Prioritisation of IMAP Proposed Bike Network

Prepared for IMAP Councils

July, 2020

Institute for Sensible Transport

Prepared by

Liam Davies, Vaughn Allan, Dr Elliot Fishman
and Gary Tong

Institute for Sensible Transport

ABN 78 504 466 884
102/1 Silver Street, Collingwood
VIC Australia 3065
E: info@sensibletransport.org.au
www.sensibletransport.org.au

Contents

Figures

Tables

Glossary

ABS – Australian Bureau of Statistics

CKT – Cycling Kilometres Travelled

DoT – Department of Transport (Victoria)

IMAP – Inner Melbourne Action Plan

LGA – Local Government Area

SA1 – Statistical Area Level 1 (ABS)

SA2 – Statistical Area Level 2 (ABS)

STRAVA – An activity tracking App popular with bike riders, especially those interested in fitness/competitive cycling

VISTA – Victorian Integrated Survey of Travel and Activity

1. Executive Summary

The global COVID-19 pandemic has radically altered cultural and economic conditions in Melbourne. The way we travel has changed dramatically, as physical distancing requirements have disrupted public life. Public transport usage has dropped dramatically and patronage levels will need to remain low to reduce the spread of COVID-19. Bike use has emerged as one way to sustainably maintain physical distancing during the pandemic.

To help people safely get around, and reduce passenger loads on public transport, cities across the globe have been rapidly building pop-up protected cycling lanes. In June 2020, the City of Melbourne committed to the rapid delivery of 40km of new high quality and protected bike lanes. These new bike lanes will be delivered in two stages with Stage One construction to commence immediately. The IMAP *Bicycle Network Model* has identified that four of the committed City of Melbourne projects within Stage One are key priority projects that will support significant growth in people cycling.

This report outlines options for extending the rapid delivery of new high quality and protected bike lanes to the surrounding Local Government Areas of Maribyrnong, Yarra, Stonnington, and Port Phillip. In total, 146km of bike infrastructure is proposed, across two stages, with several priority routes identified within Stage One.

The results show that when Stage Two is completed, cycling across the bike network is estimated to increase by 22%, with cycling on all streets in the five Local Government Areas increasing by 17% (see Figure 1). This is the equivalent of approximately 11,763 new bike trips, by comparison, there were 24,442 work related bike trips across all five LGAs at the 2016 Census.

Building the network is estimated to increase bike use in inner Melbourne by 17%.

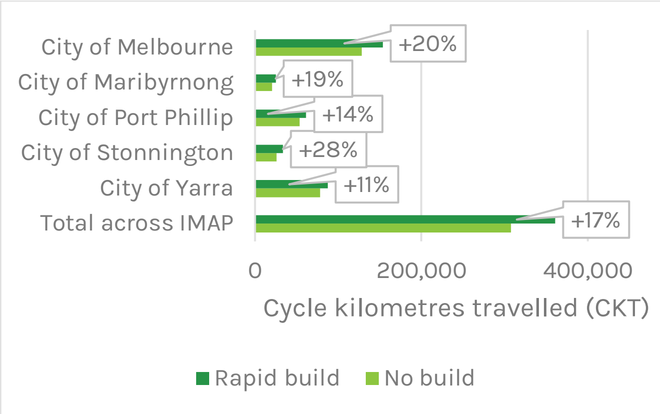

Figure 1 Projected increase in CKT from rapid build of the proposed network

In the last five years, there have been 3,061 reported crashes involving people on bikes in IMAP councils. Of these, 555 have occurred on proposed Priority Routes, and 1,609 across both stages of the proposed network – 53% of all crashes. High-level analysis reveals approximately one third of these crashes could have been avoided if protected bike infrastructure was provided.

53% of all bike crashes in the last five years occurred on streets in the proposed network.

Development of these bike lanes would build a cohesive and connected bike network across the inner city. During the COVID-19 pandemic this will be critical in reducing public transport loads to levels where safe physical distancing is possible. These routes will provide public transport users on some of Melbourne's busiest tram routes (e.g. routes 11, 19, 86, 96, the St Kilda Road corridor) and busiest railway lines (Mernda, Dandenong, and Watergardens) with safe alternatives.

2. Background

In June 2020, the City of Melbourne committed to the rapid delivery of 40km of new high quality and protected bike lanes, to address the transport challenge brought about by the COVID-19 pandemic. These 40kms of new bike lanes with planned delivery in two stages in two stages, of 20km each. Four projects within Stage One have been identified as priority projects for immediate development. In total, this amounts to the creation of approximately half of the City of Melbourne's proposed cycling network.

This report outlines options for extending this rapid delivery of new high quality and protected bike lanes to the surrounding Local Government Areas of Maribyrnong, Yarra, Stonnington, and Port Phillip. As is the case with the City of Melbourne, in each LGA approximately half of the planned bike network is identified for development. Two stages have been proposed in each LGA, with several routes in the first stage highlighted as priority routes, for immediate delivery.

When combined, the rapid development of these bike lanes would build a cohesive and connected bike network across the inner city. This will be critical in reducing public transport loads to levels where safe physical distancing is possible. With this in mind, the network has been designed to parallel key public transport corridors, and be developed in a logical and interconnected manner.

2.1 The IMAP Bicycle Network Model

The IMAP group of councils completed a *Bicycle Network Model* in early 2020. This Model delivered an estimated daily number of people riding on each street and path in inner Melbourne. It also estimated the uplift in bike riding if the full proposed bicycle network across IMAP councils and the *Strategic Cycling Corridors* were constructed.

This project uses the *Bicycle Network Model* to prioritise proposed bicycle routes in the IMAP catchment.

2.2 COVID-19 and the role of cycling

The threat of COVID-19 has caused the largest shift in travel behaviour in recent memory. At the height of the first lock down, motorised traffic volumes were down by up to 80%, yet travel on some of Melbourne's shared paths more than doubled. When travel restrictions ease in Melbourne, more people are expected to resume their commute, but seven in eight former peak public transport commuters will need to find alternative solutions to keep loadings at safe levels.

Public transport plays the vital role of bringing hundreds of thousands of people into the Melbourne CBD every day. Indeed some 60-70% of Melbourne CBD workers arrive by public transport, mostly on crowded trains.

Australia's Chief Medical Officer and his state-based colleagues have made it clear that one person per $4m^2$ is the desired density of people to reduce the chance of infection. Public transport, especially at peak hour has densities exceeding this limit by a factor of 8.

2.2.1 Why is this important for cycling?

Cycling has emerged as a popular way for meeting transport and physical activity needs during COVID-19. Bicycle sales and ridership has risen dramatically in cities globally. Figure 2 compares peak public transport numbers pre-COVID-19 (left hand column). The right-hand column brings public transport loadings down to the level of one person per $4m^2$, which presents a ~6 fold reduction in public transport use. Cycling is identified as one method of reducing public transport crowding. The right-hand column of Figure 2 includes an exploration of how alternative options might grow to make up for the much lower public transport ridership. This includes an extra 50,000 people cycling to work during peak hour in order to contribute to the task of making public transport safe for those that have to use it. This represents more than a doubling of the number of cyclists on the road compared to pre-COVID-19 and is unlikely to be achieved without a substantial increase in the network of high quality, protected bicycle infrastructure.

Figure 2 Comparing pre-COVID-19 and Pandemic travel, Melbourne[1]

2.3 Objectives of this project

This project is designed to assist inner Melbourne prioritise its future cycling network by:

1. Assessing ridership growth on the proposed cycle infrastructure routes in the IMAP councils
2. Analysing network cohesiveness, in terms of the ability of future routes to connect with the 40km of bike routes committed by the City of Melbourne.
3. Focusing on a future network that can act as an alternative option for public transport users, in an effort to reduce over-crowding.

[1] See https://sensibletransport.org.au/project/keeping-australians-safe-as-they-travel-to-work-during-the-pandemic/

3. The overall network

The proposed bike infrastructure network in the IMAP member councils have been prioritised based on their alignment with the City of Melbourne's recently proposed network in response to COVID-19, as well as the other factors described earlier. Figure 3 identifies the *Priority Routes*, the proposed *Stage One* of network development, and the proposed *Stage Two* of network development. Refer to each Council section for details relating to ridership growth for the priority routes and for each stage.

Table 1 provides an overview of the increase in daily cycling kilometres travelled on the bike network, and the daily cycling kilometres travelled on other roads, for each stage of the proposed bike network delivery. Lastly, it shows this increase represented as equivalent number of new bike trips (assuming an average trip distance of 4.5km).

It is estimated that upon completion of Stage Two, cycling across the bike network would increase by 22%, with cycling on all streets in the five LGAs increasing by 17%. This is the equivalent of 11,763 new bike trips each day (assuming an average trip distance of 4.5km) – by comparison, there were 24,442 work related bike trips recorded across all five LGAs at the 2016 Census (assuming two trips per day for every bike commuter).

In the last five years, there have been 3,061 reported crashes involving people on bikes in the IMAP councils. Of these, 555 have occurred on proposed Priority Routes, and 1,609 across both stages of the proposed network – 53% of all crashes. High-level analysis reveals approximately one third of these crashes could have been avoided if protected bike infrastructure was provided.

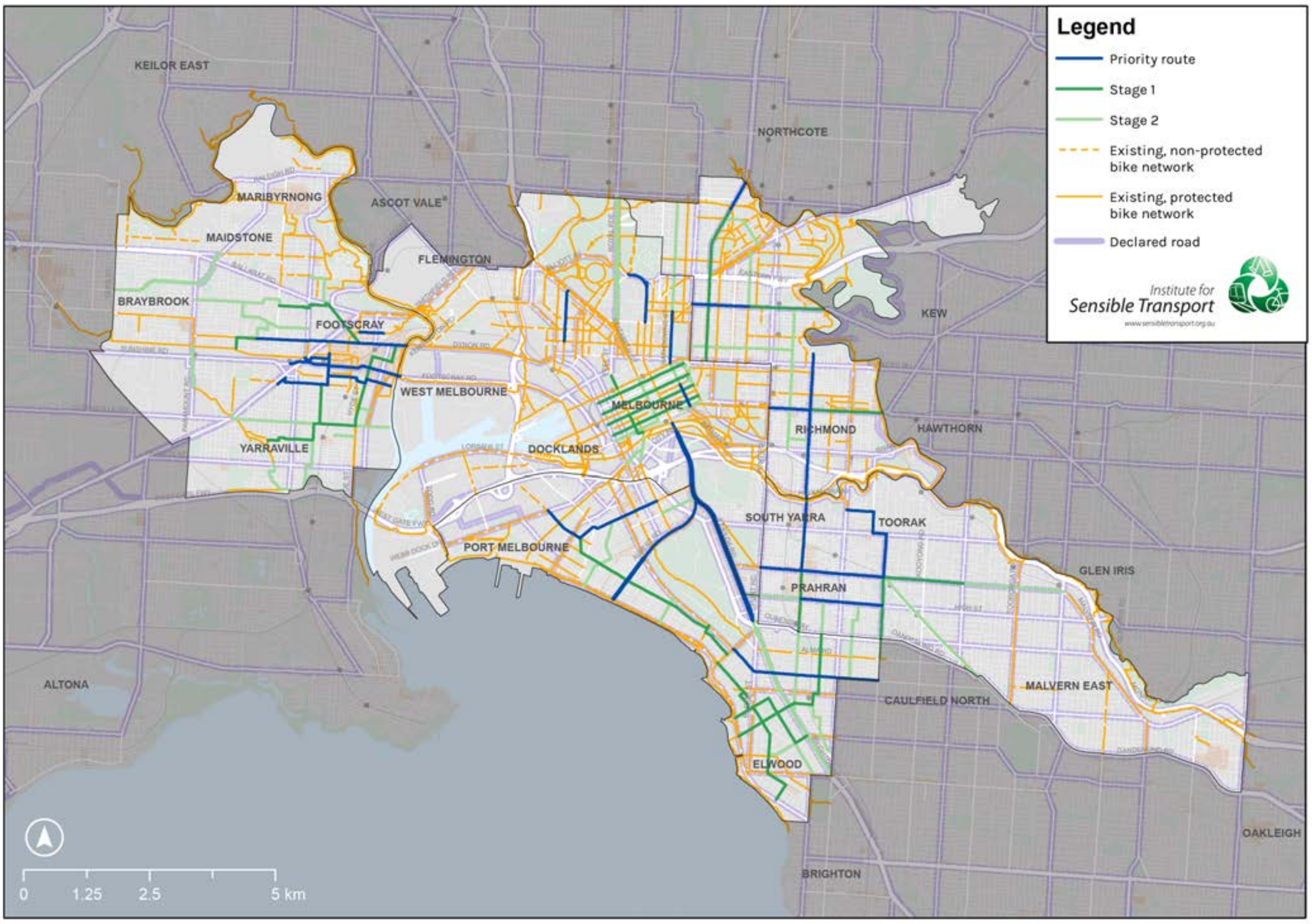

Figure 3 IMAP - Priority Routes, Stage One and Stage Two

Table 1 IMAP - Estimated daily Cycling Kilometres Travelled for each scenario

Bike Network	CKT on bike network (% increase from current)	Total CKT across area (% increase from current)	New bike trips (CKT equivalent)
Existing bike network	215,269	307,315	
Priority routes developed	245,272 (14%)	343,241 (12%)	7,983
Stage One completed	254,434 (18%)	352,846 (15%)	10,118
Stage Two completed	262,304 (22%)	360,579 (17%)	11,836

3.1 Effect on public transport

To meet physical distancing requirements, passenger loadings on public transport need to reduce significantly. Development of Stage One and Two of the bike network will significantly assist this task, by providing many public transport users with safe, direct, and comfortable alternatives to travel to work. This will assist in reducing public transport loads, making it safer for those that have no alternative.

In each LGA specific section, public transport alternative routes are outlined. Ten highlighted routes are:

1. St Kilda Road and Swanston Street, for tram users across multiple routes.
2. Royal Parade, for tram route 19 and Brunswick railway station users.
3. Rathdowne Street, for tram route 1/8 and 96, and bus route 250/251 users.
4. Hopkins Street, Sunshine Road, Buckley Street and Hopkins Road for West Footscray, Middle Footscray and Footscray railway station users.
5. Albert Road for tram route 12 and 96 users.
6. Dorcas Street tram route 1 and 12 users.
7. Caulfield Railway Line path and Bruce Street Route, for tram route 58 and 72, and Toorak, Armadale and Malvern railway station users.
8. St Georges Road and Brunswick Street for tram route 11 and 96 users and Mernda railway line users in City of Darebin.
9. Bridge Road for tram route 48 and 75 users.
10. Wellington Street for tram route 86 users.

These routes will provide public transport users on some of Melbourne's busiest tram routes (e.g. routes 11, 19, 86, 96, the St Kilda Road corridor) and busiest railway lines (Mernda, Dandenong, and Watergardens) with safe alternatives.

It should be noted that the capacity provided by these high quality and protected bike routes is greater that the projected use in this model. This provides the extra capacity the network will need to meet the increased demand in bike use infrastructure during the COVID-19 pandemic, which cities around the world have seen when exiting lockdowns.

4. Detailed results

4.1 City of Melbourne

The City of Melbourne has recently announced Stage One and Stage Two for delivering 40km of bike infrastructure. These planned routes have been used to model the future network. However, in addition to announced projects, Rathdowne Street between Grattan Street and Princes Street has been included in Stage Two. This is to support the development of Rathdowne Street in the City of Yarra. The City of Melbourne should coordinate with the City of Yarra to develop this corridor simultaneously. The entire of St Kilda Road has been identified as a Priority Route. This is to be developed in collaboration with the City of Port Phillip and the Victorian Department of Transport.

Figure 4 identifies Stage One (including Priority Routes), and Stage Two of the proposed network in the City of Melbourne. The projected increase in cycling from the development of the Priority Routes, Stage One routes, and Stage Two routes is shown in Table 2, while Table 3 provides the detailed outputs for each of the Priority Routes.

It is estimated that upon completion of Stage Two, cycling across the bike network would increase by 24%, with cycling on all streets in the City of Melbourne increasing by 20%. This is the equivalent of 5,572 new bike trips each day (assuming an average trip distance of 4.5km) – by comparison, there were 5,040 work related bike trips recorded at the 2016 Census (assuming two trips per day for every bike commuter).

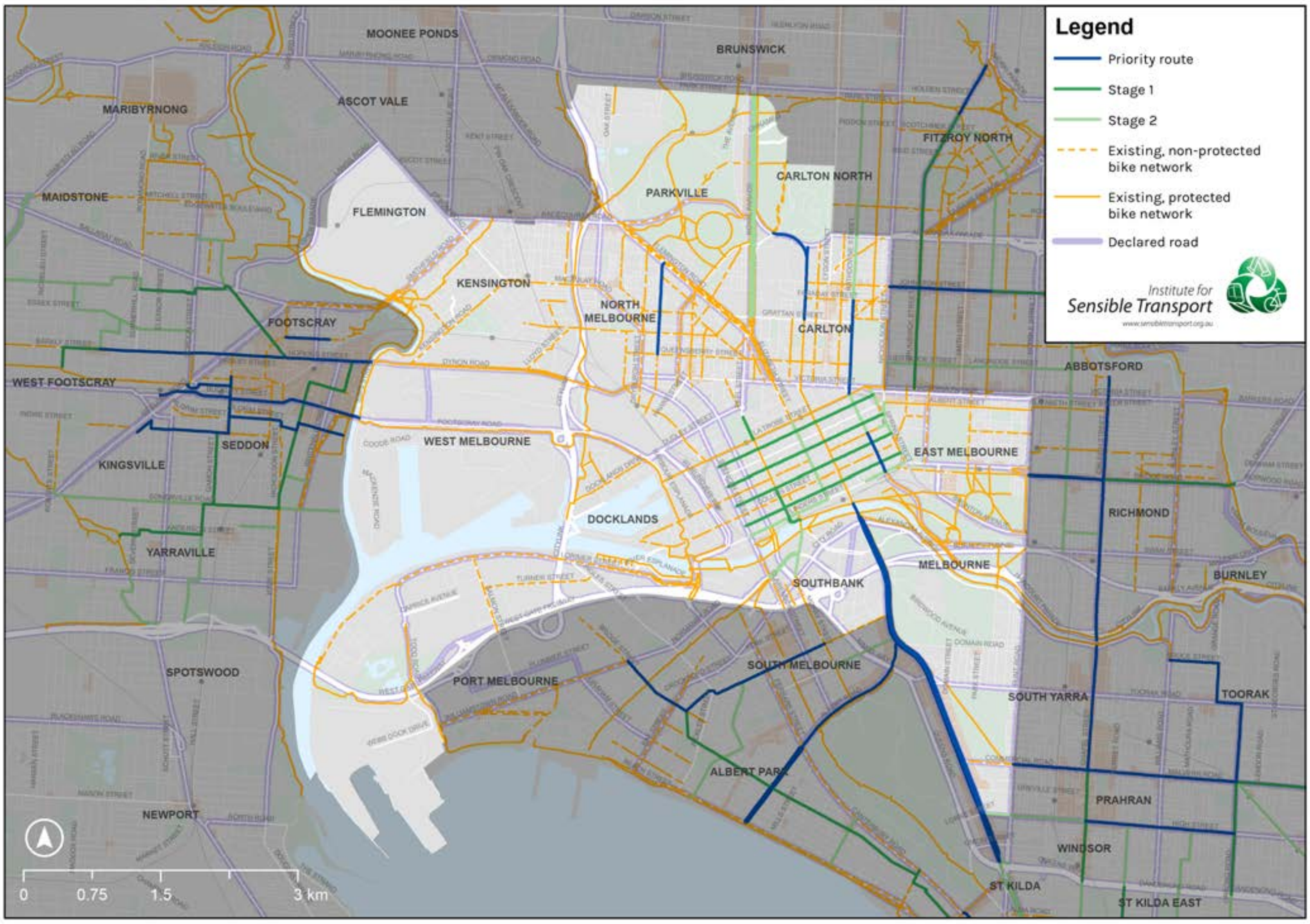

Figure 4 City of Melbourne - Priority Routes, Stage One and Stage Two

Table 2 City of Melbourne - Estimated daily CKT for each scenario

Bike Network	CKT on bike network (% increase from current)	Total CKT across area (% increase from current)	New bike trips (CKT equivalent)
Existing bike network	96,526	128,153	
Priority routes developed	111,179 (15%)	144,602 (13%)	3,655
Stage One completed	116,109 (20%)	149,869 (17%)	4,826
Stage Two completed	119,467 (24%)	153,391 (20%)	5,608

Table 3 City of Melbourne - Priority Routes

Route	Distance (m)	Est daily CKTs	Growth on route (%)
Abbotsford Street, North Melbourne	1,000	283	95%
Swanston Street North (Carlton)	1,200	427	37%
Rathdowne Street (Victoria Street to Faraday Street)	1,000	1,653	13%
Exhibition Street (Flinders Street to Bourke Street)	460	571	50%
St Kilda Road (shared with Port Phillip)	4,400	11,736	20%

Most of the proposed bike lanes are on City of Melbourne controlled streets. However, the following are declared roads, controlled by VicRoads/Department of Transport (shown with a purple halo in Figure 4):

- St Kilda Road (Priority Route in Stage One).
- College Crescent (Priority Route in Stage One).
- Royal Parade (Stage Two).

Routes have been designed to allow public transport users alternative paths into the CBD. These include:

- St Kilda Road and Swanston Street (Priority Route in Stage One), for tram users (multiple routes).
- Royal Parade (Stage Two), for tram route 19 and Brunswick railway station users.
- Abbotsford Street (Priority Route in Stage One), for tram route 58 users.
- Queens Bridge Street (Stage Two), for tram route 58 users.
- Rathdowne Street (Priority Route in Stage One, and Stage Two), for tram route 1/8 and 96, and bus route 250/251 users.

4.2 City of Maribyrnong

The IMAP model considered a total bike network of 112km in the City of Maribyrnong, with 58km to be new or upgraded routes. Of these, five routes, totalling 7km, have been identified as Priority Routes within Stage One (total of 17km), with a total of 32km being added with the completion of Stage Two.

Figure 5 identifies Stage One (including Priority Routes), and Stage Two of the proposed network in the City of Maribyrnong. The projected increase in cycling from development of the Priority Routes, Stage One routes, and Stage Two routes is shown in Table 4, while Table 5 provides the detailed outputs for each of the Priority Routes.

It is estimated that upon completion of Stage Two, cycling across the bike network would increase by 23%, with cycling on all streets in the City of Maribyrnong increasing by 18%. This is the equivalent of 851 new bike trips each day (assuming an average trip distance of 4.5km) – by comparison, there were 2,328 work related bike trips recorded at the 2016 Census (assuming two trips per day for every bike commuter).

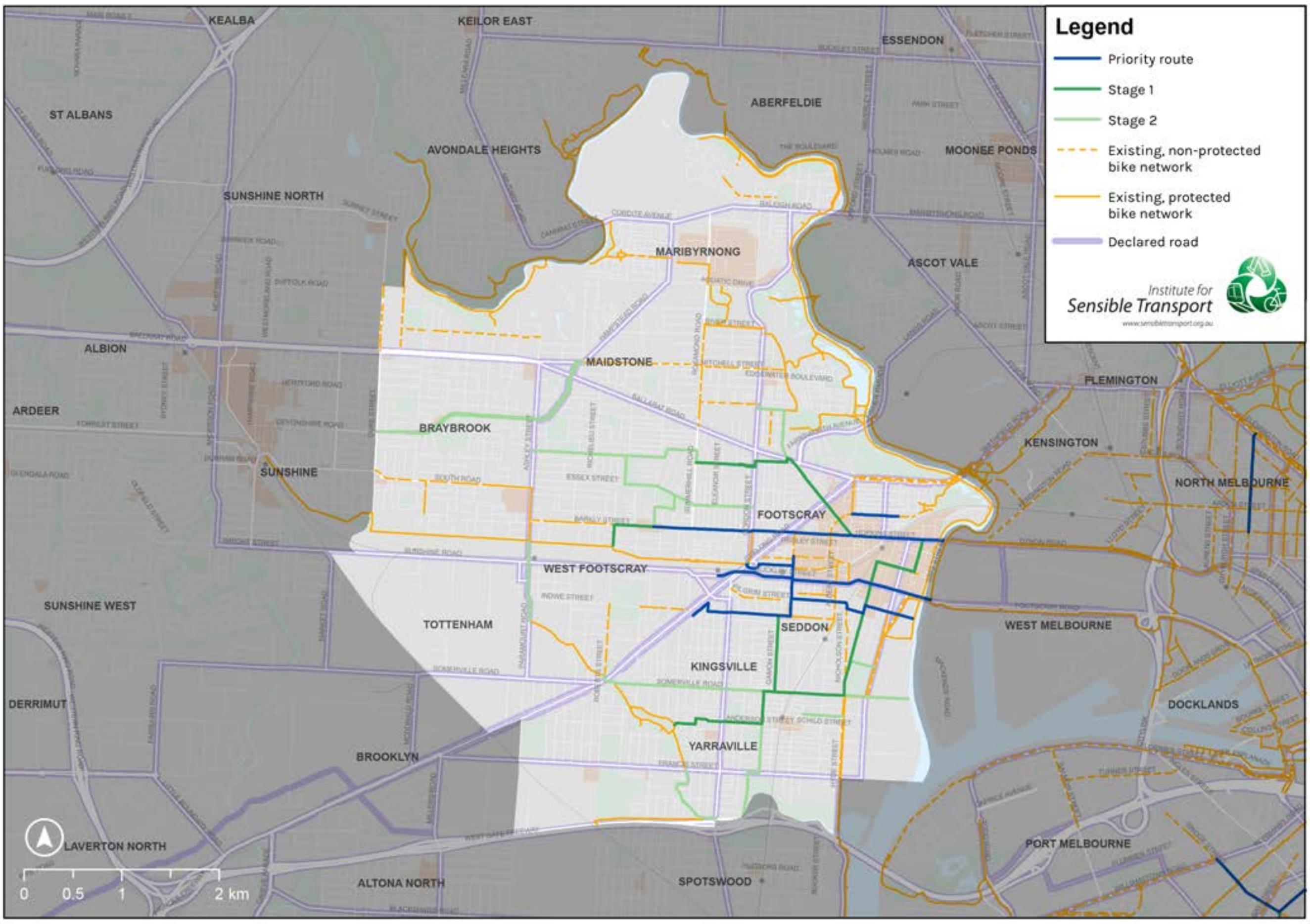

Figure 5 City of Maribyrnong - Priority Routes, Stage One and Stage Two

Table 4 City of Maribyrnong - Estimated daily CKT for each scenario

Bike Network	CKT on bike network (% increase from current)	Total CKT across area (% increase from current)	New bike trips (CKT equivalent)
Existing bike network	14,866	20,869	
Priority routes developed	17,243 (16%)	23,747 (14%)	640
Stage One completed	17,686 (19%)	24,204 (16%)	741
Stage Two completed	18,338 (23%)	24,825 (19%)	879

Table 5 City of Maribyrnong - Priority Routes

Route	Distance (m)	Est daily CKTs	Growth on route (%)
Donald Street, Footscray	500	53	225%
Barkly Street and Hopkins Street	3,000	679	55%
Sunshine Road, Buckley Street, and Napier Street	2,200	784	27%
Pilgrim Street Shimmy (from Geelong Road Service Road to Maribyrnong River)	2,700	1,637	14%
Errol Street and Victoria Street	950	426	14%

Most of the proposed bike lanes are on City of Maribyrnong controlled streets. However, the following are declared roads, controlled by VicRoads/Department of Transport (shown with a purple halo in Figure 5):

- Hopkins Street (Priority Route in Stage One).
- Sunshine Road, Buckley Street, and Napier Street (Priority Route in Stage One).

Routes have been designed to allow public transport users alternative paths into the CBD. These include:

- Hopkins Street (Priority Route in Stage One), into Dynon Road for Footscray railway station users.
- Sunshine Road, Buckley Street and Hopkins Road (Priority Route in Stage One), into Footscray Road for West Footscray and Middle Footscray railway station users.
- Pilgrim Street (Priority Route in Stage One), into Footscray Road for Seddon railway station users.
- Droop Street (Stage One), into Hopkins Street as an alternative for tram route 82 users.
- Sommerville Road and Hyde Street (Stage One), into Footscray Road as an alternative for Yarraville railway station users.

4.3 City of Port Phillip

The IMAP model considered a total bike network of 109km in the City of Port Phillip, with 66km to be new or upgraded routes. Of these, four routes, totalling 17km, have been identified as Priority Routes within Stage One (total of 30km), with a total of 46km being added with the completion of Stage Two. The entire St Kilda Road corridor has been identified as a Priority Route. This is to be developed in collaboration with the City of Melbourne and the Victorian Department of Transport.

Figure 6 identifies Stage One (including Priority Routes), and Stage Two of the proposed network in the City of Port Phillip. The projected increase in cycling from development of the Priority Routes, Stage One routes, and Stage Two routes is shown in Table 6, while Table 7 provides the Model outputs for each of the Priority Routes.

It is estimated that upon completion of Stage Two, cycling across the bike network would increase by 19%, with cycling on all streets in the City of Port Phillip increasing by 14%. This is the equivalent of 1,721 new bike trips each day (assuming an average trip distance of 4.5km) – by comparison, there were 5,226 work related bike trips recorded at the 2016 Census (assuming two trips per day for every bike commuter).

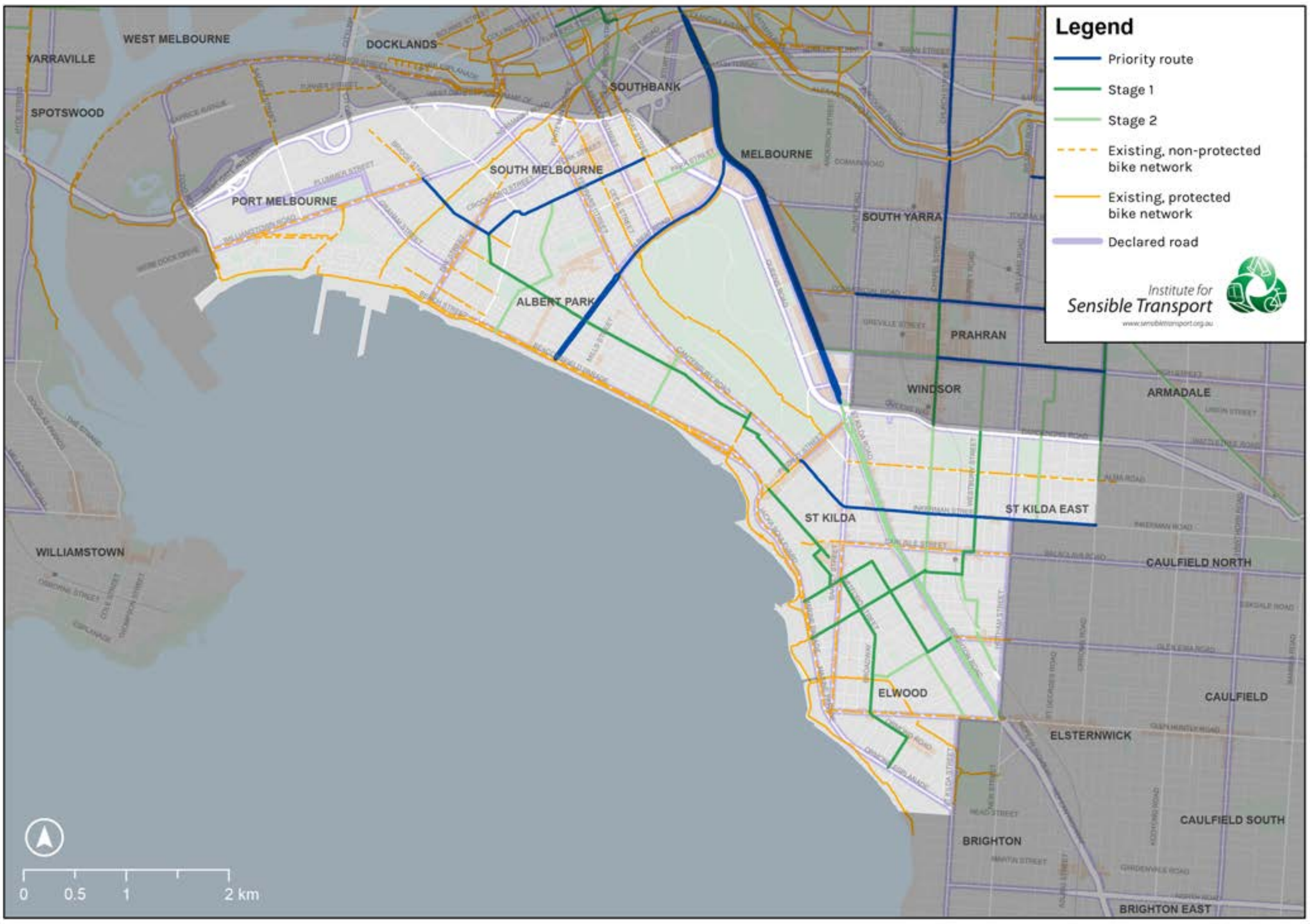

Figure 6 City Port Phillip - Priority Routes, Stage One and Stage Two

Table 6 City of Port Phillip - Estimated daily CKT for each scenario

Bike Network	CKT on bike network (% increase from current)	Total CKT across area (% increase from current)	New bike trips (CKT equivalent)
Existing bike network	35,330	53,844	
Priority routes developed	39,652 (12%)	59,020 (10%)	1,150
Stage One completed	40,717 (15%)	60,119 (12%)	1,394
Stage Two completed	42,219 (19%)	61,603 (14%)	1,724

Table 7 City of Port Phillip - Key Routes

Route	Distance (m)	Est daily CKTs	Growth on route (%)
Bridge Street, Esplanade Avenue, and Dorcas Street	2,500	454	82%
Shrine to Shore (Albert Road and Kerferd Road)	2,500	1881	16%
Grey Street and Inkerman Street	3,100	1053	28%
St Kilda Road (shared with City of Melbourne)	4,400	11,736	20%

Most of the proposed bike lanes are on City of Port Phillip controlled streets. However, the following are declared roads, controlled by VicRoads/Department of Transport (shown with a purple halo in Figure 6):

- St Kilda Road (Princes Bridge to St Kilda Junction) (Priority Route in Stage One).
- Albert Road and Kerferd Road (Priority Route in Stage One).
- St Kilda Road (South of St Kilda Junction) and Brighton Road (Stage Two).

Routes have been designed to allow public transport users alternative paths into the CBD. These include:

- St Kilda Road and Brighton Road (Priority Route in Stage One and Stage Two), for tram users (multiple routes).
- Albert Road (Priority Route in Stage One), into Moray Street, for tram route 12 and 96 users.
- Dorcas Street (Priority Route in Stage One), into Moray Street for tram route 1 and 12 users.
- Inkerman Street (Priority Route in Stage One), into St Kilda Road for Balaclava railway station users
- Acland Street (Stage One), into Fitzroy Street and St Kilda Road for tram route 96 users.
- Richardson Street, Longmore Street, and York Street (Stage Two), into Albert Road and Moray Street, for tram route 12 and 96 users.
- Nelson Road, Moubray Street and Bridport Street West (Stage Two) into Dorcas Street and Moray Street for tram route 1 users.

4.4 City of Stonnington

The IMAP model considered a total bike network of 50km in the City of Stonnington, with 33km to be new or upgraded routes. Of these, four routes, totalling 7km, have been identified as Priority Routes within Stage One (total of 12km), with a total of 19km being added with the completion of Stage Two.

Figure 7 identifies Stage One (including Priority Routes), and Stage Two of the proposed network in the City of Stonnington. The projected increase in cycling from development of the Priority Routes, Stage One routes, and Stage Two routes is shown in Table 8, while Table 9 provides the detailed outputs for each of the Priority Routes.

It is estimated that upon completion of Stage Two, cycling across the bike network would increase by 34%, with cycling on all streets in City of Stonnington increasing by 28%. This is the equivalent of 1,644 new bike trips each day (assuming an average trip distance of 4.5km) – by comparison, there were 3,092 work related bike trips recorded at the 2016 Census (assuming two trips per day for every bike commuter).

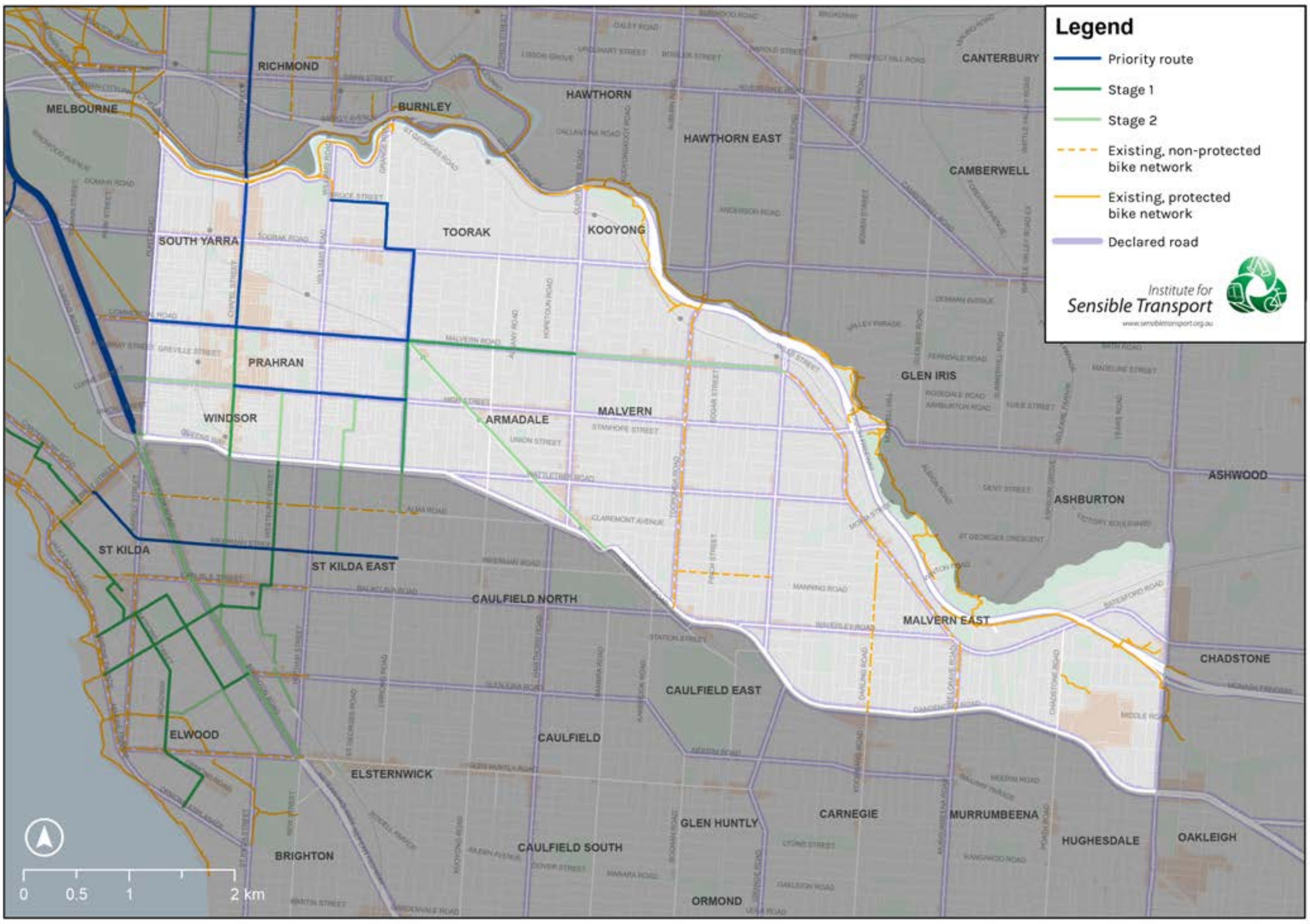

Figure 7 Stonnington - Priority Routes, Stage One and Stage Two

Table 8 City of Stonnington - Estimated daily CKT for each scenario

Bike Network	CKT on bike network (% increase from current)	Total CKT across area (% increase from current)	New bike trips (CKT equivalent)
Existing bike network	16,794	26,107	
Priority routes developed	20,220 (20%)	31,515 (21%)	1,202
Stage One completed	21,242 (26%)	32,451 (24%)	1,410
Stage Two completed	22,481 (34%)	33,515 (28%)	1,646

Table 9 City of Stonnington - Priority Routes

Route	Distance (m)	Est daily CKTs	Growth on route (%)
Chapel Street (Yarra River to Malvern Road)	1,350	1,948	26%
Commercial Road and Malvern Road	2,450	687	68%
Bruce Street, Grange Road, Toorak Road and Orrong Road	2,100	544	269%
High Street (Chapel Street to Orrong Road)	1,650	607	44%

Most of the proposed bike lanes are on City of Stonnington controlled streets. However, the following are declared roads, controlled by VicRoads/Department of Transport (shown with a purple halo in Figure 7):

- Chapel Street (between the Yarra and Toorak Road) (Priority Route in Stage One).
- Toorak Road (Priority Route in Stage One).
- Commercial Road (Priority Route in Stage One) and Malvern Road (all stages).
- High Street (Priority Route in Stage One).
- Orrong Road (Priority Route in Stage One).

Routes have been designed to allow public transport users alternative paths into the CBD. These include:

- Chapel Street (Priority Route in Stage One, and Stage One), into Main Yarra Trail for tram route 78 and South Yarra, Prahran and Windsor railway station users.
- Bruce Street, Grange Road, Toorak Road and Orrong Road (Priority Route in Stage One), into Main Yarra Trail, for tram route 58 and Toorak railway station users.
- Commercial Road and Malvern Road (Priority Route in Stage One, Stage One, and Stage Two), into St Kilda Road, for tram route 72 users.
- High Street (Priority Route in Stage One, and Stage Two), into Chapel Street and St Kilda Road, for tram route 6 users.
- Caulfield Railway Line path (Stage Two), into Bruce Street Route, for Toorak, Armadale and Malvern railway station users.

4.5 City of Yarra

The IMAP model considered a total bike network of 86km in the City of Yarra, with 39km to be new or upgraded routes. Of these, five routes, totalling 5km, have been identified as Priority Routes within Stage One (total of 11km), with a total of 20km being added with the completion of Stage Two.

Figure 8 identifies Stage One (including Priority Routes), and Stage Two of the proposed network in the City of Maribyrnong. The projected increase in cycling from development of the Priority Routes, Stage One routes, and Stage Two routes is shown in Table 10, while Table 11 provides the detailed outputs for each of the Priority Routes.

It is estimated that upon completion of Stage Two, cycling across the bike network would increase by 16%, with cycling on all streets in the City of Yarra increasing by 11%. This is the equivalent of 1,975 new bike trips each day (assuming an average trip distance of 4.5km) – by comparison, there were 8,744 work related bike trips recorded at the 2016 Census (assuming two trips per day for every bike commuter).

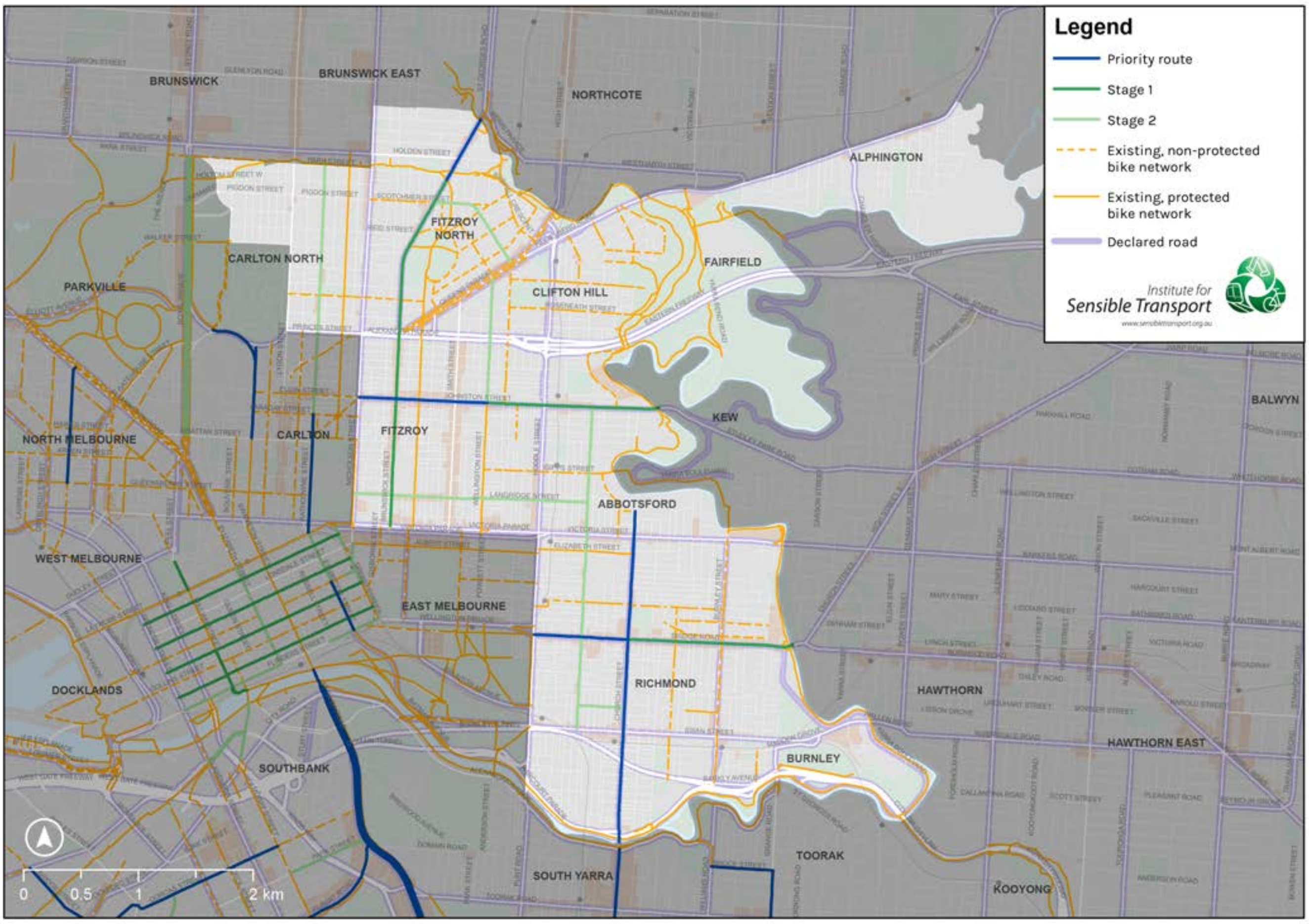

Figure 8 City of Yarra - Priority Routes, Stage One and Stage Two

Table 10 City of Yarra - Estimated daily CKT for each scenario

Bike Network	CKT on bike network (% increase from current)	Total CKT across area (% increase from current)	New bike trips (CKT equivalent)
Existing bike network	51,753	78,343	
Priority routes developed	56,979 (10%)	84,357 (8%)	1,337
Stage One completed	58,680 (13%)	86,203 (10%)	1,747
Stage Two completed	59,799 (16%)	87,245 (11%)	1,978

Table 11 City of Yarra - Priority Routes

Route	Distance (m)	Est daily CKTs	Growth on route (%)
St Georges Road (Merri Creek to Capital City Trail)	600	1210	12%
Johnston Street (Nicholson Street to Wellington Street)	1,110	1399	65%
Church Street (Murray Street to Yarra River)	2,885	2080	25%
Bridge Road (Hoddle Street to Church Street)	820	577	40%

Most of the proposed bike lanes are on City of Yarra controlled streets. However, the following are declared roads, controlled by VicRoads/Department of Transport (shown with a purple halo in Figure 8):

- St Georges Road (Priority Route in Stage One and Stage One).
- Brunswick Street (Stage One)
- Johnston Street (Priority Route in Stage One and Stage One).
- Church Street (Priority Route in Stage One).
- Bridge Road (Priority Route in Stage One and Stage One).

Routes have been designed to allow public transport users alternative paths into the CBD. These include:

- St Georges Road and Brunswick Street (Priority Route in Stage One, and Stage One), for tram route 11 and 96 users and Mernda railway line users in City of Darebin.
- Johnston Street (Priority Route in Stage One, and Stage One), for bus route 200/207 and Victoria Park railway station users.
- Bridge Road (Priority Route in Stage One, and Stage One), for tram route 48 and 75 users.
- Church Street (Priority Route in Stage One) for tram route 78 and West Richmond railway station users.
- Rathdowne Street (Stage Two) for tram route 1/8 and 96 and bus route 250/251 users.
- Wellington Street (Stage Two) for tram route 86 users.

5. Conclusion

This analysis has identified *Priority Routes*, *Stage One*, and *Stage Two* routes within each Council area. The development of these routes will grow cycling participation and serve as an alternative to public transport to support a COVID-19 safe transport system. Using the *IMAP Bike Network Model*, we were able to estimate growth along each *Key Route*. The results found that constructing these key routes would increase bike riding across the bike network in IMAP by 22%.

It is recommended that Councils within IMAP focus on the construction of these *Priority Routes* in the immediate future, being followed shortly by the remainder of Stage One routes, and Stage Two in the short-term future. Due to the urgency brought on by the pandemic, it may be necessary to follow other global cities in the use of pop up, fast build materials, to fast track the development of the network.

Quickly rolling out Stage One and Stage Two of the safe, protected bike network will help take pressure off the public transport network while physical distancing requirements are in place. This will improve connectivity with the existing protected bike network and increase bike ridership, not only on the new sections, but across the network.

6. Methodology

6.1 Bicycle Network Model

The Model uses observed data to predict changes in bike riding participation across Melbourne's inner LGAs, based on the bike infrastructure improvements that have been proposed by the IMAP local governments as well as the Victorian Department of Transport. The model has several discrete sub-modules that interact to generate a network wide model which estimates current and future bike riding activity, origin and destination of activity, relative changes to bike riding safety, and potential network effects of infrastructure.

This methodology was developed for a previous IMAP project. This approach offers the IMAP councils a replicable, updatable *Bicycle Network Model* for the IMAP area that is capable of expansion to Greater Melbourne. We have used a range of data sources and standard GIS software, widely used by local government. Figure 9 provides an overview of our approach.

The rest of this section will detail each of the key steps used in the development of the Model.

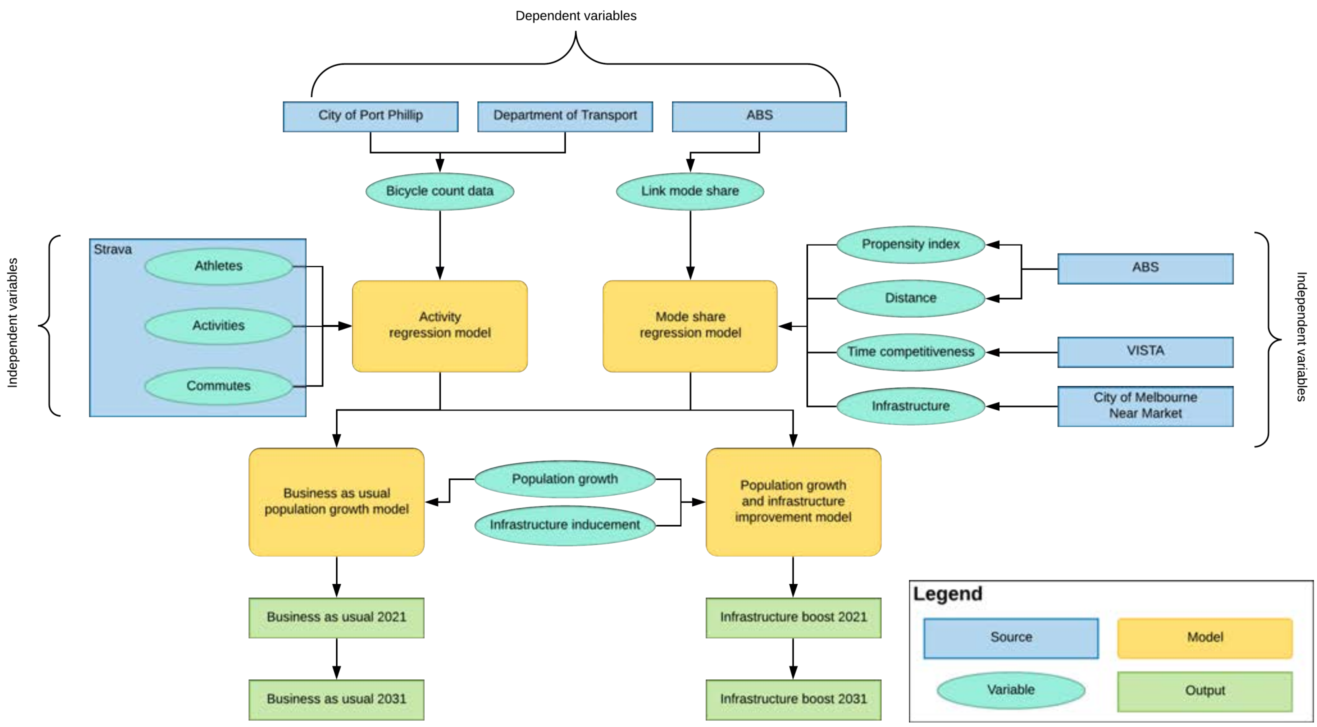

Figure 9 Flowchart of the Model methodology

6.2 Baseline bike riding activity module

A baseline of bike riding activity across inner and middle Melbourne was generated using Strava (Strava, 2019), a bike riding activity tracking App, calibrated to existing road usage observations. Strava allows users to track their bike riding activity online. This data set has been calibrated using actual bike riding activity observations from 166 network segments within the study area, shown in Figure 10. The bike network was segmented into three categories: on road; off road; and circuit training (activity spots in the network known to attract disproportionately high levels of bike riding activity from Strava users. This segmentation recognises and ameliorates bias towards certain road typologies, and conversely, away from certain infrastructure typologies. For instance, Yarra Boulevard is a bike training route, whereas Canning Street is a commuting link. For each of these three segments a multivariate regression analysis was undertaken, drawing on three Strava variables:

1. Activity (all movements over a section of network)
2. Commutes (movements self-selected by App users as commute trips); and
3. Athletes (the total number of users over a section of network).

The result was a network usage estimation across the entire road network of the study area, with an estimated total number of users per day, per section. From this, total bike riding kilometres travelled in 2019 can be estimated. This baseline was then increased with the other modules, to project future activity.

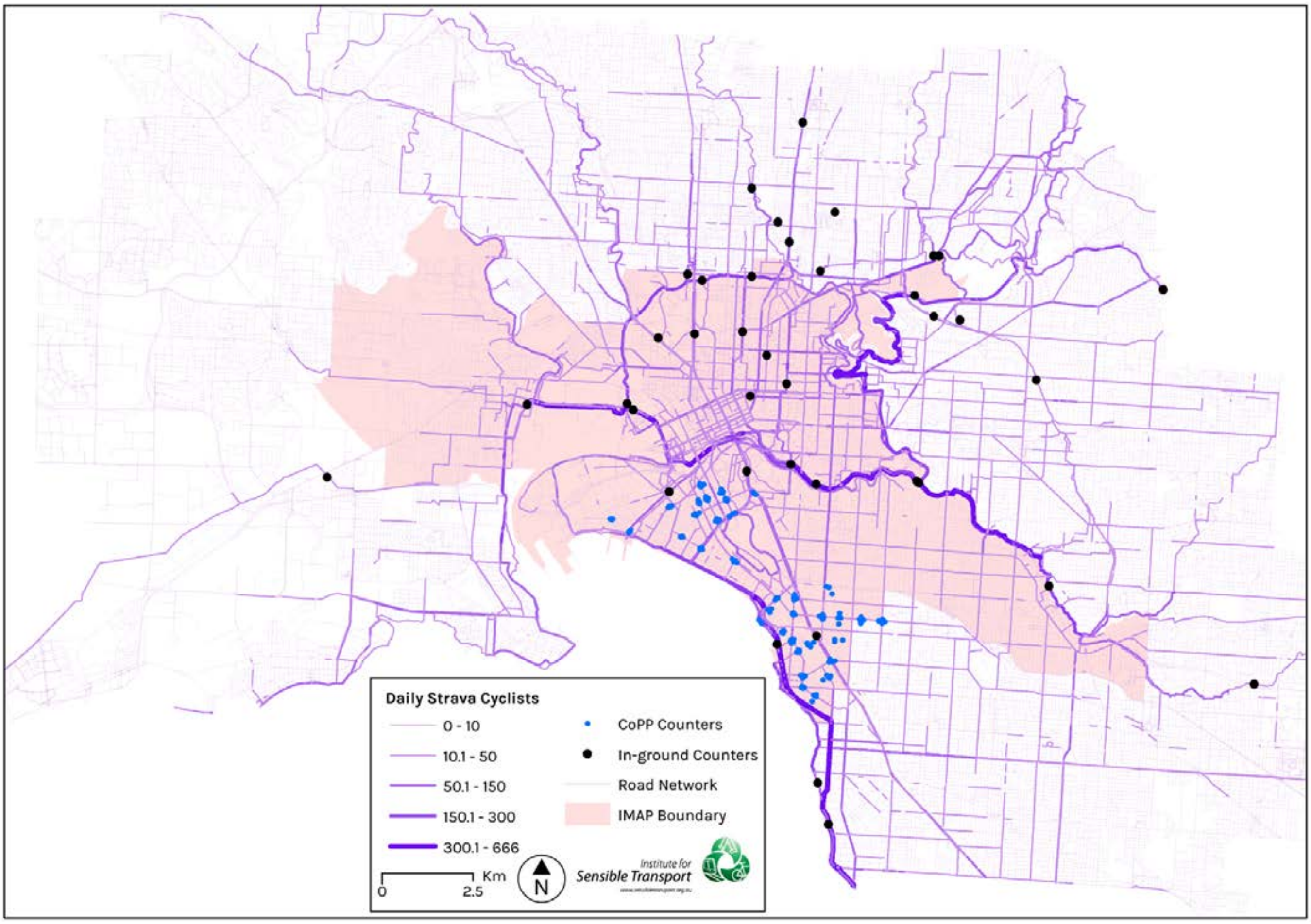

Figure 10 Daily Strava bike riding activity and Bicycle Counters, 2018

6.3 Mode share module

Commute journeys were mapped using Australian Bureau of Statistics 2016 Census data using Statistical Area Levels 2 (SA2) as the origin and destination. Euclidian (as the crow flies) lines were drawn between all SA2s in the study area to all other SA2s in the study area, with journeys by each major mode and in total recorded against each line. This generated a schematic of travel across the study area, with riding mode share of each link calculated (see Figure 11). The thickness of the line in Figure 11 is proportional to the number of bike riding trips between SA2s.

Increases in bike riding activity was predicted, with an increase to commute journeys modelled, and then scaled up using a combination of Australian Bureau of Statistics (Journey to Work) and Victorian Integrated Survey of Travel and Activity (all-purpose journey) data sets to represent a prediction of total bike riding activity in the study area. This method was adopted as it reliably shows where bike riding activity starts and ends within Melbourne.

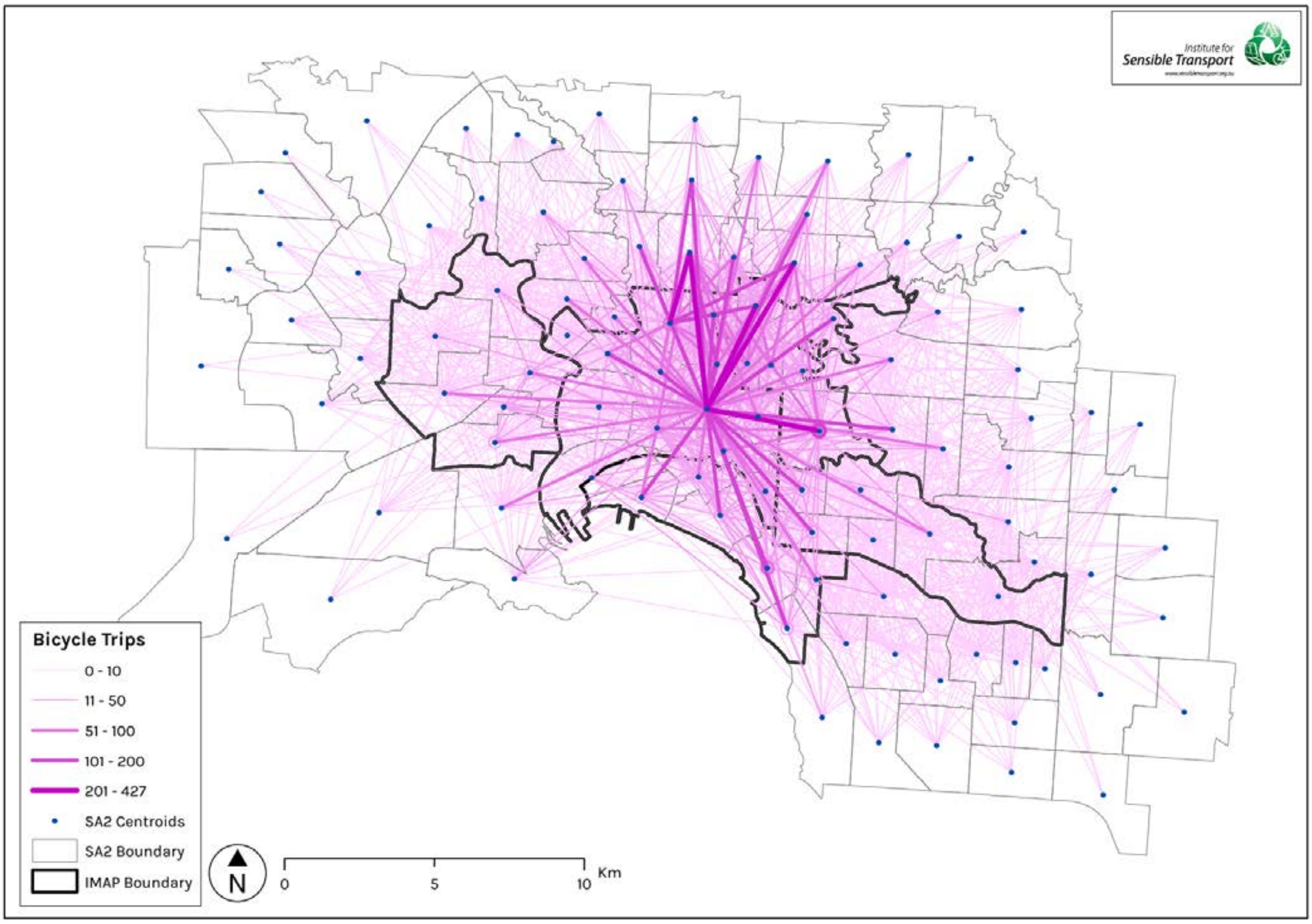

Figure 11 Bike trips between SA2s in study area

NB: Circles indicate trips that start and finish in the same SA2

Source: ABS Census, 2016

This mode share module was used in two predictions. Firstly, bike riding participation increases due to population growth was forecast. Population growth predictions were used to scale the number of journeys occurring from each SA2 accordingly (i.e., if an SA2 is predicted to increase in population by 10% between 2019 and 2031, it was estimated that this would lead to a proportional increase in travel along all links). This method of adjustment was used to increase activity from 2016 levels to estimate activity in 2019, and then predict activity in 2021 and 2031.

Secondly, the increased bike riding participation, brought about by improvements to the bike infrastructure network were modelled. This modelling was based on projected growth in bike riding participation along each origin-destination link, due to infrastructure changes. This was modelled using regression analysis of existing observed travel mode share (as determined from analysis of ABS Census data) as the dependent variable, and four independent variables used as the predictors:

1. Distance: the length of the line between centroid of the origin SA2 and centroid of the destination SA2
2. Bike Use Propensity: the propensity for cycle use of the link, determined by seven key demographic factors closely correlated to bike riding activity
3. Time Competitiveness: the ratio of bike riding time to that of the main travel mode of each link, calculated from VISTA's travel times; and
4. Attractiveness of infrastructure: the attractiveness of the link to bike riding, based on the Near Market report's findings, weighted to the network wide attractiveness of each SA2 in the link.

Each section of the network was coded with an existing and future infrastructure type. This allows a coding of *existing attractiveness* and *future attractiveness* of each network section. The attractiveness is based on City of Melbourne's Near Market research findings (see CDM Research & ASDF Research, 2017), showing that there is a higher level of attraction to bike riding when physical separation from motor vehicles exists. The distance weighted attractiveness of each section of the network was used to generate a SA2 wide attractiveness for east-west and north-south travel. This attractiveness score was joined to each link, weighted to the length of that link in each SA2. This generated an attractiveness of the link as a whole. This allowed the regression model to assess the attractiveness of each link, in relation to each other link, to assess how much of a difference to mode share the infrastructure attractiveness of the journey is (the other three variables, which all show correlation towards bike riding participation, were included to attempt to isolate the role that *infrastructure* has in attracting people to ride).

The calculation emerging from the regression modelling was used on each link, to project a modelled bike riding mode share of the link under existing conditions. Secondly, the calculation was used to estimate bike riding mode share under changed infrastructure. It should be noted that, as these are computer generated models of mode share, there was divergence from observed travel patterns, likely due to many exogenous factors such as cultural attitudes towards bike riding, which are not possible to reliably quantify. For this reason, we have used the difference between an existing and change scenario as a projected mode share shift to bike riding. For instance, if a link is modelled to have a current mode share of 12% bike riding, increasing to 15% with improved infrastructure, but it is observed that currently the link has a 20% mode share, only the difference of 3% is modelled as the increase, projecting a future 23% mode share.

The change in mode share was then projected across all links and joined to each SA2, which was then assigned to the street network (using the Baseline as existing activity), based on future attractiveness. VISTA data was analysed to determine the ratio of commute trips to all trips, with the resulting ratio used (1 in 5 trips i.e. only 20% of trips are commutes) to scale up bike riding activity, projecting total bike riding activity. This allowed for projected increases in bike riding, both from population growth, and infrastructure improvement, to be separately projected, and modelled to occur on streets with the greatest attraction. An integrated network flows from this, whereby improvements to the network allow a redistribution of bike riding, lowering the demand on some links.

For instance, the installation of new or improved infrastructure parallel to existing routes of high demand will attract both new and existing bike riders, lowering the potential demand along current infrastructure corridors. In essence the model is able to draw bike riding activity towards newly improved network sections. An example of this is shown in Figure 12, where there is a projected decrease in ridership on Faraday Street, Carlton if the proposed network is constructed. This is because Grattan Street is proposed to be upgraded to separated lanes. The increase in riders along Grattan Street are not purely due to riders shifting from Faraday to Grattan, but also incorporate other trips such as Rathdowne to Grattan, Barkly to Grattan among others. This is consistent within known behaviours, where people on bikes will deviate from the shortest route in order to use higher quality infrastructure (Winters et al., 2010).

6.4 Modelled Scenarios

The combination of these two elements of this module allow for projections of bike riding kilometres travelled under the following scenarios, per SA2 and per network section, as shown in **Error! Reference source not found.**.

Table 12 Modelled scenarios

2019	2021	2021	2021
Base line	Key Routes	25% of network	50% of network

Figure 12 Example of how the model draws riders to more attractive infrastructure

Nb. This image is illustrative only and may not represent the most up-to-date projected changes in bike riding volumes

6.5 Adjusting for COVID-19

Several adjustments to the model were made to better reflect changed transport behaviours. Previously, *time competitiveness* was seen as the most important factor for mode choice. Increased risk perception towards public transport usage is now likely a stronger determinant. In the model, we used the time competitive switch to estimate increased attraction to bike ridership, as a surrogate for contagion avoidance. A 'switch' in the model is a standalone factor that can be altered depending on changed circumstances, for instance through new research or data. This was deemed an acceptable use of an existing switch within the model, as building in contagion avoidance would require a complete rebuild of the model.

In effect, we have decreased bicycle travel time by 5%, increased traffic congestion 5%, and decreased bicycle travel distance perception by 10%. These changes act as surrogates to the transport network, which make bike riding more attractive to public transport users, and likely increase in car trips as the economy reopens and more people go back to work.

6.6 Prioritisation process

A mix of quantitative criteria and strategic alignment indicators were used to develop the proposed routes and recommended infrastructure sequencing. As part of this analysis, routes were selected based on multiple criteria, including:

1. Connectivity to City of Melbourne COVID-19 bike network
2. Ability to act as an alternative to high volume public transport
3. Connectivity with the existing protected bike network
4. Alignment with State Government SCCs
5. Alignment with municipal bike plan
6. Ridership uplift.

Routes were then ranked into three different categories for each municipality:

1. Key Routes
2. Top 25% of the proposed bike network
3. Top 50% of the proposed bike network

The model was re-run for each of the three categories to estimate change in bike activity for each section of the network.

The identified routes were then reviewed and refined to ensure they fit logically into the broader bike network across IMAP.

6.7 Limitations

COVID-19 has disrupted existing travel patterns. A large proportion of trips are now being avoided, through working at home, online shopping, and reduced socialising. The Model used in this analysis was developed pre-COVID-19. Many of the determinants for transport mode choice have likely changed in the immediate future, while some could change permanently. Because no research is available to provide up-to-date metrics on transport mode choice, it is not possible to make large changes to the Model. As such, we have only made some minor modifications using the variable inputs we have available in an attempt to better reflect likely travel behaviours.

Institute for Sensible Transport

102/1 Silver Street, Collingwood
Melbourne, Australia VIC 3066
E: info@sensibletransport.org.au
www.sensibletransport.org.au

Institute for
Sensible Transport