegro, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom and the United States.

The International Transport Forum's Research Centre gathers statistics and conducts cooperative research programmes addressing all modes of transport. Its findings are widely disseminated and support policymaking in Member countries as well as contributing to the annual summit.

The "Pedestrian Safety, Urban Space and Health" report was developed by a group of international experts representing 19 countries, under the aegis of the Research Centre of the International Transport Forum. Several key conclusions and recommendations were made in that report that are of relevance to Geelong's Growth Areas. They include:

- Conclusion: The vitality of a city is closely linked to people being out and about on foot for many purposes. Beyond walking for access to goods and services, these other activities in the urban space are collectively termed "sojourning". Walking and sojourning are at the heart of urban life and contribute to liveable, attractive, prosperous and sustainable cities.
  Narrative – Cities are places to live, connect and socialise. Urban space is for sojourning as well as moving around. Walking is fundamental to human existence and the quality of life.
- Conclusion: Walking is, however, the neglected transport mode and, despite being at the start and end of all trips, is rarely captured in government statistics on mobility and is often neglected in planning and policy development.
  Narrative – The simplest, most sustainable and cheapest means of locomotion has been largely taken for granted – despite the fact that all trips begin or end on foot. Walking is a necessary complement of public transport. However, motorised traffic has generally received priority, exposing pedestrians to crash risks, pollutant emissions and noise. The entire urban environment, including the road transport system, should be designed with greater priority assigned to the needs of pedestrians. The importance of walking as a share of all trips and the willingness of people to walk up to 1-2 kilometres is highlighted in Figure 1 from the OECD report (reproduced as Figure 19 below).

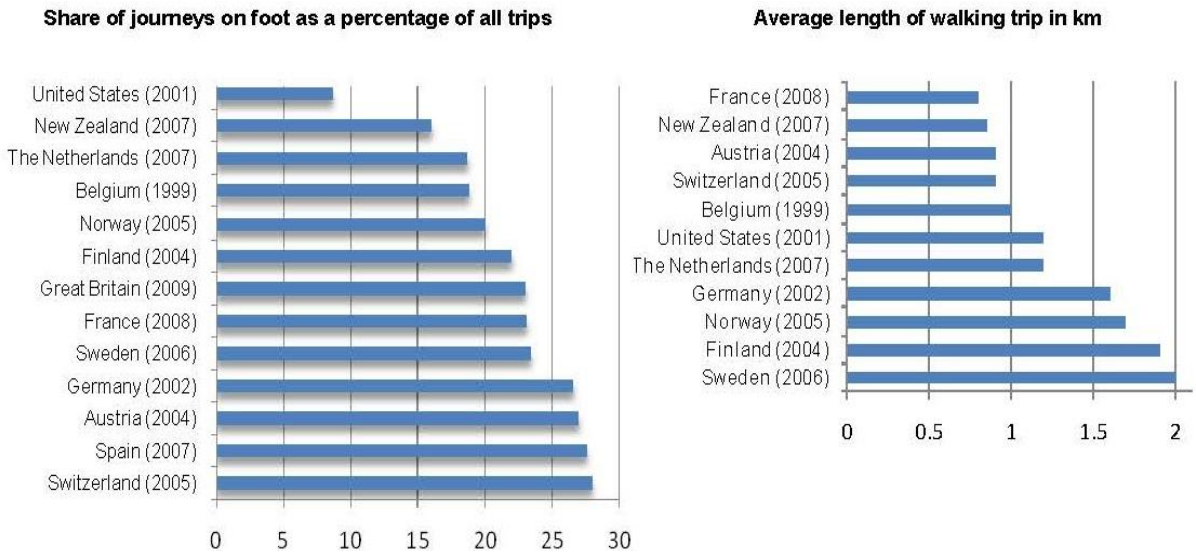


Figure 19: Share of Walking and Average Length of a Walking Tip

- Conclusion: Walking and public transport are interdependent elements of sustainable urban mobility. Walking is facilitated by a well-connected network with pedestrian-friendly infrastructure and well-designed urban space.
  Narrative – Pedestrians should be provided with a well-connected network of footways designed to minimise the effects of geographical, topographical, and physical barriers to pedestrian mobility. This network crucially needs to provide easy access to public transport facilities.
- Conclusion: Pedestrians are amongst the road users most vulnerable to traffic injury. It has become highly challenging, especially for older and young people, to cope with the complex, sometimes hostile, traffic conditions that characterise today's cities and towns.
  Narrative – Pedestrians do not pose a significant risk to other road users, yet are exposed to life-threatening risks. However, they have been overlooked in the development of current traffic codes which have been focussed on facilitating the flow of motorised traffic. Insecurity, whether real or perceived, has a major impact on the decision to walk, especially in relation to children and elderly people. Of particular concern is an observed decline in walking among children, in part motivated by their parents' perceptions that walking is a high-risk activity. At any given time, around 30% of pedestrians have impaired mobility (because they are overloaded, or have temporary or permanent health impairments). Because of the ageing of the population in many countries around the world, public authorities must prepare for a future where a growing number of highly vulnerable people will be even more dependent on walking.
- Conclusion: Lowering motorised traffic speeds reduces the frequency and severity of crashes, especially those involving pedestrians. Reducing speed also contributes to smoother traffic flow, and enhances in many ways the liveability and sustainability of cities.
  Narrative – Pedestrian safety and the survival rate from collisions with vehicles are directly linked to the speed of motorised traffic. (Figure 20 reproduced from Figure 3 of the OECD report) illustrates the total distance required to stop at speeds of 50 km/h and 30 km/h, respectively, taking into account driver reaction time. The risk of death or serious injury to a pedestrian rises rapidly at impact speeds above 30 km/h. Travel speeds of 30 km/h can reduce the risk of fatal injury to a pedestrian by over 80% compared to travel speeds at 50 km/h. Speeds above 30 km/h are too dangerous in mixed traffic zones and cities should not permit speeds of more than 50 km/h on any road designed also to be used by pedestrians. The large majority of pedestrian injuries or fatalities occur in urban areas and, according to police reports, 70-80% of those in traffic collisions occur while crossing the road, including between 33% and 50% at pedestrian crossings.

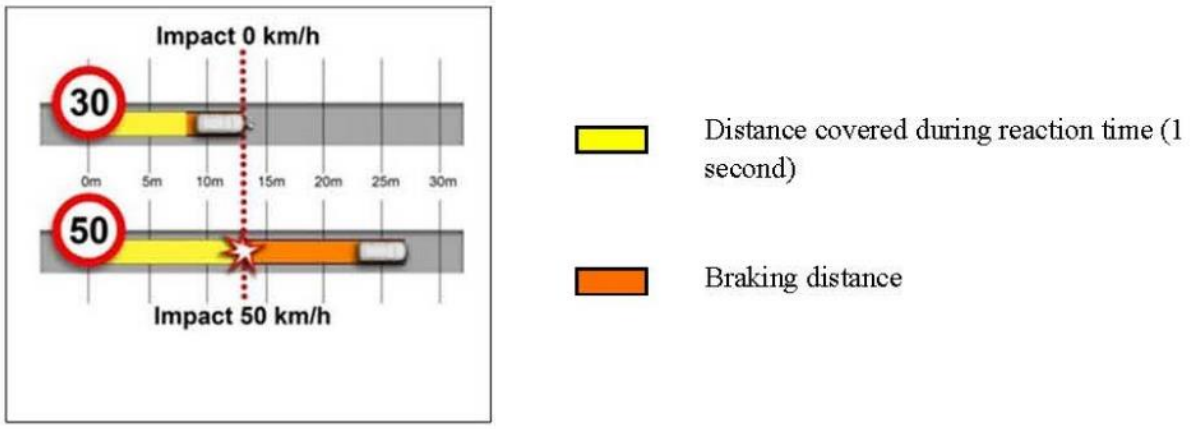


Figure 20: Stopping Distances at 30km/h and 50 km/h

- Conclusion: Motorisation has contributed to urban sprawl, and cities have evolved to accommodate car use, with many negative impacts on life and social cohesion. Changes are required now to manage the preponderant role of motorised traffic in industrialised countries. This is also urgent in low- and middle-income countries, which are now moving rapidly towards much higher levels of motorisation.
  Narrative – Cities are becoming increasingly dependent upon motor-vehicle transport as they expand in ways that contribute to urban sprawl. Planning and design features are required to reduce motor-vehicle use and promote alternative transport modes. The needs of pedestrians should be considered when planning urban environments so that people can easily walk or travel by public transport to and from their chosen destinations. In addition, city planners should aim to develop pedestrian-friendly environments, including footways that are conducive to walking.

The OECD report outlined a series of recommendations, for consideration by governments, designed to help achieve sustainable mobility. The most relevant in the context of the Geelong Growth Areas are:

1. Integrate mobility management and urban planning and take better account of the needs of pedestrians from the earliest stages of urban development projects and transport investments, with the object of creating seamless, high-quality networks for pedestrian activity.
2. Incorporate public transport services as an integrated part of the development of new urban areas and the regeneration of existing areas, through planning guidance and financial support for public services. This can support a long-term shift towards higher density, mixed-use, walking and transit-oriented urban form and a reduction in urban sprawl.
3. Encourage the responsible authorities to give higher priority and more space to non-motorized traffic and public transport in city centres. This includes a number of key actions: providing easy, safe, well-maintained and secure pedestrian access to public transport and to all city centre destinations; development of car-free areas; parking policies to discourage over-use of cars in city centres; and regulations to prevent parking on pavements and crossings, which undermines the quality of walking and, in severe cases, renders it impracticable or dangerous.
4. Develop national pedestrian planning guidance for local administrations. Plans should be required to give consideration to the impact of projects on pedestrians, and cyclists, as part of project appraisals and environmental impact assessments. Plans should also consider the development and setting of targets for future levels of walking, as well as addressing needs for financial support. Public participation through, for example, pedestrian associations should be solicited in developing urban transport plans. Safety should receive specific attention in national planning guidance, with recommendations for implementation at the local authority level.

5. Adopt a safe system approach for the design of the walking environment so that it is organised in such a way that specific risk groups are not exposed to avoidable risks.
6. Implement traffic-calming policies and generalise 30 km/h zones in city centres, residential areas and other high pedestrian activity areas. This should be based on a functional classification of urban spaces, streets and road networks, supported by appropriate infrastructure design criteria to create low-risk and amenable urban environments for non-motorised road users. To be fully effective, best-practice education, communication and enforcement programmes are needed. The development of intelligent speed adaptation systems is also recommended.

SAFER CITY STREETS

Safer City Streets is the global traffic safety network for liveable cities. Safer City Streets helps cities to improve their urban road safety performance by sharing data, experiences and knowledge – by learning from each other. Currently, 34 cities are taking part in Safer City Streets: Aguascalientes, Amsterdam, Astana, Auckland, Barcelona, Belgrade, Berlin, Bogotá, Bordeaux, Brussels, Buenos Aires, Copenhagen, Dublin, Fortaleza, Guadalajara, Kiev, La Paz, Lisbon, London, Lyon, Melbourne, Mexico City, Milan, Montreal, Morelia, Nantes, New York City, Paris, Riga, Rio de Janeiro, Rome, São Paulo, Stockholm, The Hague, Vilnius, Warsaw, Zürich. The network is managed by the International Transport Forum (ITF), which collects and analyses relevant data from cities in a dedicated database.

Safer City Streets builds on a 2013 pilot project with nine cities from Europe and North America that agreed to share data on crashes, population, mobility and traffic. The success of the pilot gave birth to the idea of a worldwide network. Safer City Streets is being developed by the ITF and modelled on the global road safety network of countries hosted by the ITF (known as the International Traffic Safety Data and Analysis Group, or IRTAD), that has run for more than 25 years. The IRTAD Group has been hailed by the World Health Organization as “a model of a multi-country effort” and its crash data as “simply the best in the world” by Global NCAP, the car assessment programme.

Dynamic and liveable cities rely on efficient mobility systems, and road safety plays a large part in this. Every minute, a person dies in city traffic. Millions are killed or injured every year causing great human suffering and significant economic losses. Crashes also nurture a feeling of insecurity. Among people killed on city streets, 8 out of 10 are pedestrians, cyclists and other vulnerable road users. Where active mobility is seen as dangerous, efforts to promote walking and cycling are undermined. Reducing the risks of urban traffic thus not only saves lives. Safer streets encourage sustainable forms of transport and help a city to reduce pollution, cut emissions, fight congestion and have healthier citizens – in short, to make a city more liveable.

SHARED ZONES AS A ROAD SAFETY AND COMMUNITY BUILDING STRATEGY

Enhanced road safety is the starting point for building liveable and sustainable communities. In recent years, there have been an increasing number of efforts to calm traffic via improved road design with compact spaces that aim to change driver behaviour and ultimately reduce their travel speeds. Initiatives hoping to establish the harmonious coexistence of humans and automobiles through reduced speeds are evident in local speed management programs in Australia and overseas. There has also been a worldwide trend toward promoting “walkable cities,” which allow people to walk to places necessary for daily life.

Shared zones are one of the strategies being implemented in many cities in Australia and across the world to promote active transport and road safety outcomes. The case studies reviewed as part of this study demonstrate that shared zone treatments can be applied in a wide range of conditions and that they are not limited to areas with low vehicle traffic volumes. However, despite the abundance of shared zone installations and the continued popularity of such treatments in many countries including parts of Australia, the evidence in support of the effectiveness and safety performance of shared zones is not comprehensive and continues to be developed worldwide.

The basic idea of the shared zones that have been reviewed in this study is that streets that are made to look like social spaces will promote slow, negotiated social behaviour, while streets that look like roads (segregated areas for different users, many signs and markings) will promote travel-focussed 'traffic behaviour'. More specifically, proponents argue that when a space looks unsafe and people/drivers are not sure how to behave, they will slow down and negotiate the space carefully, thus increasing safety. In theory, the uncertainty of the environment influences drivers to slow down to walking pace as they travel through the area. Shared zones, ideally, thus encourage both safer (slower) speeds and safer, more diligent behaviour.

A 2009 study of shared zones in Melbourne and Sydney found that the appearance of the sites had a large effect on their usage: shared zones that looked like typical streets (with long, bitumen surfaces) were treated by both drivers and pedestrians as streets, with pedestrians giving way to vehicles despite the signage. However, in shared zones that looked like pedestrian areas (with narrow lanes or wide squares, paving or stone surface, level kerbs, seating or street furniture very close to or in the middle of the vehicle travel area) the study observed that most vehicle drivers gave way to pedestrians, although there were exceptions. This suggests that the shared zone design concept does indeed change behaviour in the Australian context.

In response to these concerns, urban design, engineering and education responses have been implemented in many places around the world to make it virtually impossible to speed in shared zones. Examples of such design features include horizontal and vertical deflections to the vehicle path at the start, middle and end of a shared space; high-visibility 'gateway' features to suggest entry into a non-standard road space; strict enforcement of no-parking rules (particularly when the space is newly redesigned); and education campaigns to educate all road users of a space about how shared zones work and the new norms of behaviour required.

Because the approach is relatively new, it is not yet known whether the effects on driver behaviour are permanent, or merely a response to a novel environment. It is possible that any effects of a perceived 'riskier' environment will be temporary, and wear out as users become accustomed to the level of risk and uncertainty in the space. In addition, differences in road culture may limit the value of information gathered in Europe, where the concept has been more widely applied, to understand its potential performance in Australia.

Importantly, vulnerable pedestrians such as the elderly, children, vision and mobility-impaired pedestrians may be at greater risk in such environments. In particular, blind and visually impaired pedestrians who are not able to make eye contact with other road users are at an obvious disadvantage if space negotiation in shared zones is truly based on eye contact between road users. Deaf and hearing-impaired pedestrians may also be disadvantaged by the inability to hear vehicles and bicycles approaching from behind. Mobility-impaired and elderly pedestrians may be less able to quickly adapt their course to get out of the way of faster vehicles. The elderly, children and cognitively-impaired individuals may find the lack of clear cues and rules about when to cross the space confusing and difficult to negotiate. These problems may lead to such potential users avoiding the space entirely, thus reducing their overall mobility. To date, these issues have not been studied in depth.

A further concern is whether all road users adapt positively to the new space, or whether some will continue to behave unsafely. Not all drivers follow existing road rules and social norms, as evidenced by continuing crashes caused by disqualified drivers, drink driving, and speeding. Hans Monderman himself acknowledged that road design would not change the behaviour of "the 15 percent of drivers who will behave badly no matter what the rules are" (Lyall, 2005). For example, young, inexperienced drivers may simply be incapable of adequately assessing the risk of a shared space environment and behaving appropriately; it is known that young drivers underestimate risks, overestimate their driving capability (Brown & Groeger, 1988), and fail to adapt their visual scanning and driving behaviour to more complex road environments (Underwood, 2007).

A review of the literature, relevant studies and publications reveals that relatively little has been undertaken to thoroughly monitor and measure the effectiveness of shared zones, particularly the comparison between 'before and after' implementation data as it relates to safety and traffic operation. The limited data available so far suggest that crash rates are not consistently either higher or lower than comparable traditional environments. There is wide variability between sites in both the extent of the application of shared zone principles, and the effect of the reconstruction on crash rates.

Many of the crash evaluations suffer from problems such as limited data collection times, the lack of a comparison site or control data to account for wider trends, failure to collect exposure data, and failure to collect injury data for collisions not involving vehicles (such as pedestrian-cyclist collisions, single-cyclist and pedestrian fall incidents). There is also little data on the number of pedestrians and cyclists (and in some cases, vehicles) using the sites before and after redesign; changes in exposure of these road users could account for changes in crash rates per year. Importantly, crash data typically only includes incidents involving motor vehicles. Thus, if shared zones resulted in an increase in collisions between pedestrians and cyclists, crash data would not necessarily note this. Likewise, injury data is generally not available for injuries from non-vehicle incidents such as pedestrians and cyclists slipping on tactile guidance strips (which replace kerbs in many shared zone implementations), falling after stopping suddenly to avoid another road user, or colliding with unexpectedly placed street furniture. Hospital admissions data are more likely to give a true picture of safety for pedestrians and cyclists in shared zones. However, this information may not be available in all jurisdictions, and was not included in any of the shared zone reviews evaluated as part of this study.

Overall, crash evaluations have shown mixed results, with some projects seeming to improve safety, some seeming to worsen safety, and most showing no difference due to low numbers of (casualty) crashes both before and after redesign. Most of the crash evaluations that have been done were not well controlled, and suffer from problems such as insufficient time periods, lack of comparison sites and lack of exposure data leading to unreliable results. The evidence currently available, in terms of both crashes and road user behaviour, is not adequate to scientifically determine whether shared zones are truly a safety improvement, a safety risk, or have little effect on safety.

Notwithstanding the scarcity of strong published evidentiary data with respect to the safety implications of shared zones, authorities and road agencies around the world have continued to pursue such treatments (where site conditions and the surrounding environment have provided a favourable context for implementation of the shared zones).

It is therefore reasonable to conclude that while published data on the safety performance of shared zones is somewhat scarce, the involvement of road agencies in setting guidelines, standards and criteria for shared zone installations (across multiple jurisdictions worldwide) would indicate that a judicious process has been followed by these agencies through their own internal review of shared zone treatments. Moreover, the ongoing expansion of such treatments, in a diversity of environments, reflects that agencies are increasingly comfortable with adoption of shared zone treatments and/or have conducted sufficient due diligence to satisfy themselves of the merits and safety performance of such schemes.

WHAT MATTERS MOST?

In terms of those aspects of street design and road safety that are of most relevance to this project, the literature review has identified the following:

- Pedestrians and cyclists are the most vulnerable road users
- The risk of death or serious injury to a pedestrian rises rapidly at impact speeds above 30 km/h
- Lowering motorised traffic speeds reduces the frequency and severity of crashes, especially those involving pedestrians and cyclists
- Travel speeds of 30 km/h can reduce the risk of fatal injury to a pedestrian by over 80% compared to travel speeds at 50 km/h
- The rate of traffic fatalities increases as urban density decreases
- It has become highly challenging, especially for older and young people, to cope with the complex, sometimes hostile, traffic conditions that characterise today's cities and towns
- Motorisation has contributed to urban sprawl, and cities have evolved to accommodate car use, with many negative impacts on life and social cohesion
- Reducing vehicle speeds contributes to smoother traffic flow, and enhances in many ways the liveability and sustainability of cities
- Traffic calming strategies create safer streets and promote walking and cycling
- Shared zones can be an effective road safety and community building strategy

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8. APPENDIX A – "PLANNING AND DESIGNING HEALTHY NEW COMMUNITIES: SELANDRA RISE"