MEASURING ACCESSIBILITY AND PROVIDING TRANSPORT CHOICE

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ABSTRACT:

The Melbourne Sunday Age recently published a topical article about car culture. The article notes *"Poor design and weak guidelines governing new suburbs in outer Melbourne are increasing car reliance, with residents forced to drive to local facilities"*. It is the issue of 'forced', meaning not providing transport choice, which is the focus of this technical paper.

Accessibility and access are key terms used in two objectives of the Australian Transport Council Vision which is *"Australia requires a safe, secure, efficient, reliable and integrated national transport system that supports and enhances our nations economic development and social and environmental well-beings"*. Similarly, the New Zealand Transport Strategy requires transport and land use to be better integrated and includes targets for improving both access and mobility. Together with the spatial distribution of land uses these form the key components of 'Accessibility'.

Clearly Australia and New Zealand support the concept of improving accessibility. The first step then is to develop a means to measure accessibility. Once a measurement methodology has been developed, it can be applied to an area to measure the accessibility from points to various land use activities by any mode or combination of modes. It can then be used to guide decision making and provide targeted investment to improve accessibility for specific transport users, modes or areas including providing transport choice.

As part of a research project for the New Zealand Transport Agency, Abley Transportation Consultants has developed a methodology to calculate the accessibility score for a district, city, town, suburb or neighbourhood. This methodology has been tested in Christchurch City and Gisborne District where accessibility has been mapped and the quality of accessibility identified. This has proved successful in Gisborne when combined with geodemographic data where it has allowed the identification of targeted users such as those without access to a private motor vehicle and poor public transport accessibility. Similarly in Christchurch City it has also proved successful to test changes in accessibility due to certain infrastructure provision. These projects prove there is a mechanism to optimise the decision making process and locate land use activities or transportation infrastructure where it provides the most benefit for all members of the community.

This presentation will interest those involved in the integration of land use and transportation network planning in both Australia and New Zealand. It will be of special interest to those involved with local government and setting targets for the level of land use integration, and hence accessibility planning.

NOTE: This technical paper is generally unchanged from that presented to the Australian Institute of Traffic Planning and Management (AITPM) National Conference at the Hilton Brisbane, Brisbane Australia from the 21 to 23 July 2010.

1 INTRODUCTION

As cities grow and develop over time, changes take place which impact the accessibility to various services and activities for the population living within and around our cities. The Melbourne Sunday Age recently published an article[1] about car culture. The article notes *"Poor design and weak guidelines governing new suburbs in outer Melbourne are increasing car reliance, with residents forced to drive to local facilities"*. It is the issue of being 'forced' to use only the private motor vehicle that is the focus of this technical paper. As transport professionals we wish to provide transport choice and a transport system that is resilient[2] for the communities we are supporting.

Land use changes such as the establishment of shopping mega-centres, which provide cheaper prices and a wider range of goods have precipitated the demise of the local store. These mega-centres provide a greater level (and range) of services, but conglomeration of many shops in one place means there are fewer of these locations and they are often more sparsely located. Overall this has the potential to increase travel distances and these increased distances can potentially reduce accessibility. The secondary effect of increased distance is potential lower accessibility for the most disadvantaged members of the community. This has the possibly of magnifying inequalities in the transport system

Urban sprawl also typically increases the distances people need to travel and therefore increases travel times. Some cities have addressed urban sprawl through the provision of high speed arterial roads and motorways, but this cements a reliance on the private motor vehicle and results in an increased dependence on oil, increased air pollution and other negative environmental impacts. It can also increase inequality in accessibility because it does not provide for all people in the community, especially those that do not have access to a private motor vehicle. So has accessibility improved?

Questions planners often ask is how has accessibility changed, how much is required, and how can accessibility be measured to test the usefulness of certain policies to improve the long term sustainability and liveability of a city? First things first then, 'what is accessibility?'

2. BACKGROUND

2.1 Defining Accessibility

Accessibility is defined as the ability or ease with which activities, either economic or social, can be reached or accessed. Therefore, an accessibility assessment is the measurement of how easy it is for an individual to reach a desired activity, based on a set of measurable factors.

Accessibility is concerned with both the land use and the transport system, and provides an integrated way of assessing changes in one or the other or both. One of the earliest definitions is *"Accessibility is a measurement of the spatial distribution of activities about a point, adjusted for the ability and the desire of people or firms to overcome spatial separation."*[3]

Accessibility includes three components: 'access', 'opportunity' and 'mobility'. These are described as:

> 'Access' represents the ability to use the transportation network. For example a bus with a low floor enables mobility impaired people ease of boarding and access to the public transport network. Similarly being licensed to drive and having access to a vehicle enables people to use the road network.

[1] http://www.theage.com.au/victoria/new-suburbs-forced-to-adopt-car-culture-20100320-qnag.html

[2] http://www.merriam-webster.com/dictionary/resilient *"a: capable of withstanding shock without permanent deformation or rupture b: tending to recover from or adjust easily to misfortune or change"*

[3] Hansen, W.G. (1959) How Accessibility Shapes Land Use. Journal of the American Institute of Planners Volume 25 Pages 73-76.

'Opportunity' represents the availability of a land use activity or service. For example the presence of a supermarket provides an opportunity for shopping, and a school or college provides opportunity for education.

'Mobility' represents the quality of moving through the various transportation networks. For example congestion on a highway often represents the level of mobility for vehicles. The amount of delay when crossing the street often represents the level of mobility for pedestrians. Expressions such as 'level of service', 'average network speed' and 'operating capacities' are terms commonly used to describe mobility.

It is this last term 'mobility' that people will be the most familiar, especially from the perspective of motorised vehicles. A significant amount of study has been undertaken in the area of mobility and mobility continues to remain a major area of research. Unfortunately mobility is often the only way that the quality of the transportation system can be measured as accessibility is generally ill-defined. As a result, the interaction between access, opportunity and mobility within our districts, cities, towns, suburbs and neighbourhoods is often not well understood.

2.2 Accessibility and Traditional Transport Modelling

Traditionally, transport modelling considers how many people 'would' choose a particular motorised transport mode based on existing behaviour. Mathematical models are derived to anticipate and forecast the required changes in the transport network when supply and demand changes. Unsurprisingly, often these models result in adding capacity to roads to enable more efficient travel because they are based around measuring mobility (i.e. the 'would').

However, the analysis of what people 'would' do does not recognise other travel options that may be only slightly less economically efficient, or are currently not provided, so they are not utilised. Additionally, measuring the 'would' does not take account of how many people 'can not'. Accessibility planning acknowledges the opportunity rather than just the ease of moving through the transport network. Accessibility measures what people 'could' do.

Accessibility modelling can include all modes of transport and is closely linked to demographic data. It does not replace traditional transport modelling but is complementary. It is best used as a precursor to or with traditional modelling and as an input to the decision making process.

Measuring accessibility not only provides a more realistic representation of the transportation world (including those that may be transport disadvantaged); but accessibility also provides a better measure when considering the long term sustainability of the transportation network. This is because unlike traditional transportation modelling that typically only models mobility using one or maybe two modes of transport (such as motorised vehicles and public transport), accessibility modelling evaluates all modes. This includes the traditional modes of transport as well as and more sustainable modes of transport such as public transport, walking and cycling. Accessibility modelling also includes the various interchanges between these modes such as walk-public transport-walk, car-walk, cycle-public transport-cycle-walk and so on.

2.3 Accessibility in Australia and New Zealand Policy

There are no supporting frameworks for measuring accessibility in Australia or New Zealand although both countries are very supportive of improving accessibility at the national level.

Improving 'access and mobility' is one of five transport objectives in the New Zealand Transport Strategy[4] (NZTS). The strategy states:

> *"There are formidable challenges facing the transport sector. It needs to find affordable ways to support the economic transformation of New Zealand and improve the health, safety, security and accessibility of New Zealanders, while at the same time addressing climate change and other environmental impacts. Business as usual will not lead us to where we want to be in 2040."* [emphasis added]
> [Summary, page 4]

[4] http://www.transport.govt.nz/ourwork/KeyStrategies/new-zealand-transport-strategy/

It is this explicit acknowledgement that improvement will not be provided by 'business as usual' that is important. Therefore, change is required and replicating past processes will not provide the transport system our leaders or communities are demanding us to provide.

The New Zealand Government Policy Statement on Land Transport Funding 2009/10 – 2018/19[5] (GPS) is also explicit on the need to improve accessibility. The GPS states that accessibility is an important transport activity[6] and:

> *"Tools such as accessibility planning will assist in the future with identifying the best solutions to transport problems in this area."* [emphasis added]
> [Accessibility, page 14, paragraph 72]

The organisation tasked with implementing the NZTS and GPS is the New Zealand Transport Agency (NZTA). The NZTA Statement of Intent 2009-2012[7] includes providing an outcome for 'improved transport access' and states:

> *"Good accessibility is achieved through good integration between different networks and between modes of transport, good access to transport services, and services that are accessible for everyone in society, including young people, older people and people with impairments."* [emphasis added] [Page 18, paragraph 1]

…they go on and say…

> *"A high level of personal mobility is an important feature of modern societies and very much taken for granted. We assist personal mobility by investing in new and improved transport networks. However, we are also concerned about transport accessibility, the ability or ease with which, either social or economic opportunities, can be reached or utilised.* [emphasis added] [Page 19, paragraph 1]
>
> *We remain actively engaged in addressing accessibility through a 'whole of journey' approach and through considering the needs of everyone in society.* [emphasis added] [Page 19, paragraph 2]

Australia too has very strong support for improving accessibility. The Australian Transport Council provides the most guidance on the importance of accessibility measurement[8].

The recent Australian Government, Infrastructure Australia, Major Cities Unit says in their 'State of Australian Cities 2010'[9] that:

> *"Over the past half-century, Australian cities have been designed primarily to provide accessibility by road. Accessibility for people without access to a motor vehicle can be limited unless supported by good public transport. In the 2006 General social survey, adults in the youngest age group (18 to 24 year olds) and the older age groups (75 years and over) were the least likely to have access to motor vehicles and more likely to experience difficulty getting to places they needed to go (ABS 2007b)."*
> [emphasis added] [Chapter 7, page 117, paragraph 2]

…they go on and say…

> *"There are considerable spatial variations in living affordability based on cost of housing and the availability of transport alternatives to the private motor vehicle and the accessibility of places to the range of facilities and services within cities."*
> [emphasis added] [Chapter 6, page 107, paragraph 1]

..and conclude with…

> *"The design of urban environments can contribute to the health and wellbeing of communities by supporting active living, active and passive recreation opportunities, public transport and social connectivity."* [Executive Summary, page 4, paragraph 2]

[5] http://www.transport.govt.nz/ourwork/KeyStrategies/GPSonLandTransportFunding/

[6] New Zealand Government Policy Statement on Land Transport Funding 2009/10 – 2018/19 – Page 13, paragraph 68.

[7] http://www.nzta.govt.nz/resources/statement-of-intent/index.html

[8] National Guidelines for Transport System Management in Australia, 5 Background Material http://www.atcouncil.gov.au/documents/pubs/National_Guidelines_Volume_5.pdf

[9] http://www.infrastructureaustralia.gov.au/files/MCU_SOAC.pdf]

It is the issue of identifying the spatial variation of accessibility and then designing better urban environments that is, in the option of the author, the key to being able to provide more accessible environments.

Accessibility planning is generally undertaken at two levels. The higher level includes accessibility planning at a national or large spatial scale where transport policy can be measured over a number of smaller implementation levels. The lower level includes accessibility planning for a small city, suburb or neighbourhood. Typically, higher level assessments are undertaken by central government, and lower level assessments are undertaken by regional or local government.

Accessibility planning takes a cross-sector perspective of policy and indicator development. Central government, local and regional councils and the private sector must all be involved. The role of the private sector in accessibility analysis should not be underestimated. Retailers, developers and other private companies have been major users of road based accessibility analysis for many years. Understanding the socio demographic characteristics of the catchments of a location is often critical to a commercial activity's viability. Public authorities can use the same techniques with the focus on policy sensitive user groups and with a greater interest in public transport than private companies would typically consider.

Accessibility policy can be thought of as the 'should', in other words, setting the direction between the 'could' (or can not) and the 'would'.

2.4 Previous Attempts to Measure Accessibility

Probably the most internationally well known accessibility measure for transport professionals is the UK Public Transport Accessibility Levels (PTAL). The Transport for London[10] (TfL) Transport assessment best practice guidance document states:

> *"Public Transport Accessibility Levels (PTALs) are a detailed and accurate measure of the accessibility of a point to the public transport network, taking into account walk access time and service availability. The method is essentially a way of measuring the density of the public transport network at a particular point, (called the Point of Interest).* [Appendix B, page 88, paragraph 1]
>
> *The current methodology was developed in 1992, by the London Borough of Hammersmith and Fulham. The model has been thoroughly reviewed and tested, and has been agreed by the London Borough-led PTAL development group as the most appropriate for use across London."* [Appendix B, page 88, paragraph 2]

Alternative methodologies to assess accessibility to the public transport network are limited. Consequently PTAL has also been used extensively outside London. It has also been applied further than just testing the existing public transport network including:

- Providing information for car parking restraint, where high PTAL values are used to vary maximum parking standards.
- Providing residential development densities, where PTAL values are used to guide neighbourhood design.

The extensive use of the PTAL methodology is encouraging but it is well known the methodology has faults. TfL identify that PTAL does not include all the quality measures associated with the supply of services but more importantly, strategically PTAL does not consider where people intend to travel. This is the major failing of the methodology, i.e. it only tests the supply side of the equation. Others have proposed different public transport accessibility methodologies such as Public Transport Relative Accessibility Percentage (PTRAP)[11]. PTRAP is an intermediate step towards full accessibility modelling including using population as a proxy for demand i.e. it attempts to utilise both sides of the supply and demand equation.

[10] Transport for London is a statutory body created by the Greater London Authority Act 1999. S. 141 (1) of the act gives the Mayor of London a general duty to develop and implement policies to promote and encourage safe, integrated, efficient and economic transport facilities and services to, from and within London.

[11] Gent C, Symonds G, Capita Symonds Limited, "Advances In Public Transport Accessibility Assessments for Development Control – A Proposed Methodology", 2005 Planning and Transport, Research and Computation (PTRC) Annual Transport Practitioners' Meeting.

Abley Transportation Consultants are very familiar with the PTAL methodology having undertaken a PTAL automated calculation assessment for Christchurch[12] using a very detailed time based[13] walking network. The results of this project were published in a report to the Christchurch City Council in 2008[14]. One of the images from the Christchurch City PTAL analysis has been accepted into ESRI Map Book Volume 25[15] as shown **Figure 1**.

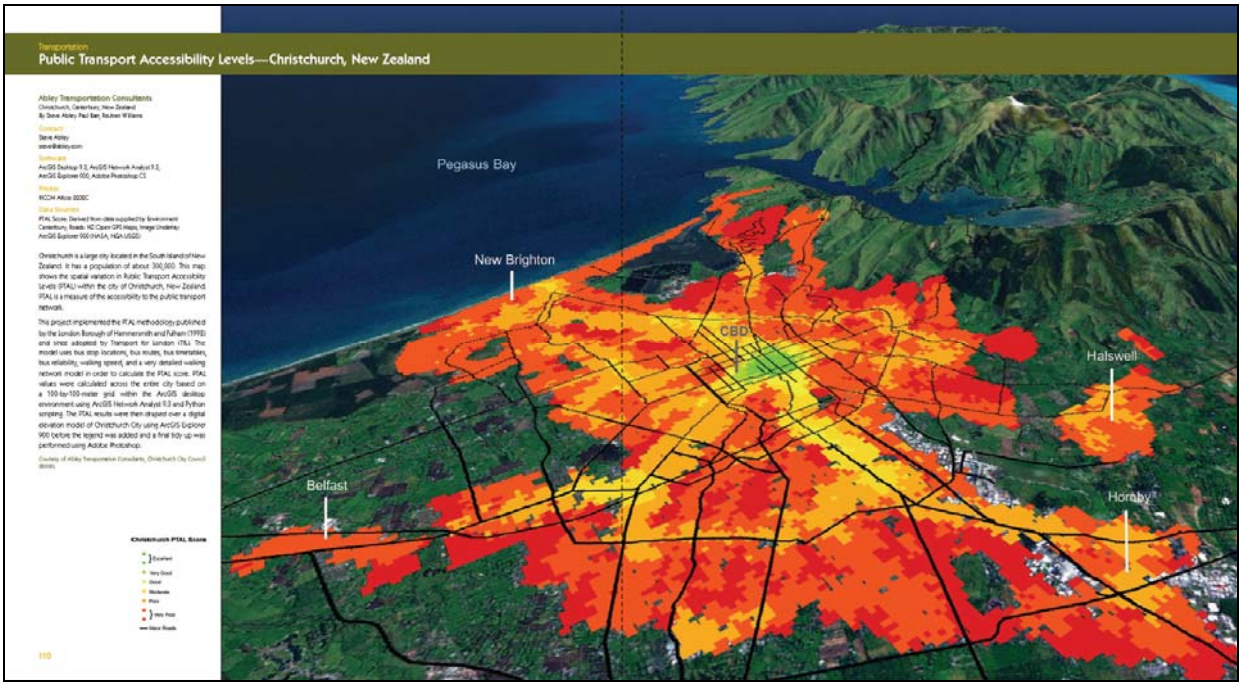

Figure 1 Christchurch City PTAL - ESRI Map Book Volume 25

Other techniques, similar to PTAL include the New South Wales (NSW) Roads and Traffic Authority 'Public Transport Accessibility'[16] and the Sutherland Shire Council 'Accessibility Index'[17]. Both techniques have specific application, the NSW technique for the variance of car parking maximums, and the Sutherland Shire Council to measure (and the author expects to also test and improve) accessibility by walking and public transport.

There are also a multitude of computer programs with differing methodologies that vary in price, complexity and usefulness. These including PTAM (West Yorkshire Passenger Transport Executive, UK), WALC (University of Westminster, UK), Amelia (University College London, UK), Accession (Citilabs, UK) and Capital (CalculAtor for PublIc Transport Accessibility in London, TfL, UK); to name just a few.

3. MEASURING ACCESSIBILITY

3.1 Research and Applications

Research Requirements

Given the New Zealand policy support for improving accessibility, and Abley Transportation Consultants previous experience developing measurement techniques[18], the NZTA

[12] Christchurch is described in detail later in terms of size and population.

[13] Rather than distance based that includes the walking time and delays crossing the road depending on traffic flows and crossing type.

[14] Report to Christchurch City Council 'Commercial Strategy – Transport Public Transport Accessibility Levels', Abley Transportation Consultants, Issued 19 May 2008, 67 pages.

[15] The ESRI Map Book will be distributed to all attendees at the ESRI International User Conference in San Diego. 12 July 2010. ISBN: 1589482549, Publisher: ESRI Press, 120 pages.

[16] Presentation to Austroads forum on Accessibility Measurement 'Public Transport Accessibility Measures: Practical applications for car parking policy' Mark Ozinga Manager Land Use & Transport Planning NSW Roads & Traffic Authority, 20-21 October 2009. Austroads is the association of Australian and New Zealand road transport and traffic authorities and aims to promote improved road transport outcomes. Attended by Steve Abley.

[17] www.sutherland.nsw.gov.au/ssc/home.nsf/Web+Pages/A9335C2538595404CA257574000E0A69?OpenDocument and https://mapping.ssc.nsw.gov.au/Sutherland/

[18] Including PTAL and also Community Street Reviews, see http://www.levelofservice.com/

commissioned Abley Transportation Consultants to develop a methodology to assess the accessibility of a neighbourhood in May 2007.

The original aim of the project was to develop a tool, principally for local authority use. The tool was required to assess the following:

- How well a neighbourhood provides for residents with differing abilities and needs.
- To measure access to destinations that provide the services residents need (such as primary schools, retail groceries, doctors surgeries, sports grounds) by all modes, but especially walking, cycling and public transport.

Furthermore, the accessibility tool should[19]:

- Provide clear, objective, quantifiable measures of how accessible an area is by walking, cycling and public transport (preferably compared to car access).
- Give sufficient detail to identify the nature of the problems so that improvement options can be developed and assessed for all modes.
- Identify the key obstacles to greater use of active modes in the area.
- Take into account the quality (attractiveness, legibility) of the walking and cycling routes – not just the access times and safety.
- Be user friendly and intuitive to use without a large investment in training.
- Be affordable enough that councils can use it.
- Be compatible with other data and complementary projects.

Since the research was commissioned the scope has been broadened to not only include the development of a methodology for calculating an accessibility score that includes for the assessment of a neighbourhood; but also a town, city or district. Indeed the methodology that has been developed could be extended to assessing the accessibility of a country including New Zealand or Australia.

The methodology for how the land uses, transport networks and calculations are undertaken has been compiled into a research report. The research report is currently waiting peer review by NZTA staff and later publication[20].

Research Applications

As an extension to the original research project, and after application of a successful trial to measure accessibility in Christchurch[21] New Zealand, the NZTA commissioned Abley Transportation Consultants to apply the accessibility score methodology to Gisborne District[22]. Further work is currently taking place in Napier and Hastings[23] including close liaison with the development of a traditional 3-step[24] transport model.

More recently the Christchurch City Council[25] commissioned Abley Transportation Consultants to undertake a pilot project and test a headline indicator for measuring accessibility in Christchurch. The indicator was expected to measure changes in accessibility over time due to population changes and a number of intervention projects.

Abley Transportation Consultants has undertaken the calculations for accessibility within a geographic information system (GIS). This enables the sharing of common data between agencies and the outputs are highly graphical and so are easily interpreted. The calculations are automated within the GIS software because of the quantum of data.

A location of Gisborne District and Christchurch City is shown in **Figure 2**.

[19] Adapted from Request for Proposal 50_07

[20] NZTA research reports are available at http://www.nzta.govt.nz/resources/results.html?catid=3

[21] Located on the East Coast, South Island, New Zealand, Area: Christchurch City: 45,240 Hectares. Population of Christchurch: 348,435 (March 2006)

[22] Located on the East Coast, North Island, New Zealand. Area District Area 835,500 Hectares. Population of District 44,499, population or Gisborne City 41,922 (March 2006).

[23] Titled the 'Heretaunga Plains Transportation Study'

[24] Trip generation, Trip distribution and Route assignment. Excludes mode choice.

[25] http://www.ccc.govt.nz/

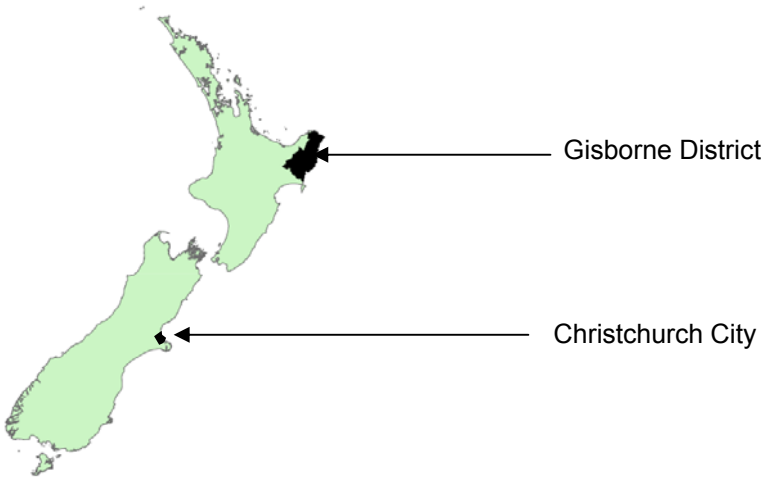

Figure 2 Map showing Location of Christchurch City and Gisborne District

Gisborne Accessibility Planning

Gisborne District is located in the northeastern corner of the central North Island and is also referred to as the East Cape, East Coast, Eastland region and Tairāwhiti. Gisborne City is the easternmost city in New Zealand and is the location of Gisborne District Council which is the largest district council in the North Island by area maintaining some 1,855 kilometres of local roads. The largest and most dense population in Gisborne District that comprises 94% of the District's population lives is Gisborne City.

The NZTA was piloting accessibility planning in Gisborne to try and identify access-related problems faced by Gisborne's most 'at risk' residents. The resulting accessibility action plan is expected to detail transport and non-transport solutions to these access problems, which should contribute to the delivery of policy outcomes across the health, education, housing and social services portfolios. The accessibility score mapping helped identify these at risk groups when combined with geodemographic[26] data and other analysis techniques.

A photograph of Gisborne City showing the harbour and the central business district is shown in **Figure 3**.

Figure 3: Photograph of Gisborne City

[26] Geodemographic means the spatial representation of demographic information. Geodemographic data is information about people represented spatially e.g. people per household.

Christchurch City Accessibility Indicator

Christchurch is the largest city in the South Island of New Zealand, and the country's second-largest urban area after Auckland. Christchurch is located one third of the way down the South Island's east coast, just north of Banks Peninsula.

The Christchurch Transport Plan is currently under development by Christchurch City Council. The Plan has developed a number of objectives to support the direction and guide the approaches taken. One of the objectives identified is accessibility in terms of access to opportunities such as shopping, schools, health services by all modes of travel. To support and monitor progress Council intends to have one headline indicator for each objective. The purpose of this project was to test an accessibility indicator that Council may use in the Transport Plan and consider the sensitivity of the indicator to change against a number of intervention projects.

A photograph of Christchurch City showing the University of Canterbury in the foreground and the Port Hills (Banks Peninsula) in the background is shown in **Figure 4**.

Figure 4: Photograph of Christchurch City

3.2 Data Inputs

The accessibility score methodology developed by Abley Transportation Consultants uses 8 Core+[27] land use activities. These are:

- Doctors
- Hospitals
- Primary Schools
- Secondary Schools
- Further Education
- Convenience Stores (Dairies, Petrol Stations, Convenience Stores)
- Supermarkets
- Employment (places of work)

[27] Based on the six core measures for determining accessibility proposed by the British Government's Social Exclusion Unit 'Making the connections: Final report on transport and social exclusion'. United Kingdom: Office of the Deputy Prime Minister 2003

The accessibility score methodology uses transport networks for:

- Walking
- Cycling
- Public Transport
- Private Motor Vehicle

There is some work involved in the creation of the above datasets although given the power of the accessibility analysis they are very powerful and available for other uses as well.

The datasets can also include existing and future land uses that would ideally coincide with and enable linkage to the Australian Bureau of Statistics[28] or Statistics New Zealand[29] future census years[30]. In this way accessibility can be forecast based on populations or planned growth strategies and land uses and transport networks optimised to provide the best accessibility for all members of the community.

3.3 Accessibility Indicators

Two main outputs were produced:

- threshold maps and reports
- continuous maps and reports

Threshold reports are fairly simple to understand whereas continuous reports are more complex, but also more useful.

The calculations for both indicators are undertaken over many points, typically destinations or households, or the smallest unit of area measurement e.g. meshblock. This enables a series of maps to be produced for each mode and land use activity that highlights the spatial variation in accessibility across a district, city, town, suburb or neighbourhood. Once the accessibility of a location is known, it can be targeted for improvement.

Threshold Indicators

Threshold mapping and reports provide values for the number or percentage of a population that can access a destination type within a specified threshold. Threshold values can be reported in time, distance or economic cost. Threshold reports are more common and used frequently with accessibility planning indicators. Threshold indicators are calculated based on the destination.

Threshold reports use a simple yes-no approach. A threshold report can answer a question 'How many people can reach a doctor within 30 minutes of travel by public transport?'

Continuous Indicators

Continuous maps and reports record the number or percentage of a population with access to a destination type, but weight the population closer to the destination higher than a population that is further away. This is because generally the closer the activity is to the origin the more attractive it is. Continuous indicators can be calculated either from the origin or destination.

Deterrence functions (Lamda λ values) are used to determine the rate at which destinations further away are gradually assigned less and less weight until they become insignificant to the overall results i.e. <5%. The only difference between continuous and threshold indicators is the shape of the deterrence function.

Of the two continuous indicators, one includes those activities that are 'supplied' by people i.e. employment; and the other includes those land uses that are 'consumed' by people i.e. the other seven Core+ land use activities.

The indicator for employment is a summation of possible job opportunities that are within reach of the measurement point weighted against the proportion of people that would undertake a trip of that duration by that mode. The indicator for the other activities is more complex and uses a harmonic series to represent the value of cumulative opportunities that

[28] http://www.abs.gov.au/
[29] http://www.stats.govt.nz/
[30] For Australia and New Zealand at 5 year intervals i.e. 2011, 2016, 2021 etc.

are within reach of the measurement point. Both techniques can be extended and combined to calculate a mode weighted accessibility score against for each land use activity for one of six age groups.

The age groups are loosely based on the life stages: pre-school, primary school, secondary school, further education, working and retired/elderly. A second weighting matrix can be used to combine each of the activities and age results into a set of age group adjusted composite accessibility scores. Finally the age group scores can be combined by weighting each age group based on the fraction of the total population. This then produces a comprehensive 'consumed' accessibility score.

3.4 Gisborne Accessibility Score Mapping

It is not simple to describe the vast array of mapping that was produced for this project within this technical paper. That material, including a description of the analysis techniques, will be presented at conference. Simplistically, the two main mapping techniques that were used are; threshold and continuous mapping.

An example of a threshold map for cycling in Gisborne City to secondary schools is shown in **Figure 5**.

The figure shows that cycling is a practicable transport mode and in terms of coverage at least, the dashed black line accounts for the area where 52% of people within that area consider a cycling trip an acceptable distance. In terms of the threshold reporting, the map shows that 67% of Gisborne City households are within the 10 minute catchment of a secondary school by cycling.

The maps shows, that because the secondary schools are typically clustered to the west, accessibility via cycling is poorest to the east. It clearly illustrates the river acts as a barrier to secondary schools and an area of poor accessibility exists to the south. Both these areas would be worthy for further investigation as to the underlying reason for poor accessibility. Transport or land use proposals would then be developed to remedy these poor accessibility issues.

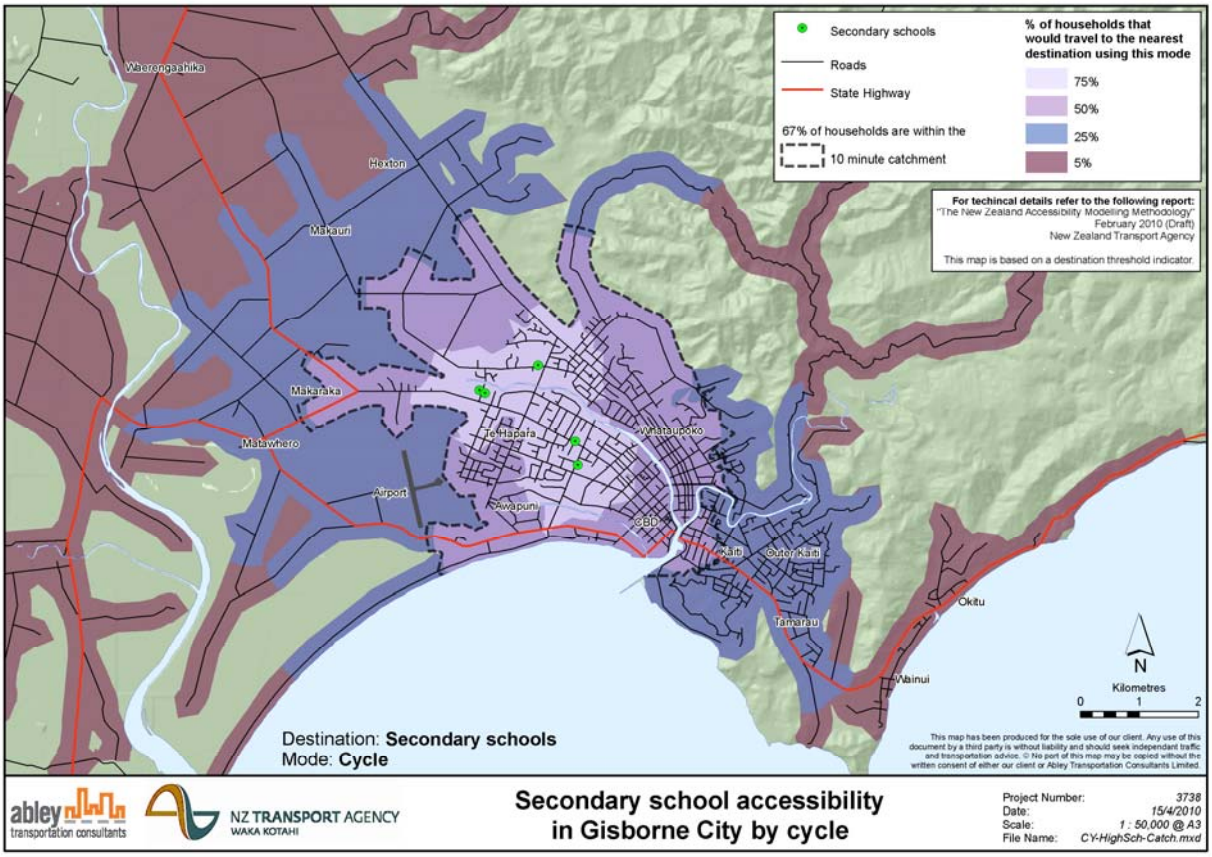

Figure 5 Gisborne City - Threshold Mapping - Destination based, One Opportunity Only

An example of a continuous map for cycling in Gisborne City to secondary schools, taking into consideration the benefit of multiple destinations, is shown in **Figure 6**.

The figure shows subtle differences to the threshold map and specifically the significance of poor accessibility to the east. This is because although the threshold maps show areas of low levels of accessibility, the continuous maps show locations that also have less choice to multiple destinations. The effect is the area to the east shows significantly lower accessibility than indicated in the threshold map. This would then be a higher priority target area and might be rectified by improving other modal transport choices. This could include improving use of public transport or improving cycling choice and efficiency.

Other intervention items for improving accessibility could include network and engineering changes such as:

- Improving priority for certain users i.e. lessening delays at intersections for different modes i.e. cycle lanes, advance stop boxes, pedestrian priority, bus lanes, bus gates etc.
- Adding new links and services and hence improving connectivity across the network.
- Allowing improved network connections i.e. more modal interchange.
- Lessening the awkwardness of interchange i.e. seamless ticketing.

Other intervention items for improving accessibility could include land use activity changes such as:

- Adding services at certain locations.
- Incentivising the creation of land use activities at certain locations.
- Reconciling operating hours of certain activities with journey times, especially for public transport.

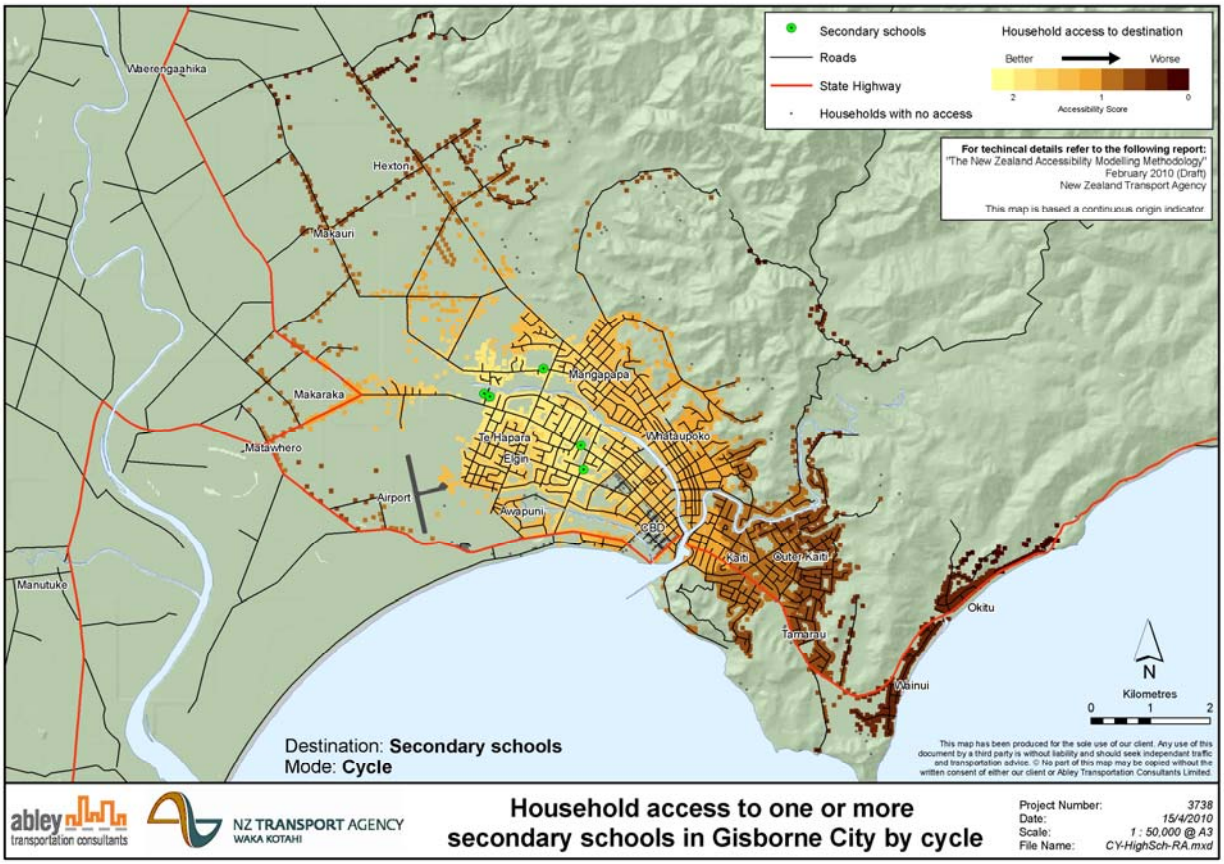

Figure 6 Continuous Mapping - Origin Based, Multiple Opportunities

3.5 Christchurch Accessibility Score Mapping

Similar to the Gisborne project, both threshold and continuous indicator maps were produced for Christchurch. Again, it is not simple to describe the vast array of mapping that was produced for this project within this technical paper. A more complete description of this material will be presented at conference.

The results for meshblock access to a significant shopping centre (termed a Key Activity Centre) via private motor vehicle is shown in **Figure 7**. The style of this figure is the same as Figure 6 although the expanse of colour is different. This is because Figure 7 (Christchurch) is based on meshblock accessibility whereas Figure 6 (Gisborne City) is based on individual household accessibility. Ideally accessibility calculations are undertaken at the finest possible level although in doing so computer processing time also increases. In the Christchurch example, the calculations were undertaken at a meshblock level to test the significance of the intervention project in the first instance with the intent to revisit the results at a household level later.

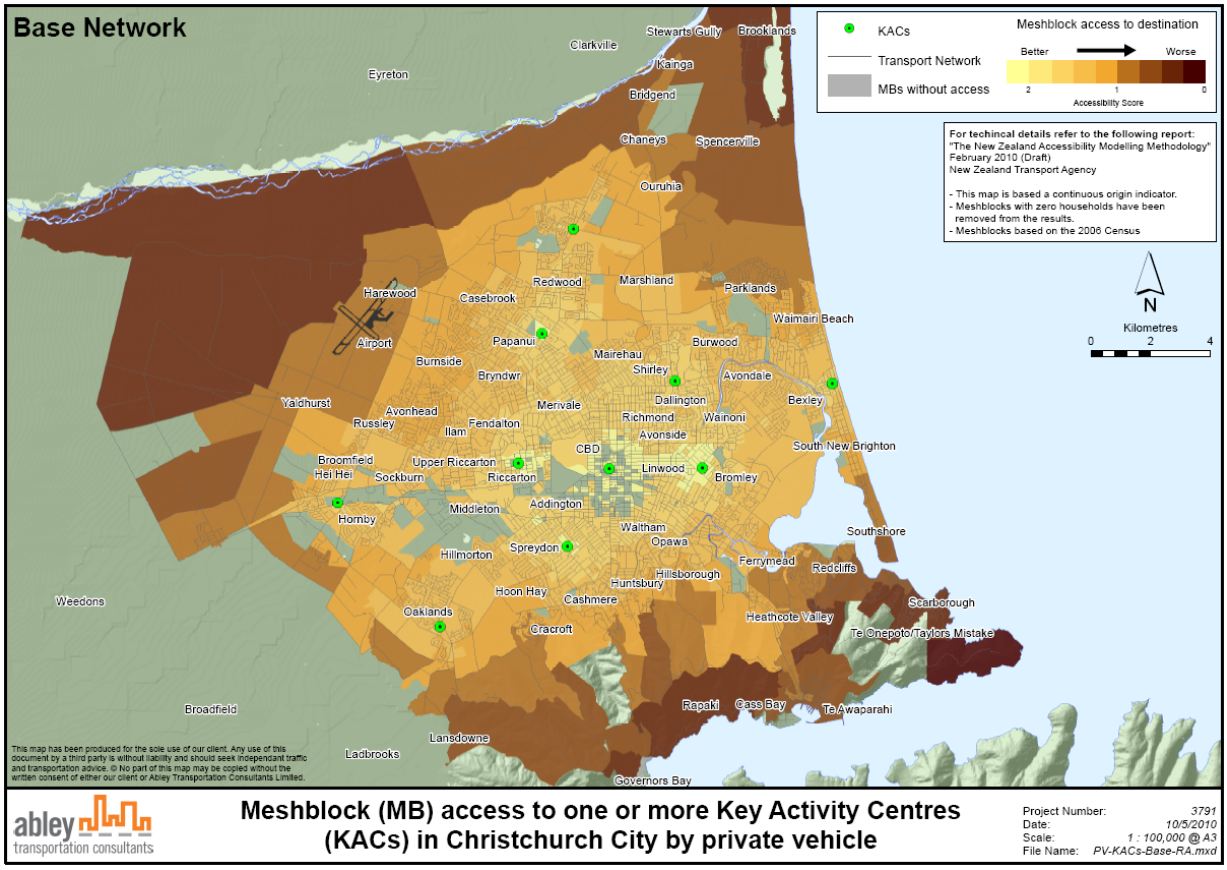

Figure 7 Christchurch - Continuous Mapping - Origin Based, Multiple Opportunities

Not unsurprisingly given the flat topography of Christchurch and the lack of physical barriers such as significant rivers, the results show generally concentric radiating accessibility from the city centre. This is because from this central location multiple Key Activity Centres can be accessed within the set deterrence time – this is a benefit of a centres based policy.

A number of interventions were then added to the base network and accessibility recalculated. The interventions included:

1. Prioritisation of bus routes - reduced bus travel times to prioritised bus route segments where improvements are planned[31].
2. Limit vehicle speeds in the central core - vehicle travel speeds decreased to reflect reduced area wide traffic management scheme to benefit ease of crossing and walking.
3. Decrease intersection cycle times in the central core - halve delay at intersections controlled by traffic signals to benefit walking.
4. Add crossing legs for all traffic signals in the central core - add new links to the walking network to benefit walking.
5. Southern Motorway Extension - add the new southern motorway extension to the private vehicle, cycle and walking networks and add appropriate links to the existing networks.

[31] www.buspriority.co.nz

6. Cycle path to Belfast - extend the current cycle path north along the railway corridor to Belfast.

The percentage change in meshblock accessibility because of the interventions is shown in **Figure 8**.

The figure shows that private vehicle accessibility improves in the west between 1% to 10% because of the Southern Motorway Extension project. A large number of meshblocks experience a small decrease in accessibility to the east and north between 1% to 10% because of the slower vehicle speeds in the central city.

Although not reported in detail in this technical paper, this decreased private vehicle accessibility is offset by very modest increase in walking and cycling accessibility and a significant increase in public transport accessibility over the whole city of between 1% to 10%. Interestingly the area to the east i.e. the area most affected with reduced vehicle accessibility (on average a 1% decrease), experiences a 10-30% increase in public transport accessibility due to the bus priority routes connecting this area to various Key Activity Centres.

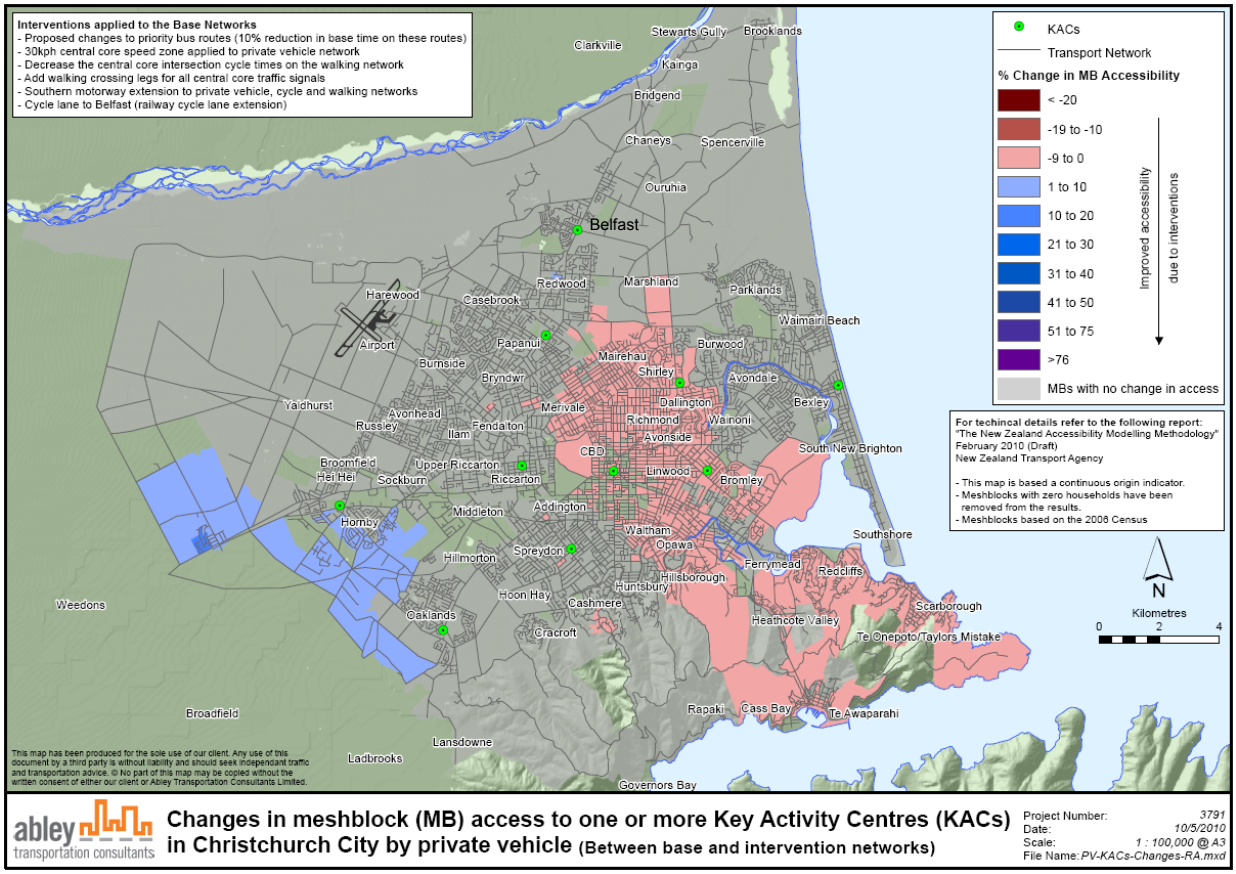

Figure 8 Christchurch - Continuous Mapping – Change due to Interventions

The work undertaken for the Christchurch City Council proves that accessibility analysis is sensitive to various interventions. This then enables transportation professionals to optimise the transportation network for all members of the community.

4. CONCLUSIONS

Accessibility mapping a highly effective way of analysing the quality of integration between land use and transport. It is an old concept, but a new area of study and one that can improve the provision and quality of the transport system. It is also a relatively inexpensive assessment technique.

Accessibility itself is often mentioned in policy such as in the New Zealand Transport Strategy and is a key component to achieving two objectives of the Australian Transport Council Vision for Australian surface transport, but it is the opinion of the author that accessibility is not well understood. This is because the relationship between mobility, opportunity and access is often ill-defined.

It is the growing understanding of the indirect and longer term interactions between transport and land use in the context of the sustainability debate, such as the contribution of transportation to global warming and the risk of peak oil that is increasing the urgency of implementing better integrated land use planning. This 'integrated' transport planning approach is a sensible and proactive response to our changing environment and the previous 'predict and provide' transport planning approach.

The work NZTA has been undertaking in Gisborne is seeking to better integrate land use and transport through accessibility planning. This work and the resulting accessibility action plan is expected to detail transport and non-transport solutions to these access problems, which should contribute to the delivery of policy outcomes across the health, education, housing and social services portfolios.

The work the Christchurch City Council has been undertaking is also seeking to better integrate land use and transport by testing the effect various intervention projects have on accessibility both spatially and quantitatively. This work will allow changes in the transport system to be monitored and better inform decision making and other intervention projects.

The methodology Abley Transportation Consultants has developed for the NZTA as part of a national research project has enabled measurement of accessibility in New Zealand communities. It is a real, tangible assessment technique that is proving beneficial to better understand, test and optimise transport investments and inform land use planning decisions.

Disclaimer: The opinions expressed in this paper are those of the author and do not necessarily represent the views of the New Zealand Transport Agency, Gisborne District Council or Christchurch City Council.