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ACCESSIBILITY PLANNING FOR MORE DECARBONISED CITIES

Transportation conference think piece paper

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1.0 Abstract

Accessibility planning is a framework and process to use accessibility indicators as a basis to identify inequities in accessibility. It the develops plans to improve accessibility. In this context, accessibility refers to spatial access rather than physical access.

Accessibility planning is a mechanism for achieving social inclusion. It does so by addressing inequities in access to goods and services by non-motorised modes - especially those who do not have access to private vehicles - using indicators of access to jobs, education, health facilities and retail facilities.
Accessibility planning is also a tool to integrate both features of the transport system (e.g. speed, and travel costs) as well as the land-use system (e.g. density and functional mix).

The majority of cities in New Zealand rapidly grew during motorised era which meant the cities are designed around private vehicles. Recent population growth has significantly exacerbated private vehicle usage and GHG emission in NZ due to lack of alternative transport modes and urban sprawling. This significantly disadvantages communities without access to a private vehicle.

This paper explores the way accessibility planning can promote mode shift (away from private vehicles) and contribute to decarbonisation while also increasing social inclusivity.

In particular, this paper refers to:

- Definition of accessibility planning
- Accessibility models/ tools help to identify gaps in accessibility
- Global practices including governance and transparency that support and/or promote more accessible and socially inclusive cities or communities around the world
- Application to NZ context.

With the National Policy Statement on Urban Development 2020 coming into effect, accessibility planning is becoming a more essential process for Urban and Transport planning decision making to avoid unnecessary urban sprawl and reduce CO2 emissions.

2.0 Introduction

Many cities in New Zealand rapidly grew during motorised era which meant the cities are designed around private vehicles and creating major environmental, economic and social issues. Furthermore, recent population growth has significantly exacerbated private vehicle usage and greenhouse gas (GHG) emissions in NZ due to lack of alternative transport modes and urban sprawl. This significantly disadvantages communities without access to a private vehicle but also contributes to significant GHG emissions.
Cities in New Zealand grew significantly from the 1950s. In the 1950s Auckland committed itself to being a large city by favouring of private car rather than public transport infrastructure development. This decision to base Auckland's transport system on motorways (rather than the development of a comprehensive public transport system) would become a fundamental influence on the shape and accelerated urban sprawl (McLaren 2019).

Today, NZ has became the 4th highest in vehicle ownership per capita in the world. NZ's motor vehicles per 1,000 people rate is higher than United States: 837 vehicles per 1,000 in USA, 838 in NZ (Wikipedia). Considering the size of New Zealand being relatively small, vehicle ownership rate is extremely high.
Today's high car ownership rate is a result of how cities in NZ were shaped around motorways. The planners believed in the improvement of mobility.
Traditionally in many countries land use planning and transport policies have been made separately (e.g Auckland council vs Auckland Transport). Some growth areas have been identified without considering impacts on the transport system. Transport planners consequently provide transport systems to connect these areas. This type of planning system often results in urban sprawl which heavily relies on use of private vehicles. In cities with high car ownership, lack of access to private vehicles becomes a major barrier for some.

Accessibility planning is a framework and process to use accessibility indicators as a basis to identify inequities in accessibility. It then develops plans to improve accessibility. This mechanism can be used for creating compact cities which ultimately reduces need for travelling by car. The term accessibility in this paper refers to the quality of travel and takes place at the community and individual level to provide access to various land uses. It focuses on travel time, travel cost, travel options, comfort, and risk while addressing the needs of all within the community (COP article, 2019).

Accessibility planning is a mechanism for achieving social inclusion. It does so by addressing inequities in access to goods and services by non-motorised modes - especially those who do not have access to private vehicles - using indicators of access to jobs, education, health facilities and retail facilities.
Accessibility planning is also a tool to integrate both features of the transport system (e.g. speed, and travel costs) as well as the land-use system (e.g. density and functional mix).

One of the accessibility planning tool commonly used in London is Public Transport Access Level (PTAL). A Public Transport Access Index (PTAI) is calculated from this data and allocated to a series of levels where PTAL 0 represents the lowest and PTAL 6b represents the highest level of connectivity (Cooper 2018). PTAL considers the frequency of public transport while indicating the level of accessibility to public transport. For example, one could be living next to a bus stop with infrequent bus service. PTAL will able to distinguish the area with high frequent public transport services and the area with infrequent service.

Traditionally in New Zealand transport issues has been dealt by building infrastructures without much consideration to change of land use. Auckland's Future Urban Zone (FUZ) is poor example of urban sprawl, which considers building new towns and infrastructures are the answers to meet future population growth. It does not choose the areas where are currently well served by public transport. Instead, FUZ areas are in greenfield area that is currently not accessible by public transport. Therefore, it will not only result in loss of nature but also increase the need of travelling in future.

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This paper refers to accessibility planning method from London where accessibility tools such as PTAL have been embedded in the planning process unlike NZ. However, recently introduced National policy statement on Urban Development: NPS- UD (2020) is likely to bring more positive impact to fill gaps between transport and urban planning. This paper explores the way accessibility planning can promote mode shift (away from private vehicles) by eliminating the need to travel. The elimination of travel need will consequently contribute to decarbonisation of cities while also increasing social inclusivity.

3.0 Decarbonisation of road transport will not meet total decarbonisation

Electric vehicles will help to reduce GHG but are not the total solution for decarbonisation to achieve more sustainable cities.

The increasing use of lithium-ion batteries as a major power source in electronic devices, including mobile phones, laptops and electric cars has contributed to a 58 per cent increase in lithium mining in the past decade worldwide. The mining process requires extensive amounts of water, which can cause aquifer depletion and adversely affect ecosystems (Stuff article 2019).

To reduce the total impact on the environment, the need for travel must be reduced through better integration between land use and transport planning: Compact cities/ 15 minutes cities.

The dependency on non-renewable resources can be reduced with an increase in pedestrian mobility. Resource depletion is a major global issue; in 2011 fossil fuels contributed 83% of the world's energy use, in 2014 consumption grew by 0.8% and leading experts estimate that the Earth only has 56 years left in its oil reserves (Arup, 2016).

City density and average mode share are strongly correlated. Figure 1 shows average mode share of home-based trips at different accessibility levels in London. The data shows in the areas with higher accessibility level, fewer cars have been used to travel.

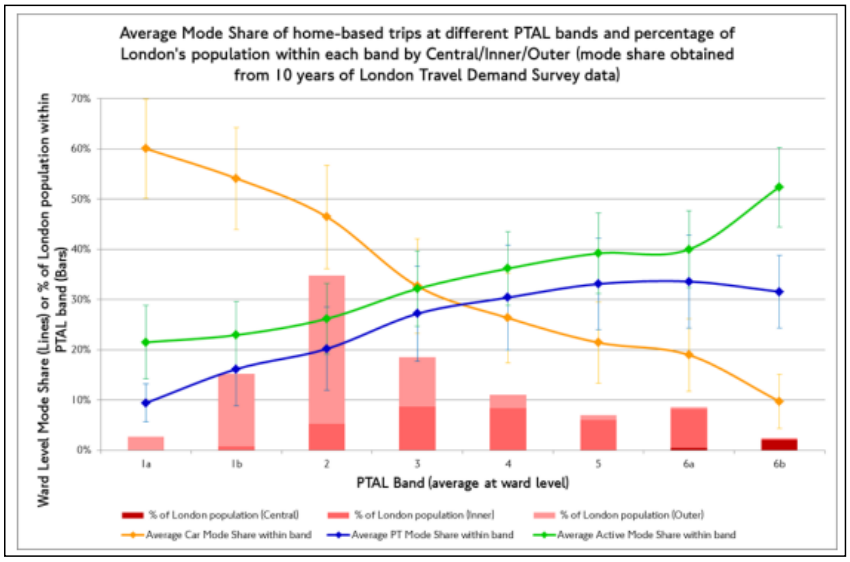

Figure 1 Mode share and PTAL band (Cooper 2018)

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4.0 15-minute cities and accessibility planning

4.1 Definition of 15 minute cities

The concept of 15 minutes cities is to improve quality of life by creating cities where everything a resident needs can be reached within a quarter of an hour by foot or bike. The 15-minute city requires minimal travel among housing, offices, restaurants, parks, hospitals and cultural venues. Each neighbourhood should fulfil six social functions: living, working, supplying, caring, learning and enjoying (BBC article 2021).

4.2 Accessibility planning and 15 minute cities

The 15 minute cities framework is a long-term urban plan. Accessibility planning is a huge part of 15 minutes city planning processes. This dimension is critical not only in helping cities reduce the amount of time lost in commuting but also in reducing the environmental and economic impacts of such activity. It allows residents to travel from residential areas, work, commercial areas, education centres, health facilities and other basic institutions in a reduced timespan (Moreno 2021).

5.0 Mobility vs Accessibility

This section explores the theories and debates of accessibility planning. The term accessibility is often confused with the term mobility. Firstly, this paper compares the term mobility and accessibility. Then, secondly, it is further going to explore how accessibility planning is often misused in transport planning especially within infrastructure led transport appraisals.

5.1 Mobility

For most of the last century, transport and urban planning have focused on speed but not on location: Mobility. It was believed that improved mobility helps people get from point A to point B as quickly as possible. In the era of mobility, people believed they can live anywhere they would like because planners will build ways to quickly move you to where you need to be. This resulted in urban sprawl, motorway building, and suburbanisation. Urban sprawl started from 1950's through to mid 1990's (Barrington-Leigh 2015).

5.2 Accessibility

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In transport planning, accessibility refers to a measure of the ease of reaching (and interacting with) destinations or activities distributed around a city or country. Accessibility is generally associated with a place (or places) of origin: land use. A place with "high accessibility" means the one from which many destinations can be reached, or destinations can be reached with relative ease. "Low accessibility" means relatively few destinations can be reached for a given amount of time, effort, cost or that reaching destinations is more difficult or costly from that place (Silva 2018).
It is believed that accessibility measures provide a useful framework for the design of integrated land use and transport policies. This framework enables searching for an improved balance between solutions increasing mobility (transport solutions) and solutions increasing proximity (land-use solutions) (Silva 2018).
"Mobility is how far you can go in a given amount of time. Accessibility is how much you can get to in that time." Good access comes from having a diversity of services intermingled within your own neighbourhood, so you don't have to go all the way across town (15-minute city article, 2013).

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5.3 Traditional transport planning vs Urban planning

Accessibility enables a move away from the traditional segregated approach of the vicious land use and transport feedback cycle. In this context, transport planning is mainly concerned with increasing speed (Mobility) while "urban planning" focuses on attracting population. This segregated approach leads to increasingly unsustainable urban settlement and mobility patterns seen in urban sprawl since the 1950s. It

resulted in dispersion of housing and activities, loss of local activities and amenities, car-dependency, and loss of relative competitiveness of public transport (Silva 2018).
Silva (2018) suggests increasing mobility does not always result in increased accessibility. In fact, it may even result in reduced accessibility levels. On the one hand we have witnessed unprecedented increases in metropolitan/regional accessibility, mainly based on car mobility. On the other, we have also witnessed the disappearance of local activities (public and private) and continued urban sprawl (of more or less alarming dimensions) and consequently the loss of neighbourhood level accessibility. In addition, we have also witnessed the loss of relative competitiveness of public transport in comparison to the car (Silva 2018).
For example, a proposed motorway is said to increase the number of jobs accessible from 30,000 to 40,000 at a regional level but the proposal might decrease the level of accessibility at a local level. When we look at a local level, the proposed motorway might divide the local area and the residents will have to walk 15 minutes longer to get to the closest groceries which could have been reached in 5 minutes in the past. The local groceries might lose competition to a mall outside the town, and the locals might lose groceries in their community completely.

5.4 How Accessibility planning is often mistranslated in transport planning

5.4.1 Accessibility planning vs accessibility in transport appraisal

It is identified the meaning of accessibility is ambiguous (Silva 2018). Accessibility is often translated as mobility as shown in the image below.

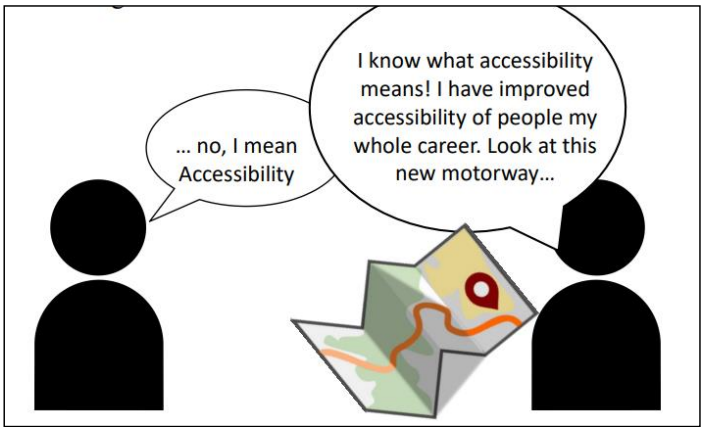

Figure 2 What accessibility means (Silva 2018)

The term “Number of people reachable within a certain time threshold” is very commonly used in transport planning as KPI measures in infrastructure led transport appraisals. This is often regarded as “accessibility planning”. The term accessibility is only used as a measure of reachability as a result of mobility improvement. In fact, this is mobility planning or management measures rather than accessibility planning. Accessibility planning must consider action and integration with land use.
Figure 3 shows the difference between Accessibility planning and Accessibility in transport appraisal.

Accessibility Planning	Accessibility in Transport Appraisal
The use of Accessibility Measures in neither good or bad	
To consider Sustainability	It is useful for Transport Appraisal – understand the potential gain (coverage, patronage, etc.)
It should reflect on relative accessibility by different transport modes	But it still focusses on improving mobility
It should consider action on Land Use	

Figure 3 Accessibility planning vs Accessibility in Transport Appraisal (Silva 2018)

An example of accessibility planning is indicated in figure 4 below. The example illustrates a new station improves the walking catchment area and shows where new residential developments can be developed within the catchment area. This example shows how a new transport system can inform land use planning which often decreases the use of private vehicles. Higher PTAL score (dark red) means the areas are highly accessible by frequent public transport.

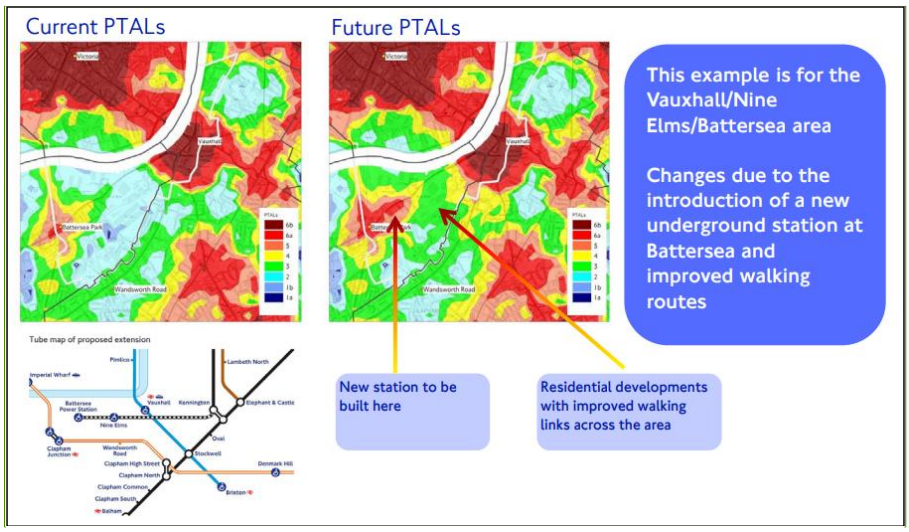

Figure 4 Use of PTAL (Cooper 2018)

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6.0 How can we apply accessibility planning better?

6.1 London practice

London uses accessibility planning to identify the gap to improve by using transport mechanisms and land use planning. For example, it is often used for identifying gaps to change land use and parking provisions as shown in figure 4.
In order to plan the transport network as well as commercial and residential development in London,

connectivity analysis is key. It enables Transport for London (TfL) to understand where and to what extent sustainable transport options are available throughout London in accessing jobs and other amenities. Connectivity analysis plays an important role in informing London's approach to planning development and providing new infrastructure (Cooper 2018).

This section explains the connectivity measures and indicators that TfL has developed and maintains. They can be categorised into four distinct groups based on their comparable methodologies:

- Access to the public transport network (PTAL)
- Access through the network - measuring location-based catchment statistics
- Access through the network - measuring London-wide catchment statistics
- Access through the network to specific opportunities and services (ATOS) (Cooper 2018).

6.2 Access to the public transport network (PTAL)

Public Transport Access Level (PTAL) is a well-established though relatively simple method of measuring access to the public transport network in London. It is the only measure that has been formally accepted and used on a statutory basis. For any location in London they combine walk access time to the public transport with service availability at network access points (stations, bus stops etc.) within a given catchment. A Public Transport Access Index (PTAI) is calculated from this data and allocated to a series of levels where PTAL 0 represents the lowest and PTAL 6b represents the highest level of connectivity (Cooper 2018).

The current plan identifies three policy areas where PTALs are utilised:

- Prioritisation of the location of high-density employment generators in areas of high PTAL ratings 5 or above
- Relating housing densities to PTALs – where areas with good public transport provision (higher PTAL) can support higher housing densities
- As a means to restrict car parking provision in areas of good transport access or high PTALs.

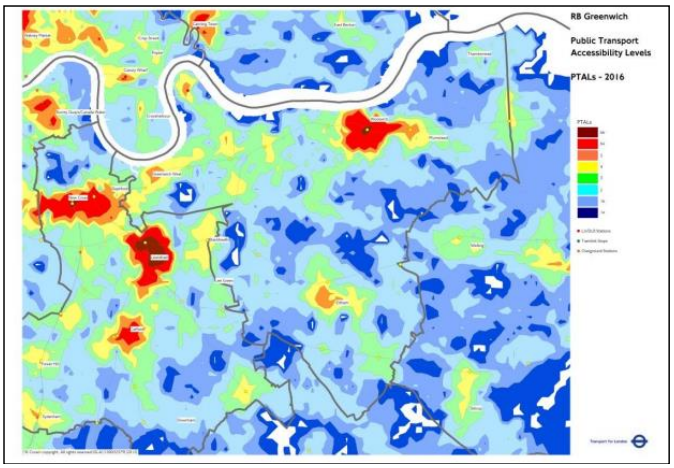

Figure 5 PTAL (Cooper 2018)

6.3 Access through the network - measuring location-based catchment statistics

It uses travel time mapping and associated catchment data to provide additional assessment of connectivity, either by all public transport modes, or a specific mode, or by car. The concept of travel time

mapping uses a series of time intervals to map travel times from or to a selected location. It indicates an appropriate count (sum) of population, employment or other services (hospitals, schools, retail locations) that are located within these time bands (Cooper 2018).

Key uses include:

- Scheme optioneering – quantifying the additional number of jobs or people that can be reached with the construction of a new transport scheme using different station locations and network alignments.
- Identifying the catchment characteristics of a specific location – for example the number of jobs that can be reached from a residential site or the number of people who can access a new commercial site. The latter could consider the total population that reside within 30 minutes to a shopping centre or the working age population that reside within a 45-minute commute to a new office development.
- Site selection and prioritisation based on the catchment characteristics. For example, comparing the number of potential employees who could access one site compared to another (Cooper 2018).

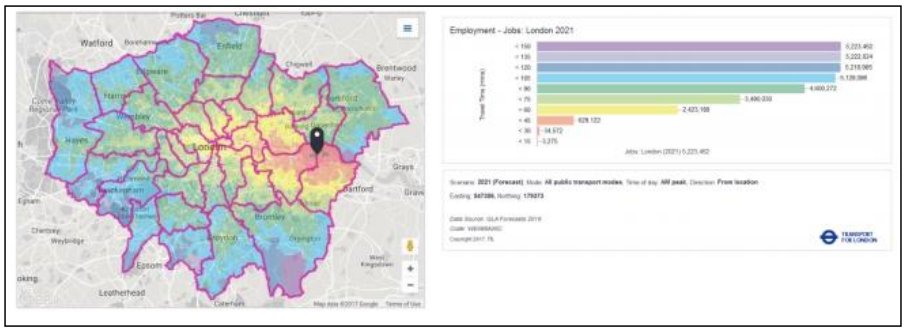

Figure 6 Travel times from Abbey Wood using the 2021 network (Cooper 2018)

6.4 Access through the network - measuring London-wide catchment statistics

Rather than simply generating travel time plots for individual locations, London-wide catchment analysis aggregates the catchment results for each zone/location in London (for example the number of jobs reachable within 45 minutes from each zone) and maps the calculated catchment statistic rather than the actual travel time values. This method has been used most frequently in the London context with population and employment data to provide a strategic view of changes in connectivity across the city (Cooper 2018).

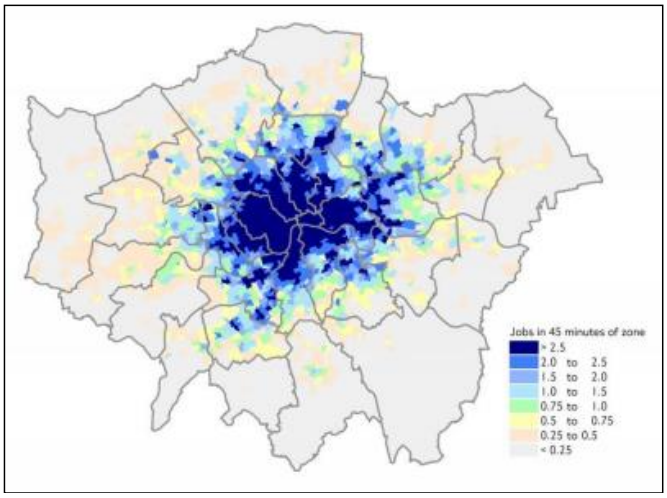

Figure 7 Number of 2041 jobs reachable within 45 minutes travel time by public transport including walking time to public transport nodes (Cooper 2018)

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6.5 Access through the network to specific opportunities and services (ATOS)

In planning terms an agreed catchment-based connectivity indicator that takes into account London's dense urban environment, could support decisions on the most appropriate location for new facilities as well as public transport services (Cooper 2018).

Such a measure could help support the Mayor in setting regional priorities, as well as improve collaboration between transport providers, such as TfL, with service providers, such as the National Health Service (NHS), in London. For these reasons TfL developed a London-specific connectivity measure of access to opportunities and services (ATOS) as a response to and building on the UK's Department for Transport (DfT) 2007 initiative to publish core national accessibility indicators (Cooper 2018).

Local authorities outside London were also required by the DfT to set a target for at least one local accessibility indicator as part of their Local Transport Plan. The indicators looked at the proportion of the resident population that can access a service within a certain time, for example: the percentage of 16-74 year olds within 20 minutes of an employment centre. In the case of London, the local authorities (boroughs) were not obligated to report on accessibility as Transport for London was and is accountable for ensuring good quality access. In addition, most of the indicators set by the DfT would be met within the Greater London area (Cooper 2018).

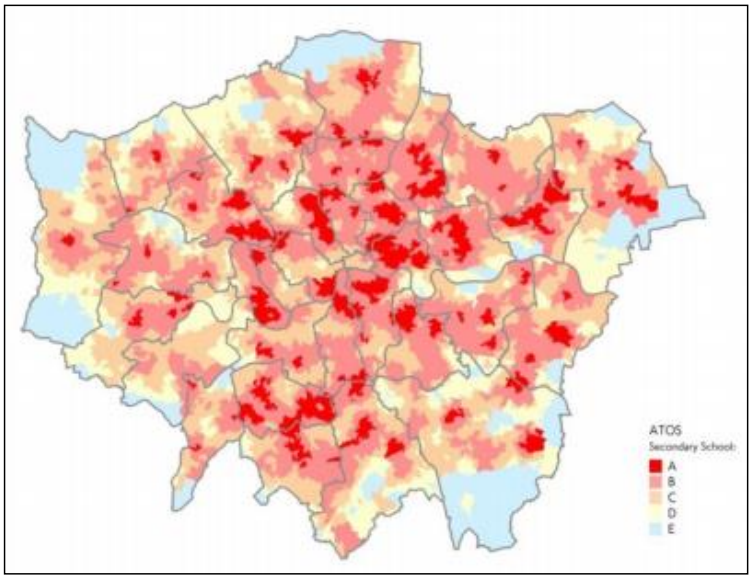

Figure 8 Access to the three nearest secondary schools by PT and/ or walking (Cooper 2018)

7.0 Application

7.1 New Zealand

Waka Kotahi looks after the national transport system. Therefore, the agency does not have authority over land use change. Naturally, the agency's focus is "mobility improvement" in partnership with other agencies rather than "accessibility improvement" as shown in the section before. This can be seen in the agency's statement regarding accessibility:
Accessibility is defined as the ease with which people are able to reach key services and destinations. Access to these activities, including work, education, health care, shopping and recreation, is fundamental to personal, economic and community wellbeing (Waka Kotahi 2014).
As a result, many infrastructures led projects in NZ often use accessibility measures as a part of appraisals. These measures do not intend to change land use but solely act as an instrument to provide measurements to justify cost of the projects in transport appraisals. These measures are then used to improve mobility rather than accessibility. To this date, there have been number of projects improving mobility resulting in urban sprawl in New Zealand to meet housing shortage or to meet the predicted growth. Currently, PTAL is not used in NZ at all.

7.2 National policy statement on Urban Development: NPS- UD (2020)

In December 2020, the National Policy Statement on Urban Development (NPS-UD) was published. The purpose of NPS-UD is to ensure local authorities enable development capacity for housing and business — through their land-use planning and infrastructure — so that urban areas can grow and change in response to the needs of their communities.
This policy will help closing the gaps between transport and land use planning. The policy suggests the following: :

- Buildings within a walkable range from city centres, metropolitan centres and existing or planned rapid transit stops may now be six stories, or higher.

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- Across the city, height and density reflect demand and the level of accessibility by active and public transport.
- Developers are free to determine the number of carparks in their developments. This means people who do not need or want car parks at their home or business premise are not required to pay for them.
- More people live in areas with good public and active transport links, meaning they are not reliant on cars for transport. This will help to reduce traffic and transport emissions (Ministry of Housing and Urban development 2020).

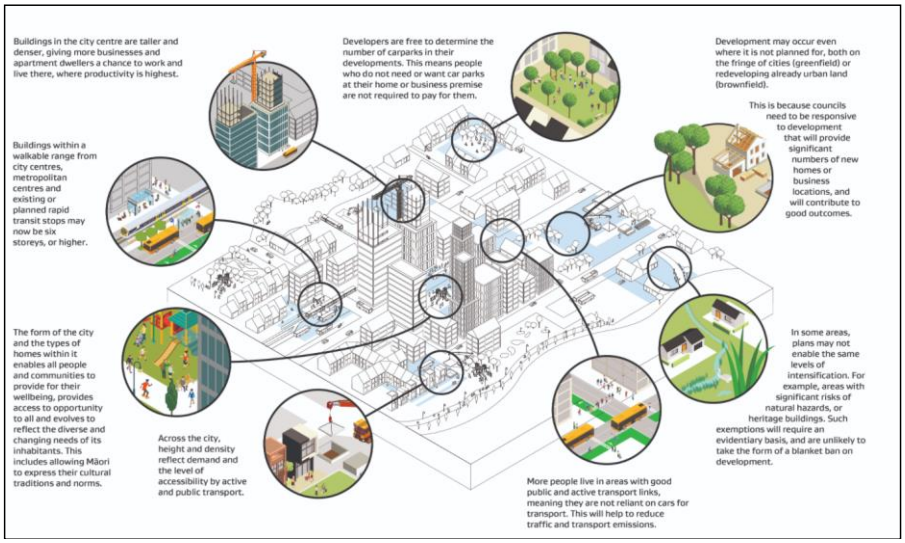

Figure 9 NPS UD policy summary

8.0 Conclusions

It is clear from this paper that accessibility planning is a core instrument for planning of successful 15 minute cities which aims to reduce private car use. Accessibility planning is not a new concept. It has been around for the last 50 years. Only recently, cities are using accessibility planning to plan more sustainable cities.

This paper also highlighted accessibility planning is often mistranslated in transport industries which raises from rather ambitious definitions. In NZ, unfortunately, accessibility planning has been misused to improve mobility as a part of the transport appraisal process.

NPS-UD (2020) is an instrument to drive away from traditional infrastructure led planning trends which adopted accessibility planning as a base instrument to drive more sustainable development. Under NPS-UD higher density developments will be planned within the areas with highly accessible areas by non-private vehicles.

Given the fact that NPS-UD requires future developments to be around highly accessible areas, the tool such as PTAL used by TfL will be useful to identify the areas with higher accessibility. Currently, there is no standard in the calculation methodology to support NPS-UD, it is recommended to have city or national wide standards to measure accessibility. Currently, there are so many tools available from various developers with different algorithms to measure accessibility. To keep consistency through cities, regions, or nations, government agencies must have a recommended standard or accessibility model which all

planners have the same access to.
It is hoped NPS-UD will promote a more integrated approach between transport and land use planning helping to achieve a more sustainable Aotearoa in future.

9.0 References

Conference Paper
Silva, Cecilia (2018) Challenges for Accessibility Planning and Research, University of Gothenburg, Sweden, Improving Transport Planning and Investment Through the Use of Accessibility Indices Workshop in Paris, ITF
https://www.itf-oecd.org/accessibility-indices-workshop
Cooper, Simon (2018) London's Accessibility Indicators: Strengths, Weaknesses, Challenges, Transport for London, Improving Transport Planning and Investment Through the Use of Accessibility Indices Workshop in Paris, ITF
https://www.itf-oecd.org/accessibility-indices-workshop

Internet
BBC article (2021): How '15-minute cities' will change the way we socialise
https://www.bbc.com/worklife/article/20201214-how-15-minute-cities-will-change-the-way-we-socialise#:~:text=The%20concept%20is%20to%20improve,parks%2C%20hospitals%20and%20cultural%20venues
Stuff article (2019): Climate Explained: The carbon footprint of electric versus fossil cars by MD ARIF HASAN AND RALPH BROUGHAM CHAPMAN https://www.stuff.co.nz/environment/climate-news/116599831/climate-explained-the-carbon-footprint-of-electric-versus-fossil-cars
Arup (2016): Cities Alive
https://www.arup.com/perspectives/publications/research/section/cities-alive-towards-a-walking-world
15-minute city article, Access, not mobility (2013) By Dan Luscher
https://www.15minutecity.com/blog/access
COP article, Community Planning and Zoning, What are the Differences between Mobility, Accessibility, and Connectivity in Transportation Planning?, View in February 2021 https://community-planning.extension.org/what-are-the-differences-between-mobility-accessibility-and-connectivity-in-transportation-planning/
NPS-UD (2020), National Policy Statement on Urban Development 2020 (NPS-UD)
https://www.hud.govt.nz/urban-development/national-policy-statement-on-urban-development-nps-ud/
Waka Kotahi website, viewed in February 2021
https://www.nzta.govt.nz/about-us/about-waka-kotahi-nz-transport-agency/
Wikipedia, List of countries by vehicle per capita, viewed in February 2021
https://en.wikipedia.org/wiki/List_of_countries_by_vehicles_per_capita

Journals
Barrington-Leigh, Christopher (2015): A century of sprawl in the United States, PNAS
https://www.pnas.org/content/112/27/8244#:~:text=Clearly%20evident%20are%20the%20rise,through%20sprawl's%20peak%20in%201994.).
McLaren, Eva (2019): A brief history of Auckland's urban form, Auckland Council
https://knowledgeauckland.org.nz/media/1419/a-brief-history-of-aucklands-urban-form-2019-web.pdf
Moreno, Carlos (2021): Introducing the "15-Minute City": Sustainability, Resilience and Place Identity in Future Post-Pandemic
https://www.mdpi.com/2624-6511/4/1/6
Waka Kotahi (2014): Accessibility planning, The NZ Transport Agency's BCA Strategic Options toolkit
https://www.nzta.govt.nz/assets/userfiles/transport-data/Accessibility%20Planning.pdf