Bike Network Model

Inner Melbourne Case Study

Institute for Sensible Transport

Introduction

Over the last two decades, state and territory governments have developed ambitions to increase cycling participation. These have been motivated by a growing recognition of the importance of enhancing sustainable mobility options; to combat congestion, stem the growth in transport emissions, reduce road trauma, and provide a more diverse set of transport options.

Central to the ambition of growing cycling participation is the need to create a more conducive environment for people to ride bikes.

It is well-established that safety concerns are a primary reason people do not ride a bike. Greater levels of high quality bicycle infrastructure are required to make cycling a more compelling option. However, in seeking to achieve a more conducive environment for cycling, some fundamental questions remained unanswered. These knowledge gaps have hampered efforts to plan future bike infrastructure improvements. For instance;

1. How much cycling takes place on a city's street and path network now, and how would this change with enhancements to the quality of the bicycle infrastructure network?

2. How safe/dangerous is cycling on each street in a city's network, in total, and on a per kilometre basis, and how might this change with improved infrastructure?

The Institute for Sensible Transport has developed a Bike Network Model, that uses ABS Census and other transport data to create a Geographic Information Systems (GIS) based Model that can estimate:

1. How much cycling takes place on every street within a city's entire street and path network.

2. How enhancements to the bike infrastructure network changes cycling levels on each street, including people diverting from one street to another, to take advantage of improvements to the network on parallel streets.

3. The risk of cycling crashes on all streets within a city's entire street and path network, to provide a clear picture of existing risk profiles (crashes per km), and how this may change via the provision of new infrastructure.

By applying the Bike Network Model, planners can provide reliable estimates of the benefits of implementing a future bicycle infrastructure network, including critical inputs for cost benefit analysis.

Bike Network Model

The Institute for Sensible Transport's Bike Network Model can be simplified into seven key steps, as shown in Figure 1.

The primary objective of the Model is to make it easier for government agencies to understand how proposed changes to their bike network will influence ridership and safety, and have a better understanding of which corridors offer the best prospects for enhancing sustainable mobility options. A useful outcome of the Model is that it provides the fundamental inputs to conduct cost benefit analysis on the proposed network developments.

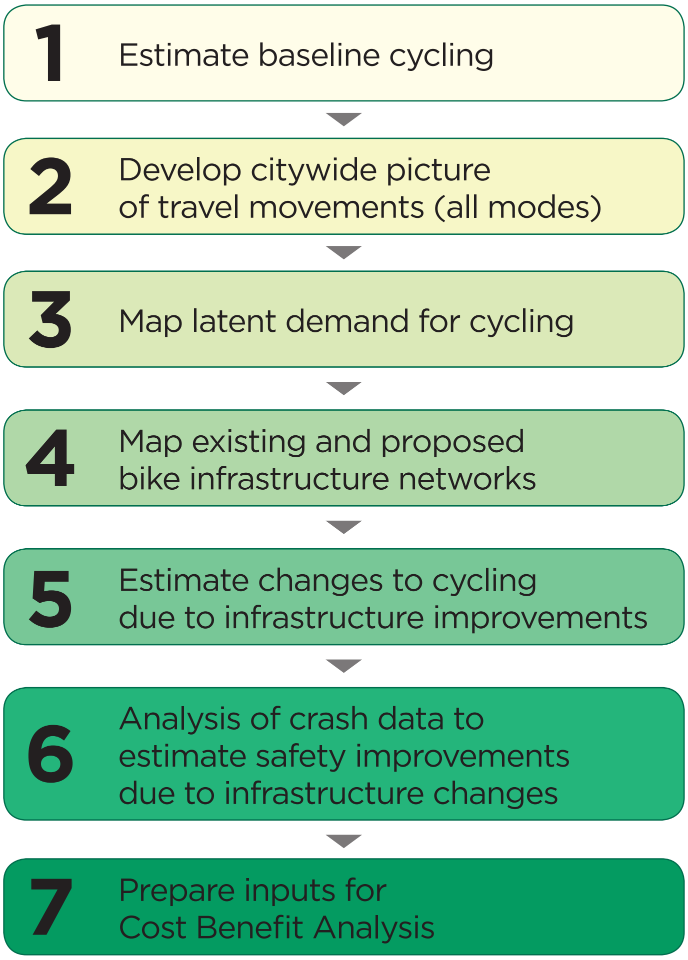


Figure 1: Bike Network Model - 7 step process

1. Estimate baseline cycling

An essential first step in the Model is the development of baseline cycling levels.
Figure 2 shows the Model's output with thicker, darker lines indicating higher estimated cycling volumes. Clients are also provided with a digital version, allowing them to see a clickable map, in which the user is able to zoom in to see estimated volumes for every street in their network. The Model uses a combination of Strava and bicycle count data to create a series of regression models to estimate bicycle volumes. This moderates for the fact that people using Strava are more likely to have recreational rather than transport cycling patterns.

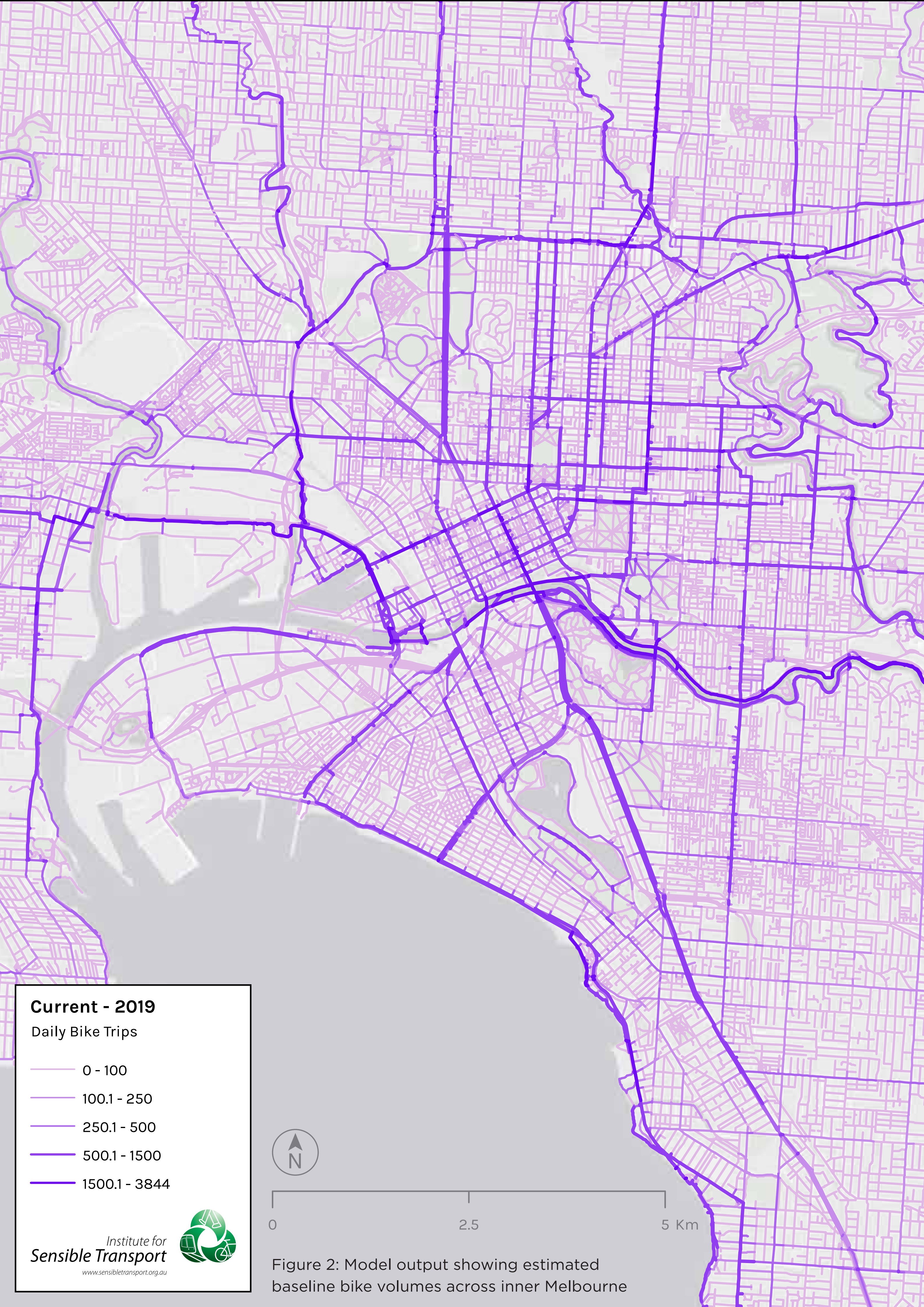


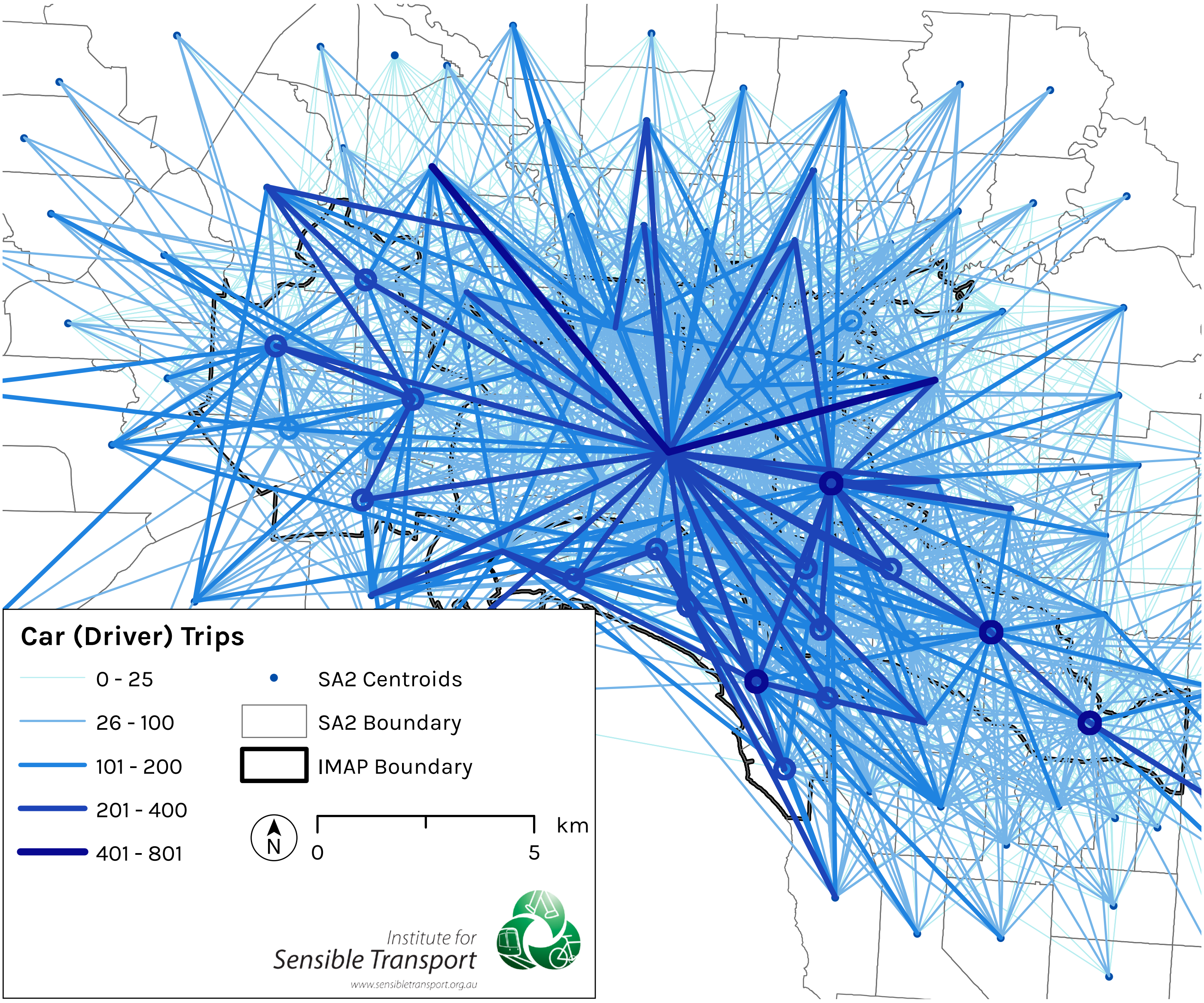
Figure 2: Model output showing estimated baseline bike volumes across inner Melbourne

2. Develop citywide picture of travel movements (all modes)

In addition to developing an understanding of current cycling patterns, the Model uses Census data to develop a picture of transport movements across all modes between given origins and destinations. We then assign these movements to the road network. This helps in determining the number of potential new bike riders, depending on the level of new infrastructure proposed.

As an example, Figure 3 shows the graphical distribution of car driver trips between SA2s[1] for trips to work. This is used as a starting point to understand the potential shift towards cycling. The circles that can be seen in Figure 3 indicate trips that start and end within the same SA2, whereas the lines represent trips between different SA2s.

Figure 3: Car driver trips between SA2s within inner Melbourne



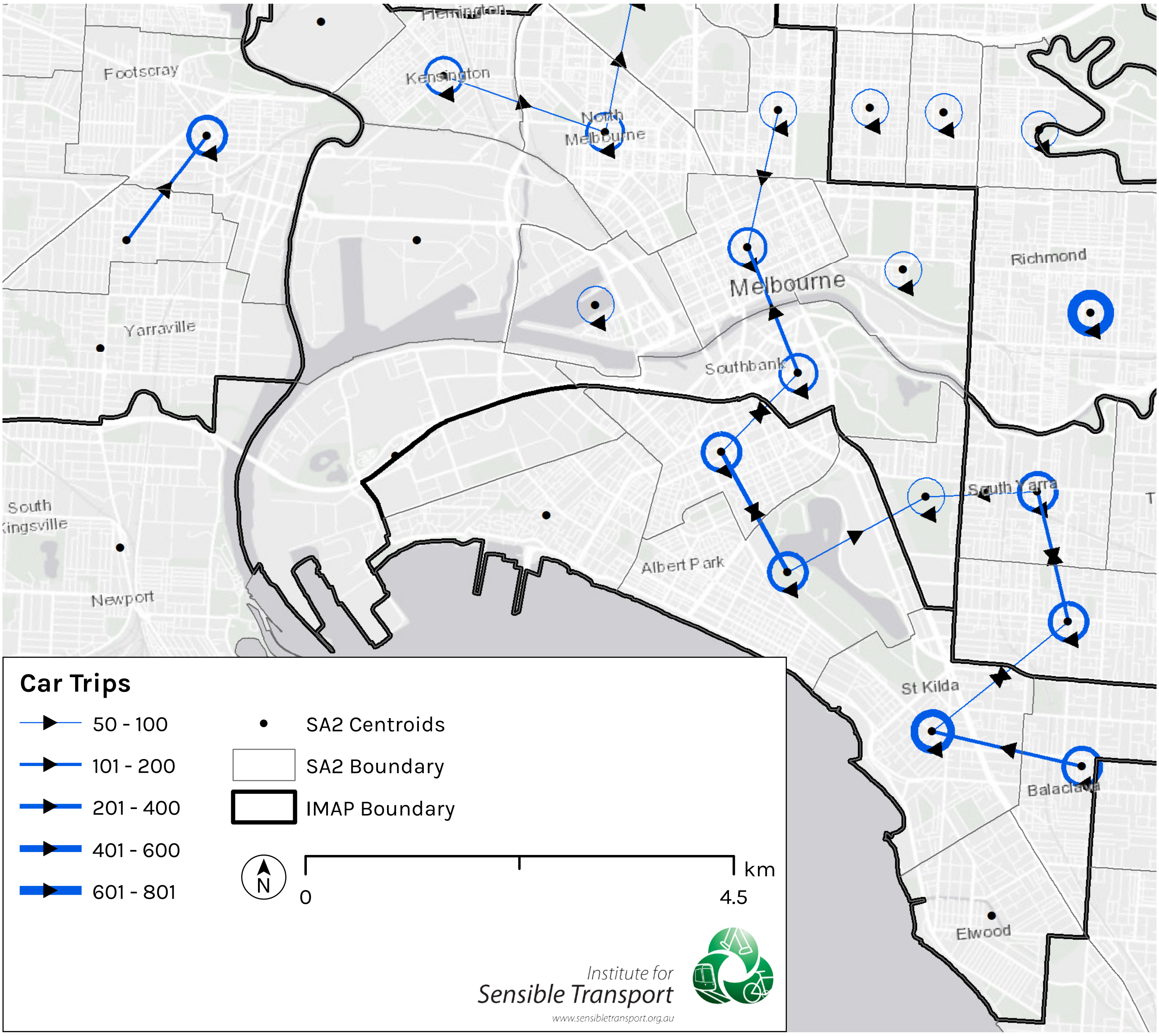
[1] An ABS geographic area intended to represent a community that interacts together socially and economically. See https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1270.0.55.001~July%202016~Main%20Features~Statistical%20Area%20Level%202%20(SA2)~10014

Our Model was able to show that approximately 31,000 car trips to work start and finish in the same suburb in inner Melbourne. This highlights the potential for shifting short distance car trips to cycling.

Data analysis undertaken in the development of the Model can also help cities understand where short distance car trips are happening most. The circles shown in Figure 4 illustrate the part of inner Melbourne in which relatively large numbers of daily short (i.e. 2 – 4km) trips occur.

Where a circle is shown, it indicates trips that start and finish within the given SA2 boundary, while the thickness indicates number of trips. The suburb of Richmond is the standout, with very high numbers of short distance car trips at peak hour.

Figure 4: Areas with the greatest capacity for converting short distance car trips

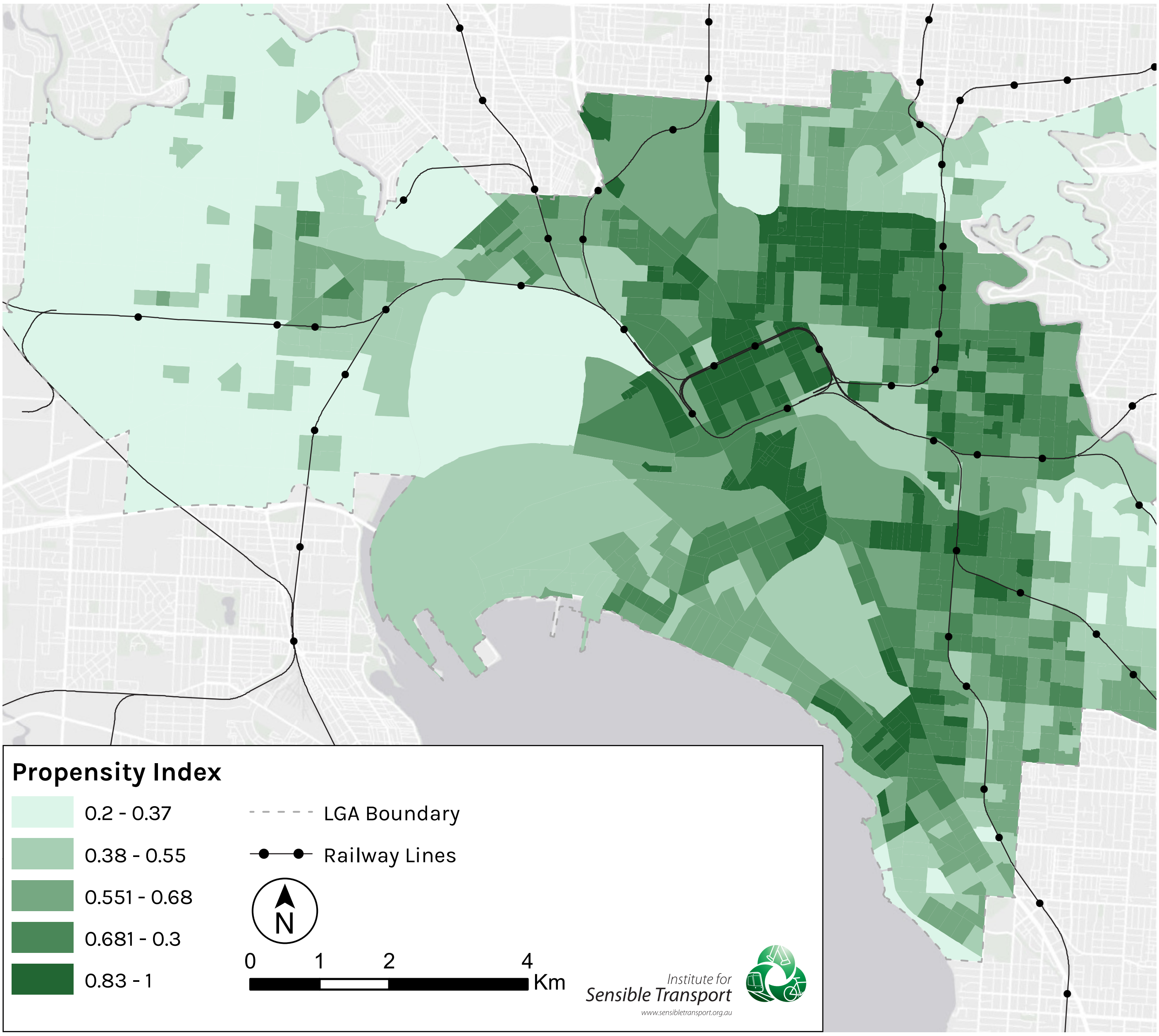


3. Map latent demand for cycling

High quality, protected bike infrastructure can be expensive – up to $11m per kilometre in some cases. It is therefore important to target investment in the areas likely to result in the strongest uptake in cycling. Our Model uses a Bike Use Propensity Index to show the spatial variation in propensity to cycle.

This Index uses 8 Census-collected variables that have been found in peer reviewed research to be statistically significant predictors of bike use. Each of the 8 variables have been produced in a map, and each map layered over the top of one another, to create an Index, which is shown in Figure 5. The darker the shade, the higher the propensity (latent demand) for cycling.

Figure 5: Bike Use Propensity Index, Inner Melbourne

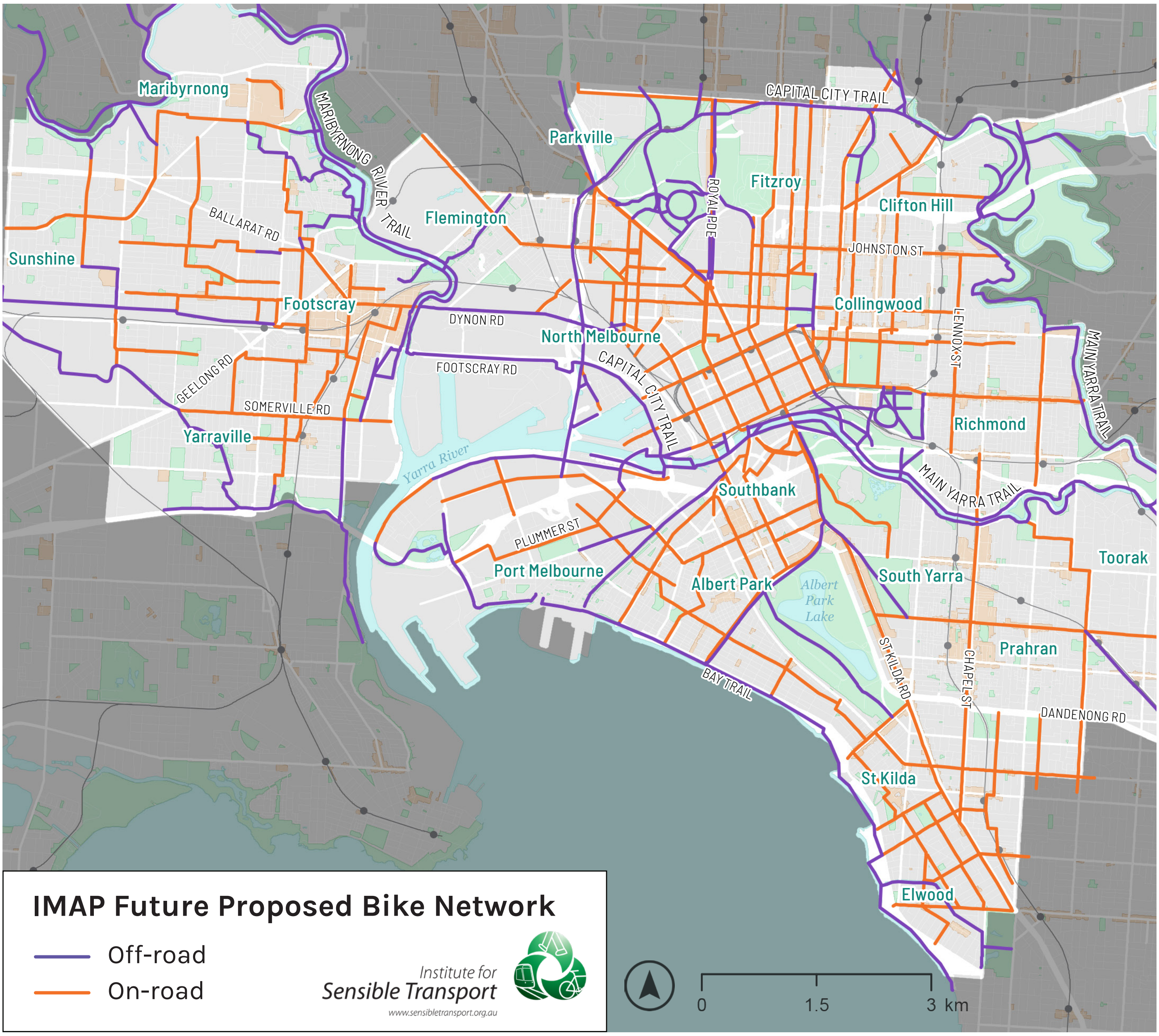


4. Map existing and proposed bike infrastructure network

The Model requires a GIS assessment of the existing and proposed bicycle infrastructure. This is critical, as the Model relies on the differences in the level of attractiveness between the current and future bicycle infrastructure.

When the proposed network is integrated with the existing bicycle infrastructure, the Model is able to forecast changes to ridership levels. These boost rates are based on empirical research of increased likelihood to cycle for different riding environments (e.g. protected bike lane, buffered bike lane, etc).

Figure 6: Inner Melbourne's existing and proposed (future) bike network



5. Estimate changes to cycling due to infrastructure improvements

Several scenarios are built into the Model, including Business as Usual (which broadly assumes the bicycle infrastructure network stays the same), as well as Full Build scenarios, in which all of the proposed infrastructure is implemented. These scenarios also integrate government population growth rates. The uplift in cycling is a function of the changes to bike infrastructure and population growth, at the SA2 level. An example of the Model output – for inner Melbourne's local government areas – is provided in Figure 7.

The estimates shown in Figure 7 hide the increase on specific streets proposed to undergo significant improvements to bicycle infrastructure. The Model is able to estimate growth at each point within a city's street and path network. This found an estimated 80% growth in cycling kilometres travelled on the future protected network.

The Model provides estimated bicycle flows across each street and path within a city's transport system as percentages (see Figure 8), and daily bicycle trips (see Figure 9). We are also able to provide this to clients as a dynamic web-based tool, allowing the user to zoom in and click to see estimated rider volumes on specific streets.

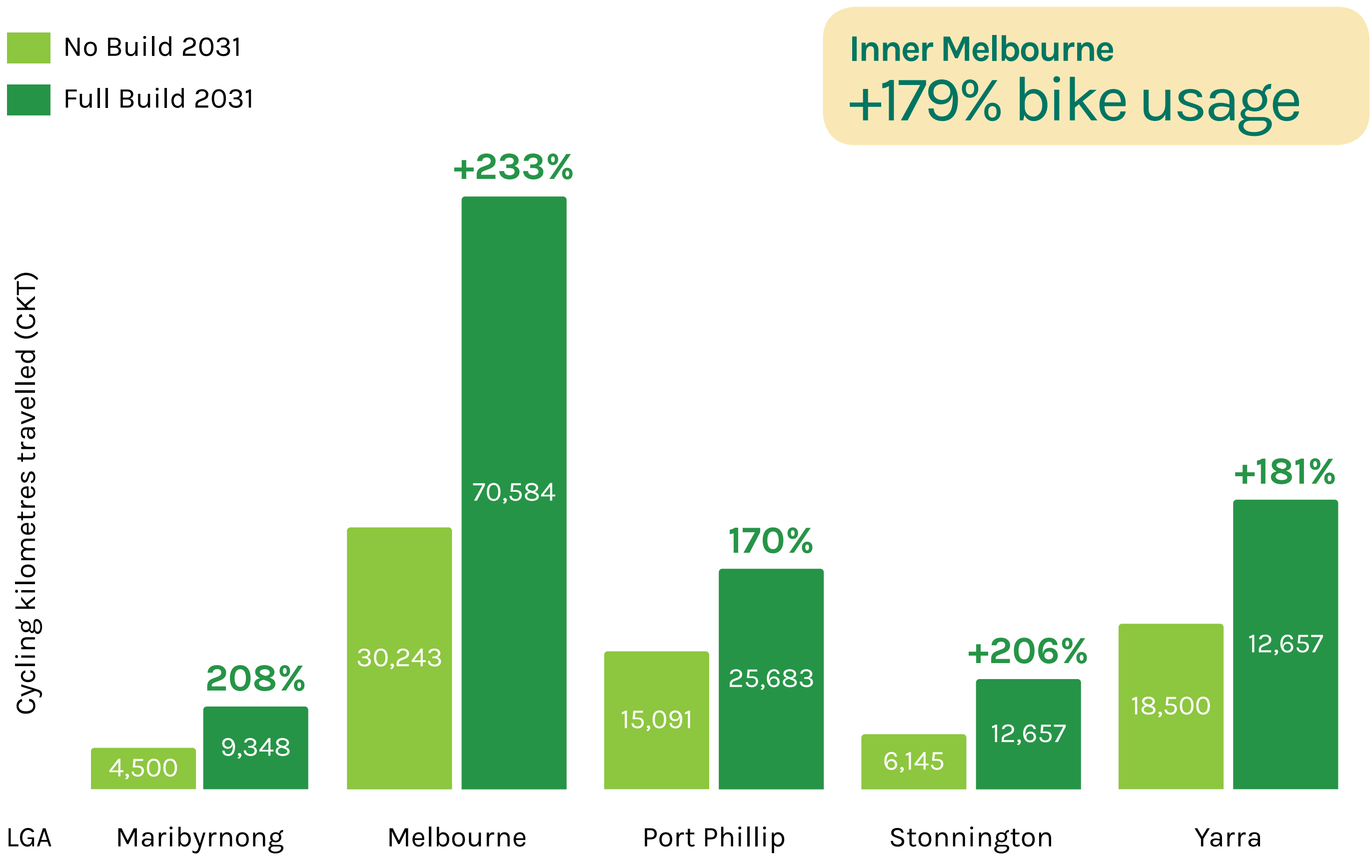


Figure 7: Increase in cycling kilometres travelled (CKT) due to infrastructure changes

Figure 8: Percentage growth in bike riding on the proposed network

When applied in inner Melbourne, on streets slatted for protected bike lanes, the Model estimated an 80% growth in cycling numbers.

What to build first?

Many transport agencies have developed extensive proposed cycling networks, but it can be difficult to determine what to build first. A key benefit of the Model is its ability to determine which sections of the bike network offer the highest boost in ridership.

Our Model allows government planners to decide which sections of the network to build first, to ensure the biggest benefits can be delivered earliest. It also helps provide a sense check on the proposed network and identify corridors with high potential for further refinement.

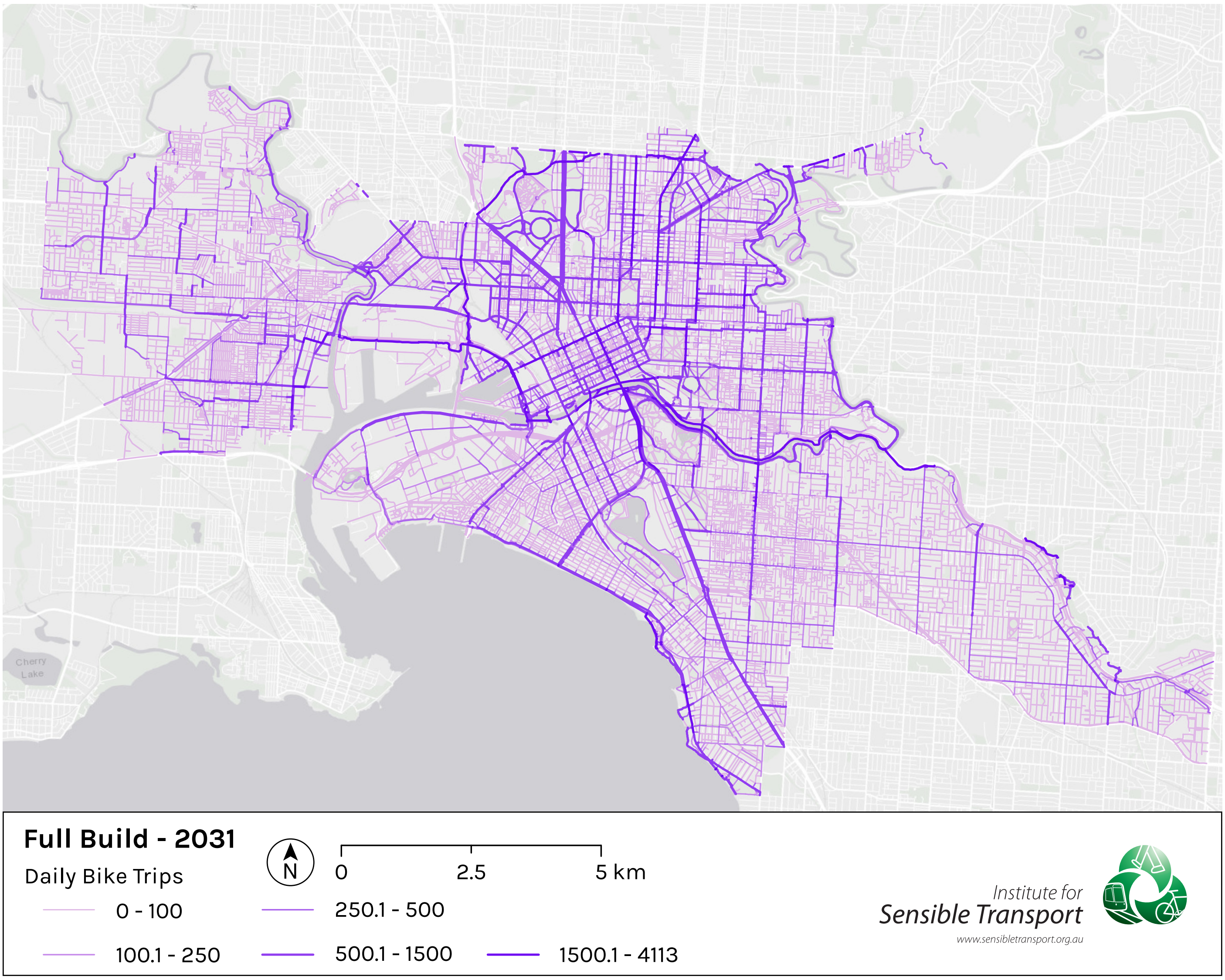


Figure 9: The Model's estimated bike volumes once the network is fully built
NB: The above estimates include population growth to 2031 from ID.com.au

6. Analysis of crash data to estimate safety improvements due to infrastructure changes

A detailed analysis of crashes over the last five years is included in the Model. This includes an examination of cycle crash severity, the type of street and the presence of any bike infrastructure. These factors, combined with the Model's estimate of cycling volumes is able to highlight existing crash risk, as well as the forecast risk following changes to bicycle infrastructure.

Interestingly, the analysis was able to identify that 80% of crashes took place on just 10% of the road network. The 10% of streets in which 4 out of five crashes occurred is highlighted in Figure 10.

Analysis conducted for this project found that fully constructing the proposed network is estimated to reduce the total number of crashes by 10% while increasing bike usage by up to 180%.

Figure 10: The 10% of streets in which 80% of crashes occurred

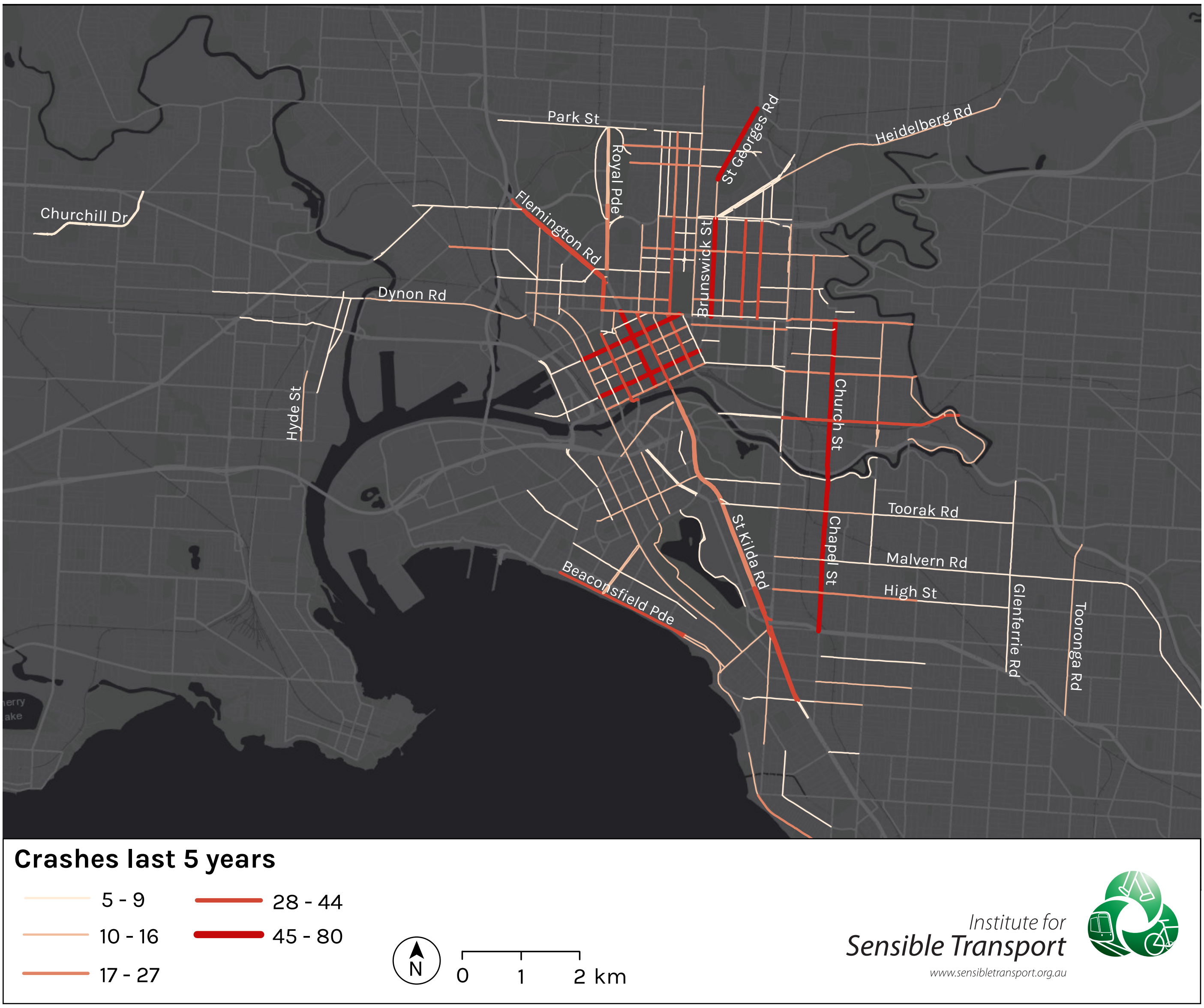
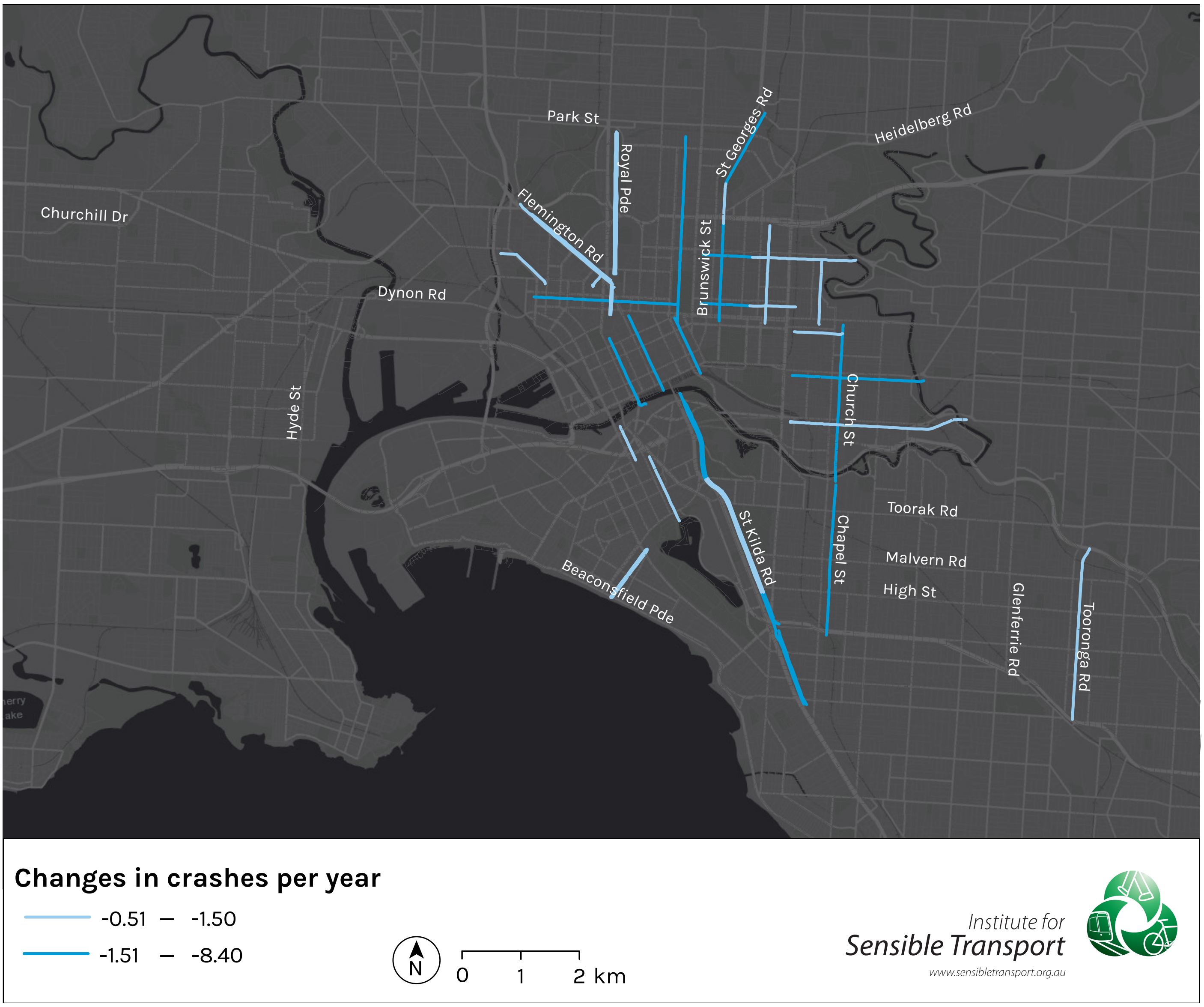


Figure 11 shows which sections of the road network are projected to have the greatest decreases in crashes per year due to infrastructure upgrades. As safety benefits often provide the biggest portion of economic benefits to bike infrastructure, building those sections of the network first would likely provide the biggest safety benefits first.

Our Model is able to identify the '*quick wins*' in the development of the cycle network, based on existing and latent demand for cycling, as well as crash risk. This helps government develop a safer and more sustainable transport network.

Figure 11: Modelling changes in bike crash exposure



Chapel Street - a case study in bicycle safety

The Model is able to provide detailed crash risk outputs for key streets within a city's transport system. Chapel Street is an iconic retail street in inner Melbourne. It is one of the busiest bike routes in south eastern Melbourne, but also one of the most dangerous.

It has a relatively high number of bike riders as of 2019 and is set to increase substantially by 2031. If the corridor was upgraded to separate motor vehicles and bike riders, it would bring an estimated extra 650 daily bike trips, to a total of 2,000 bike trips per day.

Bike riders on Chapel Street

In the last five years, there have been a total of 151 crashes involving a bike rider on Chapel Street. Of those, 26 were admitted to hospital and one bike rider was killed. Another 124 crashes involved 'other injuries'.

The following points outline the key safety implications for Chapel Street:

- On average, a bike rider is involved in a crash on Chapel Street every 12 days
- For each bike crash on Chapel Street, there is a 20% chance the bike rider will be hospitalised
- Every second bike crash on Chapel Street is caused by someone opening their car door into the path of a person on a bike
- In the last 5 years, bike crashes on Chapel Street have cost society approximately $30 million
- If no change in infrastructure takes place, the rate of bike crashes on Chapel Street will increase to one every 10 days by 2031
- If no change in infrastructure is undertaken and the same crash trends continue, the projected costs to society resulting from bike crashes on Chapel Street will be $72 million in the next 10 years

Many cities have busy streets like Chapel Street, with high demand for cycling but low levels of safety. The Bike Network Model offers a data-led assessment of identifying these streets and highlighting the safety implications for improving bicycle infrastructure.

Highlighting gaps in the network

As part of the development of the Bike Network Model, an analysis is undertaken of the existing and proposed bike infrastructure network, to highlight potential network gaps. Figure 12 has overlayed the future bike infrastructure network, our Bike Use propensity Index and highlights some of the key gaps.

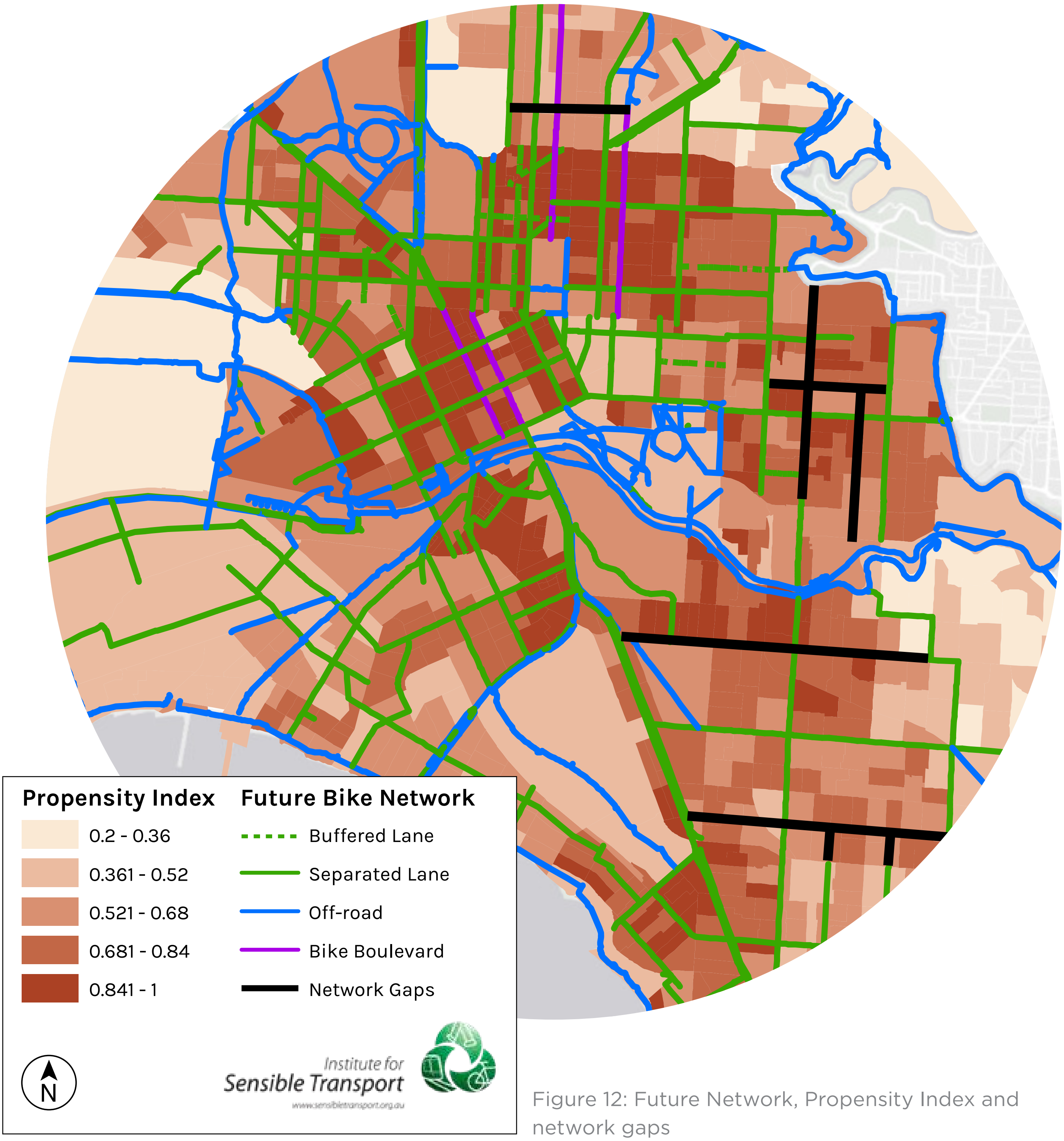


Figure 12: Future Network, Propensity Index and network gaps

7. Prepare inputs for cost benefit analysis

A useful outcome of the Bike Network Model is the ability to produce the inputs necessary for cost benefit analysis. The simplified steps shown in Figure 13 use the outputs developed by the Model to allow for cost benefit analysis. In essence, the Model's estimates for the quantum of cycling that results from the infrastructure improvements, and the value if this cycling is monetised (a $/km rate), and this is then compared to the high-level cost of building and maintaining the proposed infrastructure, based on recent projects.

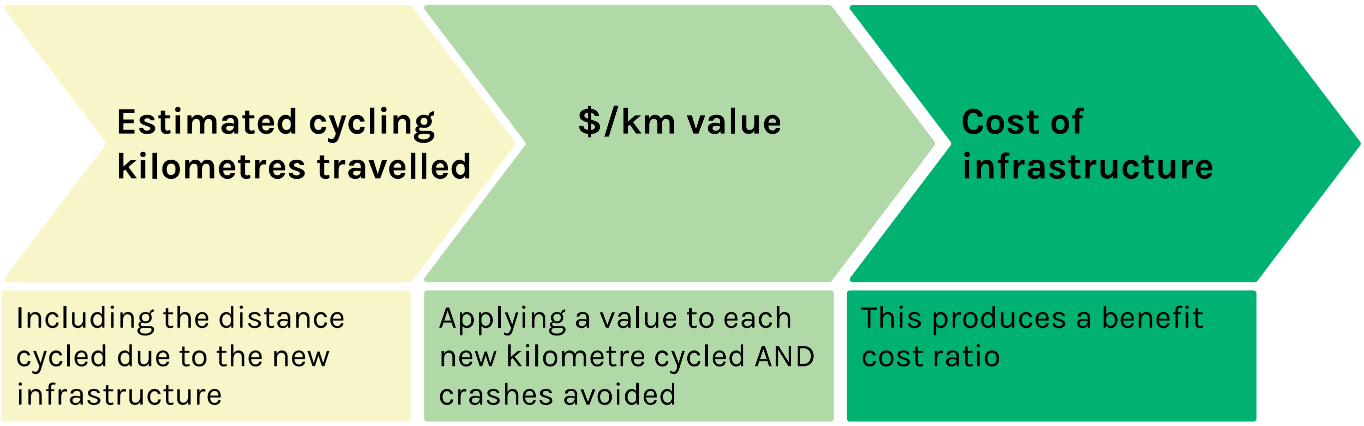


Figure 13: The Model outputs can be used to develop cost benefit analysis

Get in touch

Dr Elliot Fishman

Director

Institute for Sensible Transport

E: info@sensibletransport.org.au

P: 1300 952 759

www.sensibletransport.org.au

102/1 Silver Street, Collingwood

Melbourne, Australia VIC 3066

ABN 78 504 466 884

Institute for Sensible Transport

www.sensibletransport.org.au