Cycling Trunk Corridors in Metropolitan Melbourne: 2024 Update

Prepared for RACV

CDM RESEARCH

Contents

Executive Summary

CDM Research was commissioned by the RACV in 2019 to review the existing Strategic Cycling Corridors (SCCs) and identify a subset of routes which may offer the greatest potential for meeting the objectives of the *Victorian Cycling Strategy 2018-28*. That study identified 17 trunk corridors, primarily radiating from the Melbourne CBD, and all located within 10 km of the CBD, that offered the greatest potential to facilitate cycling for transport and reduce cyclist crashes.

Since the previous analysis disruptions to travel behaviour caused by the COVID pandemic, population growth and ongoing expansion of the cycling network may have changed the network prioritisation. The present analysis was commissioned by RACV to reexamine the network priorities in light of these changes.

This re-examination of the network focussed only on the existing cyclist crash history and potential user catchment; that is, population, employment and school student enrolments within 200 m of the corridors. Important constraints such as technical feasibility, cost and space constraints were not considered. As well as considering the population, employment and school students within the catchment consideration was given to the additional network benefits that would accrue from connecting the corridors to existing high-quality cycling infrastructure.

Spatial analysis was performed using the SCCs identified by VicRoads and relevant spatial data, including population, employment, school enrolments and cyclist crash history. The network accessibility analysis assumed equal weightings to population, employment and school enrolments. That is, the accessibility was the sum of these three catchments multiplied by a distance decay function. Corridors with the highest scores were identified as having the greatest alignment with the *Victorian Cycling Strategy*, and therefore warrant prioritisation over other corridors.

The results of this analysis are shown in Figure EX.1, where each corridor is ranked from highest (1) to lowest (21) within each attribute. Which corridors should be prioritised will depend on the relative weighting between crashes, population, employment and school students. However, it is suggested there is a compelling case to prioritise:

- Chapel Street given the crash history and high population and school student catchment.
- Sydney Road (Coburg – CBD catchment) given the high crash history, employment and school student catchment.
- Flemington Road and Mt Alexander Road (Essendon – CBD) given the school student catchment and potential network connectivity benefits.
- St Kilda Road to Port Melbourne along Part Street, Dorcas Street, Ingles Street and Turner Street as the Fishermans Bend precinct is developed.

Should electrically-assisted bicycles become more popular some of the more radial routes and middle-suburban corridors will become relatively more significant, but not to an extent that the overall prioritisation is likely to change.

	Crashes	Population	Employment	School students
Box Hill - CBD	12	3	13	14
Box Hill - CBD via Bridge Rd	17	12	11	13
Canning St	3	5	2	5
Chapel St	1	1	15	4
City Loop	11	13	14	15
Coburg - CBD	2	15	6	3
Cremorne - Fitzroy North	4	2	8	9
East Malvern - CBD	21	6	12	21
Essendon - CBD	5	9	7	2
Essendon - Heidelberg	19	10	20	16
Kew - CBD	15	18	9	8
Maribyrnong River North - CBD	9	14	16	6
Maribyrnong River South - CBD	13	16	5	18
New St	16	19	19	19
Port Melbourne - CBD	10	7	1	1
Preston - CBD	6	4	10	12
St Kilda Road - Brighton Rd	7	8	17	7
St Kilda Road - Port Melbourne	18	20	3	10
St Kilda via Cecil St	8	11	4	11
Sunshine - Footscray	20	17	18	17
Williamstown - Maribyrnong River	14	21	21	20

■ **Figure EX.1: Corridor ranking by attribute**

1 Introduction

1.1 Strategic context

The *Victorian Cycling Strategy 2018-28* states that:

> *Strategic cycling corridors are the main routes of the bicycle network, like arterials are the main routes of the road network.*
>
> *They are a subset of the Principal Bicycle Network (PBN) which is a high-level plan for some 3,500 km of existing and proposed on- and off-road cycling routes.*
>
> *Strategic cycling corridors are the most important routes for people cycling for transport as they link up important destinations: the central city, national employment and innovation clusters, major activity centres and other destinations of metropolitan or state significance.*
>
> (Victorian Cycling Strategy 2018-28, p. 20)

The Strategic Cycling Corridors (SCCs) have been developed by the State Government in conjunction with local governments. In the most recent revision (2018/19) there were around 2,800 km of routes identified across Victoria (excluding duplicated sections). This network is sub-categorised into C1 ("primary") and C2 ("main") routes; there are around 527 km C1 and 2,239 km C2 routes. The SCCs are around 0.5 – 1.0 km apart in the inner city and around 2 km apart in outer suburban areas (Figure 1.1).

There is dedicated cycling infrastructure on a portion of the network, albeit of varying quality. For example, C1 corridors follow the shared paths along parts of the Yarra River, Scotchmans Creek and Gardiners Creek. Other corridors at least partially align with roads with segregated on-road provision such as St Kilda Road, Latrobe Street (CBD) and Albert Street (East Melbourne). Others extend along roads with on-road painted bicycle lanes such as Royal Parade (Parkville) and Canning Street (Carlton). However, along most corridors there is currently little to no dedicated cycling infrastructure such that bicycle riders must share roadspace with motorists. Requiring riders to share roadspace on major roads is inconsistent with the design intent of both the C1 and C2 routes, which are targeted towards riders of all ages and abilities[1].

Some of the SCCs, particularly in inner suburban areas, run along highly contested corridors with multiple modes competing for access (e.g. Johnston Street, Burnley Street, Bridge Road). There would be significant operational challenges in providing high quality cyclist provision along these corridors, for which compromises – most likely in terms of motor traffic capacity and on-street parking – would need be made. Moreover, there is very limited funding available to build this network. As such, it seems prudent to focus on a core

[1] Department of Transport (2020) "Strategic Cycling Corridor Network Overview", https://content.vic.gov.au/sites/default/files/2023-09/Strategic-Cycling-Corridors-Overview-Document-December-2020-Copy.pdf. Accessed 24/7/2024.

network of routes which may encourage as much transport cycling as possible from limited funding and do as much as possible to complement the existing transport network in areas of greatest need. We refer to these routes as "trunk corridors" in this report.

■ **Figure 1.1: Strategic cycling corridors**

1.2 Objectives of trunk corridors

The proposed vision for these cycling trunk routes is:

> *Cycling trunk corridors are attractive and safe for competent adults to ride to workplaces, education and shops in a way that is time-competitive with driving or taking public transport.*

We note the following with reference to this vision:

- It is assumed the routes would be designed for **competent adults**: this means adults with reasonable bicycle handling skills but whom are unlikely to find riding on busy roads with traffic **attractive** unless provided with some form of protection. Further, it is assumed that the corridors will in part be within the road reserve in highly trafficked areas such that they are unlikely to be suitable for unaccompanied young children (particularly at intersections).
- Cycling to **workplaces**, **education** and **shops**: cycling is chosen to travel from A to B for transport, rather than being as a recreational activity. This implies travel time

will be a significant factor in determining the attractiveness of cycling *vis a vis* competing modes.

This prioritisation seeks to identify routes which have the greatest likelihood of achieving this vision. That is:

> *Cycling trunk corridors will have high cycling demand, either existing or latent, and offer the greatest potential to reduce cycling crashes.*

This implies that:

- There will very likely be high existing cycling demand on the corridor, given that corridors with high crash frequency tend also to be locations with high cycling demand[2].
- Cycling will offer a comparative advantage compared to other modes for transport trips. That is, driving and public transport will be comparatively unattractive given congestion or crowding and a lack of parking. In turn, this suggests the corridors will feed into major activity centres – most notably the Melbourne CBD and surrounding areas.

These objectives imply routes that serve high population and high workplace density, and with significant constraints on car and/or public transport use, will be assigned a high priority.

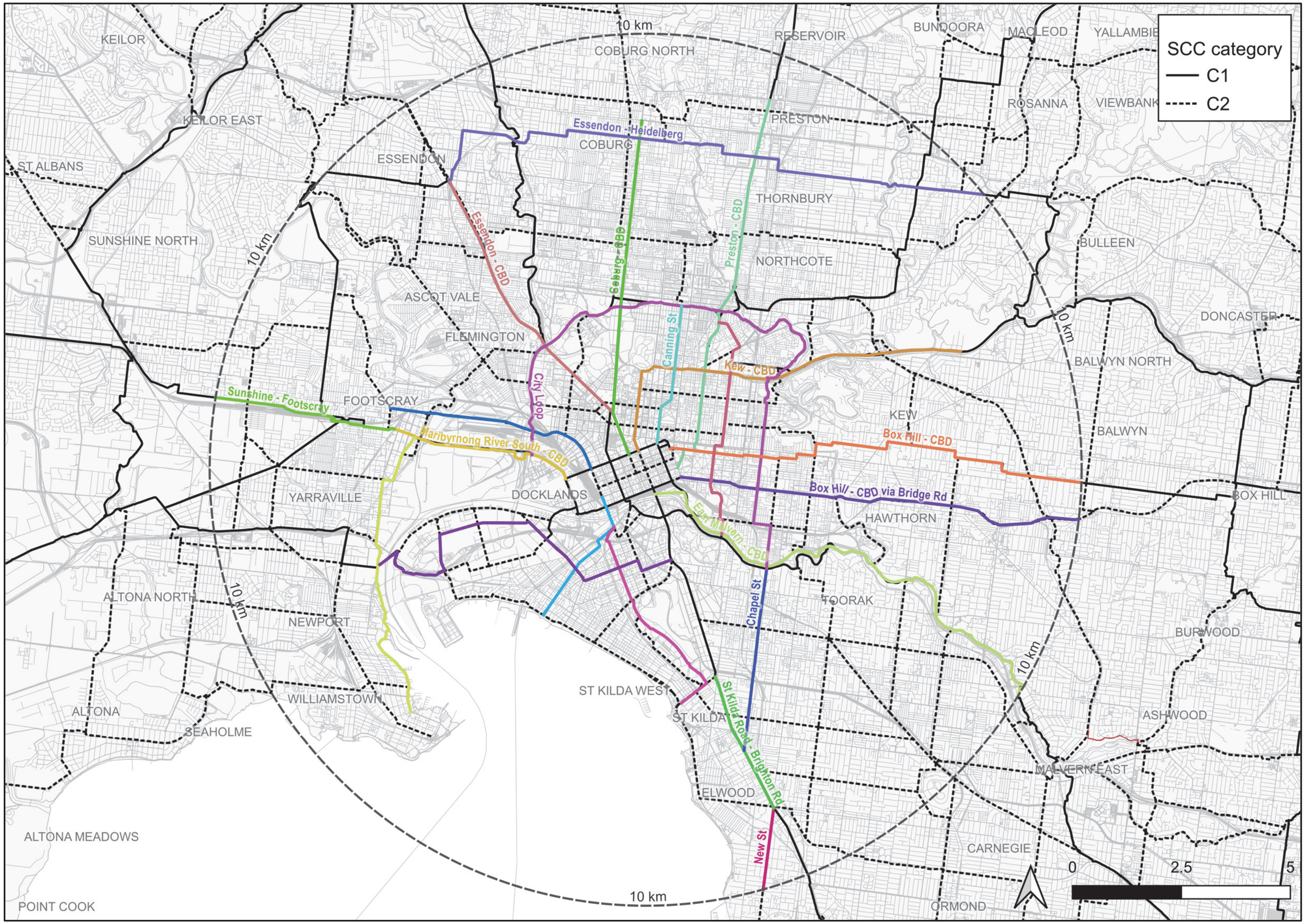
[2] There is a significant difference here between crash *frequency* and *risk*; Punt Road, Bell Street and Alexandra Parade have low crash frequency (because there are few riders) but high crash risk (because of the volume and speed of motor vehicles, and absence of cycling infrastructure). Routes such as St Kilda Road and Sydney Road have high crash frequency but *may* have low crash risk (as there are many riders).

2 Methodology

The present analysis was based partially on the methodology used in the previous 2019 study but was modified to use the most recently available data and some aspects of the analytical procedures were improved. More significantly, an additional simple network model was developed to help assess the connectivity benefits of the routes. This was also used to assess the impact of improvements that have occurred to the network since 2019 such as the William Street (CBD) and St Kilda Road protected bicycle lanes. For the purpose of the present analysis the two analytical procedures are described separately as a catchment analysis and network analysis.

2.1 Trunk corridor identification

There are an almost infinite number of possible cycling corridors, and sequence in which these corridors could be constructed, across inner Melbourne. It would be intractable to analyse all theoretically possible corridors. Instead, a pragmatic approach was taken borrowing off the previous 2019 study of identifying a subset of corridors from the Strategic Cycling Corridors that are *likely* to be of highest priority. This likelihood was determined subjectively based on an understanding of current cycling demand in inner Melbourne and those corridors which are widely understood to be important to the inner metropolitan cycling network. The Strategic Cycling Corridors identified in the 2018/19 review by the Department of Transport and Planning were used as the basis for this process. Obvious examples include St Kilda Road and Brighton Road to the south, Royal Parade and Sydney Road / Upfield Trail to the north, Main Yarra Trail and Gardiners Creek Trail to the east and Footscray Road to the west. This subjective process identified 21 corridors, largely consisting of C1 routes from the Strategic Cycling Corridors and are shown in Figure 2.1.



■ **Figure 2.1: Trunk corridors**

2.2 Analytical procedures

2.2.1 Catchment analysis

Market potential

The catchment analysis sought to understand the cycling *potential* along a route resulting from the current and projected resident population within a narrow 200 m corridor along the route, as well as employment and school student enrolments within this arbitrary 200 m corridor. The data used in this analysis was as follows:

- Population catchments from the 2021 ABS Census of Population and Employment using the mesh block geography[3]. These were expanded to 2031 using Victoria In Future (VIF) projections at the SA2 level.
- Employment catchments from the 2021 ABS Census of Population and Employment (WPP geography[4]).
- School location data and fulltime enrolments from the Department of Education and Training for 2023[5]. This data consisted of fulltime equivalent student enrolments at both public and private primary and secondary schools. It is notable that this dataset excludes tertiary student enrolments; these are likely to be very significant drivers of cyclist demand in some areas such as around Parkville.

It is important to note this spatial catchment analysis is not a cyclist demand prediction but instead is an indicator only of cycling *potential*. For example, it seems likely that a corridor with high population density, large numbers of workplaces and schools would attract more bicycle riders than a corridor with low population, few workplaces and no schools in the vicinity.

Population, employment and school student catchments were arbitrarily set at 200 m from the SCC. This arbitrary threshold was set on the assumption that those living, working or studying in the immediate vicinity of the corridor would be more likely to use the corridor than those living farther away. To account for zones that are only partially within the buffer the population was reduced by the ratio of the area overlapped by the buffer and the total mesh block area[6].

Crash history

As well as assessing the potential riding catchment along each corridor the cyclist crash history was obtained using Police-recorded crash data involving bicycle riders over a 10-year period between 31 July 2013 and 31 July 2023, inclusive. The data was analysed to obtain counts of individual riders involved in Police-recorded crashes within a 20 m buffer of

[3] Mesh blocks are the smallest ABS geographic unit and typically have 30 to 60 dwellings.

[4] The Working Population Profile (WPP) provides data on employment by place of work at the SA2 level.

[5] https://discover.data.vic.gov.au/dataset/school-locations-2023 and https://discover.data.vic.gov.au/dataset/all-schools-fte-enrolments-feb-2023-victoria.

[6] This process implicitly assumes equal population density across the zone, which may or may not be a reasonable assumption.

the corridors. All injury severities were retained and were unweighted; that is, a fatal injury incurred by a bicycle rider was treated equally to a rider involved but uninjured in a crash.

The 20 m buffer accommodates small inaccuracies in spatial coding of crash locations, as well as wide roads, particularly divided roads such as St Kilda Road where the crash location may be coded on the main carriageway or within the service roads. This process means that crashes on intersecting roadways, or on roads that pass above or below the corridor[7] within the 20 m buffer, will be included. In practice, these crashes may not be representative of the risk on the corridor and so there will be slight overcounting of crashes.

Normalisation

All indicators – population, employment, school students and cyclist crashes – were normalised to a linear density. That is, the count of each indicator within the buffer was divided by the *length* of the corridor. In this way shorter corridors are not unduly penalised compared to longer corridors, as the latter will almost invariably tend to have higher catchments than shorter corridors.

2.2.2 Network model

The catchment analysis does not consider the *proximity* of populations to employment or schools along the corridor, nor the connectivity of the network. To partially redress this shortcoming and allow for analysis of the impact of the cycling network improvements since 2019 a simple network model was developed. This model used a lightly cleaned OpenStreetMap (OSM) network of roads and paths in inner Melbourne. Each link within the OSM network was coded with key and value attributes defining the road/path classification. There is ample evidence to indicate that the majority of bicycle riders prefer quieter, less trafficked routes *and* that these preferences differ depending on the journey purpose and rider confidence. For this analysis weights were assigned based on revealed and stated preference data from the literature[8,9]. The weights are listed in Table 2.1 and are relative to protected cycleways. For example, the utility (attractiveness) of a shared path is rated as 0.74 times that of an on-road protected cycleway and for primary roads at 0.1 times. The weights were intentionally biased towards high quality, segregated cyclist provision given the design intent of trunk routes to be attractive to a wide range of riders.

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[7] One example of this situation is the Main Yarra Trail where it passes underneath the Church Street bridge in Cremorne; cyclist-involved crashes that occur immediately above the trail on Church Street are included within the buffer, but clearly are unrelated to the corridor.

[8] Wardman, M., Tight., M. and Page, M. (2007) “Factors influcing the propensity to cycle to work”, *Transportation Research Part A Policy and Practice* 41(4).

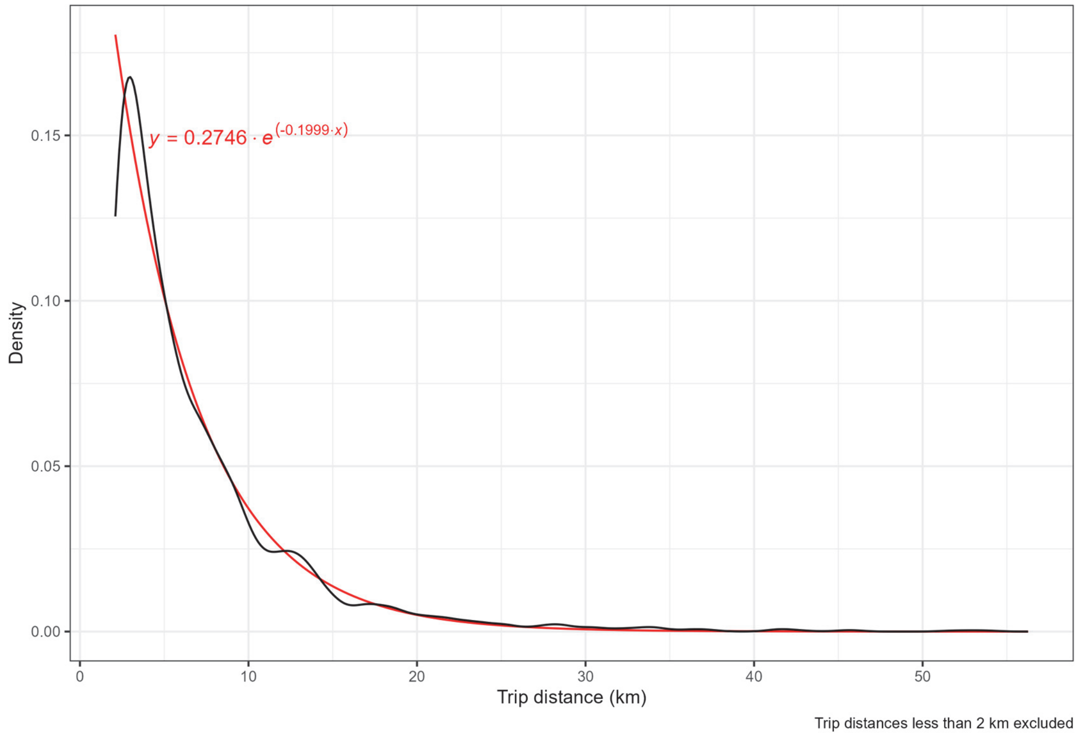
[9] CDM Research (2013) “Level of service model for bicycle riders”, *prepared for Queensland Department of Transport and Main Roads.*

■ **Table 2.1: Link weights (relative to protected on-road cycleway**

OSM link type (key:value)	Weight
highway: trunk	0.0
highway: trunk	0.2
highway: primary	0.1
highway: secondary	0.2
highway: tertiary	0.2
highway: unclassified	0.3
highway: residential	0.3
highway: service	0.3
highway: track	0.74
highway:cycleway	1.0
bicycle:path	0.74
bicycle:footway	0.2
bicycle:pedestrian	0.1
highway:steps	0.05
route:ferry	0.1
highway:living_street	0.6
bicycle:bicycle_lane	0.5

Each intersection and endpoint on the SCC network within 10 km of the Melbourne CBD was defined as a node (i.e. origin and destination). The population, employment and school students within 200 m of the corridor extending halfway to each adjacent node were used as the size variables (i.e. the trip generation and attractions). A weighted shortest-path algorithm was run between each node pair to determine the cycling corridor. An accessibility index was then determined for each node based on a sum of the population, employment and school students at each connected node. Significantly, it was assumed that short trips under 2 km are unlikely to be undertaken by bicycle and so were excluded. Furthermore, a distance decay function was applied to distant nodes. This distance decay function was based on analysis of cycling trip distances in the VISTA dataset from 2012 to 2020. An exponential decay function fit to the trip length distribution indicated a decay constant of approximately -0.2 per kilometre (Figure 2.2). In the implementation of this distance decay function origin-destination pairs with distances of over 20 km were neglected to simplify the computation; given the decay function suppresses demand at 20 km by 98% this simplification will have negligible effect on the overall index.

The accessibility index has no dimensions. Instead, higher values can be interpreted as a corridor providing greater access to population, employment and schools both within the corridor itself *and* along connected existing corridors. In this regard this index is similar to the catchment analysis *but* with the addition of considering the network connectivity and distance between populations and employment and schools.



■ **Figure 2.2: Distance decay function for cycling trips[10]**

[10] VISTA 2012-20 stops data.

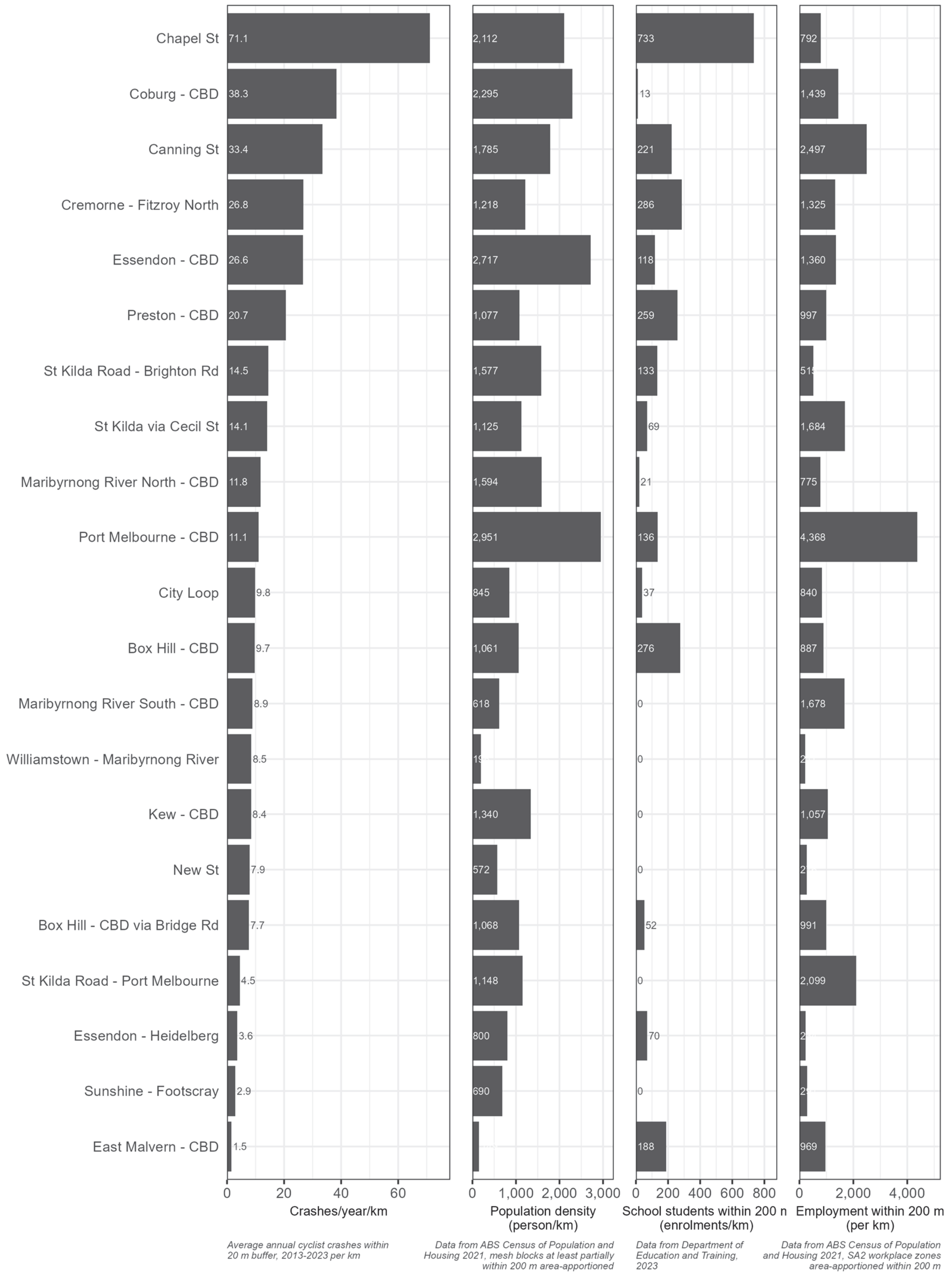
3 Prioritisation

3.1 Catchment analysis

The linear densities obtained from the catchment analysis for each corridor are shown in Figure 3.1. The corridors are sorted based on the crash linear density; Chapel Street has by far the highest density of cyclist crashes at 71 crashes/year/km and so is shown first. This corridor also has high population and school student density, although employment density is low relative to many other corridors. The Port Melbourne to CBD corridor by contrast has a relatively low crash record[11] but high population and employment catchment, primarily because it covers the southwest corner of Southbank and parts of Docklands and the western end of the CBD.

Another way of visualising the catchment is to rank each corridor within each attribute as shown in Table 3.1. In this variation of the analysis Chapel Street rates highly on crashes, population and student density but low on employment. The Coburg to CBD corridor ranks highly on crashes and population density, moderately on employment but low on student density. At the lower end, the East Malvern – CBD corridor running along Scotchmans Creek Trail, Gardiners Creek Trail and the Main Yarra Trail ranks the lowest on crash history and population, moderately on employment but high on school student enrolments.

[11] This corridor extends along the Sandridge Trail from Port Melbourne to South Wharf and the edge of the CBD.



■ **Figure 3.1: Trunk corridor statistics**

Table 3.1: Corridor ranking by attribute

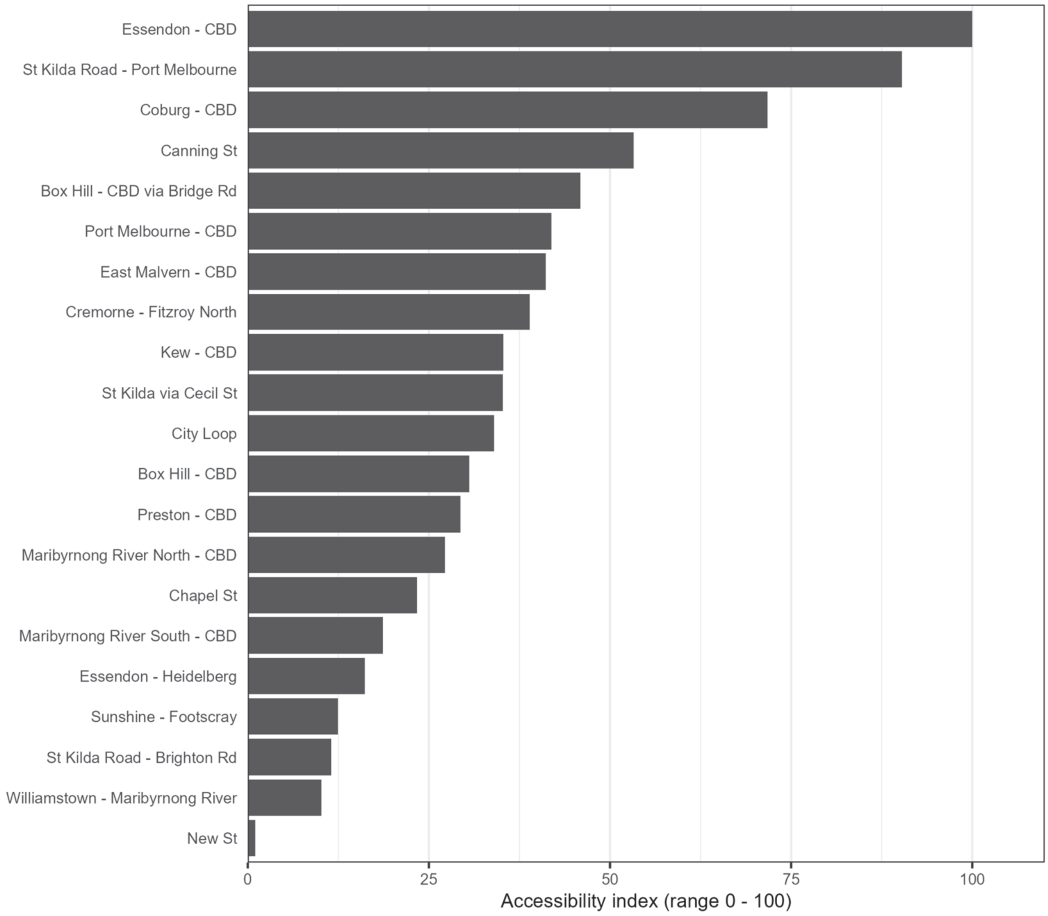
	Crashes	Population	Employment	School students
Box Hill - CBD	12	3	13	14
Box Hill - CBD via Bridge Rd	17	12	11	13
Canning St	3	5	2	5
Chapel St	1	1	15	4
City Loop	11	13	14	15
Coburg - CBD	2	15	6	3
Cremorne - Fitzroy North	4	2	8	9
East Malvern - CBD	21	6	12	21
Essendon - CBD	5	9	7	2
Essendon - Heidelberg	19	10	20	16
Kew - CBD	15	18	9	8
Maribyrnong River North - CBD	9	14	16	6
Maribyrnong River South - CBD	13	16	5	18
New St	16	19	19	19
Port Melbourne - CBD	10	7	1	1
Preston - CBD	6	4	10	12
St Kilda Road - Brighton Rd	7	8	17	7
St Kilda Road - Port Melbourne	18	20	3	10
St Kilda via Cecil St	8	11	4	11
Sunshine - Footscray	20	17	18	17
Williamstown - Maribyrnong River	14	21	21	20

3.2 Network analysis

The purpose of the network analysis was to (a) better account for the connected network benefits of particular corridors within the existing cycling infrastructure network, and (b) understand how electrically-assisted bicycles ("e-bikes") may affect the route prioritisation.

3.2.1 Network connectivity

As described in Section 2.2.2, the network model used an OSM road and path network for inner Melbourne with assumed link weights for varying qualities of cycling infrastructure provision. The trunk corridors were then added to this underlying network individually, assuming the corridors would consist of high-quality protected on-road bicycle lanes. The accessibility index was determined as the sum of population, employment and school students at each node and deflated by the distance decay function. For simplicity, and given the dimensionless nature of the index, it has then been rescaled to a range between 1 and 100 in this report. Higher values can be interpreted as meaning corridors with higher accessibility. The index for each of the 21 corridors is shown in Figure 3.2; the Essendon – CBD and St Kilda Rd – Port Melbourne corridors stand out as having very high accessibility. That is, these corridors have high resident populations in a convenient riding distance (more than 2 km, but not too far) both along the corridors themselves and then along existing connected high-quality corridors.



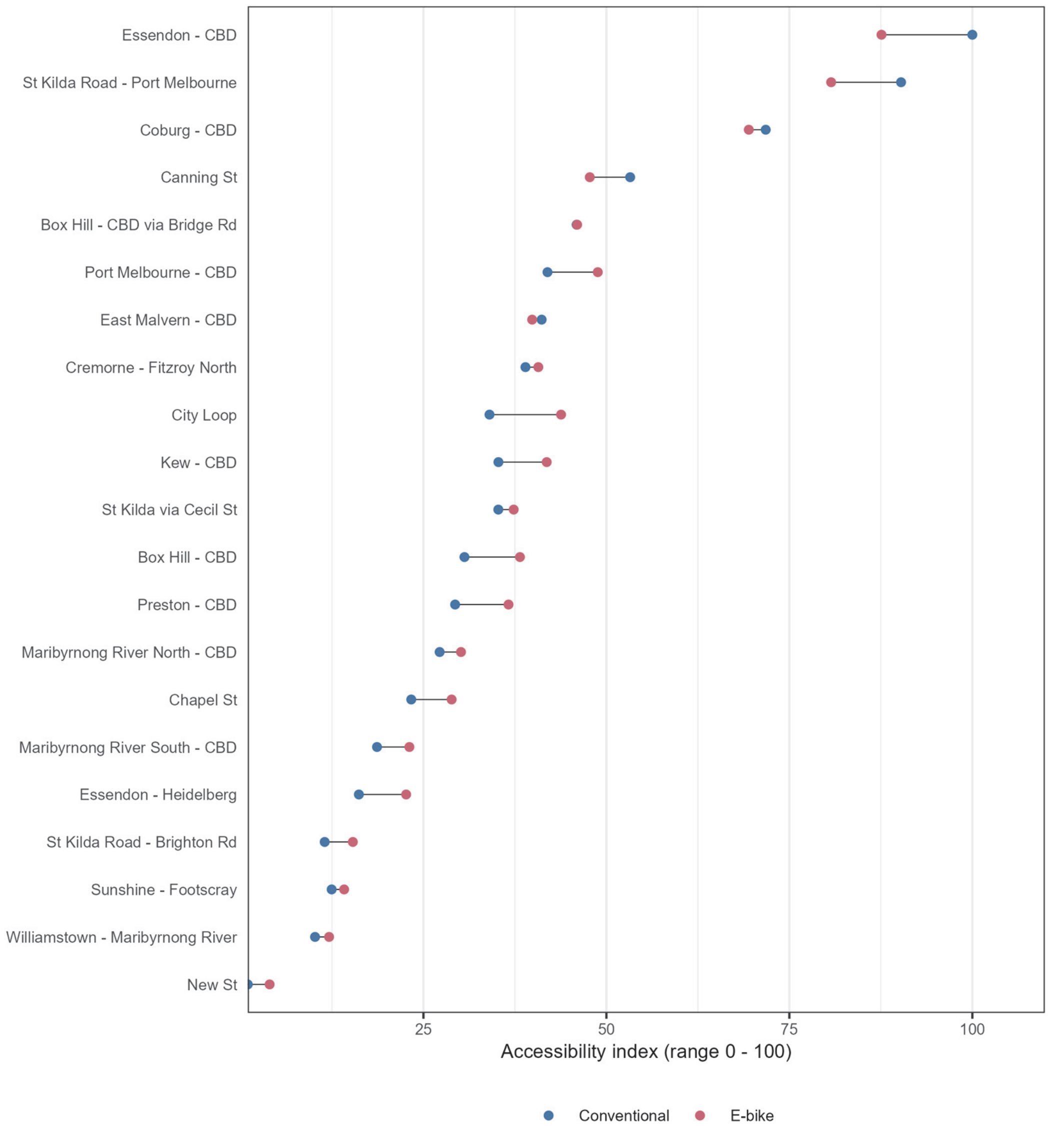
■ **Figure 3.2: Accessibility index**

3.2.2 E-bikes

The distance decay function is based on VISTA data with a decay constant of -0.2 (Figure 2.2). It is assumed most bicycle trips within the VISTA dataset involved conventional, non-motorised bicycles. The implied average trip distance with this decay constant is 5 km. This average correlates closely with that observed in a European study[12] of cycling trip distances involving both conventional bicycles and e-bikes. That study found the average trip distance for conventional bicycles was 5.3 km and for e-bikes 8.0 km, implying a decay constant for e-bikes trips of around -0.125. Adjusting the network model distance decay function accordingly and recalculating the accessibility indices results in the changes shown in Figure 3.3. The differences in route prioritisation is not substantial, although those corridors which have relatively modest winder network connectivity along their route – most notably Essendon – CBD and St Kilda Road – Port Melbourne, experience a decline in accessibility index in the e-bike scenario compared to better connected corridors such as the City Loop an Kew – CBD corridors. It should be noted that a decline in accessibility

[12] Castro, A. et al. (2019) “Physical activity of electric bicycle users compared to conventional bicycle users and non-cyclists: Insights based on heat and transport data from an online survey in seven European cities”, *Transportation Research Interdisciplinary Perspectives* 1:100017.

index in the e-bike scenario does not imply that e-bikes would reduce accessibility; indeed, all corridors exhibit an increase in absolute accessibility in the e-bike scenario. Rather, the normalisation of the index means that a decrease should be interpreted as meaning the accessibility of that corridor *relative* to other corridors decreases.



■ **Figure 3.3: Effect of e-bike scenario on network accessibility by trunk route**

4 Conclusion

The present analysis has identified cycling trunk corridors which are consistent with the objective of encouraging cycling for transport, as embedded within the Victorian Cycling Strategy. Moreover, they are consistent with the “strategic” moniker insofar as they form the arterial network of a high-quality cycling network in inner metropolitan Melbourne.

The corridors assessed as having the highest priority are:

- The compelling safety case for action along Chapel Street, and to a lesser extent Church Street Richmond and Sydney Road Brunswick.
- Corridors with high population, employment and school student catchments either directly along these corridors or along connected corridors such as Essendon to the CBD along Mt Alexander Road and Flemington Road to the CBD

While it is recognised there is spatial inequity through investing solely in the inner metropolitan area it is noted that:

- The constraints on both the public transport and private transport networks are most acute in the inner suburban area.
- The disincentives to private car travel in the inner suburban area (i.e. congestion and parking) are already acute, and likely to remain so. While the public transport network is good compared to outer suburban areas it is congested and often not time competitive with cycling.
- The population density and mixed land use patterns of the inner suburban area contributes to comparatively short travel distances, many of which will be well within comfortable cycling distances.
- Space is most constrained in the inner metropolitan area, and contested between private, public and active transport, such that modes which are most space efficient (i.e. public transport and active transport) ought to be given preferential treatment in the interests of maximising mobility with the finite space available.
- The socio-demographics of many inner suburban areas are more amenable to cycling, and indeed the knowledge economy will rely upon attracting and retaining talent which is attracted to liveable communities with ready access to non-motorised transport.

These arguments suggest that it will be the very high-quality routes in the inner metropolitan area which will encourage the greatest transport cycling activity for a given level of investment. Such arguments are supported by cyclist counts on the existing network which shows far higher cycling activity in the inner suburban area.