TRANSPORTATION CONFERENCE 2021
TRANSIT ACCESSIBILITY STUDY
Practice Paper

(This paper has been peer reviewed)

INTRODUCTION

Road transport in New Zealand (NZ) contributes to 19% of the total greenhouse gas (GHG) emissions. Despite the rising popularity of Electric Vehicles (EVs) in New Zealand, the total annual emissions from road transport is projected to increase by 7% by 2050 compared to the 2018 emissions (OECD).
One of the most effective methods to reduce carbon-footprints in transport is to switch from cars to sustainable modes. A report by Environment Health Indicators New Zealand (EHINZ) states light vehicle ownership in NZ is about 802 (per 1000 people), which is one of the highest in the world. Sustainable mobility entails optimising transport network and accessibility without compromising the safety of active users. To bring about sustainable development, the transport system of the city should be improved. This can be achieved by reducing the number of private vehicles and creating cities that make active modes more accessible to public transport hubs. Cities with strong public transportation accessibility via active modes can reduce carbon emissions by 37 million tons annually(C2ES).
The shift from motor vehicles to active modes has a direct impact on climate change and greenhouse emission reductions. The global concerns of sustainability, climate change & transport challenges prompt political decisions on active mode transport (Cole et.al. 2010). A sustainable city is a by-product of its innovations in the field of transport planning, the superior-quality implementation techniques, supportive government strategies and public trust.

TRANSIT ACCESSIBILITY STUDY

A transit accessibility study measures the interaction between a transit station and its active mode catchment and helps to improve it. A close association between walking & cycling areas and transit stations is fundamental to liveability. Transit accessibility studies effectively implement safer and better active mode connections to transit hubs. Improving the transit accessibility makes public transport (PT) catchments competitive and versatile thereby reducing the attractiveness of car.

The integration of land use and transport is the fore step to accessibility planning. It manifests the idea of people-oriented cities or 20-min city concepts within Auckland. The stages that follow are bespoke to a regional context with major contributions from political decisions, available resources and local environment. The simpler the representation of our accessibility using sustainable modes and its performance measures, the higher the probability of a positive outcome.

There are several ways of measuring accessibility but there's no effective way of comparison between these measures. Accessibility based planning techniques are gaining momentum in the NZ context. Auckland's policymakers are learning from international best practices advocating green mobility and are introducing them to future urban projects. This paper highlights the interdependence of active-mode and public transit services for a more sustainable environment.

NZ POLICIES, TOOLS AND TARGETS

The 2018 Sustainability Review builds on the Sustainability Transport Plan 2016 and initiates actions around the following 3 levels:

- Infrastructure- optimising the network has delivered 500,000 tonnes of fuel savings
- Services- Addition of e-buses and electric vehicles to the fleet
- People- changing the perception of people around walking/cycling

However, the methods proposed in these documents are mostly re-zoning land-use around transport nodes, new PT networks and developing structure plans for greenfield areas. The Government Policy Statement (GPS) on Land Transport 2021 supports the idea of a compact and dense urban form with an additional highlight on the walking, cycling and public transport improvements. The GPS acknowledges New Zealand's car-dependency and suggests long-term alternatives to modify its travel behaviour. The City Centre Master Plan (CCMP) 2019 provides emphasis on the Access for Everyone scheme within various parts of the city. This scheme ensures exclusive street access to active road users & public transport services.
The National Policy Statement on Urban Development (NPS-UD) 2020 is a comprehensive document which provides a detailed insight into the walking and cycling provisions that should be implemented around intensification areas to attain a "well-functioning urban environment". The NPS-UD 2020 aligns with our discussion in a sense to curb urban sprawl.

The New Zealand Transport Strategy (NZTS) has a number of targets associated with transport and climate change goals, including:

- Reduce transport related greenhouse gas emissions to 50% by 2040
- Increase active mode share to 30% in urban areas by 2040
- Increase Public Transport (PT) trips to 7% of all trips in urban areas by 2040
- Increase PT trips by 3% & active mode trips by 1% per year

The above policies and guidelines are tools to effective land use and transport integration at a strategic level, whereas transit accessibility studies promote accessible public transit catchments at a finer level.
Transit accessibility studies can be effectively used to achieve the above-mentioned sustainability targets for a city or town. They provide solutions to replace car trips and make active and PT modes the focus of city road space.

LITERATURE REVIEW

The topic of transit accessibility has been researched in a number of research papers, journals & studies in the past. The interesting fact, however, is the varied outreach each of these studies and the conclusions they derive. Accessibility measurements have been useful for evaluating the interrelationship between land use and transport modes, including sustainable transport such as public transit, cycling, and walking (Handy 2002). Spatial interaction models provide a holistic approach to the accessibility measures (Wilson 1967, 1971). Geurs and van Wee (2004) summarise different types of measures for calculating accessibility, including infrastructure and utility-based measures.

This paper focusses on location-based (zonal-level) measures which account for the spatial distribution of opportunities and the demand for them. Location-based accessibility measures are easy to access and communicate and provide useful inputs to transport planning policies (Curl et

al. (2011). Structural area units (Census geographic unit SA2) have been used for this study with the intent of providing maximum disaggregation of spatial data which corresponds to detailed results (Handy and Niemeier 1997). A sustainable transport pyramid should provide maximum importance to pedestrians, who are most vulnerable, followed by cyclists, public transit users & finally cars which are the problematic user class (Ogryzek et al., 2020)

CHALLENGES IN ACCESSIBILITY PLANNING

The major issues with the study of accessibility modelling is the difficulty in implementing them into planning policies. The current planning regulations within Auckland do not have set active mode accessibility standards and targets around transit stations. Partially because of the complexity of defining and measuring accessibility, and largely due to organisational barriers.

In the event of a curated planning goal being in place, the process of carrying it over from transport practitioners to stakeholders is a challenging process. An effective active-mode planning process involves complex decision-making on the part of transport agencies and councils.

The multiple institutional layers which the process has to sieve through just adds to the problem. The measures and methodology adopted in building accessible cities should tie into the policy interventions easily and should be transparent to all the levels of government organisations. Lastly, active mode planning should be complemented with infrastructure improvements and people support.

Approach to access at stations

This paper reiterates the station access policy adopted by BART (San Francisco Bay Area Rapid Transit), wherein walking, cycling and transit modes are the prime focus around station location and its design. Figure 1 shows the hierarchy of modal priority that should be implemented. The area around the stations within at least 1 km should be prioritised for walking and up to 3 km should be well-connected using cycle routes.

Pedestrian-friendly urban design can immensely increase the station accessibility. It is better than providing local bus connectivity to destinations, and just slightly less effective than improving the transit network itself.

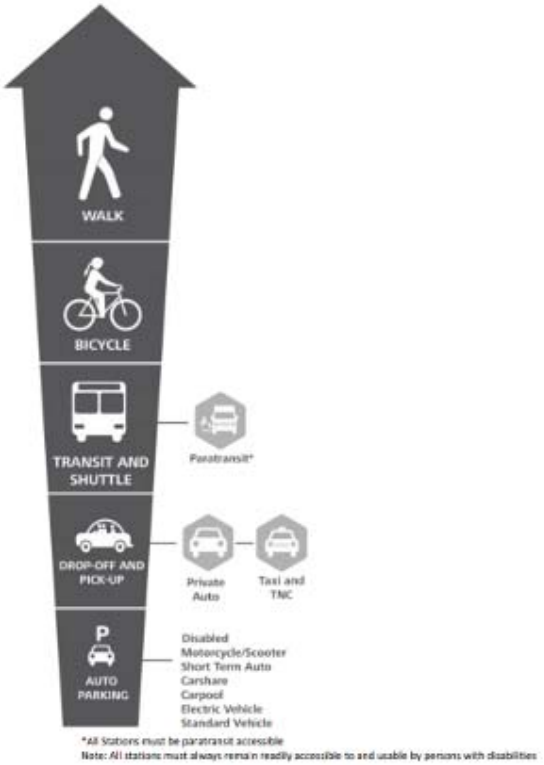

Figure 1: BART station access policy

METHODOLOGY

This assessment will analyse the transit sheds around stations comparing the catchments for walking, cycling and PT vs car as well as provide discussion around reducing the gaps. In order to create an inclusive community, the walking and cycling routes should not just be designed for physical activity but for the purpose of commuting, taking people from A to B. In an ideal world, any transit station should have an extensive walking and cycling catchment, equivalent to the public bus catchment. The 2018 Census data for 'Journey to Work & Education' was used for the study. The analysis undertaken is primarily transit-centered and therefore 3 train stations within Auckland were selected. The stations used for this study are Britomart, Newmarket and New Lynn. These stations will be referred to as the 'study stations' in the following sections. Figure 2 shows cycling infrastructure within Auckland City as well as the 3 study stations. Currently, there are gaps in the cycle network which might be the reason for the setback in sustainable first and last mile connectivity.

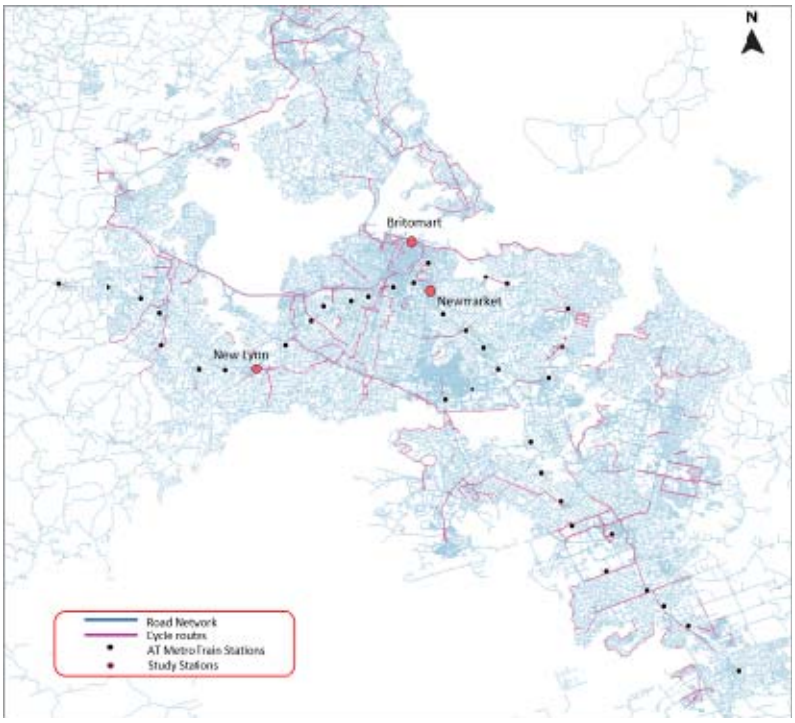

Figure 2: Auckland City area with study stations

RESULTS AND DISCUSSION

The discussion is largely based on 3 parameters:

- Landuse Proximity and Diversity
- Reachability
- Safety

Each of the study stations were reviewed against these parameters to measure their outcomes.

Land use proximity determines the population and jobs near the station, say 1 km catchment for

walking and 3 km for cycling. Similarly, low-income households can be used to measure the attractiveness of public transport hubs. The functional urban areas within a city are geographic locations which contribute significantly to housing, commercial, recreation, business or a combination of these. Every transit station area serves a primary function which should reflect the quality of sustainable accessibility around it. Multi-functional transit stations such as Britomart should have safe, dedicated active mode corridors connecting to PT stops. The
below shows the population & jobs within 1 km catchment (rounded to nearest 10).

Table 1: Population and Jobs around 1km catchment of study stations

Station	Area	Population within 1 km	Jobs within 1 km
Britomart	CBD	14,840	74,300
Newmarket	Central Auckland	10,060	22,840
New Lynn	Western Auckland	7990	6340

The Figure 3 below displays a better representation of the population and job density around the study stations. All three stations have a medium-high density population around them. Newmarket and Britomart have high employment densities. The employment areas are mostly clustered around the City Centre and adjoining areas.

Key observations

- The functionality of study stations is complex but typically homogeneous and if supplemented with accessible modes can eliminate car dependence to a great extent.
- The distinct profile around each station catchment determines whether it is a destination hub or a major trip originator or both.
- Based on the station area profiles, bespoke accessibility improvements can be implemented.

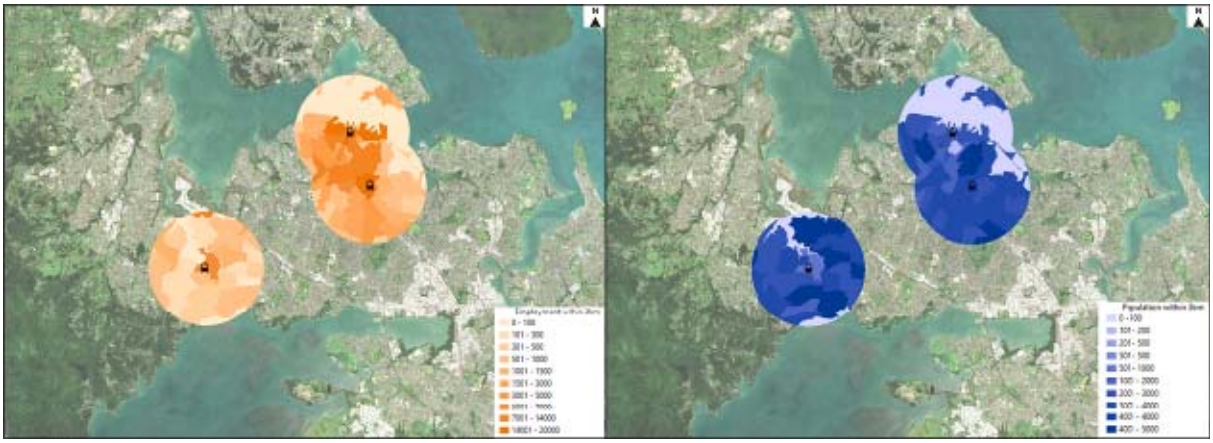

Figure 3: Employment Density and Population Density within 3km catchment

Diversity

The impact of land use diversity on transit accessibility study is limited to analysing the need to

travel. Landuse around stations should include a high-quality diverse mix of residential, employment, education, healthcare and retail facilities. A balanced urban design enables well-informed accessibility decisions and effective policymaking favouring sustainable mobility. The Figure 4 shows the distribution of land use zoning for three study stations. The areas around the stations can have a better functional diversity. Figure 5 shows the distribution of land use within 3km of station catchment.

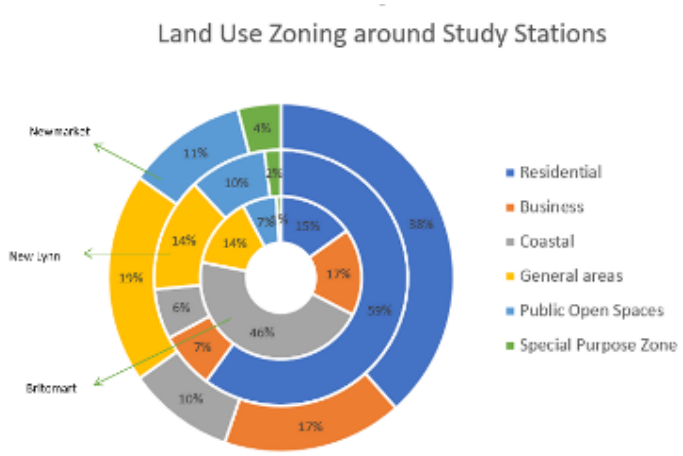

Figure 4:Land Use classification for study stations

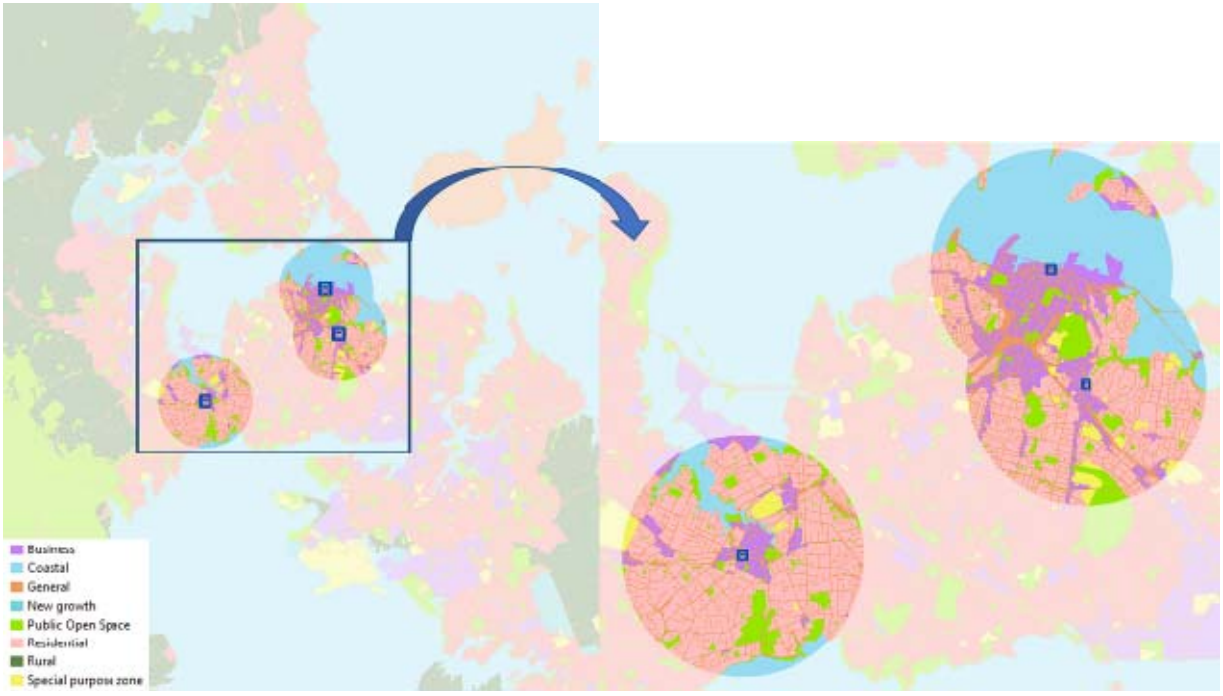

Figure 5:Land use map around station catchment

Key observations

- The Newmarket station shows a good mix of land use with residential, business and public spaces.
- Britomart has a rational distribution of land uses and high connectivity to bus stops
- New Lynn catchment land use can be developed to include business/ commercial/retail purposes

Reachability measures the areas accessed by sustainable modes within 15-30 minutes of travel. The average distance that can be covered by a single or multi-modal travel within a definite time duration. If travel using public bus is considered, then frequency of the service should also be accounted for i.e. average waiting time for a trip.

Station reachability catchment

Figure 6 shows the difference in catchments by car & PT mode from the 3 study stations using a web service app- Traveltime. The car catchment shown in the background (dark grey colour) is quite extensive compared to the public transport catchment (red colour). The gap between isochrones show that the level of access at each station is not spatially equal and the competitiveness of public transport compared to car is low. In this example, PT competitiveness is symbolised by reachability, which is an integration of network, infrastructure & service.

Increasing the public bus connectivity is a more complex process with not just infrastructure improvements but also the service frequency reforms.

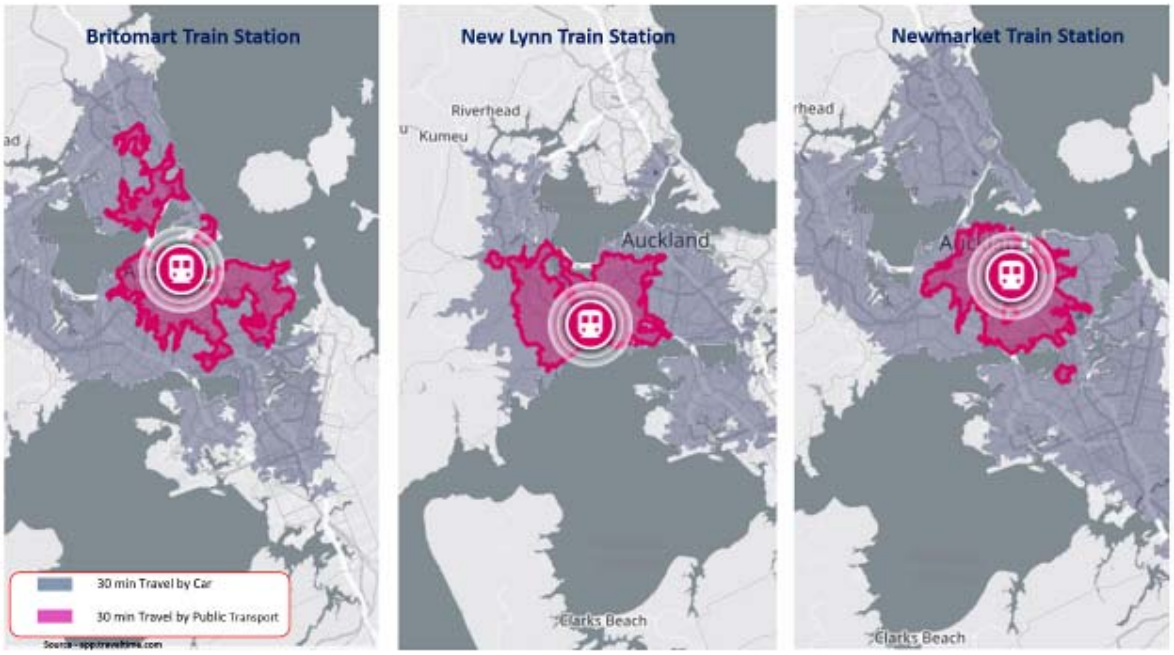

Figure 6: Gap in catchments using car and PT as a mode of transport

Evidently, the mode of transport is not dependent on distance or reachability. If that was true, Auckland would be missing more than one-fifth of the car trips below 10 km. It is driven by choice. Car users should be presented with strong motives to reverse this tendency. People travelling in and around transit stations should be incentivised to use sustainable modes with higher levels of

connectivity and reliability. Depending on the geographic location of the train station, the range of each sustainable mode can be determined. The reachability levels for different modes were analysed around the stations.

The Figure 7 below shows the extent of accessibility of cycling, PT and car modes, for a 30-minute travel. It sure reflects the massive gap that needs to be addressed, but at the same time sets pragmatic targets. For instance, the car catchment is about 3-4 times better than the PT catchment. With transit accessibility improvements, the same should be achieved for PT stations spatially. The payoff in the process can be reducing the car competitiveness and increasing attractiveness with sustainable modes.

The basic idea of increasing sustainable transit accessibility is to favour sustainable transport as a priority (make the gap smaller), even if it comes at the cost of car trips. However, there are many forms of making the gap smaller.

Closing the gap can also be improving accessibility for active modes. Reachability is an outcome of urban street design and can be changed to reflect the priority of the days. Street blocks should be designed to avoid long walking distances for pedestrians, shorter detours for cyclists and improving connectivity, safety and convenience for sustainable transport.

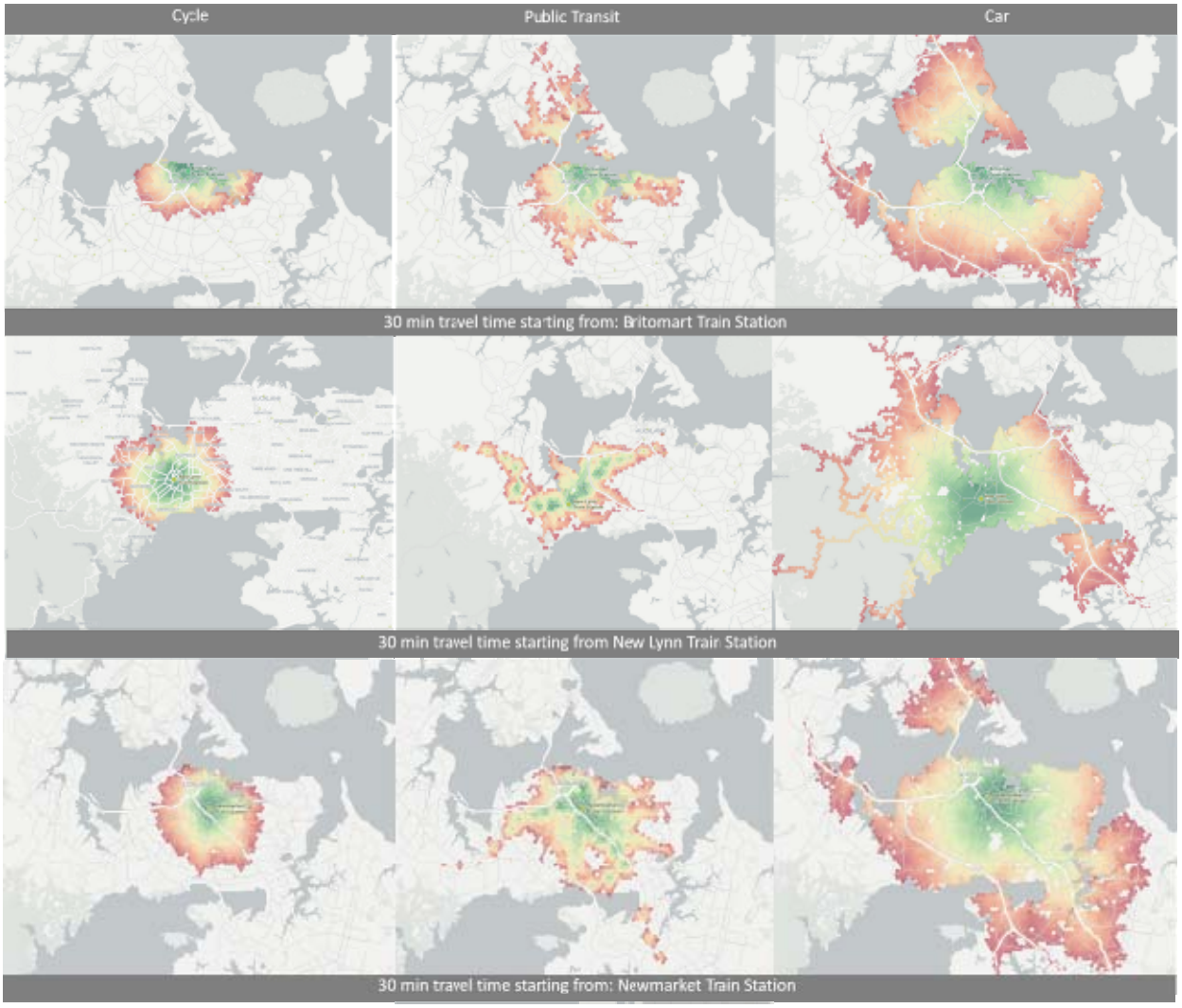

Figure 7: Accessibility by cycle, public transit and car

Safety manifests the city's local environment. More specifically, it measures the interaction between the people and transport modes. Transit accessibility measures incentivize active mode users. This can only be feasible if the speed environment is favourable to vulnerable user class. Pedestrian and bike catchments can be increased by implementing low speed on roads (AT Urban Street and Road design guide)

A transit hub is a place where different modes of transportation meet, and a variety of urban activities take place. Improving the integration between the network and urban space can be very rewarding for decarbonising transport in various direct and indirect forms. To deliver quality transit hubs, network speed in areas of high conflict is a critical tool to enable safe and appropriate interventions. If walking, cycling and transit modes are the prime focus around station location and its design the network speeds should reflect that. Lower speed limits discourage car-users and make active modes safer, faster & reliable.

In a context with poor facilities for active modes, high speeds are very alarming. Danish planning practises suggest streets with speed over 40km/h should have either painted bike lanes or curb-separated lanes. In June 2020, new speed limits of 30km/h were implemented on the roads within Auckland City Centre, which has the most vulnerable road users. Low-speed environments should be

a key feature around all transit hubs not only the City Centre.

CONCLUSION

In 2015-18, people travelling in NZ spent 82.8 % of the total travel time using a car, van or motorcycle *(EHINZ)*. This trend can be reversed if the functionality & usability of active modes around transit stations was maximised. Walking and cycling are the most innate form of transport and with careful planning they can efficiently serve as transit feeders. Transit accessibility studies provide key insights to reduce the car catchment, make reachability using PT more competitive and attractive and increase the safety for active mode users. Transit accessibility around stations can be influenced by a number of factors, which can be broadly summarised as:

- Mixed-activity neighbourhoods or balanced communities which reduces the demand to travel
- Safe and convenient walking/cycling facilities
- Reliant PT connections for those who live/work outside the active mode catchment
- Urban street design which prioritise active modes over vehicular movement
- Low speed roads provide a safe environment for active modes and discourage car-users

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