GHD

City of Melbourne

City Road Masterplan: Traffic and Access Study
Issues and opportunities report

May 2014

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Executive summary

The City of Melbourne is developing a master plan for City Road in Southbank. The master plan will guide public realm improvements towards the creation of a civic spine in line with the Mobility and Access, Open Space Network and Sustainable Infrastructure strategies of the Southbank Structure Plan 2010. The master plan will encompass a diverse range of topics including landscape architecture, urban forest, drainage and traffic engineering. While the City of Melbourne is handling some of these in-house, it has engaged GHD to provide the traffic engineering inputs to the master plan.

Currently City Road is an urban arterial road, fulfilling a regional traffic movement function between the City of Melbourne's western boundary (and ultimately Port Melbourne via Bay Street) and its eastern boundary (and ultimately Richmond via Swan Street). However, traffic surveys that have been carried out for previous studies suggest that very few of the daily trips on City Road actually travel the full length of the road, which implies that the road is fulfilling less of a traffic movement function than its classification might suggest.

City Road does fulfil the following traffic movement functions:

- It is the only viable alternative to the CityLink tunnels for placarded loads
- It is also the designated bypass route during tunnel closures
- Although it is not a designated over-dimensional (OD) route, City Road is also the designated bypass for over-height vehicles unable to enter the CityLink tunnels. All vehicles higher than 4.65 m may not enter the tunnels.

The sign posted route for such traffic from the West Gate Freeway is to exit at Power Street and to turn right onto City Road and then to re-join the M1 at the Batman Avenue entrance. From CityLink traffic must exit at Punt Road or Batman Avenue and re-join the M1 at Power Street.

However, the nature of land use in the vicinity of City Road is changing from a reasonably industrial and commercial precinct to an increasingly residential one, with several residential developments in the planning stages or about to start construction. Already there are many high-rise apartment towers on City Road, which is now the spine to a residential population of 13,000. The City of Melbourne is therefore concerned that City Road is no longer serving the suburbs through which it passes in the best possible light.

As a consequence it is anticipated that pedestrian and cyclist volumes are likely to increase dramatically. It can be expected that uses such as cafes, bars, shops and other similar businesses which rely on passing trade will seek to establish themselves on City Road. This expected change to the adjacent land uses along City Road means that the road will become less and less compatible with the suburb it serves and significant change will be needed to ensure it keeps pace with the land use changes.

The master plan aims to put forward a number of practical measures which improve the residential amenity and the pedestrian and cyclist experience on City Road. Some of the problems the road creates for residents and visitors to Southbank include:

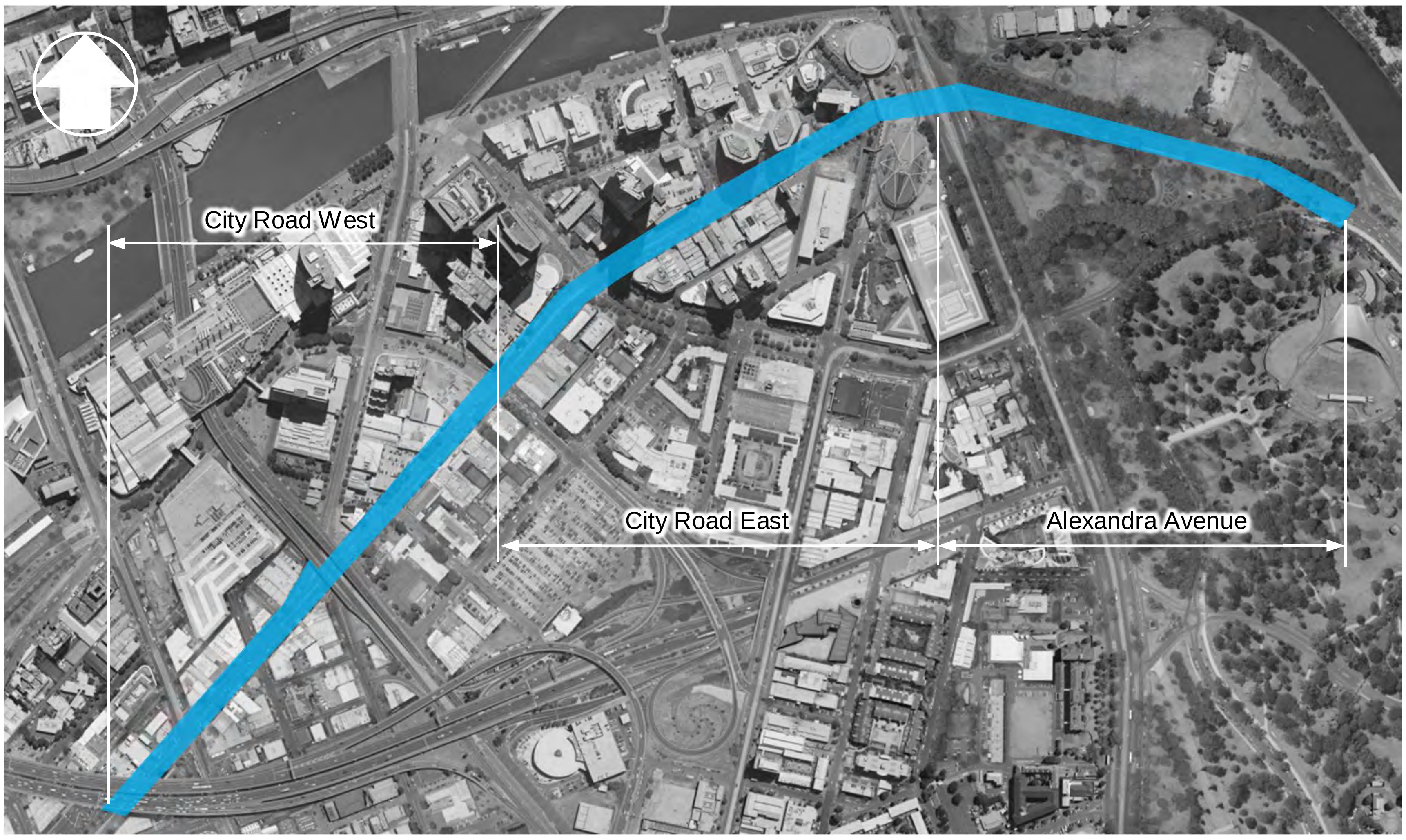
- An unpleasant walking environment where the road feels more conducive to vehicles and not pedestrians.
- The road forms a barrier between Southbank and the Yarra River and CBD areas, hampering connectivity. Many pedestrian crossing desire lines are not facilitated.
- The lack of provision for cyclists makes City Road uninviting to cycle along. This is particularly important given that the Yarra Promenade and Capital City Trail are becoming

increasingly congested during peak periods and City Road has been identified as the preferred long term alternate route.

- The arterial nature of the road is not compatible with the changing nature of its surrounding uses (e.g. it does not promote footpath activities such as al fresco dining).
- While footpaths are quite wide in places, in some locations they are narrow and are not conducive to pedestrian activity. There is particularly poor pedestrian amenity at intersections, where footpaths are often very narrow and slip lanes prioritise vehicles and extend crossing distances.
- The 60 km/h speed limit is not amenable to pedestrian or cyclist safety, particularly given the evolving nature of City Road.
- The discontinuous nature of the road at the interface with St Kilda Road means pedestrians cannot easily access St Kilda Road and the Arts Centre. The existing paths are either poorly sign posted or not DDA compliant or both.
- The road forms a significant barrier between Alexandra Gardens and Queen Victoria Gardens, where it is expected that there would be a large crossing demand.

The master plan breaks City Road into three sections: City Road West, between the West Gate Freeway and Power Street; City Road East, between Power Street and St Kilda Road; and Alexandra Avenue, between St Kilda Road and Linlithgow Avenue. These sections are shown in Figure 1.

Figure 1 Overview map



Each section is quite different from the others and this report focuses on each in turn. City Road West is the most residential of the three sections and has the most potential for change. Its traffic volumes are lower than on other sections, meaning that the requirement for road space is lower. This section also accommodates the Boyd Community Centre, which has the potential to form the hub of a new civic precinct.

City Road East carries substantially more traffic than City Road West and this is due to its role as the primary bypass of the Burnley Tunnel for placarded loads and other traffic during tunnel closures. It should be noted that traffic wishing to avoid paying a toll may also choose to use this section of City Road.

Alexandra Avenue provides almost exclusively for traffic. There is a footpath on the south side of the road, but it is set back and elevated from the road and feels more like a park path than a footpath. This leaves a road environment for traffic, but no provision for pedestrians to cross between Queen Victoria Gardens and Alexandra Gardens, where there is a clear desire line.

An important aim of the master plan is to reduce road trauma including for vulnerable road users. Crashes involving pedestrians and cyclists make up a significant proportion of crashes in the study area. This is of concern given observations that there are fewer people walking and especially cycling in the area compared to the Melbourne CBD. As the nature of City Road and Southbank changes, and as pedestrian and cyclist volumes increase, a reduction in the safety performance for vulnerable road users can be anticipated if there is no intervention.

Traffic volumes on City Road West are much lower than on City Road East and this reflects the land use and strategic functions of these two sections. Due to the higher volumes on City Road East and its strategic function as a bypass of the Burnley Tunnel, it is considered that there is less scope to reallocate capacity to active travel modes than on City Road West.

In the early stages of this project a program of consultation was undertaken with key stakeholders. This included a walk-through site inspection and a workshop to identify the main issues facing City Road and potential opportunities that could be developed to solve these issues and to meet the overall project objectives. The issues included both specific and general items and are outlined below.

City Road West	• Poor pedestrian amenity under the West Gate Freeway overpass. • There are multiple redundant vehicle crossovers which reduce on-street parking opportunities and affect the quality of the footpath. • There appears to be a large crossing demand at the Clarke Street intersection, but there is no crossing facility at this location. • There is likely to be increasing demand for crossing opportunities as residential development expands. • Poor pedestrian amenity at Queensbridge Street intersection. Navigating the intersection on foot requires multiple stage crossings and can take a long time due to the multiple signal cycles required. • Motorcycles have been observed parking on the footpath between Queensbridge Street and Power Street, where the footpath is quite narrow. • Large volumes of pedestrians cross at the Power Street intersection and this is likely to increase when the Kavanagh Street car park is redeveloped. • There are no bicycle facilities, despite City Road being a priority bicycle route under Smart Roads.
City Road East	• There is no pedestrian crossing on the east leg of the Power Street intersection, despite large volumes of pedestrians crossing at this intersection. • Large volumes of vehicles turn right from Power Street south into City Road. This section of the road is the designated Burnley Tunnel bypass and hence there is a requirement for it to carry large volumes

	of traffic. • There are long wait times for pedestrians wishing to cross City Road at the Southgate Avenue intersection and the pedestrian crossing outside the Mantra Hotel. • There is poor pedestrian amenity at the interface with St Kilda Road. It is not possible to walk through the underpass without first climbing some steps to the Arts Centre and accessing a pedestrian walkway. There is a ramp from the north side of City Road to St Kilda Road, but this is not sign posted. There is generally poor way finding and provision for disabled people.
Alexandra Avenue	• Although speed data is not available, there is anecdotal evidence of high speeds through the St Kilda Road underpass. • The Capital City Trail is becoming increasingly congested. The identified long term alternate route for cyclists is Alexandra Avenue and City Road, but there are no dedicated bicycle facilities. • There is a clear crossing desire line between Alexandra Gardens and Queen Victoria Gardens, but no crossing facility.

To respond to the changing nature of City Road and to improve road safety for all road users, opportunities have been identified to improve the amenity for pedestrians and cyclists on all sections of City Road. These are summarised below.

City Road West	• Provide pedestrian crossing near Clarke Street • Improve footpath conditions by removing redundant crossovers • Provide a median between Clarendon Street and Queensbridge Street • Review the layout of the Queensbridge Street intersection to reduce crossing distances and improve road safety • Narrow the carriageway to provide an on-road bicycle facility or a wider footpath. Parking should be permitted in the kerb side lane during off-peak periods • Reduce the speed limit • Adopt peak and off-peak signal timings to improve pedestrian priority during off-peak periods • Assign pedestrian priority zone status under Smart Roads to City Road
City Road East	• Remove parking lanes and provide an on-road bicycle facility. Parking should be permitted in the kerb side lane during off-peak periods • Reduce the speed limit • Reduce wait times at pedestrian crossings • Seek to review turns at the Queensbridge Street-City Road-Power Street triangle • Improve footpath conditions by removing redundant crossovers

	• Reinstate the kerb line near Southbank Boulevard to widen the footpath • Remove the left turn slip lanes at the Southbank Boulevard and Southgate Avenue intersections • Improve pedestrian way finding and DDA compliance between City Road and St Kilda Road • Adopt peak and off-peak signal timings to improve pedestrian priority during off-peak periods
Alexandra Avenue	• Narrow traffic lanes to reduce crossing distance • Provide a mid-block pedestrian crossing. Due to the congestion on Swan Street Bridge and the eastbound queues that regularly form along Alexandra Avenue, a crossing is unlikely to adversely affect capacity.

A key question which this report attempts to answer is how much of the existing carriageway is needed for traffic now and in the future. To answer this, traffic surveys have been carried out to establish baseline traffic volumes. These have been escalated to 2031 using information contained in the East West Link CIS in relation to expected traffic growth and land use changes. Two scenarios have been examined: a conservative scenario, which uses the most aggressive growth rates and assumes that the proposed East West Link will not reduce volumes on City Road; and an optimistic scenario, which takes the opposite position.

This provides an estimate of the required mid-block capacities for each section of the road, which are summarised in Table 1.

Table 1 Number of lanes required to accommodate forecast 2031 volumes

Location between…	Existing provision		Conservative scenario		Optimistic scenario	
	EB	WB	EB	WB	EB	WB
Clarendon Street and Queensbridge Street	2*	2	2	2	2	1
Queensbridge Street and Power Street	2	2	2	2	1	1
Power Street and Southbank Boulevard	3	3	2	3	2	2
Southbank Boulevard and Sturt Street	3	3	2	2	2	2
Sturt Street and Linlithgow Avenue	3	2	3	2	2	2

* Note that there is an additional bus lane which operates during peak periods.

The analysis indicates that mid-block lane reductions may be feasible. However, as on all urban arterial roads, the capacity is governed by the intersections, as competing routes reduce the available green time on City Road.

Intersection capacity analysis has been carried out using SIDRA Intersection software. The results indicate that a lane reduction is most likely not feasible at intersections or at most mid-block locations, as performance reduces to below acceptable limits. However, a significant limitation of the software used is that it assumes that each intersection exists in isolation, when in reality they exist as an interconnected system.

It should be acknowledged that City Road is managed by VicRoads, who may require more detailed analysis than that presented in this report if it is to consider a reduction in capacity.

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1. Introduction

1.1 Introduction

The City of Melbourne (CoM) is proposing to develop a Master Plan for City Road, part of the Southbank precinct. The Master Plan will guide public realm improvements towards the creation of a civic spine in line with the Mobility and Access, Open Space Network and Sustainable Infrastructure strategies of the Southbank Structure Plan 2010.

The master plan has the potential to achieve an improved urban environment for residents, workers and visitors by creating a place designed for people. There has been significant residential and mixed use developments recently constructed in Southbank and this is expected to continue. This amplifies the need to improve the quality of the public realm along City Road.

The CoM is developing the Master Plan in consultation with key stakeholders including:

- VicRoads;
- Public Transport Victoria (PTV);
- Department of Transport, Planning and Local Infrastructure (DTPLI); and
- City of Port Phillip (CoPP).

GHD has been engaged to provide traffic and transport planning inputs to the Master Plan working both with Council and stakeholders.

1.2 Site inspection

A site inspection involving representatives of CoM, VicRoads, DTPLI and GHD was held on 10 December 2013. The site inspection involved walking the length of the study area to identify and discuss issues and opportunities for improvement. GHD subsequently visited the site again on 4 February 2014.

1.3 Project objectives

The high level objectives of the City Road Master Plan project are to:

- Understand how City Road currently performs/operates;
- Developed an agreed set of Project Outcomes for City Road. These outcomes are expected to cover road safety, pedestrian comfort and amenity, public realm quality, transport and access for a range of modes (addressing network operating objectives), integrated water cycle management, urban forest objectives and public transport provision;
- Consider options for changes to the street that meet the agreed Project Outcomes;
- Develop a shared master plan with key stakeholders; and
- Develop an agreed implementation strategy. The Master Plan is expected to inform future capital works improvements to City Road.

1.4 Project outcomes

A stakeholder workshop was held on 16 December 2013, where stakeholders raised a number of potential transport outcomes for the Master Plan. These included:

- Improve way finding to key destinations (DTPLI);
- Improve walking and cycling safety (DTPLI);
- Improve walkability, connectivity and continuity between communities (CoM, CoPP);
- Improve opportunities to gather, connect and meet in the precinct (CoM);
- Maintain priority and throughput for public transport and increase public transport priority as land use density increases (PTV);
- Plan for a strong east-west bus route along City Road (PTV); and
- Maintain as alternative traffic route to CityLink for placarded loads and other traffic (VicRoads).

1.5 Purpose of this report

The purpose of this report is to review the existing conditions within the City Road precinct and identify the issues and opportunities to inform the development of the Master Plan.

Due to the different road environment conditions along the length of City Road, the study area has been divided into three areas consisting of:

- City Road West – West Gate Freeway to Power Street;
- City Road East - Power Street to St Kilda Road; and
- Alexandra Avenue - St Kilda Road to Linlithgow Avenue.

1.6 Assumptions

The information that has been relied upon includes:

- City Road Traffic Data Survey and Analysis, AECOM, 7 June 2010;
- Topographic survey base provided by CoM;
- Parking inventory database provided by CoM;
- Traffic volume and signal timing data provided by VicRoads;
- Southbank Arts Precinct: Additional Traffic Analysis – UrbanTrans, November 2012;
- East West Link – eastern Section: Traffic Impact Assessment, GHD, October 2013.

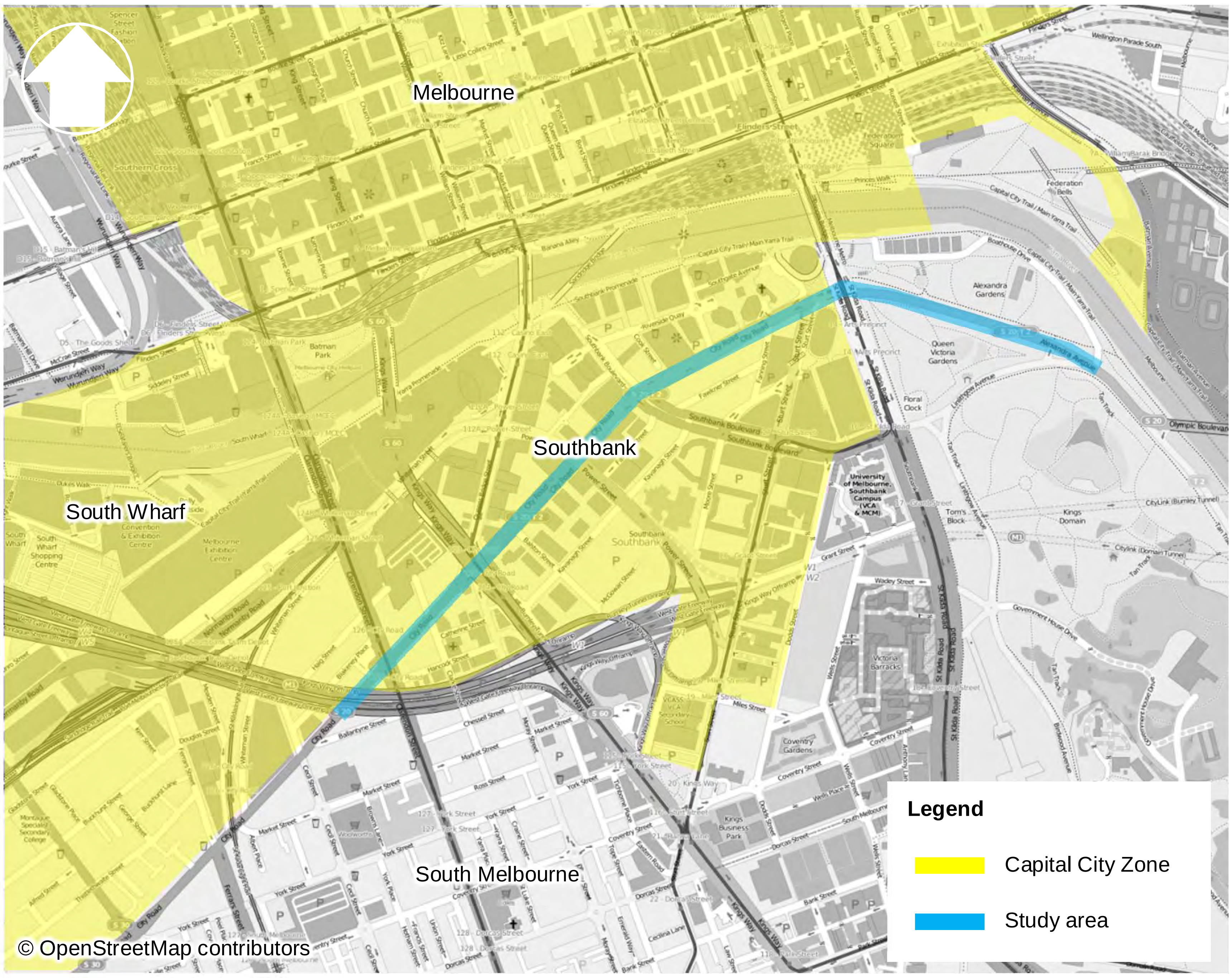
2. Study area context

2.1 Location

City Road is located within the suburb of Southbank, which in turn is located within the Capital City Zone (CCZ), as defined by the Melbourne Planning Scheme. The CCZ applies to the area commonly referred to as the Central City, the Central Business District (CBD) or the Central Activities District (CAD). While the CCZ is a town planning construct, it exists because the land uses and activities that are encouraged within the CCZ are very similar. As such, it is useful for setting policy directions and strategies.

The study area is shown in Figure 2 below.

Figure 2 Study area



2.2 Melbourne Planning Scheme

Relevant clauses from the Melbourne Planning Scheme are contained in Appendix B and key policies and strategies from them are shown in Table 2.

Table 2 Key clauses from the Melbourne Planning Scheme

Clause	Policy/strategy
21.09-2 Walking	• Strategy 1.1: Give priority to pedestrian use in high volume pedestrian areas, particularly in the Retail Core and the Central City. • Strategy 1.3: Support the extension of the existing system of dedicated pedestrian routes (including shared paths) to link all major parks and gardens. • Strategy 1.6: Ensure that pedestrians are given priority around local centres, within the Retail Core of the Central City, along key pedestrian routes, at the rail stations, high volume tram and bus stops, and around major activity generators including sports and entertainment facilities.
21.09-3 Cycling	• Strategy 1.2: Support the extension of principal cycling routes into and through the City from surrounding municipalities.
21.09-5 Private motor transport	• Strategy 1.1: Recognise that cars are complementary to other modes of transport and their use should be visitors daily managed to minimise adverse impacts on other transport modes. • Strategy 2.2: Minimise the impact of traffic through Residential and Mixed Use zones and local neighbourhoods particularly commuter traffic and heavy vehicle traffic.
21.13 Urban renewal areas **21.13-1** Southbank	• Support Southbank's development as an extension of the Central City, providing a mix of commercial and residential land uses. • Improve streetscapes as a priority along major pedestrian routes. • Give greater priority to pedestrian, cyclist and public transport amenity and access ahead of private motor vehicle use. • Encourage provision of open space and links between the Port Melbourne foreshore and the Hoddle Grid.
22.01 Urban design within the Capital City Zone Objectives	• To enhance the physical quality and character of Melbourne's streets, lanes and Capital City Zone form through sensitive and innovative design. • To improve the experience of the area for pedestrians. • To develop pedestrian and cycling connections so that Southbank has a fine grain network. • In summary, provide pedestrian connectivity and permeability through blocks

2.3 SmartRoads

VicRoads has developed the SmartRoads program in consultation with local councils and other key stakeholders to designate priorities for various transport modes on arterial roads. These priorities are set out on *network operating plans* (NOPs), which show the priority modes on each road at various times of the day. The intention is that the network will be developed over time to promote these priority modes over others on that route. The general principles of SmartRoads are:

- Pedestrians will be encouraged by facilitating good pedestrian access into and within activity centres in periods of high demand.
- Trams and buses are given priority on key public transport routes that link activity centres during morning and afternoon peak periods.
- Cars will be encouraged to use alternative routes around activity centres to reduce the level of 'through' traffic.
- Bicycles will be encouraged through further developing the bicycle network. Bicycle Priority Routes (BPRs) are an elevated sub-set of the Principal Bicycle Network (described below) and bicycle projects on these routes generally receive the highest priority for funding.
- While trucks will have full access to the arterial road network, they will be given priority on important transport routes that link freight hubs and at times that reduce conflict with other transport modes.

The network operating plan for the City of Melbourne is shown in Appendix C and is reproduced for the City Road precinct on Map 7, Map 17 and Map 25.

Of particular note is that pedestrians do not have priority along City Road, despite it being within the CCZ. All roads within the Hoddle grid do have pedestrian priority. In line with the Melbourne Planning Scheme this is considered to be a shortcoming of the NOP in Southbank.

2.4 Principal Bicycle Network

The Principal Bicycle Network (PBN) is operated by VicRoads. It is a network of proposed and existing cycle routes that help people cycle for transport, and provide access to major destinations in the Melbourne metropolitan area. Cycling for transport includes riding bicycles to work, to school, shopping, visiting friends, etc.

The PBN is also a 'bicycle infrastructure planning tool' to guide State investment in the development of transport bicycle network. The PBN is one of a number of network planning tools in Melbourne (other examples include individual Council networks) and together these networks make up the developing cycle infrastructure of Melbourne.

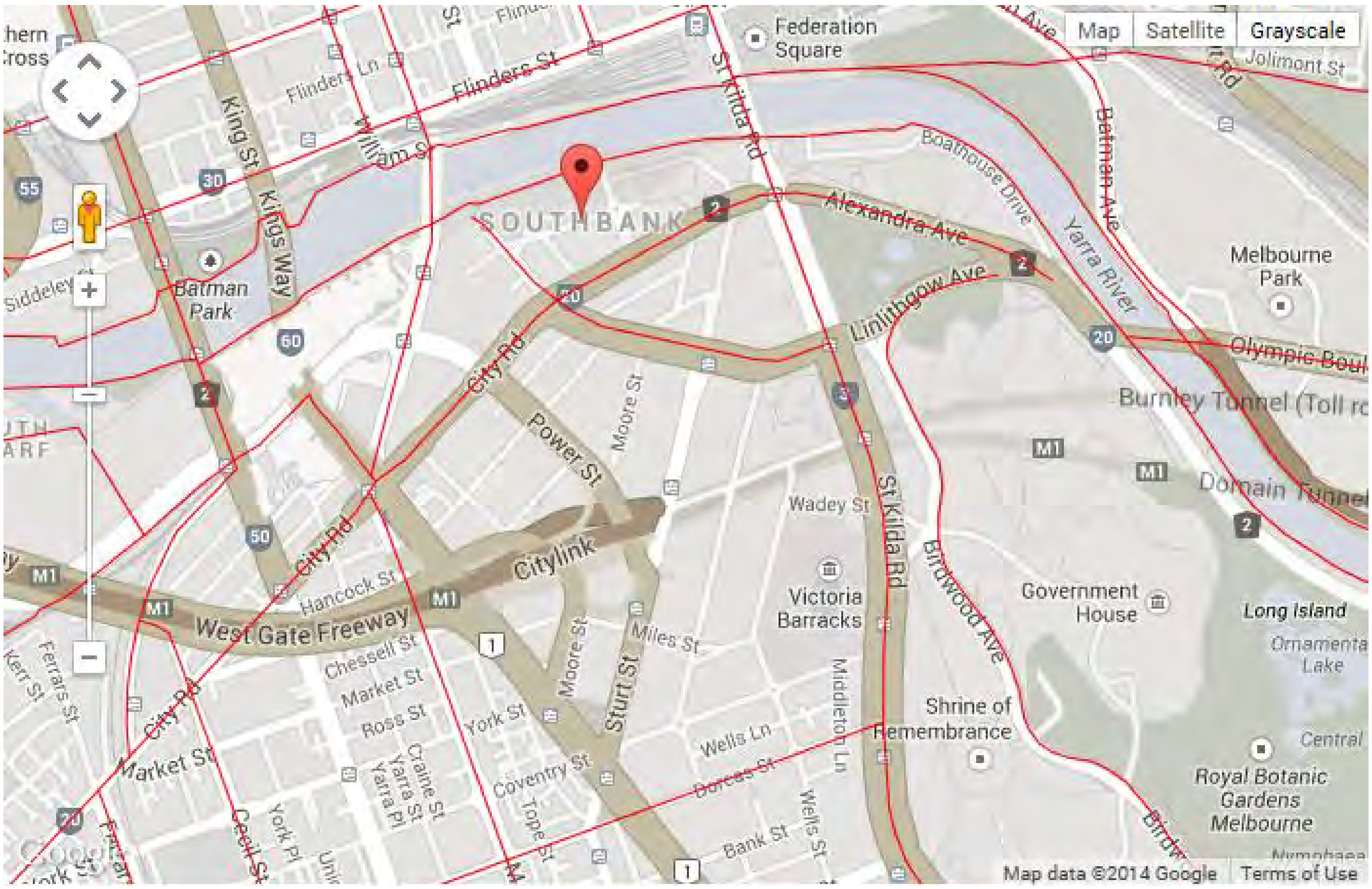
The PBN makes use of many local roads and off-road paths, as well as State arterial roads. New bicycle facilities on the PBN are designed with the principle of increasing separation between cyclists and motorists, and giving priority to cyclists at key intersections. All proposed bicycle projects on PBN routes will be eligible for funding consideration as part of the VicRoads Bicycle Facilities Program. However, VicRoads will strongly encourage the provision of bicycle lanes, paths and improvements on BPRs as the first priority. These routes are expected to deliver the highest numbers of new cyclists and will maximise investment in the network.[1]

Within the study area, the full length of City Road and Alexandra Avenue is on the PBN, whilst the BPR extends along City Road (west of Southbank Boulevard), Southbank Boulevard and

[1] Source: VicRoads fact sheet *Principal Bicycle Network*, August 2012.

Linlithgow Avenue. This is shown in Figure 3. The routes on the PBN which are also BPRs are shown on Map 7, Map 17 and Map 25.

Figure 3 Extent of PBN in Southbank[2]



2.5 Public transport

Six bus routes use short sections of City Road. The 250, 251 and 253 travel between Clarendon Street and Queensbridge Street (where there is an eastbound bus lane) and the 216, 219 and 220 travel between Power Street and Southbank Boulevard. The routes are shown in Figure 4 and the running times are shown in Table 3.

There are no tram routes along City Road, although two routes cross it. Tram Route 112 extends along Clarendon Street between West Preston and St Kilda and Tram Route 55 travels along Kings Way and Queensbridge Street between Coburg and Domain Interchange. There are also many tram routes along St Kilda Road, but as they are grade separated, they have no impact on City Road.

[2] Source: http://www.vicroads.vic.gov.au/Home/Moreinfoandservices/Bicycles/StrategicDirectionsForCycling/BicycleNetworkPlanning/PBNMap.htm

Table 3 Frequency of bus routes

Bus route	Frequency (min/max/average minutes)		
	Weekdays	Saturday	Sunday
216 - Caroline Springs to Brighton Beach	21-50 (31)	28-46 (35)	47-70 (60)
219 - Sunshine Park to Gardenvale	23-47 (30)	28-55 (35)	55-63 (59)
220 - Sunshine to Gardenvale	13-29 (15)	15-24 (15)	20-36 (29)
250 - Garden City to La Trobe University	12-40 (24)	23-40 (30)	18-68 (35)
251 - Garden City to Northland Shopping Centre	17-83 (29)	28-42 (30)	39-56 (41)
253 - Garden City to North Carlton	19-76 (31)	-	-

Figure 4 Bus routes on City Road

The key public transport outcomes from the stakeholder workshop were to maintain priority and throughput for public transport and to increase public transport priority as land use density increases. Therefore the ultimate recommendations should seek to minimise impacts on public transport routes and frequencies and to provide opportunities to improve services if possible.

It is likely that the importance of public transport along the route will increase as the population of Southbank increases and as Fisherman's Bend is developed. The preference therefore would be for the master plan to provide opportunities to improve public transport services along City Road, rather than simply to maintain them.

2.6 CityLink bypass and placarded loads

City Road east of Power Street is the designated bypass of the CityLink tunnels for *placarded loads* and other traffic during tunnel closures. A placarded load is a load which is deemed to be dangerous and can cause injury and death or serious damage to property or the environment. There are various classes of dangerous goods such as explosives, gases, flammable liquids, toxic substances and radioactive materials (among others). For safety reasons, these materials are not permitted to travel in tunnels in Victoria, including the CityLink and EastLink tunnels.

Eastbound vehicles on the West Gate Freeway must exit at Power Street and turn right onto City Road before re-joining the M1 at Batman Avenue. Westbound vehicles on City Link must exit at Punt Road or Batman Avenue, turn left onto Swan Street and continue onto Alexandra Avenue before re-joining the M1 at Power Street. It is therefore important that the section of City Road/Alexandra Avenue between Power Street and Linlithgow Avenue be maintained for vehicles carrying placarded loads.

In addition, City Road is also the designated bypass for over-height vehicles unable to enter the CityLink tunnels. Vehicles over 4.65 m in height may not enter the tunnels and must exit the Freeway as described above.

Power Street is also the entry and exit point between the freeway network and the CBD and Southbank. It therefore forms an important traffic access function regardless of other regulatory requirements.

2.7 Design standards

It is likely that sections of City Road and some intersections were designed to earlier standards and no longer meet current standards. An example of this is the low entry angle slip lanes at the Southbank Boulevard intersection, which do not meet current geometric requirements and encourage relatively high entry speeds (current standards require entry angles of 70 degrees, whereas the current layout provides angles closer to 45 degrees).

While it is impractical to continually update the existing road network to meet current standards, it is considered that where a project is seeking to make improvements to a section of the road network, it is reasonable to review the layout of that section and to update it to meet current standards if practical.

3. City Road West

3.1 Road environment

City Road West extends between the West Gate Freeway and Power Street. It is an undivided road which consists of two lanes in each direction with additional parking lanes and intersection flaring to accommodate right turn lanes. The posted speed limit is 60 km/h. The extent of City Road West within the study area is shown in Figure 5 and a view looking west along City Road between Queensbridge Street and Power Street is shown in Photo 1.

Figure 5 Overview of City Road West within the study area

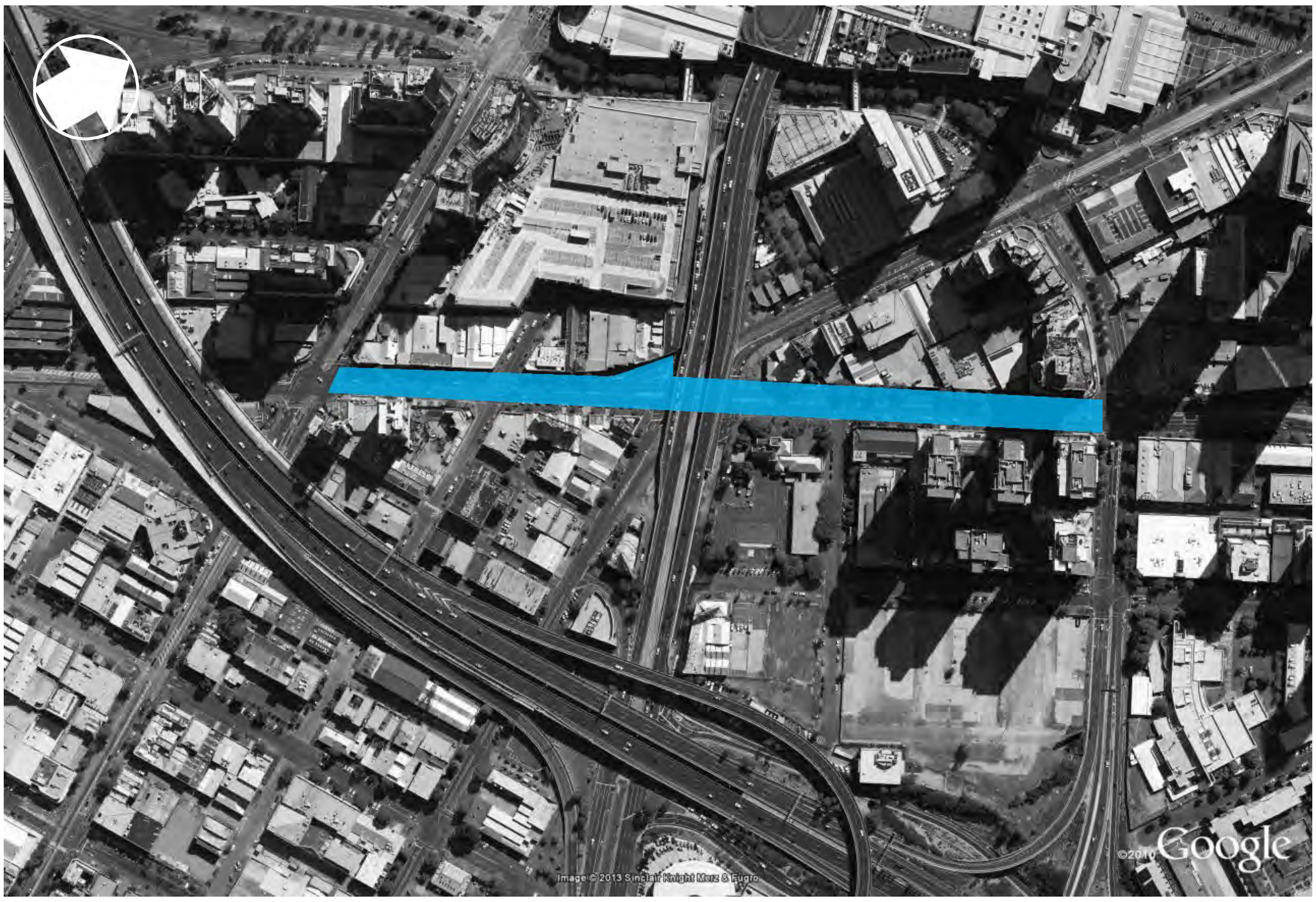


Photo 1 View of City Road West looking west

Under the VicRoads SmartRoads road use hierarchy, this section of City Road has competing mode priorities which include:

- Bicycle priority route
- Bus priority route; and
- Traffic route.

Note that City Road is not a pedestrian priority area under SmartRoads, even though it is within the Capital City Zone.

Lane widths on City Road West vary between 2.9 m and 4.2 m with additional parking lanes. There is also an eastbound peak hour bus lane between Clarendon Street and Queensbridge Street. The desirable lane width on arterial roads is typically 3.5 m, particularly where there are high volumes of heavy vehicles or bus routes. However, given that the existing lane widths are less than 3.5 m in places; that heavy vehicle volumes are relatively low; and that the road is becoming increasingly residential in nature, it is considered that narrower traffic lanes would be appropriate. This is supported by VicRoads' Road Design Guides (i.e. as narrow as 3.1 m for straight roads), and further, there are examples in the City of Melbourne where traffic lanes on arterial roads which carry freight are much less than 3.5 m wide. For example, traffic lanes on Dynon Road are 3.1 m wide and traffic lanes on Alexandra Avenue are as low as 3.0 m wide (see Section 5.1 for details).

At Workshop #1 for this study, PTV has stated that it requires existing bus services along City Road to be maintained, and if possible, for them to be improved in the future. The eastbound bus lane between Clarendon Street and Queensbridge Street is considered adequate for both these aims, but there is an opportunity to improve services by providing a westbound lane as well.

The Queensbridge Street intersection is a key transport interchange with bicycle lanes, bus stops and tram stops. It has a complex layout, as it accommodates the Kings Way overpass and a tram reserve which create wide median islands that extend crossing times and distances. There is a double left turn signalised slip lane on the west approach, which further reduces pedestrian crossing opportunities. It may be possible to reconfigure the slip lanes at this intersection to reduce vehicle entry speeds, improve road safety and reduce crossing times for pedestrians.

Photos of the intersection highlighting the multiple islands that pedestrians need to cross to navigate the intersection are shown overleaf.

It is common on inner-city roads to permit parking in the kerb side lane during off-peak periods, as traffic volumes are usually low enough at these times that two lanes are not needed for traffic flow. Therefore there may be the opportunity to remove the existing parking lane and to provide either separated bicycle lanes or wider footpaths. Kerb side parking would then be permitted in the existing left traffic lane.

Opportunities

- Reduce lane widths. This would create more room for bicycle facilities and wider footpaths.
- Remove parking lanes and provide either separated bicycle lanes or wider footpaths. Permit on-street parking in the kerbside lane during off-peak periods.
- Consider reducing the speed limit to 50 km/h.
- Seek to provide a westbound bus lane for PM peak traffic between Clarendon Street and Queensbridge Street.
- Review the layout of the Queensbridge Street intersection to reduce crossing distances and improve road safety. This should include the potential for reconfiguring the slip lanes at the Queensbridge Street intersection to reduce vehicle speeds and pedestrian crossing times.
- Assign pedestrian priority zone status under Smart Roads to City Road.

Photo 2 View of Queensbridge Street intersection looking west

Photo 3 View of Queensbridge Street intersection taken from west approach looking south

3.2 Existing traffic volumes

The 2013 SCATS volumes have been obtained from VicRoads and are summarised in Table 4. SCATS is the system which controls traffic signals in Melbourne and other cities in Australia and generally it is capable of recording traffic volumes in each lane by the use of detector loops set into the road pavement.

Table 4 2013 traffic volume data for City Road West

Location between…	Daily volume (two-way, vpd)	AM peak (0800 – 0900) (vph)		PM peak (1700 – 1800) (vph)	
		e/b	w/b	e/b	w/b
Clarendon Street and Queensbridge Street	28,900	1,142	839	1,361	841
Queensbridge Street and Power Street	22,500	792	790	783	645

Generally, volumes are reasonably consistent with very little directionality between the AM and PM peaks. Volumes are generally higher in the eastbound direction than in the westbound direction.

A comparison to arterial roads within the CBD is shown in Table 5. The analysis indicates that volumes on City Road West are much lower than on King Street in the CBD, but slightly higher than on Spencer Street.

Table 5 Comparison to traffic volumes on other arterial roads

Location	Daily two-way volume (vpd)
City Road between Clarendon Street and Queensbridge Street	28,900
King Street between Collins Street and Bourke Street	45,000
Spencer Street between Collins Street and Bourke Street	24,000

Note: volumes on King and Spencer streets are from 2012 estimates by VicRoads. Volumes have been escalated from previous years.

3.3 Walking and cycling infrastructure

The footpath on both sides of the road varies in width between about 3.5 m and 6.0 m with trees and other street furniture reducing the usable width generally to about 3.5 m. The footpath is generally in reasonable condition. During the site inspection it was noted that there are several redundant crossovers, which reduce on-street parking opportunities and often result in level changes on the footpath, as shown in Photo 4. In addition, there are several locations where fire escape doors are recessed from the footpath, creating potential personal safety issues.

Photo 4 Redundant crossover on City Road West

Currently pedestrian desire lines are generally along the intersecting roads of Clarendon Street and Queensbridge Street. Anecdotally there is also a crossing demand for pedestrians at Clarke Street associated with an access to Crown Casino. People were observed crossing at this location during the site inspection (see Photo 5). There is no median at this location, but people were observed waiting in the centre of the road to stage their crossing.

Distances between crossing locations on City Road are often long. For example, the distance between Queensbridge Street and Power Street is approximately 270 m. This is in contrast to distances between crossings in the CBD Hoddle grid which are typically 200 m apart or less.

The Queensbridge Street intersection incorporates the Kings Way overpass and a tram corridor. These create a large median which pedestrians walking along City Road must cross. The median is so wide that often pedestrians are not able to cross Queensbridge Street in one cycle and must therefore cross in two stages. This substantially reduces pedestrian connectivity along City Road in this vicinity.

The only cycling infrastructure currently provided is the eastbound AM peak bus lane in which cyclists are permitted to travel. Given that cyclist volumes are expected to increase, it is considered that dedicated infrastructure would be appropriate.

Since traffic volumes are lower during off-peak periods there is less of a need to prioritise traffic movements at those times. Consequently, it may be possible to improve pedestrian crossing opportunities by adjusting traffic signal timings to provide more green time for pedestrians.

Photo 5 Pedestrians crossing at Clarke Street

Opportunities

- Carry out crossing surveys in the vicinity of Clarke Street, where anecdotal evidence suggests there is a crossing demand. Depending on the results of the survey, consideration should be given to improving crossing opportunities and safety at this location.
- Alternatively, it may be appropriate to signalise the Clarke Street intersection. As well as better controlling traffic movements there would also be the opportunity to incorporate pedestrian crossings.
- Reinstate the footpath and kerb at all redundant crossovers.
- Consider providing a median between Clarendon Street and Queensbridge Street to enable people to stage their crossing.
- Improve signal timing at the Queensbridge Street intersection so that pedestrians do not have to cross in multiple stages.
- Seek to provide dedicated bicycle infrastructure. One option would be to remove the parking lanes and provide a separated bicycle facility as described in the opportunities box in Section 3.1.
- Investigate the possibility of adjusting signal timings during off-peak periods to improve pedestrian crossing opportunities.

3.4 Crash history

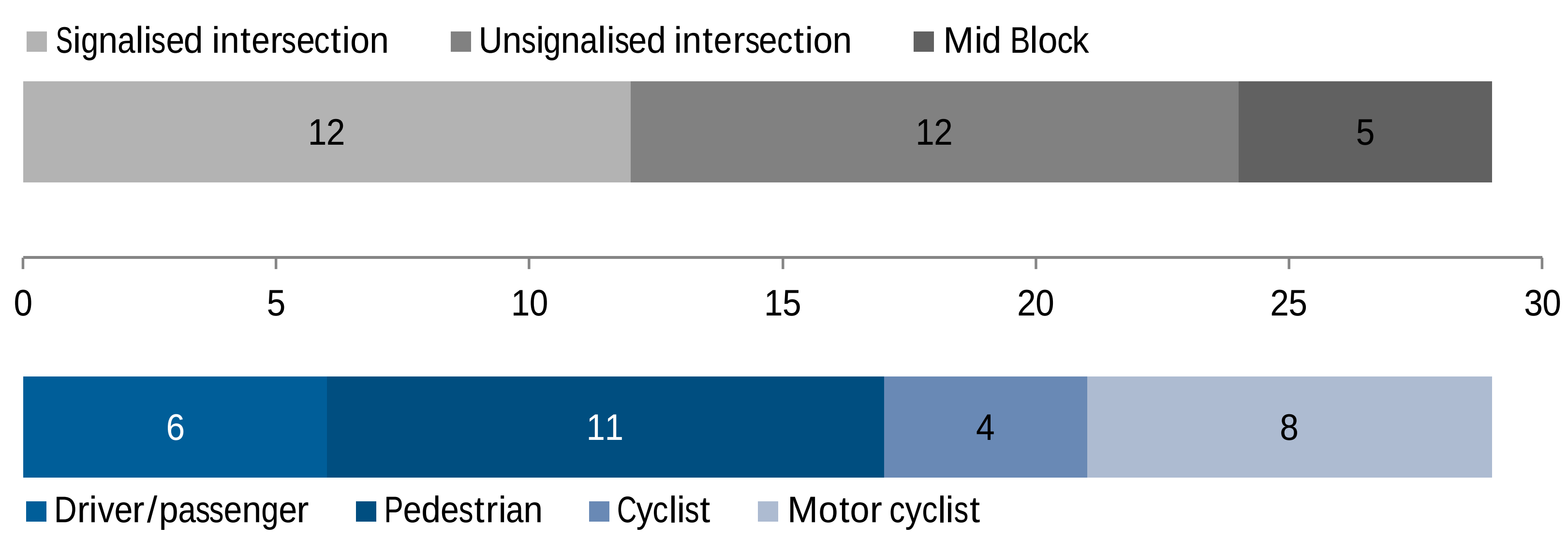
VicRoads' publicly-accessible crash database *CrashStats* has been searched for the five-year period 1 January 2008 to 31 December 2012 for the length of City Road West. In total, 29 crashes have occurred on City Road West, of which 10 resulted in serious injuries and 19 resulted in other injuries.

3.4.1 All crashes

The types of crashes that have occurred are shown in Figure 6. The most prevalent crash type is 'other pedestrian' which is made up of a variety of pedestrian crash types. The next most prevalent crash types are 'right through' which involve vehicles failing to give way when turning right off a road, and 'out of control on carriageway'.

The locations along City Road West with the highest number of casualty crashes occurred at the intersections with Clarke Street, Queensbridge Street and Clarendon Street, where the number of crashes at each location is displayed in Map 4.

Figure 6 Crash types on City Road West



Clarendon Street/City Road intersection

Of the six crashes recorded at the Clarendon Street/City Road intersection, four involved pedestrians. The majority of these crashes occurred when a car travelled straight through the intersection, hitting a pedestrian.

Clarke Street/City Road intersection

There were seven recorded casualty crashes at the intersection of Clarke Street and City Road over the five year period, all of which involved vulnerable road users (pedestrians, cyclists or motorcyclists). The intersection is not signalised, but it is unclear from the crash data whether this fact contributed to the crashes.

Two cyclist crashes occurred here. Both involved a cyclist being struck by a vehicle turning into Clarke Street.

Two pedestrian crashes occurred here. Both crashes have been coded as 'other pedestrian' which makes the circumstances of the crashes unclear. Without further information it is not possible to state what the contributory factors of these crashes were.

Queensbridge Street/Moray Street/City Road intersection

There were eight recorded casualty crashes at this intersection over the five year period. Six of these crashes involved a vulnerable road user, comprising three pedestrian crashes, two cyclist crashes and one motorcycle crash. Three of the crashes were cross-type crashes involving traffic from intersecting roads crossing through the intersection at the same time.

3.4.2 Crash rates

The types of crashes that have occurred have been classified as occurring either mid-block or at an intersection. Using this classification and 2013 SCATS volume data, the following crash rates have been calculated.

- For mid-block sections: crashes per 100 million vehicle kilometres travelled (100 mvkt)
- For intersections: crashes per 10 million vehicles entering (10 mve)

Compared to the Victorian average (as reported in the 2007 Austroads crash rates database), the crash rates along City Road West are on par with or lower than other Victorian roads and intersections of similar characteristics, as shown in Table 6. This indicates that this section of City Road performs well when compared to similar roads in Victoria.

Table 6 Crash rate summary on City Road West

Road segment	Casualty crash rate	Victorian average	Variance
West Gate Freeway to Power Street	21.10 (per 100 mvkt)	32.12 (urban undivided road)	-34%
Intersection of City Road and Clarendon Street	1.91 (per 10 mve)	2.04 (Intersection)	-6%
Intersection of City Road and Moray Street	2.12 (per 10 mve)		+4%
Intersection of City Road and Power Street	1.17 (per 10 mve)		-42%

3.4.3 Pedestrian accidents

Of all 29 casualty crashes, 10, or 35%, involved pedestrians. Of these, three were serious and eight were of other severity. The types of pedestrian accidents that have occurred are shown in Figure 7.

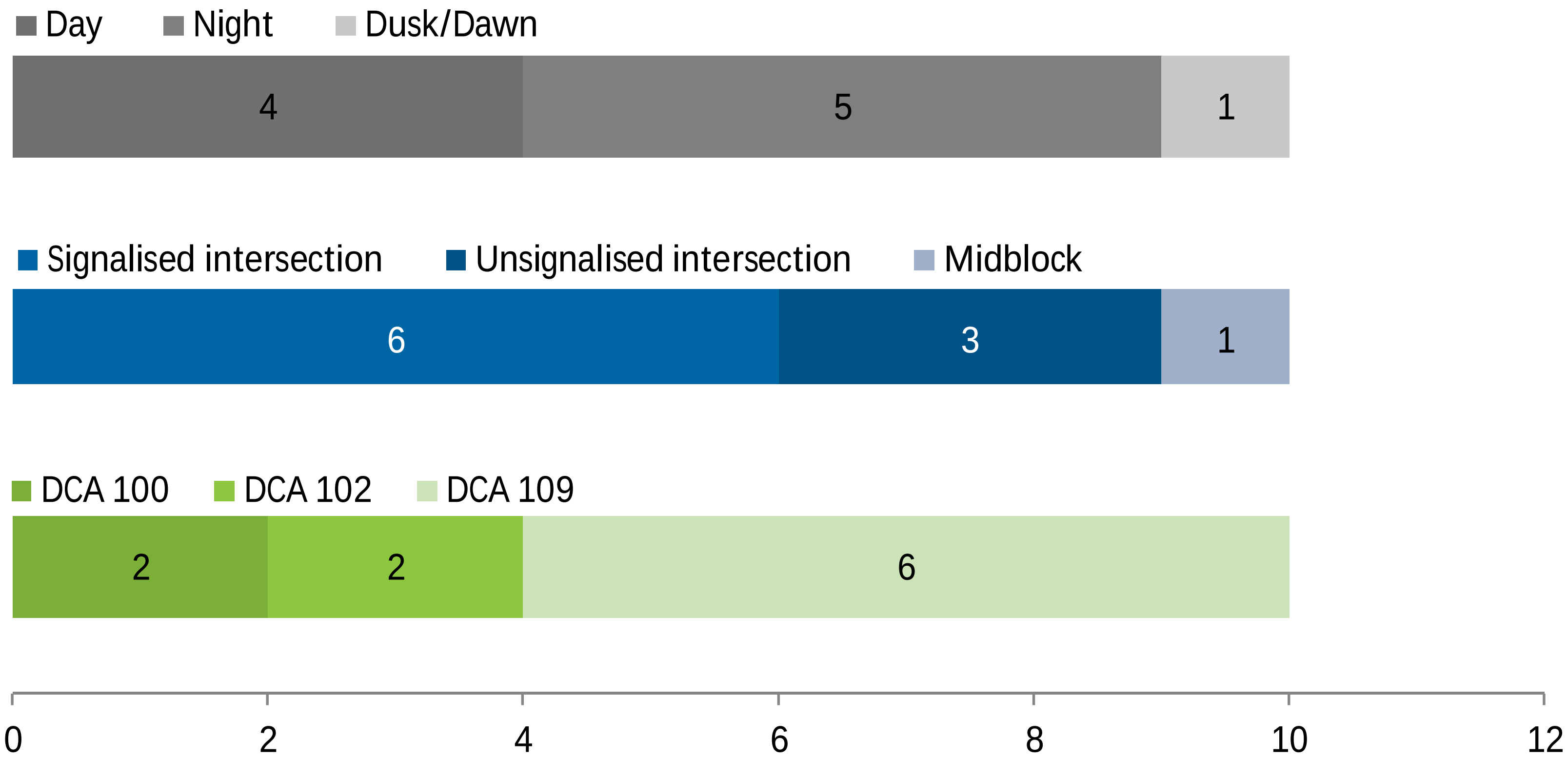
The greatest proportion of pedestrian accidents was ‘other pedestrian’ which is a category of accident types that do not fit into other definitions. The remaining accident types are ‘near side’ and ‘far side’ which involve pedestrians being struck while crossing the road (either mid-block or at an intersection).

Four of the crashes occurred at the Clarendon Street intersection and two occurred at the Clarke Street intersection. Of the crashes that occurred at the Clarendon Street intersection, two were ‘other pedestrian’ crashes and two were ‘far side’ crashes. As the intersection is signalised, it is unclear why the far side crashes have occurred. Of the crashes that have occurred at the Clarke Street intersection, both were ‘other pedestrian’ crashes. The causes are therefore unclear, but as this intersection is not signalised, they may be related to uncontrolled crossing movements.

For comparison to the rest of the City of Melbourne, data has been extracted from the City of Melbourne Road Safety Plan. The Plan contains comparative data for the CBD, the municipality, the Melbourne metropolitan area (MMA) and the state. In the CBD area, pedestrians make up about 35% of all crashes, while in the municipality they make up about 23%. Rates for the MMA and Victoria are lower at 13% and 11% respectively. This indicates that pedestrian crashes on City Road make up a similar proportion of crashes than in the CBD and a much higher proportion than the municipality and the rest of the state. Although the rate of pedestrian crashes is similar, the number of pedestrians physically moving along City Road is likely to be much lower than in the CBD. When using a comparative measure such as crashes per pedestrian kilometres walked, City Road is likely to have a higher crash rate compared to the CBD.

All pedestrian accident locations are displayed in Map 5.

Figure 7 Details of pedestrian crashes on City Road West



DCA codes:

100 – pedestrian near side

102 – pedestrian far side

109 – other pedestrian

3.4.4 Cyclist crashes

Of all 29 crashes, four (14%) involved cyclists. Two of these were serious crashes and two were of other severity. Two occurred at Clarke Street and two occurred at Queensbridge Street.

Of the crashes to have occurred at Clarke Street, one was a ‘right through’ which involved a cyclist travelling through the intersection and being struck by a vehicle turning right (i.e. not giving way). The other was a left turn side swipe, which involved a vehicle turning left across a cyclist travelling in the same direction.

Of the crashes to have occurred at Queensbridge Street, one was a ‘lane change right’ which involves one vehicle being struck by another as it changes lanes. It is not clear from the crash data whether the car or the bicycle changed lanes. The other crash was a cross type, involving both vehicles proceeding through the intersection at the same time from perpendicular approaches. As this intersection is signalised, this means that one vehicle ran a red light, but the crash data does not make it clear which vehicle did so.

Although car doorings are the most prevalent cyclist crash type in the City of Melbourne, it is noted that none have occurred on City Road West in the study period.

Again, comparison data have been sourced from the road safety plan. In the CBD and the municipality, cyclist crashes make up approximately 29% and 26% of all crashes respectively. This is substantially higher than on City Road West.

The proportion of crashes involving cyclists can be compared to their mode share on City Road (see Table 7). Bicycle Network Victoria Super Tuesday counts were conducted on 4th March 2014 at the Queensbridge Street and City Road intersection. In this survey, 105 cyclists were counted travelling along City Road between 07:00 and 09:00. Using a two-hour to one-hour conversion factor of 55%, this is equivalent to a peak hour volume of approximately 58 cyclists. When compared to SCATS volumes, it shows that while there are a low proportion of cyclists (3% of total traffic) on City Road, they represent a larger proportion of the overall crashes (14%).

Table 7 Bicycle volumes on City Road

Road segment	Vehicles AM peak (two way)	Cyclists AM peak	% Cyclists
Clarendon Street to Queensbridge Street	1,981	58	3%

Opportunities

- Crash data indicate that near side and far side crash types are the most common defined pedestrian crash types on City Road West. These typically involve pedestrians crossing the road. Narrowing the total carriageway width and providing a pedestrian crossing at uncontrolled intersections are likely to help reduce the incidence of these crashes.
- It may be possible to remove the parking lanes and provide separated bicycle lanes. Parking would then occur in the new kerb side traffic lane during off-peak periods.

3.5 Land use

The adjacent land use is a mixture of retail, residential and commercial with a number of unoccupied or under construction sites near Queensbridge Street. West of Queensbridge Street the land use is primarily commercial and retail on the north side of the road, but on the south side it is primarily residential. Just west of Power Street East there are two large residential developments.

In the future, more residential developments are expected, with proposed and planned developments throughout the length of this section of City Road (see Map 3).

3.6 Parking facilities

The 2010 AECOM report contains information on the amount of parking space in Southbank, which was sourced from the 2008 Census Land Use and Employment (CLUE) database. At the time of that study, there were about 25,500 car parking spaces in the broader Southbank precinct, comprising approximately—

- 11,800 commercial spaces;
- 8,200 private spaces; and
- 5,500 residential spaces.

While it is difficult to separate the data into the sections of City Road used in this report, within the City Road West area there are approximately 5,800 spaces which are almost exclusively associated with Crown Casino.

Given the extent of residential development that is planned along City Road, the total number of parking spaces is expected to increase.

When dealing with on-street parking, there are both advantages and disadvantages, some of which are listed below.

- Lack of adequate supply can lead to unnecessary traffic circulation which adds to congestion and pollution.
- Footpath amenity can be reduced, such as where outdoor tables are located immediately adjacent to parked cars.
- Parked cars present a hazard to cyclists. Car dooring is the predominant crash type involving cyclists in the City of Melbourne.
- Parked cars provide a measure of traffic calming, as they increase side friction and narrow the overall carriageway.
- Parked cars create activity which enhances passive surveillance and creates dynamism.
- On-street parking supports local trade and provides a level of convenience not afforded by off-street parking.

On balance it is considered that on-street parking would be a positive for City Road West, as it creates an active environment and reduces the dominance of the carriageway. Melbourne's most popular and vibrant shopping strips in the Capital City Zone, such as Elizabeth Street, Collins Street and Bourke Street, all have on-street parking supported by off-street car parks and this does not appear to discourage the development of shops, cafés or restaurants.

Opportunities

- Seek to maintain on-street parking.
- The reinstatement of kerbs at redundant crossovers provides the opportunity to increase the amount of on-street parking.

3.7 Summary of issues and opportunities

The issues and opportunities that have been identified are summarised below.

Road environment

- Reduce lane widths. This would create more room for bicycle facilities and wider footpaths.
- Remove parking lanes and provide either separated bicycle lanes or wider footpaths. Permit on-street parking in the kerbside lane during off-peak periods.
- Consider reducing the speed limit to 50 km/h.
- Seek to provide a westbound bus lane for PM peak traffic between Clarendon Street and Queensbridge Street.
- Investigate the potential for reconfiguring the slip lanes at the Queensbridge Street intersection to reduce vehicle speeds and pedestrian crossing times.
- Assign pedestrian priority zone status under Smart Roads to City Road

Walking and cycling infrastructure

- Carry out crossing surveys in the vicinity of Clarke Street, where anecdotal evidence suggests there is a crossing demand. Depending on the results of the survey, consideration should be given to improving crossing opportunities and safety at this location.

- Alternatively, it may be appropriate to signalise the Clarke Street intersection. As well as better controlling traffic movements there would also be the opportunity to incorporate pedestrian crossings.
- Reinstate the footpath and kerb at all redundant crossovers.
- Consider providing a median between Clarendon Street and Queensbridge Street to enable people to stage their crossing.
- Improve signal timing at the Queensbridge Street intersection so that pedestrians do not have to cross in multiple stages.
- Seek to provide dedicated bicycle infrastructure. One option would be to remove the parking lanes and provide a separated bicycle facility as described in the opportunities box in Section 3.1.
- Investigate the possibility of adjusting signal timings during off-peak periods to improve pedestrian crossing opportunities.

Crash history

- Crash data indicate that near side and far side crash types are the most common defined pedestrian crash types on City Road West. These typically involve pedestrians crossing the road. Narrowing the total carriageway width and providing a pedestrian crossing at Clarke Street are likely to help reduce the incidence of these types of crashes.
- It may be possible to remove the parking lanes and provide separated bicycle lanes. Parking would then occur in the new kerb side traffic lane during off-peak periods

Parking facilities

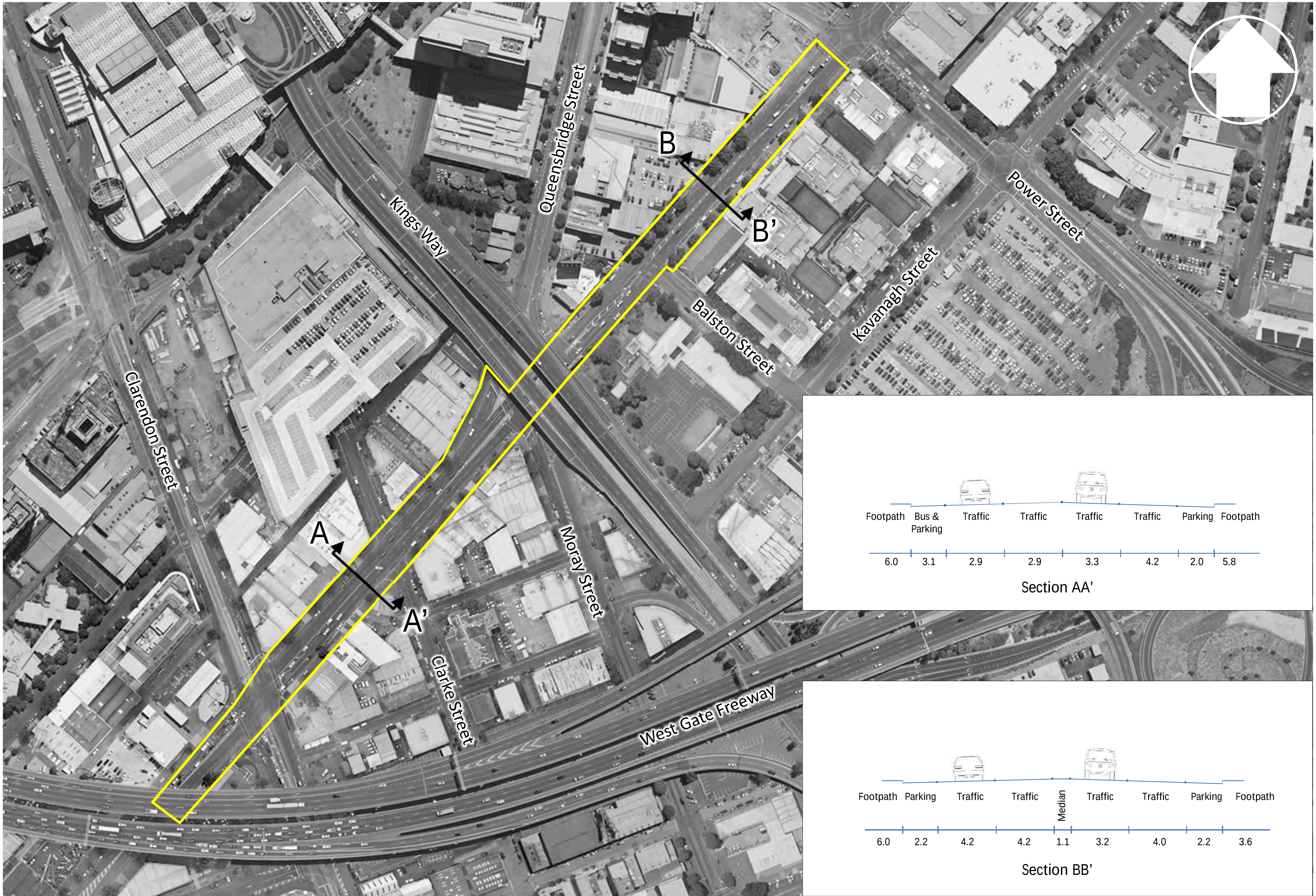
- Seek to maintain on-street parking.
- The reinstatement of kerbs at redundant crossovers provides the opportunity to increase the amount of on-street parking

3.8 Maps

The following figures graphically summarise the existing conditions, issues and opportunities:

- Map 1 Study area
- Map 2 Primary adjoining land use
- Map 3 Proposed/planned residential developments
- Map 4 Crash history – all road users
- Map 5 Crash history – pedestrians
- Map 6 Crash history – cyclists
- Map 7 Network operating plan
- Map 8 Existing (2010) peak hour traffic volumes
- Map 9 Existing (2010) commercial off-street parking supply and on-street parking restrictions
- Map 10 Issues and opportunities

Map 1 City Road West – Study area



Map 2 City Road West – Primary adjoining land use

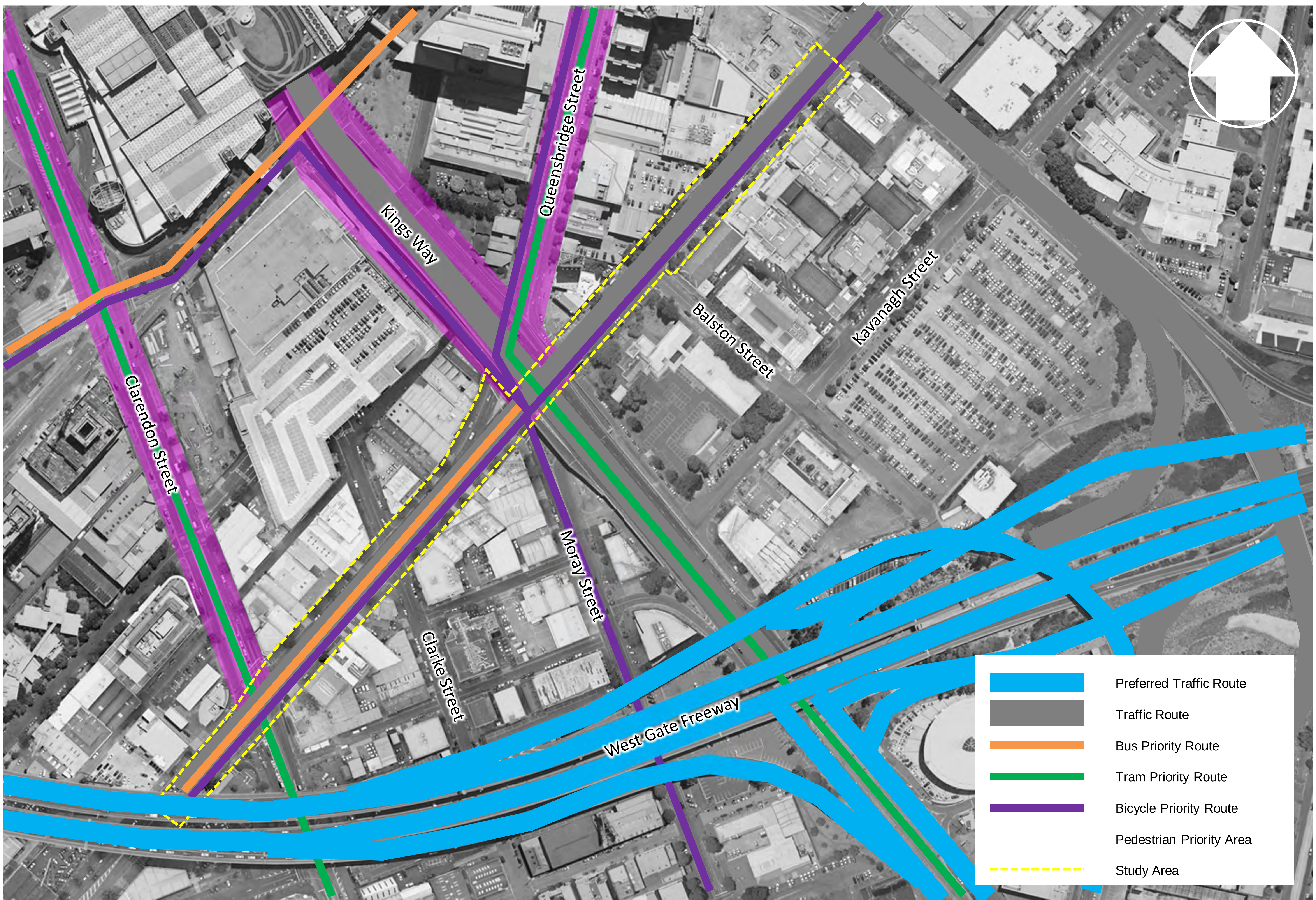
Map 3 City Road West – Proposed/planned residential developments

Map 4 City Road West – Crash history – all road users

Map 5 City Road West – Crash history – pedestrians

Map 6 City Road West – Crash history – cyclists

Map 7 City Road West – Network operating plan

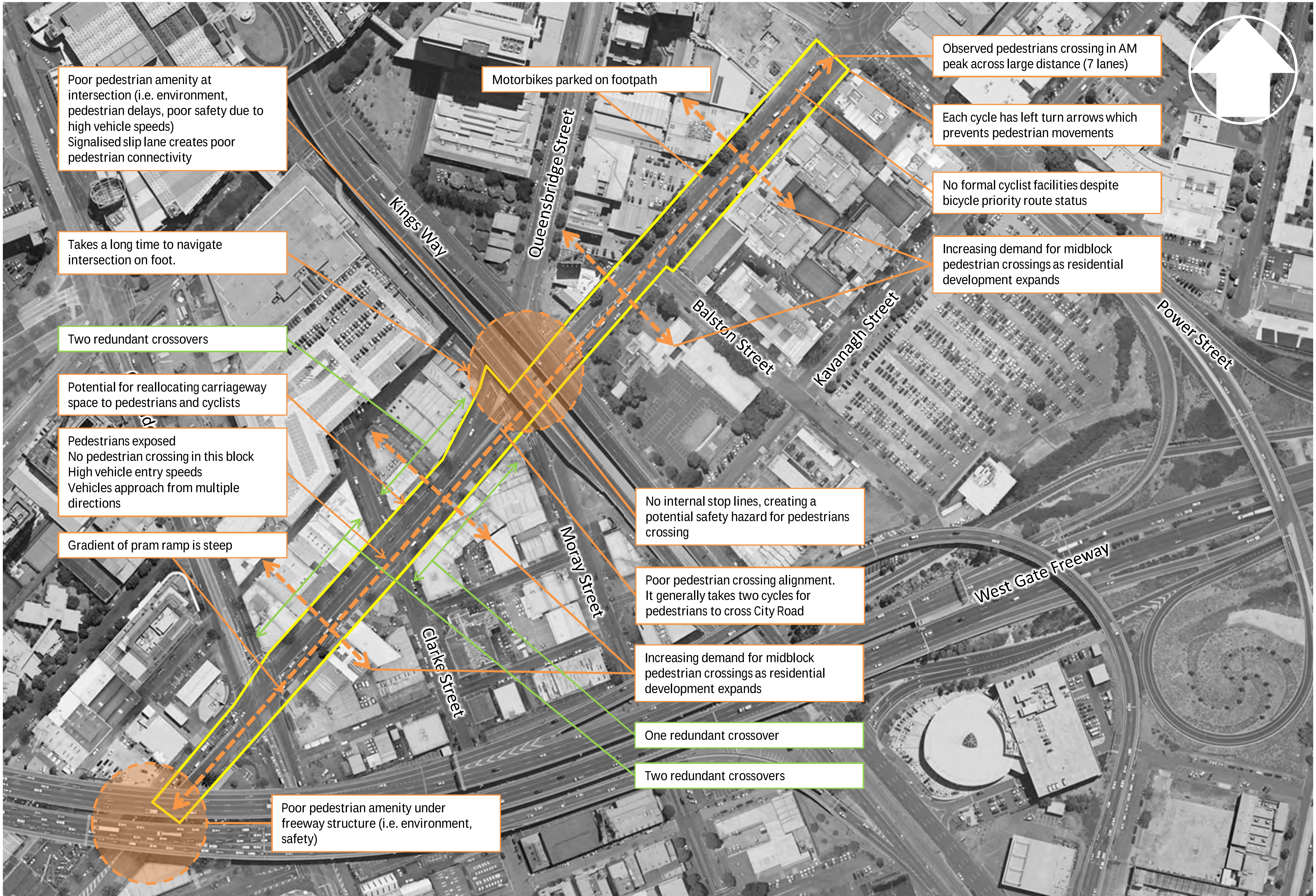


Map 8 City Road West – Existing (2013) Peak Hour Traffic Volumes

Map 9 City Road West – Existing (2010) commercial off-street parking supply and on-street parking restrictions

Notes
1. Off-street car park data from 2010 AECOM report
2. Default No Stopping restrictions and time restrictions not shown for clarity

Map 10 City Road West – Issues and opportunities



4. City Road East

4.1 Road environment

City Road East extends between Power Street and St Kilda Road. It is a divided road which consists of three lanes in the westbound direction with kerb side parking permitted during off peak periods. In the eastbound direction, there are three through lanes with an additional kerbside parking lane at the eastern end. The posted speed limit is 60 km/h. The extent of City Road East within the study area is shown in Figure 8 and a view of City Road East looking west is shown in Photo 6.

Figure 8 Overview of City Road East in study area

Photo 6 City Road East looking west

As part of the VicRoads Smart Roads road use hierarchy, this section is prioritised as:

- General traffic route;
- Bus priority route (to Southbank Boulevard); and
- Bicycle priority route (to Southbank Boulevard).

Note that City Road is not a pedestrian priority area under Smart Roads, even though it is within the Central City Zone.

This section forms part of the City Link bypass route for placarded loads and other traffic during tunnel closures. These vehicles must exit the West Gate Freeway at Power Street and turn right onto City Road.

Lane widths on City Road East are approximately 3.3 m with additional parking lanes. The desirable lane width on arterial roads is 3.5 m. However, given that the existing lane widths are less than 3.5 m in places, and that the road is becoming increasingly residential, there may be scope to provide narrower traffic lanes. Given that lane widths on Dynon Road and Alexandra Avenue (i.e. similar CBD roads with high traffic and truck volumes) are as low as 3.1 m and 3.0 m respectively, it is considered that there may be scope to narrow the lanes on City Road East to 3.1 m, although it is acknowledged that this should be considered in the context of the total cross-section and street environment.

Just west of Southbank Boulevard there is evidence of an earlier lane configuration in the form of a hatched area at the kerb side (see Photo 7 overleaf). This creates a narrowing in the footpath which could easily be improved.

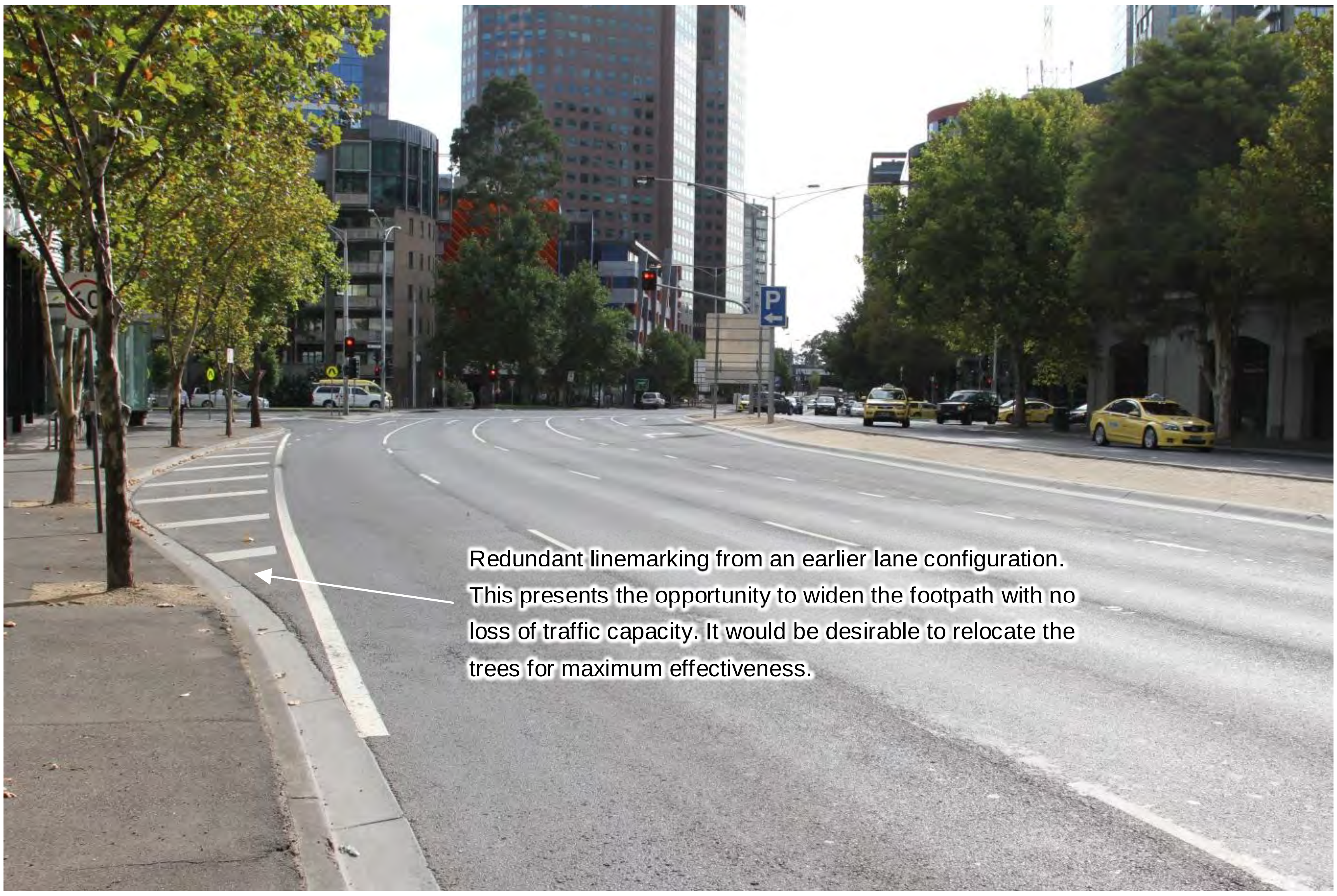
Just east of Southgate Avenue there are a number of indented parking spaces which are subject to Clearway restrictions during the evening peak period (1500 to 1900). Because these spaces are indented (there is a kerb outstand at the pedestrian crossing) the lane is not required for traffic capacity and this presents the opportunity to remove the Clearway restrictions. However, the time taken to manoeuvre into a parking space is likely to cause disruption to traffic flow, which is presumably why the Clearway restriction still applies. As the function of City Road changes over time, it may be appropriate to remove these Clearway restrictions. Another option could be to provide longer (but fewer) spaces into which cars can manoeuvre forwards.

It is common on inner-city roads to permit parking in the kerb side lane during off-peak periods, as traffic volumes are usually low enough at these times that two lanes are not needed for traffic flow. Therefore there may be the opportunity to remove the existing parking lane and to provide either separated bicycle lanes or wider footpaths. Kerb side parking would then be permitted in the existing left traffic lane.

Opportunities

- Remove parking lanes and provide either separated bicycle lanes or wider footpaths. Permit on-street parking in the kerbside lane during off-peak periods.
- Reconfigure the left turn slip lanes at the Southbank Boulevard and Southgate Avenue intersections such that they meet City Road at approximately 70 degrees.
- Reinstate the footpath west of Southbank Boulevard, as shown in Photo 7.
- Consider reducing the speed limit to 50 km/h.
- Consider removing the Clearway restrictions east of Southgate Avenue.
- Assign pedestrian priority zone status under Smart Roads to City Road.

Photo 7 Redundant linemarking near Southbank Boulevard



4.2 Existing traffic volumes

The 2013 SCATS volumes are summarised in Table 8.

Table 8 2013 traffic volume data for City Road East

Location between…	Daily volume (two-way, vpd)	AM peak (0800 – 0900) (vph)		PM peak (1700 – 1800) (vph)	
		e/b	w/b	e/b	w/b
Power Street and Southbank Boulevard	45,900	1,395	1,566	1,318	1,756
Southbank Boulevard and Sturt Street	42,200	1,387	1,582	1,468	1,118

Volumes are fairly consistent in each peak by direction, except for in the PM peak where westbound volumes are higher in the western section of the road. This suggests that the West Gate Freeway, which is accessed via Power Street, has a greater impact on traffic volumes in the PM peak than in the AM peak.

City Road East carries much more traffic than City Road West – almost double the daily volumes. There is less discrepancy in the peak periods, especially in the eastbound direction where volumes at the western end of City Road West are similar to those on City Road East.

Nevertheless, there is a significant difference in overall volumes and this must have an impact on the types of treatments that are both appropriate and feasible. Unless substantial redistribution can be achieved, it appears that wide scale measures to reallocate road space to pedestrians and cyclists are likely to be less practical on City Road East than on City Road West.

A comparison to arterial roads within the CBD is shown in Table 9. The analysis indicates that volumes on City Road East are about the same as on King Street in the CBD, but much higher than on Spencer Street.

Table 9 Comparison to traffic volumes on other arterial roads

Location	Daily two-way volume (vpd)
City Road between Power Street and Southbank Boulevard	45,900
King Street between Collins Street and Bourke Street	45,000
Spencer Street between Collins Street and Bourke Street	24,000

Note: volumes on King and Spencer streets are from 2012 estimates by VicRoads. Volumes have been escalated from previous years.

Opportunities

- The critical intersection on City Road East is Power Street, as this provides access to the West Gate Freeway. It may be possible to improve capacity at the intersection by banning right turns on the north approach and relocating them upstream to Queensbridge Street, where they would then re-join City Road at the Kings Way overpass. This right turn has more capacity than Power Street, with two lanes as opposed to one.

4.3 Walking and cycling infrastructure

Footpath widths vary between about 3.5 m and 6.0 m with trees reducing the usable width generally to about 3.5 m. The footpath is generally in reasonable condition. During the site inspection it was noted that there are several redundant crossovers which reduce on-street parking opportunities and often result in level changes on the footpath. Motorbikes have been observed parking on the footpath between Queensbridge Street and Power Street, which can reduce the walkable width.

The width of the footpath in some locations is very narrow. For example, at the Power Street intersection the footpath is as narrow as 2.3 m. East of Power Street, on the south side of City Road, there is currently construction taking place and the hoarding and scaffolding has narrowed the footpath.

The walking desire lines are generally across City Road to access facilities within Southbank and along Southbank Boulevard and Southgate Avenue. Many pedestrians have been observed crossing at Power Street and it is presumed that many have come from the large open-air car park on Kavenagh Street, while it is expected that others would be local residents and visitors. It is noted that there is no pedestrian crossing on the east leg of the Power Street intersection. The lack of a pedestrian crossing on the east leg of the intersection may be adding to the numbers crossing on the western side.

Pedestrian way finding and connectivity between City Road and St Kilda Road is poor. There is no pedestrian access at grade in the St Kilda Road underpass and there is no DDA compliant access to the Arts Centre from City Road. There is a ramp between City Road and St Kilda Road next to Hamer Hall but this is not sign posted and the gradient may be too steep to be DDA compliant. There is also a pedestrian walkway above the carriageway in the St Kilda Road underpass but this is not signposted from City Road, is not DDA compliant and is a very convoluted path which is unpleasant to use as it is dark and unventilated. Personal security may also be an issue at night. Given that the Arts Centre and the Arts Precinct in general are key destinations, there are likely to be large crossing demands and pedestrian desire lines in this area which currently are not adequately catered for.

The wait times for pedestrians to cross City Road at Southgate Avenue and the pedestrian crossing outside the Mantra Hotel are reasonably long at approximately 90 seconds. It is likely that the wait time at Southgate Avenue is due to the relatively low traffic demand on that approach and it is therefore likely that reducing this time would be impractical for capacity reasons on City Road during peak periods. There may be scope to reduce waiting times for pedestrians during off-peak periods.

This section of City Road is closer to the key pedestrian destinations of the Yarra Promenade and the Arts Precinct, which is likely to increase the crossing demand on this section. Indeed, the pedestrian crossing outside the Mantra Hotel appears to be well used, as indicated in Photo 8.

There is currently no cycling infrastructure. Given that cyclist volumes are expected to increase, dedicated infrastructure is desirable.

Since traffic volumes are lower during off-peak periods there is less of a need to prioritise traffic movements at those times. It may be possible to improve pedestrian crossing opportunities by adjusting traffic signal timings to provide more green time for pedestrians.

Photo 8 Pedestrians crossing outside the Manta Hotel

Opportunities

- Investigate the possibility of providing a crossing on the east leg of the Power Street intersection, where many pedestrians have been observed crossing City Road. It is understood that VicRoads has previously investigated this and rejected it due to right turn queues impacting on the West Gate Freeway. If pursued further, this would have to be investigated as part of a broader network solution.
- Reinstate the footpath and kerb at all redundant crossovers.
- Reinstate the kerb on the west approach to Southbank Boulevard in order to widen the footpath. To maximise the usable footpath width, the trees would need to be relocated closer to the new kerb line.
- Reduce the wait time at the pedestrian crossing opposite the Mantra Hotel.
- Seek to improve pedestrian way finding and DDA compliance between City Road and St Kilda Road.
- Investigate the possibility of adjusting signal timings during off-peak periods to improve pedestrian crossing opportunities.

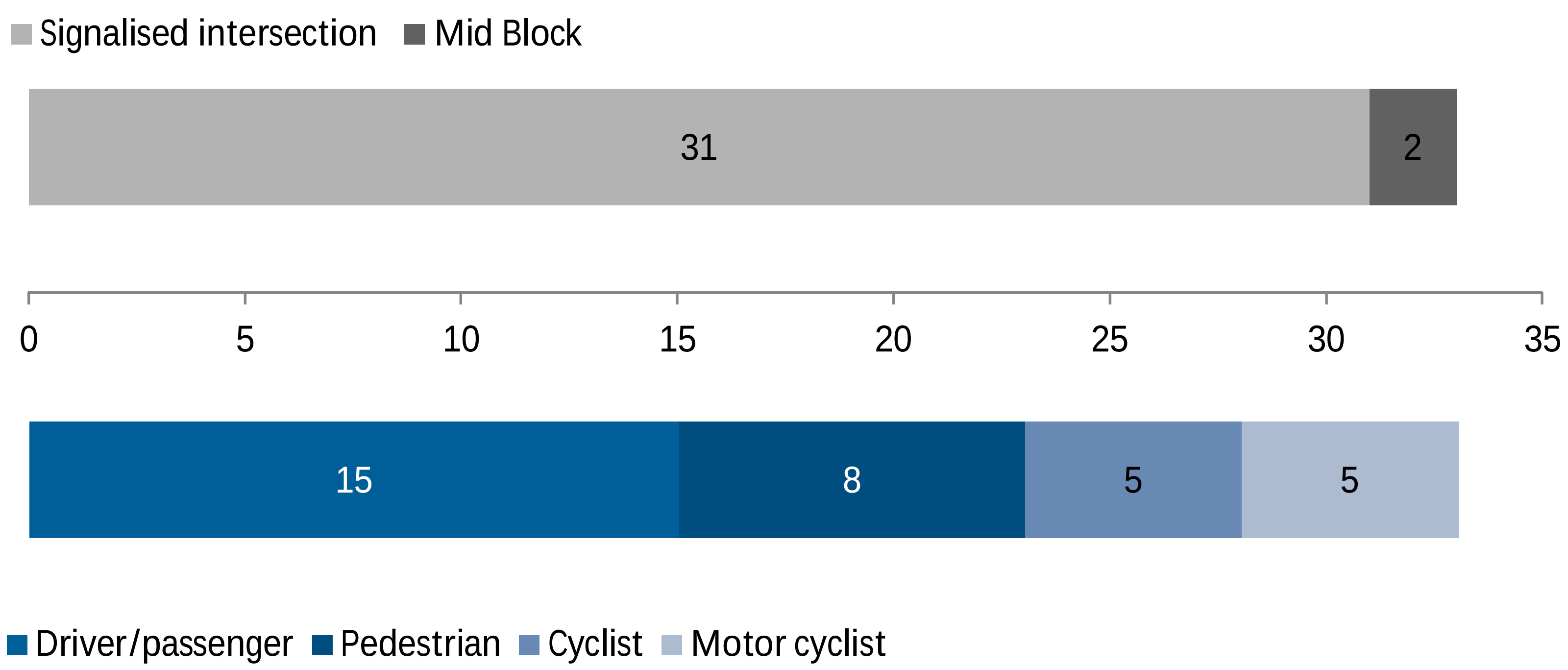
4.4 Crash history

4.4.1 All crashes

The CrashStats database has also been searched for City Road East for the same time period. During this period there were 33 crashes, of which two were fatal, 11 were serious and 20 were of other severity. One fatal crash occurred at the intersection with Fanning Street and involved a vehicle running off the road and striking two pedestrians, killing one and seriously injuring the other. The driver was also seriously injured. The other fatal crash occurred at the intersection with Southbank Boulevard and was a 'right through' type collision, which suggests that a vehicle failed to give way to a pedestrian when turning right. Only one pedestrian was injured in this accident.

The most prevalent crash types are shown in Figure 9. The data indicates that the most common crash type is 'rear end' followed by 'right through'. Pedestrian accidents also feature strongly in the statistics.

Figure 9 Crash types on City Road East



Power Street/City Road intersection

There were six recorded casualty crashes at the intersection of Power Street and City Road over the five year period. Two of the crashes involved a vehicle exiting or entering a driveway and hitting a pedestrian or a cyclist. Two of the crashes involved rear-end collisions.

Southbank Boulevard/City Road intersection

There were seventeen recorded casualty crashes at the intersection of Southbank Boulevard and City Road over the five year period. Six of the nine vehicle crashes at this intersection were rear end crashes. Five of the crashes (one motorbike, one pedestrian and three vehicle crashes) involved collisions from cross-traffic. Additionally there were two instances of cyclists being doored by parked cars.

4.4.2 Crash rates

Crashes rates have been calculated using the same methodology as for City Road West (Section 3.4.2).

Compared to the Victorian average (as reported in the 2007 Austroads crash rates database), the midblock crash rate along City Road East is significantly higher than other roads of similar characteristics. The intersection of City Road and Southbank Boulevard also experiences a higher crash rate than the state average, while the intersection of City Road and Southgate Avenue has a relatively low crash rate.

The crash rate analysis is summarised in Table 10.

Table 10 Crash rate summary on City Road East

Road segment	Casualty crash rate	Victorian average	Variance
Power Street to St Kilda Road	11.61 (per 100 mvkt)	5.57 (urban divided road)	+108%
Intersection of City Road and Southbank Boulevard	3.32 (per 10 mve)	2.04 (signalised intersection)	+64%
Intersection of City Road and Southgate Avenue	0.49 (per 10 mve)		-76%

4.4.3 Pedestrian crashes

Of all 33 casualty crashes on City Road East, 8, or 24%, involved pedestrians. Of these, two were fatal, two were serious and four were of other severity. Six occurred at signalised intersections and two occurred at mid-block locations. The types of pedestrian accidents that have occurred are shown in Figure 10.

There is no crash type which stands out as being over represented in the data, particularly as one of the two crash types which has occurred more than once is actually 'other pedestrian' which is a catch-all category for crash types which do not fit the standard definitions.

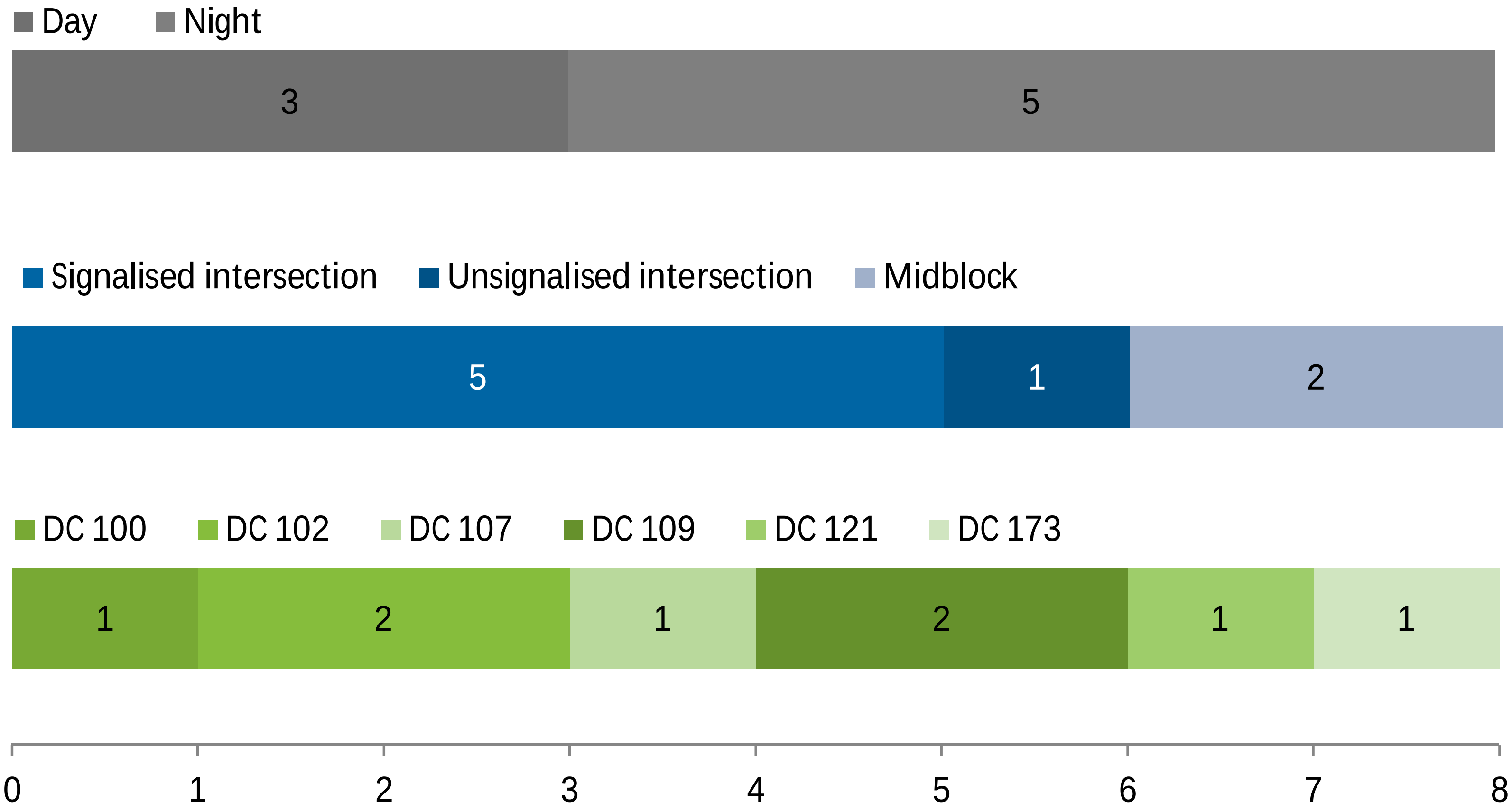
There are two crash codes which typically do not involve pedestrians; these are DCA 121 (right through) and DCA 173 (right off carriageway into object or parked vehicle). The 121 crash involved a vehicle failing to give way to another vehicle while turning right at Southbank Boulevard. It appears that a pedestrian was struck as a result of this collision and was killed. The 173 crash occurred at the Fanning Street intersection and involved a car running off the road, hitting an object and also a pedestrian who was killed as a result. It is understood that following this incident the pedestrian crossing outside the Mantra Hotel was installed.

Based on data in the road safety plan, in the CBD area, pedestrians make up about 35% of all crashes, while in the municipality they make up about 23%. Rates for the MMA and Victoria are lower at 13% and 11% respectively. This indicates that pedestrians make up a smaller proportion of all crashes than the CBD, and a similar proportion as the municipality as a whole. However, as it is most likely that the pedestrian volumes are higher in the CBD than on City Road, the lower proportion of pedestrian crashes on City Road may be due to lower pedestrian exposure rates.

There is generally no particular trend among these accidents, although pedestrians stepping out into the carriageway (near side and far side) make up the greatest group of crash types. These generally occur when pedestrians are crossing the road, suggesting that desire lines are not being adequately facilitated. Both fatal crashes involved pedestrians.

Half of the crashes occurred at the intersection of City Road and Southbank Boulevard. All pedestrian crash locations are displayed in Map 15.

Figure 10 Pedestrian crash types on City Road East



DCA codes:

100 – pedestrian near side

102 – pedestrian far side

107 – driveway

109 – other pedestrian

121 – right through

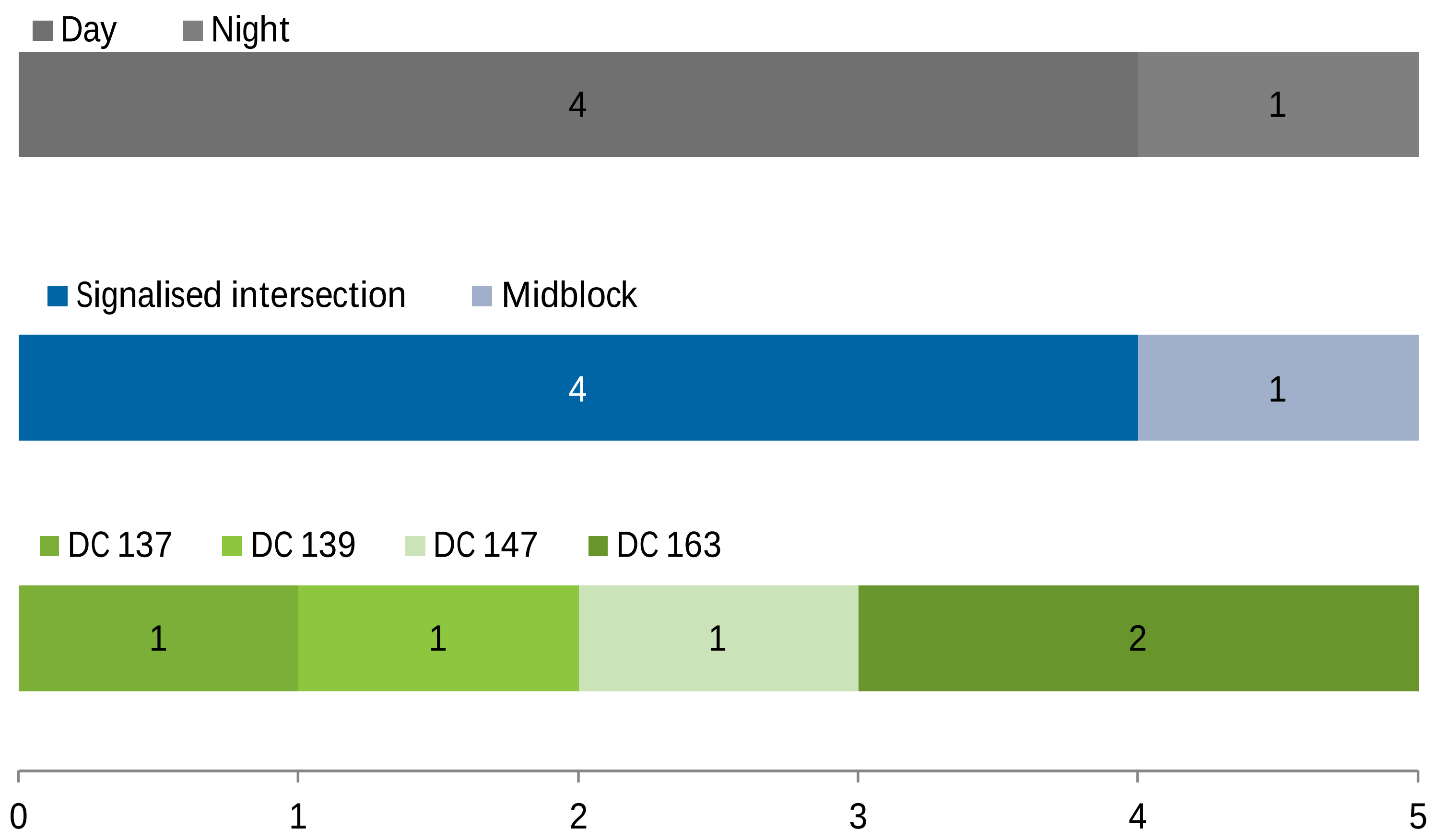
173 – right off carriageway into object or parked vehicle

4.4.4 Cyclist crashes

Of all 33 crashes, five (15%) involved cyclists. The most prevalent crash type (although there was only one more of these than other types) was 'vehicle door', which is when a parked vehicle's door is opened into the path of a cyclist. Both of these crashes occurred at the Southbank Boulevard intersection. One of the cyclist crashes was serious and the others were of other severity. The types of cyclist crashes that have occurred are shown in Figure 11.

Again, comparison data have been sourced from the road safety plan. In the CBD and the municipality, cyclist crashes make up approximately 29% and 26% of all crashes respectively. This is substantially higher than on City Road West. This lower proportion of cyclist crashes may be due to a real safety benefit on City Road (but this seems unlikely as there are no bicycle facilities) but is most likely due to lower bicycle volumes on City Road.

Figure 11 Cyclist crashes on City Road East



DCA codes:

137 – left turn sideswipe

139 – other same direction

147 – emerging from driveway or lane

163 – vehicle door

4.5 Land use

The adjacent land use is a mixture of retail, residential and commercial with the Arts Centre Precinct at the eastern end. There are a number of unoccupied or under construction sites on the southern side of City Road.

In the future, more residential developments are expected, with proposed and planned developments throughout the length of this section of City Road (see Map 13).

4.6 Parking facilities

Based on the 2010 AECOM report, there are approximately 3,900 spaces, 3,000 of which are based in the Southgate precinct. The remaining spaces are located in the open-air car park on Kavenagh Street, which has Ministerial approval to be redeveloped for residential use.

Given the extent of residential development that is planned along City Road, the total number of parking spaces is expected to increase.

When dealing with on-street parking, there are both advantages and disadvantages, some of which are listed below.

- Lack of adequate supply can lead to unnecessary traffic circulation which adds to congestion and pollution.
- Footpath amenity can be reduced, such as where outdoor tables are located immediately adjacent to parked cars.

- Parked cars present a hazard to cyclists. Car dooring is the predominant crash type involving cyclists in the City of Melbourne.
- Parked cars provide a measure of traffic calming, as they increase side friction and narrow the overall carriageway.
- Parked cars create activity which enhances passive surveillance and creates dynamism.
- On-street parking supports local trade and provides a level of convenience not afforded by off-street parking.

On-street parking is generally discouraged on roads that fulfil an arterial function, as it tends to undermine the role these roads play by increasing congestion. While some on-street parking is acceptable during off-peak periods, it is considered that Clearway restrictions would be appropriate on City Road East at peak times.

Opportunities

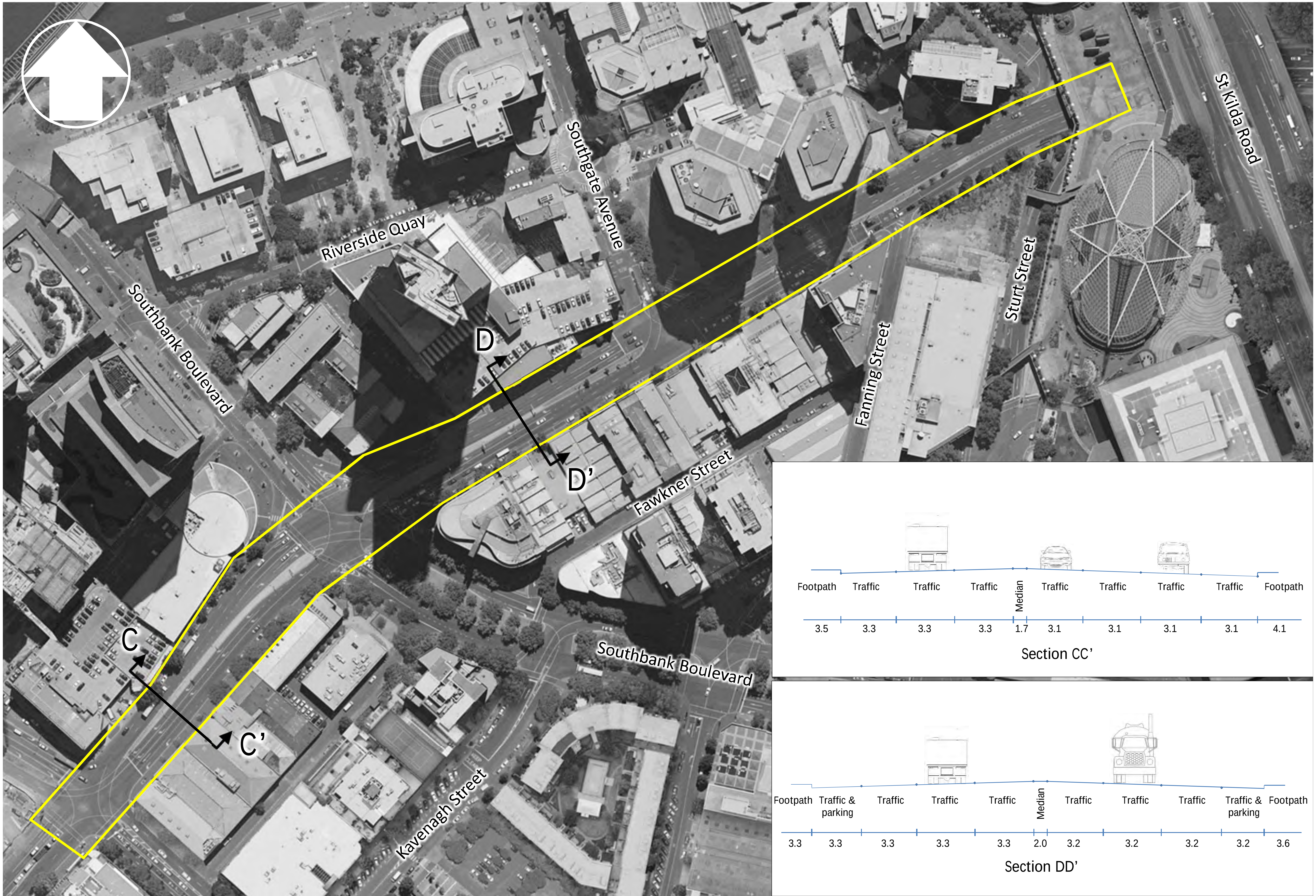
- Seek to maintain traffic flow at peak times by using Clearway restrictions.
- The reinstatement of kerbs at redundant crossovers provides the opportunity to increase the amount of on-street parking.

4.7 Maps

The following figures graphically summarise the existing conditions, issues and opportunities:

- Map 11 Study area
- Map 12 Primary adjoining land use
- Map 13 Proposed/planned residential developments
- Map 14 Crash history – all road users
- Map 15 Crash history – pedestrians
- Map 16 Crash history – cyclists
- Map 17 Network operating plan
- Map 18 Existing (2010) peak hour traffic volumes
- Map 19 Existing (2010) commercial off-street parking supply and on-street parking restrictions
- Map 20 Issues and opportunities

Map 11 City Road East – Study area



Map 12 City Road East – Primary adjoining land use

Map 13 City Road East – Proposed/planned residential developments

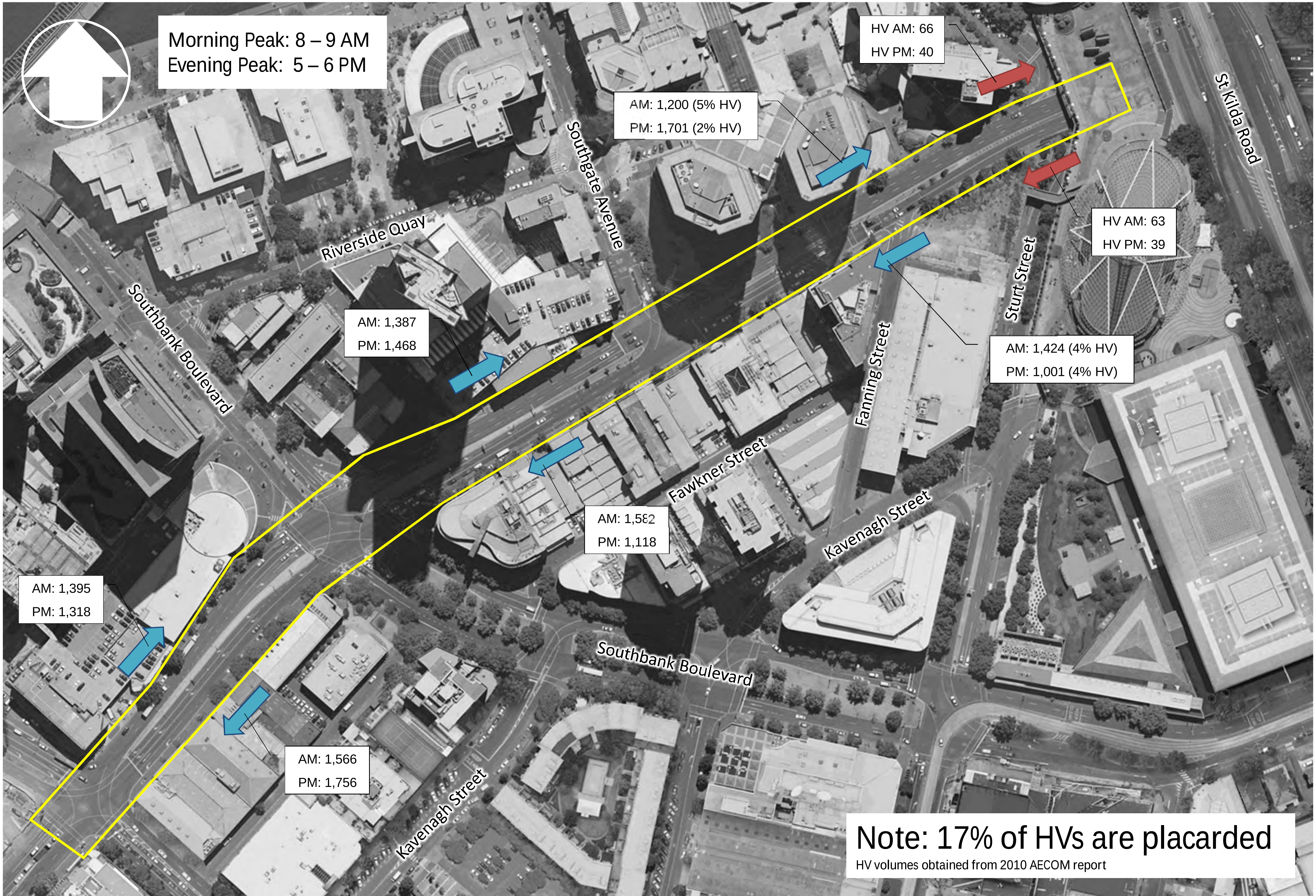
Map 14 City Road East – Crash history – all road users

Map 15 City Road East – Crash history – pedestrians

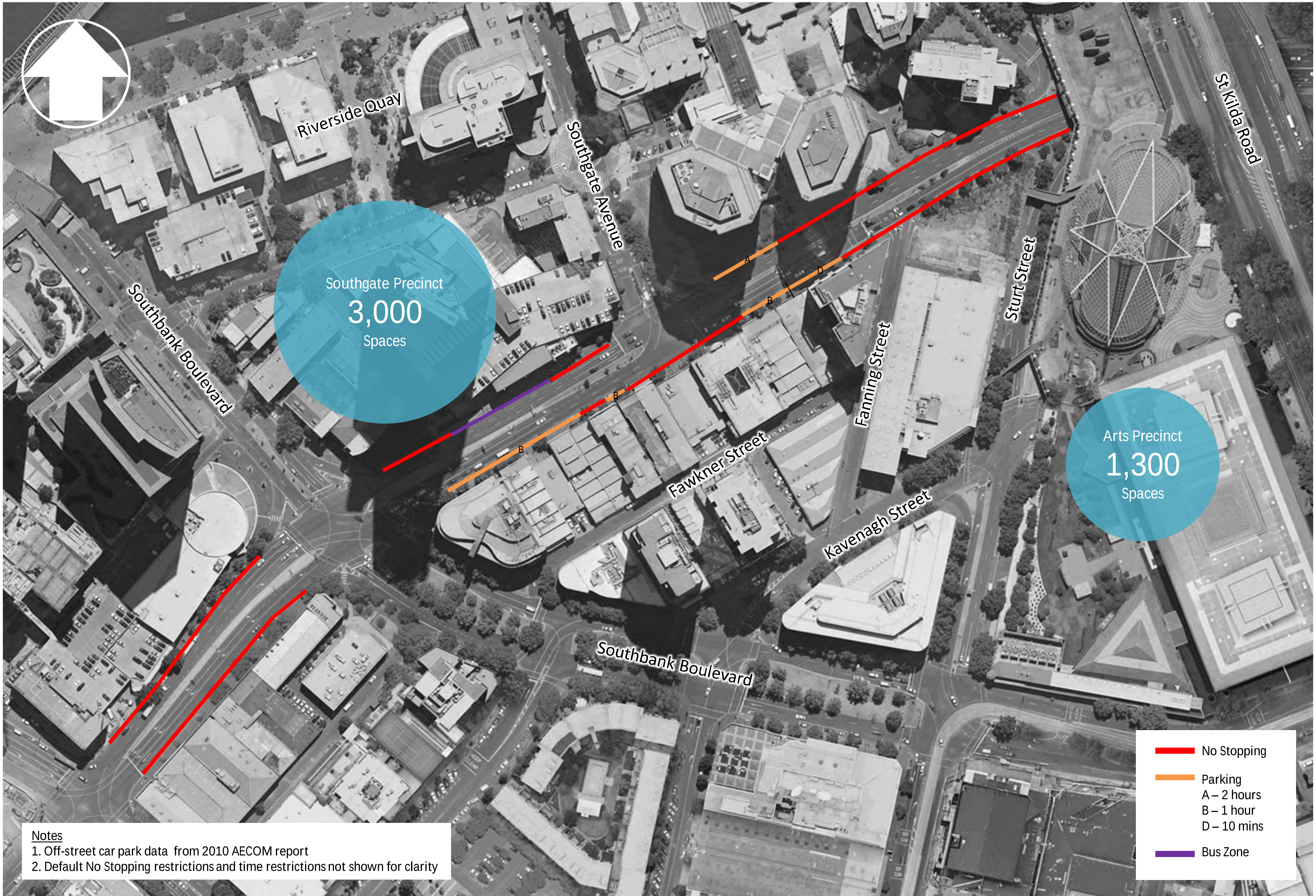
Map 16 City Road East – Crash history – cyclists

Map 17 City Road East – Network operating plan

Map 18 City Road East – Existing (2013) peak hour traffic volumes

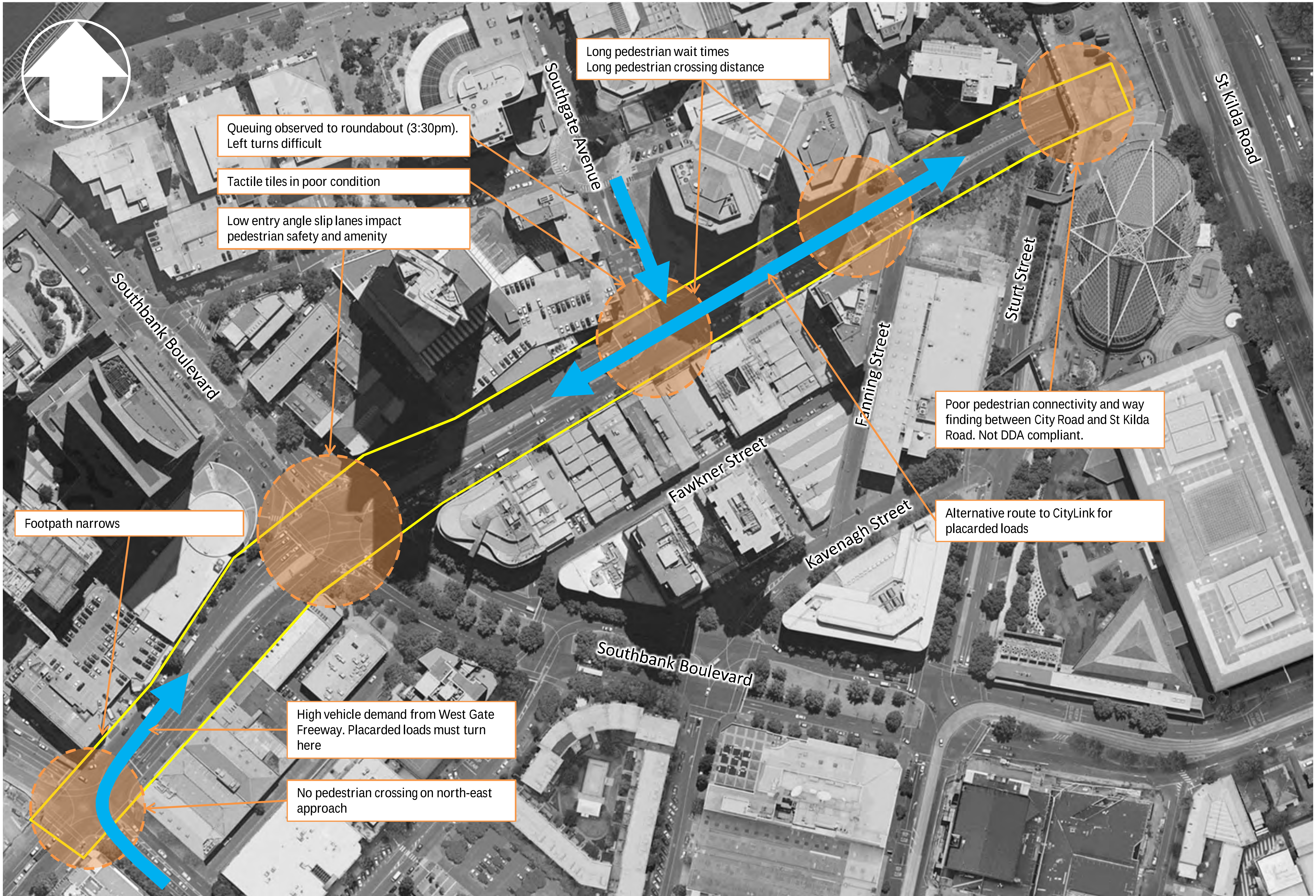


Map 19 City Road East – Existing (2010) commercial off-street parking supply and on-street parking restrictions



Notes
1. Off-street car park data from 2010 AECOM report
2. Default No Stopping restrictions and time restrictions not shown for clarity

Map 20 City Road East – Issue and opportunities



5. Alexandra Avenue

5.1 Road environment

Alexandra Avenue within the study area extends between St Kilda Road and Linlithgow Avenue. It is an undivided road which consists of three lanes in the eastbound direction and two lanes in the westbound direction. There is no on-street parking in either direction and the posted speed limit is 60 km/h. The extent of Alexandra Avenue within the study area is shown in Figure 12 and a view of Alexandra Avenue looking east is shown in Photo 9.

Figure 12 Overview of Alexandra Avenue within the study area

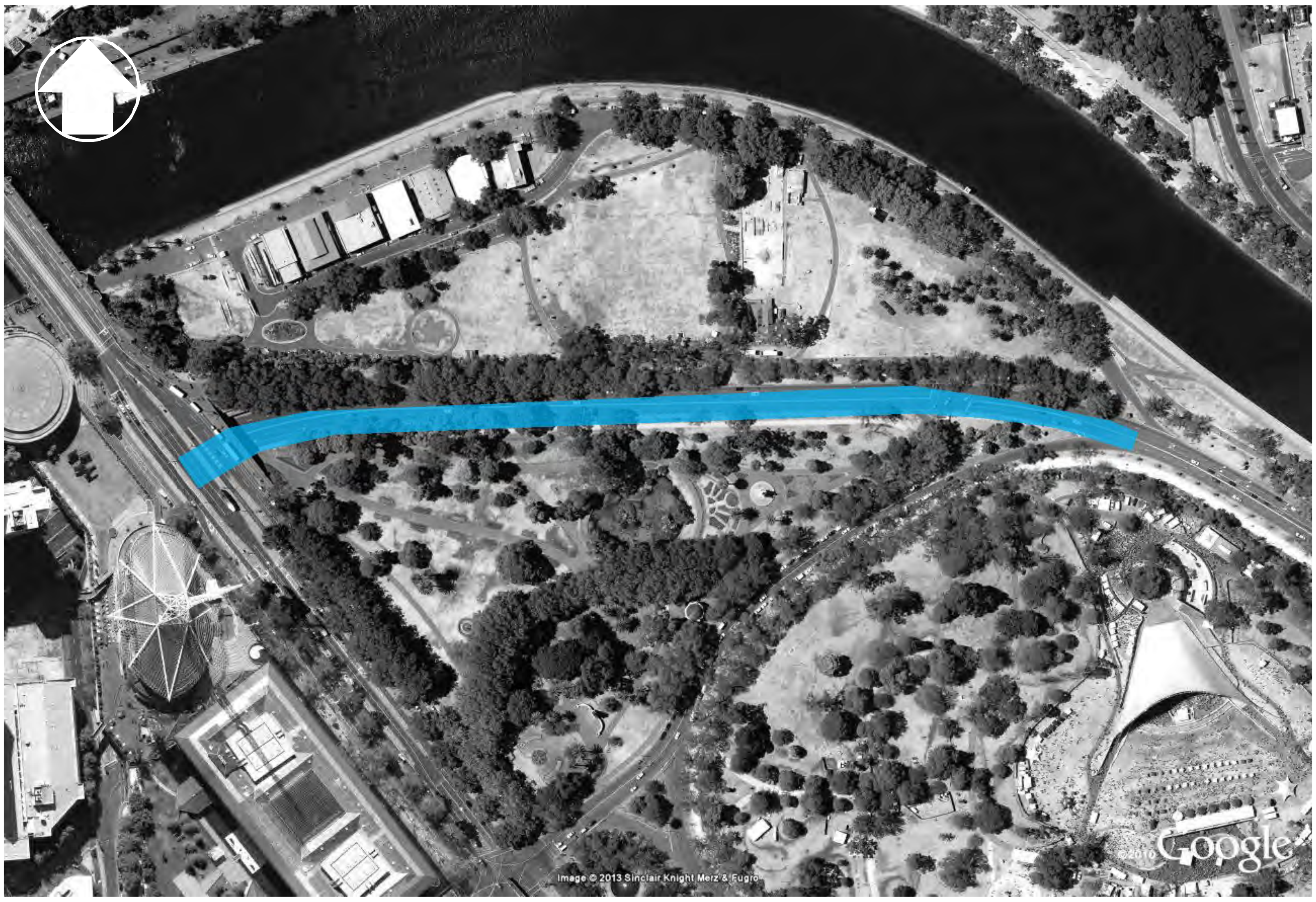


Photo 9 Alexandra Avenue looking east

Alexandra Avenue is prioritised as a General Traffic Route as part of the VicRoads Smart Roads operating plans and again there is no pedestrian priority.

This section forms part of the CityLink bypass route for placarded loads. There are parks on both sides of the road, with the Yarra River on the north side. These are major pedestrian destinations and therefore it is expected that there would be a significant crossing demand at this location, which is currently not provided for. There are also a significant number of events held in the gardens each year which add to the crossing demand.

Lane widths vary between 3.0 m and 4.0 m, with the lanes being wider closer to the St Kilda Road overpass. Given the expected pedestrian crossing demand it would be desirable to reduce the crossing distance either by removing lanes or narrowing them. Providing consistent lane widths at the narrower end of the existing range (i.e. about 3.1 m) may also help to control vehicle speeds by increasing side friction. Again, Dynon Road is an example of a freight-carrying arterial road with 3.1 m traffic lanes.

It is understood that the section of City Road/Alexandra Avenue between Southgate Avenue and Linlithgow Avenue is the longest section of road in the City of Melbourne without traffic signals. When combined with the section of the road in a cutting under St Kilda Road, which creates a tunnel-like appearance, there is ample opportunity for vehicle speeds to be high. Indeed there is anecdotal evidence of speeding on Alexandra Avenue. In the westbound direction the exit to Sturt Street is a low angle which does not discourage low speeds.

Eastbound queues along Alexandra Avenue are caused by congestion on Swan Street Bridge, where one lane is dedicated for CityLink traffic only. There may be opportunity to improve the capacity of the Alexandra Avenue/Swan Street and Swan Street/Batman Avenue intersections, but that is beyond the scope of this study.

Opportunities

- Seek to reduce the crossing distance for pedestrians by narrowing the width of the traffic lanes and maintaining this width throughout the length of this section. Lane widths in the order of 3.1 m are considered appropriate.

5.2 Traffic volumes

The 24 hour traffic volume for Alexandra Avenue is approximately 45,600 vehicles. Peak hour volumes have been obtained from a report by AECOM in 2010 (City Road Traffic Data Survey and Analysis, 7 June 2010). The maximum directional peak hour volumes in 2010 were approximately 1,400 vehicles in the AM peak westbound direction and 1,700 vehicles in the PM peak eastbound direction.

A comparison to arterial roads within the CBD is shown in Table 11. The analysis indicates that volumes on Alexandra Avenue are about the same as on King Street in the CBD, but much higher than on Spencer Street.

Table 11 Comparison to traffic volumes on other arterial roads

Location	Daily two-way volume (vpd)
Alexandra Avenue between St Kilda Road and Linlithgow Avenue	45,600
King Street between Collins Street and Bourke Street	45,000
Spencer Street between Collins Street and Bourke Street	24,000

Note: volumes on King and Spencer streets are from 2012 estimates by VicRoads. Volumes have been escalated from previous years.

5.3 Walking and cycling infrastructure

It is expected that there would be a walking desire line between the Botanical Gardens and the Yarra River which is not currently facilitated. There are currently no on-road bicycle facilities. There are shared paths in the Alexandra and Queen Victoria gardens, but as has already been discussed, connectivity between City Road and St Kilda Road is poor.

It is considered that a mid-block pedestrian crossing would be beneficial and is unlikely to adversely affect traffic capacity due to the existing queues from Swan Street Bridge.

There is evidence that the capacity of the Capital City Trail along the Yarra River is becoming congested during peak periods. The *Yarra River Corridor Pedestrian and Cycling Safety Plan* was completed by GHD in 2013. The Plan identifies the existing congestion along the Yarra Promenade and the growing perception of cyclist speed and conflict among pedestrians. It would not be appropriate or desirable to prohibit cycling along the Promenade, as cyclists add to the appeal and vibrancy of the area. The Plan recommends that the only suitable long term solution to this problem is to provide an alternative route for cyclists to reduce volumes on the Promenade. Four alternative routes are proposed and the preferred long term route is along Alexandra Avenue, City Road and Clarendon Street. One other short-listed route also uses Alexandra Avenue and City Road East. If either of these routes is to be achieved, cyclist infrastructure will need to be provided on Alexandra Avenue. The Plan recommends that a Copenhagen-style bicycle lane on Alexandra Avenue would be the most appropriate solution for cyclists, although traffic capacity was not considered as part of that study.

Opportunities

- Provide a mid-block pedestrian operated signal crossing.
- Seek to narrow the traffic lanes to reduce the crossing distance.
- Seek to improve pedestrian way finding and DDA compliance between City Road and St Kilda Road.
- Seek to provide bicycle facilities on Alexandra Avenue.

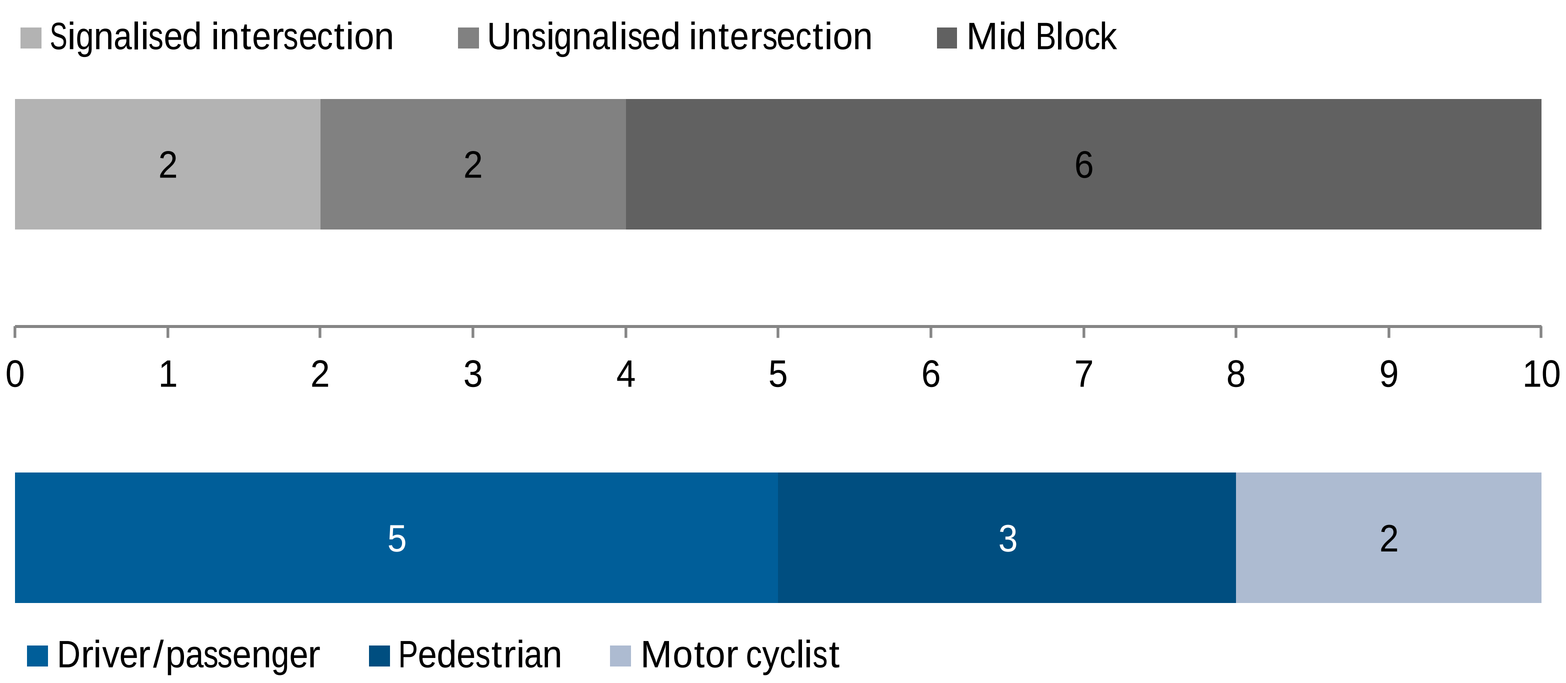
5.4 Crash history

5.4.1 All crashes

The CrashStats database has been searched for Alexandra Avenue for the same time period. During this period there were 10 crashes, of which four were serious and six were of other severity.

The most prevalent crash type was 'rear end' and 'U-turn' each of which occurred twice. It should be noted that U-turns are prohibited on Alexandra Avenue by the double centre lines. Of the remaining crash types, three involved pedestrians and two involved motorcyclists. The crash types are shown in Figure 13.

Figure 13 Crash types on Alexandra Avenue



One motorcyclist crash involved a vehicle being struck in the rear while performing a U-turn (it is not clear which vehicle was performing the U-turn). The other involved a motorcyclist losing control on the carriageway during dusk on a dry road and colliding with an oncoming vehicle. Loss of control crashes are often caused by excessive speed, but in this instance, the rider was travelling westbound and the time of day is consistent with the sun being low in the sky, potentially causing glare.

5.4.2 Crash rates

Compared to the Victorian average (as reported in the 2007 Austroads crash rates database), the midblock crash rate along Alexandra Avenue is above average. Six of the ten casualty crashes within the five year period were midblock crashes, with an estimated crash rate of 38.32 for every 100 million vehicle kilometres travelled.

The crash rate analysis is summarised in Table 12.

Table 12 Crash rate summary on Alexandra Avenue

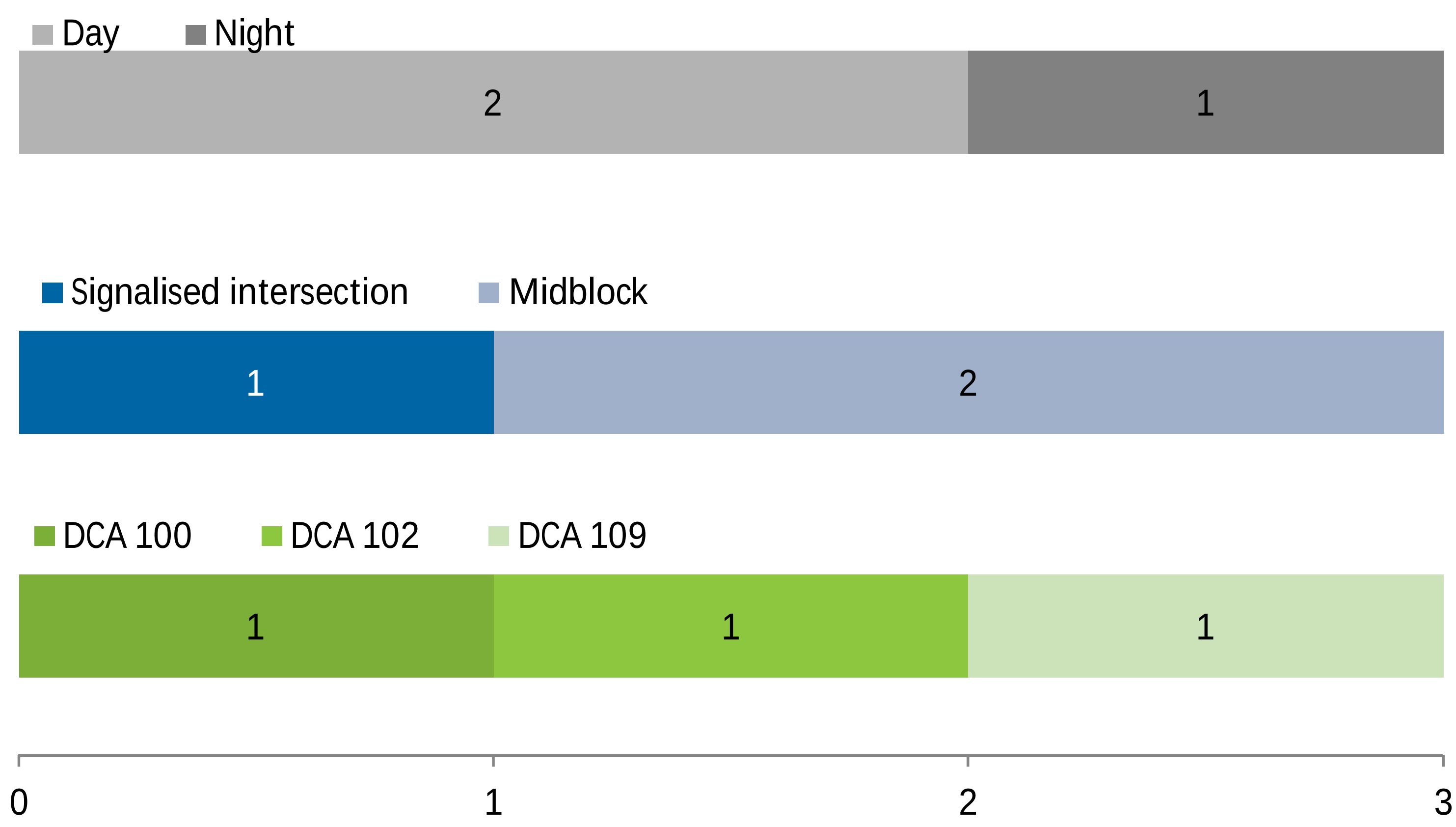
Road segment	Casualty crash rate	Victorian average	Variance
Alexandra Avenue (between St Kilda Road and Linlithgow Avenue)	38.32 (per 100 mvkt)	32.12 (Midblock)	+19%

5.4.3 Pedestrian crashes

Of the 10 crashes to occur on Alexandra Avenue, three (30%) involved pedestrians. Details of the pedestrian accidents that have occurred are shown in Figure 14.

The near side and far side crashes involved a pedestrian stepping into the road, which suggests that there is a desire line between the two parks that is not being met. One of the crashes was serious and two were of other severity.

Figure 14 Details of pedestrian crashes on Alexandra Avenue



DCA codes:

100 – pedestrian near side

102 – pedestrian far side

109 – other pedestrian

Based on data in the road safety plan, in the CBD area, pedestrians make up about 35% of all crashes, while in the municipality they make up about 23%. Rates for the MMA and Victoria are lower at 13% and 11% respectively. This indicates that pedestrians make up a slightly smaller proportion of all crashes than in the CBD, but a larger proportion than the municipality as a whole. As pedestrian volumes are likely to be much higher in the CBD, it is considered that the lower proportion of pedestrian crashes on City Road compared to the CBD is due to the lower pedestrian volumes along City Road. If there were data available to enable a crash rate per kilometres walked to be calculated the comparison would likely show a higher crash rate on Alexandra Avenue than in the CBD due simply to the much lower pedestrian volumes on Alexandra Avenue relative to the CBD (based on observations).

5.4.4 Cyclist crashes

There were no cyclist crashes on Alexandra Avenue during the study period.

Opportunities

- Provide a mid-block pedestrian and cyclist crossing facility.
- Seek to narrow the traffic lanes to reduce the crossing distance.
- Seek to improve pedestrian way finding and DDA compliance between City Road and St Kilda Road.
- Seek to provide bicycle facilities on Alexandra Avenue.

5.5 Land use

The adjacent land use is Public Open Space that is highly utilised by pedestrians and cyclists.

5.6 Parking facilities

Based on the 2010 AECOM report, there are approximately 1,200 spaces, all of which are associated with the Arts Centre and Ballet Centre. There is no on-street parking along Alexandra Avenue and this is likely to be suitable for the future given the adjacent land use.

5.7 Maps

The following figures graphically summarise the existing conditions, issues and opportunities:

- Map 21 Study area
- Map 22 Primary adjoining land use
- Map 23 Crash history – all road users
- Map 24 Crash history – pedestrians
- Map 25 Network operating plan
- Map 26 Existing (2010) peak hour traffic volumes
- Map 27 Issues and opportunities
- Map 28 On-street parking restrictions

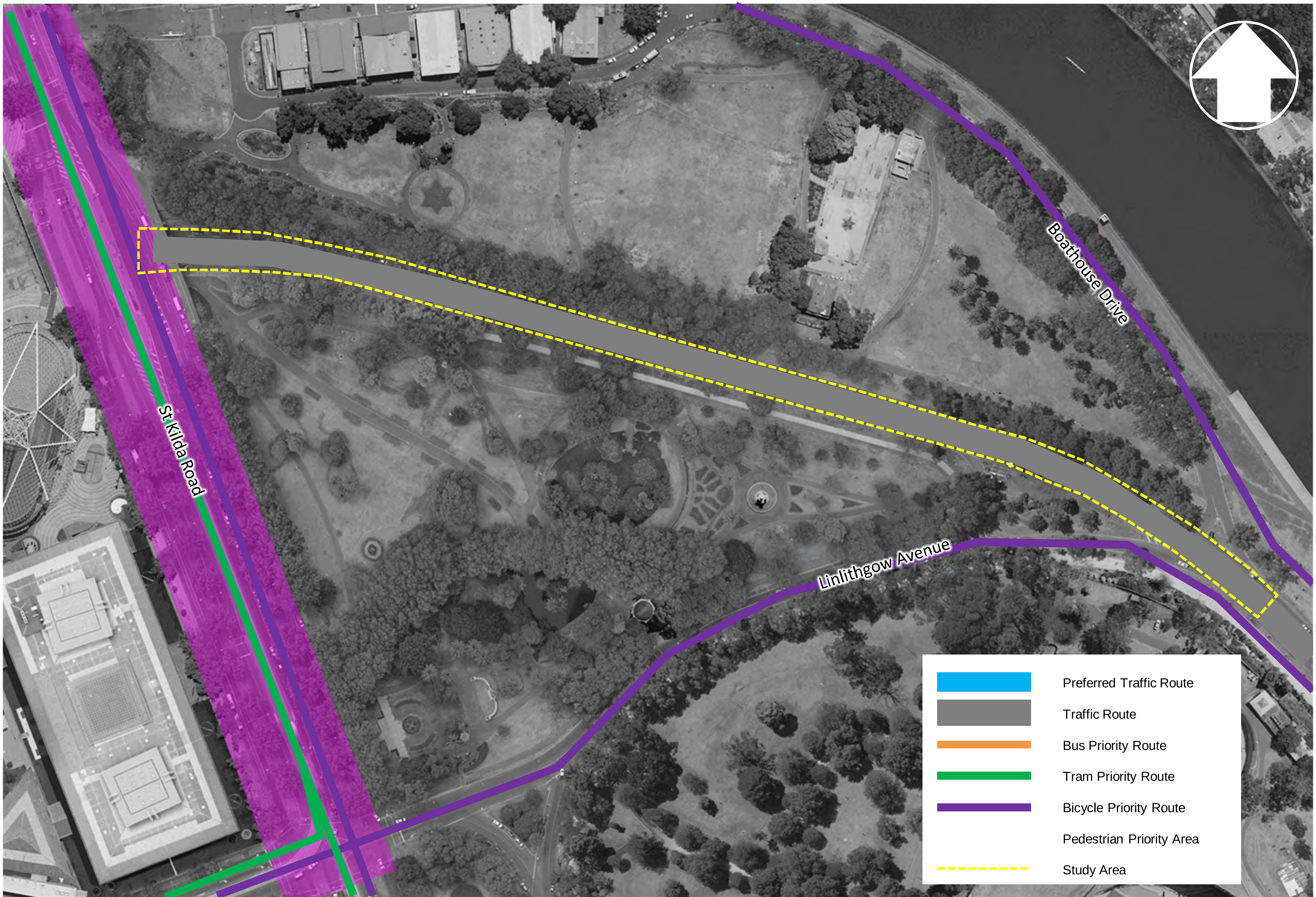
Map 21 Alexandra Avenue – Study area

Map 22 Alexandra Avenue – Primary adjoining land use

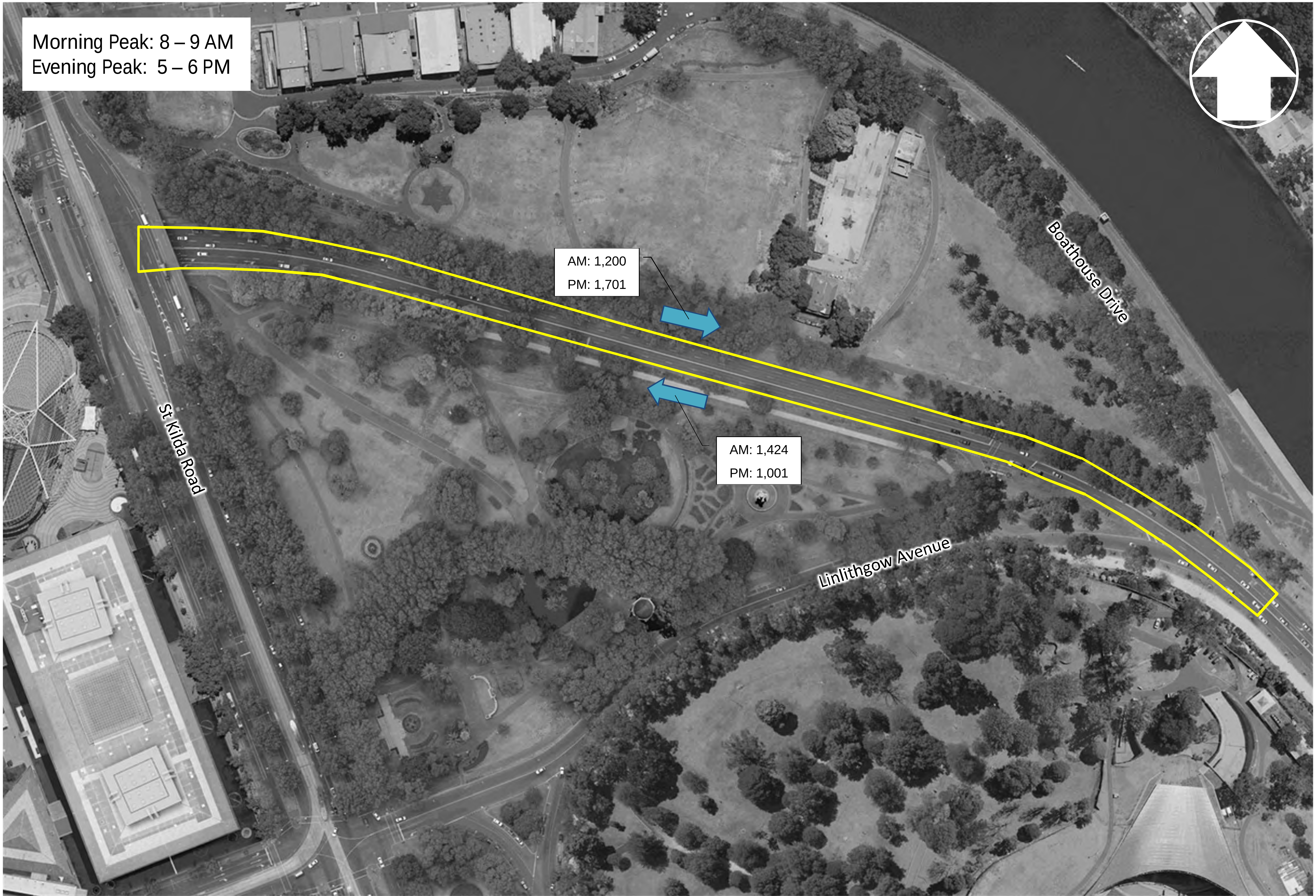
Map 23 Alexandra Avenue – Crash history – all road users

Map 24 Alexandra Avenue – Crash history – pedestrians

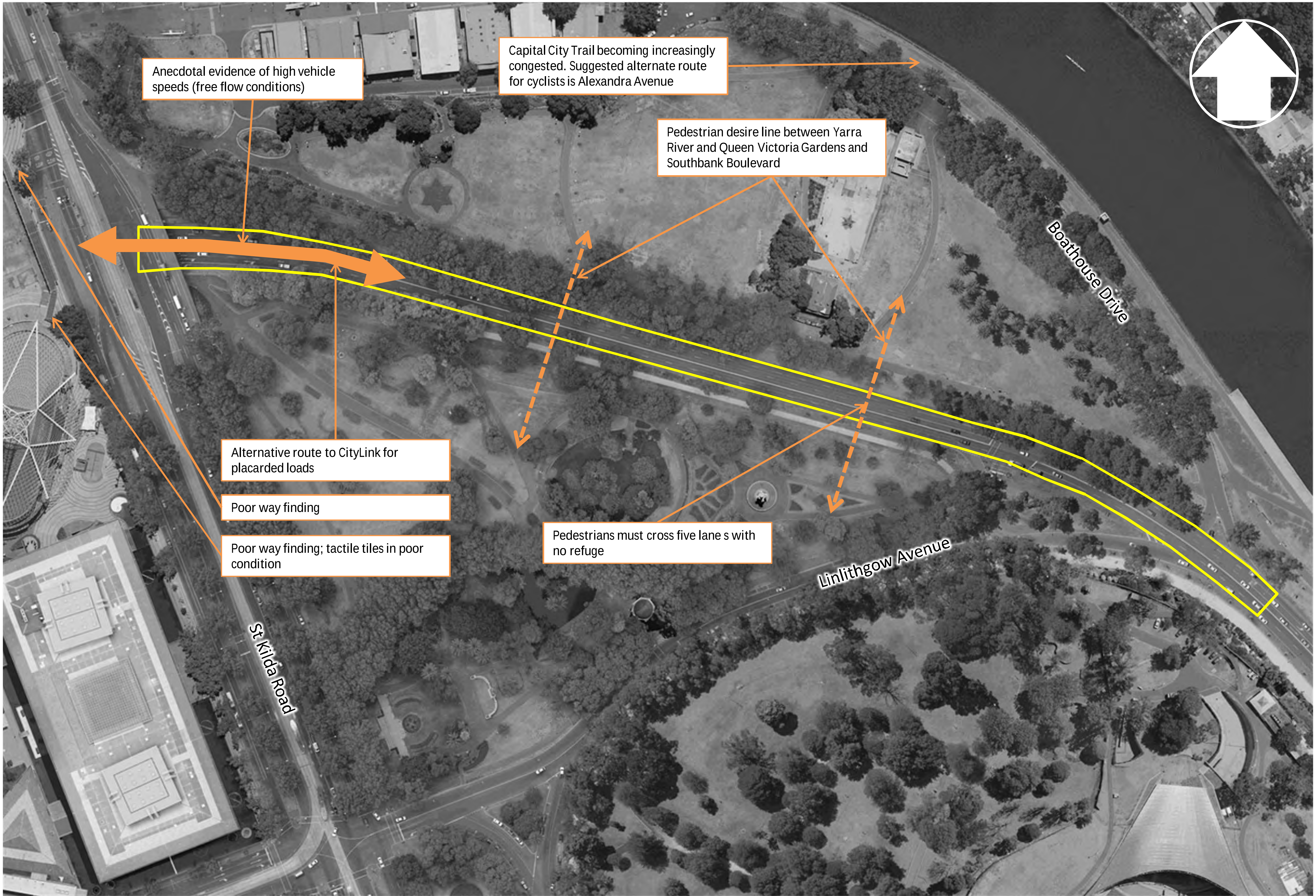
Map 25 Alexandra Avenue – Network operating plan



Map 26 Alexandra Avenue – Existing (2013) peak hour traffic volumes



Map 27 Alexandra Avenue – Issues and opportunities



Map 28 Alexandra Avenue – On-street parking restrictions

6. Future traffic volumes

6.1 Mid-block volumes

To determine the amount of road space that is required, and therefore how much can be reallocated to other uses, the future volumes of traffic need to be determined. The best way of understanding what future traffic volumes might be is to develop a strategic traffic model or to use an existing model because this would estimate the amount of traffic that may redistribute to other routes as a result of road network and land use changes beyond just City Road. Developing such a model is beyond the scope of this study and we understand there are currently no models available that are suitable. Therefore an alternative method has been used to estimate future traffic volumes.

The Comprehensive Impact Statement (CIS) for the East West Project (available on the LMA website) addresses the impact that the East West Link project may have on Melbourne's roads. Appendix E of the CIS is the traffic impact assessment (TIA). Figures 15 to 18 of the TIA show the approximate changes in traffic volumes as a result of the project. The following key information has been obtained from these figures:

- Between 2011 and 2031 volumes on City Road are expected to increase by between 10% and 20% west of Power Street without East West Link.
- Between 2011 and 2031 volumes on City Road are expected to increase by between 5% and 10% east of Power Street without East West Link.
- East West Link is expected to reduce traffic volumes on City Road between Queensbridge Street and Power Street by between 5% and 10%.
- East West Link is expected to reduce traffic volumes on other sections of City Road by up to 5%.

Based on this data, the following methodology for determining future volumes on City Road has been developed for this study. This methodology assumes that East West Link will be built.

1. Escalate 2013 SCATS volumes to 2031 by 20% west of Power Street and by 10% east of Power Street.
2. Reduce these 2031 volumes by 5% between Queensbridge Street and Power Street. Reduce these 2031 volumes by 0% on other sections of City Road. This assumes that East West Link will essentially have no impact on City Road.
3. Apply the same methodology to generate 2031 hourly volumes for the purposes of determining the number of lanes required during peak periods.

Note that this methodology takes the most conservative position; that is, it uses the highest escalation rates and the lowest reduction rates. A useful sensitivity test would be the opposite position: the lowest escalation rates and the highest reduction rates. Both of these scenarios have been tested to produce an upper and lower bound for future traffic volumes.

Step 1

2013 volumes are shown in Table 13. These are taken from 2013 SCATS data.

Table 13 2013 daily traffic volumes

Location between…	Eastbound (vpd)	Westbound (vpd)
Clarendon Street and Queensbridge Street	15,226	13,699
Queensbridge Street and Power Street	10,551	11,914
Power Street and Southbank Boulevard	20,944	24,959
Southbank Boulevard and Sturt Street	22,581	19,578
Sturt Street and Linlithgow Avenue	23,399	22,214

These volumes have been escalated to 2031 as shown in Table 14. These are the volumes assuming that East West Link is not built.

Table 14 2031 escalated daily traffic volumes

Location between…	Growth rate	Eastbound (vpd)	Westbound (vpd)
Clarendon Street and Queensbridge Street	20%	18,271	16,439
Queensbridge Street and Power Street	20%	12,661	14,297
Power Street and Southbank Boulevard	10%	23,038	27,455
Southbank Boulevard and Sturt Street	10%	24,839	21,536
Sturt Street and Linlithgow Avenue	10%	25,739	24,435

Step 2

The 2031 escalated volumes have been reduced as shown in Table 15 to represent the scenario in which East West Link has been built.

Table 15 2031 City Road volumes with East West Link

Location between…	Reduction factor	Eastbound (vpd)	Westbound (vpd)
Clarendon Street and Queensbridge Street	0%	18,271	16,439
Queensbridge Street and Power Street	5%	12,028	13,582
Power Street and Southbank Boulevard	0%	23,038	27,455
Southbank Boulevard and Sturt Street	0%	24,839	21,536
Sturt Street and Linlithgow Avenue	0%	25,739	24,435

This is the upper bound, or conservative, scenario. The same process has been used to generate volumes for the lower bound, or optimistic, scenario using the alternate escalation factors given above. The results of the analysis are shown in Table 16.

Table 16 2031 City Road volumes with East West Link for the conservative and optimistic scenarios

Location between…	Conservative scenario		Optimistic scenario	
	EB	WB	EB	WB
Clarendon Street and Queensbridge Street	18,271	16,439	15,911	14,315
Queensbridge Street and Power Street	12,028	13,582	10,445	11,795
Power Street and Southbank Boulevard	23,038	27,455	20,892	24,897
Southbank Boulevard and Sturt Street	24,839	21,536	22,525	19,529
Sturt Street and Linlithgow Avenue	25,739	24,435	23,341	22,158

Step 3

Now that the daily volumes have been determined, the next step is to calculate the peak hourly volumes so that the number of lanes needed to accommodate these volumes can be determined.

The 2013 hourly SCATS data have been escalated according to the method above to produce 2031 hourly volumes for both the conservative and optimistic scenarios. These volumes are shown in Table 17 and Table 18.

Table 17 Forecast 2031 peak hour volumes on City Road (conservative)

Location between…	Eastbound (vph)		Westbound (vph)	
	AM	PM	AM	PM
Clarendon Street and Queensbridge Street	1,370	1,633	1,007	1,009
Queensbridge Street and Power Street	903	893	901	735
Power Street and Southbank Boulevard	1,535	1,450	1,723	1,932
Southbank Boulevard and Sturt Street	1,526	1,615	1,740	1,230
Sturt Street and Linlithgow Avenue	1,320	1,871	1,566	1,101

Table 18 Forecast 2031 peak hour volumes on City Road (optimistic)

Location between…	Eastbound (vph)		Westbound (vph)	
	AM	PM	AM	PM
Clarendon Street and Queensbridge Street	1,193	1,422	877	879
Queensbridge Street and Power Street	784	775	782	639
Power Street and Southbank Boulevard	1,392	1,315	1,562	1,752
Southbank Boulevard and Sturt Street	1,384	1,464	1,578	1,115
Sturt Street and Linlithgow Avenue	1,197	1,697	1,420	998

Number of lanes required to accommodate forecast volumes

Austroads provides guidance on the capacity of traffic lanes. In an urban environment where traffic is not free flowing (such as on arterial roads) the capacity of a kerbside lane is generally 900 vehicles per hour (vph). (Where occasional parked vehicles are present in the kerb side lane, the capacity drops to around 600 vph. However, clear ways are in operation during peak periods on City Road and this is therefore not relevant.) During peak hour, where there are no impediments to flow, such as traffic signals or vehicles joining the road from driveways and the like, capacity can increase to as much as 1,400 vph. It is considered that City Road does not satisfy the criteria for a higher lane capacity due to the number of traffic signals and driveways and therefore the lane capacity is assumed to be 900 vph.

Based on a lane capacity of 900 vph the number of lanes required to accommodate the forecast volumes is shown in Table 19.

Table 19 Number of lanes required to accommodate forecast 2031 volumes

Location between…	Existing provision		Conservative scenario		Optimistic scenario	
	EB	WB	EB	WB	EB	WB
Clarendon Street and Queensbridge Street	2*	2	2	2	2	1
Queensbridge Street and Power Street	2	2	2	2	1	1
Power Street and Southbank Boulevard	3	3	2	3	2	2
Southbank Boulevard and Sturt Street	3	3	2	2	2	2
Sturt Street and Linlithgow Avenue	3	2	3	2	2	2

* Note that there is an additional bus lane which operates during peak periods.

In the conservative scenario the analysis indicates that west of Power Street two lanes will generally be needed in each direction. This is generally what is currently provided on City Road West. East of Power Street three lanes will only be needed on Alexandra Avenue, which means that on City Road East, one lane may be removed in both directions.

In the optimistic scenario the analysis indicates that west of Power Street one lane will generally be needed in each direction, except for the eastbound direction between Clarendon Street and

Queensbridge Street. East of Power Street two lanes will be needed in each direction. This means that one lane may be removed in each direction over the entire study area, except for the eastbound direction between Clarendon Street and Queensbridge Street.

In reality the actual traffic volumes are likely to fall somewhere between these two scenarios, but greater confidence cannot be obtained without more detailed traffic modelling. A strategic traffic model would take account of all known future network and land use changes and could also test configuration options for City Road. For example, removing a traffic lane is likely to cause a redistribution of traffic to other routes or transport modes. The information contained in the East West Link CIS document does not allow such tests to be undertaken.

Limitations of the analysis

The analysis assumes that existing traffic patterns will continue into the future and does not take into account potential traffic redistribution under future network and land use scenarios. Traffic that would be generated by the planned developments along City Road and in the broader Southbank area have not been taken account of directly, although it is likely that some of this development has been included in the East West Link model, which forms the basis of this assessment. The analysis also does not consider the impacts of reducing the capacity on City Road, which is likely to redistribute traffic further and/or cause a shift in travel mode.

6.2 Intersection volumes

On urban roads intersections are the primary capacity constraints to traffic flow and pedestrian connectivity. Additional lanes are often required at the stop line to allow the approach volumes to pass through the intersection without excessive delay.

To understand whether additional lanes will be needed at the stop lines (over and above the forecast mid-block lane requirements) SIDRA analysis has been carried out at the following intersections:

- Clarendon Street
- Queensbridge Street
- Power Street
- Southbank Boulevard
- Southgate Avenue

SIDRA is a commonly used software package that analyses individual intersections, taking into consideration the traffic volume, intersection layout and signal operation, and provides information on the likely operating characteristics in terms of degree of saturation (DOS), 95th percentile queue length (95Q) and average vehicle delay.

The DOS for the intersection represents the demand to capacity ratio of the most critical movement. Typically a DOS of 0.900 is considered to be the practical limit for signalised intersections.

The Level of Service (LOS) measure of A (excellent) to F (very poor) relates directly to average delays to vehicles at an intersection. LOS D is generally regarded as the realistic target in urban areas, particularly for intersections of greater size and significance.

Signal operation data has been provided by VicRoads for input to the SIDRA models.

The first stage of the analysis is to apply the 2031 volumes to the existing layouts to see what impact traffic growth and East West Link could have on the performance of the intersections. Following this analysis, the lane configurations have been adjusted in line with Table 19 and further adjustments have been made, such as the removal of left turn slip lanes.

6.2.1 Clarendon Street intersection

SIDRA models have been developed for the existing and future (2031) scenarios. The results of the analysis are contained in Appendix A.

The SIDRA analysis indicates that the intersection of Clarendon Street and City Road currently operates within capacity. The PM peak is the critical peak, operating close to its practical capacity.

Modelling of the 2031 scenarios indicates the following:

- Intersection DOS in the AM peak sits between 0.791 and 0.861. This indicates that the intersection will operate within capacity;
- Intersection DOS in the PM peak sits between 0.922 and 1.073. Given that the upper limit is marginally above capacity, further optimisation of the signals could reduce the DOS to less than 1.000 and cause the intersection to operate within capacity; and
- The critical approach in the PM peak is the north and east approach. There is limited opportunity to provide additional green time for these approaches as they oppose each other.

The key intersection results for all scenarios in both peaks are summarised in Table 20.

Table 20 Existing Clarendon Street/City Road intersection operation

		DOS	Ave. Delay (sec)	95th %ile Queue
AM Peak	Existing	0.744	39	192 m
	2031 Optimistic	0.791	40	197 m
	2031 Conservative	0.861	44	244 m
PM Peak	Existing	0.896	49	174 m
	2031 Optimistic	0.922	51	184 m
	2031 Conservative	1.073	96	317 m

City Road lane reduction

As identified in Table 19, based on optimistic mid-block traffic volumes, it is possible that the number of lanes on City Road between Clarendon Street and Kings Way could be reduced to one lane in the westbound direction, with two lanes maintained in the eastbound direction. This option has been tested for the most critical 2031 scenario to provide an indication of the feasibilities of lane reduction. The phase timings (with cycle time fixed), has been optimised by SIDRA due to the layout changes. The intersection layout is presented in Figure 15.

The results of the 2031 AM and PM peak tests are summarised in Table 21.

Figure 15 Clarendon Street/City Road intersection option layout

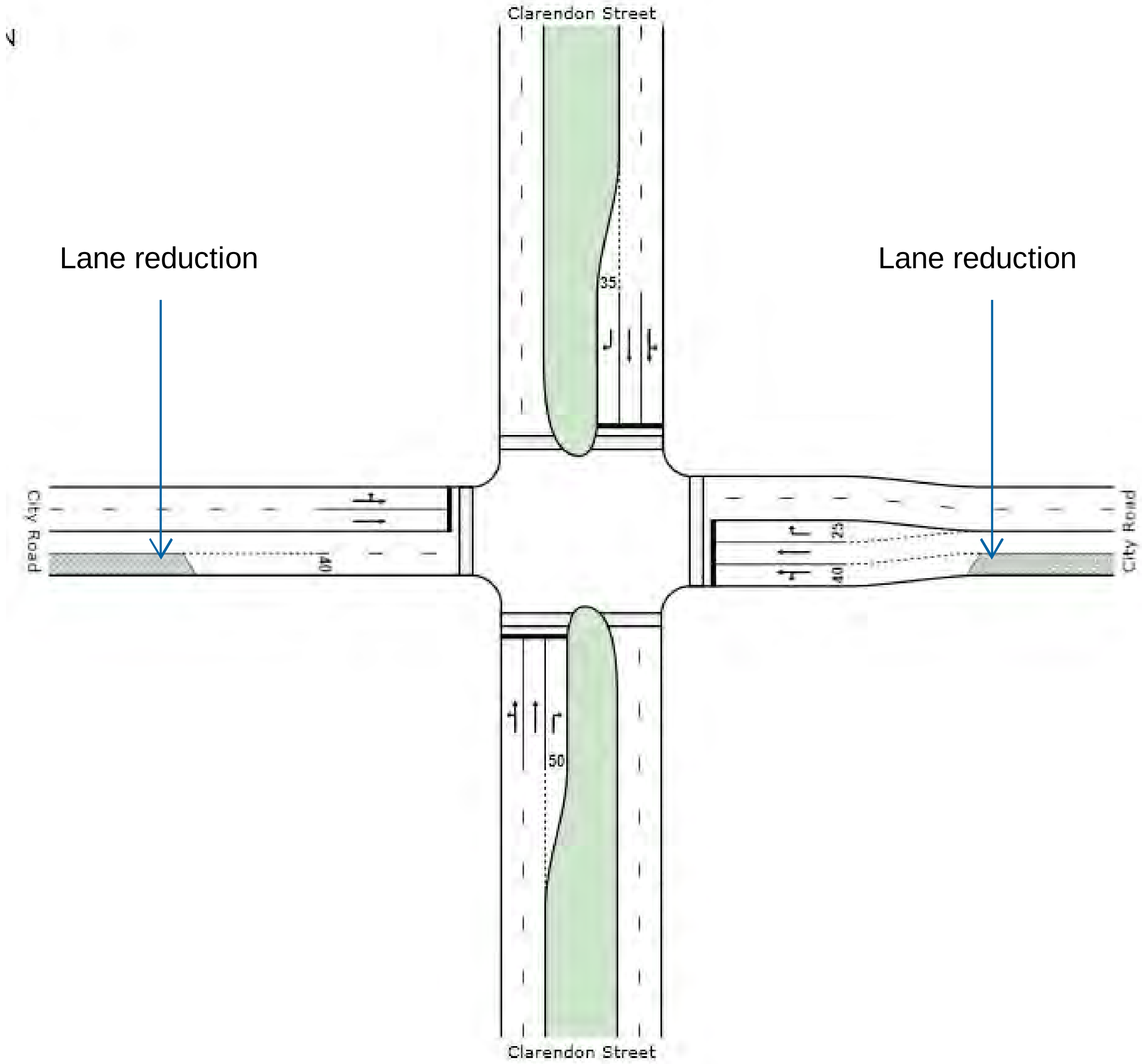


Table 21 Clarendon Street/City Road intersection operation (incl. City Road lane reduction)

		DOS	Ave. Delay (sec)	95th%ile Queue
AM Peak	2031 Optimistic	0.791	40	197 m
	2031 Optimistic (incl. lane reduction)	0.855	45	239 m
	2031 Conservative	0.861	44	244 m
	2031 Conservative (incl. lane reduction)	0.861	45	262 m
PM Peak	2031 Optimistic	0.922	51	184 m
	2031 Optimistic (incl. lane reduction)	0.959	58	266 m
	2031 Conservative	1.073	96	317 m
	2031 Conservative (incl. lane reduction)	1.101	108	497 m

The results indicate that whilst intersection performance (delays and queuing) will be impacted, in terms of intersection capacity, the DOS will increase by less than 3% as a result of reducing the number of lanes in the westbound direction.

The intersection impacts are mainly to the City Road east approach, due to the removal of a traffic lane. In the worst case, vehicle queues on this approach may extend as far as Power Street.

6.2.2 Queensbridge Street intersection

SIDRA models have been developed for the existing and future (2031) scenarios. The results of the analysis are contained in **Appendix A**.

The SIDRA analysis indicates that the intersection of Queensbridge Street and City Road currently operates well within practical capacity. The PM peak is the critical peak, operating at DOS 0.836.

The SIDRA model has been optimised by varying the phase times within a fixed cycle time to produce the most efficient outcome. The key intersection results for all scenarios in both peaks are summarised in Table 22.

Modelling of the 2031 scenarios indicates the following:

- Intersection DOS in the AM peak sits between 0.617 and 1.207. Each approach operates well under practical capacity except for the right turn lane on the southern approach.
- Intersection DOS in the PM peak is between 0.879 and 1.113. The critical movements at this intersection are the through movement from the north and the right turn from the south; and
- There is limited opportunity to provide additional green time for the critical approaches as it would adversely affect the performance of the western approach which will be operating near capacity.

Table 22 Existing Queensbridge Street/City Road intersection operation

		DOS	Ave. Delay (sec)	95^{th} %ile Queue
AM Peak	Existing	0.584	36	106 m
	2031 Optimistic	0.617	35	102 m
	2031 Conservative	1.207	45	181 m
PM Peak	Existing	0.836	37	142 m
	2031 Optimistic	0.879	39	165 m
	2031 Conservative	1.113	66	304 m

City Road lane reduction

As identified in Table 19, based on optimistic mid-block traffic volumes, the number of lanes on City Road can be reduced to one lane on both approaches, with the exception being the eastern approach where two lanes are required. This option has been tested for the most critical 2031 scenario to provide an indication of the feasibilities of lane reduction. The phase timings (with cycle time fixed), have been optimised by SIDRA due to the layout changes. The intersection layout is presented in Figure 16.

The results of the 2031 AM and PM peak tests are summarised in Table 23.

Figure 16 Queensbridge Street/City Road intersection option layout

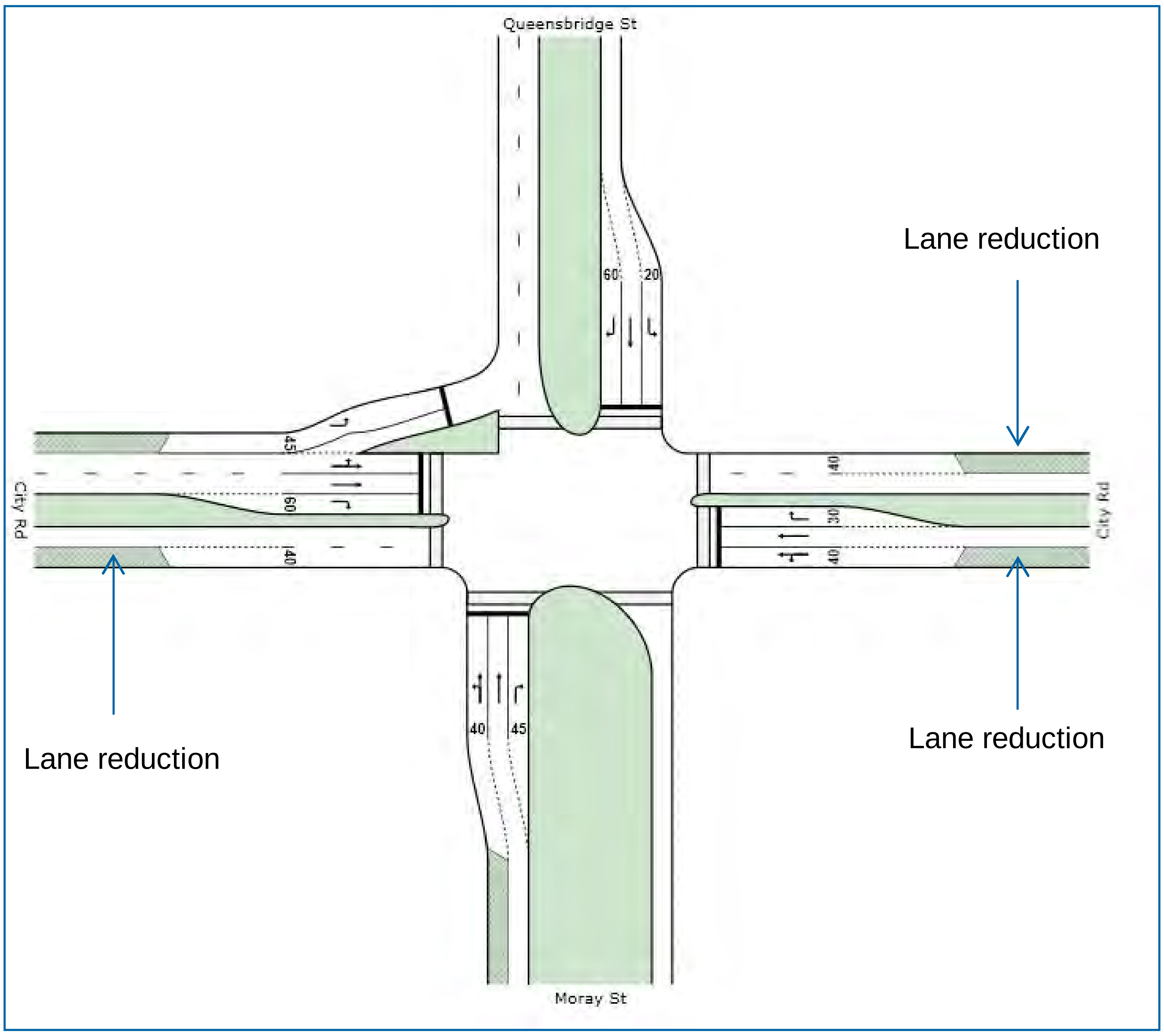


Table 23 Queensbridge Street/City Road intersection operation (incl. City Road lane reduction

		DOS	Ave. Delay (sec)	95th%ile Queue
AM Peak	2031 Optimistic	0.617	35	102 m
	2031 Optimistic (incl. lane reduction)	0.957	40	209 m
	2031 Conservative	1.207	45	181 m
	2031 Conservative (incl. lane reduction)	1.595	98	441 m
PM Peak	2031 Optimistic	0.879	39	142 m
	2031 Optimistic (incl. lane reduction)	1.170	66	276 m
	2031 Conservative	1.113	66	304 m
	2031 Conservative (incl. lane reduction)	1.269	112	516 m

The results indicate that performance reduces significantly in both the optimistic and conservative scenarios. DOS indicates that the intersection will perform over its practical capacity. Significant queue lengths and delays will be experienced, especially in the conservative AM model. These results suggest that lane reductions around the approaches to

Queensbridge Street along City Road may not be feasible and will potentially cause impacts upstream, such as blocking back through intersections.

6.2.3 Power Street intersection

SIDRA models have been developed for the existing and future (2031) scenarios. The results of the analysis are contained in Appendix A.

The SIDRA analysis indicates that the intersection of Power Street and City Road currently operates within practical capacity. The PM peak is the critical peak, operating at DOS 0.888.

Modelling of the 2031 scenarios (with phase optimisation) indicates the following:

- Intersection DOS in the AM peak sits between 0.821 and 0.919. These are both within capacity;
- Intersection DOS in the PM peak is between 0.875 and 0.980. These are both within capacity; and
- The critical approaches in the PM peak are the north and east approaches. There is limited opportunity to provide additional green time for these approaches as they oppose each other.

The SIDRA model has been optimised by varying the phase times within a fixed cycle time to produce the most efficient outcome. The key intersection results for all scenarios in both peaks are summarised in Table 24.

Table 24 Existing Power Street/City Road intersection operation

		DOS	Ave. Delay (sec)	95^{th} %ile Queue
AM Peak	Existing	0.873	49	286 m
	2031 Optimistic	0.821	46	259 m
	2031 Conservative	0.919	54	345 m
PM Peak	Existing	0.888	47	237 m
	2031 Optimistic	0.875	46	236 m
	2031 Conservative	0.980	55	306 m

City Road lane reduction

As identified in Table 19, based on optimistic mid-block traffic volumes, the number of lanes on City Road can be reduced to one lane west of Power Street. Although the analysis in Table 19 indicates that three lanes are required in the eastbound direction east of Power Street, only two lanes of eastbound traffic depart from the intersection, so two eastbound lanes have also been tested. This option has been tested for the most critical 2031 scenario to provide an indication of the feasibilities of lane reductions. The phase timings (with cycle time fixed), have been optimised by SIDRA due to the layout changes. The intersection layout is presented in Figure 17.

The results of the 2031 AM and PM peak tests are summarised in Table 25.

Figure 17 Power Street/City Road intersection option layout

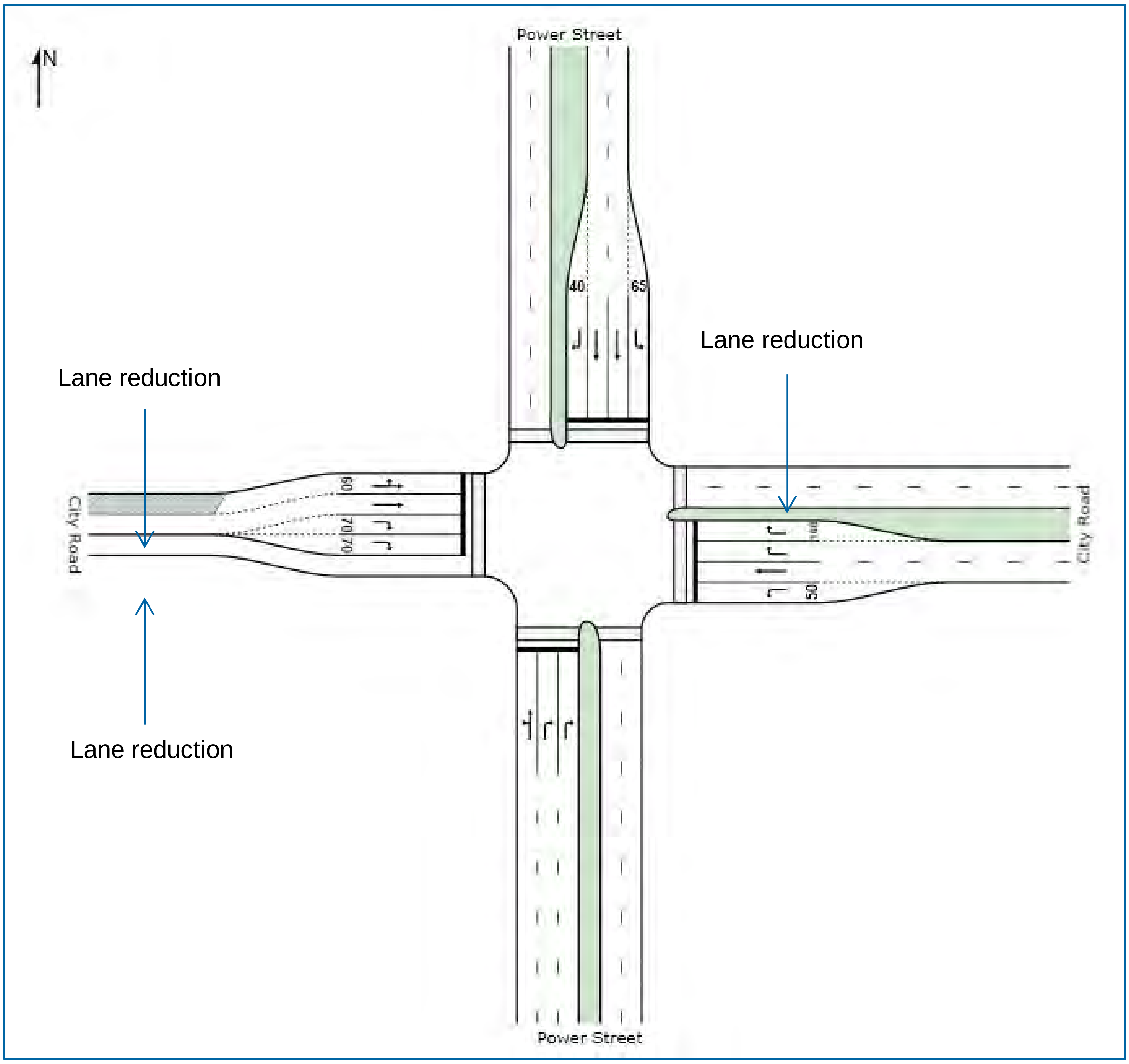


Table 25 Power Street/City Road intersection operation (incl. City Road lane reduction)

		DOS	Ave. Delay (sec)	95th%ile Queue
AM Peak	2031 Optimistic	0.821	46	259 m
	2031 Optimistic (incl. lane reduction)	1.143	116	620 m
	2031 Conservative	0.919	54	345 m
	2031 Conservative (incl. lane reduction)	1.279	184	847 m
PM Peak	2031 Optimistic	0.875	46	236 m
	2031 Optimistic (incl. lane reduction)	0.993	56	379 m
	2031 Conservative	0.980	55	306 m
	2031 Conservative (incl. lane reduction)	1.156	85	623 m

The results indicate that performance reduces in both the optimistic and conservative scenarios. DOS in the optimistic scenario is expected to be over capacity in the AM peak and near capacity in the PM peak, with significant queue lengths and delays. In the conservative scenario, the DOS rises to 1.279 in the AM peak and 1.156 in the PM peak, with queue lengths increasing significantly. The critical legs are again the east and north approaches, which compete with each other for green time. These results suggest that an eastbound lane reduction to the west of Power Street may not be feasible and may cause impacts upstream, such as blocking back through intersections.

6.2.4 Southbank Boulevard intersection

SIDRA models have been developed for the existing and future (2031) scenarios. The results of the analysis are contained in Appendix A.

The SIDRA analysis indicates that the intersection of Southbank Boulevard and City Road currently operates within capacity in the AM peak, but not in the PM peak.

Modelling of the 2031 scenarios indicates the following:

- Intersection DOS in the AM peak sits between 1.010 and 1.114.
- Intersection DOS in the PM peak is between 0.947 and 1.041. Given that the upper limits in both the AM and PM peaks are marginally above capacity, further optimisation of the signals could reduce the DOS to less than 1.000 and cause the intersection to operate within capacity; and
- The critical approaches in the AM and PM peaks are the east and north approaches. There is limited opportunity to provide additional green time for these approaches as they oppose each other.

The SIDRA model has been optimised by varying the phase times within a fixed cycle time to produce the most efficient outcome. The key intersection results for all scenarios in both peaks are summarised in Table 26.

Table 26 Southbank Boulevard/City Road intersection operation

		DOS	Ave. Delay (sec)	95th %ile Queue
AM Peak	Existing	0.908	51	219 m
	2031 Optimistic	1.010	67	316 m
	2031 Conservative	1.114	109	459 m
PM Peak	Existing	1.028	73	260 m
	2031 Optimistic	0.947	52	216 m
	2031 Conservative	1.041	72	295 m

City Road intersection modification

As identified in Table 19, based on optimistic mid-block traffic volumes the number of lanes on City Road can be reduced to two lanes on all approaches.

This option has been tested for the most critical 2031 scenario to provide an indication of the feasibilities of lane reductions. The phase timings (with cycle time fixed), have been optimised by SIDRA due to the layout changes. The intersection layout is presented in Figure 18.

Figure 18 Southbank Boulevard/City Road intersection option 1 layout

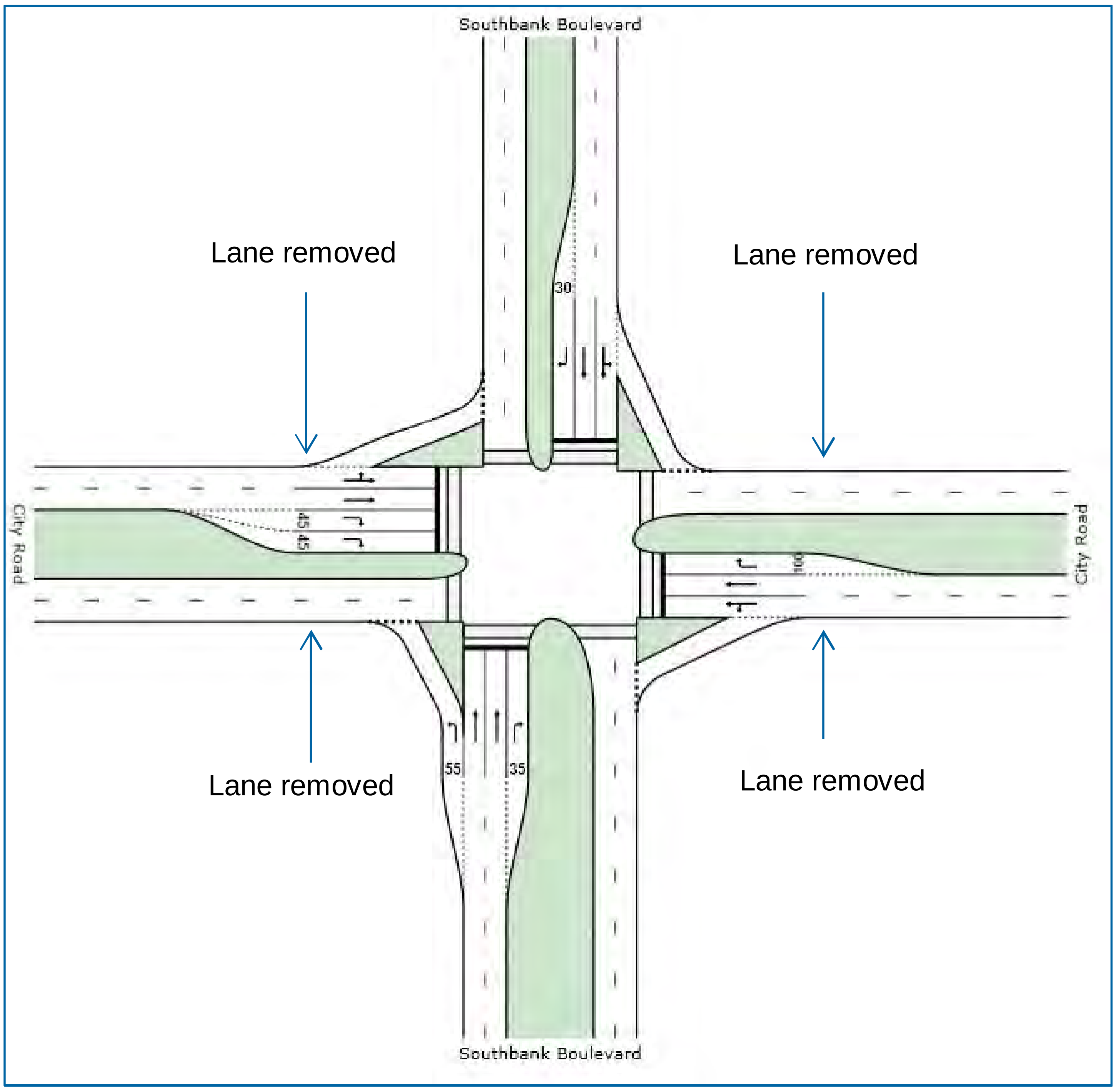


Table 27 Southbank Boulevard/City Road intersection operation (incl. City Road lane reduction

		DOS	Ave. Delay (sec)	95th%ile Queue
AM Peak	2031 Optimistic	1.010	67	316 m
	2031 Optimistic (lane reduction)	1.232	164	764 m
	2031 Conservative	1.114	109	459 m
	2031 Conservative (lane reduction)	1.359	247	1023 m
PM Peak	2031 Optimistic	0.947	52	216 m
	2031 Optimistic (lane reduction)	1.070	87	434 m
	2031 Conservative	1.041	72	295 m
	2031 Conservative (lane reduction)	1.180	132	613 m

The results indicate that the intersection will operate over practical capacity in both the AM and PM peaks, with a DOS over 1.0. Significant queue lengths and delays may be experienced, with 95th percentile queues estimated to be as long as 1023 m along City Road. These results suggest that removing a lane each side of Southbank Boulevard on City Road will not be feasible and may cause impacts upstream, such as blocking back through intersections.

Whilst the hourly mid-block volumes in 2031 suggest that the number of lanes can be reduced, as previously discussed, it is the intersections which set the capacity of a road.

There may also be scope to remove the slip lanes at the intersection, which would improve pedestrian amenity by reducing vehicle speeds and reducing the dominance of the carriageway over pedestrian space. This scenario, in which all slip lanes have been removed, has been tested. This option has been tested for the most critical 2031 scenario to provide an indication of the feasibilities of such a change. The phase timings (with cycle time fixed), has been optimised by SIDRA due to the layout changes. The intersection layout is presented in Figure 19.

The results of the 2031 AM and PM peak tests are summarised in Table 28.

Figure 19 Southbank Boulevard/City Road intersection option 2 layout

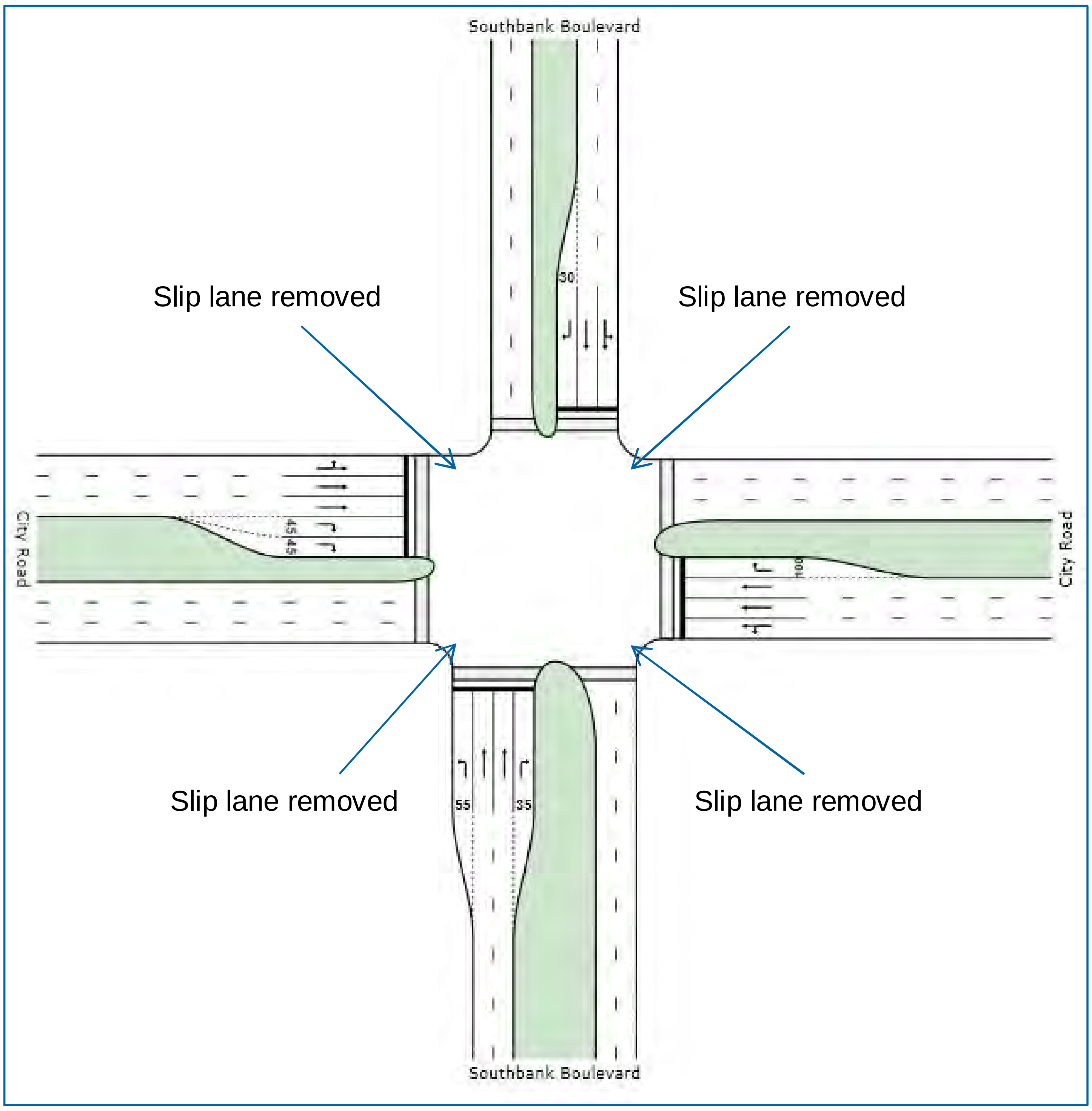


Table 28 Southbank Boulevard/City Road intersection operation (incl. City Road slip lane reduction

		DOS	Ave. Delay (sec)	95th%ile Queue
AM Peak	2031 Optimistic	1.010	67	316 m
	2031 Optimistic (no slip lanes)	1.268	89	342 m
	2031 Conservative	1.114	109	459 m
	2031 Conservative (no slip lanes)	1.399	145	493 m
PM Peak	2031 Optimistic	0.947	52	216 m
	2031 Optimistic (no slip lanes)	1.030	55	198 m
	2031 Conservative	1.041	72	295 m
	2031 Conservative (no slip lanes)	1.134	69	269 m

The results indicate that performance reduces in both the optimistic and conservative scenarios; however 95th percentile queue lengths are not expected to increase significantly. The DOS in all scenarios is expected to be over capacity with a DOS over 1.0. These results suggest that removing the slip lanes at the City Road and Southbank Boulevard intersection may not be feasible and is likely to impact on the performance of the intersection.

6.2.5 Southgate Avenue intersection

SIDRA models have been developed for the existing and future (2031) scenarios. The results of the analysis are contained in **Appendix A**.

The SIDRA analysis indicates that the intersection of Southgate Avenue and City Road currently operates within capacity. The AM and PM peak both have a DOS of 0.448, operating well under practical capacity.

Modelling of the 2031 scenarios indicates the following:

- Intersection DOS in the AM peak sits between 0.447 and 0.558. This indicates that the intersection will operate within capacity;
- Intersection DOS in the PM peak sits between 0.447 and 0.494. This indicates that the intersection will operate within capacity; and

The key intersection results for all scenarios in both peaks are summarised in Table 29.

Table 29 Existing Southgate Avenue/City Road intersection operation

		DOS	Ave. Delay (sec)	95th %ile Queue
AM Peak	Existing	0.448	15	114 m
	2031 Optimistic	0.447	15	113 m
	2031 Conservative	0.558	18	149 m
PM Peak	Existing	0.448	14	116 m
	2031 Optimistic	0.447	14	116 m
	2031 Conservative	0.494	15	133 m

City Road lane reduction

As identified in Table 19, based on optimistic mid-block traffic volumes, the number of lanes on City Road either side of Southgate Avenue can be reduced to two lanes. This option has been tested for the most critical 2031 scenario to provide an indication of the feasibilities of lane reduction. The phase timings (with cycle time fixed), has been optimised by SIDRA due to the layout changes. The intersection layout is presented in Figure 20.

The results of the 2031 AM and PM peak tests are summarised in Table 30.

Figure 20 Southgate Avenue/City Road intersection option layout

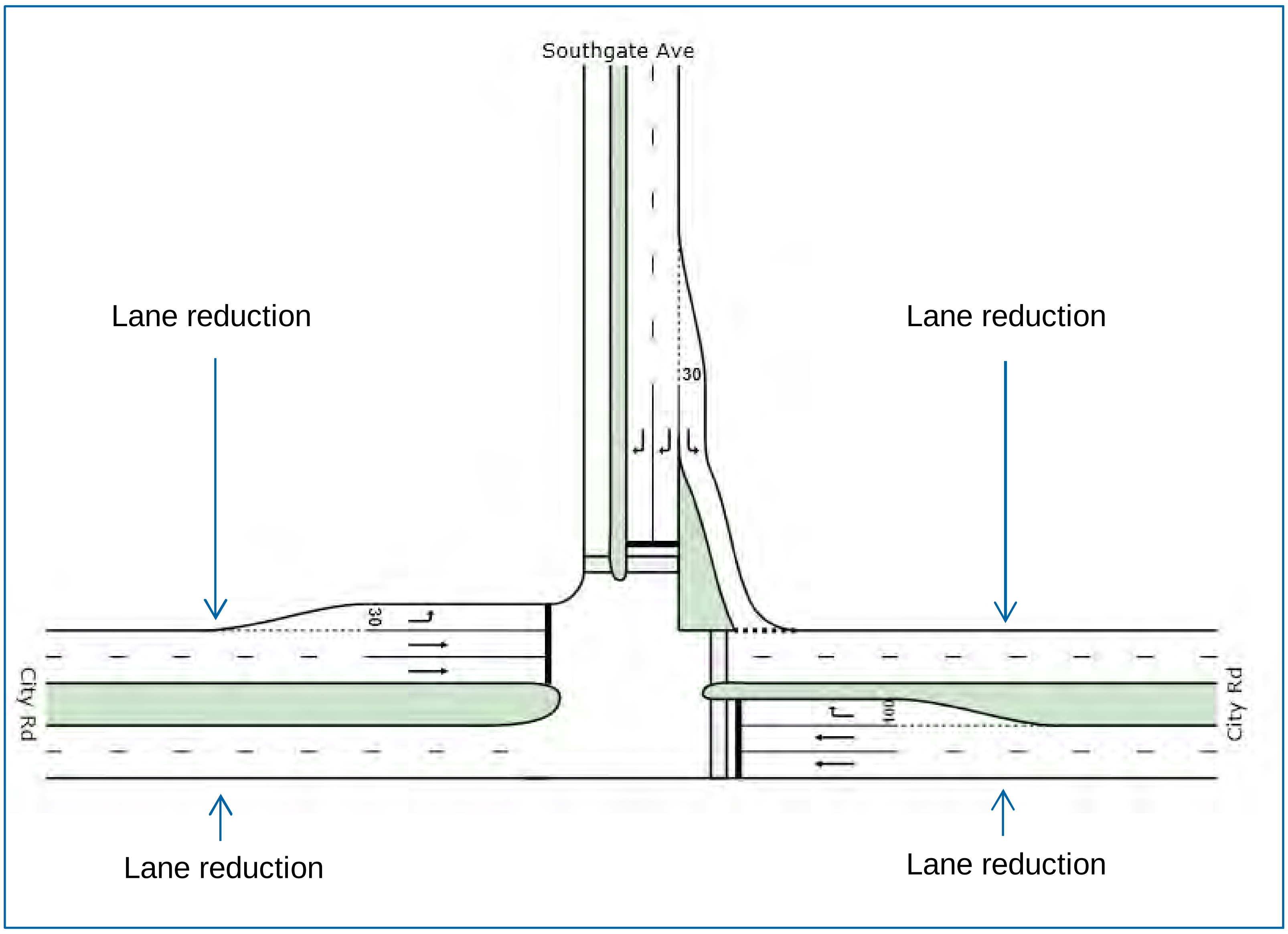


Table 30 Southgate Avenue/City Road intersection operation (incl. City Road lane reduction

		DOS	Ave. Delay (sec)	95th%ile Queue
AM Peak	2031 Optimistic	0.447	15	113 m
	2031 Optimistic (incl. lane reduction)	0.592	13	174 m
	2031 Conservative	0.558	18	149 m
	2031 Conservative (incl. lane reduction)	0.678	15	216 m
PM Peak	2031 Optimistic	0.447	14	116 m
	2031 Optimistic (incl. lane reduction)	0.632	14	193 m
	2031 Conservative	0.494	15	133 m
	2031 Conservative (incl. lane reduction)	0.699	15	229 m

The results indicate that whilst intersection performance (delays and queuing) will be impacted, the intersection is expected to continue operating within acceptable limits.

The intersection impacts are mainly to the City Road west approach; however the average delays are predicted to remain relatively static. Considered in isolation, it appears feasible to reduce the number of lanes along this stretch of City Road from three lanes to two.

6.3 Summary of intersection modelling

The key findings of this analysis are:

- At the Clarendon Street intersection, a westbound lane reduction is expected to reduce intersection capacity by less than 3%. However, queue lengths are expected to increase by nearly 200 m in the PM peak, which is considered unacceptable. This means that a lane reduction is probably not feasible based on the analysis that has been carried out.
- At the Queensbridge Street intersection, a lane reduction in both directions is expected to reduce capacity significantly, which would extend queues and delays to beyond acceptable limits. The analysis indicates that a lane reduction between Clarendon Street and Power Street is unlikely to be feasible.
- At the Power Street intersection, the analysis indicates that a lane reduction in both directions will significantly reduce capacity and extend queues and delays to unacceptable levels. It is unlikely that a lane reduction is feasible.
- At the Southbank Boulevard intersection, a lane reduction in both directions is again expected to reduce capacity significantly, as well as increase queue lengths and delays to unacceptable levels. In addition, the removal of the slip lanes on each corner of the intersection is also expected to impact significantly on capacity. It is considered removing a lane on City Road and the slip lanes at the intersection are both impractical.
- At the Southgate Avenue intersection, the analysis indicates that while a lane reduction in both directions will reduce capacity, all performance criteria remain within acceptable limits. It is therefore likely that a lane reduction could be accommodated, although it would have to be localised to the intersection as the impacts at Southbank Boulevard are expected to be too great.

The analysis carried out assumes that each intersection exists in isolation, which is not the case. This is a limitation of the software used. It also assumes that there would be no redistribution of traffic as a result of removing a lane on City Road, which is unlikely to be the case.

It should be acknowledged that City Road is managed by VicRoads, who may require more detailed analysis than that presented in this report if it is to consider a reduction in capacity.

Appendices

Appendix A – SIDRA Analysis Outputs

LANE SUMMARY

Site: AM Base V1

Intersection of City Road and Clarendon Street
2011 AM peak
Signals - Fixed Time   Cycle Time = 116 seconds (User-Given Cycle Time)

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Clarendon Street													
Lane 1	203	1.0	379	0.536	100	47.9	LOS D	10.5	74.0	Full	500	0.0	0.0
Lane 2	206	1.0	384	0.536	100	45.5	LOS D	10.6	74.9	Full	500	0.0	0.0
Lane 3	123	1.0	175	0.704	100	67.8	LOS E	7.2	51.0	Short	50	0.0	6.8
Approach	533	1.0		0.704		51.6	LOS D	10.6	74.9				
East: City Road													
Lane 1	345	1.0	769	0.448	100	29.2	LOS C	13.5	95.1	Full	500	0.0	0.0
Lane 2	402	1.0	896 [1]	0.448	100	15.6	LOS B	12.6	89.2	Full	500	0.0	0.0
Lane 3	137	1.0	187 [1]	0.733	100	62.0	LOS E	7.6	53.7	Short	25	0.0	76.3
Approach	883	1.0		0.733		28.1	LOS C	13.5	95.1				
North: Clarendon Street													
Lane 1	282	1.0	380	0.743	100	51.6	LOS D	15.7	110.5	Full	500	0.0	0.0
Lane 2	242	1.0	326 [1]	0.743	100	48.6	LOS D	13.2	93.1	Full	500	0.0	0.0
Lane 3	126	1.0	175	0.722	100	68.2	LOS E	7.5	52.6	Short	35	0.0	42.3
Approach	651	1.0		0.743		53.7	LOS D	15.7	110.5				
West: City Road													
Lane 1	220	1.0	827	0.266	100	20.3	LOS C	4.2	30.0	Short	40	0.0	0.0
Lane 2	410	1.0	530 [1]	0.774	100	35.6	LOS D	19.9	140.6	Full	500	0.0	0.0
Lane 3	530	1.0	685	0.774	100	37.0	LOS D	27.2	192.0	Full	500	0.0	0.0
Approach	1160	1.0		0.774		33.3	LOS C	27.2	192.0				
Intersection	3226	1.0		0.774		39.0	LOS D	27.2	192.0				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect

SIDRA INTERSECTION 6

LANE SUMMARY

Site: PM Base V2

Intersection of City Road and Clarendon Street
2011 PM peak
Signals - Fixed Time   Cycle Time = 118 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Clarendon Street													
Lane 1	166	1.0	454	0.366	100	43.0	LOS D	8.0	56.7	Full	500	0.0	0.0
Lane 2	168	1.0	460	0.366	100	40.6	LOS D	8.1	57.4	Full	500	0.0	0.0
Lane 3	153	1.0	391	0.391	100	52.4	LOS D	7.6	53.8	Short	50	0.0	11.7
Approach	487	1.0		0.391		45.1	LOS D	8.1	57.4				
East: City Road													
Lane 1	351	1.0	544	0.644	100	41.0	LOS D	17.1	120.7	Full	500	0.0	0.0
Lane 2	407	1.0	632 [1]	0.644	100	28.9	LOS C	17.7	125.2	Full	500	0.0	0.0
Lane 3	127	1.0	142 [1]	0.896	100	78.1	LOS E	8.3	58.7	Short	25	0.0	84.9
Approach	885	1.0		0.896		40.8	LOS D	17.7	125.2				
North: Clarendon Street													
Lane 1	394	1.0	455	0.867	100	57.6	LOS E	24.6	173.8	Full	500	0.0	0.0
Lane 2	286	1.0	330 [1]	0.867	100	55.0	LOS D	17.2	121.2	Full	500	0.0	0.0
Lane 3	239	1.0	281 [1]	0.849	100	64.3	LOS E	14.3	100.7	Short	35	0.0	100.0
Approach	919	1.0		0.867		58.5	LOS E	24.6	173.8				
West: City Road													
Lane 1	144	1.0	828	0.174	100	20.3	LOS C	3.1	21.7	Short	40	0.0	0.0
Lane 2	328	1.0	381 [1]	0.862	100	54.3	LOS D	19.8	139.9	Full	500	0.0	0.0
Lane 3	396	1.0	460	0.862	100	54.9	LOS D	24.5	173.2	Full	500	0.0	0.0
Approach	868	1.0		0.862		48.9	LOS D	24.5	173.2				
Intersection	3160	1.0		0.896		48.9	LOS D	24.6	173.8				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect

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SIDRA INTERSECTION 6

LANE SUMMARY

Site: 2031 Conservative AM

2031 based on 2011 AM Base V1
Signals - Fixed Time   Cycle Time = 116 seconds (User-Given Phase Times)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Clarendon Street													
Lane 1	234	1.0	379	0.618	100	48.7	LOS D	12.3	86.8	Full	500	0.0	0.0
Lane 2	237	1.0	384	0.618	100	46.4	LOS D	12.5	87.9	Full	500	0.0	0.0
Lane 3	142	1.0	175	0.813	100	71.3	LOS E	8.7	61.5	Short	50	0.0	23.7
Approach	614	1.0		0.813		53.1	LOS D	12.5	87.9				
East: City Road													
Lane 1	430	1.0	771	0.557	100	30.4	LOS C	17.8	126.0	Full	500	0.0	0.0
Lane 2	482	1.0	865[1]	0.557	100	16.4	LOS B	18.1	128.0	Full	500	0.0	0.0
Lane 3	167	1.0	153[1]	1.096	100	221.2	LOS F	18.1	128.0	Short	25	0.0	100.0
Approach	1079	1.0		1.096		53.7	LOS D	18.1	128.0				
North: Clarendon Street													
Lane 1	332	1.0	380	0.874	100	60.8	LOS E	20.8	147.0	Full	500	0.0	0.0
Lane 2	272	1.0	311[1]	0.874	100	58.3	LOS E	16.7	117.8	Full	500	0.0	0.0
Lane 3	145	1.0	175	0.831	100	72.3	LOS E	9.0	63.5	Short	35	0.0	60.0
Approach	749	1.0		0.874		62.1	LOS E	20.8	147.0				
West: City Road													
Lane 1	242	1.0	827	0.293	100	20.4	LOS C	4.7	33.4	Short	40	0.0	0.0
Lane 2	444	1.0	515[1]	0.861	100	44.0	LOS D	24.5	173.2	Full	500	0.0	0.0
Lane 3	590	1.0	685	0.861	100	44.7	LOS D	34.5	243.5	Full	500	0.0	0.0
Approach	1276	1.0		0.861		39.9	LOS D	34.5	243.5				
Intersection	3718	1.0		1.096		50.6	LOS D	34.5	243.5				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect

LANE SUMMARY

Site: 2031 Conservative PM

2031 based on 2011 PM Base V1
Signals - Fixed Time Cycle Time = 118 seconds (User-Given Phase Times)

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Clarendon Street													
Lane 1	209	1.0	454	0.460	100	44.0	LOS D	10.3	73.1	Full	500	0.0	0.0
Lane 2	211	1.0	460	0.460	100	41.7	LOS D	10.5	74.0	Full	500	0.0	0.0
Lane 3	192	1.0	391	0.490	100	53.6	LOS D	9.8	69.3	Short	50	0.0	34.8
Approach	612	1.0		0.490		46.2	LOS D	10.5	74.0				
East: City Road													
Lane 1	503	1.0	545	0.924	100	64.8	LOS E	34.2	241.3	Full	500	0.0	0.0
Lane 2	564	1.0	610[1]	0.924	100	54.4	LOS D	36.1	254.8	Full	500	0.0	0.0
Lane 3	179	1.0	132[1]	1.359	100	437.5	LOS F	31.1	219.5	Short	25	0.0	100.0
Approach	1246	1.0		1.359		113.6	LOS F	36.1	254.8				
North: Clarendon Street													
Lane 1	504	1.0	455	1.108	100	175.1	LOS F	57.1	403.1	Full	500	0.0	0.0
Lane 2	350	1.0	315[1]	1.108	100	200.1	LOS F	40.2	283.5	Full	500	0.0	0.0
Lane 3	300	1.0	263[1]	1.139	100	238.0	LOS F	36.9	260.4	Short	35	0.0	100.0
Approach	1154	1.0		1.139		199.0	LOS F	57.1	403.1				
West: City Road													
Lane 1	159	1.0	828	0.192	100	20.4	LOS C	3.4	24.1	Short	40	0.0	0.0
Lane 2	355	1.0	371[1]	0.958	100	76.5	LOS E	26.0	183.5	Full	500	0.0	0.0
Lane 3	440	1.0	460	0.958	100	76.0	LOS E	32.9	232.6	Full	500	0.0	0.0
Approach	955	1.0		0.958		66.9	LOS E	32.9	232.6				
Intersection	3966	1.0		1.359		116.8	LOS F	57.1	403.1				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect

SIDRA INTERSECTION 6

LANE SUMMARY

Site: 2031 Optimistic AM

2031 based on 2011 AM Base V1

Signals - Fixed Time   Cycle Time = 116 seconds (User-Given Phase Times)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Clarendon Street													
Lane 1	209	1.0	379	0.550	100	48.0	LOS D	10.8	76.1	Full	500	0.0	0.0
Lane 2	211	1.0	384	0.550	100	45.7	LOS D	10.9	77.0	Full	500	0.0	0.0
Lane 3	126	1.0	175	0.722	100	68.2	LOS E	7.5	52.6	Short	50	0.0	9.6
Approach	546	1.0		0.722		51.8	LOS D	10.9	77.0				
East: City Road													
Lane 1	369	1.0	770	0.479	100	29.8	LOS C	14.7	103.9	Full	500	0.0	0.0
Lane 2	425	1.0	886[1]	0.479	100	15.8	LOS B	13.6	95.8	Full	500	0.0	0.0
Lane 3	145	1.0	165[1]	0.878	100	72.3	LOS E	9.0	63.6	Short	25	0.0	92.9
Approach	939	1.0		0.878		30.0	LOS C	14.7	103.9				
North: Clarendon Street													
Lane 1	291	1.0	380	0.765	100	52.5	LOS D	16.4	115.6	Full	500	0.0	0.0
Lane 2	247	1.0	323[1]	0.765	100	49.5	LOS D	13.7	96.4	Full	500	0.0	0.0
Lane 3	129	1.0	175	0.740	100	68.7	LOS E	7.7	54.2	Short	35	0.0	45.2
Approach	667	1.0		0.765		54.6	LOS D	16.4	115.6				
West: City Road													
Lane 1	219	1.0	827	0.265	100	20.3	LOS C	4.2	29.8	Short	40	0.0	0.0
Lane 2	409	1.0	531[1]	0.771	100	35.4	LOS D	19.8	139.7	Full	500	0.0	0.0
Lane 3	528	1.0	685	0.771	100	36.8	LOS D	27.0	190.5	Full	500	0.0	0.0
Approach	1156	1.0		0.771		33.2	LOS C	27.0	190.5				
Intersection	3308	1.0		0.878		39.7	LOS D	27.0	190.5				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect

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SIDRA INTERSECTION 6.0.9.3896
Project: G:\31\31045\Technical\SIDRA\ClarendonSID6.sip6
8000065, GHD SERVICES PTY LTD, NETWORK / Enterprise

SIDRA INTERSECTION 6

LANE SUMMARY

Site: 2031 Optimistic PM

2031 based on 2011 PM Base V1
Signals - Fixed Time   Cycle Time = 118 seconds (User-Given Phase Times)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Clarendon Street													
Lane 1	185	1.0	454	0.408	100	43.4	LOS D	9.0	63.9	Full	500	0.0	0.0
Lane 2	187	1.0	460	0.408	100	41.1	LOS D	9.2	64.7	Full	500	0.0	0.0
Lane 3	169	1.0	391	0.434	100	52.9	LOS D	8.6	60.4	Short	50	0.0	22.2
Approach	542	1.0		0.434		45.6	LOS D	9.2	64.7				
East: City Road													
Lane 1	435	1.0	545	0.799	100	47.0	LOS D	23.9	168.5	Full	500	0.0	0.0
Lane 2	494	1.0	618[1]	0.799	100	34.0	LOS C	24.3	171.3	Full	500	0.0	0.0
Lane 3	156	1.0	132[1]	1.184	100	283.8	LOS F	20.5	145.1	Short	25	0.0	100.0
Approach	1085	1.0		1.184		75.0	LOS E	24.3	171.3				
North: Clarendon Street													
Lane 1	447	1.0	455	0.983	100	89.0	LOS F	35.9	253.3	Full	500	0.0	0.0
Lane 2	310	1.0	315[1]	0.983	100	88.4	LOS F	24.0	169.6	Full	500	0.0	0.0
Lane 3	266	1.0	263[1]	1.011	100	143.4	LOS F	23.7	167.5	Short	35	0.0	100.0
Approach	1023	1.0		1.011		103.0	LOS F	35.9	253.3				
West: City Road													
Lane 1	144	1.0	828	0.174	100	20.3	LOS C	3.1	21.7	Short	40	0.0	0.0
Lane 2	327	1.0	381[1]	0.859	100	54.0	LOS D	19.7	139.0	Full	500	0.0	0.0
Lane 3	395	1.0	460	0.859	100	54.6	LOS D	24.4	172.0	Full	500	0.0	0.0
Approach	866	1.0		0.859		48.7	LOS D	24.4	172.0				
Intersection	3517	1.0		1.184		72.1	LOS E	35.9	253.3				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect

LANE SUMMARY

Site: 2031 Conservative PM w/layout change

2031 with SIDRA optimised phase times
Signals - Fixed Time   Cycle Time = 118 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Clarendon Street													
Lane 1	209	1.0	389	0.536	100	48.1	LOS D	10.9	76.8	Full	500	0.0	0.0
Lane 2	211	1.0	394	0.536	100	45.8	LOS D	11.0	77.7	Full	500	0.0	0.0
Lane 3	192	1.0	313	0.613	100	59.0	LOS E	10.4	73.7	Short	50	0.0	40.5
Approach	612	1.0		0.613		50.7	LOS D	11.0	77.7				
East: City Road													
Lane 1	521	1.0	694	0.750	100	37.0	LOS D	25.5	180.2	Full	500	0.0	0.0
Lane 2	547	1.0	729[1]	0.750	100	24.1	LOS C	30.8	217.5	Full	500	0.0	0.0
Lane 3	179	1.0	132[1]	1.352	100	430.4	LOS F	30.8	217.5	Short	25	0.0	100.0
Approach	1246	1.0		1.352		87.8	LOS F	30.8	217.5				
North: Clarendon Street													
Lane 1	474	1.0	390	1.217	91[6]	268.0	LOS F	67.1	473.6	Full	500	0.0	0.1
Lane 2	380	1.0	284[1]	1.336	100	393.4	LOS F	64.7	456.4	Full	500	0.0	0.0
Lane 3	300	1.0	224[1]	1.338	100	407.3	LOS F	51.1	360.7	Short	35	0.0	100.0
Approach	1154	1.0		1.338		345.5	LOS F	67.1	473.6				
West: City Road													
Lane 1	303	1.0	505[1]	0.601	42[6]	34.7	LOS C	12.4	87.8	Short	40	0.0	78.3
Lane 2	651	1.0	450[1]	1.446	100	484.8	LOS F	126.8	894.9	Full	500	0.0	58.7
Approach	955	1.0		1.446		341.8	LOS F	126.8	894.9				
Intersection	3966	1.0		1.446		218.2	LOS F	126.8	894.9				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect
6 Lane underutilisation due to downstream effects

SIDRA INTERSECTION 6

LANE SUMMARY

Site: 2031 Optimistic PM w/layout change

Intersection of City Road and Clarendon Street
2011 PM peak
Signals - Fixed Time   Cycle Time = 118 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Clarendon Street													
Lane 1	185	1.0	389	0.476	100	47.4	LOS D	9.5	67.1	Full	500	0.0	0.0
Lane 2	187	1.0	394	0.476	100	45.1	LOS D	9.6	68.0	Full	500	0.0	0.0
Lane 3	169	1.0	313	0.542	100	58.2	LOS E	9.1	64.3	Short	50	0.0	27.9
Approach	542	1.0		0.542		50.0	LOS D	9.6	68.0				
East: City Road													
Lane 1	455	1.0	711	0.640	100	34.1	LOS C	20.8	147.0	Full	500	0.0	0.0
Lane 2	474	1.0	741 [1]	0.640	100	22.9	LOS C	21.7	153.2	Full	500	0.0	0.0
Lane 3	156	1.0	128 [1]	1.213	100	304.2	LOS F	21.7	153.2	Short	25	0.0	100.0
Approach	1085	1.0		1.213		68.0	LOS E	21.7	153.2				
North: Clarendon Street													
Lane 1	420	1.0	390	1.079	91 [6]	152.9	LOS F	43.9	309.7	Full	500	0.0	0.0
Lane 2	336	1.0	284 [1]	1.185	100	261.9	LOS F	45.2	319.2	Full	500	0.0	0.0
Lane 3	266	1.0	224 [1]	1.186	100	274.2	LOS F	35.7	252.0	Short	35	0.0	100.0
Approach	1023	1.0		1.186		220.3	LOS F	45.2	319.2				
West: City Road													
Lane 1	314	1.0	626 [1]	0.502	42 [6]	33.9	LOS C	12.9	91.3	Short	40	0.0	82.2
Lane 2	552	1.0	457 [1]	1.209	100	274.6	LOS F	78.9	557.1	Full	500	0.0	14.8
Approach	866	1.0		1.209		187.3	LOS F	78.9	557.1				
Intersection	3517	1.0		1.213		138.9	LOS F	78.9	557.1				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect
6 Lane underutilisation due to downstream effects

LANE SUMMARY

Site: AM base (optimised)

Intersection of City Road and Power Street
2011 AM peak
Signals - Fixed Time   Cycle Time = 119 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows L veh/h	Demand Flows T veh/h	Demand Flows R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Power Street																
Lane 1	95	283	0	378	5.0	575	0.657	100	38.5	LOS D	18.4	134.3	95	–	0.0	36.6
Lane 2	0	0	395	395	5.0	467	0.845	100	60.1	LOS E	24.1	176.0	95	–	0.0	62.0
Lane 3	0	0	395	395	5.0	467	0.845	100	60.1	LOS E	24.1	176.0	95	–	0.0	62.0
Approach	95	283	789	1167	5.0		0.845		53.2	LOS D	24.1	176.0				
East: City Road																
Lane 1	394	0	0	394	5.0	663	0.594	100	25.3	LOS C	10.4	76.2	135	–	0.0	0.0
Lane 2	0	671	0	671	5.0	778	0.862	100	41.0	LOS D	39.2	285.8	135	–	0.0	74.8
Lane 3	0	0	311	311	5.0	452	0.688	100	51.6	LOS D	16.5	120.5	135	–	0.0	0.0
Lane 4	0	0	273	273	5.0	397 [1]	0.688	100	50.8	LOS D	14.2	103.8	100	Turn Bay	0.0	8.3
Approach	394	671	584	1648	5.0		0.862		40.9	LOS D	39.2	285.8				
North: Power Street																
Lane 1	237	0	0	237	5.0	280 [1]	0.845	100	60.5	LOS E	13.8	100.6	65	Turn Bay	0.0	45.0
Lane 2	0	75	0	75	5.0	127	0.593	100	61.8	LOS E	4.5	33.0	140	–	0.0	0.0
Lane 3	0	75	0	75	5.0	127	0.593	100	61.8	LOS E	4.5	33.0	140	–	0.0	0.0
Lane 4	0	0	41	41	5.0	142	0.290	100	67.3	LOS E	2.4	17.3	40	Turn Bay	0.0	0.0
Approach	237	151	41	428	5.0		0.845		61.6	LOS E	13.8	100.6				
West: City Road																
Lane 1	105	0	0	105	5.0	215 [1]	0.489	100	50.2	LOS D	5.1	37.3	50	Turn Bay	0.0	0.0
Lane 2	0	333	0	333	5.0	413	0.807	100	52.2	LOS D	19.7	143.9	250	–	0.0	0.0
Lane 3	0	333	0	333	5.0	413	0.807	100	52.2	LOS D	19.7	143.9	250	–	0.0	0.0
Lane 4	0	0	31	31	5.0	105	0.294	100	69.4	LOS E	1.8	13.4	70	Turn Bay	0.0	0.0
Lane 5	0	0	31	31	5.0	105	0.294	100	69.4	LOS E	1.8	13.4	70	Turn Bay	0.0	0.0
Approach	105	666	62	834	5.0		0.807		53.2	LOS D	19.7	143.9				
Intersection				4078	5.0		0.862		49.1	LOS D	39.2	285.8				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect

SIDRA INTERSECTION

LANE SUMMARY

Site: PM base (optimised)

Intersection of City Road and Power Street
2011 PM peak
Signals - Fixed Time   Cycle Time = 119 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Power Street																
Lane 1	52	154	0	205	5.0	437	0.470	100	40.7	LOS D	9.7	70.8	95	–	0.0	0.0
Lane 2	0	0	244	244	5.0	331	0.737	100	59.9	LOS E	14.0	102.4	95	–	0.0	11.8
Lane 3	0	0	244	244	5.0	331	0.737	100	59.9	LOS E	14.0	102.4	95	–	0.0	11.8
Approach	52	154	488	694	5.0		0.737		54.2	LOS D	14.0	102.4				
East: City Road																
Lane 1	616	0	0	616	5.0	618	0.997	100	79.5	LOS E	37.4	272.7	135	–	0.0	70.3
Lane 2	0	675	0	675	5.0	889	0.759	100	27.7	LOS C	32.0	233.4	135	–	0.0	55.5
Lane 3	0	0	300	300	5.0	467	0.642	100	50.2	LOS D	15.6	113.9	135	–	0.0	0.0
Lane 4	0	0	258	258	5.0	401[1]	0.642	100	49.0	LOS D	13.0	95.0	100	Turn Bay	0.0	0.4
Approach	616	675	558	1848	5.0		0.997		51.6	LOS D	37.4	272.7				
North: Power Street																
Lane 1	283	0	0	283	5.0	283[1]	1.000[3]	100	52.3[8]	LOS D[8]	14.5[8]	106.1[8]	65	Turn Bay	0.0	50.0
Lane 2	55[0]	86	0	141	5.0	155	0.906	100	72.3	LOS E	9.5	69.4	140	–	0.0	0.0
Lane 3	0	144	0	144	5.0	159	0.906	100	72.1	LOS E	9.7	70.7	140	–	0.0	0.0
Lane 4	0	0	99	99	5.0	149[1]	0.663	100	67.7	LOS E	5.8	42.7	40	Turn Bay	0.0	10.8
Approach	338	229	99	666	5.0		1.000		63.1	LOS E	14.5	106.1				
West: City Road																
Lane 1	105	0	0	105	5.0	230[1]	0.458	100	44.7	LOS D	4.7	34.6	50	Turn Bay	0.0	0.0
Lane 2	0	309	0	309	5.0	508	0.608	100	41.1	LOS D	15.8	115.0	250	–	0.0	0.0
Lane 3	0	309	0	309	5.0	508	0.608	100	41.1	LOS D	15.8	115.0	250	–	0.0	0.0
Lane 4	0	0	51	51	5.0	105	0.479	100	70.4	LOS E	3.0	22.2	70	Turn Bay	0.0	0.0
Lane 5	0	0	51	51	5.0	105	0.479	100	70.4	LOS E	3.0	22.2	70	Turn Bay	0.0	0.0
Approach	105	618	101	824	5.0		0.608		45.2	LOS D	15.8	115.0				
Intersection				4033	5.0		1.000		52.6	LOS D	37.4	272.7				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

0 Excess flow from back of an adjacent short lane
1 Reduced capacity due to a short lane effect
3 x = 1.00 due to short lane.
8 Delay, queue length and stops for the short lane have been cut down to fit in the queuing space. You may wish to change the short lane to a full lane to investigate the effect on the adjacent lane performance.

LANE SUMMARY

Site: AM 2031 base cons (optimised)

Intersection of City Road and Power Street
2031 AM peak do nothing
Signals - Fixed Time   Cycle Time = 119 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows L veh/h	Demand Flows T veh/h	Demand Flows R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Power Street																
Lane 1	100	299	0	399	5.0	587	0.680	100	38.9	LOS D	19.6	143.3	95	–	0.0	42.6
Lane 2	0	0	417	417	5.0	482	0.864	100	61.8	LOS E	26.1	190.6	95	–	0.0	69.6
Lane 3	0	0	417	417	5.0	482	0.864	100	61.8	LOS E	26.1	190.6	95	–	0.0	69.6
Approach	100	299	834	1233	5.0		0.864		54.4	LOS D	26.1	190.6				
East: City Road																
Lane 1	407	0	0	407	5.0	678	0.601	100	25.2	LOS C	11.2	81.5	135	–	0.0	0.0
Lane 2	0	695	0	695	5.0	794	0.875	100	42.4	LOS D	41.6	303.6	135	–	0.0	80.7
Lane 3	0	0	326	326	5.0	467	0.697	100	51.1	LOS D	17.3	126.1	135	–	0.0	0.0
Lane 4	0	0	280	280	5.0	401 [1]	0.697	100	50.2	LOS D	14.5	105.7	100	Turn Bay	0.0	10.0
Approach	407	695	605	1707	5.0		0.875		41.2	LOS D	41.6	303.6				
North: Power Street																
Lane 1	251	0	0	251	5.0	283 [1]	0.885	100	60.6 [8]	LOS E [8]	14.5 [8]	106.1 [8]	65	Turn Bay	0.0	50.0
Lane 2	0	79	0	79	5.0	95	0.835	100	69.2	LOS E	5.2	37.6	140	–	0.0	0.0
Lane 3	0	79	0	79	5.0	95	0.835	100	69.2	LOS E	5.2	37.6	140	–	0.0	0.0
Lane 4	0	0	43	43	5.0	112	0.387	100	70.3	LOS E	2.6	18.8	40	Turn Bay	0.0	0.0
Approach	251	159	43	453	5.0		0.885		64.6	LOS E	14.5	106.1				
West: City Road																
Lane 1	116	0	0	116	5.0	215 [1]	0.538	100	50.5	LOS D	5.7	41.3	50	Turn Bay	0.0	0.0
Lane 2	0	365	0	365	5.0	413	0.885	100	60.1	LOS E	23.8	173.4	250	–	0.0	0.0
Lane 3	0	365	0	365	5.0	413	0.885	100	60.1	LOS E	23.8	173.4	250	–	0.0	0.0
Lane 4	0	0	34	34	5.0	105	0.324	100	69.5	LOS E	2.0	14.8	70	Turn Bay	0.0	0.0
Lane 5	0	0	34	34	5.0	105	0.324	100	69.5	LOS E	2.0	14.8	70	Turn Bay	0.0	0.0
Approach	116	731	68	915	5.0		0.885		59.6	LOS E	23.8	173.4				
Intersection				4307	5.0		0.885		51.3	LOS D	41.6	303.6				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect
8 Delay, queue length and stops for the short lane have been cut down to fit in the queuing space. You may wish to change the short lane to a full lane to investigate the effect on the adjacent lane performance.

LANE SUMMARY

Site: PM 2031 base cons (optimised)

Intersection of City Road and Power Street
2031 PM peak do nothing
Signals - Fixed Time   Cycle Time = 119 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows L veh/h	Demand Flows T veh/h	Demand Flows R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Power Street																
Lane 1	55	163	0	218	5.0	422	0.516	100	42.4	LOS D	10.6	77.1	95	–	0.0	0.0
Lane 2	0	0	258	258	5.0	316	0.815	100	64.7	LOS E	15.7	114.7	95	–	0.0	22.1
Lane 3	0	0	258	258	5.0	316	0.815	100	64.7	LOS E	15.7	114.7	95	–	0.0	22.1
Approach	55	163	516	734	5.0		0.815		58.0	LOS E	15.7	114.7				
East: City Road																
Lane 1	617	0	0	617	5.0	618	0.998	100	81.5	LOS F	37.4	273.1	135	–	0.0	70.4
Lane 2	0	676	0	676	5.0	905	0.747	100	26.8	LOS C	31.5	230.2	135	–	0.0	54.1
Lane 3	0	0	301	301	5.0	467	0.644	100	50.3	LOS D	15.6	114.1	135	–	0.0	0.0
Lane 4	0	0	258	258	5.0	401[1]	0.644	100	49.0	LOS D	13.0	95.3	100	Turn Bay	0.0	0.6
Approach	617	676	559	1852	5.0		0.998		51.9	LOS D	37.4	273.1				
North: Power Street																
Lane 1	283	0	0	283	5.0	283[1]	1.000[3]	100	52.3[8]	LOS D[8]	14.5[8]	106.1[8]	65	Turn Bay	0.0	50.0
Lane 2	74[0]	82	0	156	5.0	170	0.917	100	73.5	LOS E	10.7	78.1	140	–	0.0	0.0
Lane 3	0	160	0	160	5.0	175	0.917	100	73.3	LOS E	10.9	79.9	140	–	0.0	0.0
Lane 4	0	0	104	104	5.0	151[1]	0.690	100	67.0	LOS E	6.1	44.8	40	Turn Bay	0.0	15.2
Approach	357	242	104	703	5.0		1.000		64.0	LOS E	14.5	106.1				
West: City Road																
Lane 1	124	0	0	124	5.0	230[1]	0.541	100	45.1	LOS D	5.7	41.4	50	Turn Bay	0.0	0.0
Lane 2	0	365	0	365	5.0	508	0.718	100	43.0	LOS D	19.4	141.8	250	–	0.0	0.0
Lane 3	0	365	0	365	5.0	508	0.718	100	43.0	LOS D	19.4	141.8	250	–	0.0	0.0
Lane 4	0	0	59	59	5.0	90	0.658	100	73.5	LOS E	3.7	27.1	70	Turn Bay	0.0	0.0
Lane 5	0	0	59	59	5.0	90	0.658	100	73.5	LOS E	3.7	27.1	70	Turn Bay	0.0	0.0
Approach	124	729	119	973	5.0		0.718		47.0	LOS D	19.4	141.8				
Intersection				4261	5.0		1.000		53.8	LOS D	37.4	273.1				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

0 Excess flow from back of an adjacent short lane
1 Reduced capacity due to a short lane effect
3 x = 1.00 due to short lane.
8 Delay, queue length and stops for the short lane have been cut down to fit in the queuing space. You may wish to change the short lane to a full lane to investigate the effect on the adjacent lane performance.

LANE SUMMARY

Site: AM 2031 base optim (optimised)

Intersection of City Road and Power Street
2031 AM peak do nothing
Signals - Fixed Time   Cycle Time = 119 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Power Street																
Lane 1	88	266	0	355	5.0	572	0.621	100	38.4	LOS D	17.1	124.7	95	–	0.0	29.7
Lane 2	0	0	373	373	5.0	467	0.798	100	56.1	LOS E	21.5	157.1	95	–	0.0	51.2
Lane 3	0	0	373	373	5.0	467	0.798	100	56.1	LOS E	21.5	157.1	95	–	0.0	51.2
Approach	88	266	745	1100	5.0		0.798		50.4	LOS D	21.5	157.1				
East: City Road																
Lane 1	369	0	0	369	5.0	663	0.557	100	25.1	LOS C	9.9	72.0	135	–	0.0	0.0
Lane 2	0	629	0	629	5.0	794	0.793	100	33.2	LOS C	32.3	235.5	135	–	0.0	56.3
Lane 3	0	0	295	295	5.0	467	0.631	100	50.2	LOS D	15.3	111.5	135	–	0.0	0.0
Lane 4	0	0	253	253	5.0	401[1]	0.631	100	49.0	LOS D	12.8	93.2	100	Turn Bay	0.0	0.0
Approach	369	629	548	1547	5.0		0.793		37.1	LOS D	32.3	235.5				
North: Power Street																
Lane 1	223	0	0	223	5.0	283[1]	0.788	100	54.3	LOS D	12.0	87.7	65	Turn Bay	0.0	32.3
Lane 2	0	71	0	71	5.0	95	0.746	100	66.6	LOS E	4.5	32.7	140	–	0.0	0.0
Lane 3	0	71	0	71	5.0	95	0.746	100	66.6	LOS E	4.5	32.7	140	–	0.0	0.0
Lane 4	0	0	39	39	5.0	112	0.349	100	70.1	LOS E	2.3	16.9	40	Turn Bay	0.0	0.0
Approach	223	142	39	404	5.0		0.788		60.1	LOS E	12.0	87.7				
West: City Road																
Lane 1	100	0	0	100	5.0	218[1]	0.459	100	49.1	LOS D	4.8	34.9	50	Turn Bay	0.0	0.0
Lane 2	0	317	0	317	5.0	429	0.741	100	47.9	LOS D	17.7	129.3	250	–	0.0	0.0
Lane 3	0	317	0	317	5.0	429	0.741	100	47.9	LOS D	17.7	129.3	250	–	0.0	0.0
Lane 4	0	0	29	29	5.0	121	0.245	100	67.7	LOS E	1.7	12.5	70	Turn Bay	0.0	0.0
Lane 5	0	0	29	29	5.0	121	0.245	100	67.7	LOS E	1.7	12.5	70	Turn Bay	0.0	0.0
Approach	100	635	59	794	5.0		0.741		49.5	LOS D	17.7	129.3				
Intersection				3845	5.0		0.798		45.9	LOS D	32.3	235.5				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect

LANE SUMMARY

Site: PM 2031 base optim (optimised)

Intersection of City Road and Power Street
2031 PM peak do nothing
Signals - Fixed Time   Cycle Time = 119 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows L veh/h	Demand Flows T veh/h	Demand Flows R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Power Street																
Lane 1	48	145	0	194	5.0	450	0.430	100	39.1	LOS D	8.9	65.3	95	–	0.0	0.0
Lane 2	0	0	231	231	5.0	347	0.665	100	56.8	LOS E	12.7	92.4	95	–	0.0	2.5
Lane 3	0	0	231	231	5.0	347	0.665	100	56.8	LOS E	12.7	92.4	95	–	0.0	2.5
Approach	48	145	461	655	5.0		0.665		51.6	LOS D	12.7	92.4				
East: City Road																
Lane 1	559	0	0	559	5.0	573	0.976	100	69.5	LOS E	32.8	239.2	135	–	0.0	57.8
Lane 2	0	613	0	613	5.0	921	0.666	100	24.6	LOS C	26.7	194.9	135	–	0.0	38.6
Lane 3	0	0	287	287	5.0	558	0.515	100	44.2	LOS D	13.7	99.9	135	–	0.0	0.0
Lane 4	0	0	219	219	5.0	426[1]	0.515	100	42.5	LOS D	10.0	73.0	100	Turn Bay	0.0	0.0
Approach	559	613	506	1678	5.0		0.976		45.3	LOS D	32.8	239.2				
North: Power Street																
Lane 1	302	0	0	302	5.0	302[1]	1.000[3]	100	49.3[8]	LOS D[8]	14.5[8]	106.1[8]	65	Turn Bay	0.0	50.0
Lane 2	17[0]	99	0	117	5.0	126	0.926	100	76.1	LOS E	8.1	58.8	140	–	0.0	0.0
Lane 3	0	118	0	118	5.0	127	0.926	100	76.0	LOS E	8.1	59.2	140	–	0.0	0.0
Lane 4	0	0	94	94	5.0	142	0.661	100	70.1	LOS E	5.7	41.3	40	Turn Bay	0.0	7.9
Approach	319	217	94	629	5.0		1.000		62.4	LOS E	14.5	106.1				
West: City Road																
Lane 1	108	0	0	108	5.0	218[1]	0.498	100	49.3	LOS D	5.2	38.0	50	Turn Bay	0.0	0.0
Lane 2	0	317	0	317	5.0	429	0.739	100	47.8	LOS D	17.7	128.9	250	–	0.0	0.0
Lane 3	0	317	0	317	5.0	429	0.739	100	47.8	LOS D	17.7	128.9	250	–	0.0	0.0
Lane 4	0	0	52	52	5.0	90	0.571	100	72.5	LOS E	3.2	23.2	70	Turn Bay	0.0	0.0
Lane 5	0	0	52	52	5.0	90	0.571	100	72.5	LOS E	3.2	23.2	70	Turn Bay	0.0	0.0
Approach	108	634	103	845	5.0		0.739		51.0	LOS D	17.7	128.9				
Intersection				3807	5.0		1.000		50.5	LOS D	32.8	239.2				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

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1 Reduced capacity due to a short lane effect
3 x = 1.00 due to short lane.
8 Delay, queue length and stops for the short lane have been cut down to fit in the queuing space. You may wish to change the short lane to a full lane to investigate the effect on the adjacent lane performance.

LANE SUMMARY

Site: PM 2031 opt1 cons (optimised)

Intersection of City Road and Power Street
2031 PM peak
Option 1
Signals - Fixed Time   Cycle Time = 119 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows L veh/h	Demand Flows T veh/h	Demand Flows R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Power Street																
Lane 1	55	163	0	218	5.0	469	0.464	100	39.6	LOS D	10.2	74.1	95	–	0.0	0.0
Lane 2	0	0	258	258	5.0	362	0.713	100	57.4	LOS E	14.4	105.4	95	–	0.0	14.4
Lane 3	0	0	258	258	5.0	362	0.713	100	57.4	LOS E	14.4	105.4	95	–	0.0	14.4
Approach	55	163	516	734	5.0		0.713		52.1	LOS D	14.4	105.4				
East: City Road																
Lane 1	446	0	0	446	5.0	446 [1]	1.000 [3]	100	26.0 [8]	LOS C [8]	11.2 [8]	82.1 [8]	50	Turn Bay	0.0	50.5
Lane 2	171 [0]	676	0	847	5.0	848	0.999	100	84.8	LOS F	73.6	537.3	135	–	0.0	100.0
Lane 3	0	0	279	279	5.0	392	0.713	100	55.8	LOS E	15.5	112.9	135	–	0.0	0.0
Lane 4	0	0	279	279	5.0	392	0.713	100	55.8	LOS E	15.5	112.9	100	Turn Bay	0.0	16.0
Approach	617	676	559	1852	5.0		1.000		61.9	LOS E	73.6	537.3				
North: Power Street																
Lane 1	268	0	0	268	5.0	268 [1]	1.000 [3]	100	55.0 [8]	LOS D [8]	14.5 [8]	106.1 [8]	65	Turn Bay	0.0	50.0
Lane 2	88 [0]	74	0	163	5.0	170	0.960	100	83.8	LOS F	12.0	87.8	140	–	0.0	0.0
Lane 3	0	168	0	168	5.0	175	0.960	100	83.4	LOS F	12.3	90.1	140	–	0.0	0.0
Lane 4	0	0	104	104	5.0	151 [1]	0.690	100	67.0	LOS E	6.1	44.8	40	Turn Bay	0.0	15.2
Approach	357	242	104	703	5.0		1.000		70.2	LOS E	14.5	106.1				
West: City Road																
Lane 1	124	0	0	124	5.0	235 [1]	0.529	100	43.4	LOS D	5.5	40.3	50	Turn Bay	0.0	0.0
Lane 2	0	365	0	365	5.0	540	0.676	100	40.6	LOS D	18.8	137.4	250	–	0.0	0.0
Lane 3	0	365	0	365	5.0	540	0.676	100	40.6	LOS D	18.8	137.4	250	–	0.0	0.0
Lane 4	0	0	59	59	5.0	90	0.658	100	73.5	LOS E	3.7	27.1	70	Turn Bay	0.0	0.0
Lane 5	0	0	59	59	5.0	90	0.658	100	73.5	LOS E	3.7	27.1	70	Turn Bay	0.0	0.0
Approach	124	729	119	973	5.0		0.676		45.0	LOS D	18.8	137.4				
Intersection				4261	5.0		1.000		57.7	LOS E	73.6	537.3				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Site: PM 2031 opt1 optim (optimised)

Intersection of City Road and Power Street
2031 PM peak
Option 1 (optimistic scenario)
Signals - Fixed Time   Cycle Time = 119 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows L veh/h	Demand Flows T veh/h	Demand Flows R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Power Street																
Lane 1	48	145	0	194	5.0	483	0.401	100	37.4	LOS D	8.7	63.5	95	–	0.0	0.0
Lane 2	0	0	231	231	5.0	377	0.612	100	54.4	LOS D	12.3	89.9	95	–	0.0	0.0
Lane 3	0	0	231	231	5.0	377	0.612	100	54.4	LOS D	12.3	89.9	95	–	0.0	0.0
Approach	48	145	461	655	5.0		0.612		49.4	LOS D	12.3	89.9				
East: City Road																
Lane 1	438	0	0	438	5.0	438 [1]	1.000 [3]	100	25.2 [8]	LOS C [8]	11.2 [8]	82.0 [8]	50	Turn Bay	0.0	50.5
Lane 2	121 [0]	613	0	734	5.0	865	0.848	100	34.9	LOS C	40.4	294.9	135	–	0.0	77.9
Lane 3	0	0	253	253	5.0	407	0.622	100	53.0	LOS D	13.4	97.8	135	–	0.0	0.0
Lane 4	0	0	253	253	5.0	407	0.622	100	53.0	LOS D	13.4	97.8	100	Turn Bay	0.0	3.0
Approach	559	613	506	1678	5.0		1.000		37.9	LOS D	40.4	294.9				
North: Power Street																
Lane 1	271	0	0	271	5.0	271 [1]	1.000 [3]	100	54.3 [8]	LOS D [8]	14.5 [8]	106.1 [8]	65	Turn Bay	0.0	50.0
Lane 2	48 [0]	83	0	131	5.0	140	0.935	100	77.6	LOS E	9.2	67.1	140	–	0.0	0.0
Lane 3	0	134	0	134	5.0	143	0.935	100	77.4	LOS E	9.4	68.3	140	–	0.0	0.0
Lane 4	0	0	94	94	5.0	157	0.598	100	68.2	LOS E	5.5	40.5	40	Turn Bay	0.0	6.0
Approach	319	217	94	629	5.0		1.000		66.1	LOS E	14.5	106.1				
West: City Road																
Lane 1	108	0	0	108	5.0	235 [1]	0.462	100	43.0	LOS D	4.8	34.8	50	Turn Bay	0.0	0.0
Lane 2	0	317	0	317	5.0	540	0.587	100	39.4	LOS D	15.8	115.6	250	–	0.0	0.0
Lane 3	0	317	0	317	5.0	540	0.587	100	39.4	LOS D	15.8	115.6	250	–	0.0	0.0
Lane 4	0	0	52	52	5.0	90	0.571	100	72.5	LOS E	3.2	23.2	70	Turn Bay	0.0	0.0
Lane 5	0	0	52	52	5.0	90	0.571	100	72.5	LOS E	3.2	23.2	70	Turn Bay	0.0	0.0
Approach	108	634	103	845	5.0		0.587		43.9	LOS D	15.8	115.6				
Intersection				3807	5.0		1.000		45.9	LOS D	40.4	294.9				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

0 Excess flow from back of an adjacent short lane
1 Reduced capacity due to a short lane effect
3 x = 1.00 due to short lane.
8 Delay, queue length and stops for the short lane have been cut down to fit in the queuing space. You may wish to change the short lane to a full lane to investigate the effect on the adjacent lane performance.

Appendix B – Melbourne Planning Scheme

21.04 SETTLEMENT

21.04-1.2 – Urban Renewal Areas

Southbank

Starting in the early 1980s as an "Engaging with the Yarra River Initiative", Southbank has been under urban renewal for close to 30 years. It has now brought the Yarra River into the heart of the city's life and provided a dynamic extension of the Central City with good commercial and residential high-density development opportunities.

Southbank is home to the State's major arts facilities as part of its the internationally recognised Arts Precinct and other major activity areas including the Southbank Promenade, Melbourne Convention and Exhibition Centre and the South Wharf complex.

The Southbank Structure Plan 2010 was prepared to update the 1999 and 2007 plans. It provides a vision and strategy for the next 30 years for the area's continued development as an extension of the central city, with a high-density mix of commercial and residential uses, a built form of a human scale and fine grain detail, greater permeability, activity and pedestrian priority at street level.

21.06 BUILT ENVIRONMENT AND HERITAGE

21.06 – 1 Urban Design

Objective 6 To improve public realm permeability, legibility, and flexibility.

Strategy 6.3 Ensure that new developments in the Capital City, Docklands, Business and Mixed Use zoned areas provide active street frontages and minimise pedestrian disruption from car access.

Figure 2 – Built Environment

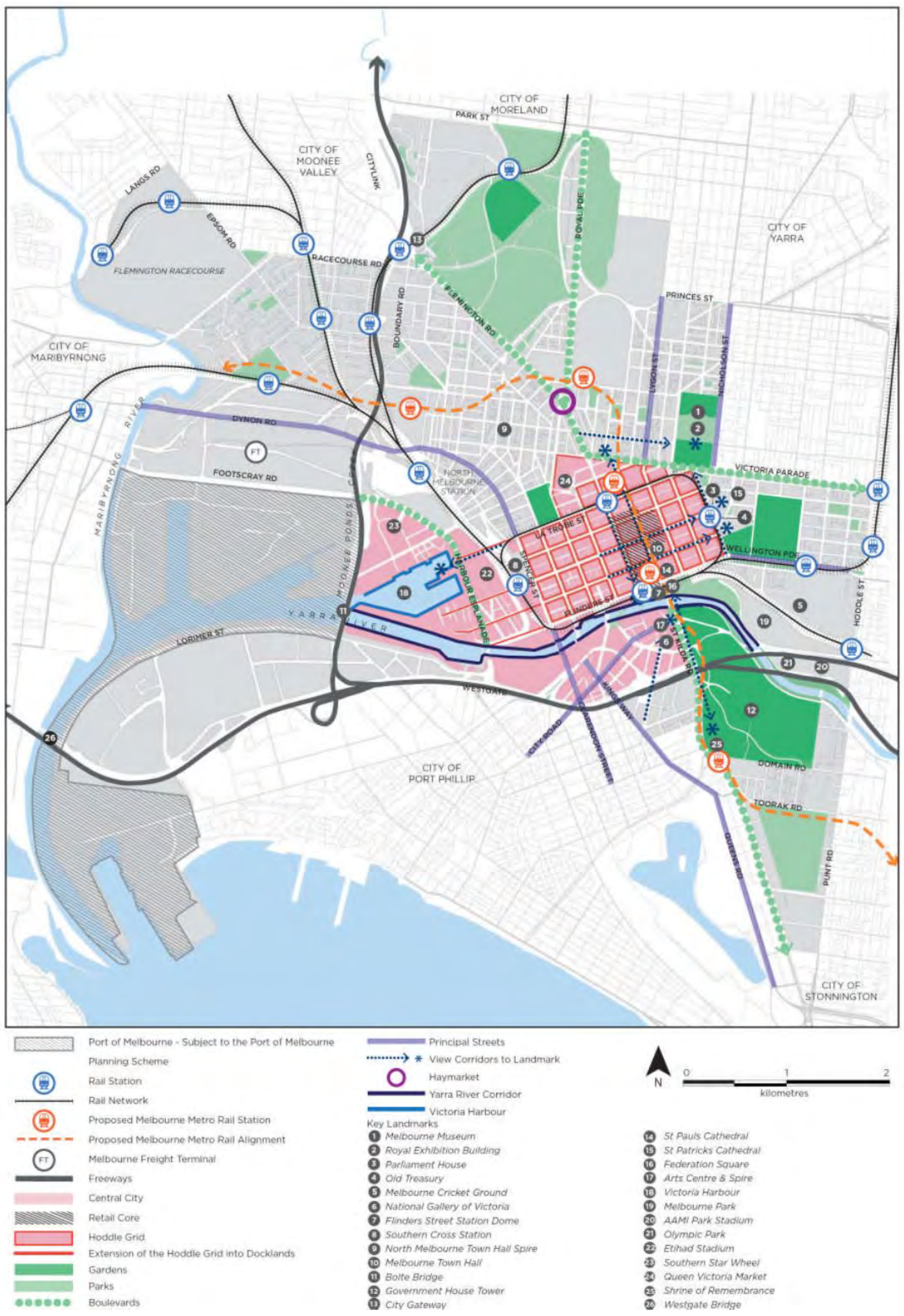


Figure 4 Transport Map

21.09 – 1 Integrated transport

Objective 1 To integrate transport and urban growth.

Strategy 1.2 Encourage development in locations, which can maximise the potential use of public transport.

Strategy 1.3 Ensure a development pattern in the Urban Renewal Areas that is permeable and fine-grained with a legible pattern of access and movement.

Strategy 1.4 Consolidate development with a mix of uses along tram and bus corridors and at and around railway stations in Urban Renewal Areas.

Objective 2 To maximise access to the City.

Strategy 2.1 Support the provision of adequate, safe public transport, pedestrian and bicycle facilities and car parking, in the City to suit 24 hour activity.

Objective 3 To enhance the role of the Boulevards and Principal Streets as entrances to the Central City.

Strategy 3.1 Ensure that development along the City's established boulevards of St. Kilda Road, Flemington Road, Victoria Parade, Royal Parade and Footscray Road (Harbour Esplanade) maintains the prominence of their landscape character.

Strategy 3.2 Ensure development along Principal Streets reinforces their character as major, high quality entries into and through the City.

21.09 – 2 Walking

Objective 1 To develop and maintain a comprehensive, safe, comfortable and convenient pedestrian network throughout the municipality.

Strategy 1.1 Give priority to pedestrian use in high volume pedestrian areas, particularly in the Retail Core and the Central City.

Strategy 1.2 Create high quality and safe pedestrian environments throughout the City.

Strategy 1.3 Support the extension of the existing system of dedicated pedestrian routes (including shared paths) to link all major parks and gardens.

Strategy 1.4 Ensure that pedestrian networks is accessible to all users, including those with wheelchairs and prams.

Strategy 1.5 Support the extension of the existing pedestrian network (including shared paths and through block links) throughout the municipality.

Strategy 1.6 Ensure that pedestrians are given priority around local centres, within the Retail Core of the Central City, along key pedestrian routes, at the rail stations, high volume tram and bus stops, and around major activity generators including sports and entertainment facilities.

Strategy 1.7 Protect and enhance the laneway system as a significant element of the pedestrian network and public realm.

Strategy 1.8 Encourage a permeable and fine-grained development pattern in Urban Renewal Areas.

Strategy 1.9 Ensure that pedestrians are not impeded by ground level activity or development.

21.09 – 3 Cycling

Objective 1 To develop a comprehensive, safe and convenient cycling network throughout the Municipality.

Strategy 1.1 Encourage improved connectivity of the City's bicycle network and support the extension of the existing system of dedicated cycle routes (including shared paths) to link all major parks and gardens in Melbourne.

Strategy 1.2 Support the extension of principal cycling routes into and through the City from surrounding municipalities.

Strategy 1.3 Ensure that new development provides bicycle access and high quality, safe and secure end of trip cycle facilities.

Strategy 1.4 Ensure a safer cycling environment by encouraging passive surveillance of the bike network and safe and secure end of trip facilities.

Strategy 1.5 Support the extension of the existing system of dedicated cycle routes (including shared paths) across the entire street network.

Strategy 1.6 Support the provision of public bike hire stations convenient to pedestrians and public transport.

Strategy 1.7 Minimise the impact of development, including vehicular crossings, on principal cycling routes.

21.09 – 4 Public transport

Objective 1 To maximise the use of public transport through efficient urban structure.

Strategy 1.1 Ensure a development pattern in the Urban Renewal Areas that is permeable and fine-grained with a legible pattern of access and movement.

Strategy 1.2 Consolidate development with a mix of uses along tram and bus corridors and at and around railway stations in Urban Renewal Areas.

Strategy 1.3 Locate major entertainment, recreation, retail, education and employment uses close to good public transport in Urban Renewal Areas.

Strategy 1.4 Encourage public transport as the primary mode of access to the Central City Strategy 1.5 Support improvements to the overall convenience, quality, and accessibility,

level of service and safety of public transport.

Strategy 1.6 Support changes and improvements to the public transport system that serve the changing needs, demography, and structure of the City.

Strategy 1.7 Support improvements to public transport waiting areas, to ensure a high level of amenity, accessibility, and safety.

Strategy 1.8 Ensure major entertainment, recreation, retail, education and employment areas are accessible by public transport and walking.

Strategy 1.9 Support a public transport system that serves the City 24 hours a day.

Strategy 1.10 Facilitate access to public transport for people with a disability.

21.09 – 5 Private Motor Transport

Objective 1 To encourage more efficient use of private motor vehicles.

Strategy 1.1 Recognise that cars are complementary to other modes of transport and their use should be visitors daily managed to minimise adverse impacts on other transport modes.

Strategy 1.2 Support the provision of purpose designed off street parking for small and micro cars, motor scooters and motorbikes to meet the needs of residents and businesses.

Strategy 1.3 Support provision of re-charging facilities powered by renewable sources of energy for electric powered vehicles.

Strategy 1.4 Support a variation to the on-site car parking requirements on sites which are of identified heritage significance if the requirements are likely to adversely impact on the significant building fabric or other significant features.

Strategy 1.5 Support the reduction or waiving of car parking for new uses and developments, which have good access to public transport.

Strategy 1.6 Discourage new commercial car parks.

Strategy 1.7 Discourage commuter car parking in the Central City.

Strategy 1.8 Encourage the co-location and sharing of car parking facilities.

Strategy 1.9 Minimise the extent of vehicle crossovers and their impediments to pedestrian access.

Strategy 1.10 Manage neighbourhood parking to ensure an appropriate level of amenity for residents in Residential and Mixed Use Zones, and parklands.

Objective 2 To reduce the negative economic, social and environmental impacts of traffic and parking, particularly on residential areas and parklands.

Strategy 2.1 Support traffic calming and parking management measures to improve the safety and amenity of the City.

Strategy 2.2 Minimise the impact of traffic through Residential and Mixed Use zones and local neighbourhoods particularly commuter traffic and heavy vehicle traffic.

Strategy 2.3 Ensure that the cumulative traffic and parking impact of developments on an area are considered.

Strategy 2.4 Ensure that traffic and parking impacts from new development is minimised.

21.13 URBAN RENEWAL AREAS

21.13 – 1 Southbank

Economic Development

- Support Southbank’s development as an extension of the Central City, providing a mix of commercial and residential land uses.
- Support a mix of uses, including residential development, with ground floor retail and small scale business uses.
- Deliver a good provision of local services and facilities for workers and visitors and within easy walking distance from all residences.

Built Environment and Heritage

- Connect and integrate Southbank with the Central City and the Yarra River.
- Position Southbank as the natural extension of the city establishing the Yarra River at the City’s centre, not its edge. Provide easy and attractive access to and across the river from the central and southern parts of Southbank.
- Promote high rise, high density development, south of the Crown Casino and the Melbourne Exhibition Centre.
- Ensure all new development creates a high quality pedestrian environment and
- positively enhances the area’s public realm.
- Encourage a mix of public and commercial uses at ground level in new developments to support street life and provide pedestrian interest.

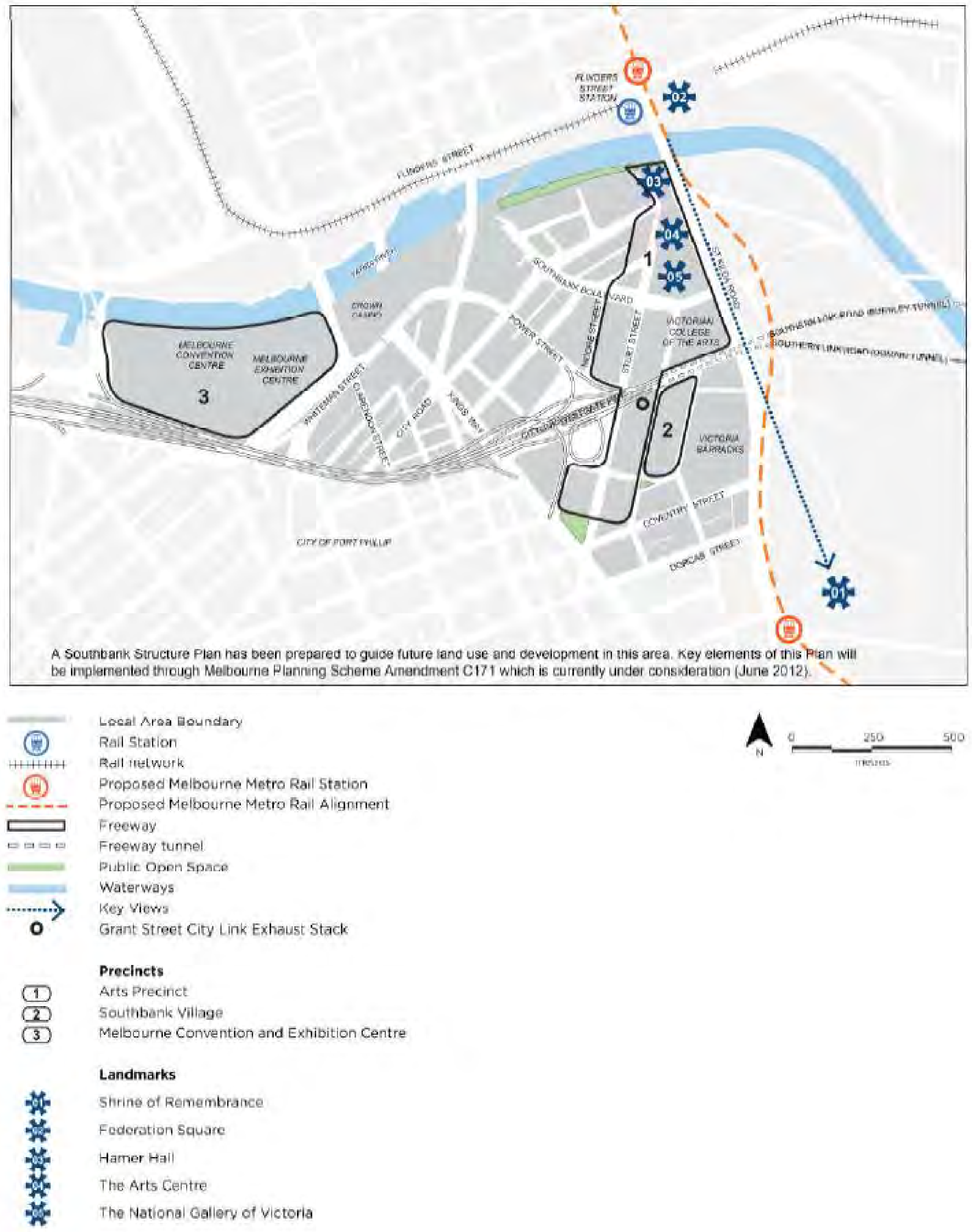
Transport

- Improve the public environment of Southbank by providing public spaces, improving pedestrian facilities and upgrading streetscapes.
- Improve streetscapes as a priority along major pedestrian routes.
- Strengthen pedestrian and cycle connections between Southbank and the Hoddle Grid and South Melbourne.
- Encourage a continuous network of through block links to increase permeability, amenity and safety and to improve access to the Yarra River and Arts Precinct.
- Give greater priority to pedestrian, cyclist and public transport amenity and access ahead of private motor vehicle use.
- Create a connected and permeable neighbourhood.

Infrastructure

- Encourage provision of open space and links between the Port Melbourne foreshore and the Hoddle Grid.

Figure 7: Southbank



22.01 URBAN DESIGN WITHIN THE CAPITAL CITY ZONE

Objectives

- To enhance the physical quality and character of Melbourne’s streets, lanes and Capital City Zone form through sensitive and innovative design.
- To improve the experience of the area for pedestrians.
- To ensure that the design of public spaces, buildings and circulation spaces meets high quality design standards.

Objectives for Schedule 3 to the Capital City Zone

- To connect and integrate Southbank with the central City and the Yarra River.
- To provide easy and attractive access to, and across the Yarra River from the central and southern parts of Southbank.
- To develop pedestrian and cycling connections so that Southbank has a fine grain network.
- To encourage the redevelopment of the area bounded by City Road, Kings Way, Haig Street/Lane and the Westgate Freeway into a vibrant, mixed use area that includes smaller premises and establishes a distinct fine grained urban character.
- To encourage buildings to be designed so that car parking can be converted to alternative uses in the future.
- To ensure developments contribute to a high quality public realm and to passive surveillance of the public domain.
- To incorporate laneways and other means of achieving building permeability.

Policy

Building Design

It is policy to:

- Encourage buildings on street junctions to emphasise the street corner.

Where Schedules 1 or Schedule 2 of the Capital City Zone apply, it is policy that the design of buildings is assessed against the following design standards, as appropriate:

- [In summary, provide pedestrian connectivity and permeability through blocks]

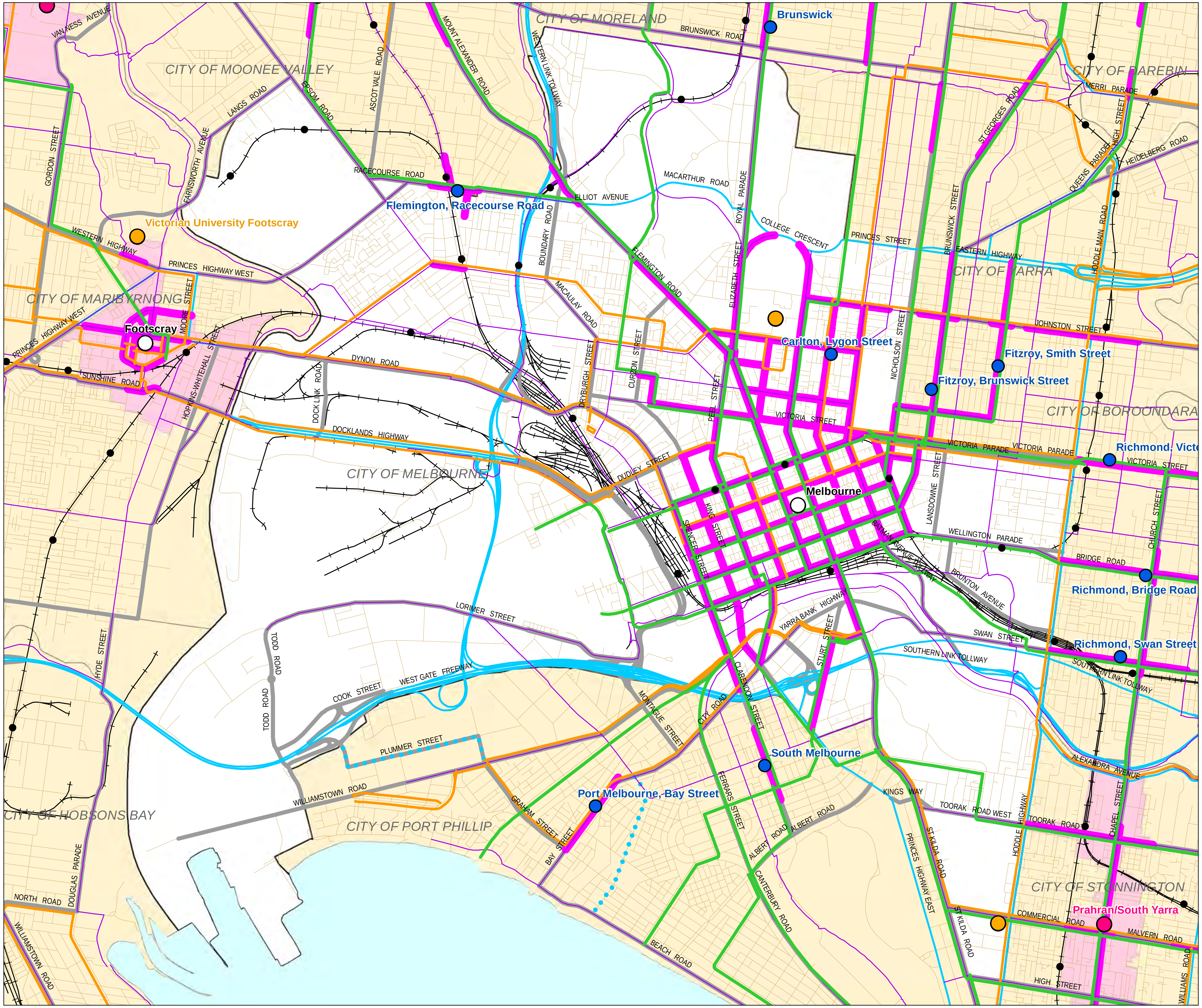
Access and Safety

It is policy that access and safety issues in public space design are assessed against the following standards as appropriate:

- Access to car parking and service areas should minimise impact on street frontages.
- Streets and public spaces should be fronted by active uses to increase interest, use, and the perception of safety.
- Lighting should be provided to improve safety.
- Alcoves and spaces that cannot be observed by pedestrians are not supported.

Appendix C – Network Operating Plan

vicroads



ROAD USE HIERARCHY

CITY OF MELBOURNE

N
VIC ROADS

0 0.2 0.4 0.8
Kilometers

LEGEND

Road Use Hierarchy

- Tram Priority Route
- Bus Priority Route
- Bicycle Priority Route
- Pedestrian Priority Area
- Preferred Traffic Route
- Future Preferred Traffic Route
- Traffic Route
- Future Traffic Route

Note: Some lines are offset to improve clarity.

Activity Area

- Central Activities Area
- Principal Activity Area
- Major Activity Area
- Specialised Activity Area

Other

- Railway Station
- Railway Line
- Local Roads
- Activity Area Boundaries

KEY MAP

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